Environmental Antimicrobial Resistance from Domestic Sources, Healthcare and Manufacturing - Prevention and Surveillance

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Workshop on *Understanding the Environmental Dimensions of Antimicrobial Resistance*, South Centre
Tuesday 28, March 2023, 14:30 (CET)

Bracing for Superbugs: Strengthening environmental action in the One Health response to antimicrobial resistance

What is antimicrobial resistance (AMR) and why does it occur?

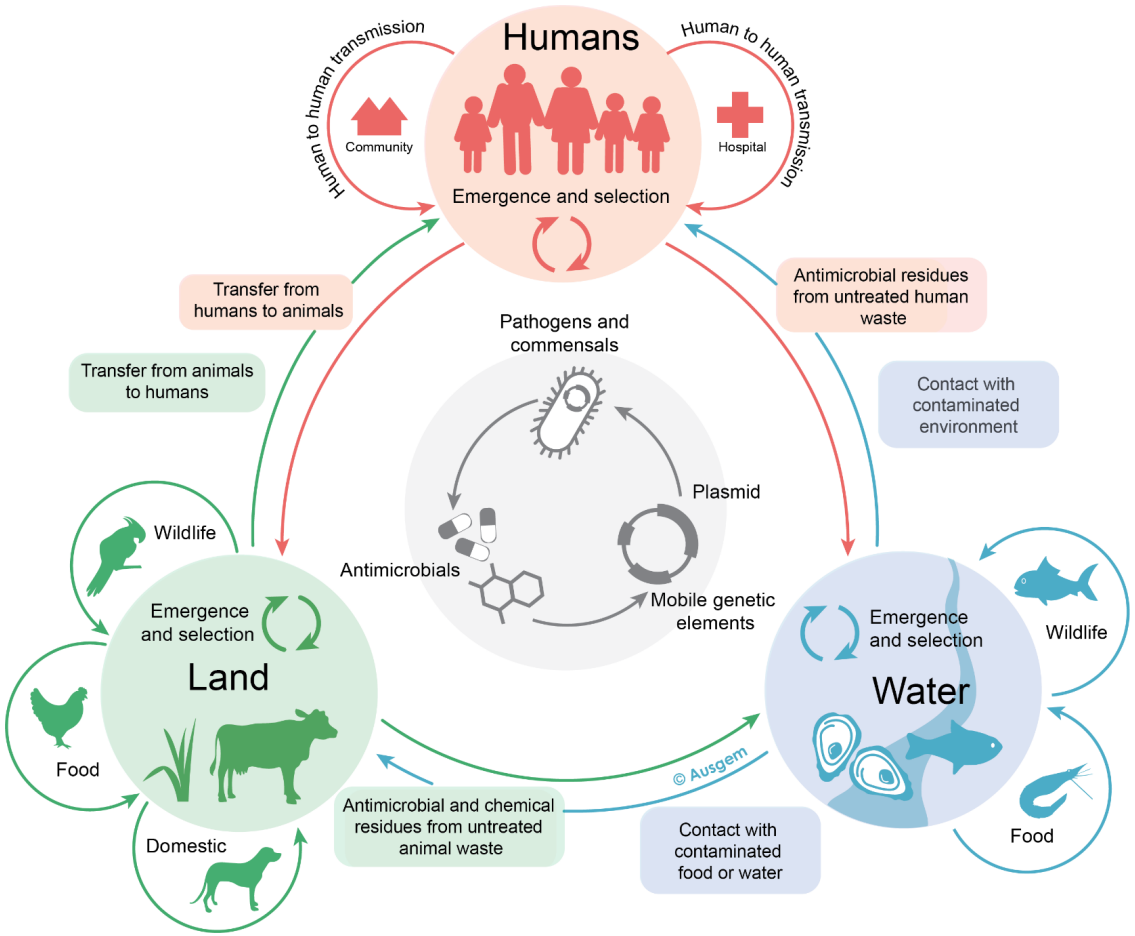
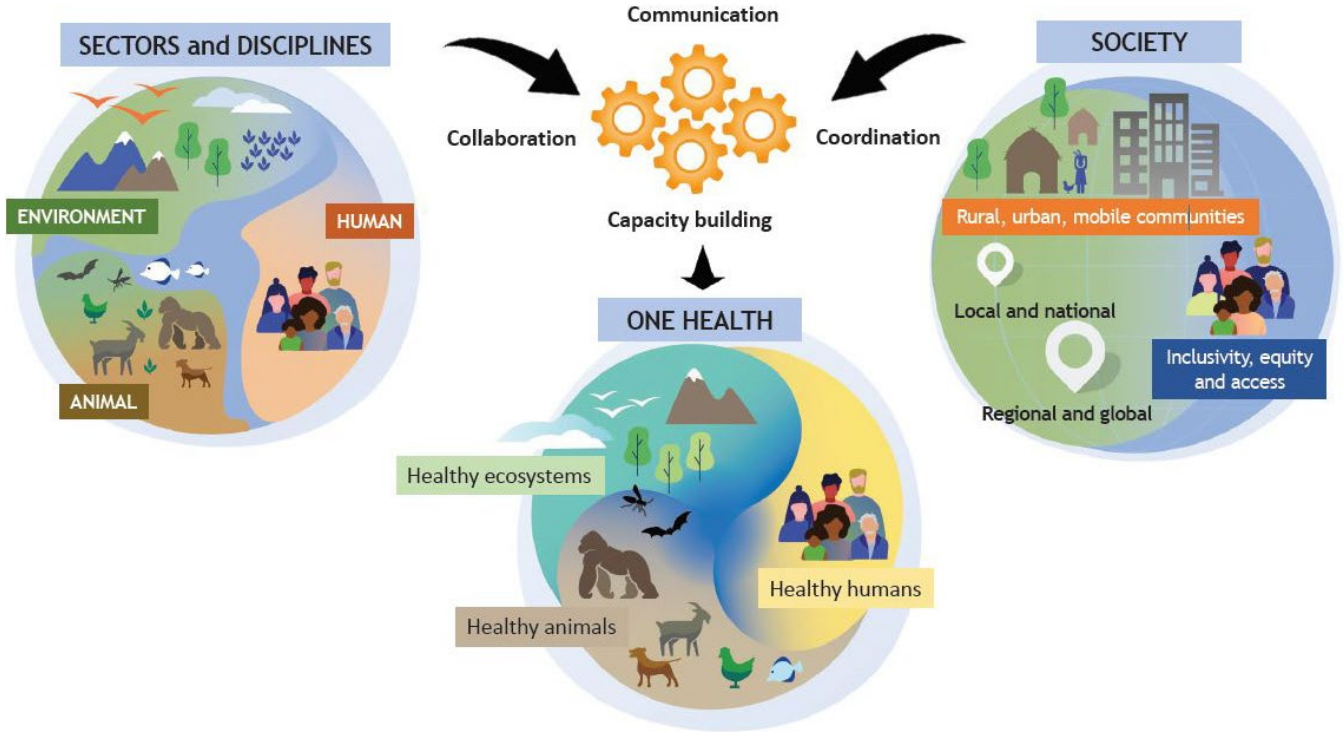


Figure adapted from The Australian Centre for Genomic Epidemiological Microbiology (ausgem.net). Courtesy of Dr Branwyn Morgan.

Recognise that the environment is key to advancing a ‘One Health’ response to AMR

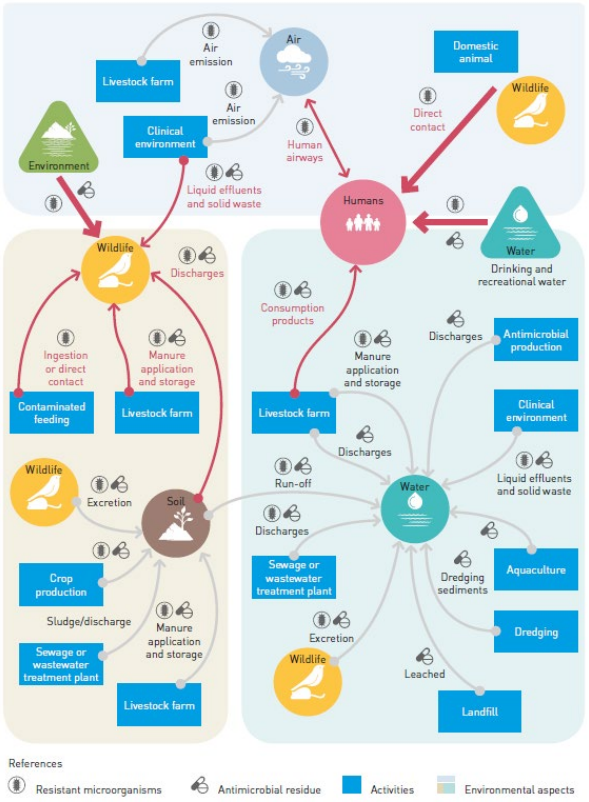
A ‘One Health’ approach, which recognizes the health of humans, domestic and wild animals, plants, and the environment are closely linked and inter-dependent, is urgently needed to prevent and reduce the burden of AMR.



One Health definition developed by the One Health High-Level Expert Panel

Identify key sources and pathways that affect AMR in the environment

Environmental resistance is complex, including many pathways for spread



Human waste releases, spanning water, sanitation and hygiene (WASH)

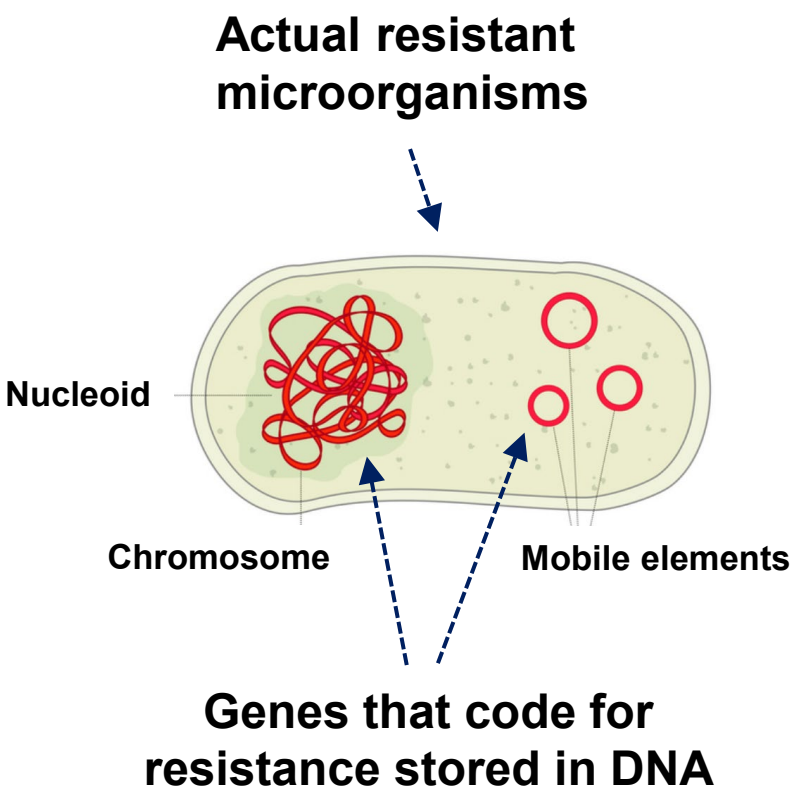
Three economic sectors and their value chains are potential drivers of AMR development and spread:

- Healthcare systems
- Pharmaceuticals and other chemical manufacturing
- Agriculture and food production

Prevention and integrated surveillance (UNEP Report)

What do we want to prevent and what requires surveillance?

Resistant microorganisms and genes, and chemicals in order of health priority



Antimicrobial resistant pathogens

- Disease-causing microorganisms resistant to antibiotics

Resistant organisms who can share AMR genes with pathogens, creating resistant pathogens

- Non-pathogenic AMR microorganisms

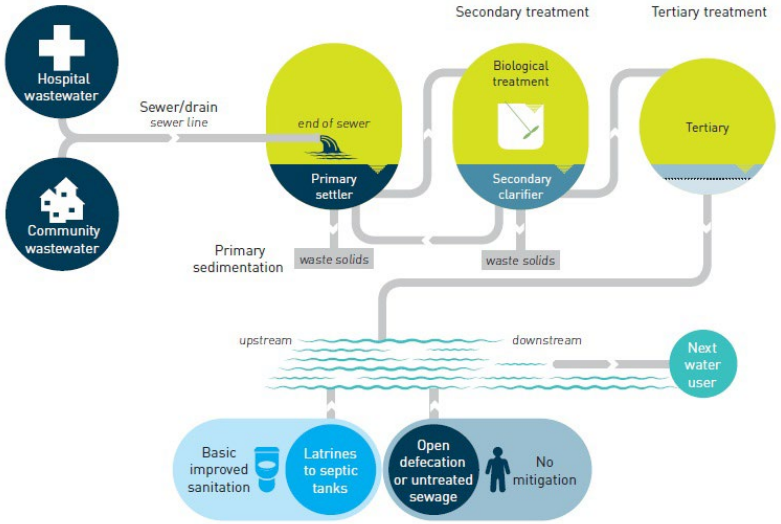
AMR genes and mobile elements that help gene-sharing

- Indicate the potential for resistance

Antimicrobials and other chemicals

Manage domestic wastewater and faecal solids as AMR sources

Poor sanitation, wastewater and related waste effluent in human and animal waste systems, such as domestic wastewater



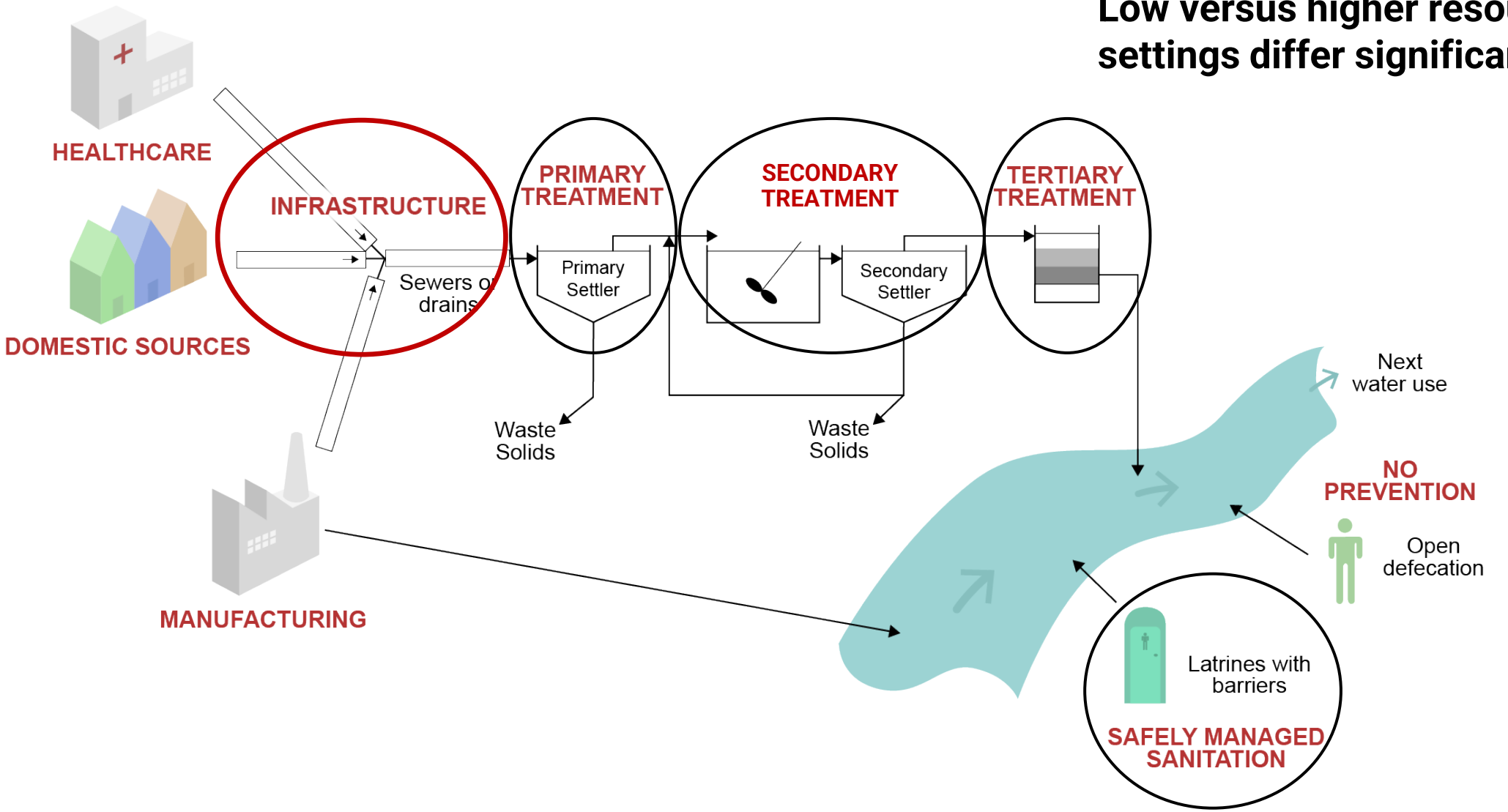
Adapted from Graham, Giesen and Bunce 2019, p. 3

Management options include:

- Increase wastewater containment, and optimize wastewater treatment and sludge management processes.
- Innovate, adapt and retrofit wastewater treatment options, including technologies for different resource settings.
- Identify technological “best buys” for each scenario.

Domestic, healthcare and manufacturing sources, and related wastes from a civil infrastructure perspective

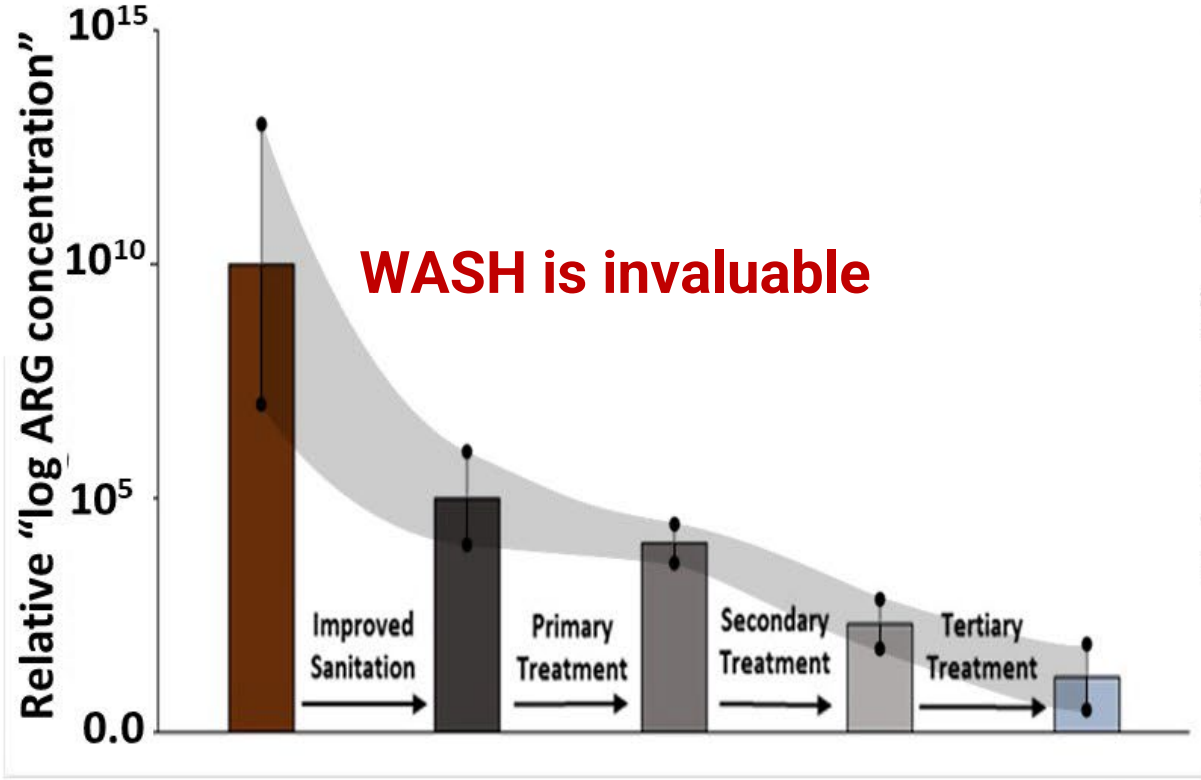
Low versus higher resource settings differ significantly



“Cost-benefit” of different waste management options – Best buys

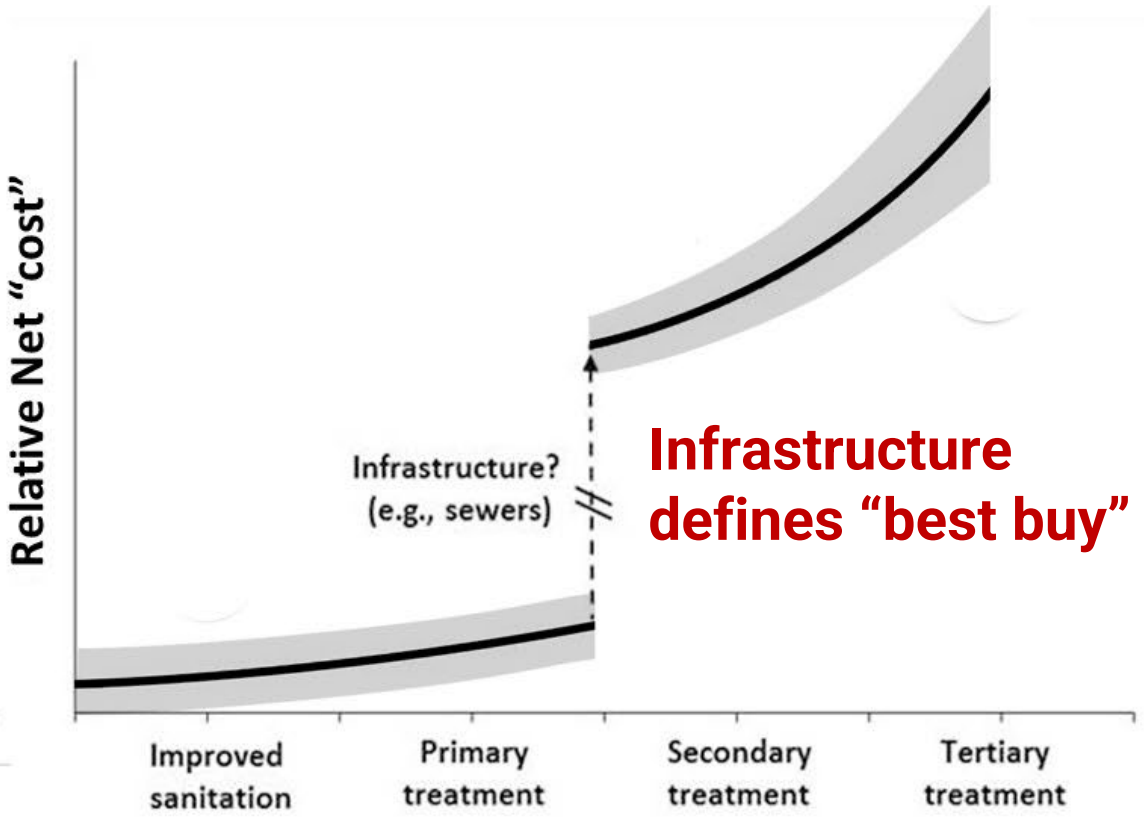
Optimal wastewater management depends on physical infrastructure

Reductions in AMR vs incremental increases in technology



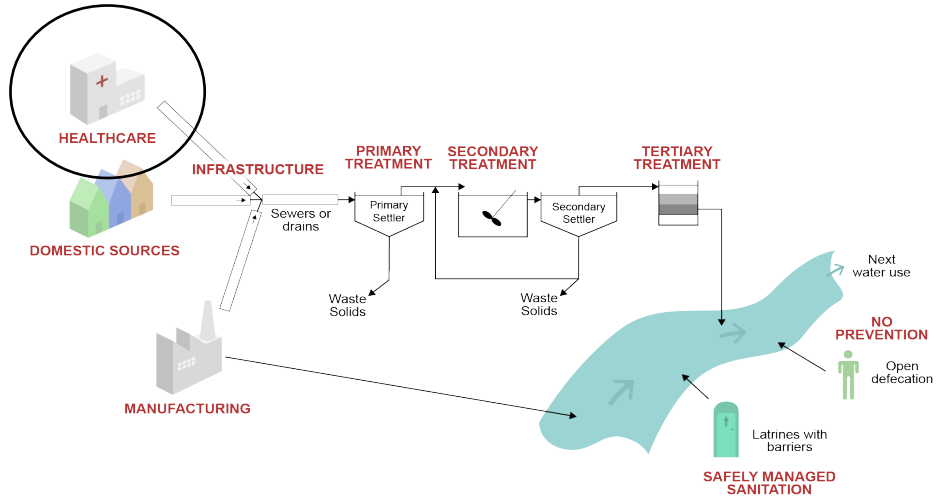
Graham et al. 2019. Strategic approach for prioritising local and regional sanitation interventions for reducing global antibiotic resistance. Water 11 (1):27.

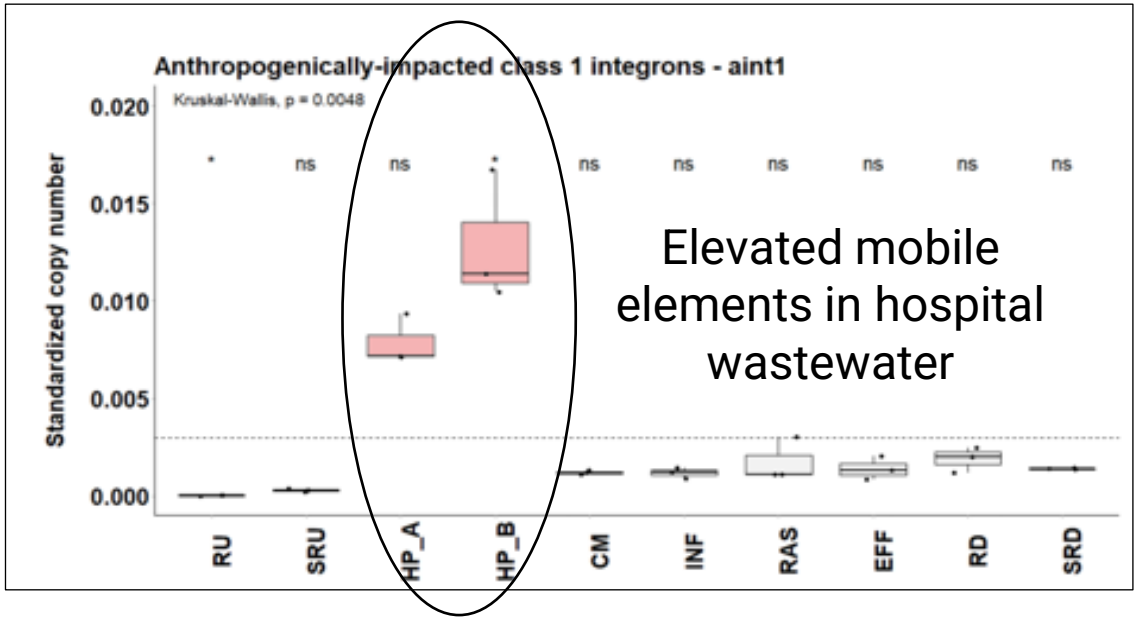
“Costs” greatly increase with technology employed



Healthcare wastewater releases are different

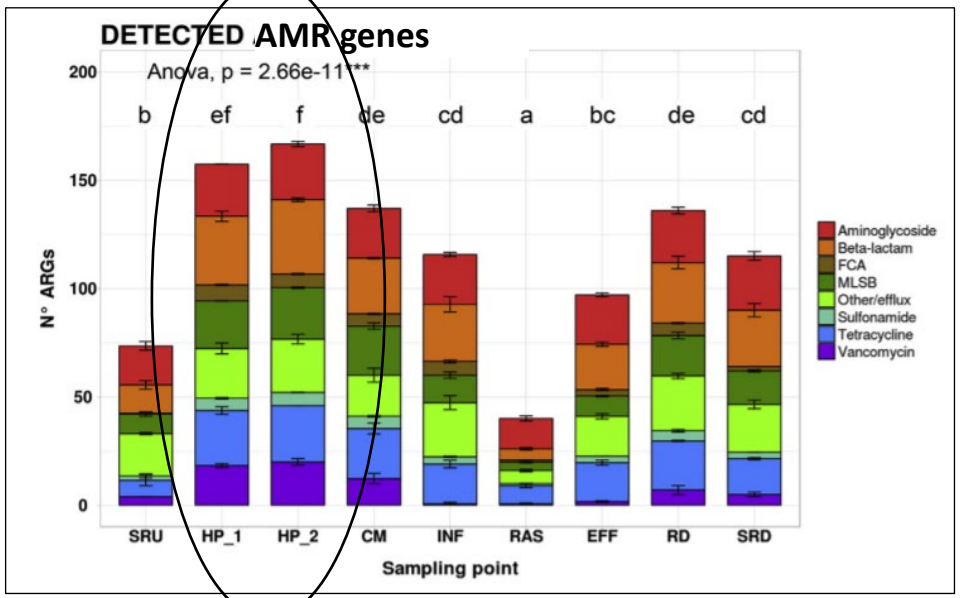
More mobile elements and AMR genes per microorganism, and extreme types of AMR





Elevated mobile elements in hospital wastewater

Relative diversity of AMR genes in hospital vs community wastewater



Quintela-Baluja et al. 2021. Dynamics of integron structures across a wastewater network – Implications to resistance gene transfer. *Wat. Res.* 206, 1 Nov 117720.

Healthcare activity and AMR releases to the environment

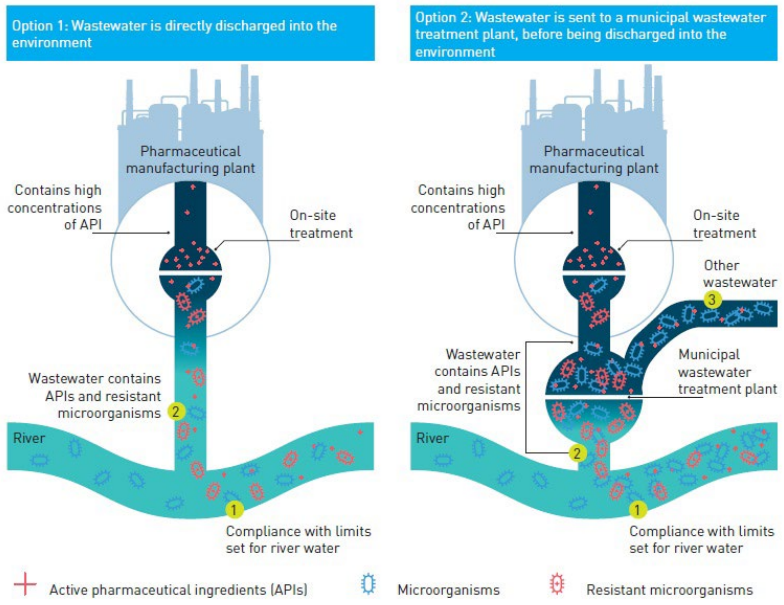
Healthcare facilities – Antimicrobial use, wastewater and effluents

Management options include:

- Consider AMR-targeted, on-site treatment of hospital wastewater to prevent spread into the environment.
- Ensure disposal and treatment of antimicrobial medicines and hazardous waste from facilities.
- Leverage hospital stewardship and infection prevention control programmes to limit environmental releases by AMR pollutants.

Manufacturing value chains and AMR in the environment

Green engineering and waste minimisation are top priority



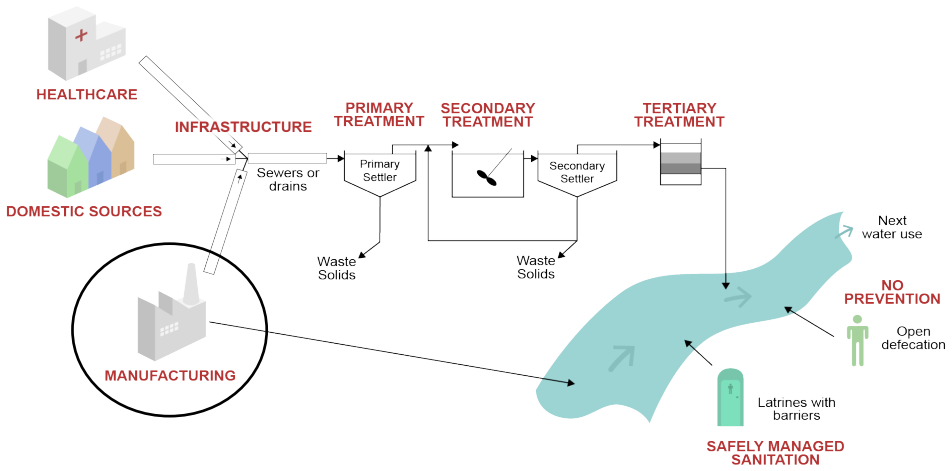
Adapted from access to Medicine Foundation 2021

Management options include:

- Green engineering and waste minimisation in standard operating procedures in antimicrobial production.
- Develop/enforce discharge targets/standards to cap AMR related discharges to the environment.
- Promote wastewater treatment technologies that reduce AMR released to the environment.
- Monitor residues, resistant microorganisms, AMR genes and mobile elements near facilities.

Address key value chains affecting AMR in the environment

Pharmaceutical manufacturing and other chemical value chains



Source-Directed Approaches:

- Engineer manufacturing processes to reduce, segregate, and treat wastes near source

Use-Oriented Approaches:

- Reduce the consumption of pharmaceutical agents and their subsequent excretion into the environment

End-of-Pipe Approaches:

- Remove pharmaceutical compounds before they enter the environment. Establish targets.

Priorities for action

- **More data & research** to understand significance and its contribution to AMR. Monitoring and surveillance

- **Priority actions**:
  - Strong focus on prevention and integrated surveillance to prioritise solutions
  - Identify “best buy” wastewater management options and promote global WASH
  - Establish international standards to guide risk reduction decisions
  - National governance, planning, regulatory and legal frameworks

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