



HERA

Health Environment Research
Agenda for Europe

Environmental drivers of pandemics: research, evidence and prevention

Results from the HERA project

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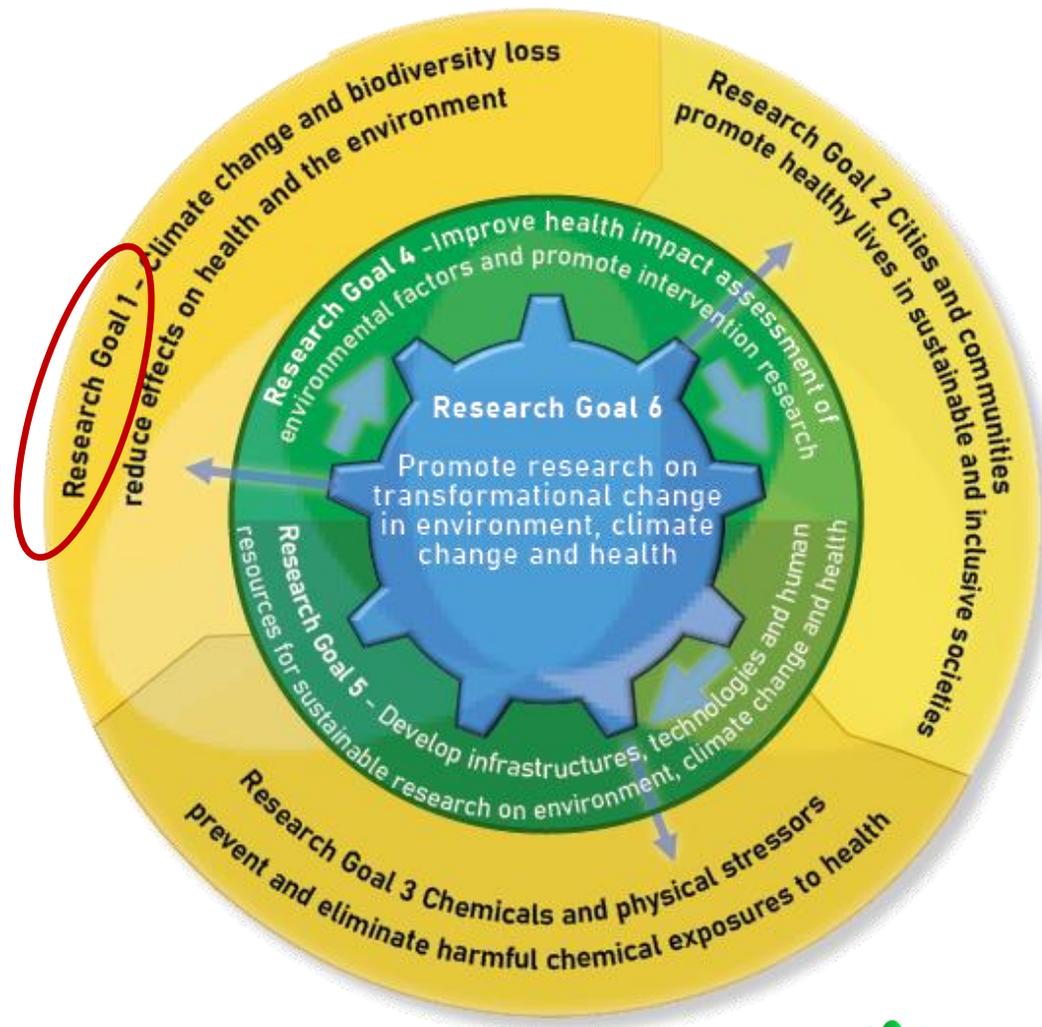
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heraresearcheu.eu

from the European
innovation programme

Integration in the HERA Research Goals

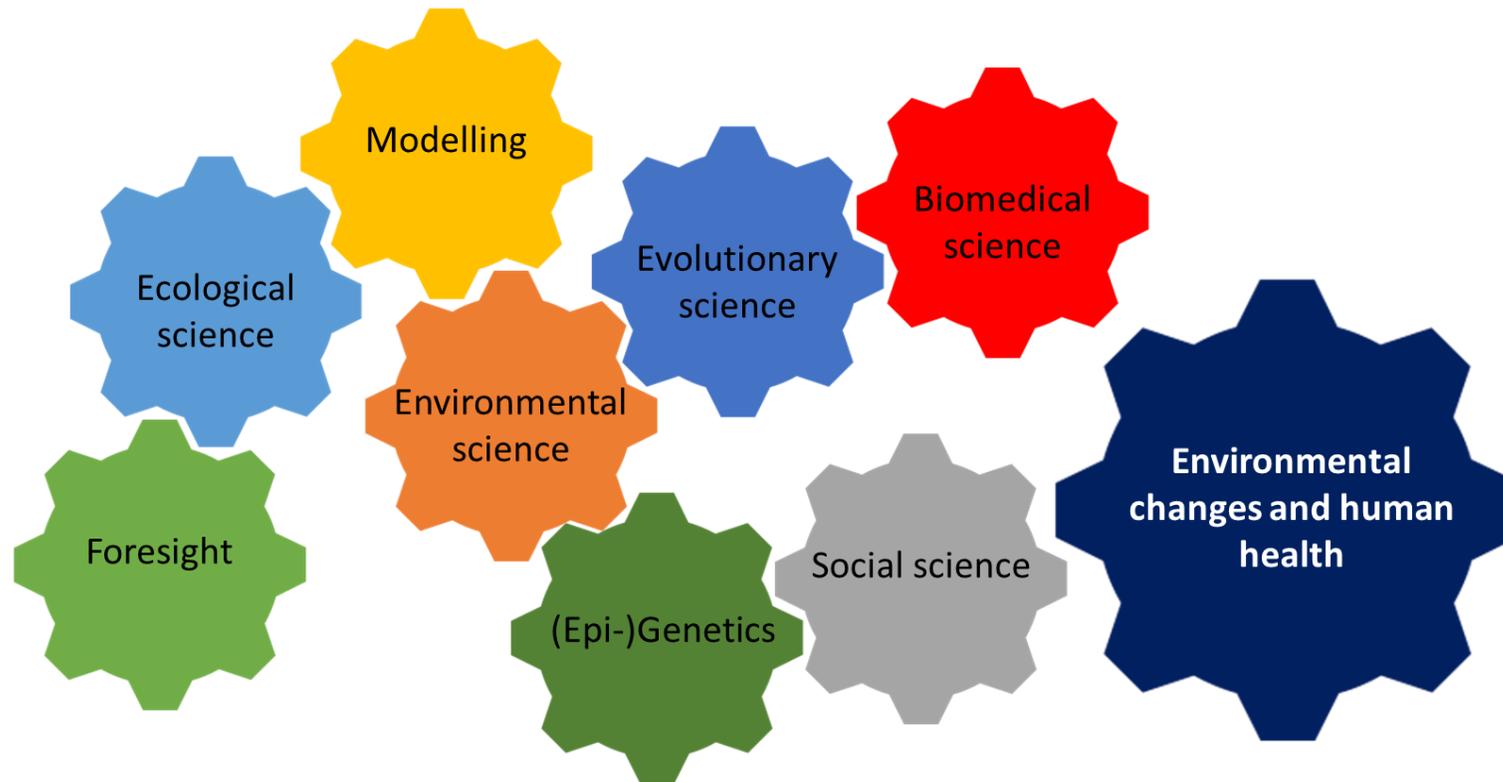


The COVID-19 and pandemics topic integrates into HERA Research Goals:

- › **RG1.3** Health and biodiversity loss
- › **RG1.4** Biological agents, environment and human health
- › **RG1.5** Food, ecosystem services and farming
- › Plus three specific research goals

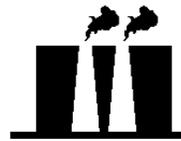
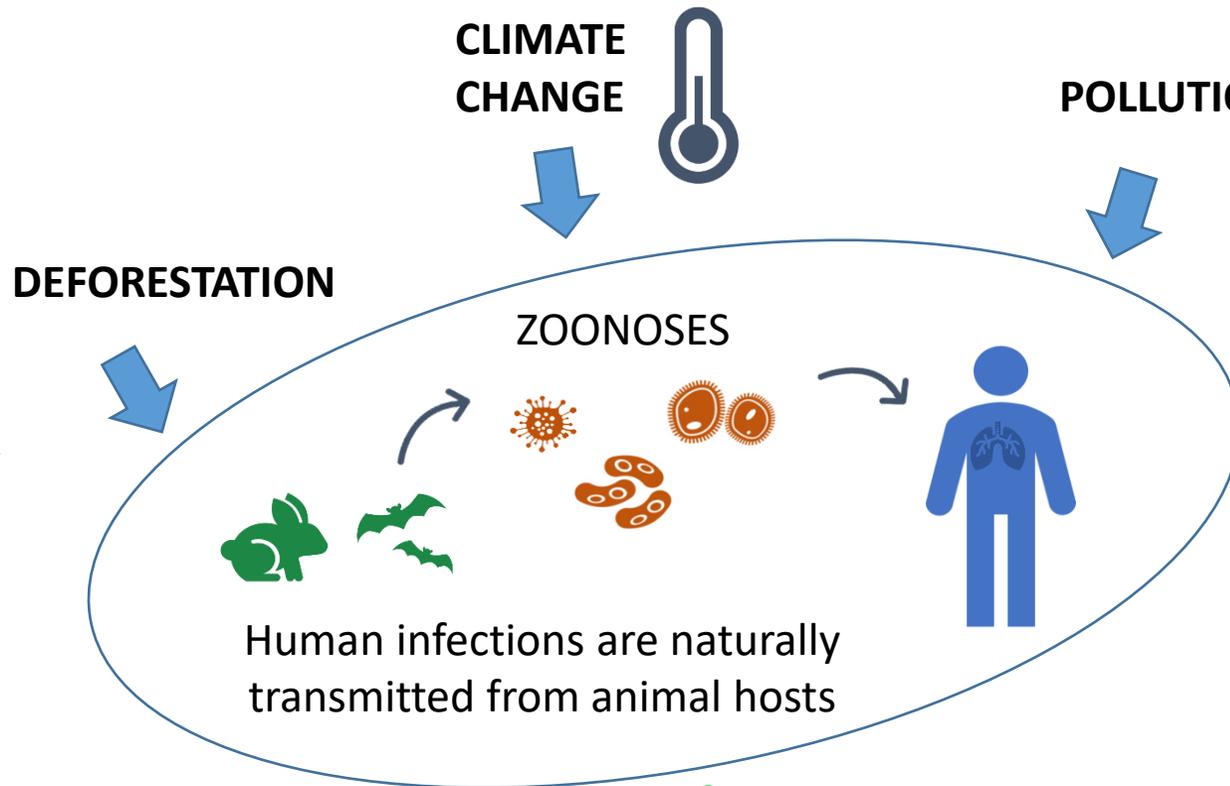
Research needs

Preventing EIDs requires clarifying the causal relationship that exists between environmental change, human activities and the evolution and spread of biological agents



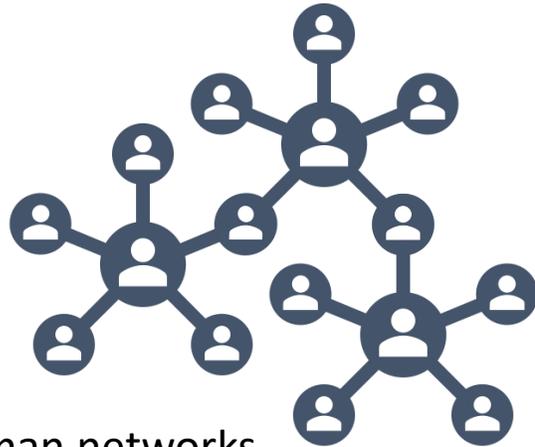
Environmental drivers of pandemics: emergence

Mitigation and prevention strategies require an understanding of what biological agents circulate in ecosystems and how they evolve under environmental/human pressure

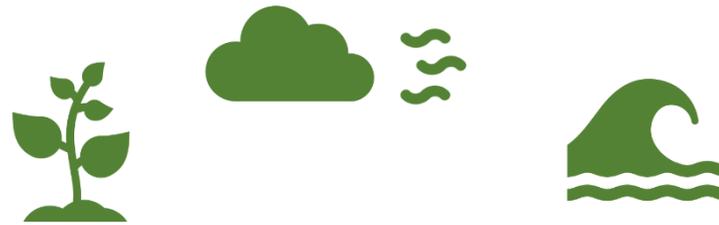


- ACCELERATED EVOLUTION OF MICROBES
- CHANGES IN GEOGRAPHIC RANGE OF HOSTS & MICROBES
- IMMUNE SUPPRESSION OF HOST DEFENSES

Environmental drivers of pandemics: rapid transmission



Human networks



Media of transmission



Intensive agriculture
& farming



Increase in international air travel and
trade (human, animals, plants, food)



Weakened public health systems

Policy relevance

- ▶ Research objectives are in line with the One health/EcoHealth/Planetary health concepts

Interlinked crises of pandemics, Antimicrobial Resistance, climate change and biodiversity loss

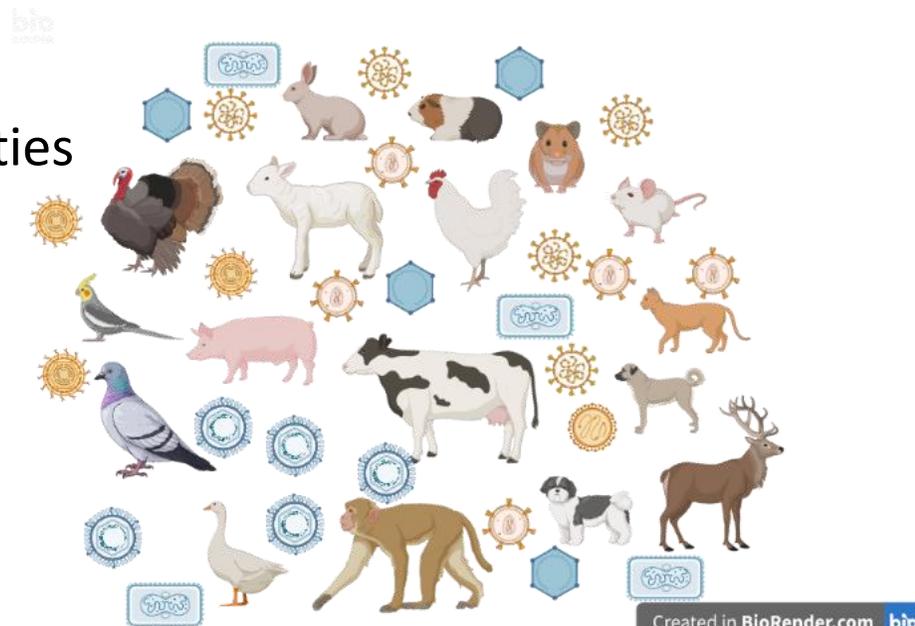
- ▶ Relevant strategies:
 - ✓ Green Deal
 - ▶ Biodiversity strategy
 - ▶ Farm to Fork strategy
 - ▶ Zero Pollution Action Plan
 - ✓ UN sustainable development goals
 - ✓ EU One Health Action Plan against Antimicrobial Resistance
 - ✓ Pharmaceutical Strategy for Europe related to AMR



Relevance for the future

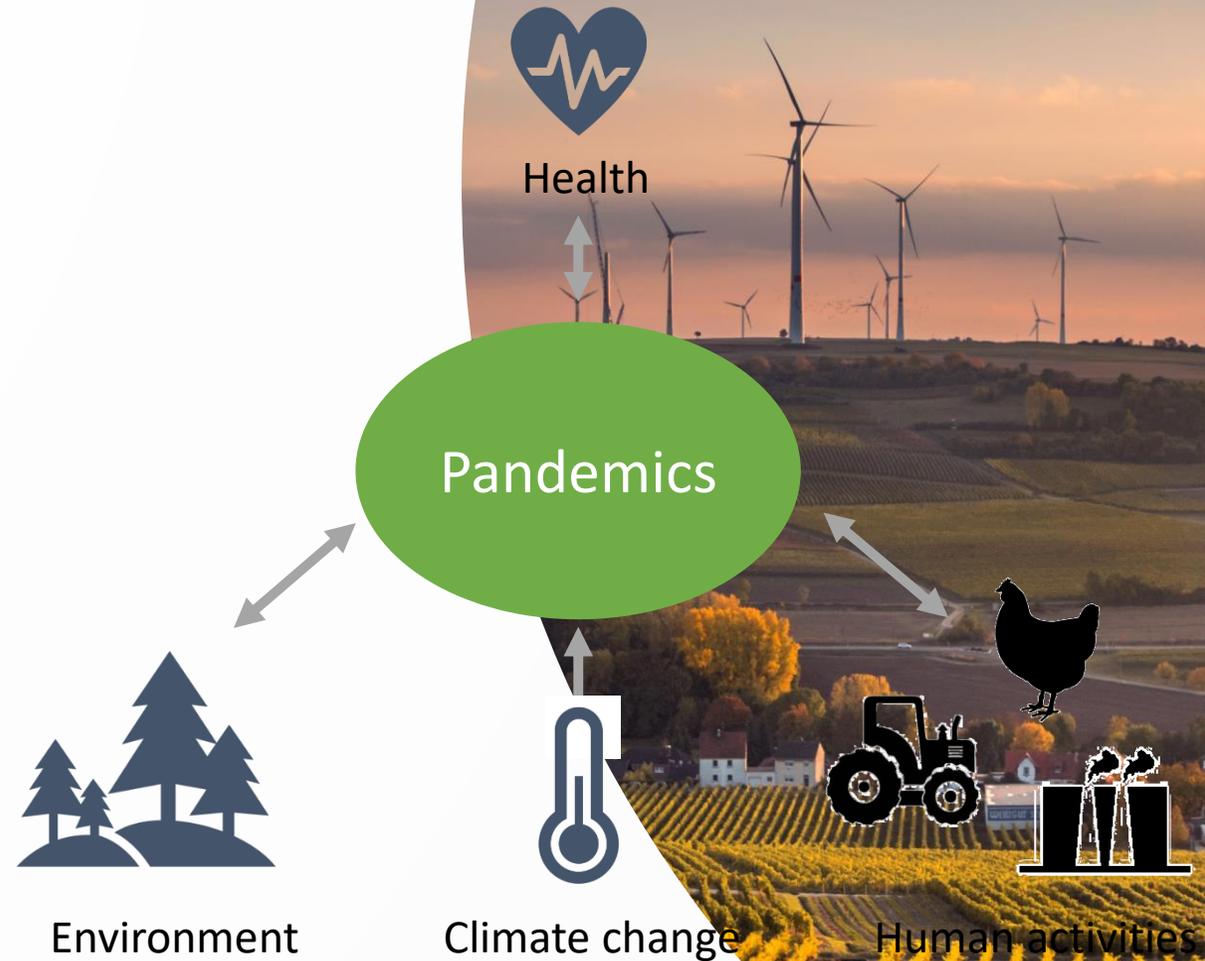
Covid-19, a case study to prevent future EID from developing into pandemics

- ▶ ~ 1.7 million viruses from 25 high-risk viral families yet to be discovered in mammals and birds, of which ~ 700,000 are predicted to have zoonotic potential (Carroll et al. 2018)
- ▶ Known drivers of zoonotic disease emergence:
 - ▶ agricultural land conversion and developmental activities
 - ▶ leading to ecosystem degradation
 - ▶ wildlife trade
 - ▶ intensive farming
 - ▶ changes in climate patterns
 - ▶ international travel, trade and commerce



Three Research Goals specific to COVID-19

- 1: Human and Environmental drivers of SARS-CoV-2 emergence and spread
- 2: Health impact of COVID-19 and environmental stressors
- 3: Integrated socio-economic, political and health implications of COVID-19 and intervention strategies



SARS-CoV-2 emergence and spread

► Viral ecology and spill over

Where, when and why it circulates

(wild and domestic fauna, human contact...)

How human activities and environmental change accelerate viral evolution and facilitate transmission

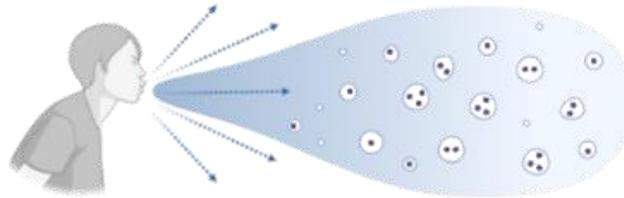
► Spread

Impact of climate and seasonality

Role of different media (aerosols and air particles)

Behaviour and virulence of SARS-CoV-2 in water, soils and wastes

Robust models of virus spread and severity



► Emergence and evolution

Emergence dating - Routes of transmission

Modelling the evolution of SARS-CoV-2 in immunized populations

Estimating the fitness of variants

→ **take action**

(land use, food system, agriculture, intensive farming, live animal markets)

→ **Protect vulnerable populations**

→ **Mitigate viral transmission**
(new tools for contact tracing...)

→ **prevent a possible evolution** towards better transmitted or more virulent variants

→ **adapt control measures and evaluate/validate their effectiveness**

► Instruments for anticipating future emergences and implementing solutions within territories

“The problems of pandemics, climate and biodiversity loss are strongly interconnected but so are the solutions”
(Oakes et al., 2020)

ECOLOGICAL HEALTH OBSERVATORIES

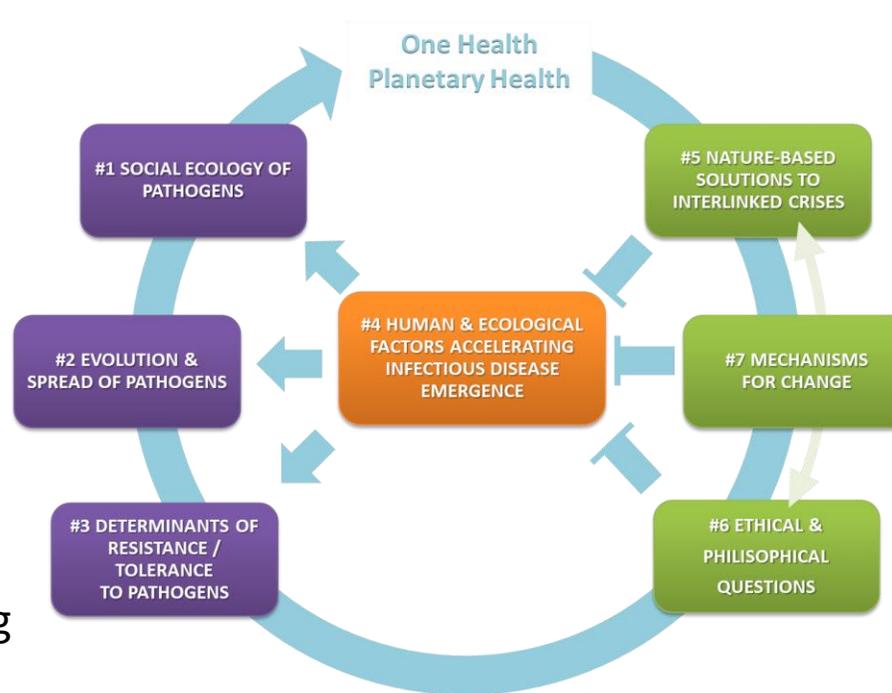


- provide robust data for research
- assist the development & transfer of monitoring methods
- share data and cobuild projects

LIVING LABORATORIES

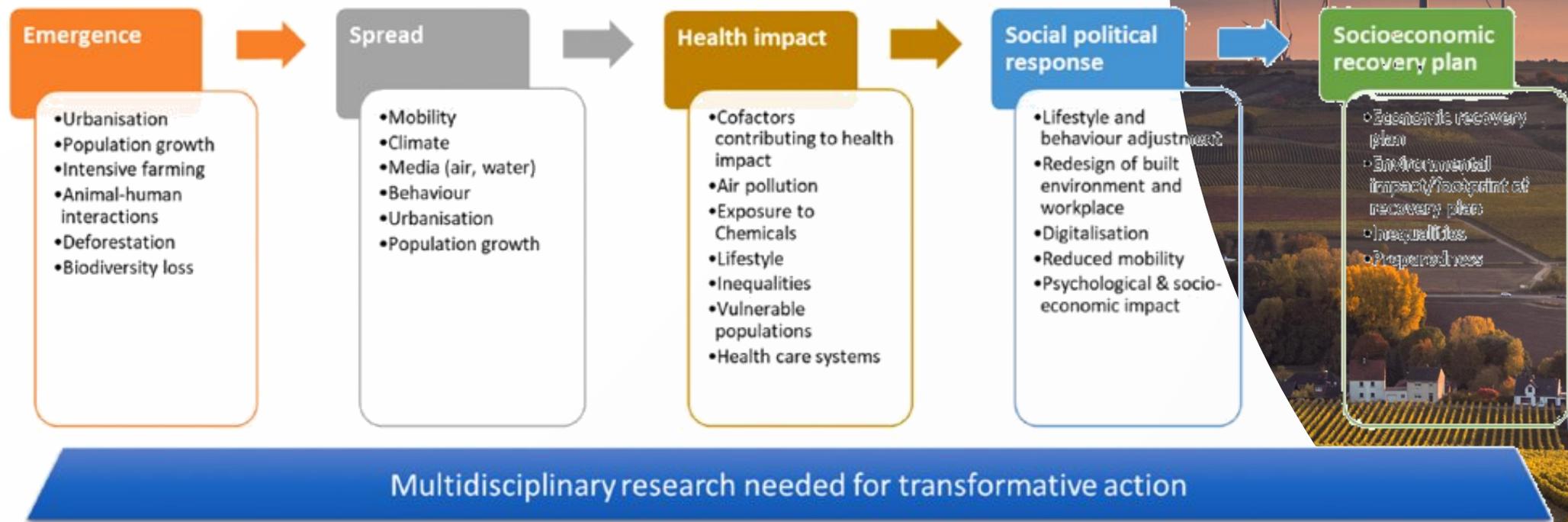


involve local actors and aim at changes in agricultural practices and environmental management



COVID-19 and global environmental change

The HERA consortium has made proposals for multidisciplinary research to achieve transformational change



(Barouki et al. 2021)

Understanding the population burden and identifying populations at risk

- ▶ Conducting large & harmonized population and patient cohorts in the EU
- ▶ Harmonizing studies to ensure comparability between various contexts
- ▶ Assessing zero-prevalence and host genetics to study the impact of environmental exposures in modulating immune responses during the pandemic
- ▶ Studying the impact of delay in routine vaccinations, cancer screening programmes and diagnosis and therapy for other diseases



How environmental stressors affect COVID-19 spread & severity

- ▶ climate change
 - ▶ heat waves and the health system
 - ▶ impact of control measures during heat waves
 - ▶ spatial and temporal variation of temperature, humidity, UV radiation
- ▶ air pollution
 - ▶ link between highly polluted areas and virus spread and impact
 - ▶ synergistic health impacts of air pollution and severity of COVID-19
 - ▶ Impacts of air pollutants on infections outcomes
- ▶ toxicants
 - ▶ Impact of exogenous toxicants on the outcomes of the viral infection

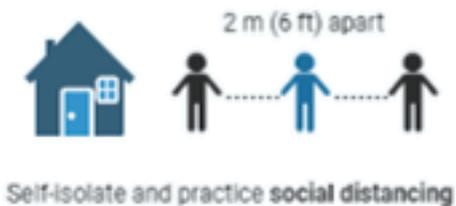
Integrated modelling, assessment, coordinate capacities

- ▶ Integrated health and social impact modelling and assessment of COVID-19
 - ▶ Related intervention strategies, Confinement, Improved environmental conditions (e.g. air quality), Economic crisis, Social and health implications, Environmental health inequalities, Inequalities in access to environmental goods (such as parks, private garden)
- ▶ Coordination of health and environmental impact prediction capacities across the EU
 - ▶ To enable and support effectively public interventions and enhance preparedness
 - ▶ Medium/long term studies on sustainable infrastructure and network



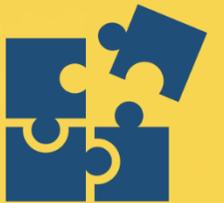
Social economic and psychological impacts of COVID-19

- ▶ Conducting large & harmonized population and patient cohorts in the EU
- ▶ Assessing impacts of intervention strategies and physical distancing including cultural and social value aspects, as well as behavioural, mental health, lifestyle, economic and ethical aspects



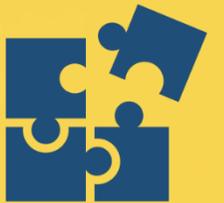
Interaction between COVID-19 and the built environment

- ▶ Study how the COVID-19 pandemic will reshape the urban built environment and how the built environment influences the occurrence and severity of the disease
- ▶ Study the role of urban density



COVID-19 and the work environment

- ▶ Study the short term risks of infection diseases and stress, burnout to develop evidence-based prevention protocols
- ▶ Assess and evaluate long term effects of the COVID-19 pandemic and the post-pandemic period on new economic settings, including types of employment, working patterns and unemployment



Implementation research of integrated social, economic, political and environmental strategies and policies for future optimal intervention



More information

- ▶ HERA paper on *Research needs on Covid-19/Environment & Health nexus Contribution of HERA*, access under: <https://static1.squarespace.com/static/5d6d2b4f677cfc00014c7b53/t/5eb474c308f6802da11db845/1588884676358/HERA-COVID-19+research+needs+05.05.2020.pdf>
- ▶ HERA paper on *Research needs for the prevention of future pandemics Contribution of HERA*, access under: <https://www.sciencedirect.com/science/article/pii/S0160412021005407?via%3Dihub>



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- ▶ Graphics: <https://www.cannypic.com/es/free-vector/free-bacteria-bug-virus-mold-vector-icon-set-440077> & <https://www.istockphoto.com/es/vector/un-icono-simple-que-representa-un-virus-vector-gm1202362971-345165116>

