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Emerging Pollutants: Protecting Water Quality for the Health of People and the Environment

Antibiotic resistance in aquatic environments: Priorities and knowledge for water quality modelling

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Programme hydrologique intergouvernemental

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GLOBAL ANTIBIOTIC CONSUMPTION (HUMAN USE)

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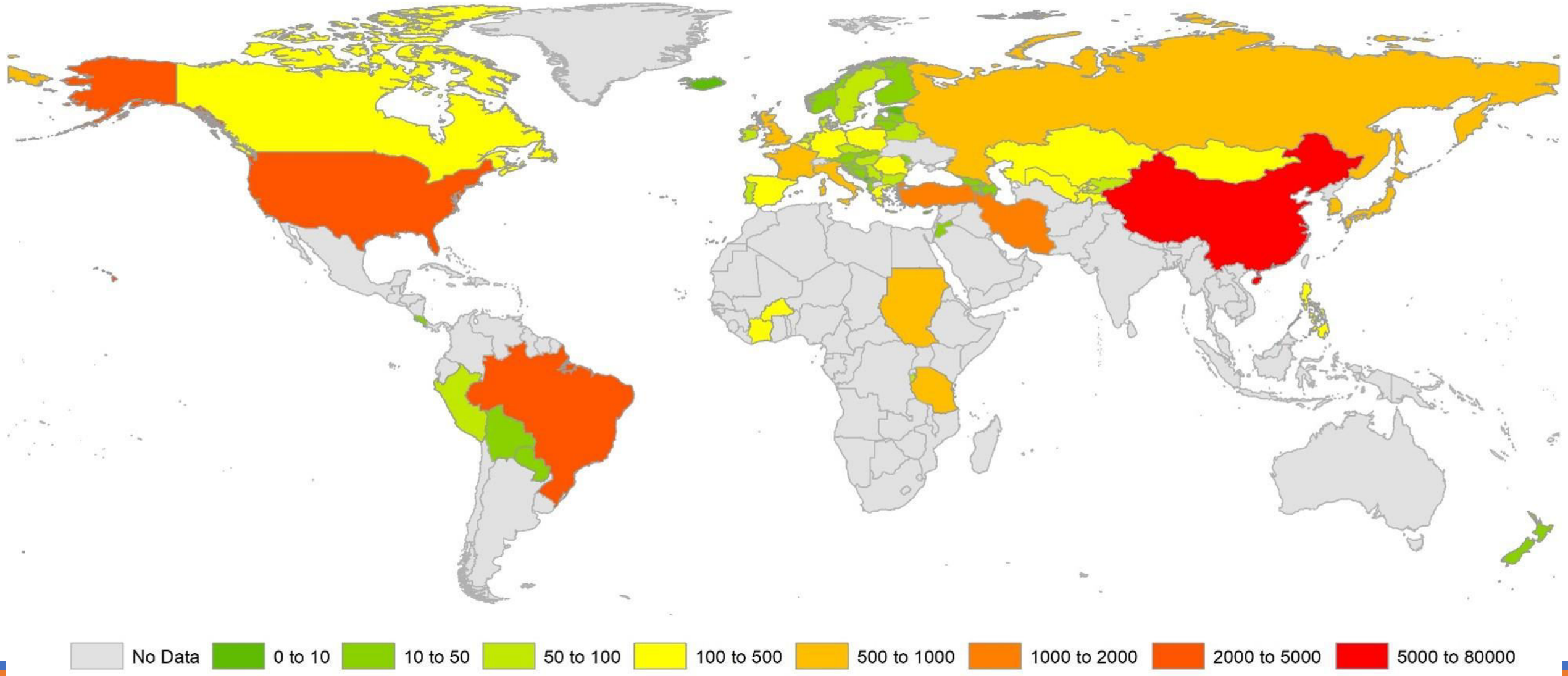
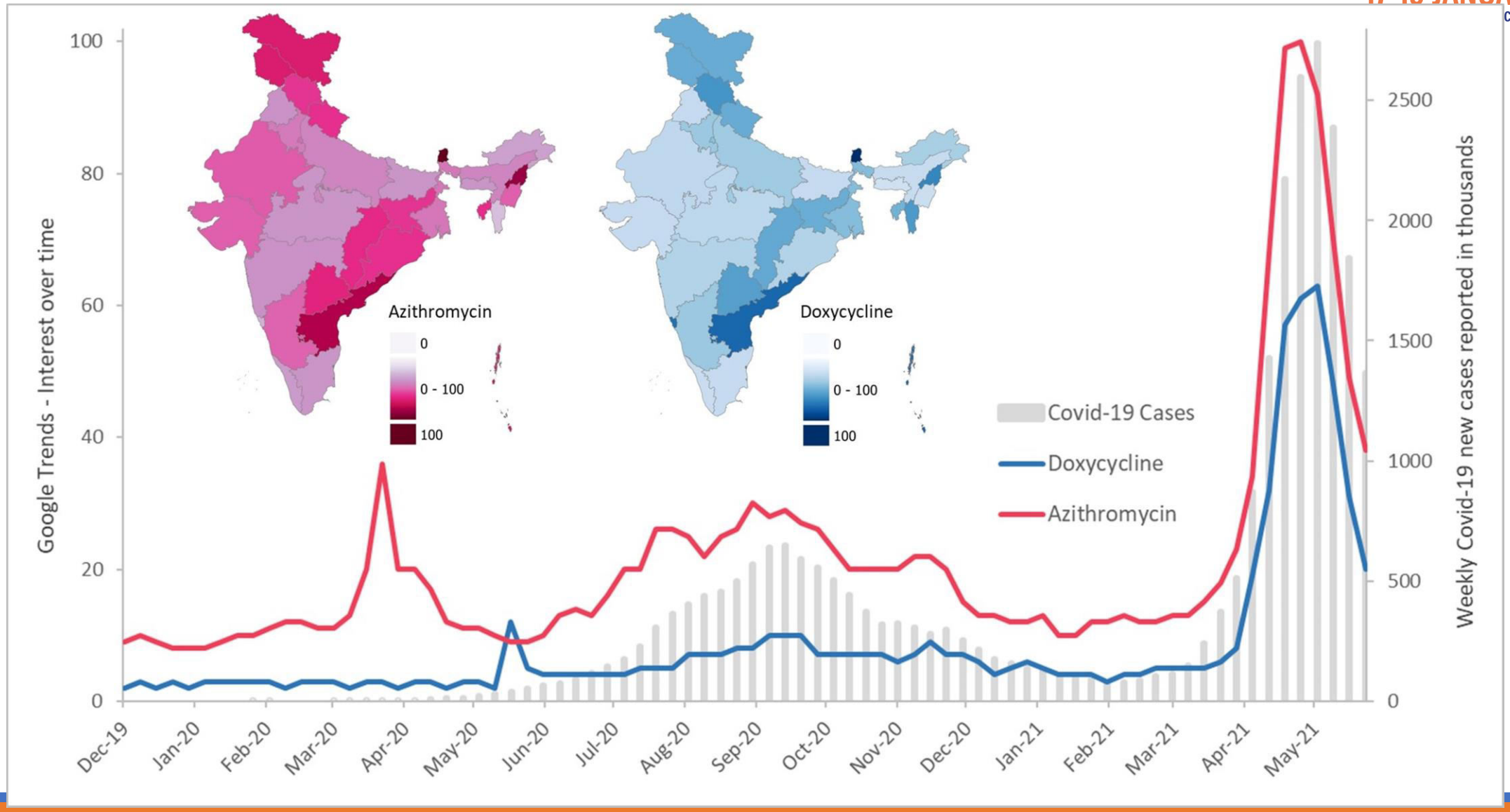


(Jampani et al., 2022 - https://www.sciencedirect.com/science/article/pii/S2666911022000090)

GOOGLE TRENDS SEARCH INTEREST DURING COVID-19



(Jampani and Chandy, 2022 - https://onlinelibrary.wiley.com/doi/10.1002/hsr2.459)

ANTIMICROBIAL RESISTANCE: AN EMERGING CHALLENGE

Two thirds of global antibiotic production used in animal agriculture
(Singer et al. 2016)

1.27 million deaths occurred in 2019 because of AMR infections and projected to increase to 10 million by 2050
(O'neill 2016; Murray et al., 2022)

The global **consumption of antibiotics** increased by 65% from 2000 to 2015, and is projected to increase 200% by 2030 in a business as usual scenario (Klein et al. 2018)

If it is left unaddressed, the **economic impact** of AMR would be more than 1 trillion USD per year after 2030
(World Bank, 2019)

Over the last decade, solutions to address AR have primarily focused on measures to **reduce the use and consumption of antibiotics**
(Hutchings et al., 2019; WHO, 2015)

AMR keeps growing!

SOURCES, PATHWAYS AND EXPOSURE OF ANTIBIOTICS, ANTIBIOTIC RESISTANT BACTERIA (ARB) AND ANTIBIOTIC RESISTANCE GENES (ARGS) IN THE ENVIRONMENT

(Jampani et al., 2022 - https://www.sciencedirect.com/science/article/pii/S2666911022000090)

ANTIMICROBIAL RESISTANCE IN WATER ENVIRONMENTS

Livestock to Environment to Society: Antibiotic consumption for livestock production ~63,000 tons in 2010 and predicted to increase 67% by 2030 (Boeckel et al. 2015)

Wastewater, polluted waters, Soil microbiomes and sediments are hotspots for the development and spread of AMR

AMR pathogens frequently identified in water: *Pseudomonas aeruginosa*, *Escherichia coli*, *Mycobacterium spp.*, *Legionella spp.*, etc.

Water quality modelling and corresponding model development for resistant bacteria and genes are in early stages – Modelling can help tackle the complexity of AMR problem in environment!

WATER QUALITY MODELLING FRAMEWORK: SOURCE TO THE RECEPTOR – FOR EVALUATING ANTIBIOTIC RESISTANCE IN AQUATIC ENVIRONMENTS

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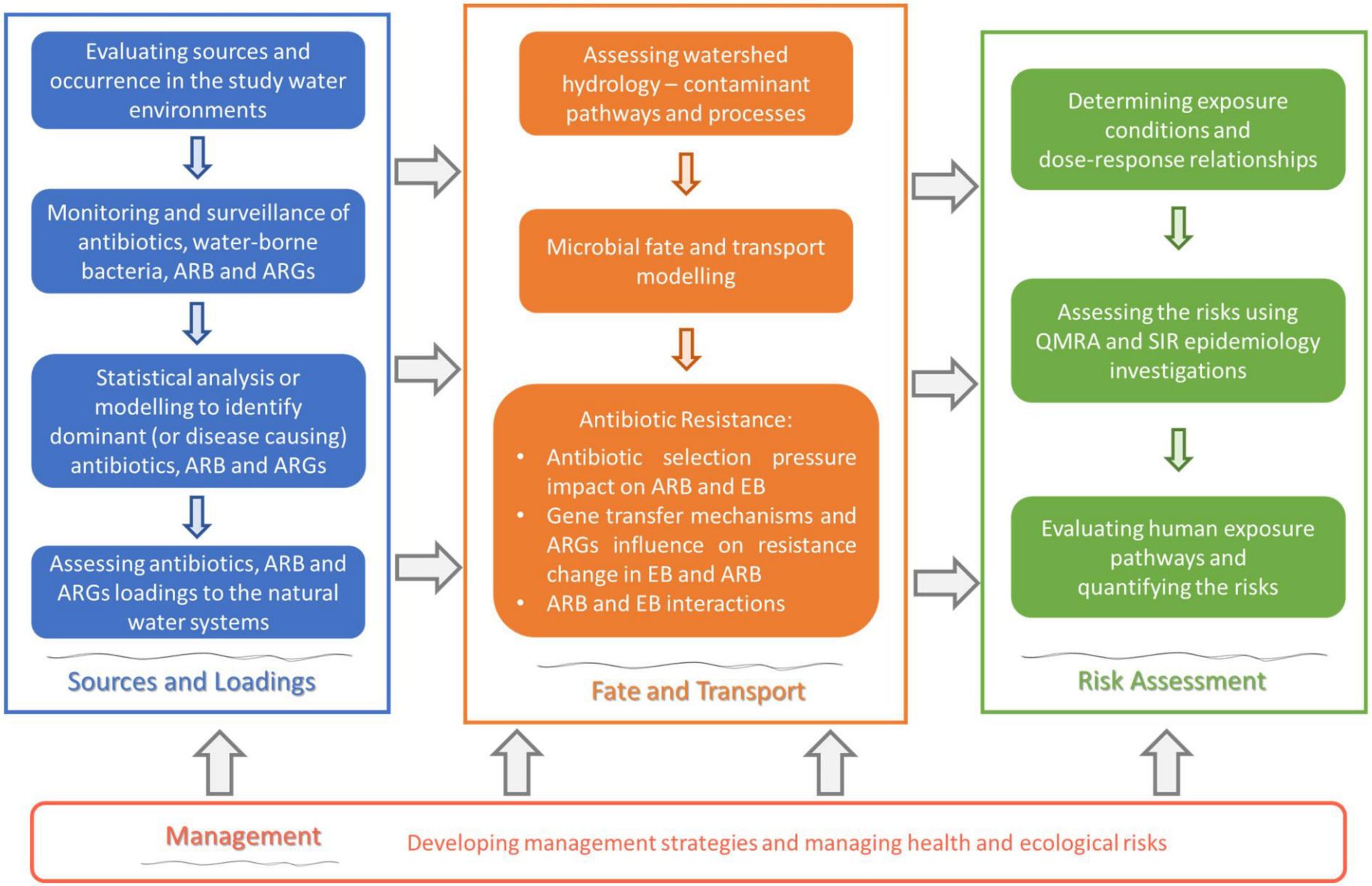

(Jampani et al., 2022 - https://www.sciencedirect.com/science/article/pii/S2666911022000090)

MODELLING FRAMEWORK: POLLUTION DETERMINANTS AND TRANSFORMATIONS OF THE ANTIBIOTIC RESISTANCE

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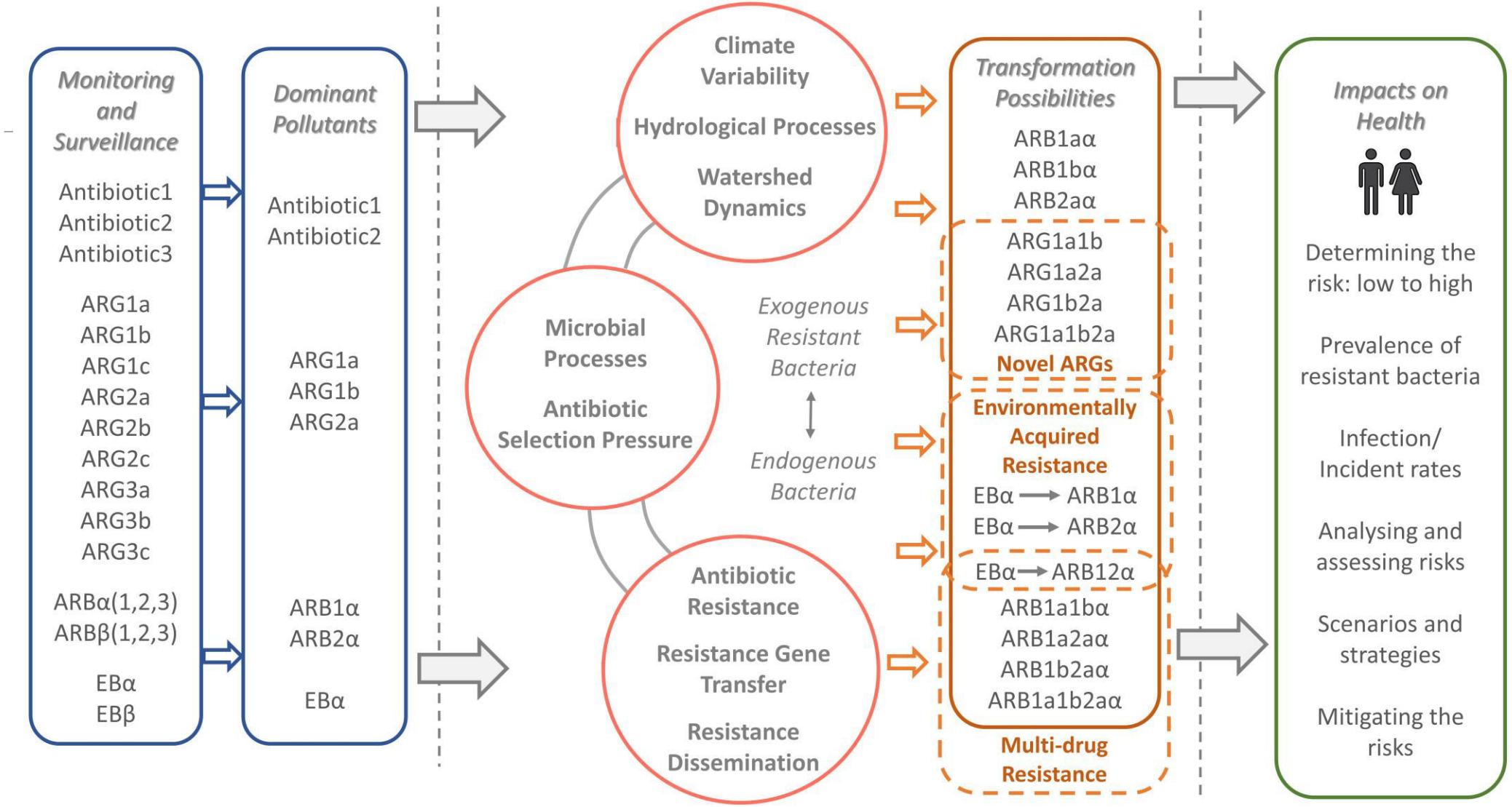

Sources and Loadings | Fate and Transport | Risks and Management

(Jampani et al., 2022 - https://www.sciencedirect.com/science/article/pii/S2666911022000090)

MODEL COMPLEXITY:
FATE AND TRANSPORT OF ANTIBIOTIC RESISTANT BACTERIA (ARB)

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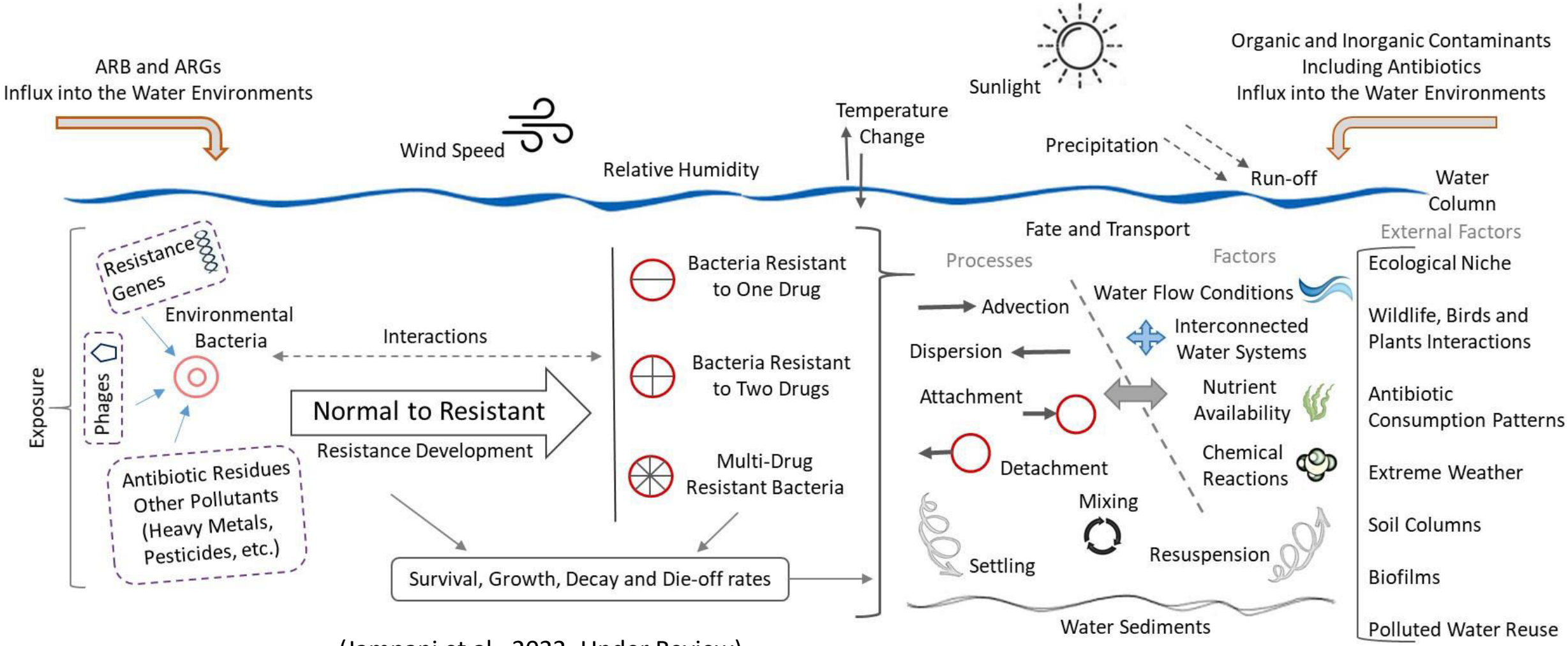

(Jampani et al., 2022, Under Review)

WRAP UP AND CONCLUSIONS

- Antimicrobial Resistance is an emerging threat – Impacts ecosystem damage and human health - environment and climate plays a critical role
- Wastewater, soils and polluted waters are hotspots for AMR development and spread
- Water quality modelling can help understand the complex processes and mitigate health risks
- We need cost effective combination of solutions – AMR Stewardship, Treatment technologies, Effective management solutions, Pollution mitigation strategies, etc. – For that water quality modelling plays a critical role in developing scenarios and management solutions.

Thanks for your attention!

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Corresponding journal articles

- Mahesh Jampani, J. Mateo-Sagasta, A. Chandrasekar, D. Fatta-Kassinos, D.W. Graham, R. Gothwal, Arshnee Moodley, V.M. Chadag, D. Wiberg, Simon Langan (2023). "Fate and Transport Modelling for Evaluating Antibiotic Resistance in Aquatic Environments: Current Knowledge and Research Priorities". Journal of Hazardous Materials (Elsevier). Under Review.
- Mahesh Jampani, J. Mateo-Sagasta, R. Gothwal, S. Langan (2022). "Water Quality Modelling Framework for Evaluating Antibiotic Resistance in Aquatic Environments". Journal of Hazardous Materials Letters (Elsevier). 100056.
- Mahesh Jampani, S.J. Chandy. (2021). "Increased antimicrobial use during COVID-19: the risk of advancing the threat of antimicrobial resistance". Health Science Reports (Wiley). Vol. 4(4). e459.

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