From climate change to AMR: understanding environmental-human health issues in a One Health framework

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Abstract

As the impacts of climate change intensify, our interconnectedness to the environment around us seems ever more apparent. Changing terrestrial landscapes impact adjacent aquatic ecosystems, as the terrestrial-aquatic continuum experiences the ever-pressing stresses of anthropogenic activity. In the Canadian Arctic, ancient carbon stores and contaminants such as methylmercury are emerging as permafrost thaw accelerates, changing their biogeochemical nature, impacting local communities and threatening ecological health in ways still yet to be fully understood. Awakening microorganisms in these once frozen grounds are all too eager to get to work, as scientists continue to try to understand how, where, and why climate change is impacting aquatic ecosystems across Canada. Increasing aquatic nutrient loads and chemical/biological contaminants adjacent to urban and agricultural lands also impact both ecosystem and ultimately human health. In the shadow of a global pandemic, the need to understand how environmental-human interactions impact human health is ever pressing, requiring the collective expertise of researchers across the environmental-human health landscape. Antimicrobial resistance (AMR), despite being a natural evolutionary mechanism for microbial survival in the environment, has been increasing in presence and prevalence in healthcare systems worldwide, resulting in drug-resistant infections that can be fatal. As such, there is a need to understand AMR in both its natural state within the environmental microbial biosphere, alongside those places (i.e., agricultural lands, wastewater treatment outflows etc.) where humans have introduced co-selective agents such as metals, antibiotic residues and other compounds that can further facilitate and even promote resistance activity in the natural environment (Fig. 1). This connection between the human health landscape and the environment around us is a vital part of understanding the risks of both climate change and AMR, requiring an integrated and collaborative One Health approach across disciplines. Here we present research associated with our Genomics Research and Development Initiative programs using novel genomics tools and large-scale laboratory simulations to better understand the

impacts of climate change and AMR in a multi-disciplinary environmental context. This work helps fullfil the need to understand the dynamics of these two global threats in an trans-disciplinary nature, drawing on the expertise of environmental microbiologists, hydrologists, bioinformaticians, and water quality experts, in tandem with public health and infectious disease experts to better understand how these threats will evolve as our planet tries to adapt to the complex stressors of the Anthropocene.

Keywords

climate change; AMR; antimicrobial resistance; water quality; one health

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Conflicts of interest

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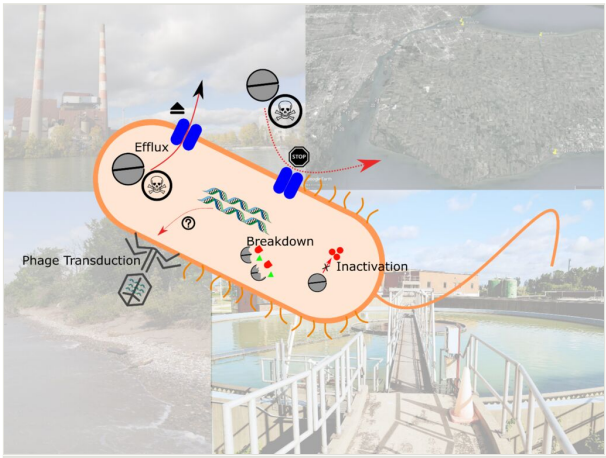

Figure 1.

Theoretical schematic of some antimicrobial resistant mechanisms amidst a regional environmental land-use backdrop noting potential sources of resistance from industrial, wastewater and agricultural effluents.