One Health

Meets the Exposome

BAPH Symposium 2025, June 6

Jos Bessems, R&D, VITO

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vito.be

1. VITO
2. Why Exposome and One Health?
3. Exposome
4. One Health



VITO

Science-to-Technology Partner

Regenerative Economy

Circular & bio-economy
Energy & water
Closed loops

3 IMPACT DOMAINS

Healthy Environment

Environment – Health impact
Space for all
Human comfort

Resilient Ecosystems

Climate mitigation
Climate adaptation
Security

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+1300
Multidisciplinary experts



Unique lab/data, scale up & test infrastructure

Systemic approach

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Turning Fundamental Research into Solutions

Creating Value and Increased Competitiveness for Companies and Governments

Fundamental Research

Research and education



Universities

Public funding research projects, (PhDs, postdocs)

Applied Research

Research in the economic reality

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Research & Technology Organisations

Contract research, Pilots



Companies



Governments



Citizens

TECHNOLOGY READINESS LEVEL

1 2 3 4 5 6 7 8 9

From Environment to Individuals to Populations

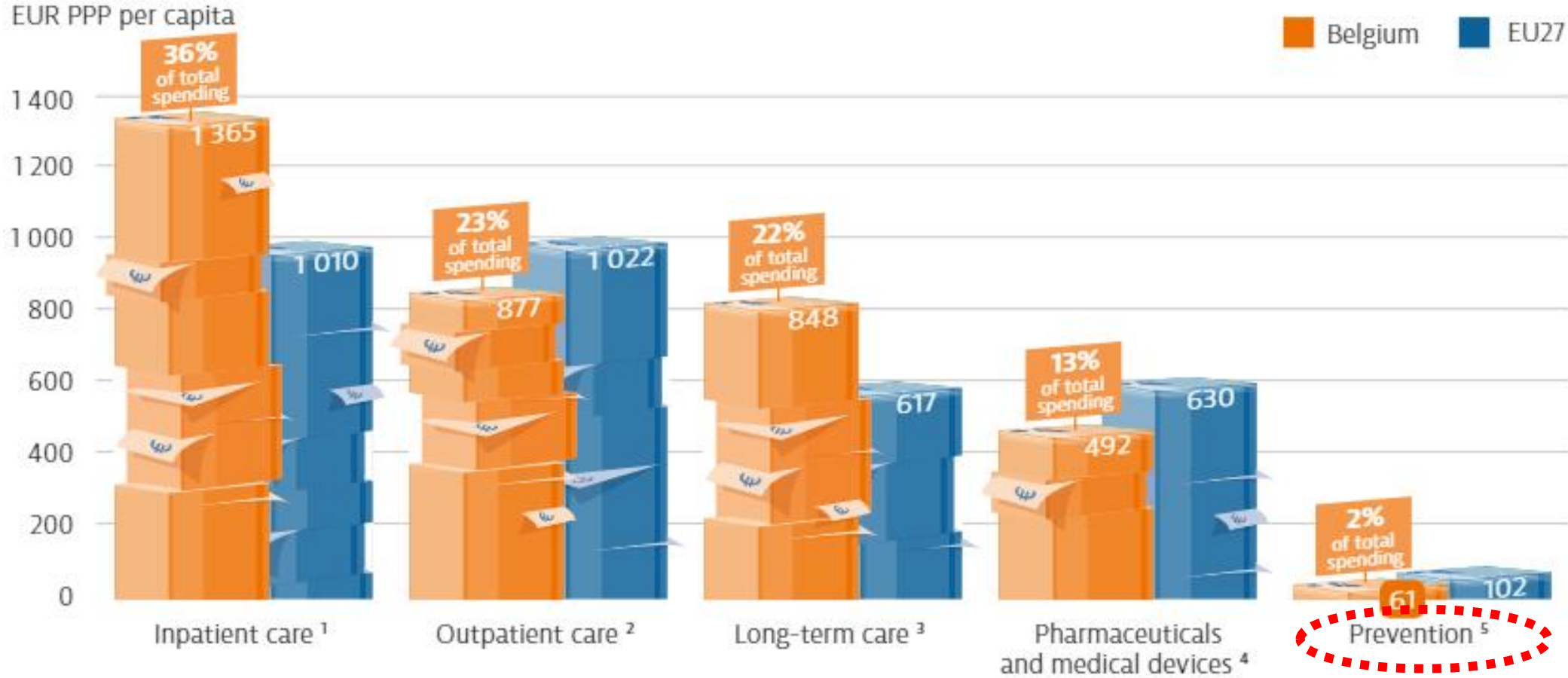
Pathways to Sustainable Health Promotion and Prevention

1. VITO
2. **Why Exposome and One Health?**
3. Exposome
4. One Health



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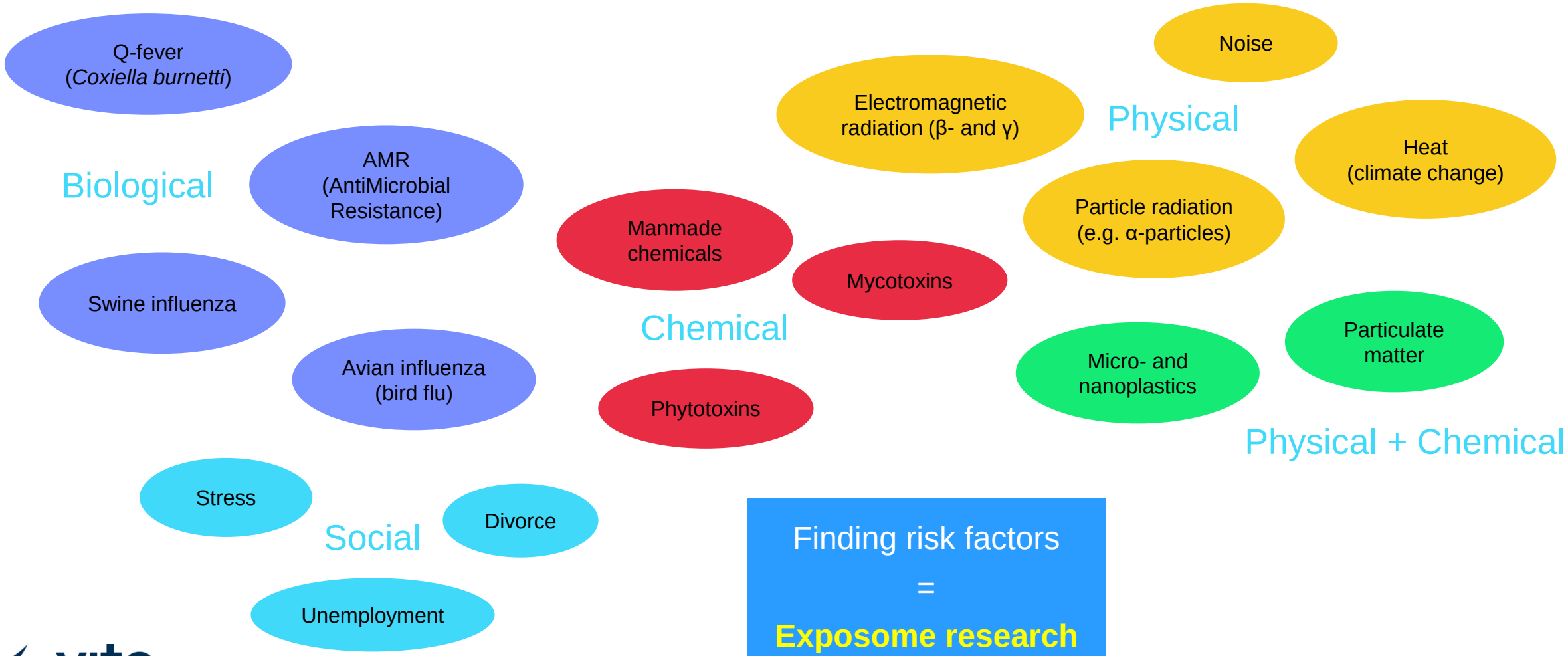
Prevention undervalued



State of Health in the EU: Country Health Profiles
Belgium: Country Health Profile 2021

Risk Factors in our Environment

Chemical, Physical, Biological, Ergonomic, Psychosocial, and Psychological



Finding risk factors

=

Exposome research

"Voorkomen is beter dan genezen"

"Mieux vaut prévenir que guérir"

Prevention is better (cheaper) than cure

Need: Find risk factors **associated** with health outcome

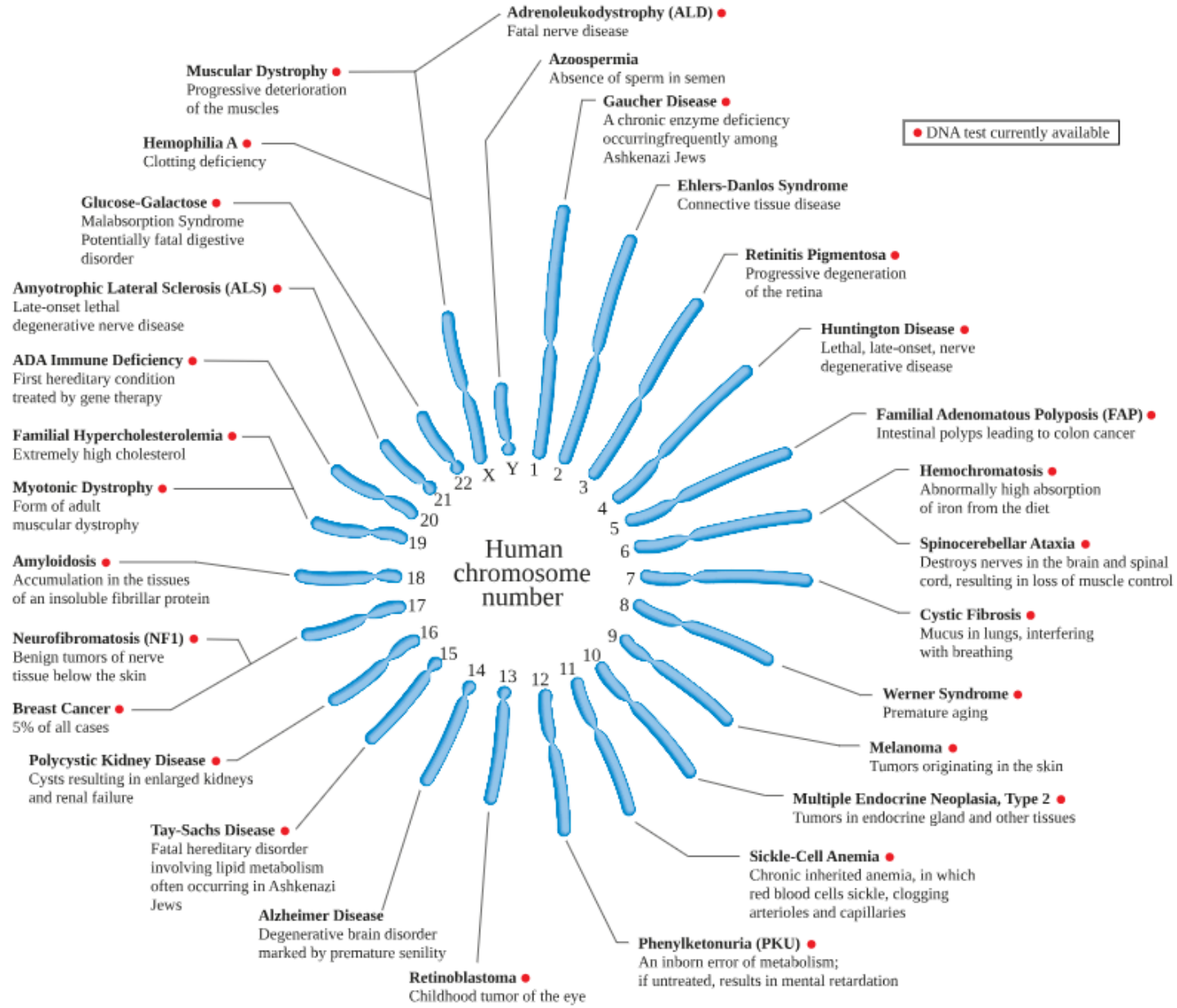
Exposome Research

Hypothesis Generation

Hypothesis Testing

1. VITO
2. Why Exposome and One Health?
3. Exposome
4. One Health





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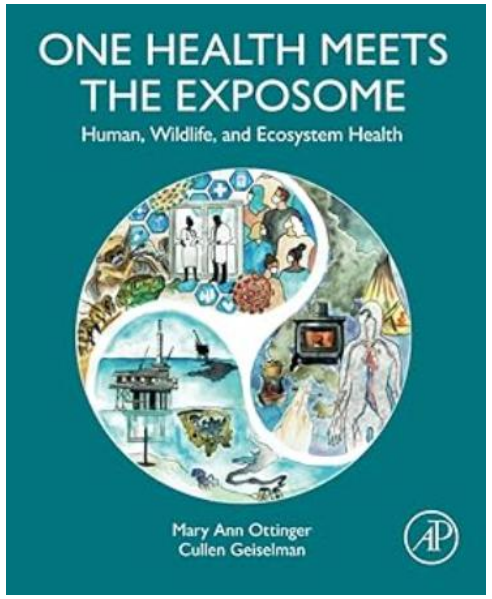
Genome: all **genetic information** of an organism.

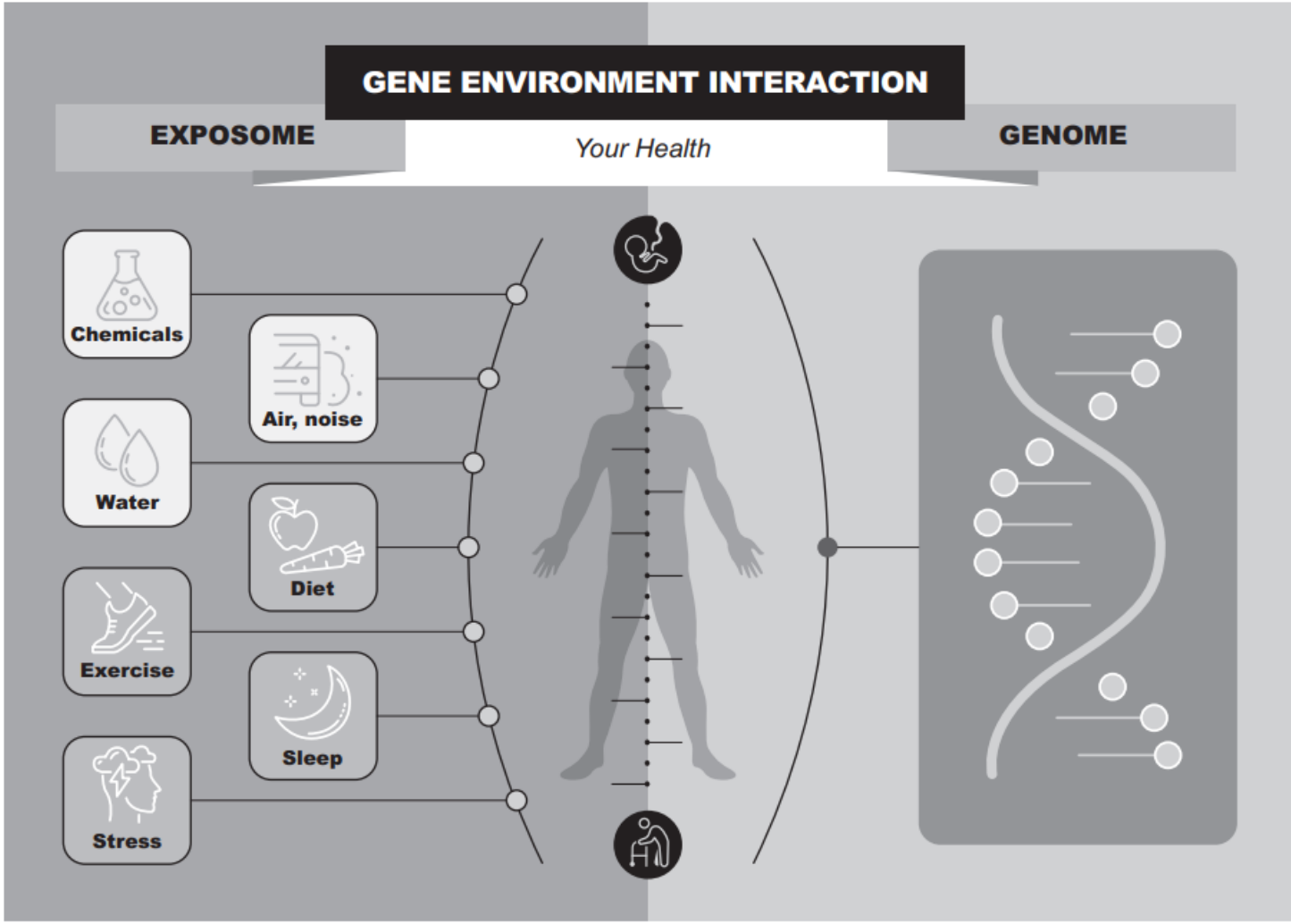
The study of the genome is called **genomics**.

Some **genetic diseases**:

- Sickle cell
- Cystic fibrosis

https://en.wikipedia.org/wiki/Genetic_disorder
http://sresearch.scienceontheweb.net/visualization.php





[One Health meets the Exposome (2023); Ch. 7 (Ottinger and Geiselman)]





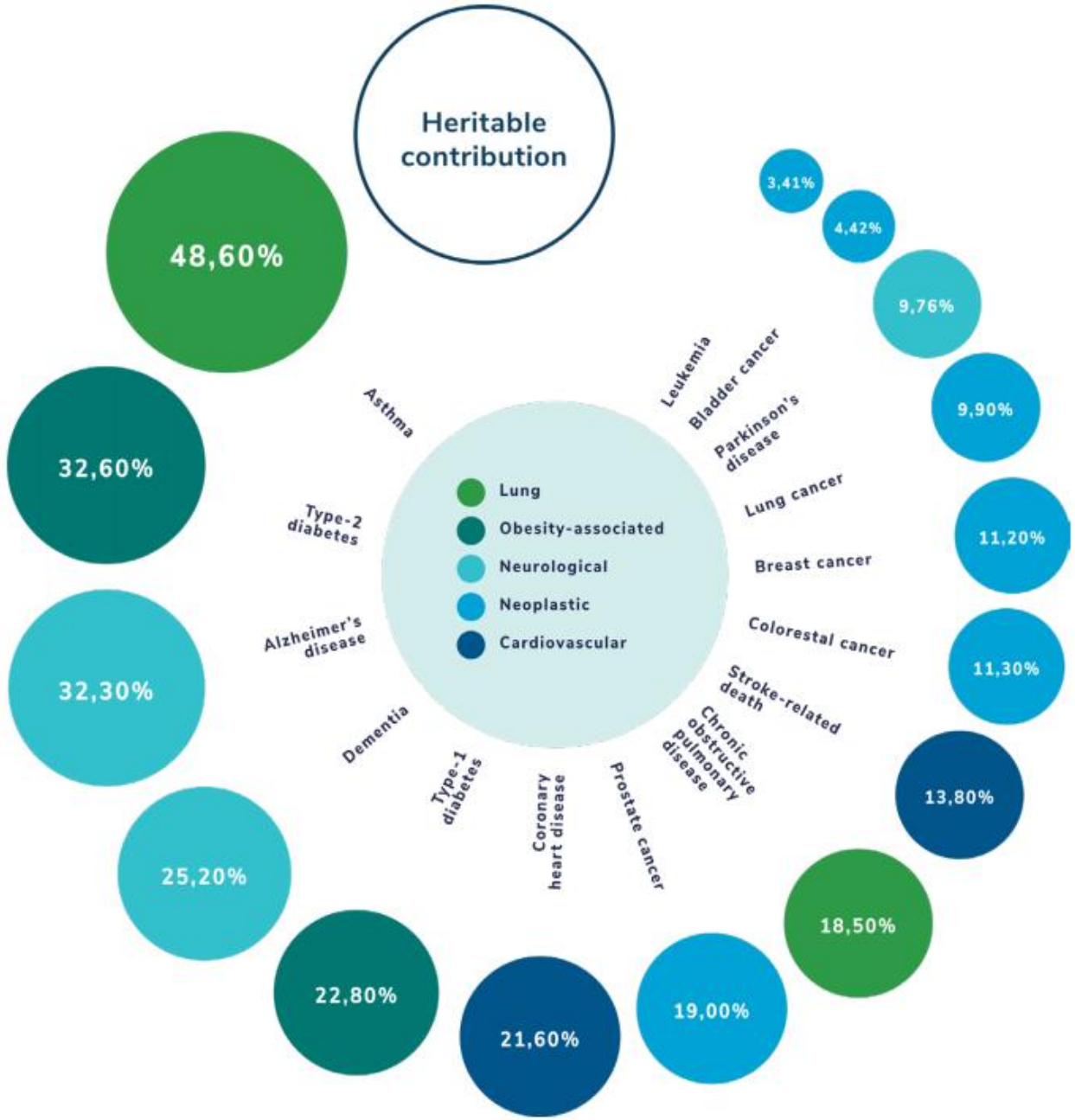
$$P = G + E + (G \times E)$$





Phenotype (P) is determined

- By the **genome (G)**
- By the **exposome (E)**
- And interactions between **exposome** and **genome** (**G x E**)



Most **chronic** diseases → **genetic** contribution < 20% (Rappaport, 2020).

Majority disease causes linked to **environmental factors**.

https://www.europarl.europa.eu/RegData/etudes/STUD/2025/765791/EPRS_STU(2025)765791_EN.pdf

Exposome

- All **non-genetic** information
- All **environmental drivers** of **health and disease**

Exposomics

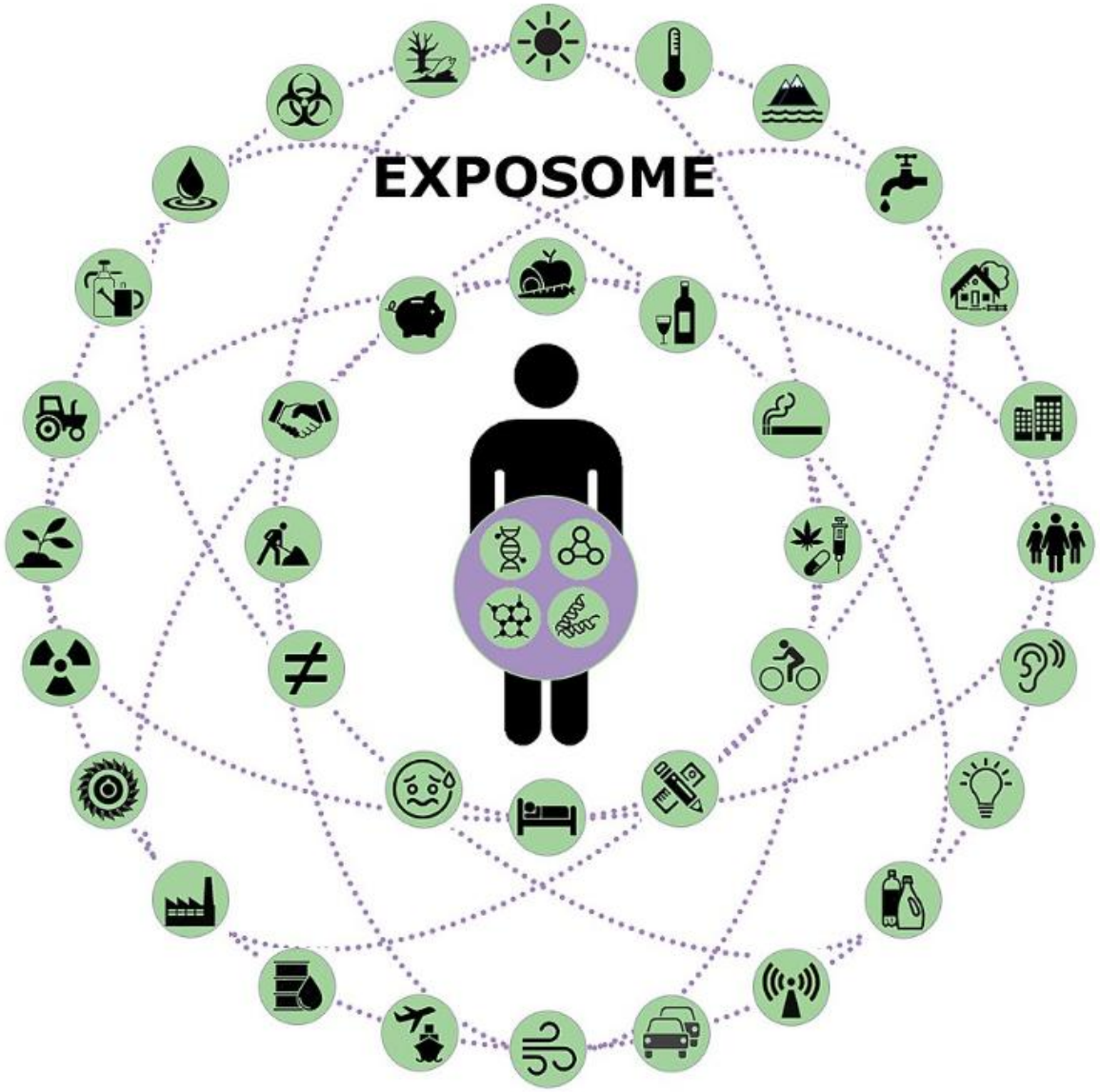
- Study of exposome

REVIEW

The exposome and health: Where chemistry meets biology

Roel Vermeulen[1,2]*, Emma L. Schymanski[3], Albert-László Barabási[4,5,6], Gary W. Miller[7]*

Vermeulen *et al.*, *Science* **367**, 392–396 (2020)



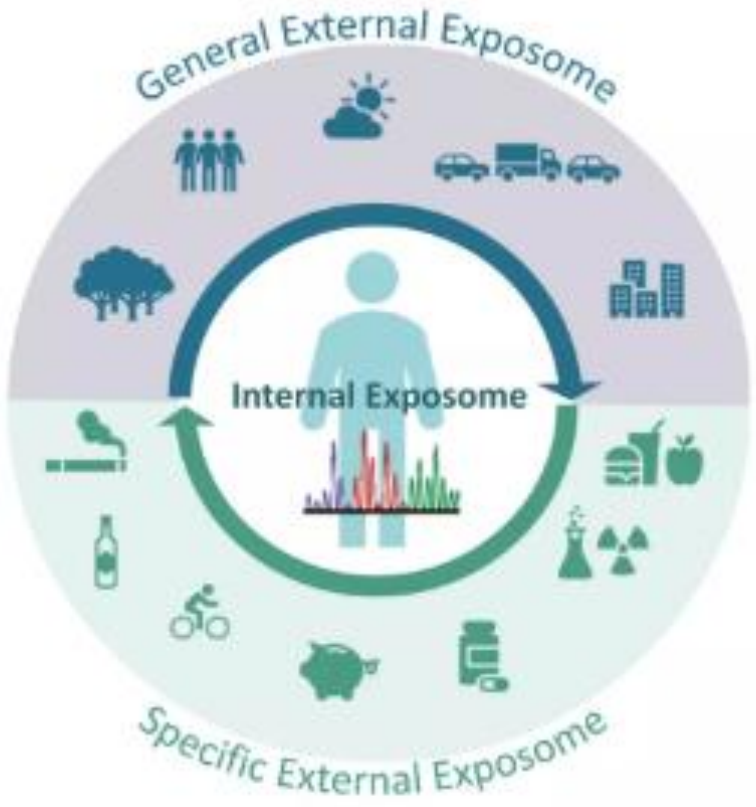
https://commons.wikimedia.org/wiki/File:Exposome_nruaux.jpg

The Exposome: Defined as all exposures from conception onwards, including those from lifestyle, diet and the environment

External:

Environmental factors

Climate
Environment
Lifestyle
Nutrition
Social contacts
Stress
...



Internal:

Biological measures

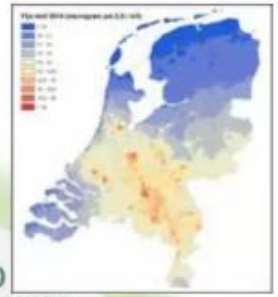
Metabolites of chemicals
Endogenous metabolites
Microbiome
Epigenetics
...

THE CHEMICAL CONSTELLATION AND HEALTH

EXPOSOME: STUDYING LIFE-LONG EXPOSURES

Roel Vermeulen, PhD







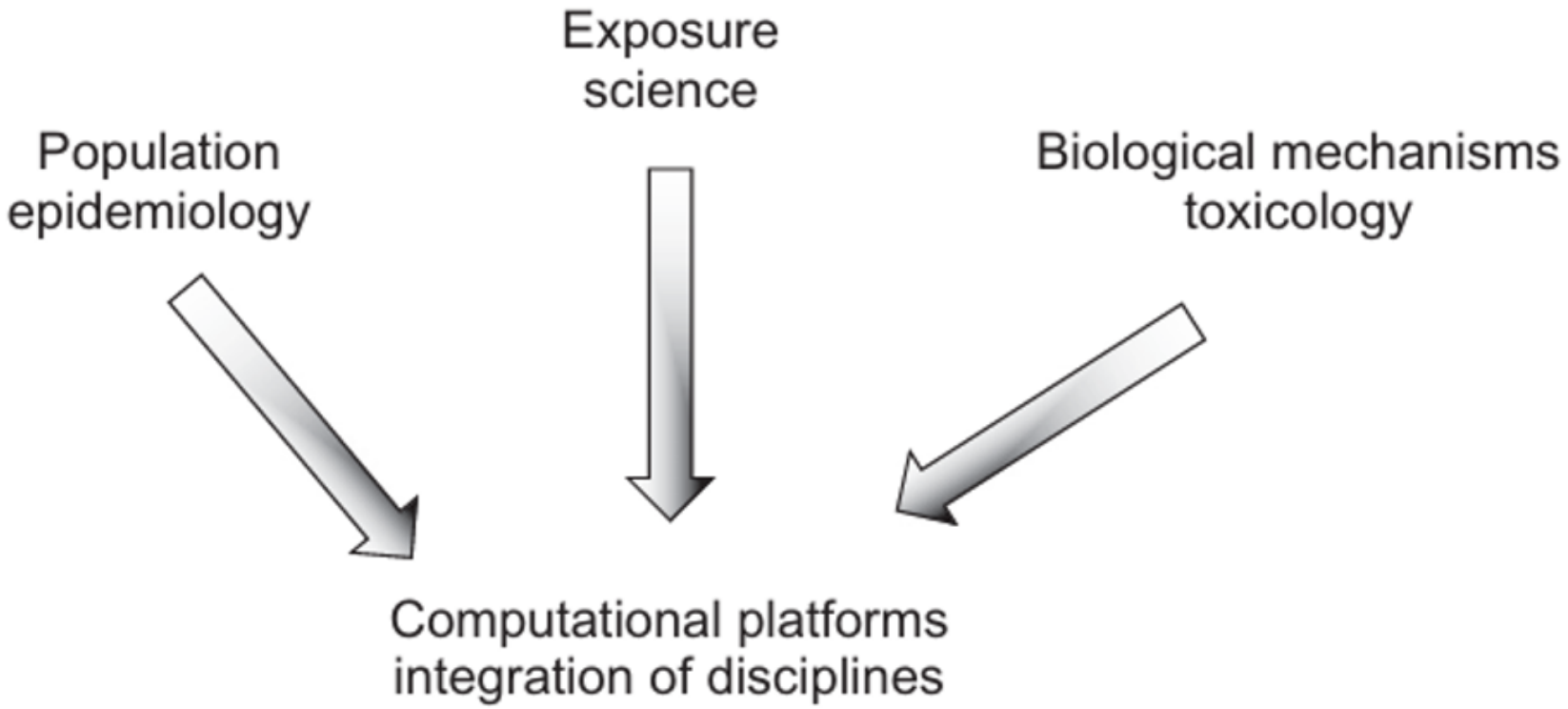






slideshow/roel-vermeulen-2019-exposome-studying-lifelong-exposures

Exposome Research



https://www.sciencedirect.com/science/article/pii/B9780128140796000043



European Human Exposome NETWORK

Policy Brief

May 2025

Unravelling the exposome

Environmental factors cause multiple diseases and are fuelling a growing public health crisis. Researchers and policymakers must work together to understand and investigate the environmental drivers of diseases, and develop interventions to slow and reverse these trajectories.

The exposome concept and exposomics

The exposome is a collective term for the physical, chemical, biological and social influences on our health. This includes the environmental factors we encounter on a daily basis throughout our lives: what we eat, the air we breathe, our social interactions and lifestyle choices.

In a shift from traditional scientific research, which focuses on how single exposures affect a single disease, the emerging field of exposomics takes a holistic view.

Exposomics uses data from a range of sources to investigate the dynamics between multiple environmental exposures and health outcomes.

This policy brief presents a selection of scientific evidence, tools, and success stories from five years of European Human Exposome Network (EHEN) research. Its aim is to inform and inspire policymakers to take action to protect citizens' health from pollution and environmental deterioration.

Policy call to action



European Parliament

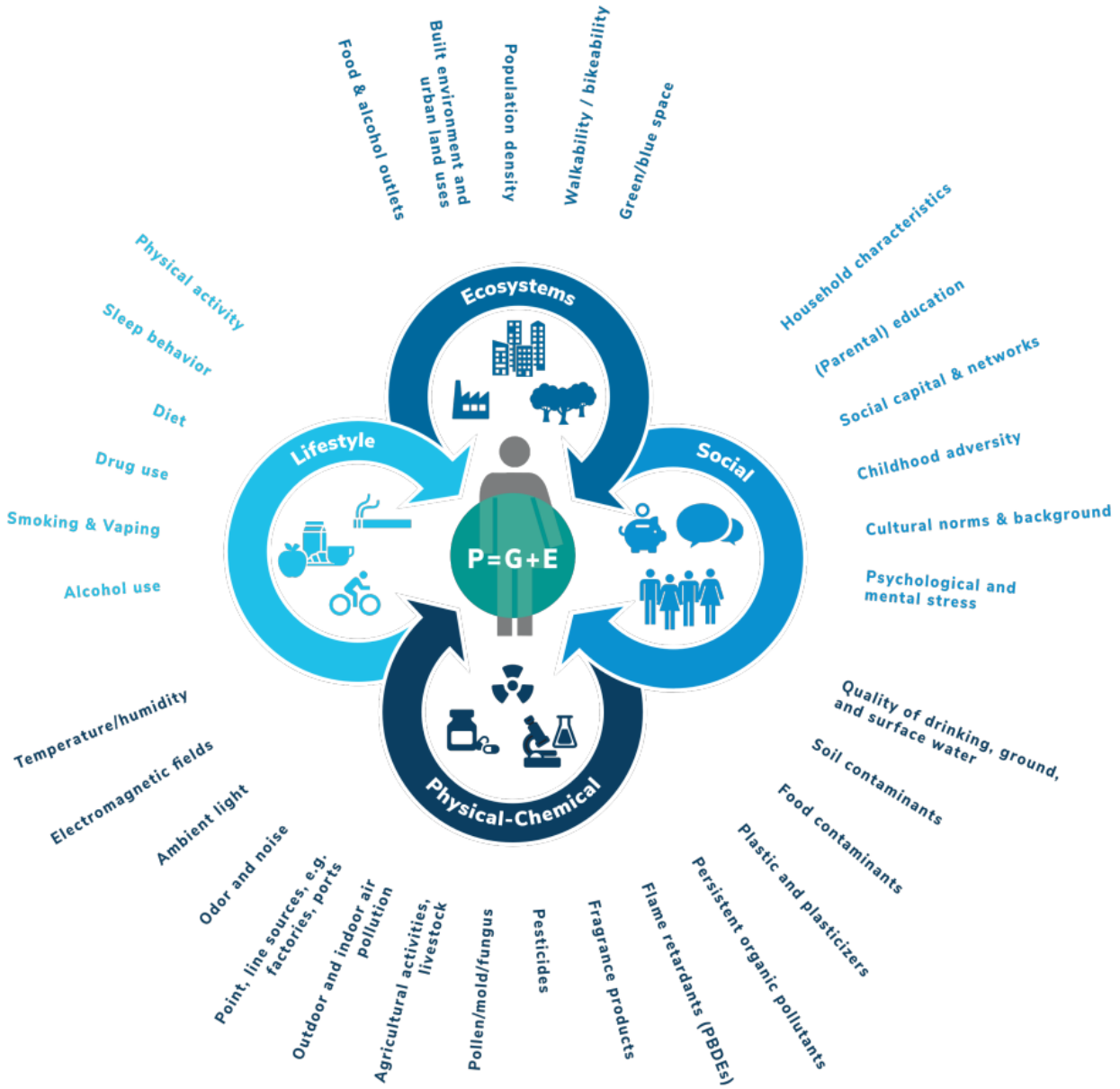
Brussels © European Union, 2025.

PE 765.791
ISBN: 978-92-848-2664-3
doi: 10.2861/5600247
QA-01-25-071-EN-N

Human exposome research

Potential, limitations and public policy implications

https://www.europarl.europa.eu/RegData/etudes/STUD/2025/765791/EPRS_STU(2025)765791_EN.pdf

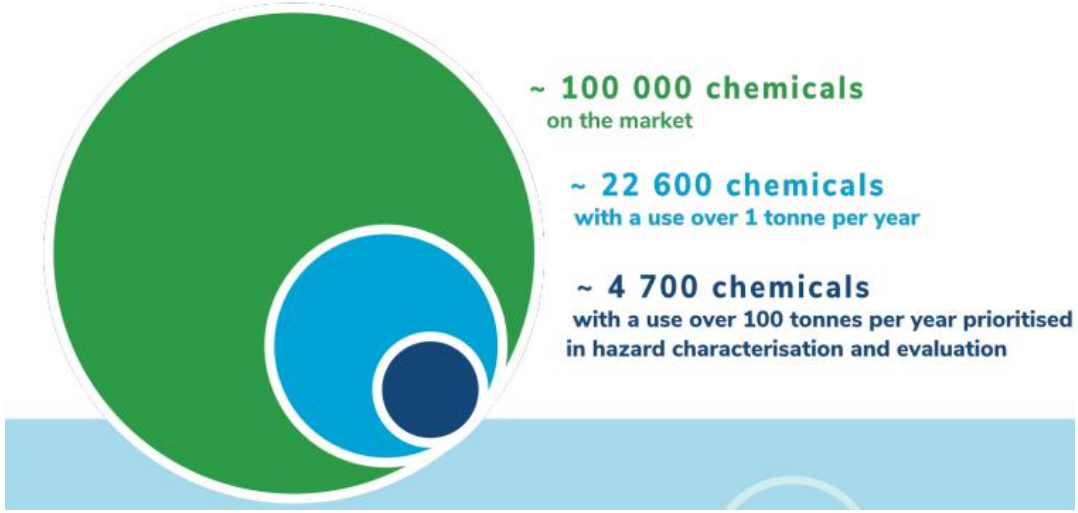


The exposome represents the integrated compilation of all the physical, chemical, biological and psychosocial factors, and their interactions, which have an impact on biology and health (Vermeulen et al. 2020).

https://www.europarl.europa.eu/RegData/etudes/STUD/2025/765791/EPRS_STU(2025)765791_EN.pdf

Huge Challenges

Even if only looking at chemical risk factors



The unknown territory of chemicals

https://www.europarl.europa.eu/RegData/etudes/STUD/2025/765791/EPRS_STU(2025)765791_EN.pdf

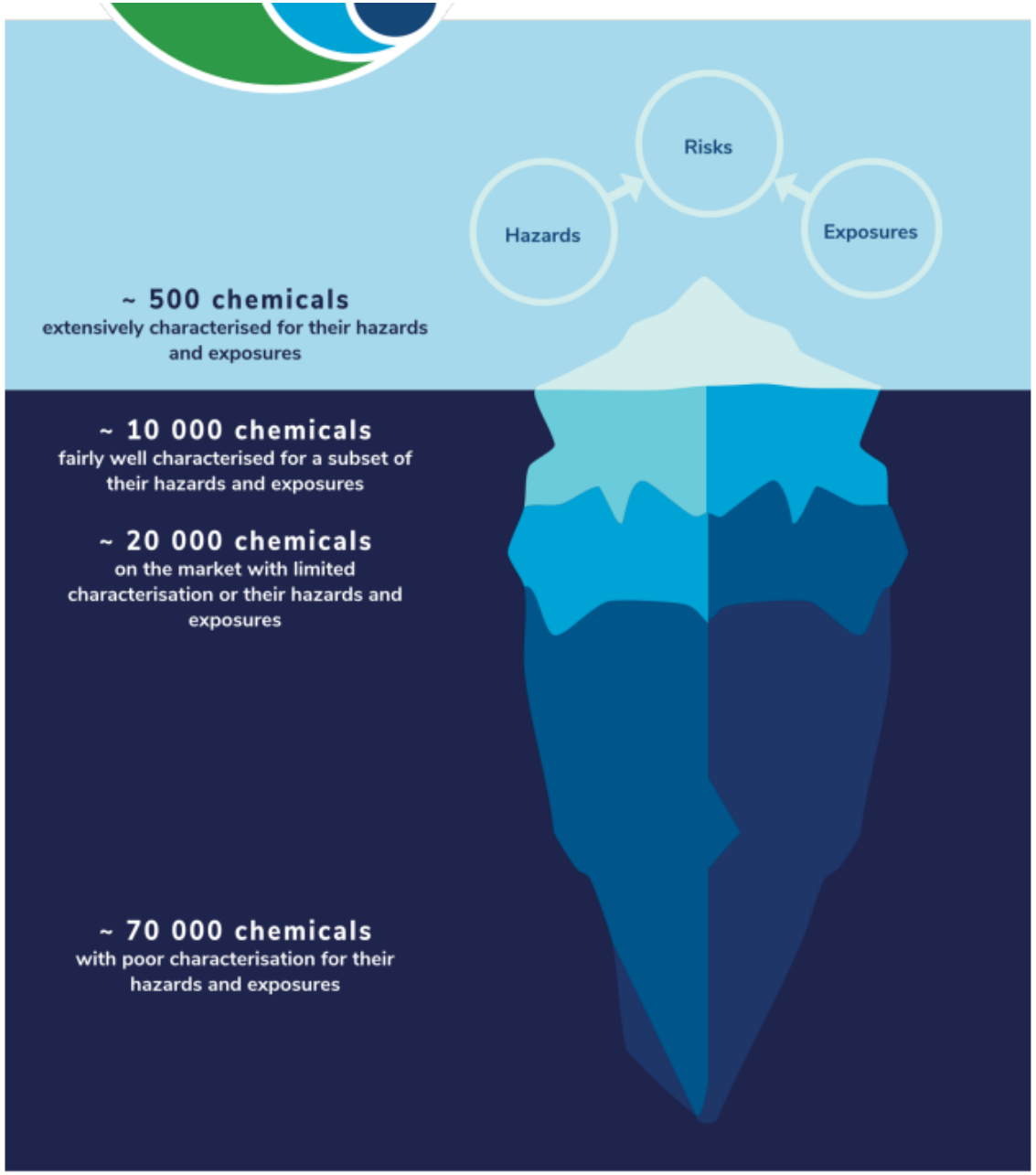
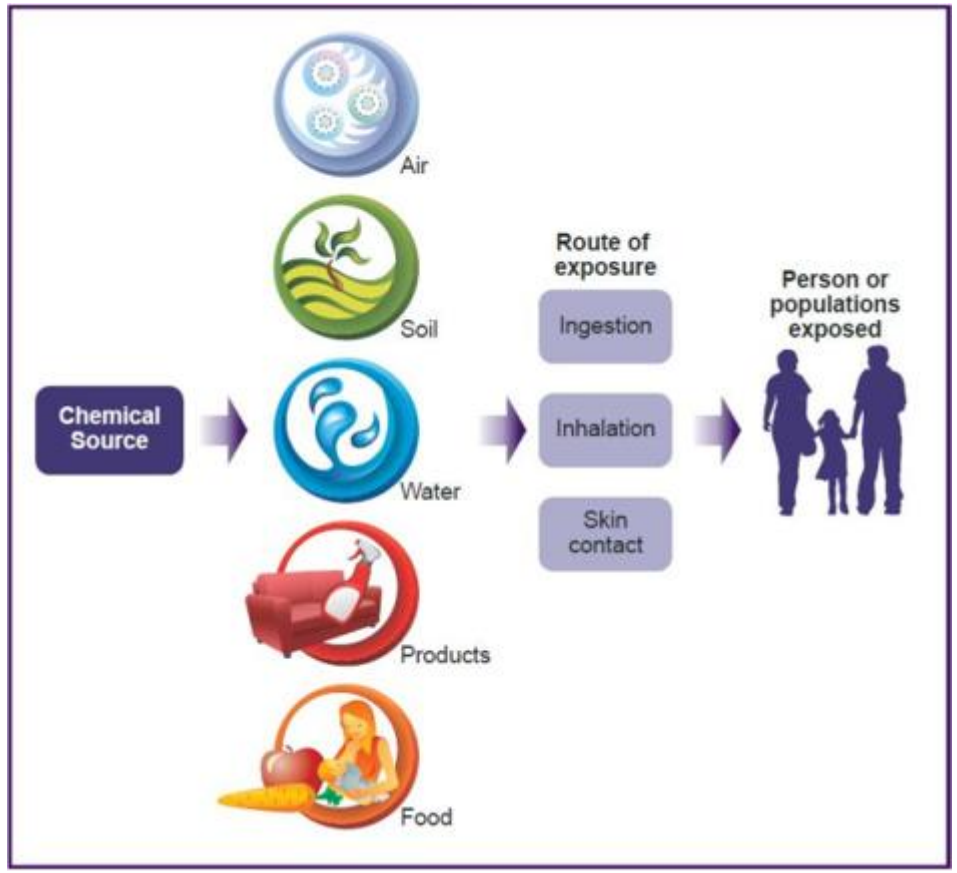


Image created by the author, data from @ EEA, 2020, The European Environment – State and outlook report.

How can we study this?

Human Biomonitoring + Health Questionnaires



Exposure biomarkers

Effect biomarkers

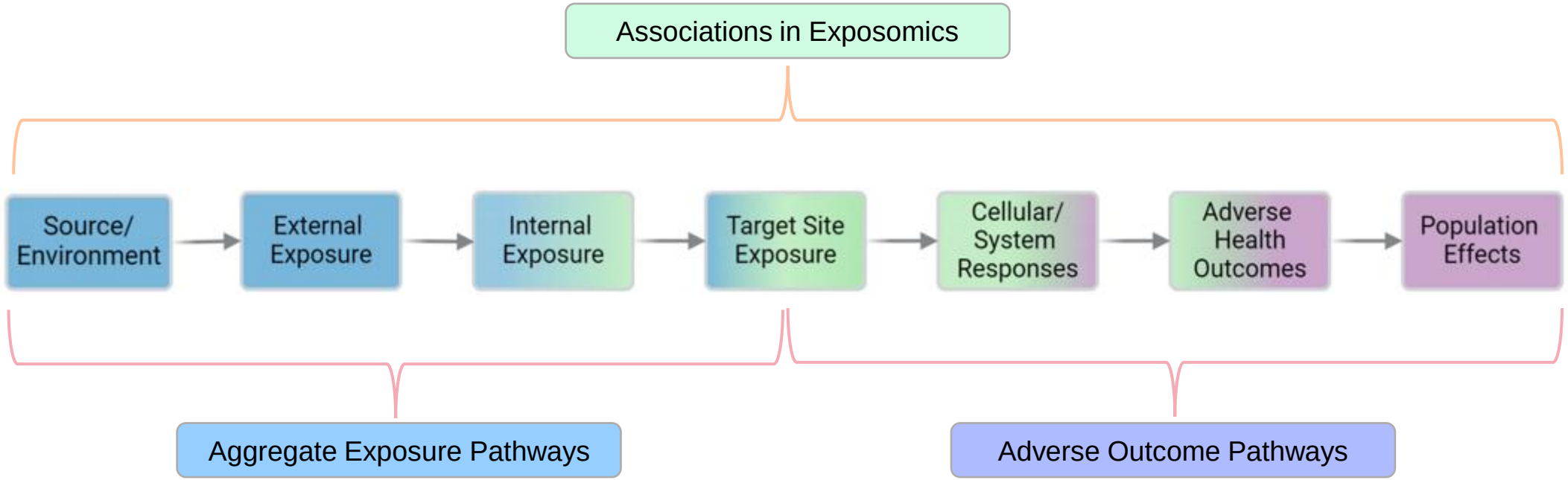
Health effects



Partners: vito, Universiteit Antwerpen, UHASSELT, Universiteit Gent, KU LEUVEN, VUB Vrije Universiteit Brussel, Provincie Antwerpen, Instituut Natuur- en Bosonderzoek

Exposomics supported by AEP and AOP

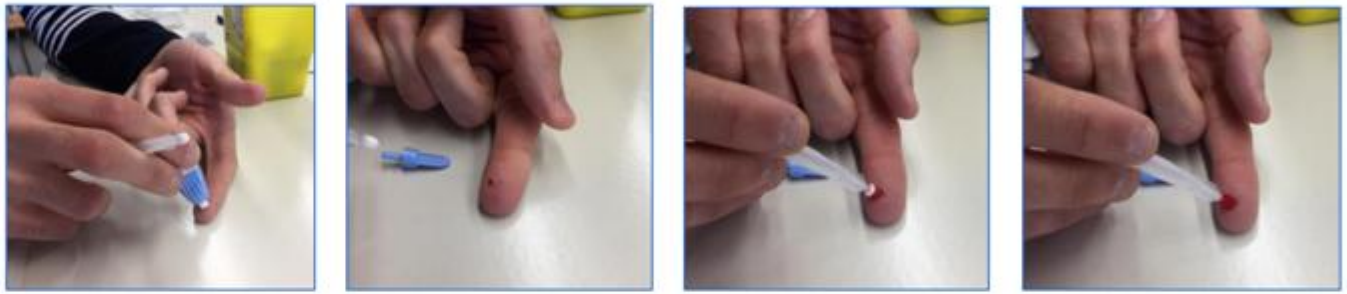
Aggregated Exposure Pathways and Adverse Outcome Pathways

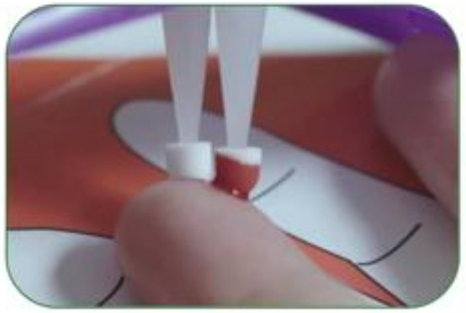


Innovative capillary blood sampling next to urine and i.v. blood

Aggregated Exposure Pathways and Adverse Outcome Pathways







toxins

MDPI

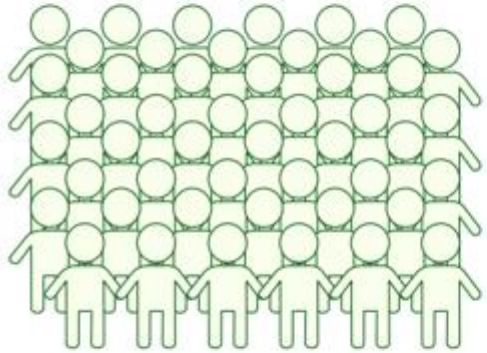
Article

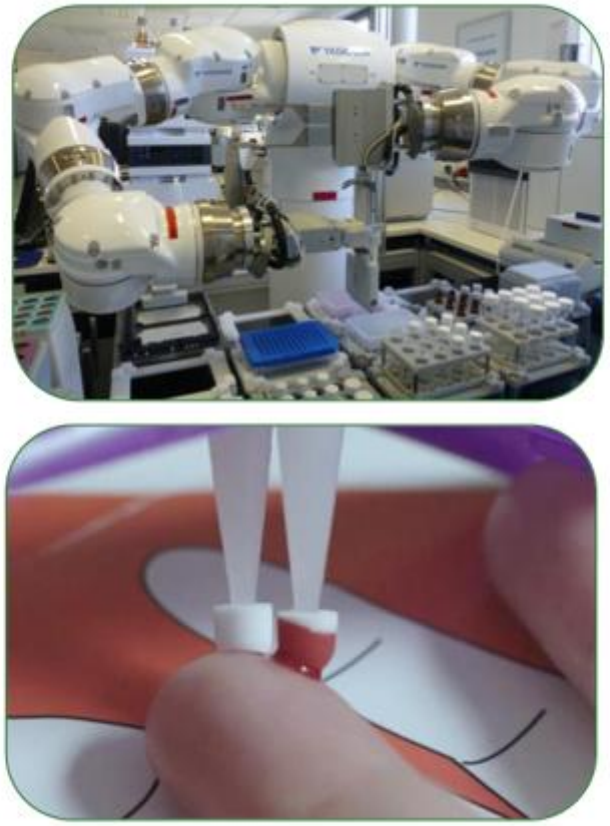
Volumetric Absorptive Microsampling as an Alternative Tool for Biomonitoring of Multi-Mycotoxin Exposure in Resource-Limited Areas

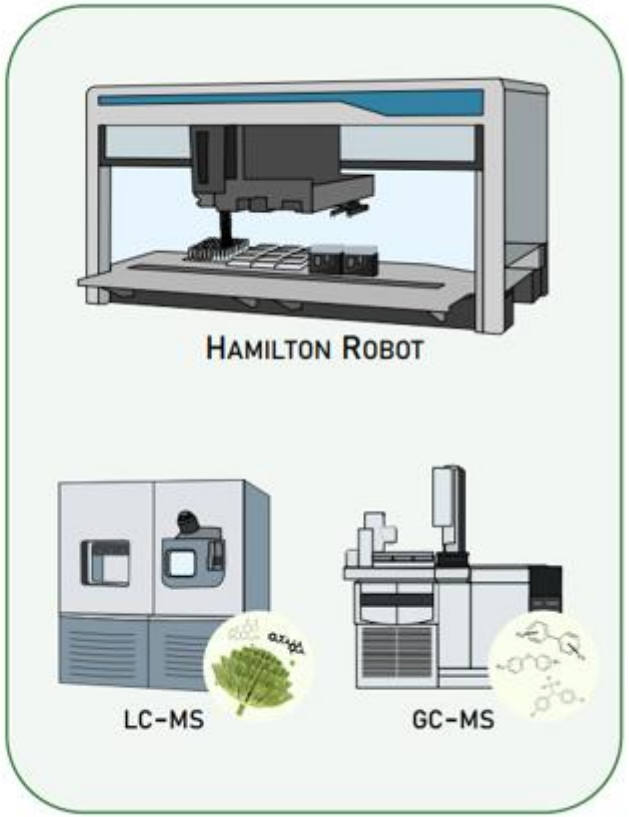
Arnau Vidal [1,*], Lidia Belova [1], Christophe Stove [2], Marthe De Boevre [1] and Sarah De Saeger [1]

Automated microsample handling

VAMS Microsamples for measurements POPs and mycotoxins

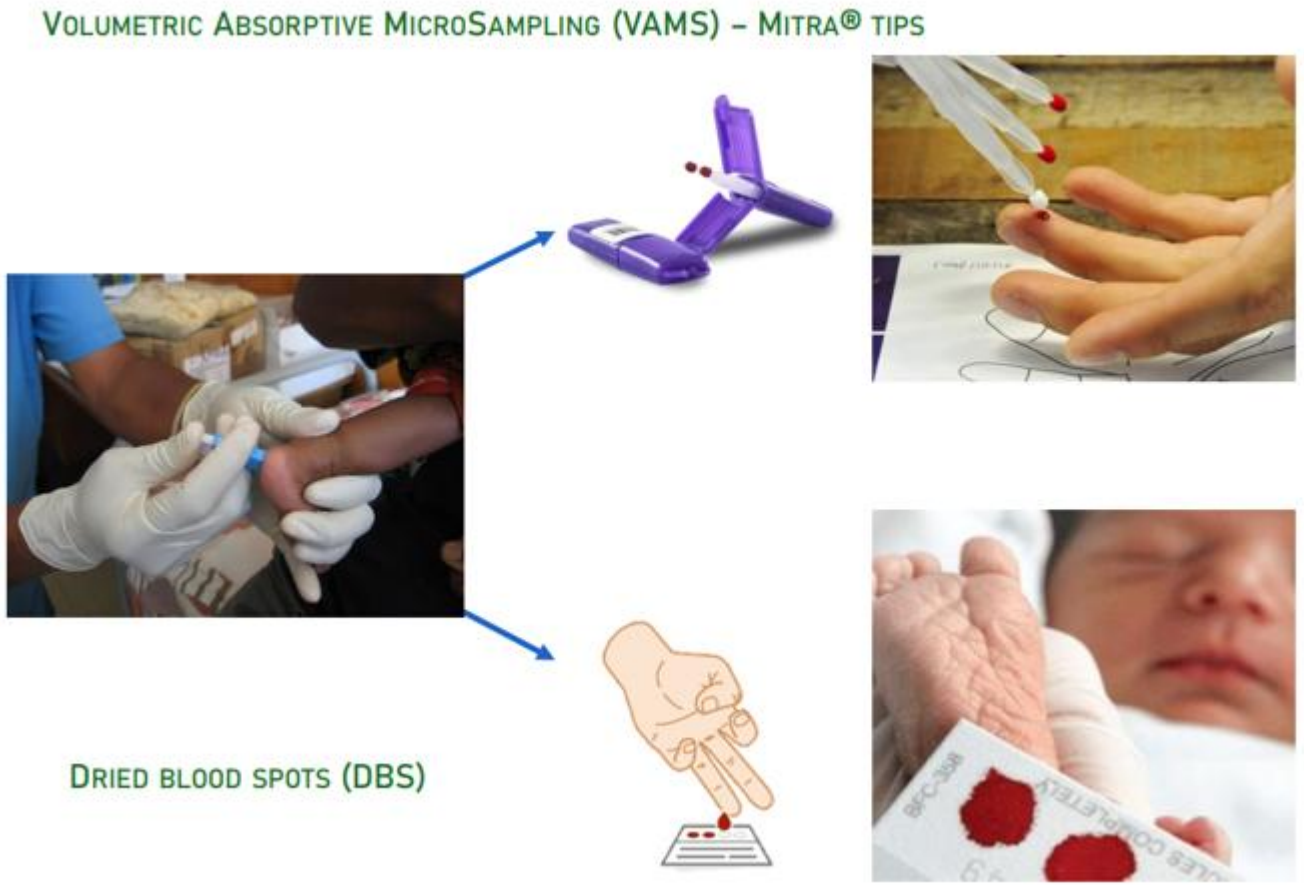






Longitudinal exposome profiling babies and children

VAMS (Volumetric Absorptive MicroSampling and DBS (Dried Blood Spots)



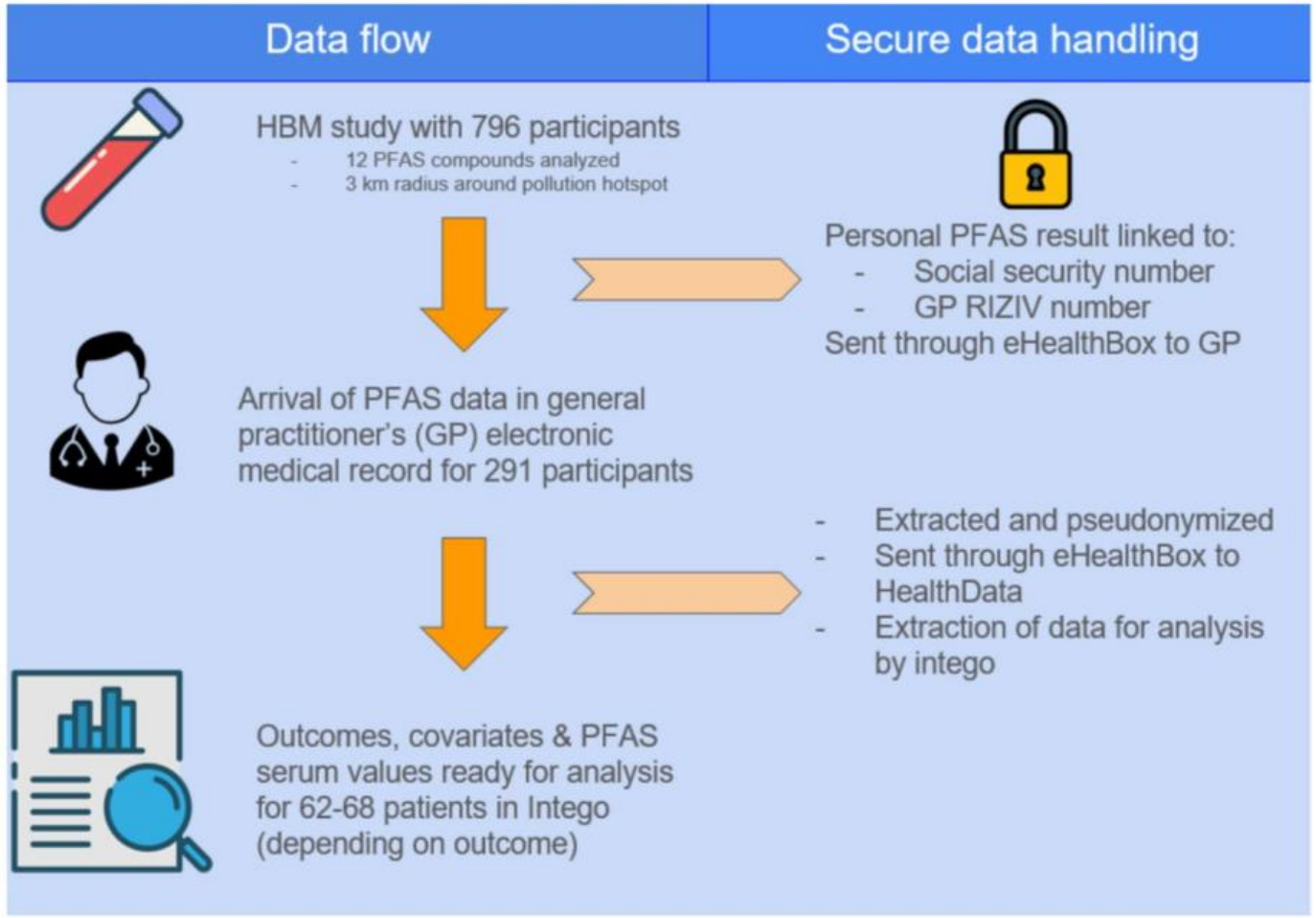
Jansen *et al. Environmental Health* (2025) 24:1
https://doi.org/10.1186/s12940-024-01152-5

Environmental Health

RESEARCH Open Access

Integrating human biomonitoring exposure data into a primary care morbidity database: a feasibility study

Pieter Jansen[1*], Elly Den Hond[2,3], Katleen De Brouwere[4], Endale Alemayehu Ali[1], Hamid Yimam Hassen[4], Ilona Gabaret[2,5] and Gijs Van Pottelbergh[1]



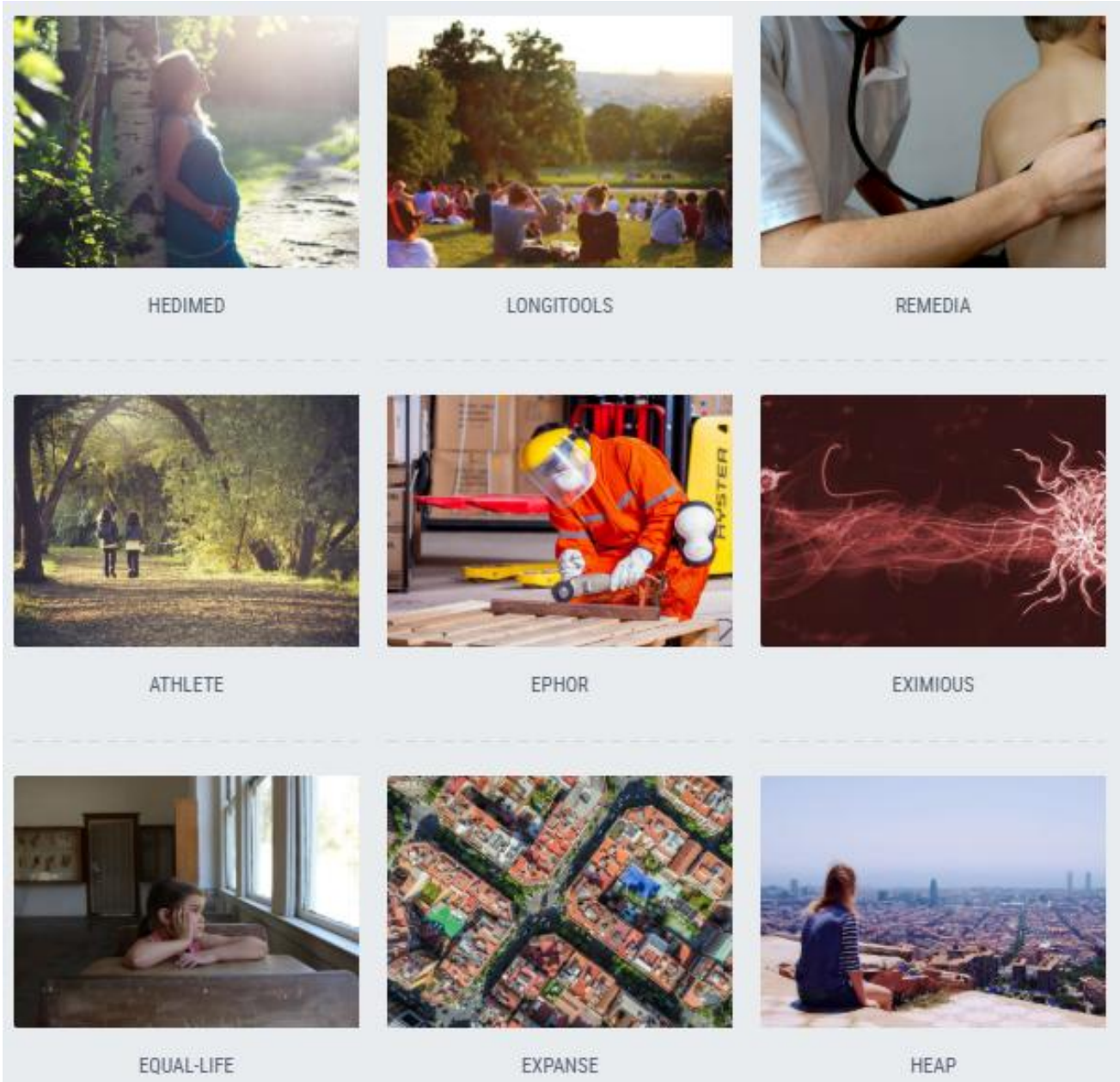
https://doi.org/10.1186/s12940-024-01152-5

European Human Exposome **NETWORK**

EHEN is a network of 9 EU-funded projects studying the impact of environmental exposure on health.



The LongITools project is measuring how exposure to air and noise pollution and the built environment, and an individual's lifestyle, psychological and social situation, interact with

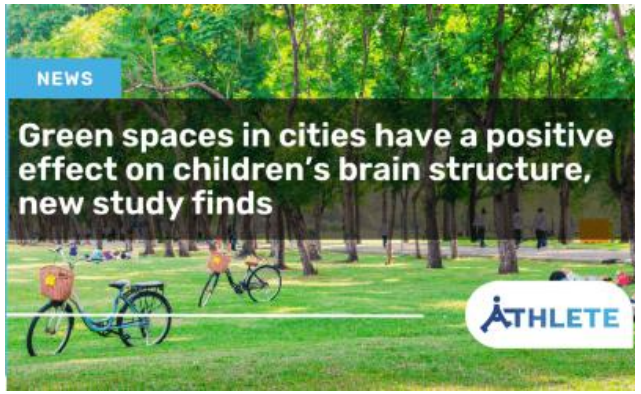


https://www.humanexposome.eu/
https://www.humanexposome.eu/portfolios/longitools/

vito.be


NEWS
New ATHLETE study links prenatal exposure to environmental chemicals with childhood growth changes
ATHLETE
#ATHLETEproject


PFAS linked to low birthweight in babies


NEWS
Green spaces in cities have a positive effect on children's brain structure, new study finds
ATHLETE


33% of European childhood asthma cases can be attributed to polluted air, according to new ISGlobal fact sheet


NEWS
Exposure to endocrine disruptors during pregnancy is linked to increased risks of metabolic syndrome in children
ATHLETE

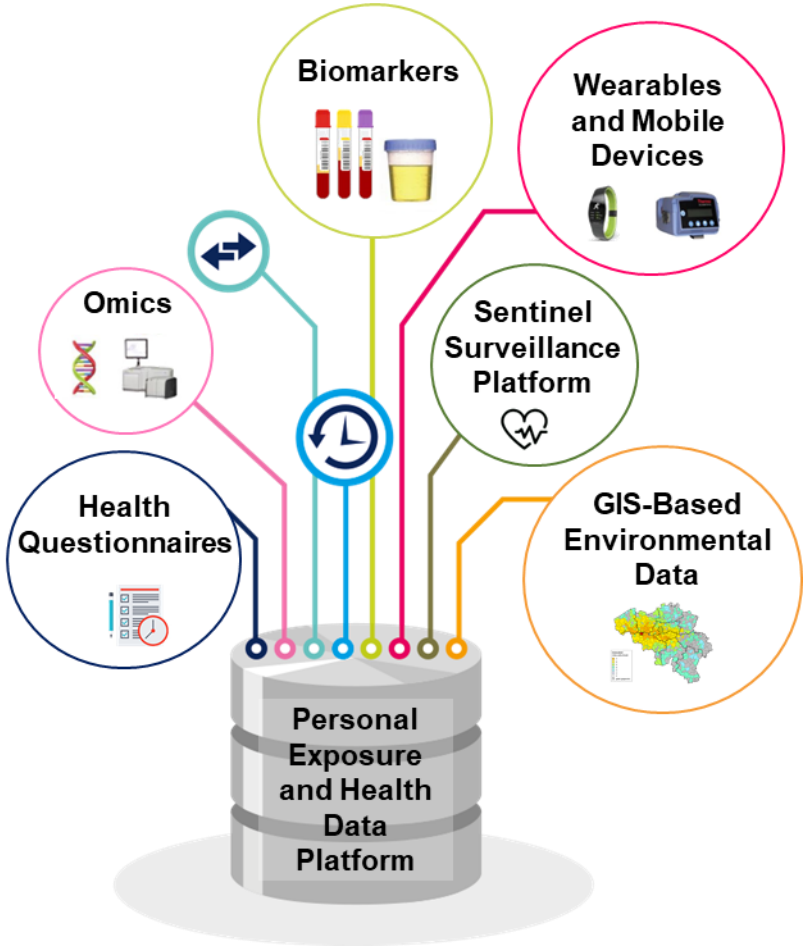

Chemical exposure and maternal weight linked to childhood obesity


Higher Exposure to Bisphenol A in the Womb Associated with Increased Risk for Asthma and Wheezing in School-Age Girls

To Remember

Human exposome research

- Combining and analysing personal data linked to data on living environment



1. VITO
2. Why Exposome and One Health?
3. Exposome
4. One Health



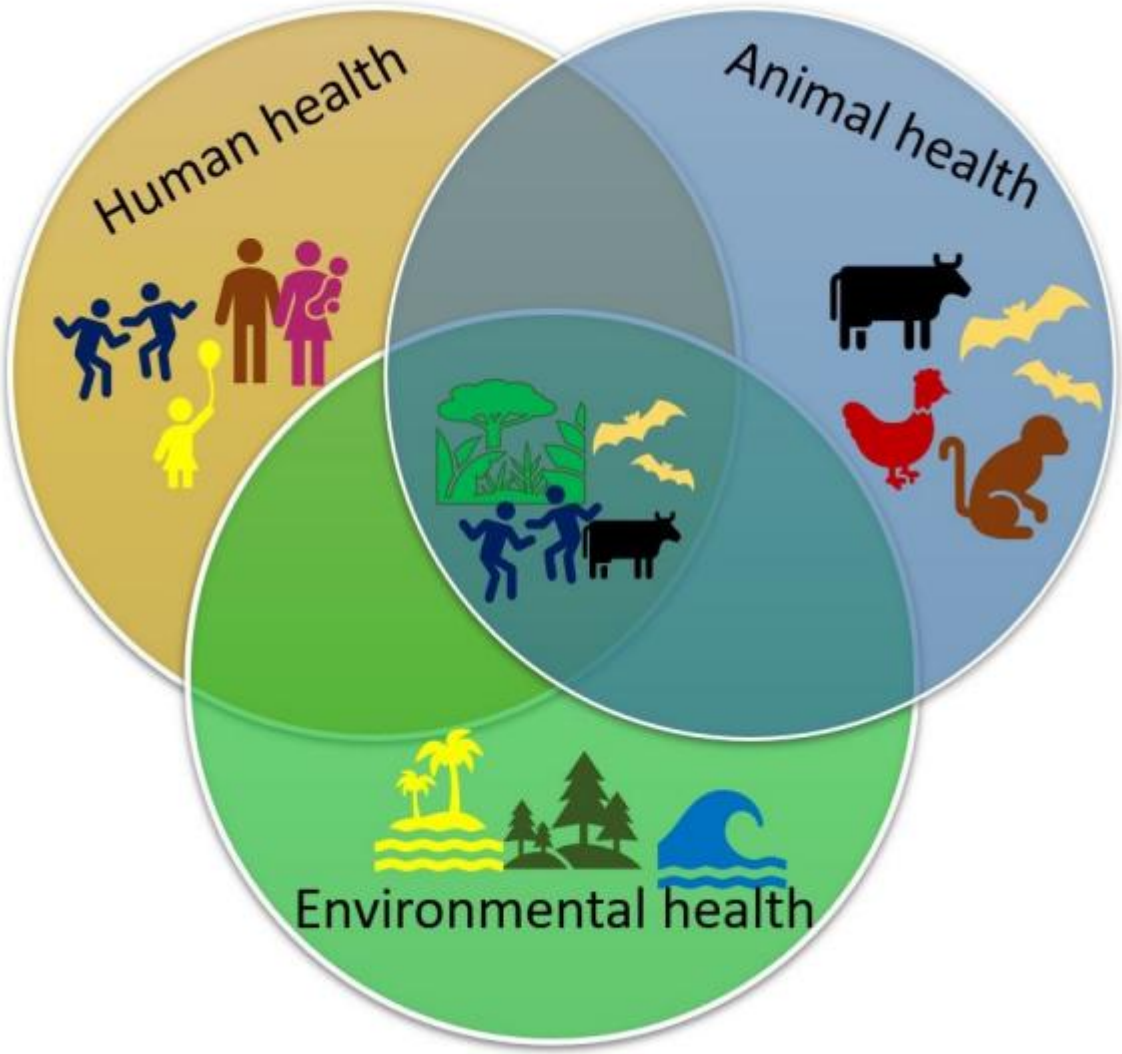
One Health Approach

An **integrated, unifying** approach

to sustainably balance + optimize health

of **people**, **animals**, and **ecosystems**

(OHHLEP, 2021)

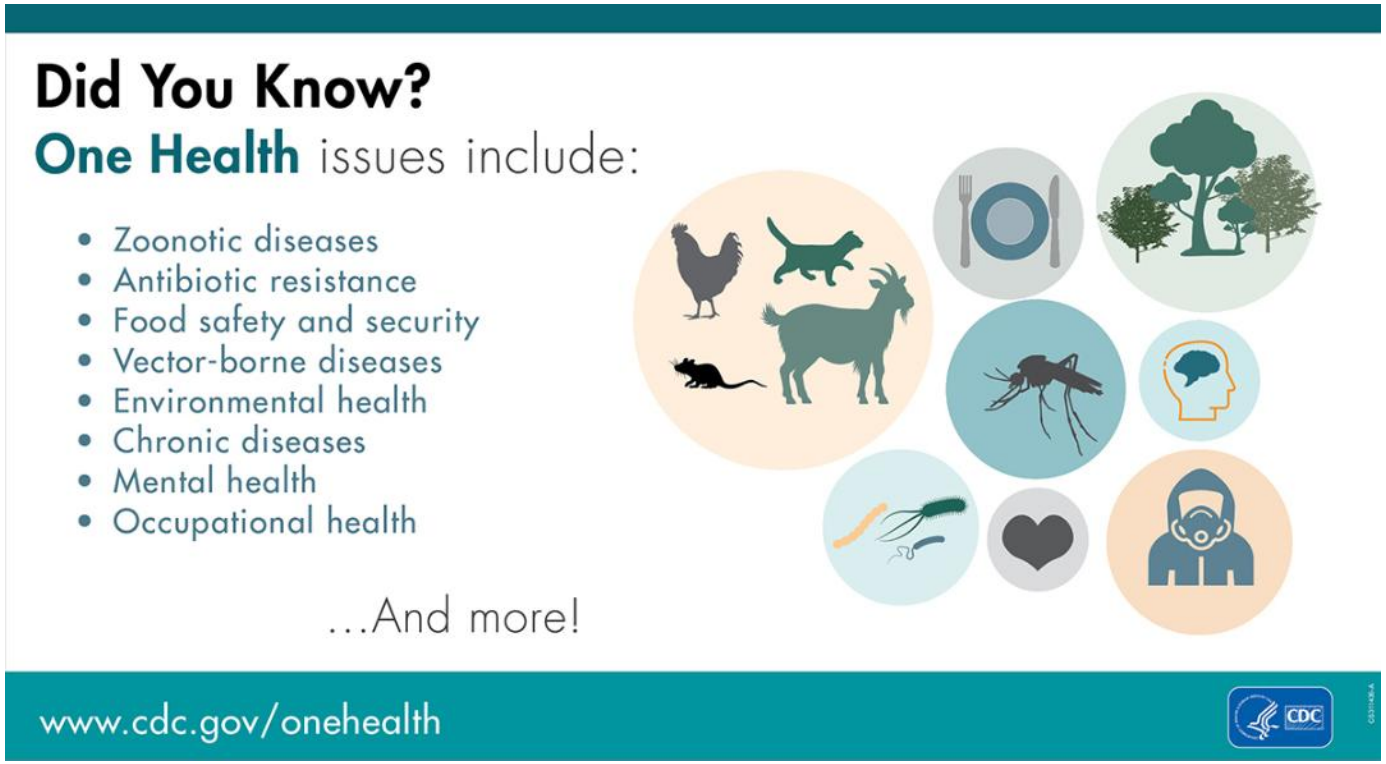


https://www.rencontressantepubliquefrance.fr/wp-content/uploads/2024/06/3-NETANYAHU.pdf

Nature, Biodiversity and Health: The interconnections



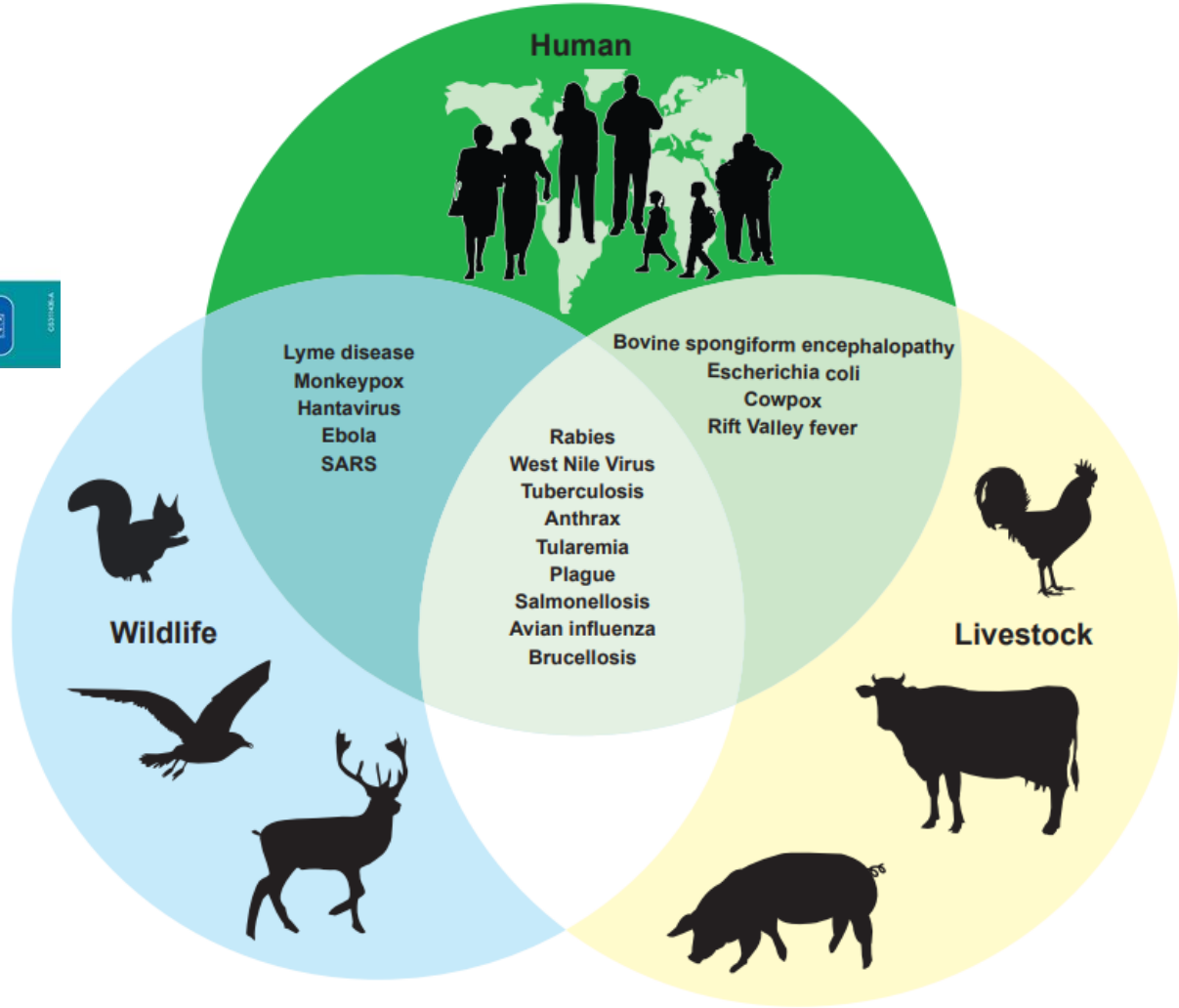
https://www.rencontressantepubliquefrance.fr/wp-content/uploads/2024/06/3-NETANYAHU.pdf



https://www.cdc.gov/one-health/about/index.html

https://journals.asm.org/doi/10.1128/msphere.00035-24

https://www.gao.gov/assets/gao-12-55.pdf



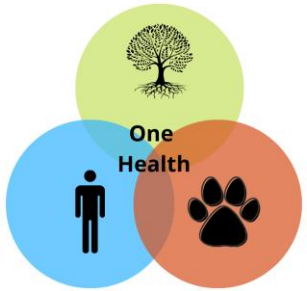
vito

Pollution & One Health



- Pollution of air, soil, water, oceans
- Mostly related to **Non-Communicable Diseases**
- Animal husbandry release feces, pollution, and antibiotics to the environment, which animals and humans are then exposed to.
- Accumulation of chemicals & heavy metals in animal food products

https://www.rencontressantepubliquefrance.fr/wp-content/uploads/2024/06/3-NETANYAHU.pdf



The One Health approach can:

- Prevent outbreaks of zoonotic disease in animals and people.
- Improve food safety and security.
- Reduce antimicrobial-resistant infections and improve human and animal health.
- Protect global health security.
- Protect biodiversity and conservation.

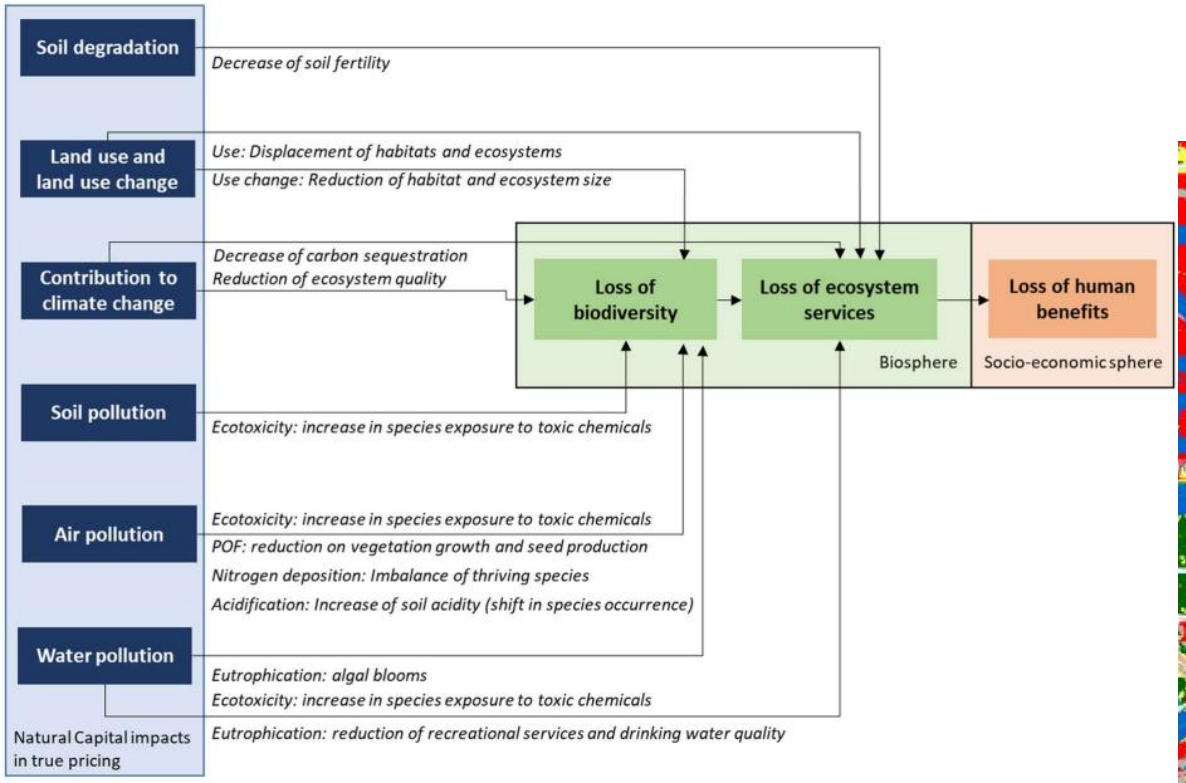
By promoting collaboration across all sectors, the One Health approach can achieve the best health outcomes for people, animals, and plants in a shared environment.

https://www.cdc.gov/one-health/about/index.html

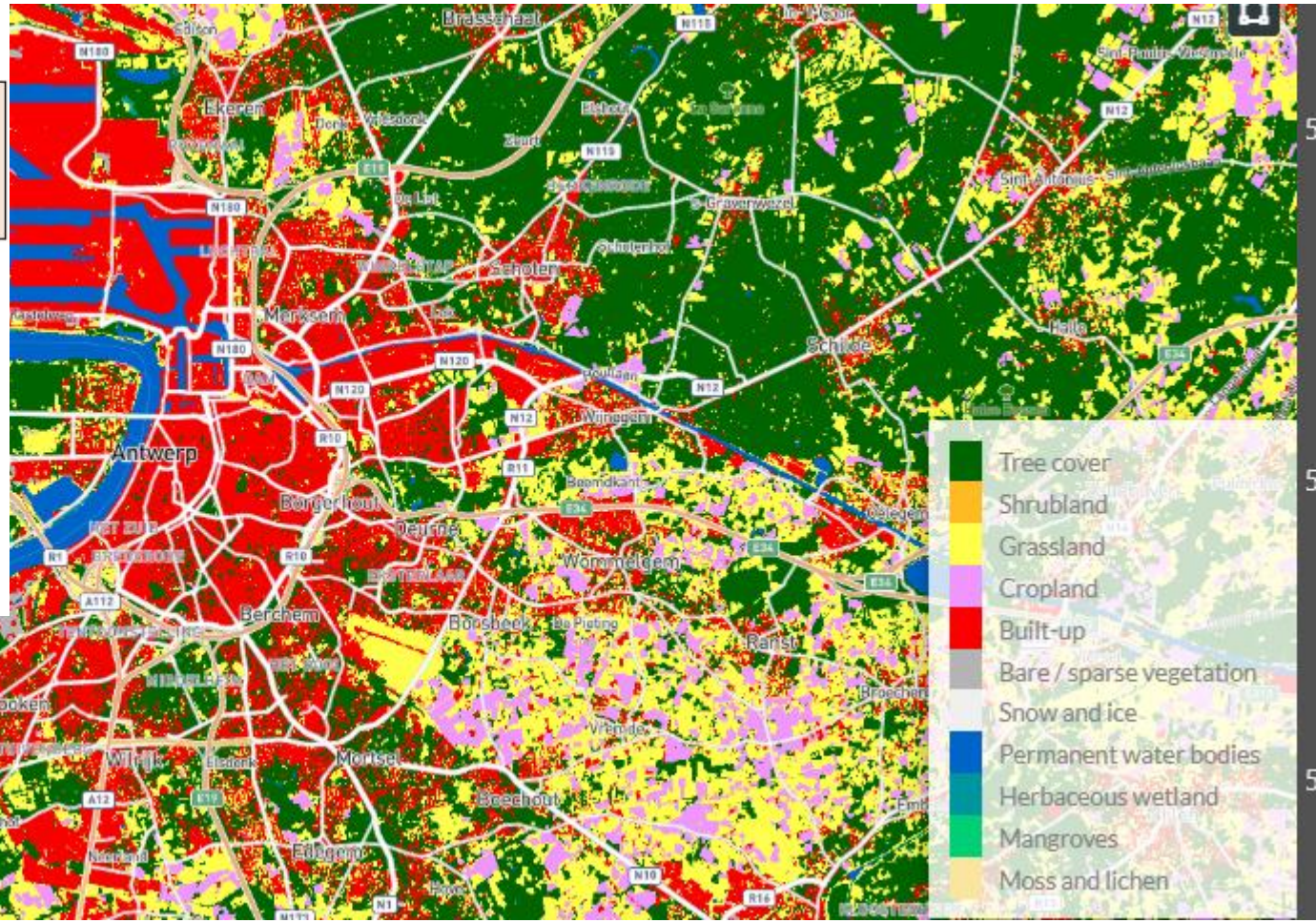
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Land use change, fertility and biodiversity loss

Loss of ecosystem services and human benefits



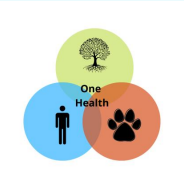
[Viewer Terrascope: WORLDCOVER 2020 MAP](#)



https://trueprice.org/wp-content/uploads/2022/07/LandUseBiodiversityandESSModule_PPSTrueAndFairPrice_finalVersion_2-1.pdf

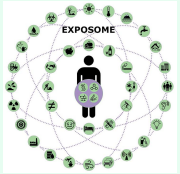
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One Health meets the EXPOSOME



ONE HEALTH

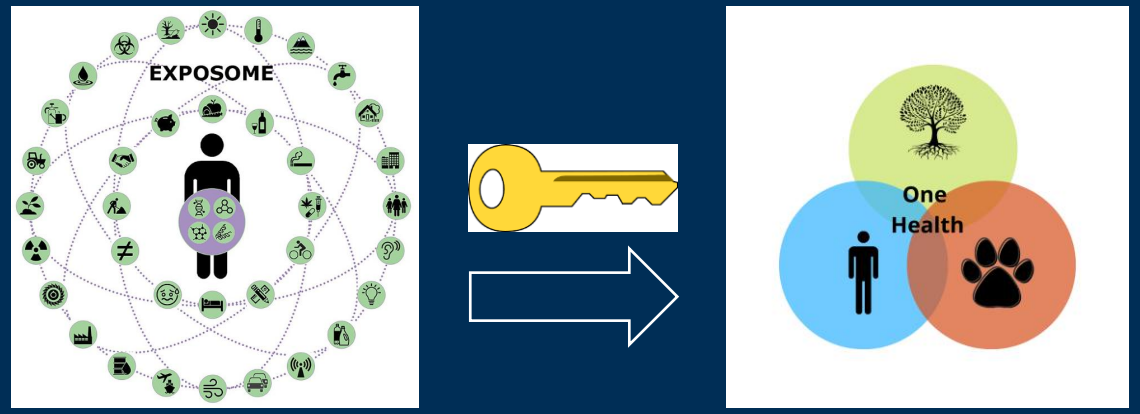
- a **FRAMEWORK** with a **GOAL**
- collaborative efforts of multiple disciplines
- **to achieve** optimal health for people, animals, plants, and the ecosystem



EXPOSOME
EXPOSOMICS

- a **CONCEPT** with **TOOLS**
- individual-centric, describing exposure in relation to health
- **using** information on any pressures that may influence human and animal health

“Exposome, the Key to One Preventive Health”



Thank you!

Questions?

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