International Journal of Infectious Diseases 137 (2023) 79–81

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

Editorial

Enhancing preparedness for reducing transmission and globalisation of Antimicrobial Resistance at the Ardh Kumbh Mela 2025, the world's largest recurring religious mass gathering

Recurrent mass gathering religious and sporting events pose substantial public health challenges for host countries since they attract millions of local and international travellers from all continents [1,2]. Past outbreaks of meningococcal disease associated with the Hajj pilgrimage, cholera at the Kumbh Mela, and of influenza at the Winter Olympics highlighted the importance of public health preparedness prior to, during and after the event [1,2,3,4]. The importation, local spread, and globalisation of antimicrobial resistance (AMR) is an important, but neglected, global public health issue associated with mass gathering events [5].

Currently, antibiotic resistant bacterial infections are a top cause of death worldwide [5]. Despite numerous global AMR initiatives over the past decade for its control, deaths due to AMR are estimated at 1.25 million annually and are expected to rise to 10 million annually by 2050 [5,6]. The importance of transmission of antibiotic resistant pathogens, including those causing sexually transmitted infections at mass gathering festivals and religious pilgrimages has recently been recognised [7]. The escalating global problem of AMR poses another complex risk to public health preparedness and response during all mass gathering events. Repeated courses of antibiotic treatments taken by pilgrims during their journeys drive AMR further [8].

The Hindu religious festival, The Ardh Kumbh Mela, is held every six years and is scheduled to take place in Prayag, (Allahabad), India from January 14th to March 4th, 2025 [9]. It is one of the world's largest recurring religious mass gathering event which attracts over 50 million people from India and across the world [1,3,8,9]. Pilgrims perform religious rites together sharing temporary sanitary facilities, bathing frequently in the waters of the tributaries of the River Ganges. A vast amount of bodily waste, such as faeces, urine, sweat, sputum, and vomit are generated dispersing billions of microorganisms contaminating the environment, water, food, clothing, environmental surfaces. This creates ideal conditions for transmission between pilgrims, organisers, local population and passing travellers, of a range of pathogens. This includes the risk of acquiring multi-antibiotic resistant enteric, respiratory and sexually transmitted pathogens from close contacts through exchange of secretions and excreta during unprotected anal, oral, and other sexual practices [1,7,8]. Over the past decade there have been several reports of antibiotic resistant strains of *Shigella sonnei, Campylobacter coli, Escherichia coli, Neisseria gonorrhoea*, HIV-1, and other pathogens at mass gathering festival and religious events [7].

The enormous daily volume of human waste generated by 50 million people assembled in a restricted geographical area, invariably exceeds the capacity of the sewage disposal infrastructures built for mass gathering events. Spatiotemporal meta-analysis of water samples from the Godavari River has shown that anthropogenic multi-antibiotic-resistant bacterial strains are generated in real time during the Kumbh Mela [10,11,12]. Thus, a combined increased risk of AMR transmission arises from inadequate sewage disposal systems and the carriage of bacteria in the skin, urinary, genital, or gastrointestinal tracts of local and international pilgrims [2,8,12]. Preparation and planning by host country authorities for mass gathering events commences years in advance. As public health authorities in India start preparing for the Ardh Kumbh Mela 2025 [12], they are currently faced with the continuing threats of Influenza virus and its variants, multi-drug-resistant tuberculosis, meningococcal sepsis, and a range of water and food borne pathogens, many of which are antibiotic resistant [2,4,8]. Recent emerging and re-emerging vector borne diseases in India include Dengue, Malaria and Nipah Virus disease are also major public health issues of concern [13,14]. In India, over the past decade, AMR has grown to become a major public health challenge the scale of which remains largely undefined. Thus, there is an ever growing, ominous threat of importation transmission, and exportation of antimicrobial resistant bacteria by local, regional and international pilgrims [15].

The Indian Council of Medical Research Antimicrobial Resistance Surveillance Network 2022 annual report shows an upward trajectory of antimicrobial resistant pathogens emerging across India [16]. For example, *Escherichia coli* resistant to imipenem has increased from 14% in 2016 to 36% in 2021; methicillin-resistant *Staphylococcus aureus* (MRSA) rates increased from 28·4% in 2016 to 42·6% in 2021. Accurate data on AMR transmission at the Kumbh Mela are scanty and there have not been any large longitudinal or cross-sectional cohort studies. The issue of AMR generation, transmission and whether the Kumbh Mela contributes to its exacerbation within India and globally remains to be defined by case-controlled cohort studies of pilgrims.

India has one of the highest rates of antibiotic usage in the world. The public health system in India is overburdened and there is limited laboratory capacity for accurate diagnosis of specific bacterial aetiology and their antibiotic sensitivities required for targeted treatment. Also inadequate is the lack of proactive and

https://doi.org/10.1016/j.ijid.2023.10.014

standardised country-wide AMR surveillance platforms [8,16]. Additionally, AMR is being driven by indiscriminate use of widely available over-the-counter antibiotics without prescriptions, self-medication, inadequate infection prevention control practices, and river water contamination with pharma waste. Wanton use of antibiotic is propagated by self-prescription of patients by private practitioners [17]. When prescribed, the choice and duration of antibiotics is empiric and dependent on patient finances to complete the courses. Digital syndromic studies showed that antibiotic stewardship at health care facilities at previous Kumbh Mela events was grossly inadequate with rampant antibiotic overuse [15]. The severe disruptions to routine health care in India and across the world because of COVID-19 appear to have exacerbated the challenges of tackling antimicrobial resistance worldwide.

Given the millions of people that are expected to converge at the Ardh Kumbh Mela in India in 2025, a range of bold measures are required to reduce local and global spread of AMR. Mitigating this threat requires visionary commitment by the Indian authorities through a coordinated multidisciplinary effort across healthcare services, local community and religious leaders, policy makers and event organisers. By integrating the specific agenda of AMR into mass gathering event planning, including pilgrims' and healthcare workers' awareness and responsible antimicrobial use into pilgrimage strategies, the many challenges of the constantly evolving AMR pandemic can be addressed seriously, ensuring the safety of pilgrims and communities alike.

Mass gathering events provide unique opportunities for conducting priority epidemiological, translational clinical, operational, anthropogenic, social, environmental, and basic science research. These are essential to accurately define several important knowledge gaps, such as prevalence of AMR at the Kumbh Mela, evolution of antibiotic resistance genes; food, water and environmental contamination, transmission between participants; globalisation or spread across India after the event; efficacy of infection control measures; antibiotic stewardship practices. These will require governmental commitment, careful planning with ring fenced resources. 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. By focussing on sustainable approaches and adopting innovative technologies, organizers and local authorities could ensure improved sanitation, protect public health, and minimise the ecological impact caused by the overwhelming accumulation of sewage waste during the Kumbh Mela [2,8,12,15].

Experience from organisers of recurring religious mass gatherings events have highlighted the importance of advanced public health planning for prevention, surveillance and response to infectious diseases and other threats to attendees and the local populations [1,8,12]. Many infectious diseases threats can be prevented by vaccinations, which reduces the need for antimicrobials. Preparations for the 2025 Allahabad Kumbh Mela are well underway with dedicated teams dealing with public health preparedness and health services. Based on experiences from other mass gathering religious events [1,4], in addition to basic vaccines against diphtheria, tetanus, pertussis, polio, measles, and mumps, it is prudent to recommend pre-travel vaccines for influenza, yellow fever, pneumococcus, invasive meningococcal disease, influenza, and new pneumococcal and meningococcal vaccines should be revisited.

Apart from recommending the routine pre-travel vaccines for preventable communicable diseases, provision of safe food and water, sanitary facilities and proactive vector control activities during the Kumb Mela will be important to reduce the risk of transmission and outbreaks of food and water-borne diseases. Increasing AMR and risk of infection awareness and education among visitors and pilgrims by promoting proper hygiene practices is essential. Organisers can set up additional and easily accessible washing stations and poster signs encouraging pilgrims to wash their hands regularly, and also highlight responsible antimicrobial use and the potential consequences of inappropriate use of antibiotics. Healthcare provider education and community awareness of AMR, introduction of rapid point-of-care diagnostics and digital tools, is required to promote evidence-based use of antibiotics. Religious and community leaders must be involved in the planning, and they should play a critical role in delivering messages on infection control and AMR education. While not the remit of Kumb Mela organisers, the opportunity can be used to enhance and support governmental national campaigns in tackling AMR, discouraging self-antibiotic medication, mandating prescriptions for antibiotics, regulating the sale of antibiotics, and having more healthcare professionals available at Kumb Mela event sites gathering sites for monitoring antibiotic prescriptions.

Other countries hosting religious mass gathering events also face the growing problem of AMR which remains undefined. India's Centre for Disease Control is currently scaling-up its AMR and healthcare associated infections surveillance programs and is expanding and IPC capacity and antimicrobial stewardship activities across the country [8,16]. India and the Kumb Mela public health authorities have an ideal opportunity to take leadership of a critical but neglected global AMR issue and get global unity of purpose to inform evidence-based planning and readiness strategies for future mass gatherings events. Coordinated action must be inclusive and requires global cooperation between all host and pilgrims' country of origin. Mass gatherings must be incorporated into the broader global antibiotic stewardship agenda and more specifically into universal action plans, to prevent AMR.

Declaration of Competing Interest

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

Acknowledgments

Dr. Avinash Sharma is DBT Wellcome Trust Fellow and Principal Investigator of the "Centre for Excellence, National Centre for Microbial Resource". Sir Alimuddin Zumla is co-principal investigator of The Pan-African Network on Emerging and Re-Emerging Infections (PANDORA-ID-NET) funded by the European and Developing Countries Clinical Trials Partnership, Horizon 2020 Framework Programme. Sir Alimuddin Zumla is in receipt of an UK-NIHR Senior Investigator award and is a Mahathir Science Award and EU-EDCTP Pascoal Mocumbi Prize Laureate.

Avinash Sharma*, Bhavuk Gupta
DBT-National Centre for Cell Science, Pune, 411007, India

Eskild Petersen
Institute for Clinical Medicine, Faculty of Health Sciences, University of Aarhus, Denmark
European Society for Clinical Microbiology and Infectious Diseases Task Force for Emerging Infections, Basel, Switzerland
International Society for Infectious Diseases

Shui Shan Lee
International Society for Infectious Diseases

International Society for Infectious Diseases; Stanley Ho Centre for Emerging Infectious Diseases, The Chinese University of Hong Kong, Shatin, Hong Kong
S.H. Ho Research Centre for Infectious Diseases

Alimuddin Zumla
Department of Infection, Division of Infection and Immunity, University College London
NIHR Biomedical Research Centre, UCL Hospitals NHS Foundation Trust, London, UK

*Corresponding Author: Dr Avinash Sharma PhD. DBT-National Centre for Cell Science, Pune, 411007, India.
E-mail address: avinash.nccs@gmail.com (A. Sharma)

References

[1] Memish ZA, Steffen R, White P, Dar O, Azhar EI, Sharma A, et al. Mass gatherings medicine: public health issues arising from mass gathering religious and sporting events. *Lancet* 2019;**393**:2073–84 PMID: 31106753. doi:10.1016/S0140-6736(19)30501-X.

[2] Sridhar S, Gautret P, Brouqui P. A comprehensive review of the Kumbh Mela: identifying risks for spread of infectious diseases. *Clin Microbiol Infect* 2015;**2**:128–33. doi:10.1016/j.cmi.2014.11.021.

[3] Aggrawal V, Dikid T, Jain SK, Pandey A, Khasnobis P, Choudhary S, et al. Disease surveillance during a large religious mass gathering in India: The Prayagraj Kumbh 2019 experience. *Int J Infect Dis* 2020;**101**:167–73. doi:10.1016/j.ijid.2020.09.1424.

[4] Alqahtani AS, Alfelali M, Arbon P, Booy R, Rashid H. Burden of vaccine preventable diseases at large events. *Vaccine* 2015;**48**:6552–63. doi:10.1016/j.vaccine.2015.09.076.

[5] GBD 2019 Antimicrobial Resistance CollaboratorsGlobal mortality associated with 33 bacterial pathogens in 2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2022;**10369**:2221–48. doi:10.1016/S0140-6736(22)02185-7.

[6] Holmes AH, Moore LSP, Sundsfjord A, Steinbakk M, Regmi S, Karkey A, et al. Understanding the mechanisms and drivers of antimicrobial resistance. *Lancet* 2016;**387**:176–87. doi:10.1016/S0140-6736(15)00473-0.

[7] Sharma A, Rodriguez-Morales AJ, Traore T, Shafi S, El-Kafrawi SA, Azhar EI, et al. Globalisation of antibiotic-resistant bacteria at recurring mass gathering events. *Lancet* 2023;**402**:e5–7. doi:10.1016/S0140-6736(22)01995-X.

[8] Balsari S, Greenough PG, Kazi D, Heerboth A, Dwivedi S, Leaning J. Public health aspects of the world's largest mass gathering: The 2013 Kumbh Mela in Allahabad, India. *J Public Health Policy* 2016;**4**:411–27. doi:10.1057/s41271-016-0034-z.

[9] Times of India 2023. Prayagraj: Govt sets October 2024 deadline for Maha Kumbh-2025. https://timesofindia.indiatimes.com/city/allahabad/govt-sets-oct-2024-deadline-for-maha-kumbh-2025-work/articleshow/94871890.cms (accessed 15 October 2023)

[10] Jani K, Bandal J, Shouche Y, Shafi S, Azhar EI, Zumla A, et al. Extended ecological restoration of bacterial communities in the Godavari River during the COVID-19 lockdown period: a spatiotemporal meta-analysis. *Microb Ecol* 2021;**82**:365–76. doi:10.1007/s00248-021-01781-0.

[11] Gupta A, Dutt V, Sharma N, Kajale S, Bhatt A, Shafi S, et al. Examining the microbial composition of natural springs in Bhaderwah, Jammu and Kashmir, India. *Environ Monit Assess* 2023;**195**:949. doi:10.1007/s10661-023-11507-z.

[12] Sharma A, Karande M, Zumla A. Advancing sewage surveillance at mass gathering events for reducing transmission of antimicrobial resistant bacterial pathogens. *Travel Med Infect Dis* 2023;**54**:102619. doi:10.1016/j.tmaid.2023.102619.

[13] Ariyanachi K, Lakshmi JT, Shireen NS, Vidya MS, Supriya G, Saranya M, et al. Vector-Borne Diseases amidst COVID-19 Pandemic in India - A Mini-Review. *Maedica (Bucur)* 2022;**17**:201–4. doi:10.26574/maedica.2022.17.1.201.

[14] Mondal Nitish. The resurgence of dengue epidemic and climate change in India. *Lancet* 2023;**401**:727–8. doi:10.1016/S0140-6736(23)00226-X.

[15] Chan IHY, Gofine M, Arora S, Shaikh A, Technology Balsari S. Training, and Task Shifting at the World's Largest Mass Gathering in 2025: An Opportunity for Antibiotic Stewardship in India. *JMIR Public Health Surveill* 2023;**9**:e45121. doi:10.2196/45121.

[16] Indian Council of Medical Research 2023: India's Antimicrobial Resistance Surveillance & Research Initiative. https://iamrsn.icmr.org.in/(accessed September 2023)

[17] Nair M, Tripathi S, Mazumdar S, Mahajan R, Harshana A, Pereira A, et al. Without antibiotics, I cannot treat": A qualitative study of antibiotic use in Paschim Bardhaman district of West Bengal, India. *PLoS One* 2019;**14**:e0219002. doi:10.1371/journal.pone.0219002.