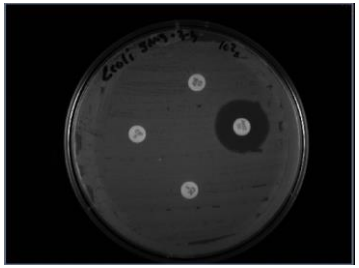
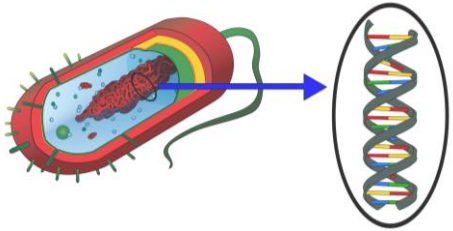
AMR and Climate Change





Amy Pruden

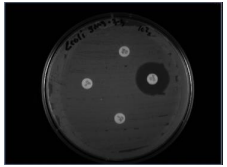
University Distinguished Professor
Civil & Environmental Engineering
Virginia Tech
USA

Trajectory and Consequences of Inaction

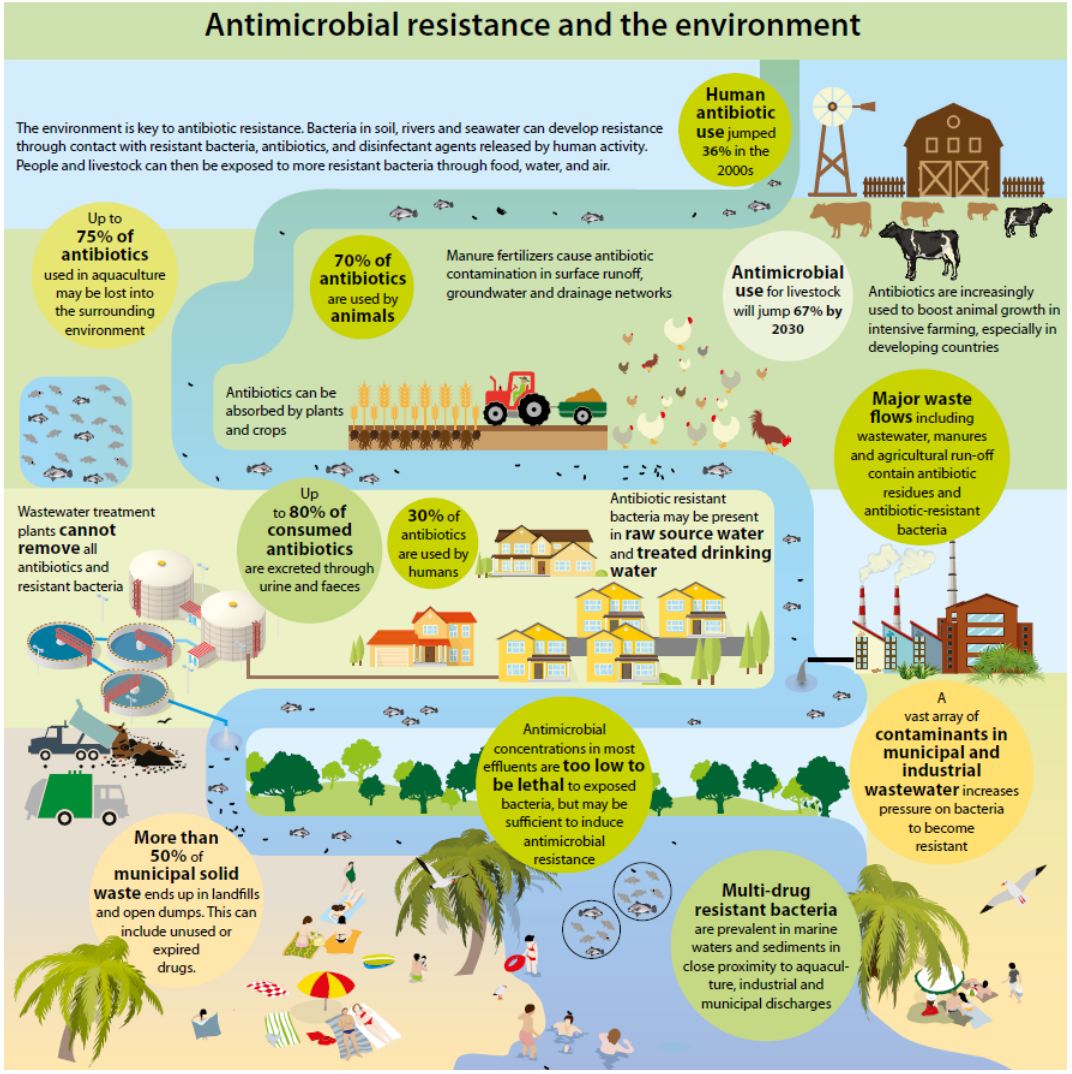
Climate Change

- Sea level rise
- Heat waves
- Droughts
- Floods
- Wildfires
- Water scarcity
- Unpredictable weather hurting agricultural production/food security
- Increased displacement of human populations
- Loss of habitat and shifting habitats for wildlife

AMR



- Antibiotics lose efficacy for treating bacterial infections
  - Pneumonia
  - Septicemia
  - Urinary tract infections
- Routine surgeries become more dangerous
- Neonates and immunocompromised at even greater risk
- Loss of efficacy of other antimicrobials (e.g., fungicides)
- Death rates surpass cancer by 2050
- A post-antibiotic era mirroring the early 20th century



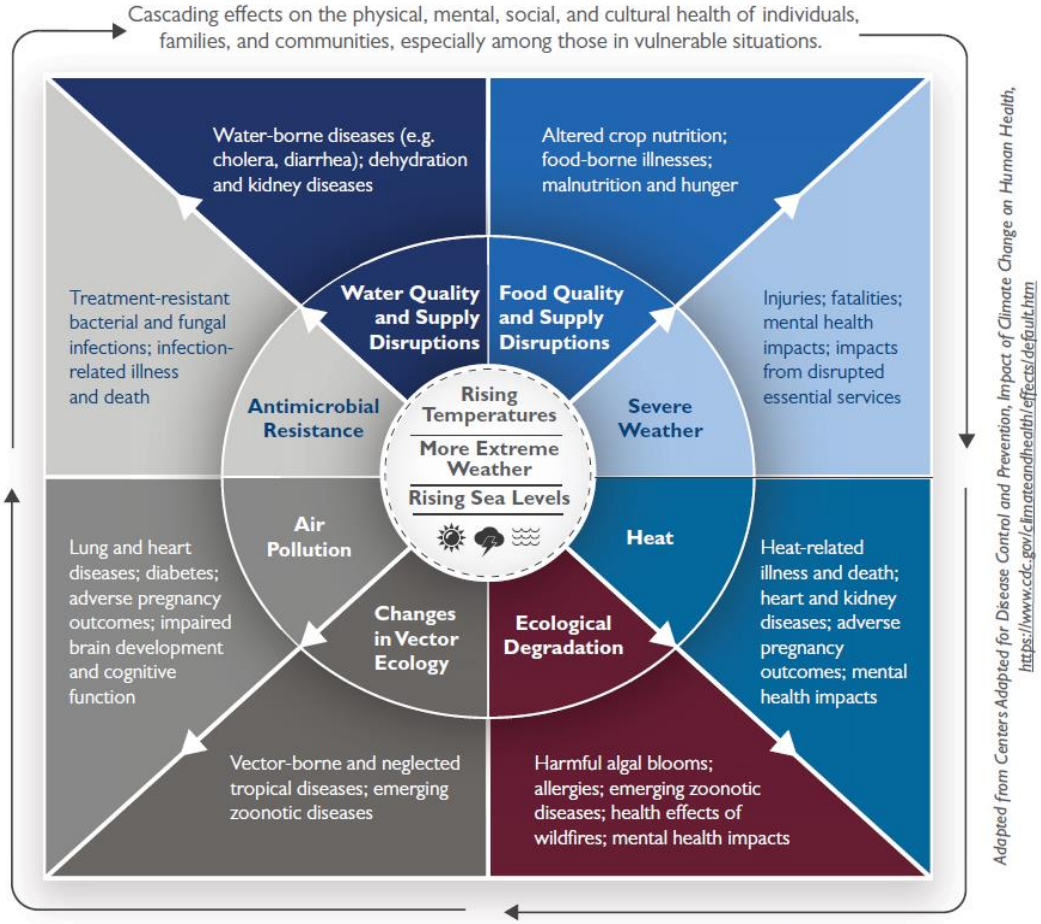
AMR in the Environment is Complex and Mutidimensional

UN environment

FRONTIERS 2017

Emerging Issues of Environmental Concern

Climate Change Can Exacerbate AMR



Climate Change can Exacerbate AMR

Increased Temperatures

- Increased growth/metabolic rates of pathogens
- Shift ecology of pathogens and vectors and opportunity for emerging disease

Increased Storm Events

- Increased dispersal of AMR
- Increased vulnerability to infection following natural disaster
- Coastal, peri-urban and well water communities most likely to be affected

Water Scarcity

- Water reuse technology and practice does not currently take into account AMR
- Need to ensure that water reuse practices do not perpetuate the spread of AMR

Environmental Science & Technology

pubs.acs.org/est

Article

Demonstrating an Integrated Antibiotic Resistance Gene Surveillance Approach in Puerto Rican Watersheds Post-Hurricane Maria

Benjamin C. Davis, Maria Virginia Riquelme,* Graciela Ramirez-Toro, Christina Bandaragoda, Emily Garner, William J. Rhoads, Peter Vikesland, and Amy Pruden*

Cite This: https://dx.doi.org/10.1021/acs.est.0c05567

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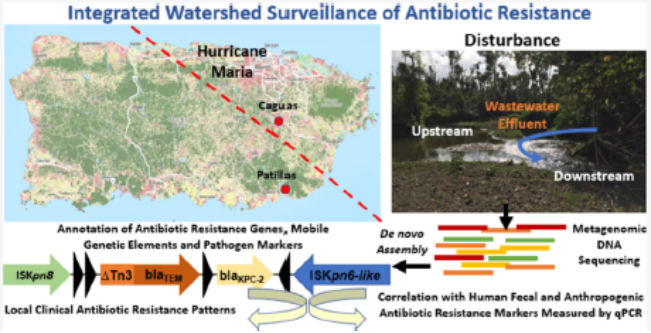
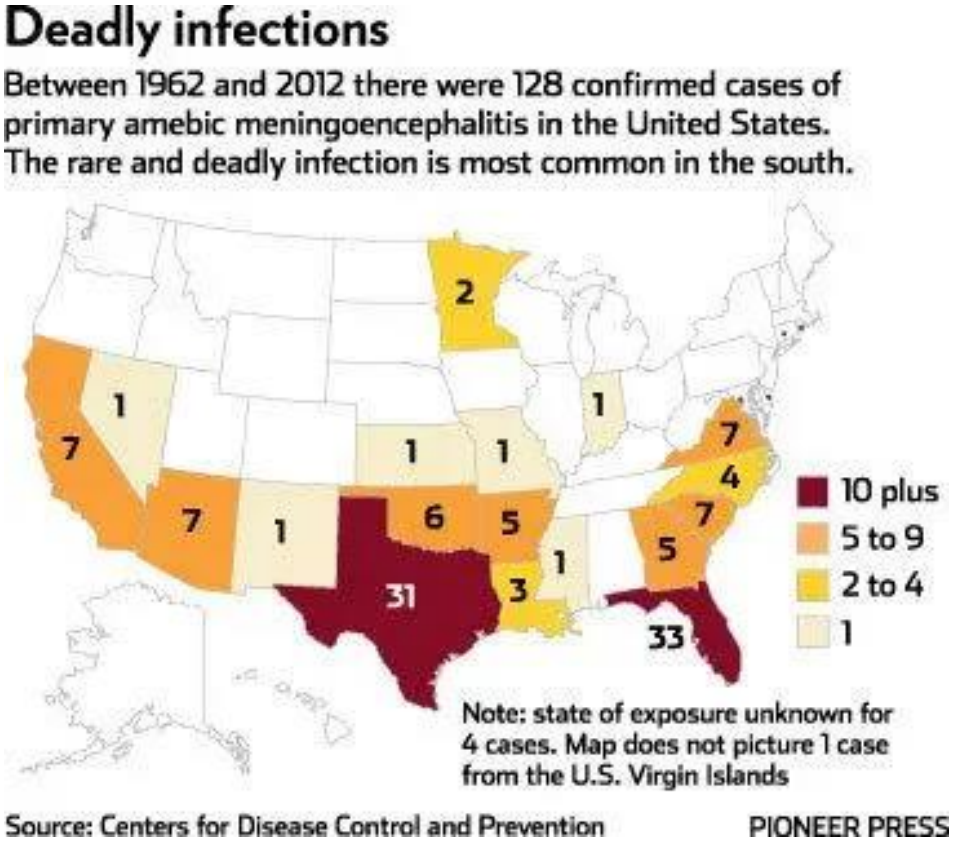
ABSTRACT: Comprehensive surveillance approaches are needed to assess sources, clinical relevance, and mobility of antibiotic resistance genes (ARGs) in watersheds. Here, we examined metrics derived from shotgun metagenomic sequencing and relationship to human fecal markers (HFMs; crAssphage, enterococci) and anthropogenic antibiotic resistance markers (AARMs; *intI1*, *sul1*) in three distinct Puerto Rican watersheds as a function of adjacent land use and wastewater treatment plant (WWTP) input 6 months after Hurricane Maria, a category V storm. Relative abundance and diversity of total ARGs increased markedly downstream of WWTP inputs, with ARGs unique to WWTP and WWTP-impacted river



Example: Northward migration of *Naegleria fowleri*



ESKAPE pathogen ideal incubation temperatures:

Escherichia coli	36°
Staphylococcus aureus	35° - 37°
Klebsiella pneumoniae	36°
Acinetobacter baumannii	37°
Pseudomonas aeruginosa	36°
Enterococcus spp.	36°

Tackling a grand challenge: Lessons learned from climate change

- Grappling scientifically with a complex, multifaceted phenomenon
- Communicating effectively to the public
- Understanding and addressing barriers to action
  - What are the real and perceived trade-offs?
  - Understanding stakeholder perspectives
  - Political will
  - Most immediate problems tend to get the attention (Policy in a crisis)
- Need systems thinking (convergence) to holistically address problem
- Identifying synergistic benefits of action

Analogous Actions

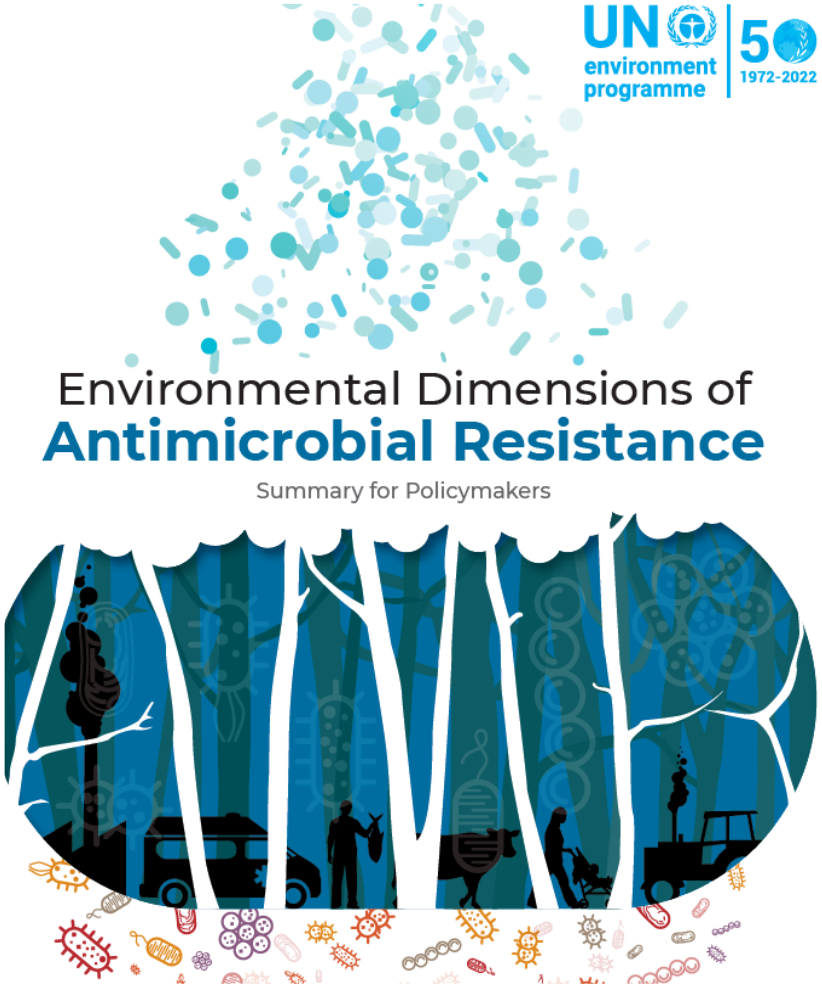
Climate Change

- Paris Agreement
- Net zero CO_2 emissions by 2050
- Mitigation (reduce, avoid, and sequester GHGs)
- Technology and Innovation (e.g., renewable energy)
- Adaptation (e.g., restore landscapes)
- Finance, investment in research and solutions

AMR

- WHO GAP, quadripartite, and NAPs
- Reducing AMU and emissions
- Mitigation (e.g., wastewater treatment)
- Technology and innovation (e.g., vaccines, diagnostics)
- Improve access and appropriate use for vulnerable populations
- Finance…

Example synergistic solution: *Implementing locally-relevant cultivation practices that reduce GHG, reduce N & P emissions, and attenuate AMR.*



"*AMR challenges cannot be understood or addressed separately from the* ***triple planetary crisis*** *of climate change, biodiversity loss and pollution and waste, all of which are driven by* ***unsustainable consumption and production***"

- Need for global action!
- Enhance environmental governance, planning, and regulatory frameworks
- Identify and target priority AMR-relevant pollutants
- Improve reporting, surveillance, and monitoring
- Prioritize financing, innovation, and capacity development

Analytical Studies

G7/G8 Health Ministerial Meetings

G7 Health Ministers' Communiqué

Berlin, May 20, 2022
[PDF]

1. We, the G7 Health Ministers, met in Berlin, Germany, on 19 and 20 May 2022, at an extraordinary time of multiple, acute crises. We affirm our common values as a strong

1. COVID-19 Pandemic
2. Antimicrobial Resistance “Silent” Pandemic
3. Climate Change

“As part of the G7 Pact for Pandemic Readiness, we commit to strengthening and supporting the development of ***integrated,*** *interoperable and interdisciplinary surveillance and* ***cross-sectoral surveillance capabilities that aim to cover all countries, multiple pathogens, antimicrobial resistance and human, animal, environmental, and climate-related inputs****, as part of the One Health approach, to reduce the risk of future cross-sector health threats…. “non-invasive”…national wastewater surveillance systems…”*

Thank You!

Take-Home Messages

- Complexity
- Synergistic Action!