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The role of wastewater-based epidemiology for SARS-CoV-2 in developing countries: Cumulative evidence from South Africa supports sentinel site surveillance to guide public health decision-making

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Abstract:
The uptake of wastewater-based epidemiology (WBE) for SARS-CoV-2 as a complementary tool for monitoring population-level epidemiological features of the COVID-19 pandemic in low-and-middle-income countries (LMICs) is low. We report on the findings from the South African SARS-CoV-2 WBE surveillance network and make recommendations regarding the implementation of WBE in LMICs. Eight laboratories quantified influent wastewater collected from 87 wastewater treatment plants in all nine South African provinces from 01 June 2021 to 31 May 2022 inclusive, during the 3rd and 4th waves of COVID-19. Correlation and regression analyses between wastewater levels of SARS-CoV-2 and district laboratory-confirmed caseloads were conducted. The sensitivity and specificity of novel 'rules' based on WBE data to predict an epidemic wave were determined. Amongst 2158 wastewater samples, 543/648 (85 %) samples taken during a wave tested positive for SARS-CoV-2 compared with 842 positive tests from 1512 (55 %) samples taken during the interwave period. Overall, the regression-co-efficient was 0,66 (95 % confidence interval = 0,6-0,72, R2 = 0.59), ranging from 0.14 to 0.87 by testing laboratory. Early warning of the 4th wave of SARS-CoV-2 in Gauteng Province in November-December 2021 was demonstrated. A 50 % increase in log copies of SARS-CoV-2 compared with a rolling mean over the previous five weeks was the most sensitive predictive rule (58 %) to predict a new wave. Our findings support investment in WBE for SARS-CoV-2 surveillance in LMICs as an early warning tool. Standardising test methodology is necessary due to varying correlation strengths across laboratories and redundancy across testing plants. A sentinel site model can be used for surveillance networks without affecting WBE finding for decision-making. Further research is needed to identify optimal test frequency and the need for normalisation to population size to identify predictive and interpretive rules to support early warning and public health action.