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Infection Control in Correctional Settings - A Systematic Review with an Emphasis on Non-COVID-19 Related Infections and Control Measures.

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Abstract

Infection Control in Correctional Settings - A Systematic Review with an Emphasis on Non-COVID-19 Related Infections and Control Measures.

By Amadin Aitua Olotu

Introduction: Well over 10.7 million people are incarcerated globally, with more than 2 million in the US alone. This includes those serving sentences and those that are yet to be tried. In carceral settings worldwide, more than half of all countries have over 100% occupancy rate. Hence, most of the world's correctional and detention systems are overcrowded, which leads to these settings being extremely conducive for the transmission of infectious diseases by various routes. Crowding of vulnerable persons increases the tendency for the occurrence and progression of disease outbreaks. The risk of being exposed to, and acquiring, infectious diseases in a carceral setting surpasses the risk outside by several fold.

Methods: This study presents the findings of a systematic review, conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. It searched the literature for articles on infection control in correctional settings published from 2008 to 2022. Due to the volume of publications responding to rapidly changing recommendations, articles related to COVID-19 infections were excluded.

Results: We found 3,473 articles and synthesized 81 which were most relevant. We described transmission occurrences and outbreaks, as well as interventions and measures initiated and recommended to prevent and mitigate cases and outbreaks of infections in carceral settings.

Conclusions: According to the Mandela Rules of the United Nations, incarcerated persons have a right to healthcare services that prevent infectious diseases or manage them when they occur. Failure to recognize this right, or to provide the needed healthcare, results in negative consequences for them, the communities outside carceral settings, and public health.

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INTRODUCTION

Records that are available, mostly from governmental sources, indicate that over 10.7 million people were incarcerated globally, as of October 2021. However, it is believed that the actual figure is over 11.4 million. This is because in a number of countries, there are people in police detention or under other forms of incarceration, not accounted for in the official counts. These figures represent not only those serving time, after conviction for offences, but it also includes people awaiting trial who have not been convicted (1). With a total number of incarcerated people exceeding 2 million, the United States leads the rest of the world, in the total number of people incarcerated in any country. When considering the prison population rate (number of prisoners per 100,000 of the national population) the US also ranks highest at > 625 per 100,000(1).

Globally, these individuals are restricted and confined in jails, prisons, juvenile detention institutions and other detention centers. In many parts of the world, these carceral facilities are overcrowded and filled beyond capacity. More than 50% of the world's countries have over a 100% occupancy rate in their correctional facilities. Over 25% of countries have over 150% occupancy rate in carceral setting buildings and at least 12% of countries have a 200% and above occupancy rate in their carceral facilities (2). This puts those confined within these facilities, at an increased risk of acquiring a number of infections that are transmissible from person to person (3–5). The limited space and shared close quarters make it easier for diseases to be spread by airborne and droplet routes and to be transmitted from infected persons to susceptible uninfected persons (4–7). Cases have been recorded, from different parts of the world, of outbreaks or the spread of diseases transmitted by these routes, in carceral settings. Such reports have been made of tuberculosis (8–11), varicella (12–15), measles (16–18), influenza (19,20), Chlamydia pneumoniae respiratory illness(21) and meningitis (22).

Injection drug users tend to be disproportionately represented in carceral settings worldwide, and in many cases injection drug use continues even during incarceration (23–25). These and other factors contribute to a higher prevalence, in jails and prisons, of infections transmissible by parenteral routes. Practices such as tattooing and piercing occur in jails and prisons, among residents, in the absence of sterile or aseptic conditions (24,26). Thus, the prevalence of such blood borne infections has been found to be usually higher in carceral facilities than in the community at large (27). All of these set the stage for the transmission of hepatitis B virus (HBV), hepatitis C virus (HCV) and the human immunodeficiency virus (HIV), in carceral settings. Reports of the occurrence of transmission of these infections in carceral settings have been published (28–31).

It has been shown that the prevalence of sexually transmitted infections (STIs) is higher in those that are admitted into carceral settings, than those on the outside (32,33). Reasons for this may include substance use, having multiple sex partners, having unprotected sex, engaging in sex commercially or in exchange for needs and a tendency to engage in more risky sexual situations. Thus, the rates of gonorrhea, syphilis, *Chlamydia trachomatis*, *Trichomonas vaginalis* and HIV that have been found at entry testing, for those being admitted into correctional facilities, when compared with the general population, have been higher (32). While it may be illegal, it is known

that sex occurs among residents of carceral facilities (24,26,31,34,35), putting the uninfected at risk of acquiring these infections during incarceration.

Skin and soft tissue infections have also been reported among those incarcerated (36,37), sometimes occurring as outbreaks (38). These tend to spread by contact, from person to person, and such close contact occurs frequently within the confined spaces that are characteristic of carceral settings. Outbreaks of illness that are transmitted feco-orally, related to contaminated food or drinks or that present with enteric symptoms, have also been reported from different carceral settings (39–44). This has constituted a serious health hazard in these facilities, to those incarcerated within.

Incarcerated individuals are a vulnerable population and the conditions of incarceration, in many cases, puts them at increased risk for different infections as outlined above. However, those who are incarcerated have a right to healthcare that is of the same standard as that obtainable on the outside, within the community. This has been declared by the guiding principles made for international and domestic laws such as the United Nations Standard Minimum Rules for the Treatment of Prisoners also known as the “Nelson Mandela Rules" (45,46). These international guidelines categorically refer to the care and treatment of infectious diseases, making it clear the prevention, control, and management of infectious diseases in those incarcerated is the responsibility of the state(s) that incarcerated them. A number of judicial decisions in favor of the incarcerated, and in line with these guidelines, have been made in different countries across the world, especially with regards to HIV infection (45). This has helped to guide, affirm, or provide legal provisions in individual countries, that mandate the provision of services that prevent, control, or manage infectious diseases in incarcerated individuals.

Carceral settings are places where the incarcerated, the working staff, and the visiting public are continuously at risk for the transmission and acquisition of infectious agents, and the subsequent development of illness or disease (3). Infection prevention and control, and public health practitioners should study these, learn from them, and seek, create, and utilize opportunities to limit them, in all carceral settings.

This paper will systematically review the literature published between 2008 and 2021 on infection control in carceral settings globally, using specific criteria, focusing on outbreaks, transmission occurrences and interventions, but with a restriction to non-COVID-19 infections. The questions this paper attempts to answer are: what interventions to prevent, limit or control the transmission or outbreak of infectious diseases occurred in correctional settings globally between 2008 and 2022 (on the dates the search was performed)? What outbreaks and incidents of transmission of infectious disease occurred? How were they investigated and what were the outcomes? What infection control measures were implemented to control or limit them?

METHODS

A comprehensive systematic review of published literature was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (47). A Population, Intervention, Comparison, Outcome, Type of study, Type of question (PICOTT) framework was used, and inclusion and exclusion or eligibility criteria were specified (shown in Table 1). A comprehensive search of major databases, including Medline through PubMed, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science Core Collection, Scopus, and the Cochrane-Central Register of Controlled Trials, was conducted. Searches executed were limited to articles published from the year 2000 till the dates of when the searches were executed.

The search of Medline using PubMed was executed on September 29, 2022. The search of CINAHL, Web of Science Core Collection, Scopus and the Cochrane-Central Register of Controlled Trials databases were all executed on September 30, 2022. The review was performed on infection control in correctional settings. Search statements used on PubMed are displayed in Box 1. The search statements used for the other databases were similar to those used on PubMed. Additional articles were added by manually searching PubMed, and also from articles referenced by included articles.

Duplicates were removed, and then title and abstract screening commenced to exclude ineligible articles. A decision was taken to exclude all articles before 2008, during the screening process. At least 2 independent reviewers reviewed each article with a 3rd independent reviewer to resolve articles with conflicts or on which 2 different decisions had been made. The articles selected were then subjected to full text reviews by 2 reviewers that met to resolve any conflicts at that stage. Figure 1 is the PRISMA flow diagram showing the progress from total number of articles retrieved, through the screening and assessment processes, to the final qualitative synthesis.

Another decision was taken to focus this paper on the included peer reviewed articles that were about infectious diseases other than COVID-19. A systematic review by Esposito et al. deals with the prevention of COVID-19 in correctional settings (48). Only the final form of study publications, and not prior abstracts, were included for extraction.

Table 1. Eligibility Criteria

PICOTT Elements	Inclusion Criteria	Exclusion Criteria
Population	Person(s) living or working inside a jail, prison, or juvenile justice facility, immigration detention or any other type of detention facility.	Persons not dwelling or working in a locked custodial facility.
Intervention	Any measure to treat or control, or prevent acquisition or transmission, of infection to persons living or residing in a carceral setting. Measures to investigate, mitigate, control or limit outbreaks of infectious disease in carceral settings.	Medical treatment of established chronic infections not focused on or related to the prevention of transmission. Prevalence studies not related to control.
Comparison	Persons in community setting (or carceral setting); same jurisdiction, adjusted for age, gender, race, etc. (May not be applicable in some studies)	Not Applicable
Outcome	Infections prevented, newly acquired, diagnosed, and/or treated. Outbreak controlled, failed to control outbreak, result of outbreak investigation.	Chronic conditions, non-transmissible infections
Type of study	Emphasis on quantitative studies. English only, from 2000 till date*	Qualitative studies (with exceptions when qualitative data helps explain quantitative data) or mixed studies.
Type of question	What prevents infection? What prevents an outbreak? What helps to detect an outbreak early? What mitigates an outbreak?	Prognosis
Publication Type:	Peer-reviewed articles	Conference proceedings, Abstracts

* A decision was later made to exclude articles before 2008.

Box 1: PubMed Search Statement

Correctional[ti] OR Jail*[ti] OR Prison*[ti] OR Inmate*[ti] OR Detention[ti] OR Carceral[ti] OR Incarcera*[ti] OR penal[ti] OR (Juvenile[ti] AND (justice[ti] OR detention[ti] OR hall*[ti])) OR "Correctional Facilities"[Major]

(Outbreak*[tw] OR Infection*[tw] OR Infectious*[tw] OR Epidemic*[tw] OR Contag*[tw] OR Transmi*[tw] OR Spread[tw] OR Airborne[tw] OR Droplet*[tw] OR Foodborne*[tw] OR "Disease Outbreaks"[Mesh] OR "Communicable Disease Control"[Mesh] OR "transmission" [Subheading])

(Intervention*[tw] OR prevent*[tw] OR control*[tw] OR Precaution*[tw] OR Hygiene[tw] OR PPE[tw] OR "Personal protective equipment*"[tw] OR Sanitation[tw] OR Clean*[tw] OR Program* OR "health education"[tw] OR Immuniz*[tw] OR Vaccin*[tw] OR screen*[tw] OR "Preventive Health Services"[Mesh] OR "Public Health Practice"[Mesh])

Correctional[ti] OR Jail*[ti] OR Prison*[ti] OR Inmate*[ti] OR Detention[ti] OR Carceral[ti] OR Incarcera*[ti] OR penal[ti] OR (Juvenile[ti] AND (justice[ti] OR detention[ti] OR hall*[ti])) OR "Correctional Facilities"[Major] (Outbreak*[tw] OR Infection*[tw] OR Infectious*[tw] OR Epidemic*[tw] OR Contag*[tw] OR Transmi*[tw] OR Spread[tw] OR Airborne[tw] OR Droplet*[tw] OR Foodborne*[tw] OR "Disease Outbreaks"[Mesh] OR "Communicable Disease Control"[Mesh] OR "transmission" [Subheading]) (Intervention*[tw] OR prevent*[tw] OR control*[tw] OR Precaution*[tw] OR Hygiene[tw] OR PPE[tw] OR "Personal protective equipment*"[tw] OR Sanitation[tw] OR Clean*[tw] OR Program* OR "health education"[tw] OR Immuniz*[tw] OR Vaccin*[tw] OR screen*[tw] OR "Preventive Health Services"[Mesh] OR "Public Health Practice"[Mesh])

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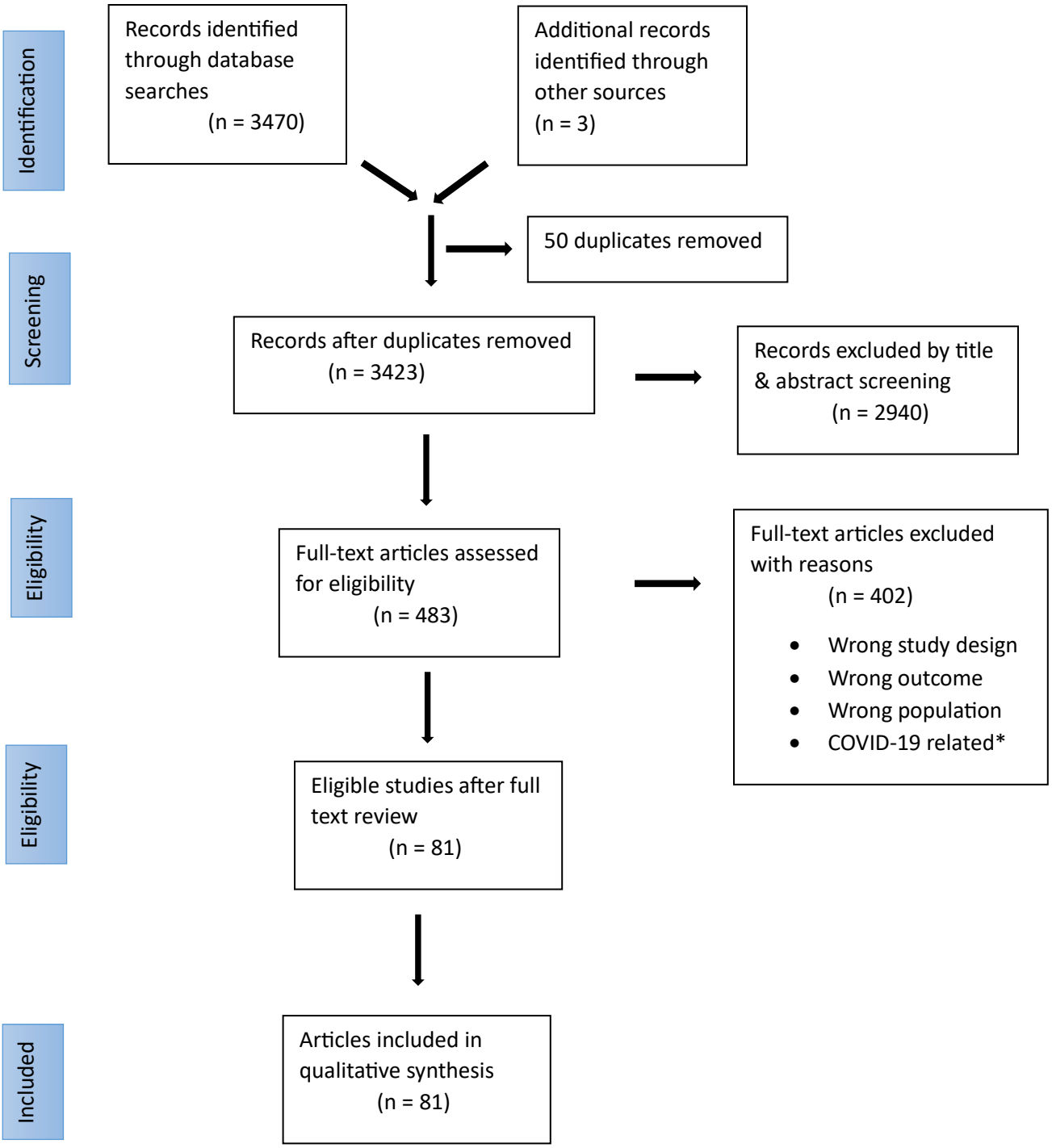
Figure 1. PRISMA Flow Diagram



(*COVID-19 related articles were excluded at the stage of full text review.)

RESULTS

After duplicates were removed, following the searches on the databases, 3423 articles were left, as shown in the PRISMA flow diagram (figure 1). Separate and independent sets of reviewers screened the titles and abstracts of the articles to exclude ineligible articles. Following which, the full texts of the remaining articles were reviewed for eligibility. Eighty-one (81) articles that met the relevant criteria and were not COVID-19 related were included in the qualitative synthesis and Table 2 summarizes the data extraction and synthesis for all included articles.

Infections Transmitted or Transmissible Through the Respiratory Route (Airborne, Aerosol, Droplet Nuclei and Droplet Routes)

(49,50).

Tuberculosis

Overview

Tuberculosis (TB), caused by bacteria belonging to the *Mycobacterium tuberculosis* (MTB) complex, is an infection that is the quintessential example of infectious agents transmitted by the airborne route (49). TB remains a significant problem in carceral settings globally (5,7–11,51–58). It is characterized by prevalence and incidence rates up to 5 or more times higher than that in the general population (5,59). And by instances of transmission and outbreaks, within carceral settings (10,11). These outbreaks have been documented to extend to involve the community or conversely, originate in the community and spread in carceral settings.

Risk factors and challenges

Studies reviewed showed that the risk factors and conditions that are conducive for the acquisition or reactivation of TB exist in many carceral settings. These include overcrowding, poor ventilation, extended periods of confinement in enclosures without access to sunlight, and malnutrition (4,5,7,8). A study sited in a Cameroonian prison, found an occupancy rate of over 400% and 3.3% of residents having a BMI of < 18.5 (8). A significant association between TB and underweight was found in the same study, however TB also causes weight loss and the study did not address which occurred first in those individuals: “TB” or “weight loss”. Using a modelling approach based on architectural, structural and cell occupancy conditions in 3 prisons, a Brazilian study evaluated the risk of TB transmission. They found that when exposed to an infectious cell mate for 180 days in the prevailing conditions, there was a mean estimated risk of TB transmission of over 75% (7). A systematic review examining the association between cell spatial density and infectious diseases reported that one of the studies reviewed found a significant association between TB infection and cell spatial density (4) however, the possibility of exposure and outcome misclassification in the study was noted . With regards to systemic issues, an extensive expert review, catalogued numerous challenges that have hamstrung the control of TB in carceral facilities, in different countries across the globe (5). These include deficiencies in or a complete absence of diagnostic capacity and infrastructure, treatment provision and supporting mechanisms, funding, oversight, and commitment from responsible authorities.

Transmission, outbreaks, outbreak investigations and opportunities for improvement

Genotypes of MTB from isolates found at entry or initial screening of residents were found to be genotypically similar to isolates obtained from other patients at subsequent screenings (9), in another Brazilian study, suggesting transmission and continuing circulation amongst residents. It was discovered that 84% of 94 MTB strains genotyped by restriction fragment length polymorphism (RFLP), belonged to one of 12 clusters identified. TB transmission in carceral settings, and also in the community were found to be linked by a study detailing the investigation of FL0117, a decade-old TB genotype cluster involving U.S.- and foreign-born persons in Florida (10). The investigation used whole genome sequencing (WGS), phylogenetics, and transmission modeling to establish that an outbreak identified in a prison was linked to an earlier outbreak in the community. The outbreak was amplified in carceral settings and progressed to involve transmission to individuals in the community when incarcerated individuals were not diagnosed before their release. A similar situation was found by a study which reported the investigation of a Tennessee Prison TB outbreak (11). A former prison resident with TB was the source of infection for 3 people in the community, 2 of them children, and one of the children an infant who had developed TB meningitis. The MTB strain isolated from the former resident, was identical to the strain involved in an outbreak in the prison he was released from, about a year earlier. Lapses were identified in TB diagnoses and infection control procedures in the prison that contributed to the spread of the outbreak within and outside the carceral setting. These show that delayed TB diagnosis or deficiencies in the implementation of TB infection control protocols in carceral settings will lead to continued transmission within carceral settings and in the community.

The Tennessee TB outbreak investigation (11), involved a review of State TB surveillance data, correctional facility records, and interviews of patients. Correctional facility records reviewed include health records, screening records and movement and work rotation records to identify contacts of known TB cases among prison residents, staff, and visitors. Those identified as contacts who had not been screened were traced for screening, to identify cases of TB disease or latent TB infection (LTBI) for treatment. Genotype results were compared for patients with available isolates. Prison wide TB screening was also conducted to identify LTBI or TB disease in 3 different cycles. Deficiencies identified, that included deviations from the CDC guidelines for TB prevention and control in correctional settings published in 1996 (60) and reviewed in 2006 (61), were noted and corrective changes implemented. These deficiencies include poor documentation of TB symptom screening at intake and subsequently annually, failure to review tuberculin skin test (TST) results periodically to detect changes, delayed chest x-rays and physician evaluations for those with positive TST results, and absence of an airborne infection isolation room (AIIR). Other notable deficiencies were a failure to treat those with LTBI, failure to institute directly observed treatment (DOTS) for those treated, a lack of a designated person or persons for TB infection control, and a lack of established procedures for notifying the health department of TB cases.

Active case finding for TB control.

Some studies found that active case finding using symptom screening to make a presumptive diagnosis and identify those requiring definitive TB diagnosis, using smear microscopy, liquid culture or GeneXpert, was a useful practice (51–56,58). It promoted earlier diagnosis of TB (and thus earlier initiation of treatment). A study involving 4 correctional facilities in South Africa found that adding the use of a digital x-ray with computer assisted diagnosis to identify those with presumptive TB, improved the yield of TB case detection (52). It resulted in the diagnosis of twice as many TB cases when compared with using symptoms alone. A Brazilian study, using modeling, compared TB control using DOTS, symptom screening and chest x-ray screening either singly or in combination (55) . Their model found that combining symptom screening with chest x-ray screening and implementing them at entry and in annual mass screenings, in addition to DOTS, had the potential to reduce average TB prevalence rapidly from 4.6% to 0.7% or lower within 3 years. A cluster randomized trial involving 16 prisons in Ethiopia (58) found that active case finding using trained peer educators significantly increased the mean case detection rate, in prisons utilizing them, when compared with control prisons without trained peer educators.

TB treatment, prevention, and control programs: gaps and recommendations.

In a study of all those diagnosed with TB and receiving TB treatment in the Uganda Prisons Service over 1.5 years, 53% of 137 residents transferred during treatment were found to have defaulted (59). The odds of anti-TB treatment default were 8.4 times greater among those transferred during treatment than among those not transferred. Another study, which evaluated the TB prevention and control program in a large urban jail in the US, identified and reported multiple deficiencies (57). These included incorrectly asking TB symptom screening questions over 70% of the time and recording “No” as the response when questions were not asked. Other problems were delays in chest x-rays for some of those requiring them and lack of specific criteria to indicate cases requiring AIIR for suspected TB. Procedures, data forms and a unified database for contact tracing were also lacking. Corrective actions, however, were reported to have been taken to remedy the identified problems, following the study.

A review of TB and HIV coinfection in carceral settings (62), made a number of recommendations for TB and HIV coinfection, prevention, treatment and care continuum in those incarcerated. These recommendations addressed some of the issues identified by other studies and relate to TB both in those with and without HIV. They include implementing active case finding, screening for TB in people living with HIV (PLWH) with both symptoms and chest x-rays and strengthening prison health systems to the level available to the un-incarcerated, generally. The integration of electronic health records (EHR) to ensure patients on treatment for HIV or TB do not experience treatment interruption when released or transferred to other prisons, was also recommended.

TB disease preventive therapy or treatment for latent TB infection is often indicated in correctional settings. A 2019 paper presented a study which compared a 3-month regimen of once weekly rifapentine and isoniazid versus 9 months of twice weekly isoniazid (63), and

completion rates were 90% versus 42%, respectively. Side effects, and cost per fully treated patient, were both substantially lower in the former regimen.

Measles

Measles, caused by the rubeola virus, an RNA virus of the genus *Morbillivirus* and family Paramyxoviridae, is another infection transmitted by the airborne route (49). It continues to occur in carceral settings (16–18) across different countries. Outbreaks of measles in an Australian high security facility and a US Immigration and Customs Enforcement (ICE) detention center were reported by an Australian study and a US study (17,18), respectively. Both outbreaks involved residents and staff of the facilities, and measures taken to limit the outbreaks included, isolation of cases, quarantines, restriction of movement and the offer of vaccination to susceptible individuals. A high uptake of vaccination among residents, and genotyping of viral isolates to confirm that genotypes were the same or had similar sequences, were reported by both. The implementation of messaging and provision of information, to staff and residents, about the situation and prior to vaccination (18), was part of the response in the Australian facility.

The response to a measles outbreak in a UK prison (16) was reviewed in a study. The vaccination statuses of residents and staff were unknown prior to the outbreak and patient zero was a member of staff. Although the response to the outbreak included vaccination, less than 30% of eligible residents received the vaccine. Problems identified include low immunity and distrust of authorities among residents, unvaccinated staff, lack of a response team and supplies, and shortage of both custody and healthcare staff. Other issues were lack of proactive screening and immunization, lack of adequate education or information provision to prisoners about the infection and the vaccine, lack of adequate vaccination space and lack of suitable infrastructure. In Swiss study, immunization data of residents of a juvenile corrections facility was compared with that of un-incarcerated adolescents, residents had significantly lower vaccination rates for MMR and other vaccines (64). Vaccines were subsequently administered to them during their detention, with 27.6% (32/116) becoming up to date.

Varicella and Herpes zoster

Varicella (chicken pox) and herpes zoster (shingles) are both due to infection with the Varicella zoster virus (VZV), a DNA virus of the family Herpesviridae, which is transmitted by the airborne route. It causes varicella as an acute primary infection, and herpes zoster due to reactivation of the latent virus, which is present in dorsal root ganglia, following a primary infection. VZV transmission and outbreaks, involving individuals with varicella or herpes zoster, continue to be problems to be contended with in carceral settings (12–15). Two studies detailing the responses following a case and outbreaks of varicella, in a Swiss prison (13), and a US prison (12), respectively, reported measures put in place to prevent and control the outbreaks. These include isolation of cases in AIIR, quarantines for those exposed or without proven immunity, serological testing to determine those without immunity and offer of vaccines to those without immunity. The US study also reported provision of education to staff and limiting them from work until provision of proof of immunity. The cost incurred in responding to 2 outbreaks, that occurred over the course of 2 years in that prison, was estimated to be $161,042.88. The case of

varicella in the Swiss prison triggered a response that was similar in content to that reported by the US study, however, it was marked by the rapidity of the response. An offer of vaccination was made to those who had a negative history of chicken pox even before results of immunity testing were available to ensure provision of vaccines within 3-5 days of exposure. Notable also was the provision of educational materials, about the infection and the response, to residents in multiple languages (up to 9) represented in the resident population, in a culturally sensitive manner. Uptake of serological testing was 100%, with a similarly high uptake of vaccination. No secondary cases were found to have occurred.

In an Italian prison for women, admission of cases to a hospital, limitation of movement and provision of acyclovir to HIV positive residents, were measures implemented following an outbreak of varicella (14). In addition, facemasks for airborne infection protection were provided to staff, and those of them with a negative history of varicella were offered vaccination. No mention was made of an offer of vaccination to non-immune residents. In a case of VZV transmission within a juvenile correctional facility, reported by a Canadian study (15), herpes zoster in a teenager, was followed 13 days later by chicken pox in another teenager. Both occupied the same unit and the 2nd teenager had previously been vaccinated with the approved univalent varicella vaccine. Both cases were confirmed by polymerase chain reaction (PCR) and direct florescent antibodies, respectively, to be VZV positive, and both were confirmed to wild type strain by genotyping. Measures implemented to limit further transmission include isolation of the varicella case, clinical surveillance, education and restricted movement and admission into the affected unit, till the expiration of the incubation period. No further infections were recorded.

Use of modelling for decision making in varicella outbreak management

Setting

An article published in 2020 reported the response to an outbreak of varicella in an immigration detention facility in England (65), designated an “immigration removal center” (IRC), composed of 2 separate constituent centers with the combined capacity to house 1,046 residents. Following the onset of rash in a second resident of one of the centers in the IRC, 15 days after an index case of chickenpox in a resident housed in the same wing of that center, an outbreak was declared in the IRC and an outbreak control team (OCT) constituted. The 1st case was reported to have been clinically diagnosed to be varicella and isolated and was believed to have been exposed during an admission to a hospital, while the 2nd had previously been identified as a close contact of the index case.

Outbreak response

Outbreak control measures instituted by the OCT included isolation of the 2nd case, investigations to identify close contacts among residents and susceptible staff, quarantine of susceptible contacts, and limitation of movement, entry and exit from both centers of the IRC. Admissions of new individuals who were considered susceptible, into the IRC and movement between both centers were also put on hold. Vaccination of non-immune residents who were contacts of cases was considered by the OCT and a decision not to implement it taken. Transfers were suspended for residents who were found to be contacts of any of the cases and were non-

immune as well as those for whom test results for immunity had not become available. Letters of information about the outbreak were also sent to residents, staff, and visitors. Three days after the onset of rash of the 2nd case, a 3rd resident developed rash in the other center and was eventually isolated. Although no direct link or contact between this individual and the previous 2 cases was established, it was believed that he had some undiscovered contact with the index case. PCR performed on vesicular fluid obtained by swabs from 2nd and 3rd patients confirmed VZV DNA. Immunity testing by serology, was performed for close contacts, to determine those who were non-immune for quarantine and cohorting, and further limitations were put on movement. Nevertheless, 8 days after the 3rd case, a 4th resident of the IRC in the same center and wing as the 3rd patient also developed rash and was clinically diagnosed as another case of varicella. Three days later the OCT decided to expand immunity testing to the general population in the second center, to detect those who were immune and those who were non-immune. The reason was to ensure that immune residents could be moved to create space for quarantine of the non-immune or to guide cohorting and safely receive newly new residents. Especially as rooms for isolation or quarantine were said to be limited. The testing of residents was reported to have been limited to residents of the second center because free movement within the resulted in the possibility of all of them being exposed and no case had occurred in the 1st center over a couple of weeks.

Application of modelling

However, after about 274 people had been tested it was realized that resources were inadequate to complete the exercise and the OCT decided to apply modelling to compare the predicted outcomes of stopping the testing against continuing. The model applied incorporated all infection control measures that had been implemented and predicted outcomes for 3 plans or options that differed on the extent of immunity testing done. The options were, no testing and no quarantine for non-immune detainees, full testing of residents of the 2nd center and cohorting all those found to be non-immune for 21 days, and partial testing to the extent that had already been done and cohorting those already identified as non-immune until 12 days after the last patient's onset of rash. All options in the model had a 95% probability of the outbreak ending on the same date, but different projected outbreak end dates for a probability of 97.5%. Full testing had the shortest end date projection, while partial and no testing, had dates falling 5 and 11 days after. The 2.5% probability of more cases occurring over the next 4 weeks, in the 2nd center for no testing, full testing, and partial testing respectively were 18 cases, 2 cases and 3 cases. Based on the results and findings from the model, of a difference of only 1 extra case between partial and full testing the OCT decided to stop the testing. Following the expiration of 2 varicella incubation periods, and the occurrence of no new cases, the outbreak was declared over.

Outbreak of varicella in a detention facility for refugees

The utility of mass vaccination in managing an outbreak of varicella in carceral settings was explored by a 2014 publication (66), that reported the response to an outbreak of varicella in a detention facility for immigrants and refugees in Israel. The outbreak involved 2 complexes that together housed 2500 residents out of the 6000 in the entire detention facility. Over the course of 7 months, 109 cases of chickenpox were diagnosed clinically, and isolation of cases was the only

initial control measure reported. Following a report of the outbreak to the ministry of health and a subsequent visit to the facility, a recommendation for mass vaccination with 2 doses of varicella vaccine for all residents was made. Vaccine acceptance rate was relatively high at 84.3% (2108/2500). There was only 1 case of varicella in the 2 weeks following completion of the administration of the 1st dose of the vaccine to residents, and no more cases thereafter.

Mumps

A 2019 publication detailed multiple outbreaks of mumps in facilities housing detained migrants, across at least 19 states in the US, and the response (67). Over the course of the period extending from September 1, 2018, to August 22, 2019, up to 898 cases of mumps were reported. Of these, 64% (576/898) had been confirmed by reverse transcriptase PCR or viral culture with the others designated probable, among adult residents of at least 57 facilities housing migrants. Another 33 cases of mumps occurred among the staff of these facilities during the same period. Facilities were either county jails (19), ICE operated (4) or privately operated (34). In 70 patients from whom isolates had been obtained and sequenced, genotype G was the only one discovered. At least 84% (758/898) were found to have been exposed during detention and available records revealed 15% (79/527) of male patients experienced orchitis, with up to 13 patients requiring hospital care. Over 25,000 doses of MMR vaccine were reported to have been provided in response to these outbreaks.

Influenza

Influenza, caused by droplet transmission of influenza viruses, RNA viruses of the family Orthomyxoviridae, occurs as cases or outbreaks in carceral settings (19,20). A study reported a case of laboratory confirmed H1N1 influenza in 2009 (20), followed in 2010 and 2011, by 4 and 2 cases of influenza like illness respectively, in an Australian prison. One of the cases in 2010 and both in 2011 were laboratory confirmed to be due to influenza A. Measures implemented to limit spread were isolation, quarantine, and restriction of movement. Ill patients were seen by health staff in their residential quarters and not in the health center. Visitors were restricted but not banned completely. Continued transmission was not recorded, however, the fact that the prison was not overcrowded (it operated at 54.3% and 71.3% occupancy in 2009 and 2010 influenza seasons respectively), is noteworthy. Also, important to note is that residents were not moved between the index facility and other correctional facilities.

An outbreak of influenza in a Canadian correctional facility (19), with 2 initial patients presenting one after the other, who were later linked to 1 and 3 secondary cases, respectively, was reported by another study. All cases were laboratory confirmed to be influenza A using a nucleic acid amplification test (NAAT), and all were isolated in the infirmary with the implementation of contact and droplet precautions. Admissions and movement to units the patients came from were restricted. Staff were restricted from those units except for those vaccinated at least 2 weeks before or on oseltamivir post exposure prophylaxis (PEP). Exposed inmates were offered vaccines and those with comorbidities were offered oseltamivir PEP. No further cases were reported.

Chlamydia pneumoniae pneumonia

A study reported an outbreak of pneumonia, among men incarcerated in a US federal correctional facility, that was eventually discovered to be due to the atypical bacterium *Chlamydia pneumoniae* (21). Previously healthy residents presented with low-grade fever, dry cough, and body aches and other symptoms, necessitating the hospitalization of least 4 individuals. Upon suspicion of an outbreak, ill inmates were isolated in single cells and initial laboratory tests done were all negative. Subsequently nasopharyngeal (NP) and oropharyngeal (OP) swabs from 7 acutely ill inmates were tested for 18 respiratory pathogens using qPCR at the CDC, and *C. pneumoniae* was detected in 4 (57%) inmates. Acute and convalescent sera were tested for *C. pneumoniae*–specific IgM and IgG antibodies using commercially available microimmunofluorescence kits Notices were employed to educate residents and encourage those ill to present for treatment, usual fees for clinic services were waived and isolation of ill individuals discontinued to encourage residents to present for care. 33 cases were found out of 36 self-referrals. A case was defined by the presence of acute respiratory illness (ARI) supported by positive chest x-ray findings, qPCR, or IgM or IgG serology according to certain defined criteria. Azithromycin was given for treatment and doxycycline for those who remained symptomatic afterwards. A survey with active case finding was conducted on a randomly selected sample to estimate attack rates, this revealed another 19 cases. An attack rate of 10.4% (95% confidence interval, 7.0%–13.8%) was calculated for the whole facility. Self-referred cases were more likely to be white than any other race (OR 23.8; 95% CI 3.0–187.7). There was persistence of *C. pneumoniae* demonstrated by qPCR, and respiratory symptoms, in some individuals following appropriate treatment.

Meningococcal meningitis

An outbreak of meningitis caused by *Neisseria meningitidis* amongst residents of a Chinese jail, was reported by a study (22). The 3 cases involved were admitted to a hospital on account of a clinical diagnosis of meningitis, *N. meningitidis* was isolated from the CSF and blood of 2 patients by culture and identified as serogroup C meningococci by slide agglutination. Using PCR, *N. meningitidis* serogroup C was identified in CSF samples from all 3 patients. To limit the outbreak, residents sharing the same cell as the patients were given chemoprophylaxis. Those who were deemed to be close contacts of the patients were administered vaccines against serogroup A and C meningococci.

Of 166 subjects (16 cellmates of the patients and 150 residents of other cells in the jail), from whom pharyngeal swabs were obtained to assess for pharyngeal carriage of *N. meningitidis*, 47 isolates were recovered. Of these, 29 were serogroup C, 10 were serogroup B, 2 were serogroup A, 1 was serogroup W135 and 4 were non-grouped isolates. Among cellmates of the patients there was a carriage rate of 62.5% (10/16) for *N. meningitidis*, 6 of which were serogroup C, 1 serogroup B, 1 serogroup W135 and 2 non-grouped isolates. Among the 150 residents from other cells, there was a carriage rate of 24.7% (37/150) for *N. meningitidis*, 23 of which were serogroup C, 9 serogroup B, 2 serogroup A, 1 serogroup Y, and 2 non-grouped isolates. There was a significantly higher prevalence of *N. meningitidis* pharyngeal carriage in residents in the same cell with the patients than in those in other cells. Molecular analysis of 49 isolates using pulsed-field gel electrophoresis (PFGE) identified 24 isolates (2 from 2 patients, 6 from

cellmates of the patients and 16 from inmates in other cells of the jail) as an identical new pulse type designated as NMNh.CN0244. Four (4) were the NMNh.CN0001 pattern (a pulse type associated with a serogroup C outbreak in China in 2003-2004). Using multi-locus sequence typing (MLST) for 20 isolates (NMNh.CN0244 [9], NMNh.CN0001 [2] and others [9]), 11 NMNh.CN0244 and NMNh.CN0001 strains formed the sequence type -4821 (ST-4821) complex. A high MLST diversity was found between the other isolates with other pulse types. The carriage rate of ST-4821 clonal complex isolates, which has caused multiple outbreaks in China, was found to be significantly higher in cellmates than in residents from other cells (37.5% vs 13.3%).

Leprosy

Hansen's disease or leprosy, believed to be transmitted by the respiratory route, and caused by the bacteria *Mycobacterium leprae* and *Mycobacterium lepromatosis*, has been reported in carceral settings (68,69) in Brazil. Studies in Brazilian prisons (68,69), found that educating residents about leprosy and actively screening using symptoms and signs or with the aid of a leprosy suspicion questionnaire (LSQ) enhances the detection of new cases of leprosy and thus subsequent treatment.

General measures for control of infections transmitted by the respiratory route

A systematic review published in 2020 (70), assessed the responses to outbreaks of highly infectious diseases, including tuberculosis, influenza, varicella, and measles, in carceral settings, reported in 28 studies. Important themes in management of outbreaks include interagency collaboration between prison staff, the local state health department, public health laboratory, public health units and hospital services. Others are health communication, screening for contagious diseases, movement restrictions, isolation, quarantine, and contact tracing. Equally important were immunization programs, epidemiological surveillance, prison-specific guidelines, and appropriate treatment. The need for the implementation of immunization programs is underscored by a systematic review on vaccine coverage for vaccine preventable diseases (71) in those incarcerated, which found moderate to low coverage in articles reviewed. This is also supported by the Swiss study (64)finding of lower immunization rates in incarcerated adolescents.

Infections Transmitted by Contact: Bloodborne Viruses (BBV) and other infections that can also be transmitted sexually

HIV, HBV, and HCV are blood borne viruses transmitted via the parenteral route. In addition to percutaneous transmission, they all possess the notable quality of being transmissible sexually, yet, to different degrees. Both means of transmission, for all 3 viruses, do occur, or have the potential to occur, in carceral settings. Thus, issues pertaining to these infections, including transmission and measures to reduce transmission in carceral settings, have been studied and reviewed in published reports included in this review (26,28–31,35,45,72–84). Also included are articles relating to STIs that are not caused by BBV (78,85).

Guidelines and legal provisions for the care of the incarcerated

A 2016 article reviewed international, regional, and national guidelines and legal provisions for the provision of HIV related care to prisoners (45). They highlighted the guiding principle of the United Nations Standard Minimum Rules for the Treatment of Prisoners also known as "the Nelson Mandela Rules". This declares that all those incarcerated should enjoy the same standards of health care as those available in the community, including care for HIV, TB, and other infectious diseases. The African Charter on Human and Peoples' Rights, European Social Charter, and the Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights all of which affirm the right to health of all individuals were also outlined. Court decisions from different countries supporting and giving legal support to this ideal were also reported. The United Nations and these other groups concerned with the protection of human rights and dignity, unanimously and unequivocally state that residents of carceral settings should be protected from infection, and if infected from neglect or denial of treatment and care.

Harm reduction and education programs

A systematic review published in 2018 (75), examined peer-reviewed literature for the health outcomes of prison needle and syringe programs (PNSP). They found that the studies reviewed reported outcomes that included a decrease in the prevalence of HCV and HIV infections, decreased injection related abscesses and an absence of new HIV, HCV, and HBV infections. A 2017 systematic review (76), examined 27 peer-reviewed articles for interventions to reduce HIV-related risky behavior. They found that educational programs, and especially those that were peer led, were reported to be effective in increasing knowledge about HIV transmission and risk behaviors and changing attitudes and beliefs in those incarcerated. A study sited in an Indonesian prison (74), investigated the impact of a HIV control program. The program included HIV education and training, HIV prevention, counseling, testing, and care, condom provision, and harm reduction. The harm reduction program included addiction care and a methadone maintenance treatment (MMT) program and the provision of bleach but excluded a PNSP. Initial and repeat surveys, and serological tests, for HIV and HCV, were conducted among 281 prisoners who were negative at the initial test. They found no new positives, a reduced prevalence of risky behavior and a progressive reduction in AIDS related deaths in successive years.

Condom provision

A 2010 mixed methods study conducted in a Los Angeles jail (35), examined condom use and related issues, in a special unit assigned to house men who have sex with men (MSM) and male to female transgenders, and in which a condom a week was provided to those interested. They found that, among those who were having anal sex while in jail but not always using condoms, 32% reported running out of condoms and 14% were unable to access condoms. Showing that although there was a condom provision program it was inadequate and some of those who were interested in using condoms in the jail, were having sex without them. Two other studies published in 2014 and 2020 examined the feasibility, safety, security, and costs of a condom

provision program, in a single prison and in 33 prisons, respectively, in California (72,73). The 2014 study, which was a pilot (72), was a consequence of a directive by the then state governor, Arnold Schwarzenegger. He mandated the California Department of Corrections and Rehabilitation (CDCR) to ascertain the ‘‘risk and viability’’ of allowing the distribution of condoms to residents of one state prison. He expressed the position that although sex in prisons was illegal, providing condoms to residents was in line with the necessity of the improvement of prison healthcare system and ultimately public health. Condoms were provided via wall-mounted dispensers located in certain areas accessible to residents, such as restrooms in the dormitory and the medical primary care waiting area. There was no evidence of increased risk to inmates and staff or to general security. This was seen in the absence of incidents of condoms being used to conceal contraband, controlled substances, or weapons. The program cost was $1.49 per resident, and $182,319 in total costs over a year (72). Consequent on these findings, in 2014 (73), California passed the Prisoner Protections for Family and Community Health Act, mandating the CDCR to plan and implement a program for condom access in all state prisons. The 2020 study which assessed this scale up, had similar findings. There were no reports of serious incidents and only 4 cases of condoms being used to store contraband, out of 243,563 condoms dispensed over 1 year in 33 prisons. The estimated cost of condoms was $49.60 per 1000 inmates per month (73).

HBV transmission

A 2011 article reported the transmission of HBV from one resident with chronic HBV infection to another who shared a cell with him in a UK prison (28). The presence of immunoglobulin (Ig) M antibody to the core antigen (anti- HBc) confirmed acute infection in the recently infected individual who had presented with jaundice and had abnormal liver enzymes. Identical hepatitis B surface antigen (HBsAg) nucleotide sequences, in both core and precore regions, in samples obtained from both individuals, confirmed transmission. The most likely vehicle involved in transmission was a fabricated tattoo gun recovered from the cell. This report underlines the ever-present risk of HBV transmission in carceral settings and the need to protect the incarcerated through vaccination.

HBV vaccination

A 2008 study, utilizing modeling, based on prison surveillance and published literature from the UK, examined the impact of continuous vaccination at entry and mass prison population vaccination repeated at intervals on the coverage of injection drug users (IDU) (79). Continuous vaccination at entry was found to found to be more efficient at capturing IDU, captured a greater proportion of IDU, and captured a larger proportion of younger IDU. It also resulted in fewer doses being wasted than the vaccination of the whole prison population at intervals. A randomized clinical trial (RCT) conducted with 169 subjects who were residents of 3 correctional facilities in Iran (82), compared an accelerated HBV vaccination schedule with the classic schedule. The accelerated schedule involved a dose of 20 μg of recombinant hepatitis B vaccine at 0,1, 4 and 8 weeks while the classic schedule was the same dose at 0, 1 and 6 months. Comparison of the compliance, seroprotection rate and success rate of both schedules showed that the rate of compliance was significantly higher in accelerated arm (100% vs 90.5%).

Seroprotection at 2 months in the accelerated was significantly higher (60.7% vs 44%) but at 8 months was significantly higher in the classic arm (93.4% vs. 78.8%). The success rate was defined as the proportion of individuals who received the full dose of vaccination and were seroprotected based on the total number of participants in each group. The success rate of the accelerated arm was not significantly different from the classic (78.8% vs 84.6%).

A study involving 15 prisons in Italy, identified those eligible for HBV vaccination by serological screening and offered them vaccination using an accelerated HBV vaccination schedule (0, 7, 21 days) (80). 730 residents from the 15 prisons were found eligible for vaccination, 601 were scheduled for vaccination and 404 completed the 3rd dose resulting in a relatively high coverage of 55.34%. Training and education programs for staff and residents, and a peer education program for residents on HBV infection, screening and vaccination were implemented prior to the screening and vaccination (81). Multiple languages, understood by different groups of residents, were used to deliver the programs for residents to them. Of those eligible for screening, 91.3% (1075/1177) consented, 82.3 % (601/730) of those eligible for vaccination consented to be vaccinated and received the 1st dose. Of those who received the 1st dose, 90.3% (543/601), received the 2nd dose (day 7). Most of those who didn't receive the 2nd dose, didn't because they had been released or transferred. The relatively high rates of screening and vaccination uptake were attributed to the education and training programs delivered prior to screening and vaccination.

A study published in 2016 reported the implementation of a BBV/STI clinic led by nurses (78), with the education of staff and a review of clinical procedures in 2 prisons for men and 1 for women in Australia. A comparison of pre-intervention and post intervention data revealed that HBV vaccination increased from 2% to 19%. STI testing also increased from 5% to 17% for chlamydia and 1% to 5% for gonorrhea.

HCV transmission and risk factors

A case report published in 2017 reported the transmission of HCV in an Australian prison (30), following treatment with DAAs and a negative PCR result after the treatment. A positive PCR result was received from a sample collected about 14 weeks post treatment. There was a difference in genotype and the patient reported sharing injecting equipment with a known HCV-positive contact, about 4–6 weeks after the negative PCR result. The tests results were the same on repeat testing.

A 2013 cohort study, which followed 119 residents of 4 prisons in Spain who had achieved sustained virologic response (SVR) following treatment of HCV infection with pegylated interferon and ribavirin, over an average of 1.4 years, found 9 were reinfected (29). Eight had a different genotype, supporting reinfection. These reinfections occurred in those with an IDU history. Only one was incarcerated all through the follow-up period confirming that the reinfection occurred within the prison, unlike the others who spent time outside the prison. Highlighting the fact that those incarcerated are still at risk for HCV infection following SVR.

A 2018 study involving residents of 7 Canadian detention centers (84), found a lifetime history of injection drug use to be significantly associated with HCV infection. They also found needle

sharing was significantly associated with HCV among people who inject drugs (PWID) while tattooing in prison was significantly associated with HCV infection among non-PWID.

HCV treatment as prevention

A non-randomized clinical trial involving residents of 4 Australian prisons (83), evaluated HCV incidence in uninfected and previously infected individuals at risk of infection or reinfection. The study, which was published in 2021 compared incidence, in the period preceding treatment of infected individuals with direct-acting antivirals (DAA), with the period following treatment of infected individuals. They found a reduction in HCV incidence among the at-risk population of 1643, of which 31% reported injecting drugs during the current imprisonment. HCV incidence reduced by 48%, from 8.31 to 4.35/100 person-years between pre- and post-treatment scale-up periods. Incidence of primary infection reduced by 57% from 6.64 to 2.85/100 person-years, while incidence of re-infection reduced by 41% from 12.36 to 7.27/100 person-years. Among IDUs, incidence of primary infection declined from 39.08 to 14.03/100 person-years, and incidence of re-infection declined from 15.26 to 9.34/100 person-years.

HIV transmission

In a 2009 study investigating HIV transmission among residents, within the Georgia prison system (31), 88 seroconverters were found. These were residents who had one negative HIV test result followed by a confirmed positive HIV test result during the same period of incarceration. They were diagnosed with HIV from September 1992 to February 2005, during incarceration. Of 47 seroconverters with a single negative HIV test result during incarceration, 55% (26/47) were tested more than 180 days after the start of incarceration, 32% (15/47) 42–180 days after, and 13% (6/47) less than 42 days after. The facility where HIV infection occurred was definitively identified for 41% (36/88) of seroconverters (a definite facility of infection was defined as one in which a seroconverter had a negative HIV test result followed by a confirmed positive result during the same stay at that facility). 93% (69/74) of 74 seroconverters approached agreed to participate in audio computer assisted self-interviews (ACASI). 71% (49/69) reported sex in prison, 6% (4/69) reported IDU in prison, and 41% (36/69) reported tattooing in prison before their HIV diagnosis. Genetic analysis of combined p17 gag, partial gp41 env and pol sequences for 65 to 67 seroconverters' specimens confirmed close genetic relationships and 49% (33/67) were associated in 10 distinct bootstrap-supported clusters. 67% (22/33) of those in clusters had overlapping stays in the same prison with at least 1 other member of their respective cluster 79% (26/33) reported having sex (2 of these also reported IDU), 12% (4/33) reported tattooing only, and 9% (3/33) reported no risk behaviors. Through correlation of administrative data, risk data, HIV testing data and contact-tracing data, a sexual network was identified for the largest genetic cluster.

HIV treatment as prevention

A 2009 retrospective study in a US county jail (77), evaluated the impact of antiretroviral therapy (ART) on 512 HIV positive residents and found that those continuously on ART gained CD4 cells at an average adjusted rate of 0.67 CD4 cells/month, while those intermittently on ART or never on ART lost CD4 cells at an average adjusted rate of 0.93 and 1.29 cells/month

respectively. The viral load of those never on ART and intermittently on ART were found to be 3 and 1.5 times more than those continuously on ART. The findings of this study show that some treatment or intermittent treatment is better than no treatment and that commencing treatment even if there is uncertainty about adherence to treatment following release is not harmful. With continuous treatment viral suppression is attained and if viral replication is suppressed and undetectable, HIV will not be transmittable. In other words, undetectable = untransmittable or (u=u).

Correctional officers and exposure

A cross sectional survey published in 2009, investigated the risk factors for occupational exposure to blood and body fluids among US correctional officers (CO) in five US prisons (26). They found that those employed for greater than 5 years as COs, those occupying the rank of sergeant or higher and those working mostly with maximum security prisoners, were significantly more likely to be exposed to blood and body fluids. Sources of exposure were blood/fluids on skin/clothes or an open wound, waste/fluids thrown at them, bites/scratches with broken skin, and needle stick punctures. No articles detailing incidents of transmission of BBVs to COs, were found.

Syphilis

A 2017 publication reported congenital syphilis in 2 infants present with their infected mothers in a Bolivian prison (85). The mothers were among 28 women found to have syphilis in a previous cross-sectional study that investigated 219 incarcerated women. Cutaneous manifestations of congenital syphilis were observed in the infants and fluorescent treponemal antibody absorption test (FTA-ABS) for IgM was positive in both. One of the mothers was diagnosed at birth and a history of incomplete treatment of her newborn, for congenital syphilis, was obtained. The other mother was diagnosed 2 months prior to delivery but received inadequate treatment. Both infants were referred to a hospital for treatment. The need for prenatal screening and appropriate treatment of pregnant women in carceral settings, as well as appropriate postnatal examination and care for babies born to them, is illustrated by this report.

Prevention and management of STIs

A systematic review published in 2022, reviewed and synthesized published literature on the prevalence and management of STIs (32). Important recommendations were made for the prevention of STIs in carceral settings based on their findings. These included, voluntary opt out screening for STIs at entry, for *Neisseria gonorrhea*, *Chlamydia trachomatis*, HIV, HBV, HCV, syphilis, and *Trichomonas vaginalis*. Immediate treatment for those found to be positive, and provision of vaccines, to susceptible individuals, against vaccine preventable STIs like HBV and HPV, where applicable. They also emphasized the need for programs providing condoms in correctional facilities, pointing out that it had been found that they were acceptable, and could be executed without incurring any threats to safety or security.

Infections Transmitted by Contact: Skin and Soft Tissue Infections and Infestations

Infections involving the skin and soft tissue continue to be a considerable cause of concern, significant discomfort and illness in carceral settings and have been studied and reported (36–38,86–91). These infections may be caused by bacteria (36,38,86,87), viruses (91), ectoparasites (88–90), or fungi (37).

Bacteria

A review of skin and soft tissue infections

A single-jail review of skin and soft tissue infections (SSTI) (36) found methicillin resistant *S. aureus* (MRSA) infections accounted for the majority; 68% (50/74) were MRSA, 30% (22/74) methicillin-sensitive *S. aureus* (MSSA), 1% (1/74) *Pseudomonas aeruginosa* and 1% (1/74) *Enterobacter* species. Co-existing conditions included processes associated with breaks in skin epithelia (heroin abuse, eczema, scaly skin, in-grown nails, body lice, genital warts, perforated nasal septum) or impaired immunity (e.g., diabetes). The antibiotic most frequently used for treatment was clindamycin in 52.7% (39/74) of cases, followed by cephalexin in 24.3% (18/74). Five cases had an incision and drainage (I&D) done in addition to antibiotics; this was the sole treatment in one. All cases recovered. Prevention included discussions between healthcare staff, COs, and inmates on adherence to daily showering, washing hands frequently, covering all wounds, and avoidance of sharing of towels, clothing, and razors.

A 2010 single-jail study reported the response to an outbreak of community acquired MRSA (CA-MRSA) (38). Following the increased occurrence of treatment failures following the use of β-lactam antibiotic agents to treat skin infections, including one where culture yielded MRSA. Intervention measures included the institution of SSTI surveillance, general hygiene, cleaning, and infection prevention and control (IPC) measures in the jail. Initiation of surveillance revealed that MRSA isolates were 100% resistant to β-lactams.

Conditions identified to be a possible risk for infections included a defective thermostat in the laundry machines causing inappropriately low temperatures, and a malfunction of their soap dispensers resulting in inadequate amounts of soap, and in addition overloaded machines. These were corrected; also implemented were the provision of antibacterial bar soaps, antibacterial liquid soaps, and use of bleach for surface cleaning. SSTI surveillance was expanded to also occur at intake, and isolation and cohorting were instituted for infected individuals who were detected. Early I&D was implemented for identified cases, and a new antibiotic guideline was introduced. Case numbers fell with the implementation of all these IPC measures.

CDC and Federal Bureau of Prisons (BOP) have published guidelines regarding MRSA management (92,93). A 2009 cross-sectional study surveyed facility administrators and nursing clinic directors from 9 U.S. County correctional facilities (87) to assess their compliance with IPC for MRSA. MRSA screening rate of entrants before their release into the general jail population was nearly universal (94%). Rare was performance of a physical examination on residents exposed to a MRSA-infected individual and the use of antibiotic therapy only as an adjuvant to I&D.

Another cross-sectional study (86) published in 2009, assessed the presence of MRSA on environmental surfaces, in a US jail, and found that 10 out of 132 surfaces examined yielded *S. aureus*, 8 of which were MRSA isolates. MRSA was found in the health services building on a chair and in bathrooms, in resident housing on door handles and bathrooms, and on vehicle seats. Among MRSA isolates, 4 were identical to a strain previously identified in specimens from residents in the same jail.

Randomized controlled trial to reduce the carriage of MRSA and MSSA

A 2014 report on a randomized controlled trial (94) conducted over 6 months in a US county jail to investigate the effect of the use of chlorhexidine gluconate (CHG)-soaked cloths for skin cleaning on reducing MRSA or MSSA carriage in 4196 residents. After six months, the use of the CHG soaked cloths for skin cleaning was found to have resulted in a significant decrease in S. aureus carriage when compared to no intervention, with an absolute risk reduction of 10.4%. The decrease in the carriage of MRSA found however, was not statistically significant.

Viruses

A 2022 article reported an outbreak of mpox (previously known as monkeypox) (91) caused by the re-emerging virus, the monkeypox virus (MPXV), a member of the *Orthopoxvirus* genus of the Poxviridae family of viruses, in a carceral facility in Nigeria. Twenty-one cases were found among residents during an initial visit, and 7 more on another visit 3 days later. The initial 21 residents had experienced symptoms over the course of 18 weeks, which included fever, rashes, generalized weakness, and prostration. Rashes were observed on the face, head, neck, trunk, buttocks, extremities, and genitalia. All affected individuals had enlarged lymph nodes, mostly inguinal and with some cervical, which were firm, non-fluctuant and tender. Two of 5 patient samples were confirmed positive for the monkeypox virus by PCR. The outbreak was reported to relevant authorities locally, at the state level, to the Nigerian Center for Disease Control (NCDC) and to the World Health Organization (WHO). Recommendations made include the suspension of physical attendance at court sessions, delay of inter-prison transfers, the provision of individually marked uniforms and bed linen, use of disinfectants in laundering uniforms and bedding and the elimination of rodents. However, implementation of these was reported to be poor and the spread of the outbreak was not terminated. Residents of the prison were reported to be in conditions that could facilitate human-to-human transmission including sexual transmission, as well as zoonotic transmission presumably by rodents. The route or routes of transmission involved in the outbreak, were not definitively identified.

Ectoparasites

Scabies case review

Infestations with arthropod ectoparasites such as *Sarcoptes scabiei* var. *hominis* the aetiologic agent of human scabies and the potential for outbreaks continue to be problems in carceral settings. A 2021 article reported cases of scabies seen in a youth detention center in Spain (89), over one year, and reviewed literature on the management of scabies in carceral settings. Over the course of 12 months, from November 2018 to November 2019, 61 cases of scabies were

diagnosed. 64% of them (39/61) were discovered at the time of entry into the center, 18% (11/61) within the first 6 weeks of their stay (within the incubation period), and 18% (11/61) after spending more than 6 weeks in detention, implying infection could have occurred in detention. The cases were treated with 5% permethrin cream, applied twice, a week apart. Patients were isolated for 24 hours, the topical cream was applied and left on for 8 hours. In 8 cases, symptoms continued, and treatment had to be repeated. Other control measures included changing patient's personal clothing and treating the clothing, bedclothes, mattresses, towels, and other personal items. The cells occupied by patients were disinfected and left empty for four days. Cellmates were checked and treated. The review of literature, conducted as part of the study, found oral ivermectin to be the drug of first choice for treating patients and contacts in a carceral setting.

The review of literature conducted in the 2021 study included 2 studies (88,90) that involved interventions to manage scabies in carceral settings and because of their importance, they were included in this systematic review although they were published before 2008.

Large scabies outbreak

One of these two studies was published in 2000 and reported the response to an outbreak of scabies in a prison in Tanzania which had 1153 residents (90). Following multiple instances, over the course of 4 weeks, in which residents of the prison were brought to the skin clinic of a hospital in northern Tanzania with scabies, and on a few occasions crusted scabies, a visit was made to the prison. It was confirmed by the health workers on site that many residents had scabies and discussions and plans on how to manage the outbreak were made. In addition to the preliminary visit to the prison, 5 subsequent visits were made; on day 1 of the study and after weeks 1, 4, 8 and 12. On day 1, all residents were given a 150µg/kg single oral dose of ivermectin irrespective of scabies status. 70.9% (816/1153) of residents were found to have scabies, 1.4% (16/1153) had crusted scabies, leaving 69.6% (802/1153) with scabies that were not crusted. 24% (196/816) of those with scabies were observed to have severe pyoderma, noticed majorly on their hands, buttocks and genitalia. On day 1 also, the walls and floors of all the cells were treated with an emulsifiable concentrate of 80 mg of Pirimiphos methyl diluted in 20 L of water. All the sleeping mats and blankets were laid out in the hot sun for 1 hour. Any member of staff found to have scabies was treated with 1% lindane lotion as a single application. Follow up visits after weeks 1, 4 and 8 revealed resolution of signs and symptoms of scabies in 30%, 80% and 95.5% of residents with scabies respectively. After week 8, those with crusted scabies were treated with topical 1% lindane and the walls and floors of their cells retreated on the same day. After week 12, there was no evidence of scabies in residents or staff. Antibiotics were not given for the pyoderma noted in some residents, however, complete resolution of pyoderma, with scabies treatment and resolution, was reported in all affected patients.

Scabies infestation

The second study which was published in 2005 reported the response to scabies infestation among residents of a public jail in Brazil (88). Following examination by a dermatologist, 78% (94/123) of residents were found to have scabies and no cases of crusted scabies were seen. All 123 residents and staff who had contact with them were treated with oral ivermectin (200–300

mg/kg). Clothes and linen were changed and washed in hot water. The floors and walls were washed with chlorine and water. The treatment was repeated after 7 days with the same dose and all subjects were re-examined 8 days after the second treatment. Of those who initially had scabies and were treated 90.4% (85/94) were found to have no symptoms or lesions after 8 days. For those who were not diagnosed with scabies initially but were also treated prophylactically, 93.1% (27/29) were found to still be without scabies. All those with scabies on day 8 were given a 3rd dose of ivermectin and after 30 days there were no symptoms and signs of scabies. There were no reports of significant side effects.

Fungi

A 2012 cross-sectional study examined skin infections among residents of a Nigerian prison (37) and found that about half of the residents had skin infections and up to 98% of the infections were fungal. They found a total prevalence of skin infections of 49.2% (150/305), with some subjects having 2 or more infections making up a total of 178 infections. Dermatophytoses were found in 64% (114/178) of all infections, pityriasis versicolor in 27% (48/178) and candidiasis in 2.8% (5/178). The prevalence of infections was found to be significantly different with respect to spatial density (overcrowding), frequency of bathing and frequency of using soap. Residents with skin infection were treated at the prison clinic and a teaching hospital.

Infections Transmitted by Contact: Foodborne, and Other Gastroenteric Illnesses

Incarcerated individuals are indeed at risk for many infections transmitted by different routes in carceral settings. Important among these are those that are foodborne, transmitted feco-orally or present with gastrointestinal symptoms. Outbreaks of these continue to occur in carceral settings and studies reporting the outbreaks, management of the outbreaks or conditions of those involved in preparing food for those in carceral settings have been published and are included in this review (39–44,95–97).

Pathogens carried by food handlers, and their knowledge and practice of food handling

A 2020 cross-sectional study (95) assessed the prevalence of intestinal pathogens and the quality of knowledge and practice of food handlers involved in the preparation of food in 2 prison units in Ethiopia with 2080 residents. All those involved in handling food at both prison centers, 66 in number, were included in the study, however, only 59 provided stool specimens for analysis. The study found that 62.7% (37/59) of those examined had intestinal parasites, while stool cultures from 6.8% (4/59) yielded *Salmonella* spp. or *Shigella* spp. With regards to knowledge and practice, 84.8% (56/66) believed contaminated food always showed a change in color, taste, or smell. All the participants (66/66) always handled food with their bare hands, 43.9% (29/66) had uncut nails, 53% (35/66) did not use gowns, and 54.5% (36/66) did not cover their hair, when handling food.

Outbreak investigation (*Shigella flexneri)*

A cross-sectional study published in 2010 (39) demonstrated the steps of an investigation into the extent, source of, and pathogen responsible for an outbreak of gastroenteritis, which affected residents of a prison in Iran. The investigation found that the outbreak had an attack rate of

14.02% (701/5000). From questionnaires completed by 327 case-patients, symptoms reported included diarrhea, headache, and fever, by all, nausea, abdominal cramping, and vomiting by 99%, 97%, and 95%, and bloody stools by 51% of respondents, respectively. Records reviewed revealed that all residents had eaten canned fish, preserved beans, sausages, and raw vegetables 48 hours prior to the onset of the outbreak. From some stools specimens and rectal swabs collected from randomly selected, affected residents, only *Shigella flexneri* serotype 3a was isolated. All isolates were identical in antimicrobial susceptibility/resistance pattern and by enterobacterial repetitive intergenic consensus polymerase chain reaction (ERIC PCR) testing. Water samples that were also tested yielded no growth. Although raw vegetables which were consumed by all affected were not available for testing, they were suspected to be the source of the outbreak. Food handlers were asymptomatic, and their stool samples were negative.

Epidemiology of foodborne disease outbreaks in US correctional settings

Residents of correctional institutions are inordinately affected by illnesses resulting from outbreaks of foodborne disease when compared with the rest of the population. This was one of the findings of a study published in 2017 (98), which analyzed epidemiological data on foodborne outbreaks, in US correctional institutions from 1998 to 2014. These data were captured in CDC's Foodborne Disease Outbreak Surveillance System (FDOSS). The study revealed that the median number of illnesses per foodborne disease outbreak and median number of illnesses associated with foodborne disease outbreaks per 100 000 population, were more than 5 times greater in carceral settings than in the un-incarcerated population. Included from the analysis of FDOSS data were 200 outbreaks of foodborne disease, reported in correctional institutions, which gave rise to 20,625 illnesses, 204 hospitalizations, and 5 deaths. Although these outbreaks in correctional settings were only 1% (200/18,206) of all foodborne disease outbreaks reported, they were responsible for up to 5.8% (20,625/358,330) of outbreak-associated illnesses. The pathogens most frequently confirmed to have caused the outbreaks were *Clostridium perfringens* in 28% (36/128) of outbreaks with confirmed causative pathogens, *Salmonella* in 27% (35/128), and norovirus in 16% (21/128). In 89% (178/200) of outbreaks, preparation of food occurred within the correctional institution, while in 14% (28/199) of outbreaks food-handlers were found to be the source of contamination. The contributing factors, most reported, were leaving food at room temperature or warm outdoors for several hours in 37% (28/76) of cases, an infected person or carrier being a food handler in 26% (20/76), and insufficient cleaning of instruments, materials or devices used in the preparation of food in 24% (18/76).

Outbreak investigation (*Salmonella* Enteritidis)

A 2022 study reported the outcome of an investigation into the source of an outbreak of *Salmonella* Enteritidis among residents of a US correctional facility (41) launched by the local Health Department after a report of two cases Further investigation found about 100 residents had gastrointestinal symptoms. Open-ended interviews, lists of food handlers, food menus for the month, and temperature logs were reviewed, and an environmental assessment was conducted. A sample of unopened, raw, mechanically separated chicken still within its container was collected for analysis. An *S.* Enteritidis isolate, similar to the outbreak strain genetically, was obtained

from the raw mechanically separated chicken sample. Cooking temperatures were not routinely monitored during food preparation. The health department recommended exclusion of ill workers from food preparation, increased thawing time for chicken, routine monitoring and recording of cooking temperatures, and a shift to smaller preparation volumes for meals, to reduce possible risks and promote food safety.

Review of enteric illness outbreaks and outbreak investigations

A 2011 article reviewed peer-reviewed literature and reports from government and public health entities, for enteric illness outbreaks and outbreak investigations in correctional facilities (96), internationally, between 1999 to 2009. They focused on the epidemiology of the outbreaks and infection control measures that were found to be effective. They found 72 outbreaks reports, that met the criteria for inclusion in their review. Of these, 50 were from North America, 10 from Europe, 9 from New Zealand and Australia, and 3 from Asia. The etiologic agents for 76.4% (55/72) of these outbreaks were reported to be bacteria, with *Salmonella* spp. in 27.8% (20/72) of them, *C. perfringens* in 19.4% (14/72), pathogenic *E. coli* in 13.9% (10/72), *Campylobacter* spp. in 6.9% (5/72), *S. aureus* in 2.8% (2/72), *Vibrio cholerae* in 2.8% (2/72), *Bacillus cereus* in 1.4% (1), and *Clostridium botulinum* in 1.4%(1/72). Other etiologic agents included viruses in 20.8% (15/72) of the outbreaks, with 19.4% (14/72) due to norovirus and 1.4% (1/72) due to Hepatitis A virus. Parasites, specifically *Cryptosporidium* spp., were responsible for 1.4% (1/72) of the outbreaks, and 1.4% (1/72) were due to multiple agents. A food borne mode of transmission was implicated in 66.7% (48/72) of the outbreaks, while 11.1% (8/72) were transmitted person to person. Other modes of transmission were involved in 2.8% (2/72) and for 19.4% (14/72) the mode of transmission was unknown. Symptoms, cases presented with, included diarrhea, cramps nausea and vomiting, abdominal pain, headache, bloody diarrhea, and fever. Measures implemented to control the outbreaks included limiting movement of ill inmates, exclusion of ill food handlers, education of staff/inmates, application of hazard analysis & critical control point principles (HACCP), enhanced cleaning and disinfection of surfaces, improved communication, enhanced surveillance by the facility/community/health unit, enhanced handwashing and excluding ill staff. Recommendations made included monitoring of temperatures for cooking, cooling and reheating, washing/sanitizing kitchen equipment and surfaces, maintaining food temperature logs, not cooking food far in advance of service, enhanced handwashing, excluding ill food handlers, adequate number of functioning and accessible hand basins supplied with soap and a means of drying, and education of food handlers on safe food hygiene.

Outbreak of gastrointestinal illness due to rancid tortilla chips

A 2016 article reported an outbreak of gastrointestinal illness among residents and staff of a correctional facility in Wyoming (99), that was investigated and found to be due to rancid tortilla chips, served during lunch in the facility's cafeteria. Sixteen residents and staff had presented with complaints which included stomach cramping, gas, bloating, diarrhea, and burping which were reported to have occurred 1-3 hours after lunch in the cafeteria. Following the report of the outbreak to the state department of health by the county health department, officials of both, in collaboration, investigated the source of the outbreak. Case controls studies revealed that tortilla chips were the single item associated with illness and some residents and staff reported that they

had perceived the odor and taste of chemicals during lunch. Testing of stool and food samples did not isolate any pathogens. However, other tests revealed the presence of 2 markers for rancidity, hexanal and peroxide, underlining the need for a high index of suspicion and for other alternative tests in outbreaks where routine tests for pathogenic organisms turn out negative. Also important is a heightened state of vigilance, in checking for expiry dates or other markers that indicate food is still whole or unspoiled, prior to preparation.

County jail response to statewide hepatitis A outbreak

A 2021 publication reported the response of a US county jail to a statewide hepatitis A outbreak in Minnesota (97), declared by the state department of health in August 2019, following an increasing number of confirmed cases of hepatitis, compared with preceding years. Prior to the outbreak, in the jail which was reported to be the largest jail in the state with an average of 32,000 bookings yearly, residents were offered hepatitis A vaccine at initial nursing health assessment and within 14 days of intake into the jail. With the outbreak, the health services of the jail reorganized to offer hepatitis A vaccine at initial intake nursing assessment, with vaccinations occurring within 2 days from when the offer was made. Nurses made visits to the housing units on weekdays to give the vaccines within that window. If the resident could not be accessed there was a provision for returning to reattempt to give the vaccine within a 2-day window. As part of the response, tools, and materials to create messaging, to inform and educate about the outbreak, were incorporated into the intake process, and displayed in the housing units. In the week in which the new program was initiated, hepatitis A vaccination was offered to residents already incarcerated, in their respective housing units. With the measures implemented, vaccinations increased from 16 monthly, prior to the new initiatives, to 202, 90 and 137 in next 3 successive months respectively. However, no information was provided on the presence or absence of hepatitis A cases, among residents in the jail, following the increase in vaccinations.

Outbreak of enteric illness in a Canadian correctional facility

Setting

A 2013 article reported an outbreak of illness that was characterized by enteric symptoms (40), among residents and staff of a Canadian correctional facility, and the ensuing outbreak response. The outbreak response was initiated by the public health unit, in collaboration with health care staff of the correctional facility, following the notification of the public health unit of the sudden occurrence of illness presenting with enteric symptoms in residents and staff of the facility. The correctional facility, which housed 1,017 residents and had 500 staff, had recorded 10 residents and 1 member of staff who had presented with the illness, as at the time of notification, with the likelihood of an increase in the number affected.

Outbreak response: investigation

Healthcare staff screened all residents and staff, for nausea, vomiting, diarrhea, abdominal pain, headache, and pyrexia with a temperature of 38°C (100.4°F) or greater; They identified 57 staff

and 58 inmates (115 people) who met their case definition. Nausea, diarrhea, and vomiting were the most prevalent symptoms in 43%, 34%, and 23% of cases respectively, in addition to fever, abdominal pain, headache, malaise, and loss of appetite. Symptoms persisted for 2 to 3 days, and an estimate of 24 to 48 hours was made for the incubation period, on account of the difference in time between the presentation of the index case and the case which followed it. The unit the index case was from had the highest number of cases during the outbreak (27%). Attack rates among inmates and staff were 5.7% (58/1,017) and 11.4% (57/500), respectively. Despite the provision by the health unit, of a norovirus infection fact sheet and stool sample collection kits for collection of stool samples, for subsequent analysis at the Provincial Public Health Laboratory, only two samples were collected and submitted. The 2 stool samples collected tested negative for norovirus with electron microscopy and PCR, however, based on clinical and epidemiologic features, norovirus was suspected.

Outbreak response: control measures

Other measures implemented in addition to screening, included isolation of residents who were cases or close contacts of cases, asking staff cases to remain at home till 48 hours after resolution of illness, implementing standard precautions including enhanced hand washing, contact and droplet precautions, and limiting inmate transfer within the facility. Teleconferences between facility healthcare and management staff, representatives of the Ministries responsible for Health and Correctional services, and other relevant departments were held daily to provide recommendations and guidance. Some recommendations provided included separate handling of soiled laundry from symptomatic residents, provision of PPE such as gowns, surgical/procedure masks, gloves, eye protection, headgear, and shoe covers to both residents and staff performing environmental cleaning. In addition, environmental cleaning was to be enhanced, and information provided to residents and staff on the ongoing response and the need for the activities involved. Which included frequent hand washing and cleaning, for all environmental surfaces including vehicles, to limit the transmission of the disease. These were done by the facility's healthcare team which developed information materials and messaging targeted at residents and staff to educate them, keep them informed about the outbreak and the response, and keep them abreast of developments. However, cases continued to increase after the initial implementation of these, thus a complete closure to transfers and limitation of movement of inmates out to court, and restriction of visitors were implemented. Video and audio conferencing were used for court appearances. This resulted in a reduction in cases and eventual end of the outbreak. No hospitalizations or deaths were reported.

Outbreak costs and outcome

The costs due to the outbreak included an estimated US$109,720 (2008 dollars) for supplies and hiring nurses from an external agency, and an estimated US$316,603 (2008 dollars) for employee salaries and wages including overtime and additional staffing. Wall-mounted, alcohol-

based hand sanitizer stations were installed for both residents and staff for hand hygiene, and a resolution to switch to the use of only mattresses and pillows with washable plastic covers was made. Both initiatives were outcomes of the outbreak experience.

Botulism outbreaks

A trio of articles published in 2015, 2017 and 2018 (42–44) reported on outbreaks of botulism and the resulting response, in prisons in the US states of Arizona, Mississippi and Utah, respectively, following the ingestion of alcohol illegally brewed by residents within the prisons.

Box 2: Symptoms and Signs of Botulism

Nausea, vomiting, abdominal pain, blurred vision, diplopia, dizziness, slurred speech, dysphagia, dilated pupils, extraocular palsies, ophthalmoplegia, ptosis, bilateral ptosis, weakness, fatigue, impaired gag reflex, shortness of breath, respiratory depression, cranial nerve palsies and descending paralysis.

Botulism in Arizona

Setting

The botulism outbreak in Arizona (43), which was reported to have occurred in a maximum-security prison, with 1050 residents, was discovered when 5 of them presented for care with complaints of symptoms, found to be suggestive of botulism (see Box 2). They subsequently progressed to respiratory distress, while 2 more residents also presented with similar symptoms, the following day. All 7 patients eventually required admission to ICU and mechanical ventilation. By the 3rd day, an 8th resident presented with symptoms and was also admitted to the ICU but did not require mechanical ventilation. All 8 patients received heptavalent botulinum antitoxin within 24 hours of hospital admission.

Investigation and outcome

An outbreak investigation was conducted by the Arizona Department of Corrections, the CDC, the Pinal County Division of Public Health (PCDPH), and the Arizona Department of Health Services (ADHS). Chart reviews and interviews were conducted with residents of the prison, including those affected in the outbreak and in a previous outbreak, months earlier. All 8 reported drinking from the same batch of pruno or eating potato pieces from the same pruno mixture at about the same time, on the day before the first 5 presented. The impetus for pruno production was reported to be Thanksgiving celebration. All serum samples obtained before antitoxin

administration, from each of the 8, had positive results for botulinum toxin type A. Serum samples obtained 24 hours after antitoxin administration were negative for toxin in all patients. Five rectal swabs and stool samples were positive for botulinum toxin type A. The pruno sample confiscated from a patient's cell yielded *C. botulinum* and botulinum toxin type A. PFGE patterns for botulinum toxin types were dissimilar, when those obtained from the current and previous outbreak were compared, but identical when comparison was among those obtained in each outbreak (November and August, respectively). The 7 patients who required mechanical ventilation received tracheostomy and percutaneous endoscopic gastrostomies 11 to 14 days after admission, and care in long-term care facilities, 2 to 3 weeks after initial hospitalization. The 8th patient, who was not intubated, was discharged after 5 days. None died, but those intubated experienced ventilator associated pneumonias (VAP) and other derangements in health while hospitalized. ADHS and PCDPH produced and delivered education to residents and correctional staff on signs, symptoms, and prevention of foodborne botulism. Educational fliers were bilingual and had input from the residents. Baked potatoes and sugar were banned from inmate meals to prevent pruno production. These were a departure from the response of the correctional facility to the previous outbreak, following which no preventive measures were reported to have been taken.

Botulism in Mississippi

The Mississippi outbreak of botulism (42) was reported to have occurred in a federal medium security prison. It was disclosed to have been brought to the notice of the CDC when information was received, from the Mississippi Poison Control Center and the Mississippi State Department of Health (MSDH), about 5 suspected cases of botulism among prison residents. By the following day, up to 13 residents of the prison were hospitalized, 12 in Mississippi, and 1 in Oklahoma where he had been transferred to prior to the development of his symptoms. MSDH, Oklahoma State Department of Health, Bureau of Prisons, and CDC jointly commenced an investigation of the outbreak. Clinical charts were reviewed to extract information and residents were interviewed. Thirty-three residents reported consuming hooch (also called pruno) during a period that spanned 8 days before and 10 days after the initial notification given to the CDC of the outbreak. Of these 94% (31/33) had signs or symptoms suggesting botulism (see Box 2). Of the 31 cases identified, (all men), 19 were confirmed cases (with laboratory evidence), 10 probable cases (cranial nerve palsy signs or symptoms, with extremity weakness), and 2 suspected (cranial nerve palsy signs or symptoms, without extremity weakness). It was reported that honey, potatoes, apples, and tomato paste from a bulging can were combined, hidden, and fermented in a sealed plastic bag at room temperature for 3–5 days to make the alcohol. Of 24 residents that were hospitalized, 63% (15/24) required care in an intensive care unit and 38% (9/24) required intubation and mechanical ventilation, however, there were no deaths. Eighty-three percent (20/24) of those hospitalized were administered botulinum antitoxin while 11 patients with milder illness did not require antitoxin. Staff members confiscated >20 gallons of hooch during the investigation, however the particular batch of hooch responsible for the outbreak, its mode of production and the constituents used could not be determined. The

production of alcohol in this outbreak was linked to a farewell celebration for one resident and the US National Basketball Association (NBA) finals. This outbreak of botulism was reported to be the largest in the US since 1978.

Botulism in Utah

Setting

The first indication of an outbreak of botulism in the maximum-security facility, of a state prison in Utah (44), was a resident who presented with symptom (see Box 2) less than 13 hours following the ingestion of pruno. The prison, which had a capacity to house 4000 prisoners, also contained minimum, medium, and super-maximum facilities. Over the 2 days following his presentation, more symptoms of botulism (see Box 2) also evolved in the patient, culminating in his being unable to walk. Following his transfer to an acute care hospital, he was found to have signs (see Box 2) in keeping with botulism. An assessment of impending respiratory failure, made a short while following admission, resulted in placement on mechanical ventilation. Within 3 days of this index patient presenting, the Salt Lake Valley Health Department, Utah Department of Health, and CDC were notified of this suspected case of botulism. Heptavalent botulinum antitoxin (HBAT) was sent in from the CDC and was administered to him on day 4 following presentation.

Investigation.

The chain of events which occurred was reported to have resulted in the commencement of an outbreak investigation by public health officials, to confirm the suspected diagnosis, find other cases if they existed and to determine the source of the outbreak. Medical evaluations and interviews were conducted with residents and some laboratory tests were done. Residents and staff in the section where the index patient came from were interviewed. Fliers were posted and announcements made, to encourage those with symptoms suggestive of botulism (see Box 2) to report for evaluation. Residents were informed that no one would be penalized for confessing about ingestion of pruno and were made aware of the risk of illness and death that existed for those that had consumed pruno. Prison medical staff examined residents who voluntarily presented themselves or were found during visits to individual cells. Prison staff searched cells for any remaining pruno and looked for items that might have been used to make it. Over the course of the subsequent days, 8 cases of botulism were identified out 13 residents who consumed pruno. Cases were defined by illness with at least 2 signs or symptoms suggestive of botulism (see Box 2), during the outbreak period, with laboratory evidence of *C. botulinum* or botulinum toxin in obtained samples, or a history of consuming the same batch of pruno as a case patient. Two batches of pruno were found to have been in circulation during the outbreak and all pruno found in cells were seized. Different jars and plastic laundry bags were also seen in cells. All 8 cases consumed pruno from one of the batches. All 8 cases received HBAT, sent in from the CDC, and 3 cases required mechanical ventilation. Botulinum toxin type A was identified in serum of 5 patients, and *C. botulinum* type A was isolated from the stool of 4 patients. Liquid squeezed from a sock containing strained potato, used to make the pruno, yielded *C. botulinum*

type A on culture but was negative for botulinum toxin. *C. botulinum* type A isolates from stool of 4 patients and the liquid squeezed from the sock, were identical by PFGE. Pruno remaining from the other batch, did not yield toxin or *C. botulinum*. Residents reported that oranges, grapefruit, canned fruit, water, and powdered drink mix obtained from meal trays or purchased from the commissary were used to produce pruno. One of the residents, who eventually also became ill with botulism, had fermented the ingredients over the course of some days in a sealed plastic bag referred to as a "brew bag". It was also reported that a sock may have been used to sieve the fermented liquid and the product shared to other residents using resealable plastic bags meant for laundry.

Outcome and estimated costs

Following the outbreak investigation, whole potatoes were banned in the prison and laundry bags were replaced with perforated ones, to prevent their use in pruno production in the jail. Hospital costs for the care of affected residents were estimated to be $500,000.

Infection Prevention and Control in Prison Healthcare Facilities

A cross-sectional study published in 2016 (100), assessed infection prevention and control in dental surgeries in prisons in Para, a state in Brazil. Eleven dental surgeries, in 11 of the 12 clinics located in prisons in the state were physically inspected using a structured data collection form, and 12 of the 13 dentists who worked in the prison clinic were interviewed using a questionnaire. They found that in 91% (10/11) of the prison dental surgeries there was no specific area for decontamination of instruments and no clean and tidy storage areas for sterile products. Only 27% (3/11) and 36% (4/11) of dental surgeries observed had walls and floors, respectively, that could easily be cleaned and disinfected. They also found out in the surgeries that 64% (7/11) used only one sink for washing hands, instruments, and all cleaning, while all (11/11) used dry heat in form of ovens for sterilization but did not pack instruments prior to sterilization. Only 25% (3/12) of dentists reported having access to disinfectants and descaling substances for washing instruments and having a procedure for aseptic handwashing. Only 8% (1/12) of dentists reported the presence of infection control procedures in the surgery. Lastly 58% (7/12) of dentists reported the use of the same bins for infectious waste and general waste and having no defined clean and dirty areas in their clinics.

Table 2. Overview of Literature. Infection Control in Correctional Settings 2008-2022

Article #	Referen	Year	Authors	Study Population [Country]	Study Design	Exposure or intervention / Outcome measure	Main Findings: Outcome Measure (OR, RR, Proportions)	Strengths and Limitations	Implications
1	8	2011	Noeske et al.	3219 residents of a prison [Cameroon]	Cross-sectional	Prevalence of undetected pulmonary TB, risk factors for undetected TB	Prevalence of undetected TB of 1.2%, missed by the prison's TB control program. Prison occupancy level of over 400% and 3.3% of residents had a BMI of < 18.5. TB associated with a BMI <18.5 kg/m^2 (OR 14.96, 95% CI 7.08–31.64, p <0.001). TB associated with overcrowding (OR 4.88, 95%CI 1.48–16.13, p < 0.009). TB associated with previous TB treatment (OR 4.06, 95% CI 1.70–9.71, p< 0.002)	Involved almost all residents of the prison. Methods used did not prove TB transmission occurred in the jail or that individuals with TB disease were infected by genotypically similar strains.	Highlights the possible role of overcrowding and malnutrition in the TB epidemic in a Cameroonian prison
2	51	2022	Kosambiya et	1665 residents of a prison [India]	Cross-sectional/Intervention	Active case finding for TB and HIV	121 people reported symptoms after screening and of these 7 new cases of TB were reported (2 by CBNAAT, 5 by chest x-ray). 1652 people were screened for HIV and 3 new cases of HIV found.	May not be generalizable to other settings	Suggests the use of active TB or HIV screening uncovers new cases.

3	52	2022	Velen et al.	3576 residents of 4 correctional facilities [South Africa]	Cross-sectional	TB yield from symptom screening alone to guide definitive testing compared with TB yield with symptom screening and d-CXR with CAD screening to guide definitive testing. Compare the performance of GeneXpert ultra with liquid culture.	TB yield was highest among participants tested based on positive symptoms or having a CAD score ≥ 50 (28 TB cases; 7.8 per 1,000 population). It was lowest among participants tested based on symptoms only (13 inmates with TB cases; 3.6 per 1,000 population). Xpert ultra and liquid culture were similar in perfomance (5.6 vs. 4.8 per 1,000 population; P = 0.21)	Study was adequately powered to detect the increase in yield with d-CXR	Suggests that addition of d-CXR to symptom screening would improve TB yield

4	9	2012	Sánchez et al.	Residents of a medium security prison [Brazil]	Prospective cohort	RFLP genotypes of TB strains isolated over the period of the study	12 clusters were identified and 84% (79) of the 94 strains genotyped by RFLP, belonged to one of the 12 identified clusters. The number of strains in each cluster ranged from 2–21 strains. Time space distribution shows that genotypes of MTB isolated at subsequent screenings are largely from the same clusters identified at the initial screening.	No information about or estimation of how overcrowded the cells are, compared to the number of occupants they were designed for (occupancy rate). No separation of TB infected inmates after diagnosis	Suggests that the same TB strains may be maintained in circulation in settings with overcrowding or continuous interaction of infected and uninfected prisoners

5	10	2018	Séraphin et al.	Residents of a prison and residents of the community [US]	Outbreak investigation	Use of WGS, phylogenetics, and transmission modeling to investigate a TB genotype cluster, established using genotyping by spoligotyping and 24-locus MIRU-VNTR.	Using WGS, phylogenetics, and transmission modeling, it was demonstrated what was presumed to be a single outbreak based on the use of spoligotyping and 24-locus MIRU-VNTR for genotyping actually involved distinct bacterial transmission chains separated by country of birth. Based on whole genome phylogenetic analysis two large clusters could be demonstrated. One cluster composed of genetically related strains including all of the prison isolates sequenced and cases where recent contact with a released prisoner was reported, and which could be subdivided into two smaller transmission clusters. The other main cluster included majorly, the cases, born outside the United States. There were multiple introductions of a strain endemic to a foreign country, with isolated transmission events to close household contacts in Florida. The earliest isolate was recorded from a recent immigrant it is believed this circulated in the community over years and was later introduced to the prison and the back to the community	Strong use of more recently available technology to explore outbreaks and transmission	Suggests a place for WGS in TB outbreak investigation, as it has higher discriminatory power when compared to traditional genotyping methods, for differentiating between closely related bacterial genomes and detecting transmission events.

6	53	2018	Merid et al.	2068 residents of a prison [Ethiopia]	Cross-sectional	Active case finding for TB, prevalence of TB	Out of 372 symptom postive patients 31 were found to have TB using GeneXpert, 8 positives using smear microscopy. 1 was rifampicin resistant and later confirmed to be MDR-TB using culture and DST. TB prevalence was 1748 per 100 000 persons. Persons with cough ≥ 4 weeks were more likely to have TB (OR 3.34, 95%CI 1.54–7.23). Out of 2040 tested for HIV, 0.4% (9) were HIV-positive. Only 16 of the 31 people with PTB were tested for HIV and they were negative. 90% of those with TB were in cells that were overcrowded with >100 people	HIV tests were not offered at the same time as TB tests as should be done in integrated TB/HIV case finding. HIV tests were offered 6 months after TB screening and as a result not all those with TB got a HIV test. Occupancy rate or the actual number meant to inhabit a cell was not stated.	Shows that active case finding using symptom screening to guide molecular testing of sputum using GeneXpert is feasible and to be recommended in low-income settings

7	54	2016	Paião et al.	Residents of 12 prisons [Brazil]	Prospective cohort	Incidence and risk factors for TB. Impact of active screening for TB on subsequent development of disease.	Out of 1422 prisoners who had been screened en masse at baseline (considered active detection) a TB prevalence of 703 per 100,000 (10/1422) was found. At second mass screening after a year in the remaining 1412, 18 were found to have TB for which an incidence of 1275 per 100,000 (18/1412) was reported. In 2194 prisoners who were not screened en masse and who remained in prison for up to a year, 37 cases of TB were reported (considered passive detection). An incidence of 1686 per 100,000 (37/2194) was reported. Passively detected cases were more likely to be positive (10.0 % vs 50.9 %; p <0.01). Drug use (AHR 3.22; 95 % CI 1.05–9.89) and knowing somebody with TB were (AHR 2.86; 95 % CI 1.01–8.10) associated with active TB during one year of follow up. Prisons were crowded with male prisons at 265 % capacity and female prisons at 148 % capacity.	Both the active detection and passive detection groups were in the same prisons together so the possibility that those that were TB free among the active detection group were infected by those in the passively detected group is quite high. The fact that the passively detected group were more likely to be smear positive suggests they had TB disease for longer which possibly could have been detected if they had been actively screened. The ethics of actively screening only some people and leaving others who inhabit the same overcrowded space and may be	Suggests active case finding in prisons detects TB case earlier, with the potential of limiting transmission. Suggests overcrowding may be significant factor for TB spread in Brazilian prisons.

								also infected is questionable.	

8	55	2008	Legrand et al.	TB dynamics in 1 prison, unpublished data and published literature [Brazil]	Modeling	Modeled and compared the effects of, DOTS strategy, TB detection at entry point of symptomatic individuals with eligible cough, detection of TB at entry point using chest X-ray and annual chest X-ray mass screening of inmates, on TB prevalence in a Brazilian (Rio de Janeiro) prison.	Simulating the implementation of the DOTS strategy alone, the model predicted active TB average prevalence slowly decreasing from 4.6 to 3.4% (2.4, 4.5) at year 3 and 2.2% (1.3, 3.3) at year 10. There was no change with addition of symptom screening at entry, it improved marginally with DOTS + chest x-ray screening at entry. However, annual mass X-ray + DOTS + screening at entry point, on simulation showed a rapid reduction in active TB average prevalence from 4.6 to 0.7% or lower (0.3, 1.2) at year 3, with symptom screening at entry reducing to 0.7 and chest x-ray screening at entry point reducing it even lower.	Limited generalizability to other carceral settings.	Suggests that screening with symptoms and chest x-ray at intake, annual mass screening with chest-x-ray and DOTS when implemented would reduce TB prevalence in carceral settings in countries with high and intermediate TB endemicity.

9	4	2019	Simpson et al.	Review and synthesis of the literature on the association between prison cell spatial density and the transmission of infectious diseases between prisoners. [International]	Systematic review	Evidence of association between cell spatial density and infectious diseases & quality of the studies	1st study reported a statistically significant association between cell spatial density (>5.6vs ≤5.6[m^2per person]) and MTB disease was reported (adjusted OR (aOR) 2.6; 95% CI 1.6 to 4.3); found by the review to be of fair quality. 2nd study found significant association between cell spatial density and LTBI (aOR 3.5; 95% CI 1.1 to 11.5); fair quality. 3rd study reported significant association between spatial density and pneumococcal disease with higher attack rates in 4 person cells of 2.9 m^2 per person and lower in single cells of 4.2 m^2 per person and open dormitories of 2.6m^2 per person (aOR 2.0; 95%CI 1.1 to 3.8); poor to fair quality. Also, infectious dermatosis and presenting at the clinic for contagious illness were found to be associated with spatial density by other studies	Few studies with limited generalizability. Studies reviewed were found to be of poor quality for reasons like the high likelihood of bias, confounding and misclassification	Suggests that there is some association between overcrowding in terms of spatial density and incidence of infectious diseases in carceral settings

10	7	2015	Urrego et al.	141 cells housing 1,217 inmates in 3 prisons [Brazil]	Modeling	Mean per person ventilation rates under existing architectural conditions and occupancy rates. Estimated risk of TB transmission under prevailing conditions. Projected reduction in TB transmission risks with interventions.	There was an overall mean occupancy rate of 8.6 inmates per cell, inmates were locked in cells for a mean of 18.4 hours per day, with a mean available floor area of 2.1 m^2 per prisoner (minimum standard recommended by the American Public Health Association is 5.6 m^2). Estabelecimento Penal de Corumbá (EPC); Penitenciária de Três Lagoas (PTL); Unidade Penal Ricardo Brandão (UPRB) had mean per person ventilation rates of 9.5 L/s/ person (95% confidence interval [CI]: 8.3–10.8), 23.9 L/s/person (95% CI: 21.1–26.7), and 16.4 L/s/person (95% CI: 11.9–20.8), respectively ($P < 0.001$), for a combined mean of 19.4L/s/ person (95% CI: 17.3–21.5). 49.6% of cells had less than 12 air changes per hour (ACH) and 97.9% had less than the World Health Organization (WHO)-recommended 60 L/s/person for naturally ventilated, general wards. The mean estimated risk of TB transmission after exposure for 180 days to an infectious cellmate under the existing conditions was 78.9% (95% CI: 69.7–88.1) for EPC, 81.1% (95% CI: 75.2–87.1) for PTL, and 65.6% (95% CI: 54.6–76.5) for UPRB, ($P < 0.001$). Improved case finding resulted in an 8.3% reduction in the estimated transmission risk for existing scenarios. Modeling minimum ventilation rates of 12 ACH for cells resulted in a 6.8% reduction in mean transmission risk. Combining both intervention strategies of decreasing time-to-diagnosis and	The prisons used were not randomly selected. Findings may not be generalizable to other carceral settings.	Suggests that overcrowding and poor ventilation pose increased TB transmission risks that are only minimally affected by improved case finding but may be substantially reduced by improving minimal ventilation to the WHO standard of 60L/s/person and implementing optimal cross ventilation.

							improving minimum ventilation to 12 ACH, reduced estimated transmission risks by 16.2%. Improving minimal ventilation to 60 L/s/person reduced TB transmission risk by 38.2%, and implementing an optimal cross-ventilation design reduced TB transmission risk by 64.4%.		

11	11	2008	Lambert et al.	Residents, staff, visitors of a prison [US]	Outbreak investigation	Review of state TB surveillance data to identify inmates incarcerated during outbreak (2003, 2004) for whom TB disease was reported, contact tracing, screening of contacts, genotyping of TB isolates. Identification of missed opportunities to prevent TB transmission	7 cases of TB were identified that were considered outbreak cases because they were genotypically similar (5) or were culture negative but epidemiologically linked to culture positive outbreak cases. An 8th case was reported by local health authorities a few months after his release, but the TB isolate was genotypically dissimilar and thus was not considered part of the outbreak. After the outbreak investigation another case of culture positive TB was reported in a former inmate of the index prison, over a year after his release. The TB isolate in this inmate matched the outbreak strain genotypically. The inmate was identified as part of the source investigation for an 8-month-old child with TB meningitis caused by the outbreak strain. The 8- month old, another child and an adult (3 TB cases) were contacts of this former inmate in the community. The inmate that was first diagnosed with TB had an infectious period of 147 days and had visited the prison clinic over 5 times complaining of productive cough, fever, chills, night sweats, and weight loss. 5 months after his initial complain of symptoms, a chest Xray was done, and a diagnosis of TB made. He was then isolated from the general inmate population, but he had already been moved through 5 different housing units. Although TB screening was done for staff at hiring and inmates at intake using TST, baseline and subsequent	Deficiencies in the TB infection control at the time of the outbreak were identified and measures instituted to close the gaps. May not be generalizable to other carceral settings	Useful report of TB transmission due to infection control gaps, the identification of the gaps and steps taken to close the gaps.

							annual screenings for TB symptoms were not well documented in inmates' medical records, and TST results were not reviewed systematically to detect increases in TST conversion rates. Although inmates with positive TST results were evaluated for TB disease with a CXR and physician examination, the evaluation was sometimes delayed. Inmates with LTBI were not always treated, and DOT was not available for those who were treated. Established procedures for notifying the health department about TB suspects and cases were not in place resulting in delayed contact investigations. There was no designated person or team assigned to TB infection control at the time of the outbreak, and although correctional staff received training on infection control at initial hire, ongoing TB training was not routinely offered.		

12	56	2020	Kuupiel et al.	Review of published peer reviewed literature on active case finding (ACF) TB interventions in carceral settings in 54 countries in subsaharan African (SSA) [SSA]	Scoping review	TB ACF studies/type of TB ACF done	74% (23/31) of included studies used only mass screening, 6.5% (2/31) used both mass and entry screening. 3.2% (1) used mass and routine screening by peer educators, 3.2% (1) used mass screening and tuberculin skin testing, 3.2% (1) used facility-led ACF, 3.2% (1) used mass, entry and routine screening using inmates as peer educators, 3.2% (1) used entry and routine screening using inmates as peer educators, and 3.2% (1) used mass, entry, and exit screening. 98.7% (30/31) reported smear positive as an outcome. Of the 31 studies included, 28 were cross-sectional, 2 were cohort and 1 was a cluster-randomized trial. Included studies were from 20.4% of (11/54) SSA countries.	Reviewed only peer reviewed published articles so cannot conclude that countries without published studies do not have ACF for TB, because there could be interventions of TB ACF being executed but not published in the peer reviewed literature.	States that TB ACF studies in SSA published in peer reviewed journals come from relatively few countries and are mostly cross-sectional studies.

13	57	2008	Rutz et al.	Evaluation of the TB prevention and control program in a large urban jail [US]	Program evaluation	Systematic observation of screening at intake and review of records/Adherence to TB control guidelines	All of 3 TB symptom screening questions were asked correctly during only 6.2% (6/97) of observed intake interviews. At least 1 TB symptom screening question was asked correctly during 28.9% (28/97) of intake health interviews. In 71.1% (69/97) health interviews observed, none of the TB screening questions was asked as written. In instances where the questions were not asked, the booking officers consistently recorded the answer as "No". All TSTs were administered within 14 days of intake for men and for women, in accordance with guidelines (IAWG). 78% (111/143) of male detainees who needed a CXR, had it done within 3 days from CXR referral IAWG, 15% (21/143) had a CXR between 4 and 13 days, 6% (10/143) were released before a CXR, and 0.01% (1/143) did not receive a CXR within 90 days. 15% (12/82) of female detainees who needed a CXR had it done within 3 days IAWG, 45% (37/82) had a CXR between 4 and 29 days, 34% (28/82) were released before a CXR, and 6% (5/82) did not receive a CXR within 90 days. Lack of specific clinical criteria for suspected TB disease to inform airborne infectious isolation (AII). Lack of standardized procedures, data collection forms, and a unified specific database for contact tracing. Results of evaluation were used to take corrective actions and make changes in the facility	The results of the evaluation were used to make changes to deficiencies identified in this jail. Not generalizable to other settings	Provides a good example that illustrates the need for regular evaluation of TB prevention and control programs in carceral settings.

14	5	2015	Dara et al.	Review of published articles [International]	Expert review	Challenges to TB control in prisons	Inadequate laboratory capacity and absence of new and improved diagnostic methods. Interrupted supply of quality medicines. Deficient DOTS mechanisms. Inadequate medical facilities, inadequate TB/HIV collaborative activities. Drug resistance, IDU in prison populations Lack of harm reduction and safer sex programs to prevent HIV. Limited, social support of vulnerable populations, and attention to comorbidities (HIV, hepatitis, psychiatric disease). Weak integration of community and prison TB services, and continuum of care for released prisoners and high incarceration rate. Low priority of prison healthcare for policymakers. Poor commitment of prison authorities to address TB prevention, control, and care. Unclear responsibilities of different ministries and health authorities and mismanagement of TB control in carceral institutions. Inadequate qualified and motivated staff, poor training/education and poor appreciation. Limited or poor patient education, and stigmatization of prisoners with TB. Lack of access to prisons by community representatives, NGOs, and organizations with the capacity to support the vulnerable population Insufficient surveillance, supervision, monitoring, and evaluation systems. Inadequate IC measures due to overcrowding and/or organizational and legal challenges in the timely separation of patients. Lack of funding Lack of	Extensive analysis of the challenges of TB control in carceral facilities	Governments, government ministries or departments responsible for the health of the incarcerated and carceral facilities need to address the outlined challenges.

							commitment by research institutes Legal difficulties with research in prison systems.		

15	59	2014	Schwitters et al.	Residents of prisons diagnosed with TB between June 2011 and November 2012 [Uganda]	Retrospective cohort	TB incidence, TB treatment outcomes and risk factors for treatment default.	The incidence rate of TB found during the study period was 955/100,000 person years (py) calculated from a total of 469 TB cases recorded in Ugandan Prisons Service (UPS) facilities between June 2011 and November 2012. Males, who were 98% (460) of the population, had an incidence rate of 976/100 000 py while females had 452/100 000 py. 466 prisoners started anti-TB treatment, 48% (222) achieved treatment success (sum of cured and completed treatment), 43% (202) defaulted, 5% (22) died, 4% (18) were still on treatment and 0.4% (2) had treatment failure. Of the 466 who started treatment, during anti-TB treatment, 199 remained in the same prison throughout, 137 were transferred or changed prison locations, and 130 were released. 12% of the 199 prisoners remaining in the same prison defaulted, 53% of the 137 transferred defaulted. Of those defaulting while in prison, 77% defaulted after transfer. Of the 130 prisoners released during treatment, 81% (105) were lost to follow-up. In multivariate analysis, the odds of anti-tuberculosis treatment default were 8.4 times greater among those transferred during treatment than among those not transferred.	Incident cases may have been overestimated because records used did not indicate when people were admitted into prison. Study involved all prisons in Uganda making it representative of the Ugandan carceral setting. However, it may not be generalizable to other carceral settings.	Study highlights non-completion of anti-TB treatment in Ugandan carceral settings and suggests transfers or release during TB treatment is a strong risk factor for non-completion.

16	58	2019	Adane et al.	Residents of 16 prisons [Ethiopia]	Cluster-randomized trial	Use of trained resident peer educators in active case finding for TB/mean case detection rate	Following matching of prisons into pairs, prisons included in the study were randomly assigned to an intervention group (8 prisons), and to a control group (8 prisons) over a 1-year period. 3 to 6 residents were selected in each intervention prison, trained as peer educators, and assessed post training for ability to identify presumptive TB through symptom screening. Successful peer educators were then mandated to educate other residents about TB and conduct active TB symptom-based screening, over the course of the study. Presumptive TB cases were linked to prison health officials for referral to hospitals for laboratory or radiological investigation. The mean case detection rate was significantly higher in the intervention prisons than in the control prisons (79·8% vs 26·9%; mean difference 52·9 percentage points, 95% CI 17·5–88·3, p=0·010). The odds of being diagnosed with tuberculosis was significantly higher in the intervention prisons compared with those in the control prisons (adjusted OR 1·633, 95% CI 1·630–1·636, p<0·0001).	Good quality study a cluster-randomized trial. May be generalizable to other carceral settings in Sub-Saharan Africa.	Suggests that the use of trained peer educators in active case finding for TB can increase case detection in low resource carceral settings.

17	62	2018	Herce et al.	Synthesis of literature on HIV TB coinfection among prisoners [International]	Review	Recommendations for HIV TB coinfection prevention, treatment and care continuum in prisoners	Integrated treatment for HIV TB coinfection using active case finding methods. Screening for TB in PLWHIV with both symptoms and chest x-ray. Strengthening prison health systems to the level available to the general public. Use of GeneXpert testing for pulmonary TB provision of universal test and treat for both TB and HIV, providing active TB treatment and ART. Providing newer TB preventive therapy for HIV positive prisoners without TB. Strengthening prison health systems. Integrated EHR to ensure patients on treatment for HIV or TB when transferred across prisons do not experience treatment interruption	Identifies the barriers to adequate prevention, treatment, and care for TB HIV coinfection in prison	Suggests measures to sustain effective TB HIV prevention, treatment and care continuum in prisons internationally
18	63	2019	Wheeler and Mohle-Boetani	Residents of California prisons [US]	Retrospective cohort and longitudinal cohort	Completion rates, side effects, and costs of 3HP and 9H for treatment of LTBI	9H completion rate was 42% and discontinuation due to hepatotoxicity was 14%. 3HP completion rate was 90% and discontinuation due to hepatotoxicity was 2%. The cost per fully treated patient for the 9H was $981 and for 3HP $652.	Strong evidence	Suggests 3HP is tolerated more, adhered to more and when all costs are taken into consideration including the proportion of those completing the regimen relative to the costs incurred by all who were commenced on each regimen, 3HP costs less in comparison.

19	16	2018	Junghans et al.	Staff and residents of a prison and staff of health agencies involved in the response [UK]	Review of response to a measles outbreak	Root cause analysis done and healthcare service staff interviewed	Problems: low immunity among prisoners and distrust of authorities, unvaccinated staff, lack of response team and supplies, shortage of custody staff and healthcare staff, lack of proactive screening and immunization, lack of adequate education or information provision to prisoners about the infection and the vaccine, lack of adequate vaccination space and lack of suitable infrastructure. Recommendations: ensuring full immunization of prison staff, detailed recording, opt-out testing and/or empirical vaccination of prisoners as well as the offer of the opportunistic vaccine in the event of an outbreak	Findings may not be generalizable to other settings, but the principles involved are universal.	Provides an autopsy of an outbreak response, outlines the problems and suggests ways to resolve the identified issues.

20	17	2019	Venkat et al.	Staff and detainees of a privately operated ICE detention facility [US]	Outbreak response/intervention	Measles outbreak response	Investigations and surveillance revealed that up to 15 days earlier detainees had been reported with rashes of unknown etiology which were clinically diagnosed as chicken pox or scabies without laboratory confirmation). 32 confirmed measles cases were identified comprised of 23 detainees and 9 staff members. 84% (27) of cases were laboratory-confirmed by measles IgM by serology or measles RNA by RT-PCR; 16% (5) were confirmed by epidemiologic linkage. RT-PCR–positive specimens from 4 detainees and 7 staff members (11 cases) all yielded genotype D8 viruses with identical (N-450) sequences. In 19 cases tested, comprising detainees and staff members, 95% (18) had high IgG-avidity test results and 79% (15) had high neutralizing-antibody titers (denoting reinfection). Among 9 staff members who were confirmed measles cases, 4 had been vaccinated prior to the outbreak, 2 were unvaccinated, and 3 had unknown vaccination status. Vaccination status of detainees was unknown. The attack rate (AR) was 1.65% overall, it was significantly higher in unit A (7.05%) compared with all other units aggregated together (B–F; 0.59%; P < .001); and among male (2.33%) compared with female detainees (0.38%; P = .004). It was not significantly different when comparing detainees and staff, IgG seronegative and IgG seropositive detainees (10.53%,	Samples sizes are small thus limiting generalizability	Suggests that in an outbreak of measles with in a carceral setting vaccination, isolation and quarantine are effective in containing the outbreak; however, some previously vaccinated people may be infected in such situations of high intensity exposure.

							6.45%; P = .622) , or the geographical region detainees were from. Vaccination of 1424 of 1425 residents and 190 of 510 staff, immunity verification of 445 staff, case-patient isolation, and quarantine of affected units)/source.		

21	18	2014	Chatterji et al.	Residents and staff of a high security correctional facility [Australia].	Outbreak response/intervention	Response to an outbreak of measles	Outbreak was reported by physician when 4 cases of rash and fever presenting atypically were seen. PCR confirmed measles virus in all 4 cases and an additional 1 case with classical measles presentation. Outbreak investigation and review of case notes revealed that index case occurred 17 days earlier but had been diagnosed as antibiotic-related rash. 17 cases (14 prisoners, 3 correctional staff) in all, 16 PCR confirmed, 1 by measles specific IgM. Vaccine strain virus was detected in 1 additional case. Measures implemented include isolation of cases, restriction of staff and prisoner movement, suspension of transfers, cancellation of prisoner visits, messaging and provision of information and mass vaccination (about 900 prisoners and 450 staff vaccinated with only 1 prisoner and 3 staff refusing). Those who refused vaccination were isolated and excluded from work respectively. Outbreak was contained and additional cases were not seen. Genotype found in the outbreak in the facility (G3) implied to be the same as that in a concurrent community outbreak .	Not enough information was given about the genotype of the measles virus found in the cases. Although G3 was stated no information is given about how many cases were subjected to genotyping. Exceptionally high vaccine uptake.	Highlights the place of messaging, information sharing and rapid mobilization/response in outbreak intervention

22	64	2016	Jeannot et al.	Residents of a juvenile corrections facility [Switzerland]	Cross-sectional	Analysis of immunization data for immunization rates of incarcerated adolescents and comparison with records of un-incarcerated adolescents	Out of 116 participants, 36% (95%CI: 27.5–45.3) were vaccinated on schedule for Tdap, Polio, MMR and HBV. Compared to an unincarcerated adolescent secondary school population in Geneva in 2007, the incarcerated adolescents had significantly lower immunization rates for all vaccines ($p < 0.0001$), except for the HPV vaccine ($p = 0.71$). Vaccine injections were administered during detention (about 89) and 27.6% (32/116) of adolescents became up-to-date on their vaccines during detention.	Limited generalizability to other carceral settings	Highlights the possibility of incarcerated adolescents not being up to date on immunizations and therefore being at risk of infections. Shows that such immunizations can be completed during incarceration.

23	71	2020	Vicente-Alcalde et al.	Review of literature published on vaccine coverage among prisoners. [International]	Systematic review	Vaccine coverage (defined as the proportion of prisoners who receive the vaccines recommended by the prison health authorities of their country) among prisoners.	21 studies found coverage rates of HBV vaccine among prisoners ranging from 16% to 82.6%. 2 studies found coverage rates of HAV vaccine among prisoners, of 91% from a UK study, and 65.9% and 57.1% among non IDU and IDU prisoners, respectively, from a Luxembourg study. A Swiss study reported 96% HAV immunity among 116 prisoners, of whom 52% were of African origin, by serological testing. One study found a HAV/HBV combination vaccine coverage among MSM of 77% for the second dose, 58% for the third and 11% for the fourth dose. This same study, also offered HBV vaccination using the traditional schedule to all prisoners, recording a coverage of 59% for the second dose and 22% for the third dose. The other HAV/HBV combined study found a coverage of 47% among female prisoners in the US. Among Australian prisoners, coverages of 36%,12% and 79% were found for influenza vaccine, pneumococcal vaccine and HBV vaccine respectively. A coverage of 42–46% in prisoners and 25–37% in staff was recorded from mass vaccination during an influenza outbreak, from one study, while another study looking at influenza and H1N1 recorded vaccination coverage of 70% and 64% respectively. A single study reported a vaccination coverage for MMR of 83% and 36% in prisoners and staff	The Swiss study finding of 96% immunity is not likely to be completely due to vaccination coverage. Over half of the subjects were of African origin and their immunity is more likely due to past childhood infection. All reported studies are from high income economies and their findings are not generalizable to low- and middle-income countries.	Suggests that in high income countries incarcerated individuals have moderate to low coverage for vaccine preventable diseases.

							respectively during mass vaccination following a mumps outbreak in Canada.		

24	12	2014	Leung et al.	Residents and staff of a California state prison [US]	Intervention	Prison varicella outbreak response	2 outbreaks occurred over a 2-year period, one in 2010, the other in 2011. The 2010 outbreak cases involved 3 cases occurring within 1 week of each other, in different prison housing units. No known contact between each other or other cases of VZV disease was found, no secondary spread was detected. The 2011 outbreak had 1 primary case and secondary and tertiary cases of spread within the same unit. Isolation and quarantine measures were put in place. Exposed non-immune individuals were determined by serological testing and offered immunization.	Objective definitions were made and used for cases and exposed. Some information required patient recall and is subject to bias. An effort was made to estimate the cost of the outbreak response. Cost of response may have been underestimated due to activities or impacts for which costs were not estimated.	Suggests that VZV immunity testing at intake and offering of vaccination to un-immune individuals may prevent costs associated with an outbreak response.

25	13	2010	Getaz et al.	Exposed residents of a Swiss prison [Switzerland]	Intervention/cross-sectional	Prison varicella case response	One index case of chicken pox, 110 inmates determined to have been in contact with index case, serological testing for immunity offered to them and accepted. All significant contacts without serology-proven protective immunity quarantined 78 inmates with negative history of chickenpox offered immediate vaccination. No secondary cases developed.	Use of different languages to engage a multiethnic population, high acceptance of serologic immunity testing. No mention of the offer of vaccination to susceptible staff. No counterfactual so we can't with complete certainty attribute the development of no secondary cases to the response but its possible it contributed.	suggests that immediate quarantine efforts, serological testing and offer of vaccination within 3-5 days of exposure may prevent secondary cases of chicken pox in a prison

26	14	2008	Valdarchi et al.	Residents of a women's prison [Italy]	Cross-sectional	Serological evidence of varicella IgM, estimation of attack rate	Of 314 patients who consented, 85. 5% were IgG positive (260), and 14.5% (44) were IgG-negative. 10 were IgM-positive. Estimated attack rate among susceptible persons was 21.7%	As the survey did not include all of the prison residents the number of immune or susceptible people may have been over or underestimated. The results are subject to selection bias. Although masks and vaccines where offered to staff who were considered susceptible, there was no mention of the offer of vaccination to susceptible residents	Suggests that isolation and limitation of movement may have a place in managing an outbreak of varicella in carceral settings. Suggests that the use of Acyclovir may prevent serious manifestations of infection in exposed HIV infected individuals

27	15	2016	Moreau et al.	Residents of a youth offender correctional center [Canada]	Case report/Intervention	Facility-based Varicella zoster virus (VZV) transmission / Infection prevention and control (IPAC) measures implemented.	A 13-year-old healthy male resident of this youth offender correctional center (YOCC) presented with herpes zoster (HZ) (shingles). PCR confirmed VZV. 13 days later a 14-year-old healthy male resident from the same living unit presented with varicella (chicken pox). This resident had been vaccinated with a single dose of univalent Varicella vaccine. VZ virus (VZV) was confirmed by direct fluorescent antibody. Genotyping confirmed both isolates were wild type strain. A retrospective chart and immunization record review was conducted for two VZV cases and 27 exposed resident contacts. The affected living unit, which housed both cases and a total of 19 exposed YO contacts was closed to further admissions during the investigation. The varicella case was isolated in his cell in the living unit under contact and airborne precautions for 8 days until all the lesions had dried and crusted. There was no cellmate at that time. The HZ case's lesions had resolved completely as at the commencement of the investigation. 22.2% (6/27) of contacts had self-reported a history of varicella disease, 70.3% (19/27) of contacts had received a single dose of univalent Varicella vaccine. 7.4% (2/27) of contacts whose immune serostatus was unknown had VZV serology completed which demonstrated evidence of immunity. Thus, post-exposure vaccinations were	Reliance on self reported history of chicken pox as proof of immunity may not be reliable in all carceral settings.	Presents a case of breakthrough varicella in a previously immunized incarcerated youth. Suggests one dose of varicella vaccine may not be sufficient in juvenile carceral settings in Canada. Underlines the importance of timely reporting and implementation of other infection control measures in addition to vaccination when varicella cases occur in a carceral setting.

							not required. Heightened clinical surveillance, enhanced cleaning, education, and restricted admission and movement on the affected living unit were implemented until the investigation was completed after 21 days the incubation period of VZV. No further cases occurred.		
28	65	2020	Zhang et al.	Residents of an immigration removal center [England]	Outbreak response/intervention	Response to an outbreak of chicken pox	Use of modeling to predict the outcome of different extents of immunity testing coverage to guide quarantine and cohorting to assist in making a decision of how much testing was safe to do in the face of limited resources, competing priorities and an absence of varicella vaccination response.		Suggests modeling may help in making decisions in situations of limited resources

29	66	2014	Haas et al.	Residents of a detention facility [Israel]	Outbreak response/intervention	Response to an outbreak of varicella	Over the course of 7 months, 109 cases of chickenpox were diagnosed clinically, and isolation of cases was the only initial control measure reported. Following completion of the administration of the 1st dose of the varicella vaccine to residents, there was only 1 case of varicella in the 2 weeks following and no more cases thereafter. Vaccine acceptance rate was relatively high at 84.3% (2108/2500)	Adds to the evidence that varicella vaccination is useful in limiting outbreaks	Adds to the evidence that varicella vaccination is useful in limiting outbreaks
30	67	2019	Leung et al.	Residents of detention facilities for migrants [US]	Outbreak response/intervention	Report of outbreaks of mumps in detention facilities and response	898 cases of mumps were reported, 64% (576/898) confirmed by reverse transcriptase PCR or viral culture, among adult residents of at least 57 facilities housing migrants. Another 33 cases of mumps occurred among the staff of these facilities during the same period. Facilities were either county jails (19), ICE operated (4) or privately operated (34). In 70 patients from whom isolates had been obtained and sequenced, genotype G was the only one discovered. At least 84% (758/898) were found to have been exposed during detention and available records revealed 15% (79/527) of male patients experienced orchitis, with up to 13 patients requiring hospital care. Over 25,000 doses of MMR vaccine were reported to have been provided in response to these outbreaks	Report of ongoing outbreaks and the response	Provides useful information

31	20	2012	Guthrie et al.	Staff and residents of a prison [Australia]	Review of response to cases of influenza in a prison	Review of prison records, prisoners' health records, prisoner movement and health survey records	1,4 and 2 cases of influenza were reported during the influenza season in 2009, 2010 and 2011. Isolation, quarantine and movement restriction measures were instituted. Ill patients were seen by health staff in their residential quarters and not in the health center. Visitors were restricted but not banned completely. Prison was not overcrowded operated at 54.3% and 71.3% occupancy in 2009 and 2010 influenza seasons respectively. Prisoners were not moved between the AMC and other correctional facilities. Over 70% of prisoners had ever been vaccinated. More cases of influenza were not recorded in the index prison in ACT unlike in other prisons in NSW where up to 40% of inmates were positive for influenza.	In comparing the index prison (AMC) in ACT with prisons in NSW nothing is stated about the occupancy rate in the NSW prisons, and if they were overcrowded or not or had space to isolate, quarantine or restrict those infected or suspected.	Suggests isolation, quarantine and movement restriction may help in limiting or preventing outbreaks in a prison operating below capacity and not overcrowded.
32	19	2017	Besney et al.	Residents of a remand correctional facility [Canada]	Outbreak response/intervention	Response to an influenza outbreak	2 cases of influenza were recorded within a space of 3 days, that met the outbreak definition, and an outbreak was declared and an outbreak protocol initiated. Both were linked to 1 and 3 subsequent cases respectively. All cases were isolated in infirmary and placed on contact and droplet precautions. Admissions and movement to affected units where patients came from was restricted. Staff were restricted from those units except for those vaccinated at least 2 weeks before or on oseltamivir PEP. Exposed inmates were offered vaccines and those with comorbidities were offered oseltamivir PEP. No further cases were reported.	Outbreak and case definitions were made and an outbreak protocol that protected inmates and staff was followed.	Provides evidence that appropriate and timely outbreak response may limit influenza outbreaks in short term facilities

33	21	2013	Conklin et al.	Residents of a correctional facility for men [US]	Outbreak investigation	Response to a *Chlamydia pneumoniae* outbreak	An outbreak of pneumonia presenting with symptoms including low-grade fever, dry cough, and body aches occurring in previously healthy inmates and resulting in at least 4 individuals being hospitalized. Initial laboratory tests done were all negative. NP and OP swabs from 7 acutely ill inmates were tested for 18 respiratory pathogens using qPCR at the CDC, and *C. pneumoniae* was detected in 4 (57%) inmates. Once an outbreak was suspected, ill inmates were isolated in single cells. A case was defined by the presence of acute respiratory illness (ARI) supported by positive chest x-ray findings, qPCR, or IgM or IgG serology according to the defined criteria. 33 cases were found out of 36 self-referrals. Azithromycin was given for treatment and doxycycline for those who remained symptomatic afterwards. Educational notices were employed to inform inmates and encourage those ill to present for treatment, usual fees for clinic services were waived and isolation of ill individuals discontinued to encourage inmates to present for care. A survey and active case finding were conducted on a randomly selected sample to estimate attack rates, this revealed another 19 cases. An attack rate of 10.4% (95% confidence interval, 7.0%–13.8%) was calculated for the whole facility. Self-referred cases were more likely to be white than any other race (OR 23.8; 95% CI 3.0–187.7).	Abolishing the clinic fee may have enhanced access to care. Sample size not powered to detect risk factors.	Provides a useful example of outbreak response and investigation of an outbreak due to an atypical bacterial pathogen.

34	22	2013	Zhang et al.	Residents of a Jail [China]	Cross-sectional/Outbreak investigation	Molecular characterization of *N. meningitidis* strains isolated from cases and contacts in an outbreak/*N. meningitidis* serogroup, pulsed field gel electrolysis (PFGE) pattern and multi locus sequence typing (MLST) sequence type (ST).	Using culture and PCR *N. meningitidis* serogroup C was identified in CSF and blood samples from all 3 patients. Pharyngeal swabs were obtained from 166 subjects (comprising 16 cellmates of the patients and 150 inmates in other cells of the jail) to assess for pharyngeal carriage of *N. meningitidis*. 47 *N. meningitidis* strains were isolated, of which 29 were serogroup C. Among the 16 cellmates of the patients there was a carriage rate of 62.5% (10 carried *N. meningitidis*, of which 6 were serogroup C. Among the other 150 inmates there was a carriage rate of 24.6% (37 carried *N. meningitidis* of which 23 were serogroup C. The prevalence of *N. meningitidis* pharyngeal carriage was significantly higher in inmates sharing a cell with the patients than in those sharing other cells (P<0.01, Mantel-Haenszel chi-square test). 49 isolates were subjected to molecular characterization using PFGE and 24 (2 from 2 patients, 6 from cellmates of the patients and 16 from inmates in other cells of the jail) were an identical new pulse type designated as NMNh.CN0244. 4 were the NMNh.CN0001 pattern (a pulse type associated with a serogroup C outbreak in China in 2003-2004). Using MLST for 20 isolates including NMNh.CN0244 (9), NMNh.CN0001 (2) and others (9), the 11 NMNh.CN0244 and NMNh.CN0001 strains formed the ST -4821 (ST-4821 complex), and a	A very small number of cases or sample size used to calculate carriage rates. This could have caused an overestimation or underestimation of carriage rates of ST-4821 complex	Provides evidence of an outbreak of meningitis due to *N. meningitidis* isolates belonging to the same sequence type and increased nasopharyngeal carriage in contacts of isolates belonging to the same clonal complex

							high MLST diversity was found between the other isolates with other pulse types. The carriage rate of ST-4821 clonal complex isolates was significantly higher in cellmates than in other inmates (37.5% vs 13.3%, P<0.05, Mantel-Haenszel chi-square test).		
35	70	2020	Beaudry et al.	Review of literature on outbreaks of highly contagious diseases (airborne/droplet) route [International]	Systematic review	Measures instituted for outbreak control	Interagency collaboration between prison staff, the local state health department, public health laboratory, public health unit and hospital services. Health communication, screening for contagious diseases, movement restrictions, isolation and quarantine. Contact tracing, immunization programs, epidemiological surveillance, prison-specific guidelines and appropriate treatment.	Studies are from high income countries alone. Findings may not be generalizable to carceral settings in low-income countries.	Useful summary of measures instituted to control outbreaks of highly contagious disease

36	68	2020	Bernardes et al.	Residents of a prison [Brazil]	Cross-sectional	Active search strategy for leprosy using leprosy suspicion questionnaire (LSQ) followed by clinical dermatoneurological examination. / New case detection rates	Of 896 returned LSQs, 20.9% (187) were considered to have signs & symptoms positive for leprosy (LSQ+). Out of 1250 subjects clinically examined 34 cases of leprosy were detected, for a new case detection rate (NCDR) of 2.7%. Among the 187 LSQ+, NCDR was 9.6% (18 cases), while among LSQ- (709) NCDR was 1.8%. Among 354 people who did not get the LSQ 3 cases were detected. Comparing NCDR among LSQ+, LSQ- and those who didn't get the LSQ using the chi squared test gave a test statistic of 40.3 ($p<0.00001$). A relative risk and odds ratio of 6.4 and 6.97 respectively were reported. Of the 34 cases, 44.1% (15) and 11.8% (4) were positive for anti-phenolic glycolipid I(PGL-I) IgM by ELISA and slit skin smear PCR respectively. Patients were treated and followed up over a year with improvements noted.	Relative risk and odds ratio were reported but since it is a cross-sectional study prevalence ratios would have been more appropriate. A median confinement time of 39 months (3.25 years) was stated for cases, and it was suggested that because the incubation period of leprosy is 3-5 years, it is unlikely that the cases were infected with leprosy in prison, however results show that 11 cases had a confinement time of 48 -96 months (4-8 years) showing that some could have been infected in prison.	Shows that actively searching for leprosy using LSQ followed by clinical dermatoneurological examination is likely to enhance case detection in Brazil. Suggests that serology and PCR may not be ideal for confirming leprosy diagnosis.

37	69	2015	Mistura et al.	Residents of 1 men's prison and 1 women's prison [Brazil]	Report/Intervention	Leprosy education activities were held for residents followed by screening of residents using symptoms and signs	No new cases found in women's prison, 8 suspected cases were found in the men's prison and referred to a reference center where 5 were confirmed to be leprosy.	Language was not very clear (may be due to a poor direct translation from Portuguese).	Suggests that educating prisoners about leprosy may enhance detection of new cases
38	73	2020	Lucas et al.	Residents of 33 men's prisons in California [US]	Intervention/Implementation and cost effectiveness analysis	Condom use, disciplinary actions relating to condom use, reports of serious incidents relating to condom use	243,563 condoms dispensed in total over 1 year, 354 condoms were dispensed per 1000 average daily prison population per month, only 4 incidents of condom used to store contraband, no reports of serious incidents. Condoms cost $49.60 per 1000 inmates per month	Broad engagement and involvement of stakeholders, presents cost effectiveness	Shows condom distribution in prison without negative security or safety consequences is possible

39	74	2015	Nelwan et al.	Residents of a prison [Indonesia]	Cross-sectional	Prevalence of HIV and HCV infections and prevalence of reported drug use and risk behavior among inmates who had previously tested negative at entry and had been exposed to a HIV control program. Prevalence of AIDS related deaths in successive years following the HIV control program	Repeat serological tests for HIV and HCV among 281 prisoners found no new positives, reduced prevalence of risky behavior and progressively reducing AIDS related deaths in successive years.	The reduced prevalence of risky behavior was reported and so is subject to recall bias and desirability bias. Not all those who were negative at the initial HIV and HCV screening participated in the second screening making the results subject to selection bias. It is possible that there were infected people among those who refused to be tested.	suggests that implementation of multifaceted HIV control programs with HIV testing, ART and harm reduction can reduce HIV and HCV transmission in correctional facilities.
40	75	2018	Lazarus et al.	Review and synthesis of the literature on the health outcomes of PNSP [International]	Systematic review	Reported health outcomes of PNSP	Decrease in prevalence of HCV and HIV infections. Decreased injection related abscesses. No new HIV, HCV, and HBV infections.	Few studies with different methodologies used findings may not be generalizable to many carceral settings.	Suggests prison needle and syringe programs have positive health benefits

41	76	2017	Valera et al.	Narrative review of the literature on HIV risk reduction interventions in US prisons [US]	Systematic review	Reported outcomes of interventions	Education programs were reported to be effective in increasing in those incarcerated the knowledge about HIV transmission and risk behaviors and changing attitudes and beliefs. No reports about needle and syringe programs or condom distribution programs.	Limited to prisons for adults in the US. Findings may not be generalizable to other correctional facilities such as jails, juvenile correctional facilities or correctional facilities outside the US.	Suggest educational programs have some benefit for HIV risk reduction in US prisons.

42	26	2009	Alarid	Correctional officers (CO) in 5 prisons [US]	Cross-sectional survey	Risk factors for occupational exposure to blood & body fluids.	Being employed as a CO for >5years was significant risk factor for experiencing: blood/fluids on skin/clothes (OR-1.29;p<0.01); waste/fluids thrown (OR-1.15;p<0.05); bite/scratch where skin broke (OR-1.24;p<0.05); and needle stick puncture (OR-1.25;p<0.05). Being a ranking CO sergeant and above was a risk factor for blood/fluids on open wound (OR-16.62;p<0.05). Working mainly with maximum security prisoners was a risk factor for bite/scratch where skin broke (OR-2.57;p<0.05) COs with the belief that inmate-inmate sex, tattooing, and IV drug use were common in their work environment were at risk for experiencing: blood/fluids on skin/clothes (OR-1.35;p<0.01); waste/fluids thrown (OR-1.31;p<0.05); and needle stick puncture (OR-1.29;p<0.05). Being a female CO was protective against experiencing blood/fluids on skin/clothes (OR-0.18;p<0.01) or put differently being a male CO was a risk factor for experiencing blood/fluids on skin/clothes.	Low response rate of38.4%(192/500), out of which 8.3%(16/176) had to be excluded due to a significant number of incomplete responses. This makes this study subject to selection bias limiting the internal and external validity of the study. We cannot tell if those who failed to respond differ significantly or not from those who responded.	Identifies some possible risk factors for COs exposure to blood and body fluids (as a surrogate for HIV exposure) in carceral settings.

43	72	2014	Lucas et al.	Residents of a state prison [US]	Intervention evaluation	Wall-mounted condom dispensing machines program to provide condoms to inmates / Safety and security impact(risks), feasibility, and cost of the program	No evidence that providing access to condoms posed an increased risk to inmate or staff safety, or security operations. No instances of condoms being used to conceal contraband, controlled substances, or weapons were found. There were no increases in the numbers of violations overall by housing unit type or by eligible violation. There was a statistically significant decrease in the incident rate for F2 violations overall (p=.001). A total of 2,061 condoms were dispensed. The total cost of the program is $182,319, or $1.49 per inmate, for the first year, (condoms and one-off purchase of the dispensers). To maintain the program in subsequent years total cost would be $78,581, or $0.72 per inmate.	Convenience sampling done for surveys, may not be generalizable to other carceral settings.	Provides evidence that the provision of condoms in a California jail posed no risks, was feasible and amounted to spending < $2 per inmate in the 1st year and <80 cents per inmate in subsequent years.

44	35	2010	Harawa et al.	Residents of a large jail unit for MSM and male to female transgender with a condom program providing one condom per week per inmate. [US]	Mixed methods	Prevalence of sex, prevalence of sex with condoms, prevalence of sex without condoms and reasons for having sex without condoms	During the current incarceration, within the last 30 days 66% had oral sex, 53% had anal sex. 47% had sex with men, 18% had sex with transgender. 65% had anal sex with condoms, 75% had anal sex without condoms. Non-condom-program related reasons for having anal sex without condoms include: "My partner and I are both HIV negative" (34%); "I don't like the way condoms feel" (26%); "I find it difficult to stay hard/erect with a condom" (18%); "My partner and I are both HIV positive" (16%) "My partner refused to use one" (2.6%); and "I was drunk or high" (2.6%). Condom-program related reasons for not using condoms include: "I ran out of condoms" (32%); "I couldn't get a condom from the program" (13%); and "We did not have lubricant" (7.9%).	Special incarcerated population not generalizable to most carceral settings	Provides a unique picture of sex among inmates in a jail with condom provision and the reasons why inmates may still have condomless anal sex in spite of the presence of the program. Indicating opportunities to close gaps and prevent possible HIV transmission.

45	77	2009	Pai et al.	512 HIV positive residents of a county jail [US]	Retrospective cohort	ART treatment/Viral load & CD4	Of the 512 HIV positive residents studied over a 9 year period, 76% (388) of them were on intermittent ART (were on ART while in jail, but not while out of jail), 15% (79) were on continuous ART (were on ART both while in jail and while out of jail) and 9% (45) of them were never on ART (in spite of being eligible for ART by national guidelines, had refused ART in and out of jail and had never commenced ART). In a linear mixed model analysis, inmates never on ART were 2.89; 95%CI (1.71, 4.87) times more likely to have higher VL than inmates on continuous ART. Those on intermittent ART were 1.43; 95%CI (1.03, 1.99) times more likely to have higher VL than inmates on continuous ART. Inmates never-on ART and those on intermittent ART lost 1.97; 95%CI (0.96, 3.00) and 1.60; 95%CI (1.06, 2.13) more CD4 cells per month, respectively, compared to continuously treated inmates. The continuous ART inmates gained 0.67CD4 cells/month.	An assumption was made that those who accepted ART in and outside of jail were adherent to ART. Non-adherence to ART such as receiving the drugs but not taking them would have been classified as continuous ART when such individuals may have been in fact intermittent leading to some misclassification bias. May not be generalizable to other settings.	Provides useful evidence of the positive effect of continuous ART use on CD4 increase and viral load reduction and the contrary in those taking ART intermittently or never at all, in a jail setting.

46	45	2016	Torriente et al.	Narrative review of international, regional and national legal provisions for the provision of HIV related care to prisoners [International]	Review	International, regional and national legal provisions for the provision of HIV related care to prisoners	United Nations Standard Minimum Rules for the Treatment of Prisoners also known as "the Nelson Mandela Rules": prisoners should enjoy the same standards of health care as those available in the community...including for HIV, tuberculosis and other infectious diseases... . African Charter on Human and Peoples' Rights, European Social Charter, Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights all affirm the right to health of all individuals. The 2013 Alabama Federal District Court decision that struck down the segregation policy applied by the Alabama Department of Corrections, holding that it discriminated against prisoners on the basis of a disability (their HIV status) in violation of the Americans with Disabilities Act. 2007 European Court of Human Rights (ECHR) decision in Yakovenko v. Ukraine: the state was obligated to provide ART. Odafe v. Attorney General of the Federal Republic of Nigeria: the state had the obligation to provide ART regardless of the offense with which the prisoners had been charged.	Cites judgements where provisions protecting were affirmed and upheld in the face of opposition.	Highlights legal provisions for the health care of prisoners, internationally, regionally and some national examples.

47	31	2009	Jafa et al.	Residents of Georgia prison system [US]	Transmission investigation	HIV infection during incarceration, HIV risk behaviors, HIV transmission networks.	Out of 88 seroconverters (seroconverters were defined by 1 negative HIV test result followed by a confirmed positive HIV test result during their current incarceration) diagnosed with HIV during incarceration from September 1992–February 2005, 47% (41/88) were diagnosed from July 2003 to February 2005, a period when Georgia Department of Corrections (GDC) offered voluntary annual HIV testing. Of 47 seroconverters with a single negative HIV test result during incarceration, 55% (26/47) were tested more than 180 days after the start of incarceration, 32% (15/47) 42–180 days after, and 13% (6/47) less than 42 days after. The facility where HIV infection occurred was definitively identified for 41% (36/88) of seroconverters (a definite facility of infection was defined as one in which a seroconverter had a negative HIV test result followed by a confirmed positive result during the same stay at that facility). 93% (69/74) of 74 seroconverters approached agreed to participate in audio computer assisted self-interviews (ACASI), 71% (49/69) reported sex, 6% (4/69) reported IDU, and 41% (36/69) reported tattooing in prison before their HIV diagnosis. Genetic analysis of combined p17 gag, partial gp41 env and pol sequences 65 to 67 seroconverters' specimens confirmed close genetic relationships and 49% (33/67) were associated in 10 distinct bootstrap-supported clusters. 67%	Correlation of data from different sources, which included risk behavior, HIV testing, period of stay in facilities, contact tracing and phylogenetic analysis made a strong case in proving transmission.	Provides evidence of HIV transmission in carceral settings and makes a case for routine and repeated voluntary HIV testing.

							(22/33) of those in clusters had overlapping stays in the same prison with at least 1 other member of their respective cluster 79% (26/33) reported having sex (2 of these also reported IDU), 12% (4/33) reported tattooing only, and 9% (3/33) reported no risk behaviors. Through correlation of administrative, risk, HIV testing, and contact-tracing data, a sexual network was identified for the largest genetic cluster.		
48	78	2016	Winter et al.	100 persons each from 2 men's prisons and 1 women's prison (300) [Australia]	Intervention (pre and post exposure comparison)	Nurse run BBV/STI clinic, education of staff review of clinical procedures / percentage receiving BBI/STI testing and HBV vaccination	Pre-intervention to post intervention: testing from 5% to 17%(chlamydia) 1% to 5% (gonorrhea); HBV vaccination from 2% to 19%	No comparison group, possible under estimation of vaccination and testing	suggests interventions can increase testing and vaccination uptake.

49	28	2011	Viswanathan et al.	Residents of a prison [UK]	Case report	HBV transmission event	Acute hepatitis B infection (anti-HBc IgM positive), discovery of tattoo gun.	Sequencing results support a case of transmission of HBV	Supports recommendations for universal hepatitis B vaccination for prisoners at intake (opt out)
50	79	2008	Sutton et al.	Data from prison surveillance and published literature [UK]	Modeling	Modeled the impact of HBV vaccination at entry into prison (continuous) or of the whole prison population repeatedly at intervals (pulse) on the coverage of injection drug users (IDU).	Applying the model, continuous vaccination at entry was found to capture a greater proportion of IDU, found to be more efficient at capturing IDU, captured a larger proportion of younger IDU and wasted less doses than the vaccination of the whole prison population at intervals	Based on IDU data from 1997, England and Wales may not reflect current carceral situations. May not be generalizable to other carceral settings.	Suggests that HBV vaccination at entry may be more effective and efficient at providing coverage for IDU and thus preventing HBV transmission than repeated vaccination at intervals.

51	80	2019	Stasi et al.	Residents of 15 detention facilities [Italy]	Intervention, prospective	Proportion eligible for HBV vaccination from screening results. Proportion of those that received HBV vaccine	15 out of the 17 detention facilities in the region were involved in the study. 1075 subjects were screened for HBV serum markers, 67.9% (730) were neither infected nor vaccinated (HBsAg-, anti-HBc- and anti-HBs). Out of 601 individuals scheduled for HBV vaccination, 92.4% (555) received the 1st dose, out of 539 scheduled for the 2nd dose on day 7, 94.2% (508) received it. Out of 489 individuals scheduled for the 3rd dose on day 21, 82.6% (404) received it. Reasons for the difference in the number scheduled for vaccination and the number that received it include transfers, releases, rejections or refusals and other non-specified reasons. Compared to the number eligible for vaccination by initial HBV screening 55.34% coverage was achieved.	Relatively high coverage achieved. May not be generalizable to all carceral settings.	Provides evidence that accelerated HBV vaccination may achieve significant coverage in some carceral settings

52	82	2011	Asli et al.	169 subjects who were residents of 3 correctional facilities [Iran]	Randomized clinical trial	Comparison of an accelerated HBV vaccination schedule of a dose of 20 µg of recombinant hepatitis B vaccine at 0,1, 4 and 8 weeks with the classic schedule of same dose at 0, 1 and 6 months. / Compliance, seroprotection rate and success rate.	All participants in the accelerated arm (group A) completed their vaccination schedule to give 100% (85/85) compliance, while in the classic arm (group C) compliance was 90.5% (76/84), (8 subjects in group C were transferred or released before completion). The rate of compliance in group A (accelerated) was significantly higher than group C ($P < 0.001$). One month after the 1st dose in both arms, the seroprotection rate detected in group A (22.4%) was significantly higher than that in group C (4.7%) $P < 0.001$. At two months post 1st dose, seroprotection achieved in group C (44%) was significantly lower than that in group A (60.7%) ($P = 0.038$). At 8 months, the study end point, the seroprotection rate was significantly higher in group C compared to group A (93.4% vs. 78.8%, $P < 0.002$). Success rate, which was defined as the proportion of individuals who received the full dose of vaccination and were seroprotected based on the total number of participants in each group, was not significantly different between group A (78.8%) and group C (84.6%) ($P = 0.466$).	Small sample size limits generalizability of findings	Suggests that an accelerated HBV vaccination schedule may lend itself to more compliance and earlier attainment of seroprotection in those vaccinated in carceral settings, especially in those with short stays. Also suggests that the classic HBV vaccination schedule results in higher seroprotection rates in the long run and remains useful in carceral settings where residents experience long stays.

53	81	2022	Stasi et al.	Residents and staff of 15 prisons [Italy]	Intervention	Training and information programs for staff and inmates, and a peer education program for inmates. Training and programs for inmates were delivered in different languages/proportions consenting to HBV screening and vaccination using an accelerated schedule (0, 7, 21 days).	Of the inmates eligible for HBV screening, 91.3% (1075/1177) consented. Of those eligible for HBV vaccination, 82.3 % (601/730), (67.9 % of those screened), consented to be vaccinated and received the 1st dose. 90.3% (543/601) of those who received the 1st dose, received the 2nd dose (day 7). Most of those who didn't receive the 2nd dose, didn't because they had been released or transferred. 80.3% (436/543) of those who received the 2nd dose received the 3rd. Being released or transferred was the major reason for not receiving the 3rd dose.	No counterfactual to lend weight to the conclusion that the intervention was responsible for the relatively high proportion of those who consented to screening and vaccination.	Suggests that interventions that include information provision and training for staff and inmates and peer education for inmates are likely to increase the proportion of those who consent to HBV screening and vaccination in carceral settings.

54	83	2021	Hajarizadeh et al.	Residents of 4 prisons over 18 years of age [Australia]	Non-randomized clinical trial	HCV incidence in uninfected and previously infected individuals at risk of infection or reinfection; in the period preceding treatment of infected individuals, compared with the period following treatment of infected individuals	Among at-risk population of 1643, of which 31% reported injecting drugs during the current imprisonment, with longitudinal follow-up, HCV incidence reduced by 48%, from 8.31 to 4.35/100 person-years between pre- and post-treatment scale-up periods [Incidence Rate Ratio (IRR): 0.52, 95%CI: 0.36, 0.78]. Incidence of primary infection reduced from by 57% from 6.64 to 2.85/100 person-years (IRR: 0.43, 95%CI: 0.25, 0.74), while incidence of re-infection reduced from by 41% from 12.36 to 7.27/100 person-years (IRR: 0.59, 95%CI: 0.35, 1.00). Among participants reporting injecting drug use in the current imprisonment, incidence of primary infection declined from 39.08 to 14.03/100 person-years (IRR: 0.36, 95%CI: 0.16, 0.80), and incidence of re-infection declined from 15.26 to 9.34/100 person-years (IRR: 0.61, 95%CI: 0.34, 1.09).	Possible confounders were adjusted for in a regression analysis lending validation to results. This is a before and after evaluation design, there is no counterfactual so the evidence is not as strong as a cluster randomized control trial would have been. The proportion of the residents of the four prisons not enrolled in the study was less than 20%, however, the risk status of these individuals and their contributions to incidence and transmission are not known.	Provides empirical evidence that treatment as prevention using DAA (sofosbuvir/velpatasvir) reduces incidence of HCV in prisons. Strongly suggests it prevents transmission.

55	29	2013	Marco et al.	119 eligible residents of four prisons [Spain]	Cohort	HCV reinfection after SVR	7.6% (9) had reinfection. The incidence rate of reinfection was 5.27 cases per 100 person-years. 78% (7) were infected with a different genotype. 20% admitted engaging in at least one risky behavior 4.2% at least 2 (risky behaviors include, IDU, engaging in risky sexual practices [sex with IDU partner, or ≥3 different sexual partners per trimester] and tattooing performed during or after treatment. Only one was in prison the whole time. All reinfections occur in those with IDU history.	Detection of different genotypes supports reinfection. Only one individual's infection could be attributed to behavior in prison. Since the others spent time outside prison they could have been reinfected outside. Risk factors were reported and so are subject to recall and desirability bias.	Provides evidence that treatment as prevention for HCV in prison should be supported by other harm reduction (such as needle and syringe programs) methods to prevent reinfection.

56	84	2018	Poulin et al.	Residents of 7 detention centers [Canada]	Cross-sectional	Prevalence of HCV, risk factors for HCV	Prevalence of HCV infection in male subjects was 11.9% and in female subjects it was 19.2% (P = .003). A lifetime history of injection drug use significantly associated with HCV infection (AOR: 14.2; 95% CI: 9.5-21.4). Among PWID needle sharing was significantly associated with HCV (AOR: 1.4; 95% CI: 1.1-1.7). Among non-PWID tattooing in prison was independently, significantly associated with HCV infection (AOR: 2.8; 95% CI: 1.4-5.6).	Investigators relied on only a test for HCV antibodies using oral fluid or salivary specimens. This is not the acceptable specimen for HCV antibodies. HCV antibodies are not a reliable test for HCV infection as a number of those with HCV antibodies may have cleared the infection. This would have caused some misclassification, introducing information bias, and negatively impacting the internal validity of the study. Not generalizable to other settings.	Suggests tattooing maybe a significant risk factor for HCV, in addition to injection drug use and needle sharing in this carceral setting.

57	30	2017	Harkness et al.	Resident of a prison [Australia]	Case study	Report of a HCV reinfection event following treatment with direct-acting antivirals (DAAs) and negative PCR result.	39-year-old male was treated for HCV genotype 1a between weeks 4 and 16 of incarceration with 12 weeks of DAAs (ledipasvir and sofosbuvir). Four weeks after completion of therapy a negative PCR result was obtained. About month 7 of incarceration notification of a positive HCV PCR result was received from a sample collected in week 30 of incarceration. The genotype was reported as a mixed infection of genotype 3 and genotype 1 or 6. The patient reported an episode of shared injecting with a known HCV-positive contact, approximately 4–6 weeks after the negative PCR result. The tests were repeated, and the results were confirmed to the same.	Different genotypes initially before DAA treatment and after the positive PCR following DAA treatment supports the diagnosis of reinfection.	Suggests that while treating HCV infected inmates with DAAs may reduce the risk of infection in carceral settings, it does not eliminate it. And that there is still a need of provision of needle and syringe exchange programs to further reduce the risk of infection in carceral settings.

58	85	2017	Getaz et al.	Children of mothers infected with syphilis [Bolivia]	Case report	Congenital syphilis in young children	Cutaneous manifestations of congenital syphilis in 2 children, 3-month-old and 11-month-old. Scaly maculopapular rash including soles of feet and hyperpigmented macules. History of incomplete treatment for congenital syphilis.	Provides useful documentation of the risk of poorly treated syphilis and congenital syphilis in incarcerated women	Emphasizes the need for prenatal syphilis screening for pregnant women incarcerated and completion of recommended treatment schedules for syphilis and congenital syphilis
59	32	2022	Spaulding et al.	Review and synthesis of the literature on prevalence and management of STIs	Systematic review	Prevention and management of STIs	Recommendations for STI prevention including voluntary opt out screening at entry or intake, targeting Neisseria gonorrhea, Chlamydia trachomatis, HIV, HBV, HCV, syphilis, and Trichomonas vaginalis. Immediate treatment for those found to be positive, and provision of vaccines to susceptible individuals against vaccine preventable STIs like HBV and HPV, where applicable. Provision of condoms in correctional facilities,	Extensive review and synthesis of literature on STI prevention. Multiple studies included.	Provides recommendations for STI prevention in carceral settings with justification

60	38	2010	Elias et al.	Residents of a Midwestern County jail [US]	Intervention	Response to outbreak of CA-MRSA skin infections	64 cases of skin infection over the period of one year. 23 occurred preintervention but only one of this had a specimen sent for culture which obtained MRSA. Intervention measures included the institution of surveillance of skin and soft tissue infections, active observation of procedures for general hygiene, cleaning and infection control in the jail and then implementation of prevention and control measures. After initiation of surveillance 41 cases were recorded, 24 of these yielded bacterial cultures out of which 18 were MRSA. Conditions noted to be a risk for infections included defective laundry machine and deficient laundry process. Implemented measures included the provision of antibacterial bar soaps, antibacterial liquid soaps and use of bleach for surface cleaning. Introduction of extra examination and questions at intake with isolation and cohorting where infected individuals are detected. There was a reduction in cases with implementation of IPC measures.	Documentation of conditions preintervention and post intervention. Decrease in cases with implementation of IPC despite continued surveillance.	Emphasizes the need for adequate surveillance, continuous review of general cleaning processes and implementation of IPC measures. Suggests that these can control or prevent an MRSA outbreak.

61	86	2009	Felkner et al.	Environmental surfaces in a jail [US]	Cross-sectional	Presence of MRSA on environmental surfaces	10 out of 132 surfaces yielded *S. aureus* and 8 were MRSA. MRSA was found in the health services building on a chair, in inmate housing door handles, bathrooms, and vehicle seats. 4 MRSA isolates were identical and similar to strains carried nasally by inmates of the same jail isolated in a study conducted months prior to the index one.	Identifies a possible source of MRSA outbreaks in jails. Makes a link between MRSA on humans and on surfaces providing evidence for environmental surfaces as a possible transmission vehicle.	Shows the need for adherence to standard environmental surface cleaning protocols in jails even in the absence of outbreaks.

62	87	2009	Webb and Czachor	Facility administrators and nursing clinic directors of 9 county correctional facilities [US]	Cross-sectional (survey)	Assessment of MRSA prevention and control activities in correctional facilities using a survey/positive response rates to survey questions	Response rates were determined by the number of ‘‘yes’’ responses divided by the total of ‘‘yes’’ and ‘‘no’’ responses, questions without "yes" or "no" responses (left blank or marked Not Applicable [N/A]) were not included in the statistical analysis. The positive response rate for the MRSA screening questions was 88.4% overall (61 of 69). MRSA screening rate for inmates from the community and from other correctional facilities before their release into the general jail population was 94%. The positive response rate for the treatment questions was 83.6% (61 of 73) overall (this included questions about change of wound dressings daily and the use of antibiotics recommended for MRSA). The positive response rate for the personal hygiene questions was 80.6% (25 of 31) overall (this included questions about access to sinks by inmates and staff for handwashing and access of inmates to antibacterial soap for handwashing). The positive response rate for the environmental control questions was 95.4% (54 of 56) overall (this included questions about the use of an approved detergent for daily cleaning, and appropriate disposal of dressings and single use materials used in the care of MRSA infected patients). The positive response rate for the MRSA education questions was 80.4% (45 of 56) overall (this included questions on work specific training for healthcare workers and education of	The study depended on responses from people who worked in the respective facilities making it subjective and also subject to desirability bias. A direct observation of practices and procedures may have been more objective. Small sample limits generalizability to other settings	Suggests that there is some level of adherence to MRSA prevention and control recommendations in surveyed correctional facilities.

							inmates on sharing of personal items. The positive response rate for the standard precaution questions was 84.3% (70 of 83) overall.		

63	36	2009	Deger and Quick	Residents of a county jail between January 1 and December 31, 2005 [US]	Review of records of culture positive SSTI cases	Number of culture positive SSTI cases, co-morbid conditions, proportion due to MRSA, treatment modalities, outcome.	68% (50/74) of positive cultures of SSTI yielded MRSA;30% (22) yielded methicillin-sensitive *S. aureus* (MSSA). 1% (1) yielded *Enterobacter* species (1%), and 1% (1) *Pseudomonas aeruginosa*. 3 cultures yielded MSSA and one of the following species: *Acinetobacter baumannii, Klebsiella oxytoca, and P. aeruginosa.* Co-morbid *c*onditions include heroin abuse (29); eczema, scaly skin (15); alcohol abuse (14); hepatitis C or B (14); nicotine abuse (10); methamphetamine abuse (9); asthma (9); in-grown nails (3); body lice (3); genital warts (2); perforated nasal septum (2); and diabetes mellitus type 2 (2). 52.7% (39) of cases were treated with Clindamycin, 24.3% (18) Cephalexin, 6.8% (5) Quinolones, 4% (3) TMP-SMX 2.7% (2) Bactroban Ointment 2% and Doxycycline. 5 cases had an I&D done in addition to antibiotics and 1 had only an I&D. All cases that stayed till antibiotics were completed recovered, no hospitalizations, mortalities, or antibiotic associated *C. difficile* were recorded. Prevention includes discussions between healthcare staff, COs, and inmates on to adherence daily showering, washing hands frequently, covering all wounds with clean dry dressings, and avoiding sharing towels, clothing, and razors. Use of antibacterial soaps, isolation of inmates with draining wounds and provision of flu vaccine to high-risk inmates.	Not generalizable to other carceral settings.	Useful report of SSTIs and MRSA in a real-life setting.

64	94	2014	David et al.	Residents of a county jail [US]	Randomized controlled trial	Prevalence of *S. aureus* carriage in residents at 6 months.	The prevalence of carriage of any type of *S. aureus* at 6 months, was 51.1% in group 3, 40.7% in group 1 (absolute risk reduction [95% CI], 10.4% [0.01%–20.1%]; P = .047), and 42.8% (absolute risk reduction [95% CI], 8.3% [1.4% to 18.0%]; P=0.99) in group 2. The prevalence of carriage of MRSA at 6 months, was 10.0% in group 3 and 8.7% in group 1 (absolute risk reduction [95% (CI)], 1.4% [4.8% to 7.1%]; P = .655).	Small sample size at end of study, inability to monitor or ensure the use of intervention as prescribed.	Suggests bactericidal agents for skin cleaning may reduce *S. aureus* carriage
65	88	2005	Ribeiro et al.	Residents of a public jail [Brazil].	Case report/Intervention/	Measures for treatment, prophylaxis and control of scabies. /Outcome of intervention	167 residents were initially enrolled but 44 were released from jail before conclusion of the study and so did not complete the study. 78% (94/123) of residents were found to have scabies after initial examination (no cases of crusted scabies). All 123 residents and staff who had contact with them were treated with oral ivermectin (200–300 mg/kg). Clothes and linen were changed and sterilized (washed in hot water). The floors and walls were washed with chlorine and water. Treatment was repeated after 7 days, and all subjects were clinically re-evaluated 8 days after the second dose. 92.6% (87/94) of those initially with scabies and treated were found to be symptom- and lesion-free after 8 days, while 93.1% (27/29) who were initially scabies free but treated (prophylaxis) were found to scabies free at the 2nd evaluation. The 11 patients with scabies at day 8 received a 3rd dose of ivermectin with complete resolution of symptoms and clinical signs of the disease after 30 days.	May not be generalizable to other settings. No information on completion of treatment in those transferred.	Suggests that oral ivermectin is effective for the treatment of scabies in a carceral setting.

66	89	2021	Bedoya del Campillo et al.	Residents of a youth detention center and review of literature [Spain]	Case study and literature review on scabies protocols and treatment guidelines.	Number of cases, treatment, and control procedures. findings from review of literature.	61 cases of scabies were diagnosed over the period from November 2018 to November 2019. 64% (39) were discovered at the time of entry into the center, 18% (11/61) within the first 6 weeks of their stay (within the incubation period), and 18% (11/61) after spending more than 6 weeks in detention (infection could have occurred in detention. Standard treatment was with 5% permethrin cream, applied twice a week apart. Patients were isolated for 24hours, the topical cream was applied and left for on 8 hours. In 8 cases, symptoms continued, and treatment had to be repeated. Other control measures included changing patient's personal clothing, and treating clothing, bedclothes, mattresses, towels, and other personal items to eliminate any potential parasite infestation. The cells occupied were disinfected and left empty for four days. Cellmates were checked and treated. Review of literature found oral ivermectin to be the drug of first choice for treating patients and contacts in prison	May not be generalizable to other carceral settings.	Useful account that highlights the usefulness of clinical examinations at intake in detecting scabies in a carceral setting

67	90	2000	Leppard and Naburi	1153 residents of a prison [Tanzania].	Prospective study/Intervention	Response to an outbreak of scabies/Result of intervention	6 visits were made to the prison, a preliminary visit, and 5 subsequent visits on day 1 of the study and after weeks 1, 4, 8 and 12. On day 1, all residents were given a 150µg/kg single oral dose of ivermectin irrespective of scabies status. 70.9% (816/1153) of residents were found to have scabies, 1.4% (16/1153) had crusted scabies, leaving 69.6% (802/1153) with scabies that wasn't crusted. 24% (196/816) of those with scabies had severe pyoderma, mostly seen on the hands, buttocks and genitalia. on day 1 also, the walls and floors of all the cells were treated with an emulsifiable concentrate of Actellic 50 EC (pirimiphos methyl) 80 mg diluted in 20 L of water, and all the sleeping mats and blankets were laid out in the hot sun for 1 h. Any member of staff found to have scabies was treated with 1% lindane lotion as a single application. Follow up visits after weeks 1, 4 and 8 revealed resolution of signs and symptoms of scabies in 30%, 80% and 95.5% of residents with scabies respectively. After week 8, those with crusted scabies were treated with topical 1% lindane and the walls and floors of their cells retreated on the same day. After week 12, there was no evidence of scabies in residents or staff.	Intervention study with a large number of residents involved may be generalizable to other settings	Suggest that Ivermectin may be effective for the eradication of scabies in carceral settings.

68	91	2022	Pembi et al.	Residents of a prison [Nigeria]	Mpox outbreak report	Description of cases	21 cases were found during a visit that had experienced symptoms over the course of 18 weeks. Symptoms included fever, rashes, generalized weakness and prostration. Rashes were on the face, head, neck, trunk, buttocks, extremities, and genitalia. All affected individuals had enlarged inguinal and some cervical lymph nodes, which were firm, non-fluctuant and tender. 2 of 5 patient samples were PCR positive for Mpox.	Only few cases were PCR confirmed.	Provides evidence of an Mpox outbreak in carceral settings.
69	37	2012	Oninla and Onayemi	Residents of a prison [Nigeria]	Cross-sectional	Prevalence of skin infections, type of skin infections, significant associations with the prevalence of skin infections	Total prevalence of skin infections was 49.2%(150/305), with some subjects having 2 or more infections (adding up to 178 infections). Most of skin infections were fungal with dermatophytosis accounting for 64% (114/178) of infections, pityriasis versicolor making up 27% (48/178) and candidiasis 2.8% (5/178). There was a significant difference between the prevalence of skin infections among inmates living in single cells (sleeping area of 9.5 square feet per inmate) 67.1% and dormitories (sleeping area of 26 square feet per inmate) 43.2% (X^2 = 13.013, df = 1, P = 0.0001). A measure of overcrowding. There was significant difference between the prevalence in frequent and infrequent bathing respectively (X^2 = 1.131, df = 4, P = 0.025).The prevalence of skin infections among inmates who used soap daily 34.6% (28 of 81), occasionally 57.8% (59 of 102), and never 52.5% (63 of 120) was significantly different (X^2 = 10.497, df = 2, P = 0.005).	No attempt to account for possible confounding variables. Not generalizable to other carceral settings	Suggests that overcrowding and poor hygiene contributed to infectious dermatosis in this carceral setting.

70	95	2020	Mardu et al.	Food handlers in 2 prison centers [Ethiopia]	Cross-sectional	Prevalence of intestinal parasites, *Salmonella* and *Shigella,* good knowledge and good practice	62.7% had intestinal parasites, 6.8% had *Salmonella* and *Shigella* 84.8% believed contaminated food always showed a change in color, taste or smell, all of the participants always handled food with their bare hands and 43.9% had uncut nails. 53% did not use gowns, and 54.5% did not cover their hair when handling food.	Certain variables such as use of gowns, and handwashing after toilet use were self-reported not observed may be subject to recall bias or desirability bias. Real rates may be less than those reported. Parasites may have been overestimated as wet mount microscopy cannot differentiate between pathogenic (*E. histolytica*) and nonpathogenic (*E. dispar*) *Entamoeba* species	Suggests there is a dire need to educate and monitor food handlers working for and in correctional facilities for adherence to safe food handling practices.

71	39	2010	Ranjibar et al.	701 residents of a prison [Iran]	Cross-sectional	Investigation of the source an outbreak of gastroenteritis	*S.flexneri* serotype 3a was the sole isolate from some stools specimens collected from affected prisoners. All isolates were identical in antimicrobial susceptibility/resistance pattern and by ERIC PCR testing. Raw vegetables consumed by all affected were not available for testing but was suspected to be the source. Restaurant employees were not affected, and their stool samples were negative	Source of outbreak not definitively identified.	Highlights the importance of food safety and hygiene policies and practices in carceral facilities

72	41	2022	Oppegard et al.	Residents of a correctional facility [US]	Outbreak investigation	Investigation of the source an outbreak of *Salmonella* Enteritidis	15 cases of *S*. Enteritidis infection were identified, of which 5 were laboratory confirmed and 10 probable cases. All cases were food workers who all reported eating chili prepared from the raw mechanically separated chicken product. *S*. Enteritidis similar to the outbreak strain genetically was isolated from the raw mechanically separated chicken sample. Qualitative interviews and a visit by the Lincoln-Lancaster County Health Department (LLCHD) revealed that the mechanically separated chicken product was sometimes still frozen or partially frozen at the time of cooking. Routine monitoring of cooking temperatures while food was being prepared was not in place. LLCHD recommended policies to the facility and worked with them to implement them to prevent foodborne outbreaks. These included excluding ill workers from food preparation, increased thawing time for mechanically separated chicken under refrigeration, routine monitoring and recording of cooking temperatures, and adjustment of meals to smaller preparation volumes to mitigate food safety risks.	Outbreak source was identified, and appropriate measures taken to prevent a reoccurrence.	Emphasizes the need to have and implement food safety policies in correctional facilities.

73	96	2011	Greig et al.	Review of the literature on, and outbreak investigation reports of, enteric illness outbreaks in correctional facilities (1999 -2009 [International].	Review	Epidemiology of outbreaks, effective infection control measures	72 outbreaks reports, 50 from North America, 10 from Europe, 9 from both New Zealand and Australia, and 3 from Asia. 76.4%(55) of them were attributed to bacteria including *Salmonella* spp. 27.8%(20), *C. perfringens* 19.4% (14), pathogenic *E. coli* 13.9% (10), *Campylobacter* spp. 6.9% (5), S. aureus 2.8% (2), Vibrio cholerae 2.8% (2), Bacillus cereus 1.4% (1), and Clostridium botulinum 1.4%(1). 20.8%(15) attributed to viruses, with 19.4% (14) due to norovirus and 1.4% (1) due to Hepatitis A virus. 1.4%(1) due to parasites (*Cryptosporidium* spp.) and 1.4%(1) to multiple agents. 66.7% (48) had a food borne mode of transmission, 11.1% (8) were transmitted person to person, 2.8% (2) had other modes of transmission and for 19.4% (14) the mode of transmission was unknown. Symptoms cases presented with included diarrhea, cramps nausea and vomiting, abdominal pain, headache, bloody diarrhea, and fever. Measures implemented include limiting movement of ill inmates, exclusion of ill food handlers, education of staff/inmates, followed hazard analysis & critical control point principles (HACCP), enhanced cleaning & disinfection of surfaces, improved communications, enhanced surveillance by the facility/community/health unit, enhanced handwashing and excluding ill staff. Recommendations include monitoring of temperatures for cooking,	Included multiple reports from different regions of the world. Only outbreak investigations of enteric illness that are published were represented. Unreported outbreaks are not be represented though they may exist.	Provides some information on outbreaks of enteric illness in carceral settings with effective measures for prevention and control of outbreaks.

							cooling and reheating, washing/sanitizing kitchen equipment and surfaces, maintaining food temperature logs, not cooking food far in advance of service, enhanced handwashing, excluding ill food handlers, adequate number of functioning, accessible, hand basins supplied with soap and a means of drying, and education of food handlers on safe food hygiene.		
74	99	2016	Lupcho et al.	Residents and staff of a correctional facility [US]	Outbreak investigation	Investigation of an outbreak of gastrointestinal illness	Case controls studies revealed that tortilla chips were the single item associated with illness. Testing of stool and food samples did not isolate any pathogens. However, other tests revealed the presence of 2 markers for rancidity, hexanal and peroxide	Combination of epidemiological and laboratory methods to establish findings.	Provides useful evidence that outbreaks may be related to food spoilage

75	98	2017	Marlow et al.	Correctional institutions [US]	Review of CDC's Foodborne Disease Outbreak Surveillance System (FDOSS) data	Epidemiology of foodborne illnesses 1998 to 2014	The median number of illnesses per foodborne disease outbreak and median number of illnesses associated with foodborne disease outbreaks per 100 000 population, were more than 5 times greater in carceral settings than in the un-incarcerated population. outbreaks in correctional settings were only 1% (200/18,206) of all foodborne disease outbreaks reported, they were responsible for up to 5.8% (20,625/358,330) of outbreak-associated illnesses. The pathogens most frequently confirmed to have caused the outbreaks were Clostridium perfringens in 28% (36/128) of outbreaks with confirmed causative pathogens, Salmonella in 27% (35/128), and norovirus in 16% (21/128)	Robust data. Data reviewed covers a wide period of at least 15 years.	Provides an enlightening picture of the burden of foodborne illnesses in carceral settings.
76	97	2021	Zellmer et al.	Residents of a county jail [US]	Intervention	Modification of vaccine protocol in response to hepatitis A outbreak. Shorter time to vaccination use of education materials	Vaccination within 48 hours of initial offer at initial intake, initial increase in vaccination rates from 0.6% to 7.1%	Provides useful evidence from a jail setting	Suggests that actions can be taken to increase vaccine uptake in jails.

77	40	2013	Sunil et al.	Residents and staff of a correctional facility [Canada]	Outbreak response/intervention	Response to an outbreak of illness presenting with enteric symptoms	57 staff and 58 residents (115 people) were cases. Symptoms included nausea (43%), diarrhea (34%), and vomiting (23%), fever, abdominal pain, headache, malaise, and loss of appetite. The unit the index case was from had the highest number of cases during the outbreak (27%). Attack rates among inmates and staff were 5.7% (58/1,017) and 11.4% (57/500), respectively. Stool samples collected from cases tested negative for norovirus with electron microscopy and PCR, however based on clinical and epidemiologic features norovirus was suspected. Measures implemented include screening of all inmates and staff, isolation of inmate cases, asking staff cases to remain at home till 48 hours after resolution of illness, implementing standard precautions, contact and droplet precautions, limiting inmate transfer within the facility. However, cases continued to increase, thus a complete closure to transfers and limitation of movement of inmates out to court, and restriction of visitors were implemented. Video and audio conferencing were used for court appearances. This resulted in a reduction in cases and eventual end of the outbreak.	No laboratory evidence could be obtained to support the clinical and epidemiologic features of a Norovirus outbreak.	Shows that application of outbreak measures including standard precautions, isolation and movement restrictions when implemented together can contain an outbreak of Norovirus.

78	42	2017	McCrickard et al.	Residents of a federal prison [US].	Outbreak response/intervention	Response to an outbreak of botulism	Medical chart reviews and interviews were conducted. 33 inmates reported consuming hooch (also called pruno) during June 1–19, 2016, 94% (31/33) had signs or symptoms suggesting botulism. Of the 31 cases identified, (all men), 19 were confirmed cases (with laboratory evidence), 10 probable cases (signs or symptoms of any cranial nerve palsy and extremity weakness), and 2 suspected (signs or symptoms of any cranial nerve palsy and extremity weakness). It was reported that honey, potatoes, apples, and tomato paste from a bulging can were combined, hidden, and fermented in a sealed plastic bag at room temperature for 3–5 days to make the alcohol. 24 residents were hospitalized, 15 (63%) in an intensive care unit and 9 (38%) required intubation and mechanical ventilation; none died. Twenty (83%) patients received botulinum antitoxin; 11 patients with mild illness did not receive antitoxin. Staff members confiscated >20 gallons of hooch during the investigation, however the particular batch of hooch responsible for the outbreak was not determined.	No mention of the provision of education or information to residents and staff about foodborne botulism, its prevention and the risks associated with consumption of illicit prison made alcohol in the outbreak response.	Suggests that residents in carceral settings would benefit from education about the dangers of consuming illicit alcohol produced in carceral settings.

79	43	2015	Yasmin et al	Residents of a maximum-security prison [US].	Outbreak investigation	Response to an outbreak of botulism.	Chart reviews and interviews were conducted with residents of the prison. 8 residents reported drinking from the same batch of pruno or eating potato pieces from the same pruno mixture at about the same time, the day before the first 5 presented. All serum samples obtained before antitoxin administration from each of the 8 had positive results for botulinum toxin type A. Serum samples obtained 24 hours after antitoxin administration were negative for toxin in all patients. 5 rectal swabs and stool sample were positive for botulinum toxin type A. The pruno sample confiscated from a patient's cell yielded *C. botulinum* and botulinum toxin type A. PFGE patterns for botulinum toxin types were different between the current and previous outbreak but indistinguishable within each outbreak (November and August, respectively). The 7 patients who required mechanical ventilation received tracheostomy and percutaneous endoscopic gastrostomies 11 to 14 days after admission, and care in long-term care facilities 2 to 3 weeks after initial hospitalization. The 8th patient who was not intubated was discharged after 5 days. None died. Residents and correctional staff were educated on signs, symptoms, and prevention of foodborne botulism. Educational fliers were bilingual and had input from the residents. Baked potatoes and sugar	Provision of education for residents and staff to prevent future outbreaks, using a culturally sensitive and inclusive approach, to prevent future outbreaks.	Useful report of a botulinum outbreak investigation and intervention, displaying the use of education in a culturally sensitive and inclusive manner, to prevent future outbreaks.

							were banned from inmate meals to prevent pruno production.		

80	44	2018	Rao et al.	Residents of a state prison [US]	Outbreak investigation	Response to an outbreak of botulism.	Medical evaluations and interviews were conducted with residents. Fliers were posted and announcements made to encourage those with symptoms suggestive of botulism to report for evaluation. 8 cases of botulism were identified out of 13 residents who consumed pruno. 2 batches of pruno were found to have been in circulation during the outbreak and all pruno found in cells was confiscated. All 8 cases consumed pruno from one of the batches. All 8 cases received heptavalent botulinum antitoxin (HBAT) shipped from CDC. 3 cases required mechanical ventilation. Botulinum toxin type A was identified in serum of 5 patients, and *Clostridium botulinum* type A was isolated from the stool of 4 patients. Liquid squeezed from a sock containing strained potato used to make the pruno, yielded *C. botulinum* type A on culture but was negative for botulinum toxin. *C botulinum* type A isolates from stool of 4 patients and the liquid squeezed from the sock were indistinguishable by PFGE. Leftover pruno from the other batch did not yield toxin or *C. botulinum*. Whole potatoes were banned in prison and laundry bags were replaced with perforated ones to prevent use in pruno production in the jail. Hospital costs for care of affected residents estimated to be $500,000.	No information on provision of education to inmates and staff to prevent future outbreaks. Some measures to prevent future outbreaks implemented.	Useful account of a botulism outbreak investigation with an estimation of the cost of treatment of affected residents.

81	100	2016	Lima et al.	Prison dentists/inspection of prison dental surgeries. [Brazil]	Cross-sectional	State of infection control in prison dental surgeries	In 91% of prison dental surgeries there was no specific area for decontamination, no clean and tidy storage areas for sterile products. Defective sterilization procedures, absence of written infection control protocols.	Direct observation of prison dental surgery facilities allowed for objective assessment of infection control provisions	Suggests that there is a need to make provision for and implement infection control in prison dental surgeries

DISCUSSION

This review systematically examined the literature for interventions that were implemented or proposed for implementation, to prevent the transmission or outbreaks of infectious diseases other than COVID-19, in carceral settings globally. And where outbreaks had occurred in carceral settings, I explored the measures that were implemented to limit or control them, and the resulting outcomes.

Conditions present in carceral settings, such as overcrowding, poor ventilation, extended periods of confinement and other factors, contribute to an increased risk of exposure to, and acquisition of, infectious diseases for residents (3–5). This risk has frequently led to outbreaks of diseases affecting large numbers of residents (9,11,12,14–17,19,21,28–31,65–67). Nevertheless, all in carceral settings have the right to access health care services and interventions to prevent treat, control, manage and limit infections (45,46). The United Nations “Nelson Mandela Rules" strongly states these rights. Many human rights groups echo the rules. Legislation and court judgements in many jurisdictions globally have repeatedly affirmed these rights (45). Making residents of carceral settings pay for accessing healthcare while incarcerated and not employed in income generating activities runs contrary to this ideal. Furthermore, my review found that medical copay disincentivized those who were ill with symptoms to seek healthcare. Removing this impediment was necessary to control a carceral outbreak in some instances (21).

Infection prevention and control: persons, policies, procedures, and facilities

Having a definite individual or persons responsible for infection prevention and control was necessary for optimal control and prevention of infections in carceral settings. Lacking this position was identified as one of the deficiencies that contributed to a prison outbreak (11). Infection control policies, procedures and facilities need to be put in place with a system to evaluate them periodically to ensure policies and procedures are being followed. Evidence shows that policies and procedures could exist but practice be divergent (57). Furthermore, systems need initial and continuing education on infection control policies and practices for healthcare staff, custody staff and residents. Facilities needed include adequate facilities for handwashing for residents and staff as well as an AIIR or AIIRs. The absence of any of these may lead to outbreaks or a difficulty in managing outbreaks when they occur (11). Focusing on entry interviews and examinations and procedures can prevent infectious diseases in the outside community entering the facility and exposing inhabitants.

Information, education, inclusion, and engagement

Measures and interventions to prevent or control infection that incorporated adequate dissemination of information, and education of residents and staff of carceral settings, in an inclusive and culturally sensitive manner were successful (13,18,43,69,78,81). Programs that included residents and staff input as stakeholders and those that engaged residents as peer educators were effective (43,58,73). Incorporating input from residents and staff of carceral settings, and where possible giving residents a role as peer educators or facilitators, strengthens infection control initiatives.

Outbreak prevention and control

Several infections causing outbreaks in carceral settings are vaccine preventable. Immunization programs have been found to be effective in preventing and mitigating outbreaks. However, rather than implementing reactionary vaccination drives to mitigate outbreaks, the focus should be on programs that provide vaccines to susceptible residents of prison settings at entry, thus preventing outbreaks. One study suggests this (12) and cites a cost analysis that found that screening all residents and vaccinating those found to be non-immune for varicella, would save $1.3 million and prevent 116 varicella cases over 5 years in the state prisons of California.(12) The capacity for continuous epidemiological surveillance, contact tracing, quarantine and isolation, for the infections that require such a response, needs to be acquired, developed and maintained. Collaboration between different agencies with responsibilities for the custody and health of residents and for public health was a recurring theme in effective outbreak response, investigation and control (21,40–43,70,99). Collaboration includes custody staff, correctional facility healthcare staff, local, county and state health departments, public health laboratories, public health departments and units, hospitals, and entities like the US CDC or its international counterparts. Correctional facilities need to maintain connections with these other organizations able to provide resources in response to outbreaks. Their help can ensure compliance with notification for reportable diseases, while avoiding undue delays in reporting.

Airborne infections and infections transmissible by the respiratory route

Among airborne infections, TB remains an important problem in carceral settings globally. Attention must be given to measures that enhance the prevention of TB disease or its early identification. These include screening for LTBI and TB disease at entry, and at regular intervals in correctional facilities. This should be integrated with immediate access to definitive investigations for TB disease where indicated and definitive treatment for TB or LTBI respectively, when required, without delay. Unlike TB, diseases such as measles, varicella, mumps, influenza, and meningitis are vaccine preventable. Depending on local epidemiology, these vaccines should be offered to all susceptible, unvaccinated or status unknown individuals at admission or entry into carceral settings. The susceptibility of carceral staff should also be addressed. Offering workers vaccines or documenting immune status ensure that they are protected in the event of an outbreak. It is also important to note that atypical infections, like *Chlamydia pneumoniae* pneumonia, for which no vaccines are available, while uncommon, have occurred in prison settings (21). Thus, heightened vigilance and a high index of suspicion, active infection control policies and practices, and resources such as AIIRs and isolation rooms are all components of an effective infection control program.

BBVs and STIs

Harm reduction programs including needle and syringe programs were found to be effective in the prevention of HBV, HCV, and HIV in carceral settings (74,75) and could be implemented where politically feasible. Sex occurs in prisons with it comes the risk of transmission of HBV, HCV, and HIV. Condoms are effective at greatly reducing the possibility of the transmission of the BBVs and other STIs (101–103). Condoms have been found to be safe, feasible, acceptable and a cost-effective method for preventing the sexual transmission of pathogens in carceral settings (72,73). They should be made available in carceral settings. Provision of vaccines

against HBV, curative treatment for HCV and suppressive therapy for HCV are all components of an adequate infection control program. and effective treatment for sustained virologic response (SVR) or to attain viral (77), (104–107). One cannot prevent what is unknown, so the corollary of vaccination and treatment is the need to implement and sustain screening programs for all of these viruses at entry, so those who require immunization or treatment can be identified and offered the appropriate healthcare services. Screening for other STIs like gonorrhea, *Chlamydia trachomatis*, *Trichomonas vaginalis* and syphilis in carceral settings not only identifies those infected, but also provides an opportunity to treat and prevent transmission of infection. HPV vaccines are appropriate for adolescents in carceral settings.

Skin and soft tissue infections.

Interviews and physical examinations at entry into carceral settings should seek cases of skin and soft tissue conditions, such as bacterial SSTIs and skin infestations by ectoparasites. This allows appropriate placement of infected individuals and immediate initiation of treatment indicated, resulting in protection of their health and that of other residents and staff.

MRSA outbreaks have been common when laundry processes broke down or hand hygiene was inadequate. MRSA was isolated among residents and found in the environment. To prevent and control MRSA, laundry processes, environmental cleaning and general hygiene are paramount. Continuous laboratory surveillance for bacterial agents contributes to appropriate management of infections and prevention and mitigation of SSTI outbreaks.

Scabies was found to occur as cases or outbreaks in carceral settings; ivermectin is the preferred drug to treat individuals or to terminate outbreaks (88–90). However, in managing crusted scabies, combining it with permethrin cream is recommended. Another important factor was also treating contacts at the same time, even in the absence of symptoms, and adequately treating clothes and beddings either by washing in hot water or exposing to high heat. Vacuuming or cleaning the environment is also advised. Spraying or using insecticides is not needed (33). Although no articles on *Pediculus humanus* in carceral settings that met the inclusion criteria were found, human lice are known to be a problem in carceral settings. They may be managed by paying particular attention to body hygiene, treatment of clothes, beddings, mattresses, furniture, and environmental cleaning. Topical permethrin cream is appropriate treatment..

Foodborne diseases and gastroenteric illnesses

Residents of carceral settings were significantly more at risk for foodborne illnesses and have been disproportionately affected by outbreaks (98). The conditions of incarceration limit them greatly in dining options and make them utterly dependent on whatever arrangements exist in the carceral setting for food. These arrangements involve the processing and handling of food for hundreds to thousands of individuals several times a day, by individuals that may or may not be well trained or adherent to the rudiments of food safety and hygiene. Thus, multiple opportunities exist to introduce foodborne pathogens with lax systems for food processing oversight. The continuous training, education, and assessment of food handlers, whether they are residents or un-incarcerated employees, to ensure standards for food safety are met is important in carceral settings. This necessity is underlined by the study in which enteric pathogens were

isolated from the stool of food handlers (95), for 2 prison units in Ethiopia which housed 2080 residents. All food workers handled food with their bare hands, over half did not use gowns or cover their hair when handling food, and over 40% had uncut nails. Similarly, another study found that 1 in 7 outbreaks of foodborne illness in US correctional facilities were due to contamination from food handlers. It is important also to ensure that the right temperatures are maintained at each stage and all food safety and hygiene standards are adhered to. Having an individual responsible for maintaining food safety standards is another important component of an infection control program.

The desire for residents to produce and consume pruno, prison-brewed alcohol, has resulted in botulism. with negative consequences including both death and significant costs in healthcare. Preventive measures found to have been introduced in carceral settings following outbreaks include altering or eliminating the materials used in pruno production. Proactive adoption of these measures in correctional facilities that have not yet experienced such outbreaks should be considered.

Other considerations

Vaccination, systematic quarantining and isolating in the presence of airborne pathogens, principles of COVID-19 mitigation, were used and demonstrated before the COVID-19 pandemic, as effective tools for managing outbreaks of airborne infectious agents. The recognition that prolonged isolation can have a profound effect on mental health may be one lesson that emerged in the wake of the new disease. The effects of isolation on mental health warrants consideration and cohorting of individuals with the same infection, may be a preferrable alternative. Residents have been found to refrain from reporting illness to avoid isolation, in some carceral settings, and this has hindered the control of some outbreaks.

Conclusion

Incarcerated persons have a right to healthcare services that prevent infectious diseases or manage them when they occur. Failure to recognize this right, or to provide the needed healthcare results in negative consequences for them, the communities outside carceral settings and general public health.

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