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Public health actions in response to pathogen detection in wastewater and the environment: a scoping review

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The final, formatted version of the article will be published soon.

Introduction: Rapid detection of infectious disease agents is crucial for timely public health responses. Wastewater and environmental surveillance (WES) offers a complementary approach by detecting pathogens shed by infected individuals, including asymptomatic cases. This scoping review provides an overview of reported public health actions in response to WES for human pathogens. It also summarizes sampling and analysis methods and offers insights for future implementation. Methods: The protocol for this review was registered in the PROCEED open-access registry. A systematic search was conducted in MEDLINE, EMBASE, and Web of Science for peer-reviewed literature published up to 31 July 2024. Studies were included if they reported public health actions in response to WES related to infectious diseases in human populations. Two reviewers independently screened studies and extracted data on public health responses, sampling, and analytical methods. Results: Of the 6,630 articles screened, 49 met the inclusion criteria. Most studies (92%) were published between 2021 and 2024, with SARS-CoV-2 as the primary focus (82%), followed by poliovirus (16%). Research was largely conducted in high-income regions: North America (51%), Asia (22%), and Europe (14%). Target populations included urban residents (57%) and on-campus students (31%) and local authorities were more often involved in WES efforts than national agencies (51% vs. 33%). In 75% of studies, at least two public health actions were implemented, and 20% reported five or more. The most common actions related to reactive disease control (n = 69), including testing, isolation, and contact tracing. Proactive disease control actions (n = 33) and public health communication (n = 22) were also described. Weekly sampling (57%) and composite methods

(67%) were most used. Manhole sampling, despite equal frequency with treatment plant sampling (35%), led to significantly more public health actions (61 vs. 35). Long-term surveillance was often reported but rarely sustained. Quantitative and molecular analyses dominated; sequencing was rarely used (4%). Conclusion: While reporting on public health actions following WES remains limited, this review illustrates its potential to inform timely, local interventions. Future studies should broaden pathogen targets, embed public health action planning in study design, and expand WES use in low-resource settings.

Keywords: infectious agents detection, Public health response, Wastewater analysis methods, Wastewater sampling methods, Wastewater surveillance, Wastewater monitoring

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