The Role of Technology in Improving K–12 School Safety

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PRIORITY
Criminal Justice
NEEDS INITIATIVE

A project of the **RAND Corporation,** the **Police Executive Research Forum,** **RTI International,** and the **University of Denver**

For more information on this publication, visit www.rand.org/t/rr1488

Library of Congress Cataloging-in-Publication Data is available for this publication.

ISBN: 978-0-8330-9474-2

Published by the RAND Corporation, Santa Monica, Calif.

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This project was supported by Award No. 2013-MU-CX-K003, awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect those of the Department of Justice.

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Preface

The National Institute of Justice has commissioned the RAND Corporation Justice Policy Program to identify the highest-priority criminal justice technology needs across a number of sectors, including the court systems and K–12 schools. This report addresses the latter, synthesizing the key challenges associated with keeping public schools safe and the current state of safety practices and technology solutions. Although the focus is on K–12 public schools, the needs and available technologies are applicable to private schools as well.

Specifically, the report presents the results of two rapid reviews of literature on school safety and school safety technologies, the highest-priority technology needs that school practitioners identified in two day-long workshops and a pre-workshop questionnaire, six case studies, and the results of expert interviews about safety and technology needs. Integrating the results from these disparate methods, we conclude with recommendations for research and evaluation, technology developers, and schools.

This report should be primarily of interest to organizations and individuals involved with technology planning, research funding, and product development related to the U.S. K–12 school sector. Within school systems, it should be of interest to Information Technology directors and safety officers responsible for emergency planning and acquisition of safety-related products. For the broader set of educators, such as principals, guidance counselors, psychologists, and anyone else who works to design and implement school safety policies, it summarizes educator-identified top needs for and the main limitations of current technologies aimed at affecting school safety.

RAND Justice Policy

The research reported here was conducted in the RAND Justice Policy Program, which spans both criminal and civil justice system issues with such topics as public safety, effective policing, police–community relations, drug policy and enforcement, corrections policy, use of technology in law enforcement, tort reform, catastrophe and mass-injury compensation, court resourcing, and insurance regulation. Program research is supported by government agencies, foundations, and the private sector.

This program is part of RAND Justice, Infrastructure, and Environment, a division of the RAND Corporation dedicated to improving policy- and decisionmaking in a wide range of policy domains, including civil and criminal justice, infrastructure protection and homeland security, transportation and energy policy, and environmental and natural resource policy.

Questions or comments about this report should be sent to the project leader, Heather L. Schwartz (Heather_Schwartz@rand.org). For more information about RAND Justice Policy, see www.rand.org/jie/justice-policy or contact the director at justice@rand.org.

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Summary

Children and adults are exposed to nontrivial levels of violence in U.S. elementary, middle, and high schools. School shootings, although intolerable and tragic at every occurrence, represent only a small fraction of all forms of school violence. Because of their severity, these occurrences receive most of the attention from the media and policymakers. It is the more commonplace types of violence, such as physical bullying, assault, threats, and weapon-carrying, that are routine in the nation's schools. These more common forms of school violence can have damaging effects on children's performance in school and their future life outcomes. For these reasons, promoting school safety is a national priority for many federal agencies, including the National Institute of Justice. Understanding the factors associated with different levels and forms of violence is critical for developing effective solutions to improve safety in the nation's schools.

Schools have adopted a wide variety of strategies to prevent violence on their campuses, ranging from positive behavioral interventions and supports to zero tolerance policies, mandatory school uniforms, visitor management systems, anonymous tip lines, video surveillance systems, locked doors, and security guards. Many have turned to technology as one among many approaches to prevent, intervene in, respond to, and protect schools from legal liability with regard to violent acts and risks to students' safety. However, despite growth in the school safety technology sector, rigorous research about the effectiveness of these technologies is virtually nonexistent.

The purpose of this study is to synthesize expert opinion about the key challenges associated with keeping schools safe, examine the available evidence on the technologies that schools use, and present experts' views on the needs for and limits of current technological solutions and other safety practices. In conducting this study, we developed a typology of school safety technologies based on a review of the literature and summarized the available evidence about technology and the main forms of school violence. We also interviewed experts about their perceptions of the limits of and needs for technology and engaged expert panels in a prioritization exercise to identify top technology and related needs that could help keep schools safe. In addition, we developed six case studies highlighting some of the most common forms of technology as employed within schools.

How Much Violence Occurs in Schools?

Fatal and serious violence at schools is extremely rare, but its effects are devastating. Violence in U.S. schools is not uncommon; however, as one of our interviewees commented: "Schools are very safe places . . . arguably safer today than 10–15 years ago." Although fatal and serious

violence at schools generates the most media attention, such incidents are thankfully relatively rare. According to the School Associated Violent Death study, in the 2010–11 school year, there were 31 fatalities among staff, students, or other individuals on school grounds in the United States—less than 1 percent of youth homicides that occurred nationally during this period (Robers et al., 2014). The majority of schools do not experience violence of a serious nature; according to the School Survey on Crime and Safety (SSCS), in the 2009–10 school year, approximately one out of every six public schools experienced an incident of serious violent crime (Robers et al., 2014).

Although serious violence is rare, most schools experience some *level of violence.* According to the SSCS, in the 2009–10 school year, 74 percent of public schools recorded at least one incident of violence, which includes serious violence as well as fights, physical attacks, or threats of physical attack. Bullying is the most common form of school violence. Surveys show that one in five or one in four students report being bullied in the past 12 months.

By most measures, school-based violence has declined since the 1990s. According to the National Crime Victimization Survey—School Crime Supplement, between 1992 and 2012, the incidence of violent victimizations of 12–18-year-olds occurring at school dropped 57 percent, from 68 violent victimizations per 1,000 students to 29 violent victimizations per 1,000 students at school. Prevalence rates have also declined.

School climate has the strongest association with violence after accounting for multiple school characteristics. Aside from the fact that violence is most common in high schools and middle schools, school climate is the only other school characteristic that consistently correlates with school violence after taking into account other school features. *School climate* refers to "the quality and character of school life as it relates to norms and values, interpersonal relations and social interactions, and organizational processes and structures" (National School Climate Center, 2015).

Evidence suggests that violence is most likely to occur in places with the least adult supervision. Although data about the location of school violence within school campuses are scant, there is some indication that it tends to cluster in places that are least monitored by adults, such as hallways, bathrooms, or stairwells. Elementary and middle school students in one study reported feeling the least safe in areas that were unsupervised and where they had the greatest interaction with other, particularly older, students (Astor, Meyer, and Pitner, 2001).

Rates of violence differ significantly among students. Males are significantly more likely to be victims of violence and are also more likely than females to carry a weapon to school (8 versus 3 percent) and to fight at school (11 versus 6 percent; Kann et al., 2014). Hispanic and black students are more likely to be victimized at school (8.5 and 8.4 percent) than white students (5.8 percent), with black males reporting the highest levels of victimization (10.1 percent), followed by Hispanic males (9.5 percent), Hispanic females (7.5 percent), black females (6.8 percent), white males (6.2 percent), and white females (5.4 percent). Nonwhite students are more likely than white students to carry weapons (Vogel and Barton, 2013; Wilcox, May, and Roberts, 2006; Wilcox and Clayton, 2001) and engage in physical assaults (Ousey and Wilcox, 2005) and fighting (Rudatsikira, Muula, and Siziya, 2008; Zhang and Johnson, 2005). There is also growing evidence that youth who identify as gay, lesbian, or bisexual or who have experienced any sexual contact with members of the same sex are more likely than their heterosexual counterparts to be victimized and to engage in weapon-carrying and physical fighting at school (Kann et al., 2011).

Rates of violence differ across student subgroups, behavior, and activities. At the individual level, substance use is the most correlated with both perpetration and victimization (Horner, Rew, and Brown, 2012; Zhang and Johnson, 2005). But other characteristics of children are also correlated with perpetration and victimization. These include mental health symptoms such as stress, depression, past suicide attempts, and sleep difficulties; personality characteristics such as aggression, impulsivity, lack of self-control; delinquent behaviors such as violent beliefs and school misbehavior; and prior exposure to violence (Horner, Rew, and Brown, 2012; Muula, Rudatsikira, and Siziya, 2008; Vogel and Barton, 2013). Other factors that are less consistently related include students' academic involvement and achievement (Cavanaugh, 2009; Watkins, 2008) and family factors such as income and parental education (Hutchinson et al., 2014; Horner, Rew, and Brown, 2012), and peer factors (Wilcox, May, and Roberts, 2006; Koo, Peguero, and Shekarkhar, 2012). Often these factors attenuate some of the differences observed by the demographic characteristics presented above.

A substantial number of teachers are exposed to violence in schools. Nine percent of U.S. teachers reported being threatened with injury by a student, and 5 percent reported being physically attacked by a student in the 2011–12 school year (Robers et al., 2014). This equates to approximately 279,000 teachers in the United States—a nontrivial number.

School Safety Technology: Typologies, Prevalence of Use, and Evidence of Effectiveness

Several technologies exist to help schools address violence and threats to safety. We created 12 categories of school safety technologies after completing our literature review and discussed these with panel members and interviewees. Some of these technologies such as entry control equipment are commonly used, whereas others such as violence prediction technology are not. For most technologies, there is limited information about their prevalence. For all technologies, evidence on effectiveness is severely limited or nonexistent. Many technologies are relatively new and are still being developed (e.g., violence prediction software). Table S.1 lists the technologies and their rationale and summarizes what is known about the prevalence and effectiveness of each.

School Safety Technology: Perceived Appropriateness and Barriers to Adoption

Via phone interviews and an online questionnaire, we asked a variety of school safety experts about their perceptions of school safety technology and their perspectives on challenges or barriers facing schools and school systems that seek to adopt these technologies. Given that suburban and rural schools can have longer emergency response times that, in turn, create a greater need for schools to be relatively self-sufficient during the critical first minutes of emergencies such as active shooter scenarios, we surveyed urban and rural/suburban experts about school safety priorities.

Table S.1
Twelve Categories of School Safety Technologies

Technology	Example	Rationale	Prevalence
1. Entry control equipment	Electromagnetic door locks that can be remotely locked, mobile barricades, restricted areas	Makes it easier to restrict school access to authorized users	Approximately 8 out of 10 public and private schools report controlled access
2. Identification technology	Student/staff identification, visitor badges, parking stickers, palm scanners	Distinguishes those who have authorized access to school property from those who do not	Commonly used, generally on school property and at relevant school events (e.g., dances, football games)
3. Video surveillance technology	Cameras, closed circuit TV, video-recording, video–motion detection system	Used to record student actions, identify perpetrators, deter crimes by suggesting that perpetrators are being monitored	Approximately 6 out of 10 public and 4 out of 10 private schools report using cameras
4. Communication technology	Two-way interaction systems (e.g., walkie-talkies, phones, emergency communication systems, radios)	Allows students/staff to notify school office and law enforcement about incidents, unauthorized individuals, and risks	Intercoms and two-way, hand-held radios are thought to be used extensively
5. School-site alarm and protection systems	Scream alarms, motion/sound/heat detectors	Alerts those at school and emergency responders or protects those in school during an attack	Unknown, but potentially prevalent given that they can leverage existing alarms (e.g., fire alarms)
6. Emergency alerts	Automated text messages or emails, school TV stations	Alerts and prevents rumors using mass messaging	Most schools have lists of emails, phone numbers
7. Metal detectors and X-ray machines	Hand-held and walkthrough metal detectors, X-ray machines to scan book bags. often at entrance to school or as students exit school buses	Prevents weapons from being brought into school	Approximately 5 out of 100 public schools and 1 out of 100 private schools report doing random metal detector checks; approximately 3 out of 100 public schools and fewer than 1 out of 100 private schools have students walk through detectors daily
8. Anonymous tip lines	Toll-free phone hotline, voicemail system, website with anonymous posts	Relies on students, who are thought to be the top source of information for addressing/solving incidents	Likely more prevalent in areas where district/state has provided the service
9. Tracking systems	Smart phone applications, Global Positioning System (GPS) devices	Allows parents/schools to keep up-to-date on students' movements	No reliable estimates of prevalence found, although potentially prevalent with smart phones
10. Maps of schools/bus routes	Geographic Information System software	Helps emergency responders prepare for crisis	No estimates of prevalence found
11. Violence prediction technology	Data-driven software	Helps predict locations, times of misbehavior/violence	Use of this type of technology is not very common
12. Social media monitoring	Automated scans of online content (images and text) for bullying, threats, evidence of self-harm	Searches for problems online, where the majority of bullying occurs	No estimates of prevalence found

Perceived Appropriateness

With a few exceptions that we note, urban and suburban/rural panelists tended to agree on which types of school safety technologies they rated as very appropriate for the most *severe* forms of school violence and for the most *probable* forms of school violence. There were two types of technologies for which urban and suburban/rural panelists deviated. Urban panelists included video surveillance as very appropriate for both types of violence, whereas suburban/rural panelists did not, perhaps reflecting the greater manpower and infrastructure that panelists said were needed for effective video monitoring. Suburban/rural panelists, meanwhile, included social media monitoring as very appropriate for both types of school violence, whereas urban panelists did not. For the most severe forms of violence, urban and suburban/rural panelists identified as very appropriate communication technology, entry control equipment, and emergency alerts. For the most preventable forms of violence, the suburban/rural and urban panelists commonly identified communication technology and tip lines.

Barriers to Adoption

Experts also believed that certain technologies could be harmful in one way or another. Over 80 percent of panelists from the urban panel and a similarly high proportion of panelists from the suburban/rural panel believed that metal detectors and X-ray machines increased students' negative attitudes toward school and made schools seem too fortified and unwelcoming. The cost to adopt a given technology and how its adoption may drain resources for other aspects of school safety were also of concern to most panelists. Concerns about violating students' privacy were also mentioned with respect to violence prediction technologies, especially video surveillance and social media monitoring. Almost half of the stakeholders we interviewed cited the need to supplement technology with other nontechnological approaches.

Using Innovative Technology to Enhance School Safety in Practice

To see how technologies are integrated and employed in the field, we conducted six case studies of schools that employ technologies within each of the following categories the experts deemed as very appropriate for dealing with school safety challenges across both urban and rural schools and for serious and frequent types of violence: communications technology, emergency alerts, entry control equipment, video surveillance, tip lines, and social media monitoring.

The case studies illustrate the integration of school safety technologies into a combined plan, stressing the importance of a comprehensive planning approach to school safety. They portray the wide variety of in-house and contracted approaches that districts can take to effect school safety. These "early adopter" localities represent relatively technology-friendly school settings, and they expressed to us high levels of satisfaction with the technologies that they adapted over time to best fit their needs.

Prioritizing Technology and Related Needs for School Safety

The ultimate goal of this project was to identify the highest-priority technology needs to improve school safety. Given the lack of evidence on school safety technologies, we asked expert panelists in our day-long workshops to rank the appropriate technologies that they deemed most

important to meet school safety needs. Four groups of experts—two for urban safety needs and two for suburban and rural safety needs—each brainstormed and then ranked their top 10 technologies to address severe forms of violence, their top 10 technologies to address the most probable forms of school violence, and their top 10 technologies to address school violence overall.

Panelists ranked highly two types of technological needs. First, at the school, district, and state levels, panelists believed that *better data collection and analytics* are important to understand the problems that specific schools encounter and could be used for internal and external accountability for preventing, reducing, and responding to school violence. Second, staff members in particular *need easier and faster access to information* on school safety. Panelists saw this improved access to information and guides as key to preventing, reducing, and responding to the entire spectrum of school violence. Several other themes emerge from their ratings:

- *Direct two-way communication* between teachers and emergency responders was consistently ranked highly by both urban and suburban/rural expert panels.
- School policies and procedures relating to school policy are scattered and poorly understood, driving the identification of an *"all-in-one"* application on computers, phones, and tablets to allow teachers, administrators, school support staff, school facility staff, and parents to log in to access all the appropriate school safety plans in one place.
- Panelists ranked highly the need to allow anonymous submissions to *improved tip lines* that accept text messages, voicemail (converted to text), email, images, and videos. Experts also identified the need to centralize disparate tip lines so that, for example, a caller reporting a concern to a state police tip line about a particular individual who happens to be a parent of a student at a school is shared with the relevant school principal.
- Cyberbullying was a frequently raised concern, and several of the panels identified the need for *better social media analytics,* including software that would go beyond simplistic key word searches within a single social media site and keep up with the ever-changing set of social media sites and slang terms, scanning content across all those sites rather than within only one.
- A lower ranked but frequently raised issue was the importance of *visitor management systems* that are well-implemented and enhanced to include position-tracking (of ID-carrying students and adults within the building).

Conclusion: Future Directions for Investments in School Safety Technology

The themes listed above point to potential areas for investments in school safety technology. These include investments in educator–emergency responder communication strategies, comprehensive school safety plans, improved tip lines (both to make them more user-friendly and to provide automated data collection and improved analytics and reporting-out mechanisms), and an emphasis on improved implementation, including staff training, upkeep of technology, and integration of technology into the school's broader planning process. We provide recommendations to help inform three sets of stakeholders: researchers, technology developers, and practitioners at schools.

Recommendations

For Research and Evaluation

- **Evidence base.** The field is in desperate need of more evidence on what works, and schools want this information presented to them in vetted, digestible ways to help them with procurement.
- **Rigorous research designs.** There is a common concern that using technology in school safety initiatives brings only false security rather than effective solutions. Consequently, rigorous research designs such as randomized controlled trials are needed to instill trust in evaluation results about school safety technologies.
- **Measures of proximal outcomes.** Given the frequency of implementation challenges, researchers should include in their research designs measures of proximal outcomes (adherence to protocols, feelings of safety and comfort, school climate, buy-in to use of technology) that might be used to assess the effects of a new technology. It is critical to test, rather than assume, that technologies are implemented as intended.

For Technology Developers

- **Needed improvements.** Expert opinion indicates that technology vendors should focus on developing (1) reliable low-cost ways to allow teachers to have direct, layered, two-way communication with a central command and control system; (2) anonymous tip line technology that is easier to monitor and allows multiple mediums to be uploaded; (3) online platforms that keep up with changes in state and federal law and that integrate an "all-in-one" approach to give, via portals, school staff and parents the information they need, including training modules, violence alerts, prevention information, and suggested responses in the aftermath of violent events; (4) more sophisticated social media scanning across social media sites.
- **Real-world technology testing.** Vendors should test their technology solutions outside the laboratory and in real-world settings with environmental challenges and a high degree of human error. If possible, the technologies should be designed to reduce human error and track outcomes to hold people accountable for their proper use.

For Schools

- **All-hazards school safety plan.** Creating a comprehensive all-hazards school safety plan that is updated annually was consistently cited as a best practice. Such a plan is essential to using school safety technology for addressing violence or responding to an emergency after the fact. The plan should follow and respond to a needs assessment specific to the school, focusing on school culture, staff procedures and policies related to physical safety and the well-being of students and staff, and physical alterations to the facilities and campus if needed to improve safety.
- **Improving school culture.** School leaders must remember that not only can technology fail in certain instances but, more importantly, experts stressed repeatedly the need to augment technology with positive behavioral interventions for students and school cli-

mate change. A common concern is that technology solutions will not resolve the underlying psychological and social problems leading to school violence.

- **Integration of new technologies and existing systems.** Before buying technologies, schools should make sure that the technology can be integrated with their current systems and upgraded in the future. This is particularly important for technologies that generate data (e.g., tip lines, social media monitoring), so that appropriate personnel are available and procedures are in place to analyze and act on relevant data.
- **Identification of school's needs, budget, and community values before selecting a technology.** School boards can use security assessments to examine the type and amount of safety incidents a school has faced, what weapons or threats to safety have been seen, what kind of staff and resources they have available, and the anticipated effect technologies might have on the school culture.

There is no quick fix for school violence. No one intervention—technological or otherwise—can fully guarantee the security of schools or resolve the underlying causes of school violence. Instead, a holistic approach to developing a school safety plan seeks to understand and address to the degree possible what *leads* to school violence to promote "situational awareness" among students, staff, and community members. The selection of a technology should be in service of a larger school safety approach as outlined in the plan.

To employ technologies effectively and ethically, schools need to consider whether and how particular technologies could feasibly be implemented and used to successfully address the specific issues related to student safety for which solutions are needed. Understanding the nature of these technologies and how they function is an important aspiration for education research, policy, and practice. Such a review would help stakeholders decide which technologies to invest in and use.

Acknowledgments

We gratefully acknowledge the members of the School Safety Expert Panels (whose names and affiliations are listed in Appendix C) for their willingness to give a substantial portion of their time and extensive expertise to this effort. Without their participation, the work reported here would not have been possible. We also thank the practitioners in the six case study sites who graciously hosted us and helped to arrange school visits and interviews. Additionally, we would like to acknowledge all of the experts in the field whom we interviewed and to whom we promised anonymity for generously donating their time and their insight. We would also like to acknowledge the National Institute of Justice program managers and staff, particularly Steven Schuetz, who provided guidance and suggestions at all parts of the project. We would like to thank Roberta Shanman for helping to design and execute the literature search strategies and Jeremy Miles and Gabriel Weinberger for data analyses. Our RAND colleague Catherine Augustine provided a very useful critical reading of the report itself at the conclusion of the project. We would also like to acknowledge the publishing contributions of Patricia Bedrosian for editing the report and Mary Wrazen for creating and helping design the figures.

Abbreviations

CCSD	Clark County School District
CCSDPD	Clark County School District Police Department
CCTV	closed circuit television
FBI	Federal Bureau of Investigation
GIS	Geographic Information System
GPS	Global Positioning System
GUSD	Glendale Unified School District
MCT	mobile computing terminal
NCVS-SCS	National Crime Victimization Survey—School Crime Supplement
NPD	Nampa Police Department
PA	public announcement
QR	Quick Response
RFID	radio frequency identification
SAFE	Security Alert for Education
SES	socioeconomic status
SESIR	School Environmental Safety Incident Report
SRO	school resource officer
SSCS	School Survey on Crime and Safety
YRBS	Youth Risk Behavior Survey

CHAPTER ONE

Introduction

Schools should be places that facilitate academic learning and other educational outcomes and help children become productive members of society. However, both youth and adults are exposed to nontrivial levels of violence in schools. For example, children are equally likely to be victimized in school as out of school despite spending only 20 percent of their waking hours in school settings (Cook, Gottfredson, and Na, 2010). Adults also experience violence in schools. During the 2011–12 academic year, 9 percent of teachers in the United States were threatened with physical attack, and 5 percent were physically assaulted by their students, with rates double this in some states (Robers et al., 2014).

School shootings, although intolerable and tragic at every occurrence, represent only a small fraction of all forms of school violence. Nonetheless, active shooter incidents in the United States have been increasing in the past decade. Of the 160 active shooter incidents (and associated 1,043 casualties) between 2000 and 2013, 17 percent occurred in K–12 schools, causing 57 deaths and 60 nonfatal casualties (Federal Bureau of Investigation [FBI], 2013). Because of their severity, these occurrences receive most of the attention from the media and policymakers.

By contrast, more commonplace types of violence—including physical bullying, assault, threats, and weapon-carrying—are routine in the nation's schools. In the 2010–11 school year, there were over one million nonfatal victimizations, including theft and assaults, in U.S. schools (Robers et al., 2014). Put another way, only a small minority of schools directly experience serious incidents of violence, but most schools and students are exposed to some level of violence, often on a regular basis.

Although the repercussions of serious forms of violence are obvious (i.e., death and serious injury, as well as mental health consequences), more common forms of school violence can also have damaging effects on children's short- and long-term outcomes (Ttofi, Farrington, and Lösel, 2012). Beyond the immediate effects of such incidents, threats to students' safety and well-being may undermine their ability to learn effectively. Research has shown that schools' violent crime rates are associated with lower test scores (Burdick-Will, 2013), and that student exposure to school violence and peer victimization is associated with student truancy and school avoidance (Hughes, Gaines, and Pryor, 2014; Randa and Wilcox, 2010), school mobility (Carson, Esbensen, and Taylor, 2013), minority drop-out (Peguero, 2011), self-reported trauma symptoms and violent behavior (Flannery, Wester, and Singer, 2004), and suicidal behavior (Nickerson and Slater, 2009). Teacher job dissatisfaction and turnover may also result from school violence and disorder (Ingersoll, 2001) as well as direct victimization.

For these reasons, promoting school safety is a national priority for many federal agencies, including the National Institute of Justice. Understanding the factors associated with different

levels and forms of violence is critical for developing effective solutions to improve safety in the nation's schools.

Schools have adopted a number of strategies to prevent violence on their campuses, ranging from positive behavioral intervention supports to zero tolerance policies, school uniforms, visitor management systems, anonymous tip lines, video surveillance systems, locked doors, and security guards. Many have turned to technology as one among many approaches to prevent and respond to violence and to protect schools from legal liability with regard to violent acts and risks to students' safety. The use of technological approaches has been steadily growing. As early as the mid-1990s, the school security technology industry saw dramatic increases in demand, with sales in the hundreds of millions of dollars (Portner, 2015). However, despite growth in the school safety technology sector, rigorous research about the effectiveness of these technologies is virtually nonexistent.

Purpose of This Research

The purpose of this study is to synthesize information from disparate sources, including scientific research, opinions of key stakeholders (including both researchers and practitioners), and observations from the field via case studies about the use of technology to keep schools safe. These sources provide information about the prevalence and predictors of school violence in the United States, effectiveness of technologies that schools use to promote school safety, key challenges associated with using technology to promote school safety, and needs for and limits of current technological solutions and other safety practices. Specifically, we performed the following tasks for this study:

- developed a typology of school safety technologies based on the literature
- summarized the available evidence about technology and the main forms of school violence
- interviewed experts about their perceptions of the limits of and needs for technology
- engaged expert panels in a prioritization exercise to identify top technology improvement needs
- developed six case studies highlighting how schools are implementing technology to promote school safety.

A full discussion of the methods used is found in Appendix B.

Key Definitions Used in This Report

The following definitions are used in this report. Our definition of *school violence* encompasses any kind of exposure to interpersonal violence, such as witnessing, perpetrating, or being victimized by violence on school grounds, regardless of whether school is in session, on the way to or from schools or school-sponsored events on school-sponsored modes of transport (e.g., including school buses but excluding public forms of transport or walking), or during school-sponsored events. *Interpersonal violence* is defined as the use of physical force or power to

threaten or harm others. We are interested in all forms of violence occurring on school grounds by all potential perpetrators and victims—students, teachers, staff, and community members.

To categorize violence, we employ the definitions used by the most commonly cited national data sources. Namely, *serious violence* includes robberies, rapes and sexual assaults, weapon-related fighting and weapon-related threats, and aggravated assaults; *violence* is a broader term that encompasses all acts of serious violence and also includes simple assaults, fighting, weapon-carrying, and threats of physical attack.

School climate refers to "the quality and character of school life as it relates to norms and values, interpersonal relations and social interactions, and organizational processes and structures" (National School Climate Center, 2015). Our definition of school climate refers primarily to school-level norms and interactions, encompassing a range of positive indicators (e.g., parent and community involvement; average levels of students' self-reported attachment to their school, parents, and teachers; student involvement and achievement in academic and other extracurricular pursuits; students' normative or prosocial beliefs) and negative indicators (e.g., presence or perception of violence, delinquency, drug use, physical disorder, racial tensions).

School location refers to region of the country, urbanicity, and local area (e.g., county, neighborhood) conditions. We divide urban from suburban and rural schools in several sections of the report because both research and experts agree that this distinction is meaningful when considering school violence. *School organization* refers to the absolute and relative size of the school in terms of enrollment (total students, student to teacher ratio), source of funding (public versus private), and grade level (middle, high). *School demographic composition* refers to the representation of students in various demographic and income groups, such as proportion of students in the school who are racial or ethnic minorities, males, children of immigrant parents, or below the poverty level.

We also use the term *technology and related needs* throughout this report. This term refers to technological functions experts identified via brainstorming sessions that they wished could be either innovated or made ubiquitous to promote school safety.

Finally, throughout the report, we refer to the *prevalence* of technology or forms of school violence, by which we are referring to the percentage of schools or percentage of students that experience the safety problem or have the technology in question. We also refer to the *incidence* of violence, which means the number of violent acts per 1,000 students over one year.

Overview of Violence in U.S. K–12 Schools

In Appendix A, we provide a comprehensive review of the prevalence (i.e., percentage of students or schools) and incidence (i.e., violent acts per 1,000 students over one year) of school violence in the United States, how such violence differs according to characteristics of both schools and students, and what school-level and individual-level factors may be associated with violence. Here, we distill the key points from the literature to provide context for the technologies that exist to keep schools safe.

1. **Fatal and serious violence at schools is extremely rare, but its effects are devastating.** Although fatal and serious violence at schools generates the most media attention, such incidents are thankfully rare. In the 2010–11 school year, there were 31 fatalities

among staff, students, or other individuals on school grounds in the United States—less than 1 percent of youth homicides that occurred nationally during this period (Robers et al., 2014). Less than one-tenth of 1 percent (i.e., < 0.1) of 12–18-year-old adolescents attending school reported any serious violent victimization,[1] and in the 2009–10 school year, 16 percent of schools experienced an incident of serious violent crime. Even though shootings are rare, the number of such incidents is still unacceptably high. Between 2001 and 2013, there were 160 active shooter incidents in the United States, of which 27 occurred in a K–12 school, with a total of 57 fatalities and 60 wounded.[2]

2. **Most schools experience some level of violence.** In the 2009–10 school year, 74 percent of public schools recorded at least one incident of violence, which includes serious violence and fights, physical attacks, or threats of physical attack. The incidence of any type of violence was 25 events per 1,000 students annually. These rates are likely to underestimate the true prevalence and incidence of violence.

   Eight percent of students reported being in a physical fight, and nearly 7 percent of students reported being threatened or injured with a weapon on school property (Kann et al., 2014). Approximately 5 percent of high school students (9th to 12th grade) carried a weapon onto school property.

   But the most common form of school violence is bullying, defined as "any unwanted aggressive behavior(s) . . . that involves an observed or perceived power imbalance and is repeated multiple times or is highly likely to be repeated" (Gladden et al., 2014). Twenty percent of students were bullied on school property in the past year, and 15 percent of were electronically bullied through email, instant messaging, chat rooms, websites, or texting (Kann et al., 2014).

3. **By most measures, school-based violence has declined since the 1990s**. Between 1992 and 2012, the incidence of violent victimizations of 12–18-year-olds occurring at school dropped 57 percent, from 68 violent victimizations to 29 violent victimizations per 1,000 students at school. Violent victimizations outside school have experienced an even greater decline—78 percent—from 94 violent victimizations in 1992 to 20 violent victimizations per 1,000 students in 2012. Prevalence rates have also declined: In 1995, 3 percent of students reported a violent victimization and 1 percent reported a serious, violent victimization, roughly three and ten times higher than the current prevalence of victimization (Robers et al., 2014). In addition, weapon-carrying decreased from 12 percent to 5 percent between 1993 and 2013, and school fighting decreased from 16 percent to 8 percent in the same period (Robers et al., 2014). There are a few notable exceptions to the overall decline in violent victimization: There has been no apparent change in the prevalence of students who were threatened or injured with a weapon

[1] The National Crime Victimization Survey—School Crime Supplement (NCVS-SCS) was initiated in 1995 to capture the victimization experiences of a nationally representative sample of students between the ages of 12 and 18 who are enrolled in public and private schools. Students are asked to report incidents of victimization that occur on school grounds throughout the academic year (or in the previous six months, depending on the survey year). The survey has been conducted in odd years since 1999.

[2] The FBI defines an active shooter incident as "a situation in which a shooting is in progress and an aspect of the crime may affect the protocols used in responding to and reacting at the scene of the incident." Unlike a defined crime, such as a murder or mass killing, the active aspect inherently implies that both law enforcement personnel and citizens have the potential to affect the outcome of the event based upon their responses (FBI, 2013, p. 4).

on school grounds (7 percent); the percentage of *teachers* who report being physically attacked by a student has increased, and threats of injury to teachers increased from 7 to 9 percent[3] between the 2007–8 and 2011–12 school years.

4. **Rates of violence differ significantly among schools.** This variation depends on school grade level, size, location, and racial/ethnic composition. These differences are displayed in Table 1.1.
5. **School climate has the strongest association with violence after accounting for multiple school characteristics.** School level, enrollment size, and location are not likely to be causal factors that increase the risk of school violence. More often, the relationship between these factors and school violence is attenuated when studies account for the characteristics of school climate. School climate has been operationalized via a range of positive indicators (e.g., parent and community involvement; average levels of students' self-reported attachment to their school, parents, and teachers; student involvement and achievement in academic and other extracurricular pursuits; and stu-

Table 1.1
Prevalence and Incidence of Violence by School Characteristics

	Prevalence (Percentage of Schools That Report at Least One Violent Event)				Incidence (No. of Events per 1,000 Students)
School Characteristic	Violence	Serious Violence	Threaten with Weapon	Threaten Without Weapon	Violence
Primary	64.4	13.0	6.8	38.0	21.3
Middle	90.5	18.9	10.3	61.5	40.0
High	90.9	27.6	10.0	61.9	21.4
Fewer than 300 students	62.8	10.4	3.8	34.3	27.2
More than 1,000 students	95.4	32.8	12.8	72.5	23.2
City	74.9	21.7	10.2	48.6	28.8
Suburban	73.5	15.5	7.7	16.3	22.4
Town	80.3	15.6	6.3	56.2	28.2
Rural	70.2	13.2	6.2	40.0	22.5
Greater than or equal to 50% of the student body is white	71.5	13.9	6.5	44.2	20.8
Less than 50% of the student body is white	78.2	21.1	9.8	50.3	31.4

SOURCE: Neiman and Hill, 2011.

[3] This has not exceeded the high of 12 percent reported in 1993–94.

dents' normative or prosocial beliefs) and negative indicators (e.g., presence or perception of violence, delinquency, drug use, physical disorder, and racial tensions).

6. **Evidence suggests that violence is most likely to occur in places with the least adult supervision.** Although data about the location of school violence within a school campus are scant, there is some indication that it tends to cluster in places that are least monitored by adults, including in hallways or stairwells. Elementary and middle school students in one study (Astor, Meyer, and Pitner, 2001) reported feeling the least safe in areas that were unsupervised and where they had the greatest interaction with other, particularly older, students.
7. **Rates of violence differ significantly among students.** Just as there is variation by school characteristics, there is variability in who is victimized and who perpetrates violence at schools.

    - Males are significantly more likely to be victims of violence and are also more likely than females to carry a weapon to school (8 versus 3 percent) and to fight at school (11 versus 6 percent; Kann et al., 2014).
    - Students ages 12–14 are more likely to be victims of violence than 15–18-year-olds (65 versus 41 per 1,000 students) (Bouchard, Wang, and Beauregard, 2012; Burrow and Apel, 2008; Carbone-Lopez, Esbensen, and Brick, 2010; Gottfredson and DiPietro, 2011; Holt, Turner, and Exum, 2014; Van Dorn, 2004), but age is also *inversely* related to fighting at school (Rudatsikira, Muula, and Siziya, 2008) and to weapon-carrying, regardless of whether samples are based on middle or high school students (Kerres Malecki and Demaray, 2003; Marsh and Evans, 2007; Vogel and Barton, 2013).
    - Hispanic and black students are more likely to be victims at school (8.5 and 8.4 percent) than white students (5.8 percent), with black males reporting the highest levels of victimization (10.1 percent) followed by Hispanic males (9.5 percent), Hispanic females (7.5 percent), black females (6.8 percent), white males (6.2 percent), and white females (5.4 percent).[4] Nonwhite students are more likely than white students to carry weapons (Vogel and Barton, 2013; Wilcox, May, and Roberts, 2006; Wilcox and Clayton, 2001) and engage in physical assaults (Ousey and Wilcox, 2005) and fighting (Rudatsikira, Muula, and Siziya, 2008; Zhang and Johnson, 2005).
    - There is growing evidence that youth who identify as gay, lesbian, or bisexual[5] or who have experienced any sexual contact with members of the same sex are more likely than their heterosexual counterparts to be victimized and to perpetrate violence at school (Kann et al., 2011).

8. **Rates of violence differ across student subgroups, behaviors, and activities.** At the individual level, substance use is the most correlated with both perpetration and victimization. But mental health symptoms (e.g., stress, depression, past suicide attempts, sleep difficulties), personality characteristics (e.g., aggression, impulsivity, lack of self-

[4] These estimates are higher than those reported by the NCVS-SCS, which found prevalence estimates of around 1 percent across racial/ethnic groups, as described above (Robers et al., 2014).

[5] No data are available on transgender and gender-nonconforming youth; however, anecdotal evidence indicates that these youth experience even greater rates of victimization.

control), delinquent behaviors (e.g., violent beliefs, school misbehavior), and prior exposure to violence are also correlated with perpetration and victimization (Horner, Rew, and Brown, 2012). Other factors that are less consistently related include academic involvement and achievement and family and peer factors. Often, these factors attenuate some of the differences observed by the demographic characteristics presented in key point (7), above.

9. **A substantial number of teachers are exposed to violence in schools.** Nine percent of U.S. teachers in a national survey reported being threatened with injury by a student, and 5 percent reported being physically attacked by a student in the 2011–12 school year (Robers et al., 2014). This equates to approximately 279,000 teachers threatened. Female teachers are more likely than male teachers to be physically attacked, as are black teachers compared with teachers from other racial/ethnic groups. Educators who reported a student-perpetrated physical assault had significantly less experience (less than seven years working as a licensed educator and in the current school) and were more likely to have advanced degrees and to work in a special education or a social work capacity (Gerberich et al., 2014). At the school level, those institutions where teachers are more likely to experience assault injuries perpetrated by students have the following characteristics: greater average years of educational service, higher proportion of male teaching staff and students, and higher proportions of students eligible for free or reduced price lunches in the school (Casteel, Peek-Asa, and Limbos, 2007).

Limitations

When reading our report, it is important to keep in mind the limitations of the methods we employed. The most important is that we do not present causal evidence about whether specific school technologies reduce violence; this evidence is lacking from the research literature at large (for a few examples, see Bachman, Randolph, and Brown, 2011; Garcia, 2003; Jennings et al., 2011; Perumean-Chaney and Sutton, 20013; Tillyer, Fisher, and Wilcox, 2007), and an efficacy study of any one or more technologies was not within our scope. The second limitation is that our report relies largely on expert opinion. Although we sought to the best of our ability to identify a representative set of experts, we by no means exhausted all potential sources of expertise. For example, we interviewed national- and state-level administrators, researchers, national advocacy organizations, and school safety technology vendors for this report. These are important constituents who use and interact with school safety technology. But our small sample does not purport to represent educators', parents', students', or vendors' full set of views. Third, the literature review of technologies involved only one reviewer for all stages of screening, coding, and analysis (the literature review of school safety and violence involved two reviewers), and the review did not involve querying listservs, making contacts with authors, and going through reference lists of full-text reports to identify more potentially eligible reports. Because of the short time frame of this review and our desire to provide functional descriptions of these interventions, we believe that our search strategy and analysis plan were sufficient for this study's purposes.

Organization of This Report

The remainder of this report consists of five additional chapters and four appendixes.

- Chapter Two presents a typology of school safety technologies and discusses their use, any association with key outcomes, and cost considerations revealed through a rapid review of the literature.
- Chapter Three discusses stakeholder perspectives on the different types of safety technologies, including their appropriateness in promoting school safety and key challenges associated with adopting these technologies.
- Chapter Four describes six schools or localities and how they are using technology to keep their students and teachers safe.
- Chapter Five prioritizes needed improvements to school safety technologies, based on results from an expert panel.
- Chapter Six discusses future directions in school safety technology.
- Appendix A provides a more thorough review of the literature, summarized in the main text.
- Appendix B describes the methods used in this research, although each chapter presents an overview of the methods pertinent to that chapter.
- Appendix C provides a list of participants in the expert panels.
- Appendix D provides a list of technologies that the School Safety Expert Panels identified as needing improvement.

CHAPTER TWO

School Safety Technology: Technology Typologies, Prevalence of Use, and Evidence of Effectiveness

In this chapter, we focus on the types of technologies currently employed in U.S. schools (grades K–12) or that are being developed as potential solutions for threats to school safety. This analysis aims to describe the research about existing school safety technologies, how they function, and evidence about the technologies' cost and effectiveness. To understand the types of technology schools use and how these technologies are viewed by users, we first conducted a rapid review of the literature, using methods fully described in Appendix B (and briefly described below).

Methods

Rapid reviews attempt to accomplish similar goals as systematic reviews—a comprehensive review of literature and a synthesis of the evidence base—but they do so within more constrained parameters (e.g., time) and limited resources. Briefly, the information for this chapter comes from a rapid review of technologies based on a literature search of nine databases. Articles included in our review must have discussed K–12 school safety technologies currently employed in the United States. All types of reports (e.g., newspaper articles, magazine entries, reports of government legislation, nonpeer-reviewed reports, scientific journal articles) were eligible.

Technology was defined as devices developed or implemented to prevent violence in schools and to make schools safe. A *device* is further defined to include machines, software, computer applications, or equipment created for the express purpose of making schools or students safer. This definition does not include policies (i.e., guiding principles to set direction) and procedures (i.e., sets of steps or particular ways to accomplish something) that are not related to school safety devices, even if these policies or procedures explicitly concern school safety. Our search yielded 2,249 unique citations, of which 508 were eligible after full-text screening.

Individual Technologies

In summary, we identified 12 types of school safety technology through our review. Table 2.1 provides a snapshot of the 12 technologies, including the rationale underpinning the technologies, procedures for implementing them, and their prevalence. More detailed descriptions of each technology follow the table.

Table 2.1
Summary of School Safety Technologies

Technology	Example	Rationale	Procedure	Prevalence
1. Entry control equipment	Electromagnetic door locks that can be remotely locked, mobile barricades, restricted areas	Makes it easier to restrict school access to authorized users	Lock targeted doors as desired, facilitate entry into school facilities at desired access points	Approximately 8 out of 10 public and private schools report controlled access to buildings (Roberts et al., 2014)
2. Identification technology	Student/staff identification, visitor badges, parking stickers, palm scanners	Distinguishes those who have authorized access to school property from those who do not	Student/staff ID distinguishes permanently authorized access to school grounds. Visitor badges signify temporary access. Parking stickers signify vehicles with access to particular parking lots	Commonly used, generally on school property and at relevant school events (e.g., dances, football games)
3. Video surveillance technology	Cameras, closed circuit television (CCTV), video recording, video–motion detection system	Used to record student actions, identify perpetrators, deter crimes by suggesting that perpetrators are being monitored	Cameras monitor vulnerable/high-risk school areas. Video-motion detection system can produce alarm signals, switch to continuous recording, etc. Portable cameras can be quickly installed and/or relocated	Approximately 6 out of 10 public and 4 out of 10 private schools report using cameras (Roberts et al., 2014)
4. Communication technology	Two-way interaction systems (e.g., walkie-talkies, phones, emergency communication systems, radios)	Allows students/staff to notify school office and law enforcement about incidents, unauthorized individuals, and dangers/risks	School communication network that links classrooms, schoolyard supervisors, and bus drivers with the front office or security staff, as well as with local law enforcement and fire departments	Intercoms and two-way, hand-held radios are thought to be used extensively
5. School-site alarm and protection systems	Scream alarms, motion/sound/heat detectors	Alerts those at school and emergency responders or protects those in school during an attack	Alarms sound when detectors signal abnormal motion, sound, or heat	Unknown, but potentially prevalent given that they can leverage existing alarms (e.g., fire alarms)
6. Emergency alerts	Automated text messages or emails, school TV stations	Alerts and prevents rumors using mass messaging	School staff send messages to students, parents, and community during a crisis (e.g., intrusion)	Most schools have lists of emails, phone numbers
7. Metal detectors and X-ray machines	Hand-held and walk-through metal detectors, X-ray machines to scan book bags, often at entrance to school or as students exit school buses.	Prevent weapons from being brought into school	Students are inspected when entering school. Metal detectors search the person's body; X-ray machines search bags. Weapons are confiscated if found. Used by school security staff, from daily searches of all students to random searches of all students at set intervals (e.g., one day a week), to random inspections of random/targeted individuals	Approximately 5 out of 100 public schools and 1 out of 100 private schools report doing random metal detector checks. Approximately 3 out of 100 public schools and fewer than 1 out of 100 private schools have students walk through detectors daily (Roberts et al., 2014)

Table 2.1—continued

Technology	Example	Rationale	Procedure	Prevalence
8. Anonymous "tip lines"	Toll-free phone hotline, voicemail system, website with anonymous posts	Relies on students, who are thought to be top source of information for addressing/solving incidents	Hotline/voicemail/website serve as a one-stop-shop or point of contact for reporting information on incidents and problems (e.g., a student suspected of bringing weapons to school)	Likely more prevalent in areas where district/state has provided the service
9. Tracking systems	Smart phone applications, Global Positioning System (GPS) devices	Allows parents/schools to keep up-to-date on students' movements	Students carry tracking device with them to/from school, transmitting tracking signal, or school bus contains tracking device, which transmits a tracking signal	No reliable estimates of prevalence found, although potentially prevalent with smart phones
10. Maps of school terrain and bus routes	Geographic Information System (GIS)	Helps emergency responders prepare for crisis	Software used to plot school terrain and transit routes used for school purposes (e.g., bus routes)	No estimates of prevalence found
11. Violence prediction technology	Data-driven software	Helps predict locations, times of isbehavior/ school violence	Information is collected about individual or group demographics and/or behaviors, which is then used to detect and predict possible future violent behavior	Use of this type of technology is not very common
12. Social media monitoring	Automated scans of online content (images and text) for bullying, threats, evidence of self-harm	Searches for problems online, where the majority of bullying occurs (Ybarra, Diener-West, and Leaf, 2007)	Information posted on social media is collected and used to either detect/capture crimes or violence that has already occurred or prevent possible future violent behavior	No estimates of prevalence found.

Technology #1: Entry Control Equipment

What it is. Entry control equipment is used across the spectrum of preventing, preparing for, and responding to crises related to school violence and other threats to school safety. Materials typically include electronic door locks, barricades, posted signs, radio frequency identification (RFID) cards, and biometric access control systems (Green, 2005). Electronic or electromagnetic locks are remotely controlled to lock or unlock targeted doors as desired. Barricades and posted signs facilitate entry into a school facility at desired access points. Those with access cards can use them to enter facilities without signing in or checking in with school staff (Ibarra-Manzano et al., 2008). These technologies are intended to make it easier to limit school access to authorized users (Chipley et al., 2012).

Prevalence of use. In 2011–12, 88 percent of public schools and 80 percent of private schools controlled access to school buildings, and 44 percent of public schools and 42 percent of private schools controlled access to school grounds during school hours (Robers et al., 2014). Generally speaking, locks and barricades are standard, low-tech protection technologies. However, electromagnetic locking systems, considered for use by some urban schools, can have prohibitive expenses for many school districts (Gray, 2014).

Evidence on outcomes. No rigorous evidence exists on the effectiveness of entry control equipment related to school safety outcomes. Locks are thought to be useful when used on all doors to limit entry to the facility or to lock classroom doors from the inside (Sandy Hook Advisory Commission, 2015).

Cost considerations. Costs related to purchasing, installing, and maintaining this technology are likely to be low when using traditional metal locks and much more expensive when using high-tech electromagnetic systems.

Technology #2: Identification Technology

What it is. Identification technology is used to distinguish those who have authorized access to school property from those who do not. Common forms include student and staff identification cards, visitor badges, and parking stickers ("Improving Classroom Attendance," 2014). Student and staff identification cards identify those who are permanently authorized to access school grounds (Kukkala et al., 2009), visitor badges signify temporary authorized access (DeNisco, 2013), and parking stickers identify vehicles with authorized access to particular parking lots (Schneider, 2010). Some technologies link to national databases or registries (e.g., sex offender registries); identification cards can also be multipurpose (e.g., used to receive lunch). A rarer technology, palm scanners or "hand geometry identification devices," use infrared light to instantly capture a digital image of a parent's or guardian's hand, which allows for cross-checking the identity of an adult who asks to take a child out of school (Uhl and Wild, 2009). Iris recognition technology is another biometric identification technology, in which a scan of a person's eyes is compared to a stored image of the iris—which is unique to each individual (Uchida et al., 2004).

Prevalence of use. Student, staff, visitor, and vehicle identification techniques are commonly used technologies (Gray, 2014). They are generally used on school property and at relevant school events (e.g., dances, football games). Use of identification cards increased significantly from 1997 to 2005, although biometric identification was very rarely used or even installed at schools (Wilson and Henry, 2006). In 2011–12, 7 percent of public schools and nearly 3 percent of private schools required students to actually wear their badges or picture identification (Robers et al., 2014).

Evidence on outcomes. No rigorous evaluations exist on identification technology's effectiveness in reducing school violence or threats to school safety. However, there is little concern about identification technology causing harm or being unacceptable to students, staff, and communities. School leaders need to consider the physical layout of their schools and the risk of intrusion when designing procedures that use identification technology (Chipley et al., 2012). For example, single visitor entrances are used to facilitate easier supervision and checking of identification by a receptionist or security officer ("Security Is in the Cards for Cobb County Schools," 2012).

Cost considerations. Aside from technologies involving biometrics, identification technology is likely to be relatively inexpensive to purchase and use.

Technology #3: Video Surveillance Technology

What it is. Video surveillance technology is used proactively to prevent incidents by letting perpetrators know that they may be monitored, as well as to reactively follow up on incidents by recording and identifying perpetrators (Aker, 2008). Common materials for video surveillance technology include cameras, CCTV, video-recording devices, and a video–motion detection system. Cameras are placed in vulnerable or high-risk areas of school property (including school buses), and portable cameras can be quickly installed or relocated. Feeds from cameras are then sent to a monitoring station, either at the school itself or to a district office. Video–motion detection systems provide added support by producing alarm signals or switching to continuous recording when triggered (Addington, 2009).

Prevalence of use. Video surveillance technologies are common. Use of CCTV increased significantly from 1997 to 2005 (Wilson and Henry, 2006). In 2011–12, 64 percent of public schools and 41 percent of private schools used cameras (Robers et al., 2014).

Evidence on outcomes. This technology is considered to be more effective at preventing or minimizing property crimes (e.g., vandalism) than at preventing school violence or other crimes at school (Garcia, 2001). Cameras often need to be concealed, hidden, or hard-to-reach to prevent vandalism, and angled to avoid glare and maintain their ability to function properly.

Cost considerations. Camera technology can be costly for schools with limited existing wiring, and costs can increase exponentially depending on the staffing needed to monitor live video feeds and the number of units and complex features added (e.g., color picture, tilting cameras; Green, 2005). Other considerations include the need to protect the cameras themselves from vandalism; the ability to move them, since cameras can displace violent activity to nonmonitored places; and the effects of weather on the cameras (Green, 2005).

Technology #4: Communication Technology

What it is. Communication technology is used both to prepare for and to respond to crises on school grounds (Schneider, 2010). Common materials used include intercoms, walkie-talkies, emergency communication systems, radios, and phones (McLester, 2011). These devices are used to establish school communication networks that link classrooms, schoolyard supervisors, and bus drivers with school offices or security staff, as well as with local law enforcement and fire departments. This network allows staff to notify school administrators about incidents, the presence of unauthorized individuals, and other dangers or risks.

Prevalence of use. Intercoms and two-way, hand-held radios are thought to be used extensively in U.S. schools, as they are typically employed for functions other than reporting school safety threats (Romanik, and Blazer, 2009). These technologies can be used by teachers,

schoolyard staff, maintenance or custodial personnel, security guards, crossing guards, office staff, athletic staff, bus drivers, field trip supervisors, and emergency services (Sprague, 2007).

Evidence on outcomes. There are no evaluations of these devices' effect on school safety. Communication networks using these technologies are thought to be particularly helpful for staff who roam campuses, hallways with complex layouts, and secluded areas. Intercoms and emergency communication systems should be in effect 24/7 to achieve their intended purposes (McLester, 2011). In contrast, two-way radios, walkie-talkies, and phones are intended to be used during work hours by mobile users (e.g., those on playgrounds, school buses, parking lots). Portable communication units may also be useful at off-site and after-hours school events (e.g., off-site dances).

Cost considerations. Ordinary communication technology (e.g., phones, radios) may be functionally sufficient for schools and districts looking to save on costs, rather than high-tech systems.

Technology #5: School-Site Alarm and Protection Systems

What it is. School-site alarm systems are used as response technologies to mitigate a situation once a threat to school safety has occurred (Green, 2005). Local and silent alarms sound when detectors signal abnormal motion, sound, or heat in a given area. For example, passive infrared intruder alarms detect body heat, scream alarms sound only when a certain threshold of sound is reached (e.g., someone yelling in distress), and small panic transmitters are used by staff to summon emergency help (including after hours). Local alarms sound inside relevant facilities to warn those present at school that a crisis or emergency is happening, as well as to alert any perpetrators that their presence on site is known. Silent alarms, by contrast, alert emergency responders not on site (Schneider, 2001); for instance, schools may have wireless panic buttons at various locations on site that directly notify local law enforcement agencies when activated.

Prevalence of use. This review did not identify any estimates of the prevalence of school-site alarm system technologies. However, local alarms use similar technology to fire alarms, which are extremely common in U.S. schools—the infrastructure of which could be leveraged in installing school safety emergency alarms ("What Fire Alarm Inquiring Minds Want to Know," 2007). Use of panic buttons or alarms increased significantly from 1997 to 2005 (Wilson and Henry, 2006).

Evidence on outcomes. This technology is typically used to respond to emergencies rather than to prevent violent incidents (Garcia, 2001). An alarm system is thought to be most useful when it is always activated and ready to be used, particularly in secluded areas of school sites (e.g., bathrooms, long hallways). Silent alarms—either alone or connected to local alarms—need to be linked to emergency responders on call 24/7 for effective and timely mitigation of crises that need to be urgently addressed.

Cost considerations. Complex systems of alerts can costs districts millions of dollars; the use of existing infrastructure (e.g., telephone lines, local fire alarms) to send out alarms can eliminate fees and costs while also being reliable.

Technology #6: Emergency Alerts

What it is. Emergency alerts are used to inform school stakeholders of threats to school safety once they have occurred. Phone and email alerts are typically sent to students, parents, and other community members to inform them of a crisis (e.g., intruder on school campus, school shooting; Egnoto et al., 2013). School TV stations are used by school staff (e.g., principals) to

send messages to students and other school staff during school hours about potential threats to safety on school premises (Van Horn, 1998). Phone and email alerts are intended to provide community stakeholders with facts about potential or ongoing crises to help them respond if needed but also to ease community members' minds and prevent rumors that exaggerate the extent of safety issues (Thakur, Sharma, and Helmy, 2010).

Prevalence of use. This review did not identify any estimates of the prevalence of emergency alert technologies. However, many schools have lists of emails and phone numbers of at least the parents of students, facilitating the possibility that many schools could adopt this technology in a cost-efficient manner.

Evidence on outcomes. There is no research evaluating the effect of this technology on school safety. Excessive use of this technology could potentially lead students, parents, and community members to become desensitized to and ignore messages received.

Cost considerations. The technology is relatively inexpensive: Some services can provide mass texts for less than $50 a month, whereas mass email messaging is likely to have minimal costs if existing school facilities are the email recipients.

Technology #7: Metal Detectors and X-Ray Machines

What it is. Metal detectors and X-ray machines are used by school security staff to inspect students for weapons, which are confiscated if found (Gastic and Johnson, 2014). Metal detectors search for weapons on a person's body, whereas X-ray machines are used to inspect students' bags for weapons (Green, 2005). These technologies are intended to prevent weapons from entering schools. Use of metal detectors and X-ray machines varies from daily searches of all students, to random inspections of all students at given intervals (e.g., one day a week), to random inspections of random or targeted individuals (Robers et al., 2014).

Prevalence of use. In 2011–12, 5 percent of public schools and 1 percent of private schools conducted random metal detector checks on students, and almost 3 percent of public schools and 0.4 percent of private schools required students to walk through metal detectors daily (Robers et al., 2014). Metal detectors are most commonly used at school entrances, although school officials can also inspect students as they board and exit school buses (Garcia, 2003) or randomly. These technologies are usually used at high schools and to a lesser extent middle schools; they are rarely used in elementary schools (Garcia, 2001).

Evidence on outcomes. A review of 15 years of research concluded that metal detectors have no apparent effect on reducing injuries, deaths, or threats of violence on school grounds (Hankin, Hertz, and Simon, 2011). Moreover, these technologies cannot distinguish between different objects made of metal (e.g., other items in a school bag)—such determinations must be made by trained employees. Metal detectors and X-ray machines may be most helpful for and accepted by stakeholders at schools where students bring knives or guns to school and school-related events. Concerns about the use of these technologies in schools include students being late to or missing classes because of long lines, infringing on students' rights (e.g., racial discrimination), privacy, moving violence off school grounds, and creating a prison-like atmosphere (Gastic, 2011; also, see Chapter Three). Several staff members are often needed to use these technologies properly.

Cost considerations. Costs can range from $200 (for hand-held metal detectors) to as much as $20,000 for larger detectors.

Technology #8: Anonymous Tip Lines

What it is. Tip lines, whether anonymous or confidential, are used to prevent school safety threats before they occur (Stroud, 2009). Typical materials include toll-free phone hotlines or voicemail systems, anonymous text-messaging services, and websites that allow users to make anonymous posts. Signs, posters, and messages are typically delivered to students, families, and community members to inform them about the existence and purpose of these technologies. Phone hotlines or voicemail systems, anonymous text-messaging, and anonymous websites are intended to be one-stop-shops or points of contact for reporting information on incidents and problems related to school safety (e.g., a student suspected of bringing a weapon to school; Kanable, 2008).

Prevalence of use. This review did not identify any estimates of the prevalence of these technologies.

Evidence on outcomes. Anecdotal evidence suggests that this technology may be helpful, although no rigorous research was found on this technology. It is thought to help identify when a weapon is brought to school, plans to harm self or others at school, and drug use on school grounds (National Center for Education Statistics, 2004).

Cost considerations. Low-cost solutions are available, such as setting up a website or voicemail system where anonymous messages can be posted. However, monitoring and investigating messages can be costly. Schools may also be able to sign up for some free services in certain areas or states.

Technology #9: Tracking Systems

What it is. Tracking systems are used to prevent or lessen the chances of a threat to student safety in transit to and from school or school-related events (Anund et al., 2010). Student-tracking systems are intended to be carried by students; common materials include applications on smart-phones or other devices with GPS capability. GPS tracking systems located on the school bus include some sort of receiver (e.g., applications on smartphones) used by school staff and parents to track the location of the school bus (Saranya and Selvakumar, 2013).

Prevalence of use. Little reliable evidence exists on the prevalence or cost of tracking systems. However, it is likely that these types of tracking systems are or will increasingly become prevalent given the increasing ownership of smart phones by both parents and children.

Evidence on outcomes. No scientific evidence was found on the effectiveness of student- or school bus–tracking systems in preventing or lessening the chances of threats to school safety. Student-tracking systems are potentially most helpful for vulnerable students (e.g., children with special needs), younger students, and frequently truant or problematic students. School bus systems can potentially help schools identify which drivers are speeding or taking unauthorized routes and may also help parents know when school buses are scheduled to arrive at their children's stop, particularly when there are delays, and thus plan the minimal amount of time children may be waiting unsupervised for a bus to arrive (Hu et al., 2012).

Cost considerations. Schools with students who have smart phones with built-in tracking systems may save on costs. Bus-tracking may lead to more efficient and safer routes, which proponents have argued save schools costs on fuel and insurance.

Technology #10: GIS-Informed Maps of School Terrain and Bus Routes

What it is. GIS-informed maps of school terrain and bus routes are intended to help prepare for and respond to crises related to school safety (National Law Enforcement and Corrections

Technology Center, 2014). The software is used to plot school terrain and transit routes used for school purposes (e.g., bus routes to and from student homes). School district transportation office employees, for example, can use such software to plot and change school attendance zones and to plan, modify, and optimize school bus routes. The software can also be used to create a computerized mailing list and send warnings to parents of children whose bus stops are near residences of those on certain types of offender lists (e.g., sex offenders). These maps can help emergency services respond to crises at school (e.g., more quickly identify the location of an active shooter; Feliciano, 2001). Another software known as "School COP" can be used by school administrators, safety officers, and security staff to enter, analyze, and map school safety incidents. Designed to be widely distributed and usable without formal training, School COP can generate multilayered incident maps of school terrain that can indicate hot spots where school safety threats often occur and can be organized by various features of these incidents (Rich and Finn, 2001).

Prevalence of use. This review did not find prevalence estimates for using GIS-informed maps for school safety issues, although use of this type of technology is likely not very common.

Evidence on outcomes. There are no research studies on the effect of this technology on school safety. The technology is potentially useful on large campuses that may be difficult for emergency responders to navigate if they have no experience with the school site. It is also potentially useful for buses driving through high-risk zones (Rich, 2001).

Cost considerations. Proponents have argued that GIS-informed maps of bus routes, as with bus-tracking systems, can save schools money on fuel (and possibly maintenance costs) by finding efficient routes.

Technology #11: Violence Prediction Technology

What it is. Violence prediction technology is intended to prevent school violence before it occurs. This technology consists of data-driven software or monitoring of students' social media profiles online. The technology uses information collected about individual or group demographics or behaviors (e.g., from individual school records or national databases on predictors of violence); the information is used to detect and predict possible future violent behavior (Chandler, Levitt, and List, 2011).

Prevalence of use. Use of this type of technology is not very common, as the software and skills required for school safety applications are still quite new, costly, and under development. School administration, emergency services (e.g., police), and trained analysts tend to be the main users of this technology when it is implemented.

Evidence on outcomes. There is no research on the effectiveness of these techniques in addressing violence. They are potentially useful in schools and school districts with high rates of violence and at school events that have high rates of group-based violence (e.g., gang violence at football games). However, there are strong ethical concerns about this technology—will individuals or groups be profiled based on risks or demographics rather than actual actions, and will students be prematurely and possibly inappropriately flagged as delinquents or threats to school safety? (See Chapter Three.)

Cost considerations. As this technology is relatively new and under development, its costs are difficult to define, but at this stage in its development, cost is likely prohibitive for many schools.

Technology #12: Social Media Monitoring

What it is. Social media monitoring is intended to prevent school violence before it occurs and to identify ongoing threats to school safety. This technology is used to scan online content (e.g., images, text) on social media platforms for instances of school safety issues such as bullying, threats, or evidence of self-harm (Ptaszynski et al., 2010). Social media monitoring is thought to help prevent violence from happening because the majority of student bullying occurs online (Ybarra, Diener-West, and Leaf, 2007).

Prevalence of use. No estimates of the prevalence of this technology were found. Use of this type of technology is likely not very common, as the software/skills required are still quite new and either under development or being piloted for school safety applications.

Evidence on outcomes. There are no research studies on the use of this technology on school safety.

Cost considerations. Costs may best be borne at the district level given the need for a centralized monitor to use this technology. Software for automated monitoring and alerts across several social media sites can lower costs, but the human monitoring and resulting investigations and intervention can be costly.

Conclusion

A rapid review of the literature identified 12 categories of school safety technologies to help schools address violence and threats to safety. Although there is evidence that *som*e of these technologies are commonly used (e.g., identification technology, entry control equipment), for most there is limited information about their prevalence. For all technologies, evidence on outcomes is limited or nonexistent. Many technologies are relatively new and are still being developed (e.g., tracking systems, violence prediction).

In the next chapter, we examine the perspectives of key stakeholders to assess their perceptions of these technologies, more specifically, how appropriate they believe each is for reducing the most severe and most frequent forms of school violence and the barriers that exist to fully implementing each.

CHAPTER THREE

Perceived Appropriateness and Barriers to Adoption of School Safety Technology

Having reviewed the literature on technologies for promoting school safety, we next sought the perspectives of key stakeholders, including researchers, school administrators, security personnel and law enforcement, and representatives from relevant organizations, on the appropriateness of technology for addressing violence and threats to safety. We also sought their perspectives on challenges or barriers for schools and school systems seeking to adopt these technologies. We solicited this information from both key informant interviews and a panel of experts, using methods we summarize below and then describe in more detail in Appendix B.

Methods

Expert Panels

We convened two expert panels in April 2015 to identify, rate, and rank school safety needs: One focused on suburban/rural schools, and one focused on urban schools. We divided the panels on this characteristic because early stakeholder interviews (described below) told us that a key distinction in thinking about school safety is police response times—roughly under five minutes (i.e., urban districts) and over five minutes (i.e., suburban/rural districts)—since response times dictate how self-sufficient schools need to be in response to crisis situations such as cases of active shooters. A full list of panel participants is provided in Appendix C. To obtain the best possible representation of views among the expert panels, we invited a selection of researchers, school principals, professional organizations, school safety consultants, school district administrators who are responsible for district safety initiatives, and school safety journalists. We sought geographic diversity among school principals and leaders in particular.

Pre-Panel Questionnaire

Once participants agreed to take part in the panel (some panelists participated in both the urban and the suburban/rural panels), each was sent a 20-page document we had written synthesizing the research on school violence and existing technologies. This synthesis contained the content of Chapter One, Appendix A, and a table nearly identical to Table 2.1. Panelists were also sent a link to an online questionnaire we wrote that presented them with each of the 12 technologies listed in Table 2.1. A total of 18 participants (82 percent) completed the urban pre-panel online questionnaire, and 16 (80 percent) completed the suburban/rural pre-panel online questionnaire.

On the questionnaire, participants were asked to rate each technology with respect to its appropriateness for addressing severe and frequent violence (*How appropriate is this technology*

for the following problems in [urban or rural/suburban] schools: Most severe violence (e.g., mass shooting, kidnapping, rape)? Most frequent violence (e.g., bullying, weapon-carrying?) Response options were: very inappropriate (= 1), somewhat inappropriate (= 2), neither appropriate nor inappropriate (= 3), somewhat appropriate (= 4), very appropriate (= 5), and don't know.

Participants were also asked to describe the most likely harms, if any, associated with adopting a particular technology (*What are potential harms from adopting or implementing this technology?*). For the potential harms, response options were:

- violation of student privacy
- unfair treatment of certain students or student subgroups
- risk of false identification of perpetrator or victim
- increased negative attitudes toward school among students
- increased feeling that school is too fortified or unwelcoming
- cost to adopt reduces funds for more important safety initiatives
- don't know
- other, in which case participants were asked to specify other potential harm.

Panelists who participated in both urban and suburban/rural panels were asked to complete two questionnaires, one for each of the panels, although they were given the option to take only one questionnaire if they desired, because of time constraints.

To analyze the pre-panel online questionnaire, the research team assigned numeric values to the appropriateness response options and calculated mean values for each technology separately for the urban and suburban/rural panelists. The prevalence of potential harms was calculated as the proportion of panelists who indicated a specific harm. We summarized the pre-panel questionnaire and mailed the anonymous results to the panelists before the day-long workshop, and we used their rankings to structure the discussion during the panel, as described below.

In-Person Panel Discussions

The members of the school safety panels convened for day-long sessions of structured brainstorming on April 20 and April 21, 2015. On sequential days, one panel addressed issues related to urban schools, and the other addressed issues related to suburban or rural schools. On each day, between 24 and 28 panelists participated. Once panelists were convened and introduced to each other, they were divided into two groups of approximately 13 members per group to promote dialogue among all participants. Each group was led by two RAND researchers, with an additional researcher present to take notes. The panels were highly structured (details are presented in Appendix B).

Stakeholder Interviews

Over the course of four months (January 2015 to May 2015), we invited 53 representatives from four stakeholder groups to participate in a 30-minute phone interview on school safety. The four stakeholder groups were practitioners/administrators, researchers, advocates, and school safety technology vendors. The list of interview candidates was developed in consultation with the project officer at the National Institute of Justice. Efforts were made to include representation from national, state, and local levels (i.e., regions, districts). In total, we conducted phone interviews with 27 representatives out of the 53 invited. See Table 3.1 for a breakdown of our

recruitment efforts. As opposed to the expert panels, interviewees were not asked about specific technologies or barriers. Instead, we used an interview protocol posing such open-ended questions as: "What types of school violence are most common?" "What technologies do you think are most effective and why?" "What are the greatest limitations of current technologies?" We typed notes during the phone interviews that we then coded by themes such as effective technology, technology concern, and school violence that we then used to summarize results for this report.

Perceived Appropriateness

Results from the Pre-Panel Questionnaire

We present summaries of the ratings from the pre-panel survey in Tables 3.2 and 3.3. In each, the left column shows results for the urban panel, and the right column shows results for the suburban panel. The ratings ranged from 5 (very appropriate) to 1 (very inappropriate) for a particular technology.

In summary, urban and suburban/rural panelists largely agreed on which types of school safety technologies they rated as most and least appropriate for the most *severe* forms of school violence and for the most *frequent* forms of school violence. In terms of very appropriate technologies, urban and suburban/rural panelists both ranked the following three technology categories for the most severe forms of violence (although not in the same ranked order): communication technology, entry control equipment, and emergency alerts. To prevent the most frequent forms of violence, the suburban/rural and urban panelists commonly identified as very appropriate both communication technology and tip lines.

In two instances, urban and suburban/rural panelists deviated on very appropriate technologies. The first is that the urban panel but not the suburban/rural panel rated video surveillance as very appropriate for both the most severe and more frequent types of violence. We hypothesize that this could reflect the greater manpower and infrastructure that panelists said was needed for effective video monitoring, which a larger school district could provide. Suburban/rural panelists, meanwhile, rated social media monitoring as very appropriate for both types of school violence.

There was less agreement about technologies panelists rated as somewhat appropriate for severe and frequent forms of school violence. However, suburban and urban/rural panelists gave lower ratings for violence prediction technology, metal detectors and X-ray machines, and

Table 3.1
Number of Interviews by Key Informant Type

Key Informant Type	Invited	Completed	Declined	No Response	Response Rate, %
School administrator/ school-based practitioner	23	9	1	13	39.1
Researcher	14	9	2	3	64.3
Advocate	6	4	0	2	66.7
Vendor	10	5	0	5	50.0
Total	53	27	3	23	50.9

Table 3.2
Pre-Panel Questionnaire Results: Appropriateness of Technologies for Most *Severe* Forms of Violence

Urban Panel		Suburban Panel	
	Mean		Mean
Very Appropriate Technologies			
Communication technology	5.00	Communication technology	5.00
Entry control equipment	4.81	Emergency alerts	4.78
Video surveillance technology	4.67	Entry control equipment	4.76
Emergency alerts	4.59	Tip lines	4.67
		Social media monitoring	4.56
Somewhat Appropriate Technologies			
Tip lines	4.47	Identification technology	4.44
Identification technology	4.39	Video surveillance technology	4.28
School-site alarm systems	4.29	School-site alarm systems	4.00
Social media monitoring	4.19	GPS tracking of students or buses	4.00
Metal detectors and X-ray machines	3.94	GIS-informed maps of school terrain and bus routes	3.79
GIS-informed maps of school terrain and bus routes	3.80	Violence prediction technology	3.59
Neither Appropriate nor Inappropriate Technologies			
GPS tracking of students or buses	3.43	Metal detectors and X-ray machines	3.44
Violence prediction technology	3.21		

GPS tracking of students or buses for both the most severe and most frequent forms of school violence.

Comments on Individual Technologies

Technology #1: Entry Control Equipment

Both the urban and suburban/rural panel members deemed entry control equipment to be very appropriate (urban mean = 4.8; suburban/rural mean = 4.8) for addressing the most severe forms of school violence; however, both deemed such technologies only somewhat appropriate for addressing the more frequent and less severe forms of school violence (urban mean = 3.6; suburban/rural mean = 4.2).

The two components of entry control—locked doors and visitor management systems—were often discussed separately. Expert panelists noted that entry control technologies were often "defeated for staff convenience" by propping open doors, and others acknowledged that such technologies are hard to implement at schools with many points of entry, particularly open-air campuses or those with modular classrooms. But interviewees and panelists both stressed the importance of locks (both automatic locks and simple manual locks on the inside

Table 3.3
Pre-Panel Questionnaire Results: Appropriateness of Technologies for Most *Frequent* Forms of Violence

Urban Panel		Suburban Panel	
	Mean		Mean
Very Appropriate Technologies			
Communication technology	4.81	Tip lines	4.65
Tip lines	4.69	Social media monitoring	4.61
Video surveillance technology	4.67	Communication technology	4.56
Somewhat Appropriate Technologies			
Social media monitoring	4.20	Entry control equipment	4.18
Metal detectors and X-ray machines	4.06	Identification technology	4.18
Identification technology	3.78	Video surveillance technology	4.17
Entry control equipment	3.56	Emergency alerts	4.12
		GPS tracking of students or buses	3.93
		Metal detectors and X-ray machines	3.56
Neither Appropriate nor Inappropriate Technologies			
Emergency alerts	3.47	GIS-informed maps of school terrain and bus routes	3.43
School-site alarm systems	3.47	School-site alarm systems	3.41
GIS-informed maps of school terrain and bus routes	3.40	Violence prediction technology	3.35
Violence prediction technology	3.31		
GPS tracking of students or buses	3.08		

of classroom doors). One advocate told us: "[C]lassroom locks are a huge issue so teachers can lock from inside the classroom during lockdown."

Interviewees and panelists alike stressed the need for visitor management systems. Trespassing parents were particularly noted as a frequent problem. A researcher stated that to "[H]ave visual images taken when you're a guest or visitor is a fair technique," whereas others mentioned systems that link government-issued IDs and photographs to sex offender registries and other, customized lists created by the school such as of parental custody.

Technology #2: Identification Technology

Panelists believed that identification technology was only somewhat appropriate for addressing both severe (urban mean = 4.4; suburban/rural mean = 4.4) and frequent (urban mean = 3.8; suburban/rural mean = 4.2) forms of school violence. Discussion of this technology centered around the ease of implementation, particularly when IDs are multifunctional (e.g., also allowing students to buy cafeteria lunches). Another panelist referenced ID cards linked to disciplinary records, so that any staff member who scans the student's ID knows whether a suspended

student is not supposed to be on campus. Interviewees rarely mentioned identification technology in their discussions with us.

Technology #3: Video Surveillance Technology

Urban and suburban/panelists had different perceptions of the appropriateness of video surveillance technology. Among the urban panelists, video surveillance was rated as very appropriate for addressing both severe (mean = 4.7) and frequent (mean = 4.7) forms of violence, whereas suburban/rural panelists rated it as only somewhat appropriate for both forms (severe mean = 4.3; frequent mean = 4.2). Discussions in the urban panel indicated that video surveillance is now a widely accepted safety technology, with one panelist stating: "[C]ameras are viewed now as very effective in urban schools." And one of our stakeholder interviewees said: "[C]ameras more and more are becoming ubiquitous as they become more affordable and easier to put in."

Another issue mentioned by both panelists and interviewees alike was that video recording is useful "after the fact" (i.e., to investigate an incident) but does little to prevent violence, potentially because rarely is live video under constant monitoring. Even when there is full surveillance, videos may not prevent violence from occurring. A researcher and advocate who is called as an expert in violent school legal cases said: "I responded [to an incident] when ten students had been killed on campus. They had a full video surveillance of the shooting taking place but it all happens so quickly." The investigative uses of video surveillance were specifically mentioned as useful for more frequent forms of violence: A school resource officer told us: "[C]amera technology can be a useful tool sorting out physical assaults." One interviewee told a story of a principal who "now carries a camera [to fights occurring on school property] in order to document what is happening and in many instances this has caused students to disperse." A researcher mentioned: "[A]nything allowing for transparency can reduce instances of bullying, including surveillance cameras."

Technology #4: Communication Technology

Communication technology was ranked as very important in both groups for addressing severe (urban mean = 5.0; suburban/rural mean = 5.0) and frequent (urban mean = 4.6; suburban/rural mean = 4.8) forms of violence. In both groups, panel members told us that communication technology was critical to school safety plans, with one panelist noting: "[C]ommunication technology is most important for effective responses to violent events." A vendor we interviewed agreed, noting that the best current use of safety technology is for communications. Panelists stressed that two-way communication is especially important, as opposed to teachers or school central office staff being able to call 911 but then not having the technology in place to (ideally) silently communicate during an ongoing crisis. As one panelist mentioned: "[D]uring lockdowns, we [teachers/administrators] often have time periods of 30 minutes or more where there is no incoming information."

Although there was disagreement among panelists, a majority felt that teachers within classrooms should to be able to directly contact emergency responders rather than have to report to central office staff who, in turn, contact emergency responders. Those who disagreed stressed the possibility of teachers making false emergency calls to 911, potential abuse of the system by students in classrooms, the need for training teachers in how to do such reporting, and the logistics of having few rather than many simultaneous conversations with the first responding officers. Despite such concerns, panelists still felt that two-way communication was a priority. Panelists noted that in old buildings or rural school campuses, cell phone

reception was spotty, necessitating the need for rural schools in particular to invest in radios. They also noted that schools have a disincentive from improving cell coverage within a building, since they want to discourage students and teachers from spending time on their phones during school hours. Finally, one interviewee who consults with schools on their school safety plans said that technology is equally important for 911 centers as it is for schools, noting that most 911 centers are "not set up to receive texts or images, which creates a lag in the response end of the communication chain."

Technology #5: School-Site Alarm Systems

School-site alarm systems were deemed by panelists to be somewhat appropriate for addressing more severe forms of violence (urban mean = 4.3; suburban/rural mean = 4.0), although panelists were more ambivalent about this technology for addressing more frequent forms of violence (urban mean = 3.5; suburban/rural mean = 3.4). There was no significant discussion about these systems in any of the panels, nor was it mentioned by any of our stakeholder interviewees.

Technology #6: Emergency Alerts

Members of both urban and suburban/rural panels felt that emergency alerts were very appropriate for addressing more severe forms of violence (urban mean = 4.6; suburban/rural mean = 4.8). Suburban/rural panelists believed that such alerts were only somewhat appropriate for addressing more frequent forms of violence (mean = 4.1), whereas urban panelists were ambivalent about them (urban mean = 3.5). One interviewee told us: "[P]anic buttons are very helpful within the school and in the field. These give schools the ability to remove chain of command policies that often create barriers." When this technology was mentioned, panelists generally agreed that better and more efficient emergency alert systems are needed, for example to prevent false alarms in the case of panic buttons or routinely refresh information in the case of notification systems. Panelists told us that one improvement was to inform all stakeholders of relevant and truthful information before students do because "all of the kids have cell phones and . . . pictures, photos, video gets out into the public immediately." Another mentioned the need for accurate contact information for parents, because "there are some districts where many parents don't have access to computers."

Technology #7: Metal Detectors and X-Ray Machines

Although metal detectors and X-rays were deemed as somewhat appropriate for addressing the more frequent forms of violence by both the urban (mean = 4.1) and suburban/rural panel (mean = 3.6), only urban panel members felt that it was somewhat appropriate for addressing more severe forms of violence (mean = 3.9), whereas suburban/rural panelists believed that the technology was neither appropriate nor inappropriate (mean = 3.4). Although some urban panelists felt that it was essential, the majority of panelists and interviewees who spoke about this technology expressed negative views about its efficacy, cost, and forbidding appearance. Praise included that parents and often staff liked having it in place, if only for the sense of safety it imbued. Criticisms included low rates of accuracy in detection of weapons, the high cost of the equipment and the labor especially when there are multiple entrances and exits, and the false sense of security. Two interviewees mentioned that wand devices would likely be a more useful application of this technology in most schools (e.g., "wands are much more reasonable to purchase for schools with limited budgets and integrating into the school day in ways that aren't disruptive"), and some panelists also mentioned mobile detectors as a way to reduce costs and introduce surprise searches to better prevent students from bringing weapons to a school.

Technology #8: Anonymous Tip Lines

Members of the urban panel felt that tip lines were very appropriate for addressing frequent forms of school violence (mean = 4.7) but only somewhat appropriate for addressing severe forms of violence (mean = 4.47), whereas members of the suburban/rural panel felt that tip lines were very appropriate for addressing both forms of violence (severe mean = 4.7; frequent mean = 4.7). The utility of tip lines was discussed at length among panelists, who said that getting information from students is one of the largest challenges for keeping schools safe. However, many panelists stated that tip lines can generate massive amounts of data and that these lines are not well organized once information comes in. Many panelists also raised the issue of abuse of these lines by students or parents who "call in threats so that a test will get called off or delayed" and the labor-intensive need to vet information because "tip lines became an opportunity for all sorts of garbage to get sent into schools, and schools didn't know what to do with it." For handling tip lines that use Internet-based tips, one panelist talked about the need to be able to "rapidly track IP addresses to identify the source of tips." A frequently mentioned theme was that tip lines need to be multimodal in the sense that they have the capacity to electronically scan email submissions, Internet-based submissions, texts, images, voicemail, and videos to allow for user-friendly tip lines. Panelists also stressed the importance of sharing of information submitted to tip lines with local, regional, and statewide agencies.

Tip lines were also mentioned by some of the interviewees who, for example, referenced specific tip lines as examples of novel or effective applications of school safety technologies. One advocate told us about how some schools use text messages to report bullying. A school administrator from a district with a multimodal line told us that, in the month before we spoke, 84 percent of its tip line reports came through the web. Although the tip line initially started with only anonymous calls, when the district implemented a web-reporting tool, it saw growth in incident reporting. The web reports allow incident reporters to use their cell phones and to upload a photo, conversation, online chat, or video to the reporting site to bring issues to the district's attention. That function has given the district evidence it needs to follow up, which the school administrator reports has made "such an impact on preventing school violence."

Technology #9: Tracking Systems

School bus– and student-tracking systems were considered to be somewhat appropriate among the suburban/rural panelists for addressing both severe (mean = 4.0) and frequent (mean = 3.9) forms of violence, but the urban panelists rated this technology as neither appropriate nor inappropriate for both forms (severe mean = 3.4; frequent mean = 3.1). Neither panelists nor interviewees discussed tracking systems much, although they were mentioned favorably in the few instances in which urban panelists mentioned them. Student-based tracking systems in particular were mentioned as desirable for emergency responders during school emergencies and as effective ways to manage entry control within schools (e.g., by restricting access to certain parts of buildings via electronic entry). However, as was mentioned in the discussion of identification technology, preventing students from giving their ID cards to others was one concern, as was cost and the internal IT capacity to successfully host and maintain such a tracking system.

Technology #10: GIS-Informed Maps of School Terrain and Bus Routes

GIS-informed maps of school terrain and bus routes were rated as somewhat appropriate for addressing more severe forms of violence by both urban (mean = 3.8) and suburban/rural (mean = 3.8) panelists but as neither appropriate nor inappropriate by both for addressing

more frequent forms of violence (urban mean = 3.4; suburban/rural mean = 3.4). Although infrequently mentioned, panelists described GIS-informed maps of school terrain as an important ingredient for successful response to lockdowns, since police could more quickly identify points of entry and isolate areas of the school campus where the crisis occurs. The technology was mentioned by only one interviewee, who described as innovative the blueprints that allow police to easily navigate through a school.

Technology #11: Violence Prediction Technology

Compared with other technologies, this was one of the lowest rated, particularly among the urban panelists, who rated violence prediction technology as neither appropriate nor inappropriate for addressing both severe (mean = 3.2) and frequent (mean = 3.3) forms of violence. The suburban/rural panelists reached a similar rating with respect to addressing more frequent forms of violence (mean = 3.4), but this technology was rated as somewhat appropriate for addressing more severe forms of violence (mean = 3.6). Although most expressed concern with prediction technology, stating, for example: "threat events are too infrequent to build an accurate threat model" and "there will be too many false positives," panelists generally thought that the idea of predictive technology was notionally interesting and exciting.

Although interviewees and panelists were highly skeptical about the accuracy of predictions about which students might perpetrate school violence in the future, they did stress the need to collect better data about students to allow for preventive action. For example, one interviewee stressed the importance of collecting "behavioral indicators that note violence among youth before it becomes an issue. For instance, kids who are fire starters or cruel to animals. These things may not be common but when they exist there should be an intervention immediately and assessment needs to happen to ensure a support system is following the student."

Technology #12: Social Media Monitoring

Social media monitoring was considered very appropriate among the suburban/rural panelists for addressing both severe (mean = 4.6) and frequent (mean = 4.6) forms of violence, whereas the urban panelists rated it as only somewhat appropriate for both forms (severe mean = 4.2; frequent mean = 4.2). The novelty of these programs was noted as a possible reason for the relatively low ranking received by this technology; one panelist stated: "Social media monitoring is key. I think it is low on the list because people aren't using it (or don't know how to use it)." This sentiment was echoed by many of the interviewees, who often mentioned social media monitoring as the key way to combat cyberbullying. One superintendent told us: "[I]t is hard to track cyberbullying, because much happens outside the school so tools around this would be useful."

Panelists also expressed doubt about effective monitoring because of the sheer number of social media platforms and the fact that the ones students use change frequently. Some panelists also informed others in the room about such technologies, with a member of one school district telling others about monitoring for key words in chat programs on school-issued devices and another monitoring for key words on school-wide Wi-Fi networks. However, one panelist expressed doubt about automated key word searches/alerts, stating: "[K]eyword software is useless. Kids don't use the words 'guns' or 'shoot.'" We spoke with one vendor who offers social media monitoring as a service for schools, so that they need not monitor social media sites themselves. One advocate mentioned that she observes "a lot of work on administrators who now have to be cyber sleuths in order to ensure school safety." Panelists bemoaned

the time required to effectively monitor social media (e.g., setting up fake accounts) and were skeptical that school administrators could realistically add this to their already long list of responsibilities.

Barriers to Adoption

Panelists and interviewees also believed that certain technologies could be harmful in one way or another. Before convening the panel, we identified six potential harms associated with adopting technologies that we list below. Under each harm, we describe those technologies that over half of the panelists in either the rural or suburban panel believed would be harmful were the technology to be adopted.

Violation of Student Privacy

Concern about technology violating student privacy was raised by a number of stakeholders during our key informant interviews, as illustrated by this quote from a researcher:

> An issue is how technology will be used to make the campus safer, while creating a balance between security and preserving freedoms of the faculty, administration, and students. To be specific, you can put chips in ID cards and track faculty and the students. You can look and see where staff are going and know things like how long people have been in the bathroom. There will be some labor relations issues. There is space for a lot of oversharing of information. They will have to develop some reasonable standards.

Panelists were concerned that three of the technologies in particular would potentially violate student privacy: video surveillance, violence predictions, and social media monitoring. Exactly half of the panelists in both groups thought that video surveillance was potentially a violation of student privacy; police or body cameras worn by school resource officers (SROs) are a new use of video surveillance, and when mentioned during the expert panel, panelists raised significant concerns about privacy, lack of legal clarity regarding the technology's jurisdiction (e.g., whether or not the video footage is protected by the Family Educational Rights and Privacy Act, as school records are). Similar proportions thought this about violence prediction technology (urban = 47 percent; suburban/rural = 50 percent), but fewer urban panelists (41 percent) and more suburban/rural panelists (61 percent) thought this was a concern for social media monitoring.

Interviewees also raised concerns with respect to adults' privacy with regard to access control technology. A representative of one vendor company told us: "[T]here has been some resistance [to visitor management systems] mainly based on privacy concerns." And an SRO we spoke with confirmed: "[P]arents don't want to show their government issued ID." Finally, a vendor told us: "[T]here are privacy concerns that limit schools wanting to share information with local [law enforcement] officers."

Unfair Treatment of Certain Students or Student Subgroups

Only one technology, violence prediction technology, was rated by panelists as potentially harmful because it could result in unfair treatment of certain students or student subgroups. With respect to violence prediction technology, this concern was raised by 65 percent of the

urban panelists and 56 percent of the suburban/rural panelists. Neither interviewees nor panelists spoke at great length about this potential harm, except to say the prediction technology could exacerbate the school-to-prison pipeline, with African American boys in particular being disproportionately targeted for disciplinary action.

Risk of False Identification of Perpetrator or Victim

Violence prediction technology, social media monitoring, and tip lines were all rated as potentially harmful because they increased the risk of false identification of the perpetrator or victim. For violence prediction technology, this was mentioned by 59 percent of the urban panelists and 56 percent of the rural/suburban panelists; for social media monitoring, these proportions were 47 percent (urban) and 61 percent (suburban/rural), and for tip lines they were 53 percent (urban) and 61 percent (suburban/rural). Neither interviewees nor panelists spoke at length about this potential harm.

Increase Students' Negative Attitudes Toward School

Before convening our panel, we hypothesized based on the research that some forms of technology would increase students' negative attitudes toward school. In this vein, one interviewee told us that technology solutions, which are often speedily implemented, can be done poorly and lower students' sense of connectedness to school by building resentment, mistrust, and fear. She summarized: "I cringe when it comes down to tech versions of security." Similarly, a researcher we interviewed talked about the mixed message safety technology can send: "We want you to be a part of the community but we don't trust you."

Panelists raised concern that entry control equipment, metal detectors and X-ray machines, tracking systems, and social media monitoring could all increase students' negative attitudes toward school. For three of these, the concern was much more prevalent among the urban panelists than among the suburban/rural panelists: entry control equipment (53 percent versus 35 percent), metal detectors and X-ray machines (88 percent versus 61 percent), and tracking systems (53 percent versus 21 percent). On the other hand, 61 percent of suburban/rural panelists thought that social media monitoring would increase students' negative attitudes toward school, a concern endorsed by only 21 percent of urban panelists.

The concern, interviewees explained, is that technology can undermine the key ingredients they felt were essential to promoting a positive school climate. This often involved fostering a positive relationship between students and school staff. An advocate said: "[T]here is a large focus on tech but we need to focus on relationship building and the social and emotional needs of young people. That will outdo tech anyway. If they [students] feel comfortable to talk to an adult then hopefully we won't need the tech." Also mentioned as a way to foster a positive school climate was less punitive policies toward students. An advocate told us that a priority should be "training teachers how to manage and understand behavior. Being positive versus being punitive." Two researchers specifically mentioned restorative justice programs—one said: "[T]he concept of viewing crime and violence as causing harm to not just the person but to the community and being asked to restore that in a productive way. You're not expelled but are involved in a conference and then connected to service and students are brought back into the school community." Finally, one researcher highlighted skill-building for students:

> What we see over and over again is that children and adolescents who respond in criminal ways are lacking social competencies that are necessary for proper interpersonal rela-

> tionships. Very often kids who respond in an aggressive way haven't been taught to think through consequences to solutions and how to choose best option. Social competency programs are very helpful in lessening crime. . . . [B]uild school community and teach students how to react inside the community.

Although many interviewees shared the opinion that technological solutions can contribute to a negative school climate, a few interviewees mentioned that technologies can promote the opposite. During the expert panel, one panelist remarked: "There is a strong psychological effect in making people [students, parents, teachers] feel safe." Metal detectors, for example, are a visible way that some school staff and parents can feel safe. An SRO mentioned: "[E]ven though it only affects a small portion of all schools, all must prepare. School shooters are rare but physical assaults are still a threat—everyone must have a plan." In describing the difference of opinions on this issue, one interviewee offered the unique insight that there is a culture clash between educators, on the one hand, and safety officials, on the other: "Educators are touchy-feely and people responsible for safety and security are fear mongers. And that [the fear mongering] can turn off educators."

Make Schools Feel Too Fortified or Unwelcoming

A related worry that panelists and some interviewees cited with regard to technological solutions to promoting school safety is that they can make schools feel too fortified or unwelcoming. As one school administrator told us: "We struggle with the perception that we are trying to create engaging environments that potentially looks like a prison. That's a real contradiction. What we want is to be a central part of the community but to do that we put up 40-foot fences. When does safety override message of inclusiveness? We have to strike a balance between the two." Many other interviewees also mentioned the need for a delicate balance: An SRO told us that they "[d]on't want promote the perception of a police state. . . . [It's about] finding balance between keeping kids safe without them feeling like they are walking into a prison."

Most panelists believed that metal detectors and X-rays would make schools feel too fortified or unwelcoming (urban = 82 percent; suburban/rural = 78 percent). Fewer, but still over half in both panels, felt the same concern about entry control equipment (urban = 67 percent; suburban/rural = 53 percent).

Cost to Adopt Reduces Funds for More Important Safety Initiatives

Also a concern was the cost to adopt a given technology and how its adoption may take resources from other aspects of school safety. Over half of all panelists felt that the cost of entry control equipment (urban = 67 percent; rural = 47 percent) and metal detectors and X-ray machines (urban = 59 percent; suburban/rural = 61 percent) were harms associated with the technologies. Meanwhile, 61 percent of suburban/rural panelists (but only 44 percent of urban panelists) cited cost as an issue for video surveillance. A caveat is police- or SRO-worn body cameras, about which panelists raised significant concerns regarding the cost of maintaining, cataloguing, or otherwise documenting the resulting video.

Cost issues also came up repeatedly in our interviews of stakeholders. Almost half of the stakeholders we interviewed cited cost issues and specifically how investing in technology reduced other resources that they felt were more important. A researcher we interviewed stated the following, which is representative of what several said:

> [T]he biggest problem is the misconception that schools are dangerous and that shootings are frequent and that schools need to fortify themselves against some sort of imminent attack. This has led schools to overemphasize school security, to spend a lot of money on door locks, bullet proof glass, surveillance, things that are misplaced and means there is less funding for student support services, counseling—things that would be far more effective at addressing the problems that schools face.

With respect to specific costs, one issue that was brought up was the up-front cost of acquiring technology. But the more frequently raised concern was about the recurring cost to staff to maintain the technology. A superintendent told us: "[I]n the last 6–7 years there's been a lot of funding to enhance safety technology resources but unfortunately tech changes so quickly and so there's been no funding to keep those projects updated and funding has actually dropped. There are many districts who've placed tech in the buildings they can no longer afford to keep maintained." Both panelists and interviewees brought up costs associated with metal detectors and video surveillance specifically. With respect to metal detectors, one researcher said: "[M]etal detectors . . . are actually labor intensive," while another remarked that they "are costly and implementation can be difficult." For video surveillance, one researcher told an (unverified) anecdote that at least one city "is considering putting in dummy cameras because they don't have the resources to run electronic cameras constantly."

Technologies with Relatively Few Concerns

Of the 12 types of technologies, there were five where fewer than half of the panelists indicated associated harms in the pre-panel questionnaire. These were:

- **ID technology.** No concern about ID technology was raised by over half of the panelists in either the urban and rural sessions. However, one interviewee told us: "[You do] not want to promote the perception of a police state; [find a] balance between keeping kids safe without them feeling like they are walking into a prison."
- **Communication technology.** Communication technology had the lowest endorsed potential harms, although 44 percent of panelists from the suburban/rural panel did express concerns about cost.
- **School-site alarms.** As with communication technology, 44 percent of suburban/rural panelists raised concerns about the cost of school-site alarms, but other concerns were minimal.
- **Emergency alerts.** As with communication technology and school-site alarms, concerns about the cost of adopting emergency alert systems were raised by 39 percent of suburban/rural panelists, and 33 percent were concerned about the risk of false identification of the perpetrator or victim. However, generally speaking, concerns about emergency alerts were quite minimal.
- **GIS mapping.** Few panelists anticipated harms associated with this technology, with the highest endorsed harm being cost, which was raised by 44 percent of the suburban/rural panelists.

Other Comments

In our pre-panel questionnaire, we asked about the six aforementioned concerns that may be barriers to implementing technological solutions to improving school safety. During our interviews, two other themes emerged that are worth noting.

Solutions Must Be Context Specific

Interviewees and panelists tended to agree with the truism that the school safety plan of a particular school need to be context-specific. An advocate said: "Each district has to decide what will meet their needs. What works in LA might not work in Detroit." A vendor echoed this sentiment: "[S]chools must have situational protocols that are individualized to their particular school context. There is no one-size fits all solution for everyone inside the building or people at different schools." Thus, according to another advocate: "[I]ndividual school districts have to conduct their own unique vulnerability assessments to identify specific challenges." This individualized approach was mentioned by at least two vendors. One told us: "[C]ommercially, there's already zillions of tools out there to do 'A-B-C' function." The challenge is to first identify actual needs and then seek technological (and other) solutions to those needs rather than the other way around.

The "Human Side" of Technology

Interviewees and panelists concurred that any technological solution is only as good as the people operating it: "All value of systems is determined by the people operating them. We need a strong foundation of training and practices that dictate how to use them [systems]." Along these same lines, many reiterated the need for training and drills to ensure that those responsible knew how to use the technology.

A few interviewees cautioned about an overreliance on technology: "[W]e want people to understand that you can't depend on tech alone." "[O]ne of the obstacles we run into is in situations [where people put] all their eggs in one basket—overly relying on tech but in instances like a power outage they go from total confidence in their system to none because they have failed to have a backup plan to think about overall safety." Finally, issues about cost, context-specificity, and human resources were all reflected in a comment by one advocate: "You have to do an assessment looking at costs and staff capacity in order to implement [tech] efficiently. Can they afford staff and the upkeep of these techs? That has to be done in a very thoughtful manner at the district level."

Conclusions

One of our key findings from Chapter Two is the lack of evidence about the effectiveness of school safety technologies. Nonetheless, these technologies exist, some are widely used, and schools need to put school safety plans in place. Through expert panels and interviews with key stakeholders, we asked which technologies, in spite of limited data on effectiveness, the stakeholders considered appropriate for promoting school safety. Urban panelists identified several types of technology as being very appropriate for addressing the most severe forms of school violence, including communication technology, entry control equipment, video surveillance equipment, and emergency alerts. They identified communication technology, tip lines, and

video surveillance technology as very appropriate for the more common forms of violence. Suburban panelists identified communication technology, emergency alerts, entry control equipment, tip lines, and social media monitoring as very appropriate for the most severe forms of violence and tip lines, social media monitoring, and communication technology as very appropriate for the most common forms of violence.

Panelists also believed that certain technologies could be harmful in one way or another. Over 80 percent of panelists from the urban panel and a similarly high proportion of panelists from the suburban/rural panel believed that metal detectors and X-ray machines increased students' negative attitudes toward school and make schools seem too fortified and unwelcoming. The cost to adopt a given technology and how its adoption may take resources away from other aspects of school safety were also concerns for most panelists, specifically for X-ray machines and metal detectors, video surveillance, and entry control systems. Concerns about violating students' privacy were also mentioned with respect to video surveillance, violence prediction technologies, and social media monitoring.

In addition to these concerns, interviewees and panelists brought up two additional issues when thinking about using technology to promote school safety. First, interviewees mentioned that technological solutions, if adopted, must be based on a need that is specific to a school district and school buildings—there is no one-size-fits-all solution. Second, many we spoke with noted that any technology is only as good as the people running it, who are the key components of making schools safe.

Having described both what the literature reveals about school safety technologies and what stakeholders believe is appropriate for schools and barriers to adopt, in the next chapter we present six case studies that describe how school districts themselves have adopted technology in an effort to keep their students safe.

CHAPTER FOUR

Using Innovative Technology to Enhance School Safety in Practice

To see how technologies are integrated and employed in the field, we conducted six case studies of schools that employ technologies within each of the following categories the experts deemed as very appropriate for dealing with school safety challenges, across both urban and rural schools and for serious and frequent types of violence. These categories are communications technology, emergency alerts, entry control equipment, video surveillance, tip lines, and social media monitoring.

As we know from the literature and expert interviews, each school faces its own set of safety challenges and will therefore need a tailored and comprehensive school safety plan that may or may not include technology. Here are some examples of schools and school districts that did just that. They each identified problems and then looked for technology solutions to solve their problems. They identified their solutions in a different way, and their technology uses have resulted in both successes and challenges. Since schools often employ multiple technologies in concert, a goal of the case studies is to show readers how localities adopted and used multiple school safety technologies at once.

Unfortunately, there is no formal research to allow us to definitively conclude whether the technologies enhanced school safety. But, overall, many of the individuals we spoke with on our visits reported being very satisfied with these solutions and recommended them to others facing similar problems. These case studies are not meant to be an exhaustive review of technologies in the "very appropriate" categories that address school safety but instead aim to provide insight into how these types of technologies work in practice and how they are integrated into larger school safety plans. The case studies are also intended to highlight some schools and localities that are at the cutting edge of technology use. Our methods for selecting case study schools and conducting interviews are given in Appendix B.

Methods

To identify the case study locations, we asked the experts whom we interviewed by phone (described in Chapter Three) whether they knew of exemplary locations where what they consider any "innovative technological strategies" to improve school safety are used. We also conducted a general search of the Internet to learn of localities with media coverage about use of school safety technology, using such key words as "school safety," "school violence," and "technology." These two methods yielded a total of 18 candidate locations for our case studies. From this list we selected seven potential locations, which we selected for geographic diversity and for use of a diverse set of technologies from the types that the expert panel had described as very

appropriate for the most severe or most frequent forms of school violence. We then emailed a local school safety personnel (or the contact person our phone interviewee suggested) to solicit their participation in a case study, explaining the purpose of the case study and the research project overall. Six of the seven we contacted agreed to participate.

We then scheduled one telephone call with the point of contact to describe the overall project, explain the purpose of the site visit, and learn more about the school/jurisdictional structure and basics of the selected technology. Then, we corresponded through email to select ideal site visit dates. We conducted 1–2 day site visits between April and July 2015. In each instance, we used a semistructured interview protocol, reviewed a verbal consent form, and interviewed six to 14 people per site visit. In these site visits, we sought out school resource officers, principals, counselors, teachers, and school/district technology officials to learn about and view the technologies in action. The types of questions we posed included:

1. What types of school violence are most common in your district/school?
2. What types of technologies are used in your district/school?
3. What was the process for selecting these technologies?
4. What was the process of implementing the selected technologies?
5. What were the primary barriers and facilitators to implementing these technologies?
6. How effective are the current technologies? Why?
7. What are the greatest limitations of the current technologies?
8. If another school district were interested in implementing the current technologies, what advice or lessons learned would you share?

We took notes and, when possible, audio recorded each interview, which formed the basis for the case studies.

Use of a Real-Time Location and Two-Way Communication System at Skyview High School, Nampa, Idaho

In 2013, Skyview High School in Nampa, Idaho, became the first school in the United States to adopt a customizable real-time location system using radio frequency identification over Wi-Fi technology. Located 20 miles west of Boise, Nampa is the second-largest city in Idaho, with about 86,500 residents. The Nampa School District serves roughly 15,000 students across 14 elementary schools, four middle schools, and three high schools, with high school enrollment ranging from about 1,300 to 1,500 per school. The entire city falls under the jurisdiction of the Nampa Police Department (NPD), which consists of 113 full-time sworn officers and more than 100 other staff and volunteers.

The school was motivated to install the technology in the wake of the Sandy Hook Elementary School shooting in December 2012. In addition, the NPD rated Skyview as "the most unsafe school" in Nampa because of the multiple points of entry into the school. Another concern at the school was the need for shorter emergency response times, especially for teachers stationed in portable structures away from the main building.

After reviewing a number of school safety technologies, such as alarm systems and panic buttons, school leaders decided to adopt wearable safety badges that travel with teachers and

staff wherever they go on school grounds. Designed by Ekahau Inc., a vendor of Wi-Fi–based real-time location, the badges allow wearers to discreetly send a request for assistance. The digital request includes details about wearers' locations and goes to a predetermined group of school administrators and law enforcement personnel. Ekahau adapted the technology for the school setting from its prior applications in medical facilities such as hospitals, nursing homes, and mental health centers. The cost of the system, paid by an anonymous donor, was about $27,000, which included set-up, badges, power-charging stations, and the Ekahau Vision™ software. Using the school's existing Wi-Fi infrastructure and network server kept implementation costs down. Ekahau also offers remote technical support for an annual fee.

The safety badges offer three options, which can be programmed by school staff: (1) request medical assistance such as for a student having a seizure, (2) request security support in such instances as student fights, or (3) initiate a school lockdown in an emergency situation. The badges include a liquid crystal display screen that can display communication texts to badge-wearers. In addition, the location feature allows for a targeted response to threats or safety concerns. Ekahau Forensics Replay™ software allows school administrators to conduct test lock-down drills to assess the effectiveness of their safety plans by reviewing the history of safety badge activity during the drill.

When a badge holder activates the badge, his or her name, location, and type of request is transmitted either to school personnel (for lower-tier medical and security requests) or to the school's computer network, the SRO, and the 911 dispatch center for emergency requests. In the case of Skyview High School, five school staff members have access to the software on their computers to monitor and track movement of the devices. Only the principal or SRO can issue an all clear that is communicated via the badges.

Although plans for the system initially raised some concerns among teachers about "big brother" tracking their locations, and there were some false alarms as a result of the hypersensitivity of the badges, the program has been viewed as a success. According to those we interviewed for this case study, administrators, teachers, parents, and students generally like the system, and some have said that they would not want to be at a school that did not have this program in place. Reported safety incidents have declined in the two years since implementation of the badge program. Some interviewees describe the badges as a deterrent to unruly kids, who recognize that school staff are more alert and responsive with this new system. Also, law enforcement personnel we spoke with valued improved communication with the school.

Although our interviewees indicated that the Skyview safety badge program is widely considered by users to be effective, they offered a few suggestions to other schools that are considering adoption of this technology. Interviewees noted that identifying funding sources is a very important consideration, since implementation of this program at Skyview would have been nearly impossible without a private donation. In addition, teacher training and system transparency are crucial to securing buy-in. Also important are having a strong Wi-Fi system in place, obtaining individual rather than conjoined charging systems, and increasing the volume on the devices so that they are audible in a busy classroom.

Alarms, Video Surveillance, and Datacasting in Clark County School District, Nevada

In Clark County, Nevada, the local school district and police department are using a combination of technologies to address school violence. These include a stationary and portable alarm system, an extensive network of video surveillance technology, and datacasting, which is an emergency response communication system that uses television signals over repurposed broadband to provide information to first responders and other designated personnel.

The Clark County School District (CCSD) is the fifth-largest district in the nation and has been among the fastest-growing school districts over the past several years. The CCSD Police Department (CCSDPD) is a full-service police department, operating 24 hours a day, that is responsible for addressing crime on school property and ensuring the safety of over 323,000 students and nearly 40,000 employees in the district's 357 schools. Over 220 personnel are employed by CCSDPD, including 170 sworn police officers, as well as 50 civilian employees working in the Dispatch Center, Emergency Management, Security Systems, and Information Technology divisions. All high schools are staffed with two on-site officers, nine middle schools have on-site officers, and an additional 55 patrol officers work together to provide police services to the community. Additionally, there are six detectives with supporting forensic staff available to respond to or investigate offenses occurring on district property.

Alert/Alarm System

Three schools in the CCSD—Desert Oasis High School, Jack Lund Schofield Middle School, and Stuckey Elementary School—have implemented a security alarm system known as SAFE (Security Alert for Education), which is produced by Audio Enhancement. SAFE is an audio- and video-enhanced alert system with components described below. In Desert Oasis, which is located on the outskirts of the Las Vegas metropolitan area (approximately 30 minutes from CCSDPD headquarters), implementation of the alarm system was prompted by the need to easily and quickly connect the school to first responders in the event of an emergency.

SAFE includes a number of components: (1) stationary panic buttons that can be installed in discreet locations near entrances and reception areas, (2) monitoring stations outfitted with flashing lights and an alarm to alert administrators and other personnel who are nearby when a panic button has been set off, (3) classrooms equipped with audio and video technology, and (4) teacher-operated wearable panic buttons. The system is also networked to notify first responders and other designated personnel (e.g., teachers, administrators) in the event of an emergency. Classroom components include a ceiling-installed dome video camera, a microphone to pick up ambient noise, and speakers, which are used to amplify teachers' wearable microphones, with the purpose of assisting with classroom instruction. Wearable microphones include functions to turn on the classroom components and a panic button that can be discreetly pressed in the event of an emergency. All components of SAFE are not implemented district-wide because of budgetary constraints.

Interviewees told us that school personnel, particularly those at the remotely located Desert Oasis, reported feeling safer with the technology in place. In addition, CCSDPD officers noted that teachers were pleased with the technology both because of its professional development and its classroom safety functions. For example, teachers can play back recordings to self-evaluate instructional styles or share with others. Interviewees mentioned several instances in which the classroom technology components were used by teachers to record stu-

dent behaviors, which helped prevent false accusations by students of teacher abuse and bullying. Another benefit was that the technology helped to alleviate some parents' concerns about what was occurring in classrooms. The major barrier to scaling up this technology was the cost of implementing it in all 350-plus schools and approximately 13,000 classrooms. In addition, interviewees expressed concern that the value of the system may be limited if it is infrequently used or if teachers do not know how to use it. Despite these limitations, practitioners recommended this system given its potential to assist in emergency situations.

Video Surveillance

The CCSDPD Security Systems division includes a network of over 12,400 cameras installed throughout the schools. The number of cameras installed at individual schools differs widely; for example, there may be anywhere between 15 and 200 cameras installed at comparably sized schools, depending on need. The video surveillance system includes cameras, digital video-recording equipment, servers to store footage, and a web-based server in which live and recorded footage can be accessed by school administrators and personnel in CCSDPD. The web interface, which was developed in-house at CCSDPD, also includes school site–level information, such as architectural blueprints with camera locations and photographs of electronic equipment wiring and other hardware components.

District and police personnel view the video surveillance technology as critical for investigating crimes and increasing the safety of on-campus police during after-school hours. They noted that cameras may also have deterrent functions. However, because it is impossible for cameras to record all spaces in the school, stakeholders felt that the cameras are best used in conjunction with other information, such as student reports. A major challenge in using cameras is the amount of resources required to maintain them and to maintain the video footage. Practitioners recommended that, for schools considering this tool, administrators monitor cameras daily, to ensure that video is capturing relevant campus activity. It is also critical to consult with architects and building designers to identify camera locations that have few physical barriers.

Datacasting

CCSDPD also uses datacasting (data broadcasting), which uses digital television signals to securely broadcast encrypted data (audio, video, data files) to emergency responders and other designated personnel. This technology was implemented approximately ten years ago through a partnership between Las Vegas PBS—the local public television station in Clark County—and CCSDPD. Currently, the partnership is expanding to include other emergency and law enforcement agencies in the Las Vegas metropolitan area.

The datacasting system includes several components. Information about schools, including school databases, such as Infinite Campus (which contains such student information as parent contact, address, and disciplinary history), site layouts, and safety plans, is stored on servers located at the television station. When needed, information can be accessed and securely dispatched via television signals (using the broadband spectrum) to designated responders. Patrol cars are outfitted with receivers/converters capable of receiving alerts on their computer screens in the event of an emergency. Initial costs were quite high and were covered through a $100,000 grant from the Corporation for Public Broadcasting, which covered the cost of setting up the secure data servers and providing receivers/converters to patrol cars.

Most practitioners were enthusiastic about the use of datacasting because of its utility in providing important information in emergency situations. Datacasting may also be a more reliable system for transmitting data and critical information to emergency responders in crisis situations or high-volume events, such as sporting events, graduation ceremonies, or social functions, when ordinary communication infrastructure is likely to fail. The presence of large crowds at sporting events or concerts, for example, can lead to cellular network overload. In addition, the digital television signal covers a significantly larger geographic area than the typical cell phone tower. The datacasting system also has the potential to overcome interoperability issues in a secure manner by circumventing agency-specific systems and other infrastructures that inhibit information-sharing.

One major facilitator of the datacasting system is the fact that Las Vegas PBS is owned by CCSD, which uses the station for virtual classrooms, testing sites, and educational programming. However, most school districts are unlikely to have this kind of relationship with a local television station, which could represent an important barrier to implementation. In addition, datacasting does not provide any kind of audio communication, so it must be used in tandem with existing police communications such as two-way radios. Datacasting also does not have two-way capabilities—in other words, only predetermined data can be cast from a centralized operations or dispatch center. However, officers mentioned that it would be useful if they and other field personnel who are at the scene of an event could upload photographic, audio, and video data to share with others.

Surveillance, Visitor Entry, and Emergency Alert Systems at Londonderry School District, New Hampshire

The Londonderry School District in New Hampshire has instituted a number of school safety technologies over the past several years. Londonderry is a suburban community outside Manchester with roughly 25,000 residents. The Londonderry School District serves roughly 5,200 students with a kindergarten school, three elementary schools, one middle school, and one high school. Several of these schools are close to both the police department and school administrative headquarters. However, two elementary schools are farther away. The distance from these schools to the police department raised concerns among district officials and others, which influenced their choices of school safety technologies.

In the 2001–2 school year, the district experienced a series of unsubstantiated bomb threats, many of which were written on walls on school property. Initially, the standard emergency response procedures were to evacuate the buildings and dismiss the students. After the third threat, however, the superintendent decided to install fixed video cameras in its middle and high schools and temporarily placed metal detectors at school entrances and used local law enforcement to inspect students' backpacks.

Although relations between the school district and police department were once acrimonious, the situation improved as the threats mounted, and the district proactively responded to them via the partnership with local law enforcement. Today, the police department and school district work collaboratively. Three SROs are employed by the police department and assigned to the high school and middle school, with one rotating between the elementary and kindergarten schools. The police department routinely patrols school grounds and is very involved with school safety drills.

Video Surveillance System

The metal detectors and police inspection stations were a temporary measure as a first response to the highly disruptive bomb threats, but video surveillance both within and outside school buildings remains and has been expanded, with over 60 video cameras at the high school alone. Video recordings are archived for two weeks. In addition, all school buses have both video and audio recording. We were told that the benefits of these technologies were twofold: First, the external video monitors align with the newly installed entry control systems (described below), and they help school administrators identify who enters the school. Furthermore, the archived video recordings help school administrators identify students who initiate fights or display other problem behaviors. The police department has direct access to the video feeds.

Visitor Entry System

The Londonderry School District, in collaboration with the police department, also put in place a new school entry control system. All external doors to the schools are locked at all times of day, except when students are arriving and leaving. Visitors seeking to gain entry must ring a bell and announce their name and purpose. After that, they must sign in at the front desk, at which point they are provided with a visitor pass. To protect visitors from rain or snow, vestibules were constructed within the buildings where visitors could wait while they rang the bell for entrance, and video cameras are positioned to give school administrators a clear view of the visitor. In addition, monitors were installed on all doors, and all principals, assistant principals, and custodians carry walkie-talkies so that those monitoring doors can notify all relevant personnel within the school of a door that is open and should not be, and the nearest person can investigate. The walkie-talkies have an "all school" setting by which anyone carrying them can broadcast messages to all parties across all Londonderry public schools. We were told that this setting has been deployed: For example, a suspicious person at one school building triggered an all-school alert, resulting in the other schools initiating a lockdown.

Stakeholders acknowledged that these entry control procedures may make it only slightly more difficult for a person to enter a school by force, as occurred at Sandy Hook, and would not prevent such an occurrence completely. However, they indicated that these strategies prevent the more frequent lower-level threats to school safety, primarily related to parents trying to gain access to students for whom they do not have legal custody.

Emergency Alert System

In the wake of Sandy Hook, Londonderry also adopted an emergency alert system called COPsync911. One of the lessons Londonderry took from Sandy Hook was the need to reduce the time for law enforcement to respond to a crisis, an issue that school board members found particularly pertinent for schools in the more remote locations. Each classroom and administrator has a desktop computer, and each desktop is equipped with the COPsync911 software (although the software can be deployed across multiple platforms, including mobile devices such as smartphones or tablets). When an event or emergency occurs, faculty or administrative staff click the COPsync911 icon to activate it; they then have 15 seconds to cancel a call, or they can send the alert immediately, and can provide text regarding the nature of the alert. This activates an online communication platform (similar to a chat room) between school teachers, administrators, and law enforcement. Specifically, the COPsync911 system then alerts the Londonderry Police Dispatch as well as the five patrol cars equipped with COPsync911 that are nearest to the incident at the time. Currently, the alerts are sent to Londonderry police

and its 63 uniformed officers, state police troopers, and the county's sheriff deputies (both of whom subscribe to COPsync911), as well as to any other local law enforcement subscribers who happen to be close by (e.g., police from a neighboring town). The alerts themselves contain the school district, school name, physical address, and classroom number from where the threat derived. Hyperlinks provide a precise geographic location of the school, and school floor plans are built into the system to allow police to identify exactly where within the school the threat originated. Law enforcement told us that this was a distinct advantage of COPsync911 over the existing panic buttons located in multiple locations in each school building; those alerts might take 30 to 90 seconds before reaching the Londonderry police dispatch. Representatives from COPsync911 informed us that the cost differs by school size but is uniformly under $5,000 for the first year and reduces in price by 50 percent for each subsequent year.

Representatives from both the school district and the police department stated that the strong and cordial relationship between the two agencies was essential to their ability to acquire and invest in their access control and COPsync911 technologies. After Sandy Hook, there was great public support for, and resources to invest in, these types of strategies. However, representatives from both agencies also told us that, as time passes, it has become more challenging to garner both public and financial support to maintain the systems. We were also told that, as the memory of past events fades, compliance with school safety policies and procedures (e.g., asking visitors without passes who they are and what they are doing in the building) also tends to diminish.

School district and police personnel identified three areas for enhancement. Currently, only Londonderry's special education school buses have GPS tracking, and the school district is pushing to extend such tracking to all school buses. Such tracking would be available to parents so that they would know precisely when to expect their children to be dropped off, and if the bus is delayed, where exactly it is (currently, text messages are sent by administrators alerting parents about delays). The second area for improvement would be to invest in more video cameras on the exterior of school buildings to ensure a broader coverage area around school buildings. The third area for improvement would be to develop safety strategies and procedures to accommodate the numerous other activities that happen at the school after school hours—we were told that, in a given week, there were over 250 such activities. This may be as simple as teaching nonschool staff running such activities (for example, a Girl Scout troop meeting) about such features as the emergency alert system and how to use it.

Social Media Monitoring, Visitor Entry, and Surveillance at the Glendale School District, Glendale, California

Glendale Unified School District (GUSD), located in Glendale, California, is using three major technologies as part of a larger suite of tools and strategies to improve the safety of students and schools: Geo Listening, a social media monitoring service; Raptor, an entry/visitor management system; and surveillance cameras. Glendale is a suburban community of approximately 200,000 residents, located in Los Angeles County. GUSD serves the city of Glendale and the adjacent or unincorporated areas (La Cañada-Flintridge, Montrose, La Crescenta), with nearly 27,000 students across 21 elementary schools, four middle schools, and six high schools. The school district was motivated to adopt school safety technologies by a range of factors, including national, high-profile incidents of school violence, such as the shootings at Sandy Hook

Elementary School, as well as a number of incidents of self-directed violence among local students.

Social Media Monitoring

GUSD adopted Geo Listening, a social media monitoring service, in all high and middle schools in 2013. The initial motivation for use of Geo Listening was concern over student suicides in the district, including a student who committed suicide on campus during lunch hours. The student's death reportedly inspired several other students to attempt or commit suicide. Given that individuals who commit suicide often broadcast their despair in a public manner, the district decided to explore technologies to identify students who are at risk of self-harm.

Geo Listening scans student public posts on social media sites such as Facebook, Twitter, and Instagram for specified key words that might indicate harm to self or others, including such words as "sorry" "kill" "die" "end" "over" and "leave." Designated administrators at the district level and school level also work collaboratively with Geo Listening personnel to develop key words that are relevant to the local context as well as nationally trending terms (e.g., popular drugs, slang). For example, Glendale is home to a large Armenian population, so during the Armenian Genocide Centennial, Geo Listening worked with GUSD to scan for posts displaying racial/ethnic antagonism between Armenian and Turkish students.

Geo Listening can be monitored in house or by a Geo Listening analyst (the "service model"). GUSD uses the latter and reported finding it particularly useful. Each day, administrators from the district and each school receive a daily report with the prior day's social media posts. On average, the district daily report is approximately 25 pages long and could include anywhere from ten to 100 posts. Posts are categorized and assigned a risk level, ranging from low to high, with high-risk posts eliciting an immediate notification to district- and school-level administrators.

At the school level, an administrator reviews the daily report and assesses a number of criteria for each post. If an intervention is necessary, the administrator may respond in a variety of ways, including calling in the student to discuss the appropriate use of social media, involving parents, or asking a counselor to intervene. At the district level, an administrator reviews the daily report, scanning for posts that could indicate harm to self or others. He or she will then follow up with the point-of-contact at individual school sites (typically an assistant principal) to find out how the school administrator chose to deal with the particular student. If needed, the school will ask Geo Listening to gather additional information.

Although initially implemented to prevent student self-harm, the technology has had other applications. These include identifying when a student has done or is planning to do something such as getting into a fight or engaging in vandalism on campus. In addition, Geo Listening has been used to educate children and parents about the use of social media and the potential consequences of inappropriate social media posts (e.g., for jobs, college).

Overall, school administrators spoke positively about the utility of Geo Listening. The district has found that the service is an efficient way to monitor social media and identify students at risk of harming themselves or others. But administrators also emphasized that Geo Listening is only one part of an overall safety program. They encouraged collaboration across the district, as well as with law enforcement, to improve the program's effectiveness. For example, the schools work collaboratively with law enforcement to identify ways to expedite communication with first responders and to plan for emergency situation (e.g., lockdowns,

active shooters). Also, live access to school cameras allows police to more efficiently respond to potential threats.

However, the tool has several limitations. School-level administrators reported that the amount of information initially sent by Geo Listening was overwhelming and that it took some time to develop an efficient and useful set of key words to ensure that the net was not cast too widely. Those we spoke with stressed that there was a learning curve, and it took time to develop a sense of which posts required an intervention and how to appropriately intervene. Conversely, Geo Listening cannot capture every warning sign, particularly from sites where posts are anonymous or temporary such as Snapchat or YikYak. Geo Listening may become less effective if it does not evolve with social media. Relatedly, some stakeholders perceived that the tool becomes less effective as students learn that the school is monitoring them and they change their privacy settings from public to private. Another limitation is that the daily reports to school administrators often include posts that are too late for them to respond to, although the administrators reported that these are typically low-risk posts. Finally, Geo Listening appeared much less effective with middle school students than with high school students, since middle school students were less likely to use social media.

For others considering such a system, practitioners cited the importance of notifying parents and students about the use of Geo Listening. Transparency is particularly important because some may perceive Geo Listening as an invasion of privacy, a feeling that might be magnified if districts implement the system without informing the community. There might also be pushback if the tool is used for punishment rather than student safety. In GUSD's case, use of Geo Listening led to state legislation limiting the warehousing of data and requiring notifications to parents and students.

Visitor and Entry Management System

Another approach to improving school safety in GUSD is the use of Raptor, a visitor and entry management system that has been piloted in four schools. Raptor is the largest visitor management organization for K–12 schools and currently serves almost 12,000 schools. Given the occurrence of several high-profile school shootings, district administrators decided to switch from a pencil and paper system to a more automated, web-based application.

Raptor works by having visitors first present a photo ID to staff at a given entry point to a school. The individual's first and last name, birth date, and other identifying information are scanned and uploaded to the program, which is then matched against a sex offender registry database (or any other customizable database the school might want to construct such as authorized adults who may pick up children from the school). After scanning the visitor's ID, Raptor prints out a badge that includes a photo, purpose of the visit, and the location and date.

The primary benefit of the system is that it can help ensure that visitors have a legitimate purpose for being on campus, and it can serve as a potential deterrent. In the event that a visitor name matches that of a registered sex offender, the program sends out an emergency announcement, and a picture of the sex offender will flash on the computer screen, allowing the staff member to determine whether the visitor and the offender are the same person. If necessary, the screener can hit a discreet panic button to notify administrators, assistants, and school resource officers. Across the entire Raptor system, approximately 30 sex offenders are flagged in a day, including parents and random strangers.

However, there are two major limitations. First, many visitors may not have a photo ID such as a driver's license. Second, staff time must be allotted to scan in visitors. Administrators

suggested that a kiosk would alleviate some of the burden on staff by allowing regular visitors (who are already in the database) to scan and print their ID badges during the times when front desk staff are busy (e.g., answering phones, interacting with students). The primary recommendation made by administrators was to be transparent with parents about information-storing practices and to educate them (through letters, phone calls, text messages) on such issues as ensuring acceptable IDs so that parents are knowledgeable about how to access the school. As with Geo Listening, gaining community buy-in is essential.

Surveillance System

GUSD recently upgraded to Ocularis, an IP-based surveillance software program developed by On-Net Surveillance System. The district is currently using this system in four schools, and it will soon be used district-wide. Approximately 100 cameras will be installed per campus. In the school site we visited, the surveillance cameras covered approximately 45 percent of the school. The administration works collaboratively with school sites and the surveillance company to identify the ideal placement of cameras. In addition, the district collaborates with police, who can remotely access live camera feeds in the event of an emergency.

Administrators said that the new cameras are much easier to work with than the older system that was installed in 2008–9. Increased resolution and recording capacity (now two months) are the primary improvements. In addition, recording is much simpler, with the user interface allowing administrators to stream live feeds or to select recorded footage by camera and by time of day. Administrators can select segments of recorded footage, make copies to attach to incident reports, or send footage to other administrators. Although there are still trouble spots, stakeholders relayed that the surveillance system has been instrumental for adjudicating disputes and identifying disruptive behavior.

Anonymous Bystander Tip Line in Colorado

The State of Colorado has implemented an anonymous bystander tip line program known as Safe2Tell. The safety model was first piloted in the Pikes Peak region of Colorado in the late 1990s and subsequently was made available to other districts in an effort to promote communication and reduce distrust of authority by allowing reports of concerns, crimes, or abuse to be anonymous, particularly in highly diverse and economically disadvantaged areas. The program adopted a similar approach as Crime Stoppers, which rewards anonymous tipsters who provide information about felony crimes. Unlike Crime Stoppers, Safe2Tell does not provide rewards to anonymous tipsters. Safe2Tell is unique in three ways: The reporting parties and the report they give are guaranteed anonymity under Colorado's Safe2Tell law, passed in 2007; outcomes of reports are documented and include the action that was taken by responders at the local level; and an extensive education component was designed to empower students, engage them to ask for help when it involves their safety or the safety of others, and encourages their use of the Safe2Tell reporting tool.

The Safe2Tell program was launched statewide in 2004 after a state assessment showed that a hotline implemented after the Columbine shootings was underused and less than effective. Safe2Tell's core competency is giving a bystander a reporting tool, allowing people who know of concerning or dangerous situations to report them; traditional hotline programs are focused on providing help to the person in crisis and not a bystander. Safe2Tell began as a com-

prehensive strategy to provide both fidelity and accountability that other models could not. In addition, education and outreach are critical components that help in changing the attitudes of young people and adults about what to watch for and report, which results in an increased number of reports submitted. Although Safe2Tell was initially a grassroots, nonprofit organization, it has since become funded by the state through the Colorado Office of the Attorney General. Also, a Safe2Tell national nonprofit organization now provides technical assistance and guidance to other states wishing to implement the model.

Anonymous tipsters can make a report via the web (most popular), a toll-free number, or a mobile device app. Tips are received by trained dispatchers with the Colorado State Patrol dispatch center and routed instantly to the appropriate local law enforcement agencies and school-based response teams. School response teams, identified in the Safe2Tell system, typically consist of principals and assistant principals, counselors, school resource officers, and representatives from law enforcement. High-level threats to life or threats of violence are also forwarded to the state-based Safe2Tell team, as well as to appropriate fusion centers—federal, state, and local threat-related information-sharing centers.

Responses to anonymous tips differ depending on the jurisdiction (e.g., district, school) and type of report. In the case of life-threatening emergencies such as suicides or bomb threats, law enforcement and first responder teams will provide an immediate, around-the-clock response, with assistance from school response teams. A majority of reports come in after hours and on weekends. Other incidents (e.g., bullying, substance use, suspicions of abuse or neglect) may require investigation by the appropriate authorities (e.g., child services), school-based counseling, or implementation of prevention and intervention services.

An upgraded, customized, intelligence-gathering and information-sharing tipping platform system was implemented in July 2015. All reports are now routed through a centralized system with a streamlined interface. The interface includes time-stamped information and indicates which users have viewed information. In addition, the system is compliant with various laws and guidelines to protect privacy such as the Family Educational Rights and Privacy Acts, Criminal Justice Information Services security policy, and the Health Insurance Portability and Accountability Act, and encrypted to ensure anonymity. Attachments such as photographs, videos, social media posts, and other pieces of evidence can be uploaded by reporting parties to provide law enforcement with probable cause to act in an urgent situation. In addition, the new system ensures that disposition reports and in-progress notes can be completed for all tips and are accessible by the entire response team. The system also provides an integrated way for dispatchers to communicate live with reporting parties to gather more information necessary for responders (i.e., two-way communication). Law enforcement and school response teams can communicate within the software system to share critical information to aid in the response. These upgrades have improved the quality of information and efficiency of communication between school response teams, law enforcement, and Safe2Tell's state-level team.

Recognizing that students are often the greatest source of information before a tragedy occurs, the Safe2Tell program teaches students how to recognize potentially life-threatening and risky situations and when to alert an adult. This is accomplished through education, outreach, and training of staff and students about recognizing and reporting troubling behaviors and related concerns to ensure prevention and early intervention in violence and other risky behavior. Lowering the threshold from reporting a crime that has already occurred to reporting suspicious, concerning, or unsafe behavior allows the responders to intervene early and

potentially prevent tragedy. Safe2Tell encourages students to break the code of silence that is pervasive in schools and to develop empathy for fellow students who may be suffering. Safe2Tell staff provide free educational videos, toolkits, and promotional materials (e.g., posters) to schools. In addition, Safe2Tell staff make site visits to train and educate staff and students about when and how to use the system. Interviewees said that these visits are particularly useful in the aftermath of incidents because of increased awareness about and interest in prevention.

Interviewees thought that Safe2Tell was highly effective. Several participants noted that they thought that the program had saved several lives because it enabled local teams to respond to and intervene in numerous situations involving potential or real suicide, child abuse, bullying, and illicit drug use. The use of Safe2Tell has also led to the discovery and removal of weapons on school property. Reports have increased on average 58 percent each year, from 102 in 2004–5 to 3,178 in 2013–14. In addition, several participants reported that the program has helped shift the culture to a positive climate in which students care for and look out for one another and that trusting relationships between staff and students have been established. By implementing a consistent marketing strategy across Colorado, Safe2Tell education and promotional efforts and materials focus on positive messaging of engaging peers and communities to watch out for each other and to speak up when a friend needs help. Safe2Tell provides key opportunities to address issues with youth that are often identified as precipitators to violence: depression, mental health, suicidal thoughts and actions, self-harm, and threats to safety.

Interviewees identified several factors as important enablers of successful implementation of Safe2Tell. First, there has been widespread demand for responses to violence in Colorado, especially in the wake of the Columbine school shooting. Second, those involved in Safe2Tell (many of whom began as volunteers) cross multiple disciplines, which has helped to secure cross-agency buy-in. Third, having an advocate champion the program was critical to its expansion from a local pilot to a state-funded statewide tip line. Fourth, community members, including students, began to have confidence in the system and to use it more extensively as they saw effective local response to tips.

Participants emphasized the importance of gaining buy-in from the community, school staff, and students. This is particularly critical for encouraging students to report concerning behaviors. In addition, participants noted the importance of all program components, particularly outreach and education, to initiate shifts in school climate. Simply implementing an anonymous hotline is unlikely to be successful if students do not feel empowered to make reports. Providing outreach, as well as a successful intervention in response to tips, has bolstered confidence in and use of the system.

Conversely, several barriers to implementation were noted. First, because the system is anonymous, issues with false reporting or misuse of the system have occurred occasionally. Unfortunately, there are few ways to address this issue without compromising the anonymity of reporters. Although the reporting system could be confidential rather than anonymous, this may discourage reporting. The participants we spoke with encouraged identifying strategies to reduce misuse of the system rather than removing legal protections of anonymity.

Safe2Tell also encourages and provides training resources, education, and outreach to ensure awareness and use of the reporting tool. This can be difficult, given the finite amount of time staff may have in front of students, given busy school schedules. Relatedly, it can be challenging to encourage separate staff from law enforcement, counseling, and education to communicate and cooperate in the ways required to make the program work. These issues can be

overcome by the use of technology and online tools to provide toolkits for classrooms, webinars for trainings, and marketing materials at the local level. Staff can also implement creative ways to integrate the Safe2Tell message with current school programming, such as existing bullying and suicide prevention programs. This might be as simple as having a conversation with youth to let them know that they are part of the solution.

Finally, there is no statewide mandate ensuring consistent response across school districts. Because education and response are implemented at the local level, there is likely to be large variation in whether students use the program, as well as how local teams respond.

To prevent violence and tragedies, communities should focus on collaborative prevention efforts with support from multiple systems: justice, education, health, mental health, and human services. Safe2Tell provides a unique bridge between these agencies and the youth who need help to avert an act of violence or tragedy across the state of Colorado.

Putting It All Together: Miami-Dade County

The Miami-Dade County Public Schools district is the fourth-largest school district in the United States. It comprises 370 elementary, middle, and high schools serving nearly 350,000 students. It also has its own police force, the Miami-Dade Schools Police Department, consisting of 200 sworn personnel and 75 civilians. All high schools and most middle schools in Miami-Dade have an armed SRO on-site during the school day, as well unarmed security guards who both control access to the building and monitor the premises.[1] In addition to their school-day duties, officers are present for most afterschool events. In addition, between 4 p.m. and 8 a.m. Monday through Friday, a patrol force is available to respond to school alarms or attend to other incidents that may involve a student or occur on school grounds.[2] The investigative division oversees general investigations and personnel investigations, and its officers may also serve on various local task forces. The Miami-Dade Schools Police also has a K-9 unit with dogs trained in apprehension, narcotics and firearm detection, and explosive ordnance detection.

Miami-Dade has one of the most complete suites of school safety technology we have identified among school districts. The breadth of its school safety technologies is a reflection of the size of the district (which provides the funding for adopting and maintaining these systems), policymakers who have prioritized technological solutions, and the serious safety challenges confronting Miami-Dade, which, in 2013, had over 6,000 violent crimes known to law enforcement. The integration of the technologies Miami has adopted and its future plans provide lessons that are widely applicable to the range of small to large school districts.

[1] The number of unarmed security guards per school facility depends on a number of factors. School administrators have some discretion to convert one full-time guard to two part-time guards. They are not considered staff of the Miami-Dade Police Force but receive their training from the department.

[2] During RAND's ride-along with the police department one Tuesday between 4 p.m. and 6:30 p.m., the police sergeant responded to one case at a school in which a student refused to go to her home and one case at a trauma center concerning a student who had been critically injured in a school parking lot.

District-Wide School Safety Technology

Miami-Dade's Superintendent of Schools, Alberto M. Carvalho, has served in the position since 2008, and since that time technology for safety and instruction has been at the top of his agenda. The district has upgraded classroom infrastructure with more mobile devices, has developed digital instructional content, and is currently providing laptops to schools and students to achieve a ratio of three students to one computer, allowing students to use their own devices during school and providing professional development in technology use for teachers and other administrators ("Digital Convergence," undated).

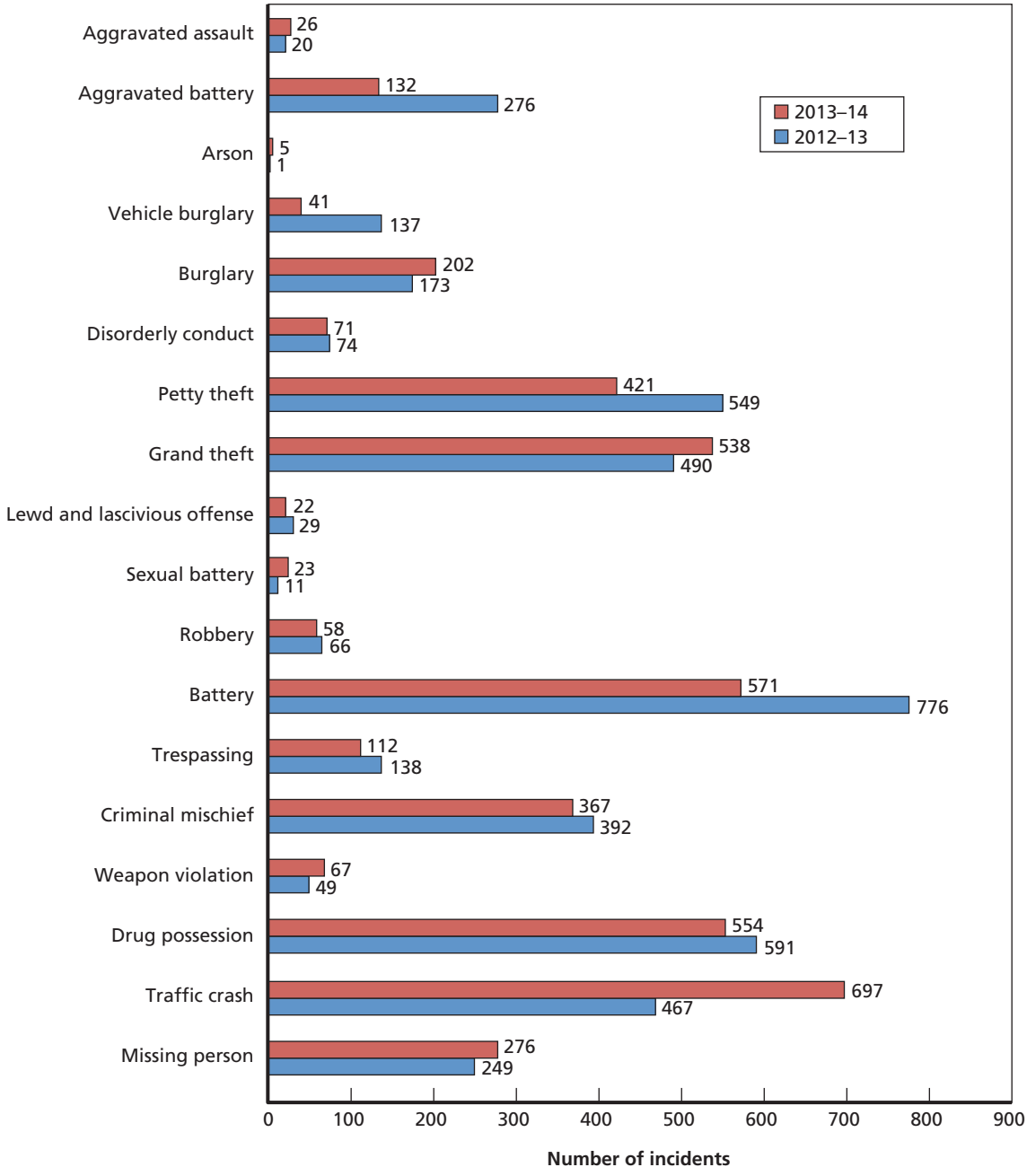
Prioritizing technological solutions is also a priority within the Miami-Dade Schools Police Department. Many of the technological advances the police force has employed are recent, and the police with whom we spoke attributed many of these changes to their new chief of police, Ian Moffett. Appointed as chief of the Miami-Dade School Police in 2013, Chief Moffett told RAND that he "hates paper": During his weekly meetings with commanders, he employs his own equipment to show videos, access documents centrally stored on a Sharepoint site, and present up-to-date data on crime trends within the schools. All police in the force have their own laptop computers with an internal broadband modem; command staff and detectives are each given a tablet computer through which they can both access available applications (for example, social media applications that may be useful during the course of an investigation) and tunnel in to a "virtual desktop" to access software that is as of yet available only in a Microsoft-friendly environment. In addition to incident reports, officers' mobile computing terminals (MCTs) enable them to know where other officers are and facilitate communication between them. In conjunction with the work of the Miami-Dade Police Department, when the Miami-Dade Schools police make an arrest, information entered in the electronic case file is linked to a barcode that is printed from the MCTs on a wristband the arrestee wears. Information is thus easily scanned and uploaded for jail staff.

Internet Security. Given that the Miami-Dade Schools police work with minors, securing police Internet transmissions was of paramount importance. For this reason, the Miami-Dade Schools Police Department has established a circuit-based (versus packet switch) Internet connection with its service provider. It has also purchased encryption technology to ensure that all police force transmissions are encrypted above and beyond security measures provided by its local service provider.

Data-Driven Policing. Chief Moffett has prioritized the collection of data on crime statistics and trends to guide policing activities. In addition to weekly commanders' meetings, each month the chief holds a "CompStat" meeting in which up-to-date crime data are presented to all commanders, including comparisons with the prior year. These are largely incident data—i.e., the number of different types of incidents, arrests, and outcomes, as well as contraband uncovered in the random metal detection process (described below), by month, over time. The data include only incidents for which there is an incident police report. For example, if school administrators and the local school resource officer deem that an incident does not require a report, it would not be reflected in the data the police force captures. An example of the data collected by the Miami-Dade Schools is presented in Figure 4.1.

Mobile Command Bus. The Miami-Dade Schools Police Department owns a mobile command bus with its own power, video, satellite televisions, and communication technologies to facilitate communication with other law enforcement and key personnel. The bus is considered a critical component to emergencies that may occur and in which the police force will spend a substantial amount of time (e.g., a school stabbing).

Figure 4.1
Example of Data Collected by the Miami-Dade Schools



SOURCE: Miami-Dade Police Department, 2015.
RAND *RR1488-4.1*

GIS-Informed Maps of Schools/Bus Routes. The police force Sharepoint site provides a folder with blueprints of all schools in the district. In addition, the police force hired a professional aerial photographer to take photographs of most school buildings, which are also stored on the Sharepoint site, as are all school bus routes. These GIS maps and blueprints are used as resources in school crises so that the school district police force can quickly call up locational

information to, say, determine where to enter a school building and seal off areas given the location of an active shooter within the building.

Anonymous Tip Lines. The Miami-Dade School Police continually monitor and staff anonymous tips that students can provide to a tip line via phone, text, or online. There is also an anonymous bullying hotline (see Miami-Dade Police Department, undated (a), for information about the tip lines). In addition, the school police partner with the Miami-Dade Police Department on the "gun bounty program" in which persons can anonymously call the Miami-Dade Crime Stoppers and receive a $1,000 reward if reporting a person illegally possessing a gun leads to an arrest.[3]

Safety Technology for the School Campus

With respect to technologies employed within schools themselves, the police force did not have detailed inventory on the exact number of schools that had each of the technologies mentioned below. However, the district police department reported that, depending on the technology and the grade level of the school, some had implemented the following technologies.

Identification Technology. All visitors to a school campus are required to present their driver's licenses to a security guard at the school entrance when accessing the building during the school day. The ID is scanned, and a sticker with the picture from the driver's license is printed. During the scanning, the software links the identification information from the license to the national sex offender registry, and if there is a match, the badge does not print, and an alert is automatically sent to the security guard creating the badge, as well as the SRO and other senior administrators (e.g., principal, assistant principal). Plain-clothes detectives routinely do spot checks of the security system by visiting schools to ensure that the detectives are denied access to the building and, when walking through the hallways without a badge, are stopped and questioned by school staff.

All students are required to wear identification cards around their necks when in school buildings during the school day (all students in Miami-Dade also wear school uniforms). The ID cards are also linked with students' school lunch accounts.

Video Surveillance Technology. All high schools and most middle schools have video cameras, which are a mixture of stationary cameras, stationary cameras that can pivot when controlled from a remote source, and portable cameras. These cameras were purchased and installed at different times and, as a result, there are 11 disparate systems across schools. These disparate systems created a barrier for school police who wanted to access live video feeds to enable them to respond to calls in a safer and more efficient manner. As a result, the police department worked for a year and a half to create a system by which all school surveillance cameras across the district could feed directly to a single computer at police headquarters. Using their laptops, officers can access the desktop computer that hosts the video feeds and thus can view any video feed being displayed on that computer.

Communication Technology. School administrators have two sets of radio transmission devices: one for internal communication within the school and one for communication across schools. Onsite SROs carry devices that are connected to both sets. The school district police department headquarters and other key personnel within the Office of the Superintendent are also connected to the cross-school device. Teachers do not carry these devices, but in the

[3] See http://www.miamidade.gov/police/involved-gun-bounty.asp.

school we visited (which was built in 2008), each classroom had an emergency communication device integrated with the school public announcement (PA) system. School administrators are trained to use the internal communication device for routine administrative school functions such as monitoring students, requesting staff services, and assisting with bus and student arrivals and dismissals; the cross-school radios are intended to communicate with emergency management and district personnel during times of crisis or when school or community threats materialize.

Metal Detectors and X-Rays. No schools in Miami-Dade County have stationary metal detectors and X-ray machines at the school entrance, but the police department performs random checks of schools and classrooms. Each week, at least one high school or middle school (and typically more than one) is subject to random screening in which officers visit a school and perform metal detection with "wand" devices. In these random checks, the police officer will choose a small number (< 10) of classrooms within the school building at random and then use the wand to scan all students' persons, bags, and staff in the classroom at the time the police arrive. The police department created a video, posted to its website, to describe the process to parents and other interested stakeholders (Miami-Dade Police department, undated (b)).

Future Plans

The district's experience with a wide variety of technologies has revealed a series of gaps that many districts grapple with. The highest-priority technological advances for Miami-Dade include the following:

Incorporating SESIR Data "CompStat" Data. Police data can be incongruent with data that schools are required to provide to the state in School Environmental Safety Incident Reports (SESIRs). Through routine monitoring of CompStat data, the police department noted this difference and, by investigating the cause, determined that discrepancies largely resulted from how schools measure incidents (e.g., a school may include in its SESIR an incident that results in disciplinary action such as an out-of-school suspension but no police involvement and thus no CompStat incident count, or a fight involving given students may be counted as five incidents by a school, whereas it would only be counted as one incident in the police data). The police force and school district want to be ahead of annual analyses produced by the state with the SESIR data, particularly when school-level statistics are incongruent between the two. Thus, the police department is working toward integrating the SESIR data when they become available (three times per year) to know in advance how the two data sources align and discover reasons for inconsistencies.

Universal Access Card. The police force is in discussions with the school district to install universal, electronic access controls at one entry point at each school so that police force badges can electronically open any school door across the district. This avoids the need for electronic lock boxes at schools or the need for actual keys.

Campus Shield. With a $4.3 million grant from the National Institute of Justice, the Miami-Dade Schools Police Department has begun developing a program entitled "Campus Shield" to facilitate data aggregation intended to facilitate proactive responses to both immediate and long-term threats to school safety. This will be done by integrating data the police department already collects with data from law enforcement at the local, county, state, and federal levels; schools' student information system data; real-time data feeds on student attendance (captured via student ID cards); and video surveillance. In addition, data from school and local tip lines may also be integrated, and there are plans to also include data from social

media. If successful, gathering and analyzing the data in a central location will help identify potential hot spots for criminal activity, patterns of behaviors that SROs and other officers can use to respond to an incident, early warning signs of students who may be starting to display behaviors that could threaten school safety or of potential victims, and the relationship between visitor access and threats to school safety. Mental health specialists are integrated directly in the Campus Shield initiative, with the hope that the data can facilitate linkages and referrals between the school and law enforcement and mental health providers in the community. As part of the initiative, the Miami-Dade Schools Police Department is collaborating with WestEd, which is evaluating the program.

Conclusions

In Chapters Two through Four, we presented an overview of technologies that exist for promoting school safety, key stakeholders' perspectives of these technologies, and case studies about how schools are using these technologies in the field. These case studies show that localities operate and need to integrate many safety approaches and technologies—not just one. They also show the variety in approaches, whether it be the selection of a vendor to monitor social media or the ways districts have adapted over time the use of video surveillance to augment entry and emergency alert systems. These localities are exemplars of "early adopters" of various technologies, and they have expressed, in general, satisfaction with the technologies as adapted over time. In the next chapter, we further build the evidence about school technology by summarizing exercises we conducted to get experts to choose among and prioritize technology needs to improve school safety.

CHAPTER FIVE

Prioritizing Technology and Related Needs to Improve School Safety

The ultimate goal of this project was to identify the highest-priority technology needs to improve school safety. In this chapter, we discuss the technology and related needs our expert panelists identified to best address the most severe and the most frequent forms of violence. The results presented in this chapter are derived from the panels' in-person discussions and their ranking sessions.

Methods

A more detailed description of the panel process is included in Appendix B. As discussed in Chapter Three, in April 2015, the members of an urban school safety panel and the members of a suburban school safety panel each convened for a day-long set of sessions to do structured brainstorming. Nineteen non-NIJ panelists participated in the urban panel and 23 in the suburban/rural panel, with some members attending both days. We split each panel into two equal-sized groups. The goal of the brainstorming was to identify improvements to school safety policies and practices that could be addressed by technology.

To elicit a list of potential improvements, we led school safety panelists through three brainstorming exercises over the course of the day: a session on problems stemming from the most severe forms of school violence that technologies could address, a session on problems stemming from the most prevalent forms of school violence that technology could address, and a final session on prioritizing technologies across the entire spectrum of school violence. Using results from the pre-panel questionnaire as a starting point, the structured discussion considered the most severe and most frequent school safety concerns separately and prompted participants to explore:

- needs for those technologies that questionnaire results indicated were very and somewhat appropriate for each of the three sets of concerns (see Tables 3.2 and 3.3 in Chapter Three)
- needs for those technologies that questionnaire results indicated were neither appropriate nor inappropriate technologies for each of the three sets of concerns (see Tables 3.2 and 3.3 in Chapter Three)
- new or nontraditional approaches or technologies (i.e., outside the categories covered in the pre-panel questionnaire) that could assist in addressing the entire spectrum of school violence.

The questionnaire responses were used as the starting point for panelists to generate a list of needs. Each group generated its own list of needs and ideas. After eliciting the ideas from the experts in the room, which we typed as a running list projected on a screen at the front of the room, each of the three brainstorming sessions culminated in a ranking exercise where the panelists ranked on a sheet a paper from 1–10 the most important technology and related needs from the brainstormed list. Since we split each panel into two working groups who met in adjacent rooms to facilitate smaller-group discussion, there were a total of four groups of experts (two groups per day and two days of panels) who each considered the same set of questions and performed the same ranking exercises but did so on the set of solutions their groups had identified. We present the results of these sessions, discussing first the identification of school safety needs and then the ranking of those needs. Note that we refer to panelists' suggestions as "technology and related needs" throughout this chapter, since not all of their suggestions were strictly technologies, and not all suggestions required *changes* to technologies. Rather, the lists that the panelists created consisted (primarily) of technological functions experts wished could be either innovated or made ubiquitous to promote school safety.

Methods for Consolidating and Ranking School Safety Technology and Related Needs

To narrow down the 199 named technology needs that the panel participants ranked to a manageable number for presentation in this report, the research team took two separate analytical steps. Initially, we pooled the identified needs across all the working groups. Because the four total groups (two panels per day over two days) functioned independently in separate rooms, there were overlaps in their individual lists and instances where individual needs (both within and across groups) could be combined to eliminate duplication and simplify the results. Three members of the research team met to collapse or reword the individual technology and related needs. This process yielded a list of 88 combined items that sought to preserve the inputs from the panel but that produced a more tractable overall list of technology and related needs. Examples of how we combined the needs are shown in Table 5.1. Details are presented in Appendix B.

Next, the research team used the original 199-item ranking data provided by the panelists to identify the highest-priority technology and related needs out of the resulting list of 88 expert-identified needs. Since all participants included ten needs in their ranked lists, we assigned each of the 199 ranked technology needs a score based on the number of times an item appeared on participants' lists and how highly it was prioritized when it did. Needs listed no. 1 by a participant received 10 points; a no. 2 rank got a score of 9, etc. As a result, a need ranked no. 1 by all ten members of a group would receive a total score of 100 points, whereas one never ranked by any participant at any point would have a score of 0, and one receiving a mix of rankings by all or a subset of the group would receive a score between those extremes. Because our working groups had different numbers of members, we normalized all scores by the number of participants in the group.

Our brainstorming sessions yielded a data set with 12 total sets of rankings (two groups per day × three ranking exercises per day × two days). The goal of our analysis was to present the technology needs in three tiers: Tier 1 for the highest-priority needs, Tier 2 for the next highest-priority needs, and Tier 3 for the remaining needs, as has been done in previous similar RAND analyses (Jackson et al., 2015; Hollywood et al., 2015). For ease of reading, we discuss only Tier 1 and Tier 2 rankings in this chapter, but all three tiers of technology and related needs are presented in Appendix D. We present the results in tiers rather than showing the

Table 5.1
Examples of Combined (Total N = 88) and Original Technology and Related Needs Produced by the Panel Working Groups (Total N = 199)

Combined Need (Examples)	Original Need (Examples)
Body cameras with live feed capability for school security/police officers	School security/police officer body cameras with live feed capability
	Creation of model policy for body-worn cameras for both SROs and outside police
Drone surveillance of school grounds or at school events	Automated drone surveillance of school grounds
	Drones for surveillance—live camera feed and threat assessment
Direct two-way communication between teachers and law enforcement	Phone/computer text alerts to emergency responders Interoperable communication/messaging technology
Early warning student tracking systems	Application that integrates data that can be used in one-on-one meetings with students (summary of attendance, issues, etc.)
	Automatic notification/feedback system that informs student that (and how) they are going down "the wrong path"
Improved social media monitoring analytics (across all major social media sites)	Social media monitoring should go beyond key word searches
	More adaptive key word searches for social media monitoring
Easier-to-use ID technology	Proper use of ID technology (policy and training)
Incorporate facial recognition into student ID cards	Integration of facial recognition with student IDs
	Facial recognition integrated with ID
Interactive, accessible dashboard for all safety-related data (e.g., Safety Cloud)	Safety Cloud
Layered and integrated mapping of school grounds (with video feeds, etc.)	Layered GIS-informed maps of districts/schools (from multiple public data sets) that also integrates cameras and/or other feeds in an easy-to-use platform
Expansion of virtual schools	Virtual reality schools
	Virtual classrooms for remote areas

NOTE: See Appendix D for a full list of needs.

rank of each individual technology need, since presenting ordered priority lists of individual needs would overstate the precision of the individual ranking results.

To ensure that our set of identified priorities appropriately reflected the preferences of the panelists, we calculated the rankings in three different ways that are described in detail in Appendix B. We estimated rankings three ways to ensure that the Tier 1 and Tier 2 lists we present below are not simply an artifact of our decisions about which and how many of the 199 individual needs we consolidated into 88 combined needs and also to ensure that the highest—and sometimes quite different—priorities of the individual panels were reflected in the final results. In the tables below, we present as Tier 1 technology needs that were ranked

in the top fifth via any of the three ranking methods we used and as Tier 2 all improvements that fell in the second fifth.

Since we held two identically structured brainstorming sessions in separate rooms on the day for urban schools' safety needs and on the day for suburban/rural schools' safety needs, we present a series of tables that report the number of urban panels and the number of suburban/rural panels that both identified and ranked the given technology need within the top or second tier of all their ranked needs. Because each panel operated independently and the interests and expertise of the panelists shaped the discussion in each session, no mechanism forced separate panels to consider school safety challenges and needs in the same way. The separate groups therefore generated different sets of ideas for how to address those challenges. As a result, the count of panels that both identified and highly ranked the individual technology need provides the reader with a sense of the agreement across the four total panels that could have ranked the given technology need. For example, two urban panels and two suburban/rural panels identifying and ranking a given technology need indicates both the high salience of and degree of consensus about the importance of a given technology need across a range of school types because it means that all four panels of experts independently identified the given technology need through their brainstorming session and that each of the four panels ranked the need highly. The two right-hand columns in each table are to allow readers to discern which technology needs experts deemed more pressing for urban or for suburban/rural schools, respectively. Within each table, the technology needs are ordered in descending order, starting with improvements that the greatest number of panels identified within Tier 1 or Tier 2, followed by technology needs that only one suburban/rural panel ranked highly, followed by technology needs that only one urban panel ranked highly.

Ranked Technology and Related Needs

In this section, we present the results of the ranking process for several types of school violence needs. First, we present top tier and second tier needs for the most severe forms of school violence (Tables 5.2 and 5.3, respectively). Next, we present top tier and second tier needs to address the most frequent forms of school violence (Tables 5.4 and 5.5, respectively). We then consider the top tier and second tier needs to address needs arising from school violence overall (Tables 5.6 and 5.7, respectively). Finally, we summarize the priorities across all ranked technology needs (Table 5.8).

Ranking Results: Most Important Technology and Related Needs to Address Severe Forms of Violence

Tier 1 and 2 needs identified from the ranking exercise for the most severe forms of violence are presented in Tables 5.2 and 5.3, respectively. There are enough differences in the rankings between the urban and suburban/rural panelists to warrant discussing the results for each separately. The full list of combined needs and rankings is included in Appendix D.

Table 5.2
Tier 1 Technology and Related Needs for the Most Severe Forms of School Violence

	Number of Panels That Identified the Improvement Within Tier 1	
Combined Technology or Related Need	**Urban**	**Suburban/Rural**
Direct two-way communication between teachers and law enforcement	1[a]	2
Certification program for educators on school safety	1	1
Integration of information on school threats (e.g., from tip lines) to support analytics at district, regional, or state level	1	1
Improved social media monitoring analytics (across all major social media sites)	(b)	1
All-in-one application with comprehensive school safety plans and procedures, including better dissemination of appropriate parts to stakeholders (parents, teachers, administrators)		1
Allowing law enforcement to tap into school live video feeds		1
Layered and integrated mapping of school grounds (with video feeds, etc.)		1
Early warning student tracking systems	1	
Multimodal tip line that centralizes and compiles tips from various sources and in various forms (video, text, images)	1	
Platform for sharing school safety best practices (regional and national)	1	
Quick and efficient incident-level communication outside school (e.g., parents, community members)	1	

NOTE: At a maximum, two urban panels and two suburban/rural panels could rank a given need as Tier 1.

[a] This need was ranked by both urban panels, but as Tier 1 in one group and as Tier 2 in the other.

[b] Need was ranked Tier 2 by one urban panel, as is shown in Table 5.3.

Table 5.3
Tier 2 Technology and Related Needs for the Most Severe Forms of School Violence

	Number of Panels That Identified the Improvement Within Tier 2	
Combined Technology or Related Need	**Urban**	**Suburban/Rural**
Improved social media monitoring analytics (across all major social media sites)	1	(a)
Identification technology to monitor entrances and exits into school buildings/ campuses, including position tracking	1	1
Fitbit tracker to identify students in high states of distress or agitation		1
Software to improve fidelity to school safety protocols including accountability		1
Interactive, accessible dashboard for all safety-related data (e.g., Safety Cloud	1	
Real-time monitoring of tip lines	1	
Multifunctional student ID cards (e.g., keys for campus, school lunches, boarding buses)	1	

NOTE: At a maximum, two urban panels and two suburban/rural panels could rank a given need as Tier 2.

[a] Need was ranked Tier 1 by one of the two suburban/rural panels, as shown in Table 5.2.

Technology and Related Needs That Both Urban and Suburban/Rural Panels Ranked Highly

There was no single technology need that both urban panels and both suburban/rural panels identified and ranked within the top fifth (i.e., Tier 1) of their ranked lists. Direct two-way communication between teachers and emergency responders came the closest; three out of four panels identified two-way communication technologies as a Tier 1 need. Experts debated at length the benefits and detractions of connecting classrooms directly to emergency responders (as opposed to only the school main office, which would then interface with emergency responders). Some worried about false alarms if teachers were to mistakenly summon police (or if the system were abused by students), but others felt it critical to take any means possible to shorten response times and to establish two-way communication so that police could gather information from teachers during the course of an emergency. Ultimately, they agreed that this command and control decision should be made at the school level.

Two out of four panels ranked as Tier 1 an (online) certification program for educators on school safety, reflecting a running theme among the panels about lack of training as a common barrier to the faithful implementation of school safety plans. Given the high rates of turnover in some categories of school-based staff—especially among school support staff, such as teachers' aides—the online delivery of this content was seen as a more practical way to ensure that staff obtain the needed training for their given job titles and making such training part of a certification process for at least teachers and administrators as a way to ensure participation.

Two out of four panels also ranked the integration of information on school threats as a Tier 1 need (e.g., from tip lines) to support analytics at the district, regional, or state level. Here, discussion centered on the greater capacity at regional or state levels to perform such analytics and also the importance of the ability to "connect the dots" about individuals or threats that may crop up in more than one locality. Finally, one suburban/rural panel named as Tier 1 and one urban panel named as Tier 2 the need for improved analytics of social media monitoring. Cyberbullying was a top concern among panelists, and school officials decried the level of effort required to monitor online activities, rudimentary key word search functions that search only single sites, and the difficulty of keeping up with the ever-changing set of social media sites and local slang terms.

Technology and Related Needs That Only Suburban/Rural Panels Ranked Highly

Three Tier 1 and two Tier 2 needs were unique to the suburban/rural panels. The first Tier 1 improvement was an "all-in-one" application to consolidate plans and procedures in one place for school staff to access. This arose from discussion about disparate safety-related policies sitting in hard copy in a school official's file drawer, not getting updated, with other staff unaware of its existence or contents. Beyond the relatively simple matter of document storage, the more pervasive concern was the lack of a single place for school staff to go for policies and procedures about a host of issues ranging from bullying, to school facility security procedures, to reporting abuse, to school safety drills. Instead, staff have to know who to ask about what, and expertise on particular areas of law or policy may be lost as those staff leave the school for other positions. The panelists discussed how a great deal of this information about policies and procedures could be standardized so the development of these modules could be done at a relatively low cost to individual schools but that easy access to this information could have a big effect, especially in the case of an emergency.

The second and third needs that only one suburban/rural panel ranked as Tier 1 were the ability for law enforcement to tap into schools' video feeds in the event of an emergency and

the mapping of school grounds to allow emergency responders to quickly isolate and access parts of a campus where the emergency occurs. Both tap into the theme of better connecting schools to emergency responders to reduce response times and improve the real-time intelligence capability of law enforcement to aid operational decisionmaking during a crisis. A Tier 2 need that was singular to one suburban/rural panel was tools to help ensure that school safety plans are implemented as designed (e.g., doors designated to remain locked during school hours actually are kept secured rather than propped open for access) and technologies that can provide early warning of a student in a state of distress or agitation using biometrics to allow quicker identification, intervention, and response.

Technology and Related Needs That Only Urban Panels Ranked Highly

The urban panelists identified four Tier 1 needs not ranked highly by the suburban/rural panels. These were an early warning student tracking system, a tip line that centralized information from various sources, a way to share school safety best practices, and a quick way to share information with school stakeholders such as parents and community members. One of the two urban groups also identified three Tier 2 needs not identified by others: an interactive dashboard for school-related data, real-time monitoring of tip lines, and ID cards that students can use for multiple purposes such as entry to the school and school bus and cafeteria payments.

Whether through tip lines, early warning systems, or behavioral intervention (which is not a technology and thus was excluded from the brainstormed list of improvements), experts sought ways to prevent rather than only react to severe safety crises. Urban panelists, in particular, returned to an underlying theme: Although hosting a simple voicemail hotline to receive tips is an inexpensive procedure, the actual monitoring, investigating, and detective work of real tip line monitoring is not. Panelists seemed to agree that some of the best intelligence comes from students and teachers "in the know" about impending problems, which makes tip lines potentially highly valuable outlets to gather information. But school officials and law enforcement do not have the ability to systematically elicit this information via tip lines (including more sophisticated tip lines that can scan uploaded images and video and convert voice to text for formula-based text searches) or the manpower to monitor and respond to it in real time, to segregate false leads from real ones, and to proactively fact-find and intervene before emergencies. The integration of tip line data across school-, district-, county-, and state-level agencies (which was ranked as Tier 1 by both urban and suburban/rural panels) touches on similar themes of how to obtain economies of scale in tip line monitoring and how to better pool information to more efficiently weed out false alarms and identify problem instances or persons who may be on another agency's radar before a given school may know.

Ranking Results: Most Important Technology and Related Needs to Address the Most Frequent Forms of Violence

The results from the ranking exercise for approaches to address the most frequent forms of violence are presented in Tables 5.4 and 5.5.

Table 5.4
Tier 1 Technology and Related Needs to Address the Most Frequent Forms of School Violence

	Number of Panels That Identified the Improvement Within Tier 1	
Combined Technology or Related Need	**Urban**	**Suburban/Rural**
All-in-one application with comprehensive school safety plans and procedures, including better dissemination of appropriate parts to stakeholders (parents, teachers, administrators)	1	2
Enhanced, technologically savvy marketing (e.g., QVR codes on posters, social media)	1	(a)
Anonymous student surveys regarding safety to identify hot spots and school climate		1
Integration of information on school threats (e.g., from tip lines) to support analytics at district, regional, or state level		1
Better electronic record-keeping of incidents for archive and analysis		1
Software to educate teachers on how to recognize bullying		1
Virtual training simulations for students and staff about school safety		1
Automated monitoring and response/referral system for cyberbullying	1	
Conversion of voice tips into text for easier triage and tracking on tip lines	1	
Educational materials (e.g., videotaped talks) for parents about safety and healthy child development	1	
Enhanced technology to support regular conference calls to maintain district preparedness	1	
Improved social media monitoring analytics (across all major social media sites)	1	
Interface for stakeholders (parents, community) to provide feedback on school safety issues	1	
Multimodal tip line that centralizes and compiles tips from various sources and in various forms (video, text, images)	1	
Virtual counselors for students	1	

NOTE: At maximum, two urban panels and two suburban/rural panels could rank a given need as Tier 1.

[a] Need was ranked as Tier 2 by one suburban/rural panel as shown in Table 5.5.

Technology and Related Needs That Both Urban and Suburban/Rural Panels Ranked Highly

The greatest agreement among the four panels was one urban and two suburban/rural groups identifying an all-in-one application as a go-to resource for school staff to look up all the school policies, procedures, and resources on safety-related matters. (This need was also ranked highly in regard to severe forms of school violence and is discussed above.) This all-in-one application touched on a theme shared by all three improvements that both urban and suburban/rural panels ranked highly: better ways to engage, train, and inform parents in particular and other community members more generally. Picking up on the often repeated theme that "problems start at home," panelists looked for engaging new ways to educate parents (e.g., TED Talk–style online lectures for parents about encouraging prosocial behaviors, early warning signs of problematic behavior, ways to support a child if he/she is perpetrating violence or being victimized) in ways that would spill over to enhanced school safety and that would be practical for

Table 5.5
Tier 2 Technology and Related Needs to Address the Most Frequent Forms of School Violence

	Number of Panels That Identified the Improvement Within Tier 2	
Combined Technology or Related Need	**Urban**	**Suburban/Rural**
Enhanced, technologically savvy marketing (e.g., QR codes on posters, social media)	(a)	1
Online platform for communicating with parents (and parents with one another) about school safety	1	1
Identification technology to monitor entrances and exits into school buildings/campuses, including position tracking		1
Online incentive system to create positive school environment		1
Platform for sharing customized school safety best-practices (local)		1
Ability to collect incident details on tip lines	1	
Cameras in school hot spots	1	
Interactive code-of-conduct technology (software, simulations, video games, virtual reality)	1	
Software that matches school incident data to suggested evidence-based programs/responses	1	

NOTE: At maximum, two urban panels and two suburban/rural panels could rank a given need as Tier 2.
[a] Need was ranked as Tier 1 by one urban panel as shown in Table 5.4.

schools to enact. Thus, one urban panel rated as Tier 1 and one suburban/rural group rated as Tier 2 technologically savvy marketing approaches for shaping safety behavior. Panelists discussed how advertisers spend significant resources to engage children and parents to sell them products, and some of this knowledge could be used to better inform and enhance school safety. At Tier 2, one urban and one suburban/rural group flagged online tools for communicating with parents about school safety. Since the roots of violence often start at home, panelists stressed parental engagement and education as critical components of school safety. They identified many obstacles to increased parent participation, including limited time, language barriers, and lack of trust, and identified technology as a potentially useful way to keep parents informed and involved while circumventing at least some of the logistical problems that inhibit parental engagement.

Technology and Related Needs That Only Suburban/Rural Panels Ranked Highly

One of the two suburban/rural groups ranked five needs as Tier 1 that the urban panels did not. These needs are listed in Table 5.4, and relate to engaging forms of training for teachers, staff, and students (e.g., video-game-style scenario enactments rather than lecture-format talking heads), better record-keeping, and increased data collection (via student surveys). Tier 2 needs identified by only one suburban/rural group did not cluster around themes; the needs related to school entry and exit, incentives for creating positive school environments, and the ability to share best practices across schools.

Technology and Related Needs That Only Urban Panels Ranked Highly

Meanwhile, as shown in the last rows of Table 5.4 and Table 5.5, urban panels identified eight Tier 1 and four Tier 2 needs that the suburban/rural groups did not for the most frequent forms of school violence. These pertained to more advanced forms of social media monitoring, improved tip lines (by converting voice messages to text and by allowing video, text, and images to be integrated into a tip line—a highly ranked improvement for the most severe forms of school violence), a lower-cost way to provide supports to students through "virtual counselors," and better ways to train parents and educators and allow them to communicate more easily with the school. With the exception of cameras for hot spots within the school, highly ranked urban needs again pertained to enhancing tip lines and more sophisticated software about code of conduct and suggested ways to respond to incidents reported within the software data collection tool. This last improvement augments the all-in-one application need with the idea that staff can find in one place engaging safety training modules; all-school safety plans, reporting forms, and related-documentation; and, suggested best-practice interventions to respond to problems, prevent them, or react supportively in the aftermath of crises.

Overall Ranking Results

When designing the structure for the panels, the participants were asked to examine the most severe and most frequent school safety concerns separately. This allowed the panels to focus on technology, policy, and practices improvements worthy of investment that would be most appropriate for one type of violence or the other and reduced the chance that one type of concern would skew the process of generating and ranking options. After those tasks were complete, we then asked each group to identify ten technology priorities out of the combined, much longer set of all needs identified during their day. This last of three ranking exercises required panelists to think across the two sets of safety concerns and possible solutions. It also restricted the groups to score a smaller fraction of the possible needs. The results of this combined ranking exercise are shown in Tables 5.6 and 5.7 for the Tier 1 and Tier 2 results, respectively.

Technology and Related Needs That Both Urban and Suburban/Rural Panels Ranked Highly

When asked to consider which needs to invest in across the whole spectrum of a school's needs, experts again ranked two-way communication between teachers and emergency responders most highly, followed by the all-in-one go-to resource for school safety plans, procedures, and policies; an extension to visitor management systems to allow monitoring of building occupants' positions within the building; and improving tip lines to become multimodal and better integrated across agencies. Only one technology that only a suburban/rural panel ranked highly across the spectrum of school safety needs was an extension of the theme to enhance tip lines to convert voice to text, and so we include mention of it with more general multimodal tip line improvement. These topics were consistent with previous rankings and reflected the topics panelists spent the most time discussing when brainstorming.

Panelists reiterated that school personnel do not receive adequate training concerning school violence and are left to identify the problems and seek out solutions themselves, depending on their own experiences. This leads to inconsistencies in the way that problems are identified and handled. Panelists believed that technology could be a promising mechanism to deliver information and training to school staff, especially if made engaging and scenario-based rather than presented in a lecture-style format.

Table 5.6
Tier 1 Technology and Related Needs Identified out of All School Safety Needs

	Number of Panels That Identified the Improvement Within Tier 1	
Combined Technology or Related Need	**Urban**	**Suburban/Rural**
Direct two-way communication between teachers and law enforcement	1	2
All-in-one application with comprehensive school safety plans and procedures, including better dissemination of appropriate parts to stakeholders (parents, teachers, administrators)	(a)	1
Identification technology to monitor entrances and exits into school buildings/campuses, including position tracking	1	(b)
Multimodal tip line that centralizes and compiles tips from various sources and of various forms (video, text, images)	(b)	1
Early warning student tracking systems	1	
Interactive, accessible dashboard for all safety-related data (e.g., Safety Cloud)	1	
Portable, cheaper video cameras for schools	1	
Quick and efficient incident-level communication outside school (e.g., parents, community members)	1	
Software that matches school incident data to suggested evidence-based programs/responses	1	

NOTE: At maximum, two urban panels and two suburban/rural panels could rank a given need as Tier 1.
[a] Need was ranked by both urban panels in prior ranking exercises, Tier 1 in one group and Tier 2 in the other.
[b] These needs were also rated as Tier 2 by one panel in prior ranking exercises.

Table 5.7
Tier 2 Technology and Related Needs Identified out of All School Safety Needs

	Number of Panels That Identified the Improvement Within Tier 2	
Combined Technology or Related Need	**Urban**	**Suburban/Rural**
Identification technology to monitor entrances and exits into school buildings/campuses, including position tracking	(a)	1
Multimodal tip line that centralizes and compiles tips from various sources and of various forms (video, text, images)	1	(a)
Conversion of voice tips into text for easier triage and tracking on tip lines		1
Improved social media monitoring analytics (across all major social media sites)	1	
Integration of information on school threats (e.g., from tip lines) to support analytics at district, regional, or state level	1	
Use of data from social media to predict violence	1	

NOTE: At maximum, two urban panels and two suburban/rural panels could rank a given need as Tier 2.
[a] These needs were also rated as Tier 1 by one panel in prior ranking exercises.

Technology and Related Needs That Only Urban Panels Ranked Highly

Consistent with prior rankings, urban panelists again ranked highly several needs relating to the prediction or prevention of school violence such as early warning systems, more sophisticated social media analytic software, and the integration of school threat data across multiple agencies. A running theme was that technologies should help educators and law officials connect the dots, such as via a dashboard (which is conceptually similar to the all-in-one application), where educators can see all the statistics on school culture, violence incidents, tip line data, social media tracking results, suspensions, etc., in one place. Another integrative application would be software that not only tracks incidents but matches them to suggested best-practice responses. Employing cheaper, moveable cameras was an exception to the connect-the-dots trend in highly ranked needs, as the cameras were seen as a good investigative tool for violent incidents, and, as such, should be moveable so that they can be moved from existing hot spots as new ones emerge on a campus.

Summarizing the Ranking Results

To develop a complete picture that looks across all three sets of rankings that each panel completed, we provide in Table 5.8 all the needs that appeared in the priority lists and their tiering. The table is ordered from the top down by needs that received the most Tier 1 rankings across all six sets of prioritization (urban and suburban/rural, for each form of violence and overall).

Table 5.8
Overall Summary of Priorities of All Ranked Technology and Related Needs

	Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
Combined Technology or Related Need	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Direct two-way communication between teachers and law enforcement	1	1			1	1
All-in-one application with comprehensive school safety plans and procedures, including better dissemination of appropriate parts to stakeholders (parents, teachers, administrators)		1	1	1		1
Integration of information on school threats (e.g., from tip lines) to support analytics at district, regional, or state level	1	1		1	2	
Multimodal tip line that centralizes and compiles tips from various sources and of various forms (video, text, images)	1		1		2	1
Improved social media monitoring analytics (across all major social media sites)	2	1	1		2	
Certification program for educators on school safety	1	1				

Table 5.8—Continued

Combined Technology or Related Need	Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Early warning student tracking systems	1				1	
Quick and efficient incident-level communication outside school (e.g., parents, community members)	1				1	
Identification technology to monitor entrances and exits into school buildings/ campuses, including position tracking	2	2		2	1	2
Conversion of voice tips into text for easier triage and tracking on tip lines			1			2
Enhanced, technologically savvy marketing (e.g., QR codes on posters, social media)			1	2		
Interactive, accessible dashboard for all safety-related data (e.g., Safety Cloud)	2				1	
Software that matches school incident data to suggested evidence-based programs/responses			2		1	
Allowing law enforcement to tap into school live video feeds		1				
Anonymous student surveys regarding safety to identify hot spots and school climate				1		
Automated monitoring and response/ referral system for cyberbullying			1			
Better electronic record-keeping of incidents for archive and analysis				1		
Educational materials (e.g., TED Talks) for parents about safety and healthy child development			1			
Enhanced technology to support regular conference calls to maintain district preparedness			1			
Interface for stakeholders (parents, community) to provide feedback on school safety issues			1			
Layered and integrated mapping of school grounds (with video feeds, etc.)		1				
Platform for sharing school safety best practices (regional and national)	1					
Portable, cheaper video cameras for schools					1	
Software to educate teachers on how to recognize bullying				1		

Table 5.8—Continued

Combined Technology or Related Need	Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Virtual counselors for students			1			
Virtual training simulations for students and staff about school safety				1		
Online platform for communicating with parents (and parents with one another) about school safety			2	2		
Fitbit tracker to identify students in high states of distress or agitation		2				
Ability to collect incident details on tip lines			2			
Cameras in school hot spots			2			
Interactive code of conduct technology (software, simulations, video games, virtual reality)			2			
Online incentive system to create positive school environment				2		
Platform for sharing customized school safety best practices (local)				2		
Real-time monitoring of tip lines	2					
Software to improve fidelity to school safety protocols including accountability		2				
Multifunctional student ID cards (e.g., keys for campus, school lunches, boarding buses)	2					
Use of data from social media to predict violence					2	

Conclusions

Given the lack of evidence on school safety technologies, after interviewing and surveying experts about the categories of school safety technologies, we turned to experts to rank appropriate technologies that they deemed most important to meet school safety needs—regardless of whether such technologies existed already (as presented in Chapter Two). Four total groups of experts—two for urban school safety needs and two for suburban and rural school safety needs—each ranked their top ten technology needs to address severe forms of violence, their top ten technology needs to address the most frequent forms of school violence, and their top ten technologies to address needs across the full spectrum of school violence.

A cluster of the desired technology needs boils down to two levels of improved information dissemination: (1) At the school/district/state level, panelists believed that *better data collection and analytics* are important to understand the problems that specific schools encounter and could be used for internal and external accountability for preventing, reducing, and responding to school violence; and (2) On the individual level, staff members *need easier and faster access to information* on school safety. Panelists saw this improved access to information and guides as key to preventing, reducing, and responding to the entire spectrum of school violence. Several specific themes emerge from panelists' ratings.

- The first is that **direct two-way communication** between teachers and law enforcement was consistently ranked highly by both urban and suburban/rural expert panels, a finding consistent with both the pre-panel survey and interviews with experts, as presented in Chapter Three. The clear message was that many of the experts felt it important that: (a) classrooms and not just the school's central office be able to contact 911, and (b) two-way communication abilities are critical (rather than, say, only panic buttons) so that emergency responders can gather information during the emergency about the location, events, and condition of victims.
- A second theme is that school policies, procedures, and data relating to school safety are fragmented and poorly understood, driving the identification of an **all-in-one application** on computers, phones, and tablets to allow teachers, administrators, school support staff, and facility directors to access all the school safety plans, training, and even data in one place. Related concerns underscored that, to be effective, school safety plans need to be developed, annually refreshed, and implemented with fidelity.
- The push for more and better information integration also came up in a third theme, related to **tip lines.** Panelists ranked highly the need to allow anonymous submissions of not just text but also voicemail (converted to text), images, and videos to tip lines. In addition to the ability to accommodate more modes of data, experts also identified the need to centralize disparate tip lines so that, for example, a call reporting a concern to a state police tip line about a particular person who happens to be a parent of a student at a school is shared with a relevant school principal.
- Cyberbullying was a frequently raised concern, and several of the working groups identified the need for **better social media analytics**, including software that would go beyond simplistic key word searches within a single social media site and that would keep up with the ever-changing set of social media sites, scanning content across all those sites rather than within only one.
- Finally, a lower-ranked but often-raised issue was the importance of **visitor management systems** that are well implemented and enhanced to include position tracking (of ID-carrying students and adults within the building).

CHAPTER SIX

Conclusion: Future Directions for Investments in School Safety Technology

Although active shooter situations are extremely rare, less severe forms of school violence are not, and schools have to be prepared to effectively prevent, reduce, and respond to a range of possible forms of school violence to keep their students safe. Comprehensive school safety planning requires a suite of programs, policies, and procedures for all hazards, ranging from such policies as safety drills for weather-related events to more capital-intensive measures such as positive behavioral interventions and supports. Technologies should supplement rather than supplant these safety plans.

With a mandate to examine schools' unmet technology needs, this project posed three basic questions:

1. What does violence in schools look like? In other words, what are the problems we need to solve?
2. What are the categories of school safety technologies, and is there evidence of their effectiveness?
3. What do experts think are the most important improvements that can be made to technologies to address the most severe and the most frequent forms of school violence?

We found a great deal of information about school violence and its prevalence and relationship to other factors. We also located many published sources from which to develop a typology of school safety technologies. But we did not find research on whether those technology solutions are effective. Since there is no rigorous research on effectiveness currently available, we interviewed experts in the field to assess how appropriate different technologies are in addressing specific school safety concerns. We also held expert panel meetings to hear experts' perspectives on how current technology is failing to meet their needs and where they would like to see improvements. Finally, we conducted six case studies to see how school safety measures work together in practice. We present our findings to help inform three sets of stakeholders: (1) researchers who are working to improve our knowledge base about school safety technologies, (2) technologists who are developing new safety-related products, and (3) practitioners who are considering acquiring technologies for school safety. The following summarizes our findings.

The Most Serious School Violence Is Rare; Lower-Level Forms of Violence Are Frequent: Solutions Must Address Violence Across the Spectrum

Approximately three out of four schools experience at least one incident of school violence per year, and bullying is the most common form of school violence. There is little agreement in the research about characteristics of schools that bear a meaningful relationship to school violence. Violence is most prevalent in high schools followed by middle schools. The research also indicates that, among school characteristics, school climate is the only consistent predictor of violence after taking into account other characteristics of schools. Although incidents of school violence are always a cause for concern, school violence is less prevalent now than it was decades ago.

School administrators typically worry about both the rare instances of serious violence and the more frequent, less-serious violence because they appear to require very different responses and prevention strategies. Interviewees and panelists stressed that there is no one-size-fits-all approach to school safety strategies for response and prevention. As one administrator put it: "Individual schools districts [should] to do [their] own unique vulnerability assessments to identify specific own challenges. The problems of Chicago public schools are different than suburban California schools."

School safety plans and policies must be customized to the individual school, but our study revealed some commonalities among safety experts about schools. The first is the importance of the length of emergency response time to the school for the unfortunate and rare case of serious violence. In simplified terms, urban schools have shorter response times, and suburban and especially rural schools have longer ones. The longer the response time, the greater the need for the school to have self-sufficient technologies to address school crises that warrant lockdowns and a way to detain intruders. There are also some differences in economies of scale resulting from an urban district having a large number of schools within its portfolio, which allows for urban schools to consider a larger array of school safety technology options, including more costly ones. In short, urbanicity is a reasonable place to start when distinguishing schools' safety technology needs, especially in the response to serious violent incidents.

There Are 12 Categories of School Safety Technologies But Almost No Research on Their Effectiveness

After scanning the literature, we developed a typology of school safety technologies that has 12 categories. We found that evidence about their effectiveness is either extremely rare or, as was the case for most of the 12 categories, nonexistent. Experts we spoke with raised concerns about this lack of evidence, about the costs of various technologies, and about the unintended negative consequences of some. Most particularly, metal detectors and X-ray machines and, to a lesser degree, cameras were cited as making a school less welcoming to students. The implication is that safety technologies that have physical presence (entry control, X-rays) generally raise concerns about creating an environment that is too fortified. These technologies also can be cost prohibitive in large schools with multiple doorways or in open-air schools common in temperate climates.

When asked which technologies were the most appropriate for the most severe forms of school violence, urban panelists identified communication technology, entry

control equipment, video surveillance equipment, and emergency alerts. Suburban/rural panelists named the same technologies except for video surveillance and added tip lines and social media monitoring. When asked about the most appropriate technology for the most frequent forms of school violence, urban panel members identified communication technology, tip lines, and video surveillance technology. Suburban/rural panel members identified the same technologies minus the video surveillance and added tip lines and social media monitoring.

Technology Should Be Improved to Facilitate Communication, Effectively Collect and Disseminate Emergency Plans and Procedures from One Place, Improve Tip Lines, and Reduce Human Error/Improve Accountability

When asked to rank the most important technology needs to prevent, reduce, and respond to school violence of various forms, a consistent theme that emerged is that communication strategies (both within the school and directly between classroom teachers and law enforcement) are regarded as critical and in need of improvement. For serious forms of violence such as shootings (or even for medical emergencies such as epileptic seizures), panelists ranked highly two-way communication between teachers, school administrators, and emergency responders to communicate current threats and escape routes and the following of emergency lockdown procedures to isolate threats within a building and for reunification after an incident. For less-serious incidents, these systems can be used to call for immediate assistance to break up disagreements and fights, deescalate a potentially violent situation or confrontation, identify and investigate someone who does not belong in the school, and get timely support for dealing with a victim of bullying.

Panel members discussed the challenges of developing a communication strategy that was robust to different points of failure (e.g., cell lines being jammed, Wi-Fi being disabled, phones going down) and that allowed all school personnel to be able to communicate with some central command and control point from wherever they happened to be on the school grounds. This identified need is difficult to meet because of a variety of environmental factors, such as old buildings and the physical layout of schools; technology factors, such as different infrastructures and points of failure; and cost factors, as each different type of communication device has start-up and maintenance costs. Each school must also determine policy issues, such as what type of command and control structure does each school use? What is the communication protocol during an emergency? These communication policies will likely need to be customized by school to meet specific needs. It was clear from the panel discussions that the current state of layered two-way communication strategies in the field is insufficient and in need of improvement. Our case studies underscore the same need for better solutions to layered two-way communication.

Another theme that emerged is that technology could be used to organize and consolidate what are often disparate pieces of what should be a comprehensive school safety plan. Staff turnover, the sense that safety is "not my job," and the lack of external incentives to create and update safety plans, such as mandatory training for certification or state accountability policies, each pose barriers to creating and maintaining comprehensive all-hazards safety plans. Thus, there is the desire for an all-in-one place where staff could go to access school policies, protocols for what to do when behaviors are observed or when events occur, legal forms, engaging online training modules customized to different school staff types, and suggested best-

practice responses to various crises or school violence incidents. Even more integrated would be a parent portal to the same all-in-one application to access training and policy data about school safety. To lower costs, some of the content could be standardized across states and districts, such as certain training modules, legal forms, and recommended best practices.

Panelists discussed different means of content distribution—for instance, a secure website, a mobile application, or some other way to get the information in an easy-to-search format that would be at their fingertips in the case of an emergency. Panelists mentioned that this could serve two purposes: It could consolidate all the information in one place for permanent and temporary school staff to access whenever they need it, and also it could be in a format that could easily be shared with police and other community responders to provide them with quick access to schematics and emergency procedures.

A third highly ranked theme was improve anonymous tip lines—to make them more user-friendly and relevant (by allowing submission of video, images, text, and voicemail), to better automate the data (image scanning, converting voice to text), to better monitor them, and to better report data out from tip lines through integration of state, district, and county agencies via data-sharing. Panelists described these tip lines as a vital source of intelligence to prevent or respond to school violence but noted that they are effective only if properly monitored. Panelists expressed a great deal of concern about creating these types of programs without proper monitoring because they could potentially make the problem worse if someone does not feel that his or her tip was acted on. Thus, the panel discussed the importance of building an accountability system to ensure that tips are property investigated and resolved. They also described how it could be used to track school- and district-level trends, monitor and track progress, and provide school-specific guidance to select evidenced-based safety programs that match schools' needs.

A fourth theme that emerged from interviews, case studies, the questionnaire, and expert panels was the frequent failure of technology as a result of the "human element" such as limited staff capacity, lack of training, and lack of funding to faithfully implement the intended technology. Examples included lack of staff to monitor video feeds or tip lines, staff propping open back doors that were locked, staff leaving radios in their classrooms, and the lack of manpower to investigate tips, alleged bullying, or other reported threats. Through our discussion with the experts, it became clear that technologies are often not implemented as intended, and, therefore, they may not be effective because of how they are actually used in the field as opposed to how they were intended to be used. This is another reason that field evaluations are so vital; lab settings where applications are first tested rarely mimic real-world scenarios. We observed this in many of our site visits: Simple human errors such as forgetting to charge batteries or lack of servicing can make adopting a new technology very challenging, and early failures can undermine long-term implementation success if those involved lose patience and refuse to use the technology.

For technologies to be used effectively, they need buy-in from the school staff (and sometimes the community) and appropriate resources to work with the technology, and the technology needs to be seen as effective so that people continue to use it. A related warning was that technology (left unmonitored) can be inappropriately treated as a "fix" (e.g., the simple presence of cameras without the use of data resulting from them) when technology should be better used to make human responses to safety needs more effective and easier.

Because it is not obvious that technology can succeed in this regard, experts debated about ways to incentivize its proper use and to provide a quick way for users to see its value

immediately and thus want to keep using it. Experts also brainstormed smarter ways for technology to build in accountability procedures to monitor use. Panelists ultimately did not generate specific recommendations on how the human element of technology could be improved, but they stressed that this is a currently unavoidable potential for failure that needs to be recognized when designing technologies.

Recommendations

Recommendations for Research and Evaluation

- The field is in desperate need of more evidence on what school safety technologies work, and schools want this information presented to them in vetted, digestible formats (e.g., via a trusted source such as a "Consumer Reports" of technologies) to help them with procurement. One administrator commented: "There is a lack of familiarity and uncertainty about the technologies available. Principals have a lack of understanding around what could be more effective and what resources are actually available."
- There is a common concern that using technology in school safety initiatives brings only false security rather than effective solutions. Consequently, rigorous research designs such as randomized controlled trials to reliably measure observed outcomes rather than perceptions of safety are needed to instill trust in evaluation results about school safety technologies.
- Given implementation challenges, researchers should include in their research design measures of proximal outcomes (adherence to protocols, buy in to the use of technology) to test, rather than assume, that technologies are implemented as intended.

Recommendations for Technology Developers

- Expert opinion indicates that technology vendors should focus on developing, expanding, or improving:
  - online platforms that keep up with changes in state and federal law and that integrate an all-in-one approach to give administrators the information they need for staff training and violence detection, prevention, and responses. Ideally, this all-in-one application would have different portals for different users (and be pilot-tested with each stakeholder type)—such as content for parents, community members, administrators, instructors, building support staff, and emergency responders. The idea is to have different areas within the application—e.g., an area where policies, plans, and procedures reside; an area for first responder information such as floor plans, staging areas, and organization charts; an area for anonymous tip line reporting and tracking; and a social media monitoring dashboard. The user type would dictate which areas of the application are accessible;

  - reliable low-cost ways to allow teachers to have direct, layered, two-way communication with a central command and control system (run through either the school or local emergency responders);

  - anonymous tip line technology that is easier to monitor and allows multiple mediums to be uploaded;

  - more sophisticated social media scanning across social media sites.

- Vendors should also keep in mind that technologies are not always used as instructed in the field. They should test their technology solutions outside the laboratory in real-world settings. If possible, the technologies should be designed to reduce human error and track outcomes to hold people accountable for proper use.

Recommendations for Schools

- Creating a comprehensive all-hazards school safety plan that is updated annually was consistently cited as a best practice. Comprehensive school emergency plans are essential to using school safety technology effectively for addressing violence or responding to an emergency after the fact. Within the comprehensive safety plan, technology is just one component. Experts also stressed that cookie-cutter plans would not be effective, since they need to be tailored to the school's specific needs. The school safety plan should therefore be developed after a needs assessment specific to the school, focusing on school culture, staff procedures and policies related to physical safety and the well-being of students and staff, and physical alterations to the facilities and campus if needed to improve safety.
- Schools must remember that not only can technology fail in certain instances, but, more importantly, experts stressed repeatedly the need to augment technology with positive behavioral interventions for students to support school climate improvements. One researcher noted: "Though tech has played a valuable role, sometimes ultimately this comes down to helping the adults who work with children learn how to connect with them and develop relationships that can head off some of these issues." A common concern is that technology solutions will not resolve the underlying psychological and social problems leading to school violence.
- Before buying technology, schools should make sure that, whatever the technology chosen, it can be integrated into their current systems and upgraded in the future. This is particularly important for technologies that generate data (e.g., tip lines, social media monitoring). It is also important to have appropriate personnel available and procedures in place to analyze and act on relevant data.
- Before selecting a technology or technologies, schools should determine their specific needs, budget, and community values. Communities likewise should hold expectations about school safety policies in accordance with each individual school's budget, resources, and demographics. To do so, school boards should procure or authorize security assessments that involve many stakeholders (administrators, parents, teachers, students, security specialists) to examine the type and amount of safety incidents a school has faced, the weapons or threats to safety that have been seen, and the kind of staff and resources available. This information should then help determine a (likely multifaceted) solution for prevention, intervention, and follow-up on potential security problems specific to each school.

Summary

Technologies must undergo rigorous evaluation so that ineffective technologies can be avoided, and those most effective in preventing, reducing, or effectively responding to school violence can be more widely implemented. Stakeholders must also accept that there is no quick fix to school violence and that no one technology or other intervention can fully guarantee the security of schools or resolve the underlying causes of school violence.

In the absence of evidence regarding effectiveness, the adoption of school safety technologies may still be appropriate in the context of a wider violence prevention program. Truly comprehensive approaches to safety assessments and plan development involve multiple stakeholders: school-based staff (e.g., teachers, administrators, school psychologist, custodians) and community emergency responders (e.g., police, fire, medical services). A security assessment examines a wide range of factors, including the physical features of the school grounds and building, preparation for weather-related threats, threats from the student body and staff, and threats from intruders and members of the school community. A school safety plan is informed by that assessment and by data about prior safety incidents to ensure that the plan is specific to and relevant to the school and its level of available staff and other resources. In addition, a holistic approach to developing a school safety plan seeks to understand and address to the degree possible what *leads* to school violence, to promote situational awareness among students, staff, and community members. The selection of a technology is thus in service of a larger school safety approach as outlined in the plan. Ultimately, whatever strategies a school uses, administrators should revisit these plans periodically to modify and update them based on innovations in the field, new evidence, and local evidence of their effects on not only school safety but also on the attitudes of students, staff, and the community toward the school.

Despite the lack of evidence about how well safety technologies prevent or allay violence at school, many school administrators who need to respond to parents' and policymakers' concerns are obtaining such technology anyway, often testing it themselves. To help schools, technology developers, and policymakers meet their near-term needs for information, we have developed categories for school safety technology, collected the best available evidence (which in this case is expert opinion) about the appropriateness and limitations of the 12 types of technology, and asked experts to prioritize the greatest needs among these categories.

To better understand how the technology is used in practice, we also provided six case studies of schools and school districts that did just that—identified problems they experienced or wanted to prevent and sought out or even self-developed and implemented innovative technology solutions. In each of these cases, despite implementation challenges, district personnel reported that their technologies positively affect their schools and improve safety but lack formal research to quantify the effects. These solutions should be studied in greater detail to see whether they could provide improved safety to other schools in other contexts, because, as experts have stressed, schools will need individualized and tailored solutions to meet their safety challenges.

Whatever strategy a school uses, administrators must consider and ideally assess its effect on students, staff, and community attitudes toward the school, as well as its effect on threats to school safety and security. To employ technologies effectively and ethically, schools need to consider whether and how particular technologies could feasibly be adopted and used to successfully address the specific issues related to student safety for which solutions are needed. Understanding how these technologies function in practice and their effects is an important

aspiration for education research. Such a review would help augment this one and would further help stakeholders decide which technologies to invest in and use.

APPENDIX A

An Overview of Violence in U.S. K–12 Schools Today

In this appendix, we review the academic literature and reports to describe what is known about the prevalence and incidence of school violence in the United States, how such violence differs according to characteristics of both schools and students, and what school-level and individual-level factors may be associated with violence. We focus, when possible, on national data sources and corresponding estimates. *Prevalence* estimates from the literature review are generally based on the proportion of students reporting a violent victimization or having perpetrated a violent act or the proportion of schools experiencing a violent event in a specified period (past 30 days, past year). *Incidence* estimates generally derive from school-level studies and document the number of violent acts per 1,000 students over a one-year time frame.

Methods

Detailed information on our rapid review methods are provided in Appendix B. In brief, we limited our review to studies published in peer-reviewed journals that were based on U.S. samples and were published after 2000. We used the search string "school OR schools AND violence OR safety" across nine databases. Included citations must have empirically and directly examined school violence on school grounds in the United States. Eligible populations including K–12 students, teachers, and other individuals directly exposed to violence on school grounds. Our initial search netted over 11,000 studies, but only 59 were included in our rapid review: six that provided descriptive statistics about prevalence and incidence of school violence and 54 that provided information on predictors of school-level violence or individual-level perpetration or victimization of violent behaviors occurring in school settings. Most of the studies derive from one of several ongoing surveys: National Crime Victimization Survey—School Crime Supplement (five studies), School Survey on Crime and Safety (five studies), Youth Risk Behavior Surveillance System (five studies), National Longitudinal Study of Adolescent to Adult health (three studies), Educational Longitudinal Study (four studies), and Schools and Staffing Survey (one study).

Fatal and Serious Violence at Schools Is Extremely Rare, But Its Effects Are Devastating

Although fatal and serious violence at schools generates the most media attention, such incidents are rare. According to the School Associated Violent Death study, between July 1, 2010,

and June 30, 2011 (the most recent period for which complete data are available), there were 31 fatalities among staff, students, or other individuals as a result of injury on school grounds in the United States—less than 1 percent of youth homicides that occurred nationally during this period (Robers et al., 2014). Of these fatalities, six were suicides, 14 were homicides of adults, and 11 were homicides of school-aged youth (ages five to 18). Across all years in which these data have been collected, less than 2 percent of youth homicides occurred on school grounds (Robers et al., 2014).

Nonfatal violent victimization at schools is also relatively rare. According to the 2011 National Crime Victimization Survey—School Crime Supplement (NCVS-SCS), less than one-tenth of 1 percent (i.e., < 0.1) of 12–18-year-old adolescents attending school reported any serious violent victimization, which is defined as rape, sexual assault, robbery, or aggravated assault, on school grounds.[1] Including simple assault, only 1 percent of school-aged youth reported any violent victimization on school grounds (Robers et al., 2014).

The majority of schools also do not experience violence of a serious nature. According to the School Survey on Crime and Safety (SSCS), in the 2009–10 school year, 16 percent of schools experienced an incident of serious violent crime, meaning that approximately one out of every six public schools reported one or more incidents of rape or other sexual battery, robbery, weapon-involved fight, weapon-involved physical attack, or weapon-involved threat of physical attack over the course of a school year (Robers et al., 2014). These incidents occur at a rate of approximately one per 1,000 students.

Although serious violence at schools is rare, the unpredictable nature of mass violence, the devastating outcomes associated with such violence, and its occurrence in K–12 schools place many school systems, administrators, teachers, parents, and students on alert. Between 2001 and 2013, there were 160 active shooter incidents in the United States, of which 27 occurred in a K–12 school.[2] Active shootings in schools are of particular concern to the FBI because they entail the incidents with some of the highest number of casualties, such as Sandy Hook Elementary School (Newtown, Conn.), in which 26 were killed and two were wounded, or Santana High School (Santee, Calif.), in which two were killed and 12 were wounded. More information about active shooter incidents in K–12 schools between 2001 and 2013 is presented in Table A.1.

Most Schools Experience Some Level of Violence

Although less than 20 percent of schools experience episodes of fatal or serious violence, most schools experience some type of violence during the school year. According to the SSCS, in the 2009–10 school year, 74 percent of public schools recorded at least one incident of violence, which includes the types of serious violence discussed in the previous section, as well as fights,

[1] The NCVS-SCS was initiated in 1995 to capture the victimization experiences of a nationally representative sample of students between the ages of 12 and 18 who are enrolled in public and private schools. Students are asked to report incidents of victimization that occur on school grounds throughout the academic year (or in the previous six months, depending on the survey year). The survey has been conducted in odd years since 1999.

[2] The FBI defines an active shooter incident as "a situation in which a shooting is in progress and an aspect of the crime may affect the protocols used in responding to and reacting at the scene of the incident." Unlike a defined crime, such as a murder or mass killing, the "active" aspect inherently implies that both law enforcement personnel and citizens have the potential to affect the outcome of the event based upon their responses (FBI, 2013: 4).

Table A.1
Characteristics of Active Shooting Incidents in K–12 Schools in the United States, 2001–13

	No.
Total Incidents	27
Primary school	4
Middle school	6
High school	14
Primary/middle/high school building	1
Other	2
Classroom/hallway	14
Cafeteria	3
Administrative offices	2
School board meeting rooms	2
Classes not in session	2
Outside	4
Shooter was a student	17 (12 high school; 5 middle school)
Total casualties	117
Killed (students/employees)	(43/14)
Wounded (students/employees)	(44/16)

SOURCE: FBI, 2013.

physical attacks, and threats of physical attack. Nearly half (46 percent) of schools reported an incident in which a student was threatened with physical attack *without* a weapon. The incidence of any type of violence was 25 events per 1,000 students annually. These rates are likely to be underestimates of the true prevalence and incidence of violence, given that the SSCS data are based on administrator reports, and schools have incentives to underreport violence; in addition, much violence is likely to be undiscovered by and unreported to school officials. This is particularly likely for less-serious forms of violence.

The Youth Risk Behavior Survey (YRBS) offers additional insights into the prevalence of the more common forms of school violence based on student self-report. Roughly 8 percent of students reported being in a physical fight during the year leading up to the survey administration, and nearly 7 percent of students reported being threatened or injured with a weapon on school property (Kann et al., 2014). In the 30 days before the survey, approximately 5 percent of high school students (9th to 12th grades) carried a weapon onto school property.

But the most common form of school violence is bullying, defined as "any unwanted aggressive behavior(s) . . . that involves an observed or perceived power imbalance and is repeated multiple times or is highly likely to be repeated" (Gladden et al., 2014). The same YRBS data indicate that 20 percent of students were bullied on school property in the past 12 months and that, during the same time frame, 15 percent of students were electronically bullied through email, instant messaging, chat rooms, websites, or texting (Kann et al., 2014). The

NCVS-SCS data offer similar estimates regarding the prevalence of bullying among children. In 2011, 8 percent of students responding to NCVS-SCS (Robers et al., 2014) indicated that they had been *physically* bullied—that is, pushed, shoved, tripped, or spit on in the past school year—and one out of five of these physically bullied students was injured as a result. A much larger proportion of students—28 percent —reported *any form* of bullying at school over the school year. This includes being threatened with harm (5 percent), others trying to make them do things they did not want to (3 percent), and having their property destroyed (3 percent).

By Most Measures, School-Based Violence Has Declined Since the 1990s

Our literature review indicated that school-based violence has declined over the past 20 years. According to the NCVS-SCS, between 1992 and 2012, the incidence of violent victimizations of 12–18-year-olds occurring at school dropped 57 percent, from 68 violent victimizations per 1,000 students to 29 violent victimizations per 1,000 students at school. It is worth noting that violent victimizations outside school have experienced an even greater decline—78 percent—from 94 violent victimizations per 1,000 students in 1992 to 20 violent victimizations per 1,000 students in 2012. Serious violence has also declined from eight to three victimizations per 1,000 students at school and 43 to seven victimizations per 1,000 students away from school between 1992 and 2012.

Prevalence rates have also declined. According to the 1995 NCVS-SCS, 3 percent of students reported a violent victimization, and 1 percent reported a serious, violent victimization, roughly three and ten times higher than the current prevalence of victimization (Robers et al., 2014). In addition, weapon-carrying decreased from 12 percent to 5 percent between 1993 and 2013, and school fighting decreased from 16 percent to 8 percent in the same period (Robers et al., 2014). Empirical research into the causes of the reductions in school violence are important and ongoing; hypotheses include positive changes in social economic conditions, drug markets, law enforcement practices, and school policies and environments as well as increases in programs geared toward violence prevention (Brener et al., 1999).

There are a few notable exceptions to the overall decline in violent victimization. First, the prevalence of students who were threatened or injured with a weapon on school grounds remained relatively stable between 1993 and 2011, at roughly 7 percent. Second, the percentage of *teachers* who reported being physically attacked by a student was higher in the 2011–12 school year than at any point since the survey began in 1987–88. Similarly, threats of injury to teachers increased from 7 to 9 percent[3] between the 2007–8 and 2011–12 school years. It is unclear whether this is due to actual changes in violence directed toward teachers or whether teachers are more likely to report violence now than in prior years. We discuss teacher victimization in more detail below.

Rates of Violence Differ Significantly Among Schools

This variation depends on school characteristics, including grade level, size, location, and racial/ethnic composition (see Table 1.1). We describe such variation although we note that these are

[3] This has not exceeded the high of 12 percent reported in 1993–94.

not causal factors. In a subsequent section, we discuss indicators of school climate that often attenuate differences between school characteristics and thus may be more causally related to school violence. Nonetheless, describing where school violence occurs and how such violence varies is important for understanding where technological resources may be needed, regardless of the cause.

Grade Level

Primary schools have the lowest prevalence of violence (64 percent), serious violence (13 percent), student threats of physical attack with a weapon (7 percent), and student threats of a physical attack without a weapon (38 percent). Middle and high schools experience similar prevalence rates for three out of four of these indicators: violence (91 percent), student threats of physical attack with a weapon (10 percent), and student threats of physical attack without a weapon (62 percent). In contrast, prevalence of *serious violence* increases with grade level; one out of four high schools reported at least one serious violent event, compared with less than one in five middle schools (19 percent) and one in eight elementary schools (13 percent).

National survey results indicate that middle schools experience higher *incidence rates* than either primary or high schools for all four indicators of violence. Middle schools experience 40 violent incidents for every 1,000 students whereas elementary and high schools experience 21 violent incidents per 1,000 students. The similarity in prevalence rates, and differences in incidence rates across middle and high schools, indicates that although a comparable *proportion* of middle and high schools experience violence, such events occur more frequently in middle schools.

Enrollment Size

The prevalence of all forms of violence increases with student enrollment size, with the smallest schools (enrolling fewer than 300 students) reporting the lowest prevalence of violence (63 percent), serious violence (10 percent), threats of physical attack by students with a weapon (4 percent), and student threats of physical attack without a weapon (34 percent). Large schools (enrolling 1,000 or more students) reported the greatest prevalence of these same offenses, with 95 percent of large schools reporting any violence, 33 percent reporting serious violence, 13 percent reporting weapon-related threats of physical attack, and 73 percent reporting nonweapon threats of physical attack. On the other hand, relative size, measured as the ratio of students to teachers, was unrelated to incidence of school violence (Eitle and Eitle, 2003; Veliz and Shakib, 2012).[4]

Findings regarding the influence of school size on students' self-reported victimization are inconsistent. There is evidence of negative relationships between school size and victimization (Peguero and Jiang, 2014; Peguero, 2013), as well as null relationships (Augustine et al., 2002, middle schools; Gottfredson and DiPietro, 2011; Koo, Peguero, and Shekarkhar, 2012; Peguero and Popp, 2012). On the other hand, positive associations between school size and victimization were shown in at least one state's high schools (Augustine et al., 2002) and when enrollment size was measured using the concept of relative size, defined above (Gottfredson and DiPietro, 2011). The disparate findings between reports on the prevalence of schools that experience violent incidents versus students' self-reports of victimization may be in part attrib-

[4] For a discussion about, and challenges to, the causal effects of school size on violence, see Cook, Gottfredson, and Na, 2010.

uted to the greater absolute volume of students: Personnel in larger schools may witness and be exposed to more violence simply because of the number of students, but the rate of victimization does not vary (Klein and Cornell, 2010).

Location

Schools located in areas designated as towns[5] had the highest likelihood of reporting violence (80 percent), followed by schools located in cities (74 percent), suburbs (74 percent), and rural areas (70 percent). Schools in cities and towns had similar incidence of violence (29 and 28 per 1,000 students, respectively), as did schools in suburban and rural areas (22 per 1,000 students; Neiman and Hill, 2011).

The likelihood of a school reporting *serious violence* increases with urbanicity. In 2009–10, over 20 percent of schools located in cities experienced an event involving serious violence, followed by over 15 percent of schools in suburbs and towns and 13 percent of schools in rural areas. Incidence of violence, as reported to administrators, is greatest in urban schools (38 per 1,000 students), followed by suburban schools (28 per 1,000) and rural schools (14 per 1,000); the incidence of serious violent events is larger in cities (1.3 per 1,000 students), followed by towns and rural areas (1.1 per 1,000 students) and suburbs (1.0 per 1,000 students) (Neiman and Hill, 2011). On the other hand, several studies have found that students in urban schools report lower levels of violent victimization than suburban, small town, or rural areas (Augustine et al., 2002, high schools; Bouchard, Wang, and Beauregard, 2012; Peguero and Jiang, 2014).[6]

Racial and Economic Composition

The relationship of school demographic composition to violence is unclear. Taking multiple characteristics of the schools into account together, several studies have found that there is more violence in schools with a greater proportion of nonwhites (Eitle and Eitle, 2003; Klein and Cornell, 2010; Veliz and Shakib, 2012), whereas other studies have found that measures of racial heterogeneity or other indexes of diversity within a student body have generally been unrelated to school violence (Klein and Cornell, 2010, for threats; Maume, Kim-Godwin, and Clements, 2010). Studies have also found no relationship (Gottfredson and DiPietro, 2011; Peguero, 2013) or a negative relationship (Peguero and Jiang, 2014) between the racial or ethnic composition of the school and student-reported victimization. For example, Peguero and Jiang (2014) found a negative relationship between student reports of violent victimization and the percentage of African American and Latino students among the student body, and a positive relationship between the percentage of students who are from immigrant families.

The relationship between economic status and violence is similarly mixed. Children from higher socioeconomic status (SES) families have been found to have a lower likelihood of being disciplined for student- and teacher-directed violence (Taylor, Davis-Kean, and Malan-

[5] These definitions are based on the National Center for Education Statistics "urban-centric locale code" system, which groups school locations into four categories: city, suburb, town, and rural. Category definitions are based on population size and distance from principal cities, urbanized areas, and urban clusters. For more details see National Center for Education Statistics, undated.

[6] There is weak support that area/neighborhood characteristics are associated with school violence (Eitle and Eitle, 2003; Clark and Lab, 2000; Maume, Kim-Godwin, and Clements, 2010), although for discussions on, and challenges to, the causal effects of urbanicity on school violence, see Maume, Kim-Godwin, and Clements, 2010; Veliz and Shakib, 2012; and Klein and Cornell, 2010.

chuk, 2007) and self-reported weapon-carrying (Coggeshall and Kingery, 2001; Wilcox and Clayton, 2001), yet several other studies have found no effect of family SES on involvement in suspendable offenses (Cavanaugh, 2009) and weapon-carrying (Cao, Zhang, and He, 2008; Horner, Rew, and Brown, 2012; Marsh and Evans, 2007; Wilcox, May, and Roberts, 2006) after accounting for other covariates. Although the proportion of students in poverty has a positive relationship to administrator-reported rates of school violence in several studies (Maume, Kim-Godwin, and Clements, 2010; Veliz and Shakib, 2012), this finding may be attributable to greater rates of disciplinary actions taken by school officials rather than actual violence as reported by students (Klein and Cornell, 2010). In general, researchers have not found that poverty is related to student victimization (Carbone-Lopez, Esbensen, and Brick, 2010; Koo, Peguero, and Shekarkhar, 2012; Peguero, 2013; Peguero and Jiang, 2014); however, one study found that it was positively associated with female (but not male) victimization (Peguero and Popp, 2012).

Evidence Suggests That Violence Is Most Likely to Occur in Places with the Least Adult Supervision

Although data about the location of school violence are scant, there is some indication that it tends to cluster in places that are least monitored by adults. In the NCVS-SCS (Robers et al., 2014), bullying (but not necessarily violent or physical) was most common in hallways or stairwells, with 46 percent of students reporting being victims of bullying in these locations, followed by classrooms (33 percent), outside on school grounds (22 percent), in bathrooms or locker rooms (11 percent), in the cafeteria (9 percent), on the school bus (7 percent), and elsewhere (2 percent). Astor, Meyer, and Pitner (2001) found that elementary and middle school students reported feeling the least safe in areas that were unsupervised or undefined and where they had the greatest interaction with other, particularly older, students.

School Climate Has the Strongest Association with Violence After Accounting for Multiple School Characteristics

School level, enrollment size, and location are not likely to be causal factors that increase the risk of school violence. More often, the relationship between these factors and school violence is attenuated when studies account for characteristics of school climate. *School climate* refers to "the quality and character of school life as it relates to norms and values, interpersonal relations and social interactions, and organizational processes and structures" (National School Climate Center, 2015). The definition we apply in this report refers primarily to school-level norms and interactions, encompassing a range of positive indicators (e.g., parent and community involvement; average levels of students' self-reported attachment to their school, parents, and teachers; student involvement and achievement in academic and other extracurricular pursuits; and students' normative or prosocial beliefs) and negative indicators (e.g., presence or perception of violence, delinquency, drug use, physical disorder, and racial tensions). Across multiple factors, indicators of school climate appear to have the strongest association with school violence; however, school climate is a general concept with a variety of indicators and, hence, there is considerable variability in findings.

School Disorder and Social Problems

School disengagement (e.g., student absenteeism,[7] low test scores, dropping out) is positively related to rates of school violence (Eitle and Eitle, 2003; Maume, Kim-Godwin, and Clements, 2010). In addition, aggregate racial tensions are positively associated with school-level violent incidents (Maume, Kim-Godwin, and Clements, 2010). School delinquency (Tillyer, Fisher, and Wilcox, 2011), violence levels (Nofziger, 2009), the presence of gangs (Bouchard, Wang, and Beauregard, 2012; Ferguson, 2003; Van Dorn, 2004), and the availability of drugs are all positively associated with school-based victimization (Ferguson, 2003; Van Dorn, 2004). School disorder and social problems are also positively associated with violent victimization and bullying (Burrow and Apel, 2008; Carbone-Lopez, Esbensen, and Brick, 2010; Peguero and Jiang, 2014; Peguero and Popp, 2013), at least among some students.

Values and Behavior Regarding Violence

Values and behavior regarding violence are often measured as the degree to which student agree with statements endorsing violent behaviors such as: (a) "In order to gain respect from friends, it is sometimes necessary to beat up on other kids," (b) "It is alright to beat up another person if he or she called you a dirty name," (c) "It is alright to beat up another person if he or she started the fight," (d) "Hitting another person is an acceptable way to get him or her to do what you want." High levels of agreement with these statements are significantly associated with student perpetration of violence (physical attack, robbery, sexual assault) (Ousey and Wilcox, 2005). In addition, having observed school violence is positively associated with engaging in suspendable offenses (Cavanaugh, 2009). The presence of gangs and others' drug use is also positively associated with weapon-carrying (but not gun-carrying) (Cao, Zhang, and He, 2008).

Scholastic Performance, Extracurricular Participation, and College-Going Expectations

Schools' average ratings of students' college-going expectations (Maume, Kim-Godwin,and Clements, 2010) and athletic and math participation (Veliz and Shakib, 2012) are associated with lower rates of school violence.

Familial and Community Factors

Although parental involvement is unrelated to school violence, community involvement—a six-item count of community-based organizations and social service agencies involved in the school's efforts to promote safe and drug-free schools—was positively associated with school violence (Maume, Kim-Godwin, and Clements, 2010).[8] Similarly, no relationship has been shown between other familial and community-level indicators of school climate and measures of lifetime and past-month weapon-carrying and self-reported perpetration of physical attacks, including school capital—an index of the average school attachment, church attendance, and religious commitment reported by students in the school (Wilcox and Clayton, 2001), average levels of student attachment to school or parent (Ousey and Wilcox, 2005), PTA participa-

[7] Watkins (2008) found no effect of absenteeism and other measures of school disorder (e.g., disconnectedness, fearfulness, physical fighting) on student weapon-carrying at school, and Maume, Kim-Godwin, and Clements (2010) found that attendance rates were unrelated to school violence.

[8] In this case, school violence is likely to lead to increased involvement of community-based organizations (rather than the reverse).

tion (Watkins, 2008), and proportion of students with a college-educated parent (Vogel and Barton, 2013).

Student Engagement

Among national samples, student reports of attachment to adults at school (Bouchard, Wang, and Beauregard, 2012) and normative beliefs about student behavior[9] (Gottfredson and DiPietro, 2011) have been found to be inversely related to reports of serious crime and personal victimization. Schools' closeness of ties (Gottfredson and DiPietro, 2011) and school efficacy[10] (Tillyer, Fisher, and Wilcox, 2011) were unrelated to victimization.

Rates of Violence Differ Significantly Among Students

Just as there is variation by school characteristics, there is variability in who is victimized and who perpetrates violence at schools. We describe such variation by sex, age, race, and sexual minority status, although we note that, as above, these are not causal factors; below, we discuss individual-level attributes that may be more causally related to school violence. Nonetheless, describing violence across these dimensions is important for understanding those students who might benefit most from technologies aimed at reducing school violence.

Sex

Incidence rates of violent victimization among males are roughly one-third greater than among females (60 versus 45 per 1,000 students) (Robers et al., 2014). According to their own reports, males are also more likely than females to carry weapons to school (8 versus 3 percent) and to fight at school (10.7 versus 6 percent; Kann et al., 2014).

Age

Students ages 12–14 experience greater rates of violent victimization than 15–18-year-olds (65 versus 41 per 1,000 students) (Bouchard, Wang, and Beauregard, 2012; Burrow and Apel, 2008; Carbone-Lopez, Esbensen, and Brick, 2010; Gottfredson and DiPietro, 2011; Holt, Turner, and Exum, 2014; Van Dorn, 2004). Age is also *inversely* related to fighting at school (Rudatsikira, Muula, and Siziya, 2008) and to weapon-carrying, regardless of whether samples are based on middle or high school students (Kerres Malecki and Demaray, 2003; Marsh and Evans, 2007; Vogel and Barton, 2013).

Race/Ethnicity

Hispanic and black students are more likely to experience school-based victimization (8.5 and 8.4 percent) than white students (5.8 percent), with black males reporting the highest levels of victimization (10.1 percent), followed by Hispanic males (9.5 percent), Hispanic females (7.5 percent), black females (6.8 percent), white males (6.2 percent), and white females

[9] This 23-item scale assessed student attitudes about the wrongness of six misbehaviors (e.g., cheating, stealing) and averaged responses across the school.

[10] Defined as communal schools and cooperation/involvement among teachers, students, and principals.

(5.4 percent).[11] Nonwhite students are more likely than white students to carry weapons (Vogel and Barton, 2013; Wilcox, May, and Roberts, 2006; Wilcox and Clayton, 2001) and engage in physical assaults (Ousey and Wilcox, 2005) and fighting (Rudatsikira, Muula, and Siziya, 2008; Zhang and Johnson, 2005).

Sexual Minority Youth

There is growing evidence that youth who identified as gay, lesbian, or bisexual[12] or who had experienced any sexual contact with members of the same sex were more likely than their heterosexual counterparts to be victimized at school. At schools where students were asked about sexual identity and contact in the YRBS, the median percentage of youth reporting any or exclusively same-sex contact reported being threated or injured with a weapon on school property was 18 percent compared with 8 percent of youth reporting exclusively heterosexual contact. Similarly, a median of 19 percent of gay and lesbian, 16 percent of bisexual, and 17 percent of those who were unsure of their sexual identification reported being threatened or injured with a weapon on campus compared with 6 percent of heterosexual-identified youth (Kann et al., 2011).

Youth reporting any same-sex contact or a nonheterosexual identity are also significantly more likely to perpetrate violence at school than their peers (Kann et al., 2011). The median prevalence rates for weapon-carrying and fighting on school property were greater among youth who had experienced any or exclusively same-sex contact. Similarly, a median of 16 percent of gay and lesbian youth, 13 percent of bisexual youth, and 10 percent of youth who were unsure of their sexual identification reported weapon-carrying at school, relative to 5 percent of heterosexual-identified youth; a median of 22 percent of gay and lesbian, 19 percent of bisexual, and 16 percent of unsure youth reported fighting at school compared with 11 percent of heterosexual youth.

Rates of Violence Differ Across Student Subgroups, Behavior, and Activities

A wealth of research has attempted to explain both why demographic groups experience different rates of school violence and other individual-level attributes that may predict either victimization of perpetration. At the individual level, substance use is the most predictive of both perpetration and victimization, followed by personality characteristics, delinquent behaviors, and prior exposure to violence. Other factors that are less consistently related include academic involvement and achievement, family and peer factors, and demographic characteristics.

Substance Use

Use of such substances as alcohol, tobacco, and illicit drugs has a strong positive association with several measures of school-based violence perpetration. These factors have consistently predicted student self-reported weapon-carrying (Coggeshall and Kingery, 2001; Estell et al., 2003; Horner, Rew, and Brown, 2012; Muula, Rudatsikira, and Siziya, 2008; Rountree, 2000;

[11] These estimates are higher than those reported by the NCVS-SCS, which found prevalence estimates of around 1 percent across racial/ethnic groups, as described earlier (Robers et al., 2014).

[12] No data are available on transgender and gender-nonconforming youth; however, anecdotal evidence indicates that these youth experience even greater rates of victimization.

Zhang and Johnson, 2005; Vidourek, King, and Bartsch, 2015; Williams et al., 2002; Ybarra et al., 2014), involvement in suspendable offenses (Cavanaugh, 2009), fighting (Coggeshall and Kingery, 2001; Rudatsikira, Muula, and Siziya, 2008; Zhang and Johnson, 2005), and perpetration of assaults and threats (Vidourek, King, and Bartsch, 2015). Coggeshall and Kingery (2001) reported that use of alcohol and marijuana at school is associated with increased risk for weapon-carrying and fighting at school. Being drunk at school had a large, significant effect on weapon-carrying, particularly among females; being high at school was associated with weapon-carrying among white females (Kodjo, Auinger, and Ryan, 2003).

Substance use has also been linked to self-reported victimization. For example, heavy smoking and binge drinking were positively associated with self-reports of being threatened or injured at school (Zhang and Johnson, 2005).

Mental Health

Mental health symptoms are also positively associated with perpetration of violence at school. Students reporting high levels of stress (Horner, Rew, and Brown, 2012), symptoms of depression, and having had thoughts about or having attempted suicide in the past (Muula, Rudatsikira, and Siziya, 2008; Coggeshall and Kingery, 2001) are also more likely to report weapon-carrying at schools. One study found that insufficient sleep was also associated with self-reports of being threatened or injured by a weapon at school (Hildenbrand et al., 2013).

Student Personality Traits

Personality traits and other individual characteristics may also affect school-based violence. Parents of middle school students who exhibit aggressive behaviors and anger are more likely to report disciplining their children as a result of violence they exhibited toward teachers and other students (Taylor, Davis-Kean, and Malanchuk, 2007). Aggression has also been linked with weapon-carrying (Ybarra et al., 2014; but see Estell et al., 2003). In addition, impulsivity and low self-control have been positively associated with perpetration of violent behaviors at school, such as physical attack, robbery, and sexual assault (Ousey and Wilcox, 2005), as well as weapon-carrying (Vogel and Barton, 2013). By contrast, certain other personality traits such as behavioral competence,[13] feelings of self-worth, and task persistence[14] may also *insulate* children from being both victims and perpetrators of school violence (Horner, Rew, and Brown, 2012).

There is mixed evidence regarding the role of personality traits and victimization. For example, one study found that externalizing behaviors[15] were positively associated with physical victimization at school among young children (Foster and Brooks Gunn, 2013), whereas another study found no effect of minor aggressive activity on victimization (Augustine et al.,

[13] Behavioral competence is one of six subscales from this scale. Other examples include scholastic, athletic, and social competence; physical appearance; and global self-worth. The respondent selects one of two descriptions for each item to correspond to whichever description is most like him or her. The example item cited for behavioral competence is "some kids usually do the right thing BUT other kids often don't do the right thing."

[14] Parent-reported temperament was measured with the 38-item School-Age Temperament Inventory, which includes four subscales such as negative reactivity, approach/withdrawal, and activity. The example item for task persistence is "does not complete homework unless reminders are given."

[15] Externalizing behaviors typically refer to aggressive and delinquent behaviors and are typically contrasted with internalizing behaviors such as anxiety, depression, and withdrawal.

2002). Impulsivity and low self-control were associated with being victimized at schools in two studies (Augustine et al., 2002; Tillyer, Fisher, and Wilcox, 2011), but another study found no effect on bullying victimization (Holt, Turner, and Exum, 2014).

Student Deviance

Delinquent attitudes and behaviors and school misbehavior are correlated with both victimization and perpetration of school-based violence. Furthermore, violent victimization is correlated with perpetration of violence. Violent beliefs[16] predicted involvement in suspendable school offenses in one study (Cavanaugh, 2009) but were unrelated to perpetration of physical violence in another (Ousey and Wilcox, 2005).

Not surprisingly, school misbehavior is positively associated with school-based victimization for both males and females (Koo, Peguero, and Shekarkhar, 2012; Peguero and Popp, 2012). Having been suspended in the past is positively associated with later weapon-carrying (Watkins, 2008), particularly among females (Kodjo, Auinger, and Ryan, 2003). As would be expected, a history of suspensions is predictive of engagement in future suspendable offenses (Cavanaugh, 2009). Truancy and skipping school have been found to be positively associated with female (although not male) weapon-carrying (Marsh and Evans, 2007) and non-gun weapon-carrying by all students (Cao, Zhang, and He, 2008). The number of detentions and suspensions had a modest, statistically significant effect on weapon-carrying (Ybarra et al., 2014). Prior in-school gun-carrying was positively associated with later gun and non-gun weapon-carrying (Wilcox, May, and Roberts, 2006).

Self-reported delinquency and criminal behavior have been associated with school-based weapon-carrying (Ybarra et al., 2014). Problem behavior[17] (Wilcox and Clayton, 2001) and past-year frequency in which students had attacked someone with the intent to hurt seriously, as well as past-year prevalence of arrest (Williams et al., 2002), were all positively associated with weapon-carrying at school. Violence perpetration (Kodjo, Auinger, and Ryan, 2003) and involvement in physical fighting were associated with weapon-carrying at school (Cao, Zhang, and He, 2008; Muula, Rudatsikira, and Siziya, 2008).

Violence perpetration and victimization are often correlated. For example, some students may carry weapons for self-protection in response to victimization (Wilcox and Clayton, 2001). Two studies with national samples have found that fear and exposure to violence are associated with weapon-carrying. Cao, Zhang, and He (2008) found that fear of being attacked was positively associated with weapon- though not gun-carrying according to the NCVS-SCS; however, neither victimization nor bullying victimization was associated with either form of weapon-carrying. Other studies have found that weapon victimization (Muula, Rudatsikira, and Siziya, 2008; Watkins, 2008), property victimization (Muula, Rudatsikira, and Siziya, 2008), violent victimization (Kodjo, Auinger, and Ryan, 2003; Muula, Rudatsikira, and Siziya, 2008), and exposure to violence (Vogel and Barton, 2013) all elevate the risk of weapon-carrying.

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[16] Violent beliefs is a four-point Likert scale assessing student attitudes toward violent behaviors. The items were not reported; however, Cavanaugh reports adapting the scale from Funk et al., 1999.

[17] This scale is an index in which eight binary items are summed to indicate whether the student had been referred to talk to someone for substance use, received counseling or was hospitalized for behavior/moods, had been placed in a special class/school because of behavior, had been placed in an alcohol/drug treatment program, had been arrested, jailed, or detained had sold drugs.

School misbehavior, history of suspension, truancy, and skipping school are positively associated with school-based victimization (Bouchard, Wang, and Beauregard, 2012; Burrow and Apel, 2008; Koo, Peguero, and Shekarkhar, 2012; Nofziger, 2009; Peguero and Popp, 2012) for both males and females. Likewise, self-reported delinquency, deviance, violence perpetration, and involvement in physical fighting are also associated with being victimized at school (Augustine et al., 2002; Burrow and Apel, 2008; Carbone-Lopez, Esbensen, and Brick, 2010; Kodjo, Auinger, and Ryan, 2003; Nofziger, 2009; Peguero, 2013; Tillyer, Fisher, and Wilcox, 2011).

Family

The evidence is mixed on the relationship between family characteristics and school-based violence. As stated above, the research is inconclusive about SES and perpetration of violence, once accounting for other factors. In addition, family size (Horner, Rew, and Brown, 2012) and structure (i.e., residing in a two-parent household) are unrelated to weapon-carrying (among females) or involvement in suspendable offenses (Cavanaugh, 2009). However, Marsh and Evans (2007) found that residing with both parents was inversely related to male weapon-carrying. Exposure to family violence and parental conflict are both positively associated with weapon-carrying (Marsh and Evans, 2007; Yexley, Borowsky, and Ireland, 2002; but see Wilcox and Clayton, 2001). Conversely, parental attachment, involvement, and monitoring are inversely associated with weapon-carrying (Marsh and Evans, 2007; Watkins, 2008; but see Ousey and Wilcox, 2005).

Family characteristics such as SES, size, and composition are only weakly related to victimization (Ferguson, 2003; Augustine et al., 2002; Hutchinson et al., 2014; Koo, Peguero, and Shekarkhar, 2012; Nofziger, 2009; Peguero, 2013; Peguero and Jiang, 2014). In addition, family size (Burrow and Apel, 2008) or residing in a two-parent household both appear to be unrelated to victimization (Burrow and Apel, 2008; Peguero and Jiang, 2014; Vogel and Barton, 2013; Watkins, 2008).

Qualitative aspects of family functioning seem to be more relevant to explaining school-based victimization. Parent-child physical aggression is positively associated with children's school-based victimization (Foster and Brooks-Gunn, 2013). On the other hand, parental attachment, involvement, and monitoring are inversely associated with victimization (Peguero and Jiang, 2014).

Academic

A number of studies have found no effect of educational performance on weapon-carrying (Estell et al., 2003; Watkins, 2008; but see Horner, Rew, and Brown, 2012), assault (Burrow and Apel, 2008), involvement in suspendable offenses (Cavanaugh, 2009), or discipline as a result of perpetration of violence (Taylor, Davis-Kean, and Malanchuk, 2007). However, attachment to school appears to be inversely related to weapon-carrying (Watkins, 2008; Wilcox, May, and Roberts, 2006; Wilcox and Clayton, 2001) and the perpetration of violence (Ousey and Wilcox, 2005).

Attachment to school (Tillyer, Fisher, and Wilcox, 2011) and academic achievement or scholastic competence are inversely related to victimization (Peguero, 2013; Peguero and Jiang, 2014), particularly female victimization (Koo, Peguero, and Shekarkhar, 2012; Peguero and Popp, 2012). However, Holt, Turner, and Exum (2014) found no effect of educational performance on physical bullying victimization, once controlling for other student and school

characteristics. Involvement in sports and other extracurricular activities appears to have a more complex relationship with school violence. Several studies have found an unexpected positive relationship between violent victimization and extracurricular activity, variously measured as participation in athletic teams, art, academic, service, or other clubs or organizations (Bouchard, Wang, and Beauregard, 2012; Koo, Peguero, and Shekarkhar, 2012); involvement in school sports (although not school activities) (Tillyer, Fisher, and Wilcox, 2011); and academic activities (Peguero, 2013). These counterintuitive findings may be attributable to the fact that students involved in these types of activities spend more time at school and are therefore at greater exposure for potential victimization.

Peers

There was no effect of peers' academic achievement on weapon-carrying (Estell et al., 2003); however, reporting violent or aggressive behaviors of peers has been found to be positively associated with weapon-carrying (Estell et al., 2003) and perpetration of violence (Ousey and Wilcox, 2005). Because peer measures are typically based on adolescents' perceptions of their peers' behaviors rather than on the direct report of their peers themselves, these results should be interpreted somewhat cautiously.

Peer attachment has been found to reduce the likelihood of victimization (Tillyer, Fisher, and Wilcox, 2011). In one study, however, positive peers, who endorse such values as attendance, studying, getting good grades, graduating, and continuing education, were found to be associated with an increased likelihood of victimization (Peguero and Jiang, 2014).

Other Factors

Other social bonds, such as social support and student reports of the closeness of ties and their social and interpersonal connectedness, are negatively related to weapon-carrying (Horner, Rew, and Brown, 2012; Kerres Maleckie and Demaray, 2003; Kodjo, Auinger, and Ryan, 2003). Religious ties appear to be unrelated to weapon-carrying (Wilcox and Clayton, 2001; Rountree, 2000). Parent gun ownership was found to be positively associated with weapon-carrying at school among students in an urban Kentucky county, whereas student gun ownership and use were associated with weapon-carrying at school among students in an eastern Kentucky county (Rountree, 2000) and among all youth in another study with the same sample (Wilcox and Clayton, 2001). As with perpetration, social bonds may serve a protective function: Individual reports of closeness of ties and social and interpersonal connectedness are negatively related to personal victimization (Gottfredson and DiPietro, 2011).

Teachers Are Exposed to a Nontrivial Amount of Violence in Schools

As discussed above, 9 percent of U.S. teachers reported being threatened with injury by a student, and 5 percent reported being physically attacked by a student in the 2011–12 school year (Robers et al., 2014). As with victimization of students, teacher victimization also differs by both individual and school-level attributes. Female teachers are more likely than male teachers to be physically attacked, with 6 percent of female teachers reporting victimization, compared with 4 percent of male teachers. In addition, black teachers are more likely to be victimized, with 14 percent of black teachers reporting threat of injury by a student, compared with 9 percent among other racial/ethnic groups, and 8 percent of black teachers reporting being physi-

cally attacked by a student, compared with 4 percent among other racial/ethnic groups. Educators who reported a student-perpetrated physical assault had significantly less experience (less than seven years working as a licensed educator and in the current school) and were more likely to have advanced degrees and to work in a special education or a social work capacity (Gerberich et al., 2014). Educators with advanced degrees may be at greater risk of workplace assault because they are more likely to work with students with behavioral issues. On the other hand, teachers assigned to smaller numbers of students were at lower risk (Gerberich et al., 2014).

Conclusion

To summarize, violence in U.S. schools is not uncommon; however, as one of our interviewees commented: "Schools are very safe places . . . arguably safer today than ten to 15 years ago." Serious violence is, thankfully, rare. In addition, serious and less-serious forms of violence have experienced considerable declines since the 1990s. Nevertheless, less-severe forms of school violence are still routine. Three out of four public schools report that at least some violence occurs on campus one or more times per year. Bullying is the most common form of school violence. Surveys show that one out of five or one out of four students report being bullied in the past 12 months. Notably, the level of teacher victimization is not trivial and remains an understudied area of research.

Violence appears to be most prevalent in high schools, although middle schools experience more violent events. Other differences across schools in rates of school violence appear to be driven by various aspects of school climate, which plays an important role in predicting violence. At the individual level, student substance use, delinquency, and prior exposure to violence are associated with school-based violence victimization and perpetration. However, large differences in conclusions remain, as can be seen in individual studies.

APPENDIX B

Methods

In this appendix, we describe five major approaches used in this study:

- a rapid review of school violence
- a rapid review of technologies
- stakeholder interviews
- expert panels
- case studies.

A Rapid Review of Literature on School Violence

To answer our research questions, we completed a rapid review of the literature on school violence. According to Khangura et al. (2012), unlike traditional systematic reviews, which typically take between six months and two years and involve a more exhaustive search for references, our rapid review was completed in a less than six months and is therefore more limited in scope. As a consequence, the findings should be interpreted conservatively.

Although less comprehensive than traditional systematic reviews, rapid reviews are a useful way to describe and categorize the literature and can inform decisionmaking by providing up-to-date summaries of the state of the evidence base. Rapid reviews attempt to accomplish similar goals as systematic reviews—comprehensive review of the literature and a synthesis of the evidence base—but they do so within more constrained parameters (e.g., time) and limited resources. For example, we limited our review to studies published in peer-reviewed journals that were based on U.S. samples and were published after 2000. Because our aim was to be as comprehensive as possible within these constraints, we made every attempt to scan and identify literature on studies of school-level violence and individual-level perpetration of or victimization by violence at schools.

Search Strategy

We developed a systematic search strategy for nine databases: Education Abstracts, ERIC, JSTOR, PsycINFO, PubMed, Social Science Abstracts, Sociological Abstracts, Web of Science, and WorldCat. We searched for English-language articles in these databases published from January 1, 2000, to December 1, 2014. The following search string was used to identify studies: "school OR schools AND violence OR safety."

Selection Criteria

To be eligible for this rapid review, citations must have directly examined school violence on school grounds in the United States. Eligible populations included K–12 students, teachers, and other individuals directly exposed to violence on school grounds. All empirical peer-reviewed articles and nonpeer-reviewed reports were eligible. Examples of eligible forms of school violence include:

- student reports of being victimized at school, such as being threatened or injured with a weapon, forced to give up money and possessions, or being hit, hurt, or assaulted
- student reports of perpetrating violence at school, such as robbing or assaulting another student
- student reports of carrying a weapon, such as a knife or handgun, to school
- student reports of fighting at school
- administrator reports of serious crimes occurring on campus, such as attempted rape, sexual battery, robbery, or physical attack.

Data Collection and Analysis

Two Ph.D.-level researchers conducted an initial scan and sort of the titles and abstracts for all records. The majority of studies were deemed ineligible because they were published with samples outside the United States, were nonempirical (e.g., narrative reviews, calls for action, thought pieces), or were empirical evaluations of school-based violence prevention and intervention programs.

For the remaining studies, researchers inspected the full text to determine whether they were eligible for our review. The majority of these studies were eliminated because they did not examine school-based violence; for example, they examined peer victimization among school-based samples without specifying the location of violence being described or modeled outcomes that focused solely on nonviolent offenses outside our scope, such as theft or substance use, or else grouped both violent and nonviolent items in their measures of school-based victimization We also eliminated qualitative studies using small samples (fewer than 30) because of their more limited generalizability.

Eligible studies were grouped into two categories: descriptive statistics about prevalence and incidence of school violence (question 1) and predictors of school-level violence or individual-level perpetration or victimization of violent behaviors occurring in school settings (question 2). Once these studies were categorized, we further extracted from them data along several dimensions and cataloged their population covered, geographic scope, sampling strategy and sample size, covariates included, and findings. Although our initial search netted over 11,000 studies, our final literature review relied on six studies for addressing question 1 and 54 for addressing question 2.

Primary Sources of School Safety Data

Most of the studies were derived from one of several ongoing surveys, each of which employed a unique research methodology and definition of school violence. Table B.1 summarizes these data sets.

Table B.1
Common Sources of School Safety and Violence Statistics

Survey Name	Primary Measures	Sponsor	Geographic Scope	Number of Studies
National Crime Victimization Survey–School Crime Supplement	Student-reported violent and serious violent victimization, weapon-carrying	U.S. Census Bureau, Bureau of Justice Statistics	Nationally representative sample of households—12–18-year-olds enrolled in grades 6–12	5
School Survey on Crime and Safety	Principal-reported violent incidents	National Center for Education Statistics	Nationally representative sample of public primary and secondary schools	5
Youth Risk Behavior Surveillance System	Student-reported weapon-carrying, threat or injury, and fighting	U.S. Centers for Disease Control	Representative samples of 9th–12th-grade students at national, state, and large urban levels	5
National Longitudinal Study of Adolescent to Adult Health	Student-reported weapon-carrying	University of North Carolina	Nationally representative sample of 7th–12th-grade students in 1994–95 school year	3
Educational Longitudinal Study	Student-reported violent victimization	National Center for Education Statistics	Nationally representative sample of 10th-grade students	4
Schools and Staffing Survey	Teacher-reported violent victimization	National Center for Education Statistics	Nationally representative sample of schools	Indicator report only

How Much Violence Occurs in Schools?

To answer this question, we relied heavily on the most recent report from the Indicators of School Crime and Safety series (Robers et al., 2014), published annually by the Bureau of Justice Statistics and the National Center for Education Statistics, and supplemented with additional materials as needed. In particular, we relied on the most recent comprehensive reports analyzing the main sources of data on school violence: the annual Youth Risk Behavior Surveillance System (Kann et al., 2014), the biennial National Crime Victimization Survey's School Crime Supplement (DeVoe, Bauer, and Hill, 2011), and the biennial School Survey on Crime and Safety (Neiman and Hill, 2011). The *Indicators of School Crime and Safety* report summarized data from many of the previously discussed surveys, censuses, and other databases to provide a comprehensive overview of the levels of violence and victimization in U.S. primary and secondary institutions, whereas each of the individual reports provided a greater level of detail on school violence from a single data source.

What Predicts School-Based Violence?

To answer this question, we focused on studies that had examined simultaneously multiple predictors of school violence, noting that they differed widely in their research designs, modeling strategies, and the extent to which they address omitted variables.

School-Level Predictors of Violence

We began by examining school-level predictors of violence. These studies referred to characteristics or qualities of schools and were typically based on aggregated responses of student or teacher surveys or administrative reports. School violence outcomes were measured either at the school level (e.g., rate of violence) or, in the case of multilevel studies, at the individual level (e.g., frequency of past-month threats of violence). We examined four sets of school predictors: location, organization, demographic composition, and climate.

Individual-Level Predictors of Violence

More studies have examined individual characteristics of perpetrators and victims of violence in school settings. At the individual level, student health-related behaviors, particularly substance use, are the most predictive of both perpetration and victimization, followed by personality characteristics, delinquent behaviors, and prior exposure to violence. Other factors that are less consistent include academic involvement and achievement, family and peer factors, and demographic characteristics.

Rapid Review of Technologies

To promote methodological rigor and transparency in reporting, a rapid review of technologies was designed and written using the Preferred Items for Reporting Items for Systematic Reviews and Meta-Analyses Statement and the American Psychological Association's Meta-Analysis Reporting Standards.

Search Strategy

We developed a systematic search strategy for nine databases: ERIC, Education Abstracts, Criminal Justice Abstracts, NCJRS, Academic Search Complete, Business Source Complete, Web of Science, Scopus, and WorldCat. We searched for English-language articles in these databases published from January 1, 1990, to December 3, 2014. The following search string was used to identify studies: (school OR schools) AND (violence OR security OR weapon* OR shoot* OR gun OR guns) AND (software OR computer* OR technolog* OR access control OR closed-circuit OR "closed circuit" OR surveillan* OR "anonymous tip" OR "early warning" OR "emergency alert" OR metal detect* OR equipment OR device*). Key sources identified by the project team and client representatives were also examined. No other information sources were searched.

Selection Criteria

To be eligible for this rapid review, retrieved citations must have discussed school safety technologies currently used in the United States. Eligible populations included students and schools in grades K–12. All types of reports (e.g., newspaper articles, magazine entries, reports of government legislation, nonpeer-reviewed reports, scientific journal articles) were eligible for this rapid review.

We defined technology as devices developed or implemented to prevent violence in schools and to make schools safe. A device is further defined to include machines, software, computer applications, or equipment created for the express purpose of making schools or students more safe. This definition does not include policies (i.e., guiding principles to set direction) and

procedures (i.e., sets of steps or particular ways to accomplish something) that are not related to school safety devices, even if these policies or procedures explicitly concern school safety. A priori examples of excluded interventions, policies, or procedures include:

- school uniform policies
- corporal punishment of students by adults
- policies to hire or train school resource officers
- anti-bullying policy stipulating what bullying is and the consequences of it
- interventions to provide cognitive-behavioral therapy for at-risk students
- investment in a fence around the school property to prevent loitering
- partnerships between the school district and local police department to share information
- student disciplinary policies
- electronic school risk assessment templates that are not "dynamic"—even if they involve an electronic interface.

We defined school violence as interpersonal violence, or the use of physical force or power to threaten or harm others, that occurs on traditional and charter public school property during or outside school hours, on the way to or from these schools or school-sponsored events, on school-sponsored modes of transport, or during these schools' sponsored events. This definition includes anyone—adults and children—who experiences interpersonal violence in these settings. A priori examples of eligible forms of school violence include:

- all types of experience of interpersonal violence—witnessing it, perpetrating it, being victimized by it—on school grounds or during school-sponsored events, including home games or away games
- cyberbullying done on school computers or with privately owned technology (e.g., children's cell phones) if used while on school grounds
- interpersonal violence on school-sponsored transit, such as school buses or school vans
- interpersonal violence by adults or minors during or outside school hours on school property (e.g., gang fights on school playgrounds at nights or on weekends).

A priori examples of ineligible forms of violence include:

- all forms of self-harm, such as suicide, cutting, or eating disorders, even when that self-harm occurs at school
- verbal abuse that does not involve a threat of physical force or immediately lead to the use of physical force
- corporal punishment of students by adults
- interpersonal violence that occurs while children are in transit to or from school on non-school-sponsored transit (e.g., violence on subways or public city buses, even if the school subsidizes the use of such transit, walking to and from school, or car transit)
- interpersonal violence in public and private spaces that do not belong to the school (e.g., the school neighborhood)
- interpersonal violence perpetrated through nonschool property and not on school grounds (e.g., cyberbullying done from a home computer by school-aged children)

- alternative education schools (e.g., area learning centers, juvenile correctional facilities, alternative learning centers, residential treatment facilities, special education schools, or extension schools)
- illegal activities if they do not involve interpersonal violence (e.g., drug use on school campus that does not also involve a violent incident).

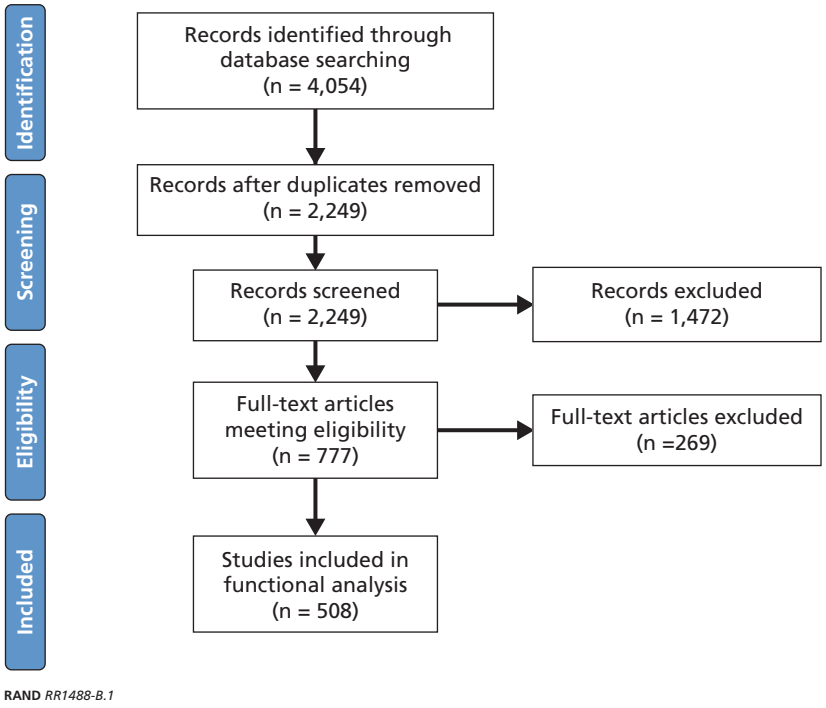
Data Collection and Analysis

One researcher (a Ph.D.-level reviewer) screened articles for eligibility. After duplicates identified from the systematic search were removed, the researcher scanned the titles and abstracts of all remaining citations. Articles passing eligibility criteria at this stage were then retrieved, if available. Because of the short time frame of review, the full texts of several citations, although potentially relevant, could not be accessed. The reviewer screened the full texts that could be retrieved to confirm eligibility. A data extraction form was then developed using items from the Template for Intervention Description and Replication checklist and guide and the Oxford Implementation Index. The reviewer then summarized each identified school safety technology according to items within these frameworks, using data-reduction and matrix-based thematic extraction. The variables sought from these frameworks were:

- physical materials used to employ the technology
- the procedures, activities, and processes involved in using the technology
- the rationale, theory, or goal of the elements essential to the technology
- the users of the technology
- information related to the duration and intensity of delivering the technology (e.g., camera recording 24/7 over the course of the school year)
- the types of locations where the technology is used
- modifications or adaptations of the technology to local contexts
- the extent to which the technology is implemented as planned/designed in real-world applications
- information about the prevalence or use of the technology
- information about the cost associated with using the technology
- information about the acceptability of the technology to various stakeholders (e.g., students, teachers, parents)
- information about the technology's effectiveness in reducing school violence or threats to school safety
- information about potential unintended negative effects or harms of the technology
- crisis management stage that the technology addresses (mitigation and prevention, preparedness, response, or recovery).

Figure B.1 outlines the flow of the process used to identify school safety technologies. Our search yielded 4,054 hits. After removing duplicates, 2,249 citations remained (Academic Search Complete, 186 citations; Business Source Complete, 390 citations; Criminal Justice Abstracts, 406 citations; Education Abstracts, 159 citations; ERIC, 194 citations; NCJRS, 352 citations; Scopus, 167 citations; Web of Science, 289 citations; WorldCat, 106 citations). After title and abstract screening, 777 citations appeared to meet the eligibility criteria. Of these, 508 retrieved articles were eligible after full-text screening.

Figure B.1
School Safety Technology Flow Diagram



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Stakeholder Interviews

Over the course of four months (January 2015 to May 2015), we invited 53 representatives from four stakeholder groups—practitioners/administrators, researchers, advocates, and school safety technology vendors—to participate in a brief interview on school safety. The list of interview candidates was developed in consultation with the project officer at the National Institute of Justice. Efforts were made to include representation from national, state, and local levels (i.e., regions and districts). The types of organizations targeted for these interviews included:

1. national organizations
   a. school resource officers
   b. school administrators
   c. school facilities
   d. federal-level administrators
   e. district administrators
   f. school mental health professionals
2. state-level education administrators
3. regional or district-level offices of education administrators
4. training/technical assistance professionals/consultants
5. advocacy organizations
6. teacher and parent organizations
7. researchers/research organizations

8. vendors of school safety technologies

In total, we conducted phone interviews with 27 representatives from the four stakeholder groups. See Table B.2 for a breakdown of our recruitment efforts.

To protect confidentiality, we do not name the individuals or their organizations, but they came from county offices of education, associations of school principals, universities, associations of school resource officers, school safety vendors, safety magazines, and advocacy organizations who work at the state or national levels.

To solicit their participation, we first sent an invitation email requesting a 30-minute telephone interview to discuss the nature and extent of school violence and potential technological solutions for improving school safety. All candidates who agreed to participate in an interview received a copy of the consent form in advance via email, which was reviewed at the beginning of each interview. One senior project associate and one research assistant conducted the interviews. Interviews were audio recorded for note-taking purposes. Nonverbatim notes were also taken by the research assistant during the interviews. The audio recordings were used to fill in any missing important information.

Using standard qualitative data analysis techniques, we analyzed the interview data. To increase intercoder reliability and the validity of the findings, we developed a codebook including the codes and detailed descriptions of each code. The codebook was created based on major topics in the interview protocol and recurrent themes articulated by interviewees. Specific codes included the following:

1. main safety concerns (i.e., most common types of violence that schools face)
2. variability
   a. level of urbanicity
   b. school-level variance
3. main technologies (i.e., most commonly used technologies by schools)
4. effectiveness (i.e., technologies that are most effective)
5. limitations (i.e., greatest limitations of the current technologies)
6. greatest need (i.e., greatest need for more or new technologies; where money should be invested)
7. barriers (i.e., barriers to adopting a promising technology)
8. nontechnology (i.e., examples of nontechnological solutions schools used to address school safety)
9. other (i.e., other considerations when thinking about school safety).

Table B.2
Number of Interviews by Key Informant Type

Key Informant Type	Invited	Completed	Declined	No Response	Response Rate, %
School administrator/ school-based practitioner	23	9	1	13	39.1
Researcher	14	9	2	3	64.3
Advocate	6	4	0	2	66.7
Vendor	10	5	0	5	50.0
Total	53	27	3	23	50.9

Interview notes were divided into individual quotes consisting of one or more sentences that seemed to reflect each code. Quotes were entered into Microsoft Excel by their source (i.e., ID number, type of organization, type of interviewee), and relevant code. Each quote within each structural code was then manually reviewed, and subthemes were created through content analysis. Subthemes were then highlighted to another color for easier text analysis and validation, and a new bivariate was created for each theme and a "1" was assigned to each quote to indicate that a specific theme was mentioned within a specific quote. After the themes were created for each structural code, all subthemes were arranged in ascending order to indicate the magnitude of the number of times that specific subtheme was mentioned.

Two coders (the same senior project associate and research assistant who conducted the interviews) reviewed the codebook in detail before the analyzing the interview data. The research assistant took the first pass at coding the data. Then, the project associate reexamined 20 percent of the coded interviews to ensure that no themes were missed.

Expert Panels

We convened two expert panels to identify, rate, and rank school safety needs. The full panel consisted of experts from both urban school districts and suburban/rural school districts. (Some panelists participated on both panels.) A full list of panel participants is provided in Appendix C. To obtain the best possible representation of views among the expert panels, we invited a selection of researchers, school principals, professional organizations, school safety consultants, school district administrators who are responsible for district safety initiatives, and school safety journalists. We sought geographic diversity among school principals and leaders in particular.

Prepanel Questionnaire

Once participants agreed to participate in the panel, they were sent a 20-page document we had written synthesizing the research on school violence and existing technologies. Reading materials focused on Prevalence and Trends in School Violence and School Safety Technologies, including a table nearly identical to Table 2.1. Panelists were also sent a link to an online questionnaire that presented them with each of the 12 technologies listed in Table 2.1. Participants were then asked to rate each technology with respect to its

- Appropriateness for addressing severe and frequent violence (How appropriate is this technology for the following problems in [urban or rural/suburban] schools:? Most severe violence [e.g., mass shooting, kidnapping, rape]? Most frequent violence [e.g., bullying, weapon-carrying])? Response options were very inappropriate (= 1), somewhat inappropriate (= 2), neither appropriate nor inappropriate (= 3), somewhat appropriate (= 4), very appropriate (= 5), and don't know.
- Effectiveness (For urban schools: How effective would this technology be in reducing urban school violence, where emergency response times are short? For suburban/rural schools: How effective would this technology be in reducing suburban/rural school violence, where emergency response times can be long?) Response options were very ineffective, somewhat ineffective, neither effective nor ineffective, somewhat effective, very effective, and don't know.

Participants were also asked to describe the most likely harms, if any, associated with adopting a particular technology (What are potential harms from adopting or implementing this technology?). For the potential harms, response options were

- violation of student privacy
- unfair treatment of certain students or student subgroups
- risk of false identification of perpetrator or victim
- increased students' negative attitudes toward school
- make school feel too fortified or unwelcoming
- cost to adopt reduces funds for more important safety initiatives
- don't know
- other, in which case they were asked to specify other potential harms.

Panelists who participated in both the urban and suburban/rural panels were asked to complete two questionnaires, one for each of the panels, although they were given the option to take only one questionnaire if they desired because of time constraints. A total of 18 participants (82 percent) completed the urban pre-panel online survey, and 16 (80 percent) completed the suburban/rural pre-panel online survey.

To analyze the pre-panel online survey, the research team assigned numeric values to the appropriateness response options and calculated mean values for each technology separately for the urban and suburban/rural panelists. The prevalence of potential harms was calculated as a percentage, i.e., the proportion of panelists who indicated a specific harm.

In-Person Panel Discussions

The members of the school safety panels convened for day-long sessions of structured brainstorming on April 20 and April 21, 2015. On sequential days, one panel addressed issues related to urban schools and the other addressed issues related to suburban or rural schools. Participants were drawn from across the educational sector. As noted above, some participants participated on both panels. On each day, between 24 and 28 panelists participated. Once panelists were convened and introduced to each other, they were divided into two groups of approximately 13 members per group to promote dialog from all participants. Panels were led by two RAND researchers, with an additional researcher present to take notes.

The morning and afternoon sessions were identical, and each consisted of four phases: The morning session focused on technologies to address severe forms of violence, and the afternoon session focused on technologies to address frequent forms of violence.

Phase 1. In the first phase, panelists were presented with the technologies that they rated in the pre-panel online survey as "very appropriate" (see Chapter Three) for addressing the most severe or frequent forms of violence. They were first asked to describe why the given technologies were appropriate for addressing the form of violence being discussed, and then they were asked to describe the most important improvements that could be made to these technologies to make them even more appropriate for addressing that form of school violence. These needs were listed on the screen so that all participants could see them in real time. Participants were reminded of the most frequently mentioned harms for each item.

Phase 2. The second phase mirrored the first phase, but in this case panelists were presented with the technologies that they rated in the pre-panel online survey as neutral or "somewhat appropriate" for addressing the form of violence being discussed. Again, panelists were first asked to describe why the given technologies were not as appropriate as the first group for

addressing that form of violence, and then they were asked to describe the most important improvements that could be made to these technologies to make them more appropriate for addressing it. As with the first phase, needs were listed on the screen so that all participants could see them in real time. Participants were reminded of the most frequently mentioned harms for each item.

Phase 3. The third phase was a brainstorming phase in which panelists were asked an open-ended question: Are there technologies outside the 12 categories we've presented that could address the threat to school violence being discussed? Ideas that were discussed, regardless of the support (or lack thereof) from other panelists, were listed on the screen so that all participants could see them in real time.

Phase 4. In the final phase, a combined list from Phases 1 to 3 was distributed to participants and each was told: Pretend you were an investor in school safety technologies. Prioritize which top 10 technology improvements [from the list] you would invest in.

Post-Panel Discussion and Overall Rankings. In the final session of the day, the moderators first led the group in an open discussion with three overarching questions: (1) What is the appropriate role of technology in a comprehensive school safety plan? (2) What is the ideal suite of technologies in a comprehensive school safety plan? (3) Are there any aspects of technology that we haven't discussed today? Finally, before they left, panelists were given a list of all the technological improvements and new technologies they listed from both the morning and afternoon sessions. They were then told a repeat of Phase 4 as a final iteration: Pretend you were an investor in school safety technologies. Looking across the technology improvements for the most severe and most common forms of school violence, prioritize which top 10 technology improvements you would invest in.

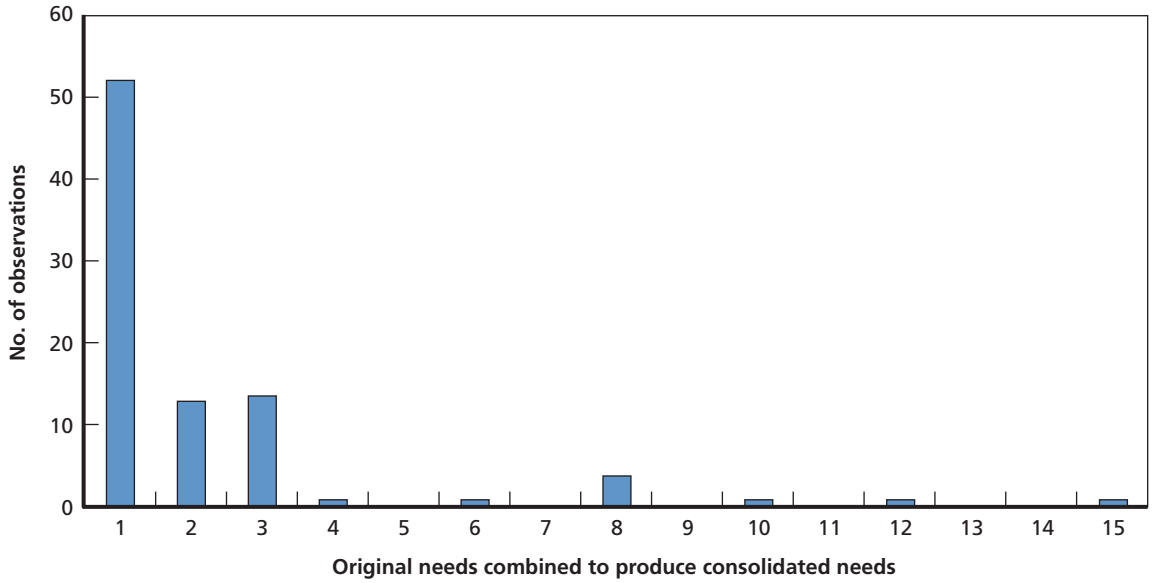
Analysis of Prioritization Data

Each subpanel completed three ratings (associated with Phases 1, 2, and 4), and there were four subpanels: two working groups representing urban schools and school districts on Day 1 and two working groups representing suburban/rural schools and school districts on Day 2. This resulted in 12 sets of ratings. Across Phases 1 and 2 on both panel days, 199 different needs were identified, with the number identified in each individual session varying between 19 and 37, with an average between 24 and 25. When the groups carried out the "overall rankings" (using a list of needs combined from previous sessions), the total number of needs considered by each group varied from 39 to 64, with an average of approximately 50.

From each of these lists of needs, each participant independently selected his or her top priorities, submitting an ordered list from their top (No. 1) priority down to the tenth priority need. Most participants provided a full list of 10 ranked needs, although some stopped after providing between 5 and 10.

As described in Chapter Five, because the groups functioned independently, there were overlaps in their individual lists and instances in which individual items on the lists of priority needs (both within and across groups) could be productively combined to simplify the results. This was done separately by three members of the research team, and differences between the items were resolved through discussion. This consolidation process resulted in 88 combined needs. The number of items consolidated to produce the final list ranged from one (in cases where there was no consolidation) to a high of 15, with an average of 2.3. Figure B.2 presents a histogram of the numbers of items combined into each of the final combined needs. As shown, consolidation was minimal in the vast majority of cases.

Figure B.2
Number of Original Panel Needs Combined to Produce Final Combined Needs



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This process resulted in a dataset of each participant's top 10 priorities for the needs identified in their working group sessions, a subset of which were represented in the overall set of "combined needs" that resulted from the consolidation process. In processing these data to produce prioritized lists of the consolidated needs, we had to address several risks:

- If single needs that were very highly ranked were combined with other lower-ranking needs, treating the score of the combined need as an average of the scores of its constituent items would make the prioritization very sensitive to the needs the research team chose to combine and might not reflect the panels' preferences.
- If multiple needs with mid-range scores reflecting the panels' preferences about different original single needs were combined, then each of those needs should reasonably be treated as contributing to the overall score of the combined need. However, treating the score of a combined needs as the sum of their constituent needs similarly risked artificially skewing the panels' priorities, given that different numbers of needs were combined during the simplification process (Figure B.2).

Our approach also had to account for the different lists of needs identified by each working group (which varied in number) and variation in the number of participants in each working group, meaning that it would not be appropriate to treat needs' total scores as simple sums of the rankings of all the individual participant's scores.

To address these concerns, we used three separate measures for each combined need, calculated from the underlying priority numbers assigned to the original needs by the members of the panel. First, each need was given a "raw" score based on the different participants' rankings—i.e., every time a participant gave the need a No. 1 ranking, it received 10 points; every time it received a No. 2 ranking, it received 9 points, etc. The raw score for an original need was determined by summing up all these points, with the possible score going from a

high of 10 times the number of people in the ranking group to 0 (if no group member included that need on their list of 10 priorities). This raw score was then normalized by the number of participants in the working group to take different participant numbers into account. This "normalized score per participant who rated the need" was the starting point for three separate measures for each combined need:

1. The maximum normalized score for any of the needs that made up the combined need: To address the possibility of one high-scoring need that the panel felt was very important being combined with other lower-scoring needs, one measure for each combined need was the highest score for any of its component needs. If three needs were combined that had normalized scores of 5, 2, and 0, respectively, the score for the combined need on this measures would be 5. For needs that were not combined with other needs, its score would be the same as its starting score.
2. The sum of all individual normalized scores for the combined need: Although using a sum gave advantage to combined needs that were assembled from larger numbers of original needs, using it was still viewed as useful as one of three separate measures. Doing so provided a way to capture a situation in which none of the elements of a combined need rated highly enough to score well on measure 1, but its various components had each received medium-level scores. For our hypothetical need made up of components with normalized scores of 5, 2, and 0, the value for this measure would be 7.
3. The fraction of its highest possible score the need received: To have a measure that was truly independent of the number of original needs that were combined during our simplification process of creating combined needs, we added the normalized scores for each combined need and divided that sum by the total possible number of points that need could theoretically have received. For example, a single need that was not combined with any other need could theoretically have a value of 10 when all the normalized scores for all raters were added together—if and only if all raters put that need as their first priority. So dividing the observed score of that need by 10 would produce the fraction of that maximum score the need actually received per participant's ranking. Likewise, a combined need that we devised from two original needs would have a theoretical maximum score of 19 (10 + 9), if all participants had rated one of the needs as No. 1 and the other as No. 2 on their list of priorities. By extension, the maximum score for a three-item combined need is 27 (10 + 9 + 8) if every panelist had ranked the three component items No. 1, No. 2, and No. 3. Returning to the hypothetical example used above, if panelists ranked three items that made up a combined need with normalized scores of 5, 2, and 0, this would make the combined need score (5 + 2 + 0)/27, or 0.26. The purpose of this measure is as a complement for measure 2 that is not dependent on the number of needs that were combined during our analysis.

To identify Tier 1 and Tier 2 needs from each of the working group lists, we flagged combined needs that fell in the top fifth of the distribution of any of the three measures (i.e., a need that had a score on one more or more of the measures that was greater than 0.8 times the highest value observed for that measure). We categorized needs falling in the second fifth (i.e., between 60 and 80 percent of the maximum value) as falling into Tier 2. All other needs were assigned to Tier 3.

Each list from each pair of working groups (e.g., both of the groups examining urban school issues for the most severe school safety concerns) were then combined to form the final list. The combined needs were assigned to the highest tier observed in either of the two working groups of the relevant panel day—i.e., if a need fell in Tier 1 in one workshop and Tier 3 in the other, it was included as a Tier 1 need in the final list. This practice ensured that the different priorities of the different groups were captured.

Case Studies

As described in Chapter Four, to identify the case study locations, we asked experts whom we interviewed by phone if they knew of exemplary locations where any innovative technological strategies were used to improve school safety. We also conducted a general search of the Internet to learn of localities with media coverage about innovative use of school safety technology using such keywords as "school safety," "school violence," and "technology." These two methods yielded a total of 18 candidate locations for our case studies. From this list we selected a total of seven potential locations, which we identified for geographic diversity and for use of a diverse set of technologies from the types that the School Safety Expert Panel had described as very appropriate for the most severe or most frequent forms of school violence. We then emailed local school safety personnel (or the contact person our phone interviewee suggested) to solicit their participation in a case study, explaining the purpose of the case study and the research project overall. Five of seven we contacted agreed to participate.

We then scheduled one telephone call with the point of contact to describe the overall project, explain the purpose of the site visit, and learn more about the school/jurisdictional structure and basics of the selected technology. Then, we corresponded through email to select ideal site visit dates. We conducted 1–2-day site visits from April to July 2015. In each instance, we used a semistructured interview protocol, reviewed a verbal consent form, and interviewed six to 14 people per site visit. In these site visits, we sought out school resource officers, principals, counselors, teachers, and school/district technology officials, to learn about and view the technologies in action. The types of questions we posed included:

1. What types of school violence are most common in your district/school?
2. What types of technologies are used in your district/school?
3. What was the process for selecting these technologies?
4. What was the process of implementing the selected technologies?
5. What were primary the barriers and facilitators to implementing these technologies?
6. How effective are the current technologies? Why?
7. What are the greatest limitations of the current technologies?
8. If another school district was interested in implementing the current technologies, what advice or lessons learned would you share with them?

We took notes and audio recorded each interview, which formed the basis for the case studies.

APPENDIX C

Panel Participants

Day 1: Urban School Districts

Lina Alathari, Research Psychologist, U.S. Secret Service, National Threat Assessment Center

Anthony Bland, Executive Director of School Safety, Camden (N.J.) City School District, Office of Safety and Security

Sean Burke, President, School Safety Advocacy Council

Mo Canady, Executive Director, National Association of School Resource Officers

Jadine Chou, Chief Safety and Security Officer, Chicago Public Schools, School Support Center/Safety and Security

Edward A. Clarke, Executive Director, Maryland Center for School Safety

William Ford, Supervisory Physical Scientist, Division Director, National Institute of Justice, Research Division

Calvin Hodnett, Senior Management Analyst, U.S. Department of Justice, Office of Community Oriented Policing Services

Joel Hunt, Computer Scientist, Crime Mapping/Geographical Information Systems, National Institute of Justice, Research Division

Paul Kesner, Director, Safe Supportive Schools Program, U.S. Department of Education, Office of Safe and Healthy Students

Patrick Kissane, Executive Director, New Jersey Association of School Resource Officers

Day 2: Rural/Suburban School Districts

Lina Alathari, Research Psychologist, U.S. Secret Service, National Threat Assessment Center

Catherine P. Bradshaw, Associate Dean for Research and Faculty Development, Curry School of Education, University of Virginia

Sean Burke, President, School Safety Advocacy Council

Mo Canady, Executive Director, National Association of School Resource Officers

Timothy Enos, President, Florida Association of School Resource Officers

Benjamin Fernandez, Member Representative, National Association of School Psychologists; Lead School Psychologist, Loudoun County (Va.) Public Schools

William Ford, Supervisory Physical Scientist, Division Director, National Institute of Justice, Research Division

Robin Hattersley Gray, Executive Editor, *Campus Safety Magazine*

Calvin Hodnett, Senior Management Analyst, U.S. Department of Justice, Office of Community Oriented Policing Services

Joel Hunt, Crime Mapping/Geographical Information Systems, National Institute of Justice, Research Division

Paul Kesner, Director, Safe Supportive Schools Program, U.S. Department of Education, Office of Safe and Healthy Students

Patrick Kissane, Executive Director, New Jersey Association of School Resource Officers

Jamie Koppel, Senior Fellow, School Climate and Discipline, U.S. Department of Justice, Office of Juvenile Justice and Delinquency Prevention

Virginia Larsen, School Psychologist, Samuel W. Tucker Elementary School, Alexandria (Va.) City Public Schools

Ian Moffett, President-Elect, National Association of School Safety and Law Enforcement Officials, Miami-Dade Schools Police Department

Michelle Nutter, Program Manager, Center for Safe Schools

Mike O'Shea, Program Manager, Compliance Testing Program, Aviation Policy, National Institute of Justice, Policy, Standards and Grants Management Division

Marisa Randazzo, Director, Georgetown University, Threat Assessment Program

Heidi Riccio, Principal, Medford (Mass.) Public Schools

Steve Schuetz, Physical Scientist, Information Technologies, National Institute of Justice, Research Division

Vanessa Snow, Major, Riviera Beach (Fla.) Police Department

Tom Vaccarello, Director, Fairfax County (Va.) Public Schools, Office of Safety and Security

Richard "DJ" Waddell, Professor, Johns Hopkins University, Applied Physics Laboratory, Principal Professional Staff

Wendy Wuenker, Teacher, Cypress Bay High School, Weston (Fla.) Public Schools

Phelan Wyrick, Social Science Analyst, National Institute of Justice, Office of Research and Evaluation

Deborah Laliberte, Emergency Preparedness Coordinator, Gilford High School, Gilford (N.H.) Public Schools

Dawn LeBlanc, Principal/Assistant Director, North Montco Technical Career Center, Lansdale (Pa.) Public Schools

Heather Leighton, Principal, Lummi Nation School, Bellingham (Wash.) Public Schools

William Modzeleski, Senior Consultant, SIGMA Threat Management Associates

Mike O'Shea, Program Manager, Compliance Testing Program, Aviation Policy, National Institute of Justice, Policy, Standards and Grants Management Division

David Ouellette, Project Director, New Hampshire Council on Developmental Disabilities

William Panos, Director, Wyoming School Facilities Department

Cindy Pappas, Senior Policy Advisor, U.S. Department of Justice, Office of Juvenile Justice and Delinquency Prevention

Susan Payne, Director of Safe Schools, Safe2Tell

Nancy Ritter, Writer/Editor, National Institute of Justice, Office of Communications

Steve Schuetz, Physical Scientist, Information Technologies, National Institute of Justice, Research Division

Emily Tanner-Smith, Research Assistant Professor, Vanderbilt University, Peabody Research Institute and Department of Human and Organizational Development

Ken Vaughn, Chief, Student and Support Services Officer, Tyler (Tex.) Independent School District

Richard "DJ" Waddell, Professor, Johns Hopkins University, Applied Physics Laboratory, Principal Professional Staff

Bob Wooldridge, Captain, Knoxville (Tenn.) Police Department

Phelan Wyrick, Social Science Analyst, National Institute of Justice, Office of Research and Evaluation

APPENDIX D

Complete Listing and Tiering of Combined Technology and Related Needs

The discussion in the main body of the report covered combined needs that were prioritized into Tiers 1 and 2 by the school safety panels. In this appendix, we present the full list of combined needs with their associated tiers. Table D.1 lists the technology need, the number of separate panels in which an improvement related to that combined improvement was identified (providing a measure of the breadth of *interest* in the need, even if it was not a Tier 1 or 2 priority), the days on which it was identified (showing whether it was of interest to urban, suburban/rural, or both panels), and the tiered prioritization in each of the rankings as described in Appendix A. This table is a more complete version of Table 5.8 in the main body, which present similar data but only for the Tier 1 and 2 needs.

Table D.1
Complete List of Panel Rankings of Combined Technology and Related Needs

Combined Technology Improvement	Identified In		Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	No. of Groups	Panel	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Fitbit tracker to identify students in high states of distress or agitation	1	Suburban/rural	3	2	3	3	3	3
"Hot mics" in classroom that responds to a codeword to enable communication when radios/phones are inaccessible	1	Urban	3	3	3	3	3	3
"Unobtrusive" robot roaming halls for detecting safety issues	1	Suburban/rural	3	3	3	3	3	3
Tracking/accountability system for tip lines	1	Urban	3	3	3	3	3	3
Ability to collect incident details on tip lines	2	Urban, suburban/ rural	3	3	2	3	3	3
Ability to override all other communications via command radios during an incident	1	Suburban/rural	3	3	3	3	3	3
Alert system that notifies first responders of students with special needs within the school	1	Suburban/rural	3	3	3	3	3	3
All-in-one application with comprehensive school safety plans and procedures, including better dissemination of appropriate parts to stakeholders (parents, teachers, administrators)	4	Urban, suburban/ rural	3	1	1	1	3	1
Allowing law enforcement to tap into school live video feeds	1	Suburban/rural	3	1	3	3	3	3
Analytics (via video, student ID cards, or other devices) to identify unexpected movements and predict problems	3	Urban, suburban/ rural	3	3	3	3	3	3
Anonymous student surveys regarding safety to identify hot spots and school climate	1	Suburban/rural	3	3	3	1	3	3

Table D.1—Continued

Combined Technology Improvement	Identified In		Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	No. of Groups	Panel	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Automated crisis response plan that activates when an event occurs	1	Suburban/rural	3	3	3	3	3	3
Automated drone surveillance of school grounds or at school events	1	Suburban/rural	3	3	3	3	3	3
Automated monitoring and response/referral system for cyberbullying	1	Urban	3	3	1	3	3	3
Automated protocol once credible and specific threat is identified via tip line	1	Suburban/rural	3	3	3	3	3	3
Automated scanning for weapons via video	1	Urban	3	3	3	3	3	3
Automated screening protocol to signal more in-depth "human" behavioral threat assessment	1	Urban	3	3	3	3	3	3
Better electronic record-keeping of incidents for archive and analysis	2	Urban, suburban/ rural	3	3	3	1	3	3
Body cameras with live feed capability for school security/ police officers	2	Urban	3	3	3	3	3	3
Cameras in school hot spots	1	Urban	3	3	2	3	3	3
Certification program for educators on school safety	3	Urban, suburban/ rural	1	1	3	3	3	3
Clearinghouse of information about funding available to purchase school safety products	1	Urban	3	3	3	3	3	3
Conversion of voice tips into text for easier triage and tracking on tip lines	3	Urban, suburban/ rural	3	3	1	3	3	2

Table D.1—Continued

Combined Technology Improvement	Identified In		Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	No. of Groups	Panel	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Electronic fence around school to shut down student use of social media and texting	3	Urban, suburban/ rural	3	3	3	3	3	3
Metric to characterize and quantify school safety issues	1	Urban	3	3	3	3	3	3
Device that detects gunpowder/bomb making materials	1	Urban	3	3	3	3	3	3
Direct two-way communication between teachers and law enforcement	4	Urban, suburban/ rural	1	1	3	3	1	1
Drone surveillance of school grounds or at school events	2	Urban, suburban/ rural	3	3	3	3	3	3
Early warning student tracking systems	4	Urban, suburban/ rural	1	3	3	3	1	3
Easier and more effective scanning and retrieval of electronic archived information	2	Urban, suburban/ rural	3	3	3	3	3	3
Easier-to-use ID technology	1	Urban	3	3	3	3	3	3
Easier, faster identification of IP address of social media user	1	Urban	3	3	3	3	3	3
Educational materials (e.g., TED talks) for parents about safety and healthy child development	2	Urban, suburban/ rural	3	3	1	3	3	3
Emergency alert “keyboards” in classrooms that provide details of incident to all classrooms/offices in a school	1	Urban	3	3	3	3	3	3

Table D.1—Continued

Combined Technology Improvement	Identified In		Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	No. of Groups	Panel	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Enhance visitor management system to include a banned visitor list (sex offenders, parental custody)	1	Suburban/rural	3	3	3	3	3	3
Enhanced technology to support regular conference calls to maintain district preparedness	1	Urban	3	3	1	3	3	3
Enhanced, technologically savvy marketing (e.g., QR codes on posters, social media)	2	Urban, suburban/ rural	3	3	1	2	3	3
Expanded emergency alert system to notify all facilities in area that serve children	1	Suburban/rural	3	3	3	3	3	3
Gunshot monitors within schools that provide incident details to centralized monitor	2	Urban, suburban/ rural	3	3	3	3	3	3
Identification technology to monitor entrances and exits into school buildings/campuses, including position tracking	3	Urban, suburban/ rural	2	2	3	2	1	2
Improved social media monitoring analytics (across all major social media sites)	3	Urban, suburban/ rural	2	1	1	3	2	3
Incorporation of facial recognition into student ID cards	2	Urban	3	3	3	3	3	3
Incorporation of GIS with mobile communication system	1	Urban	3	3	3	3	3	3
Incorporation of school climate/violence into school ratings	1	Suburban/rural	3	3	3	3	3	3

Table D.1—Continued

Combined Technology Improvement	Identified In		Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	No. of Groups	Panel	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Independent rating system for school safety products (e.g., federal or consumer reports)	2	Suburban/rural	3	3	3	3	3	3
Integration of information on school threats (e.g., from tip lines) to support analytics at district, regional, or state level	4	Urban, suburban/ rural	1	1	3	1	2	3
Interactive code-of-conduct technology (software, simulations, video games, virtual reality)	1	Urban	3	3	2	3	3	3
Interactive, accessible dashboard for all safety-related data (e.g., Safety Cloud)	1	Urban	2	3	3	3	1	3
Interface for stakeholders (parents, community) to provide feedback on school safety issues	2	Urban, suburban/ rural	3	3	1	3	3	3
Internet-crimes technology adapted to school setting	1	Suburban/rural	3	3	3	3	3	3
Layered and integrated mapping of school grounds (with video feeds, etc.)	1	Suburban/rural	3	1	3	3	3	3
Less-obtrusive metal detectors	1	Suburban/rural	3	3	3	3	3	3
Less-than-lethal technology for school staff with longer range and requiring less training than TASERs	2	Urban, suburban/ rural	3	3	3	3	3	3
Management tool for school leaders to track educators' professional development	1	Suburban/rural	3	3	3	3	3	3

Table D.1—Continued

Combined Technology Improvement	Identified In		Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	No. of Groups	Panel	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Marketing of technology and incentivization of people to provide helpful tips to a tip line	2	Urban, suburban/ rural	3	3	3	3	3	3
Mechanism to lock every room at once	1	Urban	3	3	3	3	3	3
Multimodal tip line that centralizes and compiles tips from various sources and of various forms (video, text, images)	2	Urban, suburban/ rural	1	3	1	3	2	1
Online incentive system to create positive school environment	1	Suburban/rural	3	3	3	2	3	3
Online platform for communicating with parents (and parents with one another) about school safety	2	Urban, suburban/ rural	3	3	2	2	3	3
Public announcement (PA) system available to CCTV staff to intervene immediately	1	Suburban/rural	3	3	3	3	3	3
Peer-led tip line for less serious school safety threats	1	Suburban/rural	3	3	3	3	3	3
Platform for sharing customized school safety best-practices (local)	2	Urban, suburban/ rural	3	3	3	2	3	3
Platform for sharing school safety best-practices (regional and national)	1	Urban	1	3	3	3	3	3
Portable, cheaper video cameras for schools	2	Urban, suburban/ rural	3	3	3	3	1	3
Quick and efficient communication outside school hours	1	Urban	3	3	3	3	3	3

Table D.1—Continued

Combined Technology Improvement	Identified In		Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	No. of Groups	Panel	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Quick and efficient incident-level communication outside school (e.g., parents, community members)	1	Urban	1	3	3	3	1	3
Real-time picture/virtual representation of the school showing the location of all people	1	Urban	3	3	3	3	3	3
Real-time monitoring of tip lines	1	Urban	2	3	3	3	3	3
Retrofitting schools to have better cell reception in rural areas	1	Suburban/rural	3	3	3	3	3	3
Satellite imaging of school premises	1	Urban	3	3	3	3	3	3
Screens showing real-time videos to students of themselves	1	Suburban/rural	3	3	3	3	3	3
Social network tool to ensure that each student has a personal connection with at least one staff member	1	Suburban/rural	3	3	3	3	3	3
Software that matches school incident data to suggested evidence-based programs/responses	1	Urban	3	3	2	3	1	3
Software to build students prosocial characteristics	1	Urban	3	3	3	3	3	3
Software to educate teachers on how to recognize bullying	1	Suburban/rural	3	3	3	1	3	3
Software to improve fidelity to school safety protocols including accountability	1	Suburban/rural	3	2	3	3	3	3

Table D.1—Continued

Combined Technology Improvement	Identified In		Tier with Respect to the Most Severe Forms of School Violence		Tier with Respect to the Most Frequent Forms of School Violence		Tier When Ranked Across All Identified Needs	
	No. of Groups	Panel	Urban	Suburban/ Rural	Urban	Suburban/ Rural	Urban	Suburban/ Rural
Software to integrate information on community members with school records (e.g., sex offenders, custody, others known to federal agencies, and information about how to find out more information about them)	1	Urban	3	3	3	3	3	3
Software to manage and refresh parent/guardian contact information	1	Suburban/rural	3	3	3	3	3	3
Multifunctional student ID cards (e.g., keys for campus, school lunches, boarding buses)	3	Urban, suburban/ rural	2	3	3	3	3	3
Student referral management system	3	Urban, suburban/ rural	3	3	3	3	3	3
Technology to monitor and alter students' classroom assignments to minimize conflicts between students	1	Urban	3	3	3	3	3	3
Training for educators about student profiling	1	Urban	3	3	3	3	3	3
Use of data from social media to predict violence	1	Urban	3	3	3	3	2	3
Video cameras in classrooms	1	Urban	3	3	3	3	3	3
Video-chat to connect peer-mentors to share best practices for addressing bullying and other forms of common violence	1	Urban	3	3	3	3	3	3
Virtual counselors for students	2	Urban	3	3	1	3	3	3
Virtual schools	2	Urban, suburban/ rural	3	3	3	3	3	3
Virtual training simulations for students and staff about school safety	2	Suburban/rural	3	3	3	1	3	3

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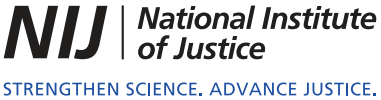
Violence in schools negatively affects children's future life outcomes and the culture and performance of the school. For these reasons, promoting school safety is a national priority for many federal agencies, including the National Institute of Justice. This report focuses on school safety technologies as one among many approaches to prevent and respond to school violence. In the report, the authors summarize existing research on school violence, categorize school safety technologies and describe the available research about them, present six case studies of innovative technologies as used in schools, summarize experts' views of technologies and safety problems based on interviews, and present experts' rankings of technology needs to improve school safety produced during two day-long panels. These activities revealed that some of the most pressing safety needs that technology could address relate to (1) enabling two-way communication between teachers and emergency responders; (2) "all-in-one" applications that would integrate currently fragmented and outdated school safety policies, procedures, and training for school staff and parents; (3) advances in social media monitoring; and (4) improved tip lines to make them more robust and effective. Results should be of interest to organizations and individuals involved with K–12 school technology planning, research funding, and product development.



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ISBN-10 0-8330-9474-2
ISBN-13 978-0-8330-9474-2

RR-1488-NIJ