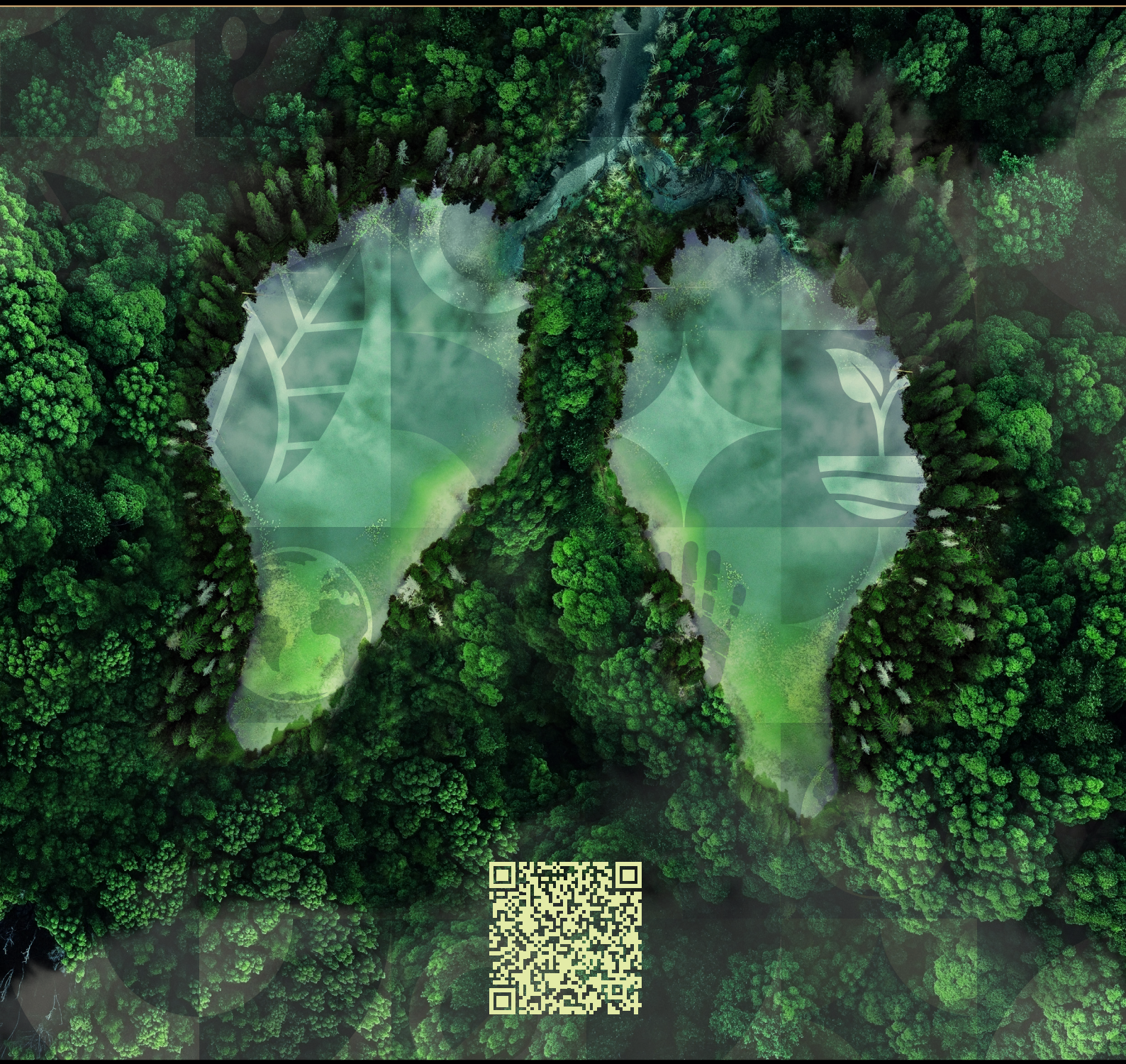
European Research Council

Established by the European Commission

European Commission

Frontier Research for One Health



ERC-funded frontier research: One Health, One Future.

ERC-funded frontier research is redefining how we think about health - not in silos, but as a connected system. Some of today's most urgent challenges - climate-driven health risks, biodiversity loss, pandemics, antimicrobial resistance - do not stop at disciplinary or sectoral borders. Neither does science.

The One Health approach recognises this reality. It embraces the interdependence of human, animal and environmental health, and calls for innovative thinking that cuts across science, policy, and society. ERC-funded projects do precisely that: they explore the unknown, push boundaries, and deliver breakthroughs that can transform how we prepare, prevent and respond to global risks.

> ***Curiosity-driven research is a crucial instrument for addressing challenges that link human, animal and planetary health. This is clearly demonstrated by the research of the ERC grantees featured in this brochure, which represents only a sample of ERC-funded work in the area of One Health.***
>
> Maria Leptin, ERC president

ERC frontier research underpins One Health and helps shape the future of resilience.

The featured ERC-funded projects in One Health illustrate how frontier research informs bold policy, sparks innovation and builds systems capable of anticipating crises rather than merely reacting to them. These projects translate cutting-edge science into tangible societal impact, take discoveries to the decision-making table, and leverage ERC research to create a healthier future.

Across disciplines, evolutionary virology is uncovering the zoonotic threats of tomorrow, while nanotechnology is fueling the creation of next-generation vaccines. Paleoscience traces antimicrobial resistance through ice and sediment records, while artificial intelligence is revolutionising how we model and monitor diseases. Furthermore, machine learning, computer simulations and stochastic modelling help forecast some environmental impacts of climate change. Environmental neuroscience explores how brain activity interacts with social and physical environments, while social sciences are revealing the behavioural and governance levers that make communities more resilient towards climate change.

"One Health is an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals and ecosystems."

OHHLEP (One Health High-Level Expert Panel, WHO Quadripartite)

"The pandemic clearly showed how prevention, response, antimicrobial resistance, health inequalities and environmental protection are interlinked."

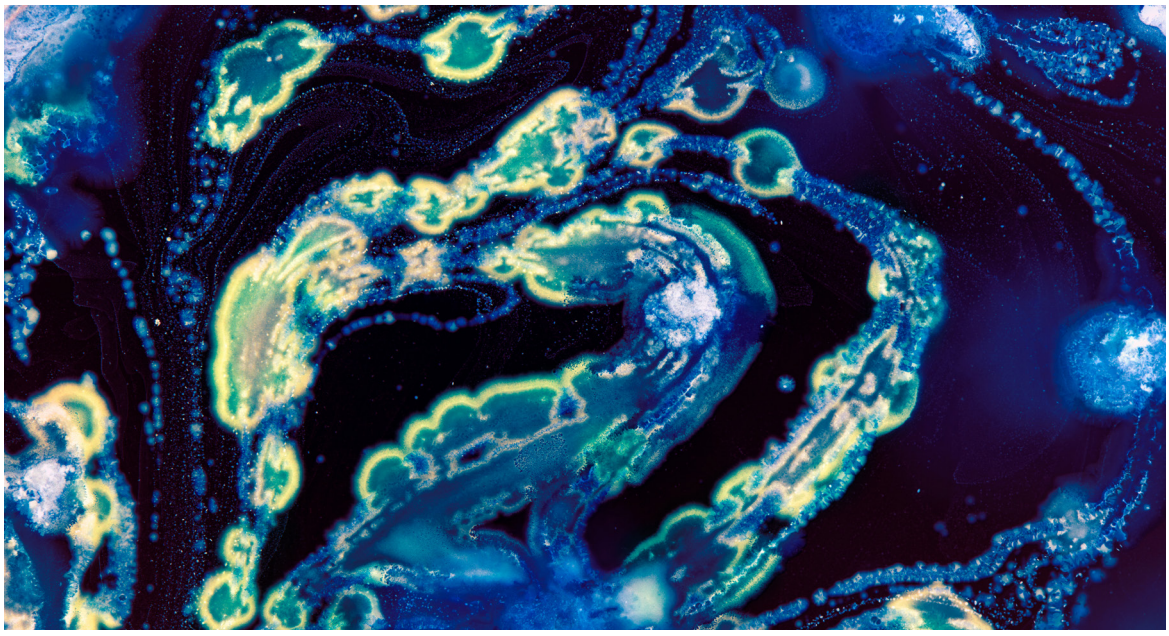
SAM (Scientific Advice Mechanism of the European Commission) Scoping Paper

"To become effective, collaborations must be expanded across governance levels, linking scientific evidence, risk assessment and policy action."

Scientific Opinion on One Health Governance in the EU (2024)

ERC projects on ‘One Health’

Outsmarting outbreaks: Tackling zoonoses, antimicrobial resistance and future pandemics



PALVIREROL - Paleovirology, the evolutionary dynamics of viral cross-species transmissions, and the consequences of virus-host gene exchange

Aris Katzourakis

Host institution: University of Oxford (UK)

Tracing the evolution of viruses

Viruses are omnipresent parasites connected with human evolution and are extensively studied. However, their long-term evolution is not well known as they do not easily form a geological fossil record.

The PALVIREVOL project is pioneering groundbreaking methodologies to harness their genomic fossil record. Their research delves into the history of viral cross-species transmission, exploring the significant impact of gene flow between viruses and their hosts on the evolution of immunity and pathogenicity. The project has already discovered novel viral lineages integrated within animal host genomes, alongside DNA viruses circulating in various mammalian species. The team developed advanced mathematical models to decode virus-host interactions within intricate microbial ecosystems. PALVIREVOL is reshaping our understanding of viral evolution and its influence on the natural world.

PeptideKillers - Peptide Killers of Bacteria

Robert Vácha

Host institution: Masaryk University (CZ)

Peptide killers of bacteria

Antibiotic resistance occurs when bacteria develop mechanisms to avoid being killed by one or multiple antibiotics.

This makes infections harder to treat and creates an urgent need for new therapies. Some bacteria are now resistant to all known antibiotics, raising fears of a global post-antibiotic era. The ERC-funded project PeptideKillers aims to develop promising peptide therapeutics that are selective for bacteria without harming human cells.

To achieve this, the team is building an innovative model of cell membranes and creating a new method to study how peptides interact with different membrane types. This approach will help identify peptides that specifically target bacterial membranes. It could also lead to designing peptides that attack viruses, cancer cells, or even certain cell organelles—opening the door to new treatments, sensors, and biomarkers.

NANOBAC - Antibody-guided design of multivalent nanoparticle vaccines against bacterial pathogens

Johan Malmström

Host institution: Lund University (SE)

Nanoparticle vaccines against bacterial infections

NANOBAC is advancing vaccine development with a focus on combating antimicrobial resistance (AMR). The project aims to build the molecular characterisation of animal and human circulating serum antibody repertories and establishing a framework for antibody-guided design of next-generation nanoparticle vaccines against bacteria. The nanoparticle vaccines developed will be used to investigate structural properties of protective antibody responses required for immunity. This innovative approach is adaptable to multiple protein families and bacterial pathogens, paving the way for broad-ranging applications in the fight against AMR. NANOBAC is shaping the future of vaccine technology to safeguard global health.

Paleo-MARE - A paleoecological approach to deciphering the impact of heavy metals on antibiotic resistance spread in the environment

Catherine Larose

Host institution: National Centre for Scientific Research (FR)

The link between heavy metal pollution and antibiotic resistance

The widespread use of antibiotics has led to the spread of antibiotic resistance genes across the globe. This spread has critical consequences for human and environmental health with an estimated 700 000 deaths a year resulting from infections that no longer respond to treatment. The presence of heavy metal resistance genes and antibiotic resistance genes in microbial genomes suggests a co-selection. However, present day ecosystems are contaminated by both. The project Paleo-MARE uses paleoecological archives to identify the co-selection processes of heavy metal resistance genes and antibiotic resistance gene, shedding light on how these pollutants have shaped microbial evolution. By extracting the genomes of microorganisms in ice and sediment-cores, the team will determine global driving forces controlling heavy metal pollution and the spread of antimicrobial resistance from pre-industrial times to the present time.

ALIVEAfrica - Animals, Livelihoods and Well-being in Africa

Hannah Brown

Host institution: University of Durham (UK)

A closer look at animal-focused development

Across the sub-Saharan Africa, animals provide sources of food and income. However, unsustainable hunting practices reduce biodiversity and cause risk of zoonotic disease transmission. Also, higher antimicrobials in food animals drive increased drug resistance. With a focus on Sierra Leone and Kenya, the project ALIVEAfrica is analysing the role of animals on contemporary livelihoods and the implications of human-animal relations for the well-being of multispecies communities. It also explores the mechanisms of governance that seek to manage human-animal relations. A deeper understanding of human-animal relationships will benefit sustainability across species.

VR3PP - Visual Representations of the Third Plague Pandemic

Christos Lynteris

Host institution: University of St. Andrews (UK)

Visual Representations of the Third Plague Pandemic

The project VR3PP studied the visual production of the third plague pandemic (1894-1959), caused by Yersinia pestis, that resulted in 12 million deaths globally. As the first systematic photographic chronicling of a disease outbreak, it established epidemic photography as a distinct genre, integrating scientific and lay perceptions. The project highlighted how epidemic photography influenced urban pathologisation and burial practices, especially in colonial contexts, and intersected with advances in epidemic mapping and disease ecology. It explored the entanglement between plague photography, contributing to social and scientific developments, and informing contemporary depictions of epidemics.

The health of our planet; the health of us all

DIGDEEP - Digging Deep: An Underground Plant Trait Perspective on Diversity-Disease Relationships

Liesje Mommer

Host institution: Wageningen University (NL)

How plant diversity protects against disease

Although plant species diversity is often associated with reduced plant disease risk, there is still no complete understanding of how biodiversity affects disease risk. This gap in knowledge is relevant for agriculture, where monocultures often suffer from frequent diseases despite heavy pesticide use.

The DIGDEEP project explores how plant traits, symbiotic fungi, and rooting patterns impact disease risk. The project aims to understand belowground plant-pathogen interactions in biodiverse systems with multiple pathogens, stimulate crossovers with phytopathology and animal epidemiology, and provide a knowledge base to design agricultural systems that are intrinsically resilient to pathogens. By combining experimental and modelling techniques, this project aims to guide the development of more diverse and robust agricultural systems.

SEACHANGE - Quantifying the impact of major cultural transitions on marine ecosystem functioning and biodiversity

James Scourse, Callum Roberts, Bernd R. Schöne, Kristine Bohmann

Host institutions: University of Exeter (UK), Johannes Gutenberg University Mainz (DE),

University of Copenhagen (DK)

Human cultural transitions impact on the marine ecosystem

Ocean conservation is a global concern, but we do not currently know what the oceans were like before major impacts caused by humans. By using sediments, shells and bones, and a host of cutting-edge analysis techniques, the SEACHANGE project aims to reconstruct marine ecosystem baselines, and assess the impact of human activities on marine biodiversity and ecosystem functioning. The project aims to discover how depleted the current marine environment is, what measures are needed to help biodiversity recover, and how long this might take.

CoSense4Climate - Compressed Sensing for Climate: A Novel Approach to Localize, Quantify and Characterize Urban Greenhouse Gas Emitters

Jia Chen

Host institution: Technical University of Munich (DE)

A revolutionary approach to monitoring emissions

Climate change threatens with unpredictable environmental consequences unless we tackle greenhouse gas emissions head-on. The challenge? Measuring global greenhouse gas emissions accurately and uncovering unknown sources.

The CoSense4Climate project is developing new types of sensors, methods and models to locate and quantify the emission sources of greenhouse gases and air pollutants in cities. The project uses high-resolution modelling, satellite data, and atmospheric remote sensing to produce hourly maps of biogenic CO2 flux estimations with the aim of revolutionising atmospheric inversion. The project seeks to establish a new standard in greenhouse gas emission monitoring, offering new hope in the fight against climate change.

VIBRANT-SEA - Validating Biodegradation Rates and Reactions Applying Novel Technologies and Systems Ecology Approaches

Linda Amaral-Zettler

Host institution: Foundation for Dutch Scientific Research Institutes (NL)

Exploring biodegradable plastics in marine environments

Plastic marine debris poses a significant threat to the planet, prompting efforts to find eco-friendly alternatives to single-use plastics. The ViBRANT-SEA project aims to study the breakdown rates of biodegradable plastics and their additives. It will also create a fish model for toxicity testing and analyse microbial metagenomes from global plastic samples to identify genes and enzymes associated with plastic biodegradation in marine settings. The project uses advanced techniques to measure biodegradation rates and develop a marine fish organoid model for toxicity assessment.

EQUALSEA - Transformative adaptation towards ocean equity

Sebastian Villasante

Host institution: University of Santiago de Compostela (ES)

Understanding inequality in society from ocean stressors

Inequality is one of the defining challenges of the 21st century, affecting the well-being of people worldwide. Oceans play a critical role in this context, as they provide food, livelihoods, and opportunities for recreation, among many other essential functions. With a focus on ocean equity, the EQUALSEA project sheds light on how ocean stressors, such as climate change and

biodiversity loss, affect marine protected areas and coastal communities and how this translates into broader societal impacts. The project analyses how transformative changes can be fostered to address such ocean-related inequalities.

BrainScape - How the physical environment shapes the human brain

Simone Kühn

Host institution: Max Planck Society for the Advancement of Science (DE)

A closer look at how the environment shapes the mind

If our biology and social surroundings impact our behaviour, how do our physical and biological environments affect brain function, health and mental well-being? The emerging field of environmental neuroscience aims to bridge this knowledge gap by investigating the bidirectional relationships between brain activity and the social and physical surroundings of organisms. The BrainScape project places particular emphasis on studying healthy living environments, evidence-based urban planning and the impacts of climate change to identify pivotal aspects of the physical environment. The project employs cutting-edge technologies in controlled studies, including a unique one involving discordant monozygotic twins. The overall aim is to uncover the pathways and mechanisms responsible for environmental impacts that directly influence brain function and mental well-being.

Smart science: How AI is revolutionising One Health

PULSE - Perception Ultrasound by Learning Sonographic Experience

Julia Noble

Host institution: University of Oxford (UK)

Developing a new generation of ultrasound imaging capabilities

The greatest barrier to the universal implementation of ultrasound in clinical medicine today is the need to train sonographers to the highest level to ensure diagnostic images are of consistently high quality and fit for purpose.

PULSE explores the use of artificial intelligence-based technologies to reduce the need for highly trained ultrasound operators. The project builds on the observation that sonographers find it easier

to interpret their own scans than review those taken by others. The innovation in PULSE lies in applying state-of-the-art machine learning and computer vision techniques to build computational models that capture how expert sonographers perform diagnostic studies, integrating multiple perceptual cues.

MolStressH2O - Molecular mechanisms and consequences of thermal stress rippling through changing aquatic environments

Katharina Wollenberg Valero

Host institution: National University of Ireland (IE)

Enhancing the understanding of the impacts of heat stress

Heat stress is a driver of current mass mortalities related to anthropogenic global warming. MolStressH2O explores whether thermal stress can be propagated by means of chemical communication (stress metabolites) to naive receivers of different species and tries to identify heat-induced stress metabolites and their molecular pathways of action. The project will identify the role of functional genomic network constraint and explore through artificial intelligence-led simulations whether networks with topological node constraints outperform those without constraint. MolStressH2O aims to enhance the understanding of these mechanisms, as well as of the extent to which organisms will respond to anthropogenic warming.

LACRIMA - Lagrangian Climate Risk and Impact Attribution

Win Thiery

Host institution: Free University of Brussels (BE)

The lifetime impact of climate change on people

Global warming leads to increased frequency, intensity and duration of extreme events, such as heatwaves. Studies on the impact of climate change often fail to consider how vulnerability and climate risk change over a person's lifetime. On the other hand, demographic research often neglects the effects of climate change on population dynamics and vulnerability. The ERC-funded LACRIMA project aims to identify the impacts of climate change and associated risks from a cohort perspective. The project utilises machine learning to reconstruct significant climate change impacts, such as heat-related mortality and areas affected by wildfires. Additionally, it will identify age-specific vulnerabilities to climate extremes, quantify how these impacts affect life expectancy globally, and project how exposure to extreme events may lead to irreversible consequences.

KARST - Predicting flow and transport in complex Karst systems

Marco Dentz, Benoit Noetinger, Philippe Renard, Bojan Mohar

Host institutions: Spanish National Research Council (ES), IFP Energies Nouvelles (FR),

University of Ljubljana (SL), University of Neuchâtel (CH)

Predicting flow and transport in complex Karst systems

Karst aquifers - a type of groundwater system that forms in soluble rocks - can transmit water and contaminants at extremely high speeds. In the context of climate change, it is increasingly important to prepare for extreme flooding events and to understand their impacts on karst aquifers. Despite their significant socio-economic importance and association with high-profile disasters, karst structures and processes remain difficult to characterise and assess. The KARST project will develop the next generation of coupled stochastic modelling frameworks and computer simulations to predict karst processes, evaluate the vulnerability of karst aquifers, and forecast their responses to extreme events such as flash floods.

ABRSEIST - Antibiotic Resistance: Socio-Economic Determinants and the Role of Information and Salience in Treatment Choice

Hannes Ullrich

Host institution: German Institute for Economic Research (DE)

New policy design to reduce antibiotic resistance

Antibiotics have been a breakthrough in the treatment of human diseases, but their widespread use has accelerated the development of antibiotic-resistant bacteria. According to the World Health Organization, antibiotic resistance is a major global threat, responsible for approximately 700 000 deaths each year due to untreatable infections. Addressing this challenge requires the design of new policies governing both the supply and demand of existing and novel antibiotics.

ABRSEIST identifies and assesses feasible and effective demand-side policy interventions targeting both physicians and patients. By applying a broad set of econometric tools to uncover the mechanisms linking antibiotic consumption and resistance - alongside machine learning methods and rigorous econometric analyses - ABRSEIST aims to generate robust evidence on effective intervention designs, thereby improving our understanding of antibiotic prescribing, use, and the emergence of resistance.

EARLY-ADAPT - FORECAST-AIR (POC) - HHS-EWS (POC)

Signs of Early Adaptation to Climate Change

Joan Ballester

Host institution: Barcelona Institute for Global Health (ES)

Analysing the environmental, socioeconomic and demographic drivers of recent trends in human health

While thousands of Europeans die each year due to ambient temperatures, there is still little information on how climate change will affect the future of public health. The EARLY-ADAPT project analyses the drivers of recent trends in human health. The project's hypothesis is that societies are beginning to adapt to climate change, but the effectiveness of early adaptation is heterogeneous among and within European societies. The work of EARLY-ADAPT helps to detect, comprehend, and measure the inequalities in adaptation.

The project's capacity for addressing inequalities in adaptation is further strengthened by two Proof of Concept grants (POCs):

- Delivering the first operational Heat-Health-Social Early Warning System (HHS-EWS) representing the health impacts of environmental temperatures to better inform potential end-users - such as public health agencies - to activate emergency plans targeting vulnerable groups. The system integrates weather forecasting, environmental epidemiology, and the social drivers of vulnerability.
- The FORECAST-AIR project, employing epidemiological models to convert air quality predictions into health forecasts, assesses predictability, with the aim of creating early warning systems that prioritise the well-being of vulnerable groups.

B-WEX - Balancing clean Water and Energy provision under changing climate and extremes

Michelle Van Vliet

Host institution: University of Utrecht (NL)

Cascading effects and feedback between water and energy systems during extreme weather events

Providing clean water and energy simultaneously to an expanding global population under changing climatic conditions is a major challenge. Demand for both resources and their systemic interdependencies is particularly intense during droughts and heatwaves. Despite the recent growth of research on the water-energy nexus, there remains limited fundamental understanding of the cascading effects and feedback between water and energy systems during extreme weather events. Yet, such understanding is urgently needed to ensure a balanced and resilient provision of clean water and energy in a changing world increasingly affected by climate shocks.

The B-WEX project aims to develop spatially explicit pathways that reveal how the provision of clean water and energy can be balanced under different water management strategies and energy transition scenarios. It accounts for feedback and cascading mechanisms associated with present and future droughts and heatwaves across regions worldwide.

Contact:
ERC-Info@ec.europa.eu
ERC-FEEDBACK-TO-POLICY@ec.europa.eu
https://erc.europa.eu/