JAMA Network Open

Invited Commentary | Public Health

Wastewater and the Elimination of Bias

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Wastewater is a misnomer. While human waste may have little value to most of the population, Zhuang et al[1] have demonstrated that wastewater sampling can be used as a powerful, informative tool to monitor drug use in specific communities.

Wastewater sampling has many characteristics of an ideal drug surveillance system.[2] Because every member of the population contributes to wastewater production, such sampling surveys everyone in a given geographic area rather than just a hopefully representative sample. Adding to this strength, wastewater sampling is also sensitive and anonymous, both of which have important implications for accuracy and protection of individual privacy. Furthermore, it is noteworthy that wastewater sampling does not have the potential biases that may arise due to the differential reporting that occurs in other passive drug surveillance systems, such as cases reported to America's Poison Centers.[3]

Because the Zhuang et al[1] study characterizes misused drugs, protecting individual privacy is paramount when conducting this type of public health research. Given that all individuals in a community, save those that may have their own septic systems, contribute to the collective eliminated biomass, no specific persons or groups can be identified and possibly stigmatized. However, the same is not true of the communities studied. While Zhuang et al[1] take pains to anonymize the specific sampling sites in their study,[1] this application of wastewater drug surveillance does have the potential to stigmatize any identified communities studied.[4] Such stigmatization has implications for factors like real estate prices, the likelihood of community improvement related to the willingness of businesses to establish themselves locally, and community gentrification. The need to be sensitive about this potential concern is amply demonstrated in the current study,[1] where so-called high-risk substances such as cocaine or the fentanyl metabolite norfentanyl were found to be more prevalent in disadvantaged or rural communities.

Importantly, these data reflect the area's contemporaneous population rather than the community's endogenous characteristics. Because the study was done in the tourist-heavy Las Vegas area, the ratio of visitors to community residents was, per the study's own data, approximately 20 to 1.[1] The implications of the study having a predominantly transient population are great. Because the population using high-risk drugs was colocated with disadvantaged areas, one might wrongly conclude that people living in these areas are more prone to illicit drug use. However, a reverse causality explanation is also possible. That is, because of the social and economic burdens facing individuals who use drugs, it is possible that these individuals might tend to migrate to disadvantaged communities. In addition, whether the drug-using population in an area is migratory or part of the base population has major implications for local public health responses and resource allocation for harm reduction interventions and related efforts.

Zhuang et al[1] have also demonstrated the high sensitivity of wastewater drug surveillance, an advantage that occurs largely due to the plentiful nature of their source material. The increased use of the mosquito and tick repellent N,N-diethyl-meta-toluamide in the summer months and the increased detection of acetaminophen in the period from Thanksgiving to after New Years are examples of the sensitivity of wastewater to detect even short-term variations in drug use. This sensitivity of wastewater sampling has important implications for its potential to be a powerful tool for various kinds of surveillance, including for the early detection of novel psychoactive substances (NPS).

The US is currently in the throes of the so-called fourth wave of the epidemic of drug-related deaths, with more than 107 000 fatalities reported in 2023 from nonmedical drug use.[5] This wave is characterized by increasing stimulant use, frequently in conjunction with synthetic opioids such as fentanyl.[6] Both stimulant and opioid NPS, and even new illicit benzodiazepines, are being introduced into the drug supply with some regularity. Currently, the ability to detect these new substances is limited to only a few laboratories, and samples for assay come from limited sources, such as drug seizures or research studies.

As an alternative that would contribute essential data for public health monitoring, wastewater sampling has enormous potential to serve as a substrate for the detection of NPS.[2] However, concomitant sophisticated analytical capabilities greatly exceeding the 39 analytes in the current study[1] would be required in order to successfully implement such a monitoring program. Identifying novel ion patterns by mass spectrometry requires a comprehensive library of known analytes. Performing this step can be technically challenging because of the need to continually update the analytical library with new NPS that have been identified in the illicit drug supply. Although the logistical barriers are substantial, harnessing the combination of wastewater sampling with the necessary analytical capabilities could potentially give rise to the most comprehensive and sensitive detection techniques for NPS that have ever existed. Taking this logical next step would be a valuable contribution to contemporary drug surveillance and public health efforts.

ARTICLE INFORMATION

Published: September 23, 2024. doi:10.1001/jamanetworkopen.2024.32608

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Conflict of Interest Disclosures: None reported.

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