Wastewater Surveillance – An Early Warning for COVID-19 Detection and Prevention and a Platform for One Health Studies on Pathogens

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INTRODUCTION

In a pandemic situation, such as the one that we are currently in, early detection plays a major role in controlling transmission and severity of disease. The history of using wastewater as a surveillance tool goes back to the year 1933 when Dr. James Wilson detected Salmonella typhi in wastewater and connected that to the cases of typhoid in the community. Even during the SARS-CoV1 epidemic, SARS-CoV1 RNA was detected in wastewater. We, as a part of the Precision Health Initiative, which is a joint effort of individuals and organisations under #COVIDActionCollab, have been able to detect the presence of SARS-CoV2 in the wastewater of different wards of Bengaluru, India. At present we are testing 45 sites covering a population of about 800 000, with each site being tested twice a week.

METHODOLOGY

Wastewater samples are collected from open drains at each site and transported to the lab in temperature-controlled boxes. The samples are subjected to physical (Heat) and chemical (PEG+NaCl) treatments, followed by filtration. The RNA extraction procedure followed is a standard protocol using the NeoDx Extraction kit. A Real-Time Quantitative PCR(RT-qPCR) is performed with the extracted RNA using the GenePath RT-qPCR kit. Interpretation of results is performed as per kit guidelines. The Exponential Weighted Moving Average (EWMA) Viral Load is calculated and this data as well as trends (increasing, decreasing, no change over two weeks) are loaded on an ArcGis storymapsprogram(https://swastihc.maps.arcgis.com/apps/dashboards/67b8b425b0d442609a097f383784cf73).Any samples with Ct values less than 29 for RDRP or N are also sent for whole genome sequencing for variant analysis. These are compared with the community positivity data that we receive from the Bengaluru city municipality.

RESULTS

The overall trends of the Covid viral loads in wastewater appear to follow those of the community positivity data across the city. At about 60 % of the sites, we observe that there is a rise in the viral loads in the wastewater before there is a corresponding rise in positivite cases in the community for the same location. As the city moves from total lockdown to a phased route out of lockdown, we have begun to observe sites that are frequently positive and show Ct values that are slowly decreasing, indicating increasing viral loads. Interestingly, we were able to pick a Covid variant (AY.12) in a sewage sample from June whereas AY.12 was first described among patients who tested positive in the city in mid-August. We have also detected other variants AY.4 and AY.10 in the wastewater.

DISCUSSION

Our data strongly suggest that waterways surveillance can be used as an additional epidemiological tool to track the Covid pandemic, identify trends in the infectivity levels in a city, and potentially identify hotspots. Trends in VT values and viral loads in wastewater could also be potentially used as an early warning. Certainly, the fact that AY.12 could be detected in waterway months before it was described in patient populations suggests that wastewater surveillance is a powerful way to track the spread of hidden, asymptomatic infections. We now intend to track other markers, such as antibiotic and antipyretic levels in the wastewater to layer an additional level of information. We anticipate that this platform can be used parallelly for the detection and description of local antimicrobial resistance levels. Thus, wastewater surveillance platforms for Covid not only help in tracking the immediate pandemic, but have the potential to be used for environmental surveillance of other conditions of public health interest.