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FACULTY
OF BIOTECHNOLOGY

PORTO

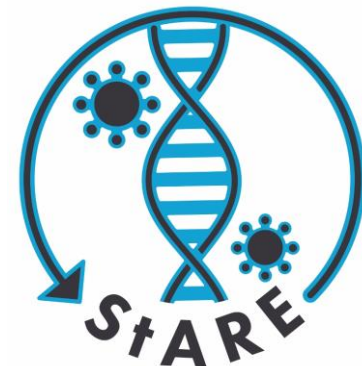
Stopping Antibiotic Resistance Evolution

Final meeting

Helsinki, 4th June 2018

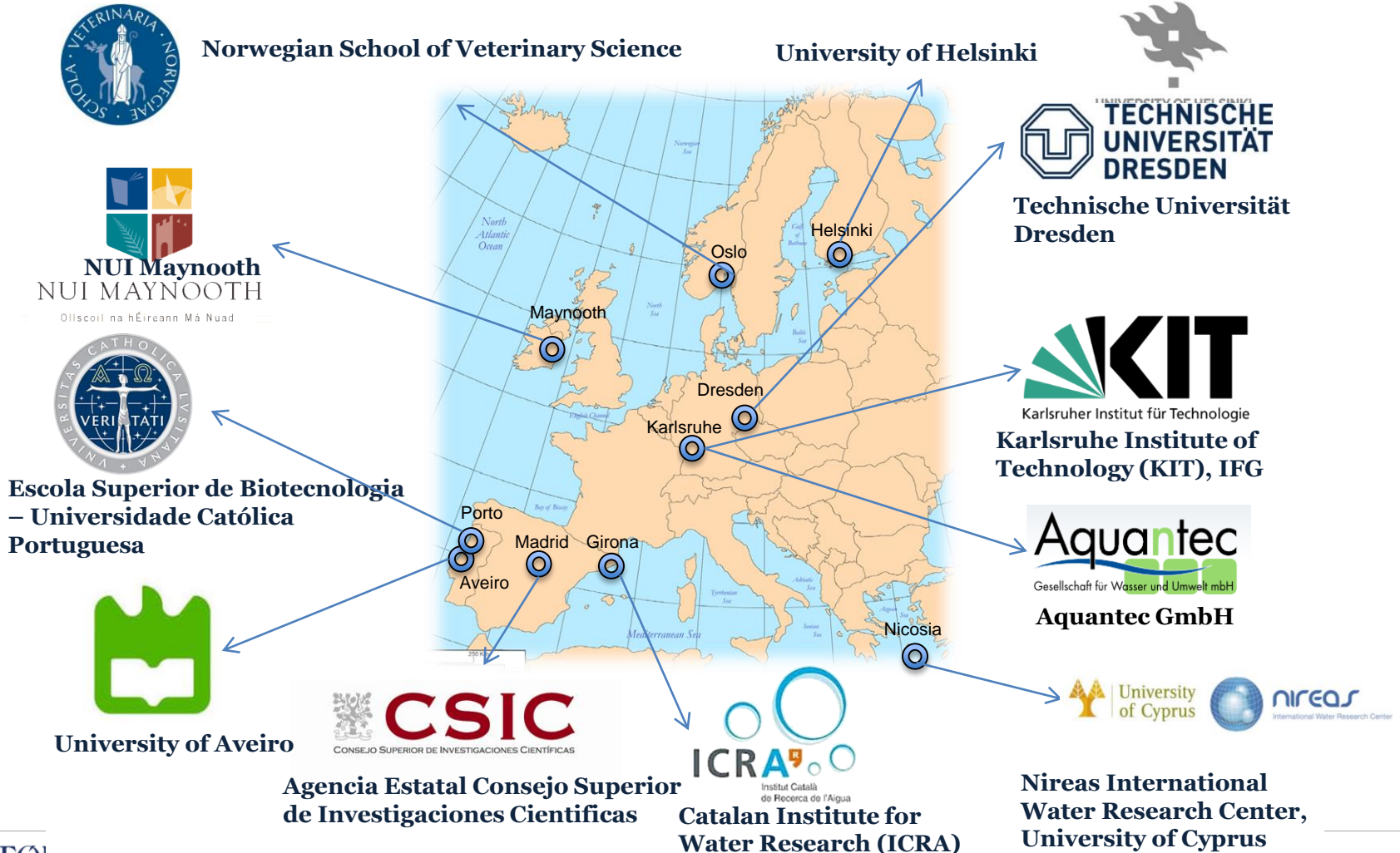


Célia M. Manaia
ESB-UCP



Consortium

11 partners – 7 countries



Consortium

Microbiology * Molecular Biology * Bioinformatics
Analytical Chemistry * Wastewater Treatment Engineering

UCP

Célia Manaia
Ivone Vaz-Moreira
Jaqueline Rocha
Carlos Narciso-Rocha
Pompeyo Ferro

ICRA

Sara Rodriguez-Mozaz
Marta Llorca
Saulo Varela

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Jose Luis Martinez
Felipe Lira
Javier Tamames

Nireas-IWRC, UCY

Despo Fatta-Kassinou
Irene Michael-Kordatou
Lida Ioannou
Stella Michael

NSVS

Henning Sorum
Kristin O'Sullivan

UAVR

Isabel Henriques
Marta tacão

TUD

Thomas Berendonk
Damiano Caccace

KIT-IFG

Thomas Schwartz
Thomas Jäger

NUIM

Fiona Walsh

UHeI

Marko Virta
Katariina Pärnänen

AQUANTEC

Christian Elpers

NORMAN

Network of reference laboratories, research centres and related organisations for monitoring of emerging environmental substances
Valeria Dúlio
Jaroslav Slobodnik

Center for Microbial Ecology Michigan State University, US
Robert Stedtfeld
James Tiedje



GLOBAL ACTION PLAN



World Health
Organization

ON ANTIMICROBIAL RESISTANCE

3/5

Objective 1: Improve awareness and understanding of antimicrobial resistance through effective communication, education and training

Objective 2: Strengthen the knowledge and evidence base through surveillance and research

Objective 3: Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures



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StARE Overview

Scientific and technological results

Collaboration, coordination, mobility, synergies and infrastructures

Stakeholder engagement

Impact and knowledge output

Continuation of the work in the future



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Objectives

1. Antibiotics and Resistance in European Wastewater

- Implement harmonized (advanced) protocols to measure A & ARG
- Launch a public database on A&ARB&ARG

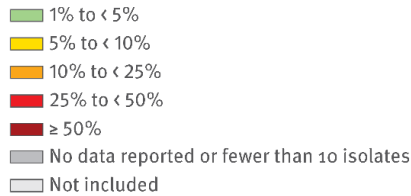
2. Wastewater treatment and removal of A&ARB&ARG

- Improved A&ARB&ARG mitigation in UWTP
 - Cost-effective wastewater treatment
 - Minimal impact on ARG dissemination, by selection or horizontal gene transfer



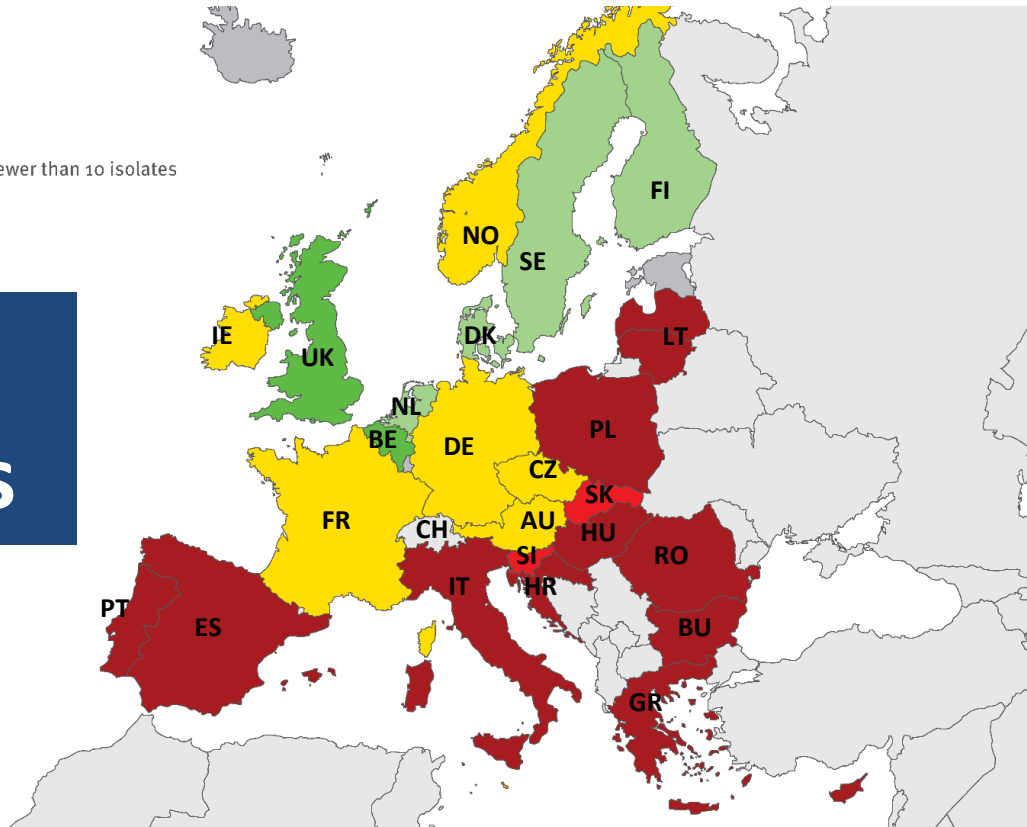
Antibiotic resistance in European wastewaters

ANTIBIOTIC RESISTANCE IN CLINICAL ISOLATES IN EUROPE...



Objective
1

The
hypothesis

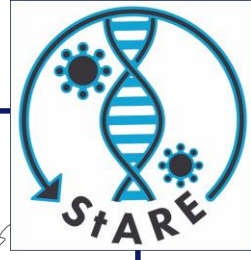


Surveillance of antimicrobial resistance in Europe (2013-2016)

Except for carbapenem resistance, large inter-country variations were noted for all antimicrobial groups under regular surveillance, with generally **higher resistance percentages reported from the southern and eastern parts of Europe** than from northern.

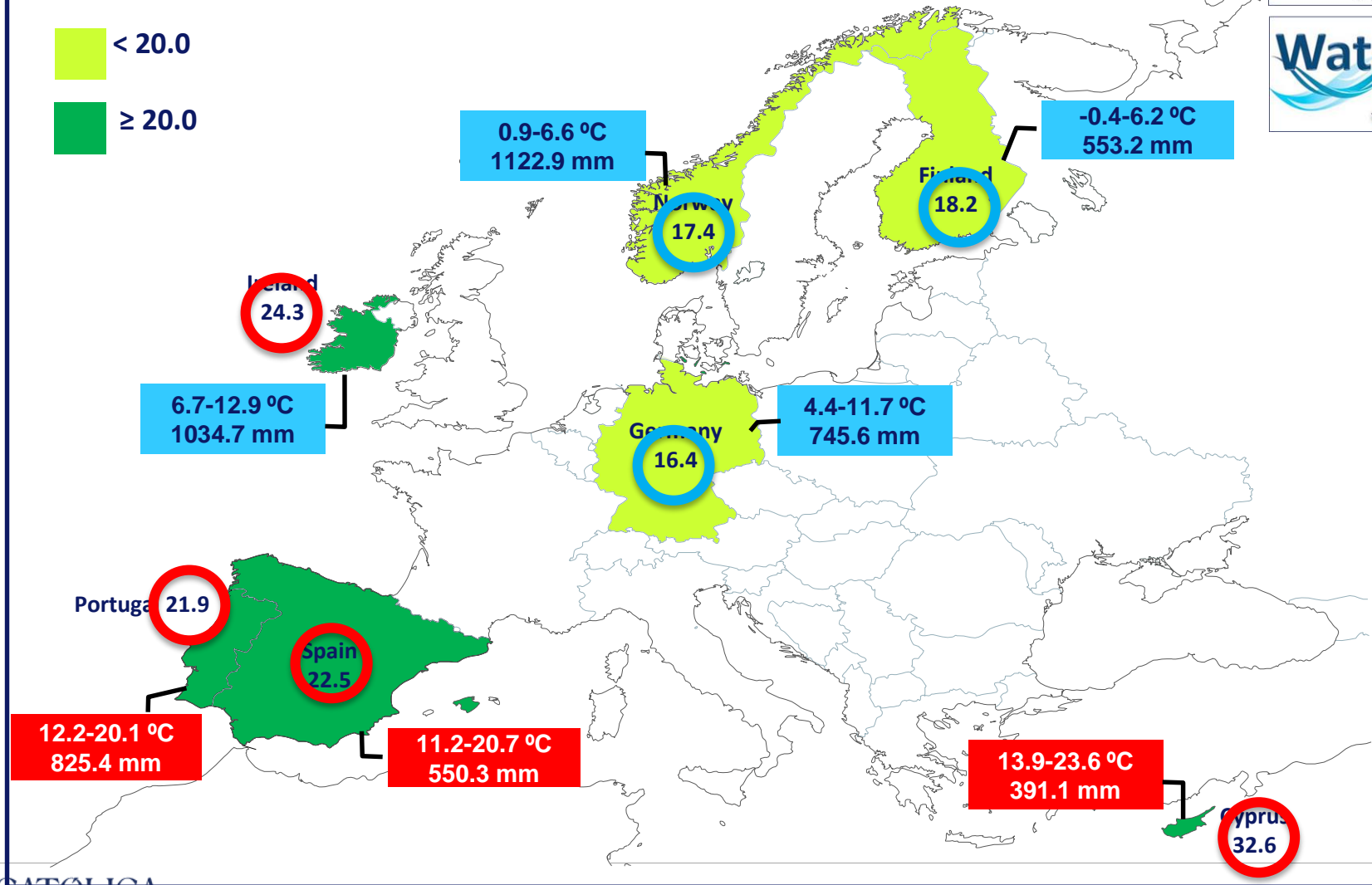


Antibiotic resistance in European wastewaters

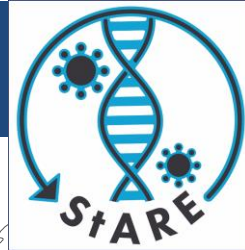


DDD per 1000 inhabitants and per day (systemic use ATC group J01 antibiotics)

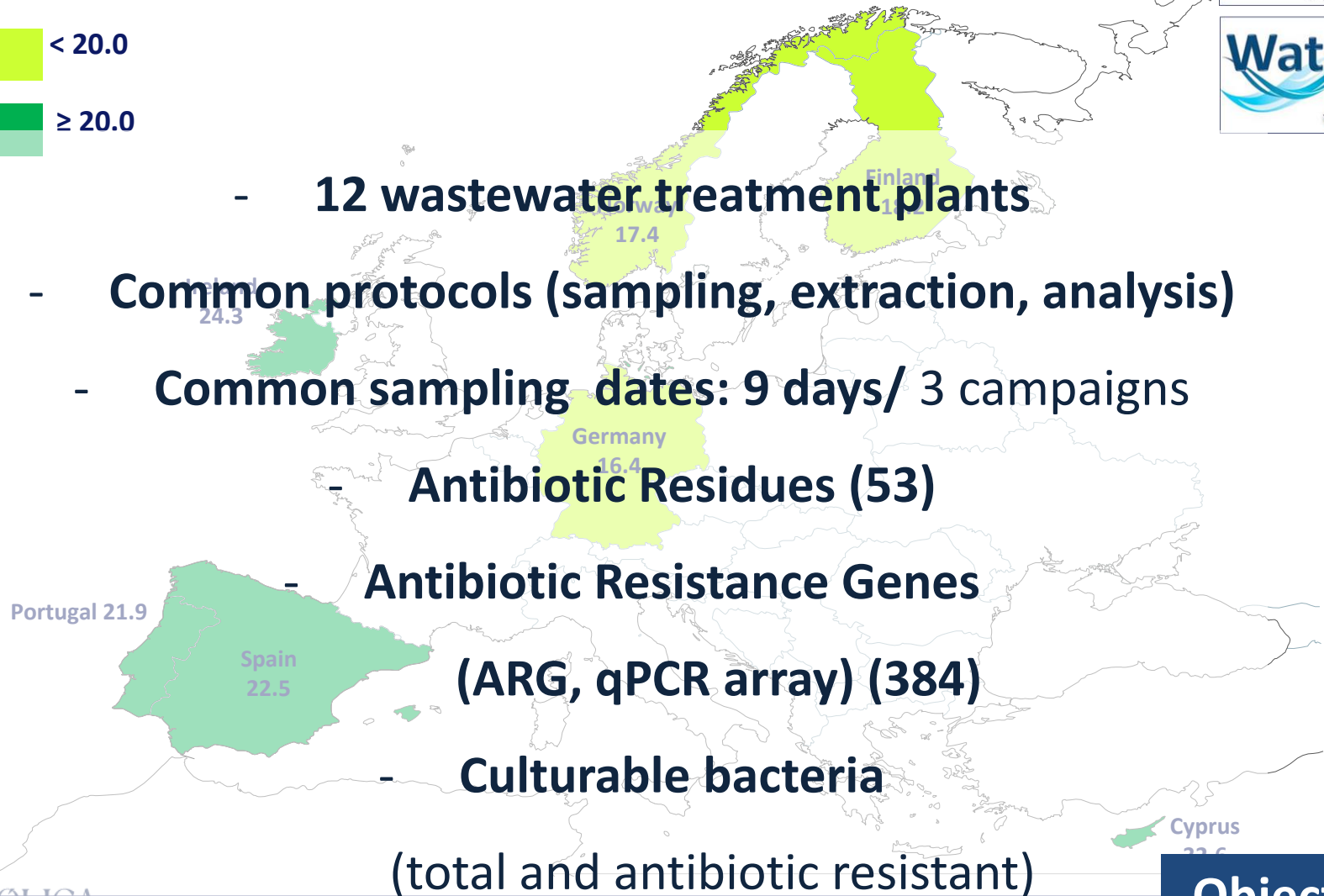
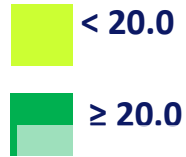
- < 20.0
- ≥ 20.0



Approach

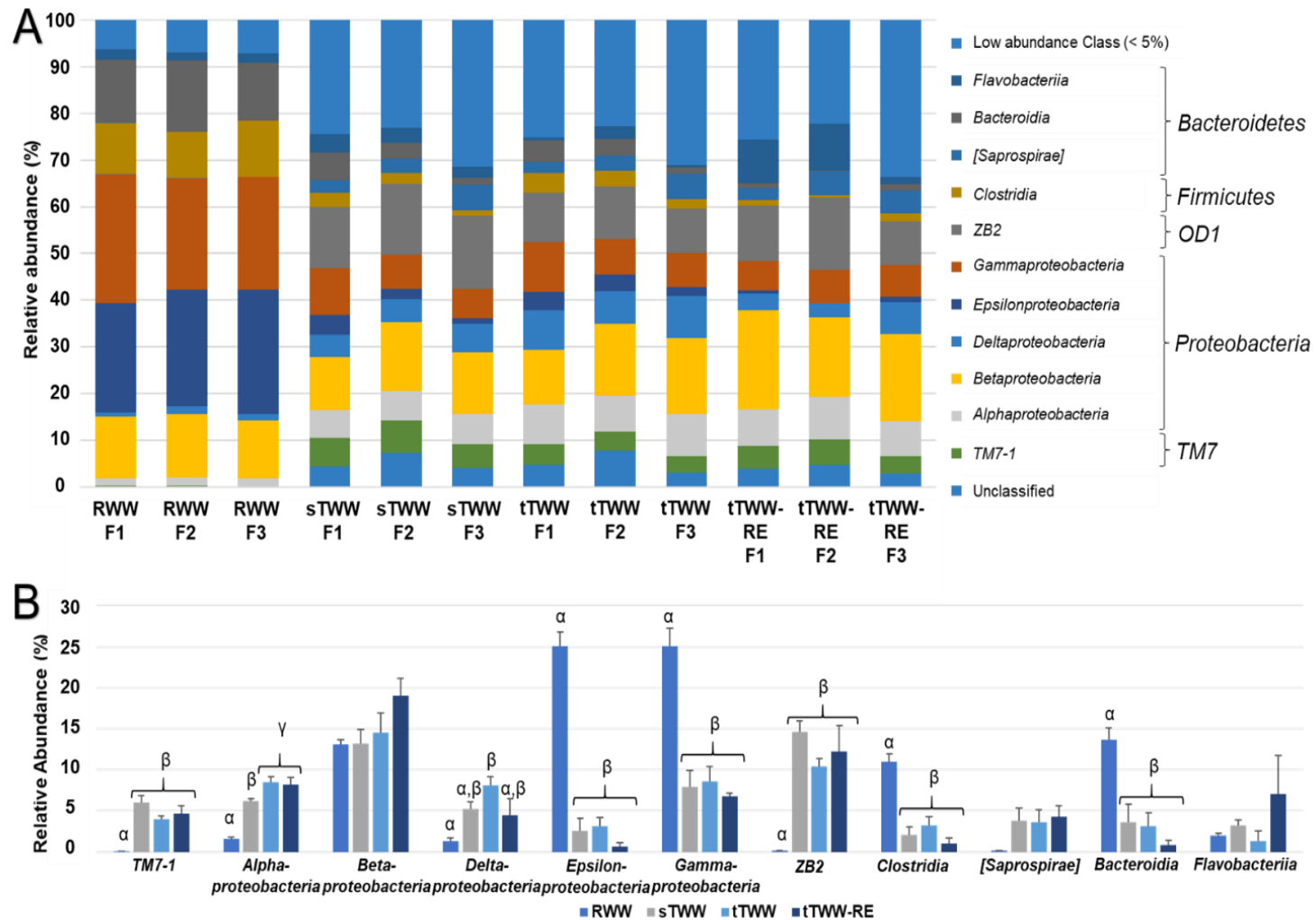


DDD per 1000 inhabitants and per day (systemic use
ATC group J01 antibiotics)

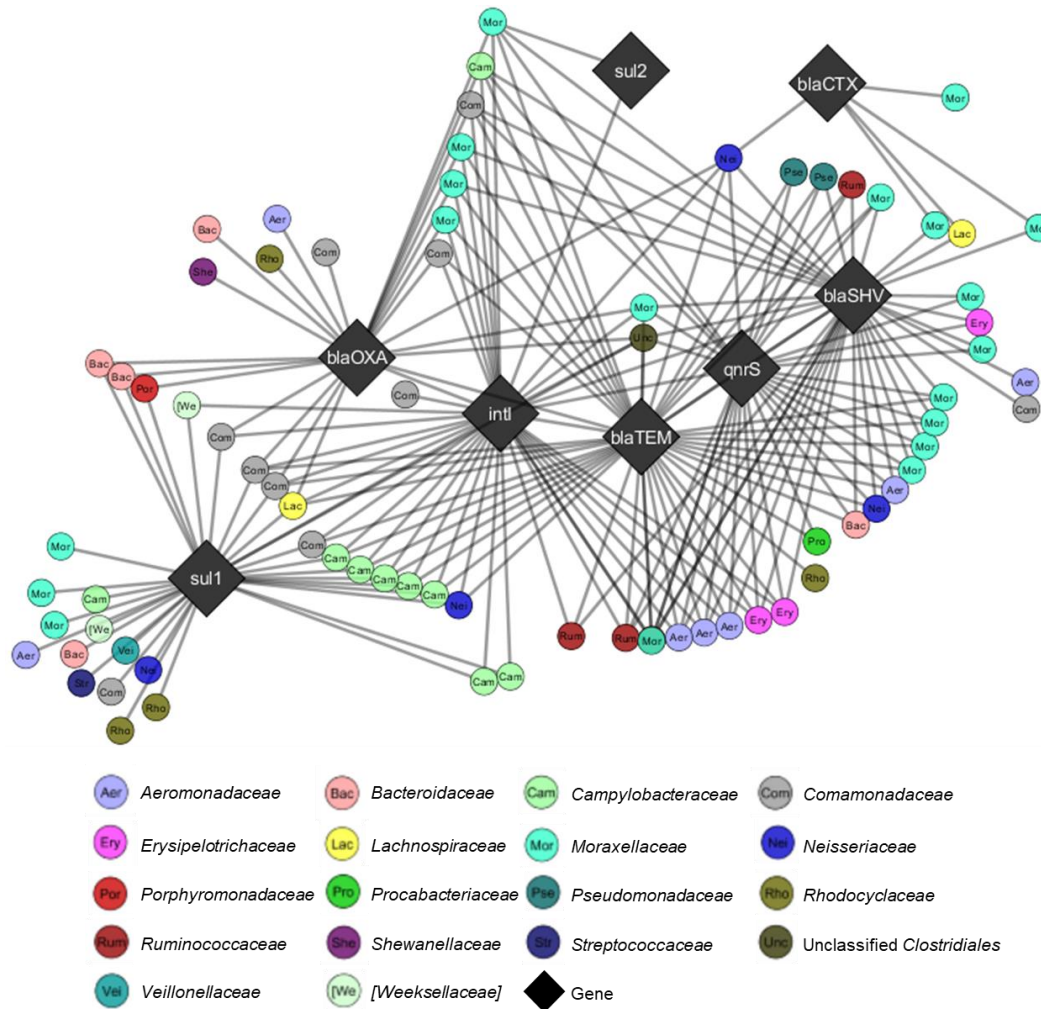


- 12 wastewater treatment plants
- Common protocols (sampling, extraction, analysis)
- Common sampling dates: 9 days/ 3 campaigns
 - Antibiotic Residues (53)
 - Antibiotic Resistance Genes (ARG, qPCR array) (384)
 - Culturable bacteria (total and antibiotic resistant)

Microbiome dynamics during treatment



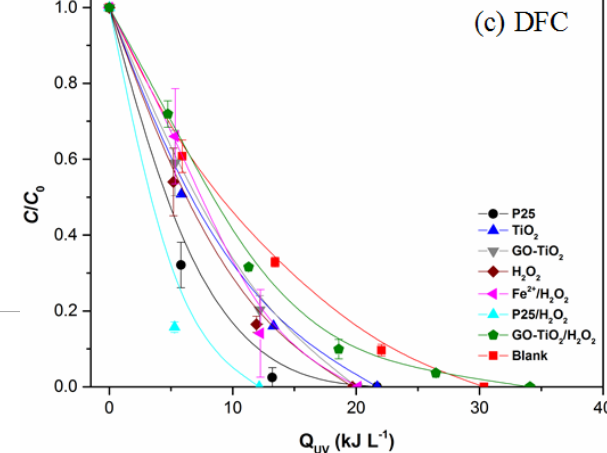
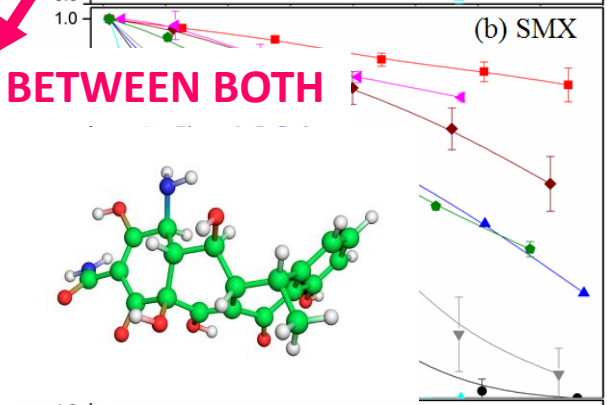
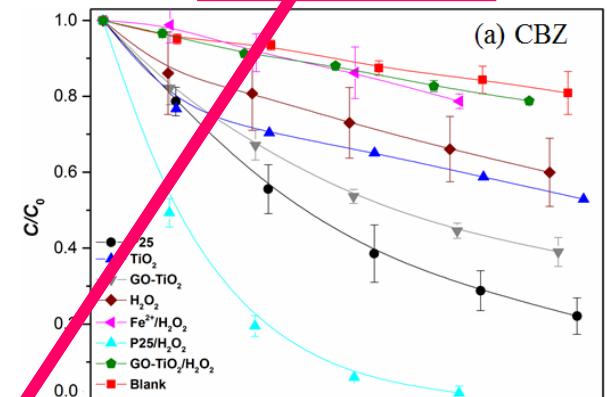
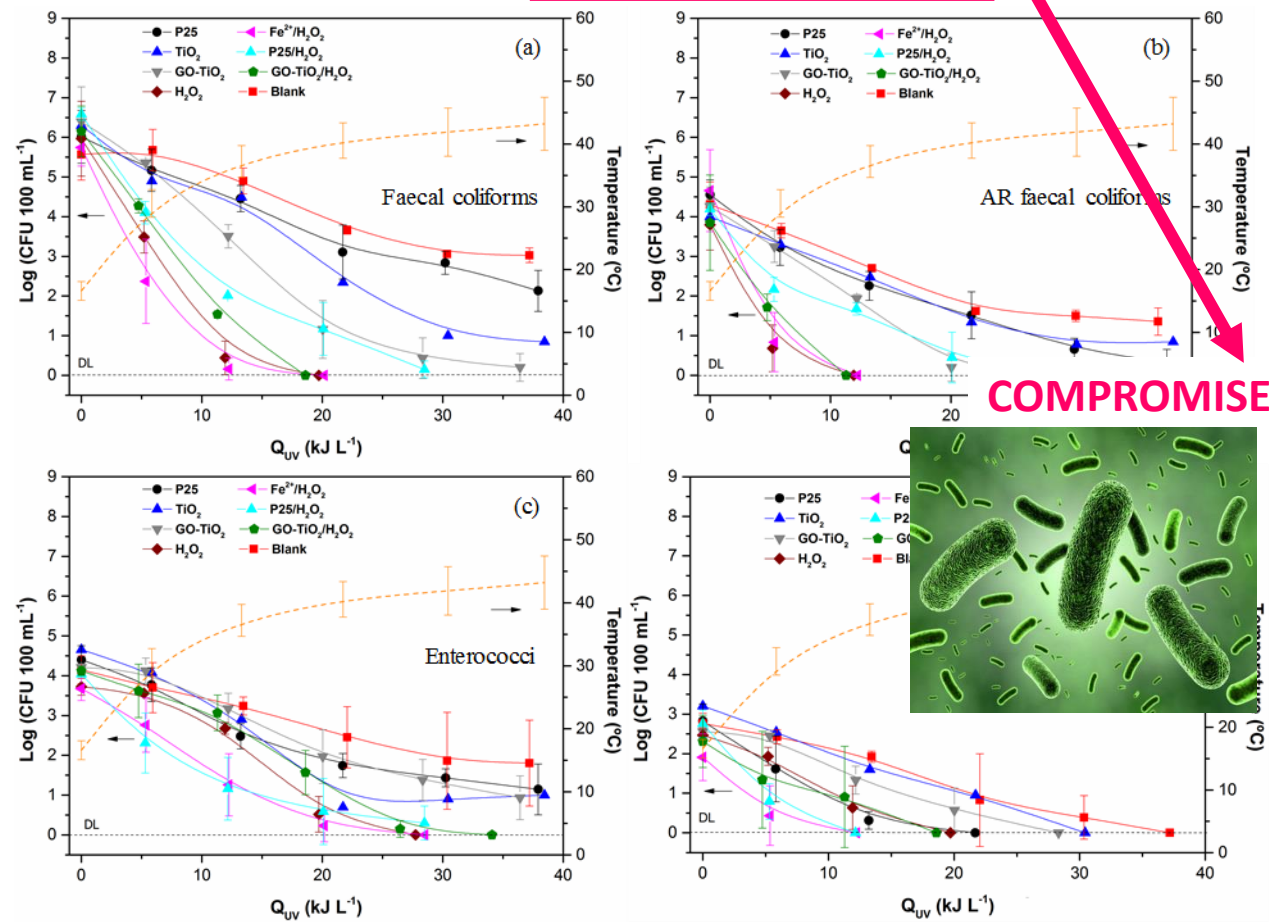
ARGs associated with human- and animal related bacteria



ADVANCED DISINFECTION PROCESSES

Microbiological

Chemical



COMPROMISE BETWEEN BOTH



Objective
2

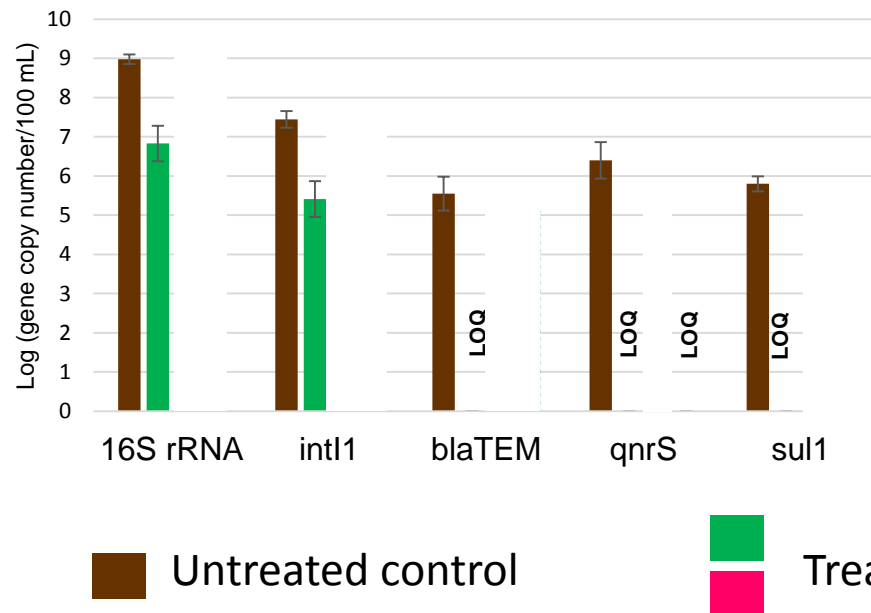
Moreira et al. 2018, Water Research, 135:195-206

TECHNOLOGY

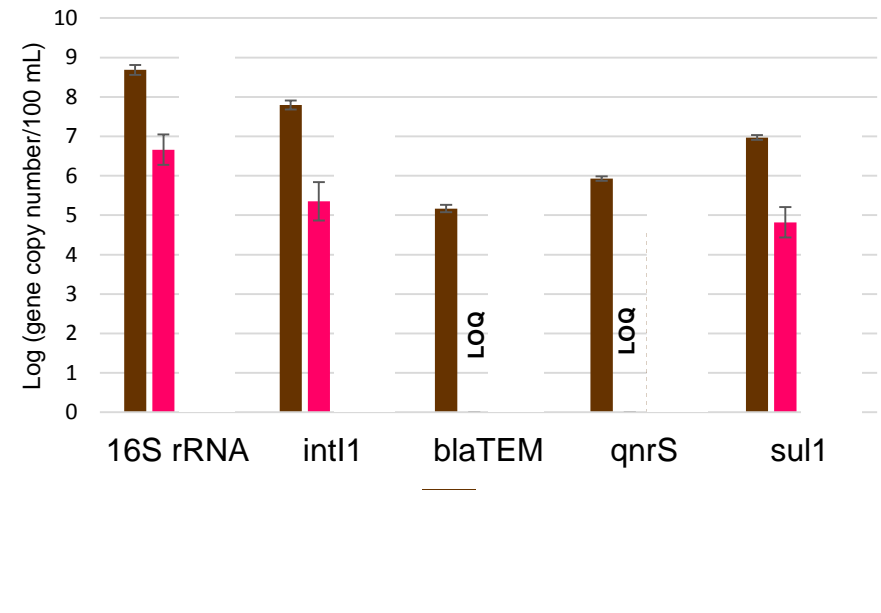
ADVANCED DISINFECTION PROCESSES

Self-replication

Ozonation

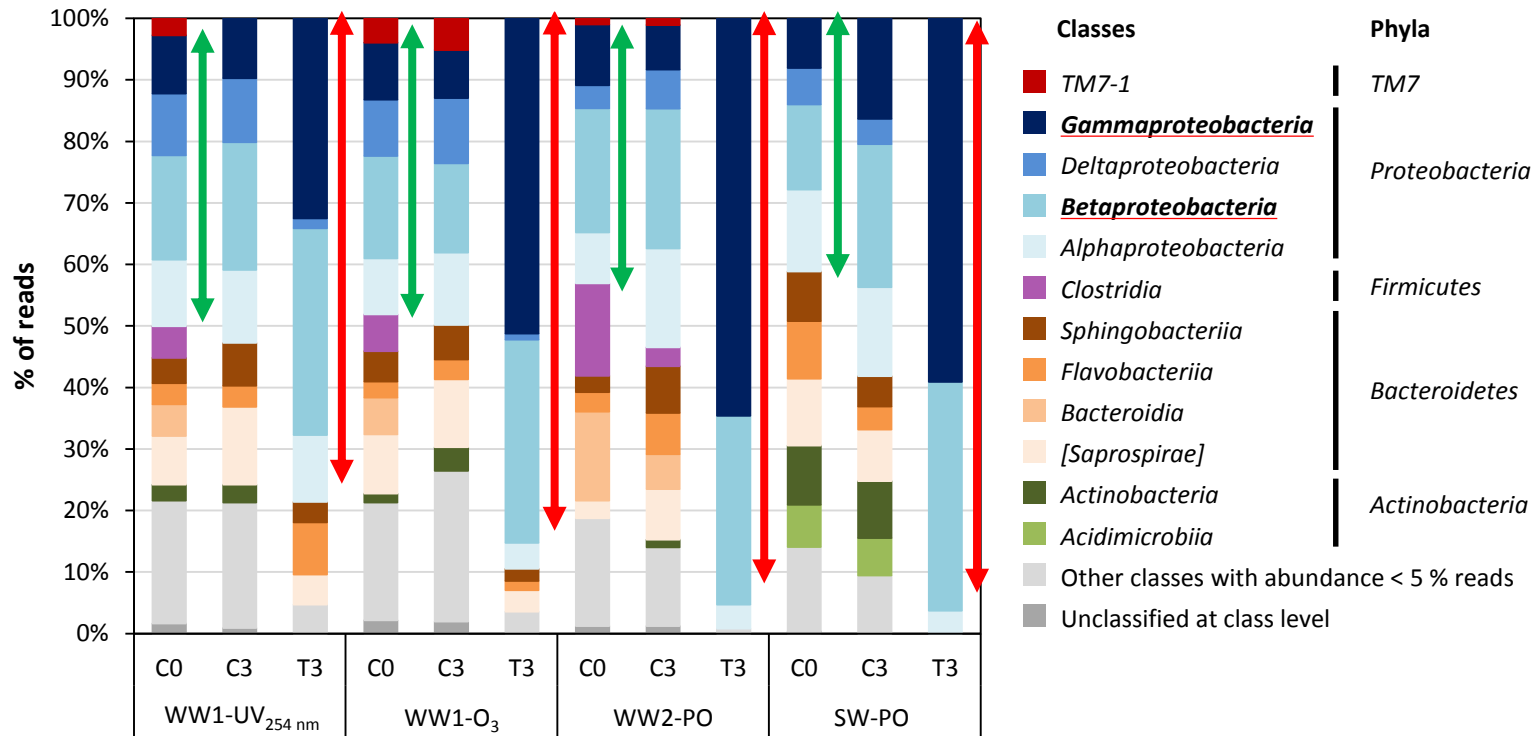


UV



SELF-REPLICATION

...is not identical for all bacterial groups...



Most fitted groups include those able to acquire AR?

StARE Overview

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Continuation of the work in the future



Collaboration, coordination and mobility

9 Mobility actions – 12 months

12 Publications \geq 2 StARE partners

A&ARG

AR Evolution

AR Removal



Norwegian School of Veterinary Science



UNIVERSITY OF HELSINKI

University of Helsinki



Technische Universität Dresden



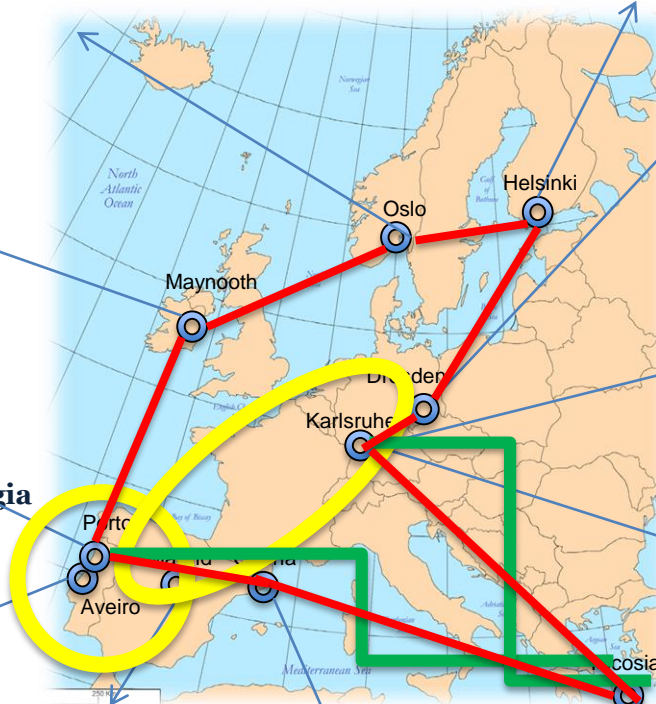
NUI Maynooth
NUI MAYNOOTH
Ollscoil na hÉireann Má Nuad



Escola Superior de Biotecnologia
– Universidade Católica Portuguesa



University of Aveiro



Karlsruher Institut für Technologie
Karlsruhe Institute of Technology (KIT), IFG



Gesellschaft für Wasser und Umwelt mbH
Aquantec GmbH



Agencia Estatal Consejo Superior de Investigaciones Científicas



Catalan Institute for Water Research (ICRA)

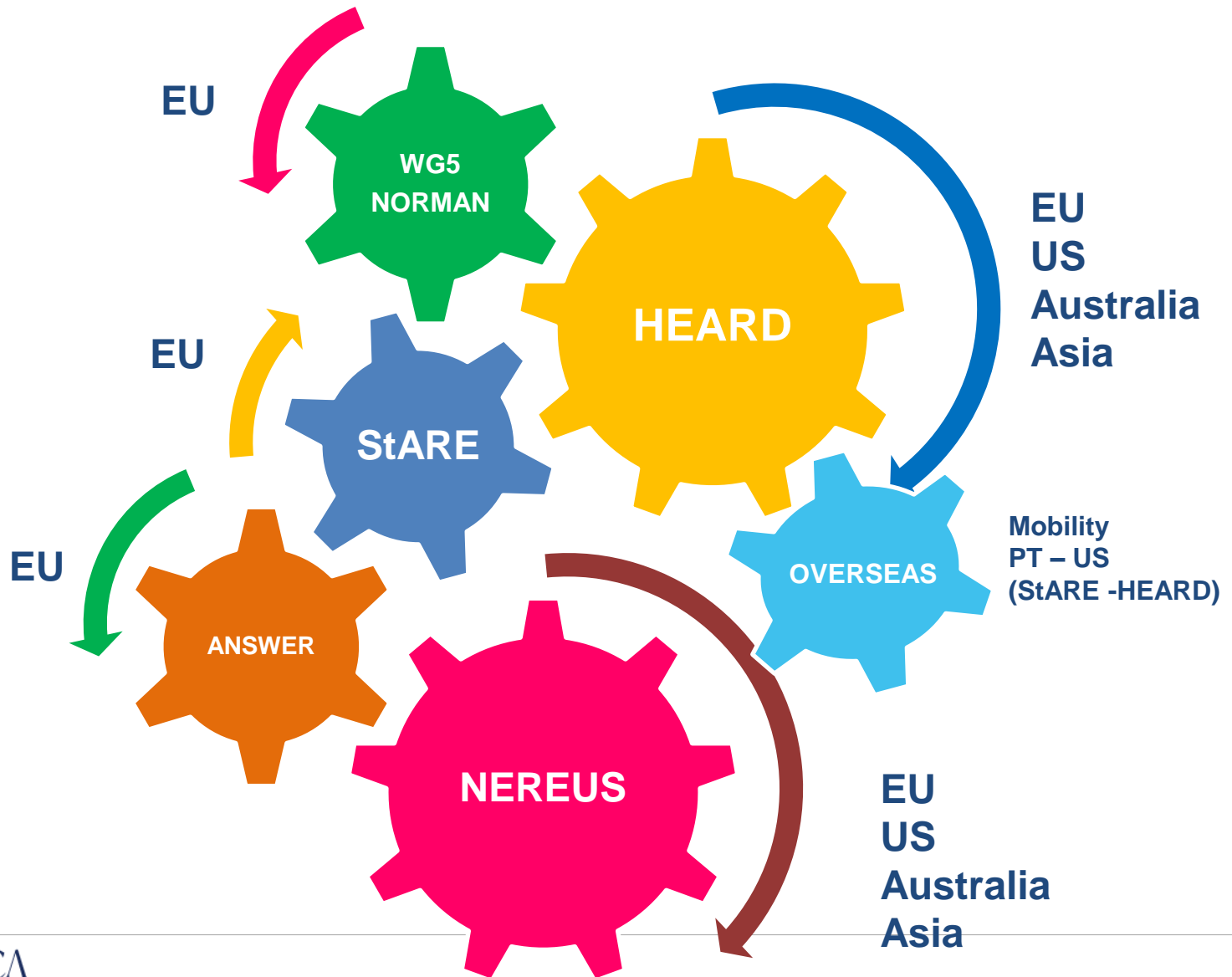


Nireas International Water Research Center, University of Cyprus



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External collaborations

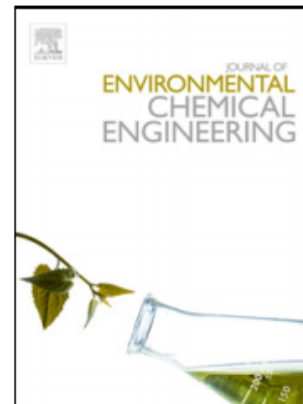


External collaborations

Accepted Manuscript

Title: Inter-laboratory calibration of quantitative analyses of antibiotic resistance genes

Authors: Jaqueline Rocha, Damiano Cacace, Ioannis Kampouris, Hélène Guilloteau, Thomas Jäger, Roberto B.M. Marano, Popi Karaolia, Célia M. Manaia, Christophe Merlin, Despo Fatta-Kassinos, Eddie Cytryn, Thomas U. Berendonk, Thomas Schwartz



ENVIRONMENTAL
Science & Technology

Cite This: [Environ. Sci. Technol. 2017, 51, 13061-13069](#)

Feature

pubs.acs.org/est

Toward a Comprehensive Strategy to Mitigate Dissemination of Environmental Sources of Antibiotic Resistance

Peter J. Vikesland,^{*,†,‡} Amy Pruden,^{†,‡} Pedro J. J. Alvarez,[§] Diana Aga,^{||} Helmut Bürgmann,[⊥] Xiang-dong Li,[#] Celia M. Manaia,[▽] Indumathi Nambi,[○] Krista Wigginton,[◆] Tong Zhang,[¶] and Yong-Guan Zhu[⊗]



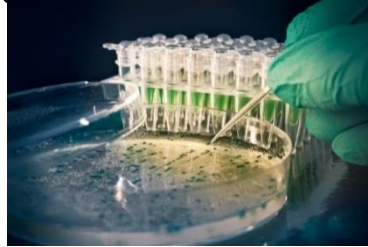
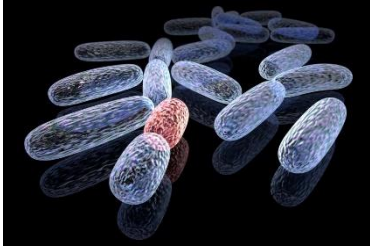
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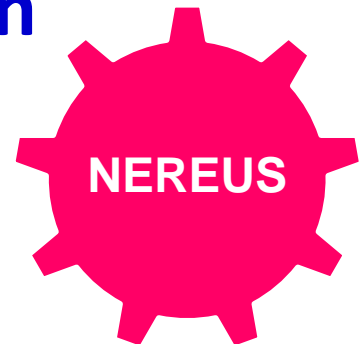
COST Action ES1403

New and emerging challenges and opportunities in wastewater reuse



Cefotaxime-resistant fecal coliform survey

Eddie Cytryn et al.



Global cefotaxime-resistant fecal coliform survey participants



Countries	Groups	WWTPs	Campaigns	Seasons
22	36	54	5	2

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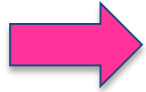
Stakeholder engagement

Impact and knowledge output

Continuation of the work in the future



Stakeholder engagement



Professionals (water management; public health, other): personal communication, sharing of research data



National **Workshop** in Portugal (15 April 2016)

~200 attendees

National **Workshop** in Cyprus (2 March 2017)



>20 invited keynote or plenary talks in (inter)national meetings attended by policy making and water management entities



General public: Media communication (e.g. TV, radio)



Summary

Scientific and technological results

Collaboration, coordination, mobility, synergies and infrastructures

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Impact and knowledge output

Training

- > 12 students enrolled (10 PhD students)

Scientific impact

- > 40 publications in international peer-reviewed journals
- > 60 communications in international conferences

Stakeholders and community

- > 40 popularization events (18 articles; 13 conferences, 10 live media, etc)

Technology transfer

Collaboration with two water treatment SMEs



Impact and knowledge output

First European integrated wastewater surveillance

Important drivers for resistance => improvement of wastewater treatment

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Continuation of the work in the future

- **ARGs database open data**
- **Results dissemination in generalist journals and stakeholder- and public-oriented events**
- **New projects**
 - **Demonstration/implementation projects with companies (approved; applications in preparation – National funds, Life, Interreg, JPIAMR, Marie Curie, etc)**



Thank you!

