

Chemicals and Health

Linking chemical exposure to health

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HUMIDIFIER



Humidifier disinfectant



Humidifier disinfectant

For my baby!

내 아기를 위하여!
가습기엔 꼭 가습기메이트를 넣자구요.

습~ 상쾌한 공기!
아빠도 좋아하겠지?

깨끗한 가습기, 신선한 공기-가습기 메이트

가습기 사용시부터 깨끗한 물을 넣으셨는지? 끓여내고 솥뚜껑
뚜껑이 100% 이상 닫혀있는지, 위생의 깨끗함을 그대로 한번
세탁을 하셔야 되게 하려면 가습기용에 가습기 메이트를 꼭 넣어야 돼요.
깨끗한 물을 넣어도, 빙이 없어도 가습기 메이트, 만능은 할수없
당연히, 위생이 가장 중요하고 깨끗한 물을 넣어야 사용 수
많은 것 도와 가습기를 잘 사용하셔요!

온 가족 건강을 위해 꼭 가습기, 가습기엔 가습기 메이트!

가습기 메이트, 내 만능 친구
가습기 메이트를 넣어야 위생이 보장되고
깨끗한 물을 넣어도 가습기 메이트가 없으면
가습기 메이트를 꼭 넣어야 돼요.

가습기 메이트
SUNKYONG

Don't turn humidifier on
unless you have this

가습기 사용은 물론 필수! 하지만
가습기 친구, 가습기 메이트

가습기 메이트는 물과 함께
가습기 사용시 꼭 넣어야 하는 필수품입니다.
깨끗한 물을 넣어도, 빙이 없어도 가습기 메이트, 만능은 할수없
당연히, 위생이 가장 중요하고 깨끗한 물을 넣어야 사용 수
많은 것 도와 가습기를 잘 사용하셔요!

가습기 메이트
SUNKYONG

가습기를 꼭 쓰시오! 가습기메이트가 없으시면.

내 건강을 보살피고 싶다면
가습기 메이트를 꼭 넣어야 돼요!
가습기 메이트를 꼭 넣어야 돼요!
가습기 메이트를 꼭 넣어야 돼요!

Humidifier disinfectants disaster



Reported case: 4261

Reported casualties: 853

Official number of victims: 228+

한겨레

'Safe for human use'!



Consumer Product Safety Commission of USA



CPSC Safety Alert

Dirty Humidifiers May Cause Health Problems

The U.S. Consumer Product Safety Commission (CPSC) is alerting consumers to possible health hazards resulting from dirty room humidifiers. CPSC has found that bacteria and fungi often grow in the tanks of portable and console room humidifiers and can be released in the mist. Breathing dirty mist may cause lung problems ranging from flu-like symptoms to serious infection. This information is of special concern to allergy or asthma sufferers whose symptoms may be increased.

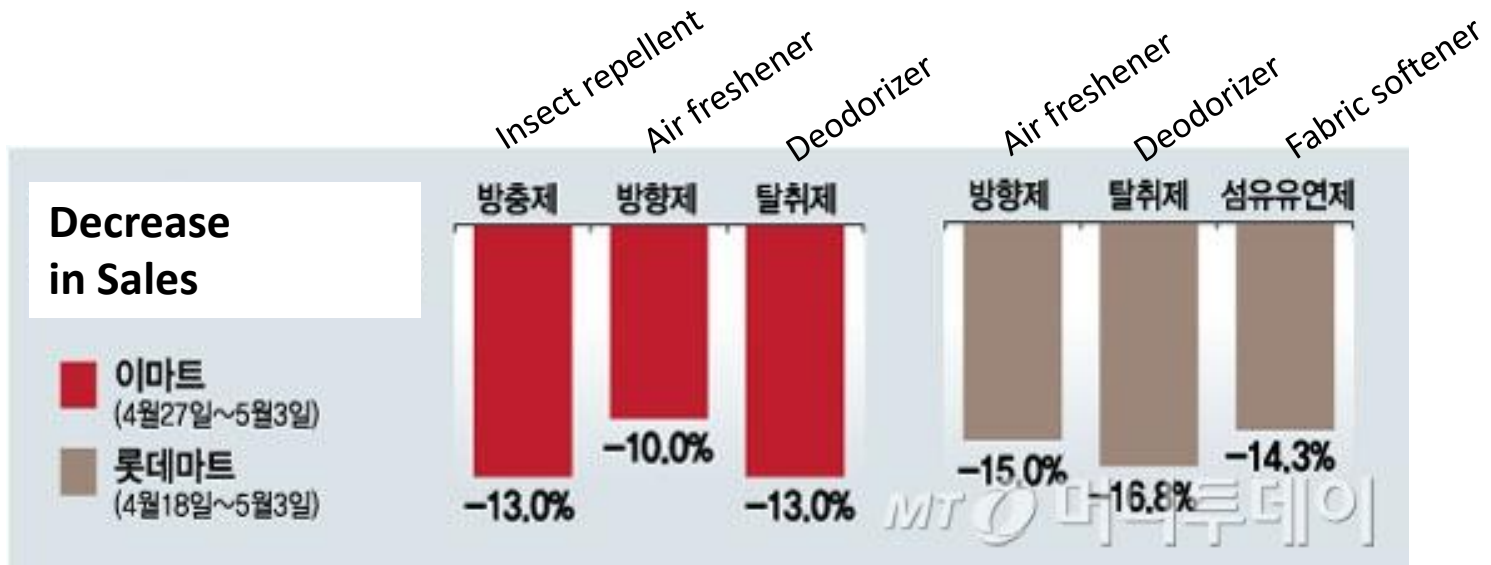
- Clean your room humidifier well and often during the heating season. Be sure to unplug the humidifier before cleaning. Follow the manufacturer's suggested cleaning methods. If chlorine bleach or other cleaning product or disinfectant is used, make sure to rinse the tank well to avoid breathing harmful chemicals. Use a brush or other scrubber to clean the tank. Be careful not to damage the motor or to scratch the inner surface. Clean or replace sponge filters or belts when needed.

Parliamentary probe on-going



Public reaction: Chemophobia

- an irrational aversion to or prejudice against chemicals or chemistry (wiki)
- Rational Fear of Chemicals!



Public reaction: 'No-Chemi'



노케미족 (No+Chemi)

화학물질(chemicals)이
들어간 제품을 거부하는 사람들

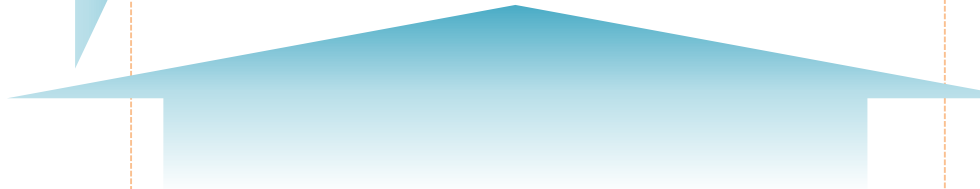
YTN NEWS

Our health can be affected by everyday chemicals!

Ecosystem Receptors

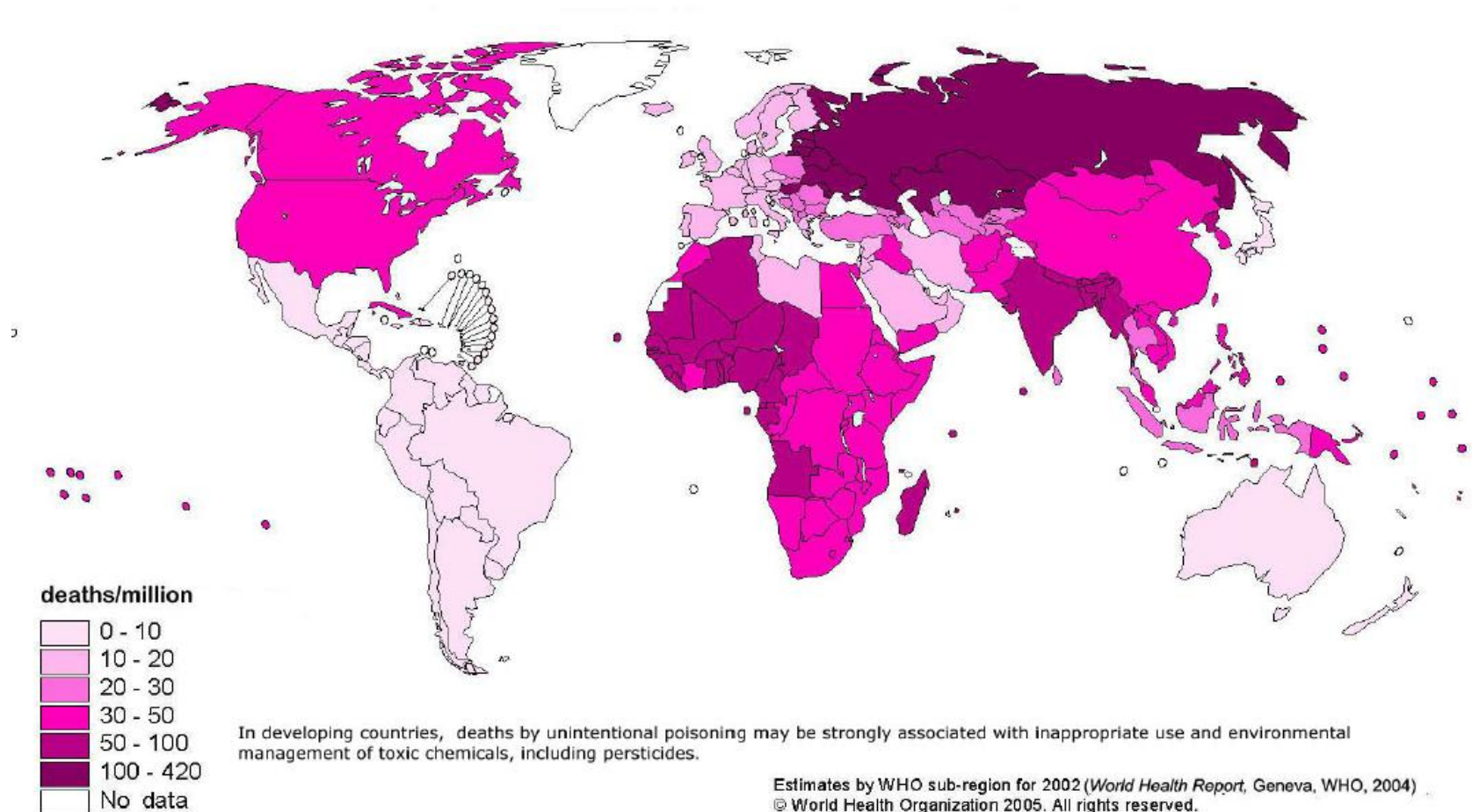


Industry/Wastes



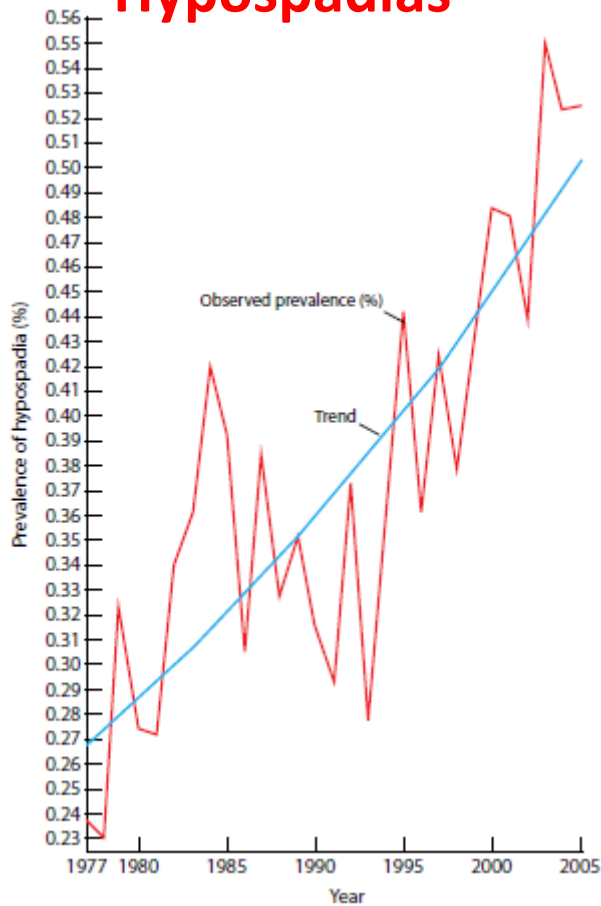
Consumer products etc.

Deaths from unintentional poisonings



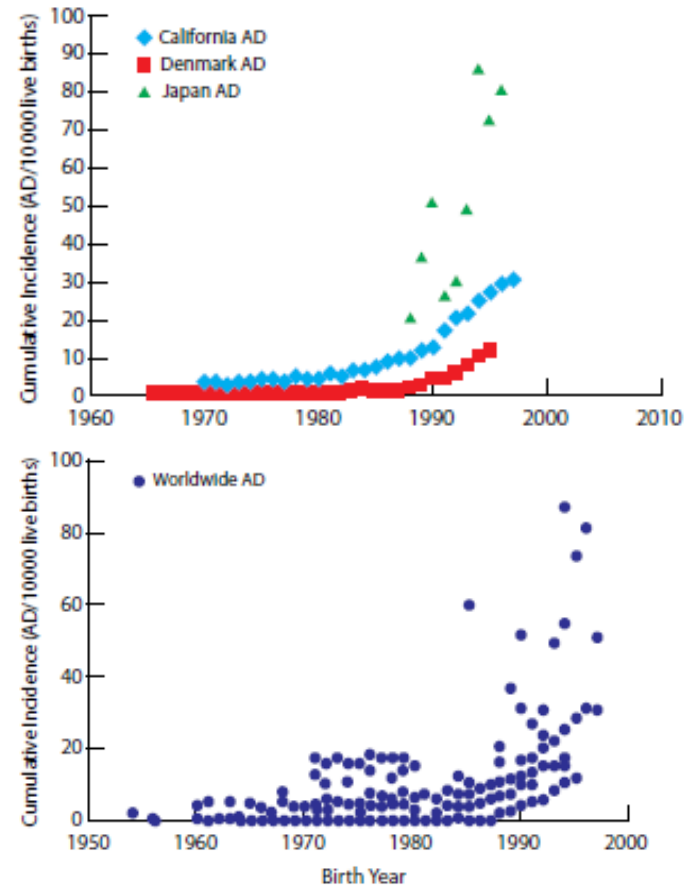
Upsurge of some diseases

Hypospadias



Prevalence of hypospadias among newborn Danish boys 1977-2005

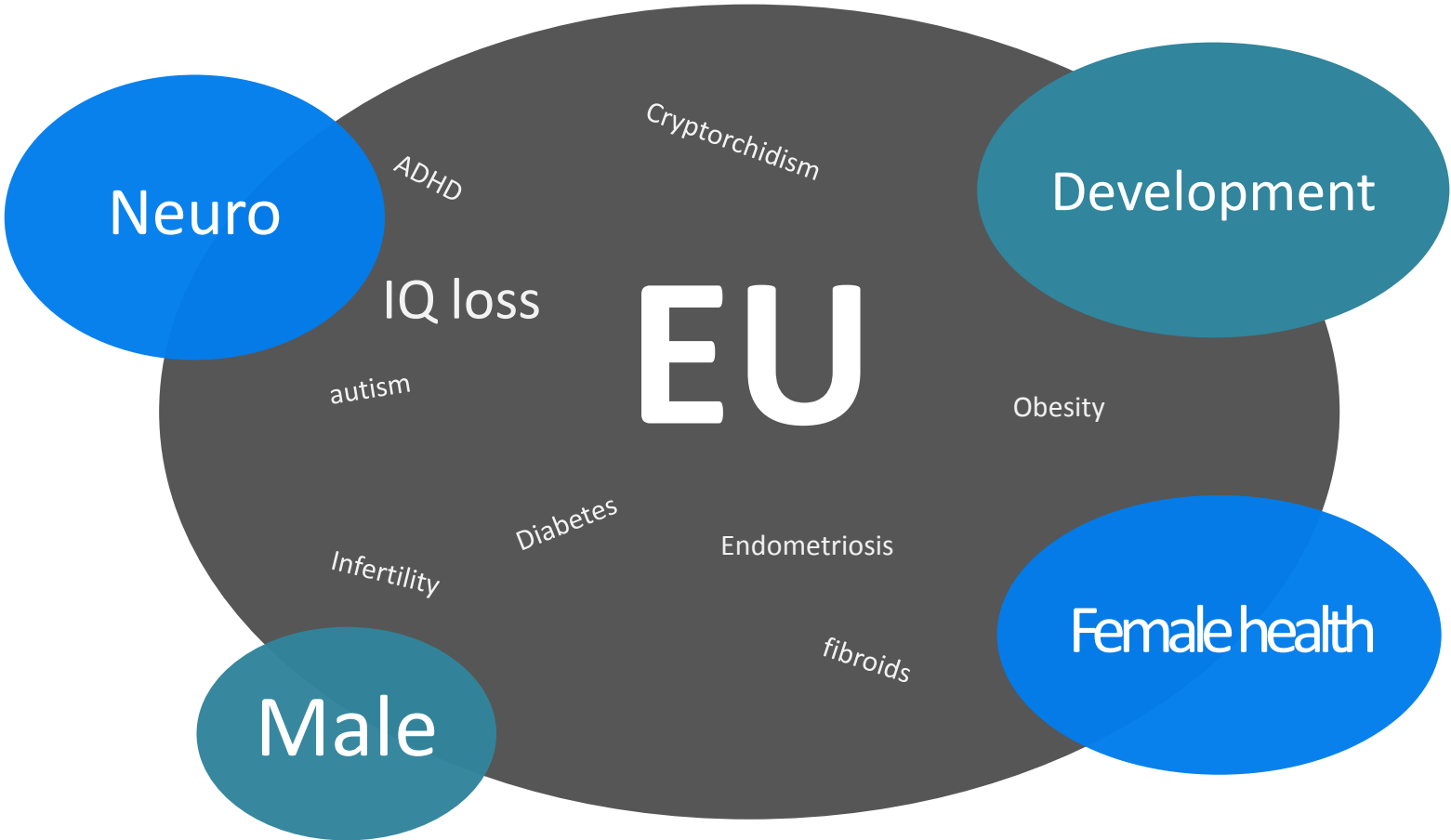
Autism



Autistic disorder cumulative incidence by cohort birth year (UNEP, WHO, 2013)

Societal cost of chemical exposures

163 B Euro/y

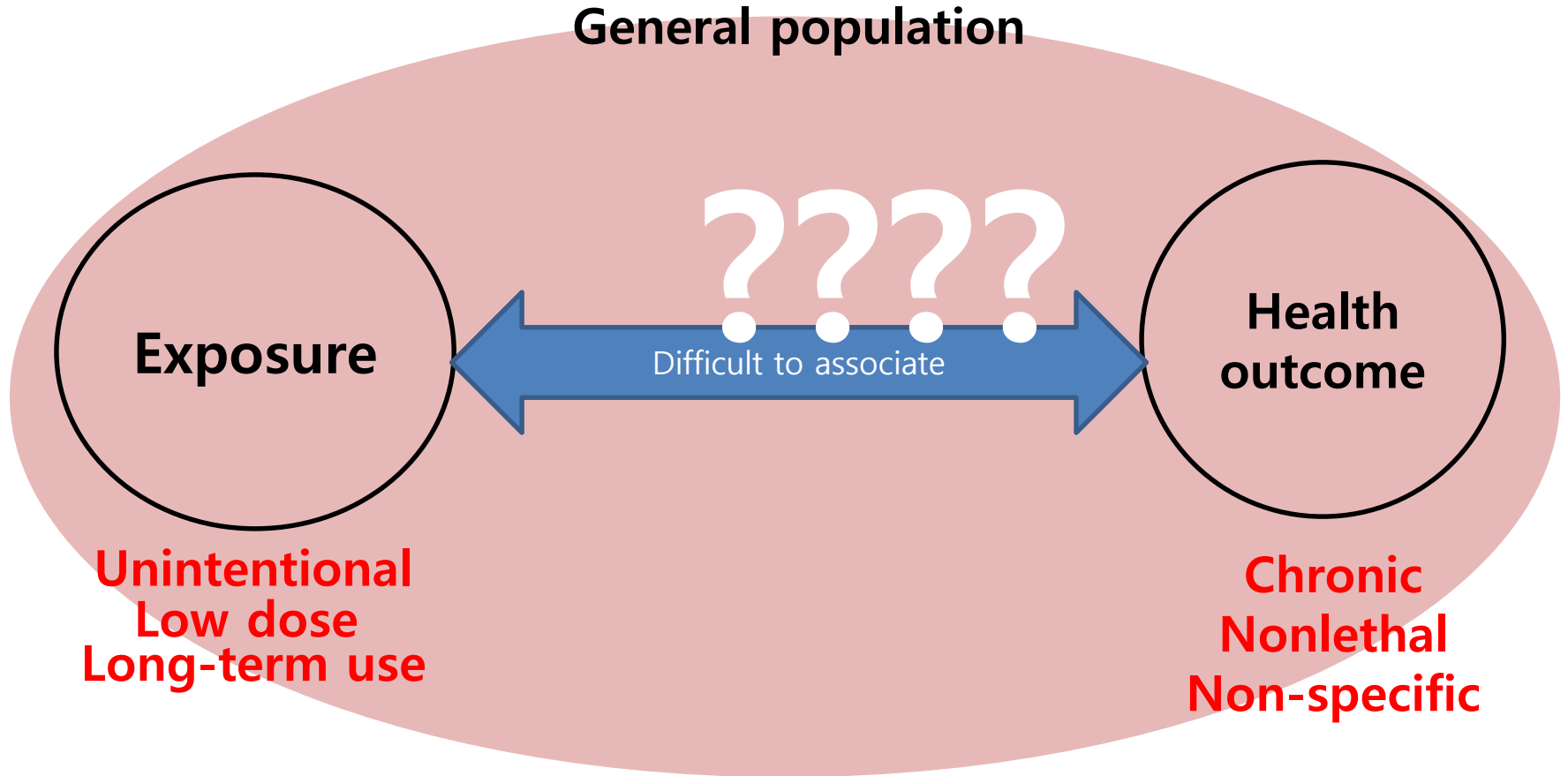


Tasks of Environ Health Scientists

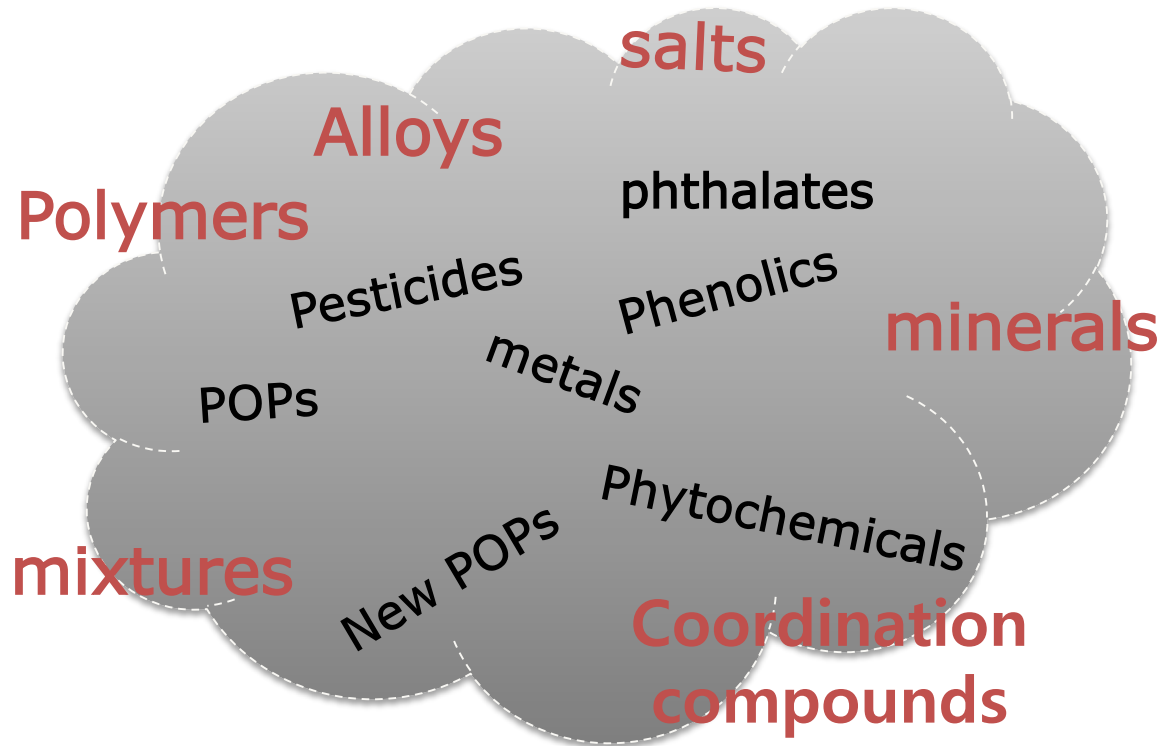
- To find bad chemicals
 - Identifying chemicals with frequent detection in high levels
 - Identifying chemicals with causal association with adverse health effects
 - Assisting in using safer chemicals
- Public health management
 - Source and pathway identification
 - Exposure mitigation etc.

Identifying chemical determinants is not easy

General population



Too many chemicals in use!



1,000
In everyday
life

45,000
In Korean Hazardous
Materials Act

100,000+
In commerce in EU

Analytical chemistry

Advance in analytical instruments and techniques



GC/Q-TOF
(Agilent 7890B/7200)



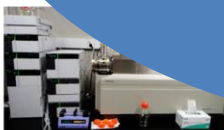
GC-MS
(Agilent)



GC-MSD
7890A/5975C(Agilent)



GC/MSD-EI, CI
(Agilent 7890A/5975C)



LC-MS/MS
Nexera UHPLC(Shimadzu), API 4000(AB SCIEX)



Multidust sampler



Passive air sampler

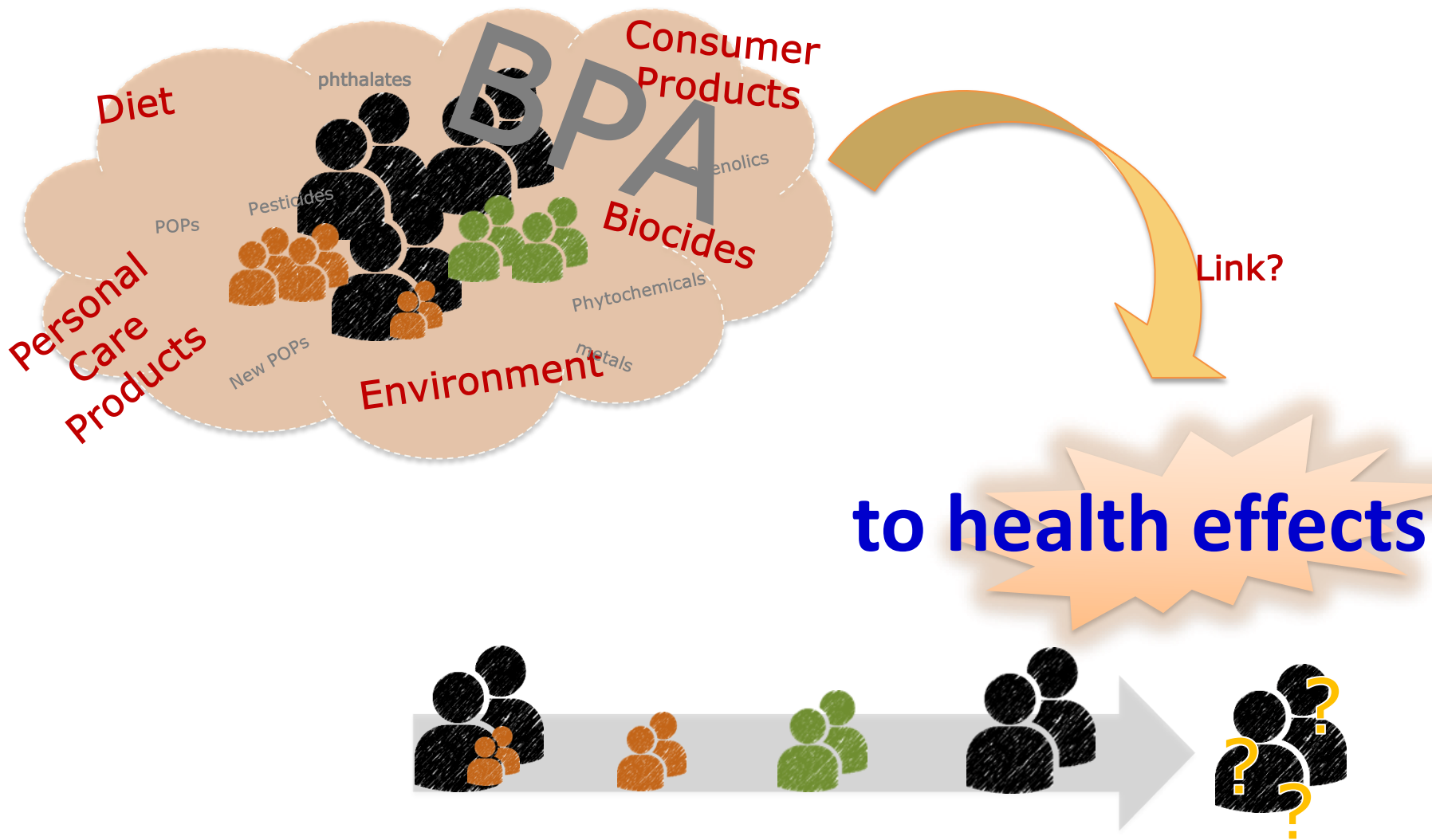


SPE manifold
(Supelco)

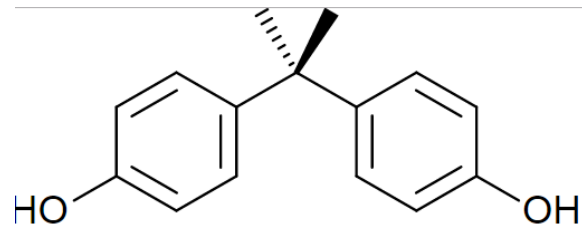


Atmospheric
deposition sampler

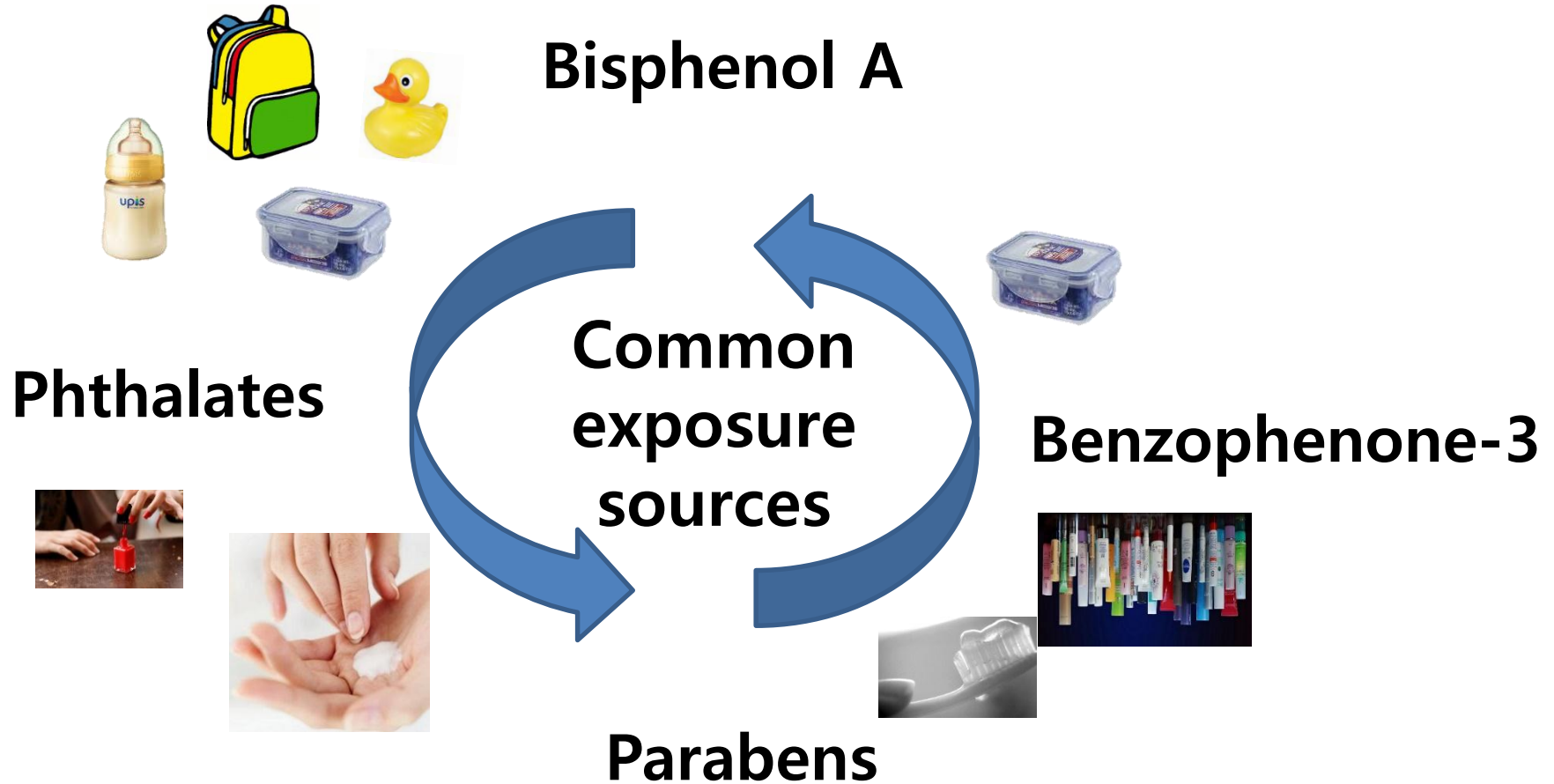
Linking chemical exposure?



Bisphenol A



Chemicals sharing common sources



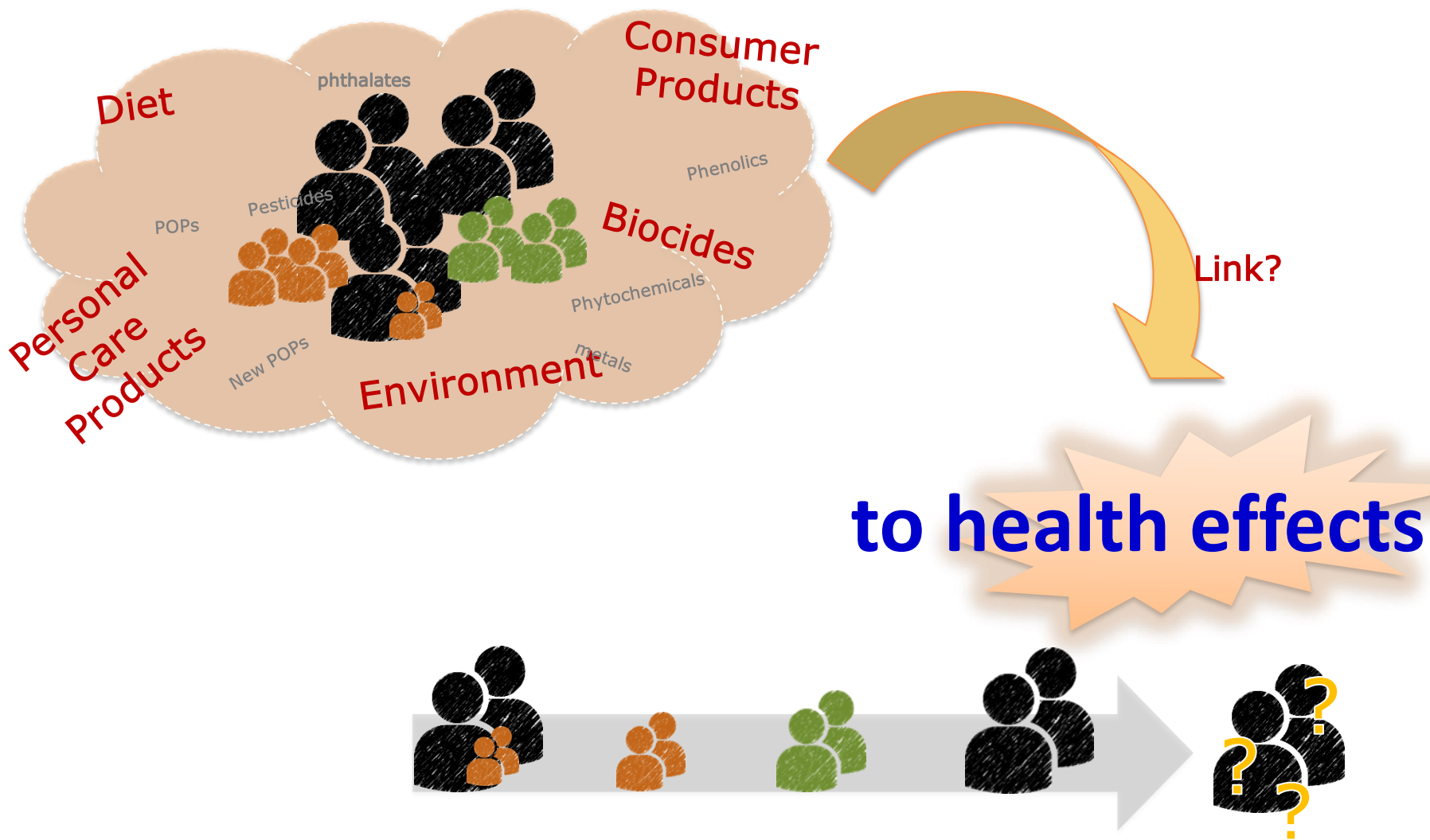
High correlations among urinary chemicals

Chemicals in urines NHANES 2007-8

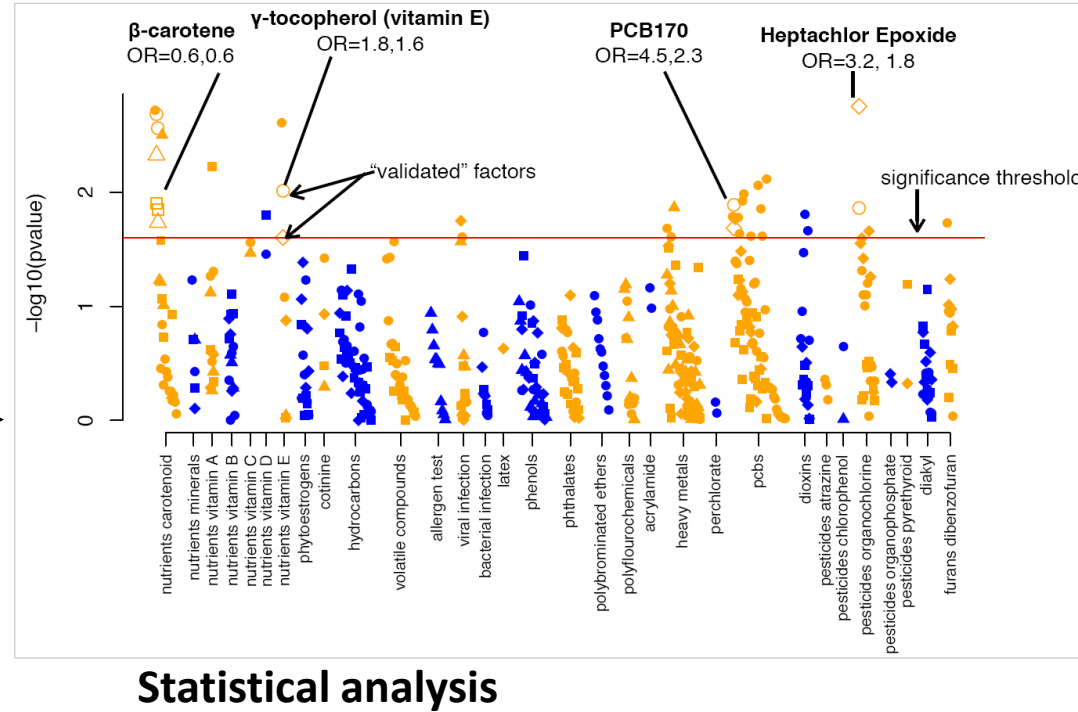
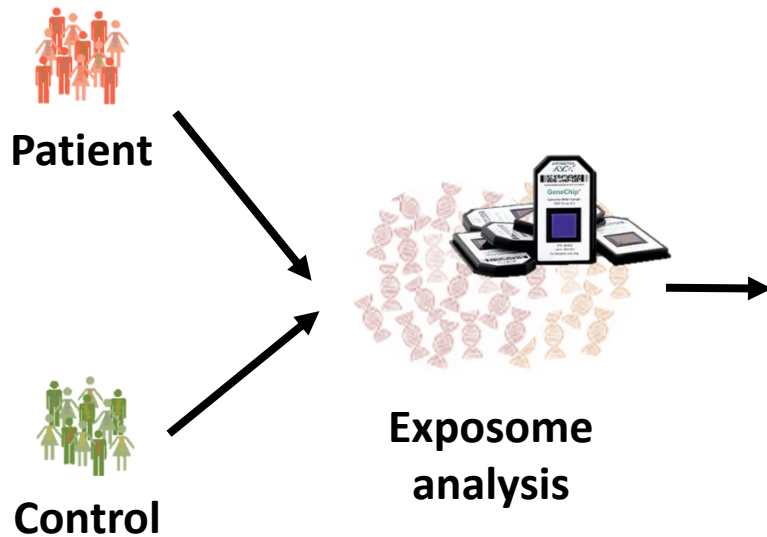
- bp3-benzophenone-3
- bph-bisphenol A
- trs-triclosan
- bup-butylparaben
- eup-ethylparaben
- mhp-methylparaben
- ppb-propylparaben
- mhh-MEHP
- mhh-MEHHP
- moh-MEOHP
- ecp-MECP
- up8-perchlorate

	In_urx bp3 1850	In_urxbp h 1850	In_urxtrs 1850	In_urxbu p 1850	In_urxep b 1850	In_urxmp b 1850	In_urxpp b 1850	In_urxmh p 1850	In_urxmh h 1850	In_urxmo h 1850	In_urxec p 1850	In_urxup 8 1837
In_urx bp3	1	0.20883	0.17522	0.26279	0.27695	0.28437	0.29241	0.16259	0.22775	0.22869	0.23581	0.14068
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
		1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1837
In_urx bph		1	0.13634	0.09174	0.13088	0.2202	0.18668	0.374	0.44788	0.45919	0.4368	0.3262
			<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
			1850	1850	1850	1850	1850	1850	1850	1850	1850	1837
In_urx trs			1	0.10106	0.13244	0.2009	0.18039	0.18968	0.18933	0.19339	0.19944	0.14237
				<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
				1850	1850	1850	1850	1850	1850	1850	1850	1837
In_urx bup				1	0.53131	0.47556	0.48991	0.08273	0.08291	0.08932	0.09112	0.07886
					<.0001	<.0001	<.0001	0.0004	0.0004	0.0001	<.0001	0.0007
					1850	1850	1850	1850	1850	1850	1850	1837
In_urx epb					1	0.47172	0.46859	0.11056	0.11737	0.11516	0.12153	0.09051
						<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.0001
						1850	1850	1850	1850	1850	1850	1837
In_urx mpb						1	0.82019	0.14982	0.17479	0.18321	0.18282	0.15673
							<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
							1850	1850	1850	1850	1850	1837
In_urx ppb							1	0.13676	0.14404	0.15297	0.14066	0.10236
								<.0001	<.0001	<.0001	<.0001	<.0001
								1850	1850	1850	1850	1837
In_urx mhp								1	0.81222	0.8019	0.77088	0.29548
									<.0001	<.0001	<.0001	<.0001
									1850	1850	1850	1837
In_urx mhh									1	0.98737	0.95151	0.39861
										<.0001	<.0001	<.0001
										1850	1850	1837
In_urx moh										1	0.9535	0.40461
											<.0001	<.0001
											1850	1837
In_urx ecp											1	0.40045
												<.0001
												1837

Linking chemical exposure?

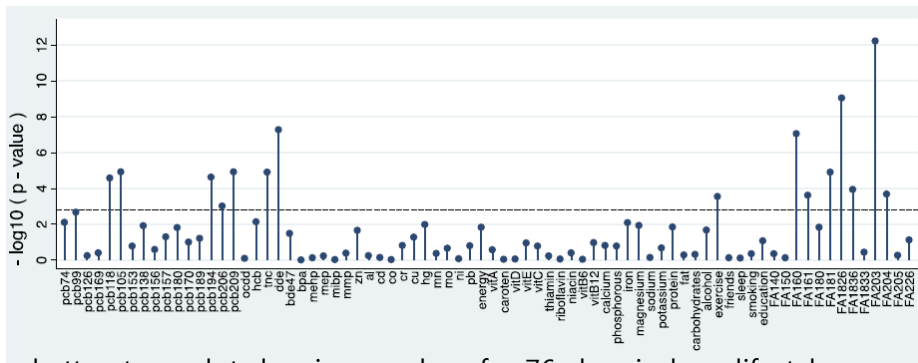


Linking chemical exposure!

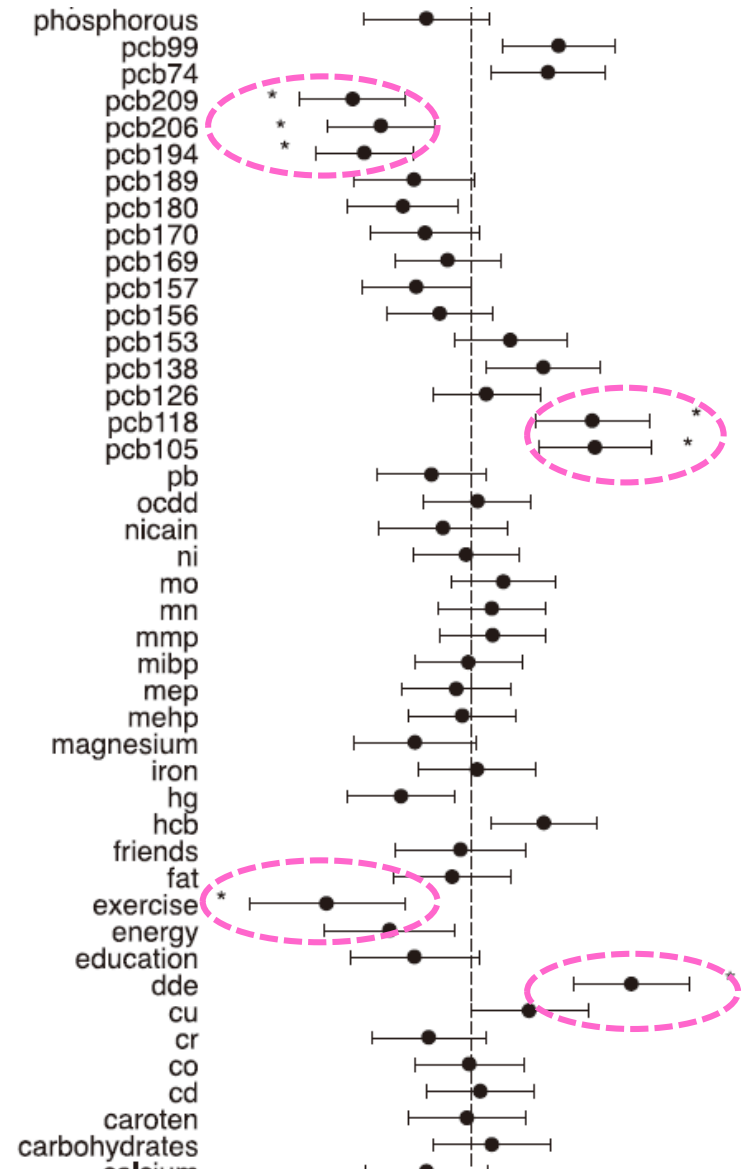


Finding environmental “loci” associated with disease

Environment-wide Association Study

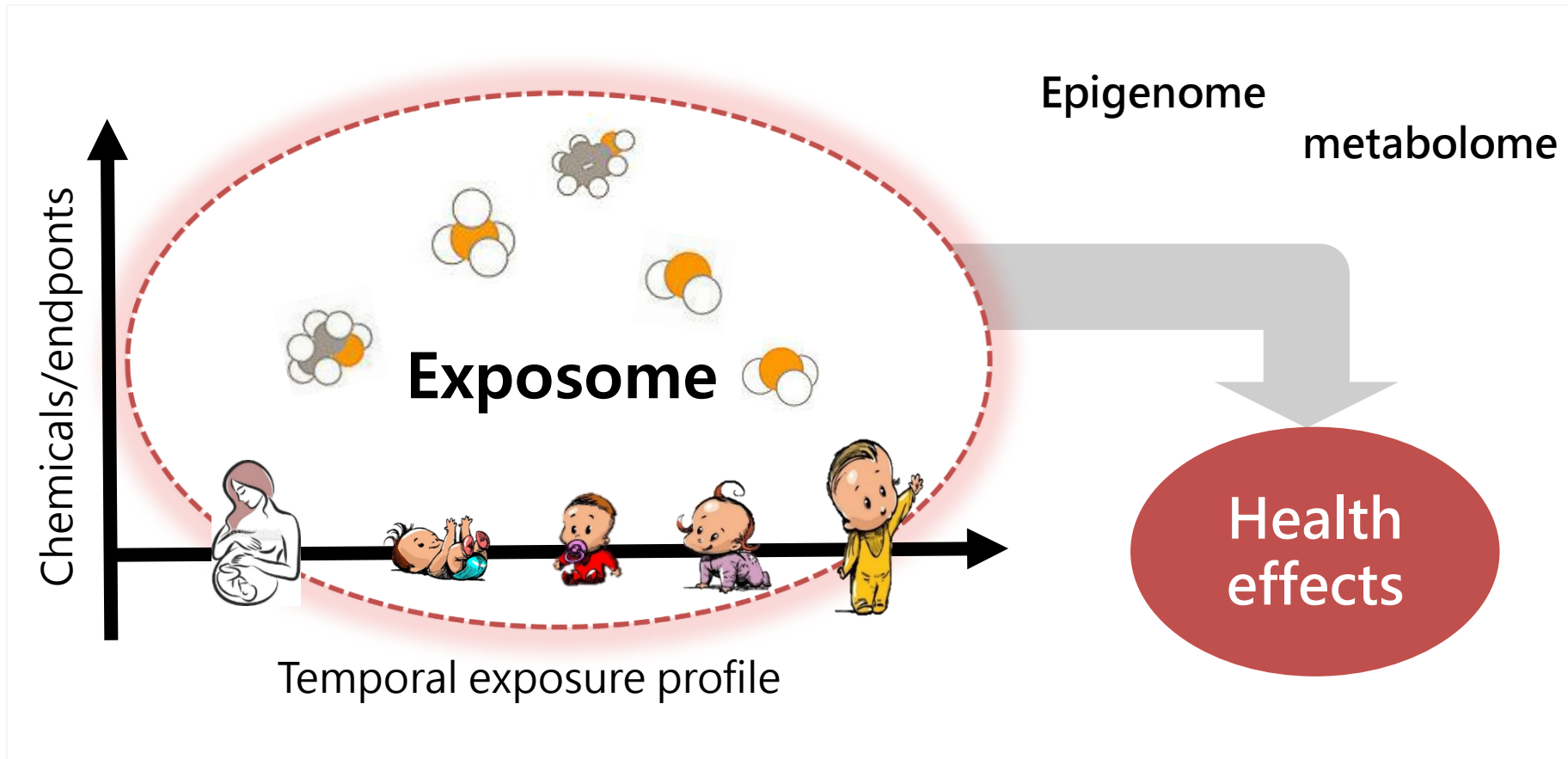


Manhattan type plot showing p values for 76 chemicals or lifestyle factors vs prevalent metabolic syndrome



Monica Lind et al., 2013

To identify chemicals of causal association



Exposure profile over sensitive period of life stages
In combination with epigenome and metabolome

Finding safer substitutes?



CANS:
The linings of most of these still contain the controversial chemical BPA.

BABY BOTTLES:
Many feature new chemicals.

RECEIPTS:
Many contain BPS, a compound that is structurally similar to BPA.

THE PLASTICS PUZZLE

When toxicologists warned that the plastics ingredient BPA might be harmful, consumers clamoured for something new. But problems persist.

BY JOSIE BLANSHOZ

INSIGHTS

Immune therapies for sepsis p. 1201

Meeting demand for rare earth minerals p. 1209



PERSPECTIVES

CHEMISTRY

Toward substitution with no regrets

Advances in chemical design are needed to create safe alternatives to harmful chemicals

By Julie B. Zimmerman and Paul T. Anastas

Vast numbers of synthetic chemicals are used in everyday consumer products. Many are safe, but some can have unintended biological or environmental effects. For example, phthalates are widely used to increase the flexibility of plastics but also disrupt hormonal balance (1). Organophosphates are highly effective insect repellents but cause severe neurotoxicity to mammals (2). In many cases, chemicals of concern have been replaced by other chemicals that are functionally equivalent and believed to be of less concern (see the photo). However, the need for expedient substitution can lead to the use of chemicals that are no less harmful than those they replace. How can such “regrettable substitutions” be avoided?

There have been many examples of regrettable substitution over the years. The example gaining most attention recently is the substitution of bisphenol S (BPS) for bisphenol A (BPA) (see the figure, panel A). BPA is widely used to make clear and tough plastics, used in water bottles, sports equipment, and CDs and DVDs; it is also used in food and beverage can coatings (where it helps to protect food from contamination and spoilage).



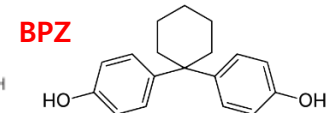
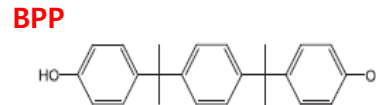
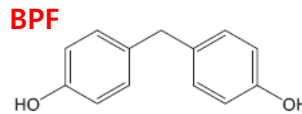
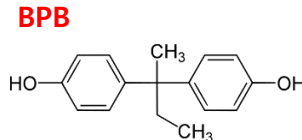
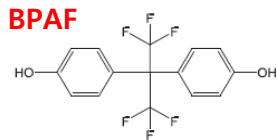
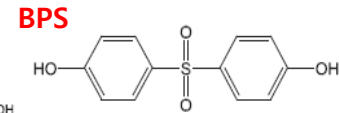
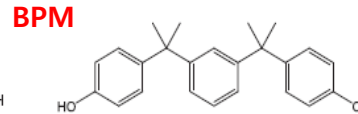
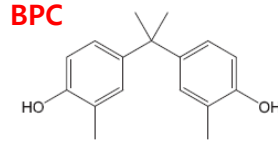
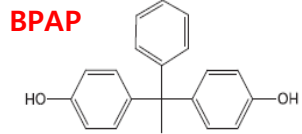
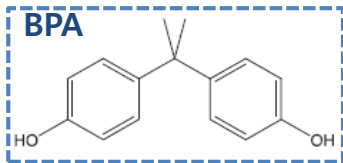
Replacement troubles. In many plastic baby bottles, bisphenol A (BPA) has been replaced with bisphenol S (BPS), but the latter compound may also have adverse health effects.

PHOTO: LAMBERT LAMBY/SCIENCE SOURCE/PHOTO RESEARCHERS

Bisphenols



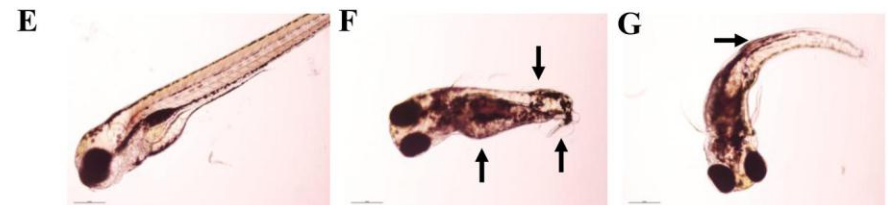
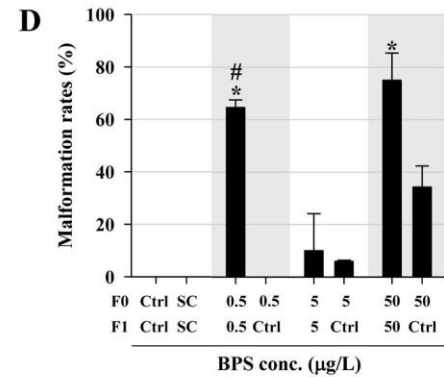
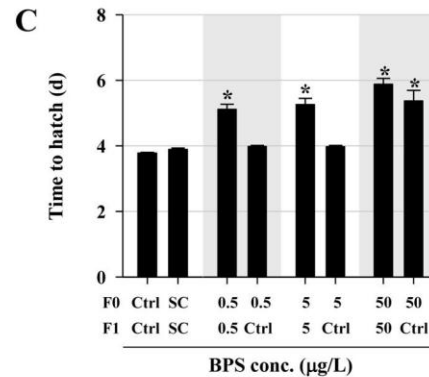
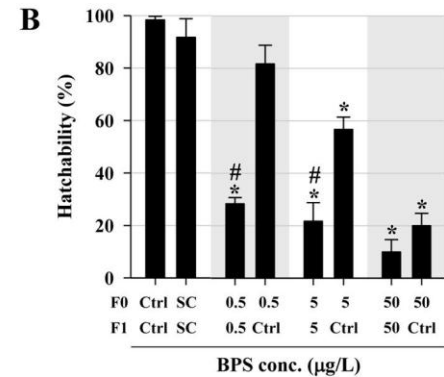
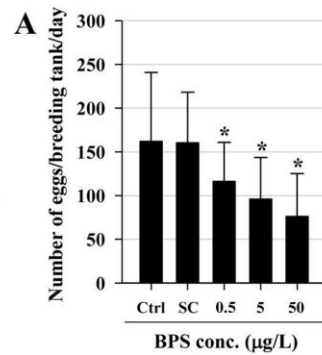
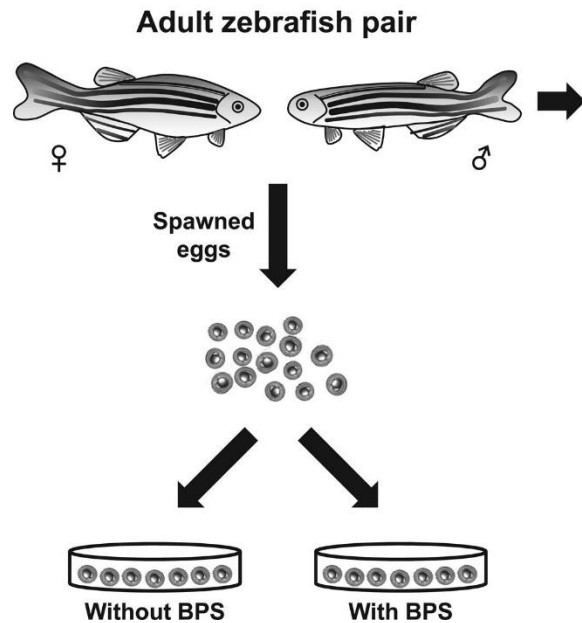
Chemicals substituting BPA



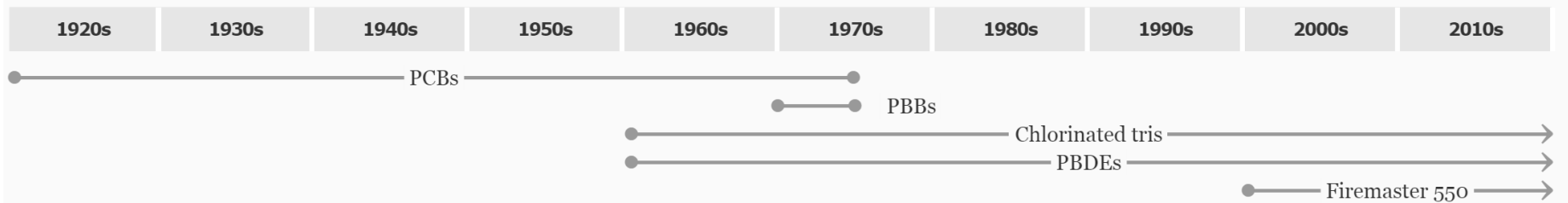
Bisphenols in receipt paper



Bisphenol S affects fish reproduction



Flame retardants replacing PBDEs



THE CHEMICALS				
<p>PCBs and PBBs</p> <p>Polychlorinated and polybrominated biphenyls</p>	<p>Penta and octa</p> <p>Polybrominated diphenyl ethers, or PBDEs</p>	<p>Deca</p> <p>Also a PBDE</p>	<p>Chlorinated tris</p> <p>tris(1,3-dichloro-2-propyl) phosphate, or TDCCP</p>	<p>Firemaster 550</p> <p>Contains TBB or 2-ethylhexyl-2,3,4,5-tetrabromobenzoate and TBPH or 2-ethylhexyl-2,3,4,5-tetrabromophthalate</p>
THEIR HAZARDS				
<p>Build up in people over time. Cancer; stomach, kidney and liver damage; thyroid problems.</p>	<p>Build up rapidly in breast milk and human blood. Hormone disruption, developmental problems, neurological deficits, impaired fertility.</p>	<p>Persists in the environment and creates penta as it breaks down. Potential carcinogen, neurological deficits.</p>	<p>Probable carcinogen, neurological deficits.</p>	<p>Chemical's brominated components found in wildlife. Levels increasing in air around the Great Lakes. Developmental problems at high doses.</p>
THEIR STATUS				
<p>Not in use.</p> <p>Scientists found these</p>	<p>Not in use.</p> <p>U.S. makers pulled penta</p>	<p>Being phased out.</p> <p>Manufacturers have agreed</p>	<p>Still in use.</p> <p>Widely used in furniture</p>	<p>Still in use.</p> <p>Widely used in furniture foam.</p>

Triphenylphosphate (TPP)

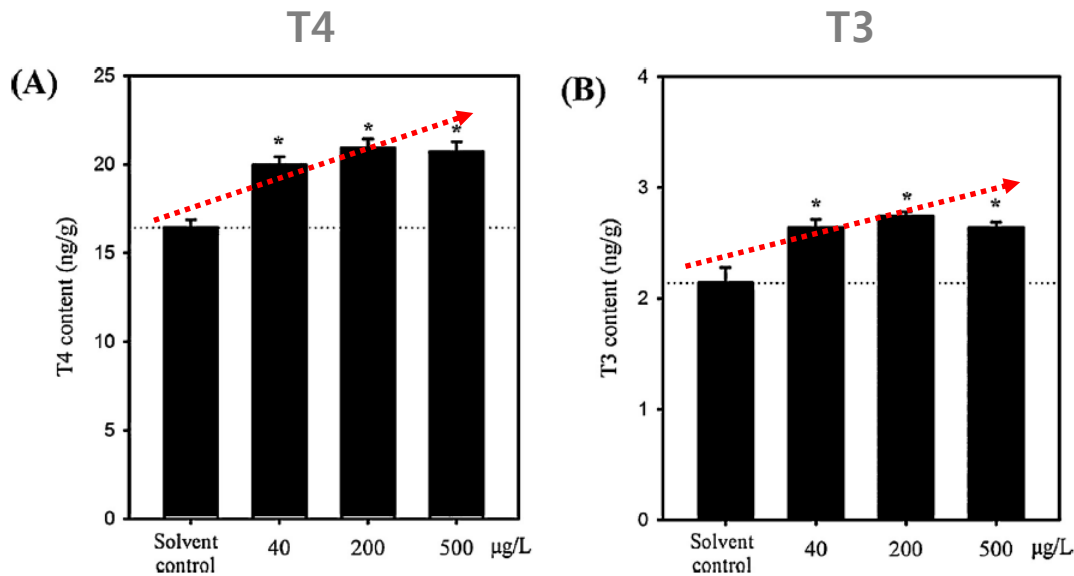
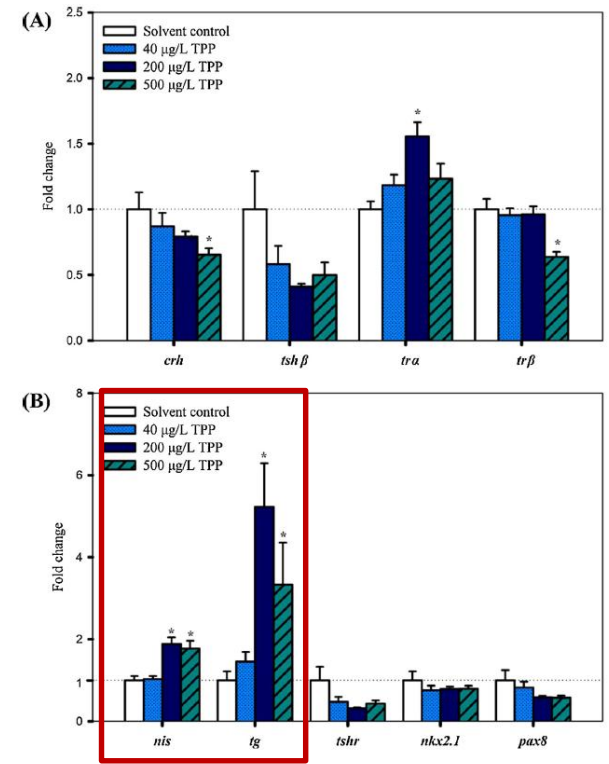
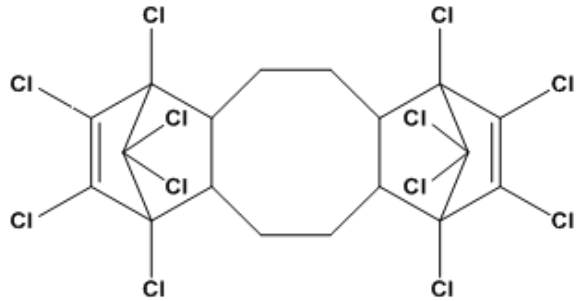


Table 1
Effects of TPP on survival, hatchability, malformation rate and body weight in zebrafish until 7 dpf.

TPP concentration	0 µg/L	40 µg/L	200 µg/L	500 µg/L
Hatchability (%) ^a	99.7 ± 0.2	99.4 ± 0.4	100.0 ± 0.0	98.1 ± 0.8
Larval survival (%) ^b	91.8 ± 0.9	92.5 ± 1.2	92.1 ± 1.1	88.7 ± 1.4
Malformation rate (%) ^c	3.0 ± 0.3	4.1 ± 0.7	4.9 ± 0.7	11.6 ± 0.9 ^e
Body weight (mg) ^d	2.3 ± 0.2	2.3 ± 0.1	2.1 ± 0.1	2.2 ± 0.1

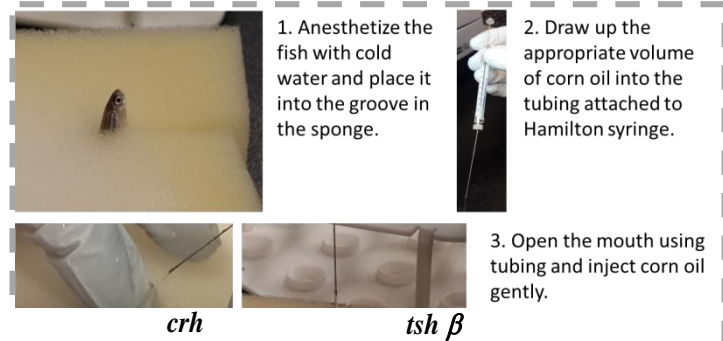
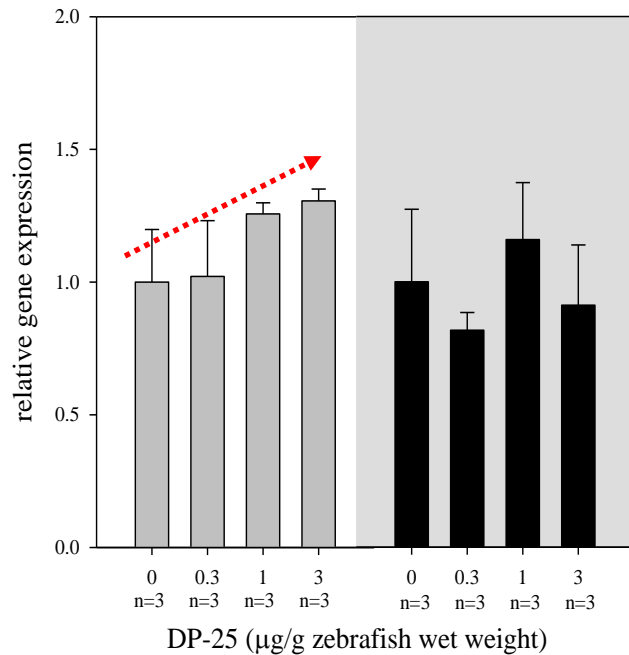


Dechlorane Plus



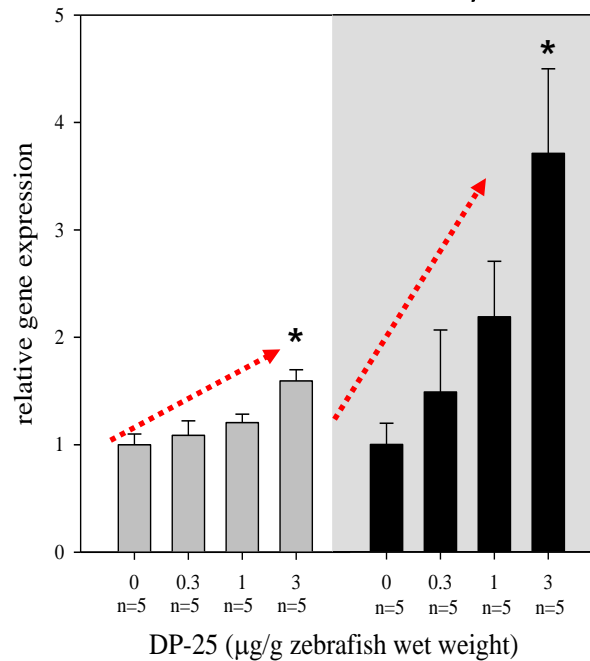
T4

T3



crh

tsh β



(Kang et al., 2016)

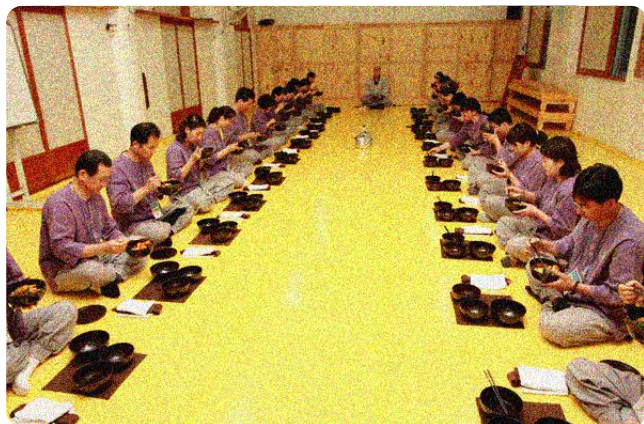
Directions

- Replacing BAD with UNKNOWN is not correct
- Directions
 - Screening measures for chemical safety

Exposure mitigation

- Which chemicals are frequently occurring at higher levels?
 - Among susceptible human populations
- Sources and exposure pathways?

Exposure- intervention study



Temple stay (Intervention on diet and life behavior)

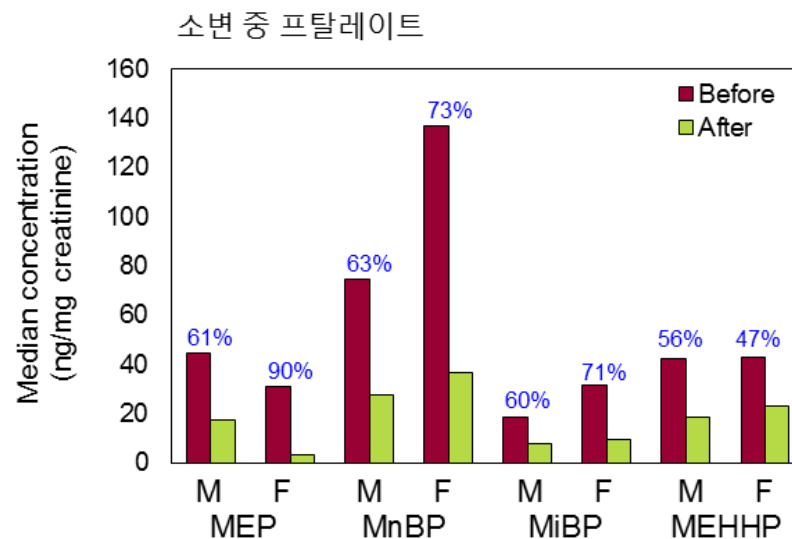
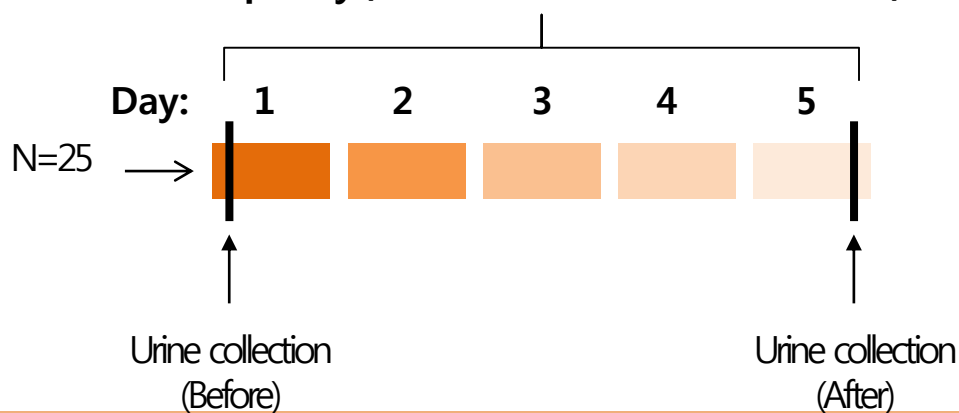


Fig. Phthalate metabolites after 5 days of temple stay (Ji et al, 2010).
*M: Male, F: Female

Studies with Mahidol

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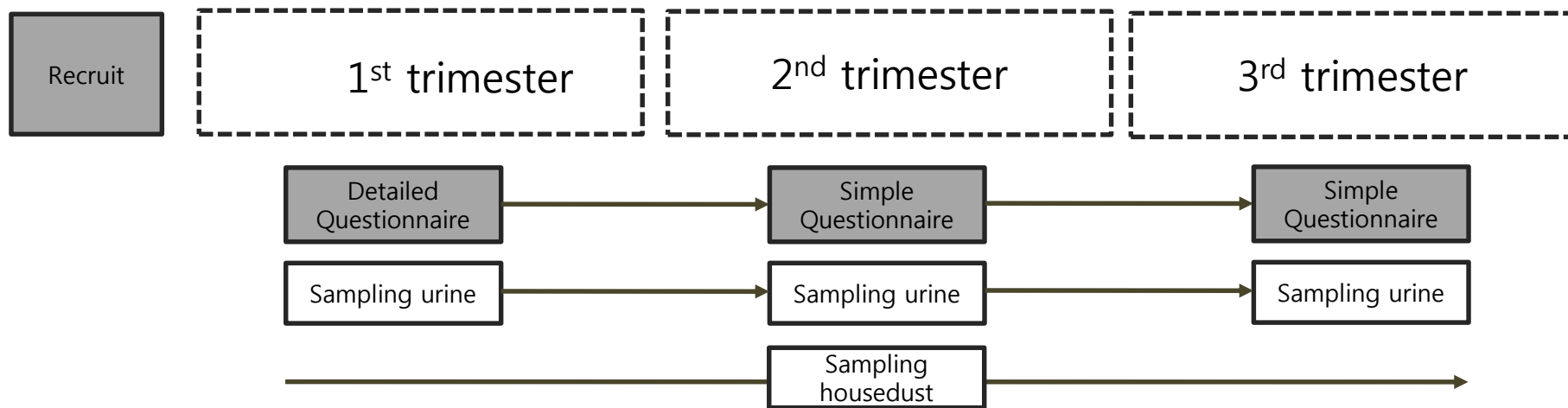
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Studies with Mahidol

- **Exposure assessment among Thai pregnant women**

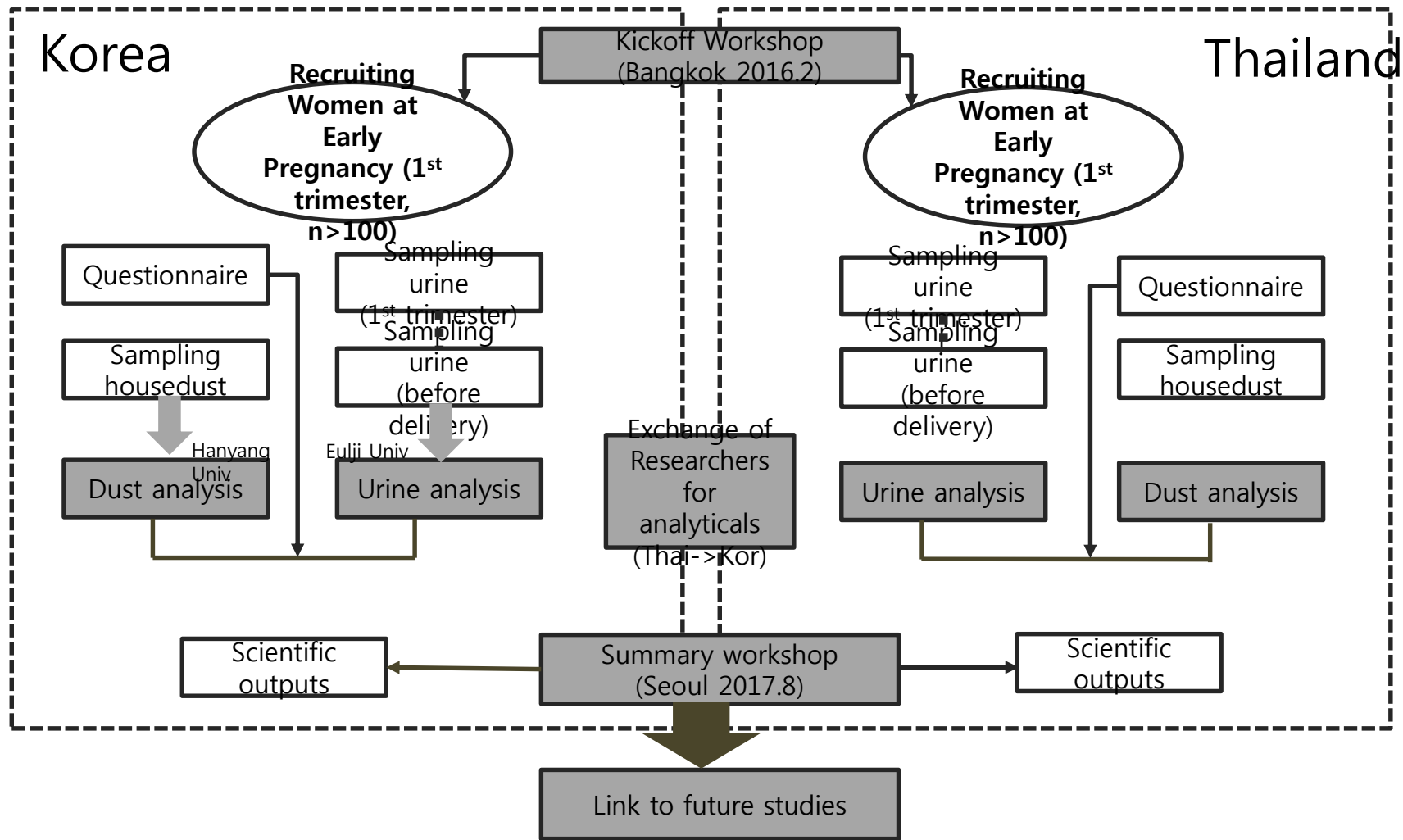


Urines should be sampled at least 3 times which include each of three trimesters.

Sampling periods are better as consistent as possible among the participating women.

Number of pregnant women reaching the 3rd trimester should be >100.

For those who want, housedust sample can be collected during the course of pregnancy.



Conclusions

- Chemicals are important determinant of health
- More helps warranted for developing safer substitutes
 - Analytical chemistry, and safety screening measures
- Identifying major chemicals of health concern is important first step to
 - Associations studies
 - Chemical management

Thank you

Season's greetings
From
Environmental Toxicology Laboratory



EDCs and Environmental Health