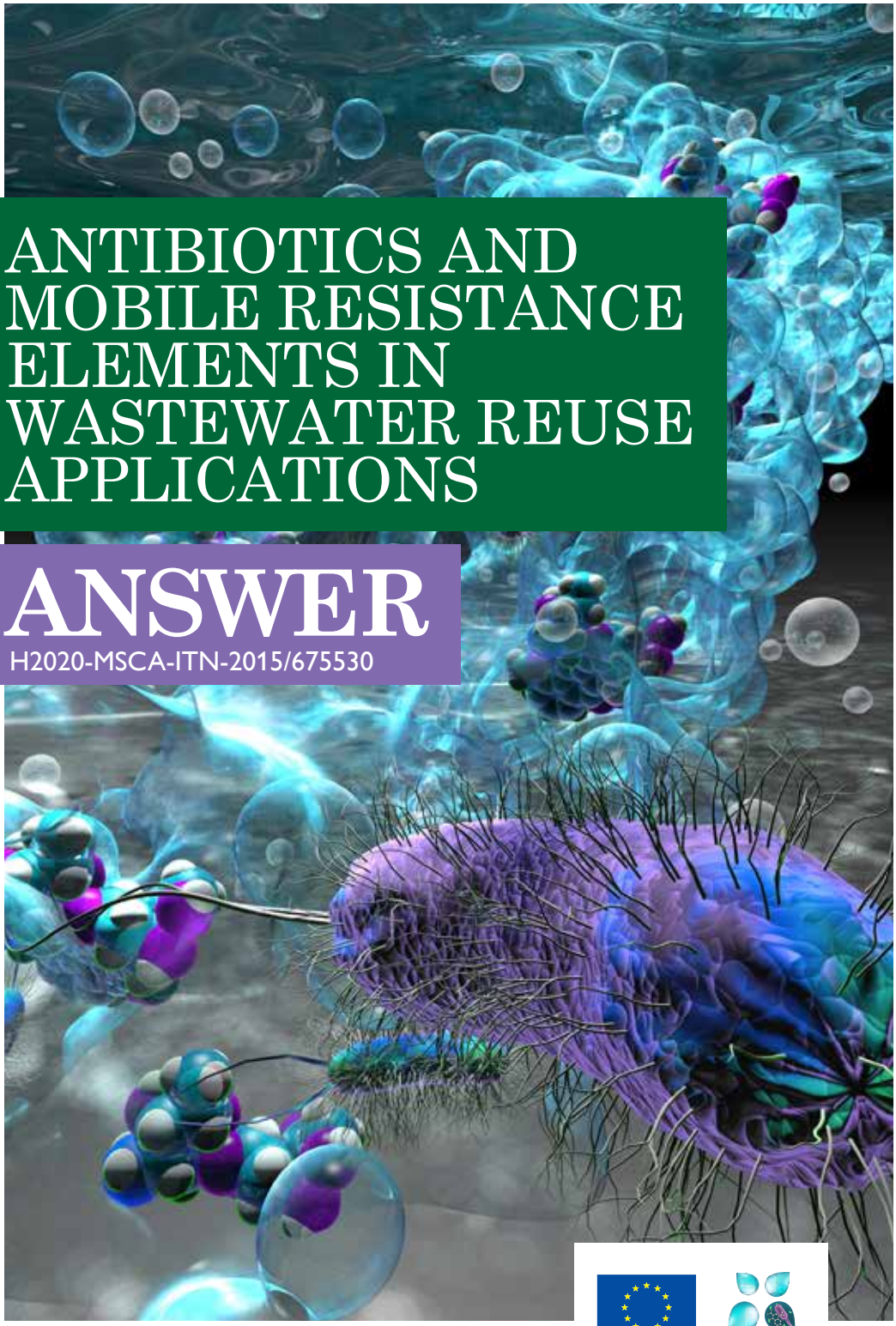


ANTIBIOTICS AND MOBILE RESISTANCE ELEMENTS IN WASTEWATER REUSE APPLICATIONS

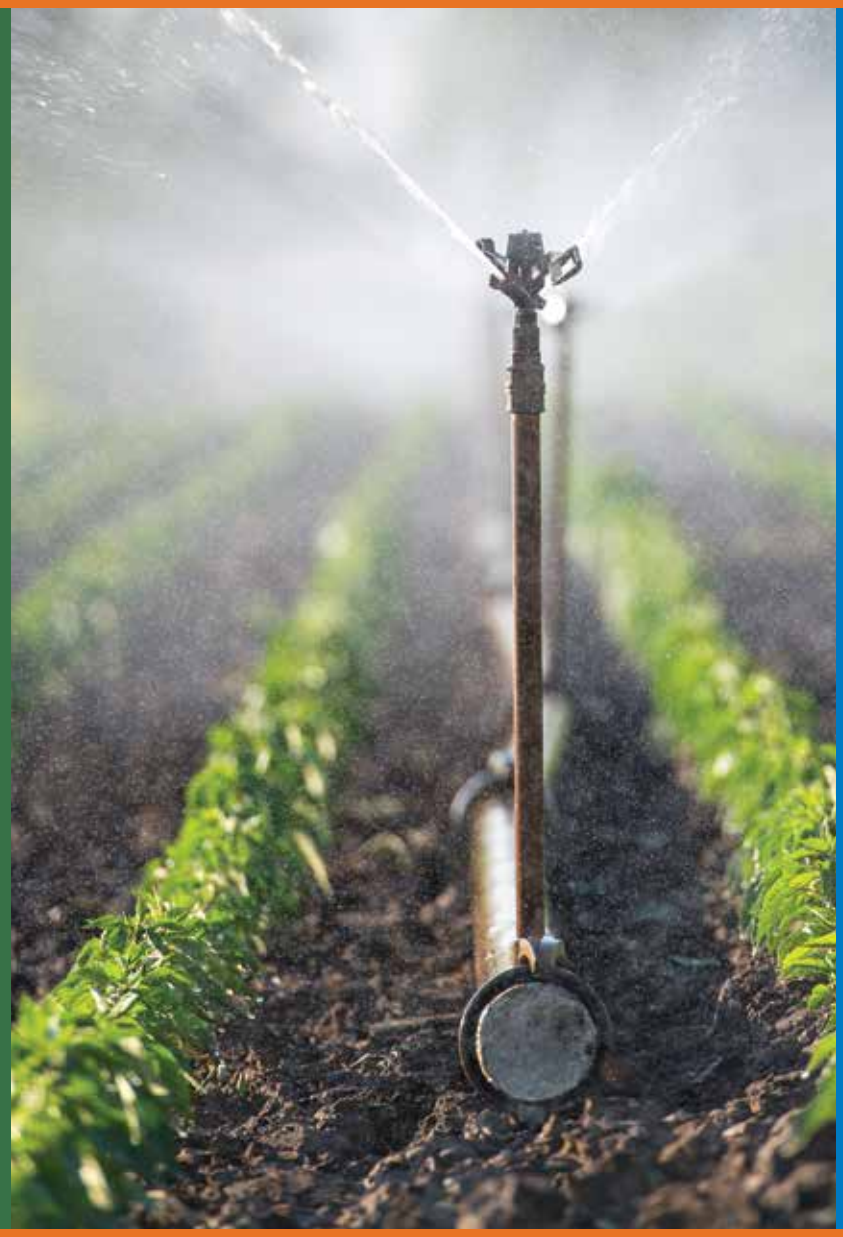
ANSWER

H2020-MSCA-ITN-2015/675530

ANSWER

THE PROBLEM

Whilst wastewater reuse is nowadays considered as an indispensable practice to cope with water scarcity, a number of wastewater quality challenges are associated with this practice. It is well-known that the available/applied wastewater treatment technologies fail to completely remove pharmaceutical compounds and especially antibiotics (A). Moreover, there is no consolidated information on the efficiency of the conventional activated sludge (being the most widely applied treatment process) to remove antibiotic-resistant bacteria and antibiotic resistance genes (ARB&ARGs). In the framework of treated wastewater reuse applications (e.g. irrigation, groundwater replenishment, storage in surface waters for subsequent reuse), the contamination of the environment, the food chain, drinking water resources, etc. by ARB&ARGs, presently, is suspected to be a public health problem. Other open questions include (i) the formation of transformation products (TPs) of antibiotics during biotic and abiotic treatment processes and their role in antibiotic resistance development, (ii) the potential crop uptake of A&ARB&ARGs, (iii) the relevance of TPs of antibiotics in the environment, (iv) the development of innovative technologies able to remove those microcontaminants from wastewater, and (v) the identification of means and solutions to promote safe reuse practices.



ORIGINALITY AND INNOVATIVE ASPECTS OF ANSWER

The originality is an inherent characteristic of ANSWER, which seeks innovations to drive further the knowledge and understanding of the reuse practice, with the aim to reduce risks and identify opportunities for establishing safe reuse systems.

ANSWER aims at providing among others concrete information on:

- the capacity of various “conventional” treatment processes to remove antibiotic resistance
- whether the TPs of antibiotic compounds can contribute to antibiotic resistance
- the uptake of such contaminants by crops/plants

ANSWER OBJECTIVES

The main objective of ANSWER project is to develop well-trained and creative Early-Stage Researchers (ESRs) through innovative PhD projects to reveal the highly complex factors driving A&ARB&ARGs propagation in the framework of urban wastewater reuse. ANSWER is developing knowledge and further understanding of the reuse practice, with the aim to reduce environmental and possible public health risks and identify opportunities for establishing safe reuse systems.

Scientific Research Objectives:

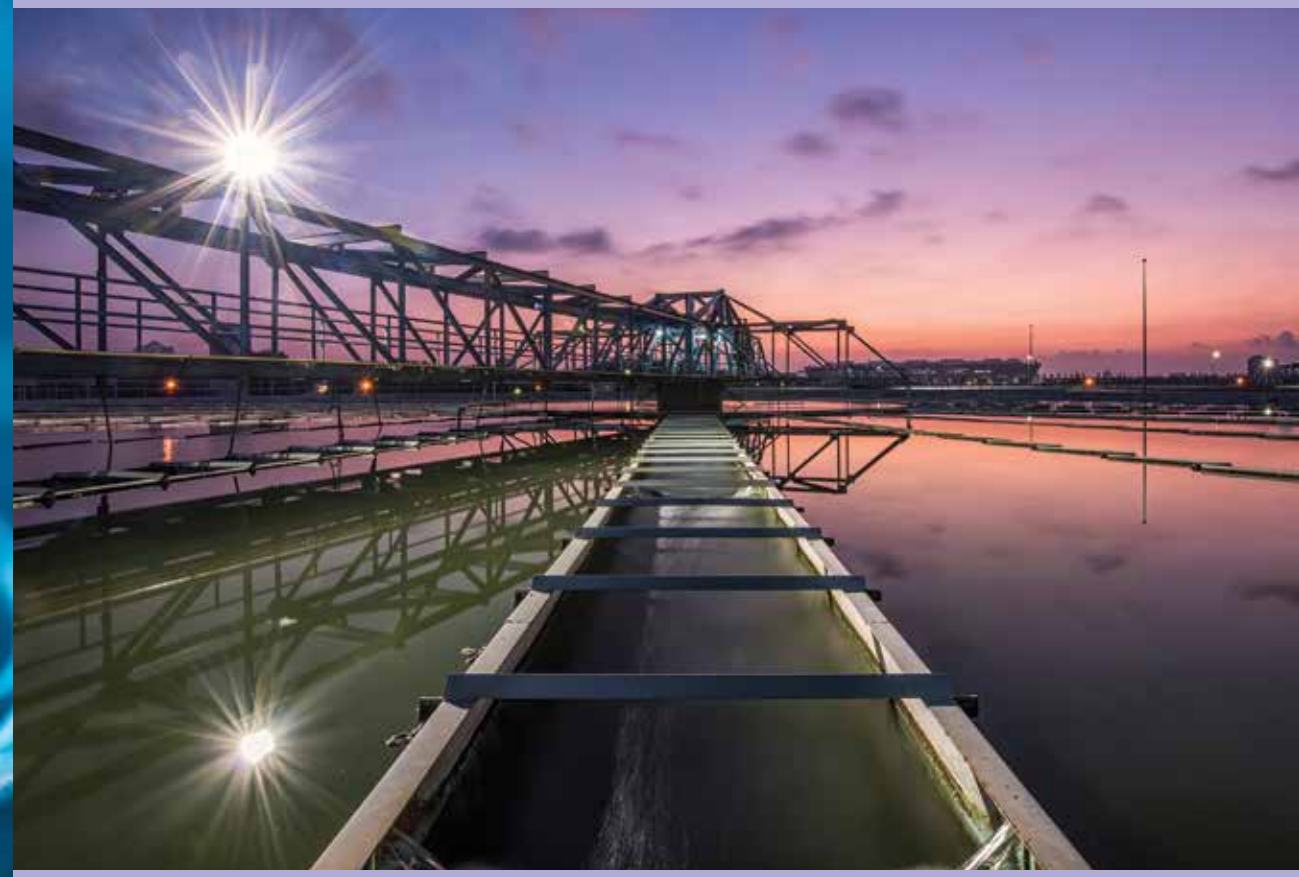
– to provide a solid approach for effect analysis concerning wastewater reuse in a European regulatory and monitoring context

– to develop novel multidisciplinary approaches/ techniques to enhance the diagnostic, mitigation and prevention capacity of A&ARB&ARGs propagation, with cost-efficiency and wide applicability

– to integrate all of the empirical data into a web-based database which will allow for:
  - automated prioritisation of chemical/biological risk factors
  - use of the data in models for large-scale projections
  - interpretation by ANSWER internal and external stakeholders for future policy development
  - the development of science-based emission limit values (ELVs) for antibiotics and their TPs and ARB&ARGs in treated wastewater.

EXPECTED IMPACT OF THE PROJECT

ANSWER aims at answering **critical questions** related to wastewater reuse, and in particular to **provide consolidated insight** on the potential effects of the reuse practice with regard to antibiotic resistance. The pioneer leadership of Europe in the field of contaminants of emerging concern in the environment, will be sustained through ANSWER, whose **benefits** will be of **scientific**, **technological**, **economical** and of course **societal character** and **significance.** The European society has many to gain from ANSWER, including contributions towards **clean environment** and **health protection**. ANSWER intends to result in a **long-lasting network** for future cooperation between the involved institutions, creating a **training platform** that will continue in the future, having a **strong impact** both on the **scientific community** and on the **careers of the ESRs**.



WORK PLAN AND ORGANIZATION

ANSWER is organized into 5 Technical Work Packages with the following objectives:

Work Package 1

Spread and transmission of A&ARB&ARGs under wastewater reuse scenarios

Objective: Understanding of the mechanisms related to the fate/evolution of A&ARB&ARGs transmission from treated wastewater to soil, crops, and water resources and assessing of their potential risks.

Work Package 2

Evaluation of A&ARB&ARGs effects and hazard identification

Objective: Development of novel tools for the detection of antibiotic resistance in wastewater/water/soil/crops and identification of the TPs of selected antibiotics formed by selected treatment processes.

Work Package 3

Innovative technological solutions for the removal of A&ARB&ARGs

Objective: Evaluation of the efficiency of innovative technologies for minimizing A&ARB&ARGs and determination of their market penetration potential.

Work Package 4

A&ARB&ARGs fate prediction through modeling approaches

Objective: Development of models to describe/predict the fate of A&ARB&ARGs from treated wastewater to soil, ground/surface water, and crops and assessment of their potential risk.

Work Package 5

Data management, prioritisation and policy guidelines development

Objective: Integration of all empirical data in a web-based database for automated prioritisation of chemical/biological risk factors and establishment of ELVs for antibiotics, TPs and ARB&ARGs in wastewater.

PROJECT CONSORTIUM

BENEFICIARIES (and their roles in ANSWER)	PARTNERS
Nireas-International Water Research Center, University of Cyprus (Cyprus) - Coordinator Assoc. Prof. Despo Fatta-Kassinos - Project Coordinator	**Austrian Agency for Health and Food Safety (Austria)** Mr. Markus Woegerbauer
Environmental Institute (Slovakia) Dr. Jaroslav Slobodnik - Advisory Board Coordinator	**Abwasserverband Braunschweig (Germany)** Dr. Bernhard Teiser
KWR Watercycle Research Institute (The Netherlands) Dr. Luc Hornstra Director of Complementary Skills Training & Personal Career Development	**BioDetection Systems bv (The Netherlands)** Dr. Harrie Besselink
The Agriculture Research Organisation of Israel The Volcani Center (Israel) Dr. Eddie Cytryn - Advisory Board Coordinator	**HighChem (Slovakia)** Dr. Robert Mistrik
Agencia Estatal Consejo Superior de Investigaciones Cientificas (Spain) Dr. Josep Maria Bayona Equal Opportunities and Ethical Leader	**The Hebrew University of Jerusalem (Israel)** Prof. Edouard Jurkevich
Adventech - Advanced Environmental Technologies, Lda (Portugal) Mr. Sergio C. Silva - Director of Scientific Training	**Istituto Superiore di Sanità (Italy)** Dr. Emanuela Testai
Universidade Catolica Portuguesa (Portugal) Assist. Prof. Celia Manaia - Director of Research	**Karlsruhe Institute of Technology (Germany)** Dr. Thomas Schwartz
Technische Universität Dresden (Germany) Prof. Thomas Berendonk - Director of Research	**VA TECH WABAG GmbH (Austria)** Dr. Josef Lahnsteiner
Universita Degli Studi di Salerno (Italy) Assoc. Prof. Luigi Rizzo - Director of Scientific Training	
Technische Universität Wien (Austria) Assoc. Prof. Norbert Kreuzinger Director of Complementary Skills Training and Personal Career Development	

ADVISORY BOARD MEMBERS






Ms. Valeria Dulio
NORMAN Association

Dr. Ernesto Liebana
European Food Safety Authority

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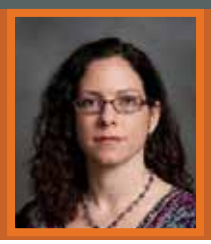
Ministry of Health, Israel

Dr. Ed Topp
Agriculture and Agri-Food Canada

Dr. Marc Mills
United States Environmental Protection Agency

Prof. Helmut Kroiss
International Water Association

EXTERNAL SCIENTISTS


Prof. Susan Richardson
University of South Carolina, United States

Prof. Amy Pruden
Virginia Tech, United States

Prof. Dionysios Dionysiou
University of Cincinnati, United States

Assoc. Prof. Teik Thye Lim
Nanyang Technical University, Singapore

Assoc. Prof. Yunho Lee
Gwangju Institute of Science & Technology, South Korea

ANSWER's NEW GENERATION OF SCIENTISTS

Gianuario Fortunato (ESR1)

Measurement of the impact of antibiotic resistance discharge in wastewater and in soil: ecological aspects

Italian

Universidade Catolica Portuguesa, **Portugal**

Roberto Marano (ESR2)

Development and application of novel methods for targeting mobile genetic elements in wastewater and downstream environments

Italian

The Ariculture Research Organization of Israel, The Volcani Center, **Israel**

Elena Radu (ESR9)

Modelling horizontal resistance genes transfer by free DNA in activated sludge treatment plants and soil

Romanian

Technische Universität Wien, **Austria**

Katarzyna Ślipko (ESR10)

Management options for conventional and advanced wastewater treatment technologies and plant operation conditions to improve the efficiency of antibiotic resistance removal

Polish

Technische Universität Wien, **Austria**

Ioannis Kampouris (ESR3)

Effect of wastewater irrigation on the passage of ARB&ARGs towards ground/surface waters

Greek

Technische Universität Dresden, **Germany**

Aparna Chandrasekar (ESR4)

Modeling the dissemination of ARB&ARGs from irrigation to ground/surface water

Indian

Technische Universität Dresden, **Germany**

Iakovos Iakovides (ESR11)

Membrane bioreactor followed by light-driven oxidation for the minimization of A&ARB&ARGs from urban wastewater intended for reuse

Cypriot

University of Cyprus, Nireas-IWRC, **Cyprus**

Ian Zammit (ESR12)

Development of a new photocatalytic reactor for wastewater disinfection and subsequent application in crops irrigation: effect on antibiotic resistance transfer and ARB&ARGs accumulation in crops

Maltese

Universita Degli Studi di Salerno, **Italy**

Gabriela Karina Paulus (ESR5)

Dissemination and fate of wastewater-derived ARB&ARGs in surface water as a storage means before reuse

German

KWR Watercycle Research Institute, **The Netherlands**

Francisco Diogo de Almeida Cerqueira (ESR6)

Genetic analysis of endophytic bacteria in edible plants by high-throughput sequencing

Portuguese

Agencia Estatal Consejo Superior de Investigaciones Cientificas, **Spain**

Francesco Biancullo (ESR13)

Light-Emitting Diodes (LEDs) driven photocatalytic membrane treatment of ARB&ARGs and market/benchmark assessment

Italian

Adventech - Advanced Environmental Technologies Lda, **Portugal**

Vasiliki Beretsou (ESR14)

Investigating the potential of transformation products of antibiotics formed during advanced wastewater treatment to induce biological adverse effects and antibiotic resistance

Greek

University of Cyprus, Nireas-IWRC, **Cyprus**

Nazareno Scaccia (ESR7)

Evaluation of possible risks of antibiotic resistance transmission to humans by treated wastewater-irrigated crops

Italian

Universidade Catolica Portuguesa, **Portugal**

Đorđe Tadić (ESR8)

Uptake of antibiotics and antibacterial contaminants in crops

Serbian

Agencia Estatal Consejo Superior de Investigaciones Cientificas, **Spain**

Nikiforos Alygizakis (ESR15)

Advanced methods for identification and risk assessment of present and future antibiotics and their transformation products in wastewater

Greek

Environmental Institute, **Slovakia**

CONTACT US

Dr. Despo Fatta-Kassinos
Project Coordinator
Nireas-IWRC, University of Cyprus
Email: dfatta@ucy.ac.cy

PROJECT MANAGERS

Scientific Manager: Dr. Irene Michael-Kordatou
(michael.irene@ucy.ac.cy)

Dissemination & Outreach Manager: Dr. Lida Ioannou-Ttofa
(ioannou.lida@ucy.ac.cy)

Financial & Administration Manager: Mr. Toumazis Toumazi
(toumazis@ucy.ac.cy)

FOR MORE INFORMATION

- **http://www.answer-itn.eu/**
- **https://www.facebook.com/answer.itn/**
- **https://twitter.com/answer_itn**
- **info@answer-itn.eu**

AGKNOWLEDGMENTS:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 675530.