Executive Summary

THE Water Research FOUNDATION

Developing a framework for antibiotic resistance in water

Occurrence, Proliferation, and Persistence of Antibiotics and Antibiotic Resistance during Wastewater Treatment (WERF1C15/4887)

The Central Issue

Antibiotic resistance (AR) is a critical human health challenge that requires a global strategy to mitigate its potential impacts. The continued spread of AR is expected to lead to high human morbidity and mortality rates, increase health care costs, make controlling infectious disease difficult, and potentially damage economies. Developing an approach to AR in the water and wastewater communities requires a comprehensive research approach to increase awareness of pharmaceuticals in water.

Context and Background

Wastewater effluent has been identified as a primary contributor of AR in the environment, as it contains antibiotic resistant bacteria and antibiotic resistant genes. The antibiotics used in the study included ampicillin (AMP), sulfamethoxazole (SMX), tetracycline (TC), trimethoprim (TMP), and vancomycin (VA).

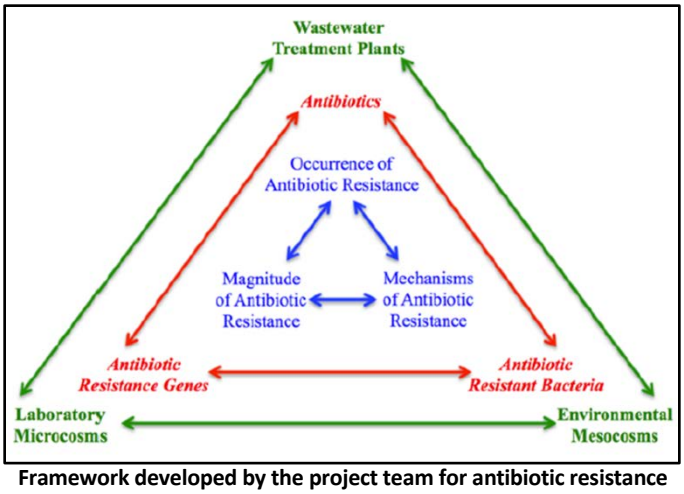
The report addresses several variables that affect the occurrence and proliferation of antibiotics and AR in water:

- Unit operations within a wastewater treatment train.
- Operational conditions, specifically solids retention time (SRT), in activated sludge systems.
- Influent wastewater quality, specifically influent antibiotic concentrations.

Findings and Conclusions

This study supported previous research highlighting the positive correlation between SRT and water quality, specifically relating to reductions in bulk organic matter, nitrogen, and some trace organics.

One operational change that can be implemented to improve the quality of wastewater effluent is increasing the SRT of activated sludge systems. Chlorination was the most effective disinfection strategy for attenuation of antibiotic resistant bacteria, while UV and ozone processes failed to achieve consistent reductions in antibiotic resistant bacteria.



Framework developed by the project team for antibiotic resistance research.

Management and Policy Implications

The research improves the industry's understanding of how unit processes and operational conditions within wastewater treatment plants impact AR. It is the first step in establishing frameworks for quantifying public and environmental health risks related to AR. It equips stakeholders with tools to address public and environmental health concerns. In particular, wastewater agencies can use this information to predict how their biological treatment systems will affect concentrations of trace organic compounds, including antibiotics, in wastewater and the level of AR within the microbial community.

- Public agencies will better understand the state of the science of antibiotic resistance and antibiotics in wastewater, and help explain how their treatment facilities might be mitigating the potential impacts of AR.
- Managers and operators of wastewater treatment facilities will benefit through a better understanding of how biological treatment systems can be modified to improve trace organic compound attenuation.

• Private industries can develop a better understanding of how specific treatment technologies can be used to address AR in wastewater and recycled water.

• Manufacturers will gain a better understanding of how the compounds they produce may impact the prevalence of antibiotic resistance in wastewater matrices.

As next steps, WRF will examine approaches and quantify the public and environmental risks related to antibiotic resistance in reuse and wastewater applications in 2018.

Related WRF Research

Project Title	Research Focus
Protecting Wastewater Treatment Plant Operators from Emerging Pathogens (WERF3C15)	Reviews existing protocols for managing liquid waste from Ebola patients prior to flushing into the sanitary sewer system. Develops a census protocol for handling liquid wastes from hospital patients infected with emerging pathogens, as well as a decision support tool to assist wastewater utilities, health officials, and hospitals to minimize risks.
Risks of Ebola Discharge from Hospitals to Sewer Workers (WERF4C15)	Investigates concerns within the wastewater treatment community regarding the risk of Ebola virus transmission to sewer workers while performing standard occupational activities downstream from a hospital that is treating Ebola patients where no pretreatment is performed prior to discharge. Examines the effectiveness of various disinfectants.
The Survival of Ebola in Sewage and during Wastewater Treatment: Evaluation Using a Viral Surrogate (WERF5C15)	Evaluates the survivability of surrogate viruses in wastewater with and without pretreatment by evaluating the effect of disinfectants on Ebola virus-containing waste and characterizing the survival of Ebola virus surrogates during anaerobic digestion.

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