Antibiotic Resistance in Surface Water and Groundwater

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State of Knowledge: Resistance in Environmental Water

2010 – 2016 Peer-Reviewed Literature

- 788 publications
- Monitoring of antibiotic resistance genes; antibiotic resistant bacteria
- Industrial contamination, hospital effluent, animal production, treated wastewater
- Antibiotics, resistant bacteria and resistance genes in aquatic compartments

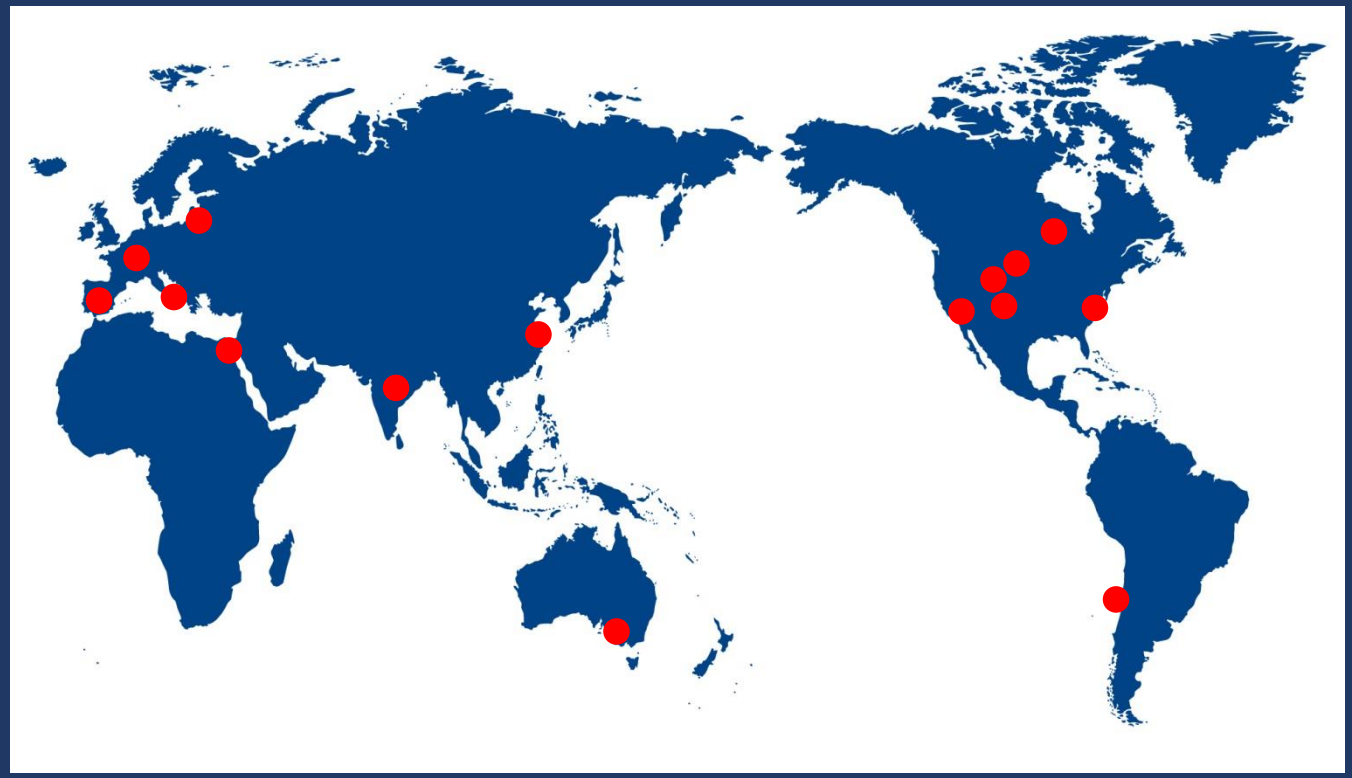


Image: http://www.imagebase.net/

State of Knowledge: Resistance in Environmental Water

2010 – 2016 Peer-Reviewed Literature

- 32 antibiotic resistance genes in surface and groundwater
- Clinically-relevant and non-pathogenic bacteria
- Movement of resistance within and between environmental bacteria is unclear

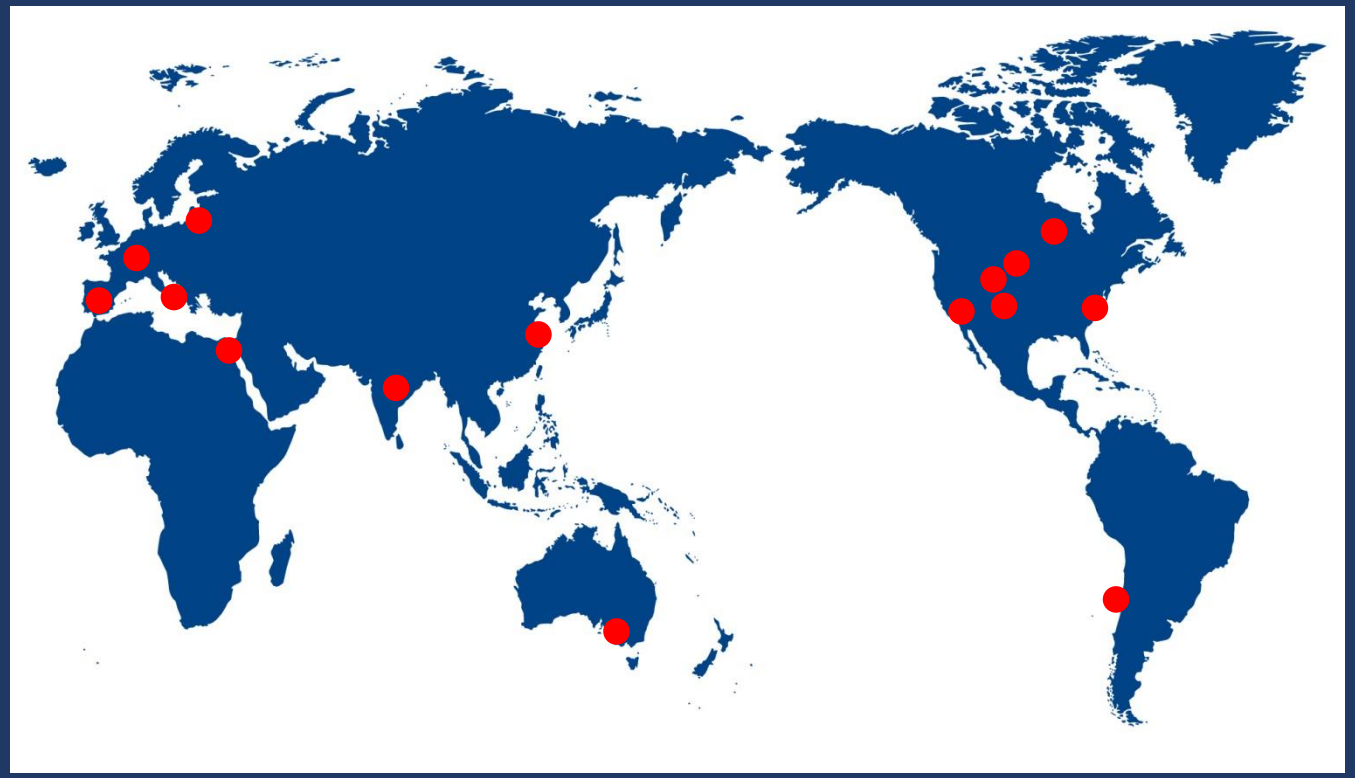


Image: http://www.imagebase.net/

State of Knowledge: Resistance in Environmental Water

2011: Vanessa D'Costa, McMaster U.

- 30,000 ybp sediments
- Diverse collection of genes encoding for resistance to 3 classes of antibiotics
- Ancient groundwater; pristine caves; 200,000 ybp ice cores
- Resistance is a natural phenomenon that predates modern selective pressure – baseline resistance

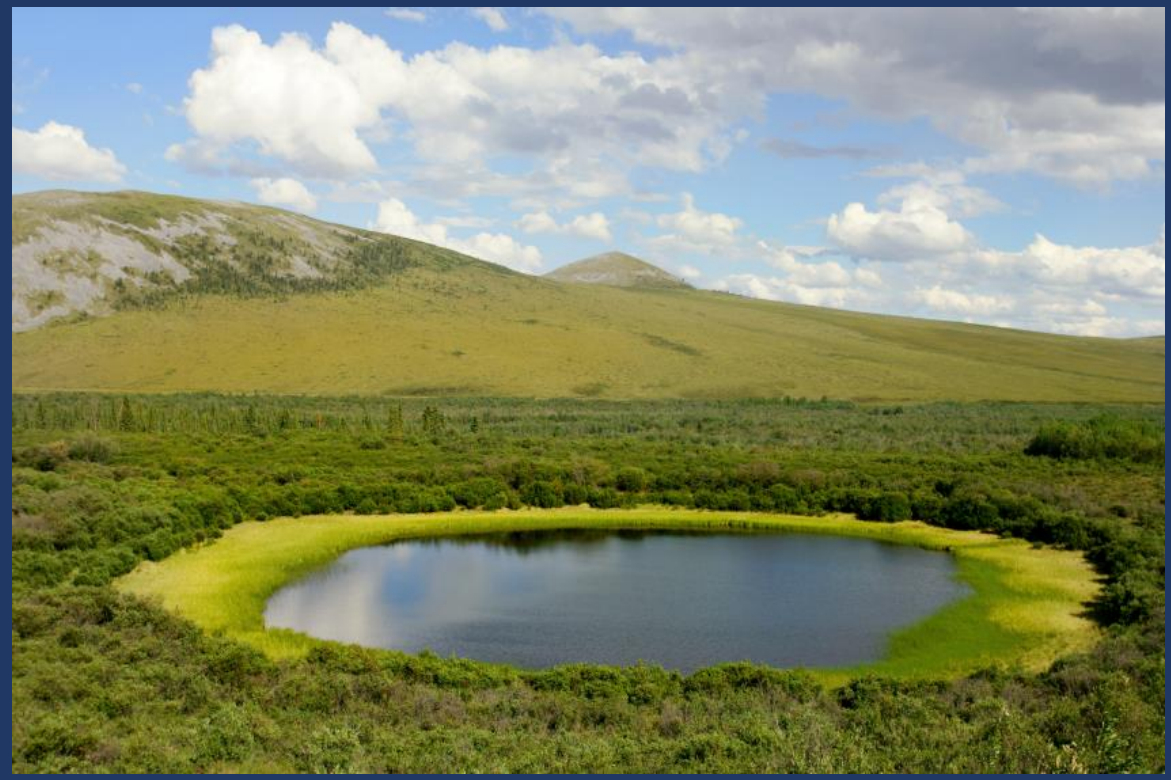
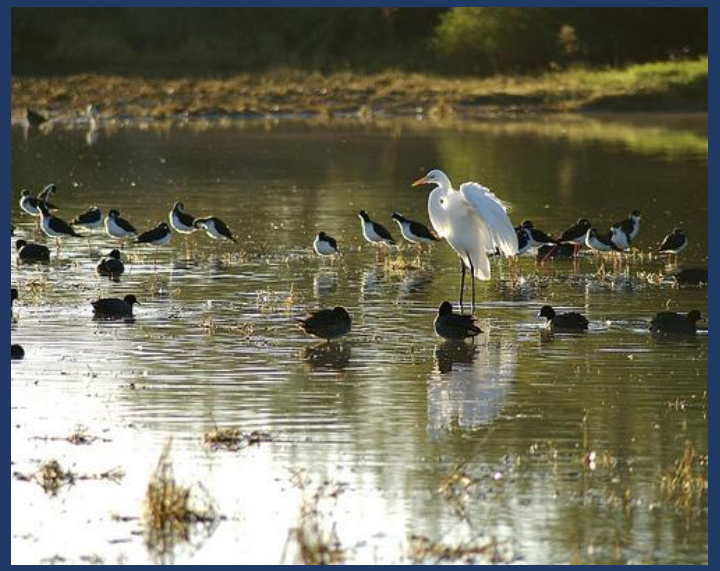


Photo: http://www.rcinet.ca/

Study Design Must Consider Baseline Resistance

2014: McLain and Williams

- 30-year recharge with recycled wastewater
- Vancomycin: 3.0%; 7.1%
- Lincomycin: 48.5%; 57.1%
- "Superbugs" (7 or more antibiotics): 3% of total; 7% of total
- Baseline resistance: critical to understanding contribution of humans to maintenance of environmental reservoirs of resistance



How Environmental Transfer is Being Addressed

August 2014 Meeting at Biosphere2 (Oracle, Arizona)
funded by USDA-NIFA Grant #2013-68003-21256
(McLain, Durso, Snow)

International effort to reach consensus on methods for assessing resistance in the environment.

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ANTIBIOTICS IN AGROECOSYSTEMS: STATE OF THE SCIENCE

How Should We Be Determining Background and Baseline Antibiotic Resistance Levels in Agroecosystem Research?

Michael J. Rothrock, Jr.,* Patricia L. Keen, Kimberly L. Cook, Lisa M. Durso, Alison M. Franklin, and Robert S. Dungan

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Water and Resistance: Knowledge Gaps

Water: a significant reservoir of antibiotic resistance and antibiotic resistance genes.

GAP: Does baseline resistance in water (or soil or sediments) correlate to human health risk?

PACCARB GOAL 2: One-health surveillance, including DOD, CDC, USDA, NIH, FDA, others

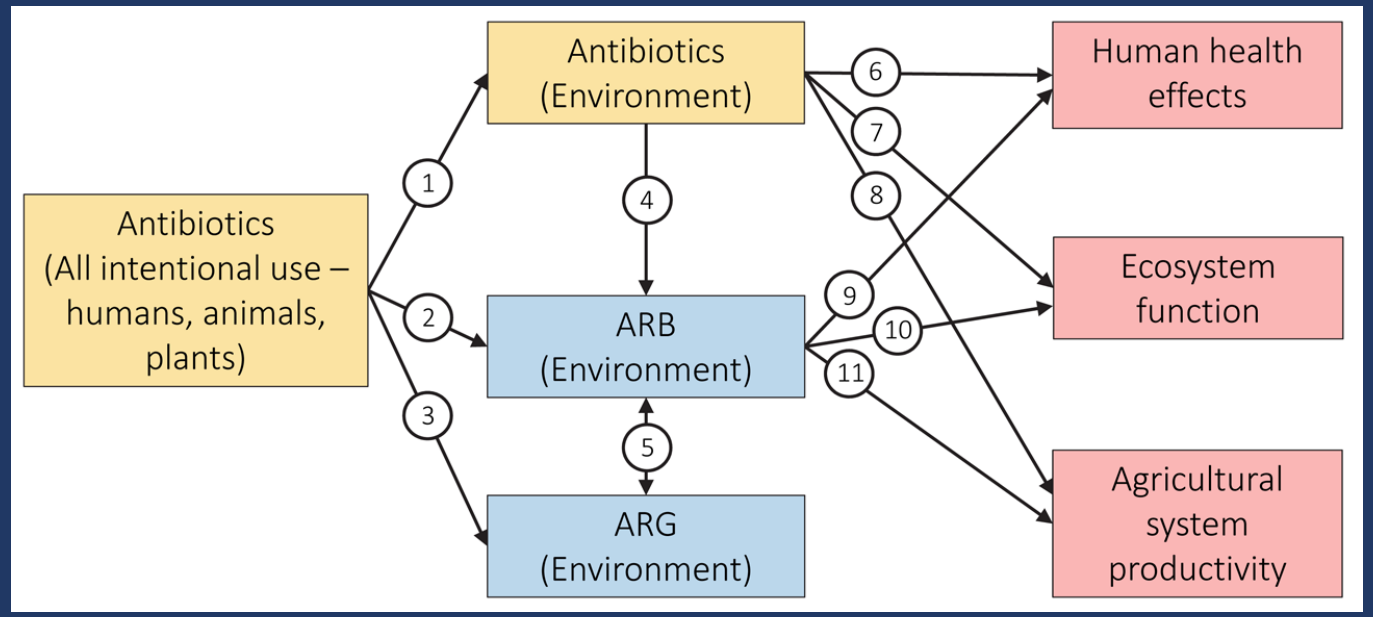

Figure: Williams-Nguyen et al. (2016) JEQ 45:394-406

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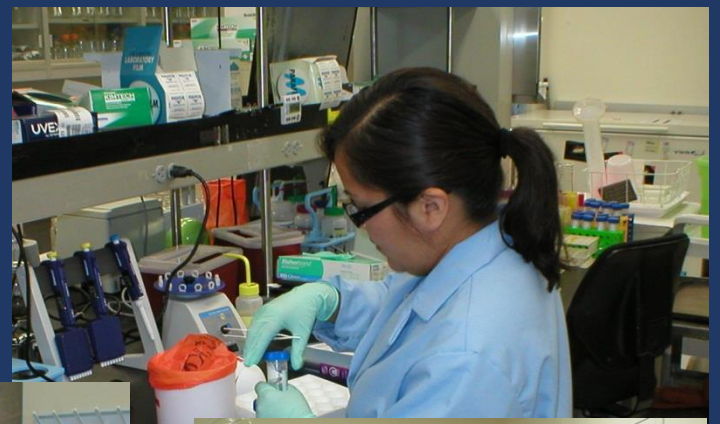
Water and Resistance: Knowledge Gaps

GAP: Dose-response effects of antibiotics?

GAP: Risk presented by antibiotic resistance genes in water?

PACCARB Goal 4: Accelerate basic and applied research

- Standardized testing
- Enhanced understanding of environmental factors
- FDA, USDA, CDC, NIH, others



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