

# **Detection of antibiotic resistance genes in water systems from a First Nation community in Manitoba**

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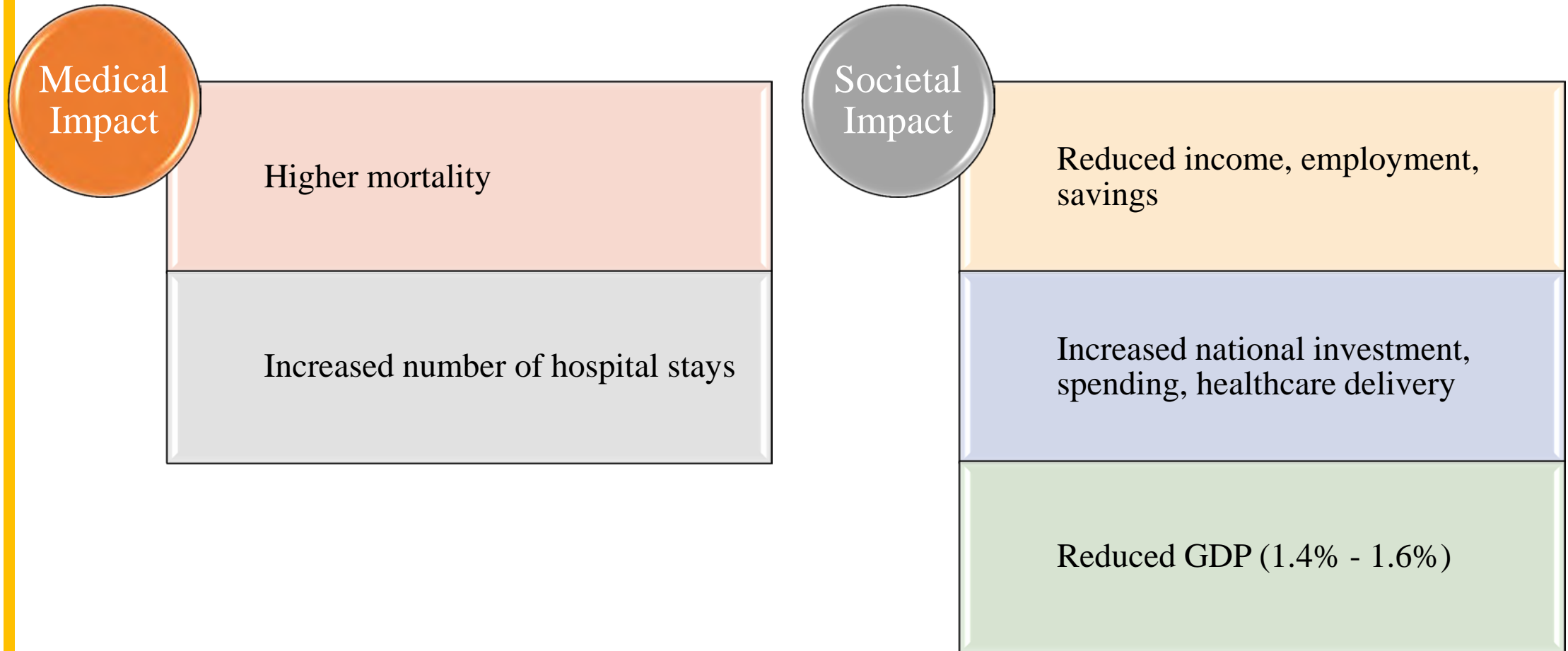


# Contributions

- Dinesh Fernando
- Hein Min Tun
- Jenna Poole
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- Ruidong Mi
- Ehsan Khafipour
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# Antibiotic Resistance and its Impact



# Antibiotic Resistance and its Impact

## European Union *population 500m*

25,000 deaths per year

2.5m extra hospital days

Overall societal costs  
(€ 900 million, hosp. days)  
Approx. €1.5 billion per year



Source: ECDC 2007

## United States *population 300m*

>23,000 deaths

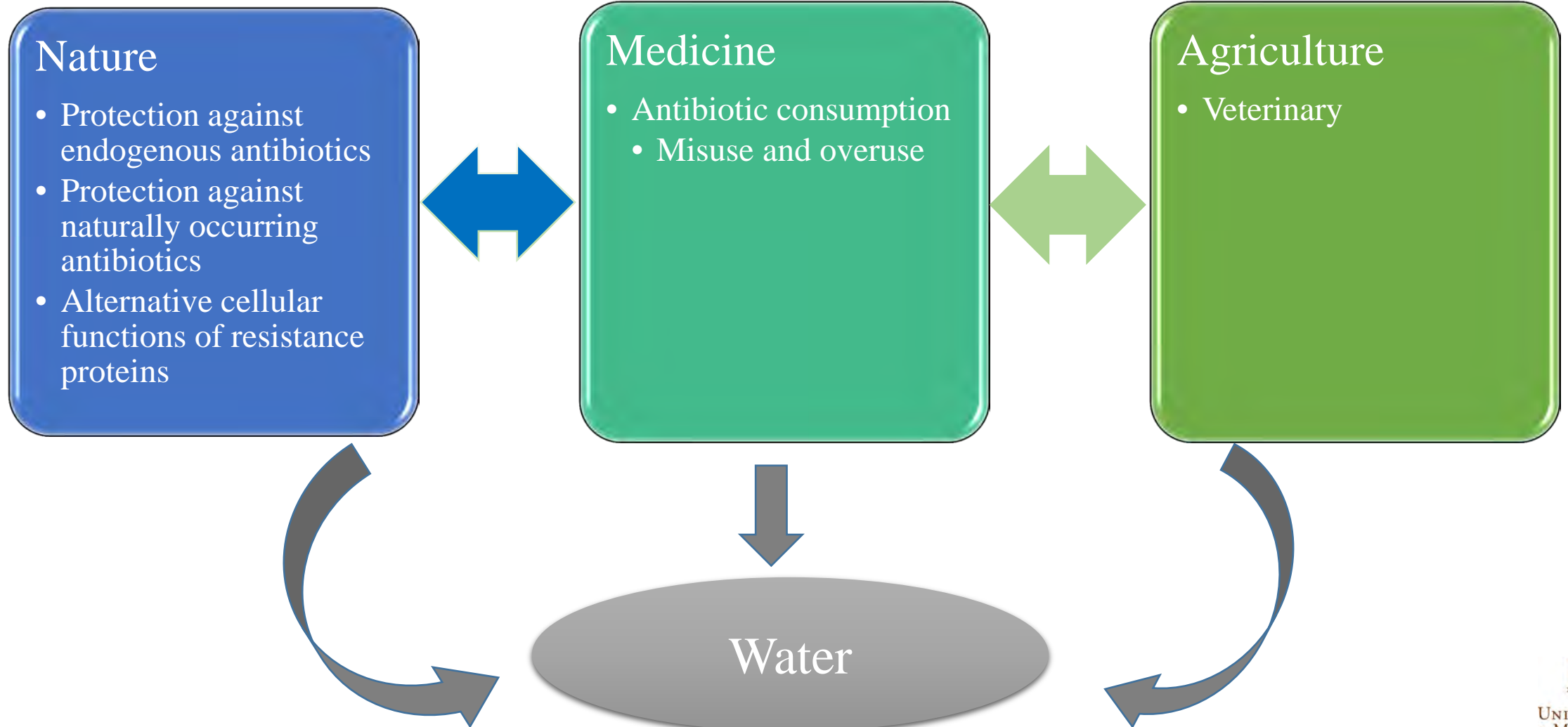
>2.0m illnesses

Overall societal costs  
Up to \$20 billion direct  
Up to \$35 billion indirect



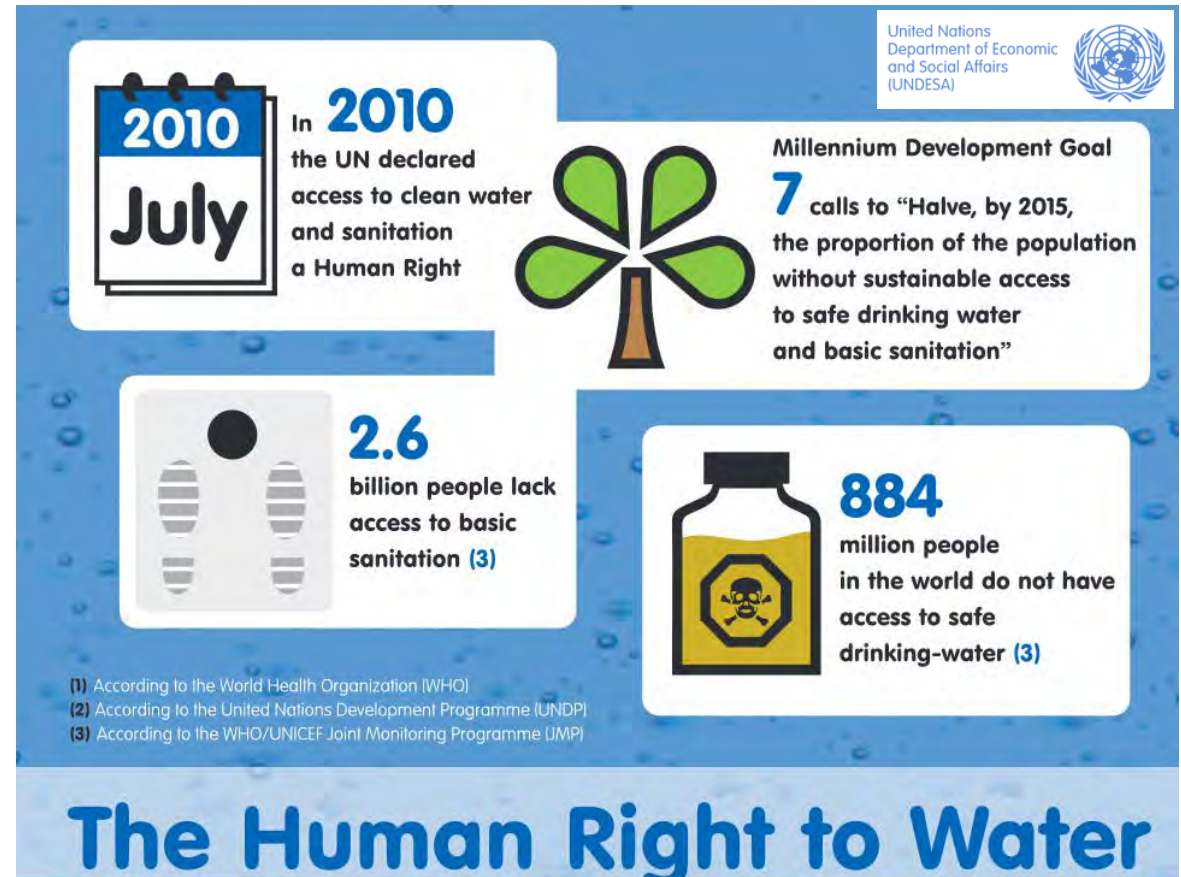
Source: US CDC 2013

# Reservoirs of Antibiotic Resistance



# Human Right to Water

- United Nations Resolution 64/292 (2010)
  - “clean drinking water and sanitation are essential to the realisation of all human rights”
    - Focus on developing countries



# Drinking water in Canada

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GO!

## DRINKING WATER




Photo: Flickr/fox\_kiyo

### The purest water in the world?

In a tiny village near Toronto, the water contains less lead than the cleanest ice layers in the Arctic

By [Fraser Los](#)

If you look closely at the countryside surrounding Elmvale, Ont., a tiny village about 90 minutes north of Toronto, you'll see the natural and ever-gushing wells of the aptly named Springwater township. The locals have always known that their water is clean, but they're only beginning to understand just how clean.

William Shotyk, a Toronto-born environmental geochemist who is a professor at the Institute of Earth Sciences at Germany's Heidelberg University, has been testing this water for over 20 years. In his new *Climate Change: The Science of the Future*, he writes:

## CBCnews | Health

Coca-Cola and PepsiCo, two of the biggest manufacturers of bottled water, have come under fire in recent years for not revealing that popular brands like Dasani and Aquafina are essentially treated tap water.



# Water in First Nation Communities

- >50% of First Nation members live on reserves
- Currently 20% of the First Nation communities under drinking water advisories
- \$4.7 billion required over the next 10 years to ensure safe drinking water for all First Nation communities





# Objective

- To determine the presence of antibiotic resistance genes in the drinking water distribution system of a Manitoba First Nation community



# Sampling Site

- Fly-in community
  - About 600 km from Winnipeg
  - Population, 4074
    - <19 years, 52%



# Water Supply

- Water treatment plant
  - Not all households have running water
- Tankers used to deliver water



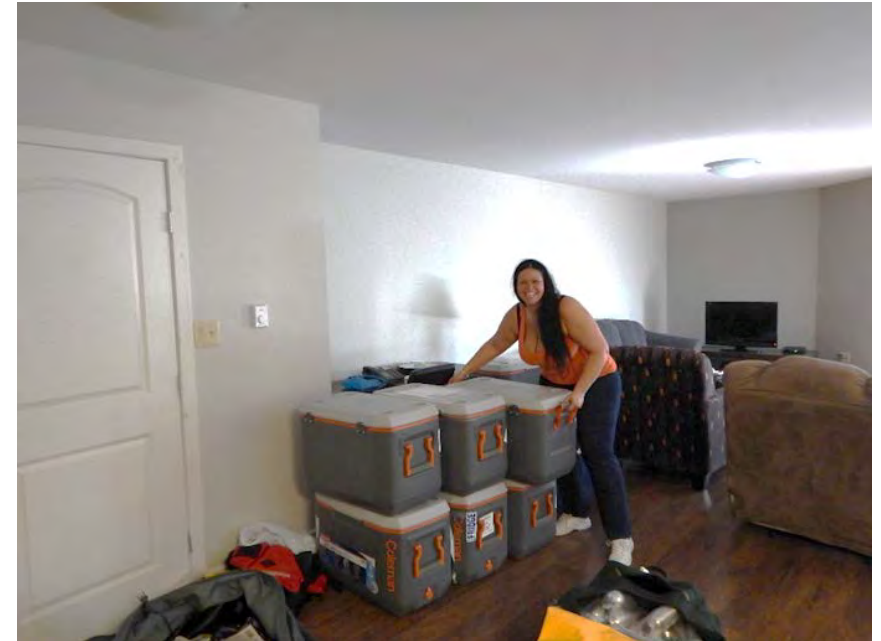
# Water Supply

- Tankers used to deliver water
  - Water stored in a variety of containers

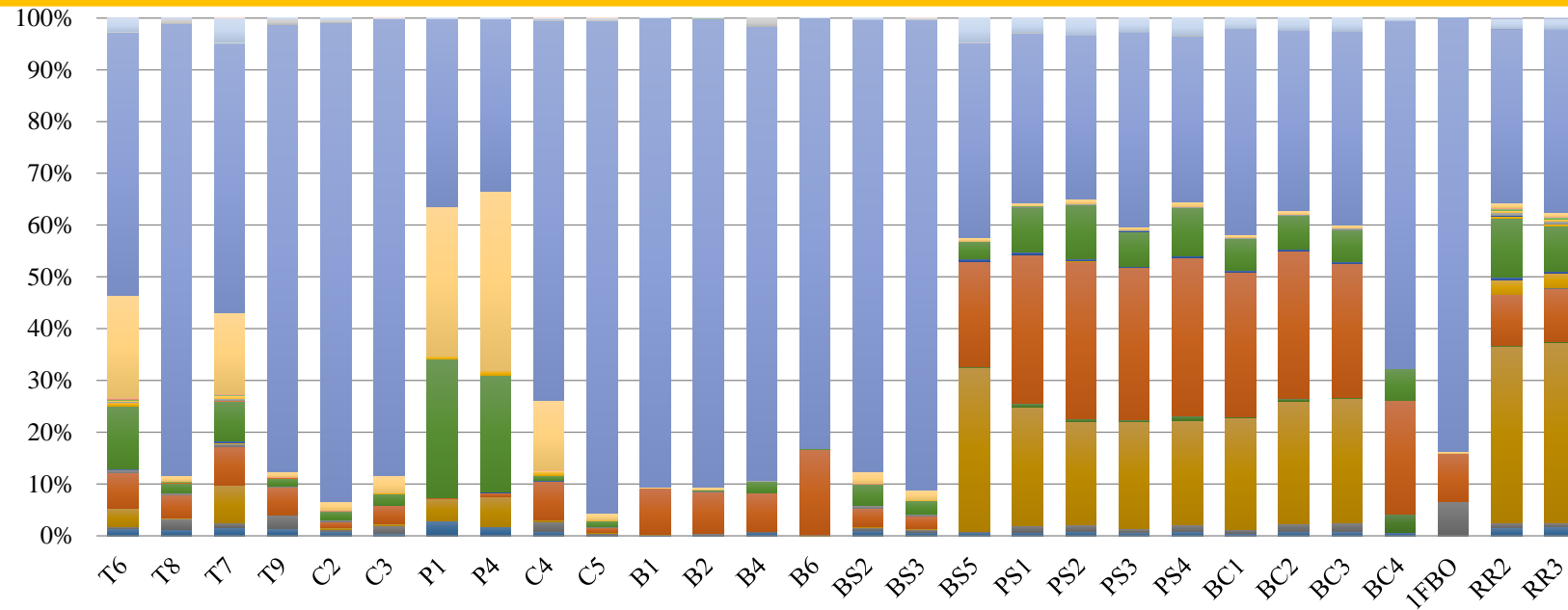


# Sampling

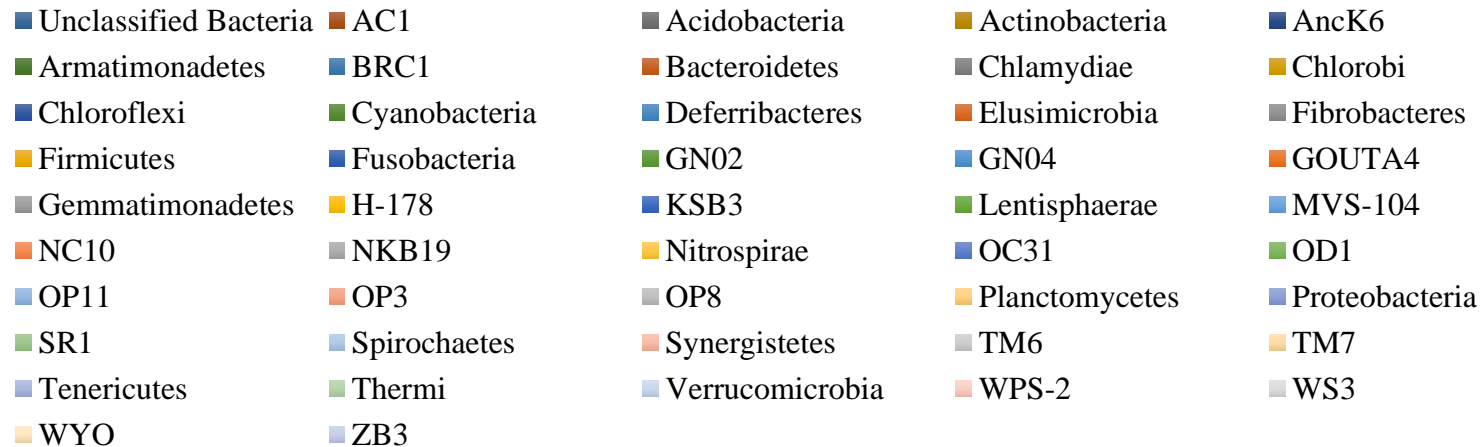
- Taps
- Cisterns
- Water treatment plant
  - Pre- and post-treatment
- Buckets
- Community fountains
- Lake



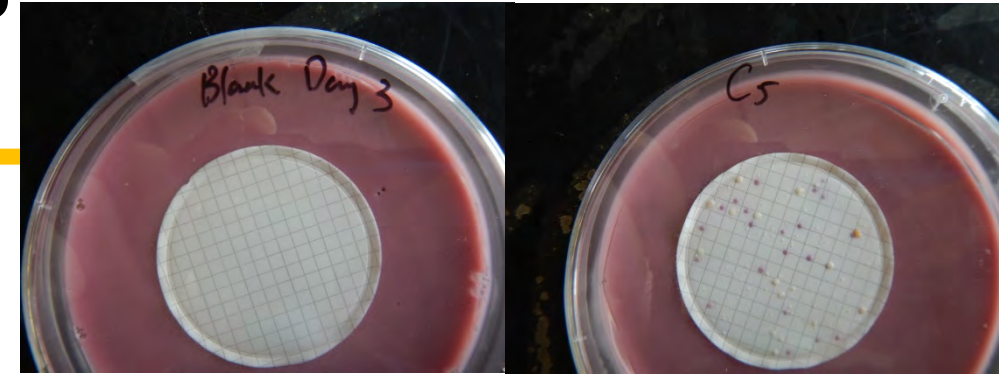
# Metagenomic Analysis (Phyla)



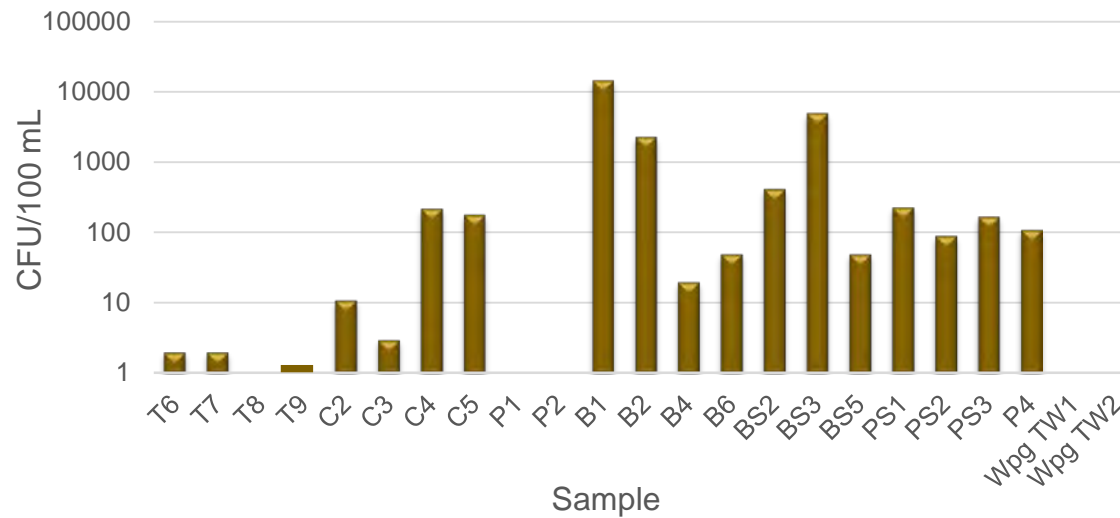
- T, Tap
- C, Cistern
- P, Water treatment plant
- B, Bucket
- BS, Community fountain
- BS5, lake sample
- PS, Plant source
- BC, Lake location near dock
- Field blank (1FBO)
- Red river (RR)



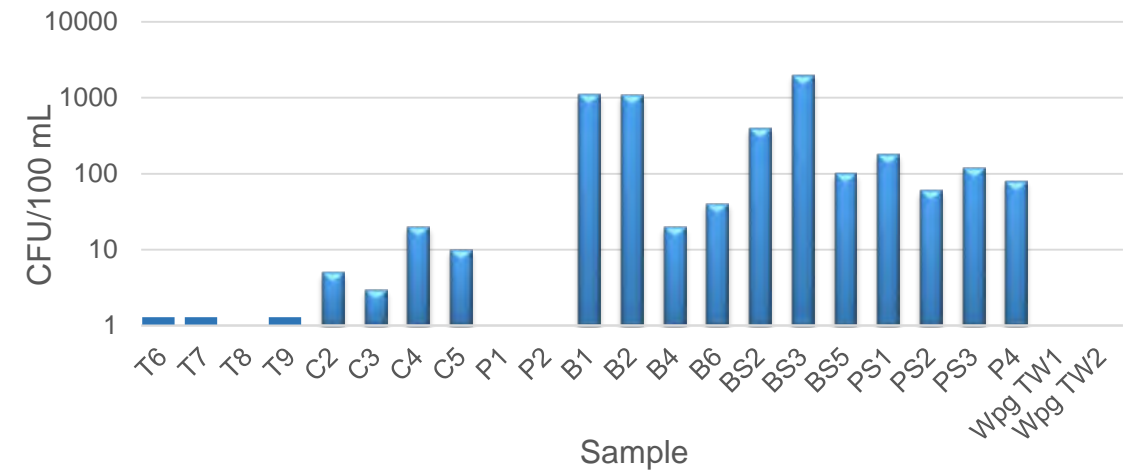
# Microbiological Analysis



Total Coliforms



*E. coli*



- T, Tap
- C, Cistern
- P, Water treatment plant
- B, Bucket
- BS, Community fountain

- BS5, lake sample
- PS, Plant source
- BC, Lake location near dock
- TW, Winnipeg tap water



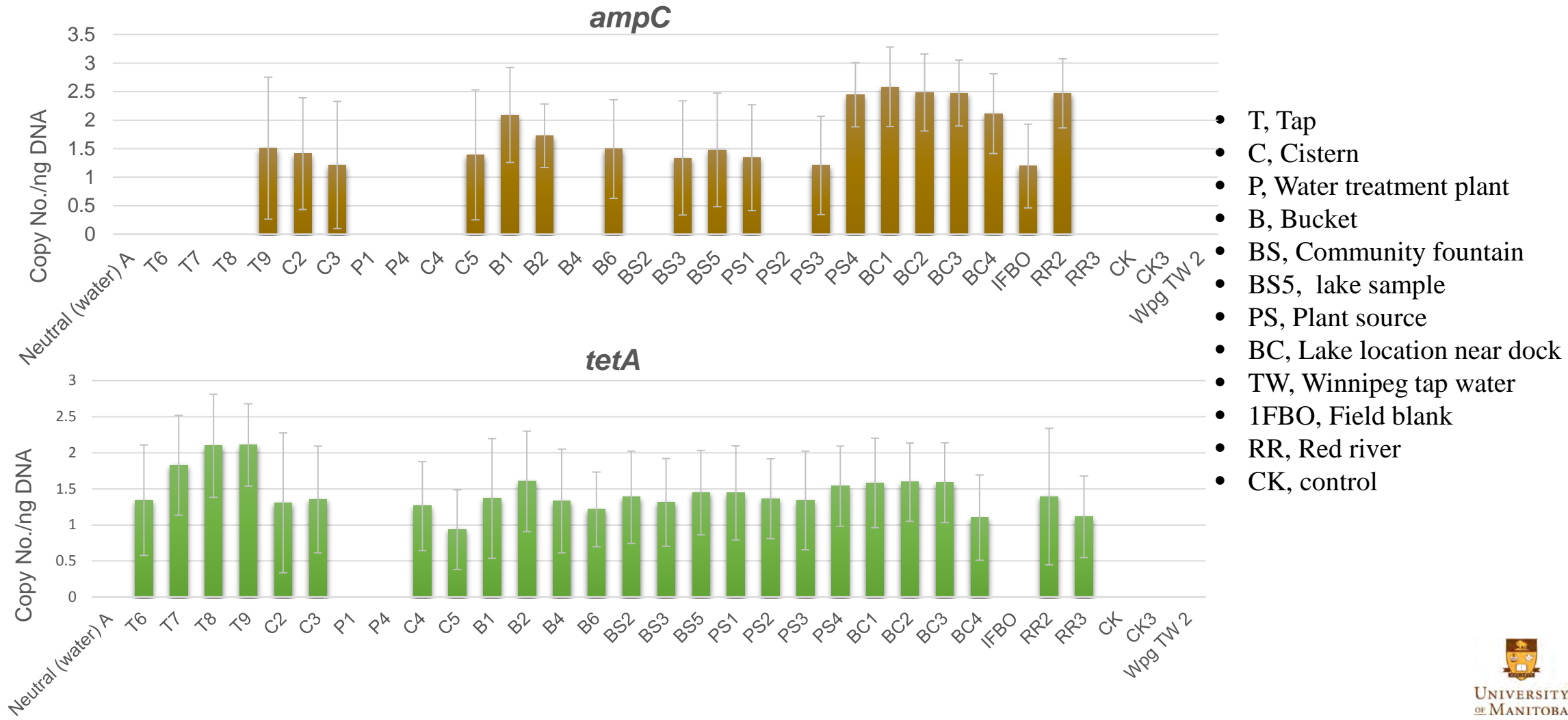
# Detection of Antibiotic Resistance Genes

- *ampC*
- *tetA*
- *mecA*
- *vanA*

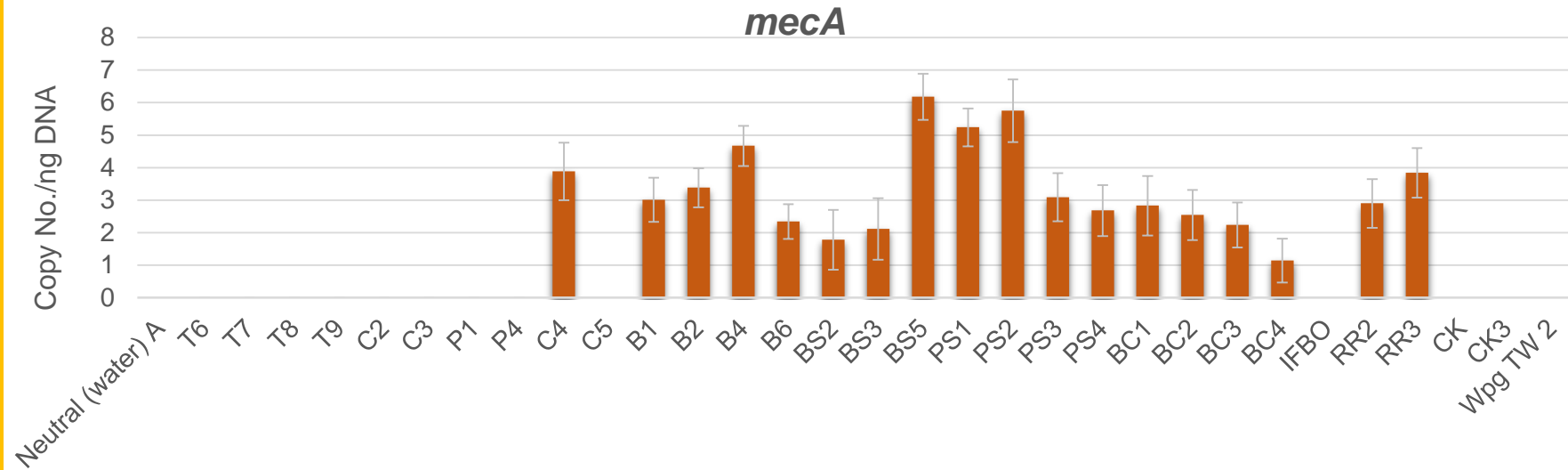




# Detection of Antibiotic Resistance Genes



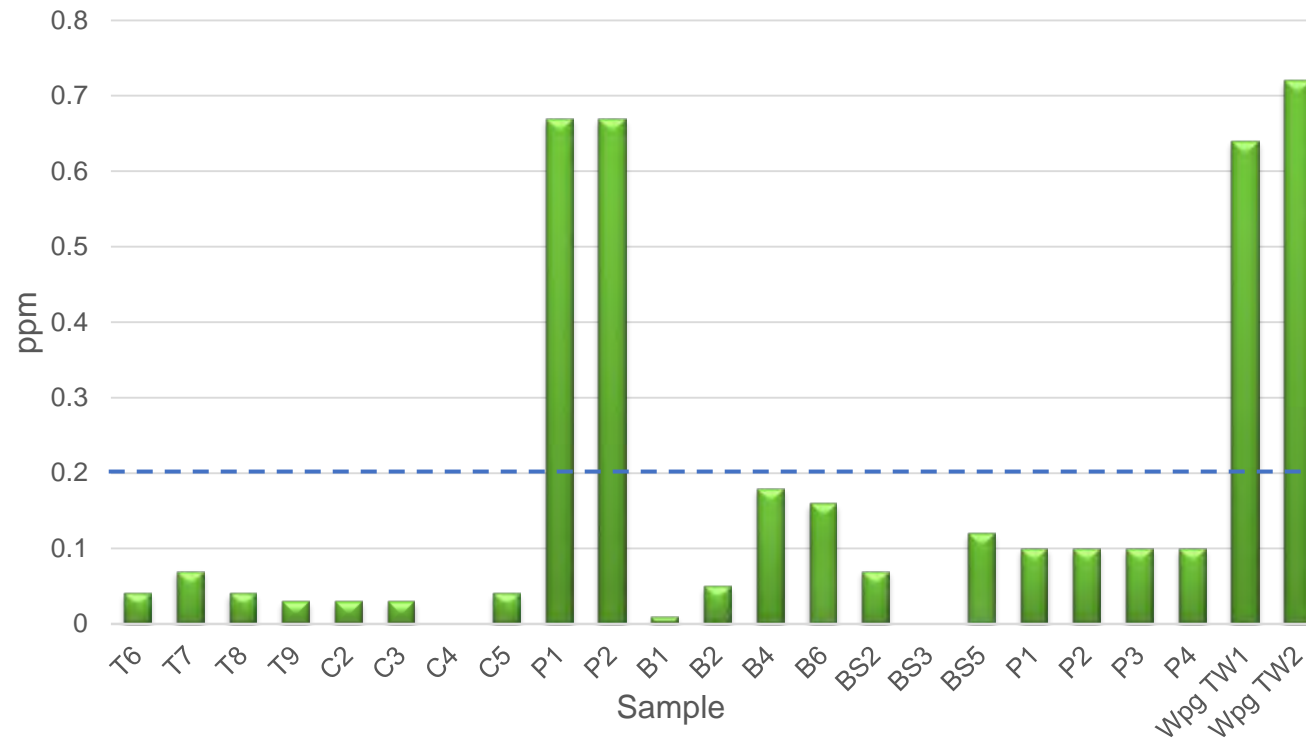
# Detection of Antibiotic Resistance Genes



- T, Tap
- C, Cistern
- P, Water treatment plant
- B, Bucket
- BS, Community fountain
- BS5, lake sample
- PS, Plant source
- BC, Lake location near dock
- TW, Winnipeg tap water
- 1FBO, Field blank
- RR, Red river
- CK, control



# Residual Free Chlorine



- T, Tap
- C, Cistern
- P, Water treatment plant
- B, Bucket
- BS, Community fountain
- BS5, lake sample
- BC, Lake location near dock
- TW, Winnipeg tap water

# Conclusions

- Total coliforms and *E. coli* number are alarmingly high in water samples from the FN community in our study
- Presence of antibiotic resistance genes
- Low chlorine levels
- Future work
  - Analyzing more samples
  - Expanding the study to four different communities
  - Testing the feasibility of a UV-based system to reduce bacterial counts



# Acknowledgements



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UNIVERSITY  
OF MANITOBA



Assembly of First Nations

Members of the First Nation Community