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A systematic scoping review of environmental health conditions in penal institutions

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ABSTRACT

Adequate environmental health conditions in penal institutions are necessary to protect and promote the health of prisoners and prison workers. We conducted a scoping systematic review to: describe the environmental health conditions in penal institutions and the associated exposures and health outcomes; identify effective approaches to prevent environmental health concerns; and identify evidence gaps on environmental health in penal institution populations. PubMed, Web of Science, EBSCOhost, Scopus, and ProQuest were searched. Peer-reviewed studies that reported original data and on environmental health conditions and/or exposures in penal institutions were included. Seventy-three studies met these criteria. The most common risk factor identified was contaminated food and/or beverages prepared or handled in the institution's kitchen. Overcrowding, inadequate ventilation, and a lack of, or sharing of, soap and other hygiene products increased the risk of adverse health outcomes. Common responses included isolating infectious patients, educating prisoners and prison staff on improved sanitation and hygiene practices, improving ventilation, and disinfecting contaminated surfaces and/or water sources. Inadequate environmental health conditions in penal institutions are common, and adversely impact the health of prisoners and prison staff, yet are preventable. Few studies have been conducted in low- and middle-income countries, biasing our results. The development and implementation of national guidelines for essential environmental health in prisons, monitoring of conditions, and greater accountability of facility managers are needed to secure the health, rights, and well-being of prisoners.

1. Background

Prisoners often come from poor, vulnerable, and socially disadvantaged populations (Ginn and Robinson, 2012; World Health Organization, 2014). Penal institutions must provide for the health needs of prisoners, as keeping prisoners healthy is a duty of the institution and helps prevents double penalty for the prisoners. Adequate environmental health conditions in penal institutions are necessary for these reasons to protect the dignity of prisoners, and to ensure an adequate standard of living (Clements, 1979; Rubino, 2001). Adequate environmental health conditions contribute to the fundamental human right to the highest attainable standard of physical and mental health (United Nations, 2005; World Health Organization, 2007).

Prisoners are detained persons who have been sentenced or are currently pending arraignment, trial, or sentencing for offences against the law (Health and Human Services, 2003; World Health Organization, 2007), while penal institutions are any institutions in which prisoners are detained (World Health Organization, 2007). There are an estimated 10.4 million prisoners worldwide (Walmsley, 2016). However, data on prison populations in certain countries are unavailable or incomplete. Between 2000 and 2015, the estimated prison population worldwide increased by 20% (Walmsley, 2016). In the United States alone, there are more than 1.5 million adult prisoners in state and federal penal institutions (Carson, 2018).

Relative to the general population, prisoners carry a higher disease burden. Among prisoners in the United States (US), 39% of federal inmates and 42% of state inmates suffer from a chronic medical condition (Wilper et al., 2009). Substance abuse, mental health, and communicable diseases, such as HIV/AIDS, sexually transmitted illnesses (STIs), tuberculosis, and viral hepatitis, are prevalent prisoner health problems (Watson et al., 2004; World Health Organization, 2014). Tackling these health problems is complicated because the

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primary function of penal institutions is correcting and punishing prisoners, which can conflict with the quality of health and environmental health of prisoners (Behnke et al., 2018; Ginn and Robinson, 2012; Watson et al., 2004).

Prisoners cannot choose their living environment, have no control over its density, exposure, and composition, and are dependent on prison administration and staff to ensure adequate environmental health conditions. Common factors that contribute to adverse health outcomes include poor or insufficient ventilation, soil, food, waste management, water, sanitation, and hygiene, exposure to sunlight and open air, and population density (World Health Organization, 2014). In the US, more than 18 states operate their penal facilities at greater than 100% capacity (Carson, 2018). Exposure to inadequate environmental health conditions in penal institutions contributes to increased morbidity and mortality (Benedict et al., 2016; Brett et al., 2014).

Previous systematic reviews have described the impact of living in penal institutions on mental conditions and communicable diseases, such as HIV/AIDS and tuberculosis (Baussano et al., 2010; Watson et al., 2004). However, no systematic review has examined environmental health conditions, exposures, outcomes, and potential control measures in penal institutions; and the impact of environmental health on prisoners is insufficiently characterized.

We conducted a systematic scoping review to better understand the causes of and prevention approaches for inadequate environmental health conditions in penal institutions. We sought to answer:

- ☆ What are the environmental health conditions in penal institutions and what are the associated exposures and health outcomes?
- ☆ What approaches are commonly used and/or effective in controlling environmental health concerns?
- ☆ What gaps are there in the evidence on environmental exposure in penal institutions populations?

2. Methods

2.1. Definitions

Prisoners are “any individual involuntarily confined or detained in a penal institution” (Health and Human Services, 2003). The term includes people sentenced under criminal or civil statute and detained for pending arraignment, trial, or sentencing. Penal institutions, or prisons, are “institutions that hold people who have been sentenced to a period of imprisonment by the courts for offences against the law” (World Health Organization, 2007). Environmental exposures include overcrowding, poor ventilation, insufficient or contaminated water, insufficient exposure to sunlight and open air, and inadequate waste management and food hygiene.

2.2. Eligibility

Studies were included that: reported environmental health conditions and/or exposures, in penal institutions where prisoners were the main population of interest, and contained primary data. There was no limit on the date of publication or geographic location.

2.3. Search strategy

Peer-reviewed studies were identified through PubMed, Web of Science, EBSCOhost, Scopus, and ProQuest. We included search terms relating to water, sanitation, hygiene, waste management, and environmental exposures, modifying a search string used in previous reviews (Moffa et al., 2019a,b). Studies included exposures to prisoners, and other populations that interact with prison settings such as prison staff and visitors. The full search strategy is described in the supplementary materials. Studies that were written in a language other than English, did not contain primary data, or did not report on environmental health within penal institutions were excluded.

Three independent reviewers used Cochrane's Covidence online software to screen the titles and abstracts of studies identified from searches. Studies approved by two of the three reviewers were included in full text screening. The third reviewer resolved conflicts.

Two reviewers screened full-text studies using the exclusion criteria described in the search statements. The search was conducted on August 28, 2017.

2.4. Data extraction and synthesis

The following data were extracted from included studies: setting (geographic information and penal institution information), study information (length, limitation, and study design), transmission routes (source, vectors, and barriers), population studied (outcomes for prisoners and other populations, number affected, risk factors), testing methods implemented, control measures, and recommended prevention approaches. Extracted data were tabulated to compare and analyze findings. The “threejs” package was used in R version 3.1.5 and RStudio 1.1.456 to map relationships and findings.

3. Results

3.1. Search results and study characteristics

A total of 6021 studies were identified, including 6010 from the database search, nine from the references of included studies, and two from online grey literature. After removal of duplicates, 4113 studies were screened by their title and abstract, resulting in 424 studies for full text review; 342 studies were excluded, resulting in 82 studies for data extraction and narrative synthesis (Fig. 1). Metadata for the 82 included studies are listed in Table 1, and the summary of the data extraction is listed in Table 2.

The study designs for the 82 studies included 29 case series, 15 case-controls, 10 cross-sectional studies, nine qualitative studies, four cohort studies, three intervention studies, two longitudinal studies, and two case studies. Eight of the studies had more than one study design, with the most common combination being case series and qualitative studies.

The included studies were published between 1959 and 2017, with study lengths from three days to 3 years and 8 months. They took place in 26 countries; 62 (76%) in high-income countries, 11 (13%) in lower-middle income countries, five (6%) from upper-middle income countries, and four (5%) from low-income countries, according to the World Bank country income classification.

3.2. Population

Within the 82 included studies, the numbers of prisoners exposed to inadequate environmental health conditions ranged from one to 1839.

In eight of the studies, prison staff, family members of prison staff, and/or community members reportedly suffered adverse health outcomes due to exposures to inadequate environmental health conditions within the prison (Awofeso et al., 2001; Davies et al., 2012; Duncan et al., 1988; Gecewicz et al., 1994; Gicquelais et al., 2014; Lupcho et al., 2016; Morse et al., 1985; Parikh et al., 1997). Of these eight studies, two found colonization and/or infection of one or more non-medical prison staff by the same species of infectious agent (Davies et al., 2012; Gecewicz et al., 1994). One study identified infection in two members of the prison nursing staff and one patient care assistant (Awofeso et al., 2001). Another study noted infection solely in non-medical prison staff and community members; the exposed prisoners were colonized by the infectious agent, but did not show signs of adverse health symptoms (Morse et al., 1985). Four studies documented health outcomes but did not identify the infectious agent among prison staff, family of prison staff, and/or community persons.

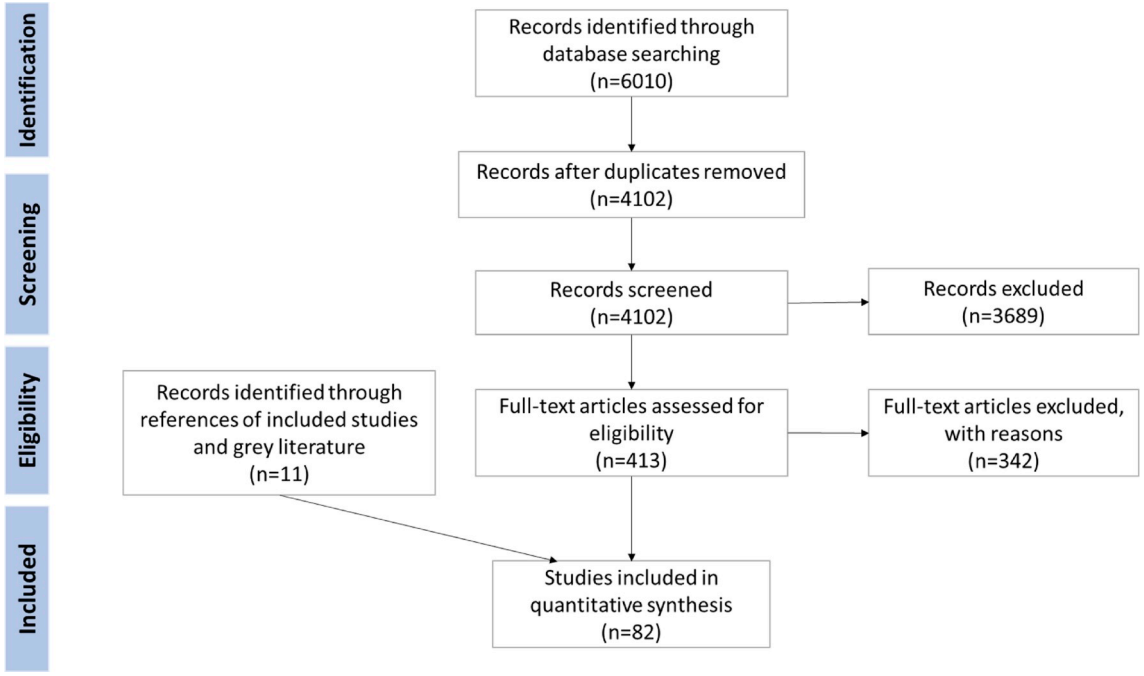

Fig. 1. Schematic of search strategy for a systematic scoping review on environmental health in prisons.

3.3. Risk factors

Of the 82 included studies, 34 (41%) identified environmental health risk factors for adverse health outcomes in prisoners. No risk factors were identified for prison staff, family of prison staff, and/or community members.

The most common risk factor was the intake of contaminated food prepared or handled in the prison kitchen, found in 14 studies (Alcabes et al., 1988; Davies et al., 2012; Ghosh and Vogt, 2006; Gicquelais et al., 2014; Hsieh et al., 2009.; Keita-Perse et al., 1999; Kimura et al., 2006; London et al., 2017; Lupcho et al., 2016; Meehan et al., 1992; Ng et al., 1997; Parikh et al., 1997; Ryder et al., 1977; Schaffzin et al., 2011). Six studies reported inadequate environmental conditions in areas including the kitchen, toilet, and showers, as risk factors for prisoners (Elias et al., 2010; Levy et al., 2003; Morse et al., 1985; Oninla and Onayemi, 2012; Rop et al., 2016; Taylor et al., 2015). Seven studies identified inadequate laundry services or a lack of clean clothes and linen as risk factors (Amwayi et al., 2010; Elias et al., 2010; Lobacheva et al., 2006; Maree et al., 2010; Oninla and Onayemi, 2012; Tobin-D'Angelo et al., 2003; Turabelidze et al., 2006). Other common risk factors included overcrowding (Aguilera et al., 2016; Gebrecherkos et al., 2016; Hoge et al., 1994; Kalonji et al., 2016; Kuruvila et al., 2002; Lobacheva et al., 2006; Macintyre et al., 1997; Urrego et al., 2015), inadequate ventilation (Aguilera et al., 2016; Gebrecherkos et al., 2016; Hoge et al., 1994; Urrego et al., 2015; Zerdo et al., 2014), and lack of, or sharing of, soap and other sanitary products (Amwayi et al., 2010; Maree et al., 2010; Oninla and Onayemi, 2012; Tobin-D'Angelo et al., 2003; Turabelidze et al., 2006).

3.4. Infectious causes

Sixty-two studies identified the infectious agent responsible for the adverse health outcomes present in the prison populations. Fifty-seven studies (70%) identified bacteria as the infectious agent (Table 2). Two studies (2%) identified influenza A, strains H1N1 and H3N3, and influenza B as the main source of infection (Awofeso et al., 2001; Robinson et al., 2012). Another two studies (2%) noted parasites as the main infectious agent (Rop et al., 2016; Schapiro and Molina, 1959). Parasites identified in these studies included *Entamoeba histolytica, Trichomonas intestinalis, Ascaris lumbricoides, Trichuris trichiura, Giardia lamblia*, and *Balantidium coli*. The remaining 20 studies (24%) did not mention the cause of infection.

The most common exposure source was contaminated food and/or beverages. Nineteen studies (23%) identified food prepared or handled in the prison kitchen as the source of the infectious agent (Table 2). In four studies (5%), the source was food and/or alcohol that was illicitly taken from the prison kitchen or made without the prison staff's knowledge (Adams et al., 2015; Briggs et al., 2013; Ghosh and Vogt, 2006; Thurston et al., 2012). Some prisons were built in areas with nearby cattle and dairy farms. Three studies (4%) reported these animals and their fecal matter to be the source of the infectious agent (Comstock et al., 2012; Junaidu et al., 2010; Morse et al., 1985). Other sources of contamination included a water reservoir, an ice machine, groundwater, food utensils, soil, and secondhand cigarette smoke.

3.5. Outcome measures

Study outcomes are listed in Table 2 and visualized in Fig. 2. Fifty-seven (70%) studies reported isolation of the infectious agent, while 45 (55%) studies reported clinical symptoms among the affected patients. Diarrhea was the most common health outcome and was listed in sixteen (20%) of the included studies. Death was reported in three (4%) studies (Awofeso et al., 2001; Brett et al., 2014; Gecewicz et al., 1994).

Seven studies explored the effects of tobacco smoking within penal institutions (Hammond and Emmons, 2005; He et al., 2016; Jayes et al., 2016; Ofungwu, 2005; Proescholdbell et al., 2007; Semple et al., 2017; Thornley et al., 2012). These studies varied in their method of monitoring of smoking, but typically measured particle mass concentrations or nicotine concentrations in areas including prison cells, outdoor yards, workshops, gyms, and common areas within the penal institution. Four studies were initiated in the context of a smoking ban within the prison (Hammond and Emmons, 2005; He et al., 2016; Proescholdbell et al., 2007; Thornley et al., 2012). Data collected by Hammond and Emmons (2005), Proescholdbell et al., 2007, and Thornley et al., 2013, indicate that smoking bans were effective in short-term reduction of particle mass and nicotine concentrations. He et al., 2015 found increases in particle mass concentration after the ban in two of the three units they surveyed, suggesting clandestine smoking.

Table 1
Metadata for studies included in a systematic scoping review of environmental health conditions in penal institutions.

Study Author	Title	Country	Income Classification	Study Design
Adams et al. (2015)	Alcohol Production, Prevention Strategies, and Inmate Knowledge About the Risk for Botulism From Pruno Consumption in a Correctional Facility—Arizona, 2013	USA	high	case series and qualitative
Aguilera (2016)	Tuberculosis in prisoners and their contacts in Chile: Estimating incidence and latent infection	Chile	high	cross-sectional
Alcabes et al. (1988)	An outbreak of Salmonella gastroenteritis in an urban jail.	USA	high	case series
Amwayi et al. (2010)	Modifiable factors associated with active pulmonary tuberculosis in a Kenyan prison	Kenya	lower-middle	case-control
Archer et al. (1984)	An outbreak of gastrointestinal illness caused by *Staphylococcus aureus* in a prison population.	USA	high	case-series and qualitative
Awofeso et al. (2001)	Influenza Outbreak in a Correctional Facility	New Zealand	high	case series
Baillargeon (2003)	Methicillin-Resistant *Staphylococcus aureus* Infection in the Texas Prison System	USA	high	cohort study
Bell (1974)	Environmental Conditions in Kentucky's Penal Institutions	USA	high	qualitative
Benedict et al. (2016)	Awareness and Environmental Exposures Related to Coccidioidomycosis Among Inmates at Two California Prisons, 2013	USA	high	case-control
Bourigault et al. (2014)	Outbreak of Skin Infections Due to Panton Valentine Leukocidin Positive Methicillin Susceptible *Staphylococcus aureus* in a French Prison in 2010 2011	France	high	case series
Brett et al. (2014)	Outbreak of Francisella novicida bacteremia among inmates at a Louisiana correctional facility	USA	high	qualitative
Briggs et al. (2003)	Botulism From Drinking Prison-Made Illicit Alcohol — Arizona, 2012	USA	high	case series
Centers for Disease Control	Public Health Dispatch: Outbreaks of Community-Associated Methicillin-Resistant *Staphylococcus aureus* Skin Infections — Los Angeles County, California, 2002–2003	USA	high	unknown
Comstock et al. (2012)	Outbreak of Shiga Toxin–Producing *Escherichia coli* O111 Infections Associated with a Correctional Facility Dairy — Colorado, 2010	USA	high	cross-sectional
Culpepper et al. (2001)	Methicillin-resistant *Staphylococcus aureus* skin or soft tissue infections in a state prison—Mississippi 2000	USA	high	case series
Davies et al. (2012)	*Salmonella enterica* serovar Enteritidis phage type 4 outbreak associated with eggs in a large prison, London 2009: An investigation using cohort and case/non-case study methodology	United Kingdom	high	cohort study
Dogbeh et al. (2014)	Field study of the indoor environment in a Danish prison	Denmark	high	qualitative
Douglas et al. (2009)	The impact of imprisonment on health: what do women prisoners say?	United Kingdom	high	qualitative
Drociuk et al. (2003)	Outbreaks of Salmonella serotype enteritidis infection associated with eating shell eggs–United States, 1999–2001.	USA	high	case-control
Duncan et al. (1988)	An outbreak of unknown aetiology in a correctional institution: implications for the development of public health laboratories.	Papua New Guinea	lower-middle	case series
Elias et al. (2010)	Community-based Intervention to Manage an Outbreak of MRSA Skin Infections in a County Jail	USA	high	surveillance and intervention study
Felkner et al. (2009)	Detection of staphylococcus aureus including MRSA on environmental surfaces in a jail setting	USA	high	case series
Gebrecherkos et al. (2016)	Smear positive pulmonary tuberculosis and HIV co-infection in prison settings of North Gondar Zone, Northwest Ethiopia	Ethiopia	low	cross-sectional
Gecewicz et al. (1994)	Legionnaires' Disease Associated with Cooling Towers - Massachusetts, Michigan, and Rhode Island, 1993.	USA	high	case-control, unknown, case-control
Ghosh and Vogt (2006)	Cluster of invasive salmonellosis cases in a federal prison in Colorado.	USA	high	case series
Gicquelais et al. (2014)	Multiple-Serotype Salmonella Outbreaks in Two State Prisons — Arkansas	USA	high	case-control
Goh et al. (1987)	Epidemiological characteristics of an institutional outbreak of cholera	Singapore	high	case series
Hamlet et al. (2006)	Impact of a salmonella outbreak investigation in a maximum security Scottish prison	Scotland/United Kingdom	high	case series
Hammond and Emmons (2005)	Inmate exposure to secondhand smoke in correctional facilities and the impact of smoking restrictions	USA	high	case series
He et al. (2015)	Unexpected increase in indoor pollutants after the introduction of a smoke-free policy in a correctional center	Australia	high	case series
Hoge et al. (1994)	An epidemic of pneumococcal disease in an overcrowded, inadequately ventilated jail.	USA	high	case-control and cohort study
Hsieh (2009)	*Clostridium perfringens* Infection Among Inmates at a County Jail	USA	high	cohort study
Jayes et al. (2016)	Second-hand smoke in four English prisons: an air quality monitoring study	United Kingdom	high	case series
Jerzynska et al. (2010)	High Exposure to Passive Tobacco Smoking and the Development of Asthma in an Adult Patient Who Had Never Smoked	Poland	high	case study
Jovanovska et al. (2016)	Health Protection of Prisoners in the Republic of Macedonia	Republic of Macedonia	upper-middle	cross-sectional
Junaidu et al. (2010)	Seroprevalence of brucellosis in prison farm in Sokoto, Nigeria	Nigeria	lower-middle	case series
Kalonji et al. (2016)	Prevalence of tuberculosis and associated risk factors in the Central Prison of Mbuji-Mayi, Democratic Republic of Congo Guillaume	Democratic Republic of Congo	low	cross-sectional
Keita-Perse et al. (1999)	Outbreak of diarrhea related to Clostridium perfringens in a correction facility: an epidemiologic investigation	France	high	case-control
Kimura et al. (2006)	Enterotoxigenic *Escherichia coli* O6:H16 Food Poisoning Outbreak in Prisons	Japan	high	case series
Kuruvila et al. (2002)	Pattern of dermatoses among inmates of district prison- Mangalore	India	lower-middle	longitudinal
Levy et al. (2003)	Tonsillopharyngitis Caused by Foodborne Group A Streptococcus: A Prison-Based Outbreak	Australia	high	case series

(*continued on next page*)

Table 1 (*continued*)

Study Author	Title	Country	Income Classification	Study Design
Lobacheva et al. (2006)	Risk factors for developing tuberculosis in remand prisons in St. Petersburg, Russia - a case-control study.	Russia	upper-middle	case-control
London et al. (2017)	Outbreak Caused by *Clostridium perfringens* Infection and Intoxication at a County Correctional Facility	USA	high	case series and qualitative
Lupcho et al. (2016)	Gastrointestinal Illness Associated with Rancid Tortilla Chips at a Correctional Facility - Wyoming, 2015.	USA	high	case-control
Macintyre et al. (1997)	Impact of Tuberculosis Control Measures and Crowding on the Incidence of Tuberculous Infection in Maryland Prisons	USA	high	cohort study
Maree et al. (2010)	Risk Factors for Infection and Colonization with Community-Associated Methicillin-Resistant *Staphylococcus aureus* in the Los Angeles County Jail: A Case-Control Study	USA	high	case-control
Maree et al. (2010)	Risk Factors for Infection and Colonization with Community-Associated Methicillin-Resistant *Staphylococcus aureus* in the Los Angeles County Jail: A Case-Control Study	USA	high	case-control
Meehan et al. (1992)	A Foodborne Outbreak of Gastroenteritis Involving Two Different Pathogens	USA	high	case series and qualitative
Miko et al. (2013)	Is Environmental Contamination Associated with *Staphylococcus aureus* Clinical Infection in Maximum Security Prisons ?	USA	high	case-control
Morse et al. (1985)	An Outbreak of Histoplasmosis in a Prison	USA	high	case-control
Ng et al. (1997)	An Institutional Outbreak of Salmonella Enteritidis in Singapore	Singapore	high	case series
Ofungwu (2005)	Indoor Air Quality Investigation and Health Risk Assessment at Correctional Institutions	USA	high	case series
Oladele et al. (2010)	Management of superficial fungal infections with senna alata ("alata") soap: A preliminary report	Nigeria	lower-middle	intervention study
Oninla and Onayemi (2012)	Skin infections and infestations in prison inmates	Nigeria	lower-middle	case series
Parikh et al. (1997)	*Clostridium perfringens* Outbreak at a Juvenile Detention Facility Linked to a Thanksgiving Holiday Meal	USA	high	case series and qualitative
Proescholdbell et al. (2007)	Indoor air quality in prisons before and after implementation of a smoking ban law	USA	high	case series
Ritter et al. (2011)	Exposure to tobacco smoke before and after a partial smoking ban in prison: indoor air quality measures	Switzerland	high	longitudinal
Roberts et al. (2006)	Tuberculosis Prevention and Control in Large Jails A Challenge to Tuberculosis Elimination	USA	high	qualitative
Robinson et al. (2012)	Influenza Outbreaks at Two Correctional Facilities	USA	high	case series
Rop et al. (2016)	Risk factors associated with intestinal parasitic infections among inmates of Kisii prison, Kisii county, Kenya	Kenya	lower-middle	cross-sectional
Ryder et al. (1977)	An evaluation of penicillin prophylaxis during an outbreak of foodborne streptococcal pharyngitis.	USA	high	case series
Sarang et al. (2016)	Prisons as a source of tuberculosis in Russia.	Russia	upper-middle	qualitative
Schaffzin (2011)	Public health approach to detection of non-O157 Shiga toxin-producing *Escherichia coli*: summary of two outbreaks and laboratory procedures	USA	high	case series
Schapiro (1959)	Intestinal parasitism among the inmates of the Central Penitentiary, Tegucigalpa, Honduras	Honduras	lower-middle	case series
Semple et al. (2017)	Characterising the Exposure of Prison Staff to Second-Hand Tobacco Smoke	Scotland (UK)	high	case series
Shah et al. (2003)	Prevalence of pulmonary tuberculosis in Karachi Juvenile Jail, Pakistan	Pakistan	lower-middle	cross-sectional
Swenty and Rowser (2014)	An Education Intervention in an Incarcerated Population to Reduce the Occurrence of Infectious Skin Diseases	USA	high	intervention study
Tavris et al. (1985)	Two successive outbreaks of *Clostridium perfringens* at a state correctional institution.	USA	high	case series
Taylor et al. (2015)	Multidrug-Resistant Salmonella Heidelberg Associated with Mechanically Separated Chicken at a Correctional Facility	USA	high	case-control
Terefe et al. (2015)	Intestinal helminth infections among inmates in Bedele prison with emphasis on soil-transmitted helminths.	Ethiopia	low	cross-sectional
Thornley et al. (2012)	Indoor air pollution levels were halved as a result of a national tobacco ban in a New Zealand prison.	New Zealand	high	case series
Thurston et al. (2012)	Botulism from drinking prison-made illicit alcohol - Utah 2011.	USA	high	case series
Tobin-D'Angelo et al. (2003)	Methicillin-Resistant *Staphylococcus aureus* Infections in Correctional Facilities	USA	high	case-control
Todrys et al. (2011)	Imprisoned and imperiled: access to HIV and TB prevention and treatment, and denial of human rights, in Zambian prisons	Zambia	lower-middle	qualitative
Topp et al. (2016)	Exploring the drivers of health and healthcare access in Zambian prisons: a health systems approach.	Zambia	lower-middle	qualitative
Turabelidze et al. (2006)	Personal hygiene and methicillin-resistant *Staphylococcus aureus* infection.	USA	high	case-control
Urrego et al. (2015)	The Impact of Ventilation and Early Diagnosis on Tuberculosis Transmission in Brazilian Prisons	Brazil	upper-middle	intervention study
Vanya et al. (2016)	Acute diarrhea caused by *Salmonella enterica* subsp. enterica serovar Give infections in male prisoners: A case report	Hungary	high	case study
Vázquez-Garcidueñas et al. (2014)	Investigation of a food-borne Salmonella Oranienburg outbreak in a Mexican prison	Mexico	upper-middle	case series
Webb and Czachor (2009)	MRSA prevention and control in county correctional facilities in Southwestern Ohio.	USA	high	qualitative
Wootton et al. (2004)	Intervention to reduce the incidence of methicillin-resistant staphylococcus aureus skin infections in a correctional facility in Georgia	USA	high	case-control
Zerdo et al. (2014)	Prevalence of pulmonary tuberculosis and associated risk factors in Prisons of Gamo Goffa Zone, South Ethiopia: A cross-sectional study.	Ethiopia	low	cross-sectional

Table 2
Summary findings for studies included in a systematic scoping review of environmental health conditions in penal institutions.

Study Author	Source	Infectious Agent	Number of Prisoners Exposed	Outcomes for Prisoners	Additional Populations Investigated	Environmental Risk Factors
Adams et al. (2015)	alcohol	/	12	unknown	/	/
Aguilera (2016)	/	/	428	unknown	/	overcrowding, inadequate ventilation
Alcabes et al. (1988)	food from prison kitchen	Salmonellae of serogroups B & D	44	diarrhea (39), abdominal pain (31), nausea or vomiting (25), fever (23)	none	intake of food made by unscreened kitchen workers, living in a dormitory
Amwayi et al. (2010)	/	/	48	night sweats (36), chest pains (32)	none	sharing of linen
Archer et al. (1984)	pork from prison kitchen	*Staphylococcus aureus*	236	abdominal cramps (199), nausea (144) diarrhea (140), vomiting (100), fever (64)	none	/
Awofeso et al. (2001)	/	Influenza A (H3N2)	35	influenza A (9), death (3)	2 nursing staff with influenza A; 1 patient care assistant with influenza A	/
Baillargeon (2003)	/	Methicillin-resistant *Staphylococcus aureus* (MRSA)	/	unknown	/	/
Bell (1974)	/	/	/	unknown	/	/
Benedict et al. (2016)	/	Coccidioides spp.	40	symptomatic (36)	none	/
Bourigault et al. (2014)	mechanical razors	Methicillin-sensitive *Staphylococcus aureus* (MSSA)	79	unknown	/	shaving with razors or getting tattoos, showering frequency, soap sharing
Brett et al. (2014)	ice machine	Franscisella novicida	3	fever (2), death (1), hypotension (1), tachycardia (1), edema (1)	none	/
Briggs et al. (2003)	alcohol	Clostridium botulinum	8	cranial nerve palsies, weakness, dsyphagia (8)	/	
Centers for Disease Control	/	Methicillin-resistant *Staphylococcus aureus* (MRSA)	928	invasive disease, including bacteremia, endocarditis, osteomyelitis (10)	none	/
Comstock et al. (2012)	cattle fecal matter	*Escherichia coli*	24	unknown	/	/
Culpepper et al. (2001)	/	Methicillin-resistant *Staphylococcus aureus* (MRSA)	47	infections on legs (26), cellulitis (21) furuncles (15), skin abscesses (12), open wounds (11), infections on arms (7), systemic infections (2)	/	/
Davies et al. (2012)	eggs from prison kitchen	*Salmonella enterica*	124	diarrhea (135), headache (127), abdominal pain (124), fever (115), vomiting (72)	1 staff member had stool positive for SE	intake of egg cress rolls
Dogbeh et al. (2014)	/	/	/	headache (12), cough (7), eye-irritations (7), breathing difficulties (6), throat irritations (5), sneeze (5)	none	/
Douglas et al. (2009)	/	/	/	unknown	/	/
Drociuk et al. (2003)	tuna salad	*Salmonella enterica*	688	unknown	/	/
Duncan et al. (1988)	water reservoir tank	Salmonella paratyphi	55	abdominal pain (46), headache (42), fever (36), malaise (32), diarrhea (25)	undisclosed staff and family of staff affected	/
Elias et al. (2010)	/	Methicillin-sensitive *Staphylococcus aureus* (MSSA) and Methicillin-resistant *Staphylococcus aureus* (MRSA)	26	unknown	/	deficient laundry machines, poor sanitation
Felkner et al. (2009)	surfaces	Methicillin-sensitive *Staphylococcus aureus* (MSSA) and Methicillin-resistant *Staphylococcus aureus* (MRSA)	18	/	/	/
Gebrecherkos et al. (2016)	/	*Mycobacterium tuberculosis*	/	unknown	/	overcrowding, windows not opened
Gecewicz et al. (1994)	cooling towers	*Legionella pneumophila*	44	Massachusetts: Legionnaires disease (11), death (3); Michigan: Legionnaires Disease (16), pneumonoia (16), death (1); Rhode Island: Legionaires Disease (17), death (2)	1 prison employee (LD and pneumonia)	/
Ghosh and Vogt (2006)	raw foods from prison kitchen	Salmonella enteritidis	3	unknown	/	intake of burrito of smuggled foods, needle exposure
Gicquelais et al. (2014)	/	Salmonella anatum, Salmonella heidelberg	155	diarrhea (122)	18 staff reported diarrhea	intake of contaminated foods

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Table 2 (*continued*)

Study Author	Source	Infectious Agent	Number of Prisoners Exposed	Outcomes for Prisoners	Additional Populations Investigated	Environmental Risk Factors
Goh et al. (1987)	food outside of prison	*Vibrio cholerae*	96	symptomatic (21)	none	/
Hamlet et al. (2006)	/	Salmonella enteridids	9	diarrhea (9), vomiting (9), fever (9)	none	/
Hammond and Emmons (2005)	secondhand cigeratte smoke	/	/	unknown	/	/
He et al. (2015)	secondhand cigeratte smoke	/	/	unknown	/	/
Hoge et al. (1994)	/	Streptococcus pneumoniae	46	colonization (46)	none	overcrowding, inadequate ventilation
Hsieh (2009)	casserole	*Clostridium perfringens*	200	diarrhea (194), abdominal cramps (170), nausea (128), generalized aches (102)	none	intake of casserole containing ground turkey and beef
Jayes et al. (2016)	secondhand cigeratte smoke	/	/	unknown	/	/
Jerzynska et al. (2010)	secondhand cigarette smoke	/	1	atopic asthma (1)	none	/
Jovanovska et al. (2016)	/	/	/	/	/	/
Junaidu et al. (2010)	milk, animals	Brucella abortus	28	colonization (2)	none	/
Kalonji et al. (2016)	/	*Mycobacterium tuberculosis*	130	Cough > 2 weeks (125), weight loss (625), temperature > 39 ℃ (115), night sweat (109), asthenia (450), thoracic pain (110)	none	incarceration time, overcrowding
Keita-Perse et al. (1999)	turkey	*Clostridium perfringens*	93	unknown	/	intake of roast turkey and gravy
Kimura et al. (2006)	kimuchi from prison kitchen	*Escherichia coli*	82	colonization (82)	none	intake of kimuchi
Kuruvila et al. (2002)	/	tinea cruris, scabies, pediculosis capitus	143	dermatoses (143), more than one infection (22), scabies (18), pediculosis capitis (15),	/	overcrowding
Levy et al. (2003)	food from kitchen	Group A streptococcus	72	unknown	/	unsanitary kitchen conditions
Lobacheva et al. (2006)	/	*Mycobacterium tuberculosis*	57	/	/	overcrowding, lack of own bedclothes
London et al. (2017)	chicken taco meat mixture	*Clostridium perfringens*	185	unknown	/	intake of chicken taco meat mixture
Lupcho et al. (2016)	tortilla chips	/	79	nausea (65), gas/bloating (61), stomach cramps (59), and diarrhea (57); vomiting (17).	undisclosed staff affected	intake of rancid tortilla chips
Macintyre et al. (1997)	/	*Mycobacterium tuberculosis*	358	Tuberculosis (358)	/	overcrowding
Maree et al. (2010)	/	Methicillin-resistant *Staphylococcus aureus* (MRSA)	92	infection (60), colonization (32)	none	MRSA skin infection: not showering daily in the jail in the previous week, shared soap with other inmates in the previous week; MRSA nasal colonization: not showering daily in previous week, not recieving newly cleaned underclothing 2 or fewer times in previous week
Maree et al. (2010)	/	Methicillin-resistant *Staphylococcus aureus* (MRSA)	60	/	/	not showering daily in the jail in the previous week, sharing soap with other inmates
Meehan et al. (1992)	turkey	Staphlococcous aureus, Salmonella infantis	215	vomiting and diarrhea (111), diarrhea (84), vomiting (20)	none	intake of turkey
Miko et al. (2013)	/	Staphlococcous aureus	/	/	/	/
Morse et al. (1985)	bird droppings	Histoplasma capsulatum	15	none	prison employees: cough (2), dyspnea (2), weight loss (2), chest pain (1), respiratory infection (1); community persons: chest pain (1), dyspnea (1), cough (1)	residence near bird roosts, demolition or excavation near residence, and history of construction or excavation work

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Table 2 (*continued*)

Study Author	Source	Infectious Agent	Number of Prisoners Exposed	Outcomes for Prisoners	Additional Populations Investigated	Environmental Risk Factors
Ng et al. (1997)	food from prison kitchen	Salmonella enteritidis	188	diarrhea (188), abdominal cramps (170), fever (148), vomiting (50), nausea (91)	none	intake of luncheon pork
Ofungwu (2005)	subsurface soil, groundwater	/	/	unknown	/	/
Oladele et al. (2010)	/	Tinea versicolor, Tinea corporis	19	/	/	/
Oninla and Onayemi (2012)	/	Tinea species	150	one infectious dermatoses (126), two infectious dermatoses (20), three infectious dermatoses (3)	none	overpopulation, infrequent bathing and lack of soap for bathing, poor toilet facilities, lack of change of clothing, prison status
Parikh et al. (1997)	/	*Clostridium perfringens*	53	diarrhea (53), abdominal cramps (48), nausea (34), vomiting (16)	undisclosed staff affected	intake of inproperly cooked turkey
Proescholdbell et al. (2007)	secondhand cigarette smoke	/	/	unknown	/	/
Ritter et al. (2011)	/	/	/	/	/	/
Roberts et al. (2006)	/	*Mycobacterium tuberculosis*	/	unknown	/	/
Robinson et al. (2012)	/	Influenza A (H1N1), Influenza B	21	influenza A (6), influenza B (1)	none	/
Rop et al. (2016)	/	Entamoeba histolytica, Giardia lamblia, Balantidium coli, *Ascaris lumbricoides*	95	protozoan infection (58), helminthes infection (24), mixed infection (13)	none	handwashing before meals and after visiting toilet, wearing footwear
Ryder et al. (1977)	egg salad sandwich, fresh fruit, bread, powdered soft drink	Group A streptococcus	/	unknown	none	intake of lunch (fresh fruit, bread, powdered soft drink, and egg salad sandwich)
Sarang et al. (2016)	/	/	/	/	/	/
Schaffzin (2011)	unpasteaurized apple cider	*Escherichia coli*	43	bloody diarrhea (23), hospitalization (9)	/	intake of cider
Schapiro (1959)	/	Entamoeba histolytica, Trichomanas intestinalis, *Ascaris lumbricoides*, Trichuris trichiura	/	E. histolytica and Trichomonas intestinalis (22), E. histolytica and *Ascaris lumbricoides* (20), E. histolytica and Trichuris trichiura (17) *A. lumbricoides* and T. trichiura (8), E. histolytica, *A. lumbricoides* and T. trichiura (7), E. histolytica and Strongyloides sterocoralis (6), E. histolytica, *A. lumbricoides*, T. trichiuraand S. stercoralis (4), E. histolytica, S. stercoralis and T. trichiura (3)	none	/
Semple et al. (2017)	secondhand smoke	/	/	/	/	/
Shah et al. (2003)	/	*Mycobacterium tuberculosis*	15	Cough > 4 weeks (20), Cough + fever > 4 weeks (10), Cough + fever > 4 weeks + weight loss (1), Cough + fever > 4 weeks + weight loss + haemoptysis (4), Cough + fever > 4 weeks + haemoptysis (1), Cough > 4 weeks + haemoptysis (2), Fever > 4 weeks (1), Weight loss + haemoptysis (1), Haemoptysis (5)	none	/
Swenty and Rowser (2014)	/	/	/	/	/	/
Tavris et al. (1985)	ham	*Clostridium perfringens*	100	abdominal cramps (95), diarrhea (88), nausea (53), vomiting (25), chills (17), fever (8)	none	/
Taylor et al. (2015)	food utensils, chicken	Salmonella heidelberg	23	diarrhea (23), fever (19), vomiting (16), fever (4)	none	/
Terefe et al. (2015)	soil	/	111	hookworms (48), T. trichiura (32), enterobius vermicularis (4), hymenolepis nana (1), multiple infections (33)	none	/
Thornley et al. (2012)	secondhand cigarette smoke	/	/	/	/	/
Thurston et al. (2012)	alcohol	Clostridium botulinum	8	carnial nerve palsies (8)	none	/

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Table 2 (*continued*)

Study Author	Source	Infectious Agent	Number of Prisoners Exposed	Outcomes for Prisoners	Additional Populations Investigated	Environmental Risk Factors
Tobin-D'Angelo et al. (2003)	/	Methicillin-resistant *Staphylococcus aureus* (MRSA)	1839	MRSA skin infections (926), skin lesions (13)	none	1) prolonged incarceration, outdoor work duty, and limited access to soap for hand washing and general bathing; 2) self-draining of boils, skin lacertion, washing clothes by hand, sharing soap
Todrys et al. (2011)	/	*Mycobacterium tuberculosis*	/	/	/	/
Topp et al. (2016)	/	/	/	/	/	/
Turabelidze et al. (2006)	/	Methicillin-resistant *Staphylococcus aureus* (MRSA)	55	/	/	poor personal hygiene score, sharing personal products, using the prison laundry to wash personal items
Urrego et al. (2015)	/	/	/	/	/	overcrowding, inadequate ventilation
Vanya et al. (2016)	/	eggs, egg powder, milk powder	2	gastroenteritis (2), vomiting (2), progressive diarrhea (2)	none	/
Vázquez-Garcidueñas et al. (2014)	/	shrimp broth, fresh melon beverage	150	diarrhea (150), vomiting (105)	none	/
Webb and Czachor (2009)	/	Methicillin-resistant *Staphylococcus aureus* (MRSA)	/	/	/	/
Wootton et al. (2004)	/	*Staphylococcus aureus*	16	7 (lession on groin or buttock), 5 (lesions on torso), 5 (recurrent disease), 4 (lesions on lower extremities), 2 (lesions on upper extremities)	/	/
Zerdo et al. (2014)	/	*Mycobacterium tuberculosis*	24	/	/	inadequate ventilation

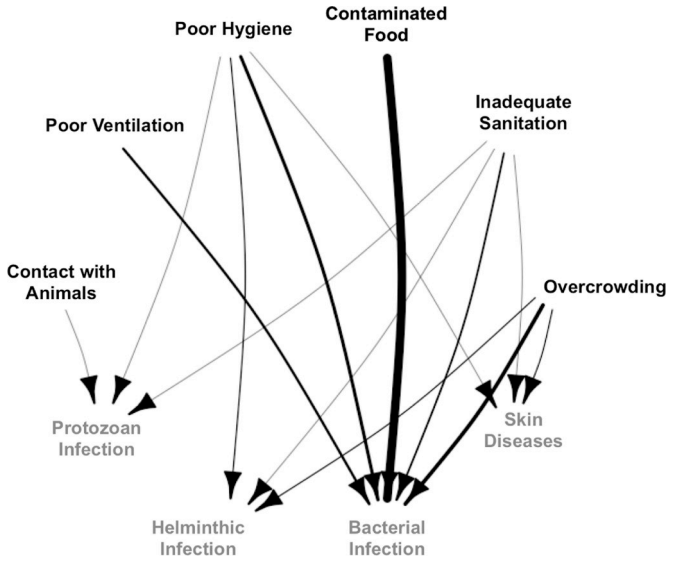

Fig. 2. Environmental health exposures (black text) and health outcomes (grey text) in prisons. Arrows represent potential associations as identified from the literature. Darker lines are indicative of the relative number of studies documenting this potential association.

The three studies, which did not involve a smoking ban, found that smoking areas in prisons are polluted and may lead to adverse health outcomes in both prisoners and prison staff.

3.6. Approaches to control and prevention

Twenty-six studies (32%) described environmental control approaches to help prevent adverse health outcomes. Common approaches included isolating patients in isolation wards and closing the penal institution to new admissions and transfers (Aguilera et al., 2016; Bourigault et al., 2014; Comstock et al., 2012; Davies et al., 2012; Ghosh and Vogt, 2006; Gicquelais et al., 2014; Hamlet et al., 2006; Hoge et al., 1994; Ng et al., 1997; Robinson et al., 2012; Vanya et al., 2016); educating prisoners and prison staff about personal hygiene, cough etiquette, handwashing, and food safety (Adams et al., 2015; Bourigault et al., 2014; Culpepper et al., 2001; Ghosh and Vogt, 2006; Gicquelais et al., 2014; Hamlet et al., 2006; Junaidu et al., 2010; Robinson et al., 2012; Wootton et al., 2004); improving ventilation (Hoge et al., 1994; Proescholdbell et al., 2018; Urrego et al., 2015); prohibiting smoking and banning tobacco and cigarette lighters (Bourigault et al., 2014; Hoge et al., 1994; Thornley et al., 2012); disinfecting contaminated sites, surfaces, and water sources (Duncan et al., 1988; Goh et al., 1987; Morse et al., 1985); increasing access to hygiene resources such as soap (Oninla and Onayemi, 2012; Tobin-D'Angelo et al., 2003; Wootton et al., 2004); , and reducing prison crowding by opening new penal institutions (Hoge et al., 1994). Ten studies (12%) listed general improvements to environmental sanitation and hygiene that would function as control approaches, such as repairing toilets, confiscation of illicit foods, supervision of inmate hygiene, and closure of kitchens (Bourigault et al., 2014; Davies et al., 2012; Drociuk et al., 2003; Ghosh and Vogt, 2006; Junaidu et al., 2010; Keita-Perse et al., 1999; Morse et al., 1985; Ng et al., 1997; Oladele et al., 2010; Swenty and Rowser, 2014).

Health education for prisoners and prison staff was a common response. Adams et al., (2015) interviewed prisoners to determine preferred methods to receive botulism-related health information and address the intake of illicit alcohol. Based on survey results, television and handouts/fliers were preferred. Prisoners reported not trusting information from the penal institution and that visitors were the most trusted source of information (Adams et al., 2015). While the

proportion of inmates who reported any botulism knowledge increased from 24% before the outbreak and intervention to 73% post-intervention, prisoners believed that convincing inmates to stop drinking alcohol was impossible. Ghosh and Vogt (2006) emphasized that education should be provided periodically, to account for inmate turnover. In some cases, inmates were educated on routes of transmission to help prevent infection (Junaidu et al., 2011).

Sixty-four studies (78%) identified prevention approaches to mitigate similar situations in the future, with some studies promoting more than one. Commonly-advocated prevention approaches, included increasing sanitary regulations in prisons (n = 33, 40%), educating inmates on proper personal hygiene and sanitation (n = 12, 15%), improving healthcare within the prisons (n = 10, 12%), early detection of disease (n = 10, 12%), and improved access to hygiene resources for inmates (n = 5, 6%).

4. Discussion

This is the first systematic scoping review of environmental health conditions in penal institutions. Studies reviewed identified several bacteria that infected prisoners. Contaminated food consumption was the most common risk factor for disease. No studies focused exclusively on prison staff.

Reporting of methods and results varied across the included studies, which ranged from observational research on nicotine levels to qualitative interviews to outbreak investigation. Several studies lacked detailed information on health outcomes, environmental risk factors, or failed to distinguish between affected prisoners and affected prison staff. Because the extracted data was inconsistent, a meta-analysis was not performed.

4.1. Cause of infection

We identified several common causes of infection within the penal institutions, including different bacteria, viruses, and parasites. Bacteria were the most common infectious agent reported: *S. enterica* and *E. coli* caused a particularly large burden of disease in prison settings. Food transmission was a common route of transmission through which prisoners were exposed to bacteria. Food contamination was attributed to sick food handlers and mis-handling of food. Common examples of inappropriate food handling include leaving food out over long periods, improper temperatures during the cooking or storage, and a lack of sanitary practices in the food handling area. The International Committee of the Red Cross (ICRC) states that every prison should have a designated food storage area that is insulated, free from rising damp, and regularly disinfected and examined (International Committee of the Red Cross, 2013). Although the implicated contaminated food had often been prepared within the kitchens at the penal institution, four studies noted that illicit food and beverages, such as alcohol, were also possible routes of transmission (Adams et al., 2015; Briggs et al., 2013; Ghosh and Vogt, 2006; Thurston et al., 2012). Prisoners stored or made illicit food without the knowledge of prison staff and frequently bartered them.

In both studies where parasites were identified as a main cause of infection, personal sanitary habits substantially affected infection rates among prisoners (Rop et al., 2016; Schapiro and Molina, 1959). Simple hygiene measures, such as handwashing before and after visiting the toilet and wearing shoes, reduce parasitic infections. Schapiro & Molina highlighted that the state of sanitation facilities within the penal institution also affects parasitic infection (Schapiro and Molina, 1959).

Many studies tested patients for the potential infectious agents. Environmental testing was rare, but stool samples were frequently tested. This was especially prominent in studies where food was the implicated disease vector. Of the 14 studies indicating implicating food as the risk factor for infection, nine used questionnaires administered to prisoners to help determine the implicated foodstuff (Alcabes et al., 1988; Davies et al., 2012; Gicquelais et al., 2014; Hsieh et al., 2009; Lupcho et al., 2016; Meehan et al., 1992; Ng et al., 1997; Parikh et al., 1997; Schaffzin et al., 2011). Only one food-related study isolated the causal agent from the food itself (Kimura et al., 2006).

4.2. Risk factors for infection

Prisoners and prison staff are especially vulnerable to the development and spread of diseases due to overcrowding and lack of hygiene resource available to prisoners. The function of a penal institution means that prisoners lack autonomy to move about freely and may be unable to avoid some risks because they are unable to decide where they reside and who they interact with. The infrastructure itself may also be a risk, as structures poorly suited to the purpose are often converted into prisons.

The intake of contaminated foods was an especially prevalent risk factor. Contaminated food often resulted in large-scale infection, as most prisoners often do not have alternative food options and may have no choice but to consume the prepared food. Many of the food-related infections affected several prisoners throughout the penal institution who had all consumed the same foods on a particular day.

Studies note that overcrowding was a risk factor for infection (Aguilera et al., 2016; Gebrecherkos et al., 2016; Hoge et al., 1994; Kalonji et al., 2016; Kuruvila et al., 2002; Lobacheva et al., 2006; Macintyre et al., 1997; Urrego et al., 2015). Despite this, many prison systems operate over their intended capacity; according to the Institute for Criminal Policy Research, prison systems in Haiti, the Philippines, Él Salvador, and Zambia are operating at 454%, 436%, 348%, and 303% of their intended capacity, respectively. In addition to increasing the risk of infectious diseases, overcrowding worsens psychiatric disorders and is associated with inhumane and cruel treatment (Garcia-Guerrero and Marco, 2012).

4.3. Control and prevention approaches

The prison setting is unusual in that security, rather than the control and prevention of disease, takes priority. Although every penal institution is responsible for protecting prisoner health, disease control and prevention approaches may sometimes interfere with the penal institution's function of correcting and detaining prisoners (Ginn and Robinson, 2012).

A common response was the isolation of infected prisoners, often to their original cells (Davies et al., 2012; Hamlet et al., 2006; Ng et al., 1997). However, Hoge et al., (1994), describe an isolation ward created to house 46 prisoners colonized with *S. pneumoniae*. In addition, overcrowding and inadequate ventilation, both of which were identified as environmental risk factors, were alleviated by moving uninfected inmates to nearby penal institutions. In four studies, transfer and admission of prisoners were postponed until the disease outbreak had been controlled (Comstock et al., 2012; Davies et al., 2012; Ng et al., 1997; Robinson et al., 2012). In Davies et al., 2012, the penal institution prevented visitors from entering the penal institution to mitigate disease transmission. However, no study mentioned the continued isolation or surveillance of prisoners who had served their time and left the prison. They are assumed to have rejoined their communities without further support or involvement.

Increasing access to hygiene resources was listed as an approach to both control and prevention. Penal institutions often lack sufficient hand washing areas and sanitary products and services, including laundering services, towels, and bedsheets (Amwayi et al., 2010; Maree et al., 2010; Oninla and Onayemi, 2012; Tobin-D'Angelo et al., 2003; Turabelidze et al., 2006). Supplies, such as soap, are often rationed or locked up to discourage theft and prevent these supplies becoming trading commodities between prisoners (Bick, 2007), suggesting that

the supply shortages seen in our review are associated with conscious rationing by the prison system as well as the funding and resources of the penal institution.

4.4. Indoor air contamination

Inadequate ventilation has been identified as a risk factor that increases the prevalence of infectious diseases in penal institutions (Amwayi et al., 2010; Benedict et al., 2016; Brett et al., 2014; Shah et al., 2003). Smoking bans have been proposed as a method to reduce particulate matter and improve ventilation and health among prisoners. The bans were introduced as long-standing initiatives without programs to their side effects. One study mentioned prisoners seeking nicotine replacement therapy or smoking cessation programs, but there were no such initiatives (Thornley et al., 2012). In He et al., (2015), the indicators for poor air quality increased after a smoking ban, suggesting clandestine smoking.

In addition to tobacco smoke, He et al., 2015 and Ofungwu, 2005 noted that other common sources of indoor air contamination included cooking, washing, and cleaning. Activities such as vacuuming or storing cleaning chemicals and materials indoors affect air quality.

4.5. Information gaps

A major finding of this review was the small number of studies from low- and middle-income countries (LMICs). The WHO Regional Office for Europe notes that the health burden is higher in prisons in LMICs than in prisons in high-income countries (World Health Organization, 2014). Prisoners in LMICs are exposed to higher risk of abuse and human right violations (Mundt et al., 2013). Despite the high health burden faced by prisoners in LMICs, of the 82 total studies in our review, only 20 (24%) were from LMICs.

There is little discussion within the studies of how the prison system itself affects prisoners and prison health. Although studies in this review attributed diseases to inadequate environmental health conditions, there was little discussion on the underlying reasons for them. As penal institutions serve to correct and detain prisoners, it is possible that poor sanitary conditions, such as overcrowding, unclean surfaces, and dirty toilets, are perceived as a form of or part of punishment (Ginn and Robinson, 2012). Similarly, personal hygiene products, such as soap and laundry detergent, may be rationed. Prisoners may disrupt penitentiary infrastructure as a form of protest or due to power struggles among different factions of the penal institution, further exacerbating the poor environmental health conditions.

Although several studies used isolation and education in disease control and prevention, we found no mention of policies or approaches to deal with prisoners leaving the penal institution, whether they were transferred to another institution or discharged. We also found no data on whether former prisoners were discharged while infectious, or whether this affected their new residence. Prisoners often receive a lack of public empathy and support, which may lead to fewer initiatives and less funding in addressing health problems among prisoners (Simooya, 2010).

4.6. Implications for policy and practice

Transforming conditions in prisons to respect human rights and ensure essential environmental health is challenging in countries where environmental health services are inadequate for the general population. Action at the international, national, and facility levels is necessary so that the rights of inmates to adequate environmental health conditions within the penal institutions are respected, protected, and fulfilled.

At the international level, international organizations should develop evidence-based guidelines that comprehensively address essential environmental health conditions in prisons, necessary to ensure that prisoner's rights, health, and well-being are protected. Indicators for monitoring can be developed based on these guidelines for adoption in national and local surveys to track conditions and trends. The Sustainable Development Goals (SDGs) call for universal access to water, sanitation, and hygiene (United Nations General Assembly, 2015). The WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) is responsible for reporting country, regional and global estimates of progress on drinking water, sanitation and hygiene and defines “universal” to include non-household settings (Chatterley et al., 2018; Cronk et al., 2015; WHO/UNICEF, 2017). To-date, the JMP has prioritized water, sanitation, and hygiene monitoring in schools and health care facilities. Penal institutions should be considered as well, and national monitoring surveys of prison conditions should be conducted to establish a baseline assessment of conditions (Behnke et al., 2018). If national monitoring mechanisms were established in the SDG-era, it may be feasible for prisons to be included in the post-SDG international development targets in 2030.

International task teams with participants from governments, international agencies, research institutions, civil society, prison institutions, prison governance organizations, prisoner associations, and prison staff should be formed to identify and prioritize improvement strategies, and develop guidance on risk control measures and prevention approaches. This could usefully include the development of context specific guidelines and tools that may be effective in reducing environmental health risks, including mitigating risks associated with overcrowding, in prisons. Communities of practice (CoP) should be encouraged and these groups may compile evidence and qualitative research to enrich the dialogue, including case studies that highlight examples of successful collaboration between ministries and/or municipalities and prison administrators for reducing environmental health risks in penal institutions. These CoPs can use findings to develop evidence-based training materials for using safe water, safe food, and practicing proper hygiene – especially in LMICs where little of these resources may be directed to prisoners. No studies were found on the special needs of women, children, and people with limited mobility and these should be explored through monitoring and future research.

At the national level (and/or federal level where appropriate), concerned actors should advocate for necessary resource allocation and good governance to safeguard health within penal institutions (Behnke et al., 2018). Associated government ministries (e.g. justice, water, health, planning, finance) should ensure inter-ministerial agreements and budget allocations for adequate provision of environmental health in prisons which may also be associated with other budgetary areas such as nutrition and energy. Where national-level steering committees and standards for environmental health in prisons are lacking, duty bearers should adopt national standards and action plans for implementing and monitoring ongoing compliance with the standards. They should also designate responsibility for and ensure adequate resources to national and regional focal points to conduct periodic supervision and capacity building. National governments should hold prison management accountable for maintaining essential environmental health standards and reporting on them and facility, local, and national monitoring data should be transparent and publicly available to civil society.

At the facility level, prison administration should work with government authorities to ensure awareness of and adherence to national standards and accountability for facility conditions. Facility improvements should be addressed in food preparation and handling areas, infirmaries, public areas, toilets, showers, cellblocks and general infrastructure. Routine capacity building of staff and prisoners on preventing health risks are necessary including; consistent daily personal hygiene routines and access to requisite supplies; and the sanctioning and formation of hygiene and maintenance committees chaired by prison administrators composed of selected staff members and prisoners

to assess conditions and take collective action in favor of cleanliness of the premises, vector control, waste management, and the upkeep of plumbing and other infrastructure.

4.7. Study limitations and limitations of included studies

A limitation of this study is that this review only extracted studies that were written in or professionally translated into English. Some relevant terms and databases may have been omitted.

There are several limitations of the included studies. Because of the sensitive nature of prisoners and penal institutions, governments and institutions may be hesitant to display the conditions of their country's prison system, leading to a skew in the included studies. There is potential bias in the relatively few number of studies performed in LMICs in this review. Our study is framed as a systematic scoping review to acknowledge this bias and the breadth of studies included. The penal institutions reported in this review came from 26 countries, with the majority of the studies reporting on US penal institutions. As a result, our findings may not be representative of penal institutions in countries not reported by this scoping review. In addition, the earliest study in our review was from 1959, which suggests that some studies are most likely not generalizable to current conditions in penal institutions.

5. Conclusion

The correctional and detaining purposes of penal institutions deprive prisoners from control over their environment, and they are dependent on administration and staff for adequate environmental health conditions. We highlight the inadequacy in these conditions and the associated health outcomes for prisoners. These circumstances create a duty of care that is reflected in the human right to the highest attainable standard of physical and mental health and the obligations of governments to respect, protect, and progressively fulfill these rights. To improve conditions, facility actors must ensure environmental health standards are met and safe conditions are assured; national actors must establish the necessary regulatory and facilitating environment including adequate facilities, regulations, financing, etc.; international actors should create a supportive environment for the endeavors of national and facility actors by establishing international guidelines and monitoring and facilitating communities of practice to exchange insights on effective approaches and good practices.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijheh.2019.05.001.

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