



Biobot Analytics

eBook

Containing Campus Contagions: The Role of Wastewater-Based Epidemiology in a Potential “Tripledemic”



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How wastewater-based epidemiology can help your campus stay ahead of respiratory diseases

Every year, the 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 to the country, as well as local communities, is astronomical. And yet the U.S. has never instituted a national surveillance or early warning system for flu or RSV. Compounding the problem is the fact that the COVID-19 public health emergency ended in May 2023, and we have an almost total lack of insight on at-home COVID-19 testing. All together, this means there is no true account of case count in the U.S. **But there is a solution: wastewater intelligence.**



College campuses face the added challenge of close-knit communities and tight living quarters that fuel the spread of respiratory infections. The COVID-19 pandemic highlighted the detrimental impact of campus closures and abrupt transitions to online learning on student populations. Students impacted by a college closure are 71% less likely to re-enroll within one month and 50% less likely to earn any credential post-closure compared with those who did not experience a closure.¹ Students also reported adverse mental health effects and “increased academic difficulty compared to before closure. Approximately 30% reported elevated traumatic stress symptoms. Greater traumatic stress was associated with greater difficulty completing assignments, more limited access to the internet and quiet places to study, and greater sibling-care responsibilities.”²

It is critical to keep students, faculty, university administrators, and university student health services informed about on-campus infection rates and target public health messages directly in order to combat respiratory diseases and contain their spread on campus. Wastewater testing is a powerful tool for achieving these goals. Unlike many viral testing programs which can be costly and must be administered patient-by-patient, wastewater testing makes it possible to test a community equitably down to the dormitory level. This is because wastewater data captures everyone who uses a toilet in a non-invasive, anonymous way. With the comprehensive, granular data provided by wastewater testing, university officials can target messaging and resources directly where they need to go and make public health decisions that are truly informed. Campus clinics 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://sheeo.org/wp-content/uploads/2023/04/SHEEO_CollegeClosures_Report2.pdf

² <https://journals.sagepub.com/doi/10.1177/00986283211043924>

³ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8983919/#:~:text=In%20the%20United%20States%2C%20to->

The Flu

Influenza is a viral infection of the respiratory system. 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. On college campuses, the rates of flu infections are believed to reach as high as 73%.⁴

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 at of RSV at \$1.3 billion⁷, while hospitalization of infants costs an estimated \$709.6 million per year.⁸ The virus also accounts for 2% of all primary care visits, and 4% of children’s hospital visits. 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 2023¹⁰, and a preventative treatment for children—monoclonal antibodies—in July 2023.¹¹

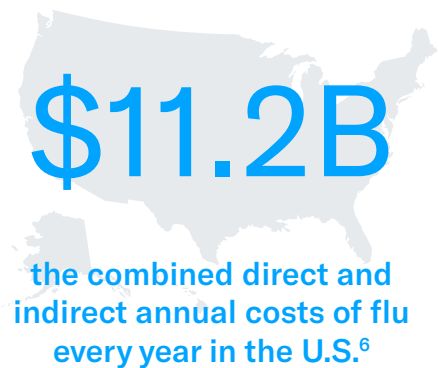


BY THE NUMBERS:

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.⁵



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

⁴ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9375805/>

⁵ <https://www.cdc.gov/flu/about/burden/preliminary-in-season-estimates.htm>

⁶ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8983919/>

⁷ <https://pubmed.ncbi.nlm.nih.gov/37167068/>

⁸ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9377037/>

⁹ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7926081/>

¹⁰ <https://www.cdc.gov/mmwr/volumes/72/wr/mm7229a4.htm>

¹¹ <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.¹²

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 2023.¹³ 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 2022.¹⁴ According to the Chronicle of Higher Education, the first year of the pandemic alone cost colleges and universities \$183 billion.¹⁵

What COVID-19 Taught Us

The COVID-19 pandemic brought the staggering complexities and challenges of public health and population health to the forefront. However, wastewater monitoring can provide valuable data to inform college administrators, decision-makers, and communities. For example, if COVID-19 is detected in dormitory wastewater, students living in that dorm can make informed decisions about socializing and masking, and administrators can implement appropriate testing protocols. Similarly, if flu rates are high, older and at-risk people living and working on campus can use this information to assess their own risk levels, and make informed decisions about their behavior.



\$183B

– estimated cost to colleges and universities in the first year of the COVID-19 pandemic

¹² https://www.who.int/health-topics/coronavirus#tab=tab_1

¹³ <https://healthpolicy.usc.edu/article/COVID-19s-total-cost-to-the-economy-in-us-will-reach-14-trillion-by-end-of-2023-new-research/>

¹⁴ <https://www.mckinsey.com/industries/healthcare/our-insights/one-billion-days-lost-how-COVID-19-is-hurting-the-us-workforce>

¹⁵ <https://www.chronicle.com/article/how-to-fight-covids-financial-crush>

Diving Into the Data Gap



The emergence of COVID-19 led to the proliferation of rapid at-home testing. This development, while helpful for disease management, has made it difficult for public health officials to keep accurate case counts. This lack of data also hinders both scientists and communities in their efforts to understand the true picture of current risk and get ahead of the problem. It's challenging to capture people's attention without targeted, community-specific messages about COVID-19 rates. After all the news and risk assessments we've heard over the past three years, these messages can start to feel like white noise.

Meanwhile, though the modes of transmission for COVID-19, influenza, and RSV are very similar, there are no at-home tests for flu or RSV, and the public is much less informed about preventing the spread of these viruses. Few are aware, for example, that both flu and RSV infections can be asymptomatic. While some patients will get tested for RSV or influenza at the doctor's office, many more will simply plod through their illnesses at home without being diagnosed – or counted. Because of these major gaps in data, we have an incomplete picture of the transmission of all three diseases.

Serving a University’s Health Needs, Equitably

The pandemic highlighted the fact that health care and health outcomes are not distributed equally across race and ethnicities. Throughout the course of the pandemic, Black, Asian, and Hispanic people experienced higher rates of infection, hospitalization, and death.¹⁶ The data is sobering, and points to systemic issues in our communities that we need to solve for. One place to start: accessing and using more data to paint a clearer picture of where problems lie. Wastewater monitoring offers a great tool. By testing for respiratory diseases in a community or campus down to the building level, campus administrators and leaders can pinpoint the locations with highest infection levels. This data can help to inform more targeted and equitable distribution of time and resources.

Case Study: Shutting Down a Respiratory Virus on Campus

Rollins College, a private liberal arts college in Winter Park, Florida, was looking ahead to the Fall 2020 semester. Administrators wanted to preserve as much of the college experience as they could, as safely as possible, despite the threat of COVID-19.

Implementing a campus-wide testing program wasn’t an option for the small school. “A robust clinical testing program using nasal swabs for everyone on campus would cost \$10 million a semester,” says Susan Rundell Singer, the college’s Provost and Vice President for Academic Affairs. “We don’t have that revenue flow at our modest institution.”

Rollins College partnered with Biobot in September of 2021 to provide residence-hall level wastewater tests and analysis. The increased granularity of the Biobot data enabled administrators to see whether COVID-19 was present in specific residence halls and if any buildings could be facing a potential spike in infections. When the wastewater showed markers of increased infections, the school was able to direct pop-up clinical testing to those locations, allowing them to quickly identify and isolate infected individuals. This reduced the scale of the spread by disrupting the chains of transmission.

When it was time to bring students back to campus at full occupancy, the team at Rollins felt confident in their plans. “Biobot is our CIA, our FBI, our secret service for the microbes, in the background helping us all stay safe,” Susan Singer says.



¹⁶ <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 Your Campus

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 provide the data we need to understand case counts, disease spread, and risk on our campuses and surrounding communities. Wastewater testing is a powerful, cost-effective tool that universities can use to target their health interventions, mitigate spread, and provide clear information to students, faculty, staff, and stakeholders.

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.



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