

Issues and Opportunities Associated with SARS CoV-2 (COVID-19) Virus Detection in Sewage

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Abstract-- COVID-19 has emerged as pandemic challenge for the world. Novel information is emerging from the research and development. In this connection several reports are confirming presence of SARS CoV-2 in the sewage. This information has concern for the sanitary professionals involved in management of sewage and sludge of sewage treatment (biosolids). The same information also has opportunities to apply wastewater related epidemiology concept for rapid screening of a community impacted by COVID-19 and extent of its spread. The present article discusses issues and opportunity involved with the available information related to detection of RNA strains and whole virus in sewage.

Key words - COVID-19, SRS CoV-2, Sewage surveillance, sewage treatment, wastewater related epidemiology

I. INTRODUCTION

Effective tools adopted by a country to tackle outbreak of pandemic COVID -19 are lock down, isolation of community wherever COVID 19 is detected and clinical management of positive patients of COVID-19. The testing of individual at local or regional level is tiresome in light of fast spreading potential of SARS CoV 2 coupled with resource constraints and absence of proven effective tool to handle the outbreak of COVID-19. Coronavirus disease 2019 (COVID-19) causes severe acute respiratory syndrome. Corona Virus (SARS-CoV-2) was first reported in Wuhan city of China in late December 2019 and World Health Organization was compelled to declare this infection as pandemic on 11.03.2020. The peculiarity of the spread lies in the fact that several people impacted by COVID -19 do not even develop symptoms but act as a carrier and spreads the disease. Whenever, a person with symptom of COVID-19 get declared as positive case, the spread to other persons is already done and there remains no measure other than making the vulnerable population to get quarantined in light of lack of objective information. Efforts are being made throughout the world to collect information on characters, indicators and containment requirements and scientists have started working on various measures for cost-effective detection of virus, assessing mode of transmission, developing treatment protocols and developing vaccines. For monitoring the

community level invasion of the virus or spread of virus in water aquifer, concerns are raised throughout the world. Although the water transmission route is not a common route of corona family viruses (commonly called as Human Corona Virus or HCoV) impacting human population but nothing can be said with certainty at present. Two main routes of transmission of the COVID-19 virus are almost established. Two main routes of transmission of the COVID-19 virus is almost established with certainty namely respiratory droplets and contact transmission. Respiratory droplets are generated when an infected person coughs or sneezes. Any person who is in close contact with someone who has respiratory symptoms (sneezing, coughing) is at risk of being exposed to potentially infective respiratory droplets. Droplets may remain in atmosphere for some time or get settled on any surface where the virus could remain viable making the surface a potential source of transmission. If the global scenario is looked into, the most common method for prevention of COVID-19 contamination at individual level is use of alcohol-based hand rubs/sanitizers or washing the hands frequently with soap and water besides usage of mask. The global availability of water itself becomes limiting factor in frequent washing of hands in several region and pockets of communities in globe due to water scarcity. A common washing for 20 second requires upto two-liter water and frequent washing even during the day time requires upto 12 litre/ per person in a family. Further, the potential of spread of COVID -19 from water and wastewater as well as use of water or wastewater as decision making tool related to COVID-19 spread became a new direction of potential research in this field. The present article aims to highlight the existing knowledge about Sewage as marker tool for community detection with COVID-19 infection and probability of infection from sewage due to COVID-19.

II. SARS CoV-2 IN HUMAN EXCRETION AND POTENTIAL RISK OF SPREAD

Few studies are carried out till date (Xiao, et al, 2020, Holshue et al, 2020, Medema, G. 2020) and observed that SARS CoV-2 is present in stool, urine and sewage. These evidences reminds about the incident in Hong Kong (WHO, 2003) where the wastewater pipeline plumbing of a building became the key source for SARS spread. The LANCET study (Gormley et al., 2017) can be correlated here. The implications Lancet works are relevant in terms of COVID-19 spread. The interconnectedness of the wastewater plumbing network, the sensitivity of the system to factors such as overuse, underuse, high temperatures, and high concentrations of infected people raise concerns over the practice of self-

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isolation and the use of hospital wards as quarantine areas. High concentrations of infected people contribute to a higher viral load in the system, thus leading to a higher risk of disease spread. Self-isolation can lead to a greater number of infected people in a building and potential system overuse. LANCET also recommended a set of precautions for this purpose to ensure that transmission through the wastewater plumbing system is minimised (1) do not ignore unexplained foul smells in bathrooms, kitchens, or wash areas; (2) make sure that all water appliances in bathrooms and kitchens are fitted with a functioning U-bend; (3) to prevent the loss of the water trap seal within a U-bend, open a tap on all water appliances for at least 5 s twice a day (morning and evening) paying special attention to floor drains in bathrooms and wet rooms; (4) if the wastewater pipe work from an appliance appears to be disconnected or open, seal it immediately (ie, use an elastic rubber glove to cover the end; a plastic bag and some tape will suffice, ensuring the bag has no holes); (5) if there appears to be any crack or leak in pipe work, seal with tape or glue; and (6) continuously monitor whole system performance (for large or tall buildings). The potential for a substantial viral load within the wastewater plumbing system (and therefore the main sewer system), in combination with the potential for airborne transmission due to aerosolisation of the virus, calls for wastewater plumbing systems to be considered as a potential transmission pathway for COVID-19. Though till date no objective evidence is available to demonstrate the effectiveness of suggestion by LANCET but the precaution may be a tool to fight SARS CoV2.

It is already established that SARS CoV-2 is 82% similar to SARS corona virus that caused an outbreak in 2003 (Medena, 2020) and the symptoms of COVID-19 is also resembling with other SARS virus and hence the features may also be similar. Therefore, if effective wastewater treatment system is operative with proper disinfection of treated sewage, the chance of spread of COVID-19 through wastewater appears to be low with the present state of knowledge. But the plumbing work in an individual building and cleanliness, detection of sewage related smell inside the house or surrounding area is an alarming situation which needs to be immediately taken care. WHO in its Interim guidance published in March 2020 has neither given clean chit for the wastewater related spread nor supported this transmission mode. World Health Organization states that COVID-19 virus is an enveloped virus, with a fragile outer membrane. Generally, enveloped viruses are less stable in the environment and are more susceptible to oxidants, such as chlorine. While there is no evidence to date about survival of the COVID-19 virus in water or sewage, the virus is likely to become inactivated significantly faster than non-enveloped human enteric viruses with known waterborne transmission such as adenoviruses, norovirus, rotavirus and hepatitis A. Finally, the fact remains that virus has already spread throughout the world and the people have to learn to live with the virus with certain precautions as the elimination of virus from world is immediately not possible as per the past experience with Polio virus and Chicken pox virus.

III. DETECTION OF SARS CoV-2 IN SEWAGE AND ITS DIMENSIONS

After demonstration of low probability of spread of SARS CoV-2 through the wastewater, researchers across the globe started conceptualizing about community level screening by the wastewater analysis to demonstrate COVID-19 infection looking into the fact that SARS CoV-2 is already present in wastewater. Testing begins globally with collecting sewage samples from local treatment plants, and running them through a process that creates copies of viral RNA to study the pathogen in detail. Another process looks for specific markers on SARS-CoV-2, to distinguish this particular virus from all the other possible microbes in wastewater samples. Some of the studies suggest that a COVID-19 infected patient can start excreting viral RNA and virus itself through their fluid excreta or stool after 03-04 days of infection (Mallapaty S., 2020). This finding is very important as the virus detection in sewage can start well before the onset of COVID-19 symptoms in infected patients. Thus, wastewater related epidemiology (WRE) study becomes important. Sewage surveillance has successfully detected several epidemic issues in past like salmonella and Polio disease and the same can be applied for COVID-19 too. However, the virus is different, the detection method is different and hence capacity building in this area collaborative work between various departments will be the route of success. Mallapaty S., 2020 has successfully outlined how the wastewater could become a tool for monitoring the community health from corona virus outbreak and its return to the society. The number of infected persons with respect to abundance of virus and viral RNA can be modelled for future surveillance. However, the treated sewage should be very cautiously disinfected before discharge or reuse. Australian researchers at the University of Queensland (UQ) and Australia's national science agency CSIRO have developed an early warning surveillance system designed to detect the presence of SARS-CoV2, a virus which causes Covid-19, in Australian untreated wastewater (sewage). The implementation of surveillance system requires multi-organisational capacity and collaboration encompassing city level sewage and sewerage management, research laboratories, public health engineering department and of course policy makers' involvement. WRE is already recognised as an effective way to trace illicit drugs and obtain information on health, disease, and pathogens. If COVID-19 can be monitored in a community at an early stage through WRE, effective intervention can be taken as early as possible to restrict the movements of that local population, working to minimise the pathogen spread and threat to public health

IV. COMMON WATER INFRASTRUCTURE AND POTENTIAL RISK OF SPREAD

There is no evidence that COVID-19 can be spread to humans through the use of drinking water pipelines, swimming pools, bath tubs or spas, water recreational activities or water playgrounds. Proper operation, maintenance and disinfection (e.g., with chlorine and bromine) is the key for making the virus inactive that causes COVID-19. But the common infrastructure invariably has gathering of people and hence while there is ongoing community spread of COVID-19, there

should be appropriate care taken both in and outside the pool including restrain on usage, to remain protected. Surveillance, tracing and detection of community spread continue to be the key to containing the outbreak.

V. CONTAMINATION RISK FROM BIOSOLID OF SEWAGE TREATMENT PLANT

Biosolids are the organic residues resulting from the treatment of commercial, industrial, and municipal wastewater (sewage). Most of the pathogenic bacteria, viruses, and parasites in biosolids are enteric, which means they are present in the intestinal tracts of humans and animals. Enteric organisms that may be found in biosolids include, but are not limited to, *Escherichia coli*, *Salmonella*, *Shigella*, *Campylobacter*, *Cryptosporidium*, *Giardia*, Norwalk virus, and enteroviruses. Exposure may potentially result in disease (e.g., gastroenteritis) or in a carrier state in which an infection does not clinically manifest itself in the individual but can be spread to others. These enteric organisms are usually associated with self-limited gastrointestinal illness but can develop into more serious diseases in sensitive populations such as immune-compromised individuals, infants, young children, and especially the elderly (NIOSH, 2002). For the COVID-19 relationship with biosolid based infection potential is yet to be established. But disinfection requirement cannot be ruled out. Where there is no off-site treatment for the generated Bio-solids, in-situ treatment can be done using lime. Such treatment involves using 1-part of 10% lime slurry per 10 parts of waste. However, workers at wastewater treatment plants should wear appropriate personal protective equipment (PPE), which includes protective outerwear, gloves, boots, goggles or a face shield, and a mask; they should perform hand hygiene frequently; and avoid touching eyes, nose, and mouth with unwashed hands. After handling the waste and once there is no risk of further exposure, individuals should safely remove their PPE and perform hand hygiene before entering the transport vehicle. Soiled PPE should be put in a sealed bag for later safe laundering.

VI. CONCLUSION

The detection of the virus in sewage, even when the COVID19 prevalence is low, indicates that sewage surveillance could be used to monitor the circulation of the virus in the population and as early warning tool for increased circulation in the coming winter or unaffected populations. There are several non-peer reviewed research papers on COVID-19 related topic in the public domain throughout the globe having lots of findings/ data. Care must be taken to the best possible way regarding containment and safety as the findings may be limited by one or more conditions of study which might not be listed in the research papers. Collaborative research for development of method for detection of SARS CoV-2 in sewage and its treatment is the immediate way forward for suitable decision making to combat the prevailing and future pandemic situation.

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