RISKS OF AMR IN THE ENVIRONMENT

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ABOUT US

We are a network of thousands of hospitals, healthcare leaders, and healthcare professionals, with members across Europe and partners across the globe.

Together we prove that it's possible to deliver the highest quality of care in a way that's sustainable environmentally and financially.

ENVIRONMENTAL IMPACT OF ANTIBIOTICS

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Ecological impacts of antibiotics in the environment

Antibiotics can affect natural microbial communities

Microbial communities play a key role in fundamental ecological processes, most importantly the **maintenance of soil fertility and water quality.**

Which processes can be affected by antibiotics in soil?

- Alter the enzyme activity, carbon source metabolism, carbon mineralization, key biochemical processes (nitrogen cycling) of microorganisms present in soil. (1)

➔ **Soil fertility**

Non-sorbed or undegraded antibiotics can be absorbed by plants.

- Alter biomass production, chlorophyll synthesis, number of leaves, root ratio...
- **Health risk to humans** → allergic reactions, chronic toxicities, digestive dysfunction, among others (2)

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1 Cycoń, M. et al.(2019) Antibiotics in the soil environment—degradation and their impact on microbial activity and diversit
2 Achal, V. (2023). Ecological and societal impacts of antibiotics pollution in China

What impact do antibiotics have in water?

Environmentally relevant concentration of antibiotics in the water ecosystems can interfere with:

- nitrogen cycling (3)
- the normal function of phosphorus-solubilizing bacteria (4)

➔ May result in biodiversity loss

More (consistent) research is needed to assess the ecological impacts of antibiotics

3 DeVries S.L.et al. (2016) Antibiotics and the Terrestrial Nitrogen Cycle: A Review.
4 Liang Y. et al. (2013) Phosphate-solubilizing bacteria resistance research to seven common antibiotics

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The environment as a reservoir for antibiotic resistant microorganisms

The environment can act as a reservoir of antibiotic resistant bacteria and play a role in the dissemination of resistant genes (5)

Pollution from pharmaceutical manufacturing, food production, community and healthcare settings spreads resistant microbes to our shared environment. (6)

Horizontal gene transfer→ potential pathogens can acquire antimicrobial resistance genes .

Studies suggest that **wastewater** significant environmental reservoir of AMR (7)

- Ideal environment for AMR bacteria and antimicrobial resistant genes to persist.
- Wastewater treatment can **reduce resistant bacteria load but cannot stop horizontal gene transfer.**
- The processing of human, farm and industrial waste together → significant impact on the emergence of AMR

AMR reservoirs may affect each other - it's important to understand the interactions between them - One Health Approach (8)

5 Samreen, I. et al. (2022) Environmental antimicrobial resistance and its drivers: a potential threat to public health

6 UNEP (2022). Environmental Dimensions of Antimicrobial Resistance: Summary for Policymakers.

7 Fouz, N. et al. (2020). The contribution of wastewater to the transmission of antimicrobial resistance in the environment: implications of mass gathering settings.

8 Despotovic, M.et al. (2023). Reservoirs of antimicrobial resistance in the context of One Health.

9 Nolan, TM. et al. (2023) Bacteriophages from faecal contamination are an important reservoir for AMR in aquatic environments.

Bacteriophages from faecal contamination ➜ important reservoir for AMR in aquatic environments (9)

- Faecal contamination may lead to increased AMR levels
- Phage particles harbouring ARG may enter human and animals through ingestion of contaminated water or food

THREE MAIN CONTRIBUTORS TO ANTIBIOTIC DISCHARGES IN THE ENVIRONMENT

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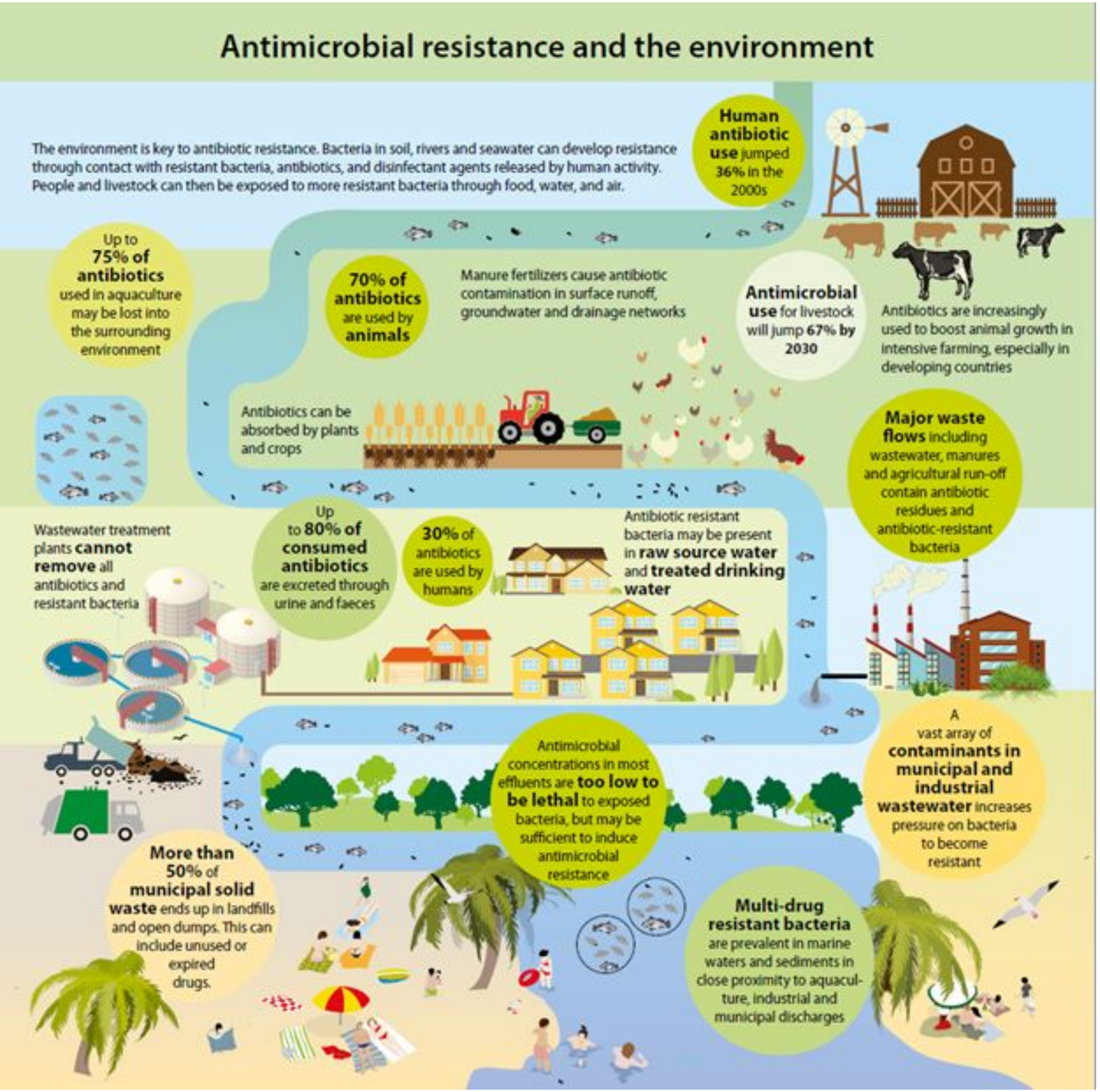

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Source. UNEP 2020

1. PHARMACEUTICAL MANUFACTURING

The pharmaceutical industry is considered largely an unregulated sector in terms of environmental pollution (10)

Untreated discharge – levels of antimicrobial mixtures in exposed surface waters (11, 12)

Studies have confirmed antibiotic residues in effluents, municipal wastewaters, surface waters, and groundwater around the pharmaceutical manufacturing sites (13, 14)

There are limited proven treatment options for pharmaceutical wastewater before release to the environment

10 UNEP (2023) Bracing for superbugs report
11 Graham, D.W. et al. (2011). Antibiotic resistance gene abundances associated with waste discharges to the Almendares River near Havana, Cuba.
12 Larsson, D.G.J.et al. (2007). Effluent from drug manufactures contains extremely high levels of pharmaceuticals
13 Tong L, et al (2020). Antibiotic resistance gene profiling in response to antibiotic usage and environmental factors in the surface water and groundwater of Honghu Lake, China
14 Deschamps, E. et al. (2012) Management of Effluents and Waste from Pharmaceutical Industry in Minas Gerais, Brazil.

2. HEALTHCARE DELIVERY

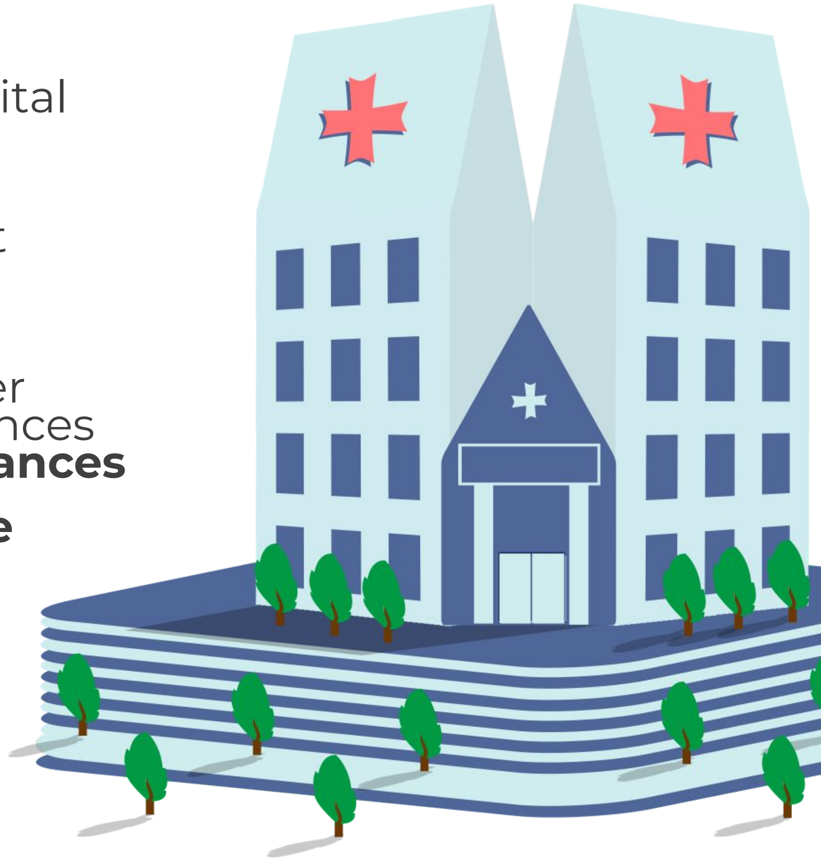
It is estimated that 30%-90% of orally administered pharmaceuticals are excreted into wastewater as active substances in the faeces and urine of patients (15)

20%-30% of inpatients receive an antibiotic treatment during their hospital stay. (16)

High-risk point sources: The proportion of resistance genes or resistant bacteria is usually higher in hospital wastewater than in household wastewater – last resort (17)

Removal rates in wastewater plants range from 0%- 87% (18). Wastewater treatment plants primarily designed to eliminate biodegradable substances and nutrients – **not able to completely remove pharmaceutical substances**

Residues discharged via effluent into surface waters – **Enter water cycle**



15 Lockwood, S. et al. (2016) Options for a strategic approach to pharmaceuticals in the environment.
16 Hocquet, D. et al. (2016) What happens in hospitals does not stay in hospitals: Antibiotic-resistant bacteria in hospital wastewater systems.
17 Paulus, G. K. et al. (2019) The impact of on-site hospital wastewater treatment on the downstream communal wastewater system in terms of antibiotics and antibiotic resistance genes.
18 Deblonde, T. et al. (2011) Emerging pollutants in wastewater: A review of the literature.

HOW TO TO REDUCE ENVIRONMENTAL IMPACT OF AMC IN HEALTHCARE?

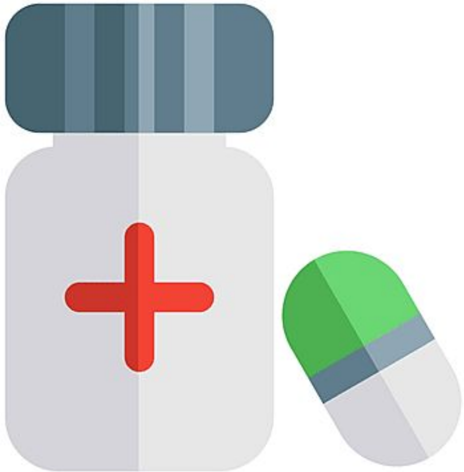
No easy fix...

1 Improve antibiotic prescription. Train healthcare professionals

2 Green procurement practices.

3 Establish protocols to safely dispose pharmaceutical waste... and follow them

4 We need build the understanding of healthcare professionals on their impact on environmental health.



AMR EDUCare

3. FOOD PRODUCTION

Animals → Around ⅔ of the total use of antimicrobials worlwide (19). Way lower in the EU!

Evidence of drug resistance in waterways near poultry and pig farms and in cattle farm waste (20)

Interventions that reduce antibiotic use in farm animals could decrease antibiotic-resistant bacteria and multidrug-resistant bacteria in animals by 15% and 24–32% respectively (21)

Increasing animal welfare standards can decrease the need for antibiotics (22)

The EU can play a leading role in the reduction of antimicrobial use in farming globally - UNGA HLM on AMR

19 Van Boeckel, TP. et al. (2017) Reducing antimicrobial use in food animals.
20 Alliance to Save Our Antibiotics; WAP (2022)Life-threatening superbugs: how factory farm pollution risks human health
21 Tang, K. L.,et al. (2017). Restricting the use of antibiotics in food-producing animals and its associations with antibiotic resistance in food-producing animals and human beings: a systematic review and meta-analysis
22 HCWH. (2023) Improve animal welfare to ensure responsible use of antibiotics

KEY TAKEAWAYS

Ecological impacts of antibiotics in the environment:

- Can affect soil fertility
- Can produce biodiversity loss in aquatic ecosystems
- More research is needed

Environment as a reservoir of AMR:

- Wastewater is a significant environmental reservoir for ARG
- One Health Approach is key to understand interactions

Main actions to **reduce antibiotic discharge** into the environment:

- Improve transparency in the supply chain (green procurement) and set discharge targets
- Improve antibiotic stewardship in humans and animals and establish strong protocols for management of waste (Wastewater)
- Reduce the need for antibiotics in farming increasing animal welfare and end routine preventative use of antimicrobials
  - EU to lead by example and become a key actor in the UNGA HLM on AMR to reduce antimicrobial use in farmed animals globally

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