Group 1 National Hub Template (HBM data for Awareness)

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Introduction:	
Background information on the evolution and status of HBM in your country.	HBM has been part of research activities in Denmark for the past 35 years, initially focusing on occupational health and lead exposures later including environmental chemicals and effect biomarkers. HBM as such has never been part of a ministerial initiative while HBM data is included for some cases with risk assessment. However, DEMOCOPHES was funded by the EPA, Health and Food ministeries, even with an extended program including blood samples and measurement of more than 60 substances in the mother/school child pairs (Mørck et al. 2015, 2016). A small study related to pain and use of painkillers in children and their mothers was added (Jensen et al 2014). HBM is part of the Centers of Endocrine disruptors (CEHOS) at the Region H. Research activities financed from grants (National or EU) including HBM are performed at universities and institutions (Copenhagen, Southern Denmark, Århus, Ålborg and Technical Universities and National research Centre of working Environment, Rigshospitalet Region H). The exposures cover outdoor and indoor air, consumer products, food and drinking water as well as occupational health. Major emphasis has been on exposure biomarkers now also with emphasis on effect biomarkers and health effects. Denmark has well defined registries of health, education, occupations, residence, income and more enabling follow-up studies including all these sociodemographic parameters. Agencies engaged in HBM4EU**:** EPA, Food Agency, Labour Inspection, Research and Innovation, Board of Health The results from HBM activities in Denmark are all published in peer reviewed journals or reports publically accessible. For dissemination many studies are reviewed in publications in the National journal of Environmental Health issued by the Board of

	Health. A board of advisors to the Ministry of Health exchanging information every year on ongoing activities. Currently a PFOS pollution from fire extinction activities has much public attention as also individual HBM measures have been included.
Main text - Results and Discussion	
Description of issue(s) which have resulted in the raising of awareness. Include brief description of sample population, substances of concern and whether local/regional/national.	Air pollution in outdoor and indoor air from environmental exposure measurements and exposure biomarkers have raised awareness related to traffic exposures (Pedersen 2009), nanoparticles, PCB in buildings (Frderiksen 2019). HBM in population studies has raised awareness towards pollutants in food (acrylamide, metals), water (pesticides), consumer products (Bisphenols, phthalates and parabens ao) as well as POPs.
Description of HBM programme **if it exists** e.g. implementation of a HBM module into HES	No political and governmental interest in a Danish National HBM program. A Recommendation for National Research Program focused on Environmental Health has been sent to the Board of Health. Two Nordic meetings for all Nordic HBM4EU hubs were hosted, financed by the Nordic Council providing overview of ongoing activities in the Nordic countries, incl Denmark 2017: Nordic workshop for scientists and regulatory agencies discussing HBM4EU - the European human biomonitoring initiative http://urn.kb.se/resolve?urn=urn:nbn:se:norden:org:diva-4933 2021:Nordic workshop for scientists and regulatory agencies discussing HBM4EU Nordisk Ministerråd - TemaNord2021-528 (norden.org)
Describe which ministries (Environment, Health etc.)/policy makers and stakeholders involved/steering/financing the HBM programme. Give examples - specific chemicals or outcomes.	The Ministry of Environment provides funding of the Center of Endocrine Disruptors (CEHOS), the Arctic program and pesticide research which to some extent include HBM. The Working Environment Research Fund has supported study of chromate exposures following the HBM4EUstudy protocol. The Board of Health supported environmental health studies however now only coordinating meetings between stakeholder institution and publishing results in the magasin Miljø og Sundhed.
Steps/processes needed or used to get the attention of policy makers.	The public awareness of HBM as a tool in exposure and risk assessment has increased dramatically after PFOS case and drinking water quality discussions**.**
Describe barriers e.g funding; challenges e.g. participant recruitment; opportunities e.g. enhancing cross government working and linking of env data with exposure measurements	Danish participation in HBM4EU has had major impact on research and education for all partners involved. Active participation in almost all WPs with many publications as well as PhD and post docs employed. Networks have been strengthened nationally, EU-wise and internationally.

currently at play in your country with regards to HBM. Have any of these barriers been addressed by HBM4EU? If yes - describe.	Participation in the continuation in PARC welcoming the longer term duration and also with new partners and areas is appreciated by the governmental institutions including more openness and preparedness for participation in EU calls for this kind of research. CEHOS continued, Arctic program continued, Use of HBM data in risk assessments, participation in GB.
Other players who would be beneficial in raising awareness and working together to promote HBM	Private institutions such as medicinal industry, contractors etc
Future plans - Are there plans to use HBM data in the future for policy or awareness - give clear examples. Will the data from HBM4EU be used?	The short answer is yes but no materialised plans yet

NB:

The network met regularly and exchanged information about progress and priorities as well as at the two Nordic meetings for all Nordic HBM4EU hubs, financed by the Nordic Council. 50 participants were present in each of the Nordic workshops, where reports have been published.

Results

Danish participation was the case in all WPs apart from WP3 and Table 1 summarizes the outcome in scientific papers reports etc. The link below provides access to all public HBM4EU documents.

Impacts of participation for the partners from Denmark

1. Research activities

Major impact on research and education for all partners involved. Active participation in almost all WPs with many publications as well as PhD and post docs employed. Network strengthened nationally, EU-wise and internationally. Participation in the continuation in PARC welcoming the longer term duration and also with new partners and areas (table summarises).

More openness and preparedness for participation in EU calls for this kind of research.

2. Ministerial alertness

Use of HBM data in risk assessments, participation in GB.

3. National HBM program/survey

No political and governmental interest in a Danish National HBM program. A Recommendation for National Research Program focused on Environmental Health has been sent to the Board of Health.

4. Public awareness

The public awareness of HBM as a tool in exposure and risk assessment has increased dramatically after PFOS case and drinking water quality discussions.

5. Expectations

The structural and organised approach with common protocols etc has been very well appreciated. Administration heavy.

Table: Overview of Danish contributions to HBM4EU and references *published and planned*.

WP	**DK-tasks**	**Results and References**
WP1: Project coordination and management	Agreement in Consortium on how to handle timely provision of ethics documents	Deliverables of annual ethics reports, and contributions to annual work plans. Legal and ethics Policy paper updated and manuscript in preparation (*Knudsen et al in prep*). UCPH leader of the ethics task 1.5.
WP2: Knowledge Hub	Training	Webinars and courses, with presentations available on internal website. UCPH participated in the Task 2.4
WP3: Internal calls	No DK applications	
WP4: Prioritisation and development of scoping documents	Focus interviews of stakeholders	Danish Ministeries and Agencies have been consulted by the HUB coordinator (UCPH) for specific issues
WP5: Translation of results into policy	Data existing and new from HBM4EU accessible in IPChem. Mixture risk assessment of PFAS	Contributions from RegionH, SDU, UCPH, NRCWE, and DTU. In total 16 Danish studies in IpChem *Louro H et al, Bil W, et al*
WP6: Sustainability and capacity building	Questionnaire and focus interview	Performed in Denmark in 2020 by UCPH and published in *Miljø og Sundhed* (*Knudsen*) and peer reviewed publications *Martisane et al (submitted),Uhl et al (in prep), Ovnair Sepai (in prep)*
WP7: Survey design and fieldwork preparation	Material for communi-cation to participants, including informed consent was developed	Used in Danish aligned studies by Region H and SDU.
WP8: Targeted field work surveys and alignment at EU level	Aligned and new studies. Secondary use of samples, data, and health information	Special attention to exposures to phthalates, BPA, DINCH in aligned studies (RegionH and SDU) as well as DEMOCOPHES study (UCPH)

WP9: Laboratory analysis and quality assurance	Choosing biomarkers and matrices for prioritized compounds, setting up quality assurance and control (QA/QC) standards for chemical analyses, coordinating analyses in HBM4EU. Analysis of samples collected in new aligned HBM studies	Compliance with HBM4EU procedures via Material Transfer Agreements (AU). AU leader of task 9.5. Scientific papers published on most suitable biomarkers, matrices and analytical methods (*Vorkamp et al., 2021*), specific methods for flame retardants (*Hajeb et al., 2022*) as well as the overall QA/QC programme (*Esteban López et al., 2021*). Series of papers produced on QA/QC for prioritized compounds (*Dvorakova et al., 2021; Mol et al., 2022; Nübler et al., 2021; 2022; subm.; Vaccher et al., 2022*). Manuscript in preparation on the analytical phase (*Vorkamp et al., in prep.)*.
WP10: Data management and analysis	Sharing of data via IPCheM,	Major contributions from data owners in aligned studies and DEMOCOPHES study.
WP11: Linking HBM, health studies and registries	Participation in workshops and surveys as well as publications Task leader on T11.1	*Tollonen et al*
WP12: From HBM to exposure	No tasks	
WP13: Establishing exposure-health relationships	Reviewing of existing literature on human exposure, mechanisms and exposure-health relationships for priority substances.	Literature review on the epidemiological evidence for a relationship between prenatal and postnatal exposure to PFAS, and thyroid function in mothers and/or infants (*Boesen et al,*). Exposure to Persistent Organic Pollutants in Danish pregnant women: hormone levels and fetal growth indices (*Bonefeld-Jørgensen et al in prep*)
WP14: Effect biomarkers	Several tasks	Assessment of chemical mixtures using biomarkers of combined biological activity: A screening study in human placentas (*Rodríguez-Carrillo, el al)* Real-life PFAS mixtures extracted from human placentas and combined estrogen activities *Wielsøe, et al. (in prep)* Benzophenone-3: Systematic integrative review of the toxicological and human

		evidence with meta-analysis of human biomonitoring studies. (*Mustieles et al. in prep*)
WP15: Mixtures, HBM and human health risk	Case study on mixture effects of antiandrogenic chemicals	D15.5 Report on case studies of mixture risk assessments. Manuscript in preparation on mixture effects on antiandrogenic chemicals.
WP16: Emerging chemicals	Effect-directed analysis for guiding identification of emerging chemicals	*Vinggaard, et al.*

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Abstracts from all presentations and small summary of discussions

Nordic workshop for scientists and regulatory agencies discussing HBM4EU 2021

Nordisk Ministerråd - TemaNord2021-528 (norden.org)

Abstracts from all presentations and small summary of discussions

https://www.hbm4eu.eu/work-packages/deliverable-1-5-legal-and-ethics-policy-paper-september-2018/

Presentation of the ethics framework of EU and internationally the organization of ethics in HBM4EU

https://www.hbm4eu.eu/work-packages/deliverable-2-17-second-report-on-the-content-and-use-of-the-online-library/

All official presentations and refernces from the training

https://www.hbm4eu.eu/work-packages/additional-deliverable-4-4-report-of-the-citizens-focus-groups/

Presentation of all performed focusgroup performances with small summary and discussion.

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