



Exposure Science and Policy

Past and Future perspectives on food

Hans Verhagen*, Claudia Cascio, Davide Arcella,
Marco Binaglia

ISES, RIVM, 4 July 2019



HEADQUARTERS
in the **heart of Parma**

KEEPING FOOD SAFE IN THE EU



WHAT EFSA DOES



Provides independent scientific advice and support for EU risk managers and policy makers on food and feed safety



Provides independent, timely risk communication



Promotes scientific cooperation

WHAT EFSA DOES **NOT** DO



QUESTIONS



ADVISE



**EU
Commission**



European Parliament

**EU
Parliament**

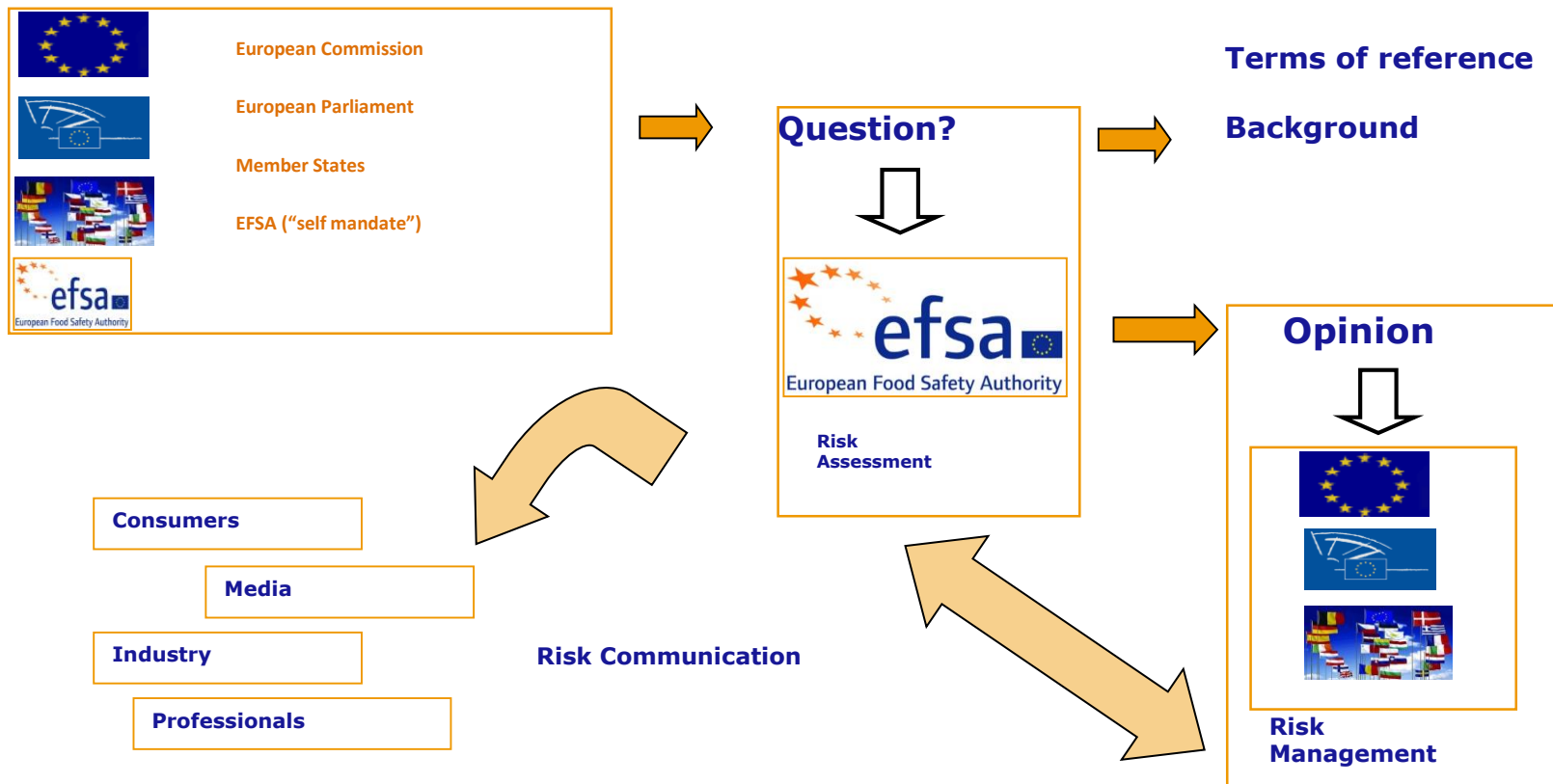


**Member
States**

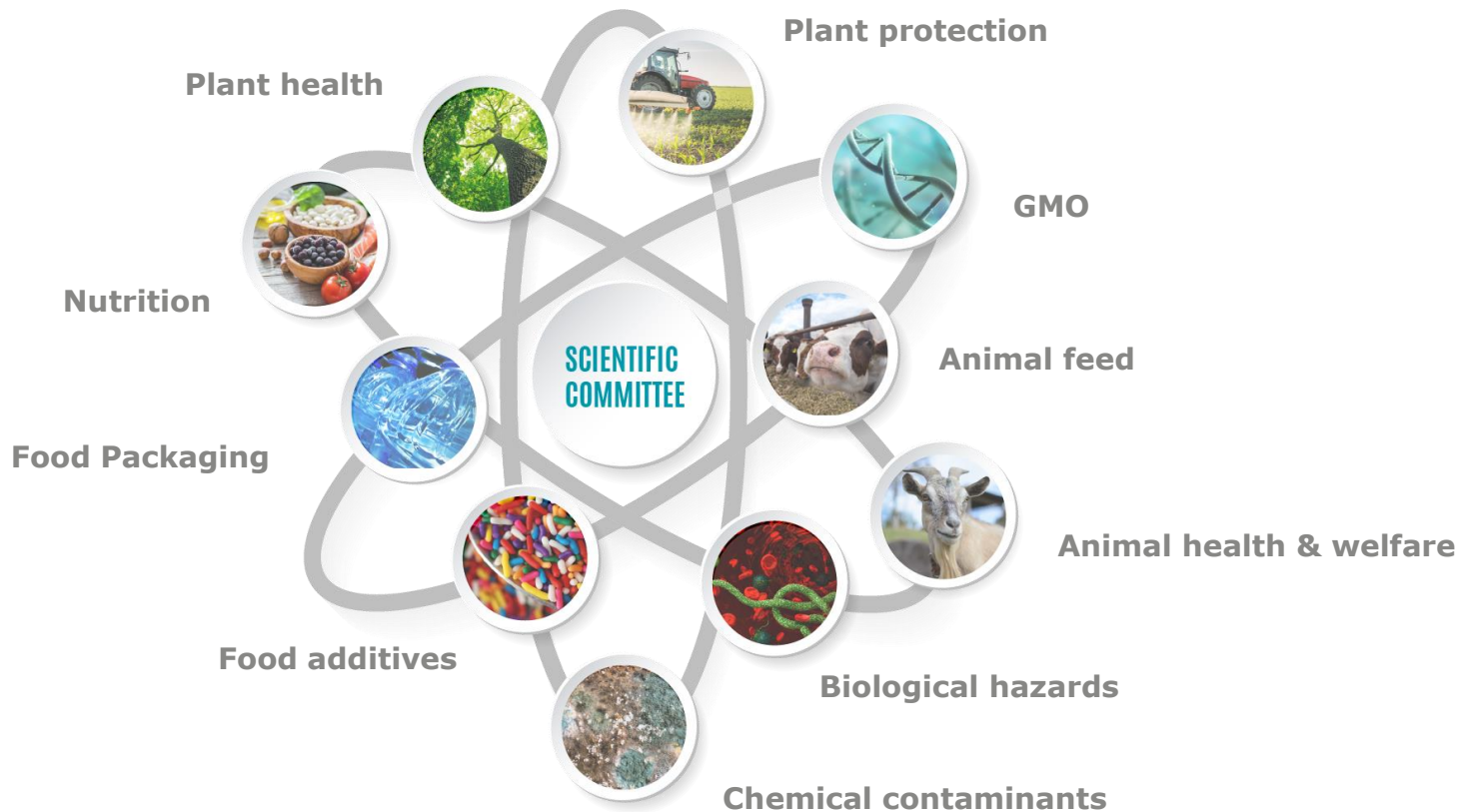


**EFSA self
mandate**

RISK ASSESSMENT@ EFSA



THE SCIENTIFIC PANELS



RISK ASSESSMENT PARADIGM



**Hazard
Identification**
(Toxicity: Genotox, CMR, ED)



**Hazard
Characterization**
(Dose-effect curves, MoA,
Kinetics, etc.)

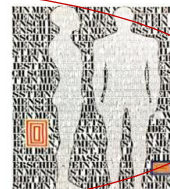


Risk Characterization

External

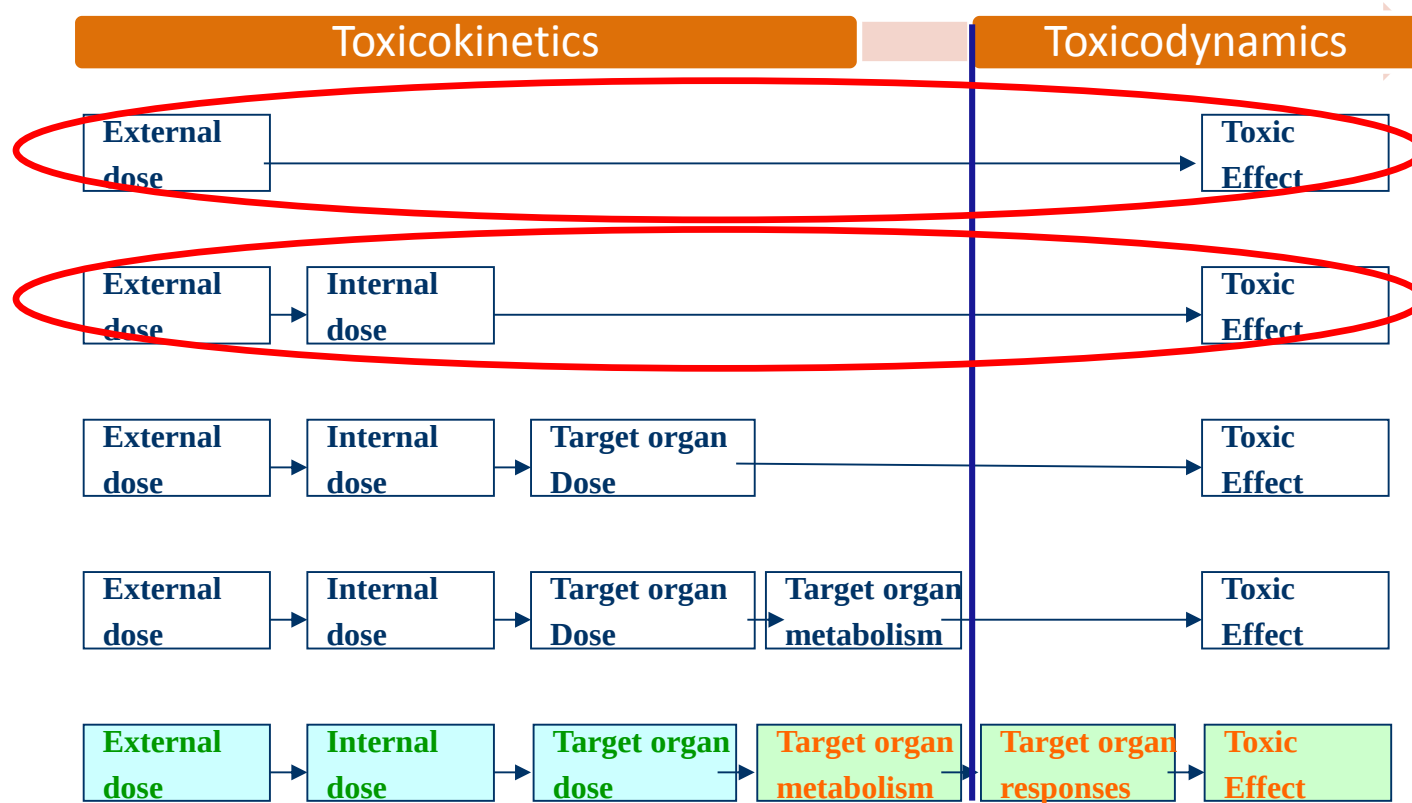
Internal

**Exposure
Assessment**

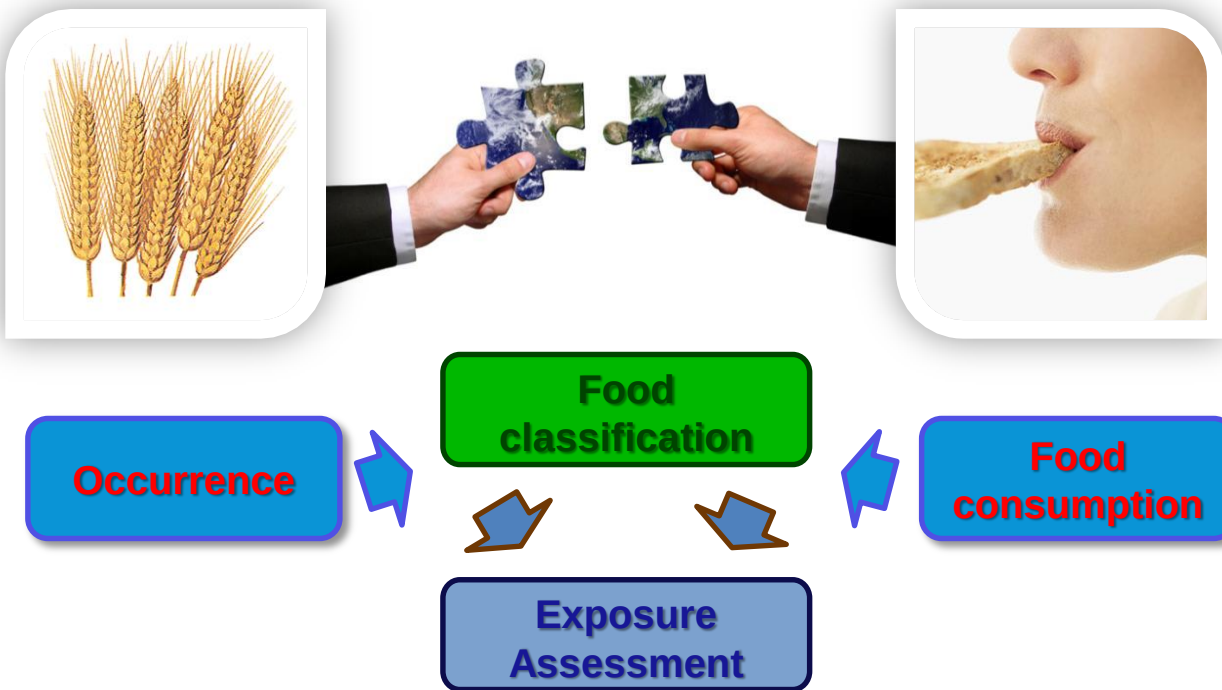


What the body does to the chemical

What the chemical does to
the body



DIETARY EXPOSURE ASSESSMENT



EFSA COMPREHENSIVE EUROPEAN FOOD CONSUMPTION DATABASE

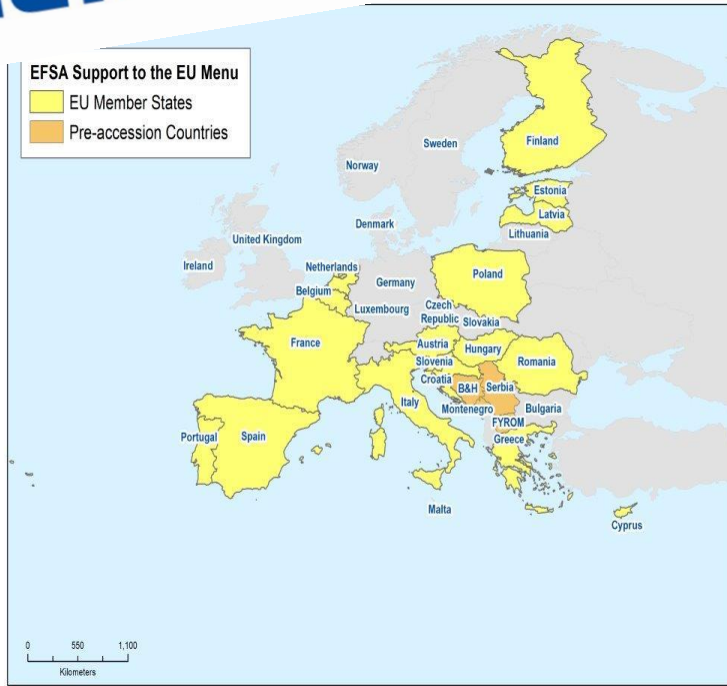
The EFSA Comprehensive European food consumption database contains data:

- 24-hour recall or dietary record method
- data collected at individual level
- most recent data within each country
- random sample at national level
- different age classes, from infants to elderly
- special population groups



<https://www.efsa.europa.eu/en/food-consumption/comprehensive-database>

EFSA Harmonisation Collaboration Food Consumption Survey **EU Menu** Diet



2011- 2016 All EU Menu projects are expected to be finalised by 2023.

MAGNITUDE OF THE CONSUMPTION DATABASE

Number of	
Member States	25
Dietary surveys	60
Population groups	132
Subjects	119,458
Different national food codes	170,878
Different FoodEx2 codes	2,523
Consumption records	12,076,637

Need for precision



Assessing exposure to contaminants



➤ **Is food intake expressed as raw or cooked?**

➤ **Is food consumed in a certain form?**
(fresh/dried/concentrated/canned, etc.)



➤ **Has processing any influence on a possible contamination?**



➤ **Is all of the reported weight edible?**

TECHNICAL REPORT

APPROVED: 30 April 2015



PUBLISHED: 30 April 2015

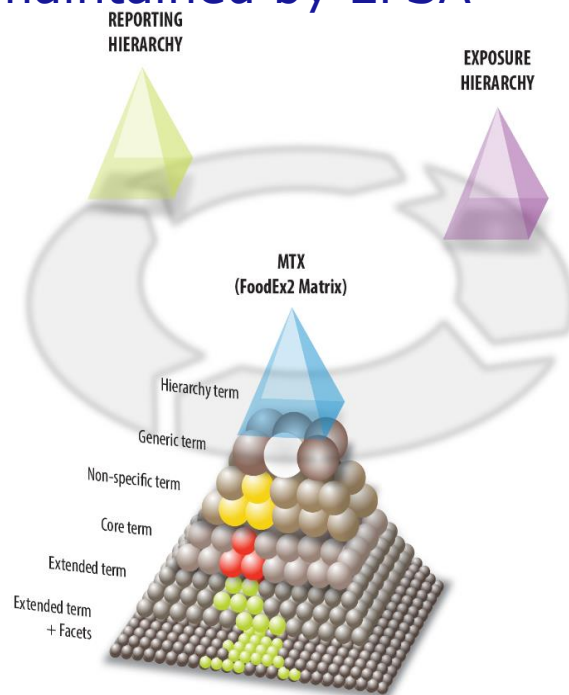
The food classification and description system FoodEx2 (revision 2)

European Food Safety Authority

A report describing the FoodEx2 and providing guidance for its harmonised use and the quality control of the codes

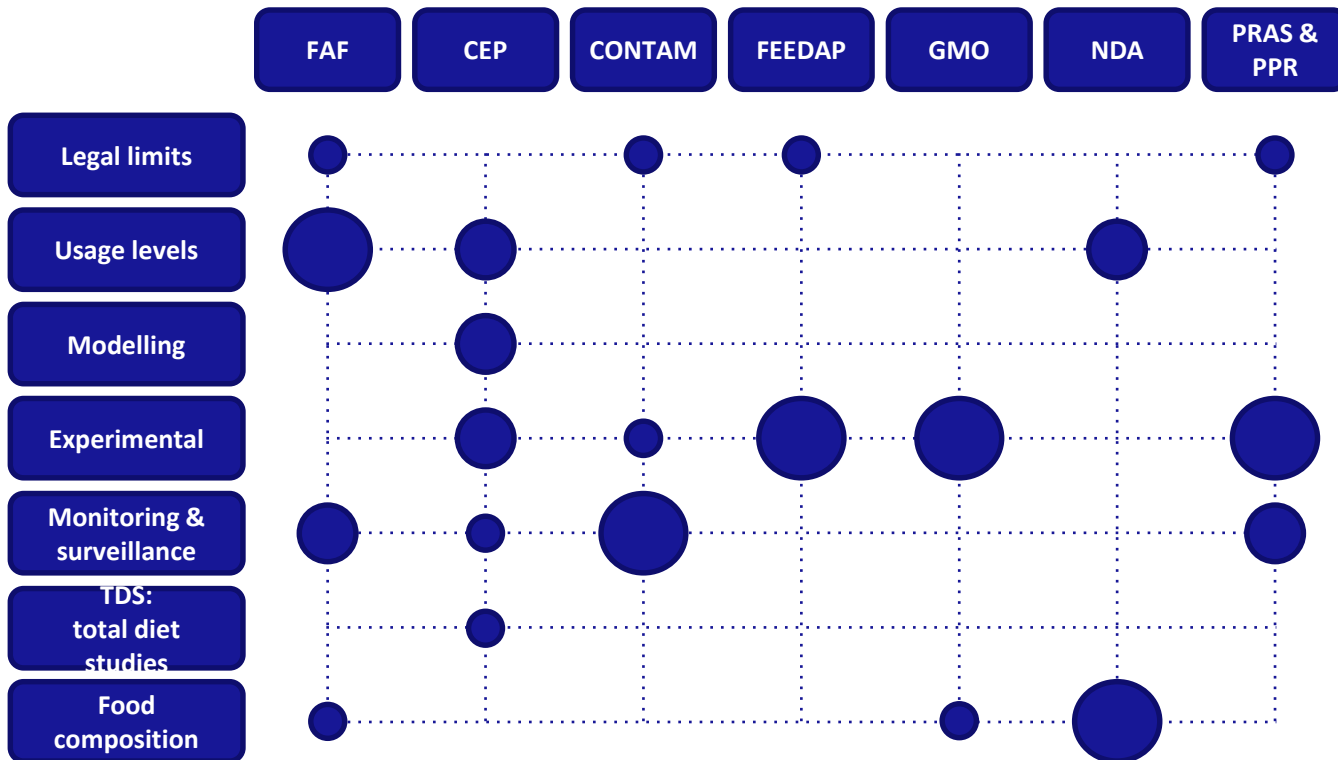
<http://www.efsa.europa.eu/sites/default/files/assets/804e.pdf>

A comprehensive food classification and description system, developed and maintained by EFSA

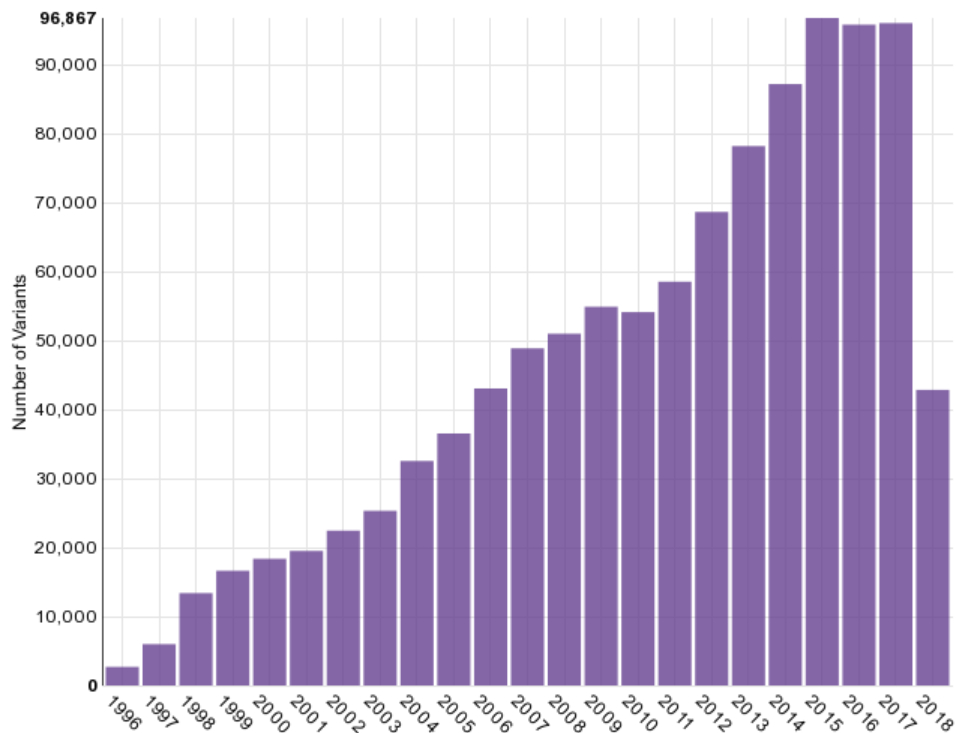


OCCURRENCE DATA

Occurrence data types and their use frequency



GLOBAL NEW PRODUCTS DATABASE (GNPD)



Food labels information on over 1 million foods, beverages and food supplements since 1996 in

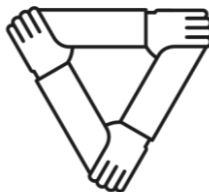
METHODS AND TOOLS

Main **methods** and **tools** for the assessment of dietary exposure to chemical substances:

- Raw Primary Commodity Model (RPC Model)
- Individual-based exposure assessment:
 - Food Additives Intake Model 2.0 (FAIM)
 - Feed Additive Consumer Exposure (FACE)
- Probabilistic exposure assessment:
 - Quantify uncertainty
 - Acute exposure assessment
 - Cumulative exposure assessment & mixtures



SCIENTIFIC EXCELLENCE

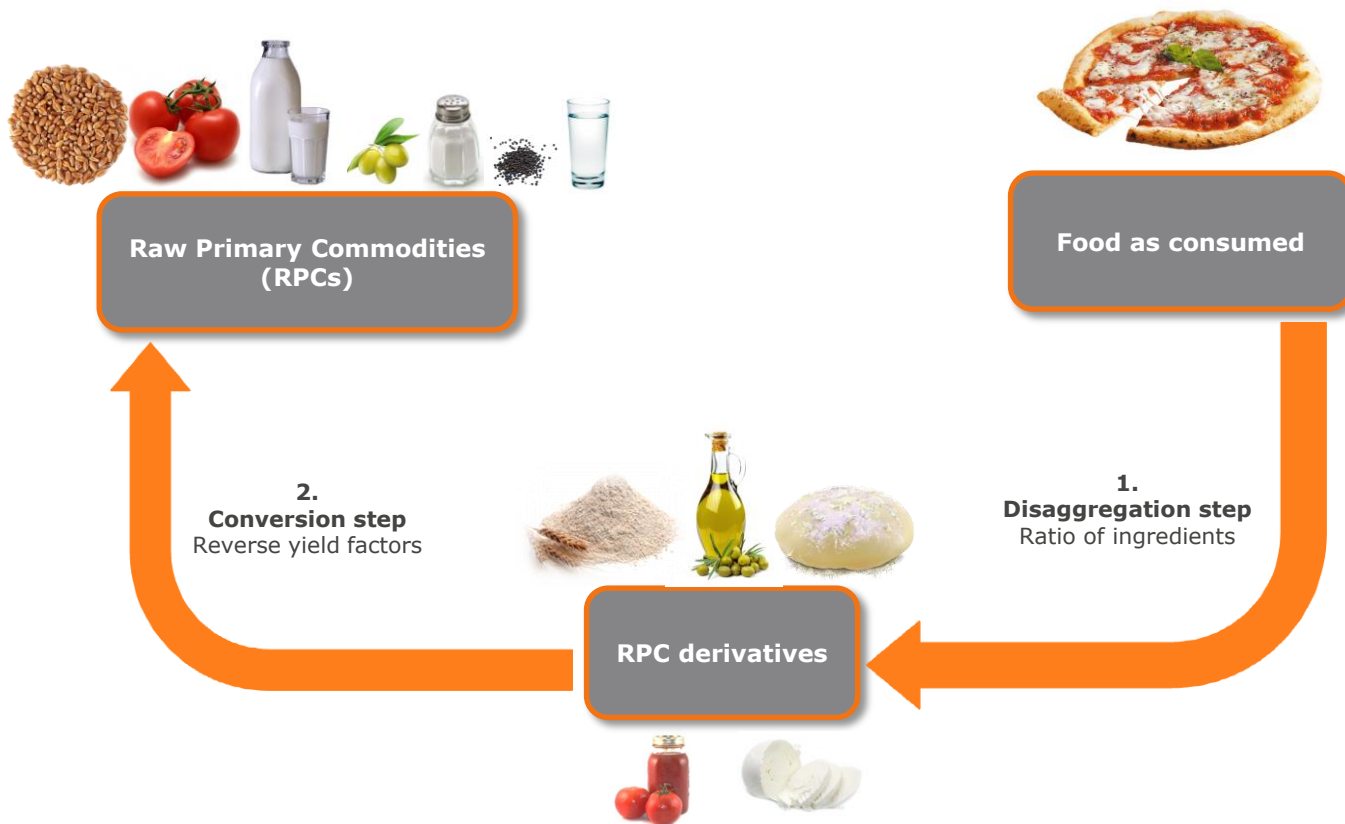


COOPERATION



INNOVATION

Raw Primary Commodity Model (RPC Model)



Individual-based exposure models

Individual consumption data

		Consumption DAY 1 (g)	Consumption DAY 2 (g)	Average consumption (g/day)
 Peter  18 kg	Meat	150	250	200
	Vegetables	65	0	32.5
	Milk			150
	Sweets	200	100	7.5
	Other	0	15	

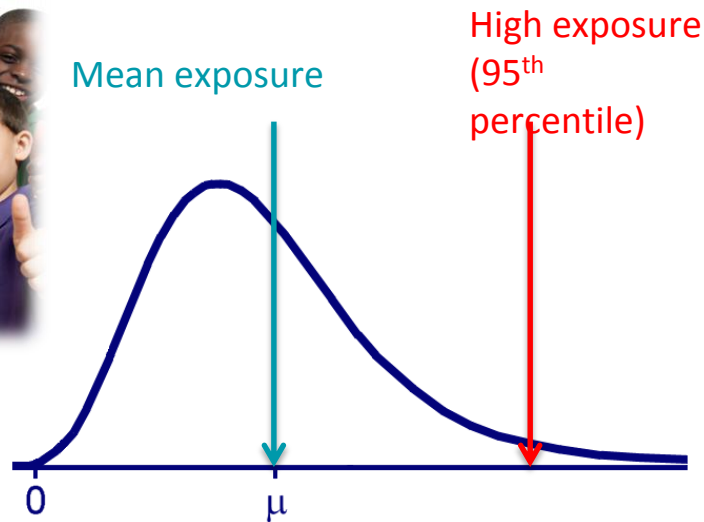
Individual-based exposure models

Individual exposure calculation

		Average consumption (g/day)	Concentration (mg/kg)	Chronic exposure (mg/day)
 Peter  18 kg	Food categories			
		200	1.8	0.36
		32.5	30	0.98
				0.11
		150	0.75	0.02
Total chronic exposure in <u>mg per day</u> : 1.47				
Total chronic exposure in <u>mg/kg bw per day</u> : 0.08				

Individual-based exposure models

Distribution of individual exposures



EXPOSURE TOOLS

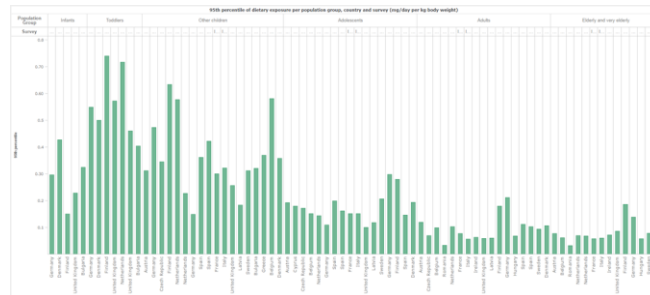
- Food Additives Intake Model (**FAIM**) 2.0
- Feed Additive Consumer Exposure (**FACE**)

MicroStrategy® | 10

FAIM and FACE are tools for estimating **dietary exposure** to food and feed additives, respectively. They allow users to estimate the mean and high level exposure for **different population groups in several European countries**.

These tools are based on **raw individual food consumption data**, from the EFSA data warehouse.

Herbs, spices, seasonings (Not Specified)	12.2	0.000000	0.000000
Vinegars	12.3 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Mustard	12.4 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Soups and broths	12.5 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Sauces	12.6 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Salads and savory based sandwich spreads	12.7 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Yeast and yeast products	12.8 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Protein products, excluding products covered in category 1.8	12.9 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Foods for infants and young children (Not Specified)	13.1 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Dietary foods for special medical purposes defined in Directive 1999/21/EC (excluding products from food category 13.1.5)	13.2 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Dietary foods for weight control diets intended to replace total daily food intake or an individual meal (the whole or part of the total daily diet)	13.3 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Foods suitable for people intolerant to gluten as defined by Regulation (EC) No 41/2009	13.4 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Water, including natural mineral water as defined in Directive 2009/54/EC and spring water and all other bottled or packaged waters	14.1.1 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Fruit juices as defined by Directive 2001/112/EC	14.1.2.1 <td>0.000000</td> <td>15.000000</td>	0.000000	15.000000
Vegetable juices	14.1.2.2 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Fruit nectars as defined by Directive 2001/112/EC and vegetable nectars and similar products	14.1.3 <td>0.000000</td> <td>0.000000</td>	0.000000	0.000000
Flavoured drinks	14.1.4 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Flavoured drinks with sugar	14.1.4.1 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Flavoured drinks with sweetener	14.1.4.2 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Coffee, tea, herbal and fruit infusions, chicory, tea, herbal and fruit infusions and chicory extracts, tea, plant, fruit and cereal preparations for infusions, as well as mixes and instant mixes of these products (Not Specified)	14.1.5 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Beer and malt beverages	14.2.1 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000
Wine and other products defined by Regulation (EC) No 1234/2007, and alcohol free counterparts	14.2.2 <td>0.000000 <td>0.000000</td> </td>	0.000000 <td>0.000000</td>	0.000000



DIETARY EXPOSURE ASSESSMENT TO CHEMICALS: EFSA ACTIVITIES AND PRIORITIES

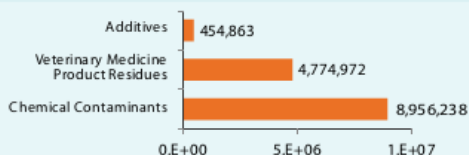
Dietary exposure is a crucial component of EFSA's risk assessments to chemicals

The Use of Common Standards for Food Coding is crucial to allow inter-domain operability and data transfer



Data Providers: National Labs, Academia,
Industry, Consumer Associations

CHEMICAL OCCURRENCE DATA



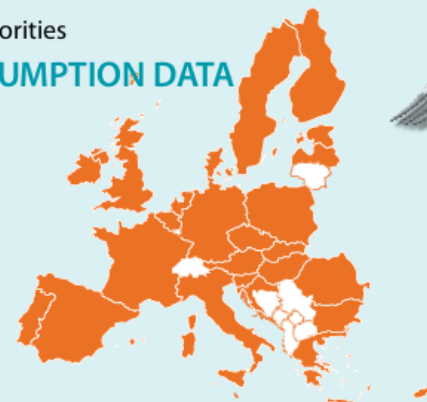
Chemical occurrence* data collected by EFSA from 2010 till 2017 (n of records)

* over 160,000,000 records on pesticides are also available

EFSA routinely collects occurrence data **at sample level** on a wide range of chemicals (e.g. contaminants, pesticides, veterinary drug residues, food additives, etc.).

Data Providers:
EU National Authorities

FOOD CONSUMPTION DATA



Food Consumption data on about 120,000 subjects from infants to elderly and from 25 EU countries are gathered in the EFSA Comprehensive European Food Consumption Database.

FoodEx



Dietary exposure assessment to chemicals for the European Citizens

PRIORITIES



Harmonization



Standardization



Accessibility



Transparency

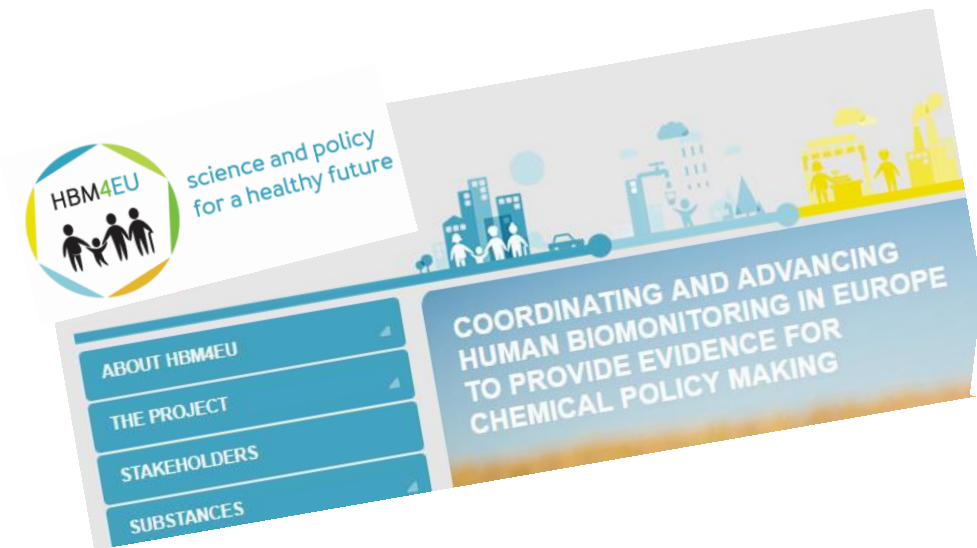


Quality

CHALLENGES

- Improving data quality and representativity
- Foster data re-use and innovation
- Promote direct access to data and the development of collaborative platforms
- EFSA is open to collaboration with other exposure domains through multi-disciplinary projects or initiatives

HUMAN BIOMONITORING – SOME EU PROJECTS

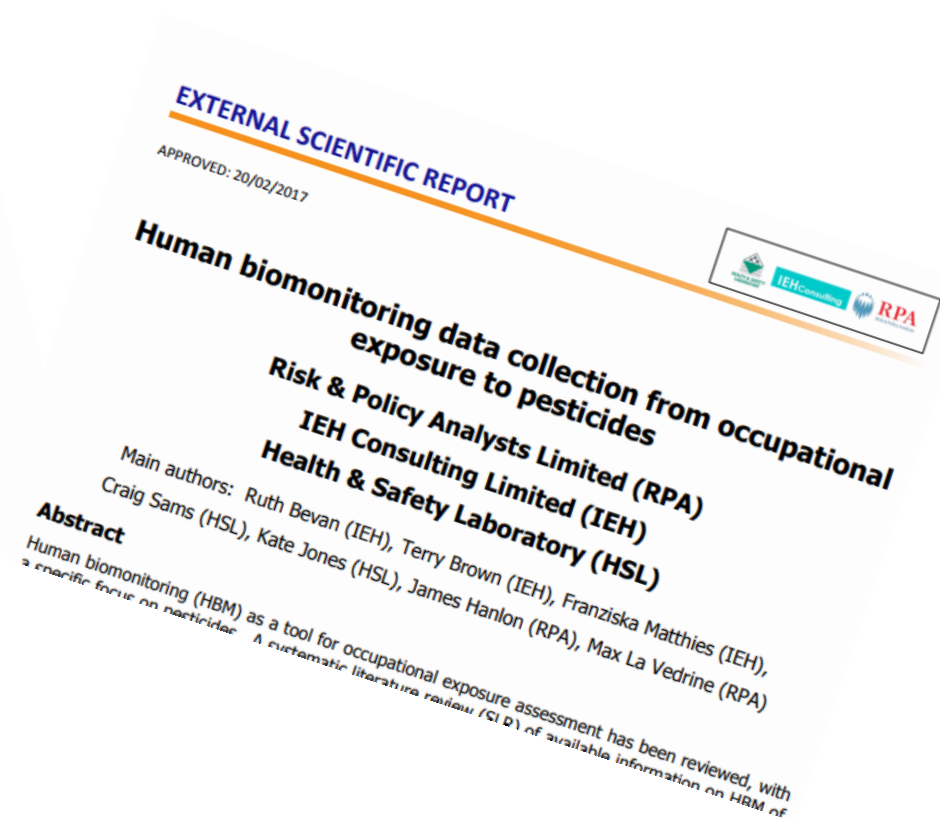


<https://www.hbm4eu.eu/>

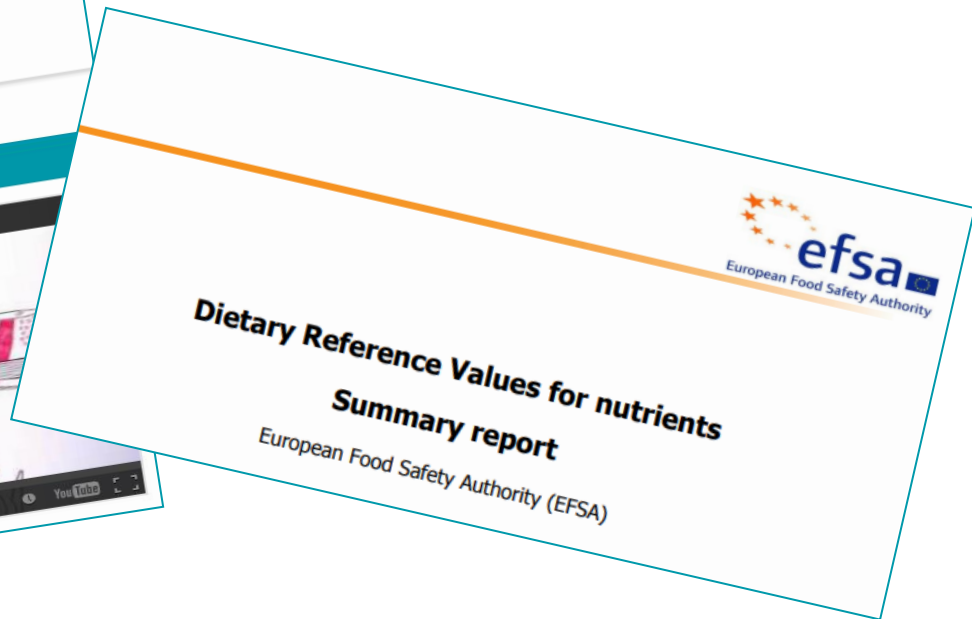


<http://foodmetabolome.org/>

EFSA PAST WORK ON HUMAN BIOMONITORING



DIETARY REFERENCE VALUES



Cd (CADMIUM) in food (2009)

- Studies on biomarkers of exposure and effects
- Biomonitoring data from the literature and trends of exposure (blood and urine)
- Cd in urine to measure body burden
- Meta analysis for dose-response relationship between urinary Cd and biomarker for tubular effects (beta-2-microglobulin) >> BMDL₀₅
- Studies (occupational and others) described and used
- Kinetic modelling

>>> **Tolerable Weekly Intake established**

Pb (LEAD) IN FOOD (2010)

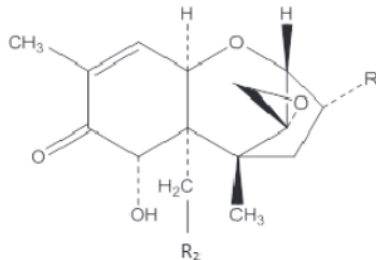
- Studies on biomarkers of exposure
- Biomonitoring data from the literature and trends of exposure
 - ✓ Blood, plasma/serum, urine, bone, hair
- Pb in blood information linked to neurodevelopmental effects in children >> BMDL01
- BMDLs also for:
 - Pb in blood vs renal effects and systolic blood pressure,
 - Pb in bone mineral vs systolic blood pressure
 - nephrotoxicity vs cardiovascular effects (adults)
- Kinetic modelling for Pb in blood versus dietary exposure

>>> **MOE calculated**

DEOXYNIVALENOL (DON) (2017)

- Deoxynivalenol and its acetylated and modified forms in food and feed
- Experimental study on DON biomarkers in urine
- Very first time in EFSA to collect biomarker data and apply them in the opinion

>>> (group) TDI of 1 ug/kg bw per day



	R ₁	R ₂
DON	-OH	-OH
3-Ac-DON	-OAc	-OH
15-Ac-DON	-OH	-OAc
DON-3-glucoside	-Ogluc	-OH

BISPHENOL A (BPA) (2015)

- Exposure calculated from the diet and back-calculated from the biomarker of exposure: **same order of magnitude**

Table 33: Average internal exposure to total BPA, as estimated by forward and backward exposure modelling. For some age classes, such as infants and children, several values are given which refer to subgroups among the age classes

Age class	Age(years)	Average internal exposure (ng/kg bw per day)	
		Forward modelling ^(a)	Backward modelling ^(b)
Infants	0–1	42/157/177/226/387	< 10
Toddlers	1–3	384	Not available
Children	3–10	301	49/107
Adolescents	10–18	172	48
Adults	18–65	134/134/140	39
Women of cba	18– 2	140	36
Elderly/very elderly	≥65	124	56

cba, childbearing age.

(a) Internal exposure assessed by combining exposure over all routes. For some age classes several values are given that refer to subgroups among the age class (see Table 31 for details).

(b) When biomonitoring data were available for more than one age class, several values are given.

CONCLUSIONS HUMAN BIOMONITORING 1/2

- Human Biomonitoring data have been used in EFSA to “validate” dietary exposure estimates but also to detect health effects
- Human Biomonitoring data are particularly important in exposure assessment and could play an important role in post market monitoring
- Further development of Human Biomonitoring of exposure to monitor substances of interest for EFSA is needed

CONCLUSIONS HUMAN BIOMONITORING 2/2

- Human Biomonitoring need to be combined with other data and tools for interpretation in risk assessment:
 - Information on dietary intake (FFQ , 24h recalls)
- Individual Human Biomonitoring data needed:
 - *Data format* compatible with EFSA's format for chemical concentration and intake data

STANDARDISATION & HARMONIZATION



**Coordinated approaches
Standard protocols
Compatible systems**

DATA MODEL COMPRISES 3 COMPONENTS:

- the **structure** in which the data can be reported
- the **catalogues** to describe the terms in a standardized way
- and the **business rules** to check the validity of the reported data

STAY CONNECTED!



Subscribe to

www.efsa.europa.eu/en/news/newsletters

www.efsa.europa.eu/en/rss



Engage with careers

www.efsa.europa.eu/en/engage/careers



Follow us on Twitter

[@efsa_eu](https://twitter.com/efsa_eu)

[@plants_efsa](https://twitter.com/plants_efsa)

[@methods_efsa](https://twitter.com/methods_efsa)