Report to Scientific Guidance Panel

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BIOMONITORING CALIFORNIA

Overview

- Phthalate metabolites method update
- Project sample analyses status
- FOX study results: metals in urine & arsenic speciation
- BPA analogs method update
- Recent publications
- Future work

Phthalate Metabolites Method Update: Automated Sample Preparation

- Increased sample throughput with automatic sample processing
- Reduced sample volume required for analyses
- Cost effective with reusable HPLC cartridges used as SPE columns
- Increased sensitivity & lower detection limits

Phthalate Metabolites Method Update: Analyte Panel Expansion

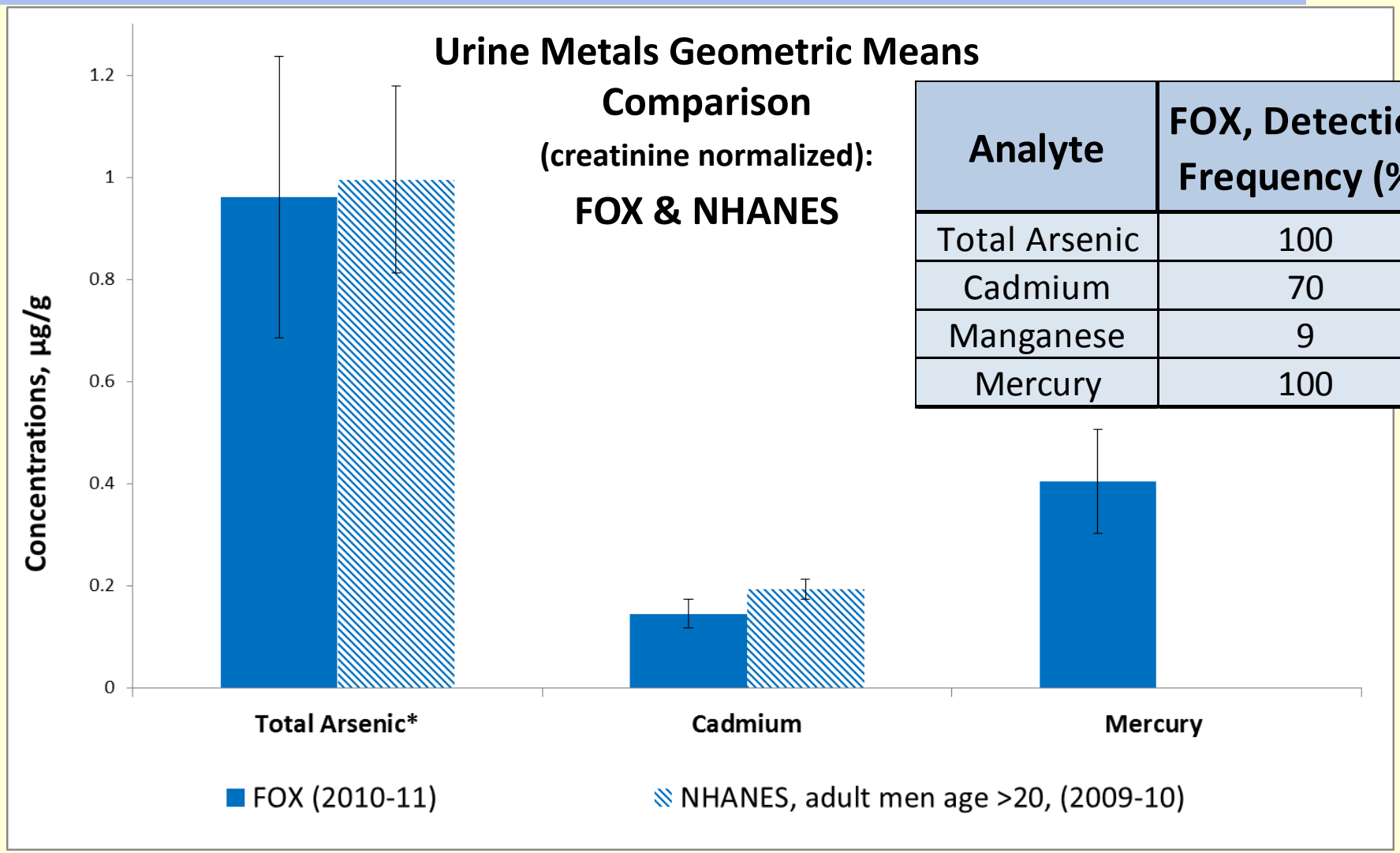
Full Analyte Name	**Abbreviation**	**Parent Compound** (Abbreviation)
Mono-(3-carboxypropyl) phthalate	mCPP	*Di-n-octyl phthalate* (DOP), *Dibutyl phthalate* (DBP)
Mono-ethyl phthalate	mEP	*Diethyl phthalate* (DEP)
Mono-(2-ethyl-5-carboxypentyl) phthalate	mECPP	*Di-2-ethylhexyl phthalate* (DEHP)
Mono-*n*-butyl phthalate	mBP	*Benzylbutyl phthalate* (BzBP), *Dibutyl phthalate* (DBP)
Mono-benzyl phthalate	mBzP	*Benzylbutyl phthalate* (BzBP)
Mono-cyclohexyl phthalate	mCHP	*Dicyclohexyl phthalate* (DCHP)
Mono-(2-ethyl-5-hydroxyhexyl)phthalate	**mEHHP**	*Di-2-ethylhexyl phthalate* (DEHP)
Mono-(2-ethyl-5-oxohexyl) phthalate	**mEOHP**	
Mono-2-ethylhexyl phthalate	**mEHP**	
Mono- isobutyl phthalate	**miBP**	*Di-isobutyl phthalate* (DiBP)

Project Sample Analyses Status

Methods in Production	MIEEP (blood n=136) (urine n=89)	FOX (blood n=101) (urine n=101)	Pilot BEST (blood n=110) (urine n=109)
Metals in blood	136	101	110
Creatinine	89	101	109
Phthalate metabolites	89	101	109
OP specific metabolites, pyrethroids & herbicides	89	101	109
Environmental phenols	89	101	90
OH-PAHs	88	101	109
Metals in urine	89	101	109
Arsenic speciation*	13	29	29
Perchlorate	not requested	not requested	109

*Samples are only analyzed if total urinary arsenic levels are ≥20 µg/L

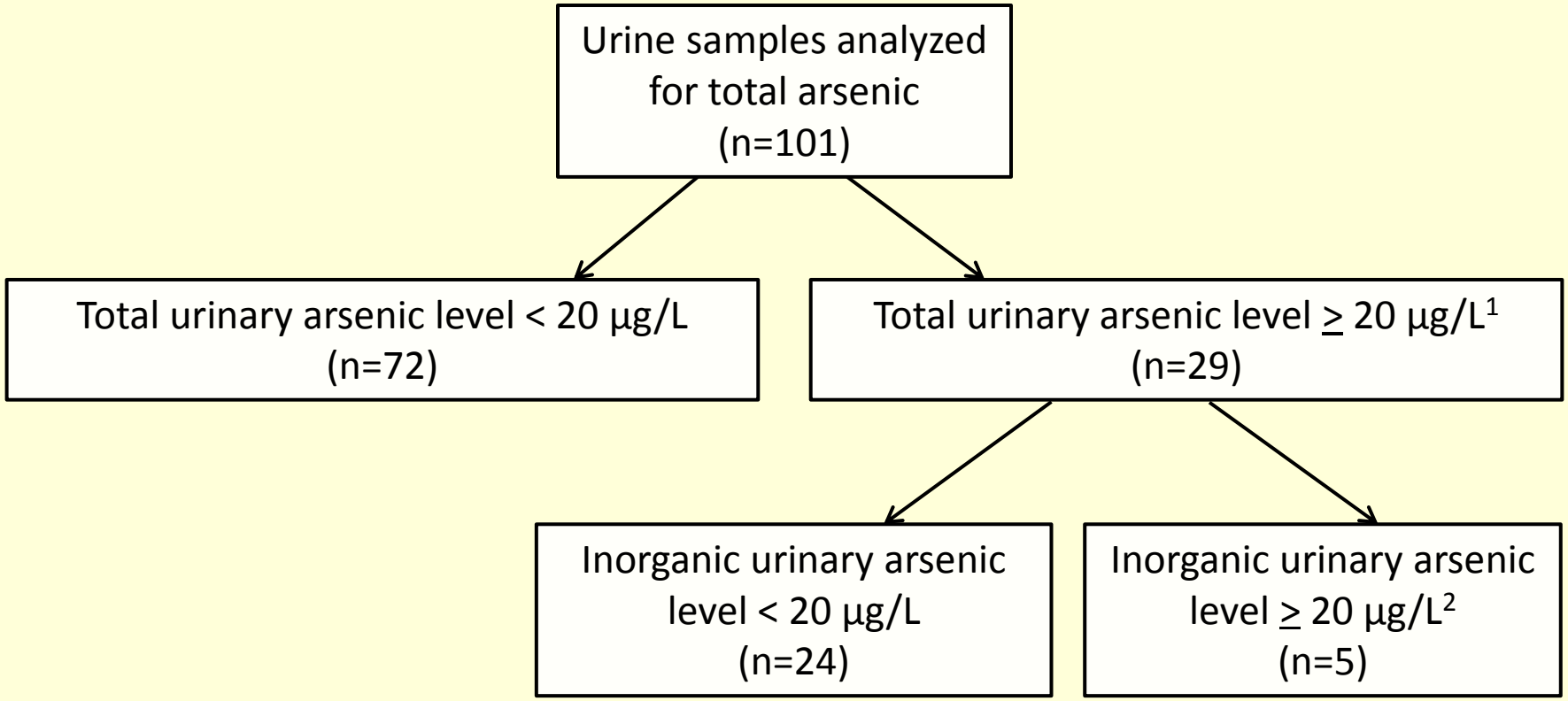
FOX Results: Metals in Urine



Analyte	FOX, Detection Frequency (%)
Total Arsenic	100
Cadmium	70
Manganese	9
Mercury	100

*Total arsenic values are scaled down by a factor of 10

FOX: Arsenic Speciation Analysis Protocol



[1] Total urinary arsenic trigger level for speciation is 20 µg/L; chosen to ensure analysis of any samples that may exceed 20 µg/L inorganic arsenic & related species.

[2] 20 µg/L corresponds approximately to the 95th percentile of the sum of inorganic arsenic & related species (As-III, As-V, MMA, and DMA [abbreviated here as "inorganic arsenic"]) from NHANES 2003-2004 (Caldwell et al., 2009).

FOX Results: Elevated Inorganic Arsenic Levels

Category	Arsenic Species	Urinary Levels, (µg/L) (range, n=5)
Inorganic arsenic & related species	Arsenous (III) acid	LOD - 3.22
	Arsenic (V) acid	all < LOD
	Monomethylarsonic acid	LOD - 6.05
	Dimethylarsinic acid	18.9 - 29.1
Organic arsenic	Arsenobetaine	2.54 - 18.2
	Arsenocholine	LOD - 1.94

*Limit of detection (LOD) for all listed analytes is 1.00 µg/L

- A follow-up survey was offered to the 5 participants with urinary inorganic arsenic ≥ 20 µg/L – survey results are being reviewed

FOX Results: Elevated Total Arsenic Levels

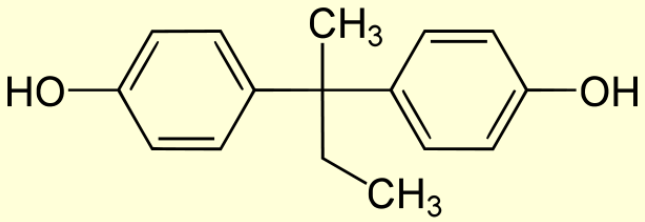
For the two participants with elevated **total** urinary arsenic (≥ 50 μg/L[1]):

- Arsenobetaine and arsenocholine were the major contributors to the total level
  - Recent fish or seafood consumption is the likely source of these organic arsenic species
- Inorganic arsenic levels were not elevated

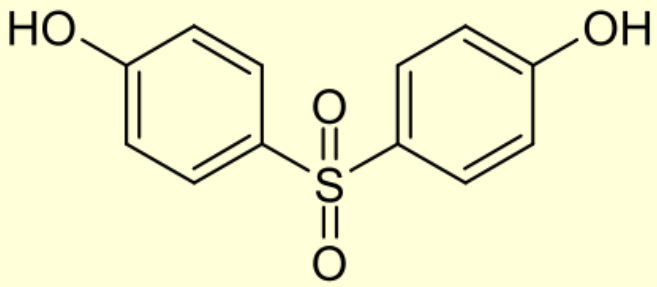
[1] Level of concern for total urinary arsenic established by CDC

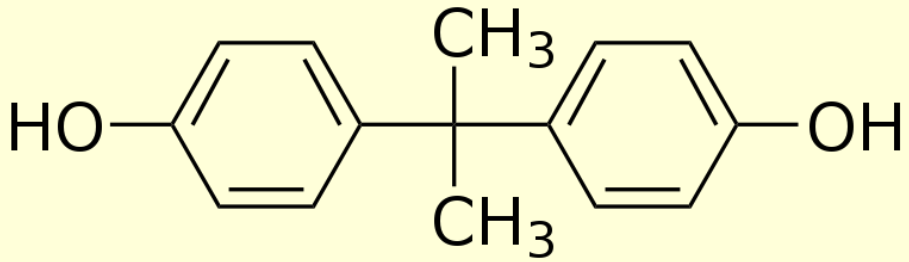
BPA Analogs Method*

BPB



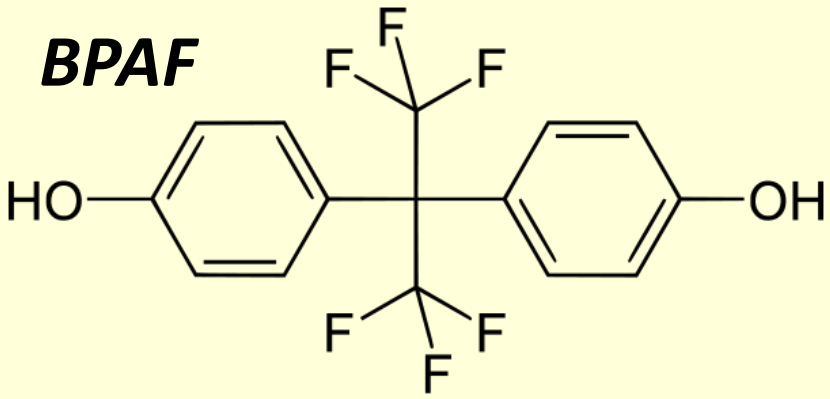
BPS



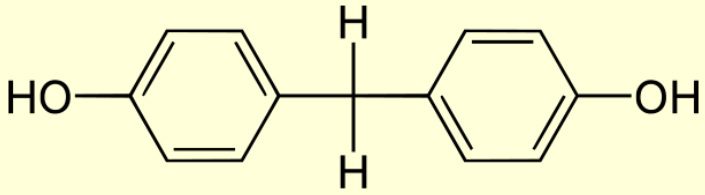


BPA

BPAF



BPF



*p,p'-Bisphenols

BPA Analogs Method*

Full Analyte Name	Abbreviation	Precision (%RSD), n=6		Accuracy (% recovery), n=6	
		QC-10 ppb	QC-50 ppb	QC-10 ppb	QC-50 ppb
2,2-bis(4-hydroxyphenyl)propane	BPA	4	8	129	100
4,4'-[2,2,2-Trifluoro-1-(trifluoromethyl)ethylidene]bisphenol	BPAF	10	25	98	92
4,4'-(1-Methylpropylidene)bisphenol	BPB	5	18	99	98
4,4'-Methylenebisphenol	BPF	5	4	91	104
4,4'-Sulfonylbisphenol	BPS	27	17	70	98

- Linear range for all listed analytes is 1-100 ppb

*p,p'-Bisphenols

Recent Publications

- Manuscripts published (2013)
  - Determination of essential and toxic metals in blood by ICP-MS with calibration in synthetic matrix (Gajek et al.)
  - Matrix effects in analysis of dialkyl phosphate metabolites of organophosphate pesticides in urine by gas chromatography/tandem mass spectrometer (Wang et al.)
  - A Comprehensive Workflow of Mass Spectrometry-Based Untargeted Metabolomics in Cancer Metabolic Biomarker Discovery Using Human Plasma and Urine (Zou et al.)
  - Development of HPLC-MS/MS method for the simultaneous determination of environmental phenols in human urine (Gavin et al.)

- Visit the Biomonitoring CA website for a list of all publications

Future Work

- Submit all data results for Pilot BEST & start analyses for Expanded BEST samples
- Analyze laboratory collaboration samples
- Complete validation for BPA analogs method
- Explore bundling OP flame retardants method with current DAPs and OP specific metabolites methods