2022 EU CONFERENCE

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HEALTH • ENVIRONMENT • SOCIETY

Antimicrobial Resistance in Food-producing Environments

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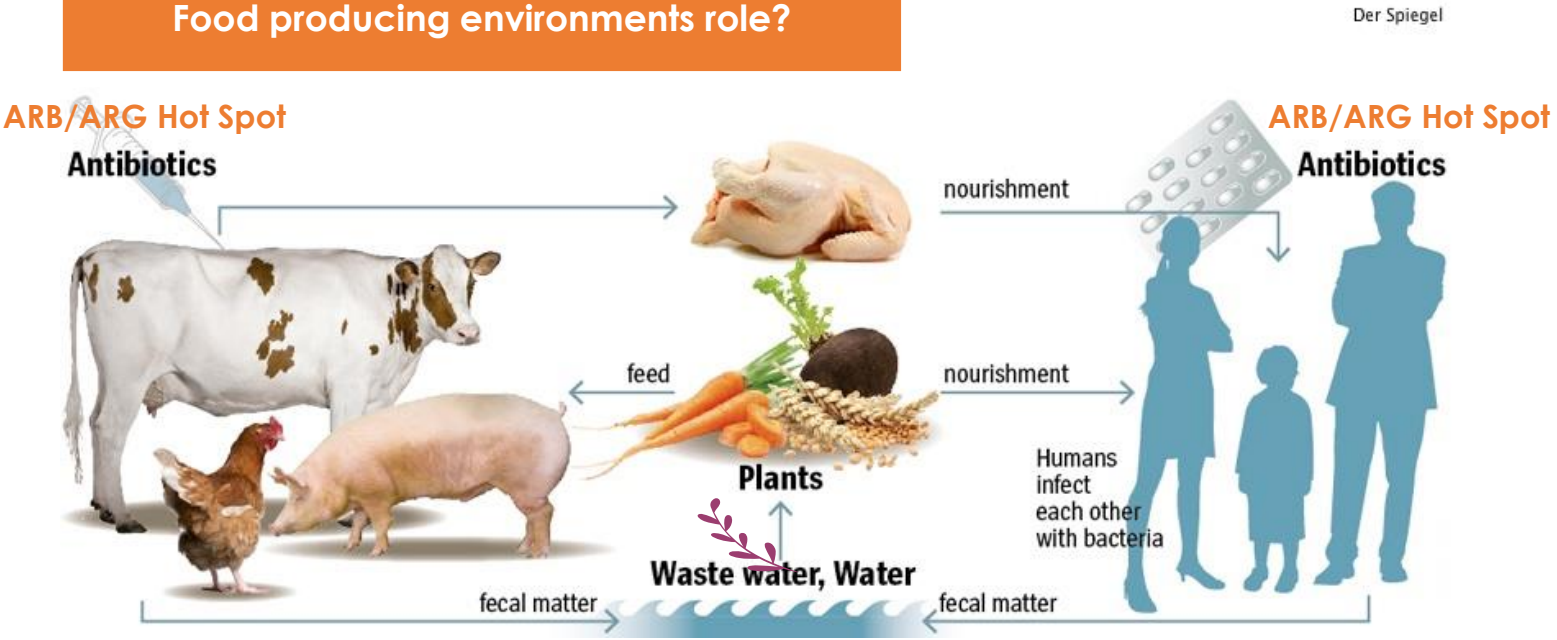
Main settings of Antimicrobial Resistance Emergence and Spread in Europe

Food producing environments role?



Need to improve scientific understanding of food-producing environments role in ABR/AGR emergence and spread (EC AMR actions plans)

ARB: antimicrobial resistance bacteria
ARGs: antimicrobial resistance genes

SCIENTIFIC OPINION

EFSA Journal

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Role played by the environment in the emergence and spread of antimicrobial resistance (AMR) through the food chain

EFSA Panel on Biological Hazards (BIOHAZ),
Konstantinos Koutsoumanis, Ana Allende, Avelino Alvarez-Ordonez, Declan Bolton, Sara Bover-Cid, Marianne Chemaly, Robert Davies, Alessandra De Cesare, Lieve Herman, Friederike Hilbert, Roland Lindqvist, Maarten Nauta, Giuseppe Ru, Marion Simmons, Panagiotis Skandamis, Elisabetta Suffredini, Hector Arguello, Thomas Berendonk, Lina Maria Cavaco, William Gaze, Heike Schmitt, Ed Topp, Beatriz Guerra, Ernesto Liebana, Pietro Stella and Luisa Peixe

https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2021.6651

European Food Safety Authority

In line with the EC AMR Action Plan

Self-task of the EFSA BIOHAZ Panel
In close collaboration with:

European Medicines Agency
Science Medicines Health

ecdc
European Centre for Disease Prevention and Control

European Environment Agency

European Commission

Terms of Reference

1 **Sources and transmission routes**

2 **ARB/ARG of highest priority for public health &**
Risk factors influencing their occurrence and persistence

Highest priority bacteria: Pathogenicity potential and resistance to last resort antibiotics (in MGE for commensals)

3 **Mitigations/strategies options**

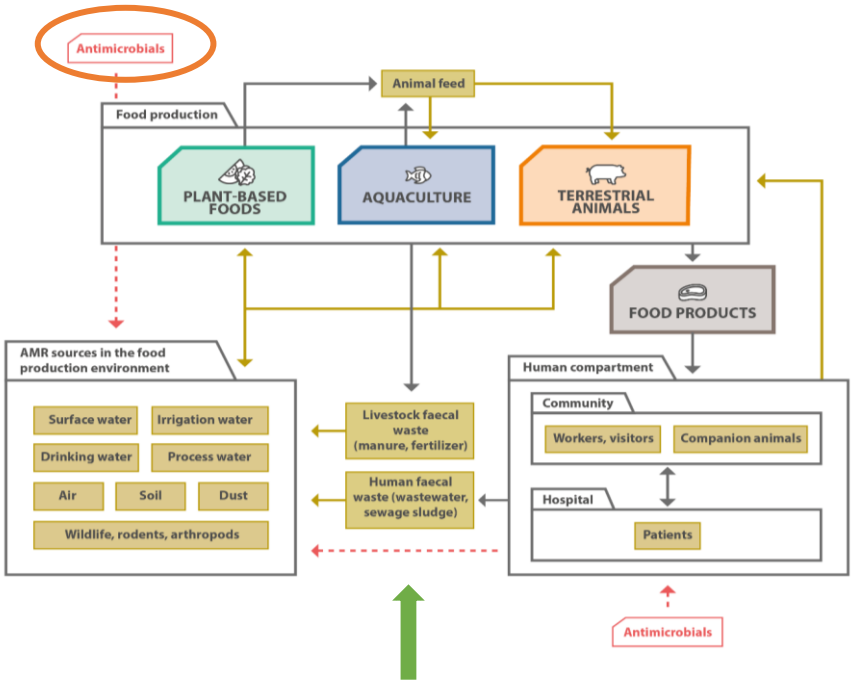
4 **Data gaps influencing the assessment &**
EU research priorities

Food sectors:

- **Plant-based food production (fruits, vegetables and other crops)**
- **Terrestrial animal production (poultry, cattle and pigs)**
- **Aquaculture (finfish, shellfish)**

ARB: antimicrobial resistance bacteria
ARGs: antimicrobial resistance genes

1 Sources and Transmission routes of AMR (ARB and ARGs)

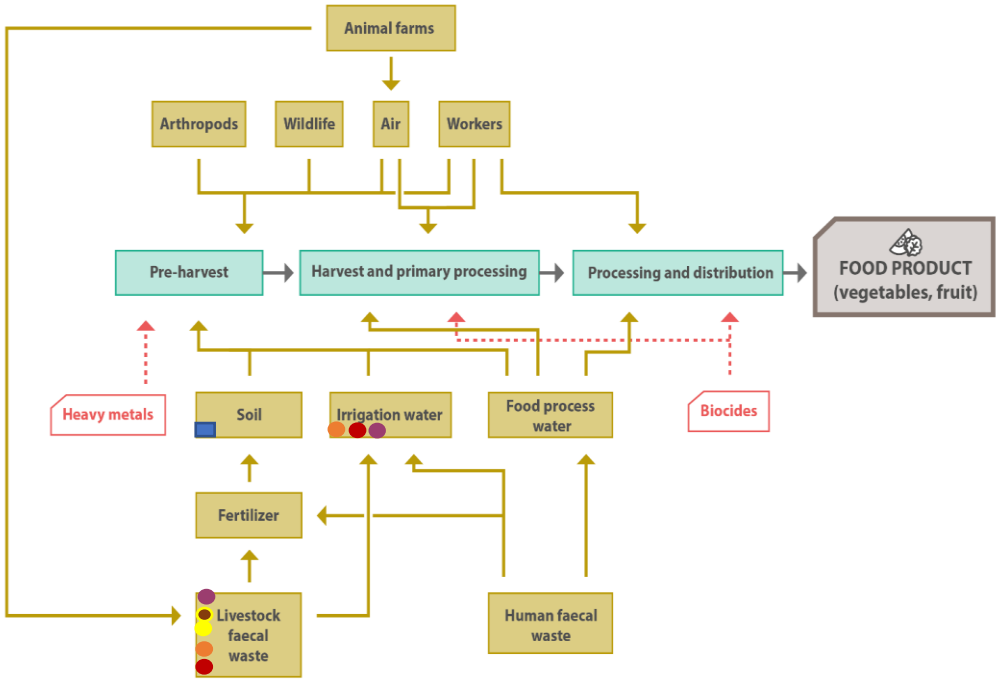


- Food-producing sectors **linked** with human, animal and environmental **ARB/ARGs sources** in a **cyclical manner.**
- **ARBs/ ARGs present in all sources and sectors** (fewer data for plants and aquaculture)
- **Most important source: faecal waste (↑)** human and animal) (e.g. through **fertilisers** and **irrigation water** in plants**; water** in aquaculture)

- Large data gaps (e.g. **sources** and **transmission routes**, **diversity** and **quantity** of ARB and ARGs/MGEs)
  e.g. testing strategies limited the detection of some ARB/ARG (e.g. carbapenem-resistant Enterobacterales*)*
- **Introduction** of ARB and ARG from **most environmental sources** into **the production chain not demonstrated**

ARB: antimicrobial resistance bacteria
ARGs: antimicrobial resistance genes

Plant-based food sources/routes of AMR (ARB and ARGs)



Major source and transmission routes: fertilisation and irrigation (of faecal origin- e.g. manure, irrigation and surface water).

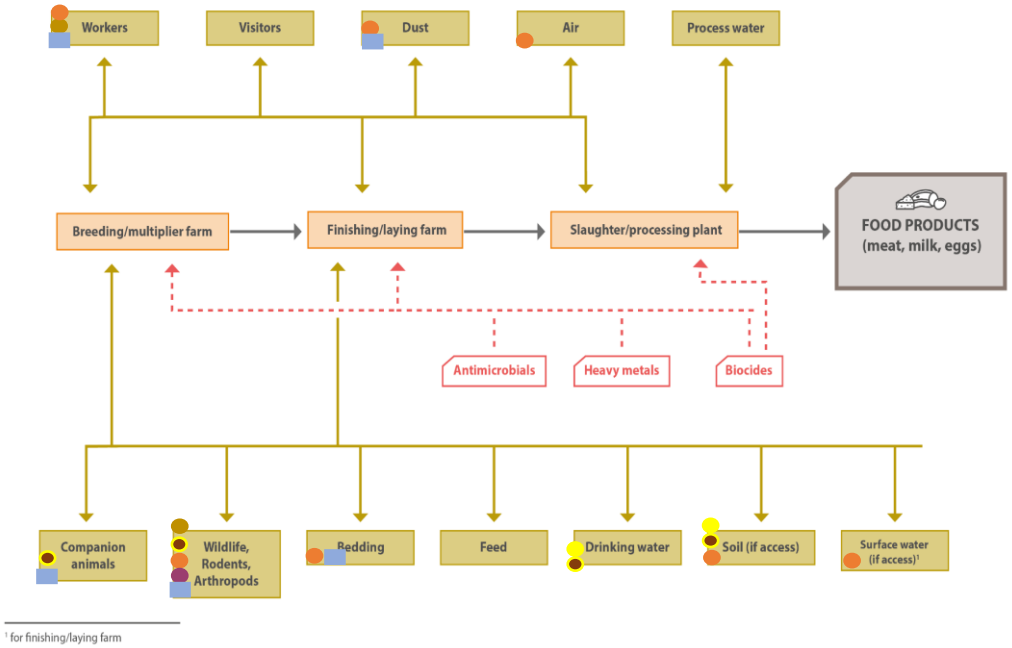
Potential sources: soil, dust, farm animals, wildlife, arthropods, workers, equipment and process water.

ABR/AGR contamination influenced by **crops characteristics** & **agricultural practices** (e.g. reclaimed water, used as irrigation water in arid areas).

Few studies on **Highly priority** ARB/ARG occurrence (examples in the figure).

PLANT-BASED FOODS

Terrestrial animals sources/routes of AMR (ARB and ARGs)

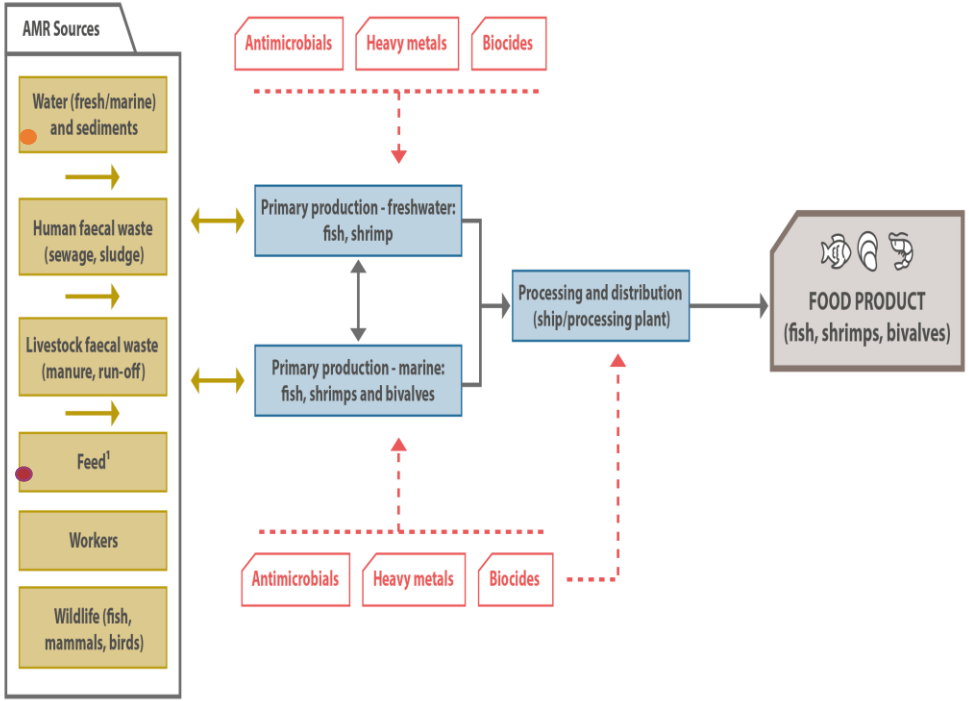


- Florquinolone-resistant *Salmonella enterica*.
- Florquinolone-resistant *Campylobacter* sp.
- Vancomycin-resistant *E. faecalis*
- Vancomycin-resistant *E. faecium*
- Extended spectrum cephalosporins resistant *E. coli*
- Colistin- resistant *E. coli (mcr-1)*
- Carbapenem-resistant Gram-
- Carbapenemase gene
- *mecA*

- Most important source: animal faecal waste
- **Other sources:** Feed, farm workers, air/dust, rodents, animal transport, equipment and visitors
- **Other potential sources:** pastures, soil, surface water, drinking water, wildlife or other domestic animal species.
  - higher relevance for animals kept outdoor as compared to closed facilities.
- **Highly priority** ARB/ARG in different environmental sources (examples in the figure). Limitations due to methodology strategy.

TERRESTRIAL ANIMALS

Aquaculture sources/routes of AMR (ARB and ARGs)



- **Sources:** Water (contaminated with human and animal faecal material), and associated sediments, and feed.
- **Potential sources:** wildlife, workers, ice and equipment.
- **Main transmission route:** water
- **Few** data on **highly priority ARB/ARG** (examples in the figure)

AQUACULTURE

Risk factors for occurrence and persistence of highest priority ARB/ARG

- **General factors:**
  - **Selective pressure** animal/ environmental microbiomes.
  - Inadequate definition/ implementation of **biosecurity measures**,

- **Bacterial traits:**
  - Resilience/stress response, biofilm formation, **ARG transferability**, **ARG co-localization same platform**, **metal/biocide tolerance**, reduction of fitness costs mechanisms, etc).

- **Replacement of animals** and **persistent environmental contamination**.

- **Microbiota of natural environments** (soil, water) is a natural reservoir and source of ARGs that could also contribute

3 Mitigation/strategies options

Apart from **prudent antimicrobial use** (AMU)…

- Correct implementation of **effective general measures** (good hygiene practices, biosecurity).
- **Biological methodologies** focusing on ARB/ ARGs (e.g. CRISPR-Cas, phages) are in the **early phase of research and development**.
- **Priority for intervention**: reducing **faecal contamination** (e.g. wastewater treatment, reducing raw sewage discharges). Priority for plant production and aquaculture.

EU Urgent Research Priorities

- **One Health-based integrated studies** & **surveillance**.

- **Long-term longitudinal cohort** studies (using **quantitative** microbiology, metagenomics).
  - Priority: **emerging highest priority ARBs/ARGs**

- **Validation of practical efficacy of mitigation methods on ARBs/ARGs contamination.**
  - e.g. animal feed &faecal waste treatment

- Studies linked to **assessment of the effect of recent and future policy developments** (e.g. within the EU Green Deal, Circular Economy, and Veterinary Medicines products Regulation (EU) 2019/6) affecting **food producing environments**, **antimicrobial use** and **climate change impacts**.

Take home message

ARBs/ARGs, present in all sources and sectors

Highly priority ABR/AGR in several sources and all sectors
Dimension of the problem (quantification/types)unknown.
Impact in Public Health mostly unknown

Priority for intervention

Biosecurity
Antimicrobial use reduction in humans and animals
Reducing faecal contamination (e.g. wastewater treatment)
Sustainable new productions

One Health-based integrated studies & **surveillance** (specially targeting Highly priority ABR/AGR)

Assessing effectiveness of recent and future EU policy developments potentially affecting AMR

Thanks for your attention!

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