Municipal Sewage COVID-19 Testing: A Much Needed Public Health Community Prevention Intervention

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As of July 17, 2020, a total of 13 926 cases of coronavirus disease 2019 (COVID-19) have been confirmed with 593 209 deaths worldwide.[1] The actual number of infected population is likely much larger. For example, a study of antibody seroprevalence in Santa Clara County, CA, USA, estimated the percentage of those infected with COVID-19 to be in the range of 2.49%-4.16%, translating to a 50-fold to 85-fold increase in comparison to confirmed cases.[2] Similarly, another study examining antibody seroprevalence in Los Angeles County estimated that 4.65% of the county population is infected, 43-fold larger than confirmed cases.[3] Consistent with these findings, a study in China estimated that undocumented, asymptomatic patients comprise 79% of all COVID-19 cases.[4] These results implicate a major risk of transmission from asymptomatic individuals. Mass testing and surveillance offers a method of surveillance and provides epidemiologists with information about hot spots and impending outbreaks.

Two major forms of COVID-19 testing are testing for viral ribonucleic acid (RNA) and serologic testing for antibodies. The RNA test is performed via polymerase chain reaction and informs whether the patient currently has an infection.[5,6] The serologic test evaluates whether antibodies to the causative agent, SARS-CoV-2, are present, indicating a previous infection with the virus.[6] A drawback to this test is the lag between symptoms and antibody formation, usually 12 days.[7] The lag between infection and symptoms, in those with symptoms, causes the COVID-19 case prevalence estimations to lag behind the true disease burden. Thus, a method of testing and surveillance that can provide real-time estimations of the cases is warranted.

SARS-CoV-2 viral shedding in the stool has been described in a variety of studies[8-12] and demonstrated in municipal sewage.[13-15] A study of municipal sewage in Connecticut found that viral RNA concentrations were detectable in all samples and correlated with the COVID-19 cases and local hospital admissions.[13] Moreover, the study found that wastewater SARS-CoV-2 RNA concentrations indicated an outbreak 7 days ahead of COVID-19 testing data and 3 days ahead of local hospital admissions.[13] Testing municipal wastewater has the potential to detect early signs of an outbreak and provide early interventions to mitigate the spread of infection.

Furthermore, the rate at which SARS-CoV-2 RNA concentrations in wastewater change has the potential to predict an increase/ decline in COVID-19 cases. For example, the number of patients admitted to Yale New Haven Hospital changed more slowly than the local wastewater concentrations of SARS-CoV-2 RNA.[13] Rapid increases in wastewater SARS-CoV-2 RNA concentrations may serve as a warning of an impending COVID-19 case surge and allow the hospital to apply early interventions in order to reserve PPE and hospital resources consumed when managing these patients. Conversely, the decline in wastewater RNA concentrations could provide a signal that infections are waning and aid in the decision to ease restrictions.[14] In addition, maintaining an accurate picture of the infection in real time may conserve hospital resources. Throughout the pandemic, there has been a shortage of health care personnel, personal protective equipment, and ventilators.[15] The allocation of these resources to a region with a predicted outbreak may prove an effective measure to reduce the stocking of medical supplies in an area with a low risk of an outbreak.

Finally, engaging in testing at the community level may have additional benefits. First, the privacy of the patient is preserved, while still obtaining valuable information about the status of local outbreaks. Second, wastewater treatment plants are becoming a growing standard in urban areas throughout much of the world.[16] This makes wastewater testing applicable in regions where clinical capacity is limited. Third, the high demand for COVID-19 testing reagents is putting them at a global shortage.[17] Allocation of COVID-19 tests to areas with increasing wastewater SARS-CoV-2 RNA may preserve testing supplies and allow for prompt use in areas of high disease burden.

There is still much to learn about the prospect of testing wastewater, but the evidence presented provides a strong argument for the quantitative monitoring of SARS-CoV-2 RNA in municipal wastewater. Monitoring wastewater RNA concentrations has the potential to serve as an early warning system to alert epidemiologists to enact appropriate public health measures prior to an outbreak and may also serve as an additional measure to ease restrictions if concentrations decrease. The United States has experienced the consequences of merely reacting to a

surge of cases, while other countries remain largely unaffected due to mass testing and surveillance. At a time when surveillance is critical, it would seem that wastewater testing is an option worth exploring. Diverting additional research efforts into wastewater testing is a realistic option that may be the advantage we need to minimize negative outcomes and put us back on track to a better tomorrow.

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