Occurrence and Fate of Antibiotic Resistant *E.coli* in Oregon Wastewater Treatment Plants

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BACKGROUND

- Due to substantial production and use of antibiotics, antibiotic-resistant bacteria emergence is a worldwide crisis.[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]
- Infection with Multi-drug-resistant (MDR) bacteria decrease therapeutic options. [4]
- Wastewater treatment plants (WWTPs) serve as a reservoir that promotes antibiotic resistance and the release of antibiotic-resistant bacteria into the environment. [5]

RESEARCH OBJECTIVES

- Evaluate 17 WWTPs across Oregon for antibiotic-resistant *E. coli*
- 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

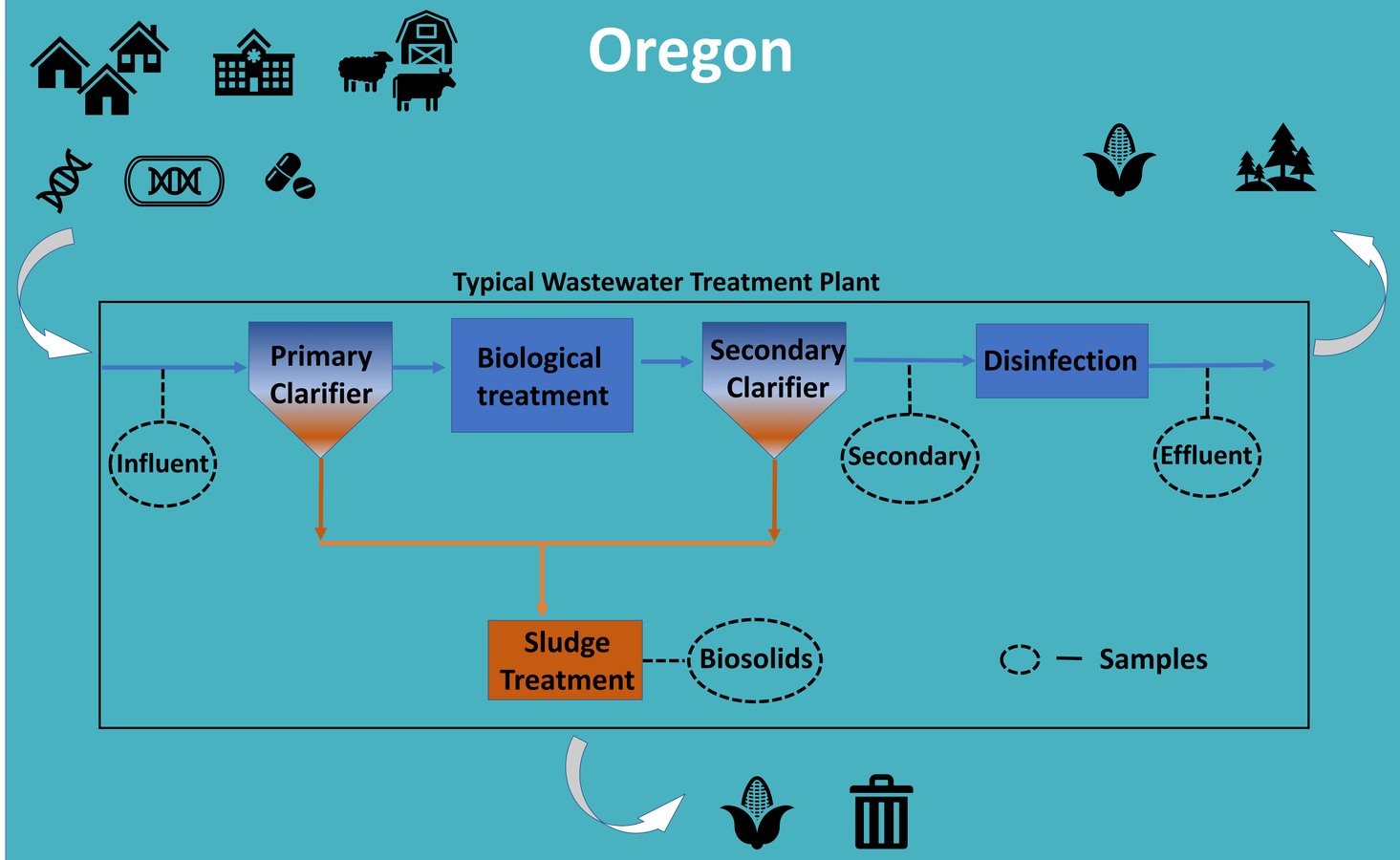
FUTURE WORK

- 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*

Table 1-Percentage of *E. coli* (*n* = 831) resistant to six classes of antibiotics

Antibiotic	% Resistant
Ampicillin	18.1
Tetracycline	13.2
Streptomycin	7.5
Sulfamethoxazole-Trimethoprim	6.4
Ciprofloxacin	2.3
Imipenem	0

Higher Prevalence of Antibiotic-Resistant *E. coli* in the COLDER seasons and in the WESTERN Oregon



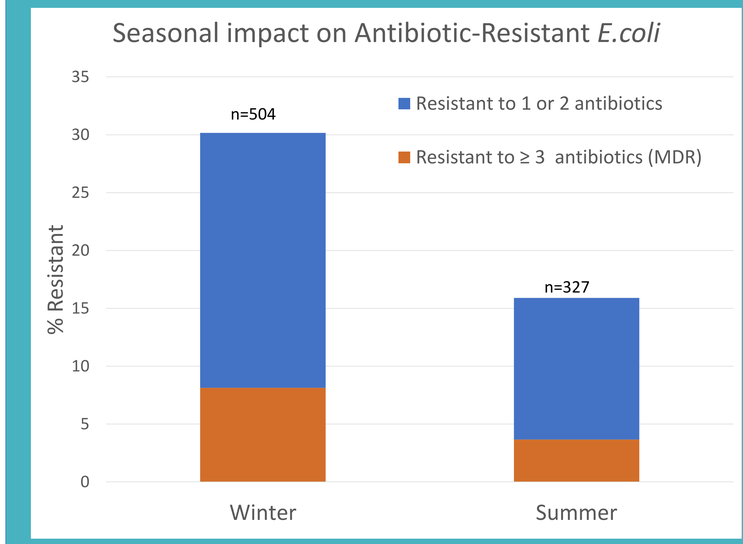


Figure 1. Seasonal impact on the prevalence of *E. coli* isolates resistant to 1 or 2, and 3 or more (MDR: multi-drug resistant) classes of antibiotics (n=831)

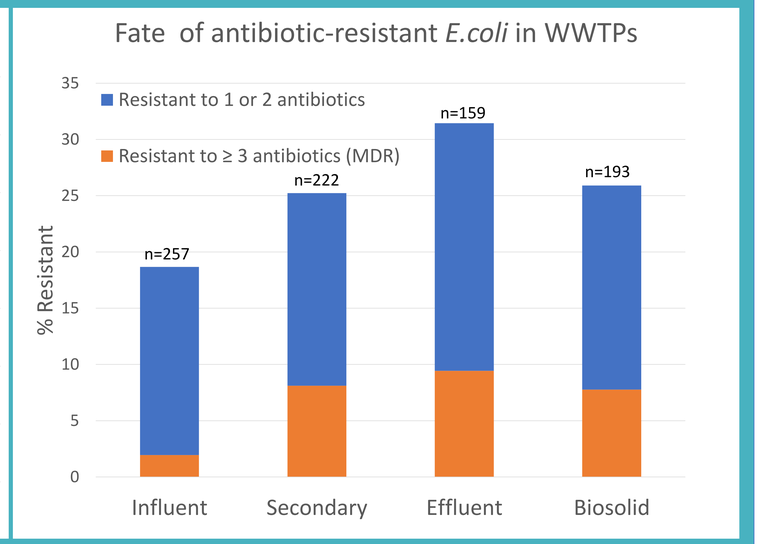


Figure 2. Percentage of *E. coli* isolates resistant to 1 or 2, and 3 or more (MDR: multi-drug resistant) classes of antibiotics in different locations of wastewater treatment facilities across Oregon

METHODS

- Wastewater influent, secondary, and effluent and biosolid were collected from 17 Oregon WWTPs between winter 2019 and summer 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

PRELIMINARY RESULTS

- Significantly higher prevalence of antibiotic resistant *E.coli* and MDR were found in winter.
- Significantly higher prevalence of antibiotic resistant *E.coli* were found in Western Oregon; results demonstrates the importance of population size (urban vs. rural communities)
- 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.
- No significant difference in disinfection efficiency between UV light and chlorination.

Geographical Impact on Antibiotic-Resistant *E.coli*

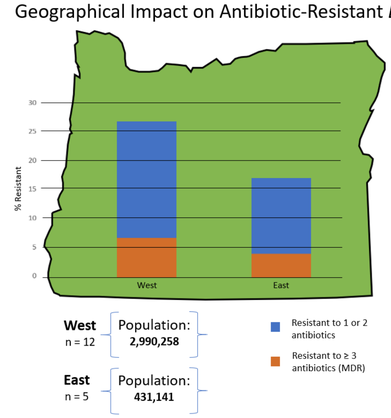


Figure 3. Percentage of antibiotic-resistant *E.coli* in western and eastern regions of Oregon, along with the overall population size of each region.

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ACKNOWLEDGEMENTS

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