Emerging Contaminants & Public Health: Lessons Learned & What Next

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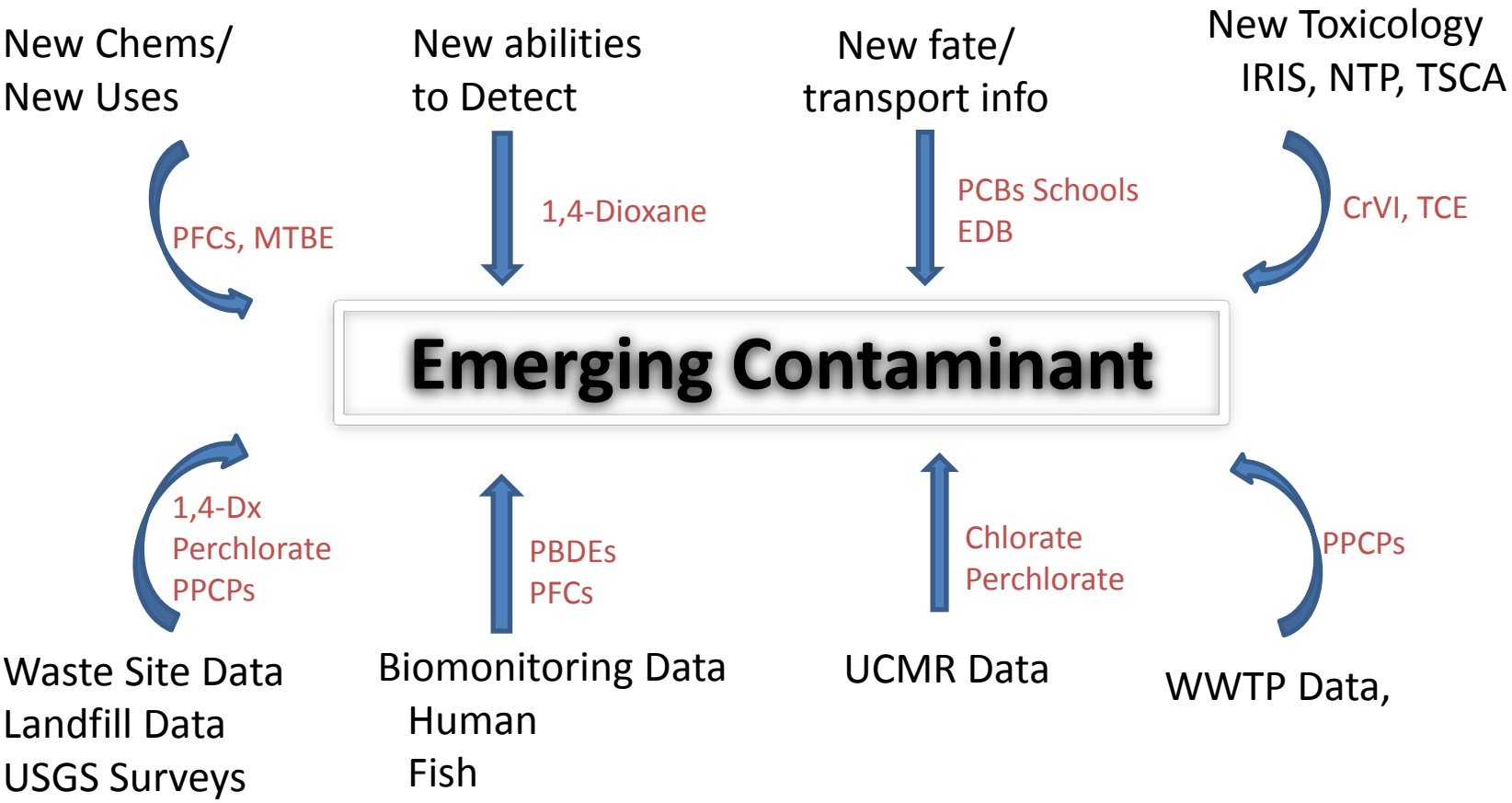
Emerging Contaminants Over Time

- Ethylene Dibromide (EDB) – 1970s
  - Surprise – it gets to GW
- Methyl t-Butyl Ether (MtBE) – 1990s
  - Surprise – it travels so far in GW
- 1,4-Dioxane – 2000s
  - Surprise – may remain at sites already cleaned up
    - hard to remove from GW
    - ***do we go back to already remediated sites?***
- Perchlorate – 2000s
  - Surprise – high levels near military bases, blasting

More Recent Emerging Contaminants

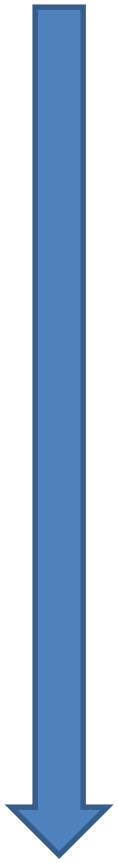
- Perfluorinated Alkyl Subs (PFOS, PFOA)- 2013
  - Surprise – GW contam from FFFs and coatings
- Hexavalent Chromium (CrVI) – 2008-2016
  - Surprise – carcinogenic by drinking
  - Surprise – much of total Cr in GW can be CrVI
- Sodium and Chloride - 2015
  - Surprise – ↑ing road salt → ↑ing Na/Cl in DW
- Pharma and Personal Care Prods – 2010
  - Surprise – WWTPs don't remove hormones, drugs

Reasons Chemicals Emerge



How Chemicals "Emerge"

LOCAL



NATIONAL

DETECTION

- Waste site detects
- USGS monitoring
- UCMR monitoring
- EPA ***modeling*** of sources and at risk supplies

RESPONSE

- Site-specific determination
- State Action Level
- Federal MCL

Sources

- New detections from historic ind/comm releases
- Residential uses (e.g., chlordane, chlorine)
- Current industrial uses and releases
  - E.g. – PFAS in WWTP traced to upstream chrome plater
    - Brainerd MN WWTP Case Study
  - Role of State Discharge Permits/Reg Programs
    - Maintain industrial and municipal releases below concern
    - However, many ECs not permited (PFOS, PFOA)
    - Small sources not permitted

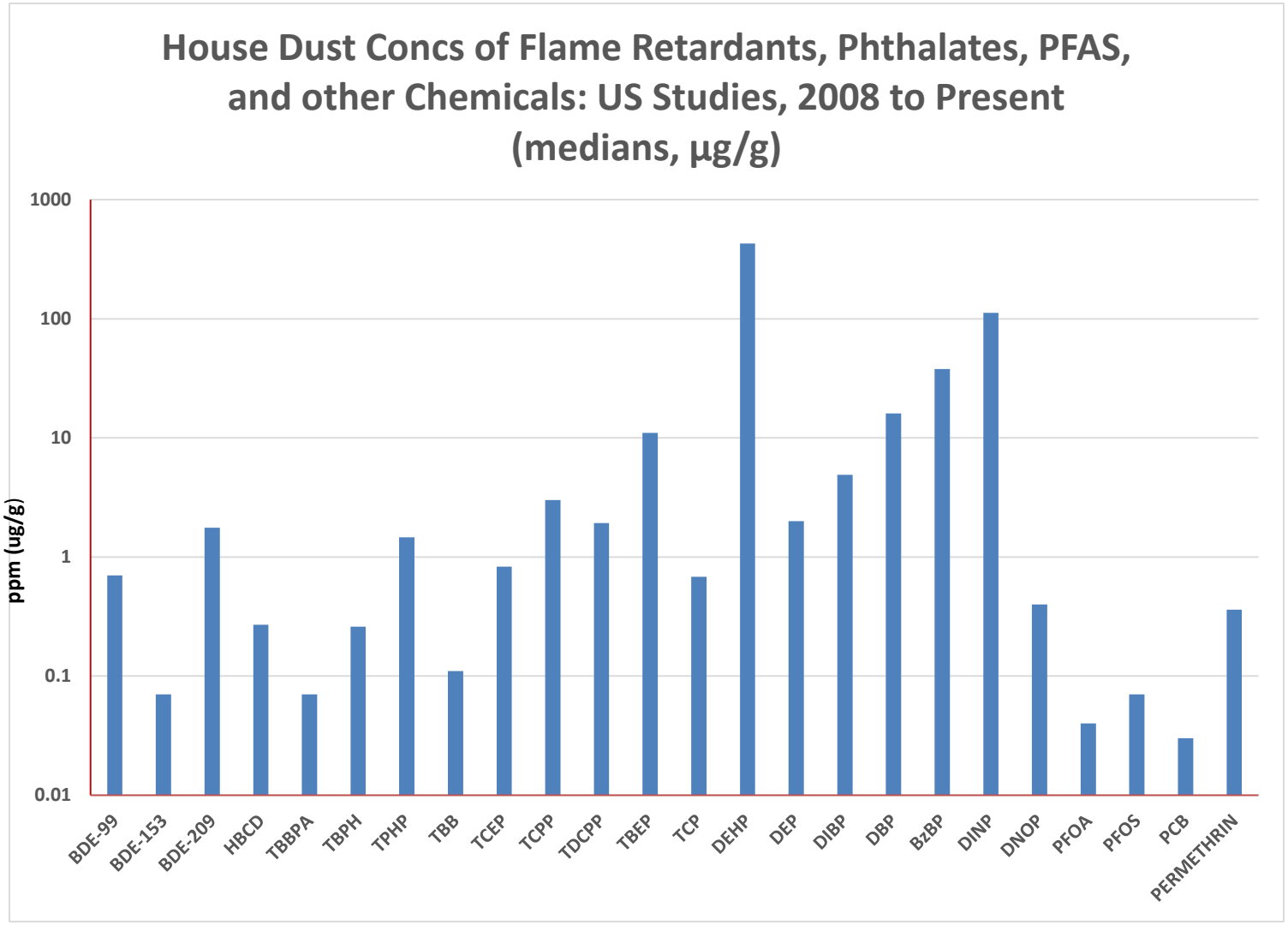
Sources (cont)

- **Landfills:** phthalates, PFAS, 1,4-Dx
- **Agriculture**
  - Legacy pesticides – e,g, chlordane, dieldrin
  - Modern pesticides – atrazine, glyphosate
  - Biosolid soil amendments – fertilizer, PFAS
  - Nutrients → Algae blooms
- **Sewage treatment plants**
  - PPCPs, PFOS,
- **Fracking chemicals** - phthalates

Media of Concern for Emerging Contaminants

- **Ground Water / Drinking water**
  - If no MCL, no one is testing tap water
    - E.g., perchlorate, PFAS
- **Surface Water**
  - Persistent chemicals → potential for fish accumulation
  - Microbeads, Nanosilver, NPEs, PPCPs from WWTPs → Ecotoxicity
- **Soil:** air deposition and disposal sources generally well known
  - Biosolid fertilizer for agriculture and home gardens
  - PFAS deposition onto soil → gw in NH
- **Food:** diet typically the major source for persistent chems

Chemicals “Emerge” into the Home from Products and Built Environment



Phthalates

- Plasticizers common in PVC, cosmetics, flooring, consumer products, medical tubing
- Anti-male endocrine disruptive effects
  - Period of in utero development most sensitive
  - Tox values still being developed
- DEHP, high concern phthalate
  - Phased out of toys, medical tubing
- Not commonly sampled – lab blank issue
- Key environ sources – landfills, fracking fluid

Tris-Phosphate Flame Retardants in Drinking Water

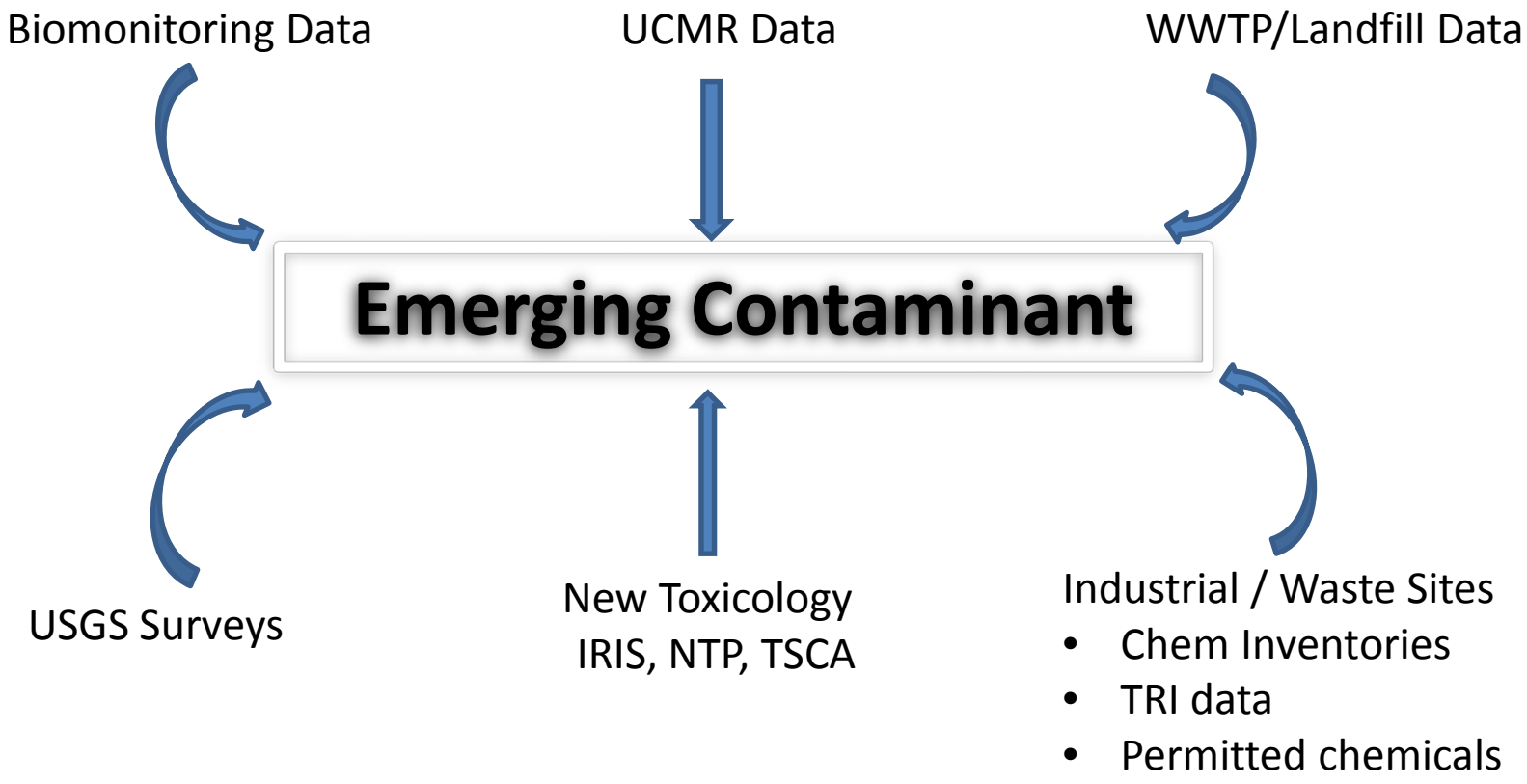
Table 2
Global comparison of mean concentrations (ng/L) of OPFRs in drinking water measured in this study with those reported for other countries.

Country	Sampling year	Water type	*n*	TBP	TCEP	TCPP	TBEP	TPP	Reference
Drinking water									
USA[a]	2006–2007	Drinking water	15	-[b]	150	220	–	–	Benotti et al. (2009)
Spain[a]	2008	Drinking water	28	32	–	40	–	–	Rodil et al. (2012)
China[a]	2014	Filtered drinking water	17	0.9	9.1	6.7	0.3	0.2	Ding et al. (2015)
Korea	2014	Drinking water	127	3.40	38.8	67.0	26.1	2.12	This study
Tap water									
China	2012	Tap water	39	–	–	33.4	70.1	40.0	Li et al. (2014)
China[a]	2014	Tap water	21	9.5	48.5	43.0	3.7	1.4	Ding et al. (2015)
Korea	2014	Tap water	75	4.29	25.3	10.7	10.7	1.98	This study
Bottled water									
China	2012	Bottled water	8	1.2	6.5	6.6	31.7	6.9	Li et al. (2014)
China[a]	2014	Bottled water	23	0.1	0.5	0.6	0.2	0.8	Ding et al. (2015)
Korea	2014	Bottled water	10	4.24	16.4	79.6	64.4	0.99	This study
Other water									
China[a]	2014	Well water	19	0.2	0.5	2.5	0.2	0.2	Ding et al. (2015)
China[a]	2014	Barreled water	19	0.1	6.9	8.0	ND[c]	0.2	Ding et al. (2015)
Korea	2014	Purified water	42	1.27	70.1	155	35.6	2.77	This study

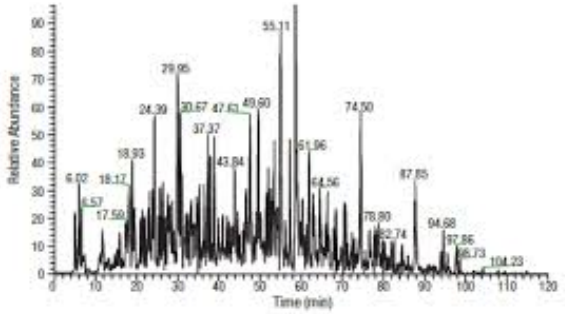
[a] Median value.
[b] Not available

Lee et al. 2016

Staying Ahead of the Curve



Proactive Testing for Emerging Contaminants



- **PFAS: list of 6 → 14 → ???**
- **1,4-Dx**
- **CrVI**
- **Perchlorate**
- **Chlorate**
- **PPCPs**
- **PCP**
- **Phthalates (DEHP)**
- **Microcystin (seasonal)**