



Biobot Analytics

eBook

Tackling the ‘Tripledemic’ with Wastewater-based Epidemiology

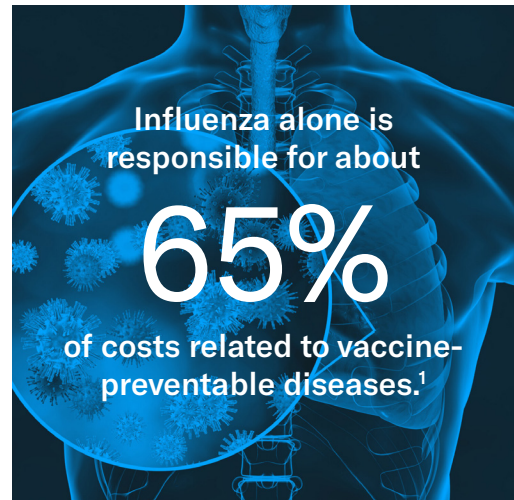
How WBE Can Help Us Stay Ahead of
Respiratory Diseases



Tackling the ‘Tripledemic’ with Wastewater-based Epidemiology

How Wastewater-Based Epidemiology Can Help Us Stay Ahead of Respiratory Diseases

Every year, flu and respiratory syncytial virus (RSV) cost the U.S. billions in direct healthcare costs and lost productivity. Layer COVID-19 on top of that, and the financial impact on the country, as well as local communities, is astronomical. Employees calling out sick as businesses are still having trouble filling positions. Classrooms shutting down due to COVID-19 and RSV exposure, keeping children out of school and parent caregivers at home. Finally, last November, parents staying home due to lack of childcare for reasons related to the three diseases hit an all-time high. And yet, in the U.S., there has never been a national surveillance or early warning system for flu or RSV. Also, the end of the COVID-19 public health emergency in May 2023, combined with a lack of insight on at-home COVID-19 testing, means there is no accurate account of case count in the U.S., either. But there is a solution: wastewater intelligence.



Keeping people informed about infection rates in their communities and enabling the targeting of public health messages directly to specific areas is essential for combating respiratory diseases. Wastewater testing is a powerful tool for achieving these goals. Unlike many virus-testing programs which can be costly and administered patient-by-patient, wastewater testing makes it possible to test a community equitably down to a neighborhood level. This is because everyone who uses a toilet is captured in a non-invasive, anonymous way. With the granular data provided by wastewater testing, local officials can target messaging and resources directly where they need to go, and make public health decisions that are truly informed. Hospitals can better prepare, individuals can take precautions based on their personal risk-levels, and communities can truly understand the circulation of respiratory disease locally.

Wastewater testing is an opportunity to stop the spread of not just one, but three costly—and sometimes deadly—diseases.



¹ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8983919/#:~:text=In%20the%20United%20States%2C%20total,%E2%80%90year%E2%80%90old%20age%20group>

The Flu

Influenza is a viral infection of the respiratory system: throat, nose, and lungs. It comes with symptoms such as fever, cough, stuffy and runny nose, chills and sweats, and fatigue. Although most people recover from flu without complications, children under two, the elderly, the immunocompromised, pregnant people, and those with other factors like asthma or obesity are at high risk for serious illness, including seizures, weakness, and dehydration, which can lead to death.

RSV

Respiratory syncytial virus (RSV) causes infections of the lungs and respiratory tract and poses a particular risk to infants under a year old and the elderly. Severe symptoms of RSV include lethargy, a bluish color to the skin, and difficulty breathing.

What RSV costs the United States

Among adults alone, studies estimate the cost burden of RSV at \$1.3 billion⁴, while hospitalization of infants costs an estimated \$709.6 million per year.⁵ The virus also accounts for 2% of all primary care visits, and 4% of children’s hospital visits.⁶ And while the flu has had vaccines licensed for widespread use since 1945, the Food and Drug Administration recently approved the first RSV vaccines for adults over 65 in May 2023⁷, and a preventative treatment for children—monoclonal antibodies—in July 2023.⁸

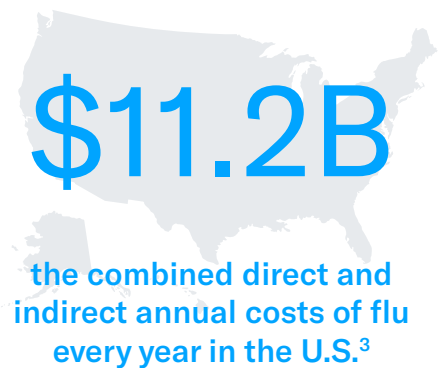


BY THE NUMBERS:

2002-2023 U.S. Flu Season

- Between **27 - 54 million** cases
- **2 - 26 million** flu-related medical visits
- **300,000 - 600,000** hospitalizations
- Between **19,000 and 54,000** deaths**
- Direct medical costs run **\$3.2 billion** annually
- Indirect medical costs are an estimated **\$8 billion**

**The wide range is due to a lack of existing surveillance and testing mechanisms.²



RSV in the U.S.

- **58,000-80,000** hospitalizations per year
- **2.1 million** outpatient visits
- **300-500** deaths in children under 5
- **6,000-10,000** deaths in adults over age 65

² <https://www.cdc.gov/flu/about/burden/preliminary-in-season-estimates.htm>

³ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8983919/>

⁴ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8983919/>

⁵ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC937037/>

⁷ <https://www.cdc.gov/mmwr/volumes/72/wr/mm7229a4.htm>

⁸ <https://www.fda.gov/news-events/press-announcements/fda-approves-new-drug-prevent-rsv-babies-and-toddlers>

COVID-19

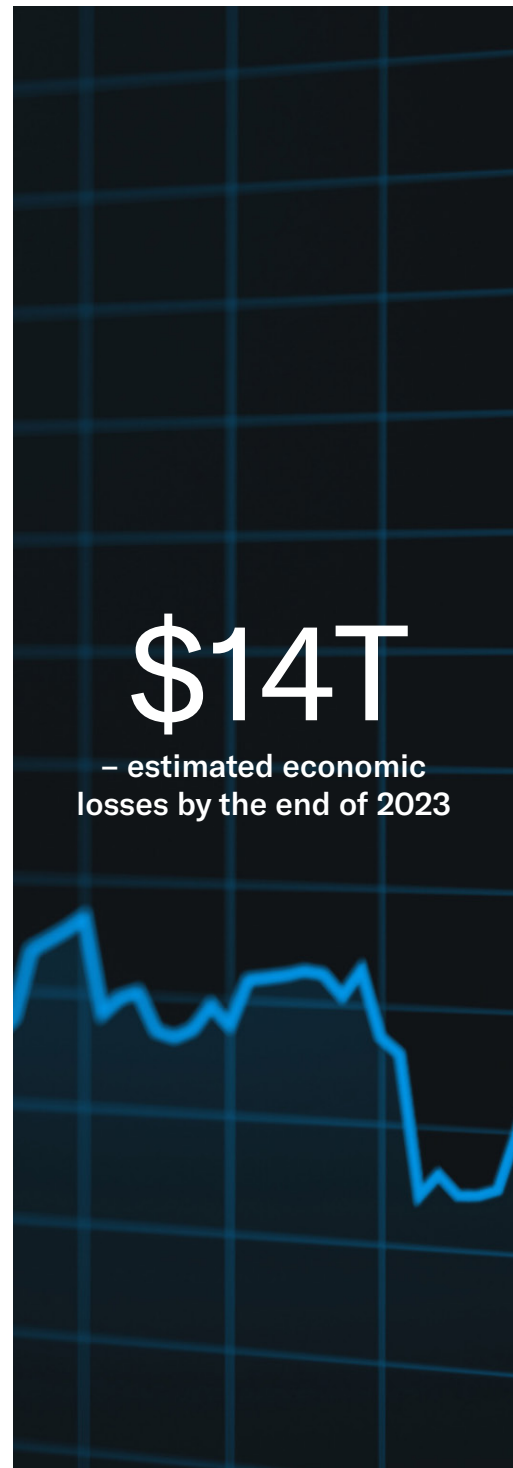
COVID-19 is a contagious respiratory illness caused by the SARS-CoV-2 virus. Most people experience mild to moderate symptoms and recover without requiring special treatment, but some may become seriously ill and require medical attention or even hospitalization. Older people and those with underlying medical conditions like cardiovascular disease, diabetes, chronic respiratory disease, or cancer are more likely to develop serious illness. Anyone can get sick with COVID-19 and become seriously ill or die at any age.⁹

What COVID-19 costs the United States

The costs of COVID-19 have been extraordinary. Since 2020, more than one million Americans have died from the disease, and COVID-19 has caused a devastating financial impact on the global economy. Researchers at the University of Southern California expect total economic losses to hit \$14 trillion by the end of 2023.¹⁰ That figure includes lost from business closures, changes in spending habits, and disruptions to airline travel and social services. Even though lockdowns have been lifted in many parts of the world, the impact of the pandemic on productivity continues, with McKinsey estimating that COVID-19 reduced the available workforce by as much as 2.6 percent in 2022.¹¹

What COVID-19 Taught Us

The COVID-19 pandemic highlighted the challenges of public health and population health. However, wastewater monitoring can provide valuable data to inform community health departments and decision-makers. For example, if RSV is detected in wastewater, parents in a specific school system can be notified, which may influence whether or not they keep their child home from school or how quickly they get care from a doctor. Similarly, if flu rates are high, older and at-risk people in a community can use this information to assess their own risk, and make informed decisions about their behavior.



⁹ https://www.who.int/health-topics/coronavirus#tab=tab_1

¹⁰ <https://healthpolicy.usc.edu/article/COVID-19s-total-cost-to-the-economy-in-us-will-reach-14-trillion-by-end-of-2023-new-research/>

¹¹ <https://www.mckinsey.com/industries/healthcare/our-insights/one-billion-days-lost-how-COVID-19-is-hurting-the-us-workforce>

Diving Into the Data Gap



The emergence of COVID-19 led to the development of rapid at-home testing. This, however, has made it difficult for public health officials to keep accurate case counts. That lack of data also hinders scientists and communities in their efforts to get ahead of the problem and understand the true picture of current risk. Without targeted messages about COVID-19 rates at the community-level, it's hard to get people to pay attention. After all, there's been so much COVID-19 news and risk assessment over the last three years, it can start to feel like white noise.

Meanwhile, though the transmission of COVID-19, influenza, and RSV is very similar, there are no at-home tests for either flu or RSV, and the public is much less informed about preventing the spread of these viruses. Few are aware, for example, that there are asymptomatic cases of both flu and RSV. Even if some patients do get tested for RSV or influenza at the doctor's office, many others will just plod through their illnesses at home. Because of this data gap, we have an incomplete picture of the prevalence of all three diseases.

Serving a Community's Health Needs, Equitably

The pandemic highlighted the fact that health care and health outcomes are not distributed equally across race and ethnicities. Black, Asian, and Hispanic people had higher rates of infection, death, and hospitalization throughout the pandemic.¹² The data is sobering, and points to systemic issues in our communities that we need to solve for. One place to start addressing those issues: creating more data to paint a clearer picture of where problems lie. And wastewater testing offers a great tool. By testing for respiratory diseases in a community down to a neighborhood level, local governments and health departments can track not only where COVID-19 infections are highest, but RSV and influenza, too. This creates a more complete picture of how infections and resources are distributed.

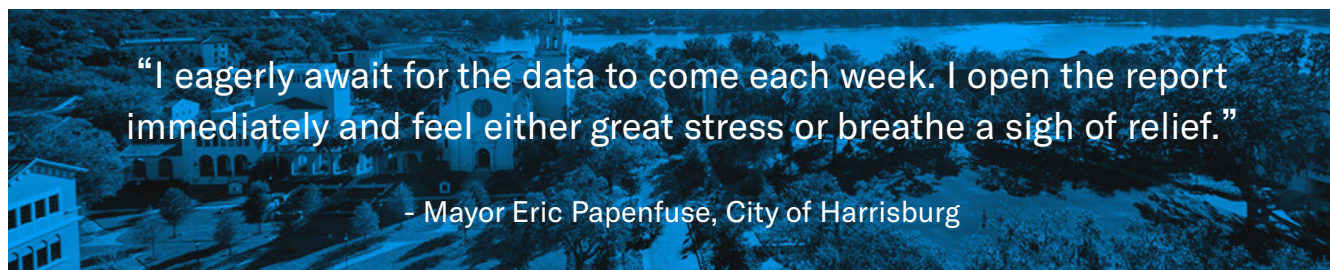
Case Study: Protecting a State Capital, and its Livelihood

Before the COVID-19 pandemic hit, Harrisburg, Pennsylvania swelled with commuters during the day. Once remote work took over, the local economy was devastated. Mayor Eric Papenfuse knew that he had to respond to the dual health and economic crises in a comprehensive and informed way. He partnered with Biobot Analytics to analyze wastewater for indicators of COVID-19 at the city level, generating data that is more specific than the usual public health information, which was only collected at the county level.

With the data in hand, local officials were able to make more informed decisions about community events and distancing guidelines, and Mayor Papenfuse could keep the community updated via a weekly Facebook Live COVID-19 briefing. "Presenting the scientific data has been a tremendous way of helping people understand where we are in terms of the virus in our community," he says. "It allowed us to tell a better-informed narrative in an easy-to-understand format."

The data was particularly helpful in making decisions about student safety. At the start of the pandemic, Harrisburg schools had to go entirely online in a city where internet access is not guaranteed, and where not all students have the tools they need to learn. By monitoring virus concentrations in Biobot data over time, Harrisburg School District leaders could evaluate whether, and when, to return to a hybrid schedule.

In addition to informing city policies, Biobot's data also helped decision makers understand how Harrisburg's COVID-19 data compared to other areas in the region, and at state and national levels. "I would recommend Biobot Analytics for any municipality that has a wastewater system," Mayor Papenfuse says.



¹² <https://www.kff.org/racial-equity-and-health-policy/issue-brief/COVID-19-cases-and-deaths-vaccinations-and-treatments-by-race-ethnicity-as-of-fall-2022/>

Protecting Communities

The past three years have made it clear that we need better mechanisms for testing both emerging and existing infectious respiratory diseases. Our current systems do not give the data we need to understand circulating case counts in our communities and do not show a clear picture of community risk. Wastewater testing is a powerful, cost-effective tool that local governments can use to target their health interventions, mitigate spread, and provide clear information to their communities.

How It Works



Program Design

We assist in developing the right sampling program for your community



Sample

We supply sampling protocols, instructions, and materials for wastewater sample collection and shipping



Lab Analysis

qPCR and ddPCR based analysis of wastewater samples followed by stringent quality control to ensure consistency and accuracy



Data Analysis

Our data science team uses proprietary models to identify noteworthy trends in your results



Data

Expert data interpretation with public health scientists, epidemiologists, and data analysts

Our Story

Biobot is the first company in the world to commercialize data from sewage. Our original mission was to test wastewater for opioids to help governments understand community usage, and better deploy resources for prevention and treatment. But with the rise of COVID-19 in 2020, there was a clear case to expand our work to infectious diseases. Today our wastewater monitoring is used to combat other long-circulating but costly diseases like norovirus, influenza, and RSV.



Discover more about our technology at biobot.io or email us at hello@biobot.io