WHITE PAPER | SMART SENSORS FOR SAFER SCHOOL RESTROOMS

Detecting Without Watching

A privacy-first approach to restroom vaping detection for K-12 school districts in the US and Canada

Overview

Vaping among teenagers has become a persistent operational and health concern for K-12 school districts across North America. The behaviour concentrates in student restrooms, the one school area where video surveillance is neither permitted nor appropriate. This paper examines the problem, sets out the constraints any restroom monitoring program must satisfy, and describes a privacy-first architecture that pairs a non-video environmental sensor inside the restroom with the district's existing camera and notification infrastructure. It also documents the technical requirements, deployment scenarios, and installation considerations observed during a district pilot, so that technical and administrative audiences can assess what a rollout involves.

The problem

Teenage vaping rates rose sharply after 2019 and remain elevated. In Canada, the Canadian Tobacco and Nicotine Survey (CTNS) 2022 reported that 30.0% of youth aged 15 to 19 had ever vaped and 13.6% had vaped in the previous 30 days. Comparable surveillance in the United States has tracked the same broad trend among high school students. The result is a shared challenge for districts in both countries: a widely used product that is easy to conceal, produces a vapor aerosol rather than persistent smoke, and is consumed primarily in unsupervised spaces.

Governments have responded with funding. The Province of Ontario committed $30 million over three years to help school boards purchase vape detectors and related security measures for student restrooms. In the United States, districts have funded detection through capital budgets, safety grants, and settlement funds. The demand is established; the open question is technical: how can a district detect and deter vaping in the one room that cannot be placed under camera surveillance?

Design constraints

Restrooms are protected spaces, and that protection holds without exception. Districts are simultaneously accountable for student safety and for the responsible use of public funds. A workable approach must incorporate three requirements:

- **Privacy.** No cameras and no audio recording inside the restroom.
- **Timely awareness.** Staff are notified while an event is in progress, in time to respond rather than to review after the fact.
- **Integration with existing systems.** Districts already operate surveillance and notification systems in hallways and common areas. A monitoring program should extend that investment rather than replace it.

These requirements are in tension. Detection devices that incorporated audio features drew regulatory attention in some jurisdictions, and Ontario called for clearer privacy guardrails after such devices appeared in school restrooms. The determining factor is therefore not only whether a district deploys detection, but how the device is selected and configured.

A privacy-first model: detect with a smart sensor, review with the hallway camera

This architecture separates detection and video into two functions handled by two devices. A non-video environmental sensor is installed inside the restroom. The cameras already mounted in the adjacent hallway remain in place and continue to observe a public corridor.

When the in-restroom sensor registers an event, it transmits a silent signal to the district's existing video management system over TCP. The management system associates the alert with the hallway camera covering the restroom entrance, allowing staff to review who entered and exited around the time of the event. Because the response is tied to an existing hallway camera, the restroom itself remains camera-free. Administrators can then choose how to act on the alert, whether by speaking with the student, contacting a parent or guardian, or directing broader anti-vaping education, which converts a passive record into an active deterrent.

How detection works

The sensor continuously measures airborne particulate matter and other air-quality indicators, and it evaluates those readings against configurable thresholds. Vaping aerosol raises the concentration of fine particulates (measured in micrograms per cubic meter), and the sensor uses particulate data (for example, PM10) as the data source for its vaping, THC, and masking events. Because detection is based on measured particulate load rather than a captured image or sound, the device produces an alert without recording anything that could identify an individual.

Each event type has an independent threshold, operator, and repeat-holdoff interval, so a district can tune sensitivity and suppress duplicate notifications for the same event. Masking (the use of a competing aerosol or scent to conceal vaping) is detected as its own event, as is physical tampering with or removal of the device.

How the layers work together:

Layer	Function
In-restroom sensor	Detects vaping, THC, masking, and tampering through air-quality monitoring. No camera and no image capture. Sends a silent alert only.
Hallway camera (VMS)	Existing surveillance in the public corridor provides entry and exit context when an alert occurs. No new restroom coverage is introduced.
Recording and search	The NVR tags sensor-triggered footage so staff search by event rather than scrubbing hours of recording. Configurable pre- and post-event buffers frame each alert.
Notification	Notification is delivered through CMS and can be configured to send alerts by email or text when an event is detected. Delivery can be restricted to defined recipients and hours.
Central oversight	A district-wide dashboard aggregates activity across schools, so safety teams can review patterns by location, day, and time from one console.

Technical architecture and requirements

The reference implementation integrates the smart sensor with i3 International's video management and cloud software. Once a sensor is configured, the NVR discovers it automatically and adds it as a smart sensor input, after which video channels and optional relay outputs can be linked to each sensor. The core components are:

- **NVR and video management (SRX-Pro).** An i3 NVR running SRX-Pro v7.3.2.229 software or higher, with Smart Sensor licenses enabled. Sensor communication uses TCP on a configurable port (20225 by default). An optional display license drives sensor-triggered channel display on a public-view monitor, and an optional UIO8v2 I/O device supports relay outputs such as a strobe or siren.

- **Recording configuration.** Linked channels are set to sensor-plus-motion recording, with pre-record and post-record buffers so that footage captures the seconds before and after each trigger.
- **Cloud alerting and reporting (CMS).** CMS Web (v6.7.2.0 or higher) and CMS Mobile (v3.8.2.0 or higher) deliver email and mobile alerts and a health-monitoring dashboard. Alert delivery can be scoped to specific recipients and to defined working hours, so notifications reach the right administrators without generating after-hours noise. Video thumbnails and in-app video review require an i3 video-streaming subscription or a local video-on-demand server; without either, alerts are delivered as plain text.
- **Cameras.** The hallway cameras need not be replaced. i3 NVRs support a range of third-party cameras, so a district with existing cameras can retain them and add only the NVR software, the sensors, and the required licenses and subscription.

Deployment scenarios

Two starting points are common, and the architecture accommodates both:

- **New to i3, existing cameras retained.** Districts with third-party cameras keep those cameras and add an i3 NVR (or replace the existing recording server), the sensors, licenses, and a CMS subscription. This lowers the entry cost and preserves prior camera investment.
- **Existing i3 environment.** Districts already subscribed to CMS and operating i3 NVRs update SRX-Pro to the required version, add Smart Sensor licenses, install the sensors, and link them to existing hallway channels. i3 ensures best compatible version of CMS is installed in the customer’s domain. This is the fastest path, because the video and notification layers are already in place.

Hosting is a further variable. A district that keeps its network segregated from the public internet can host the CMS server on its own infrastructure. A district willing to use i3's hosted services can avoid that infrastructure cost and manual updates. The choice depends on each district's security posture and budget.

Installation considerations

- **Mounting.** Sensors are ceiling-mounted, not wall-mounted, and secured with appropriate anchors. Although pendant or pole mounts exist for ceilings above nine feet, they are not appropriate for school restrooms: students can reach and swing on a suspended device, creating a liability and durability risk. Where ceilings are high, districts should evaluate alternative placement rather than a pole mount.
- **Placement.** Devices should sit away from air vents and exhausts, which can disperse aerosol and delay or mask detection.
- **Software update and licensing.** The NVR's SRX-Pro software must be current, and appropriate licenses must be purchased so that smart sensors are recognized and added to the setup as actively monitored devices.
- **Phased rollout.** Districts typically begin with the restrooms where the behaviour concentrates, review the resulting data, and expand on that evidence.

Program design: detection as the start of a response

Detection technology is most effective as the first step in a defined response rather than as an enforcement tool on its own. Districts reporting progress pair detection with education, cessation support, and communication with families. Detection establishes where and when an event occurred; the district's wellbeing strategy determines what follows. An alert routed to a counsellor-informed response influences behaviour more durably than one used only to assign consequences.

Districts also differ in how they introduce the program, and the architecture supports both approaches. Some announce the rollout to students and staff. Others deploy the sensors discreetly in a stealth configuration that produces no lights or sounds at the device and signals silently to the NVR; this approach is used where visible devices would invite vandalism, since a ceiling-mounted sensor is easy to identify and disable. In the pilot district, sensors were deployed in stealth mode for that reason. Either way, the alert is what enables a staff member to be present in the right place at the right time. Configuration reinforces the intent: alerts can be routed privately to a specific administrator and limited to the events that bear on student health and safety, keeping the deployment tightly scoped.

Beyond vaping: other configurable capabilities

Although this paper addresses vaping, the same sensor detects a broader set of events, and the same NVR and notification layers handle them. A district can enable only what is relevant and switch off the rest. Configurable event types include masking and other air-quality indicators, aggression, the sound of a gunshot, and spoken distress keywords. Because these are non-video and non-identifying in the same way as vaping detection, some districts extend sensor coverage beyond restrooms to hallways and stairwells. For districts working to protect students from a wider range of threats, including the possibility of weapons on campus, the same infrastructure can support that effort without adding cameras to sensitive spaces.

Conclusion

Although student privacy and student safety are often addressed separately, this design puts both at the forefront. A district that detects with a non-video sensor inside the restroom and reviews with existing hallway cameras can respond to vaping in near real time while keeping the protected space camera-free. Built on the video and notification systems a district already operates, and paired with the education and support that change behaviour, the approach addresses a persistent problem without introducing surveillance where it does not belong. i3 International continues to refine this integration with the districts deploying it.

Sources and notes

1. Youth vaping prevalence in Canada: 30.0% of youth aged 15 to 19 reported ever vaping and 13.6% reported vaping in the past 30 days. Canadian Tobacco and Nicotine Survey (CTNS) 2022, Statistics Canada and Health Canada: canada.ca/en/health-canada/services/canadian-tobacco-nicotine-survey/2022-summary.html.
2. $30 million over three years for school safety and vape detectors, announced in Ontario's spring 2024 budget. CBC News: cbc.ca/news/canada/toronto/ontario-vape-detectors-funds-1.7158396. Global News: globalnews.ca/news/10389832.
3. Provincial call for privacy guardrails around restroom detection devices. Global News (2024): globalnews.ca/news/10462178.
4. Technical requirements (SRX-Pro v7.3.2.229+, Smart Sensor licenses, CMS Web v6.7.2.0+, CMS Mobile v3.8.2.0+, TCP port 20225, particulate-based detection, stealth configuration, and mounting guidance) reflect i3 International's HALO 3C integration and training documentation. Deployment observations reflect current pilot work and are descriptive, not guaranteed outcomes.