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Can Wastewater-Based Epidemiology and Artificial Intelligence Predict Nosocomial Infections?

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Early detection and prediction of nosocomial infections remain major challenges for hospital infection control and antimicrobial stewardship programs. In this study, we evaluated the potential of wastewater-based epidemiology (WBE) combined with shotgun metagenomics and artificial intelligence (AI) to predict the occurrence of antibiotic-resistant pathogens in a large tertiary-care hospital located in the Ruhr metropolitan region of Germany.

Over a two-year period, hospital effluent was sampled weekly, resulting in a total of 104 wastewater samples. In parallel, clinical microbiology records were collected, including isolates and associated antibiotic resistance profiles identified in routine diagnostics.

Our results demonstrate that hospital wastewater contains substantial predictive information regarding the emergence and prevalence of antibiotic-resistant pathogens. Depending on the organism and resistance phenotype, wastewater-derived signals provided an early warning window of approximately one to three weeks before corresponding increases were observed in clinical isolates. This lead time could support targeted infection prevention measures, enhanced surveillance activities and proactive antimicrobial stewardship interventions.

A One Health AI approach linking environmental monitoring with clinical microbiology and public health can successfully support clinical infection control.

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AMR, WBE, prediction, AI

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Professional Status of the Speaker

Professor

Junior Scientist Status

No, I am not a Junior Scientist.

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