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# Travel Medicine and Infectious Disease

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## Advancing sewage surveillance at mass gathering events for reducing transmission of antimicrobial resistant bacterial pathogens

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Mass gathering festival, sporting, and religious events pose significant strain on public health planning and response resources of the local community, locality, state, or nation hosting the event [1]. These mass gatherings pose a considerable risk of transmission of a range of viral and bacterial pathogens during the event and, globalization after the event. Recurring religious pilgrimages such as the Hajj and the Kumbh Mela in particular pose increased potential transmission of bacterial and viral pathogens due to very close contact between pilgrims, communal rituals, kissing of religious objects, communal bathing and sharing of sanitary facilities [1–3]. Large numbers of people living together create unhygienic conditions where bacterial pathogens from the gastrointestinal and urinary tracts are transmitted between attendees via the feco-oral route [2].

Management and disposal of human waste during these gatherings is an unsurmountable task and poses a significant challenge due to the substantial volume of waste generated, which often exceeds the capacity of the host city's sewage disposal infrastructure. In religious events like the Hajj, millions of pilgrims gather, a large number of animals are sacrificed as part of religious ritual. This results in a significant surge in animal and human organic waste. With the growing global problem of antimicrobial resistance (AMR) and its potential of globalisation of AMR bacterial pathogens [2–5], there is an urgent need for proactive surveillance of transmission of pathogenic bacteria, instituting optimal infection prevention and control measures, and ensure appropriate use of antibiotics [4]. Moreover, inadequate waste disposal practices can lead to human waste accumulation in public areas, escalating the risk of other infectious diseases such as typhoid, viral hepatitis, cholera, among others. If not appropriately disposed of, human and animal waste at mass gathering events can contaminate soil and water, posing a threat to humans, animals and ecosystems [5]. It thus becomes imperative to develop and implement effective waste management strategies at Mass Gathering events. By embracing sustainable approaches and adopting innovative technologies, organizers and local authorities can ensure proper sanitation, protect public health, and minimize the ecological impact caused by the overwhelming accumulation of sewage waste

[4–6]. During the COVID-19 pandemic, sewage surveillance emerged as a promising tool to monitor the prevalence of SARS-CoV-2 in communities [7]. Studies have shown that the virus can be detected in human feces and urine, even in asymptomatic individuals, and can provide an early warning of an outbreak in a particular area. Sewage surveillance at mass gathering events should now go beyond COVID-19 and a sustainable sewage surveillance global platform needs to be in place for all mass gathering events and should include monitoring for AMR pathogens. By monitoring the pathogen load in the sewage system of the host city, authorities can identify potential hotspots of transmission and take rapid infection control actions and pre-emptive measures to prevent the spread of the pathogens. This can include the installation of temporary rapid testing facilities and the implementation of targeted quarantine measures. Transmission and globalization of AMR from wastewater during mass gathering events remains a neglected global issue [2–5]. Wastewater at MG events creates ideal environments for AMR bacteria and AMR genes (ARGs) transmission. Water treatment can reduce bacterial load, but ARGs are undegradable, and horizontal gene transfer enables continuing spread in the environment.

By fostering collaborations between organizers of mass gathering events and their public health authorities, and the mass gatherings global scientific fraternity, valuable real-time data for infectious disease surveillance and pathogen prevalence in sewage during mass gathering events can be achieved. Setting up effective global longitudinal and cross-sectional wastewater AMR surveillance collaborations across continents is essential to identify the nature and scale of the problem. This will allow study of the emergence, transmission and surveillance of AMR and ARGs, and globalisation thereof when attendees return to their home countries and help generate data to inform global public health strategies and response efforts. By analysing the data collected from sewage surveillance, researchers can also identify the trends in the spread of the infections during religious gatherings and assess the effectiveness of various pre-event, during event and post-event public health intervention strategies. Leadership and resources for this should come from countries hosting recurrent mass gathering religious events.

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## Author declarations

All authors declare no conflicts of interest. The views expressed are those of the authors and not necessarily those of their respective institutions.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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