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WATER IS INDICATOR FOR CORONAVIRUS DISSEMINATION

T. Pratheep*, P. M. Ravikumar

Department of Biotechnology, PRIST Deemed to be University, Thanjavur-613403, India.

ABSTRACT: Water related diseases are cause severe illness and mortality worldwide. Newly recognized and established water related pathogens are important challenge to public health sector. Advance methods of examination, epidemiological studies and diagnosis have permitted us to detect new pathogenic species. Pathogenic virus presence in the water environments is responsible for a considerable proportion of waterborne diseases. This review was elucidating the coronavirus dissemination in water environments and using as an indicator for epidemiological study. Human coronavirus main route of transmission is droplets and close contacts, however their faecal elimination also suggests the possible spread through water. The limited information on human coronavirus in the environment suggests that research is required to understand this virus in the water cycle. Knowledge of the persistence of the coronavirus in water, along with its endurance and different removal treatments could be useful for epidemiological study, risk assessment and management.

Keywords: Coronavirus; SARS; MARS, Covid-19; Water; Sewage water.

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Corresponding Author: Dr. Pratheep Thangaraj* Ph.D.

Department of Biotechnology, PRIST Deemed to be University, Thanjavur-613403, India.

Email Address: pratheeptp@gmail.com

1. INTRODUCTION

Water contamination is recognized as a risk for human health, which can source for pathogen dissemination, build the conditions for infection. Waterborne exposures are notoriously difficult to assess retrospectively [1]. Waterborne infections are caused by ingestion, airborne or contact with contaminated water by pathogens which includes bacteria, viruses, protozoa and helminths [2]. Which is major public health concerns worldwide and high cost for their prevention and treatment.

Sensitive diagnostic tools are developed to detect pathogen contamination in water and able to detect pathogens effectively. Viruses are pathogenic typically around 20–300nm in diameter, making them hard to detect and to remove. Many viruses exhibit significant resistance to chlorination as well as prolonged existence, and their presence in water uncorrelated with bacteria indicator. Viruses are species specific, with less known examples of zoonoses (disease pass from animal to human) [3]. Coronaviruses (CoV) are considered as zoonoses, threats to world population. CoV is a Ribovirea, enveloped and single strand RNA genome virus, which named for their crown like morphology, are 80 to 160 nm. It can be classified into four genera: alpha (αCov), beta (βCoV), gamma (γCoV), and delta CoV (δCoV) [4]. Previously identified αCoV: human CoV-NL63 and human CoV-229E; βCoV: human CoV-OC43, HKU1 cause self limiting common cold like illnesses [5]. Other βCoV's are Severe Acute Respiratory Syndrome CoV (SARS-CoV), Middle East respiratory syndrome CoV (MERS-CoV) and SARS-CoV-2 are emerged in twenty first century and their infection can result in life threatening disease and have pandemic potential. The life cycle of the SARS-CoV, MERS-CoV and SARS-CoV-2 is almost similar, but different intermediary host [6]. SARS-CoV is emerged in Guangdong province of southern China in 2002 and spread to 33 countries, which transmitted from bats to human and nosocomial communication between human to human [7]. One decade later in 2012, MERS-CoV emerged in Jeddah, Saudi Arabia and spread around 27 countries. The consumption of camel milk, urine, or uncooked meat may be conducive to transmission [8, 9]. Recent emerged SARS-CoV-2 from Wuhan City, China on 2019 designated as CoV disease 2019 (COVID-19), its sources are under investigation but linked to a wet animal market [10, 11]. SARS-CoV-2 affected around 44,002,003 people and died 1,167,988 of those affected worldwide as of 29th October, 2020 [12]. SARA-CoV-2 is transmitted by droplets generate from breathing, sneezing, coughing, etc., and contact. Xiao et al., (2020) [13] reported the presence fragments of SARA-CoV-2 RNA in feces or anal swab of infected patients. Which is transmission through the fecal-oral route, however, has not been demonstrated, nor has occurrence in water environments been proved to date. This review focuses on the twenty first century CoV dissemination in water environments and using as an indicator for epidemiological study. The reported outcomes are aimed to get better understanding on transmission pathways, and quantification of CoV in water affords the ability to supervise the occurrence of infections among the population via water based epidemiology.

CoV concentration and detection methods

The CoV concentration is minimal in the water sample; this sample can then be used for virus detection by molecular, immunological or cell culture–based methods. Protocols for the concentration of viruses in water samples are: 1. adsorption of viruses to a filter; 2. elution of adsorbed viruses with protein-rich buffer; 3. re-concentration of viruses by flocculation/ precipitation, and 4. extraction of viruses [14]. Various methods can be used to detect CoV in concentrated samples, direct examination is electron microscopy study, and indirect method is diagnostic signals using immunological or molecular methods [15]. Electron microscopy study is a laborious, painstaking, time-consuming, cost-effective method and limited sensitivity. It may require the adaptation of the virus before it can grow effectively [16, 17]. Immunological tests such as enzymatic immunoassay, radioimmunoassay or enzyme-linked immunosorbent assay are used for testing the environmental samples, but their analytical sensitivity is too poor. To overcome these various limitations and disadvantages, molecular technique real-time quantitative PCR (q-PCR) has used to detect the CoV. The q-PCR is allows the quantification of amount of target virus present in a sample. It is closed-tube design that reduces the risk of carry-over contamination, wide range of quantification and possibilities for automation [18].

SARS-CoV dissemination in water

SARS-CoV was observed in feces, urine and water from The 309th Hospital of PLA, China. Additionally, inactivation of SARS-CoV in wastewater with sodium hypochlorite and chlorine dioxide was studied. It shows, SARS-CoV can only persist as infectious particles for a very short time in *in vitro* environments and is highly sensitive to conventional disinfectants [19]. Same research group analyzed in sewage discharges from two hospitals in Beijing, China, hosting SARS patients during the 2003 outbreak. In the both cell culture virus was detected in hospital sewage before disinfection and, some cases in after disinfection. Possible explanation of authors includes viral inactivation by disinfectants [20]. In the second study, two surrogate CoV's, transmissible gastroenteritis virus and murine hepatitis virus survival was evaluated in reagent-grade water, lake water, and settled human sewage [21]. Authors suggest that contaminated water is possible vehicle for human exposure if aerosols are generated. However, surrogate CoV have different resistance behaviour compared to respiratory human CoV. SARS-CoV was identifying in hospital wastewater, domestic sewage and tap water, thus demonstrating temperature strongly influences viral persistence [22].

MERS-CoV dissemination in water

Bibby and Peccia (2013) [23] metagenomic study performed in sewage sludge samples, diversity of viruses such as CoV, Klassevirus, and cosavirus were detected. Interestingly, CoV's showed a higher relative abundance in influent samples compared to effluent ones. Later, another study conducted in surface water in Kazakhstan, majority of the sequences were related to Coronaviridae, Reoviridae and Herpesviridae [24]. Another method, glass wool filtration and simultaneous concentration effectively examine the viral presence in runoff water. Recovered organisms were enumerated by qPCR, bovine origin viruses including Bovine CoV, Bovine Viral Diarrhea Virus types 1 & 2, Bovine Rotavirus group A, and Poliovirus 3 detected [25]. Recently, CoV survival was examine in tap water (filtered and non-filtered) and wastewater, shows CoV was inactivate faster in filtered tap water than unfiltered tap water [26].

SARS-CoV-2 dissemination in water

Three studies have epidemiology investigated in wastewater, support to public health surveillance for COVID-19 infections in communities. In Australia, SARS-CoV-2 RNA concentrations apply to estimate the number of infected individuals in the area by Monte Carlo simulations [27]. Another study, presence of SARS-CoV-19 RNA fragments analyzed with RT-PCR in the water resource recovery facility in the Netherland. They report the inability to detect any RNA in the effluent (preliminary data) [28]. Same study also conducted in Massachusetts, USA and found the presence of SARS-CoV-2 at high titters during March 18 - 25 using RT-qPCR (preliminary data), further research going on [29]. In India, wastewaters are examined in Ahmadabad, Maharashtra; Chennai, Tamilnadu and other metro cities, shows SARS-CoV-2 RNA detected [30, 31]. Earlier, sewage sampling is useful to characterize the epidemiology of poliovirus distribution during the country's polio eradication program and it is still a key method of detecting poliovirus. Same type of method followed to study epidemiology of SARS-CoV-2.

2. CONCLUSION

Wastewater examination may represent a complementary approach to assess the presence and even pandemic. Temperature, chemicals and disinfectant affect the CoV persistence in water. The wastewater epidemiology approach is useful to vigilant population that is covered by a specific sewage treatment plant [32, 33]. Regular examinations of wastewater serve as an indicator to verify whether the pandemic and other infectious diseases under control in particular area. Currently, CoV presence in waters is very limited and no data available for its presence in surface or groundwater or transmitted through contaminated drinking water. Further researches are needed to investigate CoV persistence in water body and in relation to varies climatic and seasonal conditions.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are base of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The author confirms that the data supporting the findings of this research are available within the article.

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CONFLICT OF INTEREST

Authors have no conflict of interest.

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