Environment Protection Authority Victoria

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One Health Approach

What about the environment?

EPA acknowledges Aboriginal people as the first peoples and Traditional Custodians of the land and water on which we live, work and depend. We pay respect to Aboriginal Elders past and present and recognise the continuing connection to, and aspirations for Country.

Who are we?

Environment Protection Authority Victoria (EPA) is Victoria's environmental regulator.

We work with community, industry and business to prevent and reduce the harmful effects of pollution and waste on Victoria's environment and people.

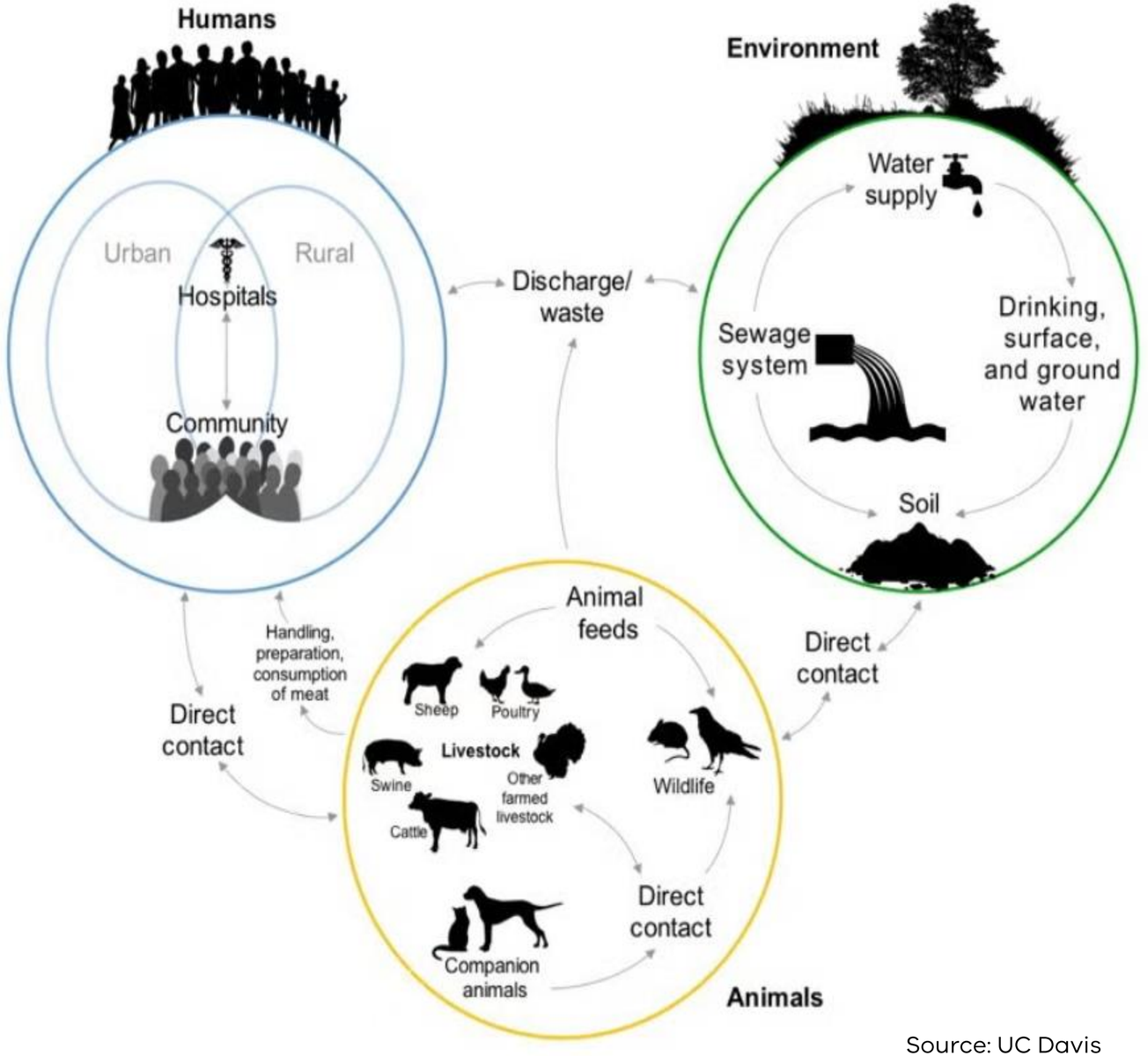
The environment is everyone's business.

epa.vic.gov.au

One Health Approach

One health is a unifying approach to balance and optimise the health of people, animals and ecosystems.

- Because the health of humans, domestic and wild animals, plants and the wider environment is closely linked and interdependent.
- Because we need clean water and air as well as safe food



Source: UC Davis

The environment is a reservoir

- Any substance consumed by humans and animals ends up excreted into the environment as parent molecules or metabolites
- Potential to contaminate groundwater, rivers, lakes, agricultural land
- Potential to react with other pollutants or exert selective pressure

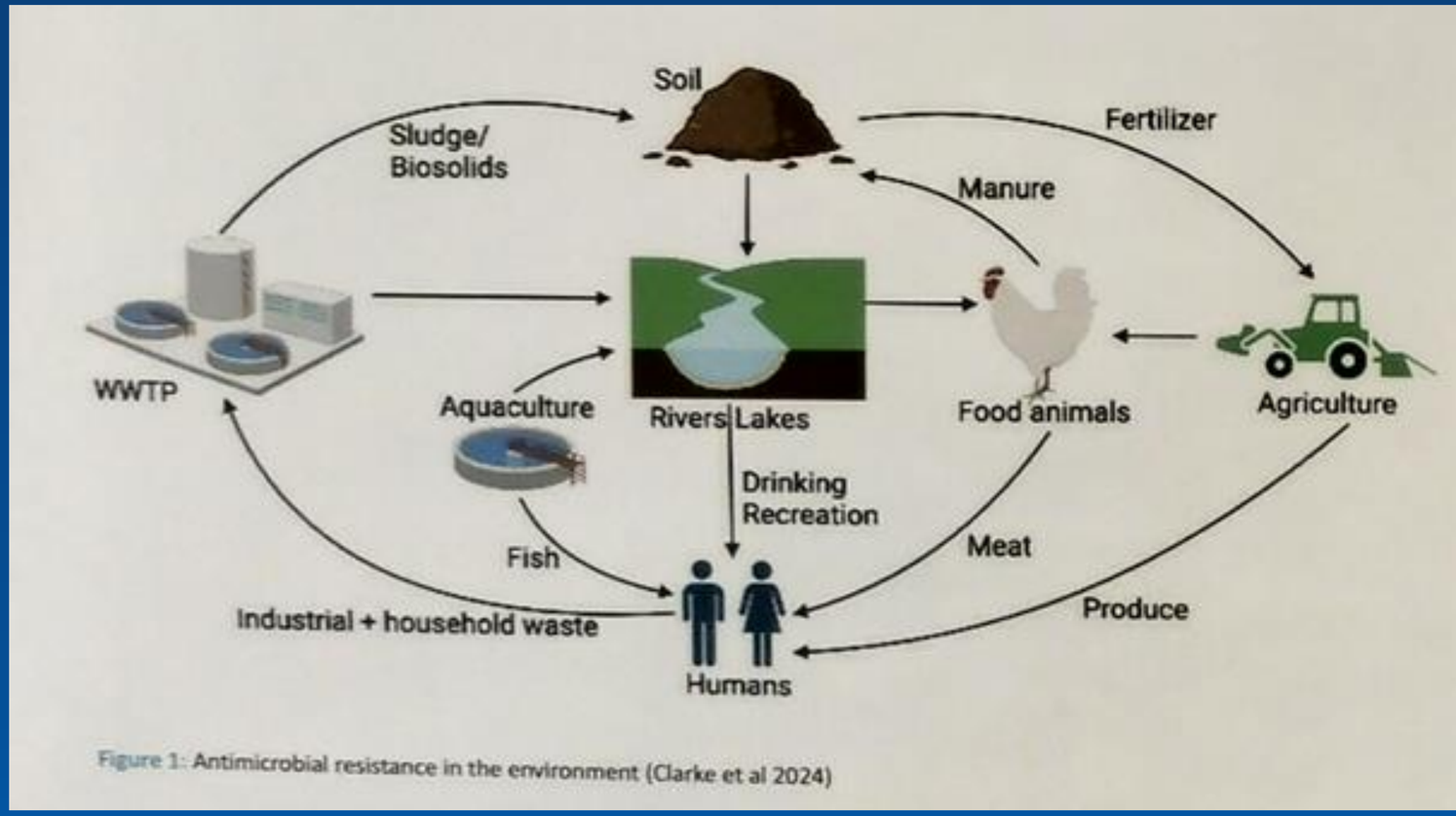


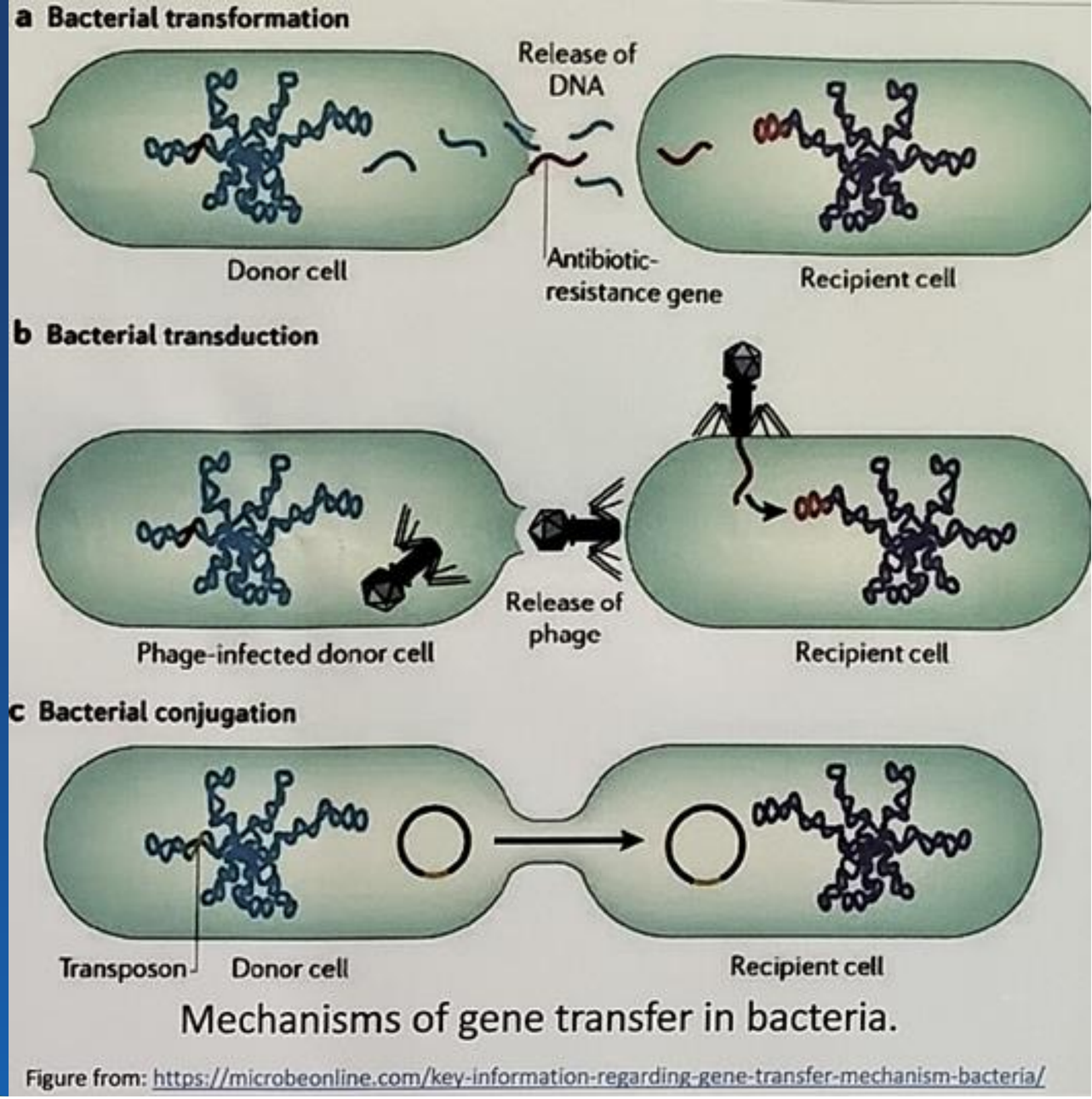
Figure 1: Antimicrobial resistance in the environment (Clarke et al 2024)

The Super Bug example: AMR

The environmental microbial world is a reservoir of genetic material:

- under anthropogenic pressures
- prone to environmental dispersal
- the environment itself may play a key role in AMR generation and persistence.

As a result, the environment also plays a crucial role in the development, transmission and spread of AMR



Mechanisms of gene transfer in bacteria.

Figure from: https://microbeonline.com/key-information-regarding-gene-transfer-mechanism-bacteria/

A few statistics about AMR

In Australia

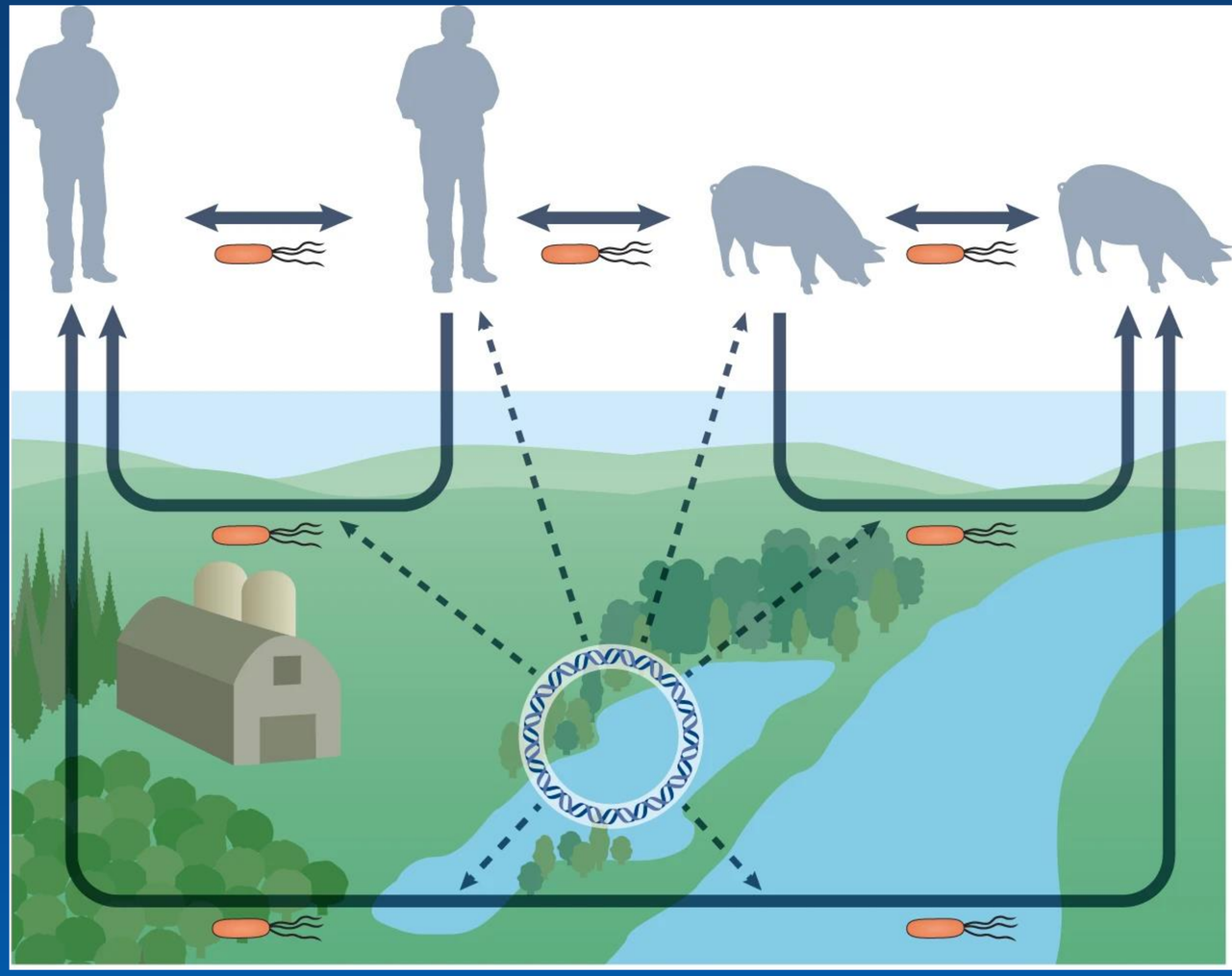
- 21,663 AMR infections in hospitals per year
- 70% are UTIs
- Cost: over 500 million dollars (loss of quality adjusted life years and direct hospital costs)

And it is not going to get any better…

In 2050: more deaths globally due to AMR than all cancers combined

Pathways for transmission of human opportunistic pathogens and recruitment of resistance genes from the environmental microbiota

Transmission of pathogenic bacteria between humans, between animals or between humans and animals (either direct or via the environment):	Uptake of new resistance factors from the diverse environmental microbiota:
• Common	• Relatively rare
• Risks are in principle quantifiable and predictable	• More challenging to predict
• Consequences of each transmission event are limited	• Consequences of single transfer events may be vast
• Transmission rates can be reduced	• Irreversible



What are the environmental regulations important for solving AMR?

Human and animal health are only parts of the equation

AMR is the response of microorganisms to a change in the environment.

Conventional germ theory does not take that into account.

➔ Resolving the environment issues might also be part of the answer.

➔ Need for environmental interventions and regulatory actions.

- *Pesticide application increases the abundance of clinically relevant pathogens, chemical resistant genes and mobile genetic elements.*
- *Increase in frequency of cyanobacterial blooms due to eutrophication and climate change. They may help in the spread and diversity of AMR.*

Environment sector in a vacuum ?

Waste streams from human/animal /pharmaceutical origins

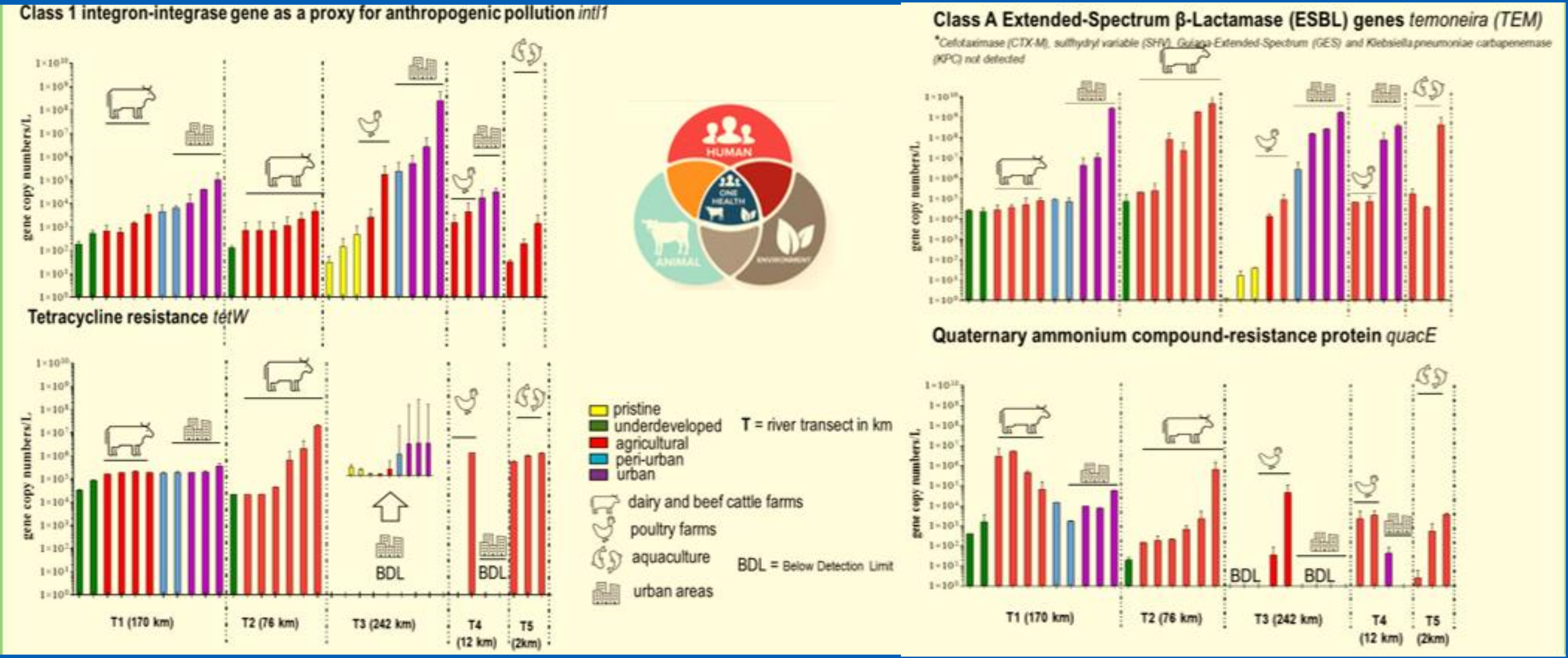
Solution = treatment to destroy pathogens and pharmaceutical residues ?

Challenge:

Antibiotics and chemicals promote resistance at very low and environmentally relevant concentrations but reducing emissions comes at a huge cost

➔ One Health Approach

AMR in Victorian rivers



Study across 50 Australian Wastewater Treatment plants

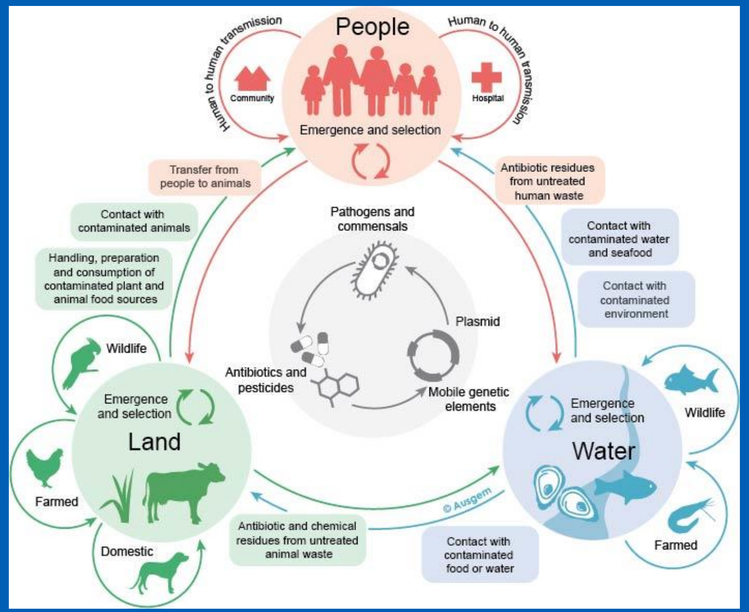
- All common antimicrobials (AMs) and their transformation products are ubiquitous in wastewater and biosolids
- 50 WWTPs release 5.4 kg/day or 0.54 g/day/1000 inhabitants of antimicrobials/transformation products in natural waters
- 7 AMs exerted potential for AMR emergence. Ciprofloxacin poses medium/high risks in most WWTPs
- Quinolones, nitroimidazoles, lincosamides and macrolide transformation products are poorly removed
- AM use (quinolones) is correlated with major socio-economic factors

GAPS

- Antibiotic stewardship is incomplete in dealing with entry of antibiotics into sewage (animal and human use, disposal)
- Link between sectors for food safety are poorly understood
- Limited guidance on potential for AMR and ARG development (during biological processes or in recycled water systems) and limited guidance in maximum AMR/ARG removal by treatment processes for waste and wastewaters.

Barriers

- Lack of coordination in the efforts against the rise of AMR with significant data silos across states and sectors
- Lack of harmonisation when it comes to testing.



No Guidelines for AMR/ARG in treated wastes reuse and treated wastewater discharges or recycled water.

They need to be based on demonstrated public health impacts.

Global response for a global issue

United Nations report ‘Bracing for Superbugs’

Recommendations

- Enhancing environmental governance, planning and regulatory framework
- Harmonized reporting, surveillance and monitoring
- Raising knowledge and awareness
- Financing innovation and sector engagement

Some more challenges

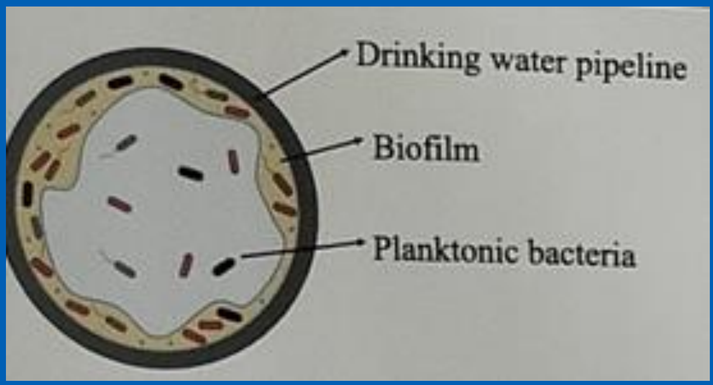
- AMR organisms and ARGs are detected consistently in source waters.
- Treated water supply networks are potential sources for AMR proliferation due to regrowth potential of AMR organisms after treatment.

Presence of opportunistic pathogens in aquatic environments with potential clinical transmission (for example *Elizabethkingia*) and other AMR pathogens such as *Campylobacter*.

However, AMR creation and persistence in aquatic environments is poorly understood.

Extended spectrum beta lactamase (ESBL) producing *E. coli* species thrive in wastewater environments

Chlorination stress can promote horizontal transfer of ARG within biofilms in water distribution systems.



Wish List

- Antimicrobial stewardship across all sectors (human, animal, plant health)
- Adequate waste and wastewater containment and treatment
- Limit agricultural antibiotic use and reduce discharge to protect water sources from pollutants, AMR organisms and antimicrobial residue contamination
- Harmonised surveillance approach across all one health sectors

ONE HEALTH APPROACH

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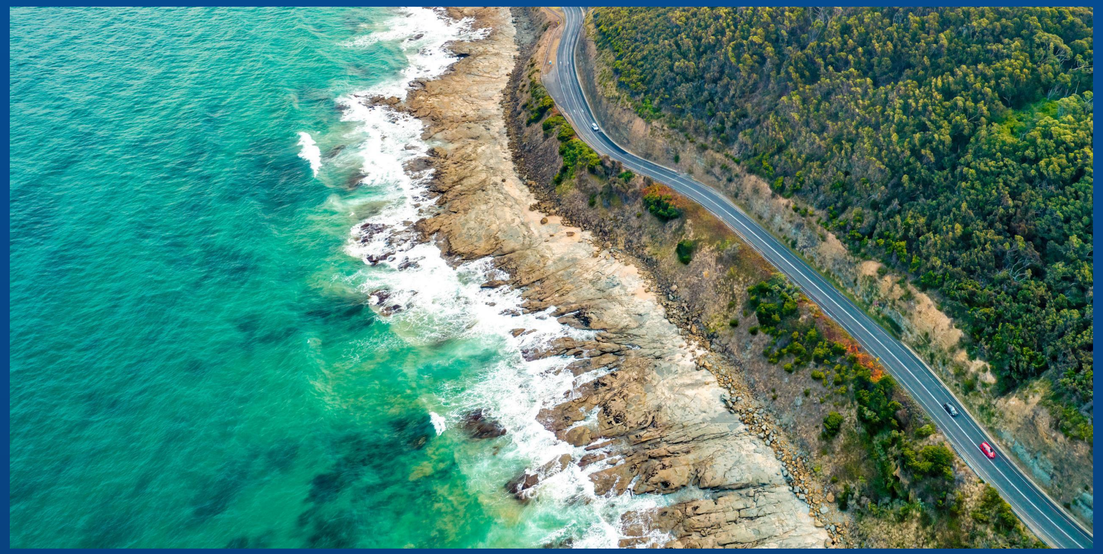

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