



Respiratory virus wastewater surveillance at the sewershed level

Understanding the importance of flu surveillance

Influenza viruses are the causative agents of [influenza](#), an acute, highly contagious respiratory disease. Influenza can manifest with a wide range of clinical severity, from mild symptoms to severe, life-threatening conditions. Monitoring influenza activity is critical due to the virus's potential to cause significant morbidity and mortality, strain health care resources, and undergo [antigenic drift and shift](#) in humans and [animals](#), leading to the emergence of novel strains. Surveillance efforts encompass evaluating subtype predominance, assessing vaccine effectiveness, and informing the annual selection of vaccine strains. Year-to-year variability in influenza severity is influenced by these antigenic changes, impacting both the clinical burden and the efficacy of antiviral treatments. Continuous surveillance and data analysis enable public health authorities to implement targeted interventions, including vaccination campaigns and public health messaging, thereby mitigating the impact of seasonal influenza outbreaks and potential pandemics.

Understanding the importance of RSV surveillance

Respiratory syncytial virus ([RSV](#)) is a leading cause of respiratory illness, particularly among infants and young children, as well as older adults and individuals with weakened immune systems. RSV infections can range from mild cold-like symptoms to severe respiratory distress requiring hospitalization. Despite its significant burden on public health, outpatient clinical settings do not routinely test for RSV, as there is no specific treatment, making it challenging to accurately track its prevalence and activity. However, surveillance of RSV is crucial for informing and assessing the impact of new RSV prevention strategies, such as the development and implementation of vaccines and monoclonal antibodies. Effective RSV surveillance enables public health authorities to evaluate the effectiveness of these interventions, optimize resource allocation, and improve overall public health outcomes.

Building on COVID-19 wastewater surveillance

The [COVID-19](#) pandemic highlighted the role of wastewater surveillance in early detection and monitoring of infectious diseases within communities. Monitoring wastewater for COVID-19 has yielded valuable insights into the viral activity and trends at the sewershed level, providing complementary data to clinical observations and informing public health decisions. This success opened doors for extending wastewater surveillance to other respiratory viruses like flu and RSV.

Flu and RSV wastewater surveillance

Wastewater surveillance can provide early insights into flu and RSV activity in a community. While public health departments traditionally rely on clinical data to monitor seasonal activity, analyzing wastewater samples complements existing surveillance systems. Early detection of viruses in wastewater provides specific and timely data that cover a wider portion of the population compared to existing surveillance systems. Wastewater surveillance represents a proactive method for monitoring community health, allowing public health authorities to implement timely interventions, such as targeted vaccination campaigns and public health messaging. Additionally, by identifying trends in virus presence, wastewater surveillance can inform hospitals, emergency medical services, and emergency planners about potential surges in people seeking health care. This insight enables proactive preparation and resource allocation to manage increased healthcare demand effectively.



People ill with flu typically begin shedding virus in their stool one day post-infection, peaking before symptoms emerge ([Hutchinson, 2018](#)). Research on RSV shedding and how it relates to detecting the virus in wastewater is ongoing.

Flu wastewater surveillance findings

- Analyzing wastewater data complements existing surveillance systems by identifying the onset, peak, and decline of flu season.
- Trends observed in wastewater correlate with clinical data trends; wastewater surveillance data can supplement existing flu surveillance data in regions with little or no clinical testing data to provide comprehensive insights into the timing and severity of flu activity.
- Wastewater surveillance addresses equity concerns for populations not represented in clinical testing data, as it doesn't rely on health care-seeking behavior.
- Conducting genetic sequencing of wastewater samples for flu will aid in identifying high-risk strains circulating in communities.

RSV wastewater surveillance findings

- Public health agencies and wastewater utilities need to collaborate further to conduct additional research and verify the degree of correlation between wastewater data and clinical RSV metrics.
- Some differences between clinical and wastewater trends for RSV stem from variations in the populations being studied. RSV clinical data is limited because outpatient testing is not routinely conducted, while wastewater data may exclude key age groups that have a high RSV infection burden, such as infants who use disposable diapers.
- Wastewater surveillance can provide hospitals and other health care settings with the first indication they should prepare for surges in RSV-infected patients.

Recommendations for action

- When flu or RSV is detected in the wastewater at the community level and there are indications of an increase in these viruses, the local public health agency will determine the appropriate response, which may include:
 - Communicating guidance on preventive measures such as vaccination, hand hygiene, and other non-pharmaceutical interventions.
 - Providing information about when and where to seek medical care if symptoms develop.
 - Proactive deployment of resources such as vaccines, medical supplies, and personnel to areas with elevated viral activity.
- Wastewater surveillance for respiratory viruses can help public health officials identify the beginning of the respiratory virus season to inform increased vaccination efforts for RSV and flu.
- Regional evidence from wastewater surveillance prompts healthcare providers to initiate testing when local infection rates rise, helping them and facilities prepare for potential patient surges.

Limitations

- Limitations in clinical testing for RSV and flu reduce the available data points to validate prevalence estimates based on wastewater surveillance results.
- Wastewater surveillance often excludes the youngest demographic for RSV, as diapered children do not typically contribute to wastewater systems.
- The development of wastewater sequencing techniques for flu and RSV is ongoing, limiting the ability of strain identification in the upcoming viral respiratory season.



- Continuous year-round monitoring is recommended to accurately detect viral activity onset and potential off-season detections. However, this may pose logistical challenges or strain resources due to the need for sustained utility engagement and testing.
- Further challenges include potential sampling biases from sentinel site models. These emphasize the importance of considering demographics, population dynamics, and data from clinical surveillance systems to ensure results from wastewater testing are translated into effective public health interventions.

Conclusion

Integrating wastewater data with clinical metrics yields valuable insights into the dynamics of flu and RSV transmission, facilitating timely public health interventions.

Flu and RSV wastewater surveillance provides a local perspective on data, complementing statewide summary data and avoiding biases that may be introduced by healthcare-seeking behavior. Additionally, wastewater data availability extends to areas where hospitalization rates and other clinical data might not be accessible, filling critical gaps in surveillance and enhancing the capacity of public health officials to respond to local disease trends.

Wastewater surveillance can also be a helpful source of redundancy in infectious disease surveillance systems. It is particularly beneficial for addressing delays in reporting or gaps in access to clinical testing.

Continuing flu and RSV wastewater surveillance year-round facilitates the identification of off-season cases and provides a better grasp of seasonal trends.

Wastewater surveillance serves as a critical tool in protecting public health and mitigating respiratory viruses by alerting health care staff to prepare for potential viral respiratory surges, for appropriate allocation of resources, guiding regionally targeted interventions, and contributing to robust, multimodal surveillance systems.