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Wastewater surveillance for rapid identification of infectious diseases in prisons

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COVID-19 remains one of the biggest global public health challenges, accounting for more than 6·2 million deaths since the beginning of the pandemic. Alternative tools for rapidly identifying, containing, and reducing the spread of SARS-CoV-2, the virus that causes COVID-19, are crucial for susceptible populations. Examples include individuals living in prisons, care homes, and hospitals, among whom infection rates and mortality are often elevated compared with the general population.[1]

Prison facilities including general prisons, juvenile detention centres, immigration detention centres, and community-rehabilitation centres represent particularly high-risk settings because individuals who are incarcerated reside in confined, densely populated, closed, and poorly ventilated conditions. In 2020, *The Lancet* reported that prisons "are in no way equipped to deal with COVID-19"[2] and infection burdens in such settings are unknown due to paucity of testing. In the USA, more than 2700 COVID-19-related deaths have occurred in prison settings, with a mortality rate of around 200 prisoners per 100 000 population (April, 2020, to April, 2021),[3] resulting in COVID-19 mortality rates 2·4–3·0-times higher than the general population.[4]

High prevalence and transmissibility of disease agents in prisons is also associated with the elevated risk profiles among individuals in the criminal justice system, such as complex medical and lifestyle histories (age, sedentary lifestyle, asthma, and obesity), high prevalence of multimorbidity, and various life-threatening conditions. Such problems are highest in prisons in low-income and middle-income settings due to substantial overcrowding, inadequate food and water availability, poor ventilation, and poor sanitation, all of which exacerbate transmission of infectious diseases between individuals living in prison. Prisons are also connected to communities (and other prisons) through prison staff and residents being infected in the community and through prisoner transfers to other facilities. In addition, infections can spread through prisoner day release, during prison receptions, and during medical care. More studies are needed to ascertain whether prisons can act as amplifiers of, or reservoirs for, COVID-19 and other infectious diseases[5] and whether prisons represent points at which interventions could be implemented to prevent wider transmission. We contend that inadequate action on managing prison health will result in further outbreaks of COVID-19 and other emerging infectious diseases that affect the health and wellbeing of staff, residents, and local populations.

Wastewater-based surveillance has been widely applied during the COVID-19 pandemic as an unbiased, aggregate and anonymous method of monitoring for population-level infection trends and the spread of variants,[6] but it should not replace clinical testing for infectious diseases. Despite ethical concerns, wastewater-based surveillance of prisons has been used in numerous countries for surveillance of self-administered prescription and recreational drugs.[7] Our experience of wastewater-based surveillance across spatial scales (from sewershed to building to sub-building level) has enabled early identification of local outbreaks and informed targeting for rapid clinical testing, to reduce the disease burden and prevent further infections.[8]

Three key barriers remain to fully realise the benefits of wastewater-based surveillance technology: first, paucity of data on virus faecal shedding between individuals makes it difficult to scale pathogen load to cases, and the impact of vaccines and disease variants on virus shedding warrants further research; second, determining the scope of the contributing population (eg, defecation frequency and movement of individuals between and within sewer catchments); and, third, dilution from other water sources, such as industrial scale laundries, reducing infectious disease marker signals. Prisons are unique, since residents in most prisons contribute regularly to the same wastewater stream (with the exception of day release prisoners and staff) and, therefore, provide a representative indicator of cases, such as COVID-19, when paired with clinical surveillance data.

Prisons present several challenges for implementation of wastewater-based surveillance. First, access to wastewater is restricted for most research groups

and prison infrastructure (eg, sewer pipes) can make installation of sampling equipment difficult. Second, individuals who live in prisons represent a marginalised population, and a strict ethical code is required for research work,[9] thus ethical review board oversight is crucial. Third, the minimum size of the population that can and should be monitored is unknown. Fourth, the nature of prisons makes their wastewater variable and some common chemical markers (eg, ammonia)[10] are not appropriate to use to extrapolate to non-prison populations as other sources (eg, laundry) can substantially alter these markers in prisons. Experience from 1 year of wastewater-based surveillance monitoring in UK and US prisons has shown that such surveillance provides public health officials insight with regard to infectious disease carriage and transmission between people who live in prison and prison staff, among whom rapid action could alleviate the risk of larger outbreaks. Linking people who live in prisons to communities through lead-lag analysis has shed light on factors that govern whether a prison is a reservoir or amplifier for infectious agents. Wastewater-based surveillance could be important for the protection of populations at high risk of infectious diseases and could offer long-term advances in public health surveillance after COVID-19, for example for other pathogens of high significance (eg, HIV) and antimicrobial resistance (broader wastewater-based surveillance targets). Wastewater-based surveillance could enable public health authorities to develop targeted prevention and education programmes for hygiene measures and prevention of drug use within prisons.

MDC and DG contributed equally to writing this Comment. We declare no competing interests.

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