Criminal Justice Testing and Evaluation Consortium
A Program of the National Institute of Justice

Contraband Detection Technology

in Correctional Facilities

An overview of technologies for screening people, vehicles, and correctional settings

This technology brief is part of a series of documents that focus on contraband in corrections. This first brief provides an overview of the types of contraband and associated technologies and products used to detect contraband on people, in vehicles, and in the environment. The goal of this brief is to provide definitions of common technological terms, highlight challenges of contraband detection, compare contraband detection technologies, and discuss the future of contraband detection. The other supporting documents focus in greater depth on managing specific contraband, including drugs, weapons, and cell phones, as well as specific detection strategies related to mail and drones.

Key Takeaways

- Contraband detection technologies can generally be classified as either scanning for contraband that is (1) person borne, (2) vehicle borne, or (3) within an environment or space.
- Person-borne handheld detectors are low cost, portable, and effective but take more time to scan. Walk-through devices speed up scanning but are more expensive. Less expensive options are very limited in the types of contraband that can be detected, while more expensive options can detect more types of contraband but may have higher radiation exposure.
- Vehicle-borne handheld detectors are less expensive than drive-through detectors but have limited range and require more scanning time. Like person-borne options, less expensive options are limited in the types of contraband that can be detected.
- Environmental detection technologies are used to identify contraband hidden in walls, furniture, mail, and packages. These handheld/portable and fixed devices vary widely on their range, cost, and ability to detect various types of contraband.

In April 2017, Johns Hopkins University (JHU) published a National Institute of Justice (NIJ)-funded report that provided significant in-depth detail on contraband detection. The JHU report, *A Market Survey on Contraband Detection Technologies*, provided detailed specifications for 103 available products and devices from 34 vendors. This brief leverages JHU's categorization of detection technologies and summarizes the distinctive differences in applications and costs, while also offering updated insights on technologies and products. Although this report draws heavily from the 2017 report, it provides the reader more recent literature surrounding contraband in correctional facilities and discusses future needs for contraband detection technologies in facilities across the United States.

Resources for Considering Contraband Detection Solutions for Correctional Facilities

This document explores contraband detection technologies. Additional documents in this series address specific contraband topics.

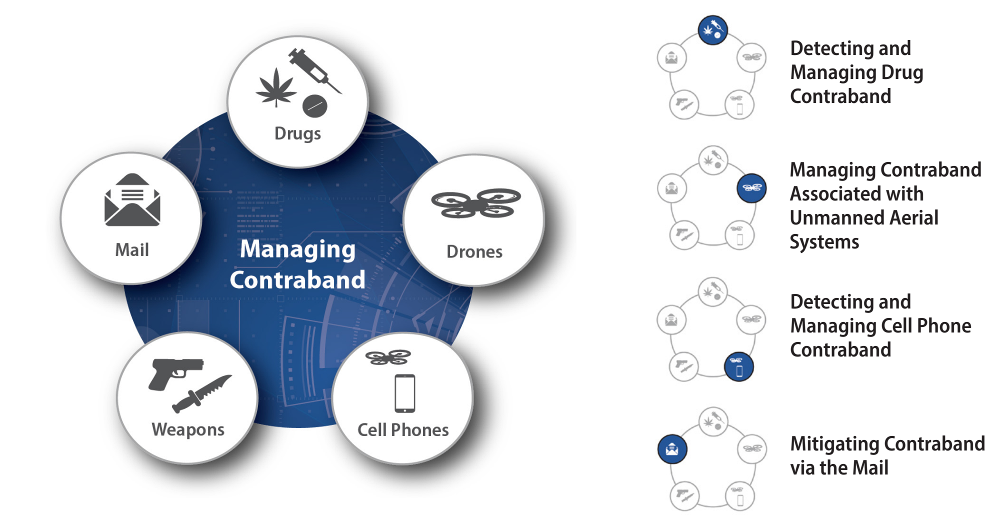


Figure 1: Contraband detection must consider methods of entry, types of contraband, and other associated factors. Briefs in this series highlight technologies used and their associated trade-offs related to performance, price, and operational issues.

What is Contraband?

Contraband refers to items that inmates are prohibited from having in their possession, including weapons, explosives or combustibles, drugs, money, electronics, tattoo instruments, and food, alcohol, or tobacco products.[1] A person is guilty of promoting prison contraband when they unlawfully introduce any contraband into a detention facility or, if a person confined in a detention facility knowingly and unlawfully makes, obtains, or possesses any contraband.[1,2] Individual facilities typically provide inmates with an extensive list of prohibited items; however, rules may also cover situations in which an allowable item becomes contraband when it has been stolen or altered in a manner that poses a risk or threat to individuals.[1]

The prevalence of contraband in correctional facilities is not a trivial concern. For example, the California Department of Corrections and Rehabilitation reported confiscating 592 ounces of heroin and 1,200 ounces of marijuana among other illicit drugs in 2019. Additionally, prison officials seized over 12,000 cell phones.[3] In 2018, nearly 1,000 inmates overdosed in California prisons.[4]

Correctional administrators weigh risks associated with contraband when determining where to prioritize their detection efforts. For instance, food items or items used as currency generally receive lower priority than weapons or drugs,[1] which pose a readily apparent threat, and cell phones are also a major liability. The Federal Communications Commission commissioner Ajit Pai stated, "In the hands of an inmate, a cellphone is a weapon."[5] Inmates have used cell phones to coordinate escapes, intimidate individuals outside the facility, manage gang activity, compromise prison officials, and create security breaches.[1, 6, 7]

Entry Points

Contraband can enter a correctional facility through internal manufacturing or smuggling, as illustrated in **Figure 2**.[1] Internal manufacturing includes crafting homemade weapons, such as "shivs" and "shanks," from objects, such as toothbrushes, dining utensils, and meat bones from meals.[1] Alcohol can be produced within a facility from food items, such as fruit and bread. In other cases, items such as stamps, poppy seeds, and ramen noodles can be used as a bartering currency. Although it is often underestimated, food in larger quantities becomes currency that can promote illegal activities and undermine safety.[8]

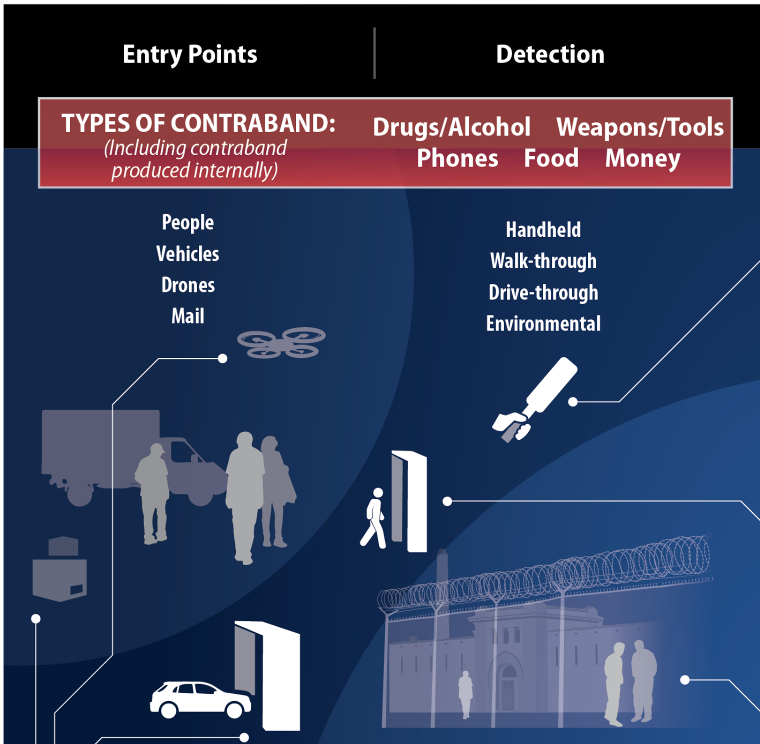
The other avenue of contraband entry is smuggling. Smuggling occurs when inmates (either new admissions or those who have access to the community via work details, hospital, court, or other means) or outside visitors (including family members, friends, and volunteers) bring items unlawfully into the facility. These items can be smuggled by people, placed inside other objects, hidden in the environment during visits, or sent and concealed in the mail. With the expansion of technology, drones have become a tool for smuggling packages over correctional walls. For example, correctional facilities in Georgia identified 138 drone sightings.[9]

Correctional officers and staff can also engage in smuggling activities on behalf of those who are incarcerated. Items such as narcotics and electronic devices can be exchanged for money or other bribes.[1] The most significant problems with corrupt staff are the reduction in morale, security inefficiencies, and their ability to circumvent detection devices. Typically, correctional staff are not searched for contraband.[10]

In 2018, in 12 separate county jails, 20 staff members were arrested, indicted, or convicted on charges of bringing in or planning to bring in contraband.[11] In 2019, eight former South Carolina correctional officers and prison employees pleaded guilty in federal court to accepting bribes to smuggle cell phones, drugs, tobacco, and jewelry.[12] Prison-specific policies help address employee-involved corruption; additionally, an increase in randomized staff searching can help address these concerns.[11]

1. Koslover, R., Hung, V., Babin, S., & Mills, A. (2017). *A market survey on contraband detection technologies* (No. 250685). DOJ Office of Justice Programs, National Institute of Justice; National Criminal Justice Technology Research, Test & Evaluation Center. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/250685.pdf
2. New York Consolidated Laws, Penal Code, Article 205, Section 205.25. Retrieved from https://www.nysenate.gov/legislation/laws/PEN/205.25
3. Stanton, S. (2020). She flew from Hawaii to Sacramento to smuggle heroin into prisons for boyfriend, feds say. *The Sacramento Bee*. Retrieved from https://www.sacbee.com/news/local/crime/article239992613.html
4. Cassidy, M. (2019). Overdoses in California prisons up 113% in three years - nearly 1,000 incidents in 2018. *San Francisco Chronicle*. Retrieved from https://www.sfchronicle.com/crime/article/Overdoses-in-California-prisons-up-113-in-three-13819811.php
5. Wiltz, T. (2016, June 07). States bedeviled by contraband cellphones in prisons. Retrieved from https://www.pbs.org/newshour/nation/states-bedeviled-by-contraband-cellphones-in-prisons
6. Grommon, E. (2018). Managed access technology to combat contraband cell phones in prison: Findings from a process evaluation. *Evaluation and Program Planning, 66*, 39–47.
7. Williams, A. (2014). *Cell phone contraband in Georgia prison: How dangerous is it?* (Unpublished doctoral dissertation). University of Phoenix, Phoenix, AZ.
8. Gibson-Light, M. (2018). Ramen politics: Informal money and logics of resistance in the contemporary American prison. *Qualitative Sociology, 41, 199–220*.
9. Russo, J., Woods, D., Shaffer, J. S., & Jackson, B. A. (2019). Countering threats to correctional institution security: Identifying innovation needs to address current and emerging concerns. *RAND Corporation*. https://doi.org/10.7249/RR2933
10. Mann, M. (2017, August 30). 5 key areas to inspect for contraband. *Corrections1*. Retrieved from https://www.corrections1.com/products/facility-products/body-scanners/articles/5-key-areas-to-inspect-for-contraband-6puuk1clLqtmWWbU/
11. Renaud, J. (2018, December 6). Who's really bringing contraband into jails? Our 2018 survey confirms it's staff, not visitors. *Prison Policy Initiative*. Retrieved from https://www.prisonpolicy.org/blog/2018/12/06/jail-contraband/
12. United States Department of Justice. (2019). *Eight former SCDC employees plead guilty to federal crimes associated with accepting bribes to smuggle contraband into SCDC facilities*. Retrieved from https://www.justice.gov/usao-sc/pr/eight-former-scdc-employees-plead-guilty-federal-crimes-associated-accepting-bribes

Detecting Contraband Through Various Entry Points



Handheld products for scanning individuals, vehicles, and environments use numerous technologies that range from high-cost ion scan technology to low-cost nonlinear junction detection. These products can scan for a variety of contraband; are portable, convenient, and cost-effective; yet they may take time to scan an individual thoroughly. A number of companies such as Garrett, REI, and CSECO offer products in this category.

Walk-through detectors use a number of scanning technologies including transmission X-ray, backscatter X-ray, digitalized X-ray, metal detection, continuous wave, millimeter wave (MMW), and thermal imaging. These systems can screen more individuals in less time than handheld devices and can be used to screen for contraband produced within a facility. Companies such as Adani and CEIA offer products for walk-through applications.

Environmental detection technologies are used to manage contraband hidden in walls, furniture, mail, and packages. Technology unique to environmental detection includes Raman spectroscopy, electromagnetic detection, and RADAR. Companies such as Adams Electronics and Metrasens offer environmental detection products for correctional facilities.

Drive-through detectors can be mobile or fixed systems, and the type and size of the vehicles they are capable of screening vary depending on the technology and items to be detected. X-ray technologies are common in vehicle-borne detection due to their high reliability and low cost. Drive-through X-ray devices work the same way as walk-through systems but on a much larger scale by detecting inorganic/metal materials, mixed materials, and organic materials. Newer products offer color coding to assist personnel with identification of varied contraband. Companies such as Leidos and Rapiscan Systems (a division of OSI Systems) offer drive-through detection products that allow passengers to remain in the vehicle.

Drones are used to drop contraband into corrections properties. Technologies for detecting drones are emerging rapidly that rely on multiple detection methods, such as radiofrequency detection, cameras, and RADAR. Some technologies for drone detection are also expanding to detect both the device and the pilot, who may be a mile or more away from the facility. Companies such as Dedrone and AeroDefense offer solutions.

Mail and package screeners use spectroscopy while invoking other technologies such as X-ray methods and metal detection. These devices are most adept at finding narcotics, explosives, and metallic weapons. Companies such as CEIA and ChemImage offer scanning solutions in this category.

The companies used to illustrate the ways contraband is detected are from the JHU report and other market research. Neither DOJ, NIJ, nor CJTEC does not endorse or advocate for any of these products.

Figure 2: Contraband can enter a correctional facility via smuggling or can be manufactured inside the facility; thus, multiple methods and technologies are needed for associated detection needs.

Considerations for Implementing Contraband Detection Technology

Many challenges in detecting contraband and implementing detection technology exist within a correctional facility. Each correctional facility is unique, and differences among facilities require different technologies, policies, and practices. The way in which contraband enters a facility, for example, via throw-overs or hidden in body cavities, food, mail, and clothing requires a wide range of tools for detection. Traditional techniques such as pat-downs or strip searches offer limited success. There is no universal system or technology that can detect all contraband. Thus, detection strategies tend to focus on the type of contraband or the method of entry.

Successful implementation of contraband detection technology must consider three common challenges: operational achievability to consider how technology adoption may work for each individual facility; policies and legislative constraints, which attempt to balance security and privacy; and health and safety standards, which ensure individuals are not exposed to high levels of radiation. Key questions for each consideration are presented in **Figure 3** and can serve as a foundation for criminal justice leaders and decision makers as they evaluate potential impacts of detection technologies.

Key Considerations for the Successful Use of Detection Solutions

Challenges	Key Questions to Consider
Operational Achievability	☐ What type of contraband is each device capable of detecting and how effective is each type (e.g., accuracy, reliability, false positive and negative readings)? ☐ What is the budget for each facility? ☐ How much training is involved to use the device? ☐ What is the detection range of the device? ☐ What are the costs associated with purchasing or leasing, and maintaining the device? ☐ How versatile is the device to fit facility constraints (e.g., space, power)?
Restrictive Policies and Legislative Constraints	☐ Are privacy rights protected with the use of this technology? ☐ What are the legal liabilities with using this device (e.g., restrictions on nonmedical use of radiation-emitting devices)? ☐ Have the manufacturers thought about ways to satisfy the device's purpose while maximizing the test subjects' privacy? ☐ Is there risk of malicious use of the device?
Health and Safety Protections	☐ Are there health risks associated with the device, and, if so, what mitigation strategies can reduce the risks? ☐ How much radiation does this device emit? How is an individual's history of exposure recorded? ☐ Does the device comply with national radiation standards?

Figure 3: Successful implementation of contraband detection technology must consider operational achievability, restrictive policies and legislation, and health and safety protections.

Technological advancements, novel applications of technology from other settings to correctional facilities, and the development of new strategies for smuggling and manufacturing contraband drive forward the development of contraband detection products; however, implementation challenges still exist.

Operational Achievability

Technology can offer several solutions and approaches to contraband detection. Ideally, technology is affordable, effective, and accessible. Contraband detection technologies vary in cost and in the time and training required for staff members to become proficient and operate these products. Although many handheld detectors can be relatively low cost (~$100 to $500), walk-through (~$5,000 to $100,000) and drive-through detectors (~$100,000) are more expensive. Sophisticated systems can cost on the order of $250,000 or more (e.g., those that use millimeter wave, backscatter or transmission X-ray technology). Certain technologies can also present compatibility issues for existing corrections communication infrastructure. For example, signal jamming—a defeat technique that interferes with authorized wireless communication and stops the use of all cell phones and other devices such as radios—can compromise corrections staff devices and cause communication issues. Other barriers to implementing technology-based detection solutions include installation limitations associated with the facility; costs and complexities, including electricity and maintenance; staffing implications resulting from additional time for scanning; and specific technology and product knowledge required for operation. For each application, subject matter experts—including those involved in security management in federal prisons—have helped to indicate the "real-world efficacy" of current products, as well as the level of adoption in corrections facilities.

Policies and Legislative Constraints

Policies pertaining to technology and the privacy rights of individuals also play a role in the use of certain strategies. For example, although signal jamming may be one way of preventing the use of unauthorized cell phones in facilities, it is illegal in non-federal correctional facilities as outlined in the Communications Act of 1934.[13, 14]

As illustrated in **Figure 4**, safety concerns need to be balanced with the operational needs of each facility. The current policy for the Federal Bureau of Prisons (BOP) applies a "reasonable assurance standard" to screening staff.[15] Some technology is controversial because it provides anatomically accurate images. For example, in 2012 the Transportation Security Administration removed backscatter X-ray systems from U.S. airports because of such concerns.[16] As correctional facilities evaluate contraband detection technologies, leaders and executives must balance the security and the privacy rights of individuals.

"Reasonable Assurance" Required

"In every search situation, BOP screening staff must be reasonably assured that persons entering secure confines do not possess prohibited objects. 'Reasonably assured' does not mean 'absolutely certain.' Rather, it is a decision-making standard that realistically balances the need to preserve institution safety and security with the need to allow persons to enter secure confines as quickly as possible to perform their duties."

Source: BOP Program Statement 3740.01

Figure 4: The Bureau of Prisons (BOP) Program statement regarding "reasonable assurance" highlights the tension between legal realities, keeping contraband out of a facility, and scanning staff in a timely and appropriate manner.

Health and Safety Protections

Health concerns related to screening devices are another challenge that corrections executives must consider when adopting detection technologies. Some devices emit radiation, and exposure to high levels of radiation over time can result in long-term adverse health effects. The American National Standards Institute and the Health Physics Society have established a set standard for radiation safety that provides guidance on the maximum number of screenings per year for a given individual:[17] "The safety standard limits the dose per screening to 0.25 microsieverts (µSv), or 25 µrem for general use full-body security screening systems. The annual dose limit is 250 µSv (25,000 µrem) over a 12-month period. To exceed this annual limit, an individual would have to be screened more than 1,000 times in one year."[17] If an issue arises, the question of who assumes the risk and upon whom liability falls is complicated. Similarly, staff operating scanners may be exposed at unsafe levels. Manufacturers could be liable if the screening devices are putting individuals at risk of adverse health effects. In the same vein, correctional facilities that deploy these devices could also be liable.

13. H.R. 1954 — 116th Congress: Cellphone Jamming Reform Act of 2019. www.GovTrack.us. 2019. Retrieved from https://www.govtrack.us/congress/bills/116/hr1954
14. The Cell Phone Jamming Reform Act would allow state governments to block cell phone signals in state prisons. The bill was introduced in 2019. See https://www.govtrack.us/congress/bills/116/hr1954.
15. Office of the Inspector General. (2016, January 1). *Review of the Federal Bureau of Prisons' contraband interdiction efforts*. U.S. Department of Justice, Evaluation and Inspections Division. Retrieved from https://permanent.access.gpo.gov/gpo69858/e1605.pdf
16. Sinclair, S., & Herzog, R. (2017). *A review of full body scanners: An alternative to strip searches of incarcerated individuals – 2017 Report to the Legislature*. Department of Corrections Washington State. Retrieved from https://app.leg.wa.gov/ReportsToTheLegislature/Home/GetPDF?fileName=Body%20Scanners%20Report%202017%20%28002%29_9de3196e-0867-4f78-97ae-343f923e1c45.pdf
17. U.S. Food and Drug Administration. (2018, March 9). *Products for the security screening of people*. Retrieved from https://www.fda.gov/radiation-emitting-products/security-systems/products-security-screening-people

Technologies for Contraband Detection

This section provides an explanation of technologies discussed in this report.

- **Backscatter X-Ray System**—Backscatter X-ray systems are one of two digital X-ray systems commonly found in correctional facilities. Unlike transmission X-ray systems, backscatter X-ray systems scatter off the individual before traveling back to their source. Although backscatter X-ray devices can detect both metallic and nonmetallic items, as well as items under clothing, they cannot detect items hidden in body cavities. A backscatter X-ray system may pick up on narcotics in pill form hidden on a person, but a transmission X-ray system would pick up on loose powder without a capsule.[18] Another major challenge of detecting contraband using backscatter is that some devices cannot detect the differences between organic materials such as explosives and narcotics and can only identify that they are present. Although backscatter X-rays have their disadvantages, they do emit less radiation than transmission X-ray. Backscatter X-ray devices detect narcotics, explosives, metallics, and nonmetallics on a person, in a vehicle, or in the environment through handheld, walk-through, drive-through, and stationary devices.

- **Camera Systems**—Camera systems or security systems are used to observe vehicles that are coming in and out of the facility. Although using camera systems may be quicker than manual visual checks of vehicles, such systems cannot see through walls or compartments. This is one major detection challenge and is the reason that camera systems often supplement visual checks or other detection devices. Camera systems can detect cellular devices, narcotics, explosives, metallics, and nonmetallics (if they are visible) in a vehicle.

- **Continuous Wave Technology or Continuous Wave Beacon**—Continuous wave solutions emit continuous waves from a transmitter, which are then reflected back to a receiver to identify cellular devices and metallics. One stationary method of this technology uses software installed on cell phones and beacons placed in correctional facilities where cell phones are prohibited. When the beacons emit a signal, the software reacts, shutting down a cell phone's functionality.[19] Instead of signal jamming, this method only prevents communication from unauthorized cell phone devices. Although the software is compatible with cellular updates and upgrades, some wireless companies are opposed to software installation, citing civil liberties and privacy concerns. Because continuous wave requires software installation, this technology can be limited for unauthorized devices without the software.[20] Continuous wave devices detect cellular devices and metallics on a person, within a body cavity, or in the environment through handheld, walk-through, and stationary devices.

- **Density Measurements**—Density measurement systems emit low gamma radiation. These rays bounce off objects back to the device to conduct the scan. The higher the density of an object, the higher the level of gamma rays will be when reflected to the device.[21] Density measurement systems can detect narcotics and explosives in a vehicle through handheld and drive-through detectors.

- **Electromagnetic Detection**—Electromagnetic detection or electromagnetic-profile detection devices scan a piece of mail or package upon insertion and read the electromagnetic waves emitted to identify the type of contraband. Electromagnetic devices detect narcotics, explosives, and nonmetallics in the environment through stationary systems.[22]

18. Huffman, C., & Eric, L. (2014). *Body cavity screening for criminal justice: Market survey (version 1.1)* (No. 246710). DOJ Office of Justice Programs, National Institute of Justice; Sensor, Surveillance, and Biometric Technologies Center of Excellence. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/246710.pdf

19. Grommon, E. (2018). Managed access technology to combat contraband cell phones in prison: Findings from a process evaluation. *Evaluation and Program Planning*, 66, 39–47. Retrieved from https://pubmed.ncbi.nlm.nih.gov/29024835/

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21. CSESCO. (2020, May 25). *How a density meter works*. Retrieved from https://cseco.com/how-does-a-density-meter-work/

22. Koslover, R., Hung, V., Babin, S., & Mills, A. (2017). *A market survey on contraband detection technologies* (No. 250685). DOJ Office of Justice Programs, National Institute of Justice; National Criminal Justice Technology Research, Test & Evaluation Center. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/250685.pdf

- **Ferromagnetic Detection (FMD)**—FMDs are a type of metal detection device that can be used to uncover the internal components of a cell phone containing ferromagnetic materials.[23] Ferromagnetic materials contain elements that exhibit strong magnetic properties. Examples of common ferromagnetic elements built into electronics today include iron, nickel, and cobalt. One advantage of FMDs is their ability to locate a cellular device even if the device has been turned off or the battery has been removed. FMDs can detect cellular devices and metallics on a person, in a body cavity, in a vehicle, or in the environment through handheld, walk-through, and other stationary devices.

- **Ion Scanning**—Ion scanning devices (aka Ion Mobility Spectrometry or IMS) measure the deflection of trace particles after they are exposed to an electric field. The speed at which the particles move helps to determine the substance of origin. The devices are used to detect drugs and explosives.[24, 25] More specifically, ion scanning technology detects the ion profile of an air sample, typically a cloth collection pad that has been contacted to a substrate of interest, such as clothing, packages, or area of the body.[26] However, without a trained operator ion scanning technology is known to discover "false positives." This technology detects narcotics and explosives on a person, in a vehicle, in the environment, or in the mail through handheld, bench-top, or walk-through devices (which are not common in correctional facilities).

- **Metal Detection**—Metal detection technology detects metallic contraband, such as weapons and coins, by transmitting electromagnetic energy and waiting for the metal to respond to the energy.[27] Metals, such as ferrous metals, produce stronger signals than other metals. Because of the higher iron content, ferrous metals are more magnetic. Detectors can easily detect ferrous metals like iron and lead. However, metals like stainless steel are more difficult to detect because of their poor conductivity and low ferrous metal content. There are numerous types of metal detection technology; however, very low frequency (VLF) and multi-frequency systems are the most common metal detection technologies in correctional facilities.[28]

- **Millimeter Wave**—Millimeter wave technology uses electromagnetic waves to detect objects beneath clothing. The waves pass through the clothing and bounce off the skin before returning to the source. Like backscatter X-ray systems, millimeter wave technology cannot identify contraband hidden in body cavities.[29] Two types of millimeter wave security screening systems are available: active and passive systems. Active systems expose the person to small amounts of energy, whereas passive systems sense the waves emitted from an individual's body.[30] These devices can detect both metallic and nonmetallic items.

- **Multi-frequency Systems**—Multi-frequency systems are a type of metal detection technology commonly found in correctional facilities. These systems are constructed in a similar way to VLF systems. However, the main difference between the two is the frequencies transmitted by each. Multi-frequency systems transmit rectangular waves instead of square waves with varying frequencies to create a magnetic field.[28] This technique differs from VLF systems, which consistently use lower frequency levels. Because of the multiple frequency levels, these systems are able to distinguish between metals, such as coins, more easily than other metal detection types.[28] Like VLF systems, multi-frequency systems can also detect metallic contraband, including cell phone components and drone components, on a person, in a body cavity, in a vehicle, in the mail, or in the environment through hand-held, walk-through, and other stationary devices.

23. Encyclopedia Britannica. (n.d.). *Ferromagnetism*. Retrieved from https://www.britannica.com/science/ferromagnetism
24. Koslover, R., Hung, V., Babin, S., & Mills, A. (2017). *A market survey on contraband detection technologies* (No. 250685). DOJ Office of Justice Programs, National Institute of Justice; National Criminal Justice Technology Research, Test & Evaluation Center. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/250685.pdf
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28. Candy, B. (n.d.). Metal detector basics and theory. *Minelab*. Retrieved from https://www.minelab.com/__files/f/11043/KBA_METAL_DETECTOR_BASICS_&_THEORY.pdf
29. Huffman, C., & Eric, L. (2014). *Body cavity screening for criminal justice: Market survey (version 1.1)* (No. 246710). DOJ Office of Justice Programs, National Institute of Justice; Sensor, Surveillance, and Biometric Technologies Center of Excellence. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/246710.pdf
30. U.S. Food and Drug Administration. (2018, March 9). *Products for security screening of people*. Retrieved from https://www.fda.gov/radiation-emitting-products/security-systems/products-security-screening-people

- **Nonlinear Junction Detection (NLJD)**—NLJD technology emits microwave radiofrequency signals. When the signals encounter semiconductor junctions from electronic components (e.g., diodes, transistors, circuit board connections), a harmonic signal returns to the receiver. By hearing the different harmonic signals and reading them on the device screen, the user can determine the presence of a cell phone or other electronic device.[31] NLJD can detect cellular devices on a person or in the environment through handheld devices.

- **RADAR**—Radio Detection and Ranging transmits a radio signal from an antenna and echoes off of objects in its path, revealing their location. RADAR is commonly used for drone and drone pilot detection because of the high range of detection. RADAR detects drone and drone pilots in the environment through handheld and stationary devices.[32]

- **Radiofrequency Detection (RFD)**—RFD devices are used to pick up radio wave frequencies emitted from telecommunication devices.[33] Measured in hertz (Hz), most cellular devices transmit frequencies through two bands of approximately 900 megahertz and 1.95 gigahertz. Advantages of RFD devices include their ability to locate drones and drone pilots. They can detect cellular devices and drones on a person, in a vehicle, or in the environment through handheld devices.

- **Raman Spectroscopy**—Raman spectroscopy devices use a 532-nanometer (nm) or 785-nm laser to identify white powders and clear liquids. A small portion of the light undergoes inelastic scatter; the return signal is received and read by a detector. Lasers at 1,064 nm can be used to identify items that may be dyed or pigmented.[34] Raman spectroscopy detects narcotics, explosives, and nonmetallics in the mail and in the environment through fixed devices.

- **Thermal Imaging**—Thermal imaging uses infrared, electromagnetic radiation with wavelengths longer than visible light to see the heat signatures of objects. Infrared light cannot be seen with the naked eye but can be sensed as heat.[35] This technology can discover contraband concealed under clothing that is warmer or cooler than the surface of the skin;[36] however, it cannot detect items hidden in body cavities. Also, thermal imaging technology cannot detect concealed contraband through wood, metal, and reinforced plastics. Thermal imaging detects narcotics, explosives, cell phones, and both metals and nonmetallics. It can be applied to detection on a person, in a vehicle, or in the environment through handheld, walk-through, drive-through, and stationary devices, depending on which type of contraband.

- **Transmission X-Ray System**—Transmission X-ray systems, which are often digital, emit X-rays that pass through an individual to create a transparent image.[37] Because of the higher level of transparency, transmission X-rays are capable of detecting more substances. These devices can detect cellular devices, narcotics, explosives, metallics, nonmetallics, and contraband on a person, within a body cavity, through body armor, in a vehicle, in the mail, or in the environment through handheld, walk-through, drive-through, and stationary detectors.

- **Very Low Frequency (VLF) Systems**—VLF systems are a type of metal detection technology commonly used in correctional facilities. VLF systems consist of two electrically balanced coils. When a metal is in close proximity to the coils, the two become unbalanced. The outer coil acts as a transmitter creating a magnetic field that is distorted once in contact with a metallic object.[38] The inner coil then acts as a receiver, reading the secondary magnetic field created by the conductive object. An audio tone is created by the magnetic field, and phase demodulators help distinguish different types of objects. VLF systems detect metallic contraband on a person, in a body cavity, in a vehicle, or in the environment through handheld, walk-through, and fixed devices.

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Contraband Detection Strategies

Contraband detection typically focuses on one of three needs: detecting contraband (1) on people, (2) in vehicles, or (3) in the environment. These types of platforms are referred to using the terminology from the JHU market analysis: person-borne, vehicle-borne, and environmental detection solutions. Person-borne detection solutions are capable of detecting contraband concealed either on a person or in a body cavity. Vehicle-borne detection solutions are capable of detecting contraband transported and concealed in vehicles entering or leaving a correctional facility. Environmental detection solutions are capable of detecting contraband concealed in the correctional facility itself.[39] Detection technologies for the three platforms often overlap and are not mutually exclusive.

Scanning for Person-Borne Contraband

Person-borne technologies detect contraband hidden on a person, including contraband concealed on a human body, concealed under clothing, or hidden within a body cavity. Various scanning technologies are used to detect person-borne contraband. As illustrated in **Figure 5**, technologies include metal detection, RFD, thermal imaging, ion scanning, and X-ray systems. Some of these technologies are used in handheld or portable devices, others are used in stationary or walk-through devices, and some are used in multiple formats. When adopting detection technologies, executives must recognize the capabilities and associated trade-offs for each technology, including the type of contraband that can be detected (e.g., metallics and nonmetallics) and the penetrative abilities, particularly whether the technology can detect contraband within a body cavity or through body armor. Additional trade-offs for person-borne detection solutions include costs and level of radiation emitted.

The radiation exposure and costs of person-borne technologies can be categorized into three levels, allowing for a comparison of the trade-offs: Level 1 (no radiation/less than 1 µSv), Level 2 (1–5 µSv), and Level 3 (over 5 µSv). Although metal detection technologies can find contraband within body cavities, their use is limited to only metallic items. Transmission X-ray technology identifies the most contraband across categories and through body armor yet has the highest amount of radiation exposure. Detection technologies detecting the fewest types of contraband with the least exposure tend to have lower costs. X-ray systems and ion scanning, which are specialized to detect narcotics and explosives, have the highest cost and are commonly used. Other commonly used systems are thermal imagers for nonmetallics, including narcotics and explosives, as well as metal detectors for weapons.

Handheld detectors use various scanning technologies to screen individuals directly for any illicit goods.[39] Handheld detectors have many advantages, including portability, convenience, and cost-effectiveness; however, handheld detectors take more time to scan an individual, especially in high-traffic areas. Given some of their limitations, handheld detectors are often used in combination with walk-through detectors.

Walk-through detectors can be placed in the entrances of facilities to quickly screen volumes of individuals when entering and leaving the property. These detectors use various scanning technologies, including transmission X-ray, backscatter X-ray, metal detection, continuous wave, millimeter wave, and thermal imaging. As indicated in **Figure 5**, some can detect items hidden in body cavities. Although transmission X-rays and continuous wave systems can detect these items, backscatter X-rays, millimeter wave devices, and thermal imaging devices cannot.[39]

39. Koslover, R., Hung, V., Babin, S., & Mills, A. (2017). *A market survey on contraband detection technologies* (No. 250685). DOJ Office of Justice Programs, National Institute of Justice; National Criminal Justice Technology Research, Test & Evaluation Center. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/250685.pdf

Person-Borne Contraband Detection Technologies: Cost, Radiation, and Detection Capabilities

Type of Technology	Cost* and Radiation Exposure		Primary Types of Contraband Detected					Penetration Abilities		
	Handheld	Walk-through/ Stationary	Cellular Devices	Narcotics	Explosives	Metallics *weapons, coins*	Nonmetallics *wood, paper, ceramic, plastic, powders, liquids*	On a Person	Within a Body Cavity	Through Body Armor
Backscatter X-Ray	$$$	$$$$		✓	✓	✓	✓	✓		
Continuous Wave	$	$-$$	✓			✓		✓	✓	
Ferromagnetic Detection	$	$	✓			✓		✓	✓	
Ion Scanning	$$$	$$$-$$$$		✓	✓			✓		
Millimeter Wave	$-$$	$$$$	✓			✓	✓	✓		
Multi-Frequency Metal Detection	$	$-$$	✓			✓		✓	✓	
Radiofrequency Detection	$-$$	N/A	✓					✓		
Thermal Imaging	$$$	$$$$	✓	✓	✓	✓	✓			
Transmission X-Ray	$$$	$$$$	✓	✓	✓	✓	✓	✓	✓	✓
Very Low Frequency Metal Detection	$	$-$$				✓		✓	✓	

** Cost figures are estimated and only include the initial upfront cost, and do not include associated costs such as upgrades, maintenance, training, etc.*

$	Under $10K
$$	$10K-$25K
$$$	$25K-$100K
$$$$	$100K+

Radiation Exposure

- **Level 1** < 1 µSv
- **Level 2** 1- 5 µSv
- **Level 3** > 5 µSv

Figure 5: Numerous technologies and associated products are aimed at detecting contraband smuggled by people, including visitors, inmates, and staff.

Scanning for Vehicle-Borne Contraband

Vehicle-borne systems detect contraband hidden inside and outside vehicles entering or leaving correctional premises. These systems augment capabilities by adding in solutions that use technologies such as density measurement and cameras. Vehicle-borne detection technologies are typically accompanied by visual searches that are informed by internal and external vehicle scanning. Vehicle-borne technologies have their own trade-offs, including cost and range (e.g., the extent to which the technology inspects internal attributes as well as external). Key characteristics of different vehicle-borne technology solutions, including the types of contraband that can be detected, are summarized in **Figure 6**.

Handheld devices are often used for screening specific parts of the vehicle, such as gas tanks and tires, and are typically used in combination with drive-through devices. Many handheld devices used for person-borne detection (**Figure 5**) can also be used in vehicle detection, such as ion scanning technology and metal detection.[40] Drive-through detectors are typically fixed systems but can also be mobile.[41] The type and size of the vehicles they are capable of screening vary.[42] Fixed drive-through detection systems can be integrated into the existing architecture of a facility.

X-ray technologies are common in vehicle-borne detection because of their high reliability and range. Drive-through X-ray devices work the same way as walk-through systems but on a much larger scale. X-ray technology is used to detect inorganic/metal materials, mixed materials, and organic materials. Although older products only detected the presence or absence of these substances, newer products offer color-coded images to assist personnel with efficient identification.[43] X-ray technology also allows passengers to remain in the vehicle, which increases efficiency.

40. Rapiscan's Mini Z is an example of a handheld backscatter device that detects contraband in hard-to-reach places, including vehicles. (Product not endorsed by DOJ, NIJ, or CJTEC.) See https://www.rapiscan-ase.com/products/handheld-inspection/mini-z-screening-system.

41. Rapiscan's ZBV system is an example of a mobile cargo and vehicle screening system that is built into a standard delivery van employing backscatter technology to screen vehicles. (Product not endorsed by DOJ, NIJ, or CJTEC.) See https://www.rapiscan-ase.com/products/mobile/zbv-cargo-and-vehicle-screening.

42. Koslover, R., Hung, V., Babin, S., & Mills, A. (2017). *A market survey on contraband detection technologies* (No. 250685). DOJ Office of Justice Programs, National Institute of Justice; National Criminal Justice Technology Research, Test & Evaluation Center. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/250685.pdf

43. Leidos' VACIS XPL system is an example of a drive-through X-ray system that uses color coding to highlight contraband. (Product not endorsed by DOJ, NIJ, or CJTEC.) See https://www.leidos.com/products/vacis.

Vehicle-Borne Contraband Detection Technologies: Cost, Range, and Detection Capabilities

Type of Technology	Cost* and Range		Primary Type of Contraband Detected				
	Handheld	Drive-through	Cellular Devices	Narcotics	Explosives	Metallics *Weapons, coins*	Nonmetallics *Wood, paper, ceramic, plastic, powders, liquids*
Backscatter X-Ray	$$$	$$$$		✓	✓	✓	✓
Camera Systems	$-$$	$$$	✓	✓	✓	✓	✓
Density Measurement Systems	$-$$	N/A		✓	✓		
Ion Scanning	$$$	N/A		✓	✓		
Radiofrequency Detection	$-$$	N/A	✓				
Thermal Imaging	$$$	$$$$	✓	✓	✓	✓	✓
Transmission X-Ray	$$$	$$$$	✓	✓	✓	✓	✓

** Cost figures are estimated and only include the initial upfront cost, and do not include associated costs such as upgrades, maintenance, training, etc.*

$	Under $10K
$$	$10K-$25K
$$$	$25K-$100K
$$$$	$100K+

Range

Level 1
Inspection via external attributes

Level 2
Inspection via external and partial internal attributes

Level 3
Inspection via external and internal attributes

Figure 6: Numerous technologies enable the detection of hidden vehicle-borne contraband prior to entering or leaving a correctional facility.

Scanning for Contraband in Facilities

Environmental detection technologies are used to manage contraband hidden in the environment, including contraband in the immediate surroundings, walls, furniture, mail, and packages. Key characteristics of different types of environmental detection technology include the cost, range, and types of contraband that can be detected, as shown in **Figure 7**. The figure highlights both handheld and fixed technologies in this category. Not surprisingly, many of the detection technologies used for person-borne contraband overlap with environmental detection technologies. For instance, the same methods used to discover a cell phone hidden on a person can be used to detect one in the environment.[44]

Given the significant number of areas that need to be searched in a correctional facility, solutions tend to be portable.[44] Examples of screening devices include handheld metal detectors and handheld trace explosives detectors.[44] FMD and spectroscopy devices can also be used to detect items in the surroundings. Although some of these devices can detect pieces of metal through walls, FMD technologies have expanded to locate other objects besides cell phones with magnetic fields, including objects as small as a staple.[45] Technologies used to scan environments such as transmission and backscatter X-ray systems, which identify multiple types of contraband, tend to be more expensive. VLF and multi-frequency metal detection technologies only identify metallics and metallic cell phone components but cost less. Although continuous wave, ion scanning, and RADAR technologies are limited because of the specialized contraband they identify, they also have the greatest range. Fixed detection systems also come at a higher price point than handheld/portable systems; these systems are typically located in high-traffic or common areas to scan the people and surroundings and be a visual manifestation of attention to contraband activities.

To be effective, mail screening devices must detect contraband soaked into paper or through thin layers of paper. For instance, traces of narcotic powder or liquified synthetic drugs may be hidden under a stamp or sprayed directly onto the paper substrate.[46] Small amounts of contraband may be hard to trace, especially because some facilities rely solely on manual examination of nonlegal mail by staff.[47] Larger boxed packages, pallets, laundry bins, and trash collectors can be screened for metal and drugs with package screeners. Package screeners are much larger systems.

In an effort to stop contraband, many correctional facilities have turned to the digitization of incoming mail. Digitization scans the mail and sends digital copies to inmates. In most cases, the original mail is held for a certain amount of time and subsequently destroyed. According to a recent request for information (RFI), the BOP is considering systems to digitize all incoming mail to eliminate narcotics and other drugs being smuggled into facilities by mail. The RFI requested information on turnkey off-site postal mail scanning services to reduce costs, streamline BOP operations, eliminate contraband, and provide investigative intelligence not currently available.[48] Detecting specific drugs and narcotics has been identified as a priority for addressing correctional agency security threats.[49] Challenges of digitization include the conversion of legal documents and other bulky correspondence, such as magazines and catalogs.[49, 50]

With the advent of drones carrying and dropping contraband onto facility property, drone detection technologies are rapidly being developed. Technologies for detecting drones rely on multiple detection methods, such as radiofrequency detection (like those in cellular device detection), cameras, and RADAR. Some technologies for drone detection are also expanding to detect both the device and the pilot, who may be a mile or more away from the facility. However, detection is merely part of the strategy, because responding to drones (i.e., safely and legally stopping it from landing), once detected, is a complex matter. Drone jammers, which operate similarly to cell phone jammers, also violate the Communications Act of 1934 and are prohibited from use in federal correctional facilities.[51]

44. Koslover, R., Hung, V., Babin, S., & Mills, A. (2017). *A market survey on contraband detection technologies* (No. 250685). DOJ Office of Justice Programs, National Institute of Justice; National Criminal Justice Technology Research, Test & Evaluation Center. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/250685.pdf
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50. Smart Communications. (n.d.). *Tablet and kiosk solutions*. Retrieved from http://www.smartcommunications.us/kiosks-and-tablets.cfm. More information about these tablets and kiosks, as well as the privacy concerns surrounding this technology, can be found here: https://reason.com/2018/10/10/pennsylvanias-4-million-prison-mail-scan/.
51. Pilot Institute. (2020). *Drone jammers: How they work, why they exist, and are they legal?* Retrieved from https://pilotinstitute.com/drone-jammers/

Environmental Contraband Detection Technologies: Cost, Range, and Detection Capabilities

Type of Technology	Cost* and Range	Range	Cellular Devices	Narcotics	Explosives	Metallics *Weapons, coins*	Nonmetallics *Wood, paper, ceramic, plastic, powders, liquids*
Backscatter X-Ray	$$$	Level 1		✓	✓	✓	✓
Continuous Wave	$	Level 2	✓			✓	
Electromagnetic Detection	$	Level 1		✓	✓		✓
Ferromagnetic Detection	$	Level 2	✓			✓	
Ion Scanning	$$$	Level 2		✓	✓		
Millimeter Wave	$-$$	Level 1				✓	✓
Multi-Frequency Metal Detection	$	Level 1	✓			✓	
Nonlinear Junction Detection	$-$$	Level 1	✓				
Radiofrequency Detection	$-$$	Level 2	✓				
Thermal Imaging	$$$	Level 1		✓	✓		✓
Transmission X-Ray	$$$	Level 1	✓	✓	✓	✓	✓
Very Low Frequency Metal Detection	$	Level 1				✓	

Cost figures are estimated and only include the initial upfront cost, and do not include associated costs such as upgrades, maintenance, training, etc.

- $ Under $10K
- $$ $10K-$25K
- $$$ $25K-$100K
- $$$$ $100K+

Range

- **Level 1** Immediate Area
- **Level 2** Within a Room
- **Level 3** Across a Larger Area

Figure 7: Numerous technologies can be used to locate and detect contraband hidden within inmates' cells, recreational areas, commissaries, and cafeterias.

Managing Weapons Contraband

Unlike drug and cell phone contraband (discussed at length in the follow-on CJTEC documents in this series), which are usually introduced to correctional facilities via an outside source, weapons tend to be manufactured internally, thus requiring different detection strategies. Improvised weapons by inmates have been around since corrections facilities have been in existence, and the gold standard for locating contraband weapons has been the physical searches of both inmates and institution environs. Physical searches are necessarily time intensive and have been complicated during this time of limited staffing from COVID-19 protocols. The pandemic has increased the attractiveness of automated detection with the assistance of technology to help limit physical searches.

Correctional facilities can adopt X-ray detection technologies, light- and thermal-based detection technologies, and FMD technologies to detect components of weapon contraband; however, despite recent advances in developing and implementing technology capable of detecting weapons, there is no perfect solution for accurately identifying all weapons. The central challenge to using technology to detect weapons contraband is that weapons lack a standard size or material: their composition may be metal, plastic, paper, glass, ceramic, or a combination of materials. Technologies that focus on anomaly detection, or that only identify metal or nonmetal objects, may generate a number of false-positive results for potential weapons. Repeated false positives (alerting to a potential weapon when none is detected in a follow-up manual search) could lead to staff complacency about the utility, to the point where they may ignore alerts.

Because the most dangerous fabricated weapons are likely to contain metal, technologies that can detect metal while generating the fewest number of false positives should be prioritized for consideration. The most comprehensive technologies that detect both metals and nonmetals are transmission X-ray, backscatter X-ray, and multi-frequency metal detection. However, these systems require staff attentiveness to interpret what the technology has detected, which introduces human error. This additional focus and interpretation could be tiring but must be a priority for correctional staff. Rigorous checkpoint monitoring by staff, regardless of the specific technology, is critical to interdicting both metallic and nonmetallic weapons in a correctional facility, increasing safety of staff and inmates and enhancing protection of the public.

Unlike cell phone contraband (where technology is constantly changing), the possibilities for weapons contraband are finite. Technology will continue to assist corrections officers in identifying potential weapons and targeting their searches, but it is not expected to replace a physical search. Intelligent software has the potential to improve efficiency in this space, because artificial intelligence and machine learning (AI/ML) could enhance technologies that currently recognize anomalies. AI/ML could be optimized to "teach" the technology in what circumstances, or what object characteristics, have greater likelihood of being a weapon. However, regardless of technological innovation, a multimodal "layered system of defense" approach that includes rigorous and random searches of inmate living, working, and recreational areas, in addition to screens at multiple points of entry into the correctional facility, will continue to be best practice for contraband weapons detection.

System-Level Strategies for Managing Contraband

Contraband is an ever-evolving challenge in correctional facilities given the threat of illicit materials being introduced by any person and entering from all possible access points. Successful interdiction efforts can only be realized when correctional officers recognize the weak points in their mitigation efforts and proactively implement a strategy to combat emerging routes of ingress. Additionally, the contraband that has made it into the facility requires correctional staff to not only locate and confiscate that material, but also determine the method by which it was introduced. Employing multilayered defensive and offensive interdiction strategies starts with appropriately trained staff and is bolstered by technology that augments their capability to perform their jobs with a high degree of success. **Figure 8** provides an overview of the BOP systems-level approach to eliminating contraband within correctional facilities. By adopting a layered method, the BOP intends to control the trafficking of contraband by reinforcing access points with physical searching, scanning people and parcels, and employing sensitive drug detection systems.

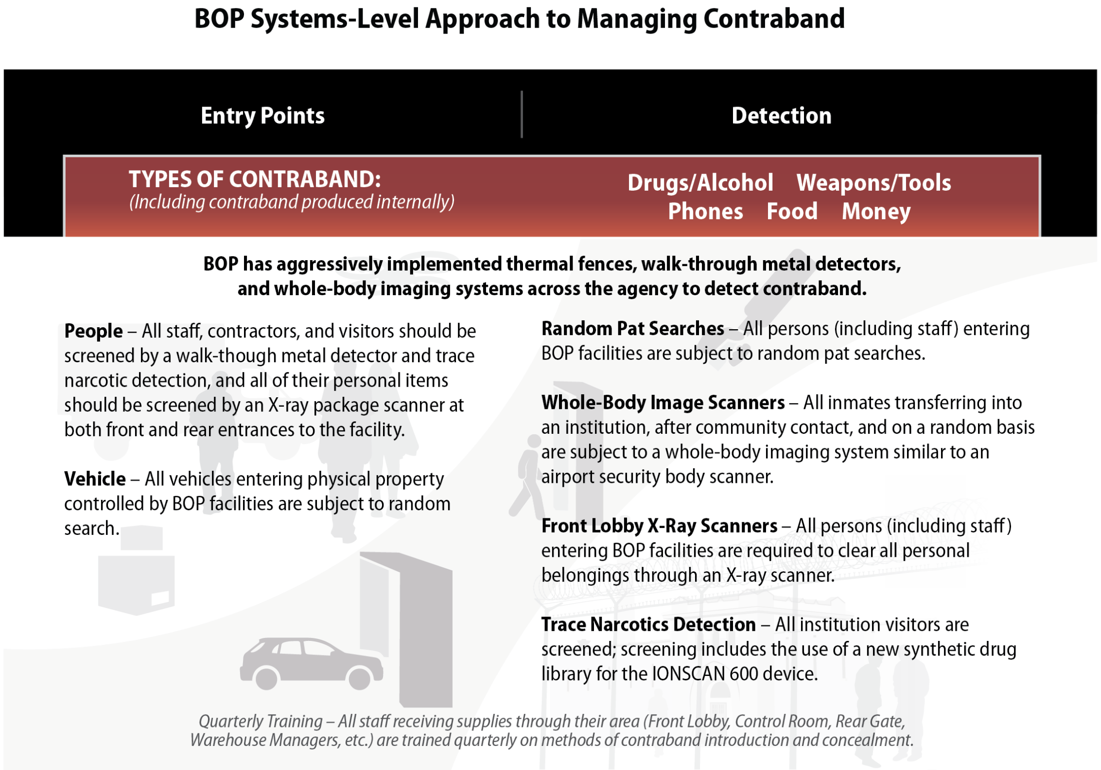

Figure 8: Adopting a systems-level approach helps facilities bring varied solutions such that multiple avenues for contraband are closed simultaneously.

The Future Outlook

The JHU *Market Survey on Contraband Detection Technologies* highlighted three areas for future consideration for contraband detection: drone detection, radio-frequency identification detection (RFID) tracking, and neutron-based detection.[52] Since the *Market Survey* was published in 2017, many advancements have been made in these three areas of contraband detection.

- **Many drone detection technologies currently on the market, including radio frequency devices, have increased detection radiuses relative to earlier technologies.** Other promising solutions, including audio detection, are currently under development. For example, an alerting system that uses microphones and thermal cameras to detect unwanted drones (and pilots) is being beta tested by Duke University in partnership with the North Carolina Department of Public Safety for eventual application in prisons.[53] The low-cost technology, created with a Raspberry Pi, includes an ML algorithm that processes data collected from a microphone (e.g., the buzzing associated with the propellers of a drone). Upon detection, it sends a notification through an app downloaded on a prison security personnel's smartphone. The ability (sensitivity and range) to detect drones is emerging, although the expense and specialized training associated with military-grade technologies put them out of reach of most correctional facilities. As noted previously, however, detecting the drone is only part of the solution. Preventing the drone from delivering the contraband, locating the pilot, and prosecuting the incident pose many additional challenges that each require varied solutions.

52. Koslover, R., Hung, V., Babin, S., & Mills, A. (2017). *A market survey on contraband detection technologies* (No. 250685). DOJ Office of Justice Programs, National Institute of Justice; National Criminal Justice Technology Research, Test & Evaluation Center. Retrieved from https://www.ojp.gov/pdffiles1/nij/grants/250685.pdf

53. Kingery, K. (2019, June 19). *An app for stopping drone deliveries over prison walls*. Durham, NC: Duke University. Retrieved from https://pratt.duke.edu/about/news/prison-drones

- **Although the current focus of drones and contraband is on the detection of drones (as a mechanism for bringing contraband into correctional facilities), drones also have the capability to be leveraged to detect foreign material and trafficking efforts, making them a potential detection solution for contraband hidden in the environment.** For example, drone-borne detection technologies are rapidly being developed and integrated for use in infrastructure inspections, traffic control, and crowd monitoring.[54] Each of these applications provides valuable contributions to contraband inspections through the development of specialized scanning optics and AI software platforms for object identification. Many of the sensors and software technologies used to support terrestrial law enforcement activities can be mounted on the Unmanned Aircraft System platform to enable more rapid scans of large areas. These systems could play a vital role in recognizing trafficking efforts both in recreational areas of the prison grounds and along the perimeter of a correctional facility.

- **New detection strategies, such as the use of hardened RFID tags and magnetic-based detection security systems, may provide an additional security modality for correctional facilities to leverage.** Hardened RFID tags can be placed in different areas across the facility to track inmates for cell checks and security checks, inmate movements, meal and recreation offerings, headcounts, razor passes, and other purposes.[55] Additionally, researchers have demonstrated how a new type of magnetic-based metal detection security system using magnetic fingerprinting can identify hidden metal objects more efficiently.[56] Although indirectly aligned with contraband detection, correctional facilities using this technology would not need to require individuals to walk through a detector.

- **Research and testing of neutron-based detection methods has advanced since the JHU report was published.** Pennsylvania State University recently tested fast neutron imaging using neutron beams.[57] Neutron-based technology is expanding to detect illicit materials and can differentiate between innocuous materials, drugs, and explosives.[58, 59] Advantages of this technology include the following: (1) neutrons are not affected by electromagnetic forces and therefore can penetrate deeply into matter, (2) neutrons only interact with nuclei and with high specificity, and (3) neutron beams can be tagged according to their elemental content.[58, 59] However, to date, no technology using these methods has been firmly adopted by security or criminal justice industries, in part because of cost and availability.

- **Correctional facilities may also benefit from emerging products focused on enhancing user friendliness.** ADANI Systems' new Conpass Smart DV scanner features a new AI-enabled threat detection technology, which enables the full-body walk-through scanner to highlight parts of a scanned image using different colors to identify different contraband.[60] Using colors to highlight different aspects of an image can help correctional facilities identify contraband more efficiently.

Products continue to emerge for broader security applications, as well as specifically for corrections. As such, future research may focus on quantifying the return on investment or the cost-benefit analysis of new solutions to demonstrate the standardized value of each product. Simply looking at the cost of these strategies does not reveal the relative benefit, because more costly strategies could prevent more contraband infiltration.

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In summary, many different types of contraband detection technologies and products are available on the market, ranging in size, cost, and capability. Technologies and products for correctional settings often benefit from broader global security needs, such as screening devices that are commonly used in settings like airports and postal screening, as well as other security and military applications. Each facility should consider the realities of their facilities, budgets, and operations when choosing to invest in technology-based management.

5 Things Decision Makers in Correctional Facilities Should Know about Contraband Detection

1. When decision makers implement detection solutions to reduce contraband, innovative thinking is foundational for success. The definition of contraband may be fluid, based on emerging and often unforeseen threats. New technology will be required to keep up with evolving threats and the surreptitious methods of both production and smuggling.
2. Numerous products available on the market have the potential to help facilities detect contraband before entry via visitors and staff and to manage contraband within a facility by scanning inmates, staff, mail, and environments.
3. Facilities should consider economic, operational, legal, safety, and privacy implications and health trade-offs before selecting and implementing detection solutions. Many walk-through and drive-through detectors currently on the market are large and expensive, retain sensitive imagery, and may emit higher levels of radiation.
4. Successful management of contraband demands multiple methods that might include combinations of technologies, systems, and processes for walk-through, handheld, vehicle, and environmental scanning.
5. Technological advances could present alternative detection options. Companies and researchers continue to improve systems, making them more effective, affordable, and easier to use for correctional facilities.

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