New York State Biomonitoring Program for Trace Elements

Event #2, 2022

Trace Elements in Whole Blood, Urine, and Serum

August, 2022

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

Event #2, 2022:
Trace Elements in Whole Blood, Urine, and Serum

8/22/2022

Dear Laboratory Director,

This report summarizes performance for the second biomonitoring proficiency test (PT) event of 2022 for Trace Elements in Whole Blood, Urine, and Serum. One of the key goals of this PT program is to achieve harmonization of biomonitoring data for trace elements.

Target Value Assignment and Performance Evaluation:
For these PT materials, target values have been assigned for a limited number of trace elements that are gradable under criteria set by the NYS DOH Biomonitoring PT program. See assay-specific narratives for details. Data for additional trace elements are reported and are included here in order to characterize the PT materials more completely. Participant data and descriptive statistics are provided for educational purposes. No target value or acceptable range is implied.

Where the data permit, robust statistics were used to assign target values based on Algorithm A as defined by ISO 13528:2005E *Statistical methods for use in proficiency testing by inter-laboratory comparisons* [1]. Acceptable ranges for the graded elements are based on consensus criteria and/or those set by the NYS DOH's PT program. For example, some are fixed based on US regulatory guidelines (Pb, Cd) while for other elements the criteria are based on a consensus of the Network of PT scheme organizers for trace elements in occupational and environmental laboratory medicine [2]. Quality specifications are element and matrix specific; full details are provided under each element specific narrative.

A confidential, three-digit code number assigned by PT program staff identifies all laboratory participants.

Samples for the next PT event (Event #3, 2022) will be shipped September 7, 2022. Comments about this report may be directed to trel@health.ny.gov.

Sincerely,

Patrick J. Parsons, PhD
Chief, Inorganic and Nuclear Chemistry,
Division of Environmental Sciences
Wadsworth Center

Kayla Mehigan
Coordinator, Biomonitoring PT Program,
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Event #2, 2022

Trace Elements in Whole Blood

Event #2, 2022:
Trace Elements in Whole Blood

PT Materials

Human whole blood was purchased from Zen-Bio, Inc. and preserved with K_2EDTA. The company certifies that this material was "non-reactive" for HBsAg, HBV DNA, HIV-1,2 Ab, HIV-1 RNA, HCV Ab, HCV RNA, and STS. Units of whole blood were filtered into polypropylene containers through cheesecloth to remove particulates and supplemented with arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), mercury (Hg), manganese (Mn), lead (Pb), barium (Ba), beryllium (Be), copper (Cu), molybdenum (Mo), nickel (Ni), platinum (Pt), antimony (Sb), selenium (Se), tin (Sn), titanium (Ti), thallium (Tl), uranium (U), vanadium (V), tungsten (W), and zinc (Zn). Whole blood samples were homogenized overnight prior to aliquoting 2-mL into polypropylene vials. PT samples were stored at -80°C until the week of the PT event, when they were thawed at 4°C prior to circulation to laboratories

Graded Elements

Seven elements in whole blood are formally graded: As, Cd, Co, Cr, Hg, Mn, and Pb. Target values for the graded elements are assigned to these pools based on (a) the robust mean calculated from data reported by all laboratories, or (b) if a robust mean is not possible, the arithmetic mean after outlier deletion.

Additional Elements

An additional 25 elements were reported by at least one participant: Ag, Al, Ba, Be, Bi, Cs, Cu, I, Li, Mg, Mo, Ni, Pt, Sb, Se, Sn, Sr, Te, Th, Ti, Tl, U, V, W, and Zn. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

The summary statistics for the additional elements are provided for educational purposes only, i.e., no acceptable response is implied. However, it is expected that each laboratory would wish to investigate a potential source of bias if warranted by these data. Future events might result in additional elements becoming graded if a consensus can be reached regarding desired quality specifications.

Results for Event #2, 2022:
Summary Statistics

Whole Blood As (µg/L)					
	BE22-06	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
Target (Arithmetic Mean (x̄))	1.7	5.1	7.4	14.1	2.6
Upper Limit	7.7	11.1	13.4	20.1	8.6
Lower Limit	0.0	0.0	1.4	8.1	0.0
Arithmetic SD (s)	0.3	0.4	0.7	2.2	0.3
Arithmetic RSD (%)	16	7.8	9.5	16	11
Number of Sample Measurements (N)	7	7	8	8	7

The acceptable range is based on quality specifications:
±6 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±6 µg/L at concentrations less than or equal to 30 µg/L. These quality specifications were established by New York State Department of Health's Wadsworth Center, the PT Program organizer.

Results for Event #2, 2022:
## Performance of Participating Laboratories

		Whole Blood As (µg/L)				
Lab Code	**Method**	**BE22-06**	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
	Target	**1.7**	**5.1**	**7.4**	**14.1**	**2.6**
103	ICP-MS/MS	1.68	5.22	7.38	14.2	2.65
110	DRC/CC-ICP-MS	1.83	5.09	7.26	14.3	2.57
147	ICP-MS	1.60	5.06	7.39	14.3	2.43
264	ICP-MS	1.69	5.00	6.82	13.66	2.51
293	DRC/CC-ICP-MS	1.75	5.6	8.12	15.39	2.9
391	DRC/CC-ICP-MS	*11.03 ↑	*8.3	8.33	9.39	*8.3
597	ICP-MS/MS	1.91	5.39	7.64	14.6	2.93
598	DRC/CC-ICP-MS	1.11	4.34	6.29	17.1	2.12

Based on the grading criteria for As in Whole Blood, 98% of results were satisfactory, with 0 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Whole Blood As
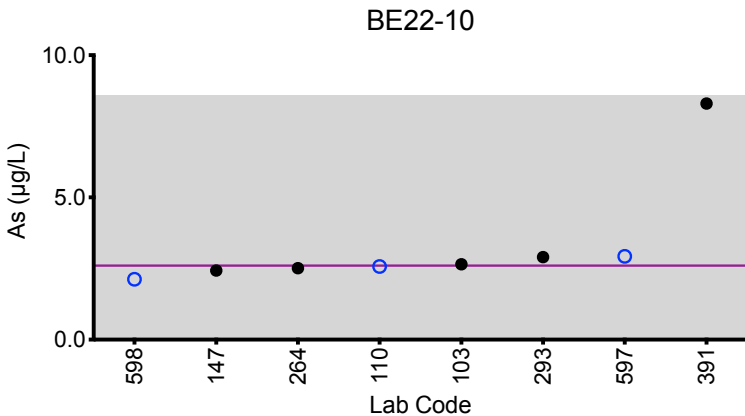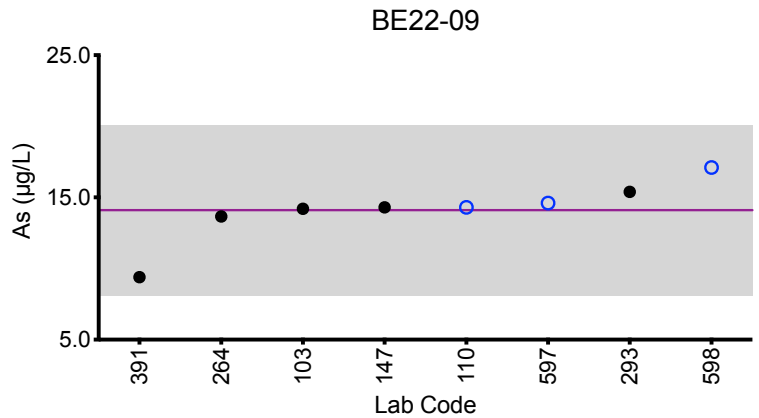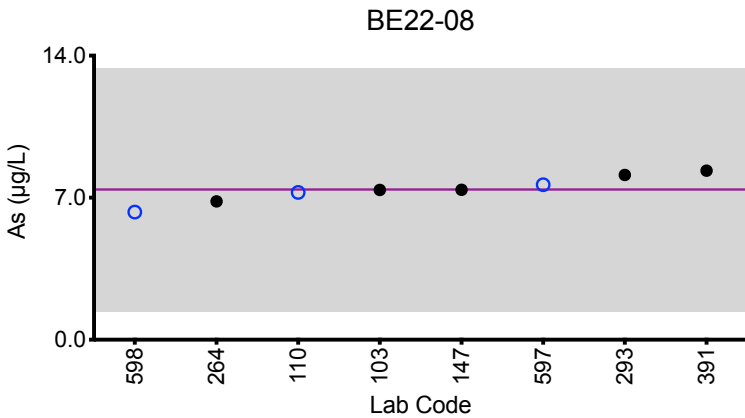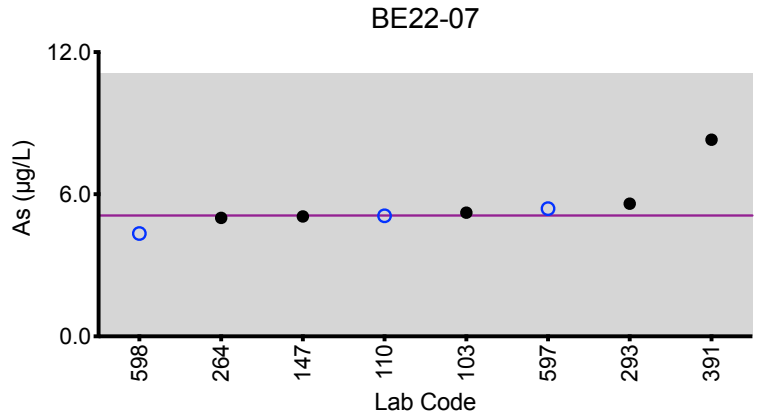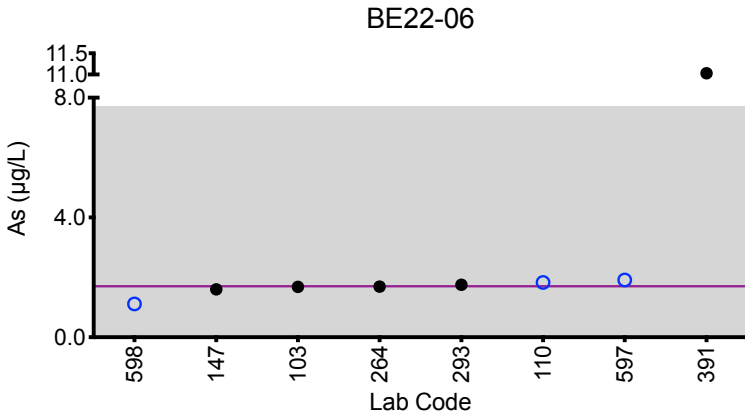
Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the arithmetic mean of all laboratories. Gray area = acceptable range based on quality specifications:
±6 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±6 µg/L at concentrations less than or equal to 30 µg/L.

Results for Event #2, 2022:
Summary Statistics

	Whole Blood Cd (µg/L)				
	BE22-06	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
Target (Robust Mean (x^*))	6.1	2.31	1.76	3.37	0.72
Upper Limit	7.1	3.31	2.76	4.37	1.72
Lower Limit	5.1	1.31	0.76	2.37	0.00
Robust SD (s^*)	0.4	0.14	0.08	0.21	0.10
Robust RSD (%)	6.9	6.1	4.5	6.2	14
Number of Sample Measurements (N)	13	13	13	13	11
Standard Uncertainty (u)	0.1	0.05	0.03	0.07	0.04

The acceptable range is based on quality specifications:
±1 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 6.7 µg/L. These quality specifications are based on those used by US OSHA for occupational exposure.

Results for Event #2, 2022:
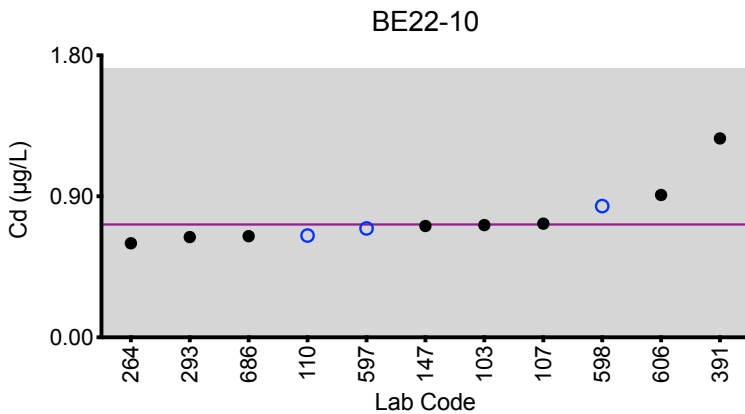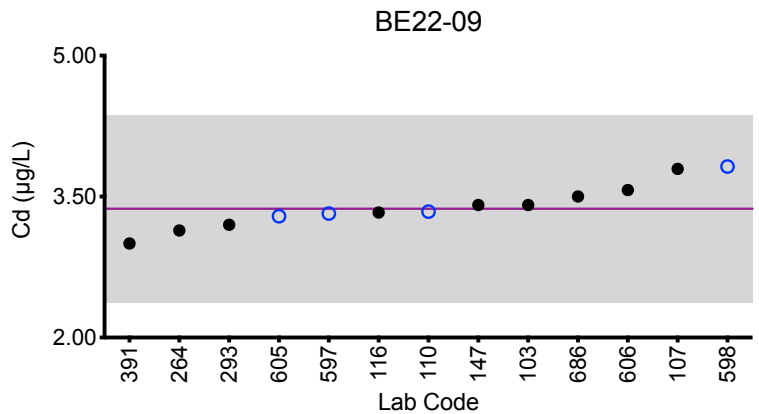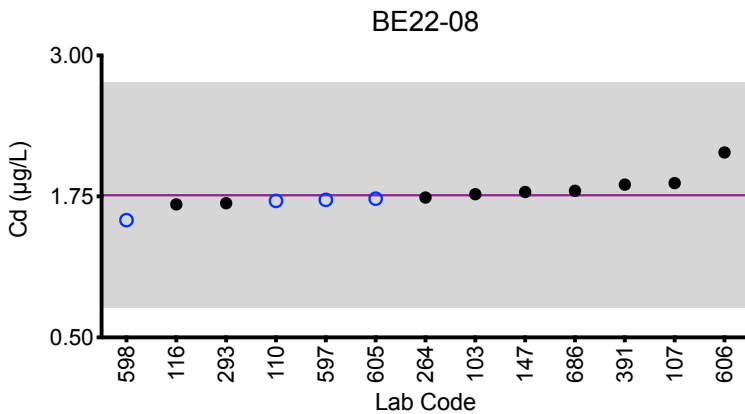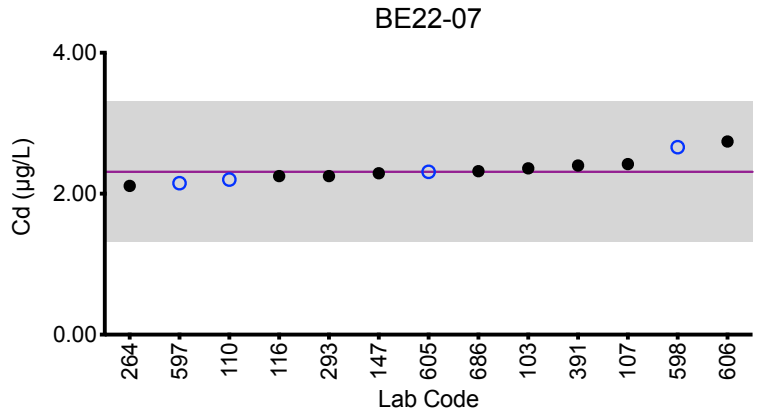## Performance of Participating Laboratories

		Whole Blood Cd (µg/L)				
Lab Code	**Method**	**BE22-06**	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
	Target	**6.1**	**2.31**	**1.76**	**3.37**	**0.72**
103	ICP-MS/MS	6.14	2.36	1.77	3.41	0.717
107	ICP-MS/MS	6.480	2.421	1.868	3.794	0.726
110	ICP-MS	6.05	2.20	1.71	3.34	0.65
116	ICP-MS/MS	5.83	2.25	1.68	3.33	<1.50
147	ICP-MS	6.07	2.29	1.79	3.41	0.711
264	ICP-MS	5.34	2.11	1.74	3.14	0.60
293	DRC/CC-ICP-MS	5.70	2.25	1.690	3.2	0.64
391	DRC/CC-ICP-MS	5.30	2.40	1.855	3.0	1.27
597	ICP-MS/MS	6.05	2.15	1.72	3.32	0.695
598	DRC/CC-ICP-MS	5.91	2.66	1.54	3.82	0.838
605	ICP-MS	6.85	2.31	1.73	3.29	<0.5
606	ICP-MS/MS	6.66	2.74	2.14	3.57	0.909
686	ICP-MS	6.30	2.32	1.80	3.50	0.646

Based on the grading criteria for Cd in Whole Blood, 100% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

![New York State Department of Health | Wadsworth Center logo]

Results for Event #2, 2022:
Summary Figures

Whole Blood Cd

BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value
based on the robust mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±1 µg/L or ±15% around the target value,
whichever is greater; thus, it is fixed at ±1 µg/L at
concentrations less than or equal to 6.7 µg/L.

Results for Event #2, 2022:
Summary Statistics

Whole Blood Co (µg/L)					
	BE22-06	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
Target (Arithmetic Mean ($\bar{x}$))	4.02	3.12	3.30	0.45	9.2
Upper Limit	5.52	4.62	4.80	1.95	11.0
Lower Limit	2.52	1.62	1.80	0.00	7.4
Arithmetic SD (s)	0.24	0.18	0.22	0.07	0.5
Arithmetic RSD (%)	5.9	5.8	6.7	16	5.4
Number of Sample Measurements (N)	8	8	8	7	8

The acceptable range is based on quality specifications:
±1.5 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±1.5 µg/L at concentrations less than or equal to 7.5 µg/L. These quality specifications were established based on discussions with the US FDA, and represent a consensus from a network of Trace Element PT program organizers

Results for Event #2, 2022:
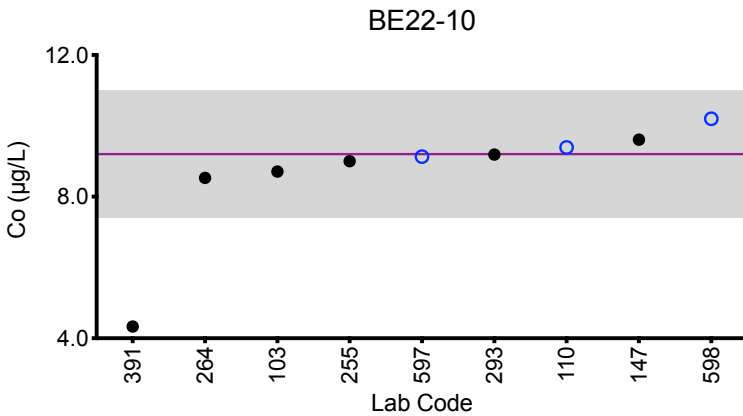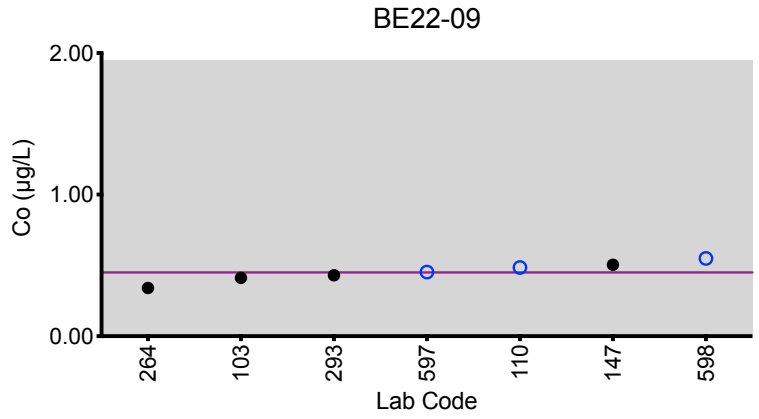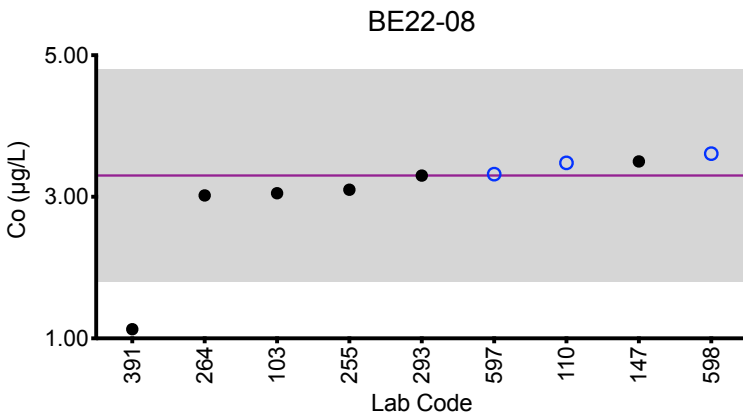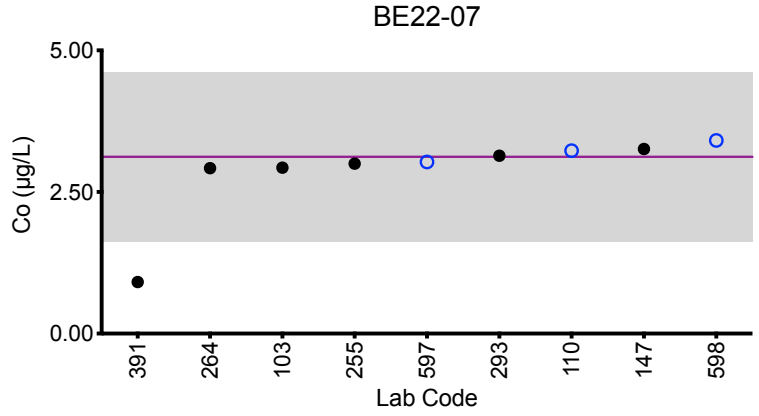## Performance of Participating Laboratories

		Whole Blood Co (µg/L)				
Lab Code	**Method**	**BE22-06**	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
	Target	**4.02**	**3.12**	**3.30**	**0.45**	**9.2**
103	ICP-MS/MS	3.85	2.93	3.05	0.412	8.71
110	ICP-MS	4.28	3.23	3.48	0.485	9.39
147	ICP-MS	4.32	3.26	3.50	0.504	9.61
255	ICP-MS	3.8	3	3.1	<0.5	9
264	ICP-MS	3.65	2.92	3.02	0.34	8.53
293	DRC/CC-ICP-MS	4.06	3.14	3.30	0.43	9.19
391	DRC/CC-ICP-MS	*1.75 ↓	*0.91 ↓	*1.13 ↓	<0.005	*4.33 ↓
597	ICP-MS/MS	4.18	3.03	3.32	0.453	9.13
598	ICP-MS	4.03	3.41	3.61	0.549	10.2

Based on the grading criteria for Co in Whole Blood, 91% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Whole Blood Co

BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±1.5 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±1.5 µg/L at concentrations less than or equal to 7.5 µg/L.

Results for Event #2, 2022:
Summary Statistics

Whole Blood Cr (µg/L)					
	BE22-06	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
Target (Arithmetic Mean ($\bar{x}$))	6.7	0.92	0.61	1.45	3.35
Upper Limit	8.7	2.92	2.61	3.45	5.35
Lower Limit	4.7	0.00	0.00	0.00	1.35
Arithmetic SD (s)	0.5	0.15	0.17	0.21	0.26
Arithmetic RSD (%)	7.5	16	28	14	7.8
Number of Sample Measurements (N)	8	5	5	7	8

The acceptable range is based on quality specifications:

±2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±2 µg/L at concentrations less than or equal to 10 µg/L. These quality specifications were established based on discussions with the US FDA, and represent a consensus from a network of Trace Element PT program organizers

Results for Event #2, 2022:
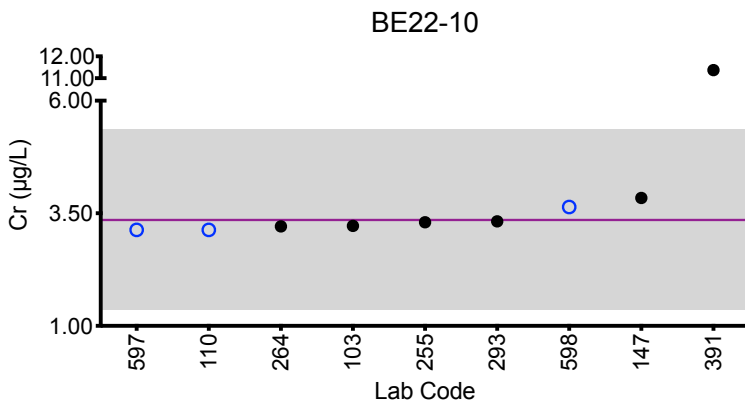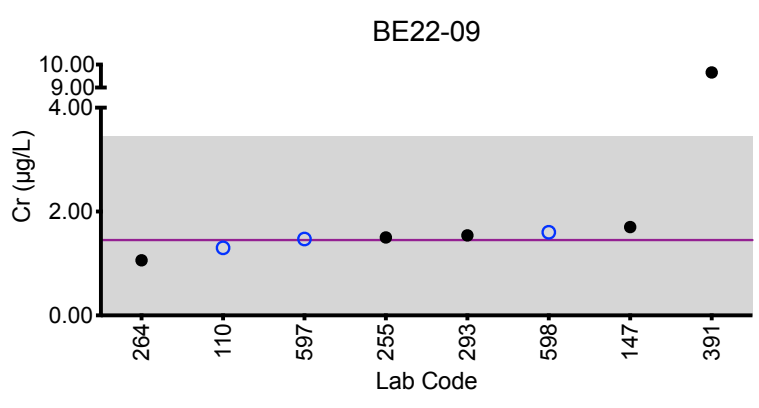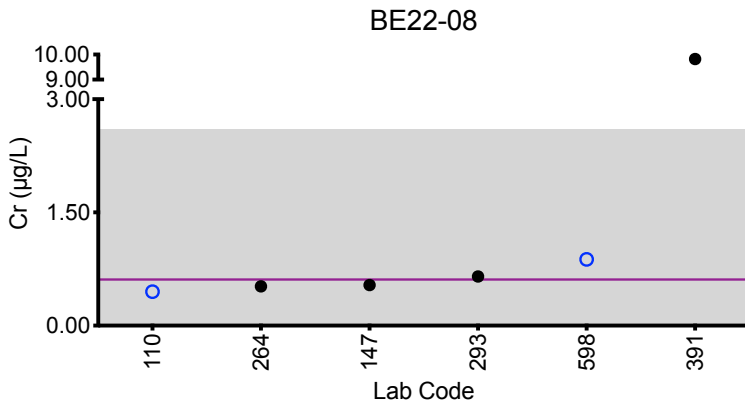## Performance of Participating Laboratories

		Whole Blood Cr (µg/L)				
Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
	Target	6.7	0.92	0.61	1.45	3.35
103	ICP-MS/MS	6.57	<1.50	<1.50	<1.50	3.22
110	DRC/CC-ICP-MS	6.26	0.75	0.45	1.30	3.13
147	DRC/CC-ICP-MS	7.80	0.900	0.537	1.70	3.84
255	ICP-MS	6.3	<1	<1	1.5	3.3
264	ICP-MS	6.49	0.99	0.52	1.06	3.21
293	DRC/CC-ICP-MS	6.53	0.81	0.65	1.54	3.32
391	DRC/CC-ICP-MS	*12.17 ↑	*8.93 ↑	*9.82 ↑	*9.66 ↑	*11.37 ↑
597	ICP-MS/MS	6.69	<0.963	<0.963	1.47	3.13
598	DRC/CC-ICP-MS	6.62	1.14	0.878	1.60	3.64

Based on the grading criteria for Cr in Whole Blood, 89% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Whole Blood Cr

BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs ● Other Labs
Horizontal purple line = assigned target value
based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±2 µg/L or ±20% around the target value,
whichever is greater; thus, it is fixed at ±2 µg/L at
concentrations less than or equal to 10 µg/L.

Results for Event #2, 2022:
Summary Statistics

	Whole Blood Hg (µg/L)				
	BE22-06	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
Target (Robust Mean (x^*))	0.88	4.0	9.8	4.5	1.82
Upper Limit	3.88	7.0	12.8	7.5	4.82
Lower Limit	0.00	1.0	6.8	1.5	0.00
Robust SD (s^*)	0.07	0.4	0.8	0.5	0.14
Robust RSD (%)	8.3	10	8.2	11	7.7
Number of Sample Measurements (N)	12	14	14	14	13
Standard Uncertainty (u)	0.03	0.1	0.3	0.2	0.05

The acceptable range is based on quality specifications:
±3 µg/L or ±30% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 10 µg/L. These quality specifications were established by New York State Department of Health's Wadsworth Center, the PT Program organizer.

Results for Event #2, 2022:
## Performance of Participating Laboratories

	Whole Blood Hg (µg/L)				
Lab Code	**Method**	**BE22-06**	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
	Target	**0.88**	**4.0**	**9.8**	**4.5**	**1.82**
103	ICP-MS/MS	0.825	3.98	9.59	4.47	1.89
107	ICP-MS/MS	0.93	4.31	10.48	5.33	1.97
110	ICP-MS	0.75	3.94	9.62	4.58	1.72
116	ICP-MS/MS	<1.50	4.37	10.7	5.20	1.81
147	ICP-MS	0.931	3.97	9.51	4.49	1.77
264	ICP-MS	0.92	3.13	7.89	3.60	1.56
293	DRC/CC-ICP-MS	1.2	4.27	9.5	4.23	2.00
352	ETAAS-Z	<3.0	4.76	10.4	4.15	<3.0
391	CV-AAS	0.3	1.48	1.6 ↓	1.08 ↓	1.02
597	ICP-MS/MS	0.920	3.81	9.51	4.42	1.79
598	ICP-MS	0.935	3.78	10.6	4.27	2.04
605	ICP-MS	0.856	4.01	9.92	4.77	1.81
606	ICP-MS/MS	0.854	4.55	11.0	5.45	1.88
686	ICP-MS	0.835	3.95	9.84	4.75	1.74

Based on the grading criteria for Hg in Whole Blood, 97% of results were satisfactory, with 1 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Whole Blood Hg
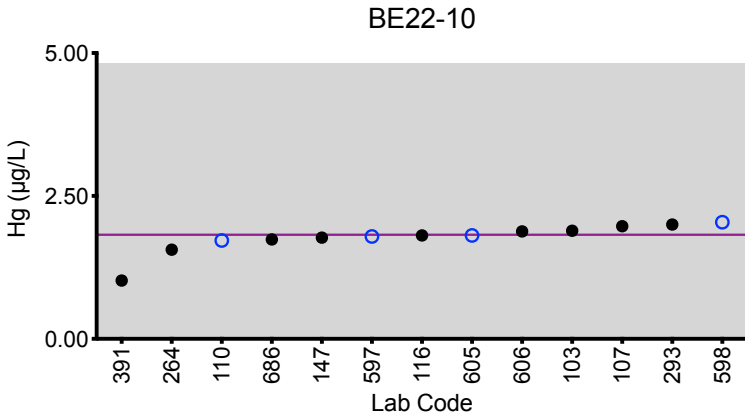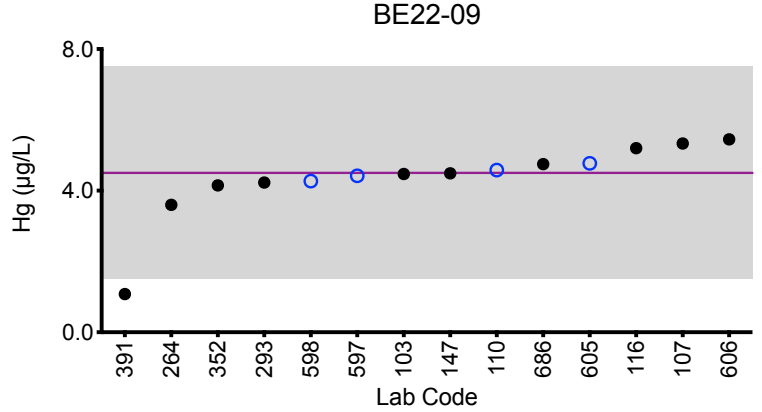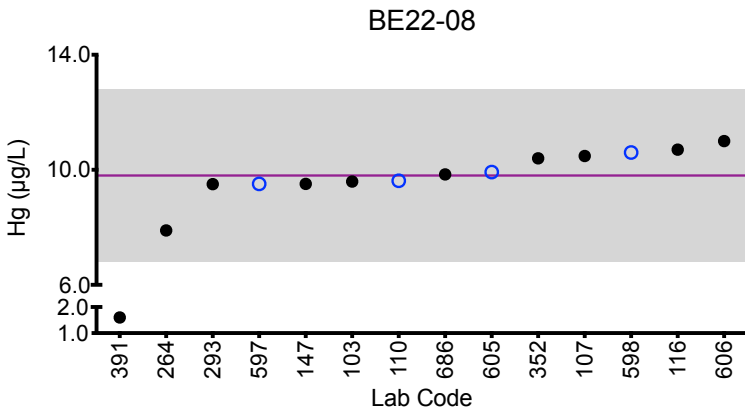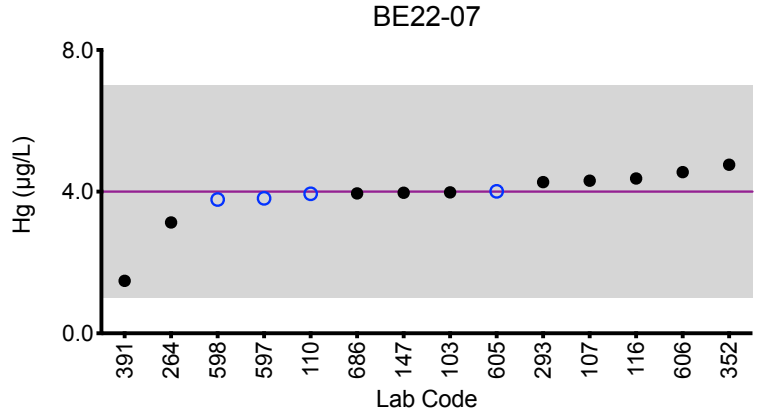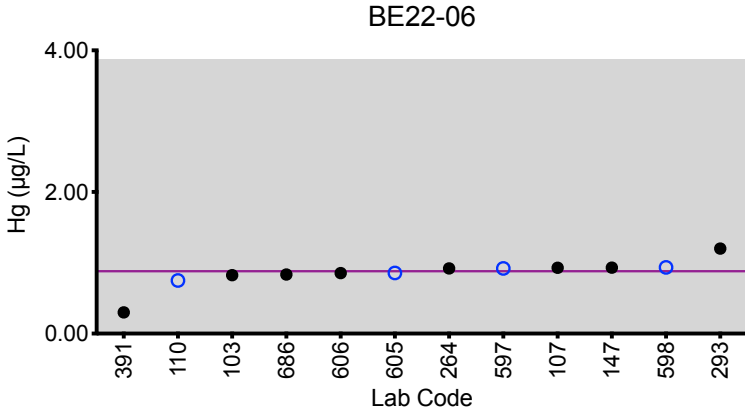
BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value
based on the robust mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±3 µg/L or ±30% around the target value,
whichever is greater; thus, it is fixed at ±3 µg/L at
concentrations less than or equal to 10 µg/L.

Results for Event #2, 2022:
Summary Statistics

Whole Blood Mn (µg/L)					
	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Target (Robust Mean (x^*))	8.9	16.9	12.9	23.0	10.0
Upper Limit	11.9	19.9	15.9	26.9	13.0
Lower Limit	5.9	13.9	9.9	19.1	7.0
Robust SD (s^*)	0.6	0.9	0.7	1.8	1.2
Robust RSD (%)	6.7	5.3	5.4	7.8	12
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (u)	0.2	0.4	0.3	0.7	0.5

The acceptable range is based on quality specifications:

±3 µg/L or ±17% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 17.7 µg/L. These quality specifications were recently proposed by a network of Trace Element PT program organizers (Praamsma M, et al. An assessment of clinical laboratory performance for the determination of manganese in blood and urine. Clinical Chemistry Laboratory Medicine 2016; 54(12): 1921-1928).

Results for Event #2, 2022:
Performance of Participating Laboratories

		Whole Blood Mn (µg/L)				
Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
	Target	**8.9**	**16.9**	**12.9**	**23.0**	**10.0**
103	ICP-MS/MS	9.43	16.8	13.1	22.3	10.1
107	ICP-MS/MS	9.32	17.55	12.98	24.31	9.70
110	ICP-MS	8.5	16.9	12.8	22.8	8.6
147	ICP-MS	10.9	17.6	14.6	24.2	11.5
264	ICP-MS	10.84	19.86	16.35 ↑	25.74	12.96
293	DRC/CC-ICP-MS	8.3	15.82	11.8	21.2	8.46
391	DRC/CC-ICP-MS	8.4	16.14	12.5	20.5	10.85
597	ICP-MS/MS	8.50	15.7	12.3	21.7	9.18
598	ICP-MS	8.53	17.2	12.6	23.3	9.89
606	ICP-MS/MS	8.94	17.3	13.3	23.6	9.65

Based on the grading criteria for Mn in Whole Blood, 98% of results were satisfactory, with 0 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Whole Blood Mn

BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the robust mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±3 µg/L or ±17% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 17.7 µg/L.

Results for Event #2, 2022:
Summary Statistics

Whole Blood Pb (µg/dL)					
	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Target (Robust Mean (x*))	1.49	3.25	5.07	12.1	0.80
Upper Limit	3.49	5.25	7.07	14.1	2.80
Lower Limit	0.00	1.25	3.07	10.1	0.00
Robust SD (s*)	0.05	0.12	0.27	0.7	0.07
Robust RSD (%)	3.4	3.7	5.3	5.8	8.8
Number of Sample Measurements (N)	13	14	15	15	10
Standard Uncertainty (u)	0.02	0.04	0.09	0.2	0.03

The acceptable range is based on quality specifications:

±2 µg/dL or ±10% around the target value, whichever is greater; thus, it is fixed at ±2 µg/dL at concentrations less than or equal to 20 µg/dL. These quality specifications are recommended by the Clinical Laboratory Standards Institute (CLSI, C40-A2) and have been proposed for use in proficiency testing programs approved under CLIA by the Centers for Medicare and Medicaid Services (CMS) in the USA. (https://clsi.org/standards/products/clinical-chemistry-and-toxicology/documents/c40/)

Results for Event #2, 2022:
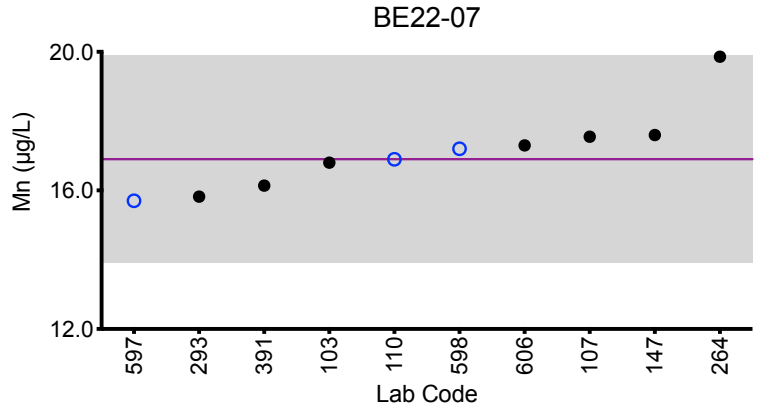# Performance of Participating Laboratories

Whole Blood Pb (µg/dL)					
Lab Code	**Method**	**BE22-06**	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
	Target	**1.49**	**3.25**	**5.07**	**12.1**	**0.80**
103	ICP-MS/MS	1.48	3.20	4.99	11.7	0.796
107	ICP-MS/MS	1.540	3.312	5.180	13.101	0.794
110	ICP-MS	1.45	3.21	4.96	12.2	0.74
116	ICP-MS/MS	<3.00	3.36	5.39	12.8	<3.00
147	ICP-MS	1.50	3.27	5.20	12.4	0.804
264	ICP-MS	1.86	2.98	4.79	11.42	0.65
293	DRC/CC-ICP-MS	1.45	3.31	4.96	12.0	0.83
343	ASV-LeadCare	<3.3	<3.3	3.9	9.7 ↓	<3.3
352	ETAAS-Z	16.2 ↑	29.4 ↑	61.3 ↑	140.8 ↑	3.84 ↑
391	ETAAS-Z	0.94	2.31	4.44	10.4	1.08
597	ICP-MS/MS	1.44	3.08	4.94	11.7	0.750
598	ICP-MS	1.47	3.23	5.21	12.0	0.821
605	ICP-MS	1.56	3.39	5.38	13.0	<1.00
606	ICP-MS/MS	1.49	3.30	5.21	12.4	<1.00
686	ICP-MS	1.48	3.17	5.05	12.1	<1.00

Based on the grading criteria for Pb in Whole Blood, 92% of results were satisfactory, with 1 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Whole Blood Pb
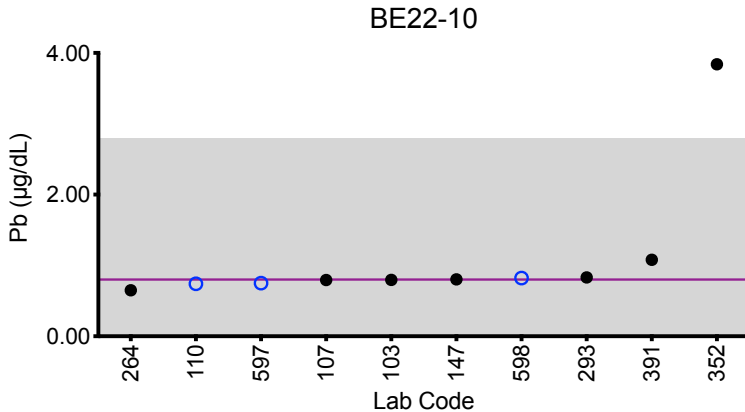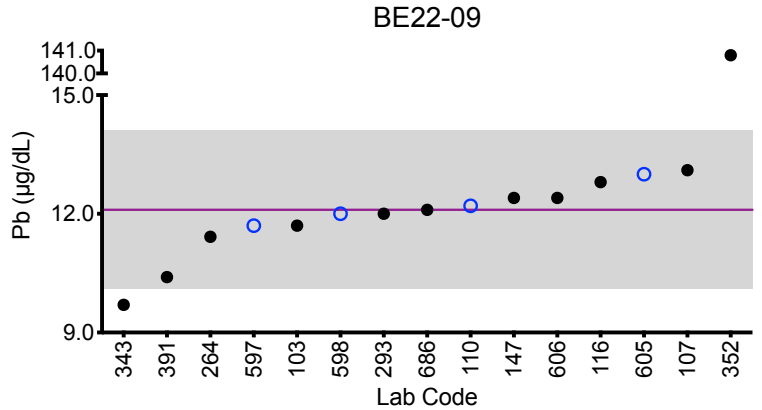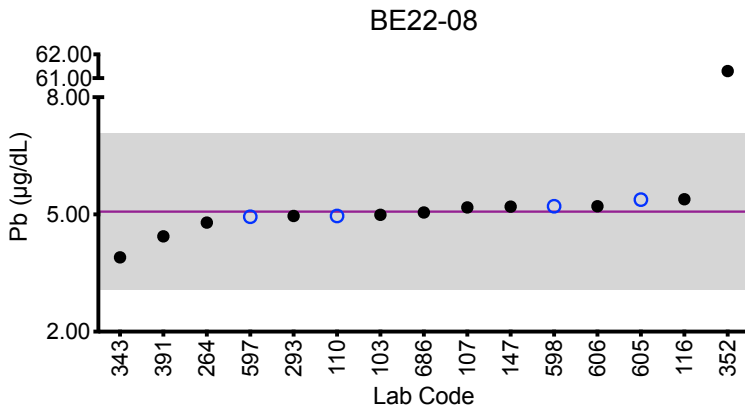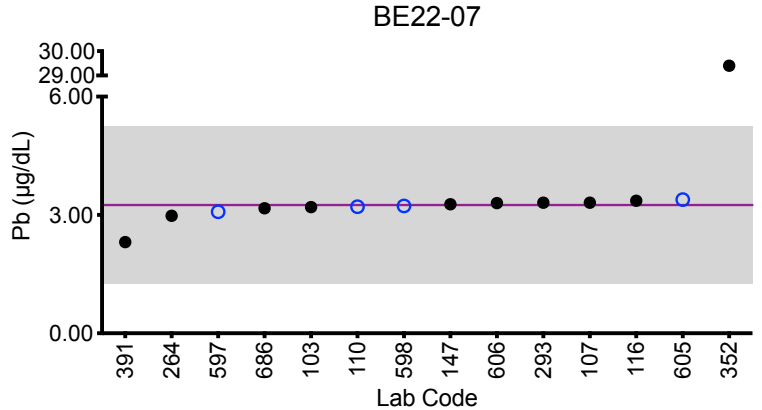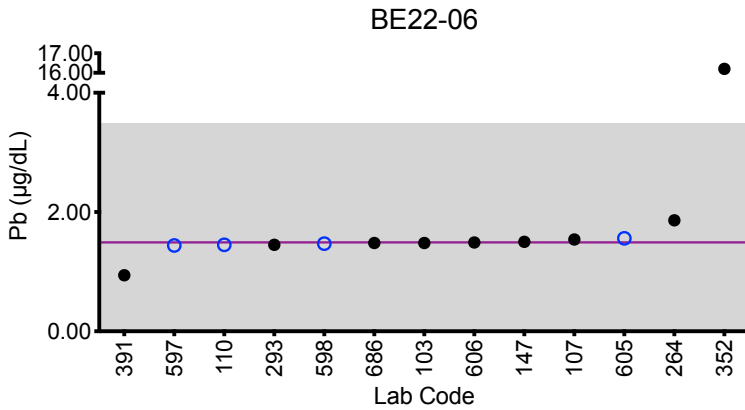
BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
o C/HHEAR Labs   • Other Labs
Horizontal purple line = assigned target value
based on the robust mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±2 µg/dL or ±10% around the target value,
whichever is greater; thus, it is fixed at ±2 µg/dL at
concentrations less than or equal to 20 µg/dL.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
103	ICP-MS/MS	<1.50	<1.50	<1.50	1.89	6.94
147	ICP-MS	0.421	0.554	0.246	1.76	6.84
264	ICP-MS	*2.07	<0.10	<0.10	*0.5	*5.84
442	DRC/CC-ICP-MS	0.394	0.453	0.263	1.8	6.75
597	ICP-MS/MS	0.360	*0.935	0.331	1.79	6.85
598	DRC/CC-ICP-MS	0.460	0.509	0.261	1.91	6.88

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\bar{x}$)	0.41	0.51	0.28	1.83	6.85
Arithmetic SD (s)	0.04	0.05	0.04	0.07	0.07
Arithmetic RSD (%)	9.8	10	14	3.8	1.0
Number of Sample Measurements (N)	4	3	4	5	5

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Whole Blood Mo
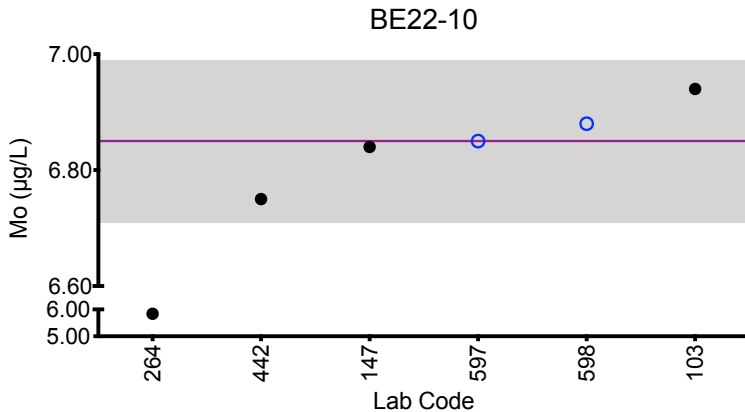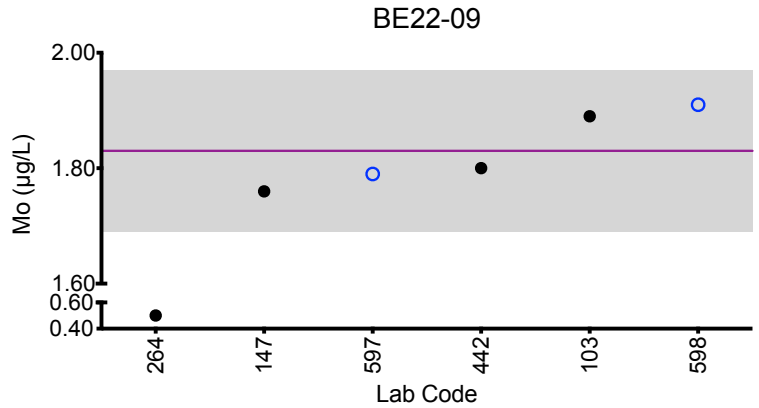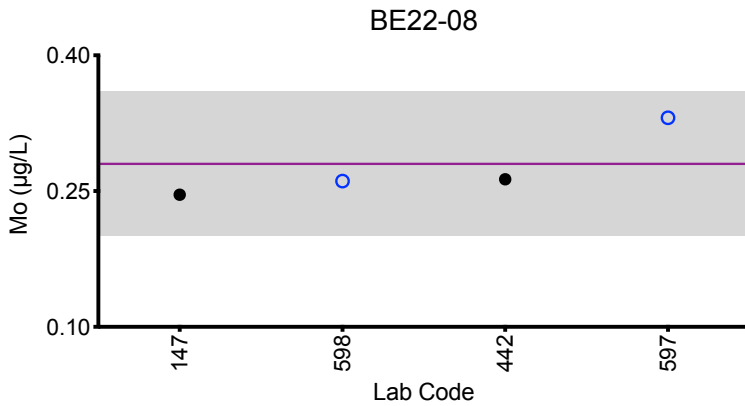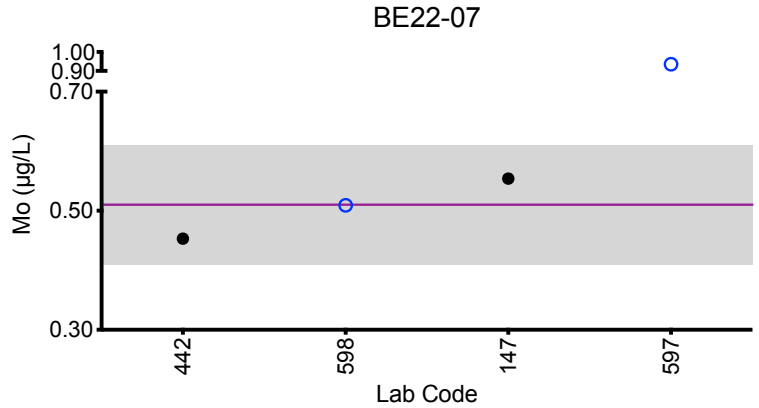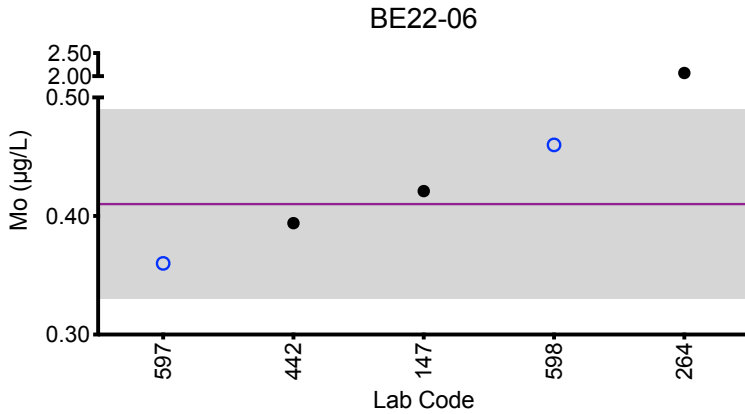
BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)						
Lab Code	**Method**	**BE22-06**	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
103	ICP-MS/MS	1.61	0.544	2.60	0.984	0.800
110	ICP-MS	2.24	0.741	3.38	1.23	0.985
147	ICP-MS	2.31	0.670	3.26	1.33	1.00
264	ICP-MS	2.01	0.61	3.11	1.12	0.90
293	DRC/CC-ICP-MS	2.000	0.69	3.22	1.17	0.96
442	DRC/CC-ICP-MS	2.072	0.446	3.1	1.11	0.731
597	ICP-MS/MS	2.31	0.788	3.38	1.37	1.06
598	ICP-MS	2.42	1.19	3.99	1.82	1.31

Summary Statistics					
	BE22-06	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
Arithmetic Mean ($\bar{x}$)	2.12	0.71	3.3	1.27	0.97
Arithmetic SD (s)	0.26	0.22	0.4	0.26	0.18
Arithmetic RSD (%)	12	31	12	20	19
Number of Sample Measurements (N)	8	8	8	8	8

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Whole Blood Sb
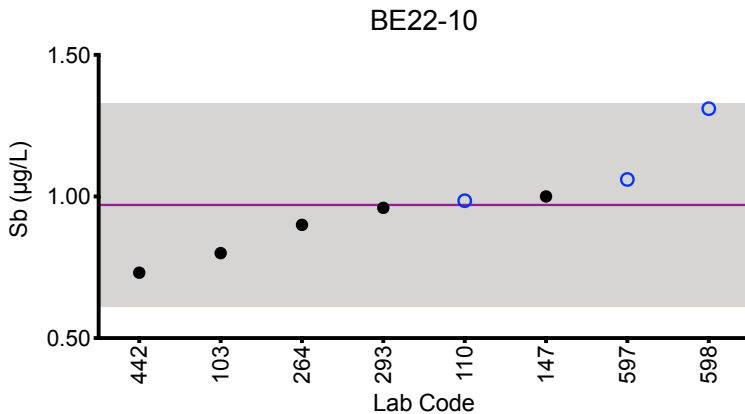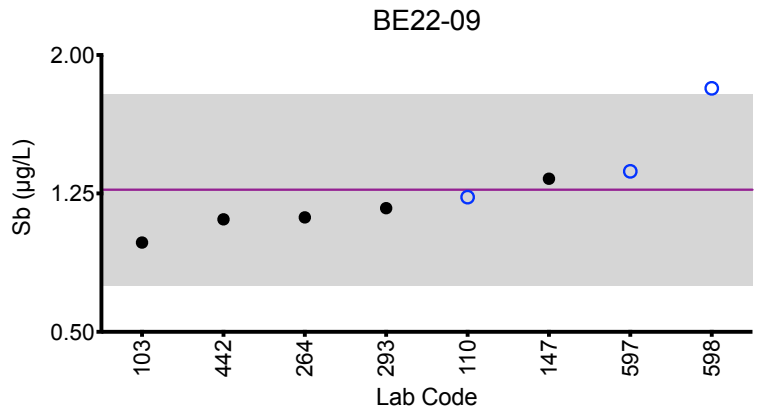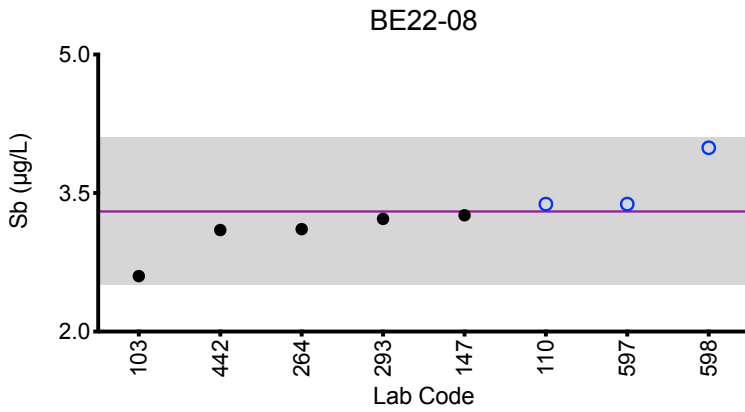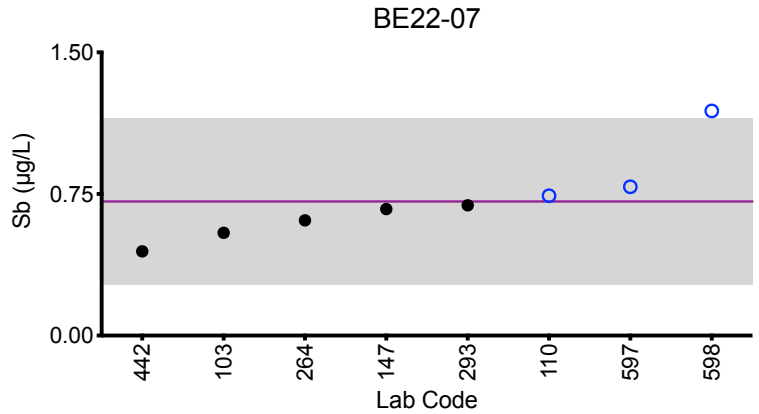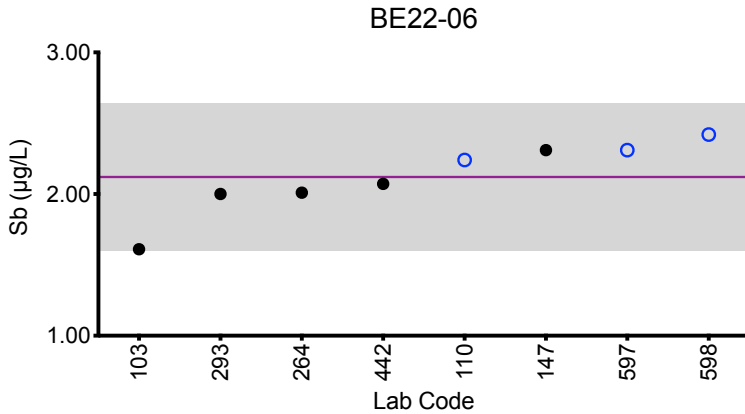
BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
103	ICP-MS/MS	114	277	364	180	373
107	ICP-MS/MS	127.7	308.5	399.6	216.6	386.5
110	DRC/CC-ICP-MS	122	275	367	179	338
147	ICP-MS	111	255	337	175	335
264	ICP-MS	95.51	220.07	304.57	155.51	294.26
293	DRC/CC-ICP-MS	116	281	351	181	368
352	ETAAS-Z	98.2	283.2	359	174	372.3
597	ICP-MS/MS	118	273	362	186	354
598	DRC/CC-ICP-MS	118	300	379	191	366

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\bar{x}$)	113	275	358	182	354
Arithmetic SD (s)	11	26	27	16	28
Arithmetic RSD (%)	9.7	9.5	7.5	8.8	7.9
Number of Sample Measurements (N)	9	9	9	9	9

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Whole Blood Se

BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Tl (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
103	ICP-MS/MS	0.220	0.840	1.27	0.379	0.504
110	ICP-MS	0.237	0.915	1.36	0.436	0.559
147	ICP-MS	0.264	0.916	1.36	0.439	0.554
264	ICP-MS	*1.51	1.04	1.43	0.38	0.51
293	DRC/CC-ICP-MS	0.23	0.87	1.31	0.40	0.53
597	ICP-MS/MS	0.229	0.865	1.26	0.411	0.530
598	ICP-MS	0.336	1.03	1.64	0.493	*0.696

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\bar{x}$)	0.25	0.93	1.38	0.42	0.531
Arithmetic SD (s)	0.04	0.08	0.13	0.04	0.022
Arithmetic RSD (%)	16	8.6	9.4	9.5	4.1
Number of Sample Measurements (N)	6	7	7	7	6

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Whole Blood Tl
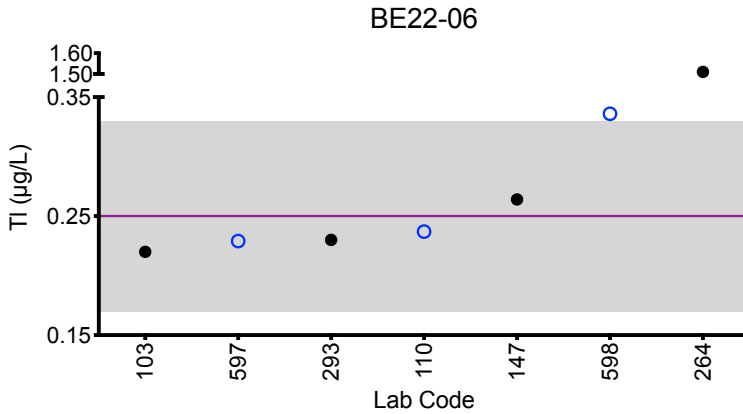
BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
103	ICP-MS/MS	0.141	<0.0500	0.0861	0.238	0.105
110	ICP-MS	0.145	0.0452	0.0902	0.251	0.107
147	ICP-MS	0.138	0.0400	0.0879	0.238	0.0986
391	DRC/CC-ICP-MS	*2.238	*0.52	*1.44	*1.166	*1.073
597	ICP-MS/MS	0.141	0.0460	0.0918	0.238	0.100
598	ICP-MS	0.127	0.0510	0.119	0.276	0.140

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\overline{x}$)	0.138	0.046	0.095	0.248	0.110
Arithmetic SD (s)	0.007	0.005	0.014	0.017	0.017
Arithmetic RSD (%)	5.1	11	15	6.9	15
Number of Sample Measurements (N)	5	4	5	5	5

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Whole Blood U
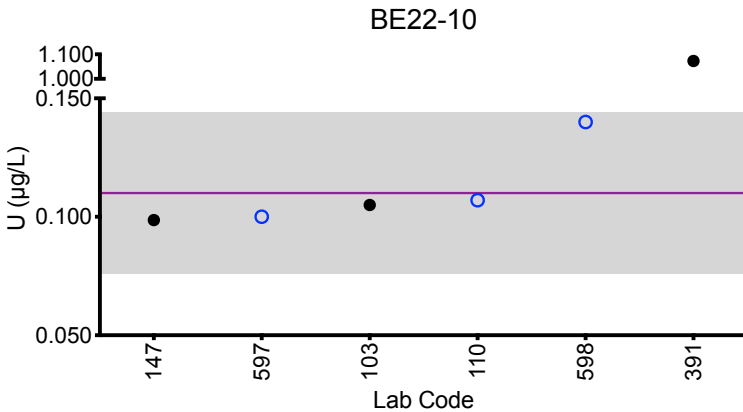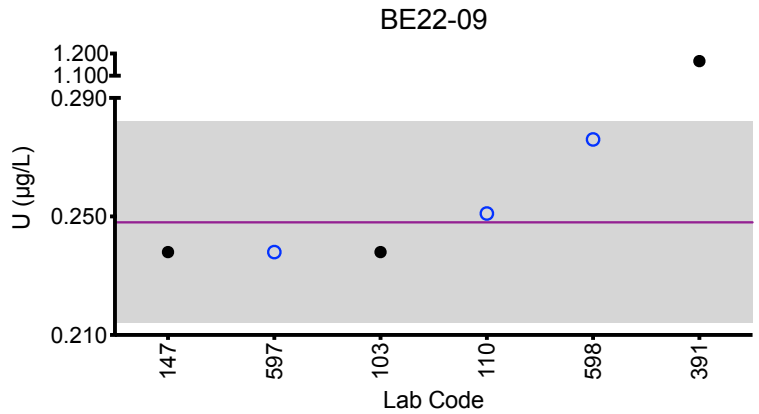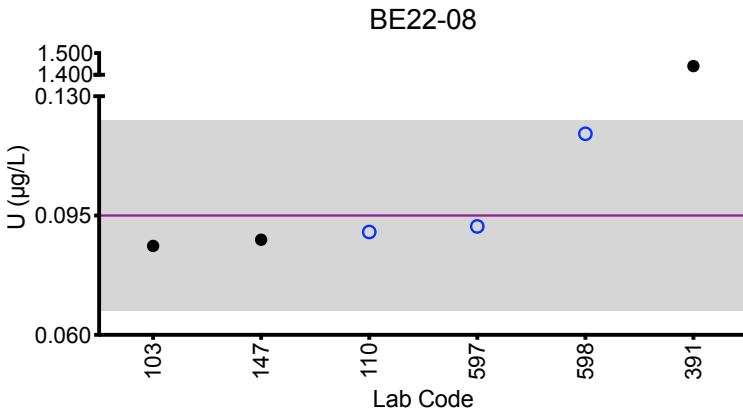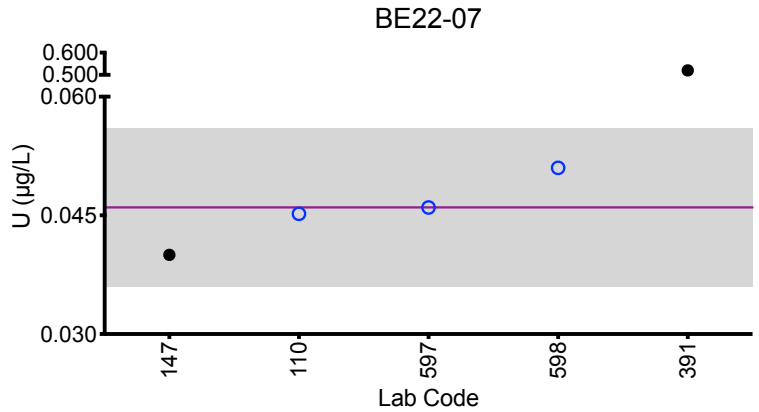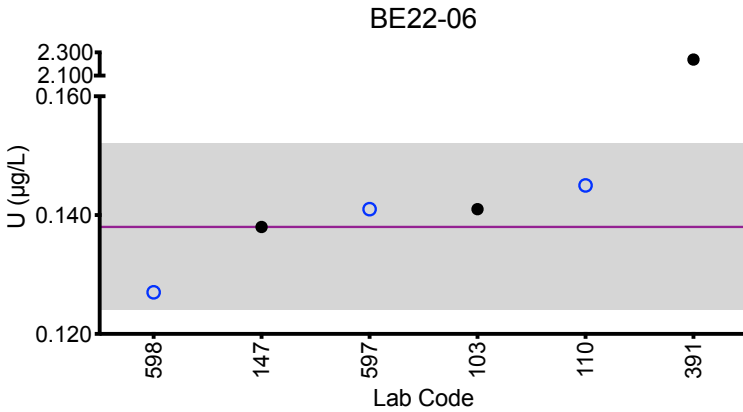
BE22-06

BE22-07

BE22-08

BE22-09

BE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
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Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
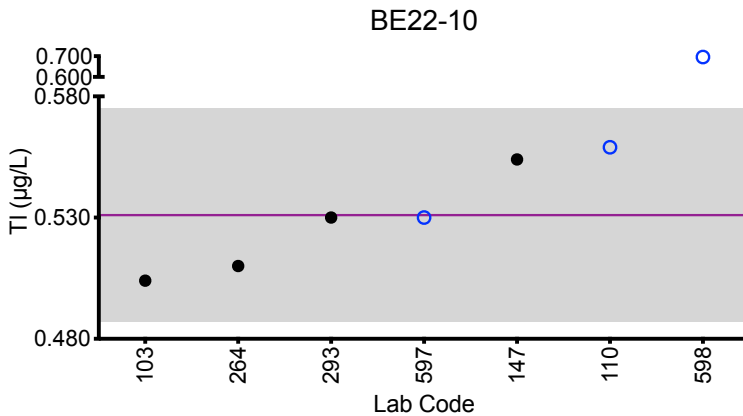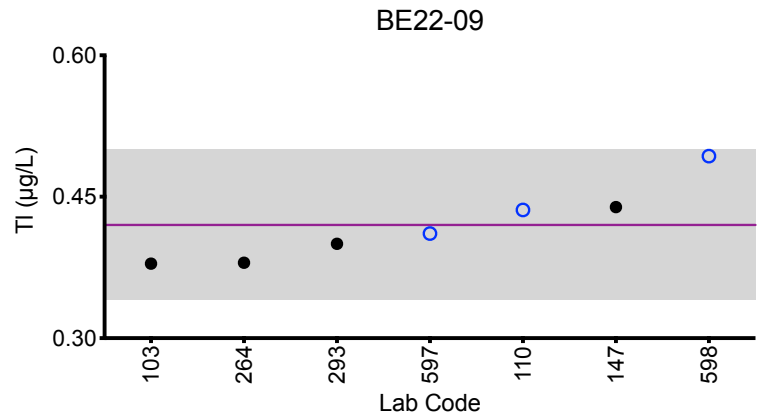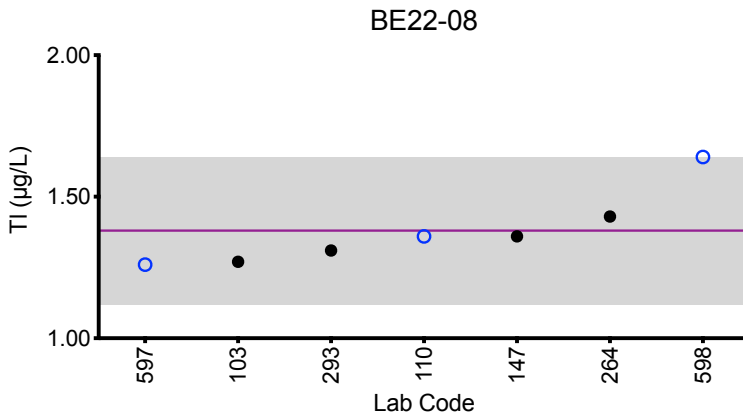## Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE22-06**	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
110	ICP-MS	7.43	9.07	5.09	3.20	3.85
147	ICP-MS	7.06	8.46	4.77	2.94	3.49
597	ICP-MS/MS	7.40	8.65	4.94	3.06	3.69
598	ICP-MS	7.18	9.80	5.88	3.56	4.56
Summary Statistics						
		BE22-06	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
Arithmetic Mean ($\bar{x}$)		7.27	9.0	5.2	3.2	3.9
Arithmetic SD (s)		0.18	0.6	0.5	0.3	0.5
Arithmetic RSD (%)		2.5	6.7	9.6	8.5	13
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

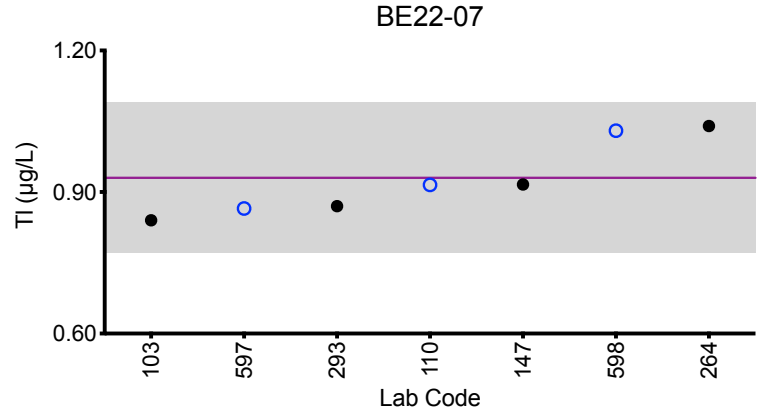# Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
110	ICP-MS	3.79	1.84	2.79	0.932	1.10
147	ICP-MS	3.47	1.86	2.44	<0.991	1.10
597	ICP-MS/MS	3.35	1.66	2.32	0.840	1.10
598	ICP-MS	3.92	2.28	2.82	1.01	1.12

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\bar{x}$)	3.6	1.9	2.6	0.93	1.105
Arithmetic SD (s)	0.3	0.3	0.3	0.09	0.010
Arithmetic RSD (%)	7.4	14	9.7	9.7	0.90
Number of Sample Measurements (N)	4	4	4	3	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
110	ICP-MS	1.81	1.49	1.62	1.79	1.51
147	ICP-MS	1.81	1.46	1.65	1.78	1.50
597	ICP-MS/MS	1.75	1.42	1.50	1.72	1.50
598	ICP-MS	1.93	1.50	1.86	1.87	1.59

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\bar{x}$)	1.83	1.47	1.66	1.79	1.52
Arithmetic SD (s)	0.08	0.04	0.15	0.06	0.04
Arithmetic RSD (%)	4.4	2.7	9.0	3.4	2.6
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)						
Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
110	ICP-MS	806	2198	966	2458	842
147	ICP-MS	801	2135	947	2484	845
597	ICP-MS/MS	774	2060	902	2370	808
598	ICP-MS	702	1960	903	2280	812
Summary Statistics						
		BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean (x̄)		770	2090	930	2400	827
Arithmetic SD (s)		50	100	30	90	19
Arithmetic RSD (%)		6.5	4.8	3.2	3.8	2.3
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
110	DRC/CC-ICP-MS	4.76	7.91	0.56	1.27	3.57
147	ICP-MS	3.84	6.87	0.371	1.21	3.45
597	ICP-MS/MS	3.90	6.63	<0.431	0.987	3.19
598	ICP-MS	5.00	7.55	*1.46	1.90	4.99

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\bar{x}$)	4.4	7.2	0.5	1.3	3.8
Arithmetic SD (s)	0.6	0.6	0.1	0.4	0.8
Arithmetic RSD (%)	14	8.3	29	31	21
Number of Sample Measurements (N)	4	4	2	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

		Whole Blood Pt (µg/L)				
Lab Code	**Method**	**BE22-06**	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
110	ICP-MS	0.531	1.41	2.18	0.290	3.71
293	DRC/CC-ICP-MS	0.450	1.230	1.93	0.24	3.40
598	ICP-MS	0.628	1.46	2.38	0.292	4.04
		Summary Statistics				
		BE22-06	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
Arithmetic Mean ($\bar{x}$)		0.54	1.37	2.2	0.27	3.7
Arithmetic SD (s)		0.09	0.12	0.2	0.03	0.3
Arithmetic RSD (%)		17	8.8	11	11	8.1
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Sn (μg/L)						
Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
110	ICP-MS	1.02	0.24	4.91	2.28	3.49
147	ICP-MS	1.01	0.315	4.63	2.11	3.17
597	ICP-MS/MS	1.10	0.403	4.63	2.31	3.37
598	ICP-MS	1.35	0.315	5.54	2.54	3.92
Summary Statistics						
		BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\overline{x}$)		1.12	0.32	4.9	2.31	3.5
Arithmetic SD (s)		0.16	0.07	0.4	0.18	0.3
Arithmetic RSD (%)		14	22	8.2	7.8	8.6
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE22-06**	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
103	ICP-MS/MS	28.2	25.5	42.6	29.4	27.0
147	ICP-MS	29.4	25.2	43.2	29.7	26.1
597	ICP-MS/MS	29.2	24.8	42.2	29.4	25.7
Summary Statistics						
		BE22-06	**BE22-07**	**BE22-08**	**BE22-09**	**BE22-10**
Arithmetic Mean ($\overline{x}$)		28.9	25.2	42.7	29.5	26.3
Arithmetic SD (s)		0.6	0.4	0.5	0.2	0.7
Arithmetic RSD (%)		2.1	1.6	1.2	0.58	2.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Ti (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
200	DRC/CC-ICP-MS	7.4	3.1	2.0	6.4	9.8
442	ICP-MS/MS	6.99	2.49	1.83	6.31	8.65
597	ICP-MS/MS	8.77	4.14	3.04	7.69	9.58

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\bar{x}$)	7.7	3.2	2.3	6.8	9.3
Arithmetic SD (s)	0.9	0.8	0.7	0.8	0.6
Arithmetic RSD (%)	12	25	30	12	6.5
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)						
Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
110	DRC/CC-ICP-MS	1.57	0.96	0.41	8.39	1.92
147	DRC/CC-ICP-MS	1.17	0.663	0.269	7.40	1.93
597	ICP-MS/MS	1.41	0.777	0.374	8.32	2.07
598	DRC/CC-ICP-MS	1.36	0.915	0.276	8.35	2.55
Summary Statistics						
		BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\overline{x}$)		1.38	0.83	0.33	8.1	2.1
Arithmetic SD (s)		0.16	0.14	0.07	0.5	0.3
Arithmetic RSD (%)		12	17	21	6.2	14
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
110	ICP-MS	0.307	1.91	1.22	0.189	0.916
200	ICP-MS	0.4	2.0	1.4	0.2	1.0
597	ICP-MS/MS	0.296	1.84	1.13	0.176	0.866
598	ICP-MS	0.417	2.12	1.34	0.244	1.02

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\bar{x}$)	0.35	1.97	1.27	0.20	0.95
Arithmetic SD (s)	0.06	0.12	0.12	0.03	0.07
Arithmetic RSD (%)	17	6.1	9.4	15	7.4
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
110	ICP-MS	6323	4571	6045	6081	4475
147	ICP-MS	5824	4183	5484	5673	4190
597	ICP-MS/MS	6310	4430	5850	6030	4490
598	ICP-MS	5980	4400	6040	6040	4610

Summary Statistics

	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
Arithmetic Mean ($\bar{x}$)	6110	4400	5850	5960	4440
Arithmetic SD (s)	250	160	260	190	180
Arithmetic RSD (%)	4.1	3.6	4.4	3.2	4.1
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
147	ICP-MS	<0.151	0.163	<0.151	<0.151	0.168

Whole Blood Al (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
147	ICP-MS	<4.86	<4.86	<4.86	4.86	<4.86
597	ICP-MS/MS	7.60	11.2	9.49	7.22	10.4

Whole Blood Bi (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
147	ICP-MS	<0.0334	<0.0334	<0.0334	<0.0334	<0.0334
597	ICP-MS/MS	<0.0285	<0.0285	<0.0285	<0.0285	<0.0285

Whole Blood I (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
147	ICP-MS	22.2	24.6	22.0	21.4	24.1

Whole Blood Li (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
147	ICP-MS	1408	0.520	2.01	1389	1.82

Whole Blood Mg (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
597	ICP-MS/MS	37600	27300	29100	36400	27100

Whole Blood Te (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
147	ICP-MS	<0.0561	<0.0561	<0.0561	<0.0561	<0.0561

Whole Blood Th (µg/L)

Lab Code	Method	BE22-06	BE22-07	BE22-08	BE22-09	BE22-10
147	ICP-MS	<0.0255	0.0255	<0.0255	<0.0255	<0.0255
597	ICP-MS/MS	0.211	0.228	0.211	0.0761	0.112

Event #2, 2022

Trace Elements in Urine

Event #2, 2022:
Trace Elements in Urine

PT Materials

Urine was collected from volunteer donors into polyethylene containers and stored at 4°C. Following collection, urine was acidified to 1% (v/v) with nitric acid and mixed with a sulfamic acid solution (stock solution contained 200 mg/mL sulfamic acid and 10% (v/v) Triton-X 100) to a final concentration of 1% (v/v) to stabilize Hg. Urine was stored frozen at -80°C pending further preparation. The urine was thawed at room temperature and precipitated salts removed by centrifugation. Urine supernatants were combined into five separate pools. Each urine pool was supplemented with arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), cobalt (Co),chromium (Cr), mercury (Hg), manganese (Mn), lead (Pb), thallium (Tl), uranium (U), aluminum (Al), cesium (Cs), copper (Cu), molybdenum (Mo), nickel (Ni), platinum (Pt), antimony (Sb) selenium (Se), tin (Sn), strontium (Sr), tellurium (Te), titanium (Ti), vanadium (V), tungsten (W), and zinc (Zn). PT samples were stored at -80°C until the week of the PT event, when they were thawed at 4°C prior to circulation to laboratories for analysis.

Graded Elements

Eleven elements in urine are formally graded: As, Ba, Be, Cd, Co, Cr, Hg, Mn, Pb, Tl, and U. Target values for the graded elements are assigned to these pools based on (a) the robust mean calculated from data reported by all laboratories, or (b) if a robust mean is not possible, the arithmetic mean after outlier deletion.

Additional Elements

An additional 23 elements were reported by at least one participant: Ag, Al, B, Bi, Cs, Cu, Fe, I, Li, Mg, Mo, Ni, Pt, Sb, Se, Sn, Sr, Te, Th, Ti, V, W, and Zn. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

The summary statistics for the additional elements are provided for educational purposes only, i.e., no acceptable response is implied. However, it is expected that each laboratory would wish to investigate a potential source of bias if warranted by these data. Future events might result in additional elements becoming graded if a consensus can be reached regarding desired quality specifications.

Educational Sample for assessing method performance at elevated concentrations

We included a special educational sample for urine (UE22-E1) in this event to assess method performance at elevated concentrations likely to be close to or even above the top calibration standard. Such samples may be challenging in inorganic mass spectrometry since a simple dilution into the linear calibration range can result in potential errors due to dilution of the urine matrix. In addition to assessing method performance at elevated concentrations, educational sample UE22-E1 can be archived at -80°C and used to provide validation of a dilution protocol or for validating the upper region of the calibration curve. Data reported for educational sample UE22-E1 were compiled and are shown at the end of the urine section. These data are provided for informational purposes only. No grading is implied.

Results for Event #2, 2022:
Summary Statistics

	Urine As (µg/L)				
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Target (Robust Mean (x^*))	47.2	7.0	2.80	1.14	24.3
Upper Limit	56.6	13.0	8.80	7.14	30.3
Lower Limit	37.8	1.0	0.00	0.00	18.3
Robust SD (s^*)	2.3	0.5	0.21	0.11	1.3
Robust RSD (%)	4.9	6.8	7.5	9.6	5.3
Number of Sample Measurements (N)	16	16	14	11	16
Standard Uncertainty (u)	0.7	0.1	0.07	0.04	0.4

The acceptable range is based on quality specifications:
±6 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±6 µg/L at concentrations less than or equal to 30 µg/L. These quality specifications are based on the same criteria used by the US Centers for Disease Control Prevention (CDC) for public health labs participating in the Laboratory Response Network (LRN) PT program for Toxic Metals.

Results for Event #2, 2022:
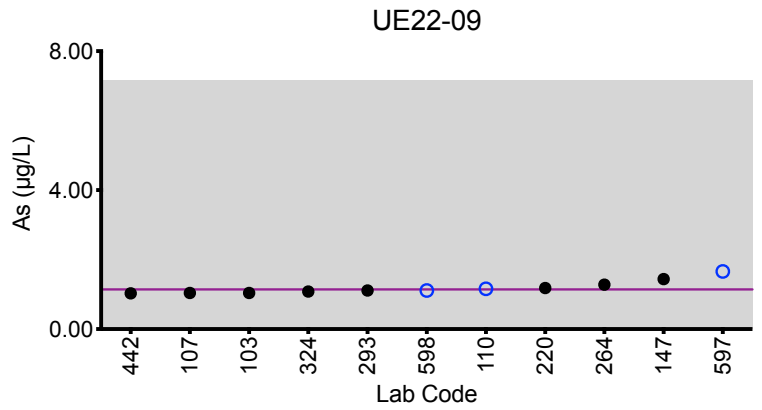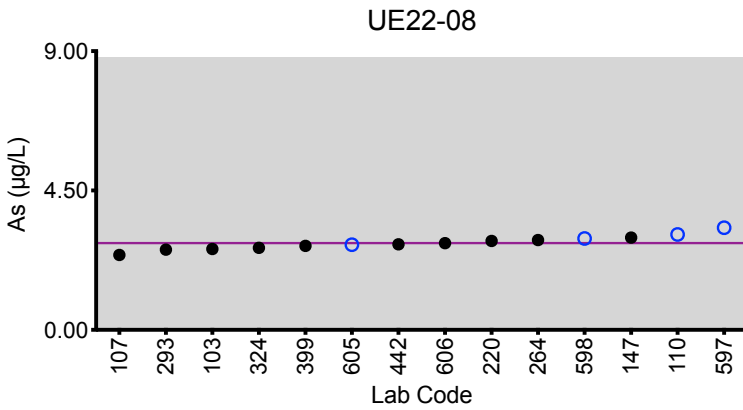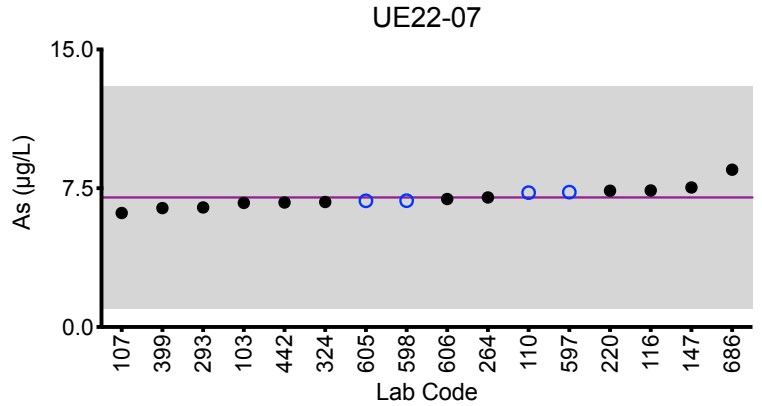# Performance of Participating Laboratories

		Urine As (µg/L)				
Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
	Target	47.2	7.0	2.80	1.14	24.3
103	ICP-MS/MS	44.9	6.71	2.61	1.04	23.2
107	DRC/CC-ICP-MS	44.12	6.16	2.42	1.04	21.32
110	DRC/CC-ICP-MS	49.7	7.26	3.08	1.16	25.3
116	ICP-MS/MS	49.9	7.38	<5.00	<5.00	26.2
147	ICP-MS	51.0	7.54	2.98	1.44	25.2
220	DRC/CC-ICP-MS	50.9	7.37	2.87	1.18	25.7
264	ICP-MS	46.27	7.00	2.90	1.28	25.13
293	DRC/CC-ICP-MS	46.46	6.46	2.59	1.11	22.4
324	ICP-MS	45.448	6.76	2.651	1.079	23.686
399	DRC/CC-ICP-MS	46.0	6.43	2.71	<2.00	21.9
442	ICP-MS/MS	45.3	6.73	2.76	1.03	23.1
597	ICP-MS/MS	45.7	7.29	3.30	1.66	23.9
598	DRC/CC-ICP-MS	46.5	6.83	2.95	1.11	24.5
605	ICP-MS	49.3	6.82	2.75	<2.00	24.9
606	ICP-MS/MS	48.3	6.92	2.80	<2.00	24.4
686	DRC/CC-ICP-MS	48.0	8.50	<6.00	<6.00	25.2

Based on the grading criteria for As in Urine, 100% of results were satisfactory, with 0 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine As

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
o C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the robust mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±6 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±6 µg/L at concentrations less than or equal to 30 µg/L.

Results for Event #2, 2022:
Summary Statistics

Urine Ba (µg/L)					
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Target (Robust Mean (x^*))	7.8	0.88	3.14	0.49	1.99
Upper Limit	9.4	1.88	4.14	1.49	2.99
Lower Limit	6.2	0.00	2.14	0.00	0.99
Robust SD (s^*)	0.5	0.07	0.22	0.04	0.14
Robust RSD (%)	6.4	8.3	7.1	7.5	7.1
Number of Sample Measurements (N)	12	12	12	7	12
Standard Uncertainty (u)	0.2	0.03	0.08	NA	0.05

The acceptable range is based on quality specifications:
±1 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 5 µg/L. These quality specifications are based on the same criteria used by the US Centers for Disease Control Prevention (CDC) for public health labs participating in the Laboratory Response Network (LRN) PT program for Toxic Metals.

An arithmetic mean, SD, RSD and n are provided for sample UE22-09.

Results for Event #2, 2022:
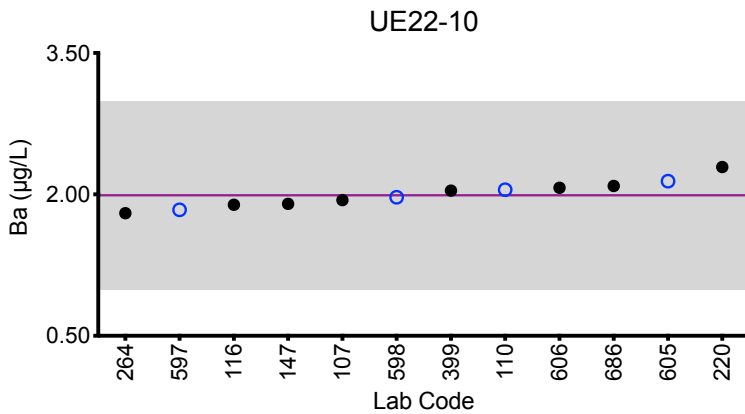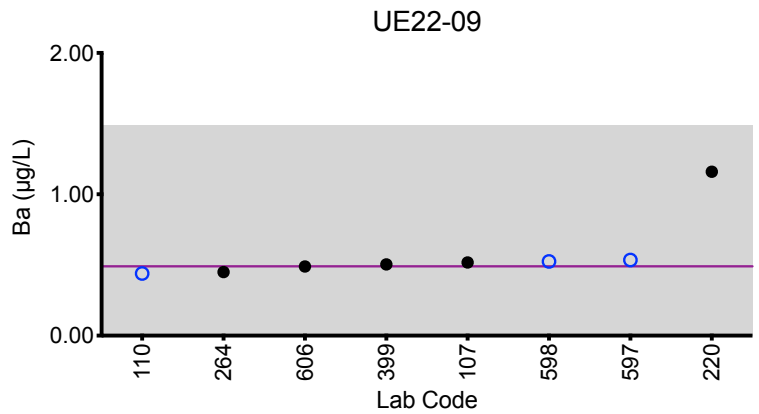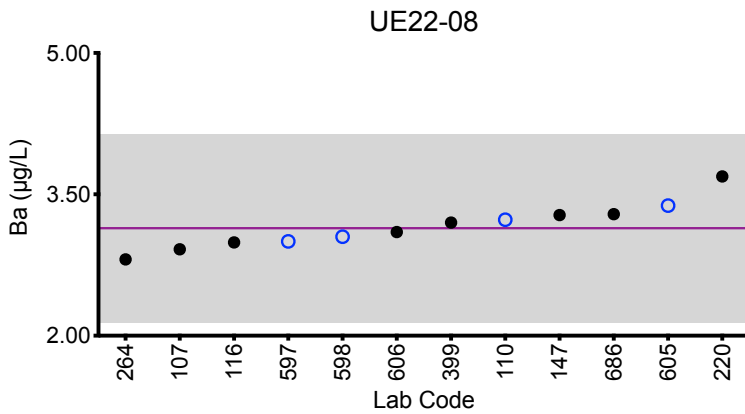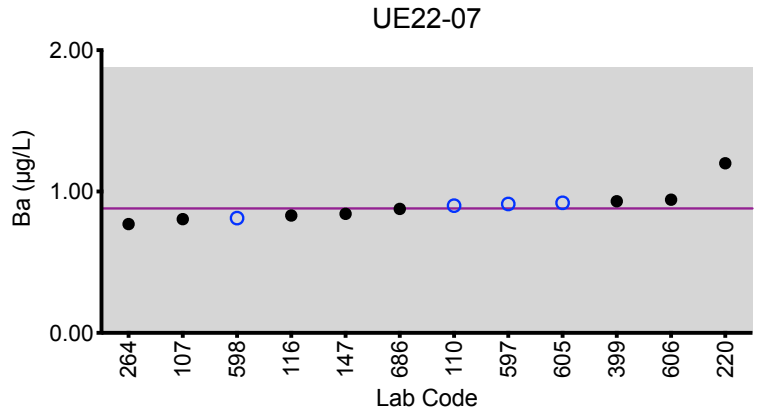## Performance of Participating Laboratories

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
	Target	**7.8**	**0.88**	**3.14**	**0.49**	**1.99**
107	ICP-MS	7.822	0.805	2.917	0.518	1.939
110	ICP-MS	7.74	0.90	3.23	0.44	2.05
116	ICP-MS/MS	8.05	0.830	2.99	<0.500	1.89
147	ICP-MS	8.08	0.842	3.28	<0.659	1.90
220	ICP-MS	8.29	1.2	3.69	*1.16	2.29
264	ICP-MS	6.62	0.77	2.81	0.45	1.80
399	ICP-MS/MS	7.91	0.931	3.20	0.504	2.04
597	ICP-MS/MS	7.30	0.912	3.00	0.535	1.837
598	ICP-MS	7.30	0.812	3.05	0.525	1.97
605	ICP-MS	8.31	0.92	3.38	<0.60	2.14
606	ICP-MS/MS	7.38	0.942	3.10	0.489	2.07
686	DRC/CC-ICP-MS	7.96	0.877	3.29	<0.600	2.09

Urine Ba (µg/L)

Based on the grading criteria for Ba in Urine, 100% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine Ba

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the robust mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±1 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 5 µg/L.

Results for Event #2, 2022:
Summary Statistics

Urine Be (µg/L)					
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Target (Robust Mean (x*))	1.95	0.61	4.10	0.10	0.82
Upper Limit	2.95	1.61	5.10	1.10	1.82
Lower Limit	0.95	0.00	3.10	0.00	0.00
Robust SD (s*)	0.13	0.03	0.24	0.01	0.04
Robust RSD (%)	6.7	5.4	5.9	8.5	4.8
Number of Sample Measurements (N)	12	12	12	8	12
Standard Uncertainty (*u*)	0.05	0.01	0.09	NA	0.01

The acceptable range is based on quality specifications:
±1 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 5 µg/L. These quality specifications are based on the same criteria used by the US Centers for Disease Control Prevention (CDC) for public health labs participating in the Laboratory Response Network (LRN) PT program for Toxic Metals.

An arithmetic mean, SD, RSD and n are provided for sample UE22-09.

Results for Event #2, 2022:
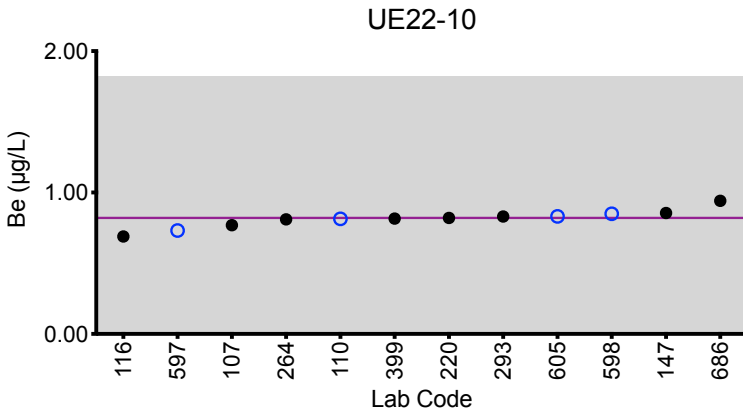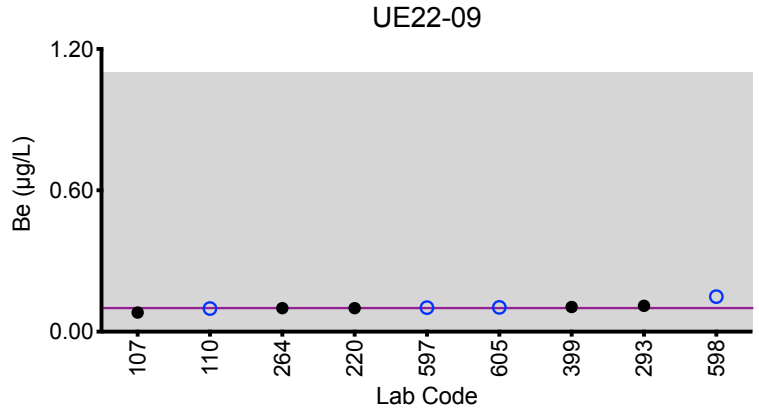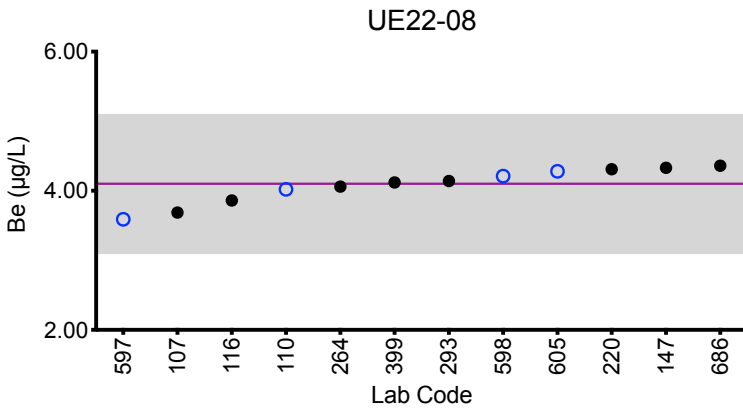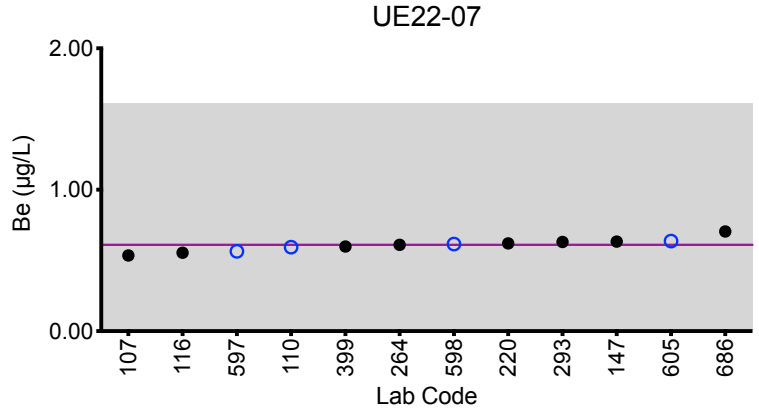## Performance of Participating Laboratories

		Urine Be (μg/L)				
Lab Code	**Method**	**UE22-06**	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
	Target	**1.95**	**0.61**	**4.10**	**0.10**	**0.82**
107	ICP-MS	1.949	0.535	3.686	0.081	0.769
110	ICP-MS	1.90	0.594	4.02	0.098	0.814
116	ICP-MS/MS	1.83	0.554	3.86	<0.300	0.689
147	ICP-MS	2.13	0.633	4.33	<0.225	0.855
220	ICP-MS	2.06	0.62	4.31	0.10	0.82
264	ICP-MS	1.87	0.61	4.06	0.10	0.81
293	ICP-MS	1.98	0.63	4.14	0.11	0.83
399	ICP-MS/MS	1.92	0.598	4.12	0.105	0.816
597	ICP-MS/MS	1.77	0.564	3.59	0.102	0.731
598	ICP-MS	1.84	0.616	4.21	*0.149	0.850
605	ICP-MS	2.08	0.637	4.28	0.103	0.831
686	DRC/CC-ICP-MS	2.08	0.705	4.36	<0.300	0.941

Based on the grading criteria for Be in Urine, 100% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine Be

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value
based on the robust mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±1 µg/L or ±20% around the target value,
whichever is greater; thus, it is fixed at ±1 µg/L at
concentrations less than or equal to 5 µg/L.

Results for Event #2, 2022:
Summary Statistics

	Urine Cd (µg/L)				
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Target (Robust Mean (x^*))	1.53	0.41	4.30	0.126	0.80
Upper Limit	2.53	1.41	5.30	1.126	1.80
Lower Limit	0.53	0.00	3.30	0.000	0.00
Robust SD (s^*)	0.08	0.03	0.30	0.023	0.07
Robust RSD (%)	5.2	8.6	7.0	18	8.8
Number of Sample Measurements (N)	17	16	17	14	16
Standard Uncertainty (u)	0.02	0.01	0.09	0.008	0.02

The acceptable range is based on quality specifications:
±1 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 6.6 µg/L. These quality specifications are based on the same criteria used by the US Centers for Disease Control Prevention (CDC) for public health labs participating in the Laboratory Response Network (LRN) PT program for Toxic Metals.

Results for Event #2, 2022:
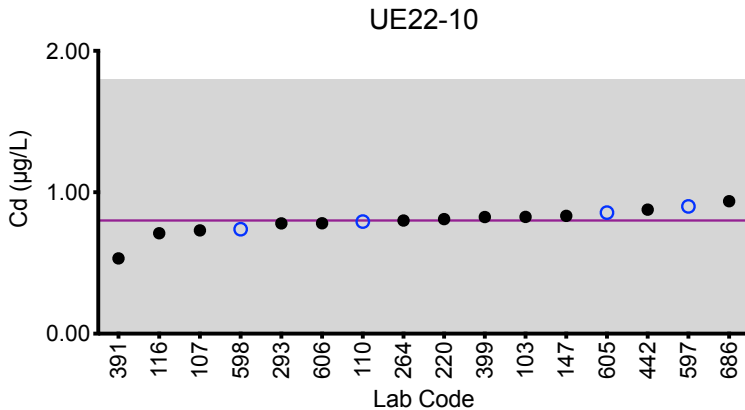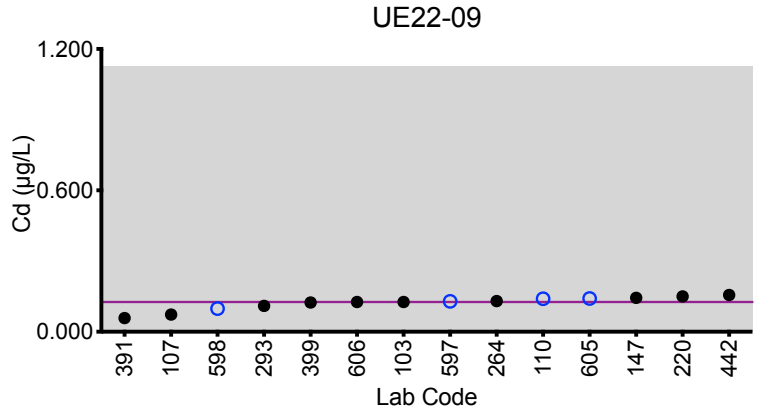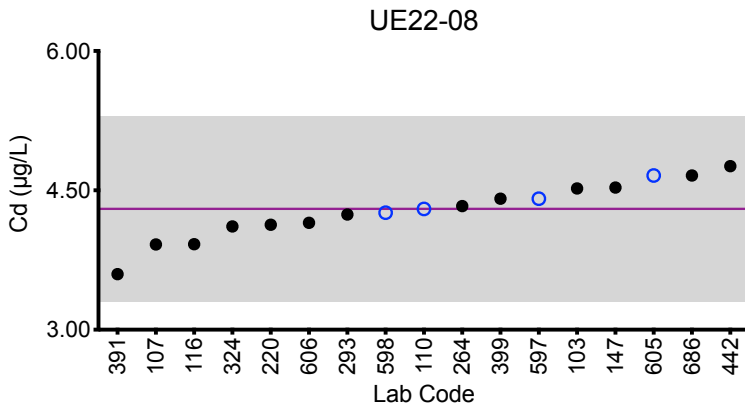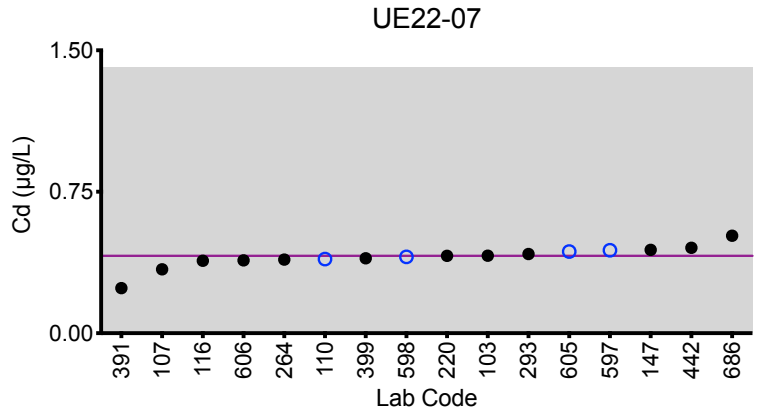## Performance of Participating Laboratories

Urine Cd (µg/L)						
Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
	Target	1.53	0.41	4.30	0.126	0.80
103	ICP-MS/MS	1.58	0.411	4.52	0.126	0.826
107	DRC/CC-ICP-MS	1.600	0.339	3.918	0.073	0.730
110	ICP-MS	1.48	0.393	4.30	0.140	0.793
116	ICP-MS/MS	1.37	0.384	3.92	<0.200	0.710
147	ICP-MS	1.57	0.442	4.53	0.144	0.833
220	ICP-MS	1.53	0.41	4.13	0.15	0.81
264	ICP-MS	1.42	0.39	4.33	0.13	0.80
293	DRC/CC-ICP-MS	1.53	0.42	4.24	0.11	0.78
324	ICP-MS	1.562	<1	4.111	<1	<1
391	DRC/CC-ICP-MS	1.184	0.239	3.598	0.058	0.532
399	DRC/CC-ICP-MS	1.51	0.397	4.41	0.124	0.825
442	ICP-MS/MS	1.52	0.453	4.76	0.156	0.877
597	ICP-MS/MS	1.54	0.4410	4.41	0.129	0.900
598	DRC/CC-ICP-MS	1.54	0.405	4.26	0.0980	0.739
605	ICP-MS	1.64	0.433	4.66	0.141	0.856
606	ICP-MS/MS	1.46	0.386	4.15	0.126	0.781
686	DRC/CC-ICP-MS	1.69	0.517	4.66	<0.240	0.937

Based on the grading criteria for Cd in Urine, 100% of results were satisfactory, with 0 of the 17 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine Cd

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
o C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value
based on the robust mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±1 µg/L or ±15% around the target value,
whichever is greater; thus, it is fixed at ±1 µg/L at
concentrations less than or equal to 6.6 µg/L.

Results for Event #2, 2022:
Summary Statistics

Urine Co (µg/L)					
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Target (Robust Mean (x^*))	1.98	3.44	0.51	NA	4.76
Upper Limit	3.48	4.94	2.01	NA	6.26
Lower Limit	0.48	1.94	0.00	NA	3.26
Robust SD (s^*)	0.13	0.13	0.07	NA	0.15
Robust RSD (%)	6.6	3.8	14	NA	3.2
Number of Sample Measurements (N)	14	14	13	NA	14
Standard Uncertainty (u)	0.04	0.04	0.02	NA	0.05

The acceptable range is based on quality specifications:
±1.5 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1.5 µg/L at concentrations less than or equal to 10 µg/L. These quality specifications were established based on discussions with the US FDA, and represent a consensus from a network of Trace Element PT program organizers

Statistical data was not calculated for UE22-09 based on a lack of consensus among participating labs.

Results for Event #2, 2022:
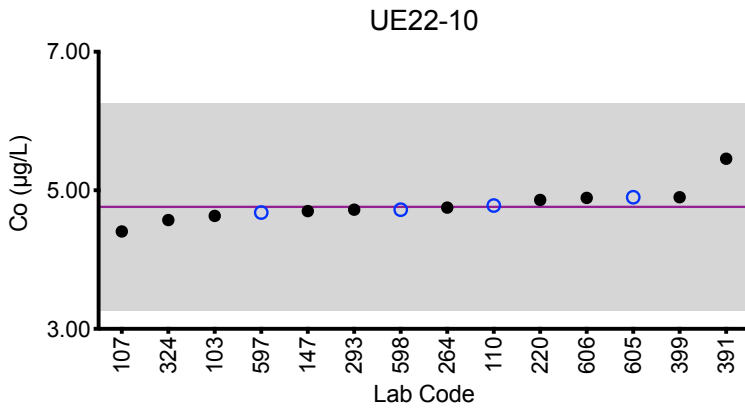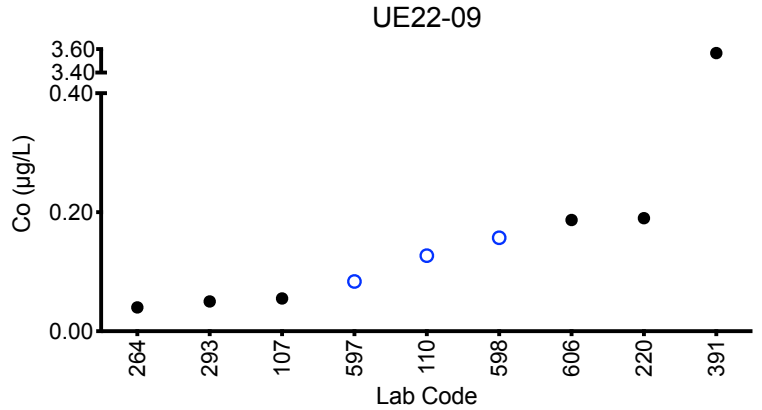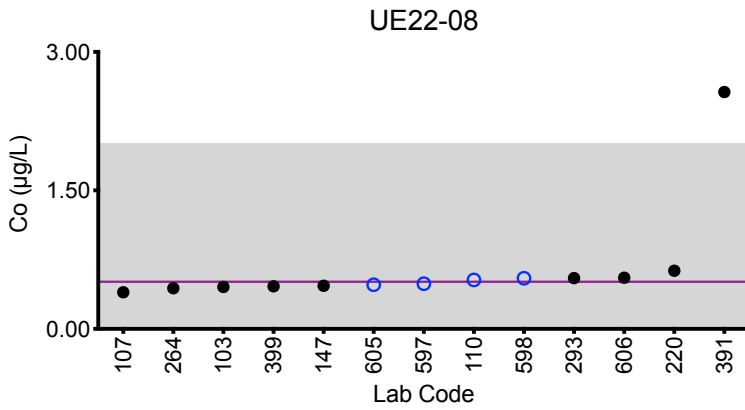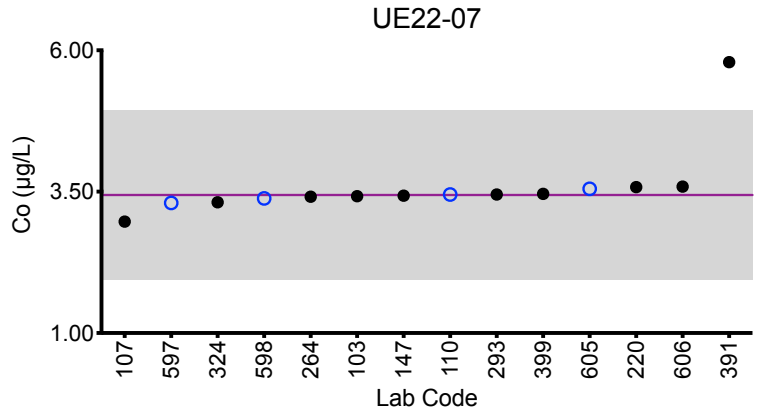## Performance of Participating Laboratories

Urine Co (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
	Target	**1.98**	**3.44**	**0.51**	**NA**	**4.76**
103	ICP-MS/MS	1.95	3.42	0.454	<0.0600	4.63
107	ICP-MS	1.925	2.971	0.397	0.055	4.406
110	ICP-MS	1.97	3.45	0.530	0.127	4.78
147	ICP-MS	2.04	3.43	0.467	<0.0648	4.70
220	ICP-MS	2.14	3.58	0.63	0.19	4.86
264	ICP-MS	1.81	3.41	0.44	0.04	4.75
293	DRC/CC-ICP-MS	1.95	3.45	0.55	0.05	4.72
324	ICP-MS	1.873	3.312	<1	<1	4.570
391	DRC/CC-ICP-MS	3.586 ↑	5.79 ↑	2.565 ↑	3.566	5.456
399	DRC/CC-ICP-MS	2.09	3.46	0.462	<0.0750	4.90
597	ICP-MS/MS	1.84	3.30	0.489	0.0835	4.68
598	ICP-MS	1.86	3.38	0.548	0.157	4.72
605	ICP-MS	2.06	3.55	0.478	<0.075	4.9
606	ICP-MS/MS	2.04	3.59	0.554	0.187	4.89

Based on the grading criteria for Co in Urine, 96% of results were satisfactory, with 1 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine Co

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the robust mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±1.5 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1.5 µg/L at concentrations less than or equal to 10 µg/L.

Results for Event #2, 2022:
Summary Statistics

Urine Cr (µg/L)					
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Target (Robust Mean (x^*))	5.4	0.89	3.25	0.93	10.0
Upper Limit	8.4	3.89	6.25	3.93	13.0
Lower Limit	2.4	0.00	0.25	0.00	7.0
Robust SD (s^*)	0.4	0.14	0.23	0.13	0.5
Robust RSD (%)	7.4	16	7.1	14	4.8
Number of Sample Measurements (N)	12	11	12	12	12
Standard Uncertainty (u)	0.1	0.05	0.08	0.05	0.2

The acceptable range is based on quality specifications:

±3 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 15 µg/L. These quality specifications were established based on discussions with the US FDA, and represent a consensus from a network of Trace Element PT program organizers

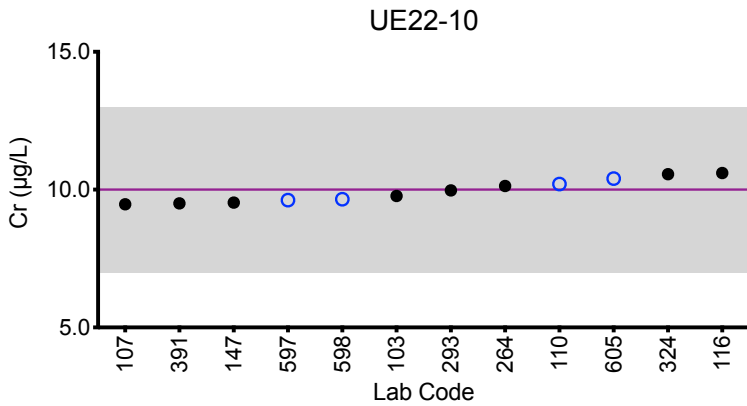# Results for Event #2, 2022:
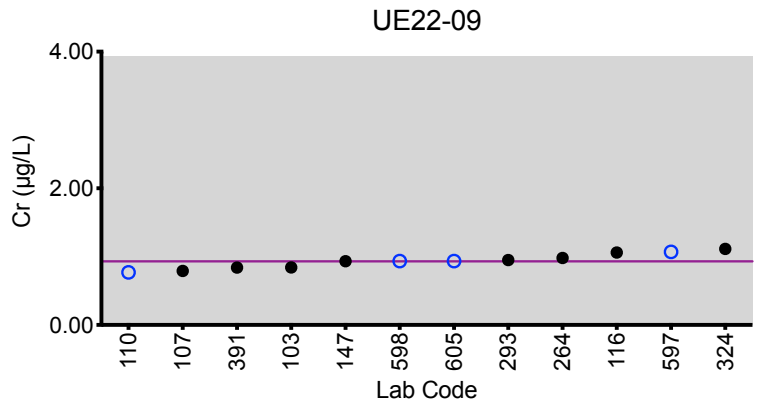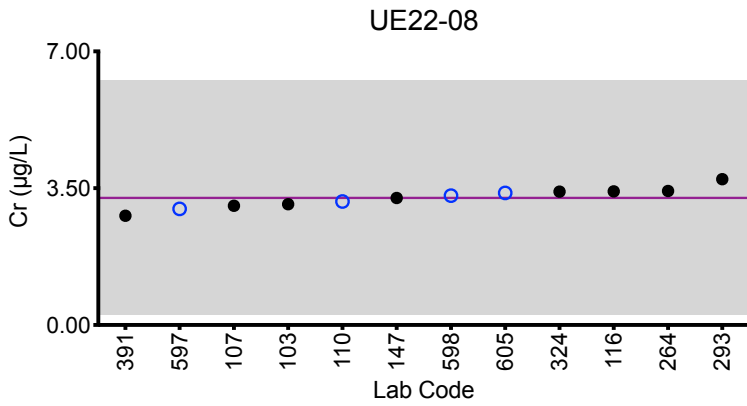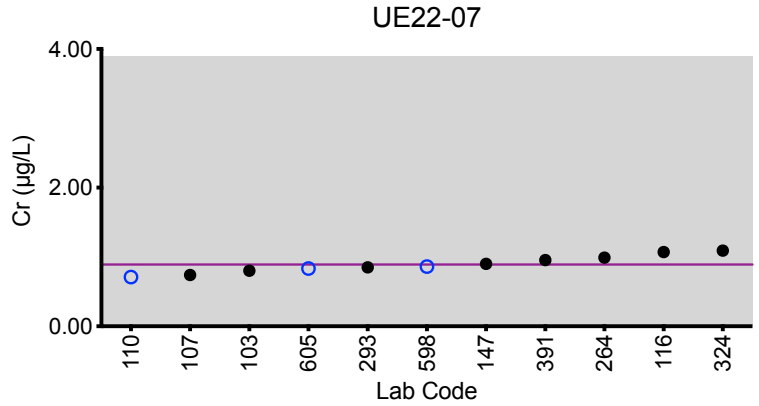## Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE22-06**	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
	Target	**5.4**	**0.89**	**3.25**	**0.93**	**10.0**
103	ICP-MS/MS	5.09	0.801	3.09	0.841	9.77
107	DRC/CC-ICP-MS	5.22	0.74	3.05	0.79	9.47
110	DRC/CC-ICP-MS	5.88	0.71	3.16	0.77	10.2
116	ICP-MS/MS	5.84	1.07	3.42	1.06	10.6
147	DRC/CC-ICP-MS	5.83	0.900	3.25	0.932	9.53
264	ICP-MS	5.50	0.99	3.43	0.98	10.13
293	DRC/CC-ICP-MS	5.47	0.85	3.73	0.95	9.97
324	ICP-MS	5.682	1.091	3.413	1.113	10.559
391	DRC/CC-ICP-MS	4.863	0.954	2.794	0.839	9.503
597	ICP-MS/MS	5.16	<1.06	2.97	1.07	9.62
598	DRC/CC-ICP-MS	4.99	0.862	3.31	0.934	9.65
605	ICP-MS	5.56	0.833	3.38	0.935	10.4

Based on the grading criteria for Cr in Urine, 100% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine Cr

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the robust mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±3 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 15 µg/L.

Results for Event #2, 2022:
Summary Statistics

	Urine Hg (µg/L)				
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Target (Robust Mean (x*))	15.0	0.60	5.9	1.82	21.2
Upper Limit	19.5	3.60	8.9	4.82	27.6
Lower Limit	10.5	0.00	2.9	0.00	14.8
Robust SD (s*)	1.0	0.17	0.6	0.27	1.8
Robust RSD (%)	6.7	28	10	15	8.5
Number of Sample Measurements (N)	14	10	14	14	14
Standard Uncertainty (u)	0.3	0.07	0.2	0.09	0.6

The acceptable range is based on quality specifications:
±3 µg/L or ±30% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 10 µg/L. These quality specifications were established by New York State Department of Health's Wadsworth Center, the PT Program organizer.

Results for Event #2, 2022:
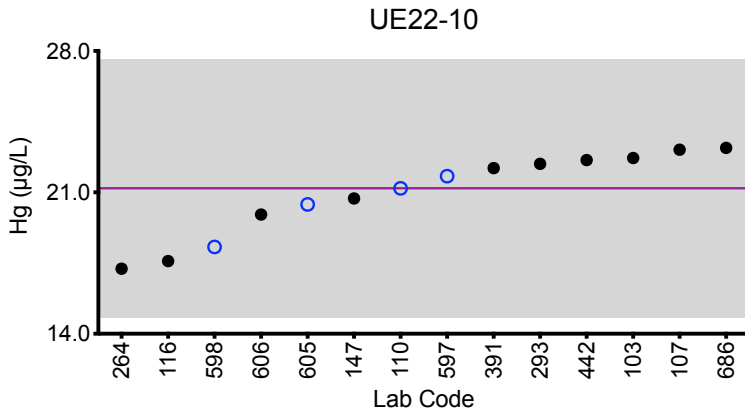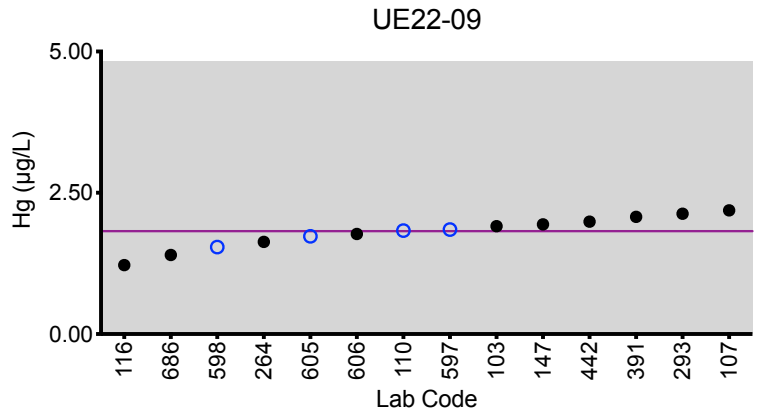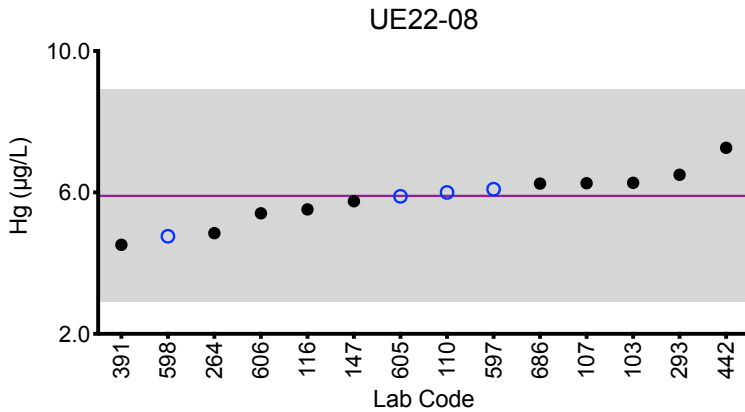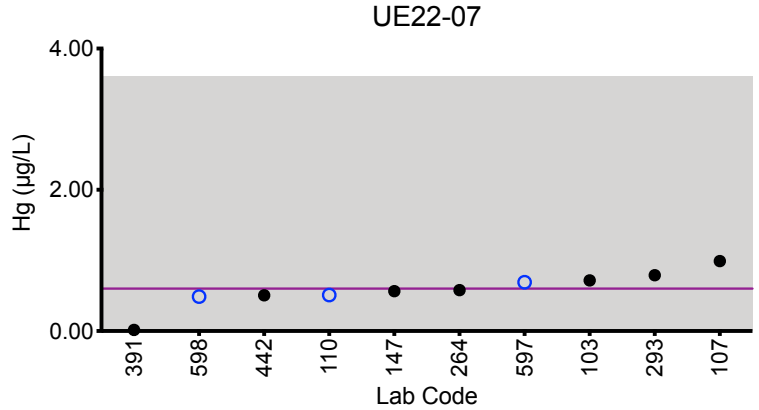## Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
	Target	**15.0**	**0.60**	**5.9**	**1.82**	**21.2**
103	ICP-MS/MS	15.1	0.716	6.27	1.91	22.7
107	DRC/CC-ICP-MS	17.27	0.99	6.26	2.19	23.11
110	ICP-MS	14.8	0.51	6.00	1.83	21.2
116	ICP-MS/MS	13.3	<0.500	5.52	1.22	17.6
147	ICP-MS	15.5	0.565	5.75	1.94	20.7
264	ICP-MS	16.32	0.58	4.85	1.63	17.22
293	DRC/CC-ICP-MS	15.6	0.79	6.5	2.13	22.41
391	DRC/CC-ICP-MS	14.021	0.015	4.518	2.074	22.201
442	ICP-MS/MS	15.6	0.505	7.26	1.99	22.6
597	ICP-MS/MS	14.6	0.691	6.09	1.85	21.8
598	ICP-MS	12.1	0.487	4.76	1.54	18.3
605	ICP-MS	14.3	<1.0	5.89	1.73	20.4
606	ICP-MS/MS	14.7	<1.00	5.41	1.77	19.9
686	ICP-MS	15.4	<1.00	6.25	1.40	23.2

Based on the grading criteria for Hg in Urine, 100% of results were satisfactory, with 0 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine Hg

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value
based on the robust mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±3 µg/L or ±30% around the target value,
whichever is greater; thus, it is fixed at ±3 µg/L at
concentrations less than or equal to 10 µg/L.

Results for Event #2, 2022:
Summary Statistics

	Urine Mn (µg/L)				
	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Target (Robust Mean (x*))	4.23	2.60	0.96	0.74	6.39
Upper Limit	5.29	3.25	1.51	1.29	7.99
Lower Limit	3.17	1.95	0.41	0.19	4.79
Robust SD (s*)	0.26	0.09	0.08	0.07	0.27
Robust RSD (%)	6.1	3.5	8.3	9.5	4.2
Number of Sample Measurements (N)	15	15	14	14	15
Standard Uncertainty (u)	0.08	0.03	0.03	0.02	0.09

The acceptable range is based on quality specifications:
±0.55 µg/L or ±25% around the target value, whichever is greater; thus, it is fixed at ±0.55 µg/L at concentrations less than or equal to 2.2 µg/L. Quality specifications for Mn are consistent with those used by other External Quality Assessment Schemes for trace elements. (Praamsma M, et al. An assessment of clinical laboratory performance for the determination of manganese in blood and urine. Clinical Chemistry and Laboratory Medicine.2016; 54(12): 1921-1928).

Results for Event #2, 2022:
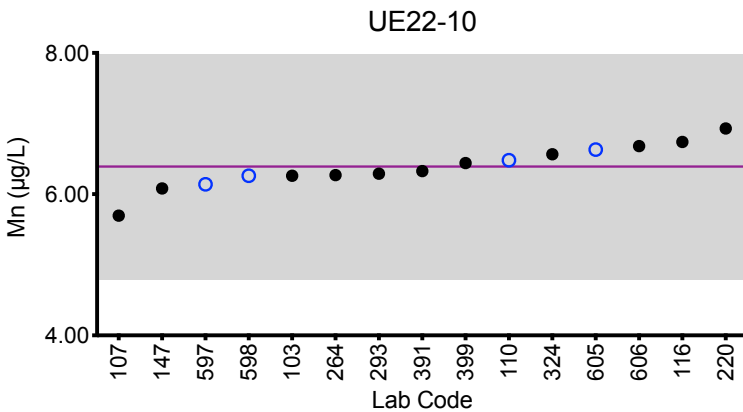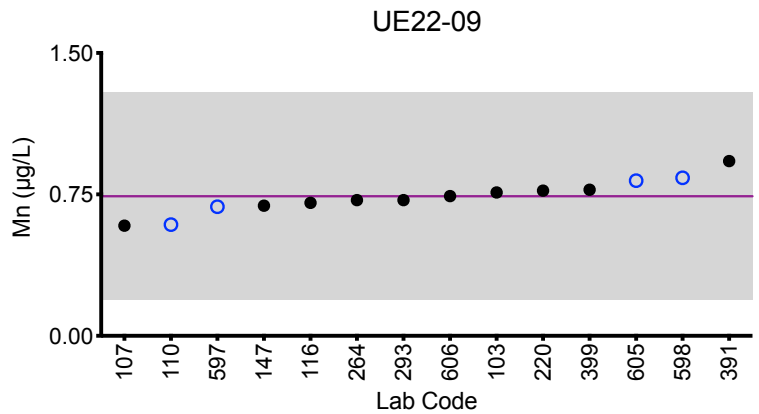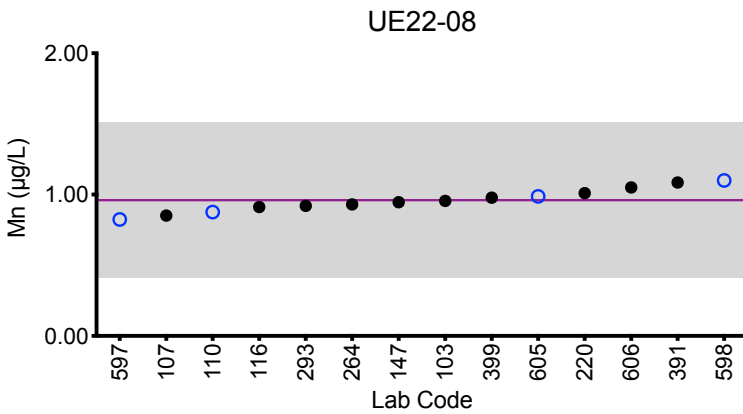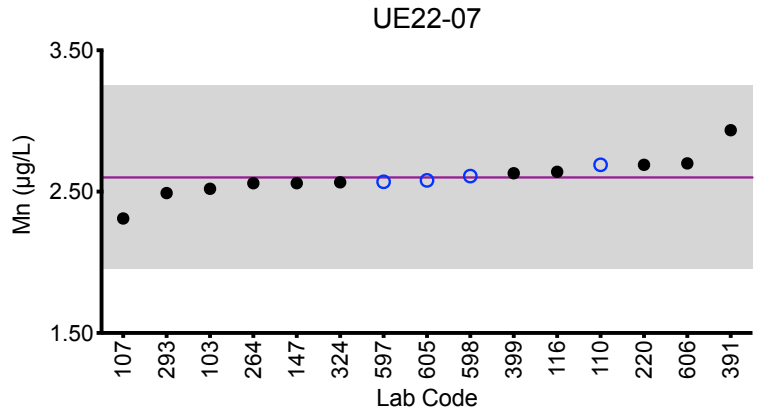# Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
	Target	**4.23**	**2.60**	**0.96**	**0.74**	**6.39**
103	ICP-MS/MS	4.11	2.52	0.955	0.760	6.26
107	DRC/CC-ICP-MS	3.918	2.310	0.851	0.584	5.696
110	DRC/CC-ICP-MS	4.40	2.69	0.876	0.590	6.48
116	ICP-MS/MS	4.27	2.64	0.912	0.705	6.74
147	DRC/CC-ICP-MS	4.36	2.56	0.946	0.690	6.08
220	DRC/CC-ICP-MS	4.38	2.69	1.01	0.77	6.93
264	ICP-MS	4.13	2.56	0.93	0.72	6.27
293	DRC/CC-ICP-MS	4.22	2.49	0.92	0.72	6.29
324	ICP-MS	4.212	2.566	<1	<1	6.565
391	DRC/CC-ICP-MS	3.976	2.935	1.085	0.927	6.326
399	DRC/CC-ICP-MS	4.63	2.63	0.978	0.775	6.44
597	ICP-MS/MS	4.00	2.57	0.824	0.685	6.14
598	ICP-MS	3.91	2.61	1.10	0.838	6.26
605	ICP-MS	4.53	2.58	0.987	0.823	6.63
606	ICP-MS/MS	4.47	2.70	1.05	0.741	6.68

Based on the grading criteria for Mn in Urine, 100% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine Mn

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the robust mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±0.55 µg/L or ±25% around the target value, whichever is greater; thus, it is fixed at ±0.55 µg/L at concentrations less than or equal to 2.2 µg/L.

Results for Event #2, 2022:
Summary Statistics

Urine Pb (µg/L)					
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Target (Robust Mean (x*))	5.97	1.19	4.11	0.343	12.09
Upper Limit	7.16	2.19	5.11	1.343	14.51
Lower Limit	4.78	0.19	3.11	0.000	9.67
Robust SD (s*)	0.18	0.08	0.14	0.026	0.18
Robust RSD (%)	3.1	6.7	3.4	7.6	1.5
Number of Sample Measurements (N)	17	17	17	15	17
Standard Uncertainty (u)	0.06	0.02	0.04	0.008	0.05

The acceptable range is based on quality specifications:

±1 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 5 µg/L. These quality specifications are based on the same criteria used by the US Centers for Disease Control Prevention (CDC) for public health labs participating in the Laboratory Response Network (LRN) PT program for Toxic Metals.

Results for Event #2, 2022:
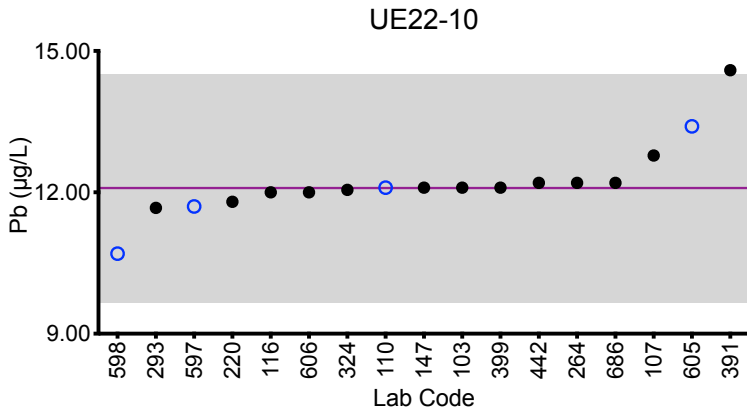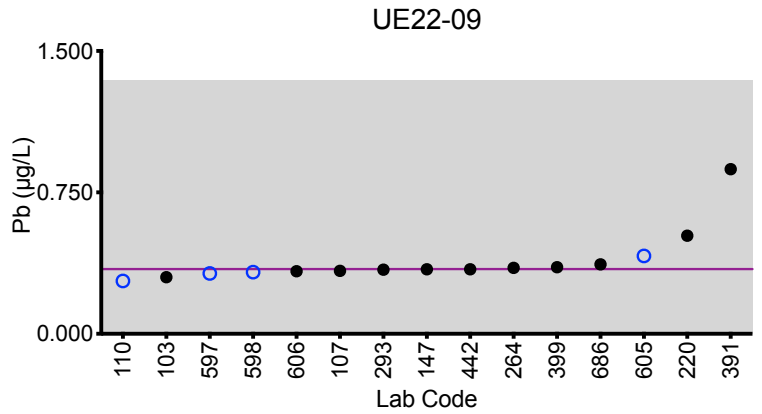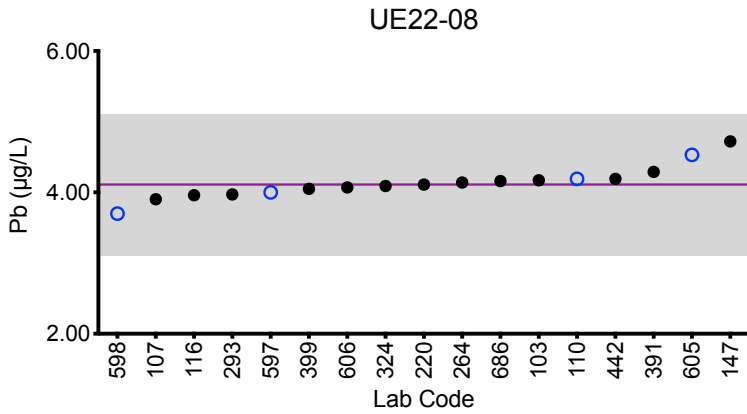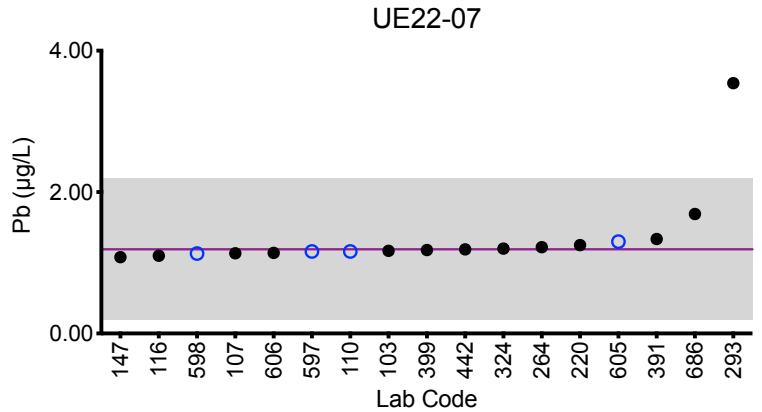## Performance of Participating Laboratories

Lab Code	Method	Urine Pb (µg/L)				
		UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
	Target	**5.97**	**1.19**	**4.11**	**0.343**	**12.09**
103	ICP-MS/MS	6.08	1.17	4.17	0.300	12.1
107	ICP-MS	6.163	1.134	3.902	0.334	12.781
110	ICP-MS	5.90	1.16	4.19	0.28	12.1
116	ICP-MS/MS	5.98	1.10	3.96	<0.300	12.0
147	ICP-MS	6.20	1.08	4.72	0.342	12.1
220	ICP-MS	5.90	1.25	4.11	0.52	11.8
264	ICP-MS	5.93	1.22	4.14	0.35	12.20
293	DRC/CC-ICP-MS	5.74	3.54 ↑	3.97	0.34	11.67
324	ICP-MS	5.975	1.201	4.089	<1	12.051
391	DRC/CC-ICP-MS	4.688 ↓	1.336	4.289	0.873	14.591 ↑
399	ICP-MS/MS	5.92	1.18	4.05	0.353	12.1
442	ICP-MS/MS	6.03	1.189	4.19	0.342	12.2
597	ICP-MS/MS	5.81	1.16	4.00	0.320	11.7
598	ICP-MS	5.49	1.13	3.70	0.327	10.7
605	ICP-MS	6.74	1.30	4.53	0.413	13.4
606	ICP-MS/MS	6.01	1.14	4.07	0.332	12.0
686	DRC/CC-ICP-MS	7.43 ↑	1.69	4.16	0.368	12.2

Based on the grading criteria for Pb in Urine, 95% of results were satisfactory, with 1 of the 17 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine Pb

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value
based on the robust mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±1 µg/L or ±20% around the target value,
whichever is greater; thus, it is fixed at ±1 µg/L at
concentrations less than or equal to 5 µg/L.

Results for Event #2, 2022:
Summary Statistics

	Urine TI (µg/L)				
	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Target (Robust Mean (x*))	1.94	0.77	0.470	0.177	1.37
Upper Limit	2.33	0.97	0.670	0.377	1.65
Lower Limit	1.55	0.57	0.270	0.000	1.10
Robust SD (s*)	0.08	0.03	0.021	0.007	0.03
Robust RSD (%)	4.1	4.1	4.5	3.7	2.3
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (u)	0.03	0.01	0.007	0.002	0.01

The acceptable range is based on quality specifications:
±0.2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±0.2 µg/L at concentrations less than or equal to 1 µg/L. These quality specifications are based on the same criteria used by the US Centers for Disease Control Prevention (CDC) for public health labs participating in the Laboratory Response Network (LRN) PT program for Toxic Metals.

Results for Event #2, 2022:
# Performance of Participating Laboratories

Lab Code	Method	Urine Tl (µg/L)				
		UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
	Target	**1.94**	**0.77**	**0.470**	**0.177**	**1.37**
103	ICP-MS/MS	1.94	0.759	0.472	0.173	1.38
107	ICP-MS	1.974	0.745	0.452	0.171	1.380
110	ICP-MS	2.02	0.931	0.547	0.255	1.39
116	ICP-MS/MS	2.01	0.780	0.456	0.175	1.39
147	ICP-MS	1.99	0.773	0.469	0.171	1.33
220	ICP-MS	1.19 ↓	0.76	0.46	0.18	1.39
264	ICP-MS	1.93	0.79	0.49	0.18	1.39
293	DRC/CC-ICP-MS	1.92	0.78	0.47	0.18	1.37
391	DRC/CC-ICP-MS	1.386 ↓	0.562 ↓	0.387	0.083	0.993 ↓
399	ICP-MS/MS	1.91	0.749	0.466	0.175	1.36
597	ICP-MS/MS	2.03	0.792	0.493	0.182	1.43
598	ICP-MS	1.73	0.720	0.449	0.179	1.23
605	ICP-MS	2.09	0.818	0.502	0.190	1.48
606	ICP-MS/MS	1.94	0.751	0.475	0.181	1.35
686	DRC/CC-ICP-MS	1.89	0.750	0.458	0.170	1.36

Based on the grading criteria for Tl in Urine, 95% of results were satisfactory, with 1 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine Tl
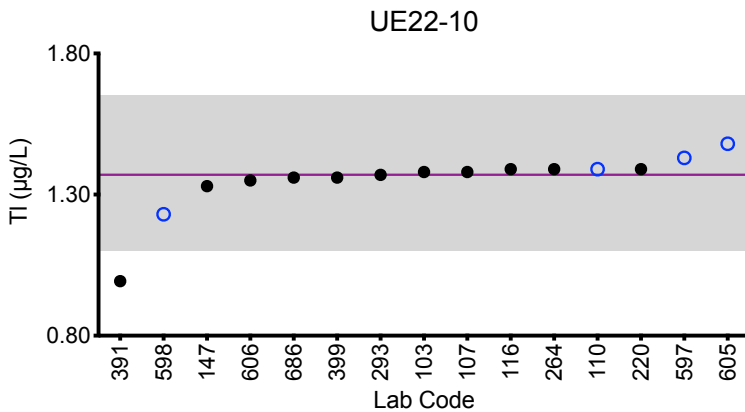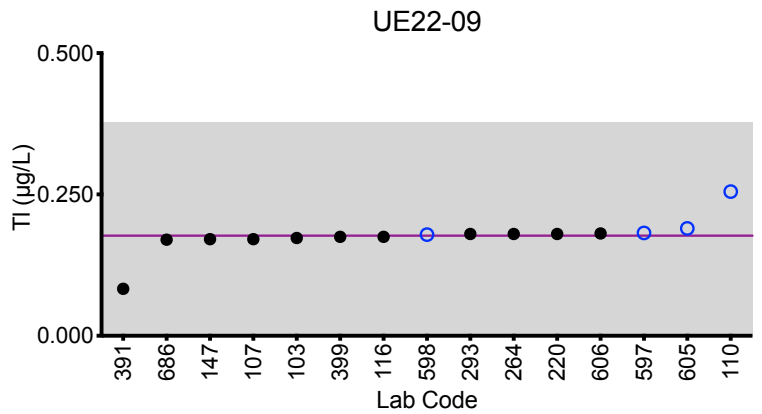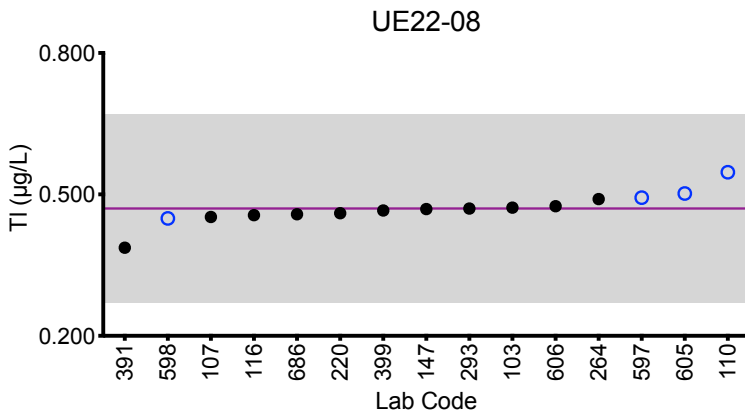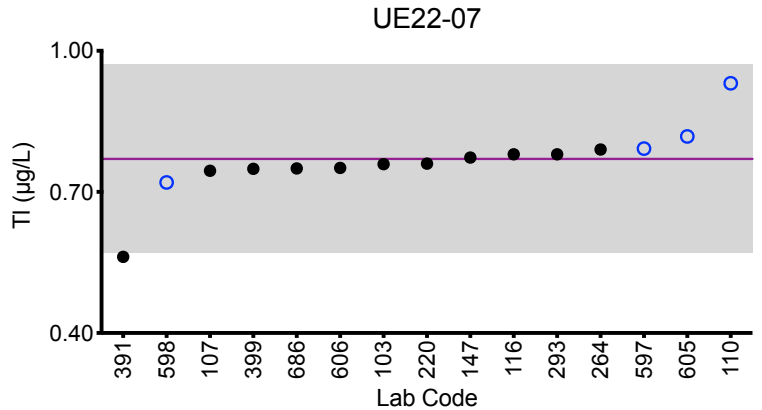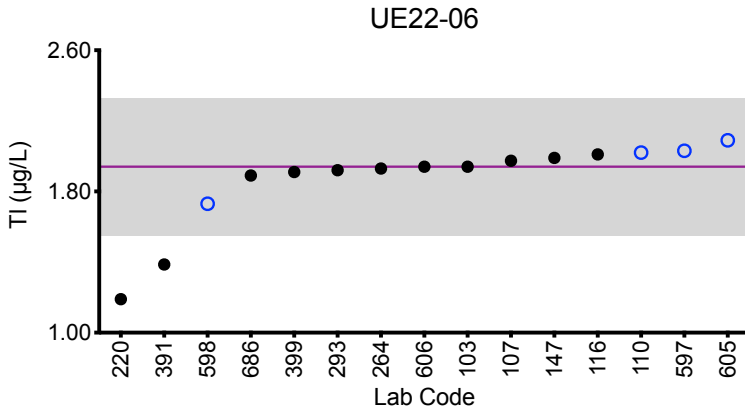
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the robust mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±0.2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±0.2 µg/L at concentrations less than or equal to 1 µg/L.

Results for Event #2, 2022:
Summary Statistics

	Urine U (µg/L)				
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Target (Robust Mean (x^*))	0.192	0.112	0.052	0.0097	0.220
Upper Limit	0.230	0.142	0.082	0.0397	0.264
Lower Limit	0.154	0.082	0.022	0.0000	0.176
Robust SD (s^*)	0.007	0.005	0.005	0.0004	0.019
Robust RSD (%)	3.6	4.5	9.6	3.8	8.6
Number of Sample Measurements (N)	15	15	15	10	15
Standard Uncertainty (u)	0.002	0.002	0.002	0.0001	0.006

The acceptable range is based on quality specifications:
±0.03 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±0.03 µg/L at concentrations less than or equal to 0.15 µg/L. These quality specifications are based on the same criteria used by the US Centers for Disease Control Prevention (CDC) for public health labs participating in the Laboratory Response Network (LRN) PT program for Toxic Metals.

Results for Event #2, 2022:
## Performance of Participating Laboratories

		Urine U (µg/L)				
Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
	Target	**0.192**	**0.112**	**0.052**	**0.0097**	**0.220**
103	ICP-MS/MS	0.192	0.119	0.0633	<0.0200	0.253
107	ICP-MS	0.2061	0.1118	0.0523	0.0096	0.2460
110	ICP-MS	0.196	0.118	0.0583	0.0100	0.234
116	ICP-MS/MS	0.192	0.113	0.0492	<0.0150	0.222
147	ICP-MS	0.195	0.113	0.0493	0.00895	0.220
220	ICP-MS	0.201	0.118	0.057	0.010	0.233
264	ICP-MS	0.18	0.11	0.05	0.01	0.22
324	ICP-MS	0.177	0.100	0.048	0.009	0.193
391	DRC/CC-ICP-MS	0.116 ↓	0.042 ↓	0.001 ↓	<5	0.159 ↓
399	ICP-MS/MS	0.193	0.114	0.0530	0.0100	0.218
597	ICP-MS/MS	0.184	0.114	0.0509	<0.0171	0.205
598	ICP-MS	0.189	0.107	0.0470	0.00900	0.199
605	ICP-MS	0.194	0.113	0.052	0.010	0.221
606	ICP-MS/MS	0.192	0.109	0.054	0.009	0.226
686	DRC/CC-ICP-MS	0.196	0.115	0.0590	<0.0150	0.222

Based on the grading criteria for U in Urine, 95% of results were satisfactory, with 1 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Urine U
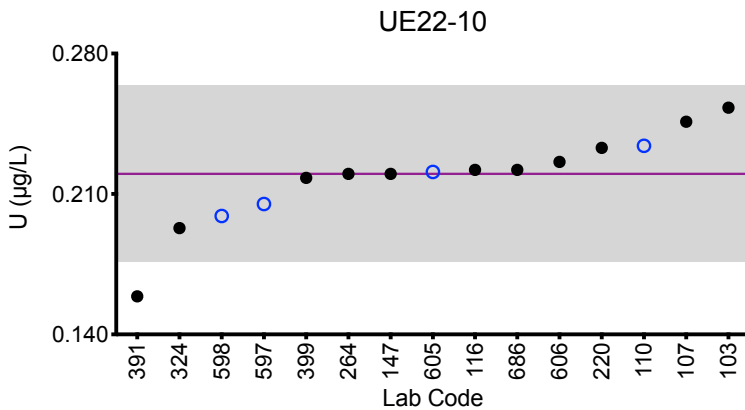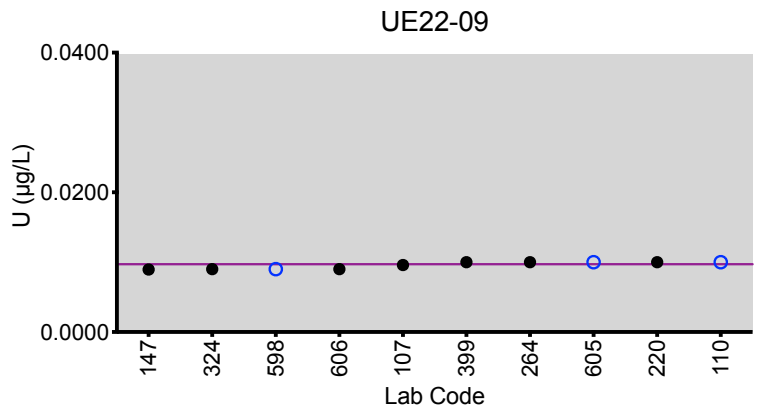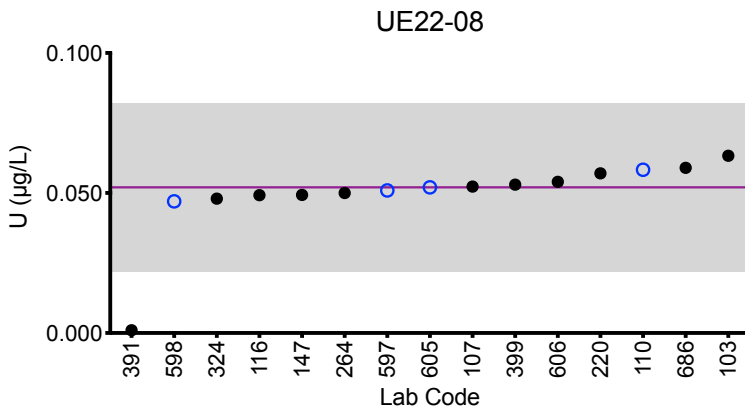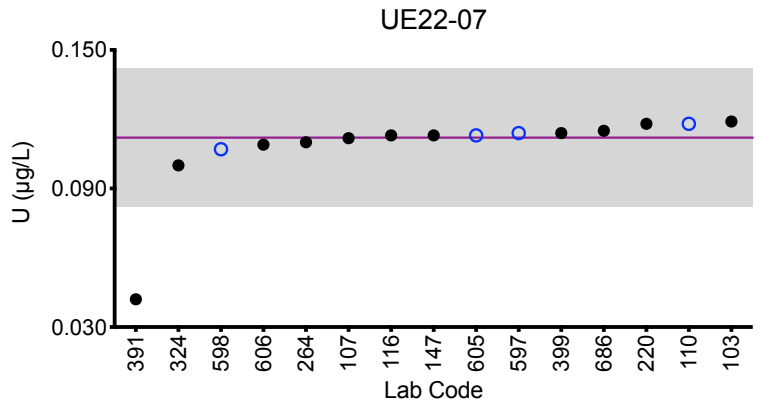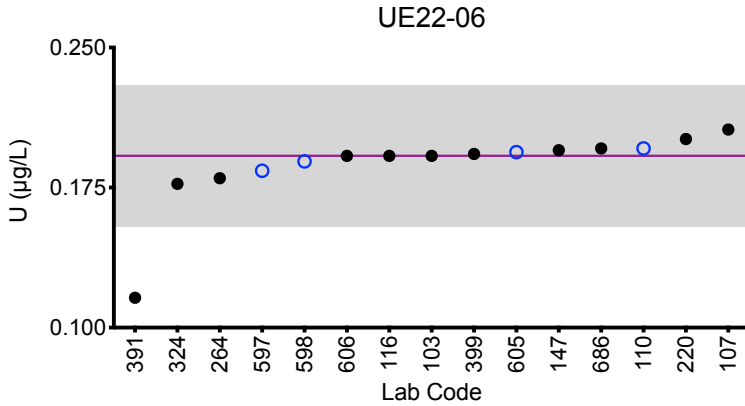
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the robust mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±0.03 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±0.03 µg/L at concentrations less than or equal to 0.15 µg/L.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Urine Al (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
147	ICP-MS	<13.8	<13.8	16.2	<13.8	<13.8
264	ICP-MS	4.19	9.73	17.94	2.26	11.96
293	DRC/CC-ICP-MS	<2.42	6.18	15.59	<2.42	9.14
324	ICP-MS	5.499	12.135	16.582	4.300	12.288
597	ICP-MS/MS	<5.89	10.7	20.8	<5.89	15.3

Summary Statistics

	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Arithmetic Mean ($\bar{x}$)	4.8	10	17.4	NA	12
Arithmetic SD (s)	0.9	3	2.1	NA	3
Arithmetic RSD (%)	19	26	12	NA	20
Number of Sample Measurements (N)	2	4	5	NA	4

*Denotes a statistical Outlier.

Statistical data was not calculated for UE22-09 based on a lack of consensus among participating labs.

Results for Event #2, 2022:
Summary Figures

Urine Al

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10
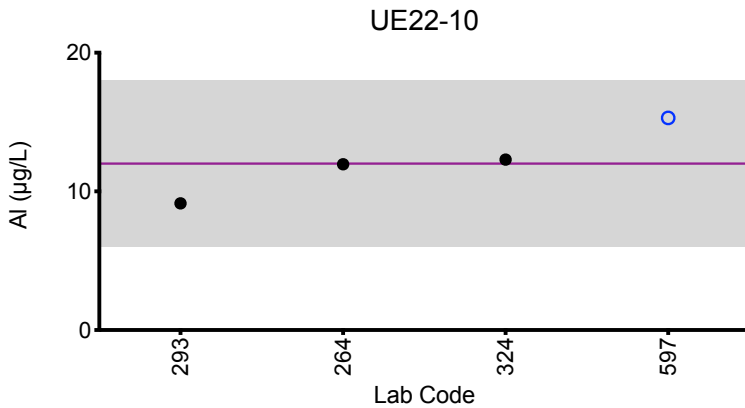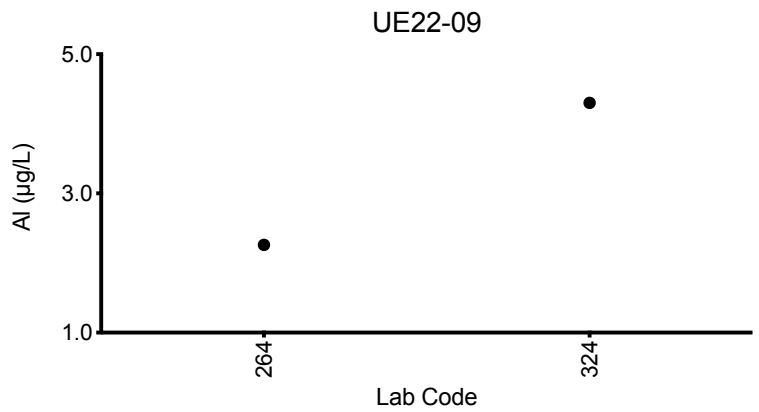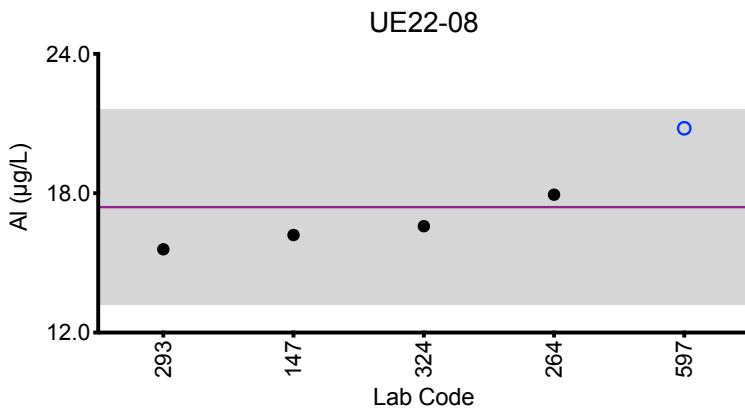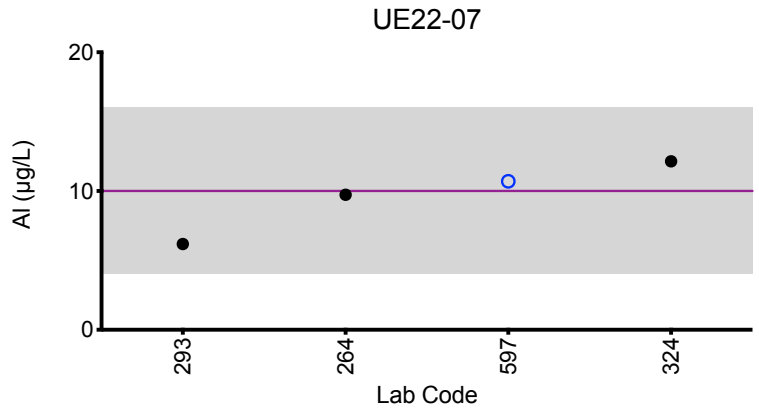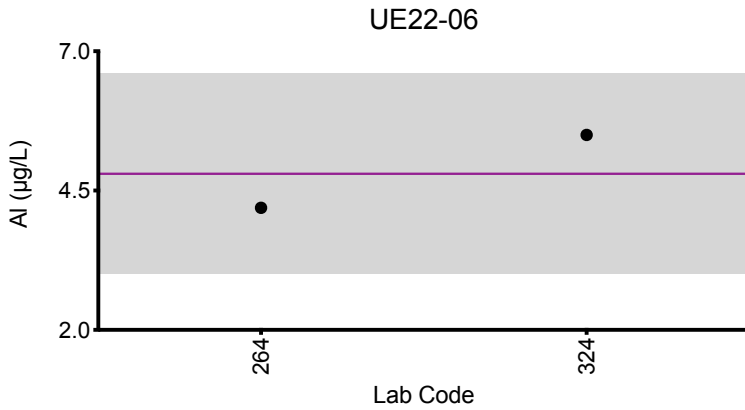
Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
107	ICP-MS	10.10	1.21	3.12	1.14	5.00
110	ICP-MS	10.0	1.32	3.38	1.25	5.27
147	ICP-MS	9.72	1.23	3.16	1.14	4.73
220	ICP-MS	10.2	1.30	3.43	1.27	5.10
264	ICP-MS	8.46	1.11	2.90	1.06	4.46
399	ICP-MS/MS	9.96	1.29	3.33	1.18	5.10
597	ICP-MS/MS	9.03	1.21	3.15	1.14	4.72
598	ICP-MS	9.36	1.24	3.23	1.17	4.87
605	ICP-MS	11.0	1.37	3.61	1.31	5.55
606	ICP-MS/MS	10.2	1.32	3.28	1.24	5.14

Summary Statistics

	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Robust Mean (x^*)	9.9	1.26	3.26	1.19	5.0
Robust SD (s^*)	0.4	0.08	0.18	0.08	0.3
Robust RSD (%)	4.3	6.3	5.5	6.7	6.1
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (u)	0.2	0.03	0.07	0.03	0.1

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Urine Cs
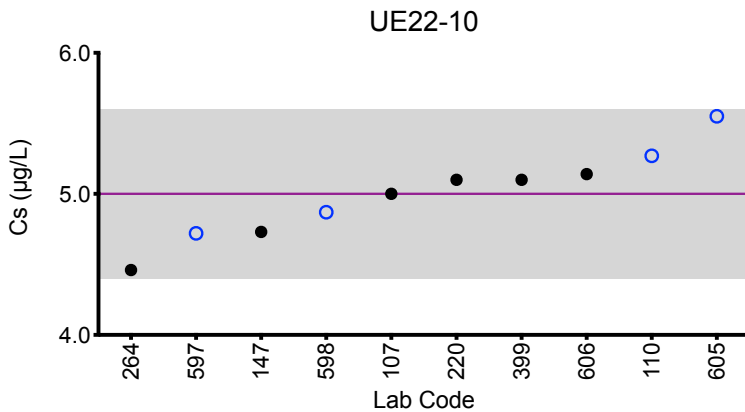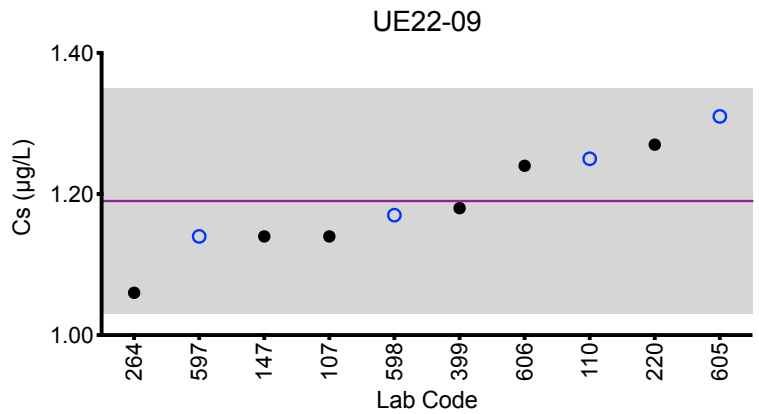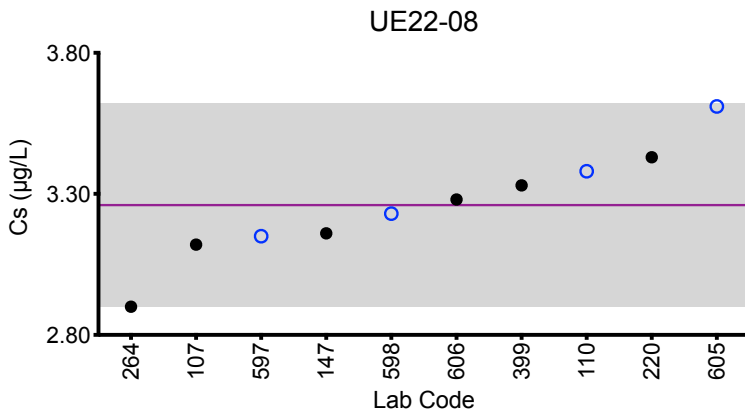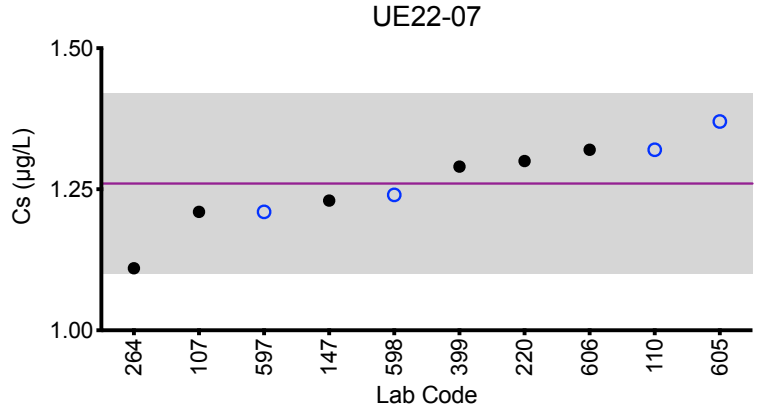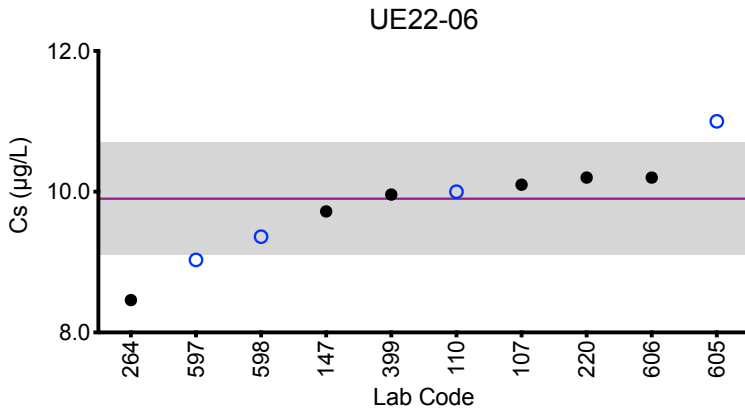
Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = robust mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
110	ICP-MS	32.1	81.8	136	*13.2	16.2
116	ICP-MS/MS	19.3	66.0	123	<5.00	8.73
147	ICP-MS	25.9	71.2	128	7.18	14.4
264	ICP-MS	19.49	67.42	118.62	4.21	9.07
293	DRC/CC-ICP-MS	18.44	62.3	116.97	3.81	8.29
324	ICP-MS	19.654	61.180	118.793	3.836	8.507
597	ICP-MS/MS	19.1	63.4	122	3.66	8.83
598	ICP-MS	17.3	60.1	112	4.55	9.08

Summary Statistics

	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Arithmetic Mean ($\bar{x}$)	21	67	122	4.5	10.4
Arithmetic SD (s)	5	7	7	1.3	3.1
Arithmetic RSD (%)	24	10	5.7	29	30
Number of Sample Measurements (N)	8	8	8	6	8

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Urine Cu
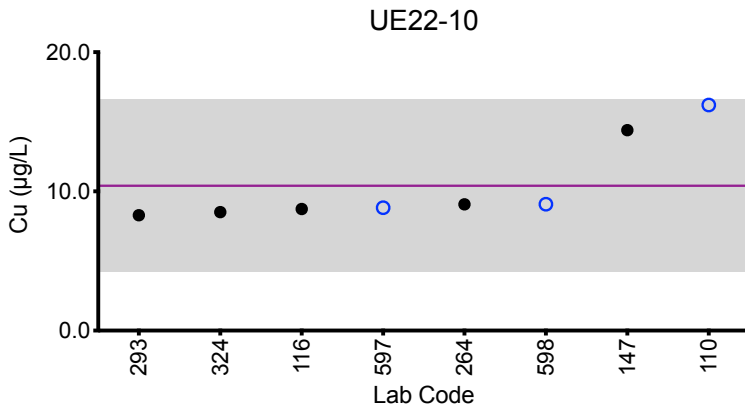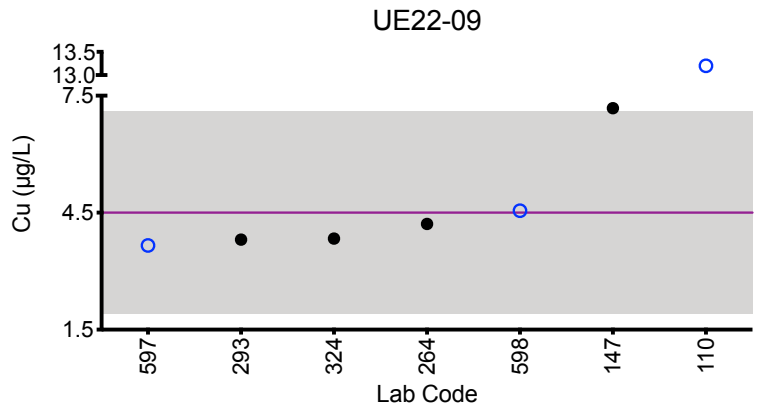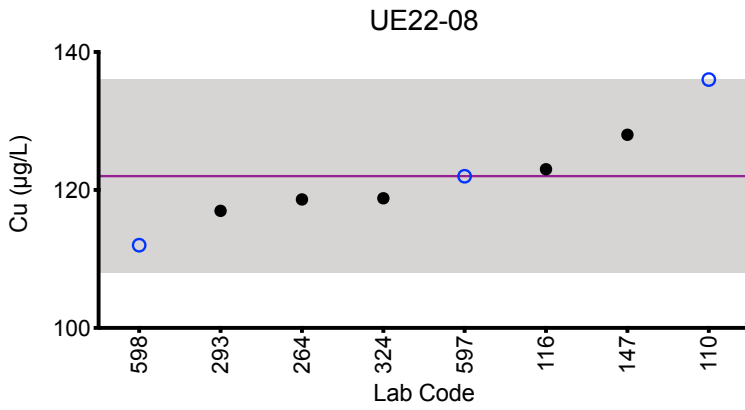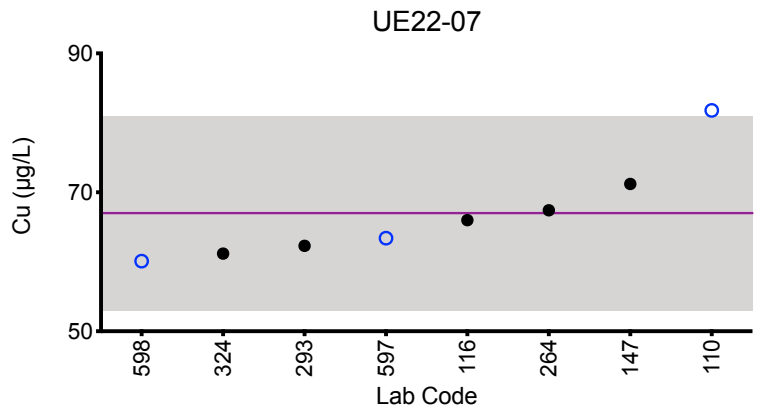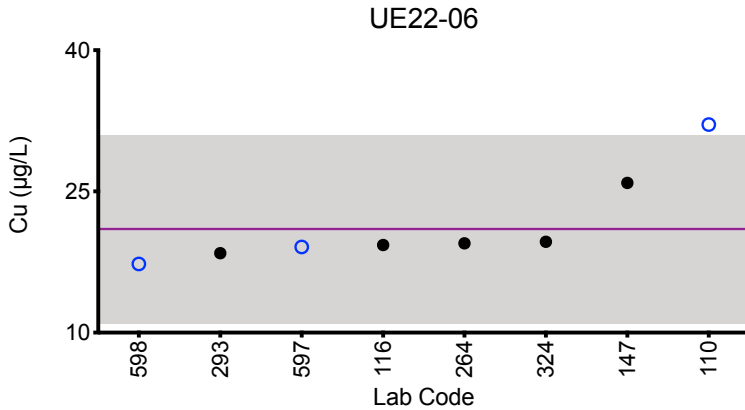
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
103	ICP-MS/MS	102	33.8	25.3	12.5	33.6
107	ICP-MS	100.34	26.91	19.95	10.39	30.13
110	ICP-MS	105	34.6	26.4	12.8	34.9
147	ICP-MS	96.9	28.4	20.5	10.9	28.7
220	ICP-MS	109	33.5	25.2	13.2	34.5
264	ICP-MS	81.08	25.69	17.41	9.67	26.45
293	DRC/CC-ICP-MS	108.32	37.04	27.67	13.69	37.26
324	ICP-MS	97.639	31.043	21.682	12.412	31.128
399	ICP-MS/MS	103	30.8	22.9	12.2	32.4
597	ICP-MS/MS	97.4	30.4	22.8	11.9	31.6
598	DRC/CC-ICP-MS	106	34.2	25.0	13.5	34.4
605	ICP-MS	111	32.8	24.5	12.9	34.6
606	ICP-MS/MS	104	32.7	23.5	12.3	33.4

Summary Statistics

	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Robust Mean (x^*)	103	32	23	12.4	32.9
Robust SD (s^*)	6	3	3	0.9	2.4
Robust RSD (%)	5.8	9.1	12	7.3	7.3
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (u)	2	1	1	0.3	0.8

*Denotes a statistical Outlier.
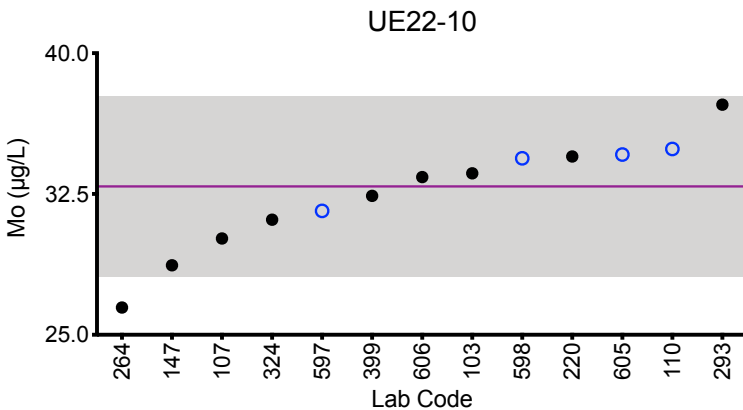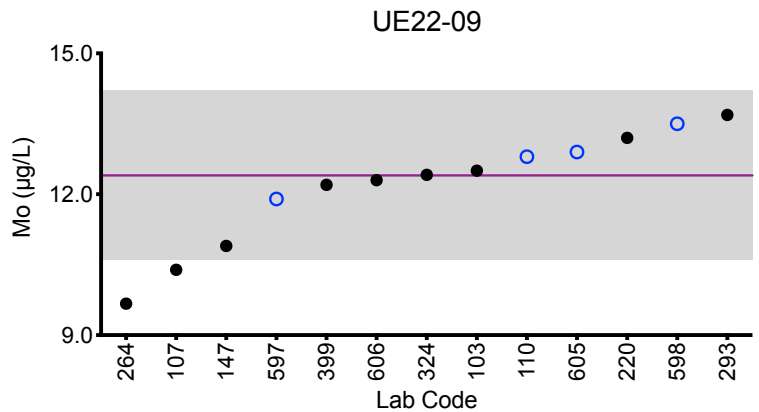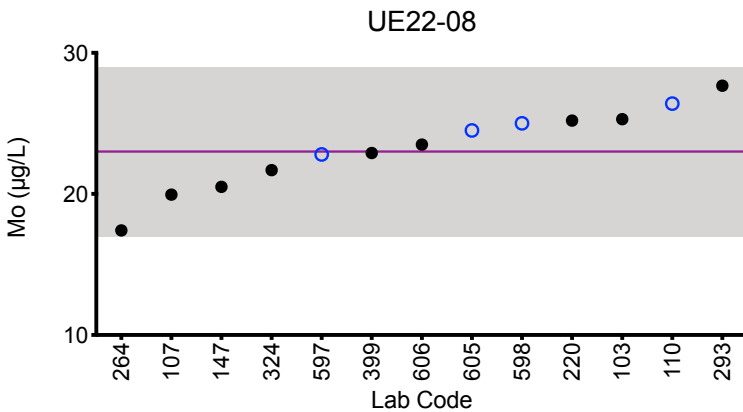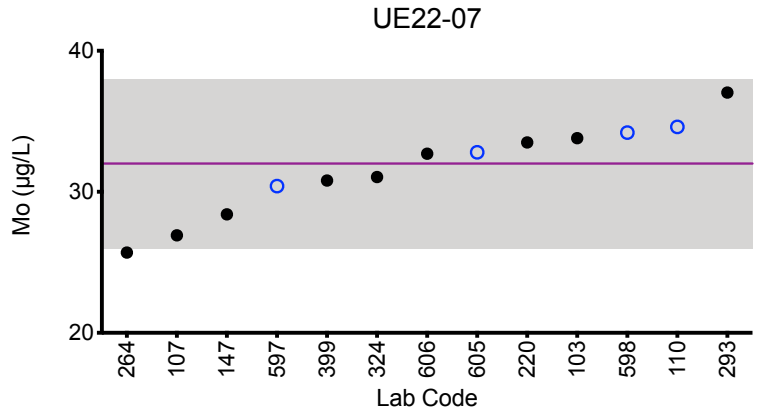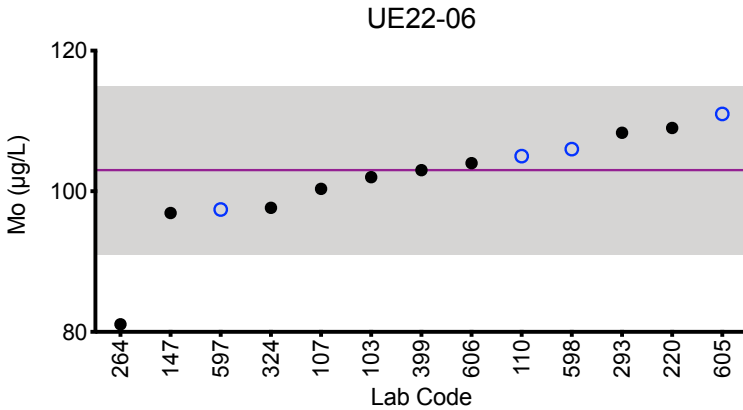
![New York State Department of Health | Wadsworth Center]

Results for Event #2, 2022:
Summary Figures

Urine Mo

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = robust mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
107	DRC/CC-ICP-MS	4.31	1.11	2.74	<0.31	5.06
110	ICP-MS	5.93	2.89	4.71	*2.00	6.97
147	ICP-MS	4.78	1.85	3.28	<0.558	5.30
264	ICP-MS	4.43	1.81	3.43	0.62	5.52
293	DRC/CC-ICP-MS	5.22	2.12	3.81	0.84	6.13
324	ICP-MS	4.631	1.951	3.542	<1	5.557
442	DRC/CC-ICP-MS	5.04	1.81	3.46	0.614	5.73
597	ICP-MS/MS	4.68	1.75	3.60	0.708	5.35
598	ICP-MS	4.93	2.21	3.91	1.35	6.02
605	ICP-MS	5.09	1.82	3.57	0.671	5.72

Summary Statistics

	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Robust Mean (x*)	4.9	1.88	3.6	0.8	5.7
Robust SD (s*)	0.4	0.17	0.3	0.3	0.5
Robust RSD (%)	8.2	8.9	8.4	35	8.8
Number of Sample Measurements (N)	10	10	10	6	10
Standard Uncertainty (*u*)	0.2	0.07	0.1	NA	0.2

*Denotes a statistical Outlier.

An arithmetic mean, SD, RSD and n are provided for sample UE22-09.

Results for Event #2, 2022:
Summary Figures

Urine Ni
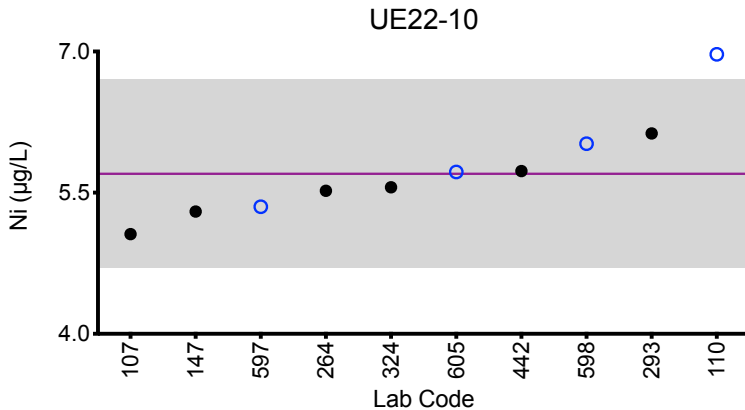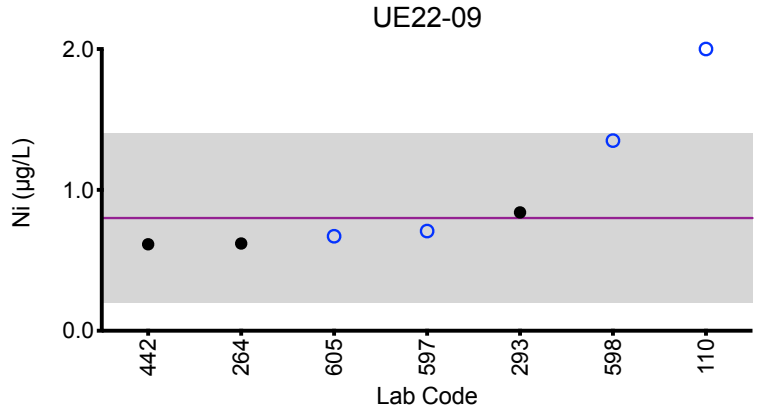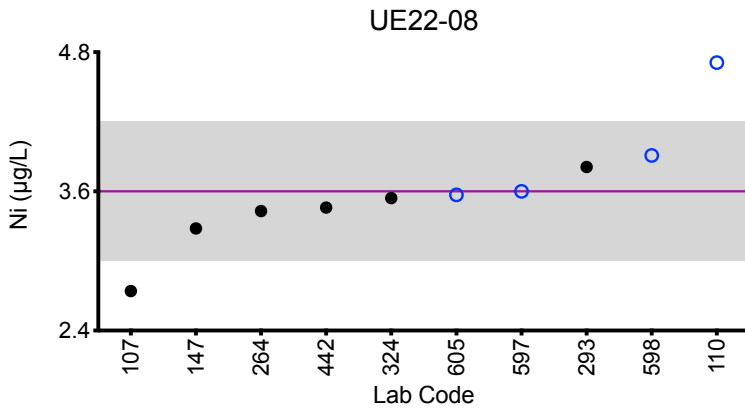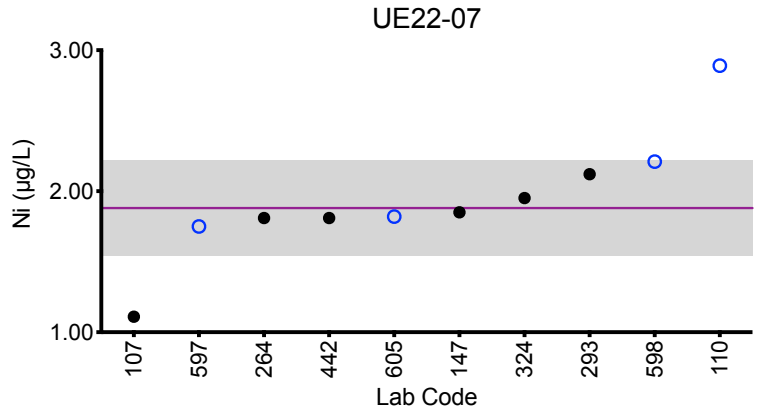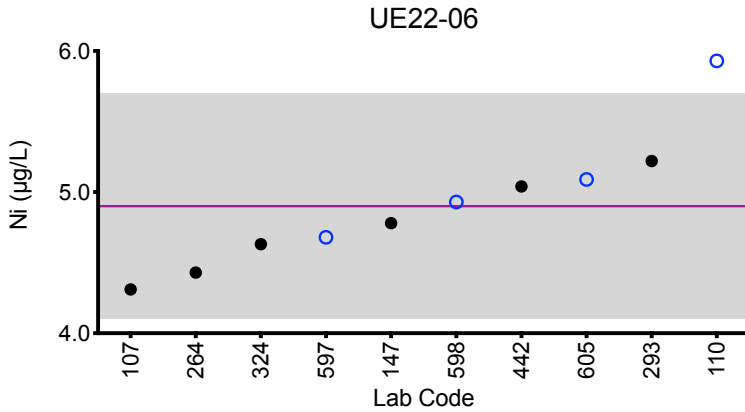
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = robust mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Urine Pt (μg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
107	ICP-MS	1.1210	0.2444	0.6841	0.0571	0.2013
110	ICP-MS	1.10	0.271	0.75	0.057	0.205
220	ICP-MS	*2.14	*0.38	*0.54	*0.24	*1.18
264	ICP-MS	1.01	0.26	0.68	0.07	0.19
293	DRC/CC-ICP-MS	1.08	0.23	0.74	0.03	0.17
399	ICP-MS/MS	1.07	0.258	0.736	0.0570	0.207
598	ICP-MS	1.05	0.278	0.728	0.0880	0.212
605	ICP-MS	1.16	0.271	0.788	0.061	0.215

Summary Statistics

	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Arithmetic Mean (x̄)	1.08	0.259	0.73	0.060	0.200
Arithmetic SD (s)	0.05	0.017	0.04	0.017	0.016
Arithmetic RSD (%)	4.6	6.6	5.2	28	7.8
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.
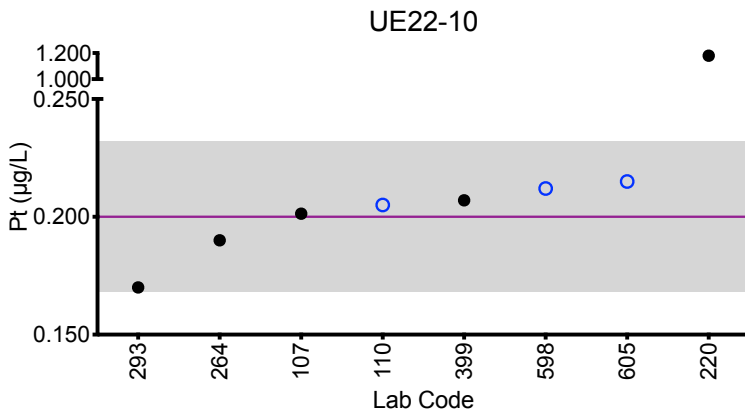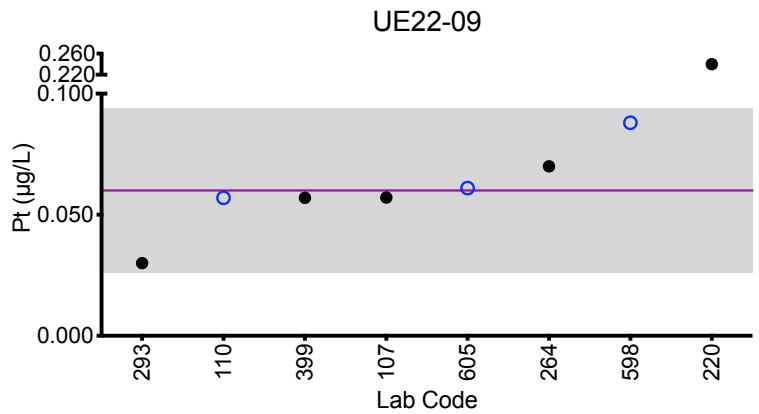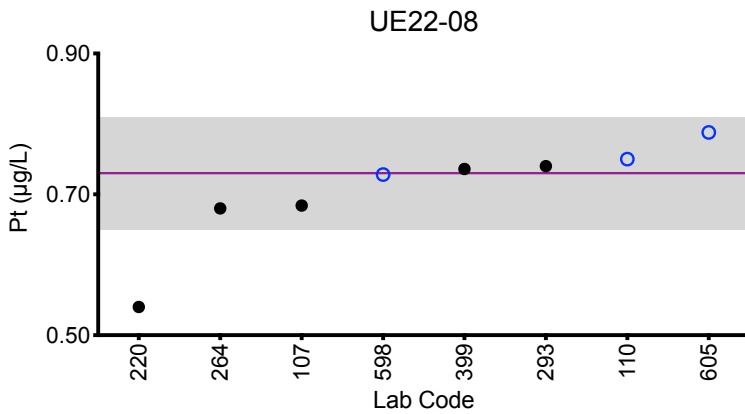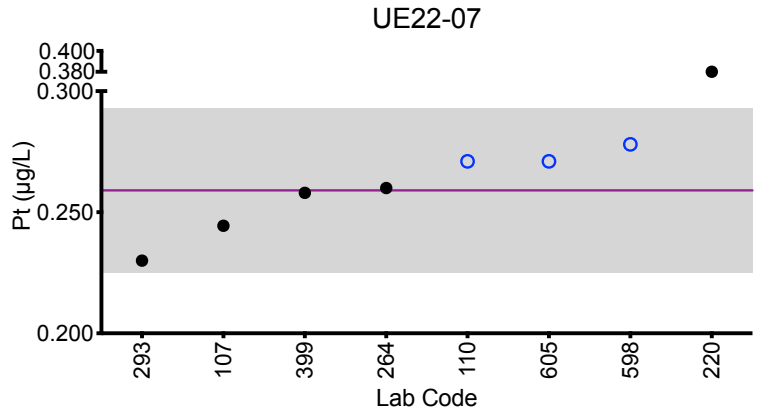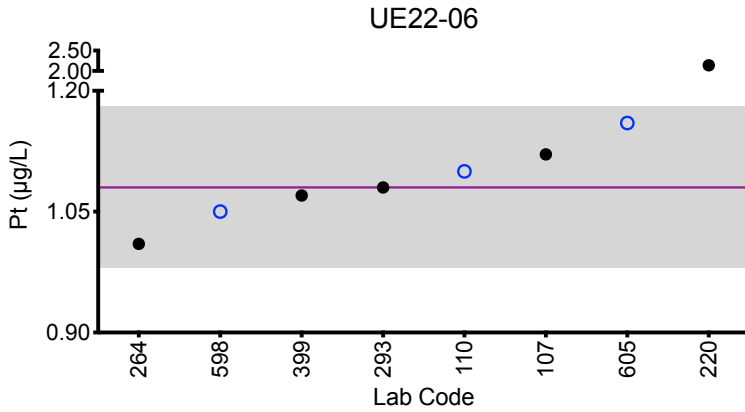
Urine Pt

UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
o C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
103	ICP-MS/MS	1.06	0.248	0.814	<0.0600	1.98
107	ICP-MS	1.136	0.277	0.668	0.089	1.881
110	ICP-MS	1.13	0.344	0.853	0.094	2.08
147	ICP-MS	1.35	0.345	0.910	0.0759	2.32
220	ICP-MS	1.19	0.32	0.82	0.11	2.02
264	ICP-MS	0.91	0.24	0.62	0.05	1.71
293	DRC/CC-ICP-MS	1.14	0.33	0.85	0.07	2.1
399	ICP-MS/MS	1.16	0.271	0.755	0.0950	2.35
597	ICP-MS/MS	1.17	0.251	0.761	0.0557	1.97
598	ICP-MS	1.08	0.291	0.761	0.0770	2.01
605	ICP-MS	1.20	<0.80	0.807	<0.80	2.05
606	ICP-MS/MS	1.11	0.221	0.718	<0.08	1.95

Summary Statistics

|	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Robust Mean ($x*$)	1.14	0.29	0.78	0.08	2.02
Robust SD ($s*$)	0.06	0.05	0.08	0.02	0.11
Robust RSD (%)	5.3	17	10	24	5.4
Number of Sample Measurements (N)	12	11	12	9	12
Standard Uncertainty (u)	0.02	0.02	0.03	NA	0.04

*Denotes a statistical Outlier.

An arithmetic mean, SD, RSD and n are provided for sample UE22-09.

Results for Event #2, 2022:
Summary Figures

Urine Sb
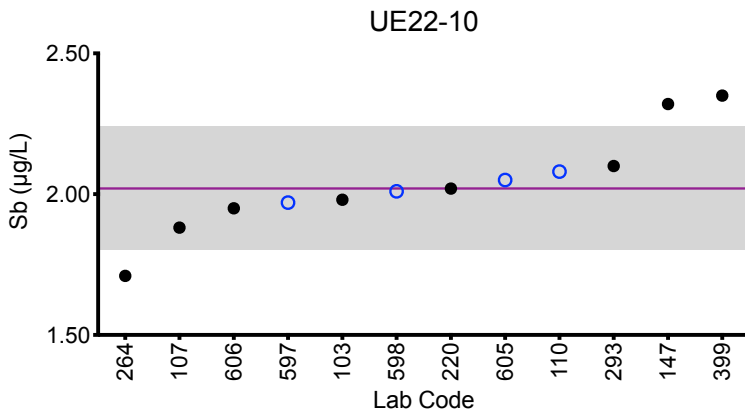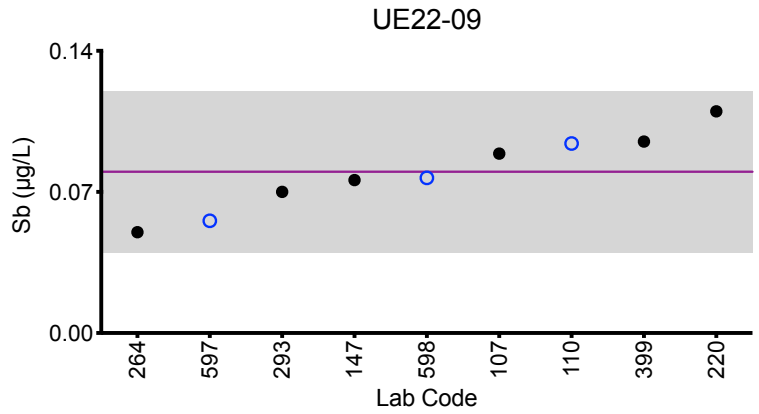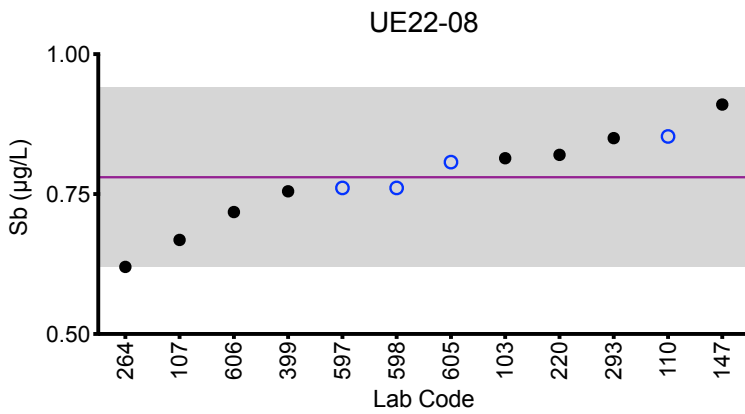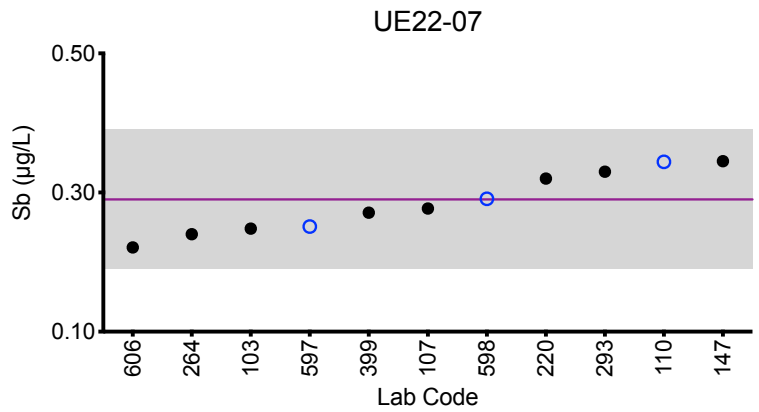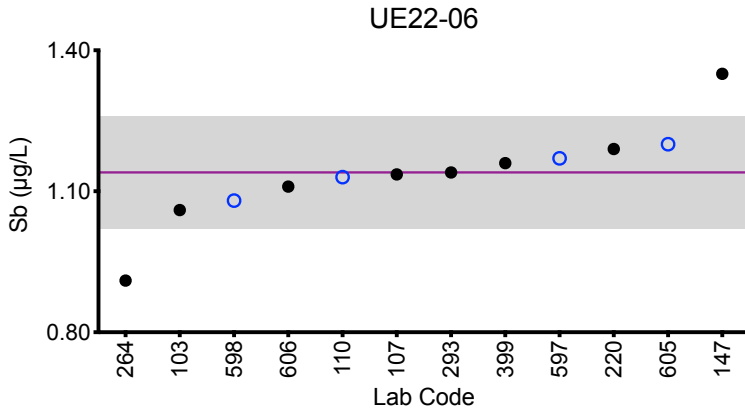
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = robust mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
Laboratory Data and Summary Statistics

		Urine Se (µg/L)				
Lab Code	**Method**	**UE22-06**	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
103	ICP-MS/MS	46.8	82.7	210	8.66	25.7
110	DRC/CC-ICP-MS	54.8	87.1	213	10.6	26.1
147	ICP-MS	46.8	82.9	209	9.46	29.5
293	DRC/CC-ICP-MS	41.83	75.77	187.06	7.89	25.26
597	ICP-MS/MS	44.3	77.4	198	9.20	26.9
598	DRC/CC-ICP-MS	45.8	84.0	208	9.09	30.2

Summary Statistics						
		UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Arithmetic Mean ($\bar{x}$)		47	82	204	9.2	27.3
Arithmetic SD (s)		4	4	10	0.9	2.1
Arithmetic RSD (%)		8.5	4.9	4.9	9.8	7.7
Number of Sample Measurements (N)		6	6	6	6	6

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Urine Se
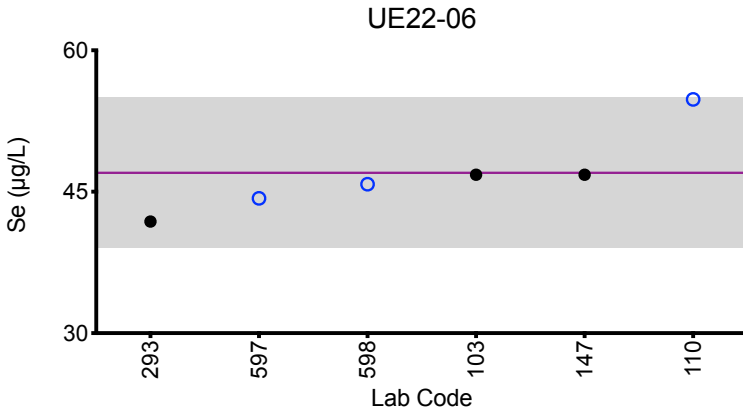
UE22-06
(Se (µg/L) vs Lab Code: 293, 597, 598, 103, 147, 110)

UE22-07
(Se (µg/L) vs Lab Code: 293, 597, 103, 147, 598, 110)

UE22-08
(Se (µg/L) vs Lab Code: 293, 597, 598, 147, 103, 110)

UE22-09
(Se (µg/L) vs Lab Code: 293, 103, 598, 597, 147, 110)

UE22-10
(Se (µg/L) vs Lab Code: 293, 103, 110, 597, 147, 598)

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
107	ICP-MS	5.28	1.52	1.04	0.22	4.48
110	ICP-MS	5.37	1.83	1.27	0.18	4.92
147	ICP-MS	6.24	1.72	1.18	0.204	4.49
220	ICP-MS	5.12	1.62	1.30	0.34	4.36
264	ICP-MS	3.73	1.14	0.76	0.16	3.35
399	ICP-MS/MS	5.42	1.89	1.35	<0.300	5.04
597	ICP-MS/MS	5.25	1.64	1.10	0.140	4.26
598	ICP-MS	4.58	1.48	0.948	0.179	3.79
605	ICP-MS	5.59	1.51	1.09	<0.90	4.62

Summary Statistics

	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Arithmetic Mean ($\bar{x}$)	5.2	1.59	1.12	0.20	4.4
Arithmetic SD (s)	0.7	0.22	0.19	0.07	0.5
Arithmetic RSD (%)	13	14	17	35	11
Number of Sample Measurements (N)	9	9	9	7	9

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Urine Sn
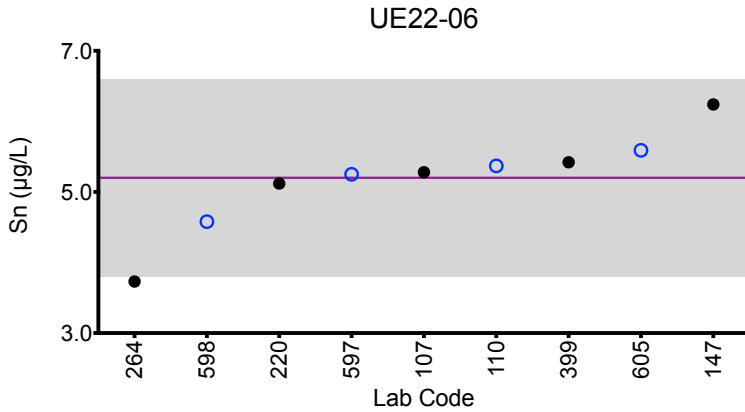
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
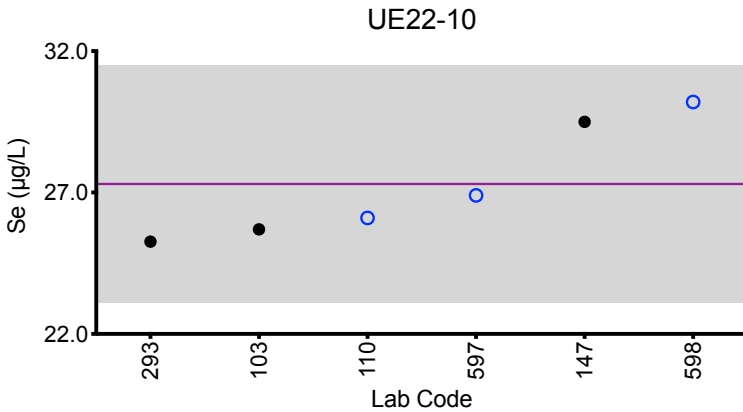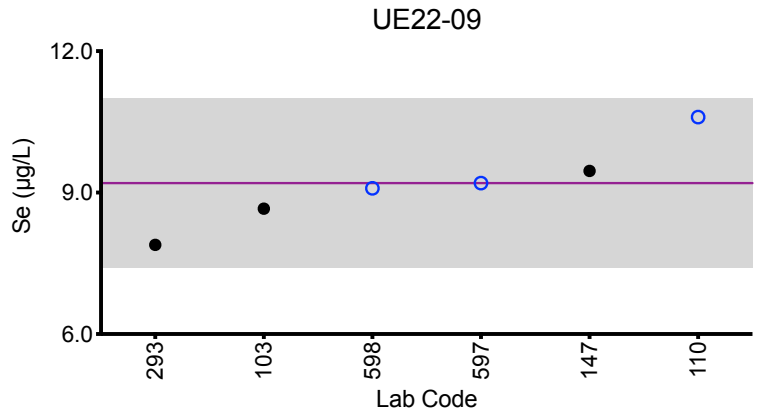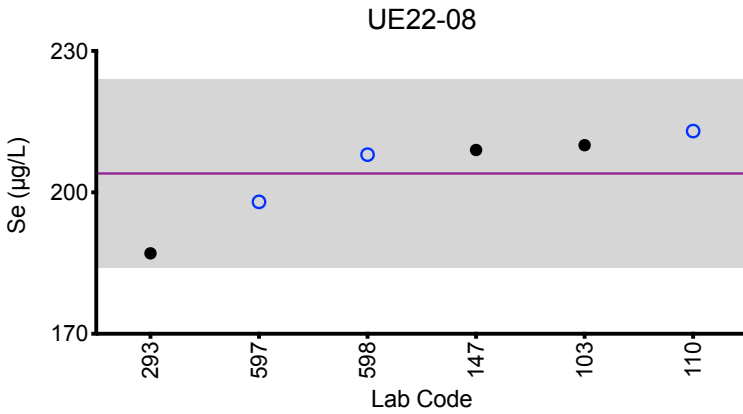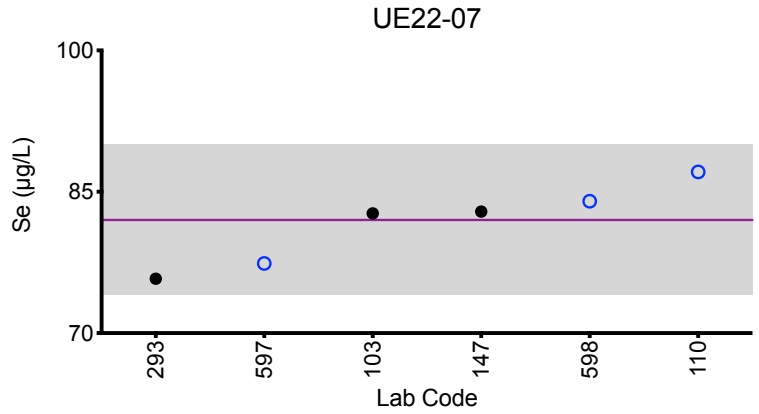## Laboratory Data and Summary Statistics

Urine Sr (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
103	ICP-MS/MS	301	47.1	254	69.1	156
107	ICP-MS	308.0	42.1	233.8	62.1	155.6
200	ICP-MS	320	53	293	72	154
220	ICP-MS	334	51.6	284	76.5	171
264	ICP-MS	285.11	41.77	249.04	60.85	142.51
399	DRC/CC-ICP-MS	338	47.9	270	69.3	161
597	ICP-MS/MS	291	46.1	248	66.8	152
605	ICP-MS	311	48.7	263	70.1	164

Summary Statistics

	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Arithmetic Mean ($\bar{x}$)	311	47	262	68	157
Arithmetic SD (s)	19	4	20	5	9
Arithmetic RSD (%)	6.1	8.5	7.6	7.4	5.7
Number of Sample Measurements (N)	8	8	8	8	8

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Urine Sr
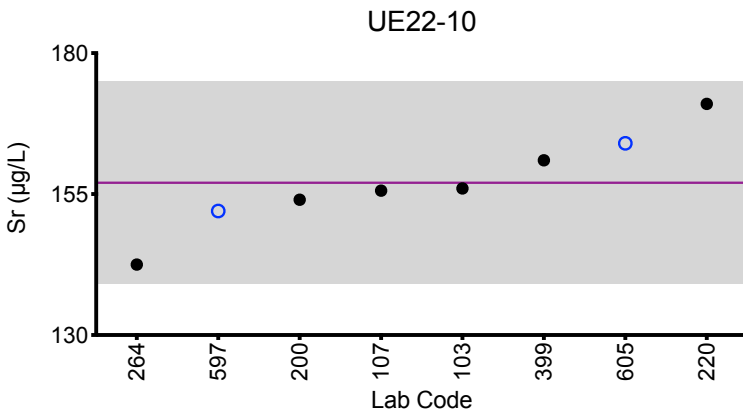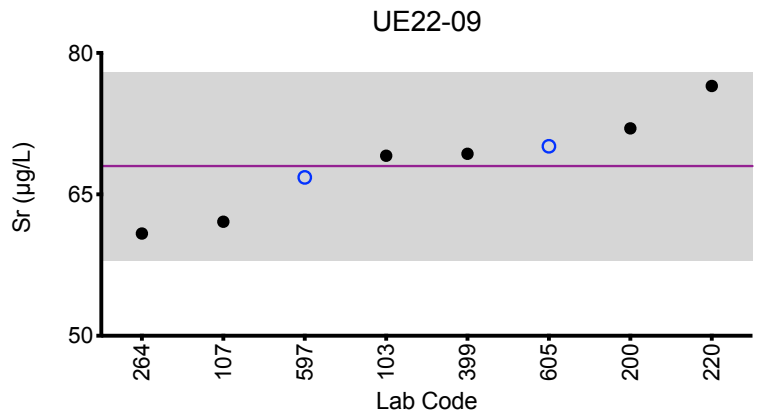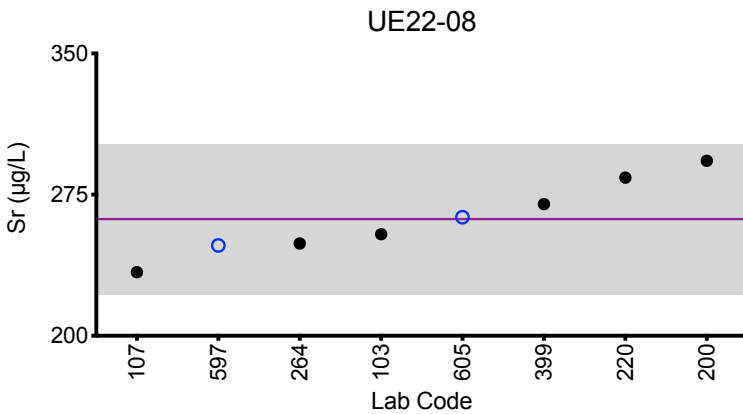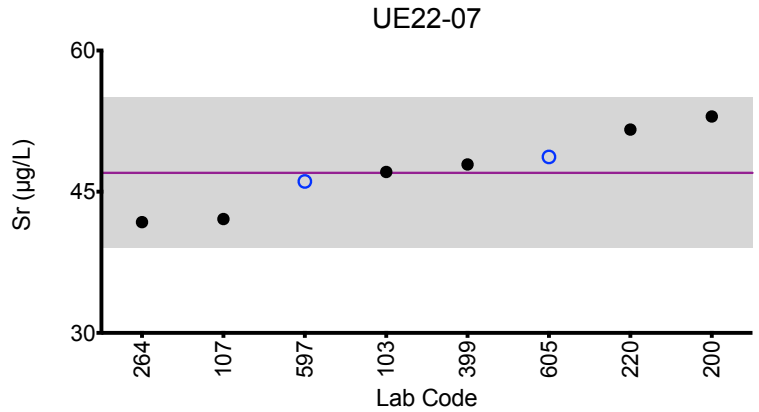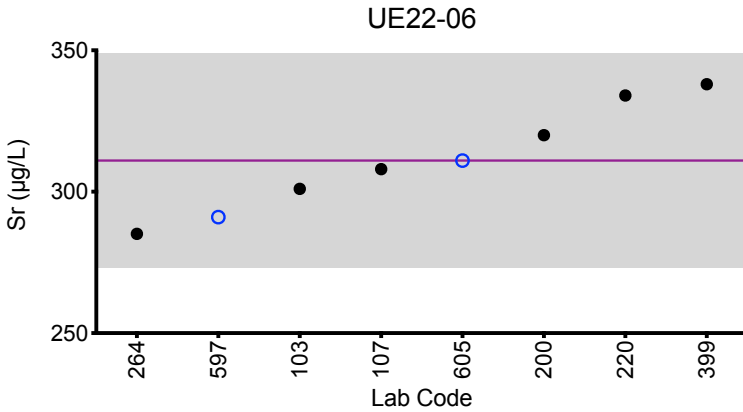
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
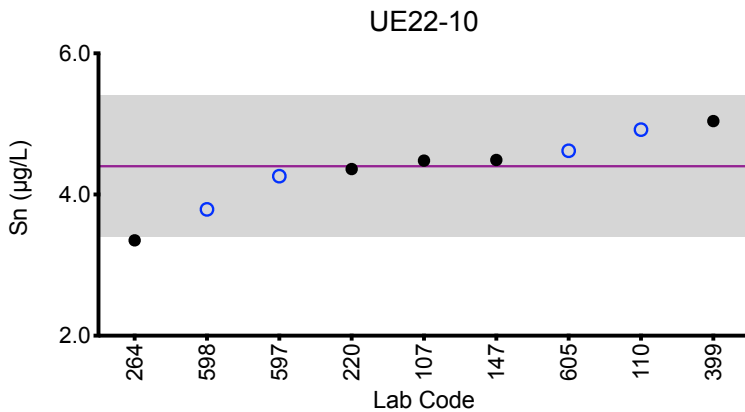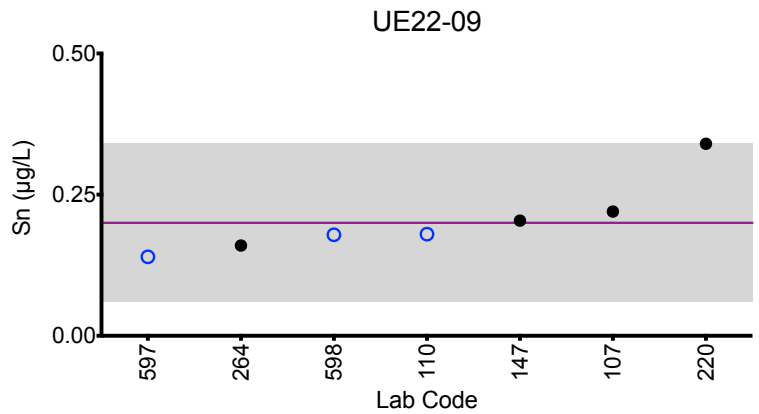## Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
116	ICP-MS/MS	5.06	3.17	0.281	0.128	1.45
147	DRC/CC-ICP-MS	4.91	2.99	0.282	0.113	1.30
293	DRC/CC-ICP-MS	4.69	2.89	0.21	*0.04	1.36
597	ICP-MS/MS	4.57	2.78	0.249	0.112	1.28
598	DRC/CC-ICP-MS	4.92	3.20	0.337	<0.2	1.52
605	ICP-MS	4.68	2.96	0.311	<0.30	1.45

Summary Statistics

		UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Arithmetic Mean ($\bar{x}$)		4.81	3.00	0.28	0.118	1.39
Arithmetic SD (s)		0.19	0.16	0.04	0.009	0.10
Arithmetic RSD (%)		3.9	5.3	14	7.6	7.2
Number of Sample Measurements (N)		6	6	6	3	6

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Urine V
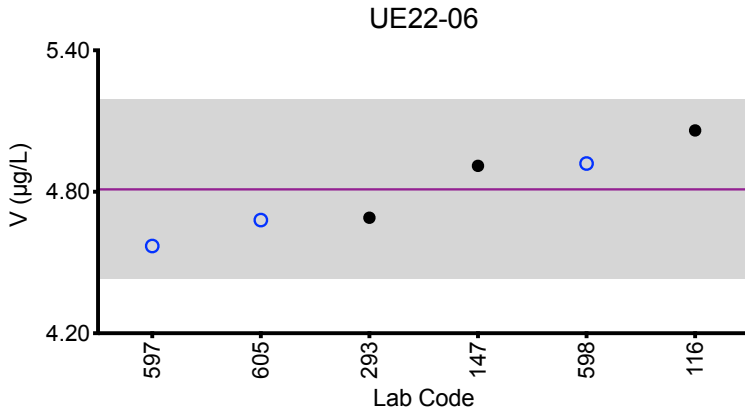
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
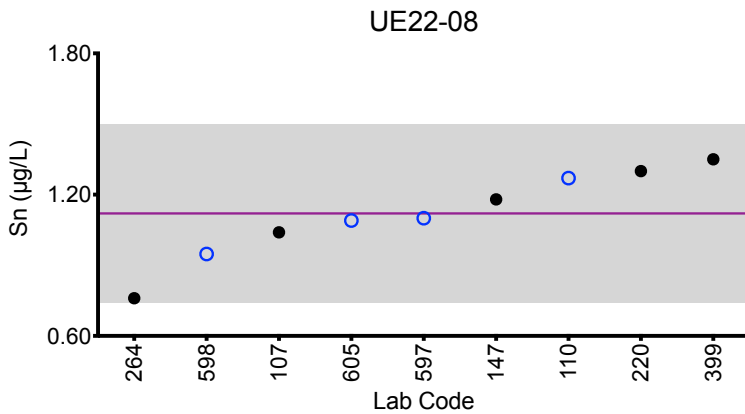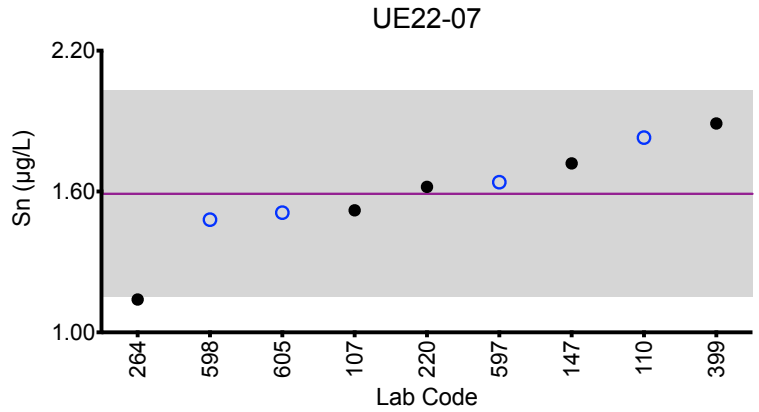## Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
107	ICP-MS	2.017	0.329	0.461	0.187	1.070
110	ICP-MS	2.14	0.364	0.547	0.213	1.17
147	ICP-MS	2.04	0.349	0.473	0.198	1.03
200	ICP-MS	2.1	0.42	0.59	0.18	1.2
220	ICP-MS	2.14	0.38	0.54	0.24	1.18
264	ICP-MS	1.89	0.34	0.48	0.19	1.08
324	ICP-MS	1.963	<1	<1	<1	1.081
399	ICP-MS/MS	2.08	0.362	0.516	0.229	1.17
597	ICP-MS/MS	2.02	0.340	0.521	0.202	1.14
598	ICP-MS	2.05	0.377	0.525	0.228	1.20
605	ICP-MS	2.20	0.361	0.547	0.213	1.20
606	ICP-MS/MS	2.05	0.337	0.538	0.207	1.11

Summary Statistics

	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
Robust Mean (x^*)	2.06	0.357	0.52	0.208	1.14
Robust SD (s^*)	0.07	0.023	0.04	0.022	0.06
Robust RSD (%)	3.4	6.4	7.1	11	5.3
Number of Sample Measurements (N)	12	11	11	11	12
Standard Uncertainty (u)	0.03	0.009	0.01	0.008	0.02

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Urine W
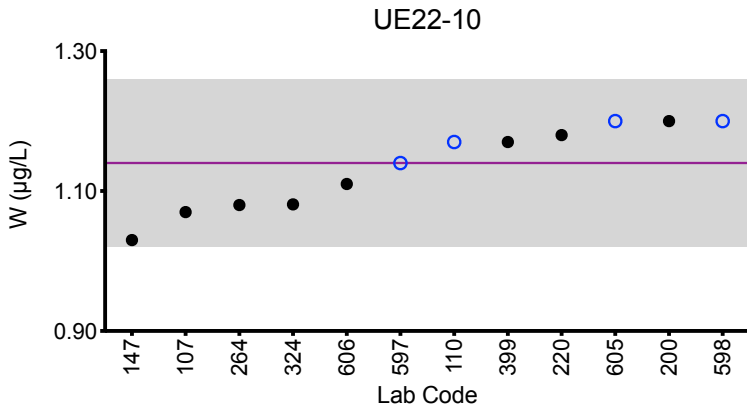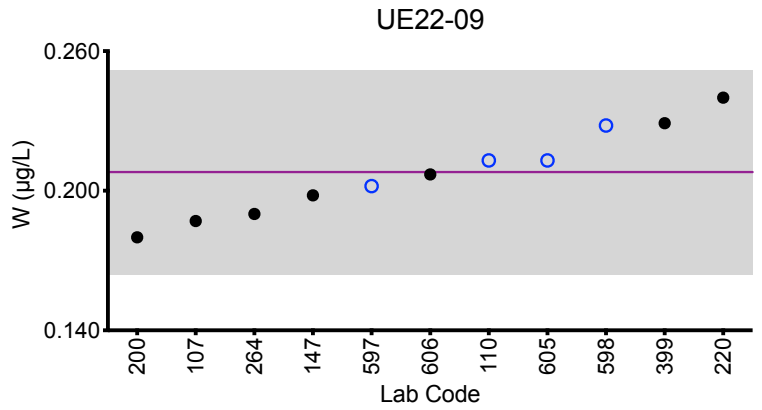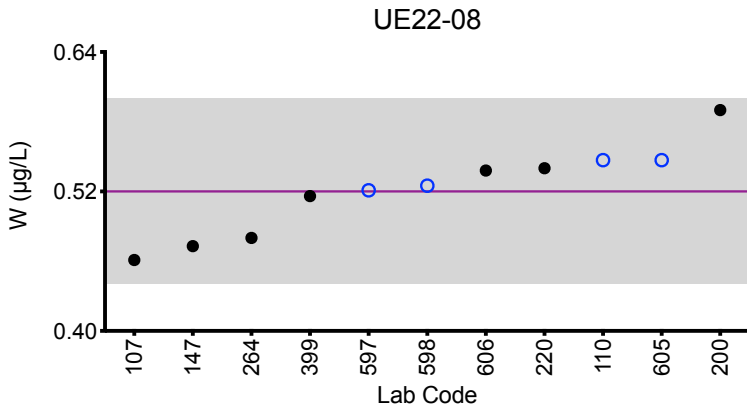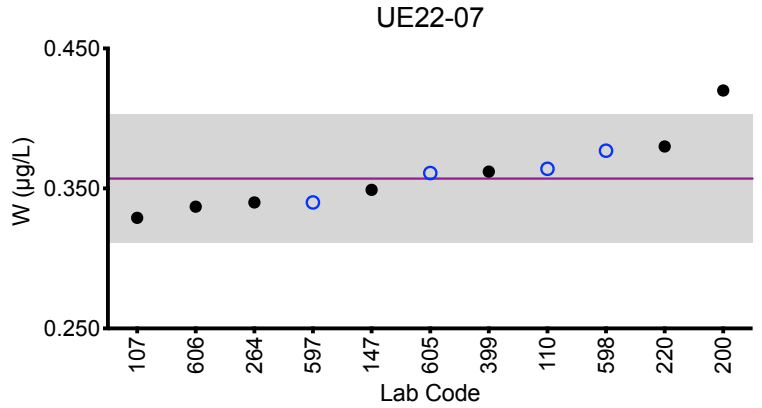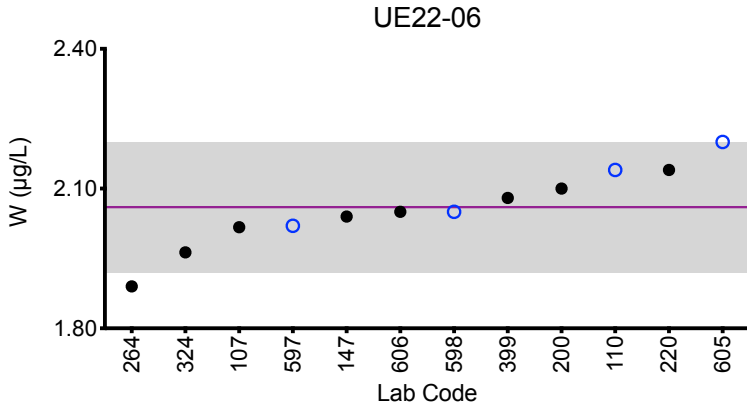
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = robust mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
Laboratory Data and Summary Statistics

		Urine Zn (µg/L)				
Lab Code	**Method**	**UE22-06**	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
110	ICP-MS	558	221	231	100	242
147	ICP-MS	565	184	216	70.6	249
264	ICP-MS	523.14	167.85	199.71	64.28	238.07
293	DRC/CC-ICP-MS	508.5	173.2	188.89	64.05	219.61
324	ICP-MS	514.809	152.376	189.085	58.333	223.248
391	DRC/CC-ICP-MS	*751.312	114.605	142.489	18.503	181.522
597	ICP-MS/MS	536	173	207	72.5	242
598	ICP-MS	466	152	182	59.5	213

Summary Statistics					
	UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Arithmetic Mean ($\bar{x}$)	524	167	195	63	226
Arithmetic SD (s)	33	30	26	22	22
Arithmetic RSD (%)	6.3	18	13	35	9.7
Number of Sample Measurements (N)	7	8	8	8	8

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Urine Zn
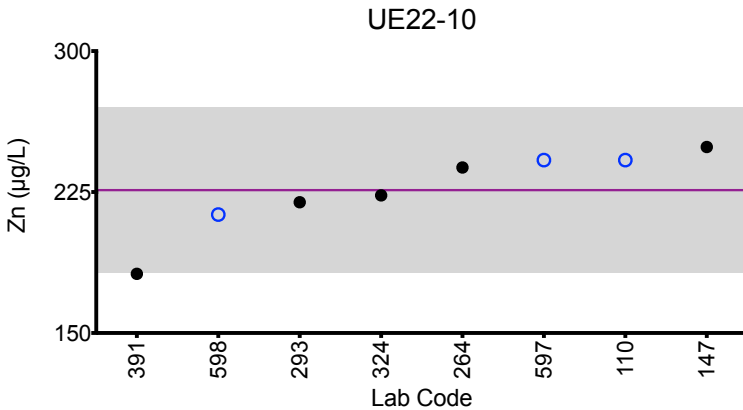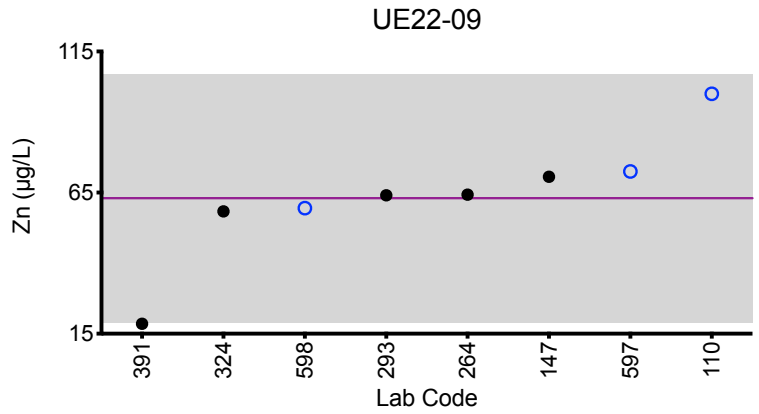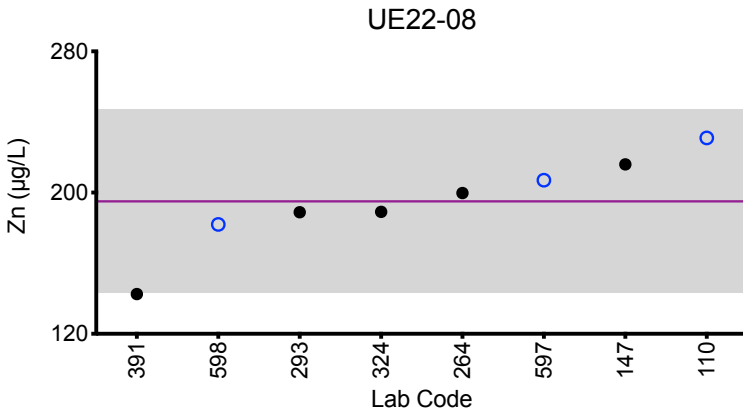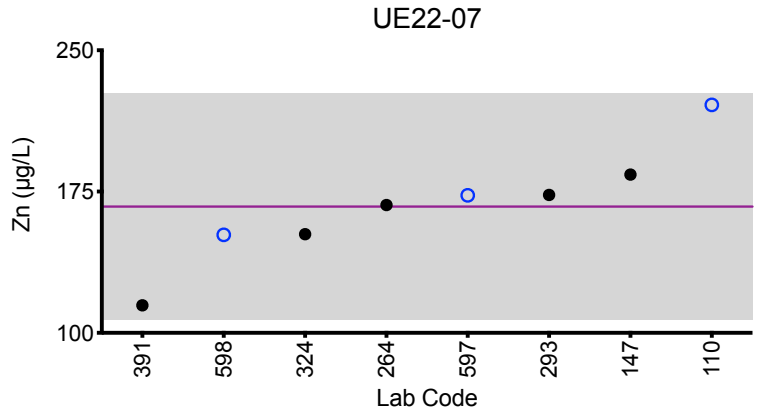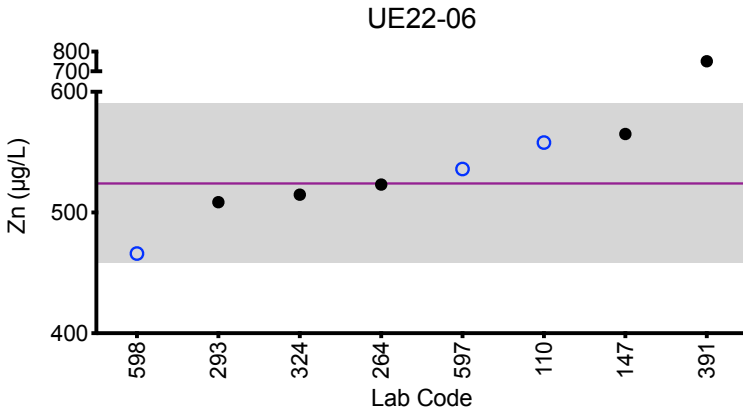
UE22-06

UE22-07

UE22-08

UE22-09

UE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
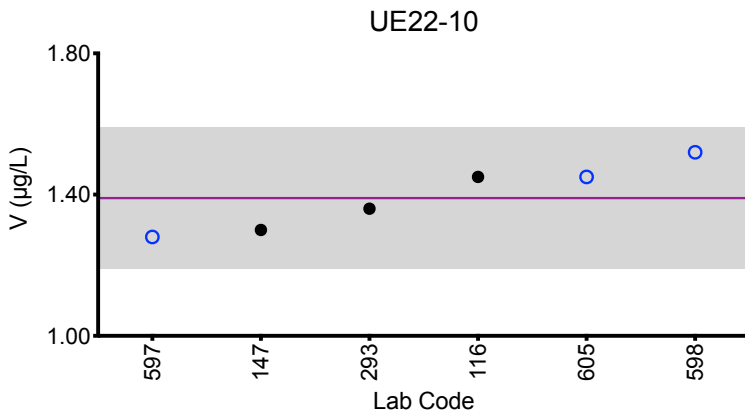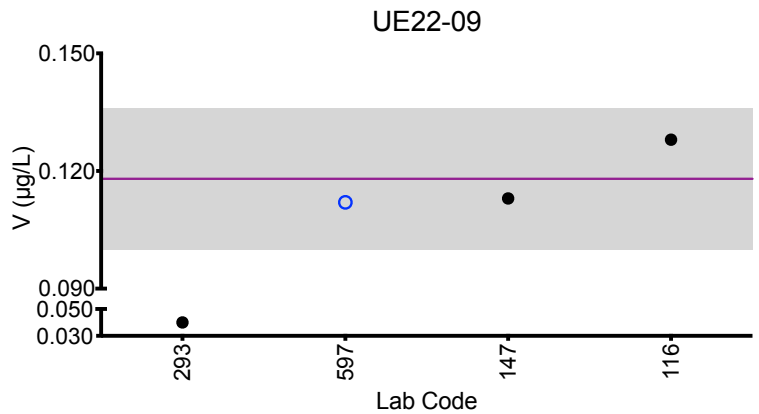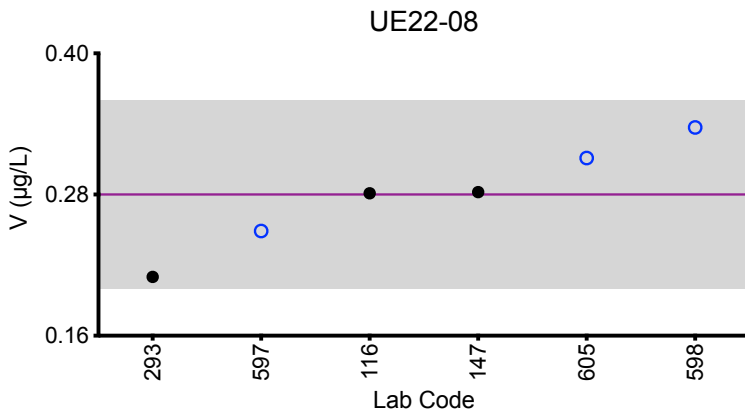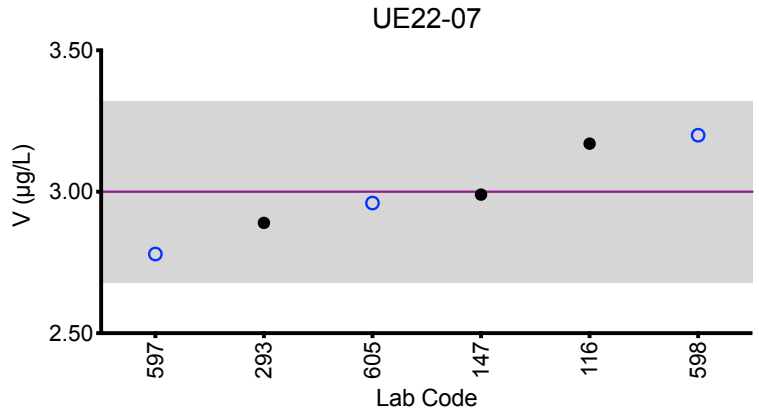## Laboratory Data and Summary Statistics

		Urine Te (µg/L)				
Lab Code	**Method**	**UE22-06**	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
110	ICP-MS	2.03	0.248	0.655	0.136	0.767
147	ICP-MS	2.45	0.214	0.534	0.160	0.805
		Summary Statistics				
		UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Arithmetic Mean ($\bar{x}$)		2.2	0.23	0.59	0.15	0.79
Arithmetic SD (s)		0.3	0.02	0.09	0.02	0.03
Arithmetic RSD (%)		14	8.7	15	11	3.8
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

		Urine Ti (µg/L)				
Lab Code	**Method**	**UE22-06**	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
442	ICP-MS/MS	0.785	1.8	2.52	0.362	3.75
597	ICP-MS/MS	<1.96	1.97	4.11	2.24	5.21
		Summary Statistics				
		UE22-06	**UE22-07**	**UE22-08**	**UE22-09**	**UE22-10**
Arithmetic Mean ($\bar{x}$)		NA	1.89	3.3	NA	4.5
Arithmetic SD (s)		NA	0.12	1.1	NA	1.0
Arithmetic RSD (%)		NA	6.3	33	NA	22
Number of Sample Measurements (N)		NA	2	2	NA	2

*Denotes a statistical Outlier.

Statistical data was not calculated for UE22-06 and UE22-09 based on a lack of consensus among participating labs.

Results for Event #2, 2022:
Additional Elements in Urine

Urine Ag (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
147	ICP-MS	<0.151	<0.151	<0.151	<0.151	<0.151

Urine B (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
200	ICP-MS	464	324	410	281	464

Urine Bi (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
147	ICP-MS	<0.0794	<0.0794	<0.0794	<0.0794	<0.0794
264	ICP-MS	0.02	0.02	0.01	0.02	<0.01
597	ICP-MS/MS	<0.0330	<0.0330	<0.0330	<0.0330	<0.0330

Urine Fe (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
324	ICP-MS	8.239	8.741	10.037	4.217	11.409

Urine I (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
147	ICP-MS	52.0	107	120	87.6	140

Urine Li (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
147	ICP-MS	26.6	12.6	15.1	11	16.9

Urine Mg (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
597	ICP-MS/MS	36000	29600	35300	18800	39800

Urine Th (µg/L)

Lab Code	Method	UE22-06	UE22-07	UE22-08	UE22-09	UE22-10
147	ICP-MS	<0.102	<0.102	<0.102	<0.102	<0.102
597	ICP-MS/MS	0.0152	0.0208	0.0208	<0.009	0.0280

Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Al (µg/L)					
Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
147	ICP-MS	<13.8	324	ICP-MS	4.615
264	ICP-MS	4.27	597	ICP-MS/MS	6.00
293	DRC/CC-ICP-MS	3.49			
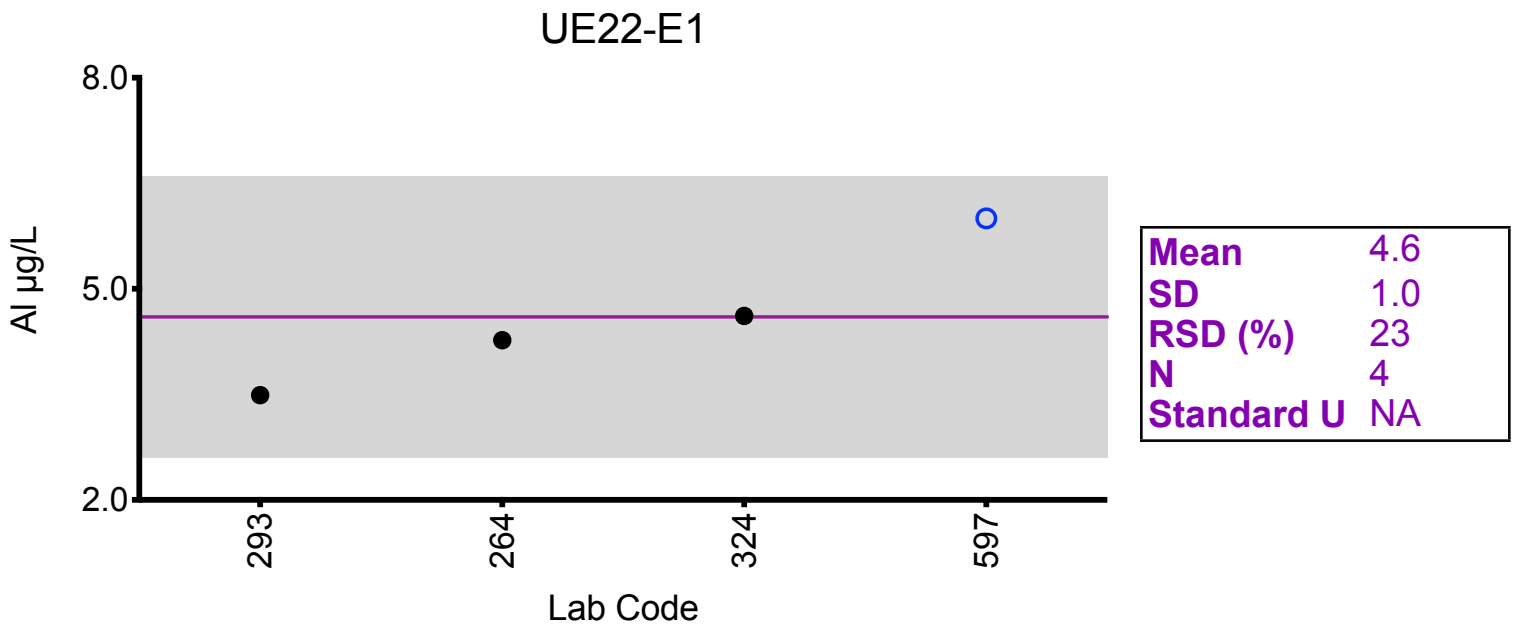
UE22-E1

Mean	4.6
SD	1.0
RSD (%)	23
N	4
Standard U	NA

Legend:

o C/HHEAR Labs   • Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine As (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	192	293	DRC/CC-ICP-MS	187.59
107	DRC/CC-ICP-MS	181.55	324	ICP-MS	155.495
110	DRC/CC-ICP-MS	203	399	DRC/CC-ICP-MS	193
116	ICP-MS/MS	216	597	ICP-MS/MS	189
147	ICP-MS	198	598	DRC/CC-ICP-MS	182
220	DRC/CC-ICP-MS	209	605	ICP-MS	208
264	ICP-MS	200.89	606	ICP-MS/MS	207

UE22-E1

Mean	196
SD	14
RSD (%)	7.0
N	14
Standard U	5

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Ba (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
107	ICP-MS	36.123	399	ICP-MS/MS	35.3
110	ICP-MS	38.5	597	ICP-MS/MS	32.2
116	ICP-MS/MS	35.6	598	ICP-MS	32.7
147	ICP-MS	33.5	605	ICP-MS	39.7
220	ICP-MS	37.8	606	ICP-MS/MS	37.3
264	ICP-MS	32.58			

UE22-E1

Mean	36
SD	3
RSD (%)	8.2
N	11
Standard U	1

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Be (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
107	ICP-MS	28.879	293	ICP-MS	30.27
110	ICP-MS	29.8	399	ICP-MS/MS	28.5
116	ICP-MS/MS	28.1	597	ICP-MS/MS	27.5
147	ICP-MS	28.7	598	ICP-MS	26.6
220	ICP-MS	31.1	605	ICP-MS	31.5
264	ICP-MS	30.22			

UE22-E1

Mean	29.2
SD	1.7
RSD (%)	5.9
N	11
Standard U	0.6

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Bi (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
147	ICP-MS	0.158	597	ICP-MS/MS	0.125
264	ICP-MS	0.13			

UE22-E1

Mean	0.14
SD	0.02
RSD (%)	13
N	3
Standard U	NA

Legend:

o C/HHEAR Labs   ● Other Labs

Horizontal purple line = Robust/Arithmetic Mean of all laboratories.

Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Cd (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	20.8	324	ICP-MS	19.397
107	DRC/CC-ICP-MS	15.801	391	DRC/CC-ICP-MS	16.139
110	ICP-MS	19.7	399	DRC/CC-ICP-MS	20.3
116	ICP-MS/MS	18.1	597	ICP-MS/MS	20.1
147	ICP-MS	19.1	598	DRC/CC-ICP-MS	19.1
220	ICP-MS	19.5	605	ICP-MS	21.7
264	ICP-MS	19.70	606	ICP-MS/MS	19.6
293	DRC/CC-ICP-MS	19.3			

UE22-E1

Mean	19.5
SD	0.7
RSD (%)	3.6
N	15
Standard U	0.2

Legend:

o C/HHEAR Labs   • Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
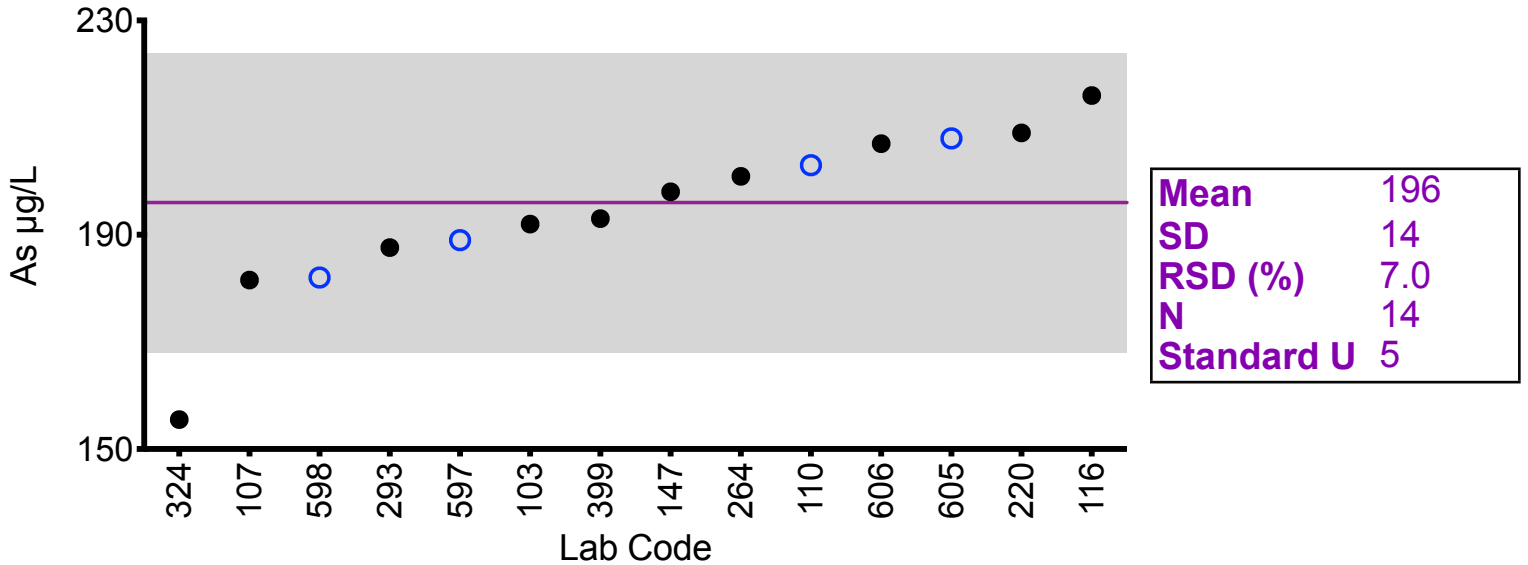
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Co (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	11.8	324	ICP-MS	8.799
107	ICP-MS	11.161	391	DRC/CC-ICP-MS	10.227
110	ICP-MS	11.9	399	DRC/CC-ICP-MS	11.8
147	ICP-MS	11.7	597	ICP-MS/MS	11.5
220	ICP-MS	12.4	598	ICP-MS	10.4
264	ICP-MS	11.70	605	ICP-MS	12.5
293	DRC/CC-ICP-MS	11.93	606	ICP-MS/MS	12.7

UE22-E1

Mean	11.7
SD	0.7
RSD (%)	5.9
N	14
Standard U	0.2

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
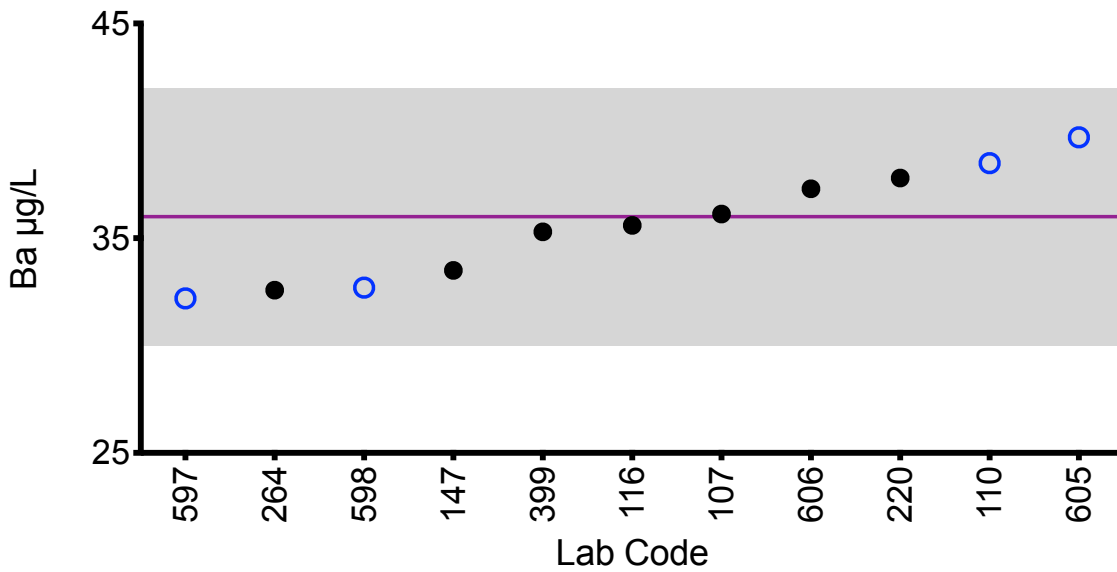
New York State Department of Health | Wadsworth Center

Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Cr (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	64.0	293	DRC/CC-ICP-MS	65.00
107	DRC/CC-ICP-MS	62.83	324	ICP-MS	51.767
110	DRC/CC-ICP-MS	66.6	391	DRC/CC-ICP-MS	60.553
116	ICP-MS/MS	70.1	597	ICP-MS/MS	60.4
147	DRC/CC-ICP-MS	64.5	598	DRC/CC-ICP-MS	63.2
264	ICP-MS	64.79	605	ICP-MS	66.9

UE22-E1

Mean	64
SD	3
RSD (%)	4.8
N	12
Standard U	1

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

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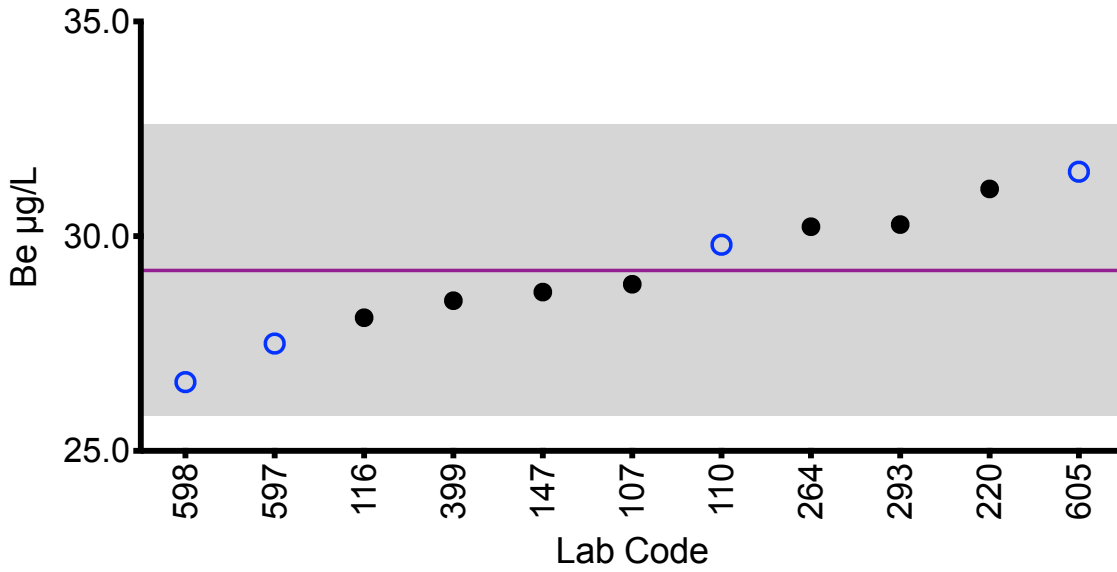
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Cs (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
107	ICP-MS	105.88	399	ICP-MS/MS	103
110	ICP-MS	108	597	ICP-MS/MS	92.1
147	ICP-MS	97.3	598	ICP-MS	96.1
220	ICP-MS	108	605	ICP-MS	118
264	ICP-MS	94.04	606	ICP-MS/MS	108

UE22-E1

Mean	103
SD	9
RSD (%)	8.3
N	10
Standard U	3

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
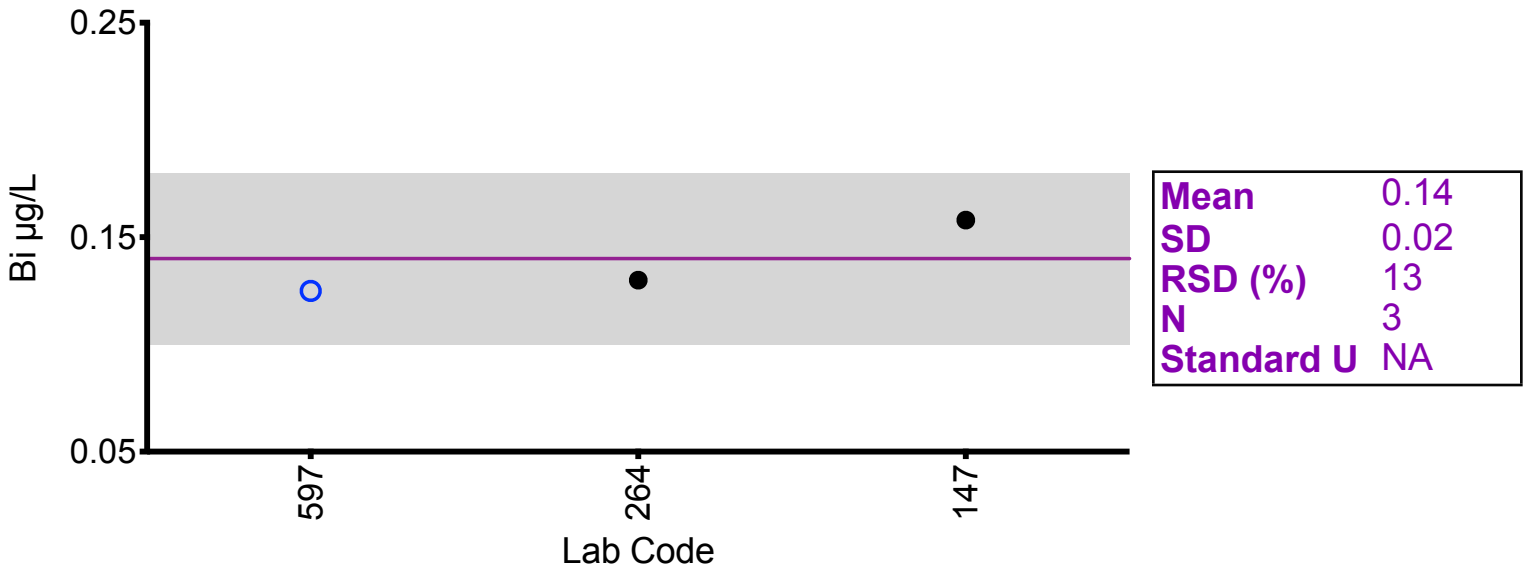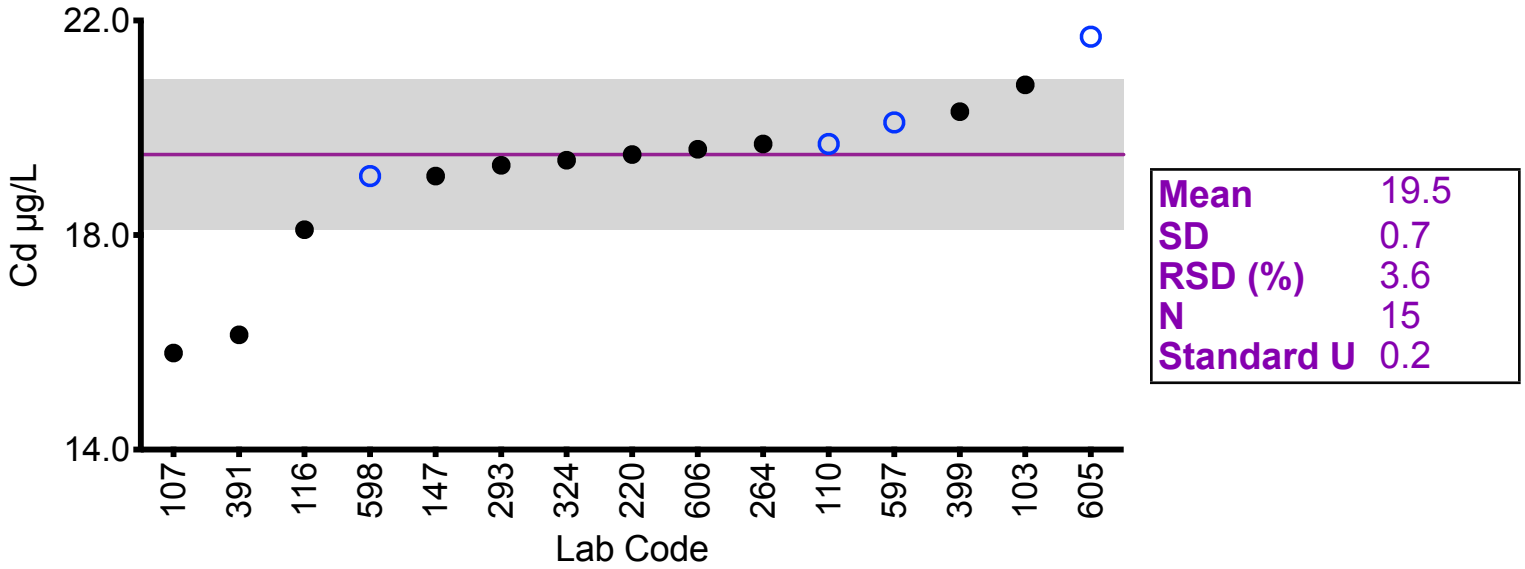
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Cu (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
110	ICP-MS	205	293	DRC/CC-ICP-MS	290.53
116	ICP-MS/MS	316	324	ICP-MS	301.973
147	ICP-MS	301	597	ICP-MS/MS	285
264	ICP-MS	299.75	598	ICP-MS	247

UE22-E1

Mean	281
SD	37
RSD (%)	13
N	8
Standard U	NA

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
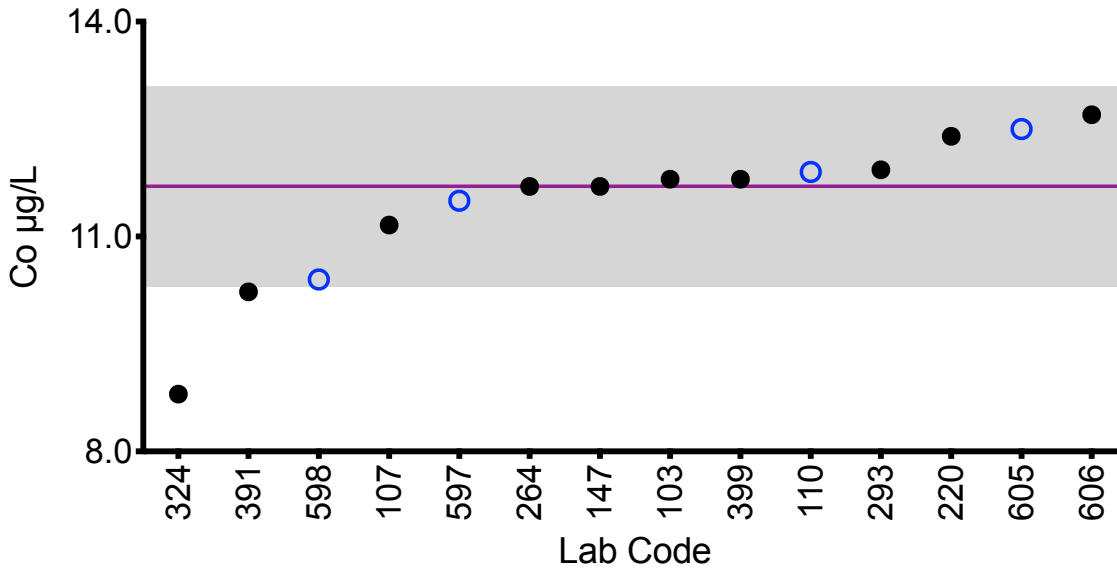
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Hg (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	69.4	293	DRC/CC-ICP-MS	71.94
107	DRC/CC-ICP-MS	76.56	391	DRC/CC-ICP-MS	69.918
110	ICP-MS	65.1	597	ICP-MS/MS	66.2
116	ICP-MS/MS	59.6	598	ICP-MS	54.2
147	ICP-MS	66.4	605	ICP-MS	64.7
264	ICP-MS	51.96	606	ICP-MS/MS	>50

UE22-E1

Mean	66
SD	6
RSD (%)	9.6
N	11
Standard U	2

Legend:

o C/HHEAR Labs   ● Other Labs

Horizontal purple line = Robust/Arithmetic Mean of all laboratories.

Gray area = ±2SD of the mean.

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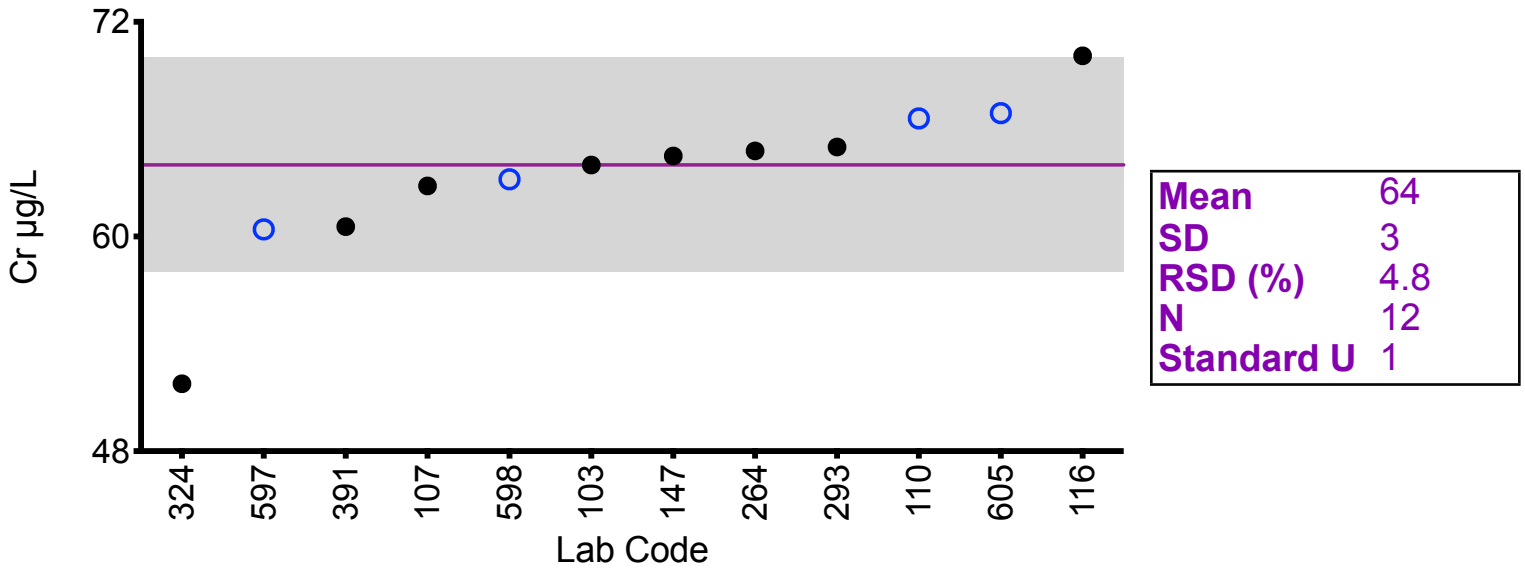
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Mn (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	38.0	324	ICP-MS	29.568
107	DRC/CC-ICP-MS	33.230	391	DRC/CC-ICP-MS	37.669
110	DRC/CC-ICP-MS	39.6	399	DRC/CC-ICP-MS	37.8
116	ICP-MS/MS	40.5	597	ICP-MS/MS	35.6
147	DRC/CC-ICP-MS	36.3	598	ICP-MS	33.9
220	DRC/CC-ICP-MS	42.2	605	ICP-MS	40.4
264	ICP-MS	38.11	606	ICP-MS/MS	41.0
293	DRC/CC-ICP-MS	37.82			

UE22-E1

Mean	38
SD	3
RSD (%)	8.6
N	15
Standard U	1

Legend:

o C/HHEAR Labs   • Other Labs

Horizontal purple line = Robust/Arithmetic Mean of all laboratories.

Gray area = ±2SD of the mean.

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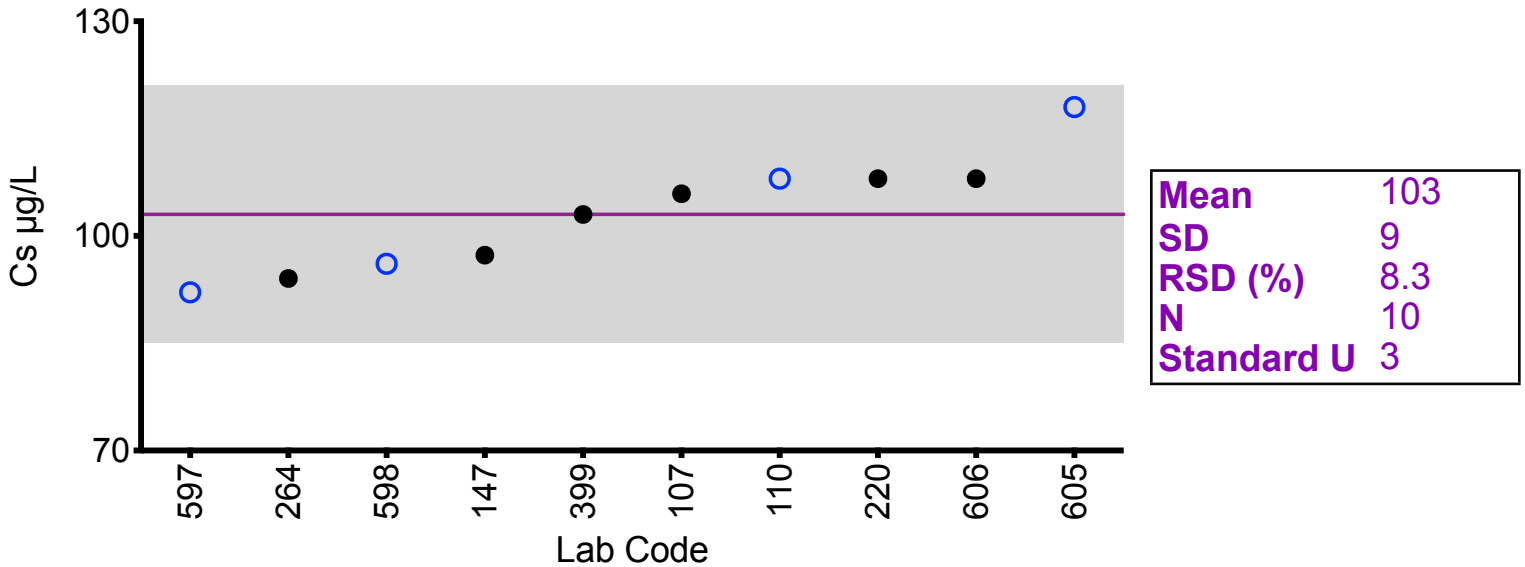
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Mo (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	458	324	ICP-MS	353.643
107	ICP-MS	424.02	399	ICP-MS/MS	434
110	ICP-MS	471	597	ICP-MS/MS	435
147	ICP-MS	404	598	DRC/CC-ICP-MS	454
220	ICP-MS	489	605	ICP-MS	491
264	ICP-MS	379.67	606	ICP-MS/MS	464
293	DRC/CC-ICP-MS	483.71			

UE22-E1

Mean	445
SD	41
RSD (%)	9.2
N	13
Standard U	10

Legend:

o C/HHEAR Labs • Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
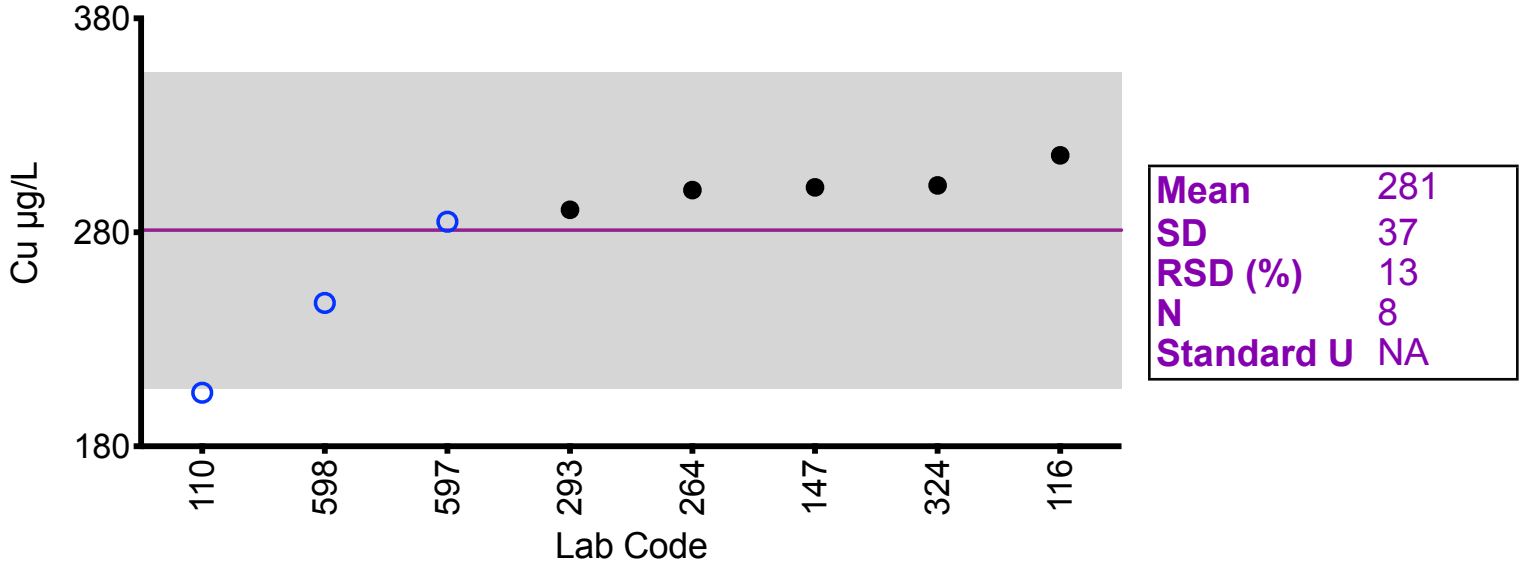
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Ni (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
107	DRC/CC-ICP-MS	65.47	324	ICP-MS	47.654
110	ICP-MS	45.6	597	ICP-MS/MS	65.4
147	ICP-MS	67.0	598	ICP-MS	62.6
264	ICP-MS	67.62	605	ICP-MS	71.6
293	DRC/CC-ICP-MS	75.89			

UE22-E1

Mean	63
SD	10
RSD (%)	16
N	9
Standard U	NA

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
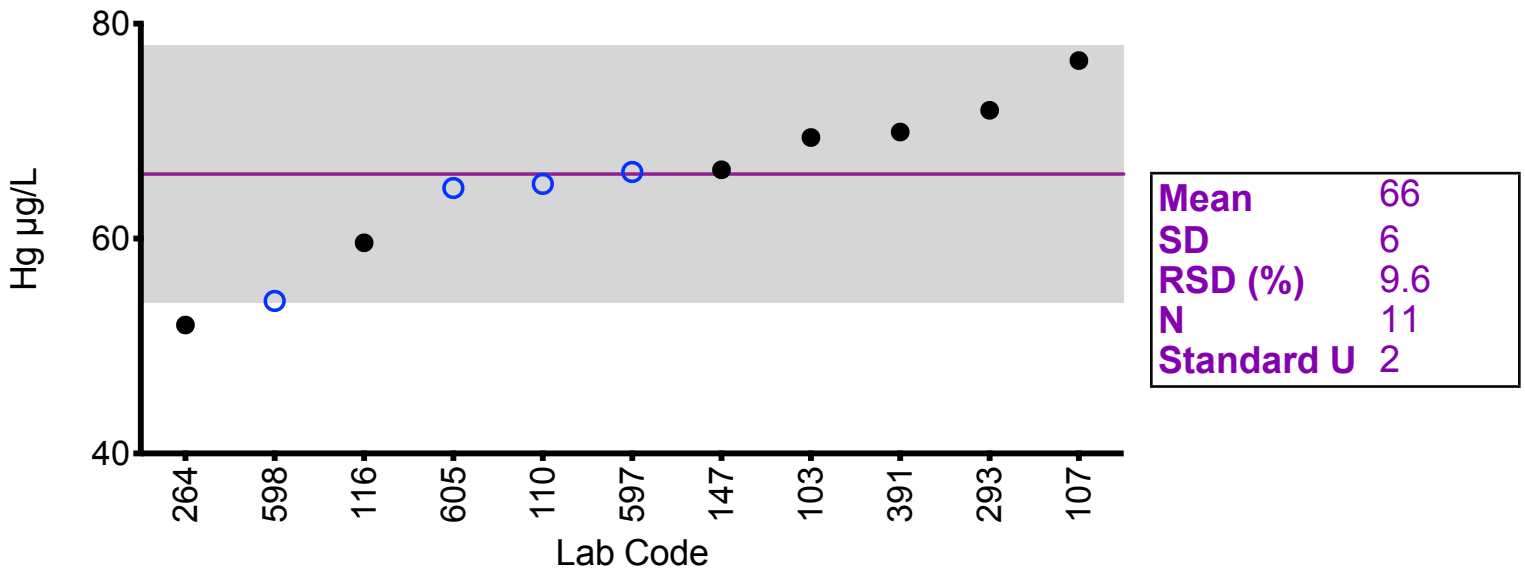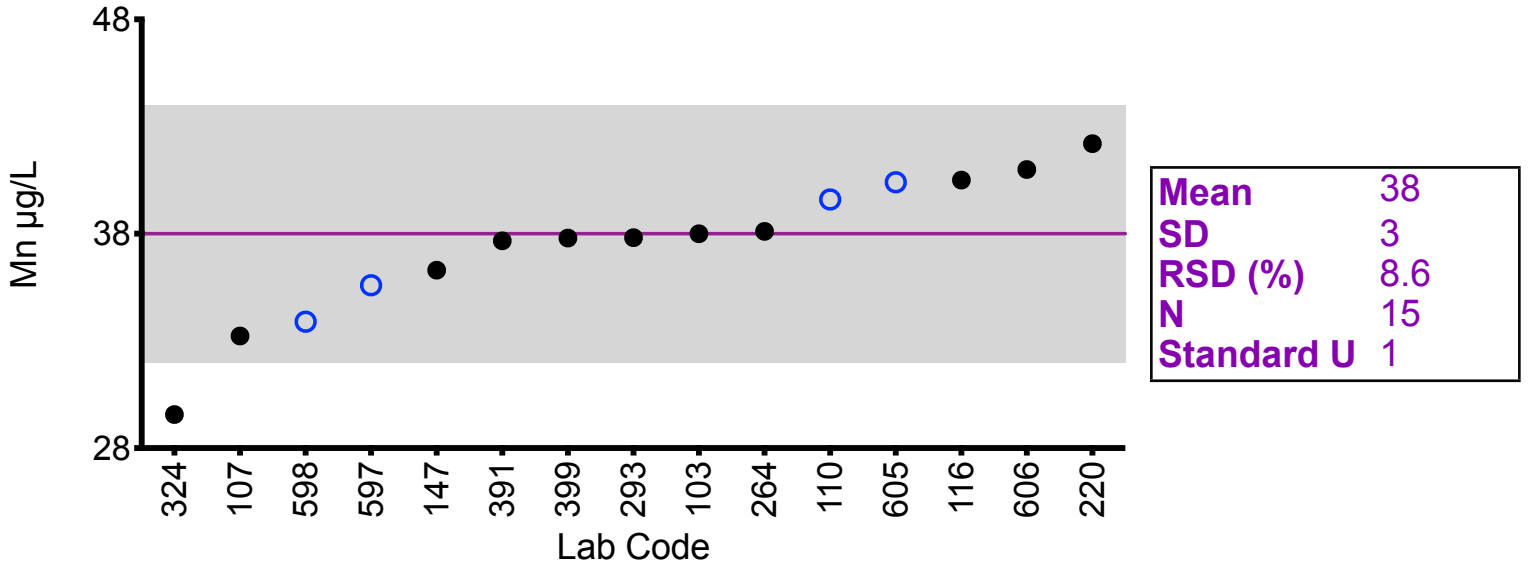
![New York State Department of Health | Wadsworth Center]

Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Pb (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	85.8	324	ICP-MS	83.290
107	ICP-MS	>40	391	DRC/CC-ICP-MS	72.322
110	ICP-MS	82.3	399	ICP-MS/MS	85.4
116	ICP-MS/MS	84.1	597	ICP-MS/MS	77.7
147	ICP-MS	77.9	598	ICP-MS	68.1
220	ICP-MS	82.2	605	ICP-MS	93.6
264	ICP-MS	84.20	606	ICP-MS/MS	84.7
293	DRC/CC-ICP-MS	82.59			

UE22-E1

Mean	83
SD	4
RSD (%)	4.3
N	14
Standard U	1

Legend:

o C/HHEAR Labs • Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
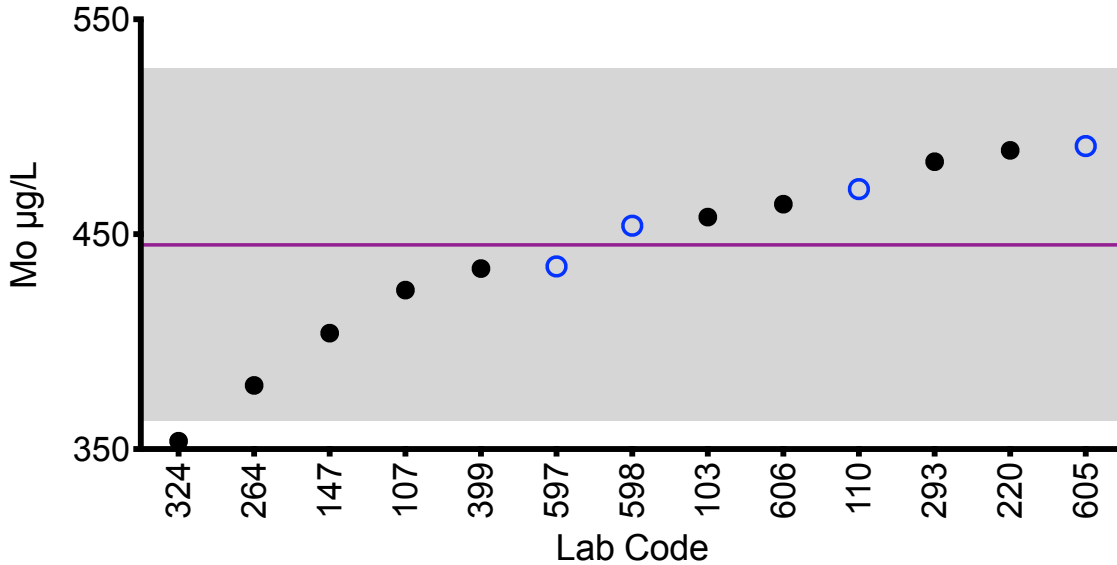
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Pt (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
107	ICP-MS	15.6099	293	DRC/CC-ICP-MS	15.19
110	ICP-MS	15.3	399	ICP-MS/MS	14.9
220	ICP-MS	*25.6	598	ICP-MS	12.7
264	ICP-MS	14.44	605	ICP-MS	16.1

UE22-E1

Mean	14.9
SD	1.1
RSD (%)	7.4
N	7
Standard U	NA

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
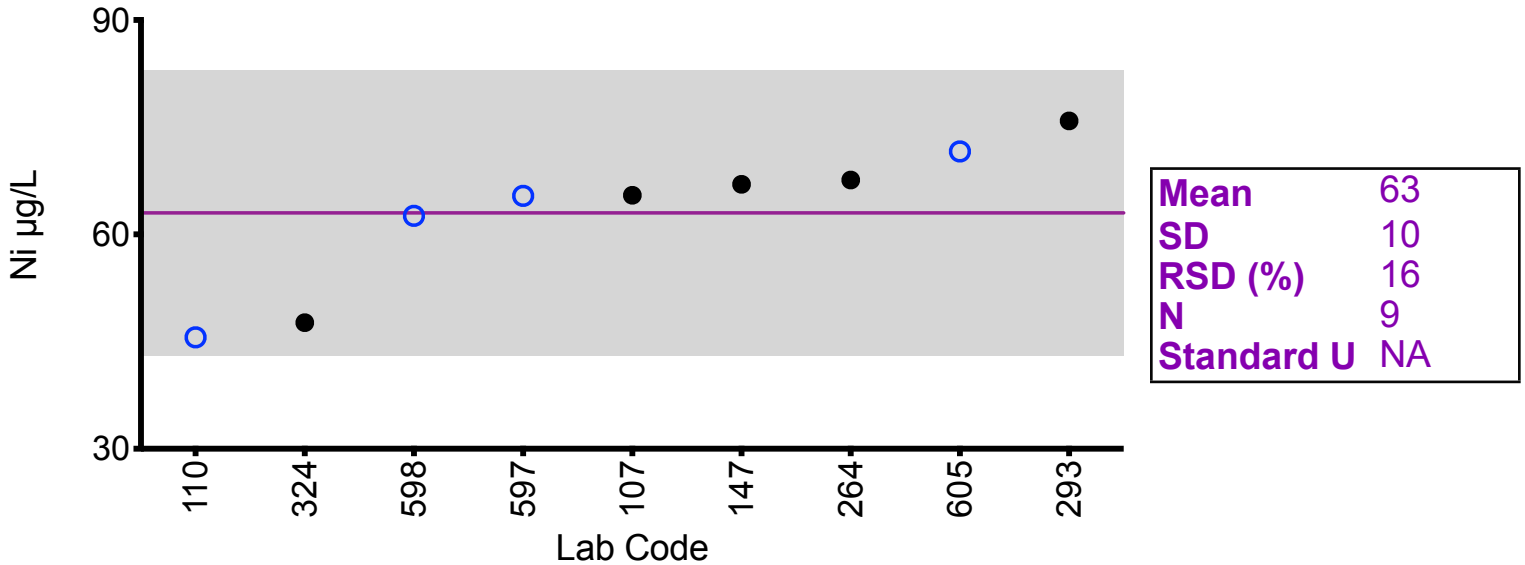
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Sb (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	19.5	293	DRC/CC-ICP-MS	26.44
107	ICP-MS	25.421	399	ICP-MS/MS	26.0
110	ICP-MS	26.1	597	ICP-MS/MS	25.0
147	ICP-MS	28.0	598	ICP-MS	24.8
220	ICP-MS	26.8	605	ICP-MS	27.5
264	ICP-MS	23.33	606	ICP-MS/MS	26.5

UE22-E1

Mean	25.9
SD	1.4
RSD (%)	5.5
N	12
Standard U	0.5

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
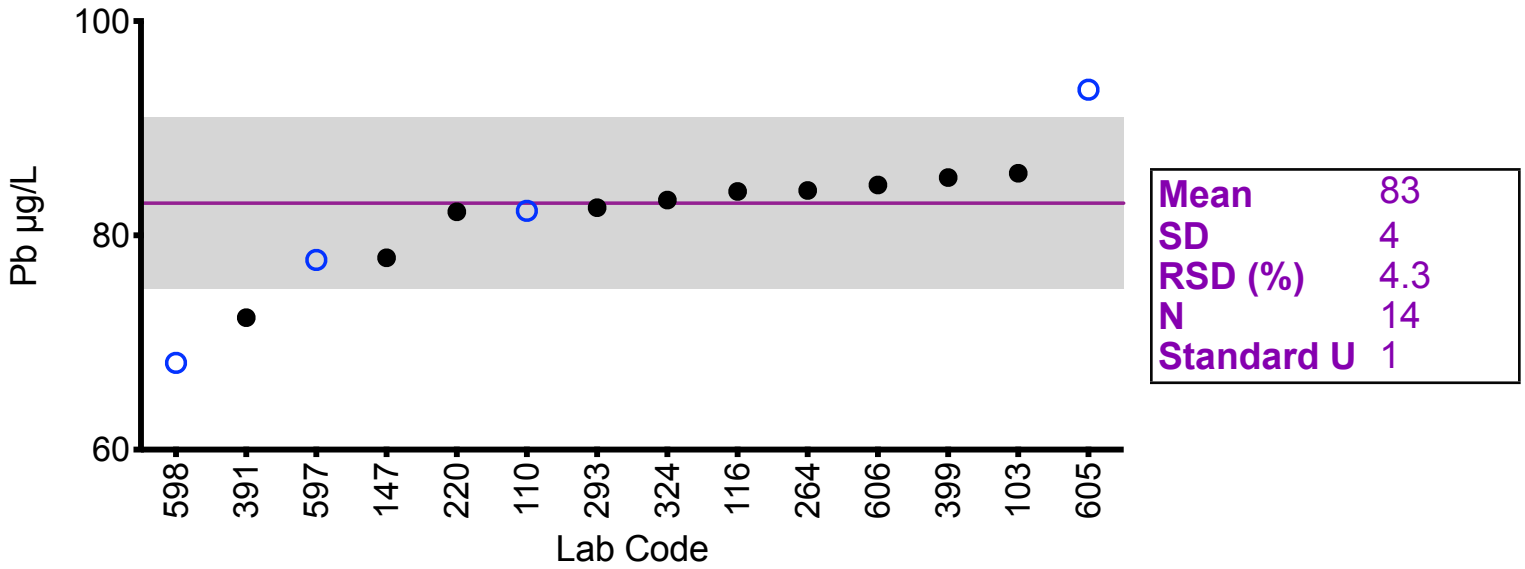
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Se (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	834	293	DRC/CC-ICP-MS	797.95
110	DRC/CC-ICP-MS	894	597	ICP-MS/MS	796
147	ICP-MS	777	598	DRC/CC-ICP-MS	812

UE22-E1

Mean	818
SD	42
RSD (%)	5.1
N	6
Standard U	NA

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
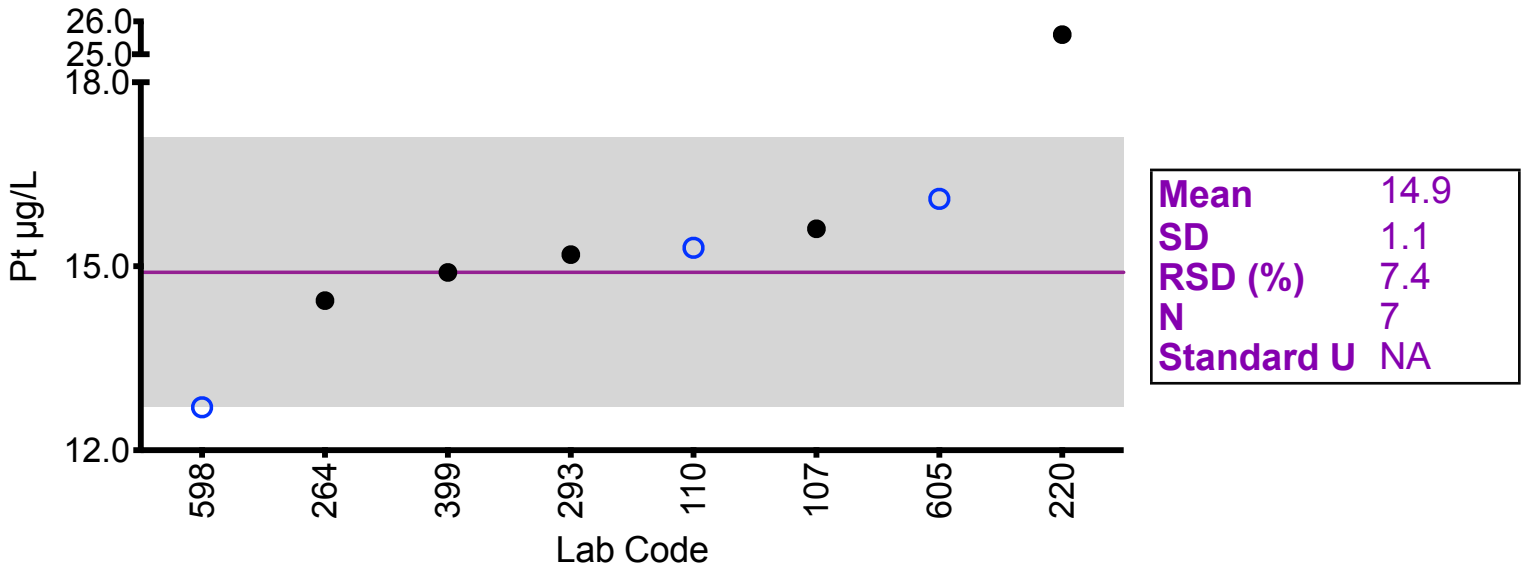
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Sn (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
107	ICP-MS	41.80	399	ICP-MS/MS	39.7
110	ICP-MS	39.5	597	ICP-MS/MS	39.4
147	ICP-MS	44.5	598	ICP-MS	34.1
220	ICP-MS	40.1	605	ICP-MS	44.2
264	ICP-MS	34.92			

UE22-E1

Mean	39.8
SD	3.6
RSD (%)	9.0
N	9
Standard U	NA

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

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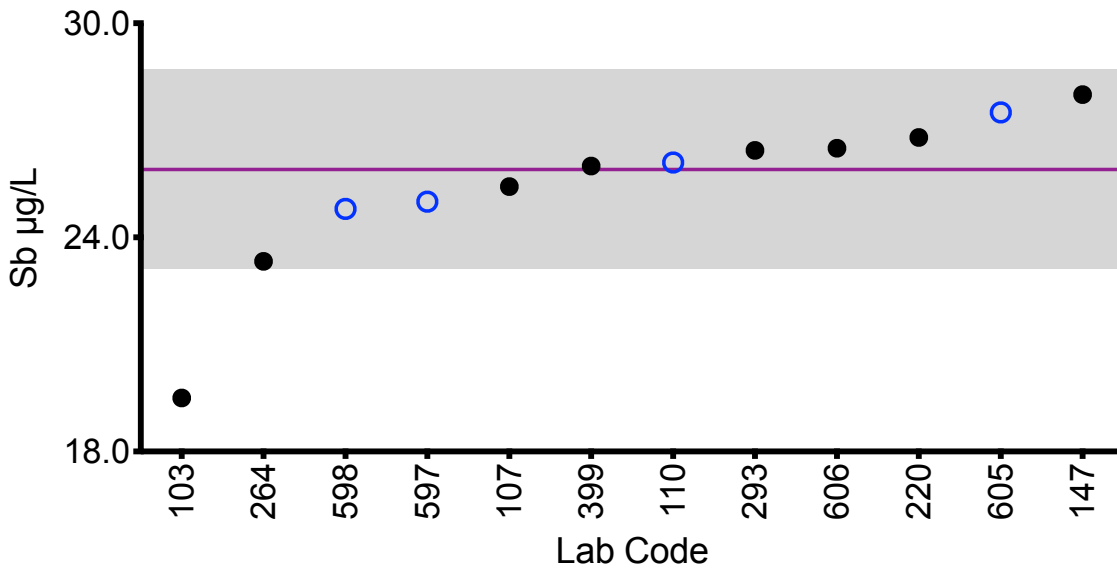
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Sr (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	782	399	DRC/CC-ICP-MS	757
107	ICP-MS	800.0	597	ICP-MS/MS	751
220	ICP-MS	847	605	ICP-MS	816
264	ICP-MS	766.12			

Mean	788
SD	35
RSD (%)	4.4
N	7
Standard U	NA

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
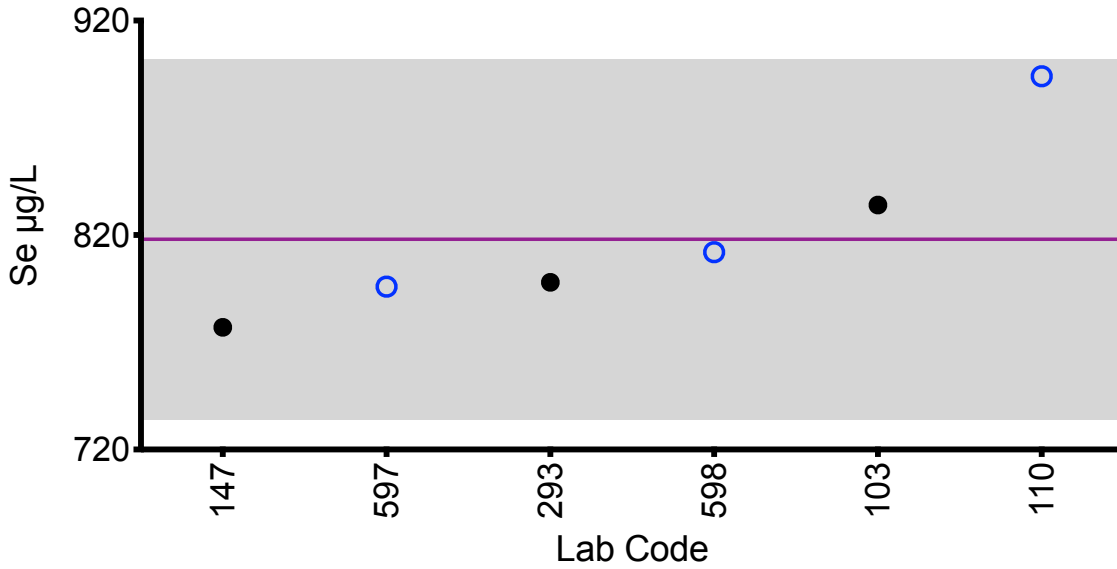
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Tl (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	35.1	293	DRC/CC-ICP-MS	34.11
107	ICP-MS	>20	391	DRC/CC-ICP-MS	26.647
110	ICP-MS	34.3	399	ICP-MS/MS	35.7
116	ICP-MS/MS	35.3	597	ICP-MS/MS	35.6
147	ICP-MS	31.7	598	ICP-MS	28.6
220	ICP-MS	34.2	605	ICP-MS	37.3
264	ICP-MS	35.06	606	ICP-MS/MS	34.8

UE22-E1

Mean	34.6
SD	1.1
RSD (%)	3.3
N	13
Standard U	0.4

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
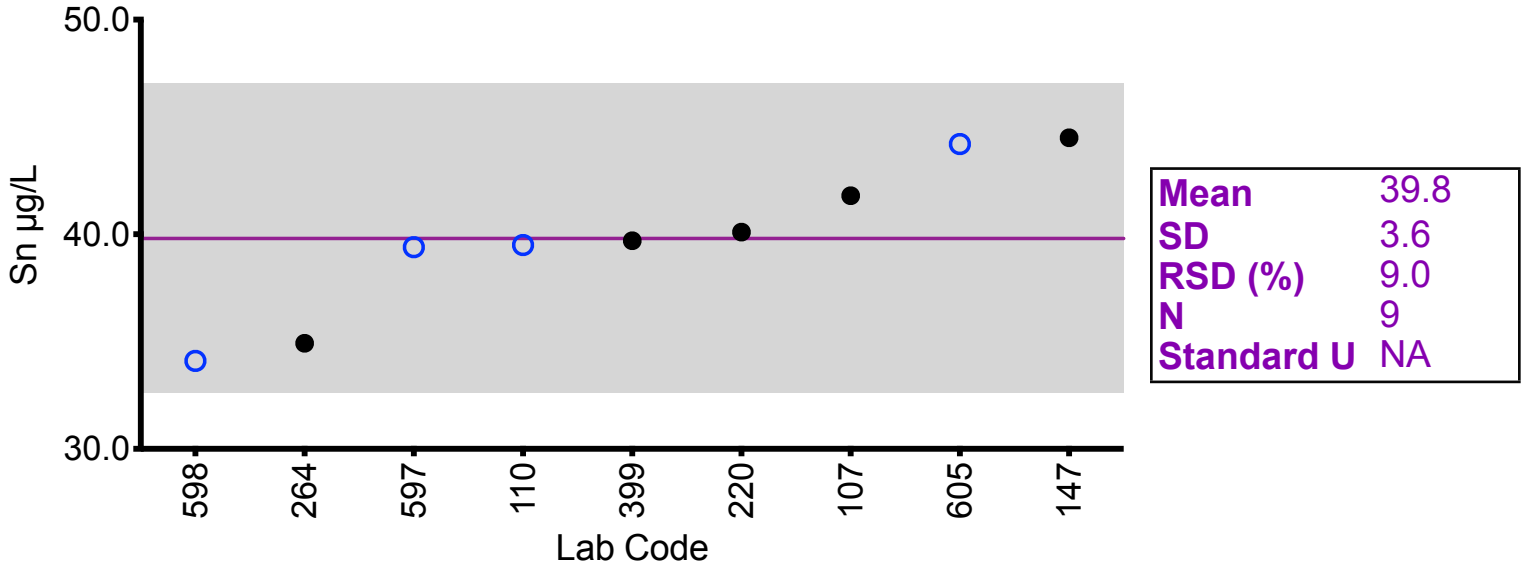
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine U (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
103	ICP-MS/MS	2.60	324	ICP-MS	1.764
107	ICP-MS	2.9456	391	DRC/CC-ICP-MS	3.085
110	ICP-MS	2.56	399	ICP-MS/MS	2.36
116	ICP-MS/MS	2.47	597	ICP-MS/MS	2.48
147	ICP-MS	2.31	598	ICP-MS	2.18
220	ICP-MS	2.62	605	ICP-MS	2.57
264	ICP-MS	2.40	606	ICP-MS/MS	2.54

UE22-E1

Mean	2.50
SD	0.18
RSD (%)	7.4
N	14
Standard U	0.06

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
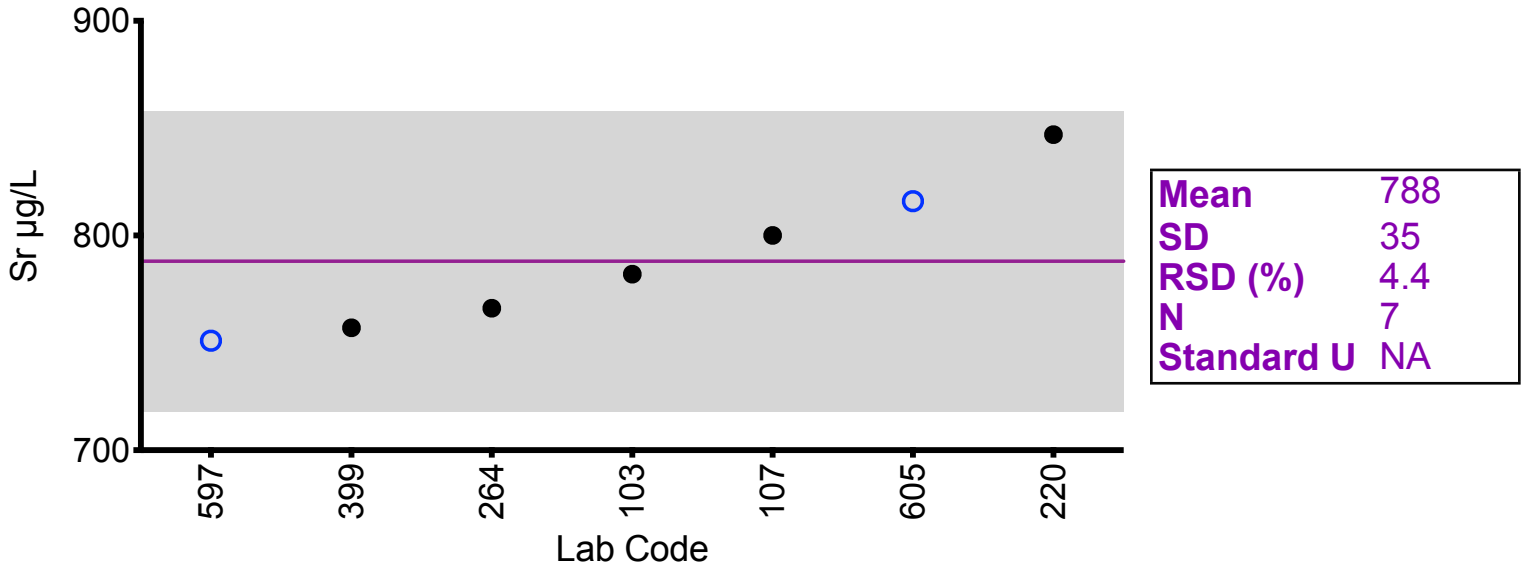
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine V (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
116	ICP-MS/MS	28.6	597	ICP-MS/MS	23.4
147	DRC/CC-ICP-MS	24.0	598	DRC/CC-ICP-MS	25.2
293	DRC/CC-ICP-MS	25.95	605	ICP-MS	25.8

UE22-E1

Mean	25.5
SD	1.8
RSD (%)	7.2
N	6
Standard U	NA

Legend:

o C/HHEAR Labs   ● Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
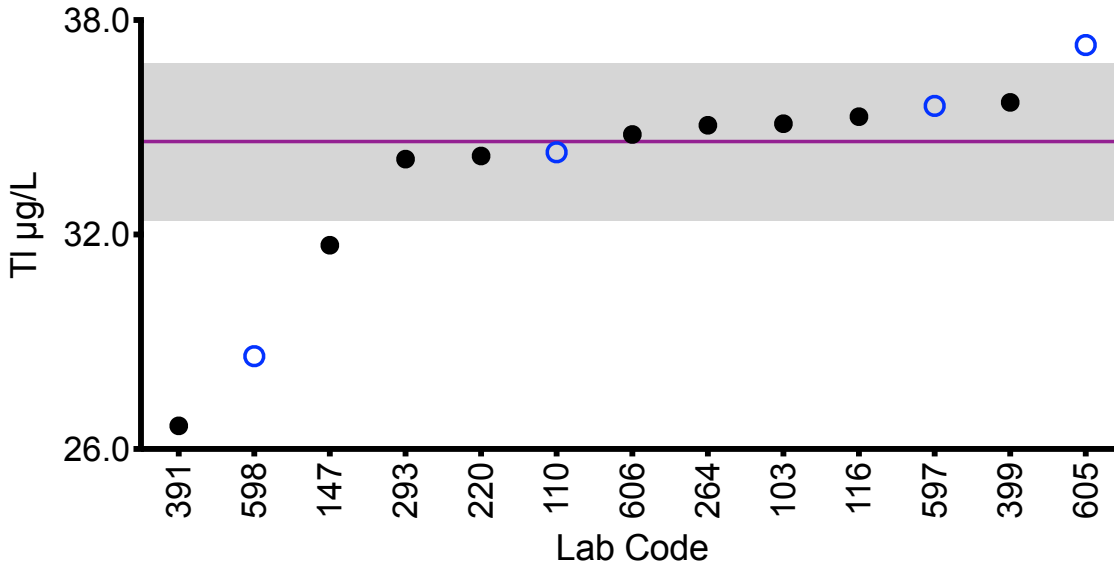
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine W (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
107	ICP-MS	23.360	399	ICP-MS/MS	25.1
110	ICP-MS	26.6	597	ICP-MS/MS	24.2
147	ICP-MS	27.4	598	ICP-MS	23.3
220	ICP-MS	25.6	605	ICP-MS	26.4
264	ICP-MS	23.89	606	ICP-MS/MS	25.4
324	ICP-MS	22.626			

UE22-E1

Mean	24.9
SD	1.7
RSD (%)	7.0
N	11
Standard U	0.7

Legend:

o C/HHEAR Labs   • Other Labs
Horizontal purple line = Robust/Arithmetic Mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
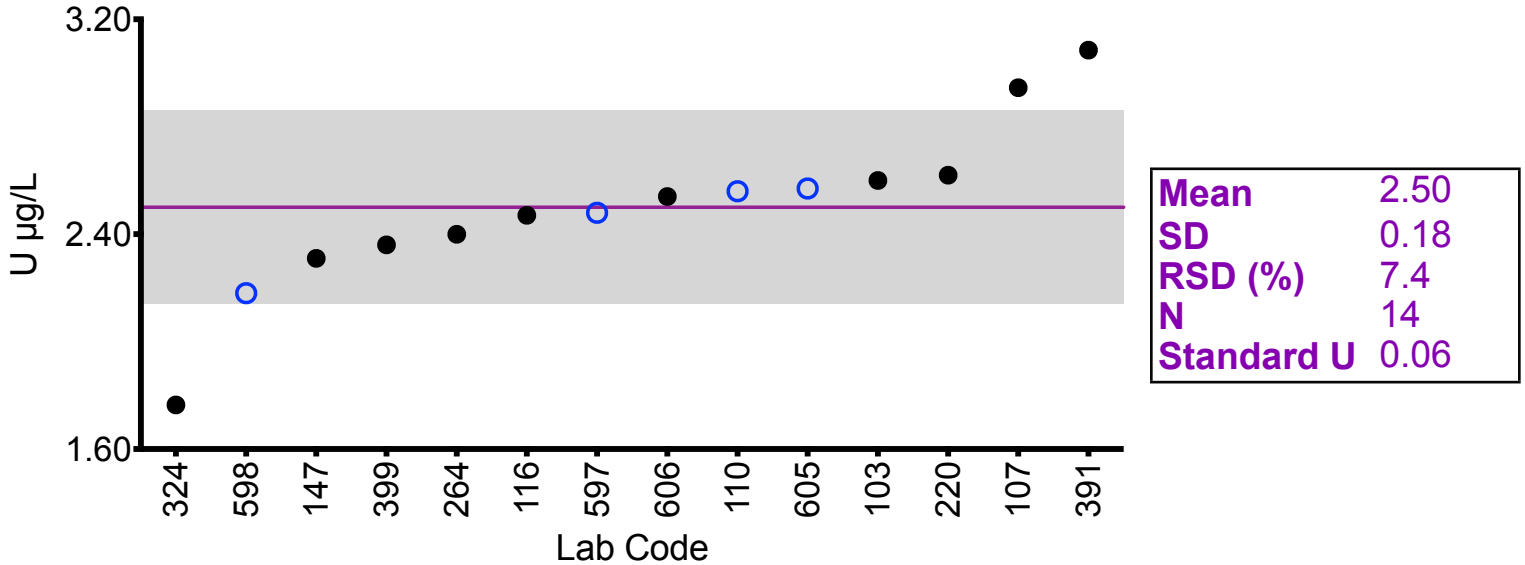
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Zn (µg/L)

Lab Code	Method	UE22-E1	Lab Code	Method	UE22-E1
110	ICP-MS	1221	324	ICP-MS	1693.340
147	ICP-MS	1765	391	DRC/CC-ICP-MS	1706.453
264	ICP-MS	1783.16	597	ICP-MS/MS	1690
293	DRC/CC-ICP-MS	1611.11	598	ICP-MS	1460

UE22-E1
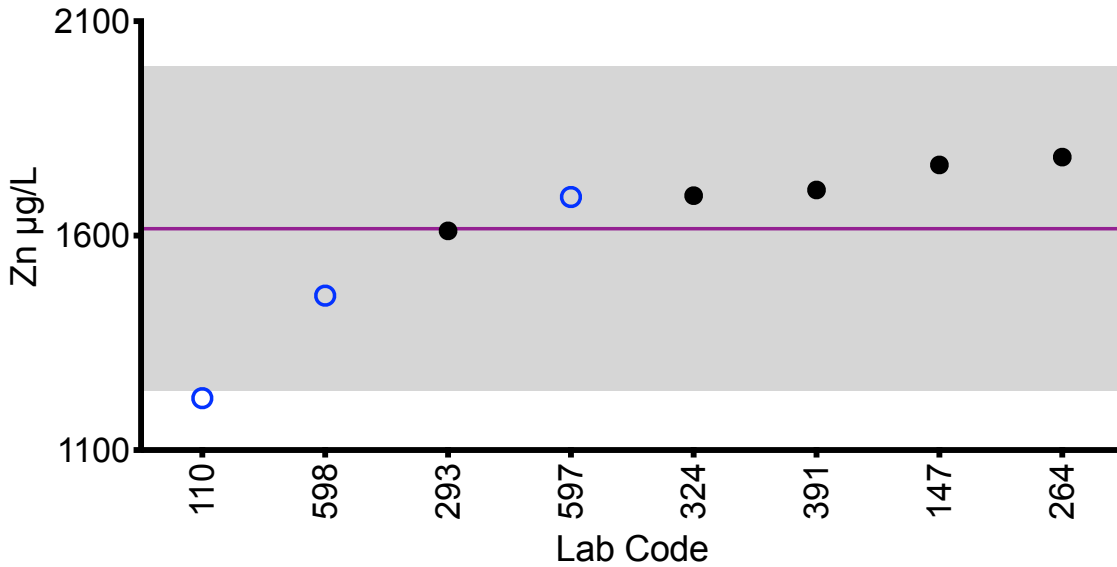
Mean	1616
SD	189
RSD (%)	12
N	8
Standard U	NA

Legend:

o C/HHEAR Labs   ● Other Labs

Horizontal purple line = Robust/Arithmetic Mean of all laboratories.

Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.
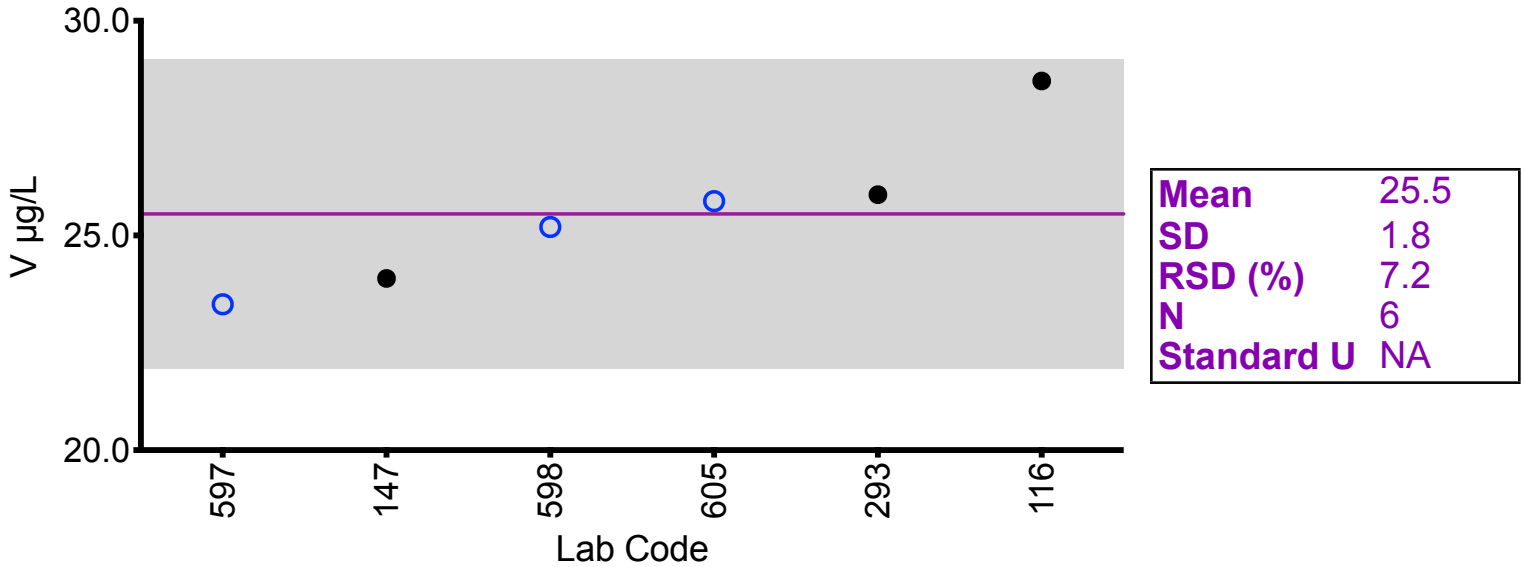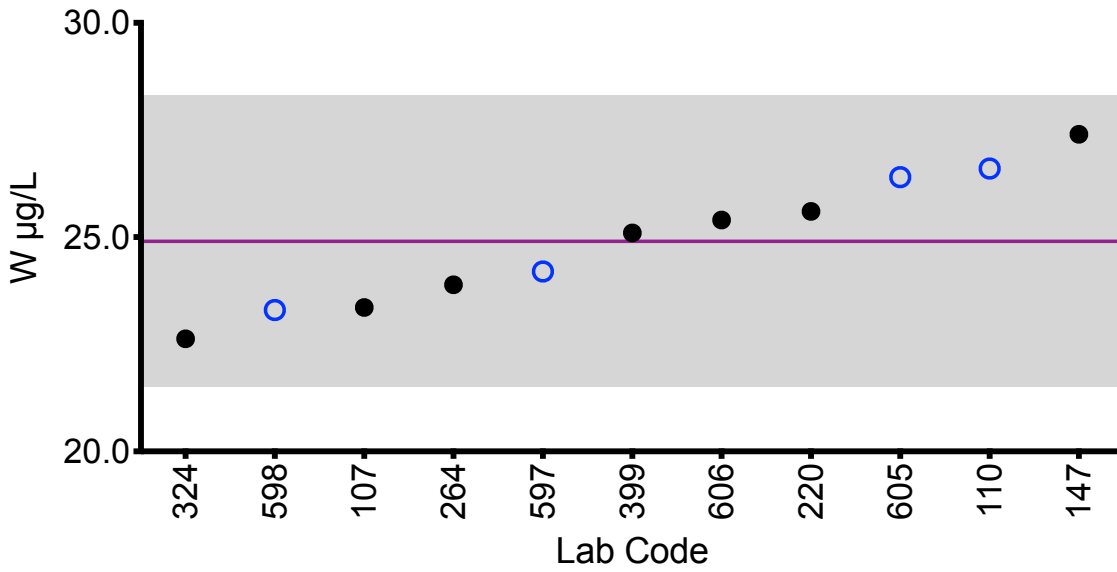
Results for Event #2, 2022:
Educational Urine Sample UE22-E1

Urine Ag (µg/L)

Lab Code	Method	UE22-E1
147	ICP-MS	<0.151

Urine Fe (µg/L)

Lab Code	Method	UE22-E1
324	ICP-MS	6.220

Urine I (µg/L)

Lab Code	Method	UE22-E1
147	ICP-MS	186

Urine Li (µg/L)

Lab Code	Method	UE22-E1
147	ICP-MS	79.8

Urine Mg (µg/L)

Lab Code	Method	UE22-E1
597	ICP-MS/MS	46500

Urine Te (µg/L)

Lab Code	Method	UE22-E1
110	ICP-MS	30.6
147	ICP-MS	37.8

Urine Th (µg/L)

Lab Code	Method	UE22-E1
147	ICP-MS	<0.102
597	ICP-MS/MS	0.0107

Urine Ti (µg/L)

Lab Code	Method	UE22-E1
597	ICP-MS/MS	<1.96

Event #2, 2022

Trace Elements in Serum

Event #2, 2022:
Trace Elements in Serum

PT Materials

Test materials were prepared from human serum obtained from Zen-Bio, Inc. The company certifies that these materials were tested by FDA approved methods and found to be negative for HIV 1Ž2 and HIV-1 RNA, and non-reactive to HBsAg, HCV3 and STS. Units of serum were filtered into polypropylene containers through cheesecloth to remove particulates and supplemented with aluminum (Al), cobalt (Co), chromium (Cr), copper (Cu), selenium (Se), zinc, (Zn), arsenic (As), beryllium (Be), cadmium (Cd), mercury (Hg), manganese (Mn), molybdenum (Mo), nickel (Ni), lead (Pb), platinum (Pt), antimony (Sb), tin (Sn), strontium (Sr), titanium (Ti), thallium (Tl), uranium (U), vanadium (V) and tungsten (W). PT samples were stored at -80°C until the week of the PT event, when they were thawed at 4°C prior to circulation to laboratories for analysis.

Graded Elements

Six elements in serum are formally graded: Al, Co, Cr, Cu, Se, and Zn. Target values for the graded elements are assigned to these pools based on (a) the robust mean calculated from data reported by all laboratories, or (b) if a robust mean is not possible, the arithmetic mean after outlier deletion.

Additional Elements

An additional 26 were reported by at least one participant: As, B, Ba, Be, Bi, Cd, Cs, Fe, Hg, I, Li, Mg, Mn, Mo, Ni, Pb, Pt, Sb, Sn, Sr, Th, Ti, Tl, U, V, and W. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

The summary statistics for the additional elements are provided for educational purposes only, i.e., no acceptable response is implied. However, it is expected that each laboratory would wish to investigate a potential source of bias if warranted by these data. Future events might result in additional elements becoming graded if a consensus can be reached regarding desired quality specifications.

Results for Event #2, 2022:
Summary Statistics

Serum Al (µg/L)					
	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Target (Arithmetic Mean (x̄))	80	30.3	103	45	52.6
Upper Limit	96	36.4	124	54	63.1
Lower Limit	64	24.2	82	36	42.1
Arithmetic SD (s)	3	2.2	6	3	1.7
Arithmetic RSD (%)	3.7	7.3	5.8	7.1	3.2
Number of Sample Measurements (N)	6	6	6	6	6

The acceptable range is based on quality specifications:
±5 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±5 µg/L at concentrations less than or equal to 25 µg/L. These quality specifications were established by New York State Department of Health's Wadsworth Center, the PT Program organizer.

Results for Event #2, 2022:
Performance of Participating Laboratories

		Serum Al (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
	Target	**80**	**30.3**	**103**	**45**	**52.6**
147	ETAAS-Z	84.4	33.3	104	47.9	55.2
264	ICP-MS	77.28	27.45	94.40	41.17	50.49
293	DRC/CC-ICP-MS	79.03	30.65	101.34	43.55	51.88
391	ETAAS-Z	78.89	32.3	111.8	48.95	53.54
485	HR-ICP-MS	83.5	28.7	104	41.9	53.1
597	ICP-MS/MS	77.9	29.3	99.7	45.7	51.4

Based on the grading criteria for Al in Serum, 100% of results were satisfactory, with 0 of the 6 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Serum Al
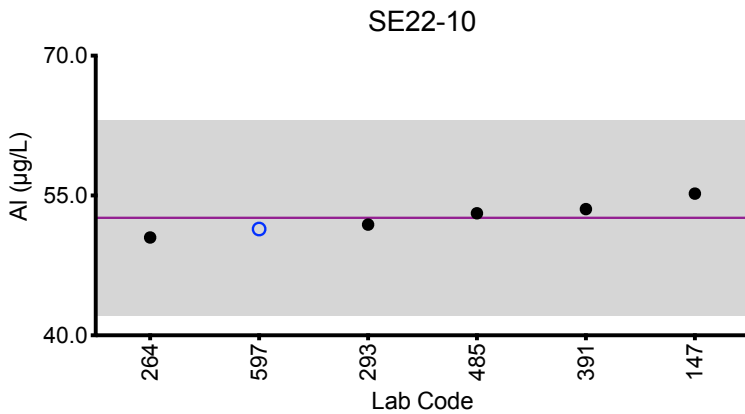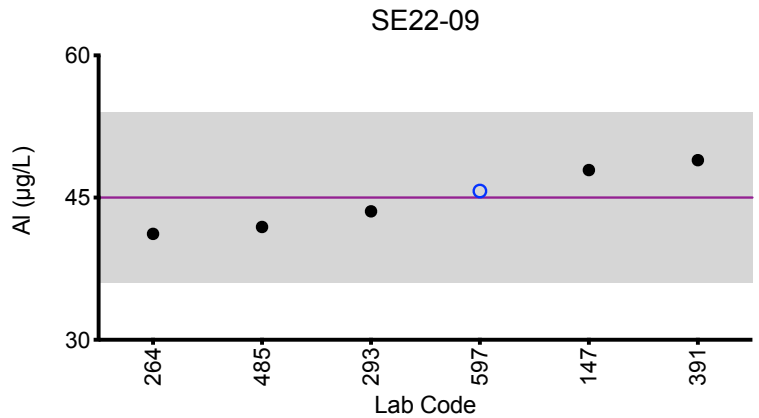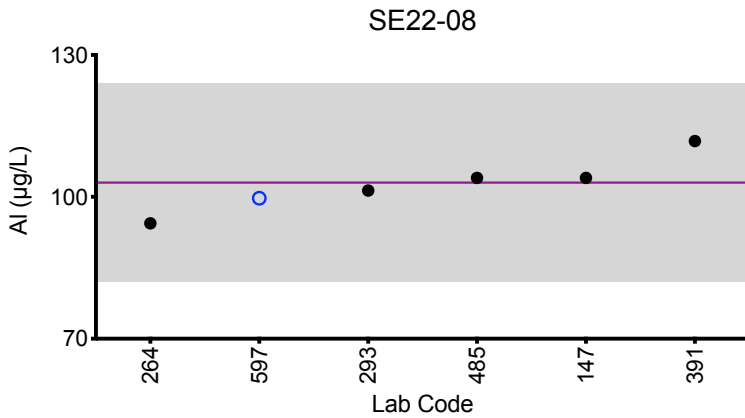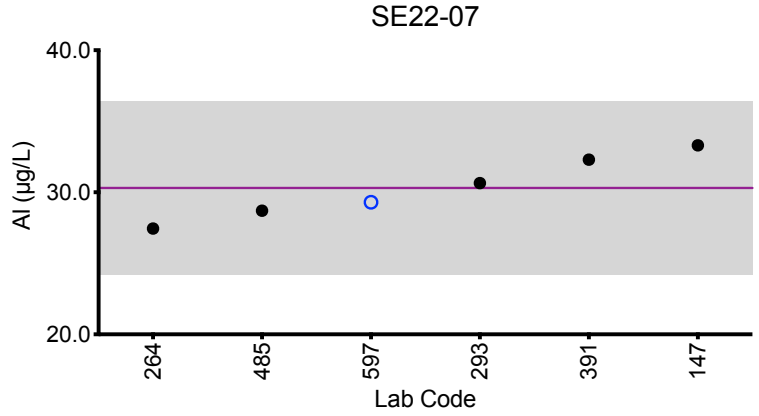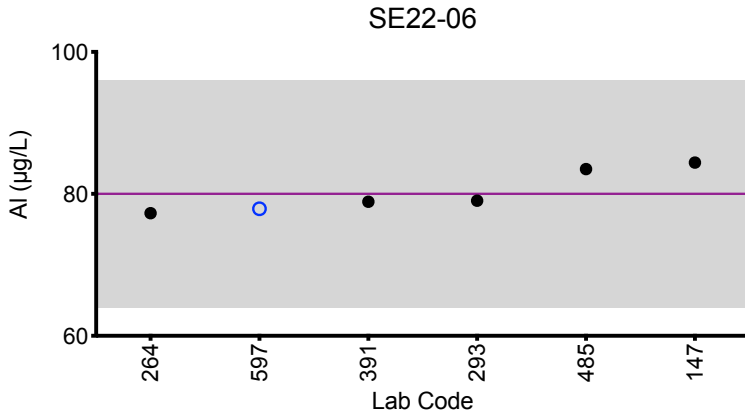
SE22-06

SE22-07

SE22-08

SE22-09

SE22-10

Legend:
o C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±5 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±5 µg/L at concentrations less than or equal to 25 µg/L.

Results for Event #2, 2022:
Summary Statistics

Serum Co (µg/L)					
	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Target (Arithmetic Mean ($\bar{x}$))	22.0	2.01	11.4	3.99	0.70
Upper Limit	25.3	3.51	13.1	5.49	2.20
Lower Limit	18.7	0.51	9.7	2.49	0.00
Arithmetic SD (s)	1.0	0.07	0.4	0.15	0.04
Arithmetic RSD (%)	4.5	3.5	3.2	3.8	5.5
Number of Sample Measurements (N)	8	8	8	8	8

The acceptable range is based on quality specifications:

±1.5 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1.5 µg/L at concentrations less than or equal to 10 µg/L. These quality specifications were established based on discussions with the US FDA, and represent a consensus from a network of Trace Element PT program organizers

Results for Event #2, 2022:
# Performance of Participating Laboratories

		Serum Co (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
	Target	**22.0**	**2.01**	**11.4**	**3.99**	**0.70**
103	ICP-MS/MS	21.5	1.88	11.1	3.87	0.666
110	ICP-MS	23.3	2.12	12.1	4.31	0.777
147	DRC/CC-ICP-MS	20.4	1.96	11.3	3.90	0.666
264	ICP-MS	21.83	2.01	11.31	3.95	0.73
293	DRC/CC-ICP-MS	21.7	2.03	11.02	3.92	0.69
442	DRC/CC-ICP-MS	21.6	2.02	11.2	3.83	0.709
485	HR-ICP-MS	23.7	1.99	11.8	4.04	0.671
597	ICP-MS/MS	22.0	2.05	11.4	4.07	0.725

Based on the grading criteria for Co in Serum, 100% of results were satisfactory, with 0 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Serum Co

SE22-06

SE22-07

SE22-08

SE22-09

SE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value
based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±1.5 µg/L or ±15% around the target value,
whichever is greater; thus, it is fixed at ±1.5 µg/L
at concentrations less than or equal to 10 µg/L.

Results for Event #2, 2022:
Summary Statistics

Serum Cr (µg/L)					
	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Target (Arithmetic Mean ($\bar{x}$))	9.2	5.02	0.77	6.16	2.21
Upper Limit	11.2	7.02	2.77	8.16	4.21
Lower Limit	7.2	3.02	0.00	4.16	0.21
Arithmetic SD (s)	0.3	0.17	0.15	0.13	0.13
Arithmetic RSD (%)	3.5	3.4	19	2.1	5.9
Number of Sample Measurements (N)	7	7	6	6	7

The acceptable range is based on quality specifications:
±2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±2 µg/L at concentrations less than or equal to 10 µg/L. These quality specifications were established based on discussions with the US FDA, and represent a consensus from a network of Trace Element PT program organizers

Results for Event #2, 2022:
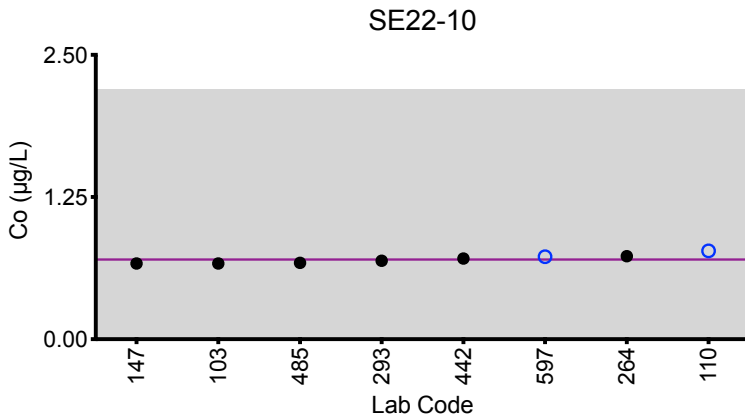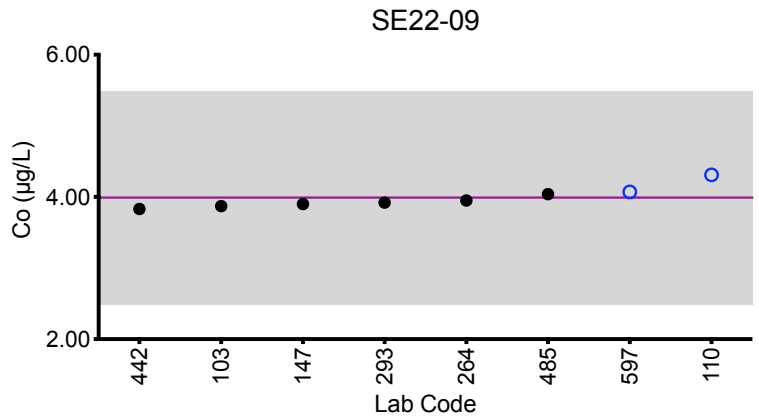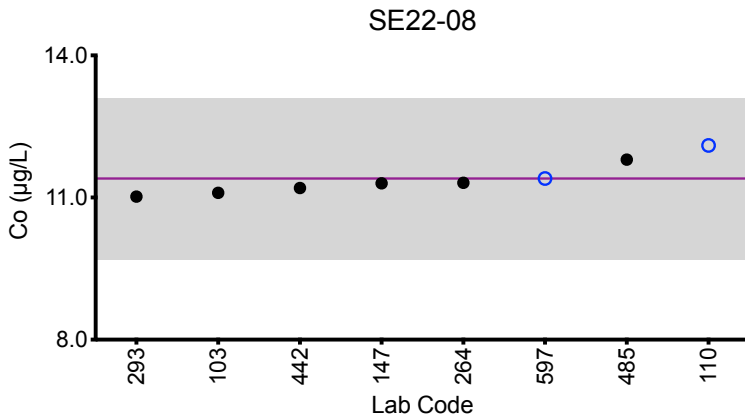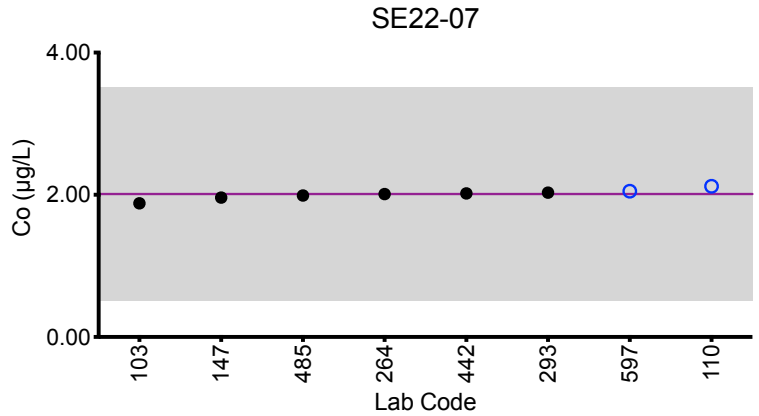## Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
	Target	**9.2**	**5.02**	**0.77**	**6.16**	**2.21**
103	ICP-MS/MS	9.19	4.83	0.617	6.02	2.06
110	DRC/CC-ICP-MS	9.63	5.31	0.88	6.29	2.23
147	DRC/CC-ICP-MS	9.10	4.89	0.655	5.98	2.16
264	ICP-MS	8.75	4.99	1.01	6.24	2.28
293	DRC/CC-ICP-MS	9.27	5.14	0.76	6.22	2.37
485	HR-ICP-MS	9.64	5.04	0.702	6.22	2.32
597	ICP-MS/MS	9.01	4.91	<0.844	*5.16	2.04

Based on the grading criteria for Cr in Serum, 100% of results were satisfactory, with 0 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Serum Cr

SE22-06

SE22-07

SE22-08

SE22-09

SE22-10

Legend:
○ C/HHEAR Labs ● Other Labs
Horizontal purple line = assigned target value
based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality
specifications:
±2 μg/L or ±20% around the target value,
whichever is greater; thus, it is fixed at ±2 μg/L at
concentrations less than or equal to 10 μg/L.

Results for Event #2, 2022:
Summary Statistics

Serum Cu (µg/L)					
	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Target (Arithmetic Mean ($\bar{x}$))	931	1024	1210	1370	1080
Upper Limit	1071	1178	1390	1580	1240
Lower Limit	791	870	1030	1160	920
Arithmetic SD (s)	34	23	50	50	40
Arithmetic RSD (%)	3.7	2.2	4.1	3.6	3.7
Number of Sample Measurements (N)	7	7	7	7	7

The acceptable range is based on quality specifications:
±95 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±95 µg/L at concentrations less than or equal to 635 µg/L. These quality specifications were established by New York State Department of Health's Wadsworth Center, the PT Program organizer.

Results for Event #2, 2022:
Performance of Participating Laboratories

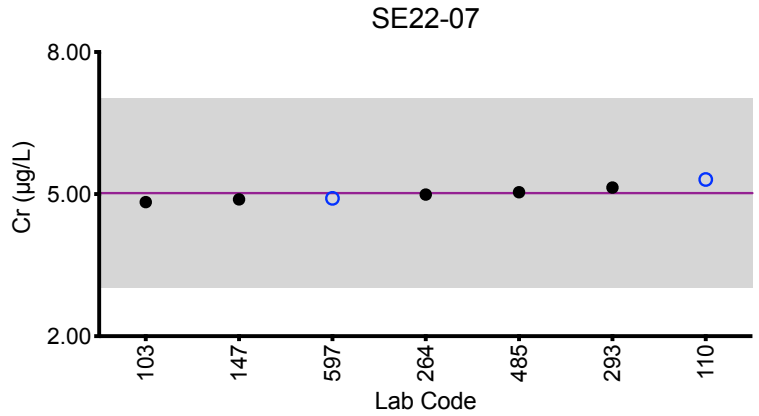| Lab Code	Method	Serum Cu (µg/L)				
		SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
	Target	**931**	**1024**	**1210**	**1370**	**1080**
107	DRC/CC-ICP-MS	919	1051	1230	1357	1080
110	ICP-MS	987	1047	1271	1425	1114
147	DRC/CC-ICP-MS	909	1004	1169	1315	1048
264	ICP-MS	923.3	1005.2	1180.6	1338.9	1051.5
293	DRC/CC-ICP-MS	922	992	1144	1303	1030
436	FAAS	889.6	1026.26	1239	1429.78	1143.8
597	ICP-MS/MS	965	1040	1250	1400	1110

Based on the grading criteria for Cu in Serum, 100% of results were satisfactory, with 0 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Serum Cu

SE22-06
Cu (µg/L) — Lab Code: 436, 147, 107, 293, 264, 597, 110

SE22-07
Cu (µg/L) — Lab Code: 293, 147, 264, 436, 597, 110, 107

SE22-08
Cu (µg/L) — Lab Code: 293, 147, 264, 107, 436, 597, 110

SE22-09
Cu (µg/L) — Lab Code: 293, 147, 264, 107, 597, 110, 436

SE22-10
Cu (µg/L) — Lab Code: 293, 147, 264, 107, 597, 110, 436

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±95 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±95 µg/L at concentrations less than or equal to 635 µg/L.

Results for Event #2, 2022:
Summary Statistics

	Serum Se (µg/L)				
	SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Target (Arithmetic Mean (x̄))	88.8	125	241	195	109
Upper Limit	106.6	150	289	234	130
Lower Limit	71.0	100	193	156	87
Arithmetic SD (s)	1.6	3	6	5	3
Arithmetic RSD (%)	1.8	2.2	2.5	2.6	2.6
Number of Sample Measurements (N)	7	7	7	7	7

The acceptable range is based on quality specifications:
±2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±2 µg/L at concentrations less than or equal to 10 µg/L. These quality specifications were established by New York State Department of Health's Wadsworth Center, the PT Program organizer.

Results for Event #2, 2022:
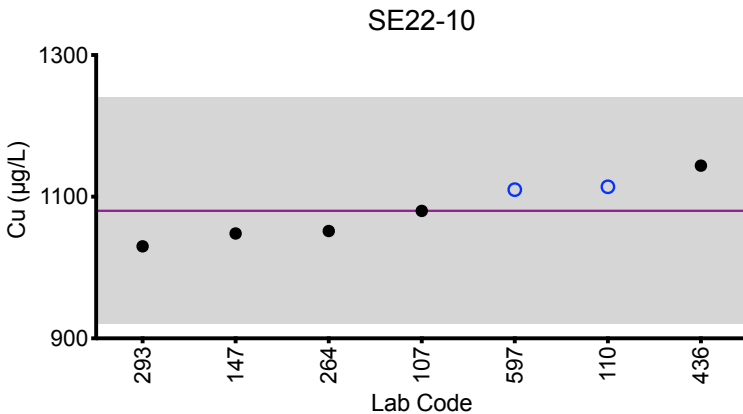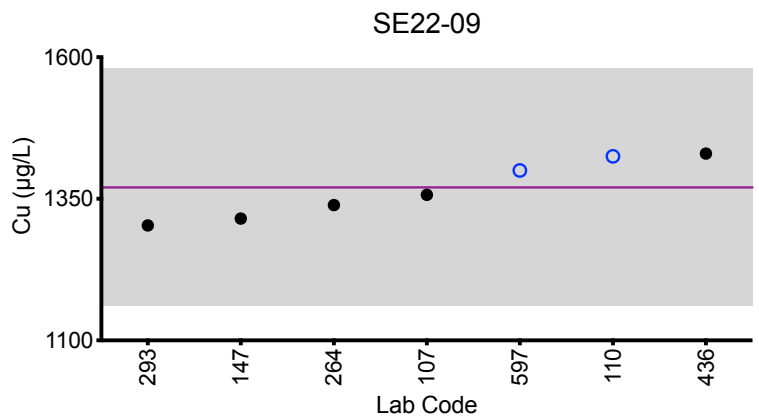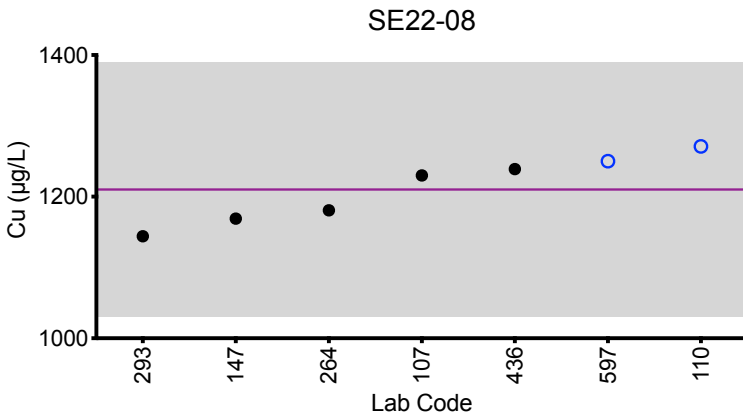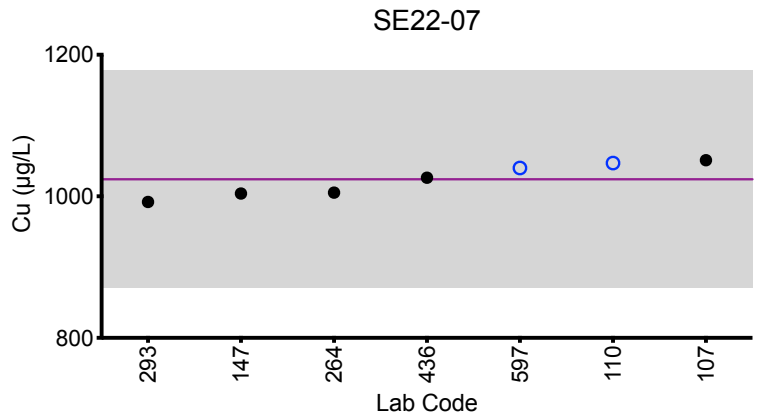## Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
	Target	**88.8**	**125**	**241**	**195**	**109**
103	ICP-MS/MS	91.0	128	249	201	112
107	DRC/CC-ICP-MS	88.4	126.3	240.7	190.8	108.5
110	DRC/CC-ICP-MS	89.4	124	244	200	106
147	DRC/CC-ICP-MS	86.1	120	231	187	104
264	ICP-MS	87.69	125.12	235.25	193.32	108.62
293	DRC/CC-ICP-MS	90	128	244	196	111
597	ICP-MS/MS	89.0	125	240	197	110

Based on the grading criteria for Se in Serum, 100% of results were satisfactory, with 0 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Serum Se

Legend:
○ C/HHEAR Labs ● Other Labs
Horizontal purple line = assigned target value based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±2 µg/L at concentrations less than or equal to 10 µg/L.

Results for Event #2, 2022:
Summary Statistics

	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Serum Zn (µg/L)					
Target (Arithmetic Mean ($\bar{x}$))	723	1050	770	726	618
Upper Limit	831	1210	890	835	711
Lower Limit	615	890	650	617	525
Arithmetic SD (s)	35	60	40	33	27
Arithmetic RSD (%)	4.8	5.7	5.2	4.5	4.4
Number of Sample Measurements (N)	6	6	6	6	6

The acceptable range is based on quality specifications:
±15 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±15 µg/L at concentrations less than or equal to 100 µg/L. These quality specifications were established by New York State Department of Health's Wadsworth Center, the PT Program organizer.

Results for Event #2, 2022:
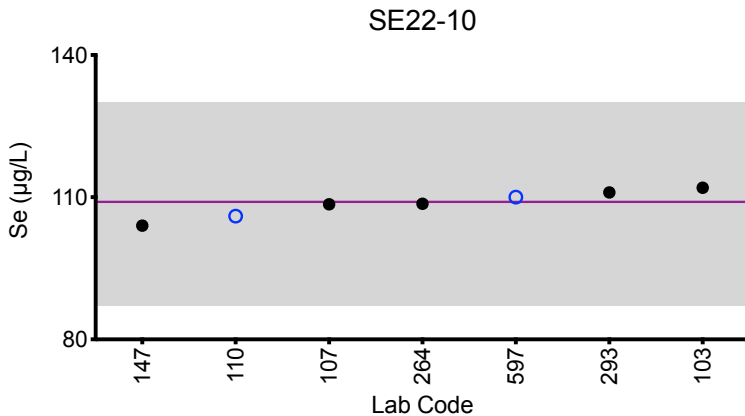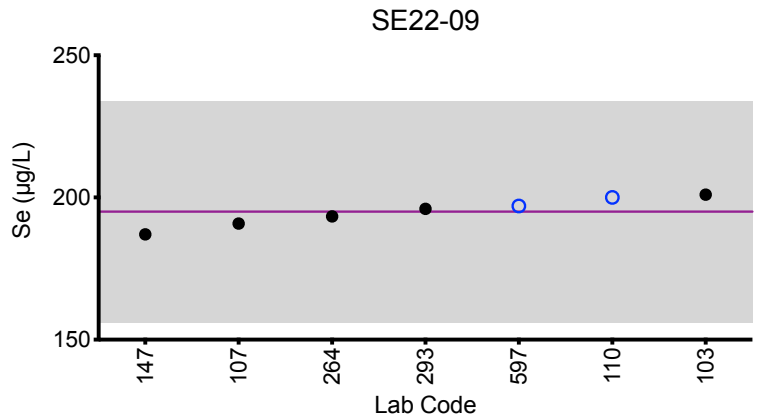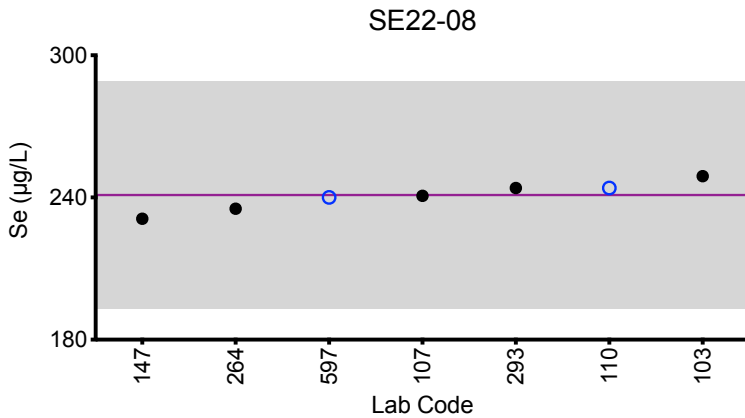## Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
	Target	**723**	**1050**	**770**	**726**	**618**
107	DRC/CC-ICP-MS	758	1159	811	751	635
110	ICP-MS	762	1073	809	765	648
147	DRC/CC-ICP-MS	693	1007	732	699	597
264	ICP-MS	689.3	1004.4	729.6	702.8	596.7
293	DRC/CC-ICP-MS	693	993	719	686	588
597	ICP-MS/MS	741	1070	791	750	644

Based on the grading criteria for Zn in Serum, 100% of results were satisfactory, with 0 of the 6 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

Results for Event #2, 2022:
Summary Figures

Serum Zn
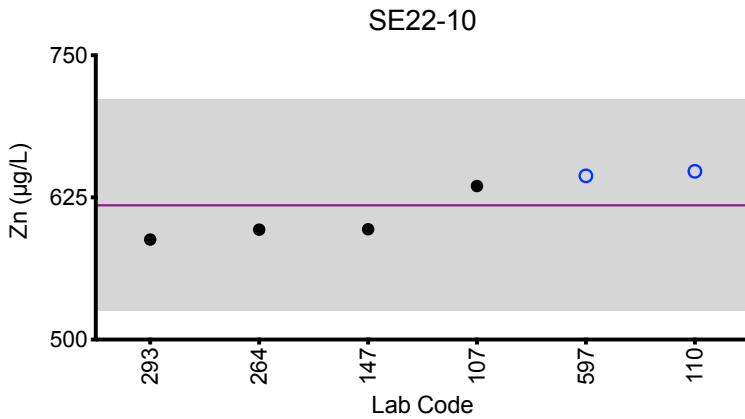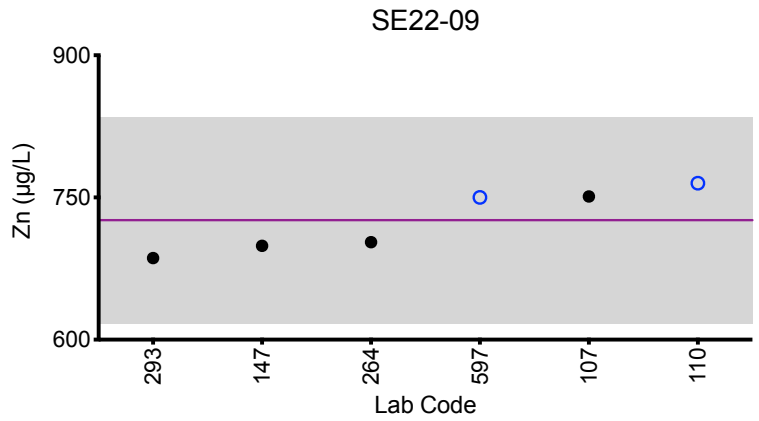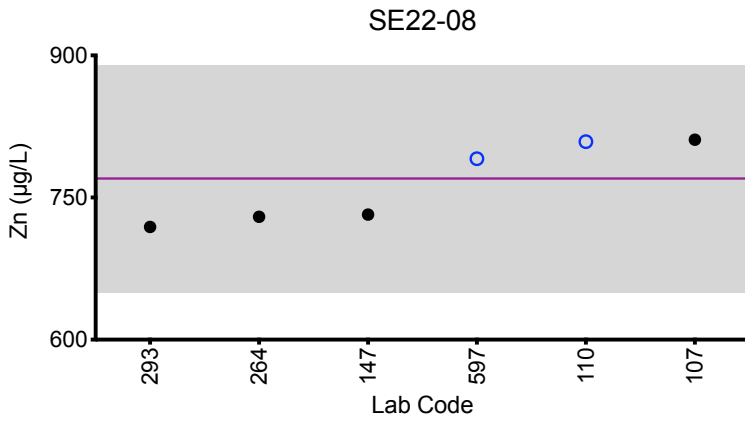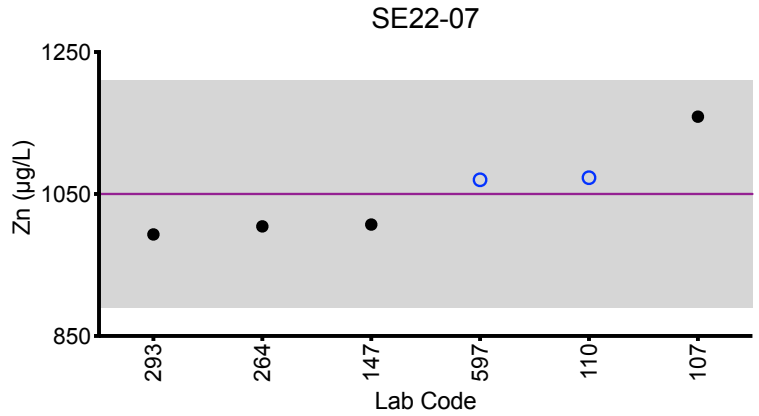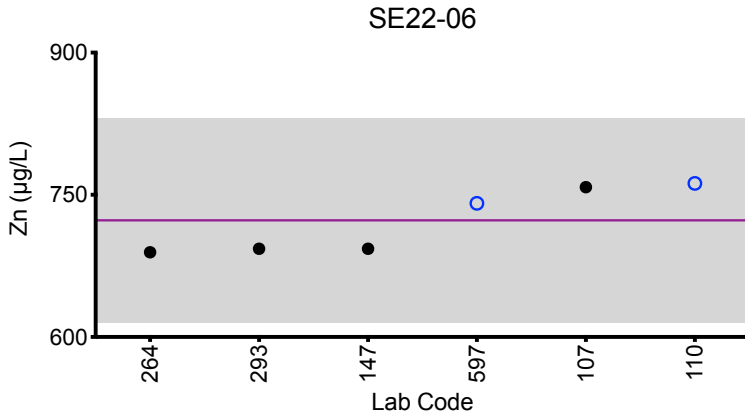
SE22-06

SE22-07

SE22-08

SE22-09

SE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = assigned target value based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±15 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±15 µg/L at concentrations less than or equal to 100 µg/L.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)

Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
103	ICP-MS/MS	3.04	12.8	1.91	6.57	4.64
110	ICP-MS	3.42	13.8	2.19	7.00	4.90
147	DRC/CC-ICP-MS	3.03	11.9	1.77	6.37	4.35
264	ICP-MS	3.88	14.45	2.56	7.83	5.53
293	DRC/CC-ICP-MS	3.26	13.20	1.91	6.75	4.7
597	ICP-MS/MS	3.14	12.7	1.88	6.68	4.68

Summary Statistics

	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\bar{x}$)	3.3	13.1	2.0	6.9	4.8
Arithmetic SD (s)	0.3	0.9	0.3	0.5	0.4
Arithmetic RSD (%)	9.7	6.9	14	7.2	8.3
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Serum Mn
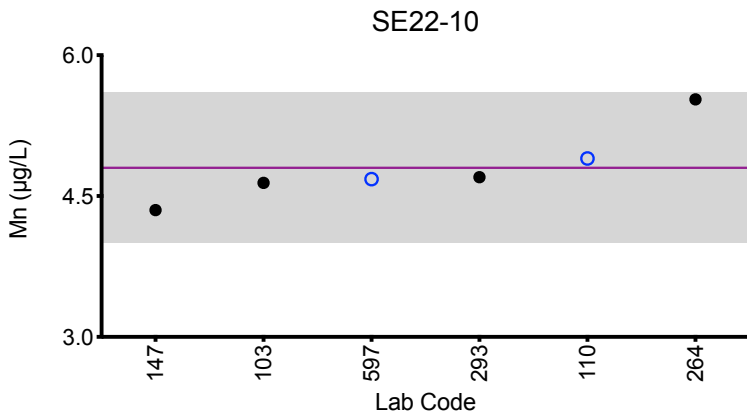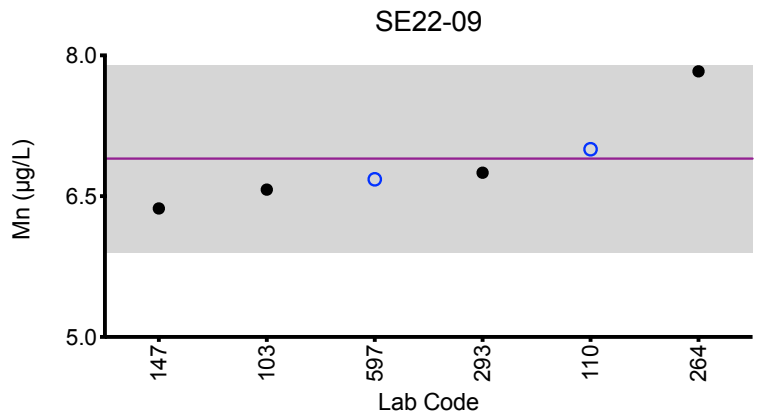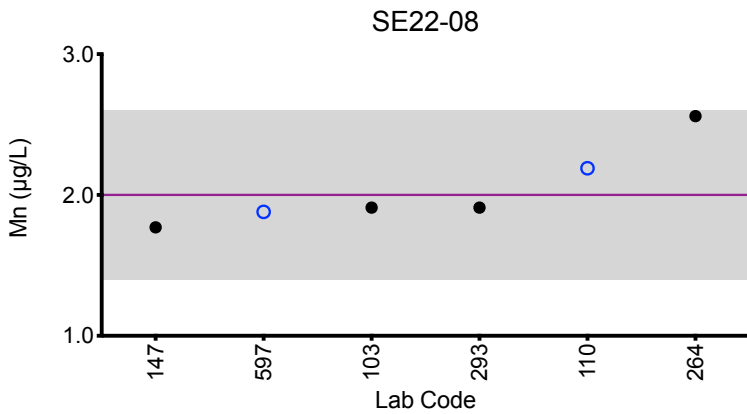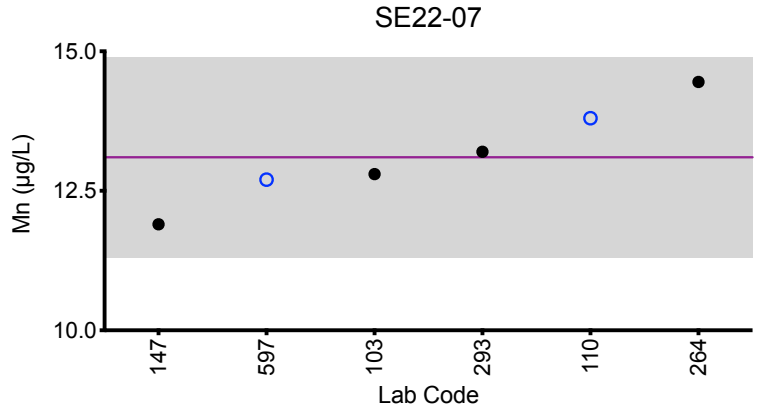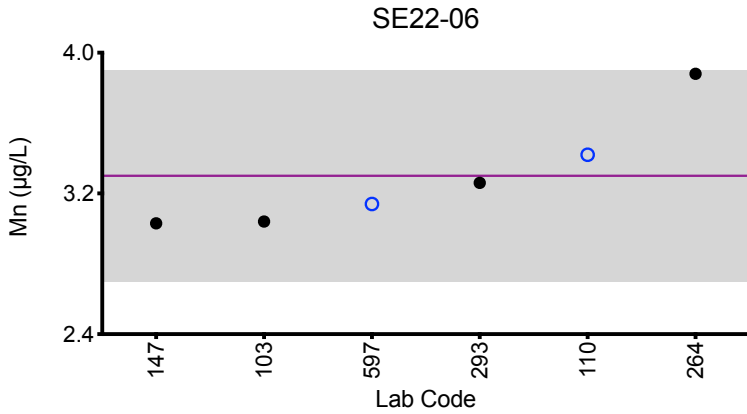
SE22-06

SE22-07

SE22-08

SE22-09

SE22-10

Legend:
o C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Mo (μg/L)

Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
103	ICP-MS/MS	3.00	7.34	1.31	2.56	4.36
110	ICP-MS	3.27	7.40	1.32	2.60	4.43
147	DRC/CC-ICP-MS	2.91	6.94	1.21	2.46	4.08
293	DRC/CC-ICP-MS	3.23	7.94	1.32	2.73	5.16
442	DRC/CC-ICP-MS	3.39	7.45	*2.19	2.90	4.60
485	HR-ICP-MS	3.11	7.03	1.38	2.65	4.29
597	ICP-MS/MS	3.04	6.89	1.33	2.55	4.31

Summary Statistics

	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\overline{x}$)	3.14	7.3	1.31	2.64	4.5
Arithmetic SD (s)	0.17	0.4	0.06	0.14	0.3
Arithmetic RSD (%)	5.4	5.1	4.6	5.3	7.8
Number of Sample Measurements (N)	7	7	6	7	7

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Serum Mo
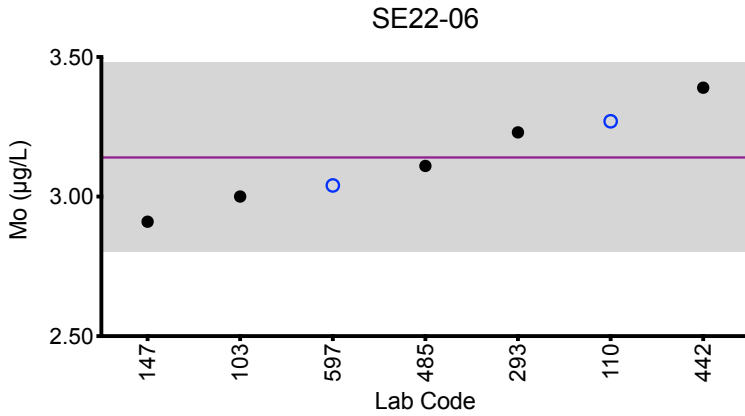
SE22-06

SE22-07

SE22-08

SE22-09

SE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

		Serum Ni (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
110	DRC/CC-ICP-MS	2.8	4.4	3.0	9.2	5.0
147	DRC/CC-ICP-MS	2.37	4.01	2.58	8.51	4.74
293	DRC/CC-ICP-MS	2.92	4.62	3.47	*13.06	6.77
485	HR-ICP-MS	2.62	3.96	2.56	8.83	4.91
597	ICP-MS/MS	2.26	3.84	2.17	8.54	4.58
		Summary Statistics				
		SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Arithmetic Mean ($\bar{x}$)		2.6	4.2	2.8	8.8	5.2
Arithmetic SD (s)		0.3	0.3	0.5	0.3	0.9
Arithmetic RSD (%)		11	7.9	18	3.4	17
Number of Sample Measurements (N)		5	5	5	4	5

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Serum Ni
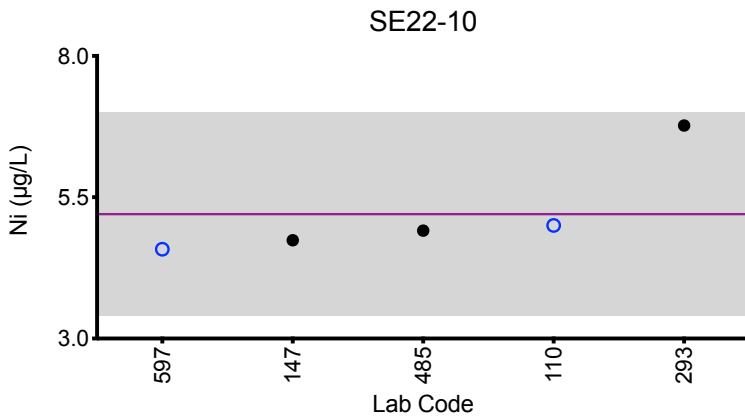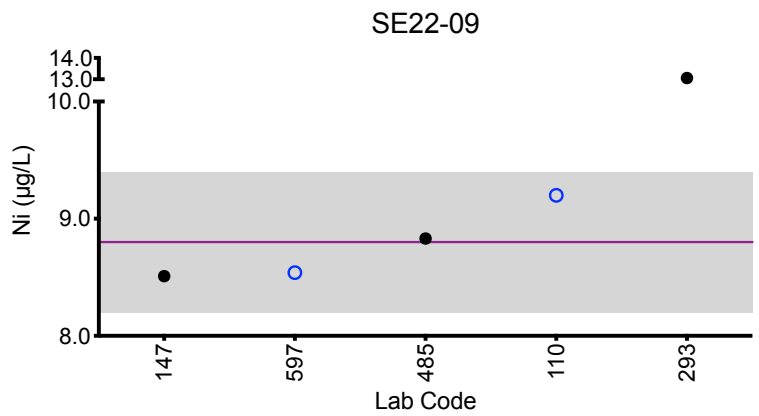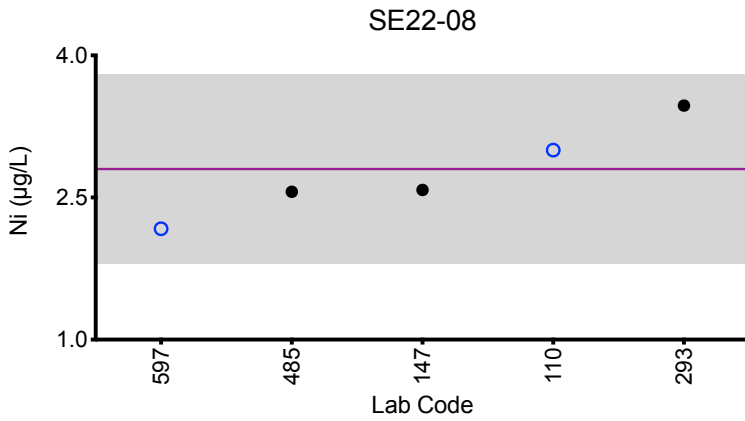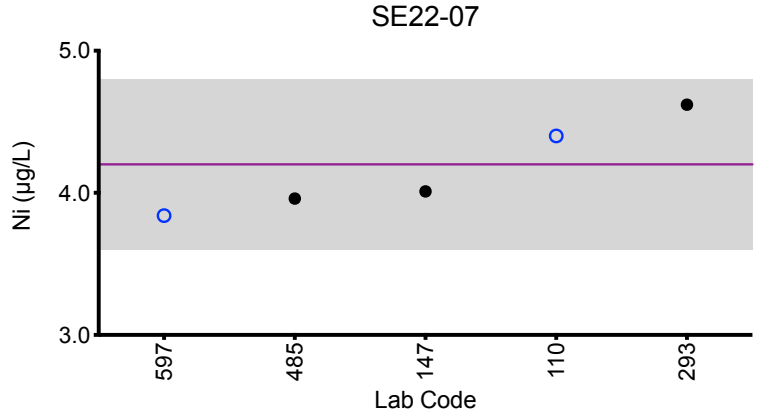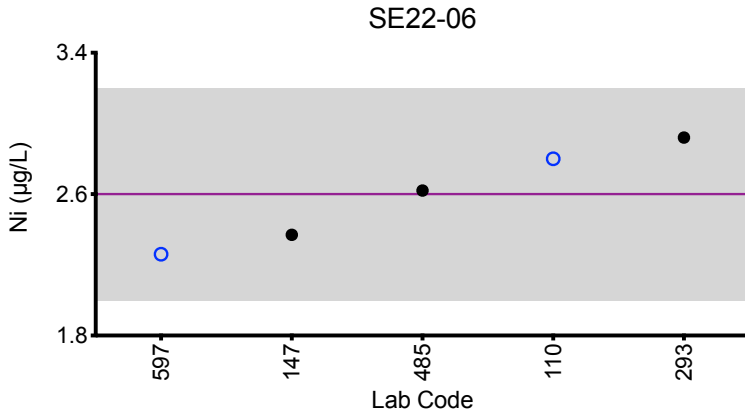
SE22-06

SE22-07

SE22-08

SE22-09

SE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
## Laboratory Data and Summary Statistics

Serum V (µg/L)

Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
110	DRC/CC-ICP-MS	1.10	*0.81	7.93	*1.70	4.49
147	DRC/CC-ICP-MS	0.827	0.297	6.89	1.13	3.77
293	DRC/CC-ICP-MS	0.9	0.3	7.2	1.2	4.0
485	HR-ICP-MS	0.854	0.295	7.3	1.17	3.93
597	ICP-MS/MS	0.848	0.321	7.06	1.22	3.84

Summary Statistics

	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\bar{x}$)	0.91	0.303	7.3	1.18	4.0
Arithmetic SD (s)	0.11	0.012	0.4	0.04	0.3
Arithmetic RSD (%)	12	4.0	5.5	3.4	7.1
Number of Sample Measurements (N)	5	4	5	4	5

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Summary Figures

Serum V

SE22-06

SE22-07

SE22-08

SE22-09

SE22-10

Legend:
○ C/HHEAR Labs   ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
Gray area = ±2SD of the mean.

The mean and ±2SD of all laboratories are not intended to be quality specifications and are included for informational purposes only.

Results for Event #2, 2022:
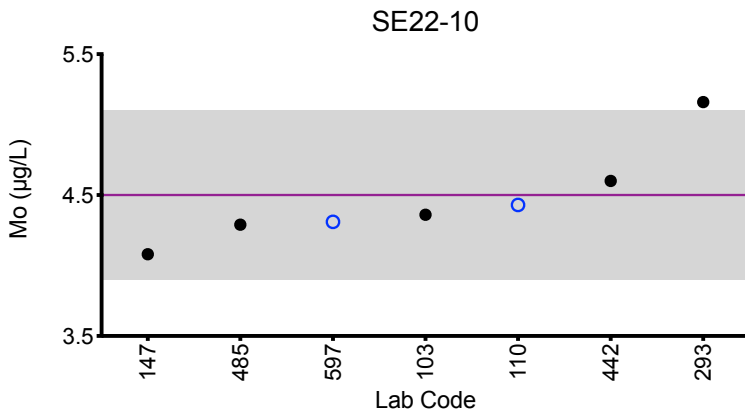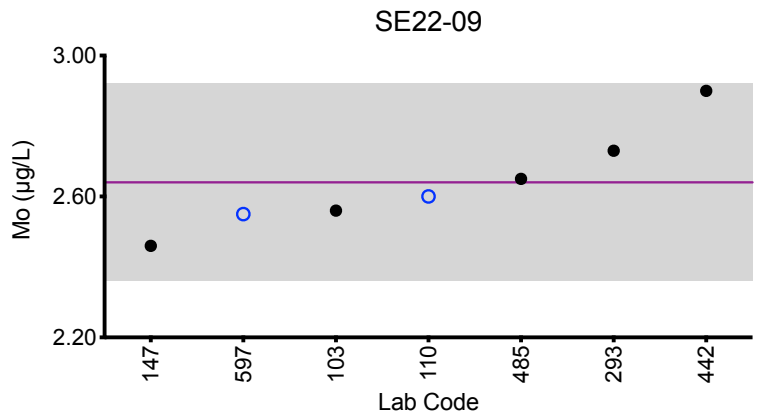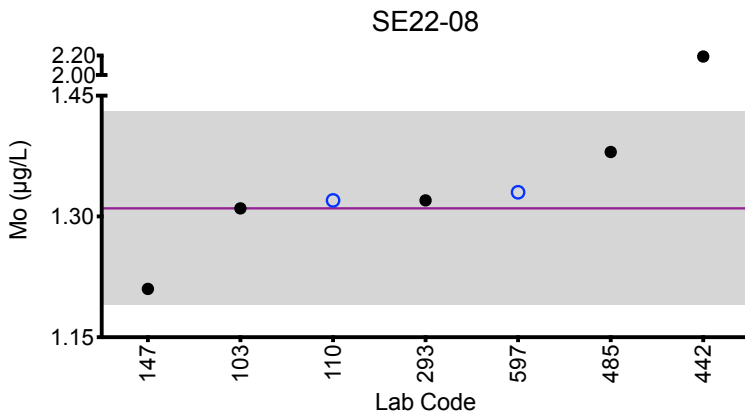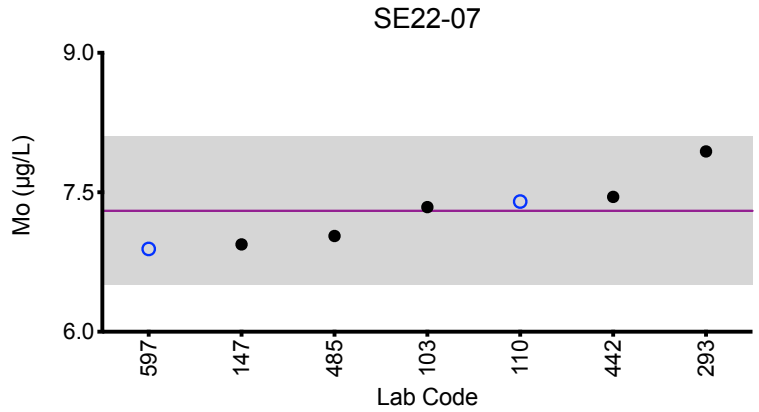## Laboratory Data and Summary Statistics

		Serum As (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
103	ICP-MS/MS	3.68	16.1	5.41	1.72	8.00
110	DRC/CC-ICP-MS	4.37	15.0	5.90	2.36	8.01
147	DRC/CC-ICP-MS	3.55	15.4	5.22	1.76	7.57
597	ICP-MS/MS	3.80	15.8	5.50	1.73	7.88
		Summary Statistics				
		SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Arithmetic Mean ($\overline{x}$)		3.9	15.6	5.5	1.9	7.9
Arithmetic SD (s)		0.4	0.5	0.3	0.3	0.2
Arithmetic RSD (%)		10	3.2	5.3	16	2.7
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
110	ICP-MS	0.95	0.73	1.05	0.85	1.24
147	ICP-MS	1.13	0.861	1.25	1.06	1.39
597	ICP-MS/MS	1.28	0.941	1.37	1.23	1.43
Summary Statistics						
		SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\bar{x}$)		1.1	0.84	1.22	1.0	1.35
Arithmetic SD (s)		0.2	0.11	0.16	0.2	0.10
Arithmetic RSD (%)		15	13	13	18	7.4
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Be (µg/L)						
Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
110	ICP-MS	2.42	0.332	1.23	4.44	0.799
147	ICP-MS	2.25	0.300	1.05	3.72	0.859
293	ICP-MS	2.420	0.32	1.25	4.19	0.940
597	ICP-MS/MS	2.16	0.301	1.18	3.92	0.841
Summary Statistics						
		SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\overline{x}$)		2.31	0.313	1.18	4.1	0.86
Arithmetic SD (s)		0.13	0.016	0.09	0.3	0.06
Arithmetic RSD (%)		5.6	5.1	7.6	7.3	6.9
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
## Laboratory Data and Summary Statistics

		Serum Cd (µg/L)				
Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
103	ICP-MS/MS	5.55	1.28	0.453	2.37	0.260
110	ICP-MS	5.50	1.26	0.453	2.29	0.229
147	ICP-MS	5.23	1.19	0.425	2.24	0.251
597	ICP-MS/MS	5.29	1.24	0.432	2.35	0.255
Summary Statistics						
		SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\bar{x}$)		5.39	1.24	0.441	2.31	0.249
Arithmetic SD (s)		0.16	0.04	0.014	0.06	0.014
Arithmetic RSD (%)		2.9	3.2	3.2	2.6	5.6
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

	Serum Cs (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
110	ICP-MS	0.979	0.559	0.617	0.351	0.400
597	ICP-MS/MS	0.974	0.578	0.632	0.376	0.407
	Summary Statistics				
		SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Arithmetic Mean ($\bar{x}$)		0.977	0.569	0.625	0.36	0.403
Arithmetic SD (s)		0.004	0.013	0.011	0.02	0.005
Arithmetic RSD (%)		0.41	2.3	1.8	4.9	1.2
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

Results for Event #2, 2022:
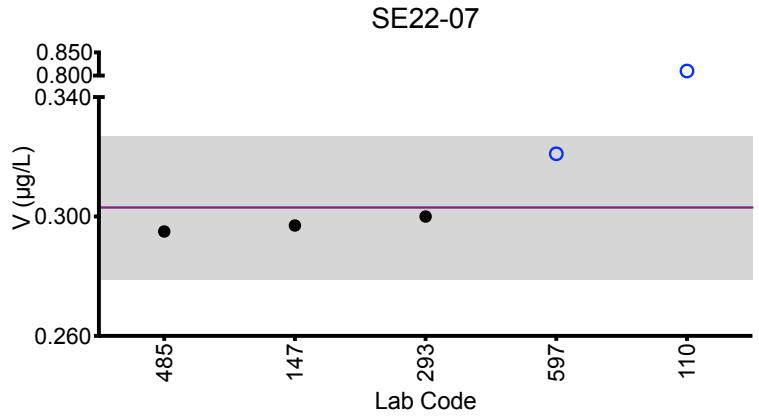## Laboratory Data and Summary Statistics

		Serum Hg (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
103	ICP-MS/MS	1.42	4.37	0.467	1.07	3.65
110	ICP-MS	1.60	4.73	0.575	1.09	3.88
597	ICP-MS/MS	1.55	4.58	0.557	1.16	3.81
		Summary Statistics				
		SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Arithmetic Mean ($\overline{x}$)		1.52	4.6	0.53	1.11	3.78
Arithmetic SD (s)		0.09	0.2	0.06	0.05	0.12
Arithmetic RSD (%)		5.9	3.9	11	4.5	3.2
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

	Serum Mg (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
264	ICP-MS	18893.7	18648.6	16855.7	18052.6	18148.2
597	ICP-MS/MS	19600	19200	17500	18900	19200

Summary Statistics					
	SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Arithmetic Mean ($\bar{x}$)	19200	18900	17200	18500	18700
Arithmetic SD (s)	500	400	500	600	700
Arithmetic RSD (%)	2.6	2.1	2.9	3.2	3.7
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
103	ICP-MS/MS	4.74	1.83	1.00	6.96	<0.100
110	ICP-MS	4.79	1.81	1.03	7.08	0.013
597	ICP-MS/MS	4.71	1.81	1.01	7.00	<0.393
Summary Statistics						
		SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\bar{x}$)		4.75	1.817	1.013	7.01	NA
Arithmetic SD (s)		0.04	0.012	0.015	0.06	NA
Arithmetic RSD (%)		0.84	0.66	1.5	0.86	NA
Number of Sample Measurements (N)		3	3	3	3	NA

*Denotes a statistical Outlier.

Statistical data was not calculated for SE22-10 based on a lack of consensus among participating labs.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)						
Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
110	ICP-MS	1.24	0.157	0.381	0.562	0.761
264	ICP-MS	1.42	0.23	0.44	0.61	0.81
293	DRC/CC-ICP-MS	1.19	0.12	0.36	0.52	0.74
Summary Statistics						
		SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\overline{x}$)		1.28	0.17	0.39	0.56	0.77
Arithmetic SD (s)		0.12	0.06	0.04	0.05	0.04
Arithmetic RSD (%)		9.4	35	10	8.9	5.2
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

		Serum Sb (µg/L)				
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
103	ICP-MS/MS	1.80	5.14	2.32	3.84	0.806
110	ICP-MS	1.94	5.43	2.40	3.92	0.85
147	ICP-MS	1.90	5.39	2.28	3.81	0.841
597	ICP-MS/MS	1.98	5.38	2.41	3.95	0.943
	Summary Statistics					
		SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Arithmetic Mean ($\bar{x}$)		1.91	5.34	2.35	3.88	0.86
Arithmetic SD (s)		0.08	0.13	0.06	0.07	0.06
Arithmetic RSD (%)		4.2	2.4	2.6	1.8	6.8
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
110	ICP-MS	1.83	0.85	3.07	7.11	4.74
597	ICP-MS/MS	1.92	1.00	3.27	6.99	4.84
Summary Statistics						
		SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Arithmetic Mean (x̄)		1.88	0.93	3.2	7.05	4.79
Arithmetic SD (s)		0.06	0.11	0.1	0.08	0.07
Arithmetic RSD (%)		3.2	12	4.4	1.1	1.5
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
103	ICP-MS/MS	189	309	377	492	335
200	ICP-MS	219	349	402	540	348
597	ICP-MS/MS	190	307	379	491	331
Summary Statistics						
		SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\bar{x}$)		199	322	386	510	338
Arithmetic SD (s)		17	24	14	30	9
Arithmetic RSD (%)		8.5	7.5	3.6	5.9	2.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Ti (μg/L)						
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
200	DRC/CC-ICP-MS	5.20	3.60	0.91	8.00	7.10
442	ICP-MS/MS	5.2	3.58	1.31	8.91	7.5
485	HR-ICP-MS	5.29	3.25	1.06	8.51	7.26
597	ICP-MS/MS	6.29	5.37	*3.19	10.3	8.66
Summary Statistics						
		SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Arithmetic Mean ($\overline{x}$)		5.5	4.0	1.1	8.9	7.6
Arithmetic SD (s)		0.5	1.0	0.2	1.0	0.7
Arithmetic RSD (%)		9.1	25	18	11	9.2
Number of Sample Measurements (N)		4	4	3	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)						
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
103	ICP-MS/MS	1.14	0.221	0.574	2.45	0.706
110	ICP-MS	1.15	0.205	0.582	2.43	0.696
147	ICP-MS	1.14	0.221	0.566	2.41	0.697
597	ICP-MS/MS	1.15	0.207	0.564	2.46	0.691
Summary Statistics						
		SE22-06	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
Arithmetic Mean ($\bar{x}$)		1.145	0.214	0.571	2.44	0.697
Arithmetic SD (s)		0.006	0.009	0.008	0.02	0.006
Arithmetic RSD (%)		0.52	4.2	1.4	0.91	0.86
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum U (μg/L)						
Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
103	ICP-MS/MS	0.184	0.122	0.177	0.0940	0.0676
110	ICP-MS	0.215	0.129	0.185	0.0994	0.0754
597	ICP-MS/MS	0.188	0.127	0.182	0.0972	0.0616
Summary Statistics						
		SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\bar{x}$)		0.20	0.126	0.181	0.097	0.068
Arithmetic SD (s)		0.02	0.004	0.004	0.003	0.007
Arithmetic RSD (%)		8.7	3.2	2.2	3.1	10
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Laboratory Data and Summary Statistics

Serum W (µg/L)						
Lab Code	Method	SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
110	ICP-MS	2.88	1.38	2.04	0.783	0.620
200	ICP-MS	2.5	1.3	2.0	0.8	0.6
597	ICP-MS/MS	2.70	1.32	1.88	0.734	0.617
Summary Statistics						
		SE22-06	SE22-07	SE22-08	SE22-09	SE22-10
Arithmetic Mean ($\bar{x}$)		2.7	1.33	1.97	0.77	0.612
Arithmetic SD (s)		0.2	0.04	0.08	0.03	0.011
Arithmetic RSD (%)		7.1	3.1	4.1	3.9	1.8
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

Results for Event #2, 2022:
Additional Elements in Serum

Serum B (µg/L)					
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
200	ICP-MS	45	75	45	52	44

Serum Bi (µg/L)					
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
147	ICP-MS	<0.0397	<0.0397	<0.0397	<0.0397	<0.0397
597	ICP-MS/MS	<0.0228	<0.0228	<0.0228	<0.0228	<0.0228

Serum Fe (µg/L)					
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
264	ICP-MS	725.51	355.25	732.68	372.44	477.75

Serum I (µg/L)					
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
147	ICP-MS	87.6	49.2	71.6	50.9	43.5

Serum Li (µg/L)					
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
147	ICP-MS	0.514	0.722	0.636	0.722	0.366

Serum Th (µg/L)					
Lab Code	**Method**	**SE22-06**	**SE22-07**	**SE22-08**	**SE22-09**	**SE22-10**
597	ICP-MS/MS	<0.00641	<0.00641	<0.00641	<0.00641	<0.00641

References

1. ISO/FDIS-13528 (2005) Statistical methods for use in proficiency testing by interlaboratory comparisons. International Organization for Standardization, Geneva.

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