



Environment
Canada

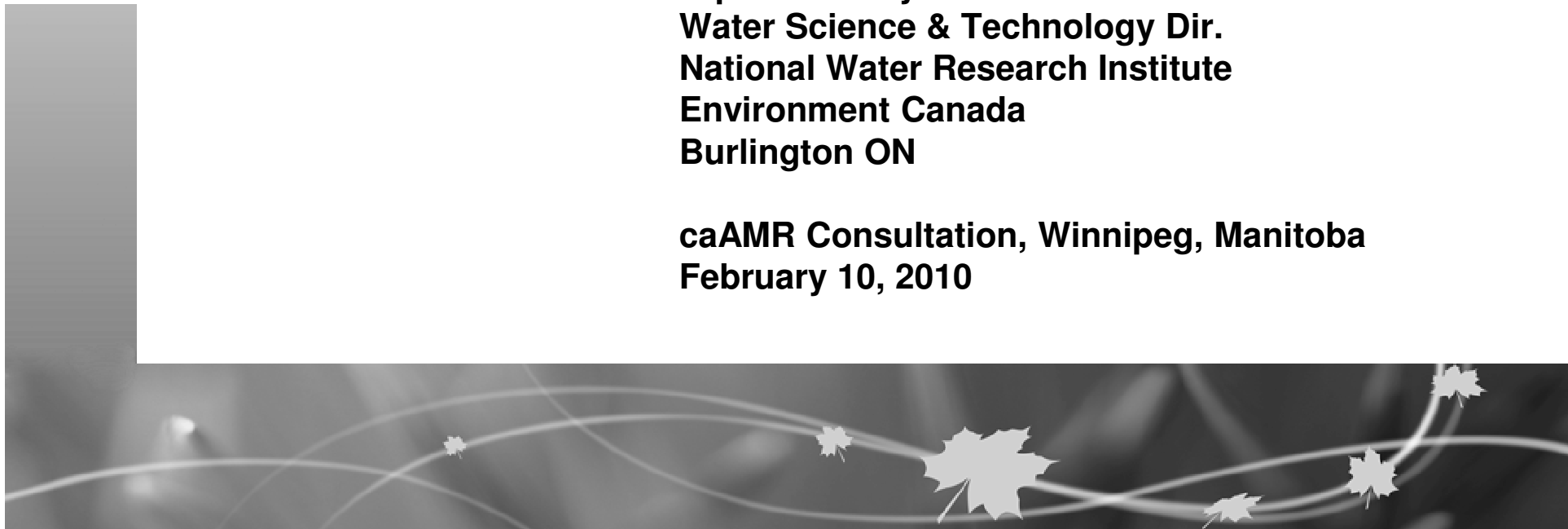
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Environmental Aspects of Community-Acquired Antimicrobial Resistance

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Presentation outline

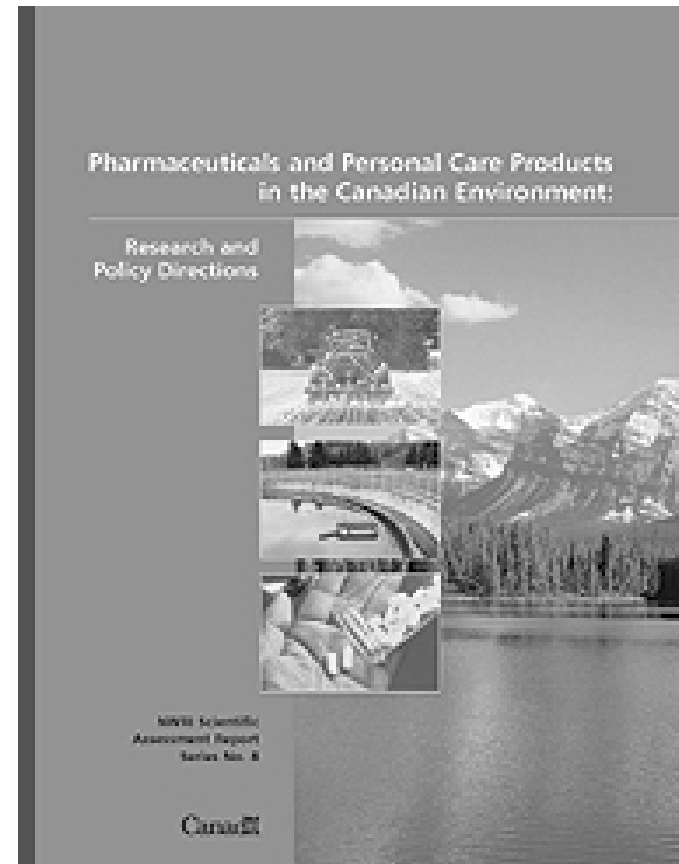
- caAMR environmental considerations
- Antimicrobials
- Antimicrobial resistant (AMR) bacteria
- Antimicrobial resistance (AMR) genes
- Discussion items

caAMR Environmental Considerations

- Human health, animal health + ecological problem
- Hospitals, farms are not closed systems
- Community (human/animal) → environmental releases
- Environment → community (human/animal) exposure
- Environmental resistome - reservoir of antimicrobial resistance with potential implications for emergence of resistance in clinically important pathogens
- Ecological component to antimicrobial stewardship

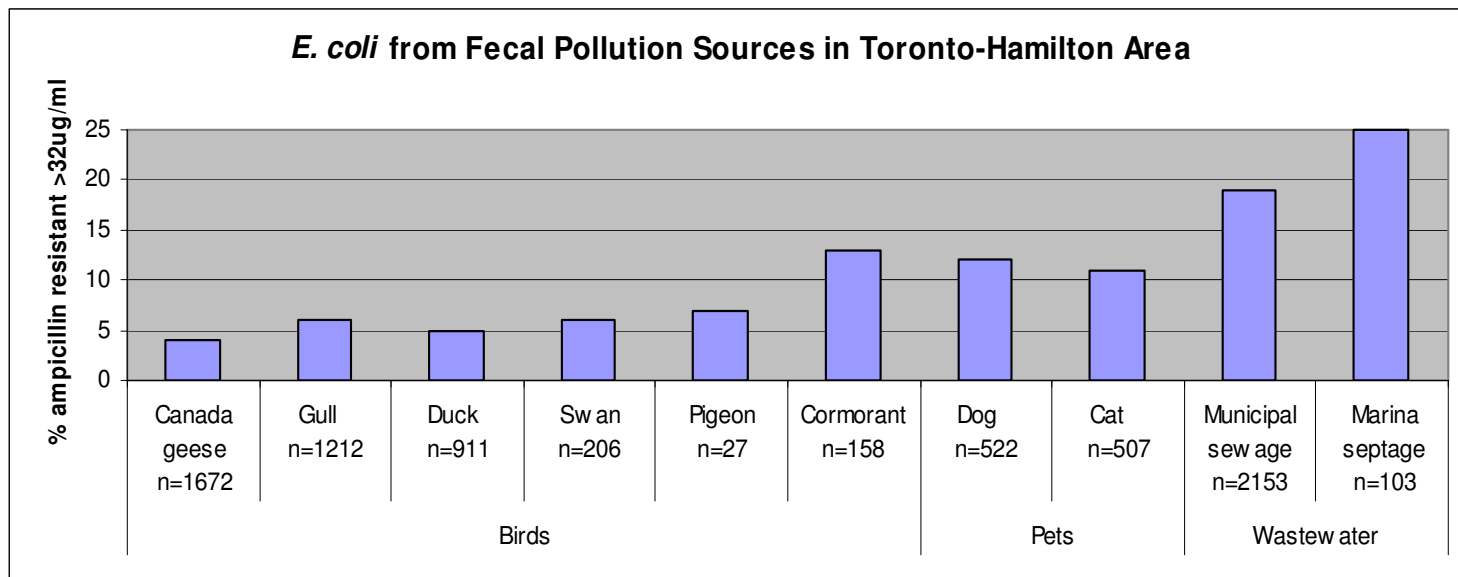
Antimicrobials → Environment

- Widespread in municipal wastewater effluents and livestock wastes
- Conc. usually $< \mu\text{g/L}$
- Sub-inhibitory effects on microbial communities in ecosystems
- Antiviral Tamiflu metabolite in wastewater effluents → waterfowl exposure?
 - Ghosh et al. 2010. *Env. Health Persp.* 118: 103-107



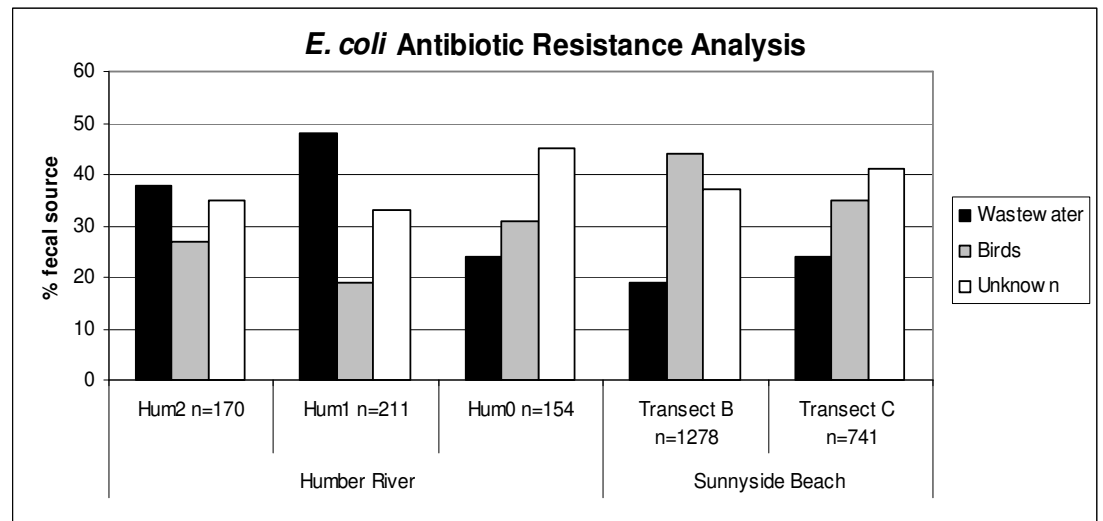
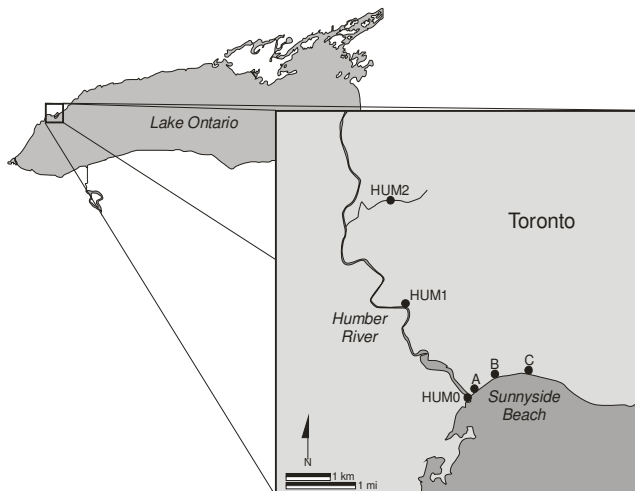
AMR Bacteria → Environment

- AMR bacteria release in STP effluents, livestock wastes
- Sewage Treatment Plants (STPs)
 - > 4000 STPs across Canada - bacterial “bordellos”
 - Selective increase of AMR through sewage treatment?
 - Zhang et al. 2009. Sci. Total Env. 407: 3702-3706



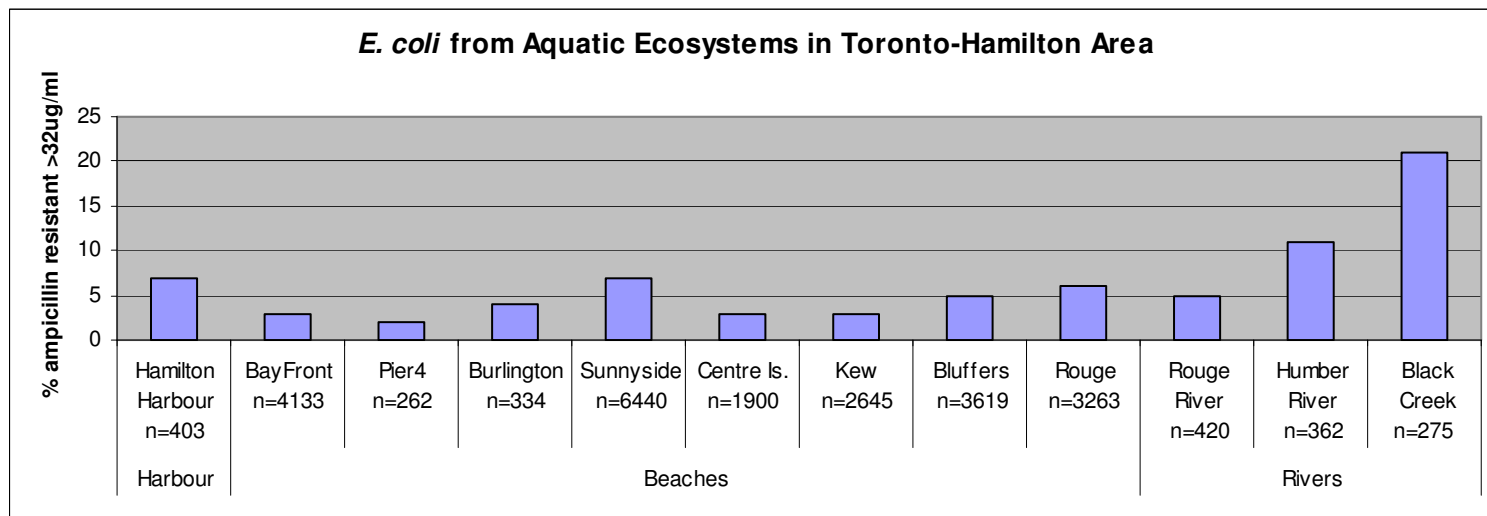
AMR Bacteria → Environment

- Antimicrobial resistance can be useful for microbial source tracking of fecal pollution
- ~ 30,000 *E. coli* isolates from Lake Ontario beaches, STP effluents, pet and waterfowl fecal droppings
 - Edge and Hill. 2007. Water Res. 41:3585-3594.



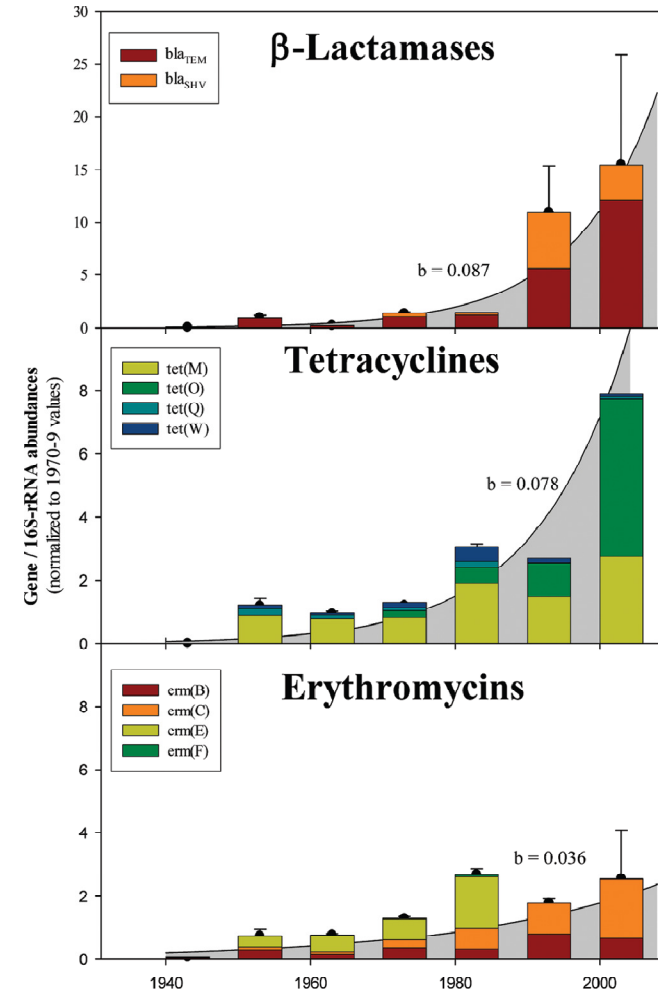
Environment → AMR Bacteria

- AMR bacteria in aquatic ecosystems, and source water for drinking, recreation, and food production
- AMR bacteria in well water; irrigation water; shellfish
- Significance of soil resistome/environmental reservoirs?
 - D'Costa et al. 2006. Science 311: 374-377.



Antimicrobial Resistance Genes

- Multi-AMR gene plasmids
- Fate of AMR genes in aquatic ecosystems
- AMR genes in drinking water distribution systems
- Increasing abundance of AMR genes in soil
 - Knapp et al. 2010. *Env. Sci. Technol.* 44: 580-587.
- AMR genes as emerging contaminants?



Discussion Items

- Widespread, continuous environmental releases of antimicrobials, antimicrobial resistant bacteria, and antimicrobial resistance genes
- Widespread potential for emergence/spread of zoonotic pathogens, AMR bacteria and AMR genes at human-animal-ecosystem interface → caAMR
- Some research and surveillance issues
 - Understanding of resistome/environmental reservoir of AMR?
 - Significance/trends of AMR entry and prevalence in environment?
 - Relative significance of environmental exposures?
 - AMR implications for managing wastewater, livestock wastes?
 - Sentinel sites to monitor increase/spread of AMR?
 - Effects of antimicrobials on microbial communities/ecosystems?
 - Consideration for AMR genes as contaminants?