European Exposure Science in a Changing Climate

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ISES Europe

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European Exposure Science priority areas and main objective

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The European exposure science strategy 2020–2030

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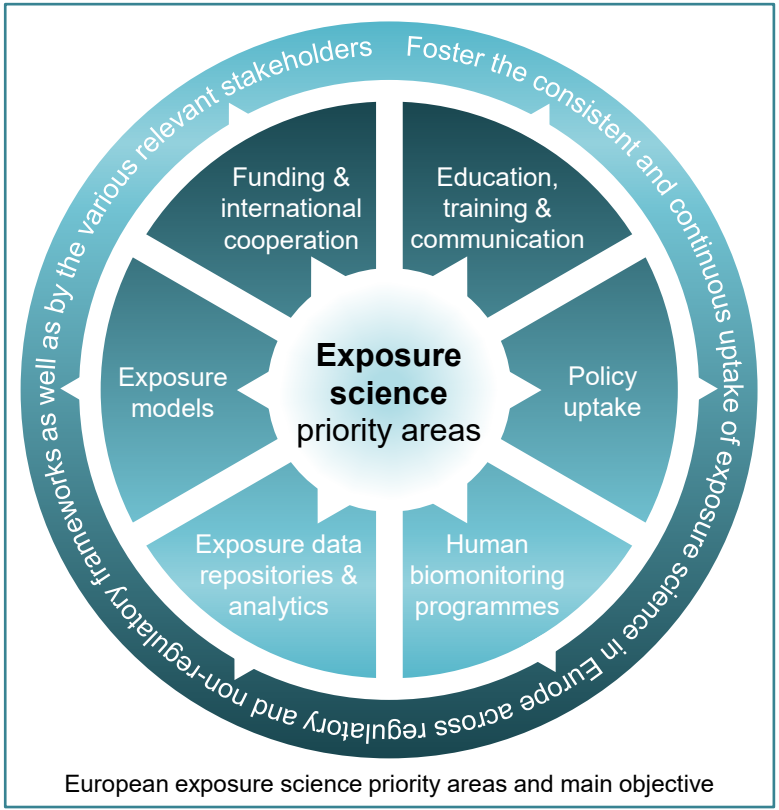

European exposure science priority areas and main objective

Education, Training and Communication as a Priority Area

- Needs to be defined for education and training in exposure science in Europe
- These needs are growing due to new research initiatives and policy ambitions
- Increasing demand for explicitly trained exposure scientists in the public and private sector
- Exposure science and innovation needs consistent, unambiguous learning outcomes
- In addition to initial training there will be need for professional development courses (continuous learning)

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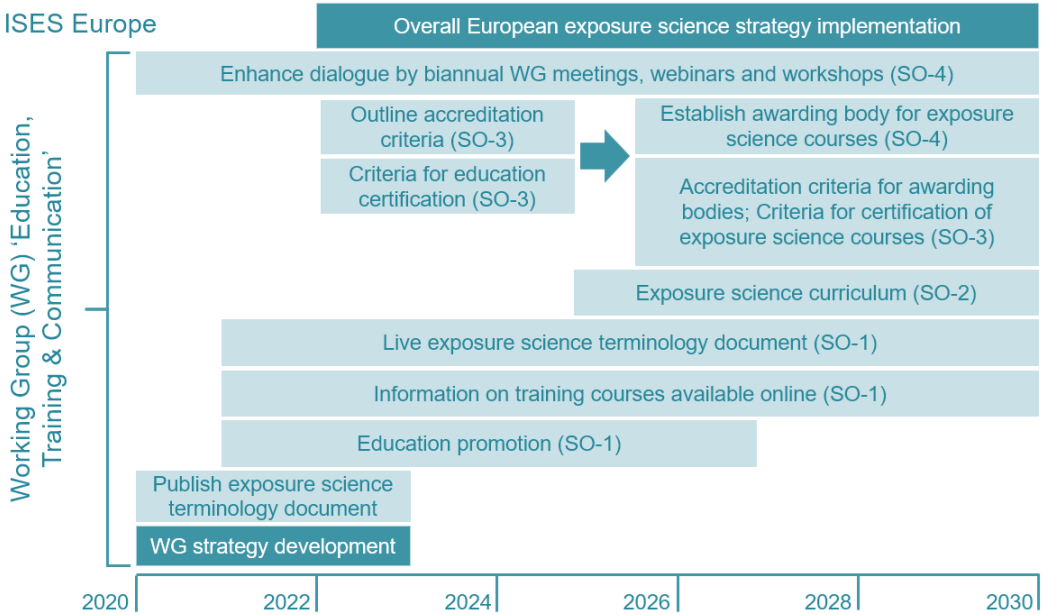
Strategic Objectives for Education, Training & Communication

1. Exposure science promotion
2. Exposure science curriculum
3. Recognition of exposure science courses
4. Enhance the dialogue among exposure scientists



Connolly A, et al. Framework for developing an exposure science curriculum as part of the European Exposure Science Strategy 2020-2030. Environ Int 2022 168:107477

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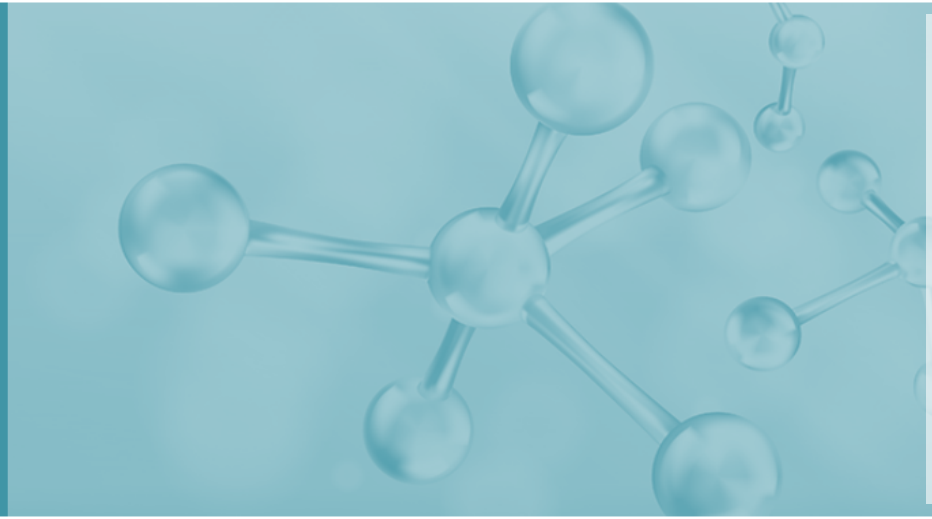

- Scenarios, determinants and routes of exposure
- Exposomics
- Strategies and design for exposure studies
- Measuring external and internal (biomonitoring) human exposures
- Quality assurance in exposure studies
- Statistical methods to analyse exposure measurement data
- Deterministic *vs.* probabilistic modelling approaches
- Modelling of exposure and dose/ Toxicokinetics and PBK modelling
- Aggregate and cumulative exposures to chemical substances
- Assessing exposures with biological markers

All courses

General Toxicology

Cellular Toxicology

Current Topics in Toxicology

Developmental and Reproductive Toxicology

Ecotoxicology – part I

Ecotoxicology – part II

Human Exposure Assessment

Radboud University · 5 days · 1.5 ECTS · Tuition fees

Apply for course

Aim of the course

To gain knowledge and understanding of exposure as an integral and necessary component in the sequence of events leading to potential health consequences.

Exposure Modelling as a Priority Area

- For a risk-based regulation of chemical substances, exposure assessment is required
- For most uses under REACH no measured exposure data are available
- For many situations (especially new substances, new uses) potential exposure has to be predicted

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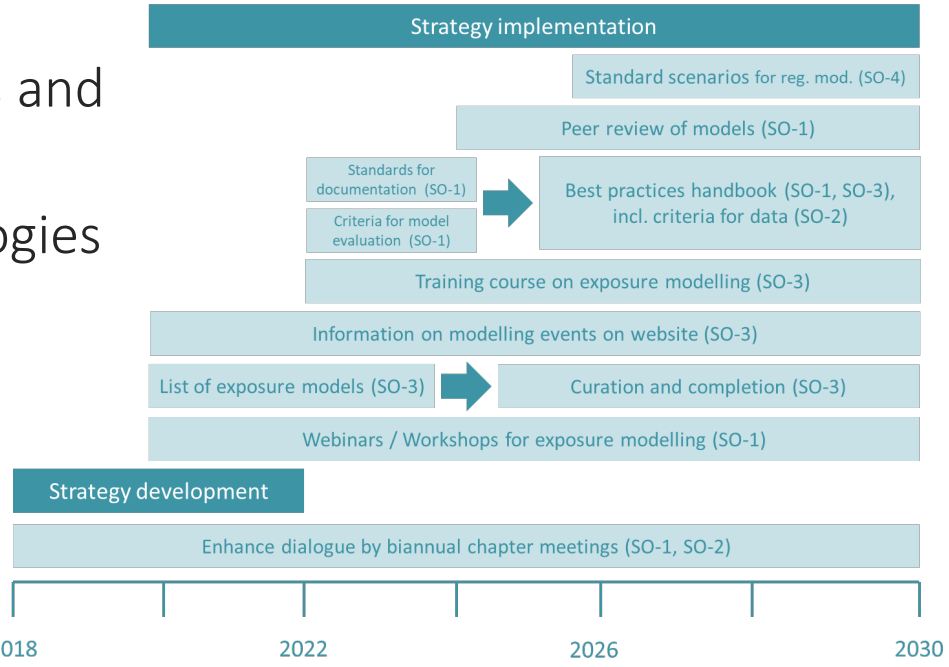
Strategic objectives for exposure modelling

1. Improvement of existing models and tools
2. Development of new methodologies
3. Improvement of model use
4. Regulatory requirements for exposure modelling



Schlüter U et al. Exposure modelling in Europe: how to pave the road for the future as part of the European Exposure Science Strategy 2020-2030. J Expo Sci Environ Epidemiol. 2022, 32(4):499-512.

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Exposure data analytics and repositories

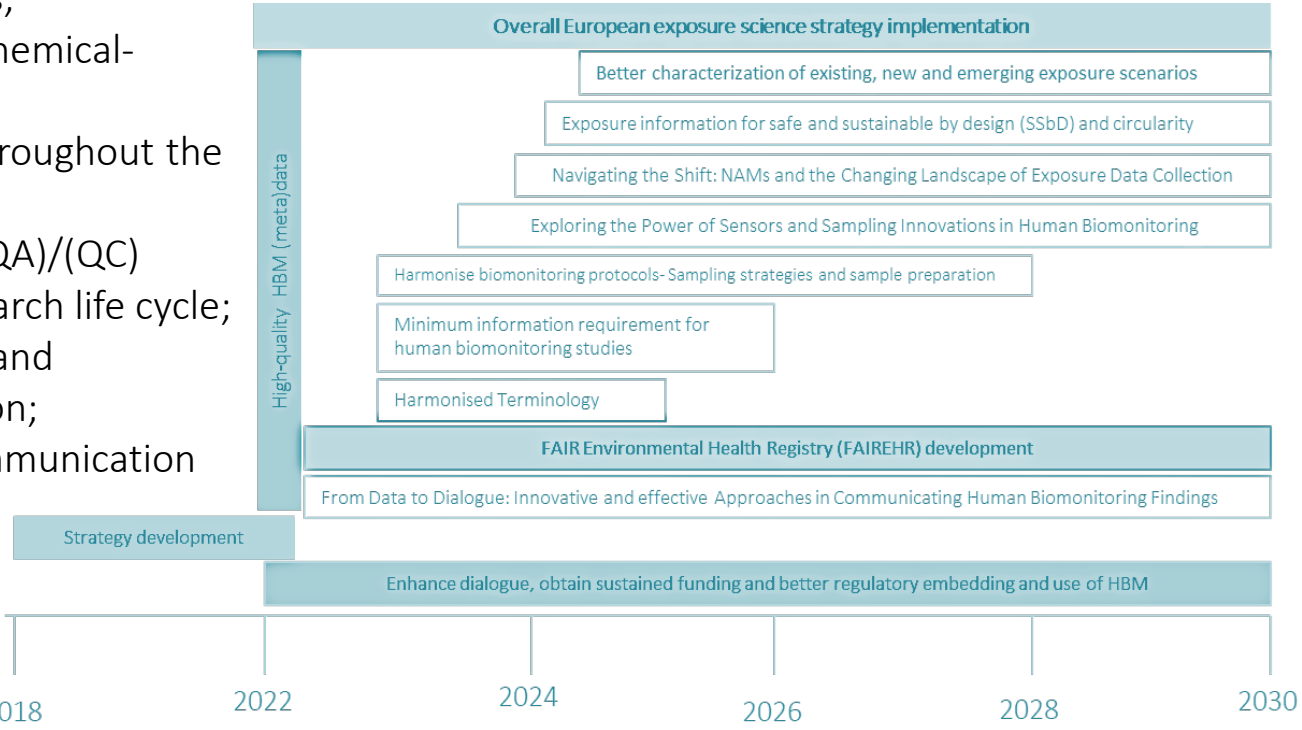
- Exposure-related data are currently scattered, frequently of unclear quality and structure, not readily accessible, and stored in various—partly overlapping—data repositories
- Need for strategic guidance for an integrated European exposure data production and management framework for use in science and policy
- Develop consistent exposure data standards and terminology for data production and reporting
- Increase data transparency and availability, enhance data storage and related infrastructure, boost automation in data management, increase data integration, and advance tools for innovative data analysis

Kosnik et al. Advancing exposure data analytics and repositories as part of the European Exposure Science Strategy 2020-2030. Environ Int. 2022 Dec;170:107610.

Strategic objectives for Human biomonitoring WG

1. Further development of sampling strategies and sample preparation towards cost-effectiveness;
2. Further development of chemical-analytical HBM methods;
3. Improve harmonisation throughout the HBM research life cycle;
4. Further development of (QA)/(QC) throughout the HBM research life cycle;
5. Obtain sustained funding and reinforcement by legislation;
6. Extend target-specific communication

Zare Jeddi et al. Developing human biomonitoring as a 21st century toolbox within the European exposure science strategy 2020-2030. Environ Int. 2022 Oct;168:107476.



Human Biological Monitoring Programmes

FAIR Environmental Health Registry (FAIREHR)

- Findable – persistent identifiers and rich metadata
- Accessible – to be read by humans and machines
- Interoperable – shared vocabularies/ontologies
- Reusable – possibility to link to other datasources

Zare Jeddi et al. FAIR environmental and health registry (FAIREHR)- supporting the science to policy interface and life science research, development and innovation. Front Toxicol. 2023 Jun 5;5:1116707

Biomonitoring Application Data Sheet (BADS)

Aspect	Specifics
Availability	Public (https://www.rivm.nl/bibliotheek/rapporten/609300023.pdf) (originally published in 2009 and currently under revision)
Contents	Key parameters: toxicokinetics, toxicodynamics reference values in populations, analytical approach, method of sample collection
Availability	On-line
Format	Standardized
Number of BADS available	15
Available for	Acrolein, acrylonitrile, arsenic and arsine, benzene and gasoline, cadmium, chromium trioxide and chromic VI acid, dioxin, ethylene oxide, hydrogen cyanide and potassium cyanide, hydrogen fluoride, methyl bromide, polycyclic aromatic hydrocarbons, styrene, toluene, xylenes

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Page 2 of Biomonitoring Application Data Sheet Styrene

Biomarkers	Mandelic acid (MA) in urine	Phenyl glyoxylic acid (PGA) in urine	Styrene in whole blood
Molecular weight	152.1	150.1	104.2
Involved enzymatic metabolism	CYP 450 and epoxide hydrolase, alcohol dehydrogenase, aldehyde dehydrogenase [5]	CYP 450 and epoxide hydrolase, alcohol dehydrogenase, aldehyde dehydrogenase [5]	-
Biological material	Urine	Urine	Blood
Type of sample	Spot urine	Spot urine	Whole blood
Sampling strategy	< 24 h	< 24 h	< 1 h
Excretion pattern	Bi-phasic elimination pattern, with half-lives of 4-9 h (fast phase) and 17–25 h (slow phase) [11]	Half-life of 11 h in a one compartment model simulation [11]	Excretion pattern styrene from blood: bi-phasic with half-lives of 0.58 and 13.0 h [5]
Materials	Polystyrene universal container	Polystyrene universal container	Vacutainers containing heparin
Transportation	Room temperature [12]	4°C (within 4 hours) [12]	4°C
Storage	4°C or -20°C	-20°C [12]	4°C
Stability	Up to 70 days at 4°C and -20°C [12]	4 days at 4°C [13]; Up to 70 days at -20°C [12]	Not reported
Measurement principle	HPLC	HPLC	GC-MS[14]; headspace solid-phase microextraction (SPME) / GC / MS [15]
Aliquot for 1 analysis	1 mL [16]	1 mL [16]	3 mL [15]
Limit of quantification	0.015 g / L (limit of detection) [16]	0.002 g / L (limit of detection) [16]	LOD 0.008 ng / mL (GC-MS) [14]; 30 pg/mL (SPME-GC-MS) [15]
Adjustments	Creatinine	Creatinine	n/a
Expression of results	mg / g creatinine	mg / g creatinine	mg/L
Conversion factor	1 mg / g creatinine = 0.74 mmol / mol crea	1 mg / g creatinine = 0.75 mmol / mol crea	1 mg/L = 9.60 * 10^{-3} mmol / L
BEI US [17]	400 mg / g creatinine (MA + PGA in urine; end of shift)		0.2 mg/L (end of shift)
BLG Germany [18]	600 mg/ g creatinine (excretion of MA + PGA in urine)		n/a
Background value	Not available		Median: 172 ng/L Range: 7 – 963 ng/L [19]
Possible confounders	Active smoking; Ethanol in combined with styrene reduces the elimination rate of MA and PGA [1]		Active smoking

Policy uptake

Priority areas

- Creating a common scientific framework for exposure assessment interfacing EU chemical policies
- Improving the coordination of regulatory processes
- Integration of exposure knowledge into companies' management systems
- Improving the uptake of exposure science innovation into the policy cycle
- Harmonising and utilising exposure science across health, safety and security policies

Bruinen de Buin et al/ Enhancing the use of exposure science across EU chemical policies as part of the European Exposure Science Strategy 2020-2030. J Expo Sci Environ Epidemiol. 2022 Jul;32(4):513-525.

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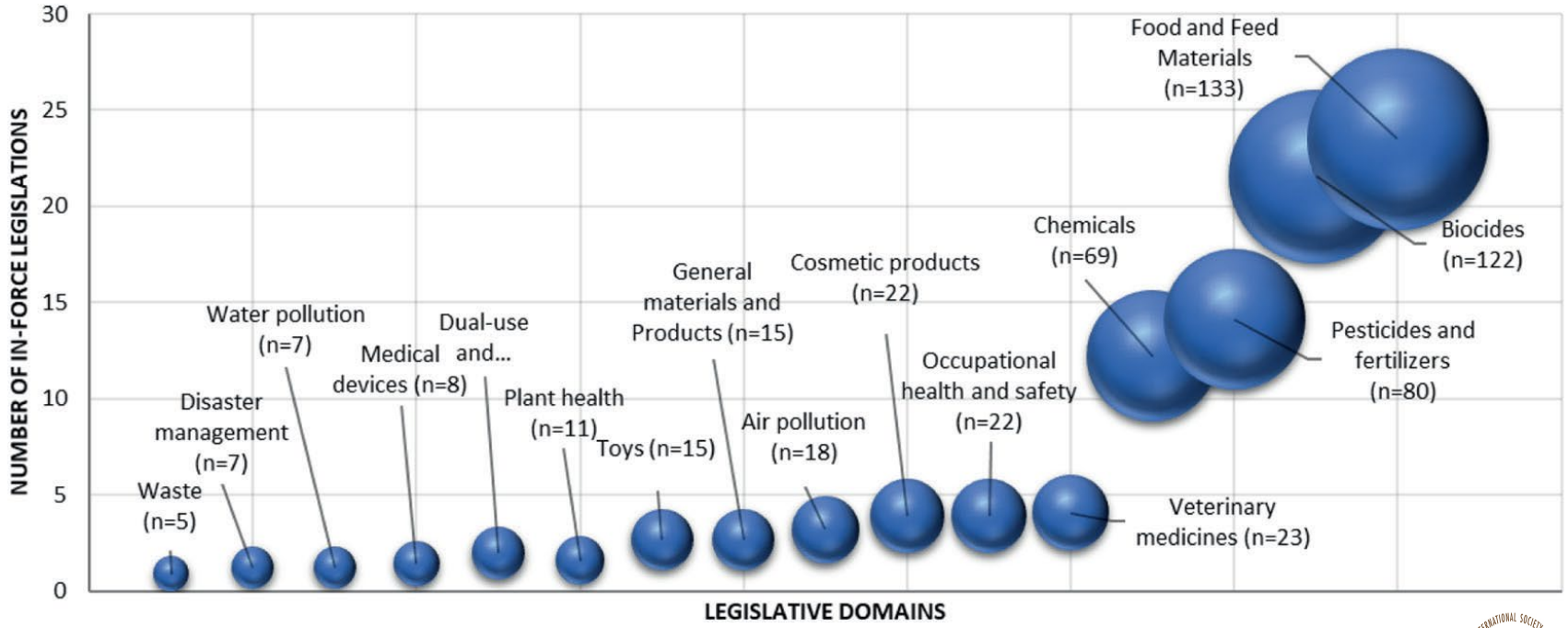
Policy uptake

EU chemical management legislation clustered into 16 domains making use of exposure information



Bruinen de Enhancing the use of exposure science across EU chemical policies as part of the European Exposure Science Strategy 2020-2030. J Expo Sci Environ Epidemiol. 2022 Jul;32(4):513-525.

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Suggestions for this workshop

- Define learning outcomes of initial training and professional development
- Data availability for predictive modelling to support risk assessment
- Initiate a joint collaboration project to support human biomonitoring application
- Foster integration of exposure knowledge into company management systems

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ISES Global

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Mission

- Meet humanity's needs for public health and environmental protection through a global community of exposure science professionals.
- Encourage the open exchange of information, provides opportunities for career development, acknowledges
- Promote excellence in the practice of exposure assessments and research in the field of exposure science

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Save the Date

ISES Europe Workshop 2024

March 19 – 21, 2024
Location: German Federal Institute for Risk Assessment
Diedersdorfer Weg 1, 12277 Berlin
ises-europe.org/events/ises-europe-2024