Characterizing the Fate of Antibiotic Resistant *E.coli* in Oregon Wastewater Treatment Plants

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BACKGROUND

- Antibiotics and their metabolites are discharged to the Wastewater Treatment Plants (WWTPs) from hospitals, residences, and agricultural runoff.[1]
- Antibiotic-resistant genes are present in some bacteria, and under the right conditions can be transferred between species.[2]
- The prevalence of Extended-Spectrum Beta-lactamase (ESBL) producing bacteria has increased over the last two decades; these bacteria are resistant to most beta-lactam antibiotics. [3]
- Multi-drug-resistant (MDR) bacteria are resistant to 2 or more antibiotics, and pose a serious risk to public health. [4]
- WWTPs are thought to be hotspots for the generation and dissemination of antibiotic-resistant bacteria and genes. [5]

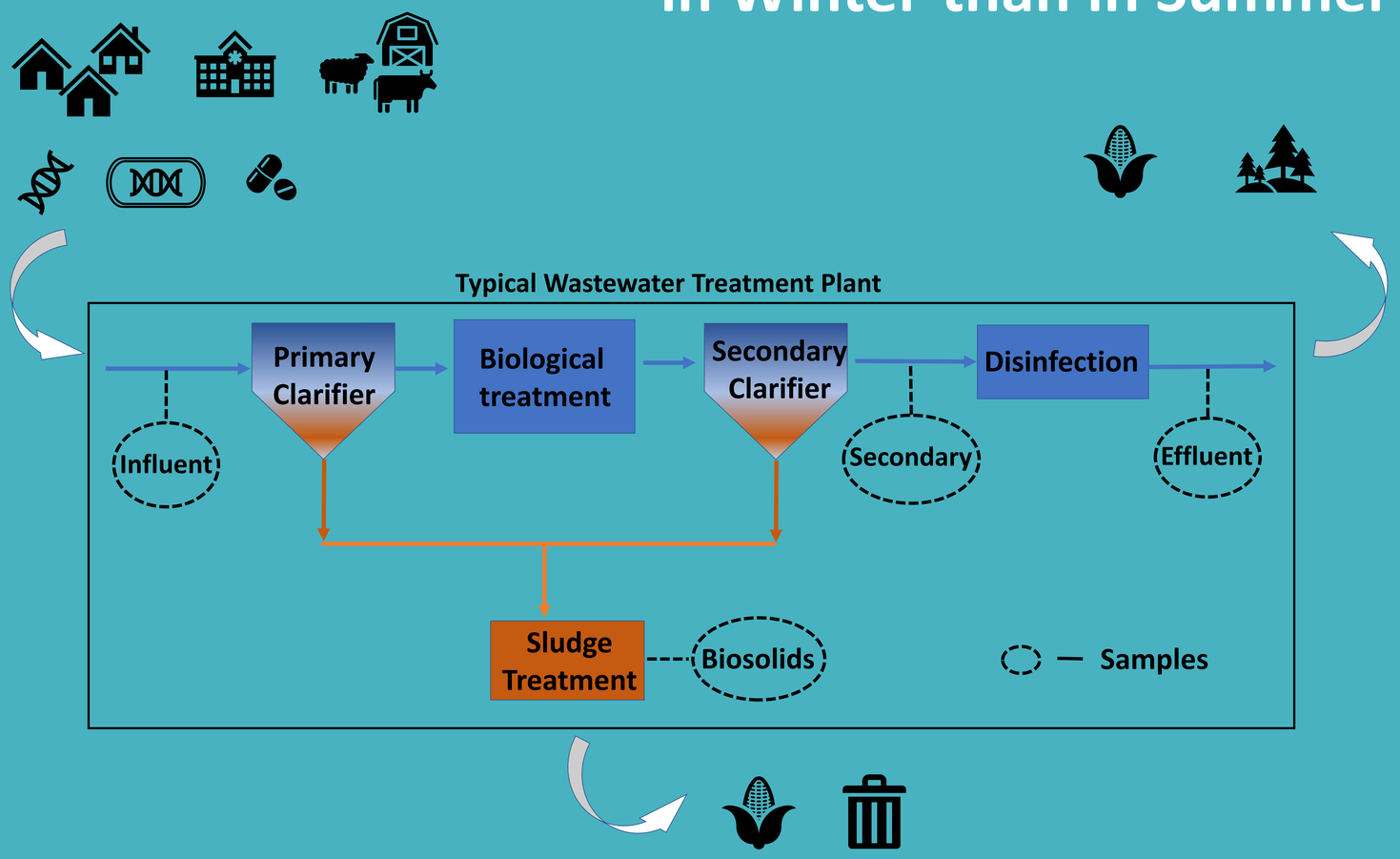
RESEARCH OBJECTIVES

- Evaluate 17 WWTPs across Oregon for antibiotic-resistant Bacteria and genes
- Determine geographical and seasonal impact on antibiotic-resistant *E. coli* prevalence in WWTPs
- Characterize the fate of antibiotic-resistant *E.coli* in WWTPs
- Identify the proportion of *E.coli* isolates that produce ESBL

FUTURE WORK

- Collect samples during Summer 2020
- Determine the effect of physical and chemical properties on the prevalence of resistant and MDR *E.coli*
- Identify genes that encode ESBL production in ESBL producing *E.coli*
- Determine the concentration of common antibiotics in wastewater and biosolid samples
- Quantify antibiotic resistance gene counts in wastewater and biosolid samples

Higher Prevalence of Antibiotic-Resistant *E. coli* in Winter than in Summer



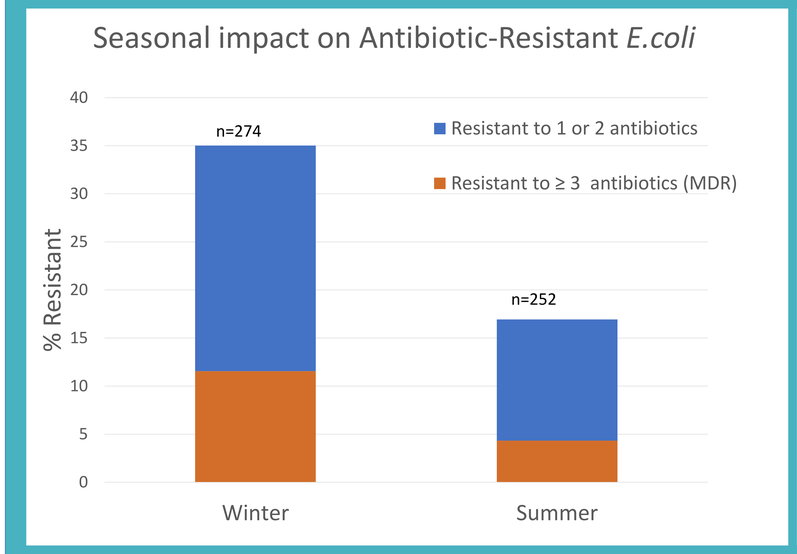


Fig1. Seasonal impact on the prevalence of *E. coli* isolates resistant to 1 or 2, and 3 or more (MDR: multi-drug resistant) classes of antibiotics (n=530)

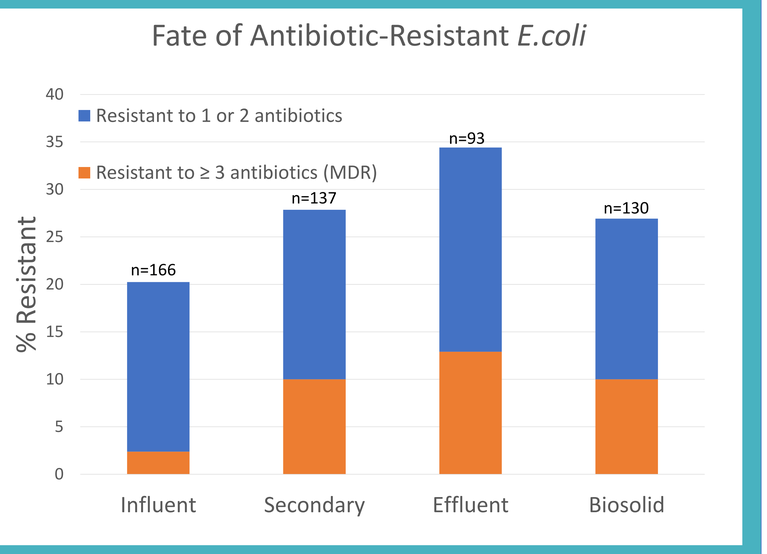


Figure 2. Percentage of *E. coli* isolates resistant to 1 or 2, and 3 or more (MDR: multi-drug resistant) classes of antibiotics in different locations of wastewater treatment facilities across Oregon

METHODS

- Wastewater influent, secondary, and effluent and biosolid samples were collected from 17 Oregon WWTPs between winter 2019 and winter 2020
- Presumptive *E.coli* were isolated from wastewater and biosolid samples
- The **Standard CLSIM100 Disk Diffusion** method was used to evaluate isolates for
  - **Antibiotic susceptibility**
  - **ESBL production**
- Statistical analysis were performed using R (version 3.6.1)

PRELIMINARY RESULTS

- Significantly higher prevalence of antibiotic resistant isolates were found in winter.
- There was no significant difference between resistances in different geographies.
- There was no significant difference between proportion of MDR isolates in winter and summer.
- There was increased MDR in biosolids indicating that the fate of MDR is in biosolids.
- 12 isolates from all locations were identified as being ESBL producers.
- Most prevalent resistance is ampicillin, the oldest and most common class of antibiotics.

Table 1-Percentage of *E. coli* (*n* = 530) resistant to six classes of antibiotics

Antibiotic	% Resistant
Ampicillin	20.7
Tetracycline	13.6
Streptomycin	9.0
Sulfamethoxazole-Trimethoprim	8.5
Ciprofloxacin	2.6
Imipenem	0

REFERENCES

1. Eggen et al., Environ Sci. 2014.
2. Fernando et al., Trends Microbiol. 2000.
3. Blaak et al., Vet. 2014.
4. Loddenkemper et al., EUR Respir J. 2002.
5. Karkman et al., Trends Microbiol. 2018.

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