

Wastewater-Based Surveillance of Antibiotics: A Citizen Science Approach

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Abstract

This project proposes a citizen science approach to monitor antibiotic concentrations in wastewater across the U.S. Community volunteers will collect samples and measure antibiotic concentrations using a low-cost testing kit, with data aggregated into a dashboard to visualize geographic and temporal trends. The project aims to provide valuable information for addressing antimicrobial resistance and engage communities in public health efforts.

By 2050, antimicrobial resistance is projected to cause **10 million deaths annually**.¹

Multiple studies have linked **antibiotic concentrations** in wastewater effluent to **growing antimicrobial resistance**.³

Public health organizations like the **CDC** heavily **advocate for** and **invest in** efforts to track antibiotic use and antimicrobial resistance.

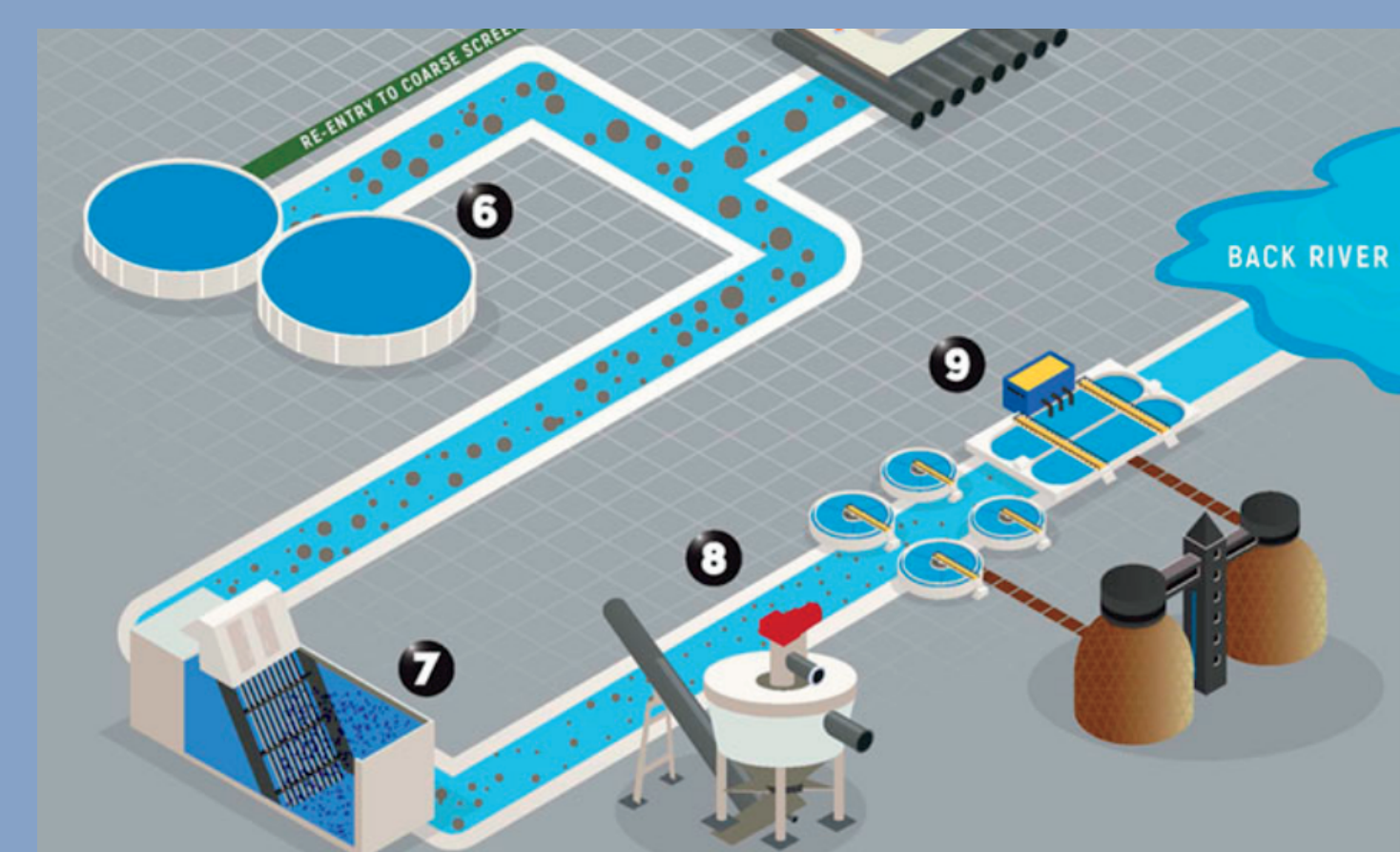
Despite this, **no widespread effort** exists to **regulate** or **monitor** antibiotic concentrations in **wastewater treatment plants (WWTPs)**.

The U.S. needs a method to **geographically track** antibiotics and antibiotic resistance.

Wastewater-based surveillance is a promising approach, and has found recent success in tracking SARS-CoV-2 levels across the U.S.⁴

Proposed Solution: The Antibiotic Dashboard

Wastewater



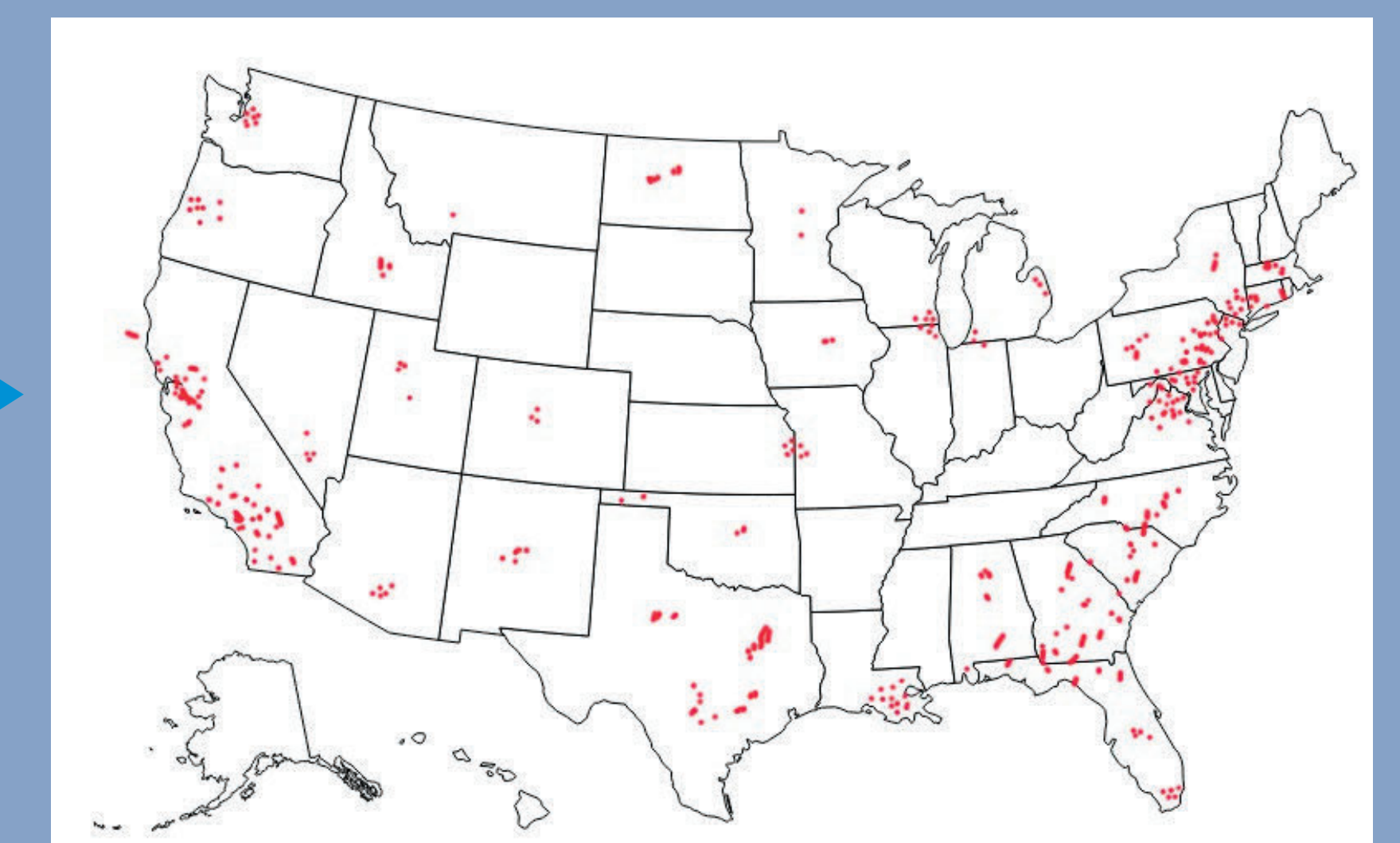
- Antibiotics are poorly metabolized by the human body, so high concentrations are **excreted through urine**.
- Monitoring these concentrations in **wastewater effluent** can serve to track both **antibiotic use** and **potential antimicrobial resistance** in a community.
- Low-cost methods like **colorimetric assays** can detect antibiotics in waters **downstream** of WWTPs.

Citizen Science



- Using the power of **citizen science**, test kits distributed to **students, schools, and clubs** would allow for testing from a **wide range of locations**.
- Test kits would be sent to citizen scientists to **collect and analyze samples from waterways downstream of WWTPs** which would be uploaded online to be added to the **antibiotic tracking dashboard**.
- **Engaging the community in public health efforts** is another major benefit.

Dashboard



- Inspired by the Johns Hopkins **COVID-19 Dashboard**, we seek to aggregate and visualize the data as a **heatmap of antibiotics** in the U.S.
- Aimed at **public health professionals, policymakers, and the general public**.
- Understanding the **geographic distribution** and **temporal evolution** of antibiotic concentrations helps **develop and evaluate strategies** to combat antibiotic resistance.

Current Progress and Future Work

- A number of **potential technological methods** for the **measurement of antibiotics** in water samples have been identified, such as colorimetry, aptasensors, or liquid chromatography.
- Future work involves selecting one method and developing a **prototype test kit**, and validating the results against standard laboratory methods like liquid chromatography-mass spectrometry.
- Future work also includes **recruiting citizen science volunteers** and developing the **dashboard**.

Acknowledgments

This project was made possible by the mentoring of **Professor Lawrence Aronhime** and **Sascha Cocron** as part of the Clark Scholar Engineering Design curriculum, supported by the **A. James Clark Scholars Program**.



1. <https://www.unep.org/explore-topics/chemicals-waste/what-we-do/emerging-issues/antimicrobial-resistance-global-threat>

2. <https://www.cdc.gov/drugresistance/index.html>

3. <https://doi.org/10.3389/fmicb.2022.977106>

4. <https://doi.org/10.1016/j.watres.2022.118535>

5. Image from <https://publicworks.baltimorecity.gov/sewer-consent-decree/headworks-project>

6. Image from <https://spacecoastdaily.com/2022/09/eastern-florida-state-college-launches-two-new-bachelors-degrees-to-tackle-bps-teacher-shortage/>