Short Communication

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How Can We Track COVID-19 Hotspots and Prevent its Spread?

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ABSTRACT

The novel coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Due to continued waves of COVID-19, countries are doing their best to vaccinate their populations and increase the testing of the virus to circumvent its spread. However, it looks difficult to contain the virus after two years. Therefore, early detection of the virus is very important. SARS-CoV-2 could survive in wastewater, and through the surveillance of the sewerage systems, COVID-19 hotspots may be tracked and its community spread can be measured and managed.

Keywords: Coronavirus Tracking; COVID-19; SARS-CoV-2; Wastewater Analysis

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The outbreak of novel coronavirus disease 2019 (COVID-19) was declared a public health emergency by the World Health Organization (WHO) on 30th January 2020, due to its spread across the globe [1,2]. Because of continued waves of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), it is essential to introduce efficient monitoring and screening techniques Virus containment remained challenging in spite of the various advancements in the research field. The most common modes of virus transmission include droplet, contact or fomite, and fecal transmission [3,4]. Fecal transmission can be a serious risk for both humans and animals in case of aerosolization of fecal waste contaminated with the virus [5]. In diarrhea patients, severe acute respiratory syndrome coronavirus (SARS-CoV) was found stable in feces at room temperature for a minimum of 1-2 days and could survive for up to 4 days in the stool [6]. This detection increases the chance of fecal-oral transmission [7] because flushing may aerosolize fecal matter and cause airborne transmission [8]. This type of transmission could be high where toilets are shared for example in quarantine centers and hospitals. From these toilets, flushed water enters into sewerage systems. Consequently, the sewerage system becomes a carrier of this virus. Countries are trying hard to maximize the testing of the virus to avoid community spread of the COVID-19 and after around two years it looks still difficult. Therefore, it is crucial to locate the COVID-19 hotspots to plan mitigation strategies And sewerage system monitoring could be an efficient strategy for finding the virus hotspots. This probable route of virus transmission may worsen the problem of community transmission [9]. Though, this environmental surveillance, the magnitude, and duration of the virus spread may be measured in specific populations. Further, bacterial and viral community interactions can be easily studied in wastewater systems. And this model has already been successfully working for monitoring of poliovirus and Aichi virus towards elimination [10,11].

Coronaviruses can survive up to 2–3 days in sewage water and up to10 days in tap water at 23 °C [10]. Further, it was also observed that temperature, organic matter levels, and the presence of antagonistic bacteria and oxidants such as chlorine may affect the virus survival [10]. Some studies reported the presence of ribonucleic acid (RNA) of SARS-CoV-2 in sewage water [12], however, the persistence of the virus in the sewage system is not yet exactly determined [13]. Fecal matter's chemical components are mostly organic in nature and may stimulate the extended survival of the virus in the system [14]. Previous studies on SARS-CoV and Middle East respiratory syndrome coronavirus (MERS-CoV), determined that coronaviruses (single-stranded RNAs) are less resistant and more fragile to water treatment procedures. It was found that the virus can be grown with the help of bacteriophage in cell culture media for propagation. After the RNA isolation, it was tested for SARS-CoV-2 activity by using a real-time reverse transcription-polymerase chain reaction (RT-PCR) assay and untreated samples tested positive. However, the treated samples showed the presence of viral RNA, it was unclear whether the virus retained infectious properties after the routine treatment [11].

Standard methods are not so far established for COVID-19 detection in wastewater, however, environmental surveillance of sewersheds helps to track COVID-19 hotspots in different areas [15]. Factors that affect the efficiency of monitoring tools include geographical location, general sanitary, climatic conditions, sampling methods like trap sampling, precipitation methods, charge-based filters, and detection methods [11]. The main challenge is that the virus' genetic markers may easily get lost during the flow of sewage [15]. Water treatment plants perhaps impact the virus signals. Researchers are investigating the procedures to understand the data collected from sewage samples. These results help to create an accurate map of how the virus is spreading and show the emergence of the next wave of the pandemic. Sampling and sample storage is a very important part; it can be dangerous for the wastewater workers due to exposure to the virus. This would help in to make policy decisions [15] find out the virus hotspots, and identify the communities with virus carriers to prevent further spread of COVID-19, and also for surveillance purposes.

Arthropods such as cockroaches and houseflies which are major vectors of some pathogens may play a role in transmitting coronaviruses mechanically by contact with contaminated surfaces and/or with the feces of infected individuals [4]. Though, SARS-CoV-2 spread to healthy individuals through inhalation of droplets of infected individuals' coughs and sneezes. To investigate and measure the potential role of houseflies and cockroaches in the transmission of COVID-19 is crucial in the countries with open sewerage systems because these arthropods feed on human feces, wastes, and carcasses [16,17] and can mechanically carry microbes including viruses in their moth parts and with their legs to transmit to a healthy individual. Previously, through nested RT-PCR, coronavirus was detected in surface wipe to study the spread of coronaviruses by cockroaches [18]. Hence, in an open wastewater or sewerage system, these arthropods could carry and transmit SARS-CoV-2.

Therefore, it is crucial to study the survival rate of SARS-CoV-2 in both surface wastewater and sewage water because of asymptomatic infections. For virus surveillance, existing wastewater treatment systems and evaluation methods should be improved. Consequently, the sensitivity of tools is very important, so that these can capture even the smallest amount of viral infection during the initial stages to prevent the spread of viral particles. In wastewater pre-treatment, the use of nanofiber filters especially electrospun nanofiber membranes can screen disease-causing pathogens. Virus detection methods such as enzyme-linked immunoassay (ELISA), RT–PCR, multiplex PCR, complementary deoxyribonucleic acid (cDNA) microarrays, isothermal nucleic acid amplification-based methods, or the newly discovered paper-based device for coronaviruses could be used in these wastewater treatment facilities. Metagenomic approaches could also be helpful to study the entire microbiota of wastewater towards management strategies. Owing to the physical stability of coronaviruses in the environment, the absence of protective immunity in humans, infection control against SARS-CoV-2 remains the primary means to prevent person-to-person transmission. Further, there is a possibility of the re-emergence of SARS-CoV-2 and other novel viruses; therefore, there is a need for preparedness for the next pandemic.

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