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COMMENTARY

Wastewater Monitoring Program in Abu Dhabi – A Boon to Early Warning & Public Health Issue Prevention

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Abstract:

The recent establishment of the wastewater monitoring regime by the Abu Dhabi (United Arab Emirates) Government as a tool to monitor the status of community well-being by studying the excretions from the sewage to steer global benchmarks of excellence in public health has been presented. The relevance of microbes and other chemical compounds in sewage and their significance for public health monitoring within the sampled community has been discussed. The key advantage of wastewater monitoring in establishing baseline data and its benefit in assessing the trend in infectious diseases, antimicrobial resistance, and illicit drugs has been presented. Undoubtedly, it is a classic tool available today for early warning signals and trend analysis for policymakers to monitor and avoid the catastrophic impact of deadly pathogens and chemical contaminants upon addressing the challenges.

Keywords: Wastewater, Infectious disease, Illicit drug, Sewage, Contaminants, Epidemiology.

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1. INTRODUCTION

The COVID-19 pandemic has created an unprecedented challenge to public health and policymakers with a devastating impact on tens of millions of people across the globe. Wastewater monitoring has been identified as an effective tool during the pandemic that covers many aspects of public health governance, such as the prevalence of SARS-CoV-2, early warning signs, monitoring of propensity trends and genetic diversity [1].

Over the past decade, a well-thought execution of reforms has led to the alignment of the United Arab Emirates (UAE) policies and plans with resilience in public health. The establishment of state-of-the-art infrastructure, population screening, and intervention programs that focus on priorities such as diabetes and cardiovascular disease, a national genome program, adoption of the population-based health model, and digital integration of medical records across the nation demonstrate continuous improvements that best serve the country. The recent introduction of a wastewater monitoring regime is yet another example of a proactive approach of the leadership for the welfare of its citizens. Ever since the discovery of the viral cause of Polio in wastewater in Philadelphia, the field of wastewater epidemiology expanded [2] to serve as an indicator for the prevalence of microbial and chemical pollutants [3]. It has also gained considerable attention as a tool to monitor the status of community well-being by analyzing excretions [4].

The relationship between the occurrence of microbes of interest in sewage and its epidemiological relevance within the sampled community provides early warning signs and prompts intervention to prevent catastrophic impact [5]. The advent of molecular methods has augmented our analytical capabilities through culture-independent techniques to elucidate trends in microbial populations in sewage samples. It has been utilized at its best as a complementary approach during the COVID-19 pandemic [6, 7]. A recent study from Albastaki and colleagues [8] reported positive signals of COVID-19 from commercial flights arriving in Dubai, suggesting the benefits of wastewater monitoring. The progression of the infection can be effectively monitored through the loads of RNA in the wastewater and has proven to be a good indicator for a trend-based action plan. It has also helped to prevent a potential outbreak in a food processing facility during the prevalence of wild and omicron variants in Mexico [9].

In the UAE, a national policy has been set for communicable disease prevention through medical fitness testing for residents, vaccination programs and mandatory regulation for medical professionals to notify suspected infectious disease incidents. Nevertheless, tracking tourist

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influx and migration of expatriates from different geographic locations and transit passengers (accounting for more than 60 percent of air travelers passing through UAE airports) remains a challenge. Wastewater monitoring can provide valuable and non-intrusive insights for transient populations and alert the authorities for preventive or control measures. Implementation of early warning systems to detect disease outbreaks can mitigate morbidity and mortality [10].

Substance misuse is a pressing global health challenge [11], and the UAE has a zero-tolerance policy on illicit drugs. The local data available is scarce, necessitating continuous monitoring for trend analysis. To ensure confidentiality and not reveal information on individuals, wastewater monitoring can provide real-time data for a specific location subjected to predictive analytical tools to estimate the trends within an acceptable degree of uncertainty [12]. Such real-time data generated, when combined with powerful modelling methods, can provide substantial information for decision-making and policy development on the status of drug abuse. Similarly, the development of resistance to antimicrobials has been recognized as a serious threat to public health across the globe, and serious efforts are being taken, starting from surveillance and trend analysis to remedial measures to curb the usage. In the UAE, a surveillance program for antimicrobial resistance (AMR) was established in 2010 and is ongoing in all healthcare facilities [13]. However, the data on AMR status in domestic animals and antibiotic use as a growth promotor are unavailable. Wastewater surveillance can serve as a tool for AMR surveillance in farming systems by monitoring the slaughterhouse effluents. Recently, a longitudinal study was conducted in the UK on community-derived antimicrobials and resistance genes to acquire insights into antimicrobial usage within two communities. The study reported quantifiable antimicrobials in wastewater having higher loads in winter than in summer, which correlates to increased usage in winter due to respiratory infections [14]. The key advantage of wastewater monitoring is that the testing can also be extended to other areas of research where baseline data is lacking. For instance, the discharge of volatile organic compounds (VOCs) from chemical processing industries and microplastic particles in the environment are some of the arenas for data generation and analysis to study the significance and impact of these compounds [15].

Wastewater monitoring has its own challenges. The sewage system infrastructures are complex and diverse, which can influence the data interpretation [16]. In the rural set-up, both public sewer and septic system exists where septic systems are not connected to a public sewer. Hence, the data may not cover the entire community, resulting in undesirable bias on the prevalence. In the case of unitary sewage systems, factors such as stormwater could result in sample dilution and false negative results for analytes of low concentration. The matrix is a rich source of biogenic organic matter, solids and colloids that could interfere with subsequent extraction and recovery of the target molecules.

The decay of biomarkers has been identified as one of the challenging factors associated with wastewater epidemiology. Travel time was observed to have a greater impact on viral loss across sewer sheds, and the degradation effect in large sewer sheds is higher than in small sewer sheds [17]. In the case of antibiotics, antidepressants and drugs like cocaine and heroin decay faster in sewage and sewer, leading to erroneous back-calculation [18]. Also, comprehensive data on the degradation effect of many biomarkers is not available, requiring further studies and validation. In addition, there are no reference methods, especially for large-scale public health interventions. The recent COVID-19 pandemic is a typical example where efforts to quantify viral copy numbers in correlation with the number of infected persons have resulted in varying levels of success [19]. Global consensus on the sampling frequency, representativeness, minimum acceptance criteria guidelines for test methods and data modeling needs to be established. Though wastewater monitoring may not be as precise as individual testing, it can serve as a mass screening procedure in a relatively shorter time at a cheaper cost. In conclusion, wastewater monitoring is a progressing tool for early warning signals and trend analysis of public health significance.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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