

Environmental Health Interventions

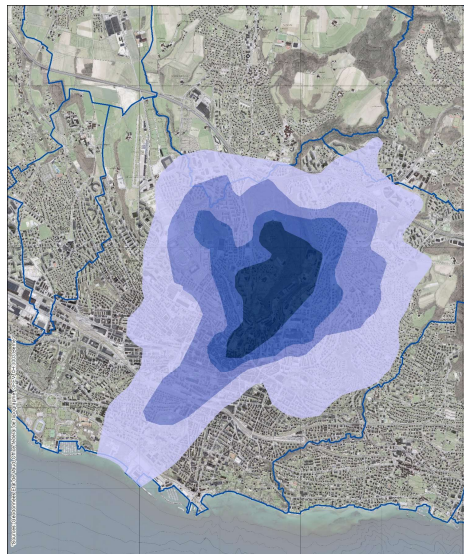
Dioxins

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Situation

Discovery of Dioxin/Furan contamination

- Redevelopment of a private plot of land on Avenue Victor-Ruffy in Lausanne
- PCDD/Fs levels in the order of magnitude of the OSol remediation value of 96 and 107 ng i-TEQ/kg
- Subsequent successive surveys for mapping (> 120)



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Dioxins and furans

- Set of congeners of similar structure
- Variable toxicity: reprotoxicity, cancerogenicity, immunotoxicity
- Environmental and human biopersistence

Name	Struktur	Anzahl Kongenere	
		1)	2)
Polychlorierte Dioxine (PCDD)		75	7
Polychlorierte Furane (PCDF)		135	10
Polychlorierte Biphenyle (PCB)		209	12

- Target value based on reprotoxic effects (most sensitive effect)

Regulatory thresholds - soils

- Calculation of toxic equivalent concentrations
- Ability to interact with AHR (aryl hydrocarbon receptor)
- Depending on the exposure scenario
- Playground sanitation threshold: based on unintentional ingestion of soil by children

$$TEQ = \sum_{i=1}^n (C_i \cdot TEF_i)$$

Regulatory values for soils		Sources
Indicative value	5 ng i-TEQ /kg soil dry matter	OSol; SR 814.12
Investigation thresholds		
Ingestion risk	20 ng i-TEQ /kg dm soil	OSol; SR 814.12
Food or feed crops	20 ng i-TEQ /kg dm soil	OSol; SR 814.12
Sanitation values		
Playgrounds	100 ng i-TEQ /kg dm soil	OSol; SR 814.12
Private and allotment gardens	100 ng i-TEQ /kg dm soil	OSol; SR 814.12
Agriculture and horticulture	1000 ng i-TEQ /kg dm soil	OSol; SR 814.12

Regulatory Thresholds - Food

- Measurement in batches, when placed on the market

Regulatory values for foodstuffs		Sources
Mixed animal fats	1.5 pg TEQ _{WHO-05} /g fat	OCont; SR 817.022.15
Raw milk and dairy products	2.5 pg TEQ _{WHO-05} /g fat	OCont; SR 817.022.15
Sheep		
Sheepmeat and sheepmeat products	2.5 pg TEQ _{WHO-05} /g fat	OCont; SR 817.022.15
Sheep livers and derived products	1.25 pg TEQ _{WHO-05} /g fresh weight	OCont; SR 817.022.15
Sheep fat	2.5 pg TEQ _{WHO-05} /g fat	OCont; SR 817.022.15
Chicken eggs		
Hen eggs and egg products	2.5 pg TEQ _{WHO-05} /g fat	OCont; SR 817.022.15

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The issues

Situation

- High soil concentrations (>100 ng/kg)
- Wide area (> 20 ng/kg)

Technical complexity

- Complex pollutant, non-specific toxicity
- Several units of measurement (I-TEQ, WHO-TEQ) and soil extraction methods
- Variability of ground level concentrations and exposure situations

Communication

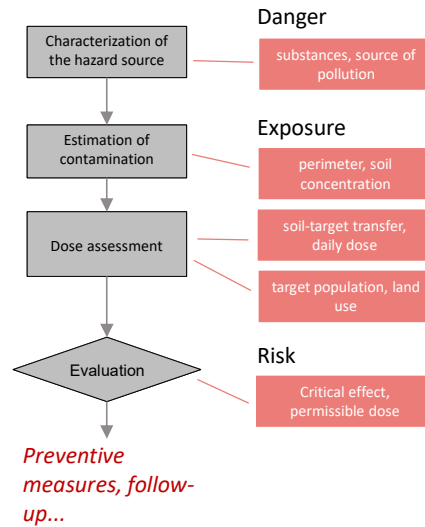
- Dioxins associated with the Seveso and Agent Orange tragedy (Vietnam)
- Legal and financial issues
- Possible lowering of the sanitation limit from 100 to 20 ng/kg

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Health assessment

Mandate DGS

- Assessing the risk
- Supporting the authorities in the choice of preventive measures
- Pluridisciplinary working group



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Situations identified

Scenarios

- Direct ingestion of soil by children
 - hand to mouth exposure
- Consumption of vegetables grown on contaminated soil
 - cucurbits, unpeeled vegetables
- Consumption of food from animals that have fed on contaminated grass/fodder
 - sheep, woolly pig
 - eggs (private poultry houses)



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Exposure assessment

Evaluation method

- Scenario of ingested doses
 - medium (conservative) scenarios
 - existing models / adaptations
- Limited sampling
 - sheep, rillettes, eggs, zucchini
- Modelling of serum concentrations
 - Different ground concentrations
 - Frequency of use/consumption

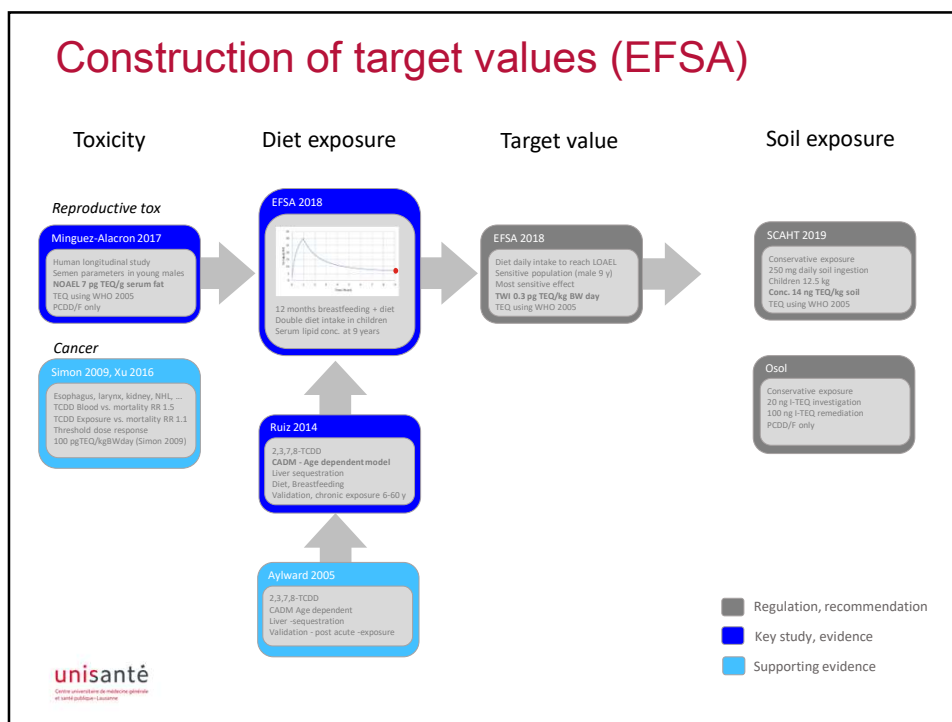
Computation	Model
Direct ingestion	Adaptation of the expert syst. (Mailänder and Hämmann 2005)
Vegetables	Bioconcentration factors (ADEME 2017)
Sheep	Adaptation of cow's model (Agroscope)
Eggs	RIVM model (Van Eijkeren et al. 2006)
Human (serum)	CADM (concentration- and age-dependent model) (Chain et al. 2018)

Target value

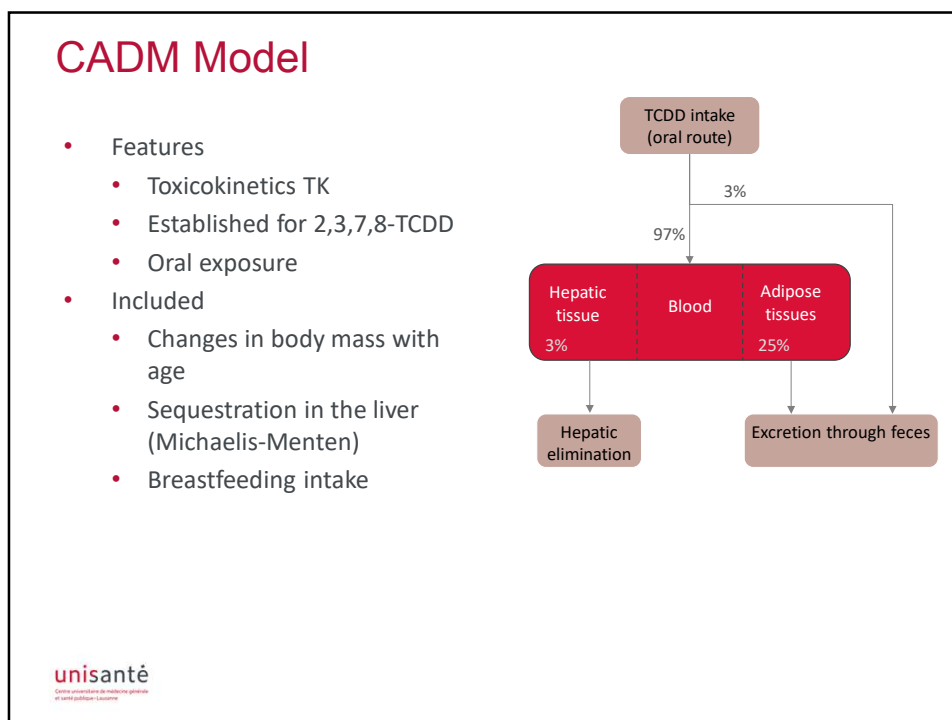
What is acceptable?

- Threshold without effect?
- Target value (WHO/EFSA) for daily intake:
0.3 pg TEQ/kg body weight.day
- Increased blood concentration in the general population

Present in our diet 0.6 pg TEQ/kg body weight.day (FOPH 2010)



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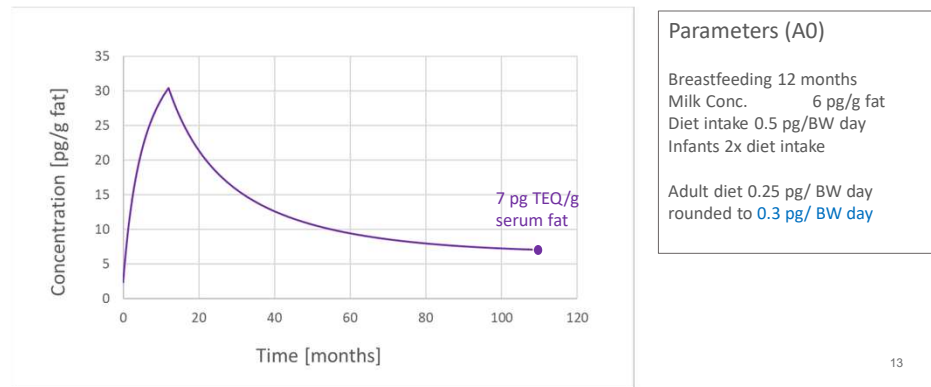


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CADM model

Initial EFSA calculation

- Endpoint: TCDD/F concentration in lipids at 9 years
- Adjustment of parameters to achieve the NOAEL of 7 pg TEQ/g fat in serum (Minguez 2017)

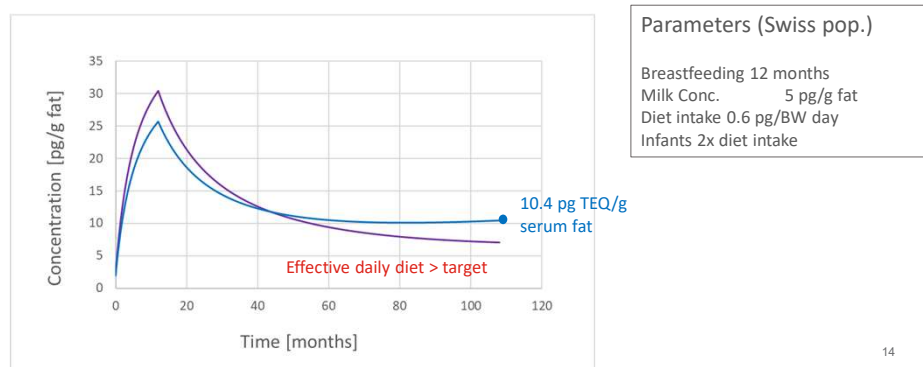


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Adjustment for the Swiss population

Adjustment for the Swiss population

- For TCDD/F
- Daily diet (EFSA ref data 2009)
- Breastfeeding according to (FOPH 2010)



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Direct ingestion of soil: parameters

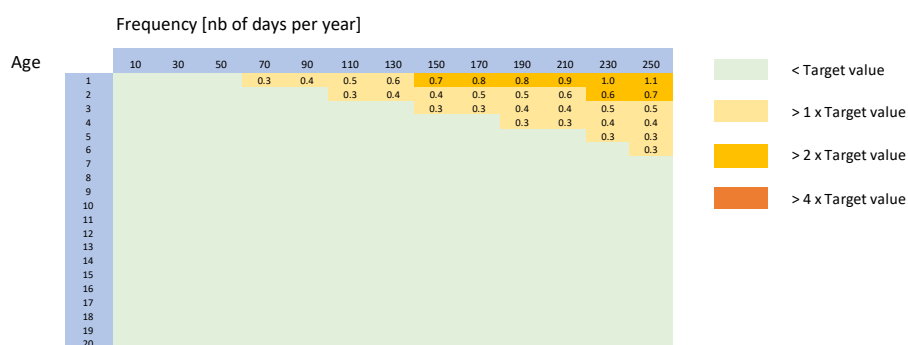
- Frequency of use of the area: 0-250 days/year
- Body mass
continuous growth of body mass with age
(according to CADM model)
- Vegetation cover
weighting of the expert model:
no source data identified
- Bioavailability: 75%.
- Age
0 to 9 years, endpoint at 9 years

Vegetation cover (%)	Availability factor
> 90%	0.7
90 - 75%	0.85
75%	1

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Direct ingestion of soil: scenarios incorporation

Soil concentration at **200** ng TEQ / kg



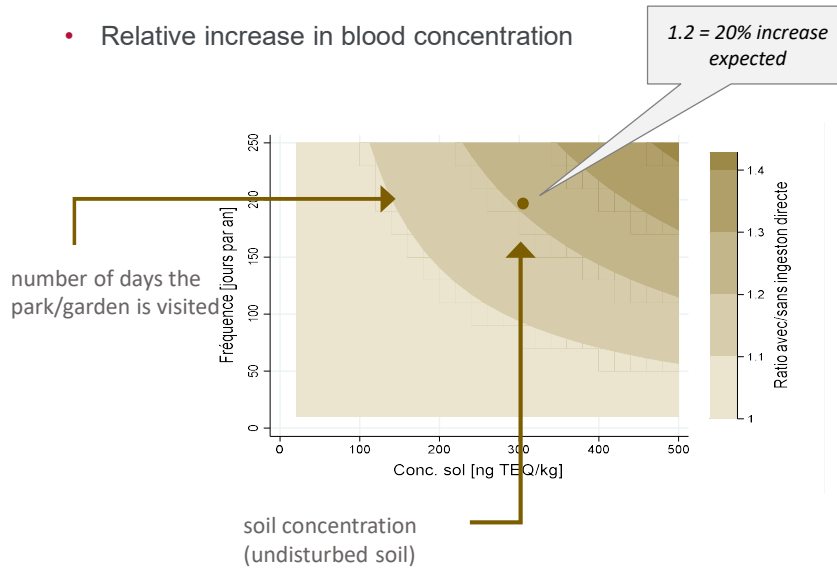
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VD1

Results

Direct ingestion of soil

- Relative increase in blood concentration



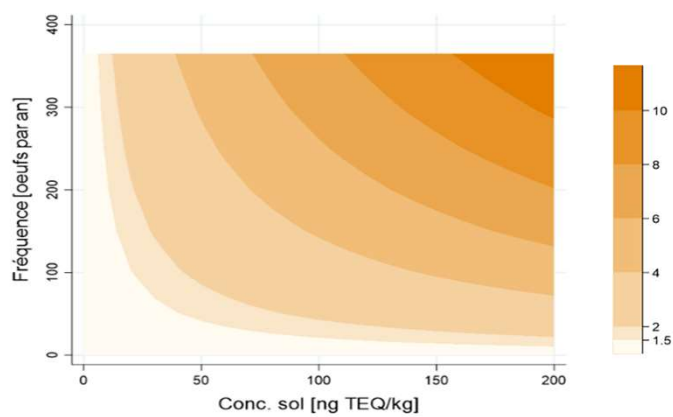
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VD1

Results

Egg consumption



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- Significant increase in blood concentration

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Diapositive 17

VD1 Vernez David; 21.09.2021

Diapositive 18

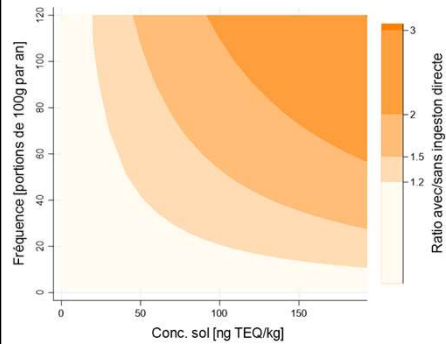
VD1 Vernez David; 21.09.2021

VD1

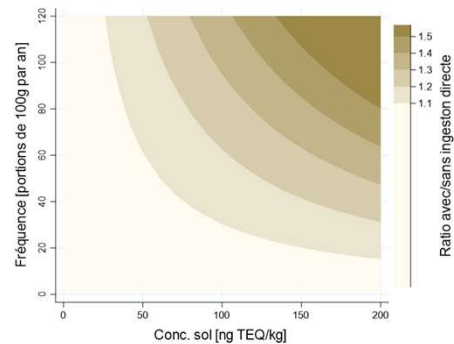
Results

Vegetable consumption

Cucurbits



Unpeeled carrots



- Moderate to significant increase in blood concentration

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Appreciation

Based on relative increase in expected dose in serum

- < 20%. Low, not expected to be noticeable in the general population.
 - standard hygiene recommendations
- 20-100 %. Notable, requires preventive measures.
 - technical or organizational measures to reduce exposure
- > 100 %. Significant, should be avoided.
 - restrictive measures



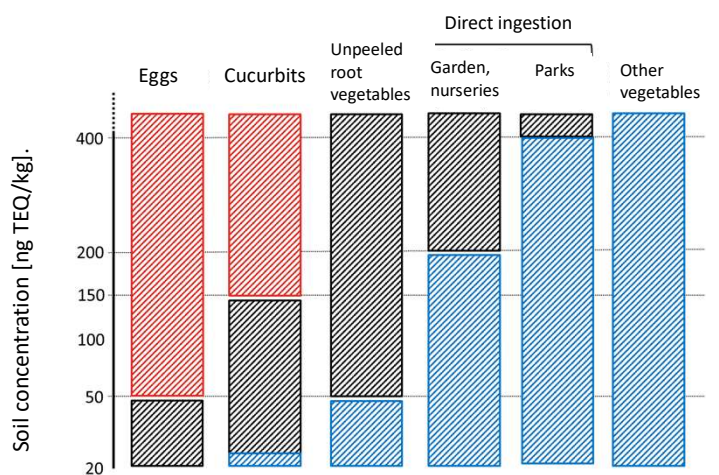
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Diapositive 19

VD1

Vernez David; 21.09.2021

Recommendations 2024



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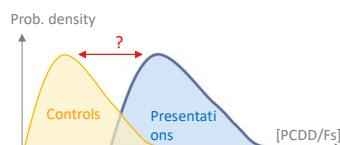
- Meat (sheep rillettes) no more on the market

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Biological monitoring study (2023-2024)

Context

- Ubiquitous pollutant (general food)
- High variability in general population
- No reference values (Switzerland)



Main objective

- Measuring PCDD/Fs body burdens between exposed and unexposed groups

Regular ingestion of meat, eggs or cucurbits from contaminated areas

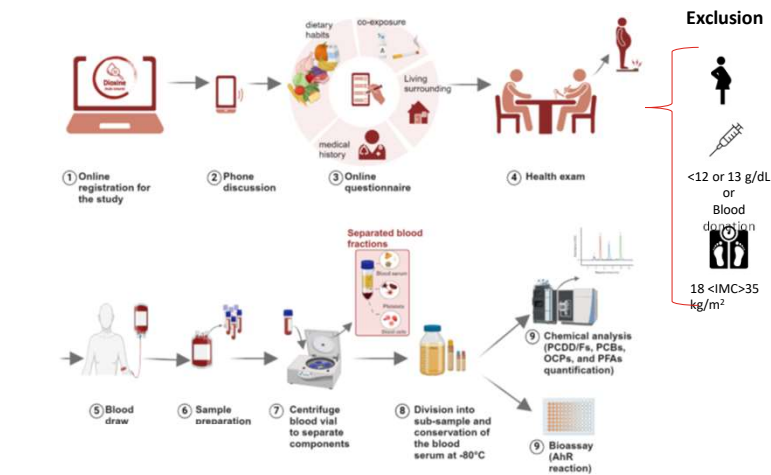
2 Groups:
50 pers. / 50 pers.

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From recruitment to serum PCDD/Fs analysis



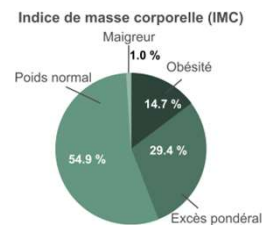
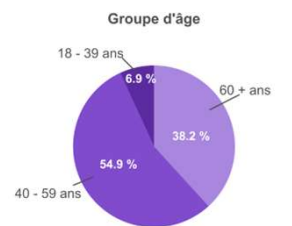
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Recruiting participants

- 305 volunteers in all
- 215 eligible volunteers
 - Inclusion of exposed group volunteers
 - Random selection of control group
- 102 participants who completed their blood tests (52 exposed group)
- Paired populations in term of age, gender, and body fat

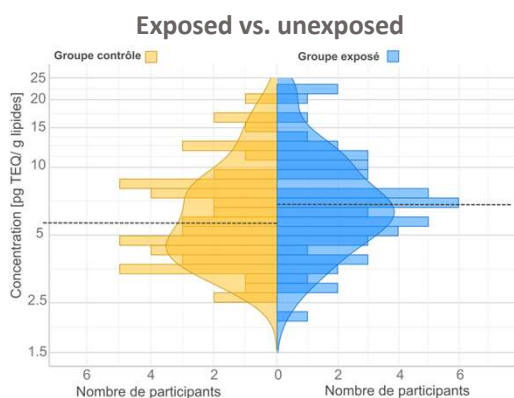


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Overall PCDD/Fs impregnation

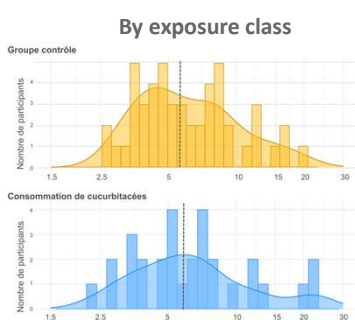


- High variability within groups
- Slight increase in the exposed group compared with the control group
 - Median Control: 5.7 [pg TEQ/ g lipides]
 - Median Exposé : 6.8 [pg TEQ/ g lipides]
- Not statistically significant

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PCDD/Fs impregnation depending on exposure



- Contribution mainly due to consumption of eggs and meats
 - Median control: 5.7 [pg TEQ/ g lipides]
 - Median exposed cucurbits : 5.9 [pg TEQ/ g fat] [pg TEQ/ g fat]
 - Median exposure to eggs and meat: 7.3 [pg TEQ/ g fat].

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Comparison with other European studies

	N participants	Age of population	Median	Interval value
Lausanne study	102	21 - 89	6.3	4.5 - 8.9 (25-75%)
Germany (Fromme 2009)	48	18 - 65	7.74	0.79 - 19.97 (5-95%)
France (Ploteau 2016)	109	23 - 48	6.10	4.52 - 8.26 (25-75%)
France (Esteban 2021)	604	18 - 74	7.46	4.97 - 10.99 (25-75%)

- Blood concentrations similar to other European countries
- Gradual decline since the '90s

Interpretation - Health effects

Reprotoxic effects (reduced male fertility)

- 30% of men in the control group and 42% in the exposed group have blood concentrations < 7.0 pg_{TEQOMS-05/g} lipids (NOAEL)
- Global problem, associated with other POPs and individual factors (smoking, obesity)

Carcinogenicity

- No significant association between dietary exposure to PCDD/Fs and an increased risk of cancer in humans in the literature.
- Cancer risk is minimal with measured PCDD/Fs blood concentrations

Recommendations based on results

- Importance of the land **use pattern in prevention**
 - breeding (meat and egg consumption) is the most problematic modality
- Usual diet is the main contributor to PCDD/Fs blood levels
 - ⇒ Participant follow-up is not appropriate
 - ⇒ No additional measures required
 - ⇒ Maintain egg and meat consumption restrictions
 - ⇒ Continue to follow standard hygiene practices
- The study enabled us to better assess the risks

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Environmental Health Interventions Asbestos



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One of many cases...

- College built in 1972
- Contains various asbestos materials
false ceilings (accessible, low agglomerate)
- First diagnosis in 2005
positive identification
negative air measurements,...nothing happens
- Second diagnosis in 2014-2015
positive identification
positive air measurement, the level of fibres in the air is 5x over the tolerated dose
- End of 2015 closure of the class
Alert the cantonal authorities
Parents' and teachers' concerns

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Ambiance amiantée au Conseil communal

Aigle: Le législatif accepte une demande de crédit de près de 25 millions pour la réfection du bâtiment scolaire «Dents du Midi» et de la salle de gym de la Planchette. Un élu critique vertement l'exécutif pour ne pas avoir procédé à un désamiantage du collège en 2005 déjà, «alors qu'une action immédiate était requise», ce que conteste la Municipalité.



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What to do?

Sanitizing and reassuring?
Close the college?
Assessing the risk?

A proven communication and management problem, a health problem to be assessed...

- Factors to consider
Large population, presence of children
Long term stay in the facility
Amphibole asbestos fibres (1000 FAR/m³ limit debatable)
Positive air measurement, the level of fibres in the air exceeds the tolerated dose in general population by a factor 5
Does the 5000 FAR/m³ measurement represent background noise?

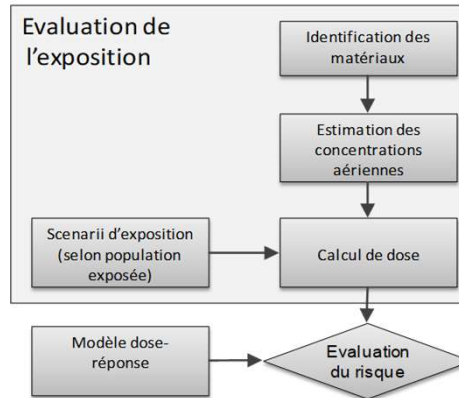
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Retrospective risk assessment

Joint Working Group

- Mandate of the Directorate of Education
- Expertise in occupational hygiene, toxicology, occupational medicine, school medicine, public health
- Parent and teacher representation
- Independent expertise

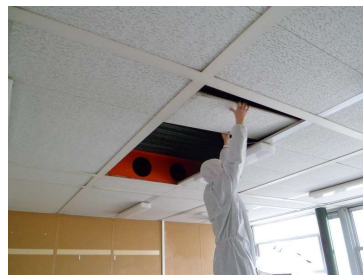
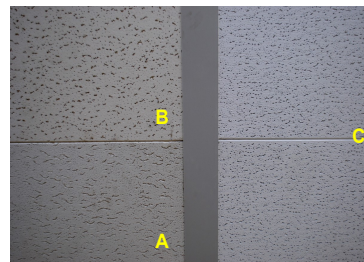


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Material identification

False ceilings

- Presence of asbestos amosite (1%)
- Population of complex false ceiling panels (positive sampling on B panels)
- Less than 50% of the ceiling area



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Estimated conc. Air

In situ measurements

- Use of classrooms being removed
 - Opening and closing of doors and blinds, shocks
 - Change of neon, change of plates
- Ambient measurements

Laboratory measurements

- Falling, breaking and cutting of plates
- Re-analysis of the 2015 contaminated sample

Other investigations

- Exposure database, grey literature
- Weather data
- History of the building



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Exhibition scenarios

Population considered

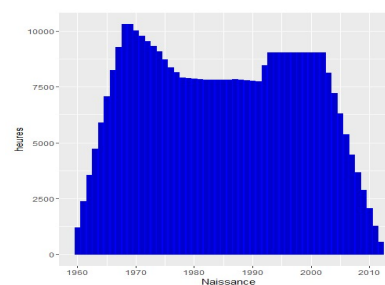
- Teachers
- Students
- Janitor

Estimation of frequencies and duration of events

- Interventions on false ceilings
- Projections of objects
- Falling plates

Data sources

- Interviews
- Teacher Questionnaire
- Teaching statistics



Maximum cumulative hours of attendance at the College according to children's birth years - without repetition (Boratto, 2013)

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Dose calculations

Population	Scénario	Age début exposition [ans]	Age fin exposition [ans]	Exposition [FAR/m ³]	Commentaires
Élève	moyen	6	15	59	
	pessimiste 1	6	17	128	redoublement de 2 années, 100% en classes amiantées
	pessimiste 2	6	17	155	Scénario pessimiste 1 + incendie ¹
Enseignant	moyen	25	34	52	
	pessimiste 1	25	54	140	ancien neteté et durée hebdomadaire maximale observée dans l'établissement
	pessimiste 2	25	54	170	Scénario pessimiste 1 + incendie
	pessimiste 3	25	65	170	Scénario pessimiste 2 + vie professionnelle entière (cas virtuel)
Concierge	réel ²	30	45	200	
	pessimiste 1	20	60	320	vie professionnelle entière (cas virtuel)

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Choice of a dose-response model

Regulatory value

- Does not distinguish the type of fiber or the pathology

Using the DECOS model (2010)

- Lung cancer
- Mesothelioma
- Adaptation to the situation of Aigle's college
Mortality of the Swiss population
Coefficient for amosite alone

Calculation of the whole-life risk

- According to the exposure scenarios

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Risk calculation

Mesothelioma risk

- Very low, on average $< 10^{-5}$
- within "acceptable" limits in the general population

No need for follow-up
Many general
recommendations

