Innovation in wastewater near-source tracking for rapid identification of COVID-19 in schools

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COVID-19 is one of the biggest global public health challenges of the century with almost 42 million cases and more than a million deaths to date. Until a COVID-19 vaccine or effective pharmaceutical intervention is developed, alternative tools for the rapid identification, containment, and mitigation of the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are of paramount importance for managing community transmission. Within this context, school closure has been one of the strategies implemented to reduce spread at local and national levels. Experience gained from influenza epidemics showed that school closures reduce social contacts between students and therefore interrupt chains of transmission between students and households.[1] How school-age children transmit coronaviruses such as severe acute respiratory syndrome, Middle East respiratory syndrome, and SARS-CoV-2 within school settings and at a local community scale is less clear. Regardless, as of mid-March 2020, about half the world's student population were required to stay at home. Evidence from human influenza outbreaks (where children are key vectors) indicates that school closures are only effective during low viral transmissivity (defined as reproductive number <2) if viral susceptibility is greater in children than in adults.[2] Although the role of children in COVID-19 transmission remains unclear (in terms of both incubation length and asymptomatic prevalence), one report suggested that children and young adults (10–19 years) spread COVID-19 to the same extent as adults,[3] and therefore, can be a source of SARS-CoV-2 in household transmission clusters. However, data is not consistent with earlier studies reporting little evidence of transmission from children to adults.[4] This knowledge gap is partly due to disproportionately low rates of community testing on children and adolescents.

Surveillance for COVID-19 focuses on identifying and testing individuals with symptoms, an approach that does not capture asymptomatic (40–56% of confirmed SARS-CoV-2 infections[5]) or presymptomatic individuals. Although mass screening is increasingly considered a way to address this problem, costs, equipment availability, and implementation compromise the feasibility of this approach. A promising, non-invasive tool that can support the COVID-19 response is the use of wastewater-based epidemiology to enable the early identification of local outbreaks and facilitate targeted use of local clinical testing.[6] SARS-CoV-2 has been identified in adult and child faeces and urine, in asymptomatic individuals and at the presymptomatic stage, with long-lasting virus shedding in the excreta at the convalescent stage in both adults and children.[7] However, few data are available on the levels and duration of shedding by children not requiring hospital treatment.[8] SARS-CoV-2 RNA fragments have been isolated from numerous wastewater treatment works, septic tanks, sewers, hospital wastewater treatment systems, and environmental discharge points[7] and reported to predate the clinical diagnosis of cases,[9,10] raising the potential for its use within an early warning system. Data at a local community level have the potential to proactively inform public health-care strategies (targeting resources with associated time and cost savings) and mitigate escalating demands on health-care providers, especially during the winter months. However, monitoring occurrence or prevalence at the inlet of a wastewater treatment plant does not allow the identification of specific groups of the population, limiting its epidemiological value for managing COVID-19 and breaking chains of transmission. More recently, the wastewater-based epidemiology approach has been successfully used for near-source tracking (NST)—eg, in the sewage drains serving buildings—permitting detection of small clusters or even individual COVID-19 cases. NST, used in combination with targeted clinical testing, has clear potential to stop outbreaks and is now being used across Estonia, Finland, France, Singapore, Turkey, the UK, and the USA. NST might be more easily justified for the more vulnerable or higher risk and undersampled groups such as people in hospitals, prisons, elderly care homes, schools (particularly boarding schools), preschool settings, and factories. Although wastewater-based epidemiology cannot replace clinical testing, routine wastewater surveillance across spatial scales (from sewershed to building to sub-building level) could enable the early identification of local outbreaks through informing the targeted use of local clinical testing (ie, when and where) to capture asymptomatic and presymptomatic cases.

Experience from the past month in most of the countries in which the school year has restarted is that as community cases rise, more children become infected. Wastewater-based epidemiology using NST provides public health officials insight into the carriage of COVID-19 within discrete groups of people for whom rapid action could alleviate the risk of a much larger outbreak. Wastewater NST could be the first line of defence for high-risk populations and could offer long-term advances in public health surveillance after COVID-19.

We declare no competing interests.

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