QMRA model to assess the human exposure to ESBL *E. coli* from poultry production through different environmental pathways

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CONTEXT

PROJECT ENVIRE

CONSORTIUM AND FUNDING

- Project duration: 2022-2025
- Germany, France, Lithuania, Poland, Tunisia
- Funded by the European Transnational Programme - JPIAMR-ACTION

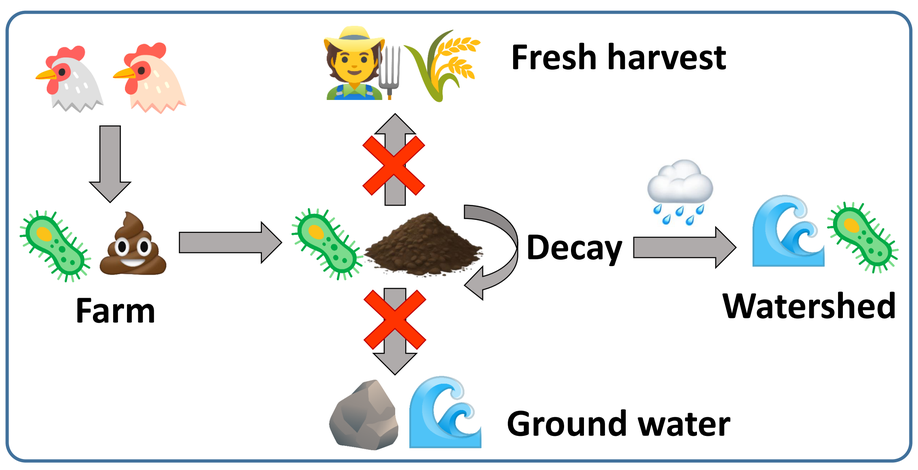
OBJECTIVES

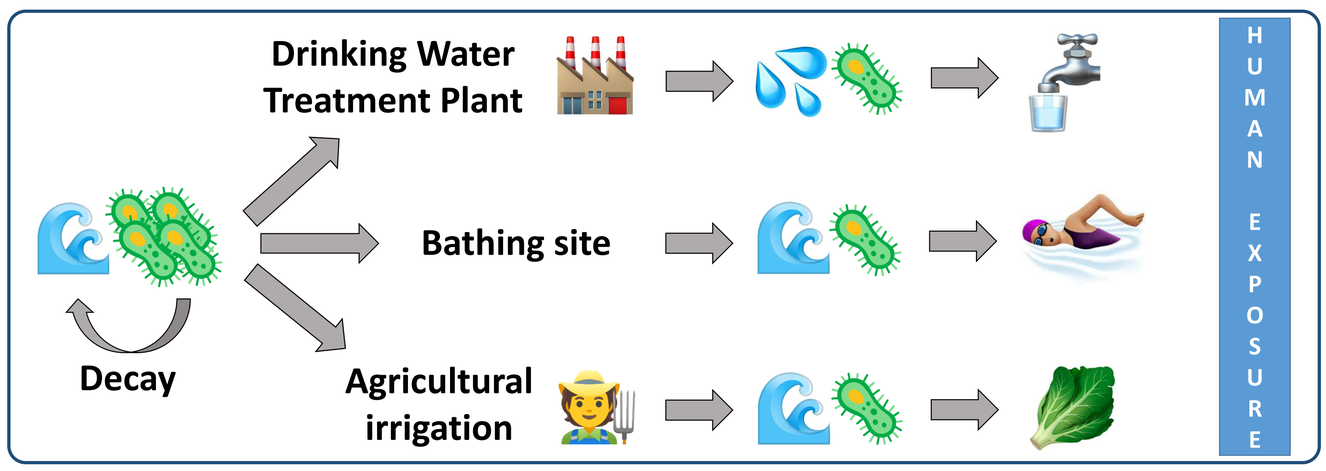
- Reduce antimicrobial-resistant (AMR) bacteria spread from broiler chickens
- Investigate the potential of various on-farm intervention measures
- Reduce transmission and human exposure to ESBL *E. coli* from broiler chicken

WORKFLOW – WP 3

- Quantitative Risk Assessment with pathways:
  - FOOD-BORNE
  - ENVIRONMENTAL ✅
  - OCCUPATIONAL
- Incorporate on-farm intervention measures

MATERIALS & METHODS ENVIRONMENTAL PATHWAYS ✅





WATERSHED CONTAMINATION

DYNAMICS of ESBL *E. coli* in environment

Poultry manure is used in agricultural lands
Surface runoff carries ESBL *E. coli* to nearby watershed
Watershed is contaminated from manure **c.f.** Sowah et al. (2020)
NO evidence: soil to fresh harvest contamination
NO evidence: soil to ground water contamination

DYNAMICS of ESBL *E. coli* in manure ➡ soil ➡ watershed

Bacteria decay in soil Merchant et al. (2012), Phang et al. (2020)
Bacteria transport from soil to watershed Neitsch et al. (2011)
⚠ **Work in Progress:** Anaerobic digestion of poultry manure

TRANSMISSION PATHWAYS

Dynamics of ESBL *E. coli* in contaminated watershed Mancini (1978)

- Decay in ESBL *E. coli* population due to environmental factors

Decay rate k := ***f*** (temperature, radiation, salinity, light extinction, water depth)

- Final *E. coli* concentration is based on time elasped before water usage

Transmission pathways:

c.f. O'Flaherty et al. (2018, 2019)

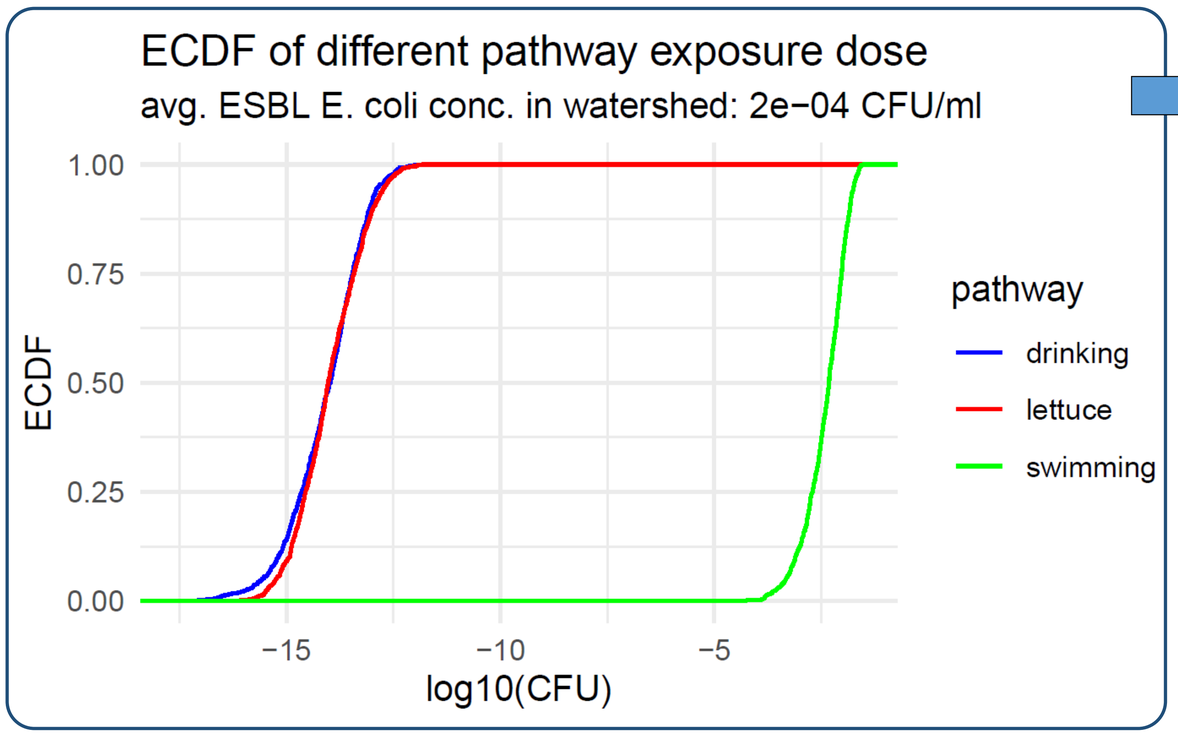
1. Drinkng water treatement
2. Swimming in bathing sites
3. Agricultural harvest irrigation

Human exposure to ESBL *E. coli*:

- 100 ml of tap water consumption
- 1h of swimming (*accidental ingestion*)
- 100 g of fresh lettuce consumption

Probability of human ESBL *E. coli* carriage
PDR: Dose-response Furusawa et al. (2024)

RESULTS & PERSPECTIVES



Relative impact of different environmental pathways

1000 Monte Carlo simulations estimated the different pathway exposure

- Recreational swimming has highest exposure among all 3 pathways
- Tap water & lettuce consumption has much less exposure

NB: **Soil – watershed dynamics of ESBL *E. coli* uses** Sowah et al. (2020)
Based on a simplified version of Neitsch et al. (2011) SWAT model

QRA module perspectives

Validation: Compare to existing literature O'Flaherty et al. (2018, 2019)
Robustness: Application of a **SWAT** model for user defined geography
Future work: Integration of anaerobic digestion experimental data

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