WASTEWATER SCAN
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Using Wastewater Data to Determine Influenza Season Characteristics

Summary of a November 2023 Paper Exploring How to Analyze Wastewater Data to Extract Relevant Public Health Insights on Influenza A

Public health departments usually rely on clinical data for characterizing and responding to seasonal influenza illness. But they now also have access to a complementary tool—wastewater measurements—that have the potential to provide additional, earlier insights about influenza outbreaks in a community. Clinical data sets ensure public health departments can warn the public about rising infections, adequately prepare local health care providers to care for sick patients, and mount vaccination campaigns and take other measures to protect vulnerable populations. However, these data may be nonspecific, delayed, and only cover a small segment of the population. Researchers have been building a scientific foundation to enable public health departments to use wastewater data to produce key insights to complement existing sources of flu outbreak data.

Overview of the Science

Public health departments can use foundational evidence to effectively use wastewater data:

- **Agencies can gain confidence that wastewater data correlate with clinical data.**
- **Wolfe et al. 2022** established that wastewater concentrations of RNA from the influenza A virus (IAV) mirror the clinical occurrence of influenza on two college campuses, thereby establishing a strong correlation between these two often-complementary lines of evidence.
- **Boehm et al. 2023** established that IAV RNA in wastewater from a large treatment plant tracks statewide positivity rates for influenza, further establishing the strong relationship between these two complementary measures.
- **Agencies can decide how to analyze wastewater data to determine timing and intensity of flu season.**
- The paper, **Schoen et al., was released in November 2023** and is the focus of this fact sheet. It builds on these two studies by establishing that wastewater IAV can be used to determine timing and intensity of outbreaks in a way that mirrors clinical metrics. The **timing of onset, peak, and offset** of influenza season roughly correspond to the insights derived from clinical data analyses, and **outbreak intensity** based on occurrence of influenza-related hospitalizations is related to IAV concentrations in wastewater.

Read the full paper:

United States Influenza 2022–2023 Season Characteristics as Inferred from Wastewater Solids, Influenza Hospitalization, and Syndromic Data

Key Takeaways

Wastewater and clinical data are complementary

- Timing and intensity of influenza outbreaks within a state or other region can be determined using data from wastewater in a way that corresponds with characteristics determined from clinical data.
- Wastewater-derived metrics that align with clinical metrics provide an opportunity to use complementary data sources to improve surveillance—whether wastewater measurements provide data on new locations, provide an early warning, or capture a population that is under-served in clinical metrics.

Guidance for how to determine metrics

- Flu season peaks as determined by wastewater data generally precede the peaks determined by hospitalization rates by 2-14 days, demonstrating wastewater's potential to serve as an early warning for identifying peak hospitalization.
- When determining outbreak onset, public health departments have flexibility for how they derive a baseline value depending on what insights they are interested in learning from wastewater data.

In what situations are the wastewater data useful?

- While the referenced paper describes timing and intensity of flu season at the scale of states and large regions, the same type of analysis has the potential to be used at more localized scales, such as a single metro area.
- Wastewater-based measurements are increasingly useful because they are specific to the disease agent—unlike syndromic data, measurements of IAV in wastewater cannot be conflated with COVID-19 cases.
- Wastewater data may be available in locations where ILI and hospitalization data are not.

Determining Outbreak Onset by Choosing Non-flu Season Baseline Values

To determine timing of influenza season, public health departments first determine a non-flu season baseline value (i.e., a baseline value for ILI within a region of interest).

Wastewater analyzes work the same way—except the baseline value is for IAV RNA concentrations instead of ILI. Schoen et al. 2023 demonstrates the use of multiple options for determining IAV RNA baseline value; the choice depends on what insights an agency is interested in learning from wastewater data. Below are two options that the paper concludes could be particularly relevant for public health agencies:

Option 1: Annual Geometric Mean

Traditionally, the CDC derives the ILI baseline value using the annual geometric mean for influenza-like illness within a region. Schoen et al. 2023 demonstrates how to derive a baseline value using the annual geometric mean for IAV RNA in wastewater.

- **What researchers found**: When researchers used a wastewater IAV RNA concentration geometric mean to detect flu season onset, flu season onset roughly corresponded with onset as derived using the ILI baseline value. Offsets between the two, however, were different, with the wastewater analysis resulting in a more conservative estimate of offset.
- **What it means:** This finding can increase public health departments' confidence in using wastewater data to determine onset of flu season, as it roughly corresponds to ILI-derived onset. For determining offset, wastewater data may provide a more conservative estimate than ILI data.

Option 2: Twice the Minimum Detection

The annual geometric mean isn't the only way that public health departments can derive wastewater baseline value. Schoen et al. 2023 demonstrate how to set the baseline value at **twice the minimum concentration** detected in wastewater.

- **What researchers found:** When researchers set the baseline at twice the minimum IAV RNA concentration in wastewater, they found that the wastewater data could detect onset 30 to 75 days earlier than the ILI data.
- **What it means:** This finding demonstrates that if a public health department is interested in detecting onset earlier than is possible with ILI data, there could be unique value in using wastewater data—although there are important qualifiers (outlined in Schoen et al. 2023).

Note: Options 1 and 2 aren't the only two ways to derive an IAV baseline value. Schoen et al. 2023 discusses other options that may be more situationally appropriate.

More Reading

- Wolfe, M.K., D. Duong, K.M. Bakker, M. Ammerman, L. Mortenson, B. Hughes, P. Arts, A.S. Lauring, W.J. Fitzsimmons, E. Bendall, C.E. Hwang, E.T. Martin, B. J. White, A.B. Boehm, and K.R. Wigginton. 2022. Wastewater-Based Detection of Two Influenza Outbreaks. Environmental Science & Technology Letters 2022 9 (8), 687-692. DOI: 10.1021/acs.estlett.2c00350.
- Boehm, A.B., B. Hughes, D. Duong, V. Chan-Herur, A. Buchman, M.K. Wolfe, B.J. White. 2023. Wastewater concentrations of human influenza, metapneumovirus, parainfluenza, respiratory syncytial virus, rhinovirus, and seasonal coronavirus nucleic-acids during the COVID-19 pandemic: a surveillance study. Lancet Microbe 4(5):e340-e348. doi: 10.1016/S2666-5247(22)00386-X.
- Alexandria B. Boehm, Marlene K. Wolfe, Bradley J. White, Bridgette Hughes, Dorothea Duong, and Amanda Bidwell. 2023. More than a Tripledemic: Influenza A Virus, Respiratory Syncytial Virus, SARS-CoV-2, and Human Metapneumovirus in Wastewater during Winter 2022–2023. Environmental Science & Technology Letters 10 (8), 622-627. DOI: 10.1021/acs.estlett.3c00385