NEW YORK STATE | Department of Health | Wadsworth Center

New York State Biomonitoring Program for Trace Elements

Event #2, 2024

Trace Elements in Whole Blood, Urine, and Serum

August, 2024

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

NEW YORK STATE | Department of Health | Wadsworth Center

Event #2, 2024:
Trace Elements in Whole Blood, Urine, and Serum

8/16/2024

Dear Laboratory Director,

This report summarizes performance for the second biomonitoring proficiency test (PT) event of 2024 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, 2024) will be shipped September 11, 2024. 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,
Division of Environmental Sciences
Wadsworth Center

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Event #2, 2024

Trace Elements in Whole Blood

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NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #2, 2024:
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.

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Results for Event #2, 2024:
Summary Statistics

Whole Blood As (µg/L)					
	BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Target (Arithmetic Mean ($\bar{x}$))	3.15	0.80	1.31	4.31	11.0
Upper Limit	9.15	6.80	7.31	10.31	17.0
Lower Limit	0.00	0.00	0.00	0.00	5.0
Arithmetic SD (s)	0.32	0.16	0.16	0.32	0.7
Arithmetic RSD (%)	10	20	12	7.4	6.4
Number of Sample Measurements (N)	6	7	7	7	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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
	Target	**3.15**	**0.80**	**1.31**	**4.31**	**11.0**
103	ICP-MS/MS	3.54	0.845	1.47	4.88	12.0
110	ICP-MS/MS	3.10	0.836	1.42	4.37	11.4
147	ICP-MS	2.60	0.482	1.03	3.81	10.8
247	ICP-MS/MS	3.18	0.763	1.31	4.19	10.3
264	ICP-MS	*0.04	0.8	1.15	4.31	10.1
293	DRC/CC-ICP-MS	3.37	1.0	1.38	4.42	11.7
597	ICP-MS/MS	3.14	0.857	1.39	4.21	10.9

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

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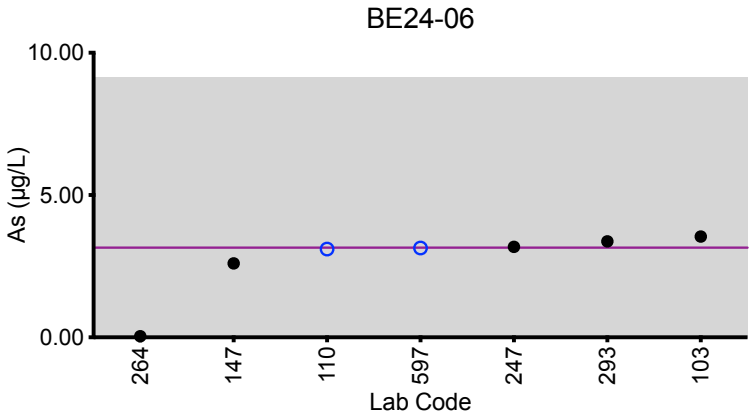
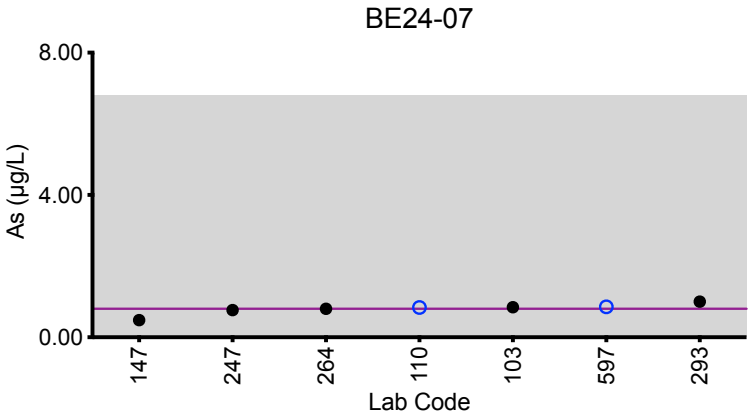
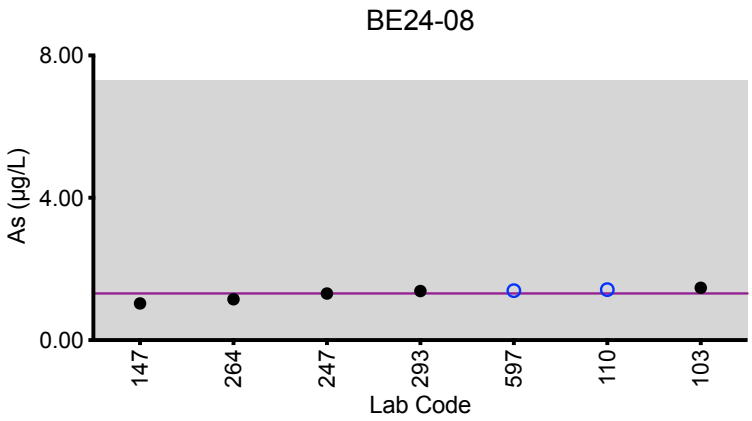
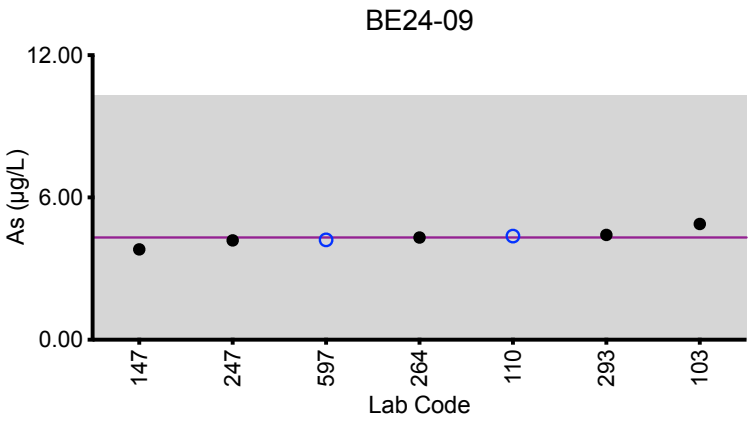
Results for Event #2, 2024: Summary Figures

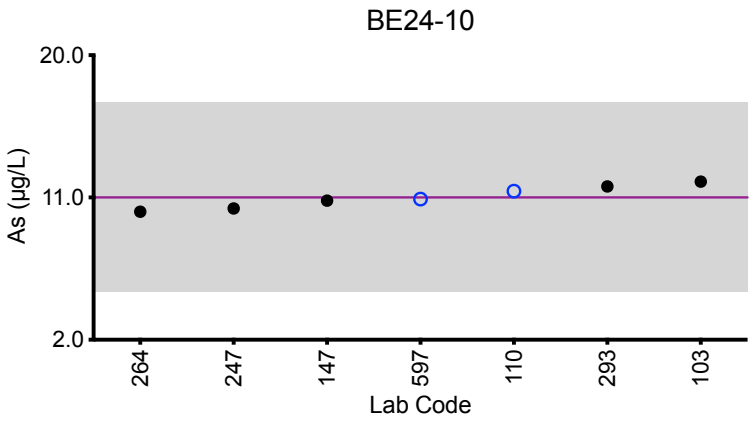
Whole Blood As











Legend:

o 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.

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Results for Event #2, 2024:
Summary Statistics

Whole Blood Cd (µg/L)					
	BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Target (Robust Mean (x*))	0.78	3.25	1.93	0.48	0.74
Upper Limit	1.78	4.25	2.93	1.48	1.74
Lower Limit	0.00	2.25	0.93	0.00	0.00
Robust SD (s*)	0.08	0.17	0.11	0.03	0.05
Robust RSD (%)	10	5.2	5.7	5.7	6.8
Number of Sample Measurements (N)	11	12	12	9	11
Standard Uncertainty (*u*)	0.03	0.06	0.04	NA	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 6.7 µg/L. These quality specifications are based on those used by US OSHA for occupational exposure.

An arithmetic mean, SD, RSD and n are provided for sample BE24-09.

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Results for Event #2, 2024:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
	Target	**0.78**	**3.25**	**1.93**	**0.48**	**0.74**
103	ICP-MS/MS	0.748	3.14	1.91	0.463	0.726
107	ICP-MS/MS	0.798	3.38	1.96	0.469	0.743
110	ICP-MS/MS	0.77	3.32	1.96	0.48	0.75
116	ICP-MS/MS	<1.50	3.2	1.87	<1.50	<1.50
147	ICP-MS	0.725	3.18	1.94	0.474	0.764
247	ICP-MS/MS	0.832	3.07	1.84	0.436	0.686
264	ICP-MS	0.04	3.07	1.49	0.5	0.72
293	DRC/CC-ICP-MS	0.70	3.14	1.800	0.5	0.69
597	ICP-MS/MS	0.833	3.42	2.03	0.515	0.776
605	ICP-MS	0.756	3.16	1.96	<0.500	0.717
606	ICP-MS/MS	0.913	3.56	2.02	<0.500	0.863
686	ICP-MS	0.837	3.55	2.13	0.523	0.819

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

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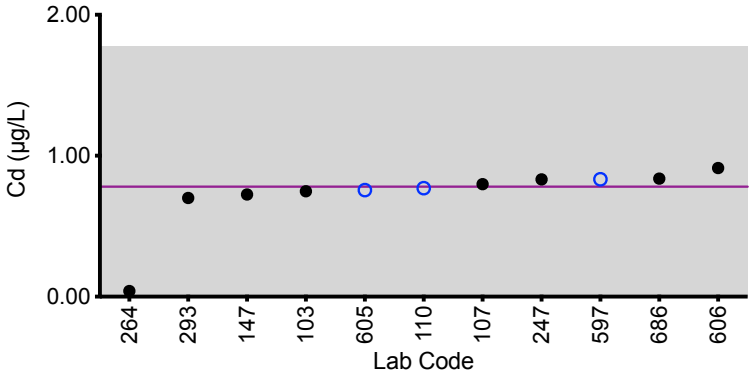
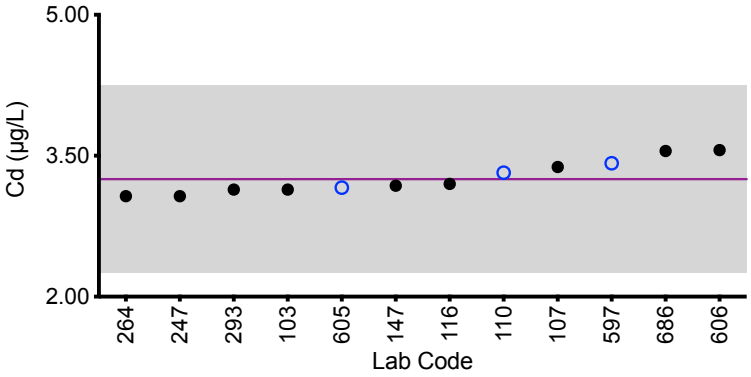
Results for Event #2, 2024: Summary Figures

Whole Blood Cd

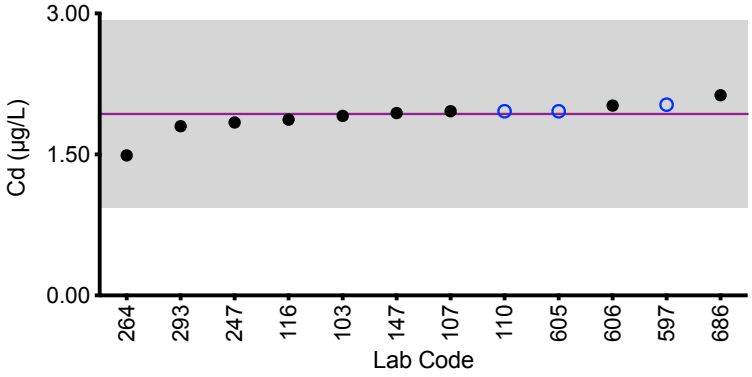
BE24-06



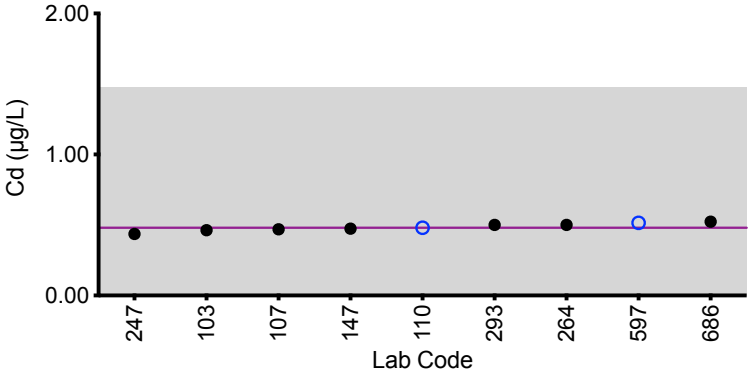
BE24-07



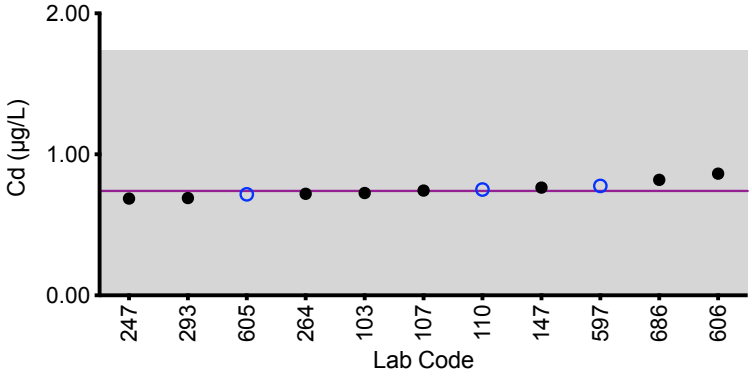
BE24-08



BE24-09



BE24-10



Legend:

o 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.

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Results for Event #2, 2024:
Summary Statistics

Whole Blood Co (µg/L)					
	BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Target (Arithmetic Mean ($\bar{x}$))	0.61	2.84	2.94	1.33	8.16
Upper Limit	2.11	4.34	4.44	2.83	9.79
Lower Limit	0.00	1.34	1.44	0.00	6.53
Arithmetic SD (s)	0.05	0.13	0.21	0.10	0.27
Arithmetic RSD (%)	8.2	4.6	7.1	7.5	3.3
Number of Sample Measurements (N)	7	8	8	8	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

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Results for Event #2, 2024:
Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
	Target	**0.61**	**2.84**	**2.94**	**1.33**	**8.16**
103	ICP-MS/MS	0.563	2.72	2.70	1.29	7.84
110	ICP-MS/MS	0.6	3.0	3.0	1.4	8.6
147	ICP-MS	0.629	2.94	2.86	1.46	8.34
247	ICP-MS/MS	0.694	2.88	2.99	1.40	8.09
255	ICP-MS	0.55	2.6	2.7	1.2	7.9
264	ICP-MS	*0.02	2.74	3.37	1.17	7.92
293	DRC/CC-ICP-MS	0.61	2.89	2.94	1.33	8.29
597	ICP-MS/MS	0.617	2.91	2.93	1.36	8.30

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

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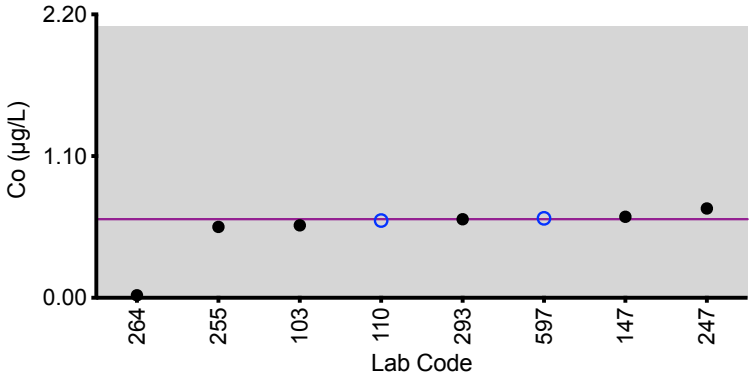
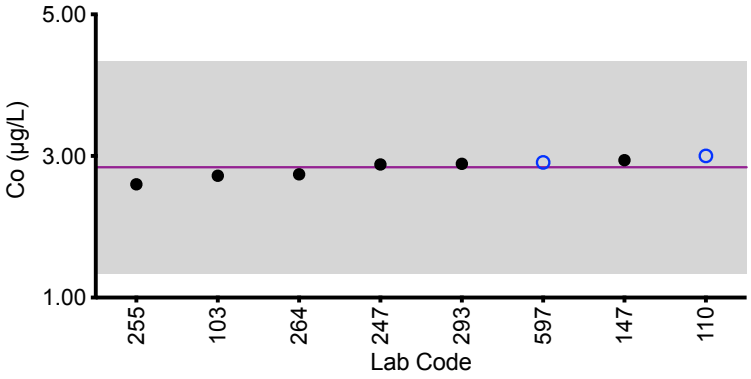
Results for Event #2, 2024: Summary Figures

Whole Blood Co

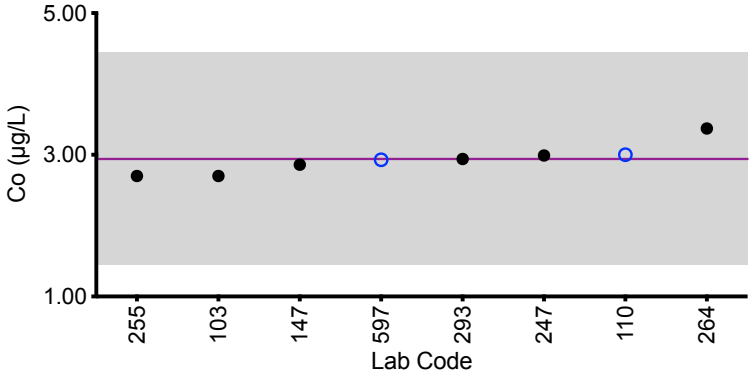
BE24-06



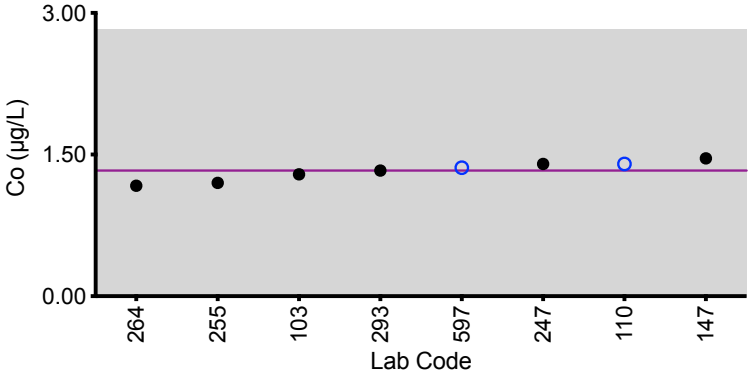
BE24-07



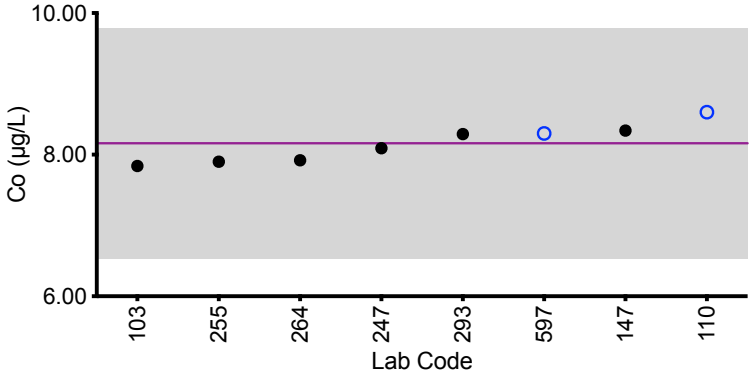
BE24-08



BE24-09



BE24-10



Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

Whole Blood Cr (µg/L)					
	BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Target (Arithmetic Mean ($\bar{x}$))	0.97	2.29	0.99	6.86	7.86
Upper Limit	2.97	4.29	2.99	8.86	9.86
Lower Limit	0.00	0.29	0.00	4.86	5.86
Arithmetic SD (s)	0.19	0.14	0.18	0.11	0.11
Arithmetic RSD (%)	20	6.1	18	1.6	1.4
Number of Sample Measurements (N)	6	7	6	7	6

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

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Results for Event #2, 2024:
Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
	Target	**0.97**	**2.29**	**0.99**	**6.86**	**7.86**
110	ICP-MS/MS	0.9	2.4	0.8	6.7	7.8
147	DRC/CC-ICP-MS	0.896	2.19	0.817	6.79	7.91
247	ICP-MS/MS	0.972	2.23	1.06	6.95	7.67
255	ICP-MS	<1.0	2.3	<1.0	6.9	8
264	ICP-MS	0.75	2.09	1.22	6.94	*7.05
293	DRC/CC-ICP-MS	0.96	2.34	0.86	7.00	7.91
597	ICP-MS/MS	1.32	2.51	1.16	6.77	7.88

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

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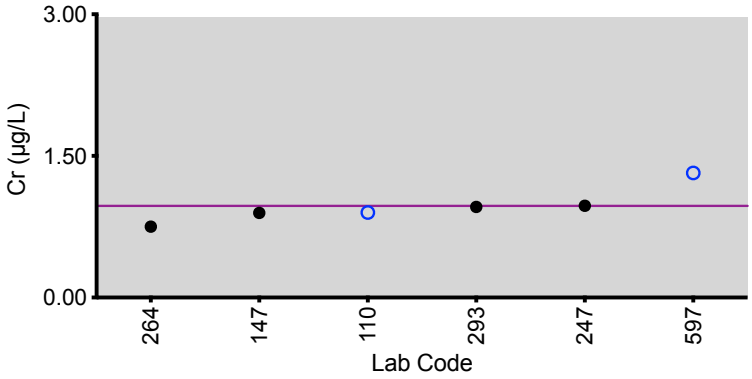
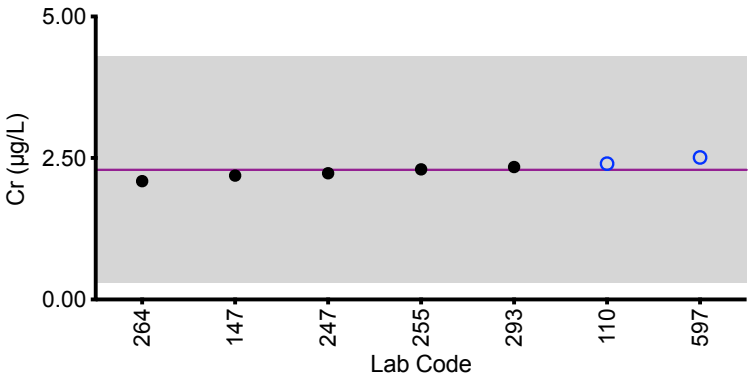
Results for Event #2, 2024: Summary Figures

Whole Blood Cr

BE24-06



BE24-07



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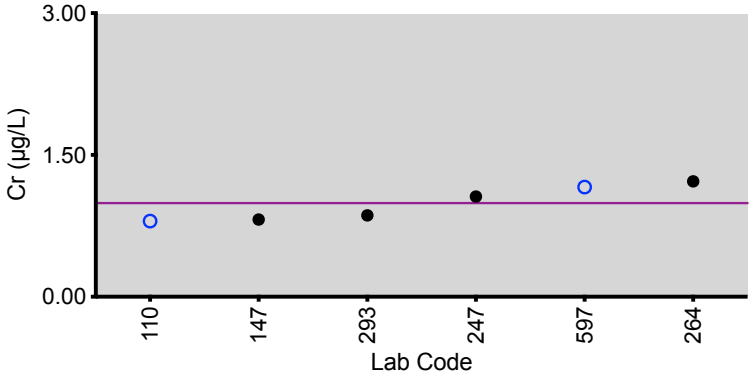
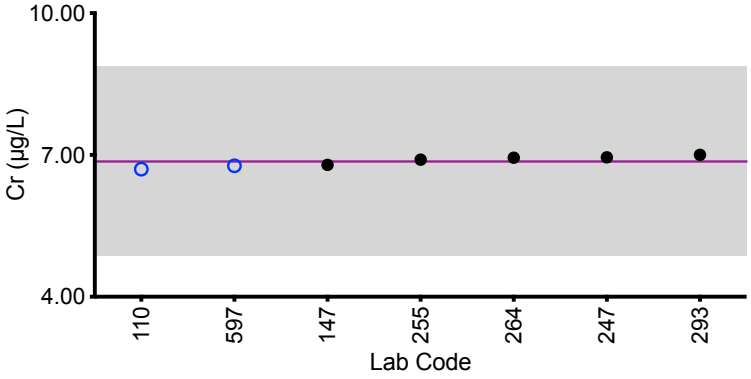
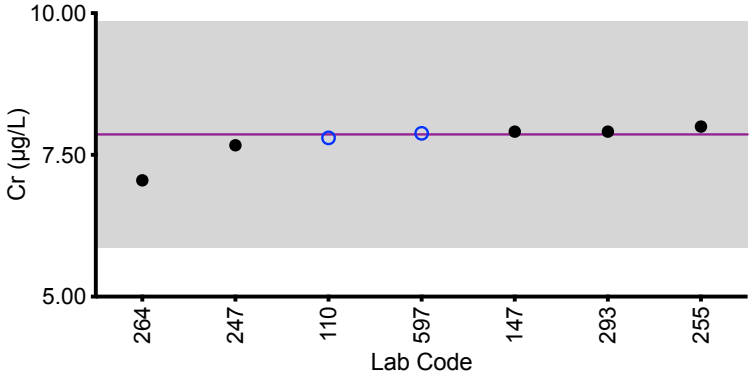


BE24-09



BE24-10



Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

Whole Blood Hg (µg/L)					
	BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Target (Robust Mean (x*))	2.22	0.86	3.7	7.7	19.2
Upper Limit	5.22	3.86	6.7	10.7	25.0
Lower Limit	0.00	0.00	0.7	4.7	13.4
Robust SD (s*)	0.14	0.08	0.4	0.4	1.6
Robust RSD (%)	6.3	9.3	11	5.6	8.3
Number of Sample Measurements (N)	13	12	13	13	13
Standard Uncertainty (*u*)	0.05	0.03	0.1	0.1	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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
	Target	**2.22**	**0.86**	**3.7**	**7.7**	**19.2**
103	ICP-MS/MS	2.12	0.836	3.45	7.63	18.3
107	ICP-MS/MS	2.31	0.900	4.19	7.86	21.0
110	ICP-MS/MS	2.17	0.86	3.38	7.41	17.8
116	ICP-MS/MS	2.32	<1.50	3.96	7.68	19.2
147	ICP-MS	2.14	0.779	4.02	8.06	19.6
247	ICP-MS/MS	2.30	0.851	3.48	7.31	18.3
264	ICP-MS	0.31	1.04	3.80	7.87	19.31
293	DRC/CC-ICP-MS	1.8	0.72	2.2	5.59	12.44 ↓
391	CV-AAS	2.5	1.10	4.7	8.74	20.50
597	ICP-MS/MS	2.24	0.890	3.31	7.17	18.1
605	ICP-MS	2.26	0.835	3.70	7.70	18.8
606	ICP-MS/MS	2.15	0.764	3.55	8.08	21.1
686	ICP-MS	2.38	0.901	3.92	7.88	21.3

Based on the grading criteria for Hg in Whole Blood, 98% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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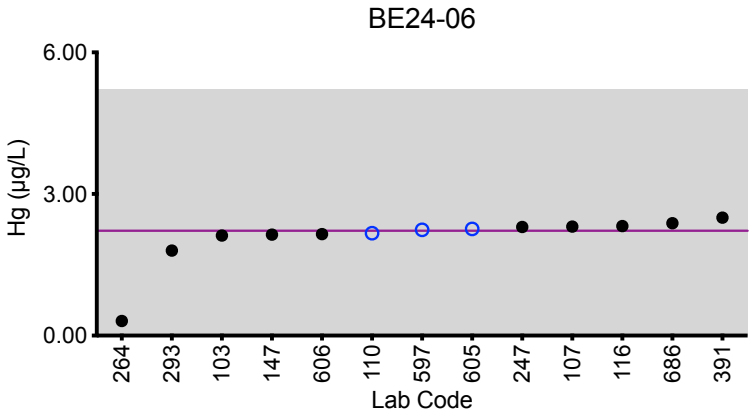
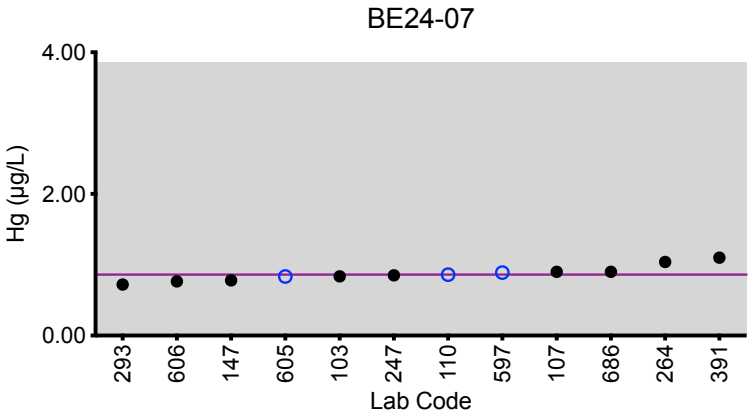
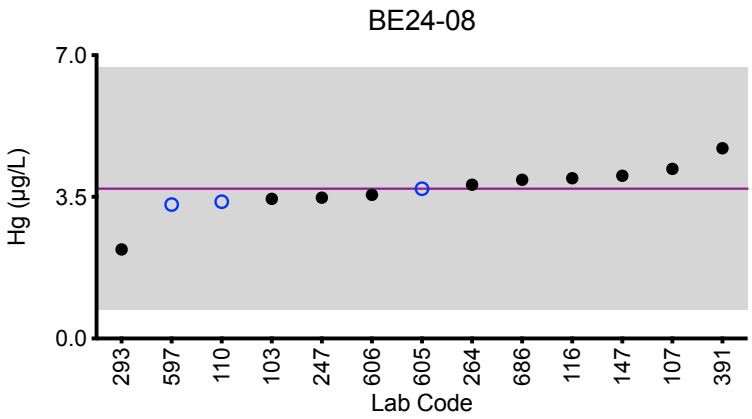
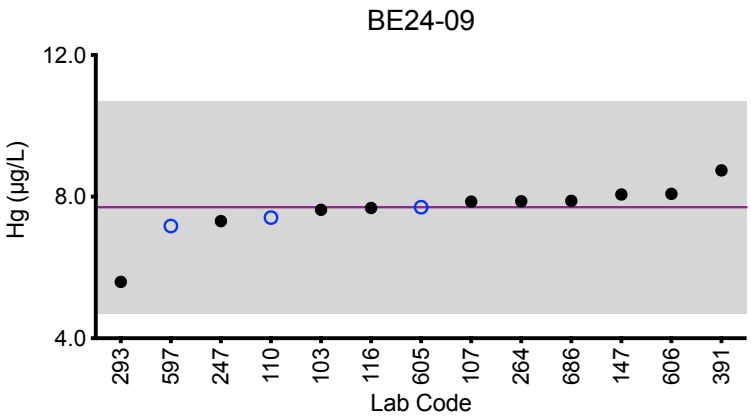
Results for Event #2, 2024: Summary Figures

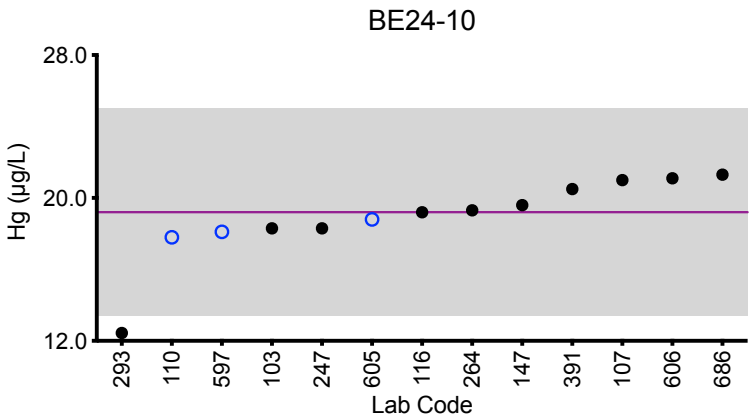
Whole Blood Hg











Legend:

o 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.

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Results for Event #2, 2024:
Summary Statistics

Whole Blood Mn (µg/L)					
	BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Target (Arithmetic Mean ($\bar{x}$))	14.8	21.7	28.8	39.7	19.3
Upper Limit	17.8	25.4	33.7	46.4	22.6
Lower Limit	11.8	18.0	23.9	33.0	16.0
Arithmetic SD (s)	1.6	1.9	2.6	1.9	2.5
Arithmetic RSD (%)	11	8.8	9.2	4.8	13
Number of Sample Measurements (N)	8	9	9	9	9

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).

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Results for Event #2, 2024:
Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
	Target	**14.8**	**21.7**	**28.8**	**39.7**	**19.3**
103	ICP-MS/MS	14.4	20.6	27.5	39.1	18.7
107	ICP-MS/MS	15.6	22.3	29.8	40.3	20.2
110	ICP-MS/MS	13.6	20.8	27.7	39.0	18.2
147	ICP-MS	17.2	24.1	31.5	41.1	22.0
247	ICP-MS/MS	14.5	21.2	29.2	38.7	20.2
264	ICP-MS	*1.93 ↓	24.7	32.6	43.7	22.7 ↑
293	DRC/CC-ICP-MS	13.0	19.06	24.1	37.7	14.33 ↓
597	ICP-MS/MS	13.3	19.8	26.5	37.4	17.3
606	ICP-MS/MS	16.8	22.4	30.5	40.4	20.4

Based on the grading criteria for Mn in Whole Blood, 93% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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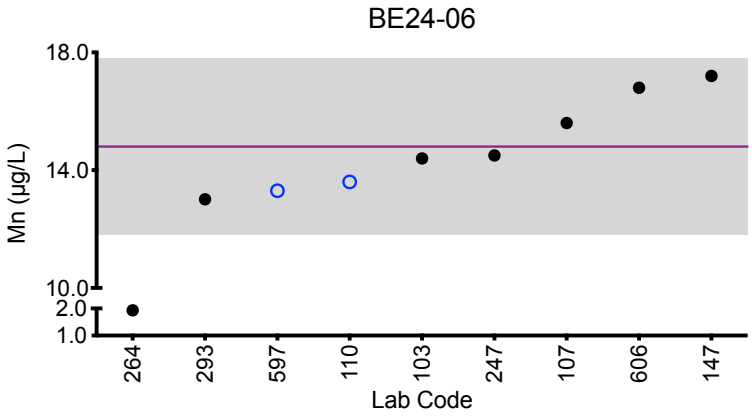
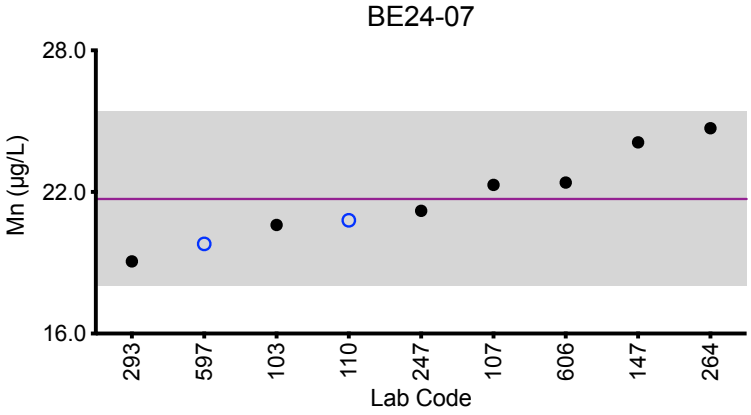
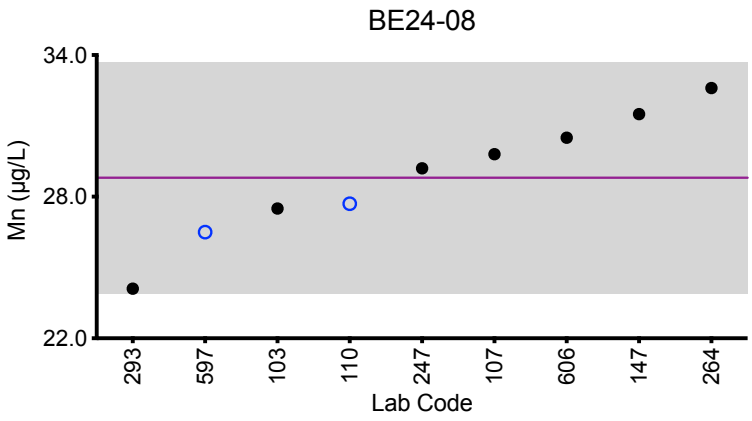
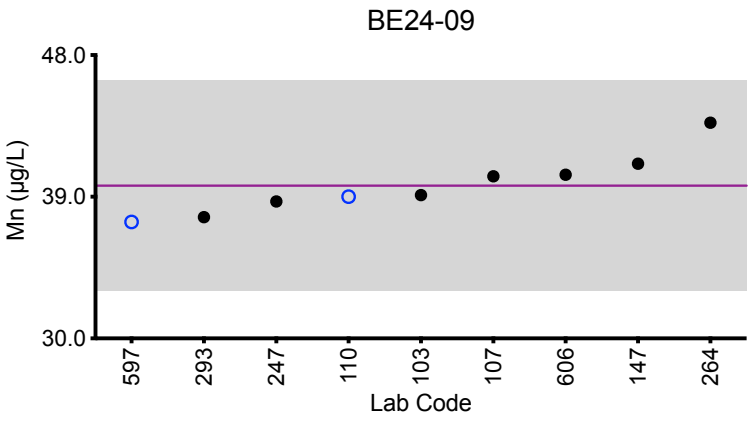
Results for Event #2, 2024: Summary Figures

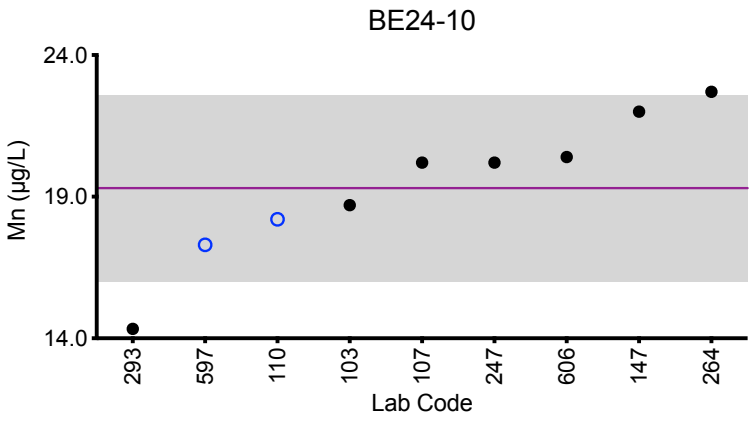
Whole Blood Mn











Legend:

o 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:

±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.

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Results for Event #2, 2024: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Target (Robust Mean (x*))	0.70	6.1	3.28	11.8	1.74
Upper Limit	2.70	8.1	5.28	13.8	3.74
Lower Limit	0.00	4.1	1.28	9.8	0.00
Robust SD (s*)	0.05	0.4	0.19	0.7	0.08
Robust RSD (%)	6.9	7.1	5.8	5.9	4.6
Number of Sample Measurements (N)	8	14	13	14	12
Standard Uncertainty (*u*)	NA	0.1	0.07	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/)

An arithmetic mean, SD, RSD and n are provided for sample BE24-06.

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Results for Event #2, 2024:
Performance of Participating Laboratories

Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
	Target	**0.70**	**6.1**	**3.28**	**11.8**	**1.74**
103	ICP-MS/MS	0.671	5.79	3.12	11.6	1.68
107	ICP-MS/MS	0.712	6.25	3.25	11.7	1.75
110	ICP-MS/MS	0.68	6.14	3.25	12.1	1.72
116	ICP-MS/MS	<3.00	5.80	3.16	11.1	<3.00
147	ICP-MS	0.726	6.64	3.51	12.9	1.89
247	ICP-MS/MS	0.712	6.09	3.27	11.6	1.72
264	ICP-MS	*0.06	5.96	3.22	11.2	1.70
293	DRC/CC-ICP-MS	0.62	5.79	3.10	11.2	1.65
343	ASV-LeadCare	<3.3	5.1	<3.3	11.5	<3.3
391	ETAAS-Z	0.72	5.43	2.59	10.5	1.41
597	ICP-MS/MS	0.787	6.76	3.57	12.8	1.88
605	ICP-MS	<1.00	6.03	3.40	12.1	1.72
606	ICP-MS/MS	<1.00	6.31	3.39	12.0	1.78
686	ICP-MS	<1.00	6.45	3.45	12.4	1.88

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

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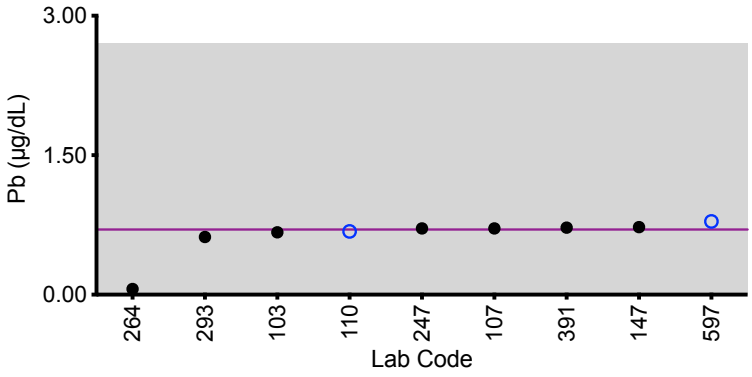
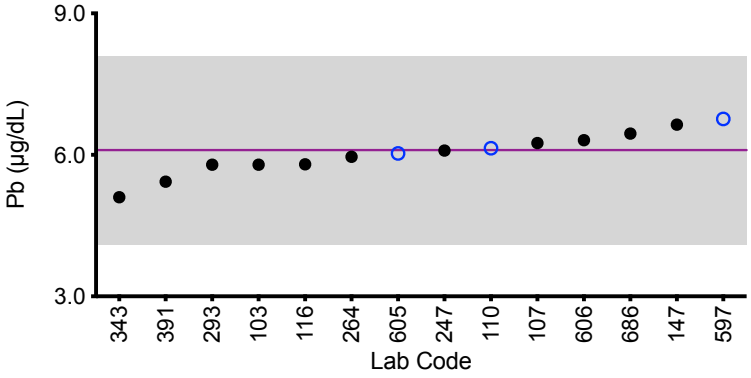
Results for Event #2, 2024: Summary Figures

Whole Blood Pb

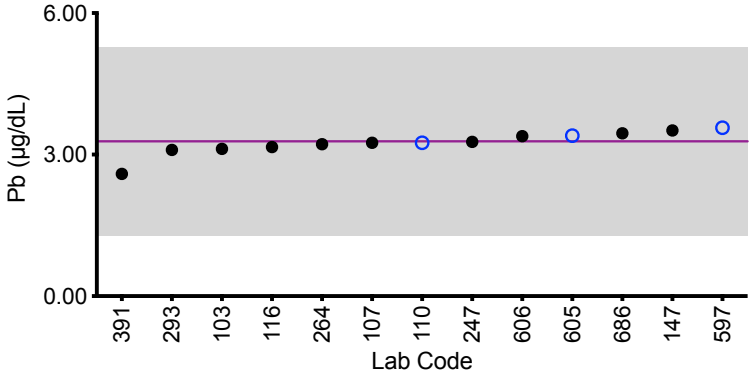
BE24-06



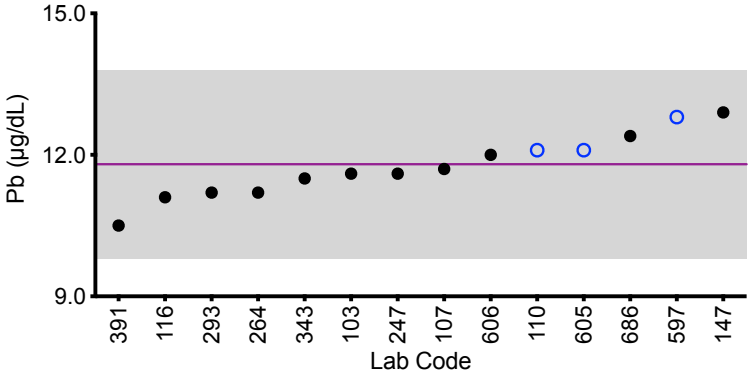
BE24-07



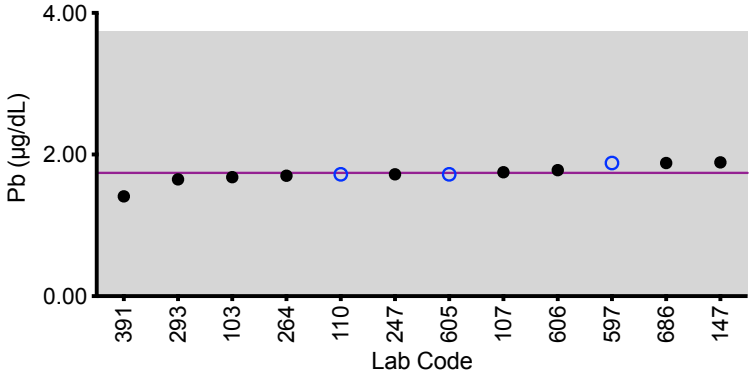
BE24-08



BE24-09



BE24-10



Legend:

o 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.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
103	ICP-MS/MS	1.22	<0.750	0.984	7.39	5.06
110	ICP-MS/MS	1.24	0.58	1.02	7.19	5.21
147	ICP-MS	1.20	0.590	1.02	7.24	5.12
264	ICP-MS	*6.6	*7.2	*7.6	*14.6	*12.5
442	DRC/CC-ICP-MS	1.18	0.536	0.914	6.88	5.01
597	ICP-MS/MS	1.18	0.523	0.971	6.36	4.75

Summary Statistics

	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
Arithmetic Mean ($\bar{x}$)	1.20	0.56	0.98	7.0	5.03
Arithmetic SD (s)	0.03	0.03	0.04	0.4	0.17
Arithmetic RSD (%)	2.2	5.4	4.1	5.7	3.4
Number of Sample Measurements (N)	5	4	5	5	5

*Denotes a statistical Outlier.

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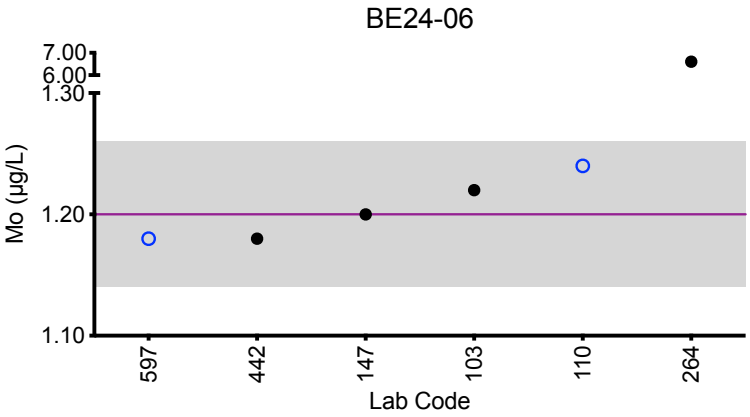
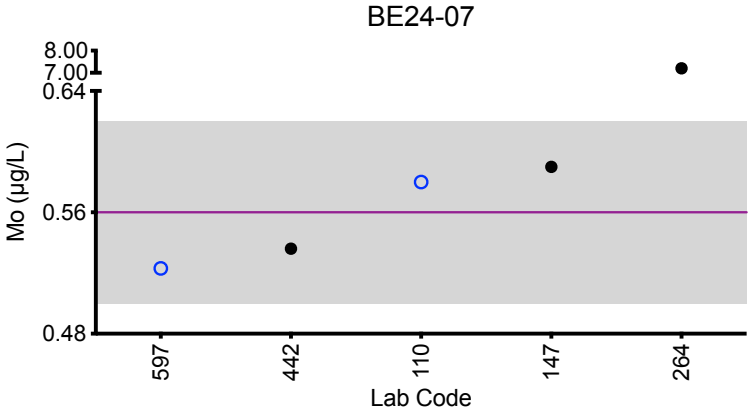
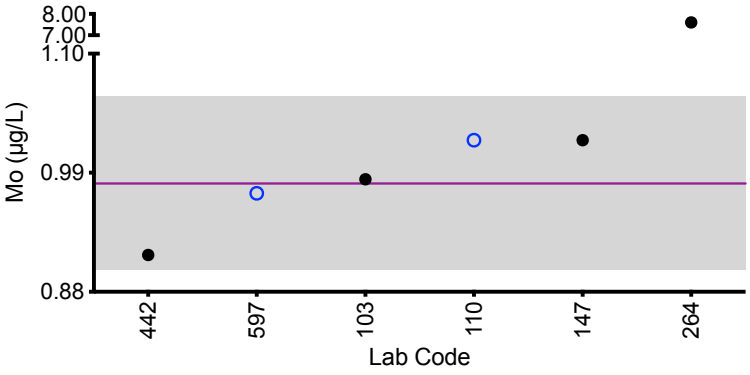
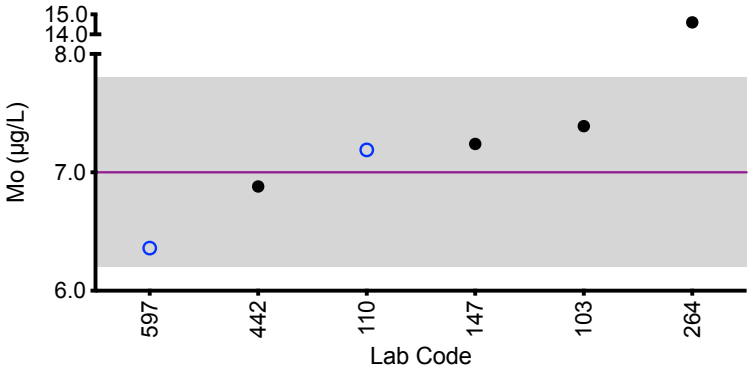
Results for Event #2, 2024: Summary Figures

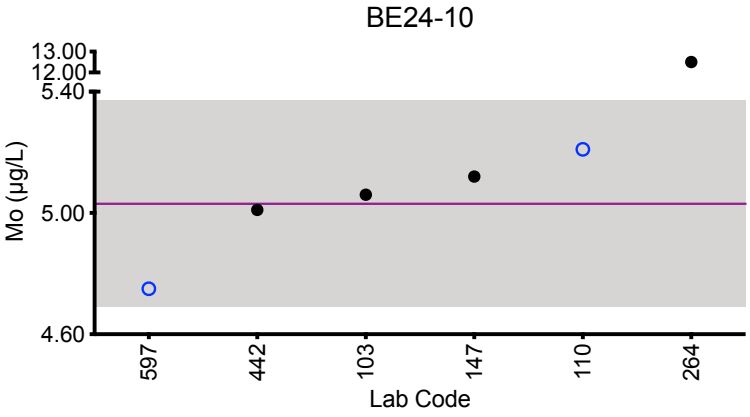
Whole Blood Mo











Legend:
o 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.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
110	ICP-MS/MS	1.67	1.00	2.51	3.72	0.99
147	ICP-MS	1.65	0.986	2.56	3.48	0.957
264	ICP-MS	*0.13	0.91	2.09	3.31	0.85
293	DRC/CC-ICP-MS	1.5	0.9	2.1	3.3	0.8
442	DRC/CC-ICP-MS	1.41	0.819	2.18	3.31	0.837
597	ICP-MS/MS	1.72	1.05	2.56	3.80	1.05

Summary Statistics

	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
Arithmetic Mean ($\bar{x}$)	1.59	0.94	2.33	3.49	0.91
Arithmetic SD (s)	0.13	0.08	0.23	0.22	0.10
Arithmetic RSD (%)	8.2	8.5	9.9	6.3	11
Number of Sample Measurements (N)	5	6	6	6	6

*Denotes a statistical Outlier.

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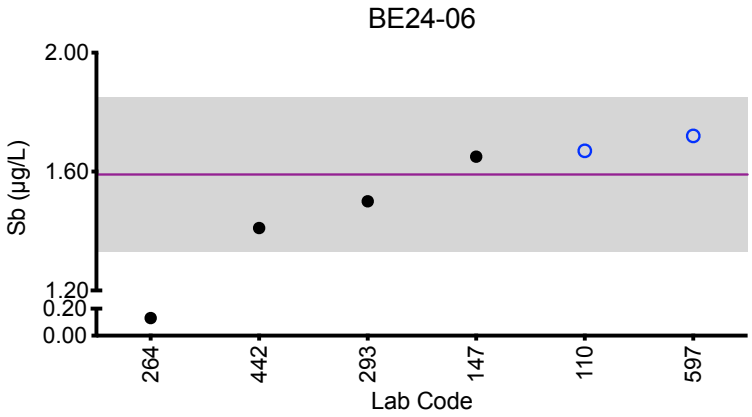
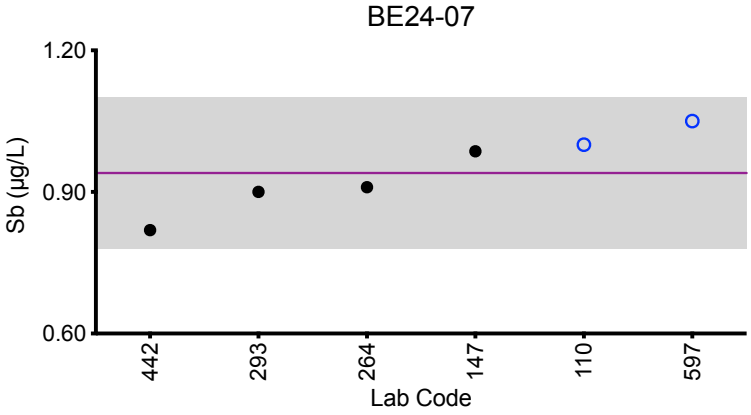
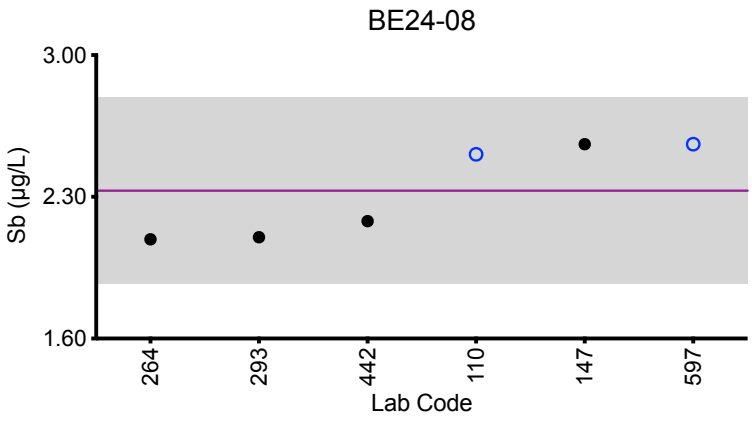
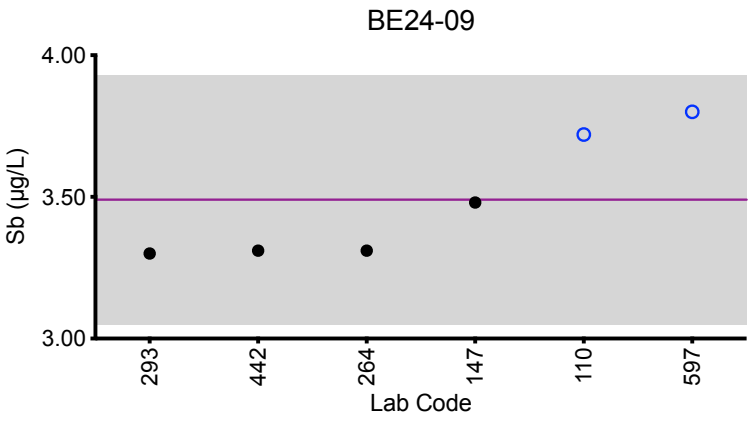
Results for Event #2, 2024: Summary Figures

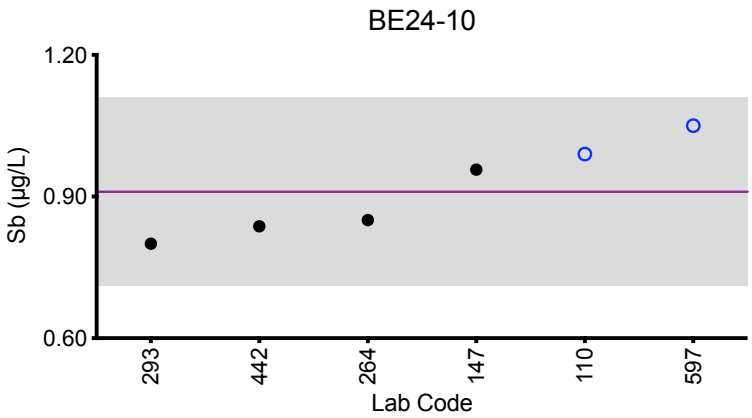
Whole Blood Sb











Legend:
o 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.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
103	ICP-MS/MS	130	374	217	280	161
107	ICP-MS/MS	130	391	219	276	158
110	ICP-MS/MS	116	346	206	252	150
147	ICP-MS	122	353	212	246	151
247	ICP-MS/MS	122	390	217	274	151
264	ICP-MS	*5.66	346	187	239	146
293	DRC/CC-ICP-MS	115	329	182	237	134
597	ICP-MS/MS	118	338	200	245	146

Summary Statistics

	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
Arithmetic Mean ($\bar{x}$)	122	358	205	256	150
Arithmetic SD (s)	6	24	14	18	8
Arithmetic RSD (%)	4.9	6.7	6.8	6.9	5.3
Number of Sample Measurements (N)	7	8	8	8	8

*Denotes a statistical Outlier.

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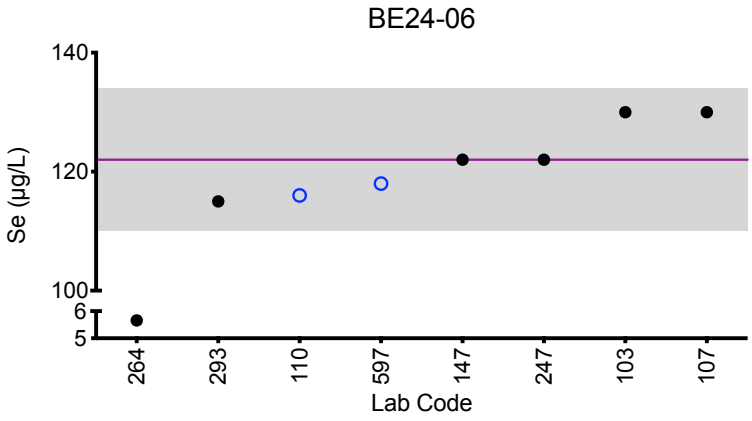
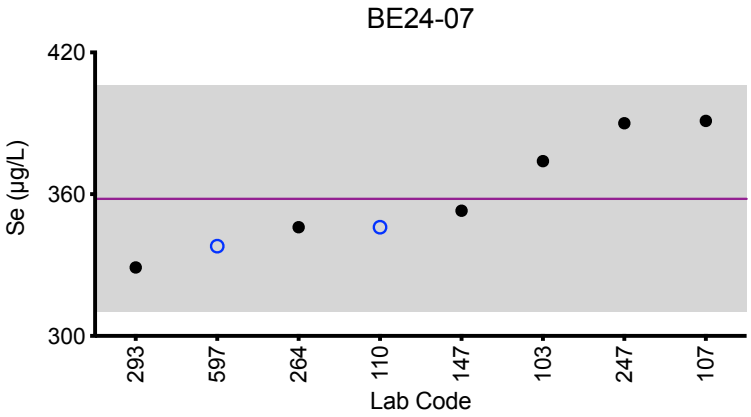
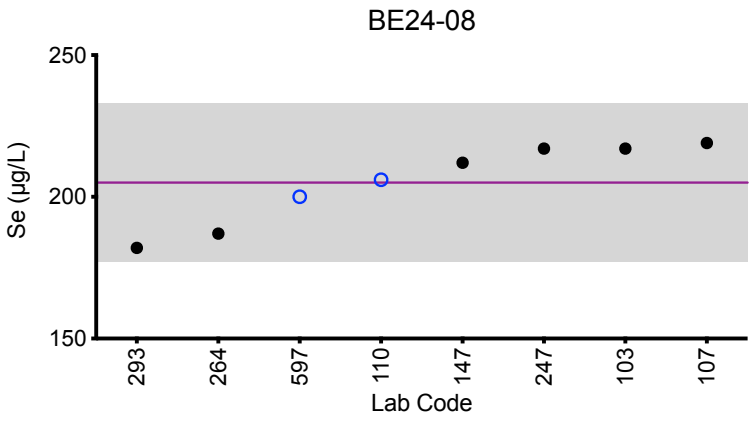
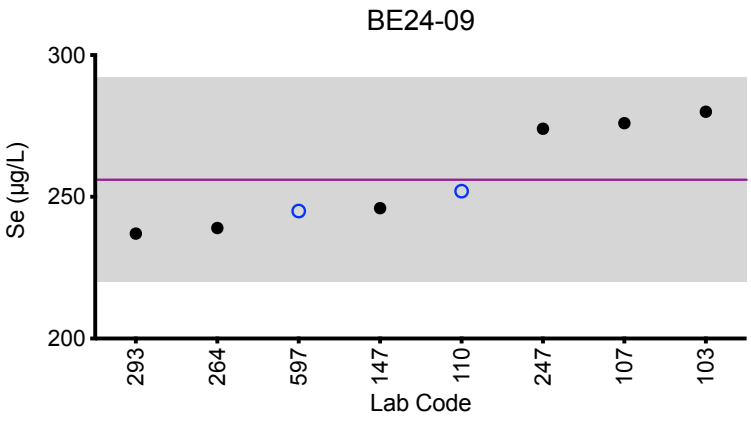
Results for Event #2, 2024: Summary Figures

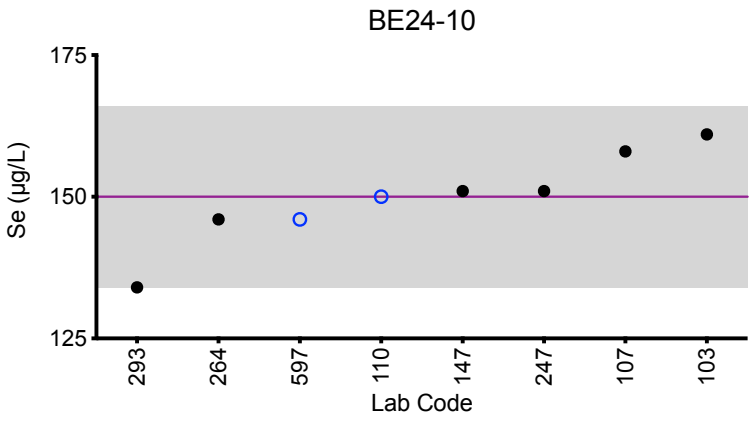
Whole Blood Se











Legend:
o 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.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Tl (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
103	ICP-MS/MS	0.509	0.123	0.828	1.53	0.423
110	ICP-MS/MS	0.547	0.127	0.876	1.60	0.441
147	ICP-MS	0.571	0.132	0.929	1.73	0.470
264	ICP-MS	*0.04	0.13	0.79	1.48	0.42
293	DRC/CC-ICP-MS	0.52	0.12	0.830	1.48	0.42
597	ICP-MS/MS	0.585	0.145	0.929	1.65	0.462

Summary Statistics

	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
Arithmetic Mean ($\bar{x}$)	0.55	0.130	0.86	1.58	0.439
Arithmetic SD (s)	0.03	0.009	0.06	0.10	0.022
Arithmetic RSD (%)	5.9	6.9	6.7	6.3	5.1
Number of Sample Measurements (N)	5	6	6	6	6

*Denotes a statistical Outlier.

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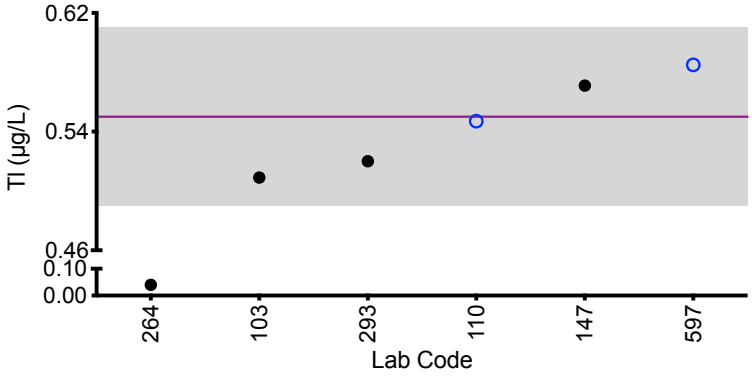
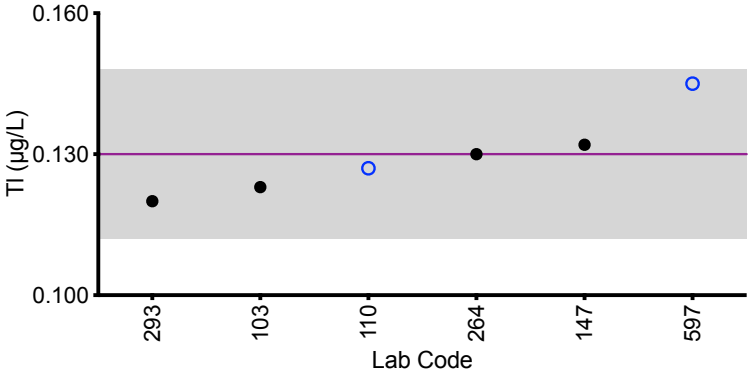
Results for Event #2, 2024: Summary Figures

Whole Blood Tl

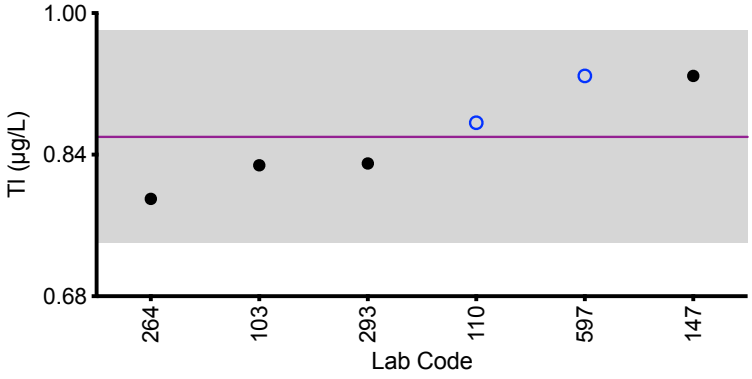
BE24-06



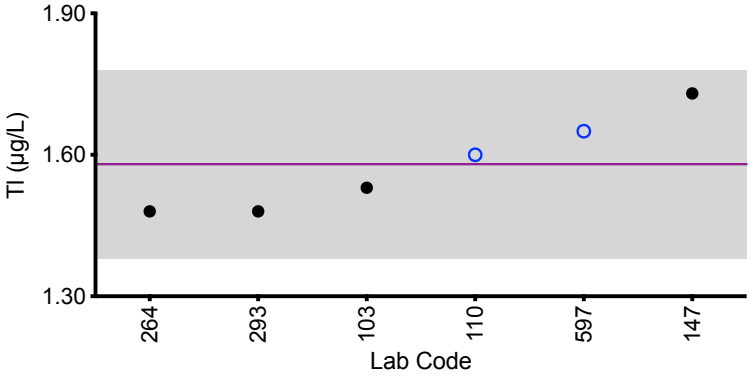
BE24-07



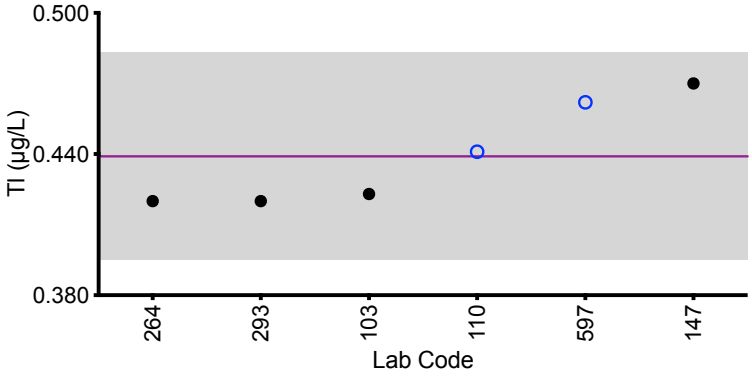
BE24-08



BE24-09



BE24-10



Legend:
o 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.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Al (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
147	ICP-MS	5.94	7.43	5.70	6.48	6.41
597	ICP-MS/MS	6.91	7.71	5.15	9.39	6.04
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		6.4	7.6	5.4	8	6.2
Arithmetic SD (s)		0.7	0.2	0.4	2	0.3
Arithmetic RSD (%)		11	2.6	7.4	26	4.8
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
110	ICP-MS/MS	1.07	3.47	1.43	6.55	11.9
147	ICP-MS	1.02	3.30	1.33	6.14	11.7
597	ICP-MS/MS	1.16	3.69	1.55	6.48	12.0
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		1.08	3.5	1.44	6.4	11.87
Arithmetic SD (s)		0.07	0.2	0.11	0.2	0.15
Arithmetic RSD (%)		6.5	5.7	7.6	3.4	1.3
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
110	ICP-MS/MS	1.45	0.54	0.69	2.09	1.54
147	ICP-MS	1.51	<0.991	<0.991	2.26	1.75
597	ICP-MS/MS	1.47	0.588	0.675	2.11	1.59
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		1.48	0.56	0.683	2.15	1.63
Arithmetic SD (s)		0.03	0.03	0.011	0.09	0.11
Arithmetic RSD (%)		2.1	5.4	1.6	4.2	6.7
Number of Sample Measurements (N)		3	2	2	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
110	ICP-MS/MS	2.05	1.98	2.00	2.03	2.01
147	ICP-MS	2.06	1.99	2.05	1.99	2.02
597	ICP-MS/MS	2.15	2.12	2.11	2.09	2.11
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		2.09	2.03	2.05	2.04	2.05
Arithmetic SD (s)		0.06	0.08	0.06	0.05	0.06
Arithmetic RSD (%)		2.9	3.9	2.9	2.5	2.9
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
110	ICP-MS/MS	1190	835	950	1590	1660
147	ICP-MS	1234	863	996	1665	1729
247	ICP-MS/MS	1232	904	992	1652	1653
597	ICP-MS/MS	1230	874	986	1660	1730
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		1222	869	981	1640	1690
Arithmetic SD (s)		21	29	21	30	40
Arithmetic RSD (%)		1.7	3.3	2.1	1.8	2.4
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood I (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
147	ICP-MS	25.9	33.9	29.0	34.0	29.5
597	ICP-MS/MS	27.7	34.9	29.3	34.5	29.1

Summary Statistics

	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
Arithmetic Mean ($\bar{x}$)	26.8	34.4	29.2	34.3	29.3
Arithmetic SD (s)	1.3	0.7	0.2	0.4	0.3
Arithmetic RSD (%)	4.9	2.1	0.68	1.2	0.97
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
103	ICP-MS/MS	<0.750	0.885	1.78	2.81	8.14
110	ICP-MS/MS	0.79	1.35	2.36	3.45	9.45
147	ICP-MS	<0.311	0.860	1.81	2.94	9.04
597	ICP-MS/MS	0.250	0.879	1.98	2.94	8.99

Summary Statistics

	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
Arithmetic Mean ($\bar{x}$)	NA	1.0	2.0	3.0	8.9
Arithmetic SD (s)	NA	0.2	0.3	0.3	0.6
Arithmetic RSD (%)	NA	24	14	9.2	6.7
Number of Sample Measurements (N)	NA	4	4	4	4

*Denotes a statistical Outlier.

Statistical data was not calculated for BE24-06 based on a lack of consensus among participating labs.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Pt (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
110	ICP-MS/MS	0.899	0.719	1.20	0.255	0.127
293	DRC/CC-ICP-MS	0.88	0.68	0.86	0.25	0.12
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		0.889	0.70	1.0	0.253	0.124
Arithmetic SD (s)		0.013	0.03	0.2	0.004	0.005
Arithmetic RSD (%)		1.5	4.3	20	1.6	4.0
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
110	ICP-MS/MS	1.60	4.99	2.22	0.62	1.51
147	ICP-MS	1.53	4.87	2.11	0.618	1.50
597	ICP-MS/MS	1.67	5.01	2.24	0.673	1.52
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		1.60	4.96	2.19	0.64	1.51
Arithmetic SD (s)		0.07	0.08	0.07	0.03	0.01
Arithmetic RSD (%)		4.4	1.6	3.2	4.7	0.66
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
103	ICP-MS/MS	19.4	26.3	25.9	27.5	26.0
110	ICP-MS/MS	20.5	27.4	27.3	27.9	27.3
147	ICP-MS	20.1	27.5	26.7	27.8	27.1
597	ICP-MS/MS	20.4	27.5	26.9	27.5	27.3
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		20.1	27.2	26.7	27.7	26.9
Arithmetic SD (s)		0.5	0.6	0.6	0.2	0.6
Arithmetic RSD (%)		2.5	2.2	2.2	0.76	2.2
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Ti (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
200	DRC/CC-ICP-MS	7.5	5.7	11.1	14.9	8.7
442	ICP-MS/MS	3.32	1.19	5.46	8.84	3.41
597	ICP-MS/MS	5.61	3.09	7.26	10.6	5.39

Summary Statistics					
	BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)	NA	NA	6.4	9.7	4.4
Arithmetic SD (s)	NA	NA	1.3	1.2	1.4
Arithmetic RSD (%)	NA	NA	20	13	32
Number of Sample Measurements (N)	NA	NA	2	2	2

*Denotes a statistical Outlier.

Statistical data was not calculated for BE24-06 and BE24-07 based on a lack of consensus among participating labs.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
103	ICP-MS/MS	0.245	0.0880	0.0336	0.183	0.0796
110	ICP-MS/MS	0.248	0.0921	0.0336	0.176	0.0800
147	ICP-MS	0.211	0.0827	0.0331	0.162	0.0734
597	ICP-MS/MS	0.251	0.0944	0.0340	0.176	0.0799
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		0.239	0.089	0.0336	0.174	0.078
Arithmetic SD (s)		0.019	0.005	0.0004	0.009	0.003
Arithmetic RSD (%)		7.9	5.6	1.2	5.2	3.8
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
110	ICP-MS/MS	0.94	0.57	0.35	4.53	3.13
147	DRC/CC-ICP-MS	0.917	0.555	0.318	4.36	3.18
597	ICP-MS/MS	0.965	0.602	0.388	4.40	3.11

Summary Statistics

	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
Arithmetic Mean ($\bar{x}$)	0.94	0.58	0.35	4.43	3.14
Arithmetic SD (s)	0.02	0.02	0.04	0.09	0.04
Arithmetic RSD (%)	2.6	4.2	11	2.0	1.3
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
110	ICP-MS/MS	0.72	1.16	0.34	0.23	0.77
200	ICP-MS	0.97	1.51	0.460	0.31	0.94
597	ICP-MS/MS	0.780	1.23	0.375	0.272	0.848
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		0.82	1.3	0.39	0.27	0.85
Arithmetic SD (s)		0.13	0.2	0.06	0.04	0.09
Arithmetic RSD (%)		16	15	15	15	11
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)						
Lab Code	**Method**	**BE24-06**	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
110	ICP-MS/MS	7710	4460	6030	5330	9180
147	ICP-MS	7405	4494	5916	5357	8981
247	ICP-MS/MS	7056	3895	5507	4635	8667
597	ICP-MS/MS	7590	4450	6000	5320	9100
Summary Statistics						
		BE24-06	**BE24-07**	**BE24-08**	**BE24-09**	**BE24-10**
Arithmetic Mean ($\bar{x}$)		7440	4320	5860	5200	8980
Arithmetic SD (s)		290	290	240	400	230
Arithmetic RSD (%)		3.9	6.7	4.1	7.7	2.6
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
147	ICP-MS	<0.129	<0.129	<0.129	<0.129	<0.129

Whole Blood Bi (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
147	ICP-MS	0.424	<0.0376	<0.0376	0.00435	<0.0376
597	ICP-MS/MS	0.389	0.00807	0.00825	0.00737	<0.00647

Whole Blood Li (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
147	ICP-MS	0.579	0.570	0.488	0.541	0.507

Whole Blood Mg (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
597	ICP-MS/MS	22900	23800	30500	24100	30500

Whole Blood Te (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
110	ICP-MS/MS	0.007	0.022	0.020	0.024	0.022
147	ICP-MS	<0.0740	<0.0740	<0.0740	<0.0740	<0.0740

Whole Blood Th (µg/L)

Lab Code	Method	BE24-06	BE24-07	BE24-08	BE24-09	BE24-10
147	ICP-MS	<0.0255	<0.0255	<0.0255	<0.0255	<0.0255
597	ICP-MS/MS	0.0105	0.00658	0.00584	0.00475	0.00514

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Event #2, 2024

Trace Elements in Urine

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Trace Elements Laboratory

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Event #2, 2024:
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), lithium (Li), 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 22 elements were reported by at least one participant: Ag, Al, 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.

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Results for Event #2, 2024:
Summary Statistics

	Urine As (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	11.0	19.0	49.7	12.2	3.07
Upper Limit	17.0	25.0	59.6	18.2	9.07
Lower Limit	5.0	13.0	39.8	6.2	0.00
Robust SD (s*)	0.8	0.9	2.6	0.5	0.14
Robust RSD (%)	7.3	4.7	5.2	4.1	4.6
Number of Sample Measurements (N)	14	14	14	14	12
Standard Uncertainty (*u*)	0.3	0.3	0.9	0.2	0.05

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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Urine As (µg/L)				
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**11.0**	**19.0**	**49.7**	**12.2**	**3.07**
103	ICP-MS/MS	11.6	20.5	53.9	13.4	3.39
107	DRC/CC-ICP-MS	11.7	19.1	47.9	12.2	3.11
110	ICP-MS/MS	10.8	18.7	48.8	12.0	3.04
116	ICP-MS/MS	11.8	19.9	50.3	13.1	<6.00
147	ICP-MS	10.3	17.7	47.8	11.4	2.65
220	DRC/CC-ICP-MS	12.2	22.2	54.5	13.9	3.63
264	ICP-MS	1.74 ↓	19.1	50.5	12.7	3.14
293	DRC/CC-ICP-MS	10.7	18.42	48.35	12	3.02
399	DRC/CC-ICP-MS	10.8	19.5	50.1	12.3	3.20
442	ICP-MS/MS	10.3	18.1	46.6	11.8	2.77
597	ICP-MS/MS	10.2	17.4	45.6	11.4	2.98
605	ICP-MS	11.0	19.1	50.1	12.3	3.07
606	ICP-MS/MS	11.3	19.1	50.1	12.0	3.03
686	DRC/CC-ICP-MS	11.5	19.1	51.9	12.1	<6.00

Based on the grading criteria for As in Urine, 99% of results were satisfactory, with 0 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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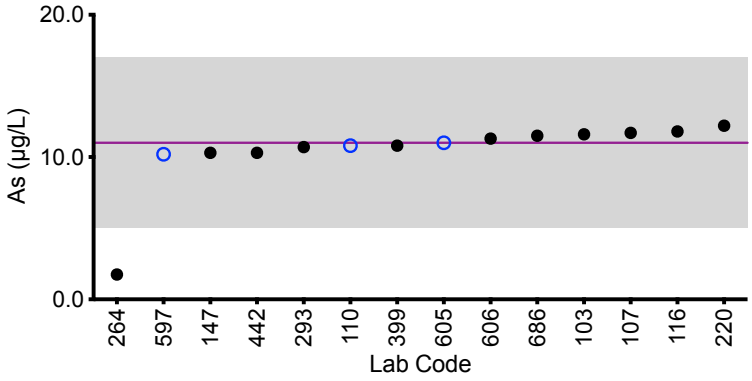
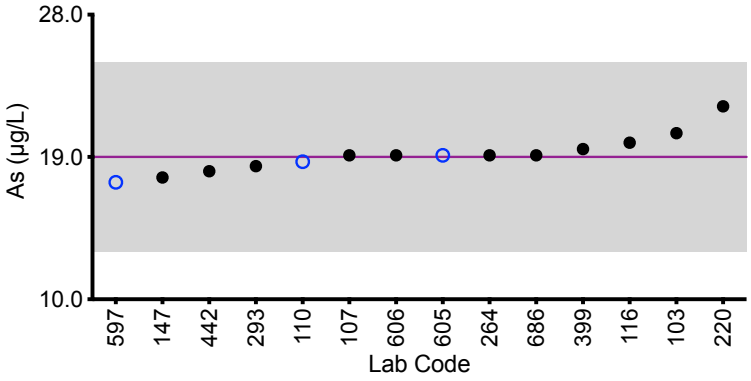
Results for Event #2, 2024: Summary Figures

Urine As

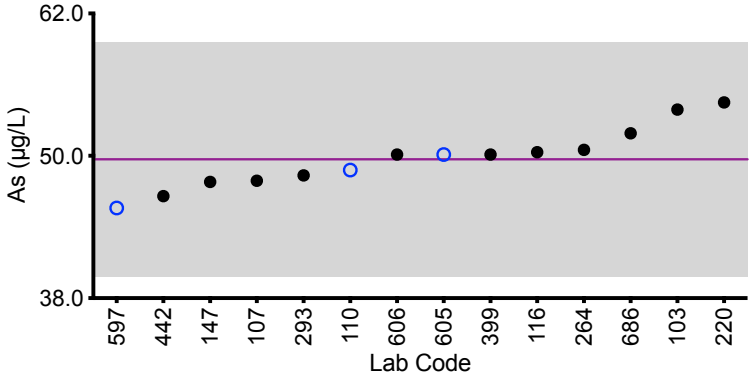
UE24-06



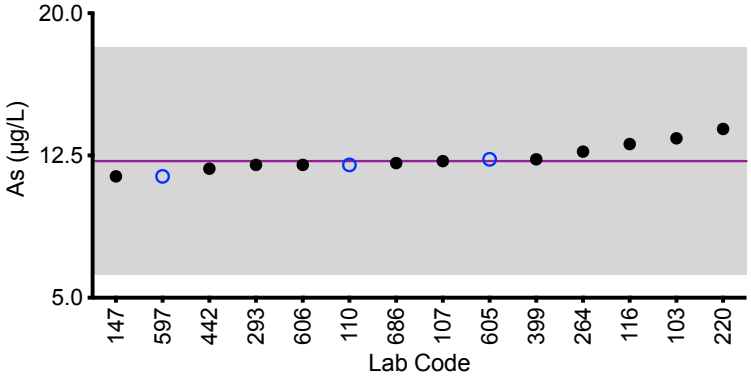
UE24-07



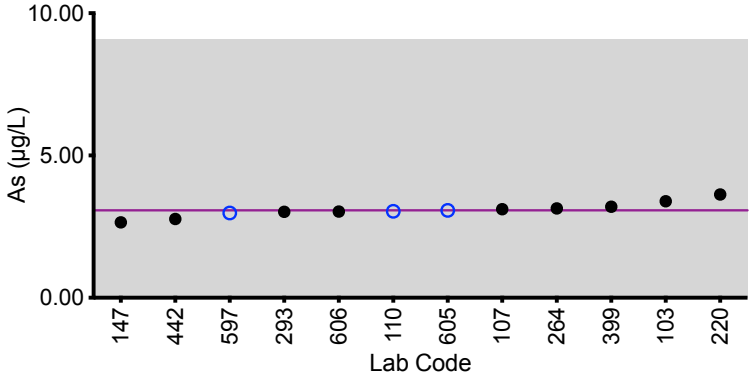
UE24-08



UE24-09



UE24-10



Legend:

o 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.

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Results for Event #2, 2024:
Summary Statistics

	Urine Ba (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	1.13	1.36	5.0	2.39	6.95
Upper Limit	2.13	2.36	6.0	3.39	8.34
Lower Limit	0.13	0.36	4.0	1.39	5.56
Robust SD (s*)	0.10	0.14	0.3	0.16	0.25
Robust RSD (%)	8.8	10	6.3	6.7	3.6
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.04	0.05	0.1	0.06	0.09

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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Urine Ba (µg/L)				
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**1.13**	**1.36**	**5.0**	**2.39**	**6.95**
107	ICP-MS	1.11	1.24	4.65	2.20	6.78
110	ICP-MS/MS	1.14	1.41	5.14	2.55	7.11
116	ICP-MS/MS	1.06	1.39	5.28	2.29	7.04
147	ICP-MS	1.02	1.16	4.38	2.10	5.89
220	ICP-MS	1.23	1.44	5.37	2.63	7.35
264	ICP-MS	0.33	1.31	4.90	2.36	6.87
399	ICP-MS/MS	1.32	1.54	5.14	2.52	7.14
597	ICP-MS/MS	1.12	1.35	4.79	2.45	6.80
605	ICP-MS	1.16	1.35	5.10	2.47	6.88
606	ICP-MS/MS	1.23	1.21	4.74	2.39	7.27
686	ICP-MS	1.10	1.53	4.90	2.33	6.76

Based on the grading criteria for Ba in Urine, 100% of results were satisfactory, with 0 of the 11 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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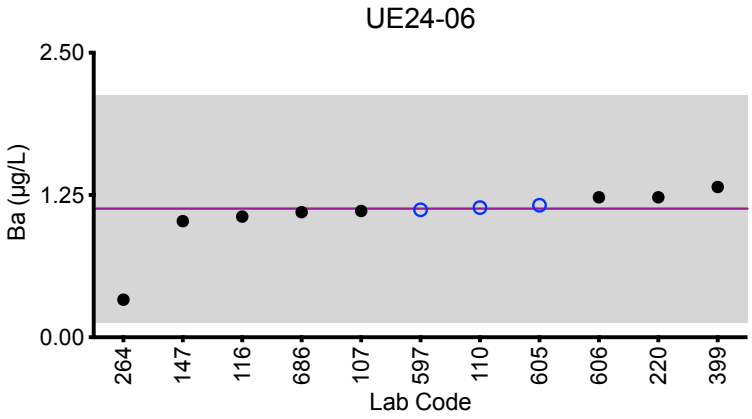
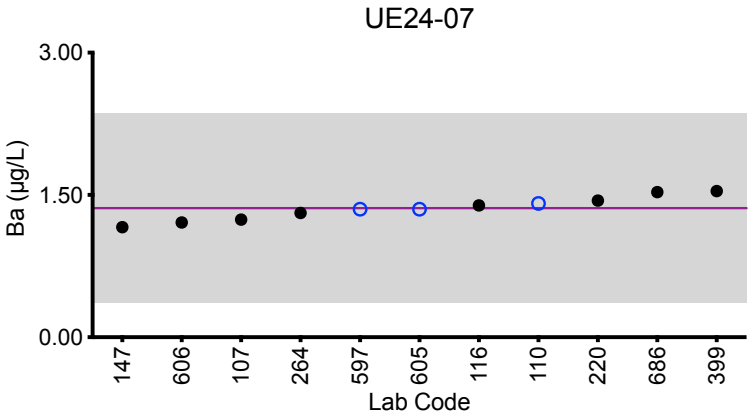
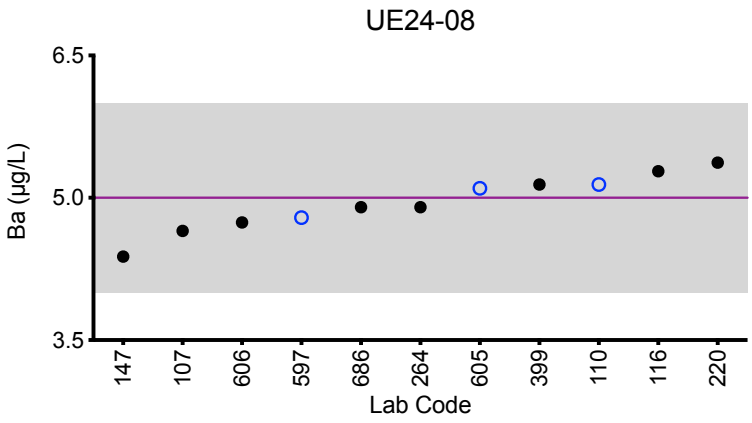
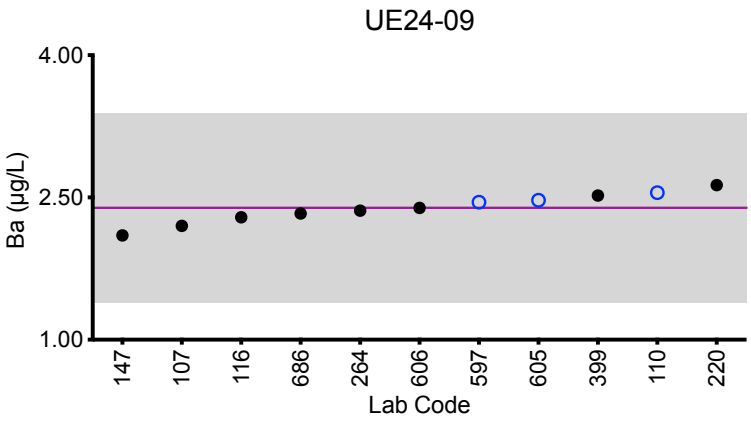
Results for Event #2, 2024: Summary Figures

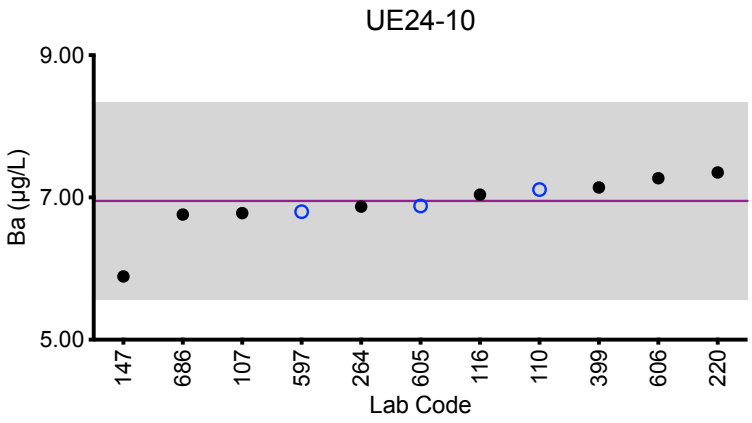
Urine Ba











Legend:
o 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.

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Results for Event #2, 2024:
Summary Statistics

	Urine Be (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	0.30	0.57	1.03	0.19	1.29
Upper Limit	1.30	1.57	2.03	1.19	2.29
Lower Limit	0.00	0.00	0.03	0.00	0.29
Robust SD (s*)	0.02	0.03	0.09	0.02	0.12
Robust RSD (%)	6.9	6.0	8.7	9.3	9.3
Number of Sample Measurements (N)	8	11	11	8	11
Standard Uncertainty (*u*)	NA	0.01	0.03	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 UE24-06 and UE24-09.

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**0.30**	**0.57**	**1.03**	**0.19**	**1.29**
107	ICP-MS	0.302	0.534	1.02	0.175	1.37
110	ICP-MS/MS	0.278	0.544	0.900	0.170	1.08
116	ICP-MS/MS	<0.300	0.59	1.04	<0.300	1.30
147	ICP-MS	0.284	0.578	1.07	<0.261	1.32
220	ICP-MS	0.330	0.605	1.11	0.211	1.41
264	ICP-MS	*0.03	0.61	1.16	0.22	1.53
293	ICP-MS	0.33	0.57	1.06	0.19	1.32
399	ICP-MS/MS	0.292	0.542	0.966	0.176	1.20
597	ICP-MS/MS	0.281	0.568	0.972	0.187	1.20
605	ICP-MS	0.306	0.581	1.08	0.196	1.34
686	ICP-MS	<0.300	0.508	0.928	<0.300	1.18

Based on the grading criteria for Be in Urine, 100% of results were satisfactory, with 0 of the 11 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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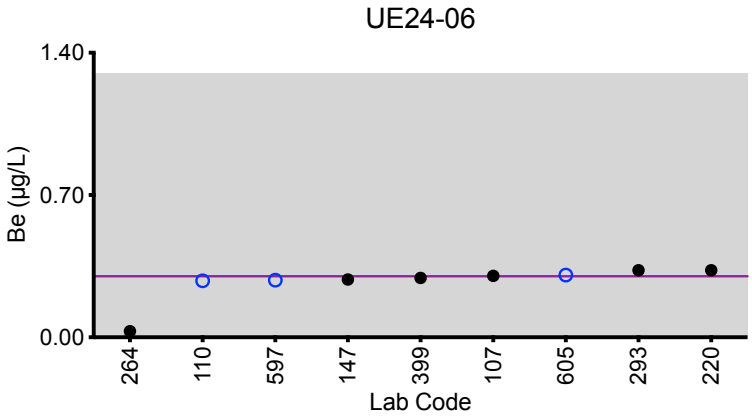
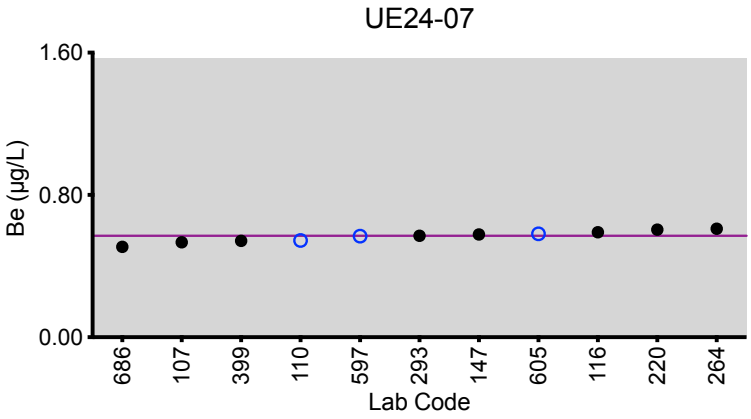
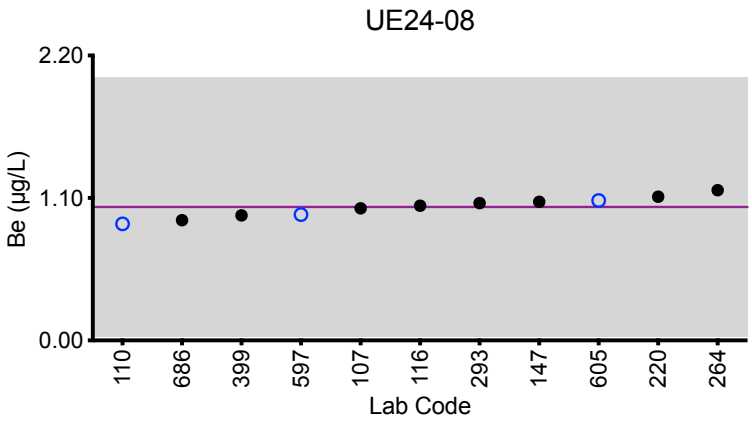
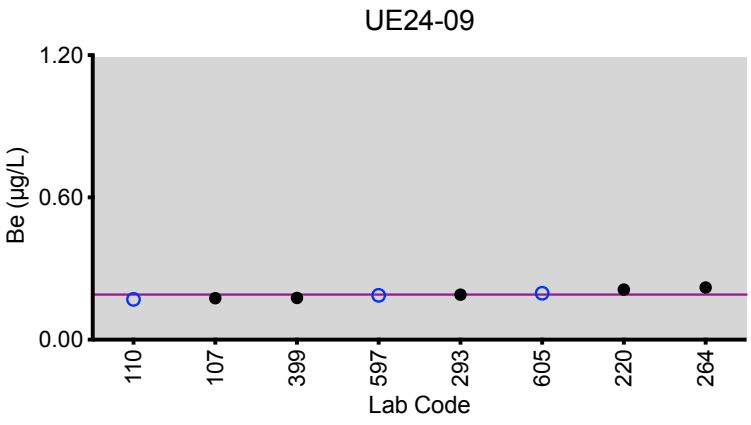
Results for Event #2, 2024: Summary Figures

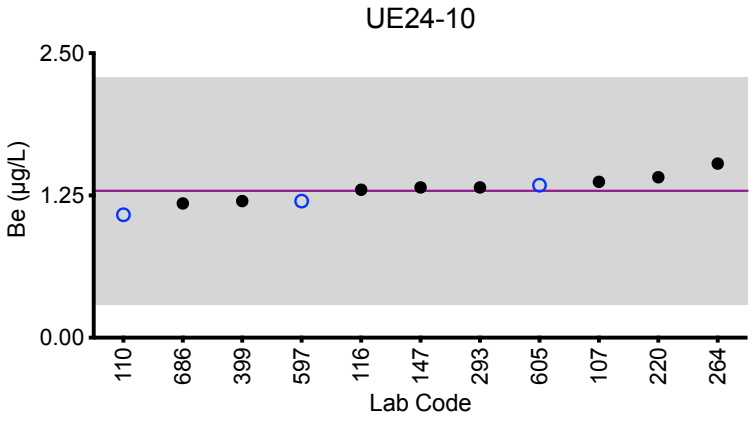
Urine Be











Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

	Urine Cd (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	0.673	1.72	0.327	3.14	1.03
Upper Limit	1.673	2.72	1.327	4.14	2.03
Lower Limit	0.000	0.72	0.000	2.14	0.03
Robust SD (s*)	0.015	0.10	0.020	0.17	0.06
Robust RSD (%)	2.2	5.8	6.1	5.4	5.8
Number of Sample Measurements (N)	14	15	14	15	15
Standard Uncertainty (*u*)	0.005	0.03	0.007	0.05	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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**0.673**	**1.72**	**0.327**	**3.14**	**1.03**
103	ICP-MS/MS	0.672	1.77	0.326	3.23	1.06
107	DRC/CC-ICP-MS	0.681	1.60	0.282	3.00	0.948
110	ICP-MS/MS	0.665	1.64	0.330	3.08	1.01
116	ICP-MS/MS	0.68	1.81	0.334	2.96	0.970
147	ICP-MS	0.682	1.87	0.317	3.43	1.03
220	ICP-MS	0.705	1.75	0.352	3.36	1.09
264	ICP-MS	0.07	1.79	0.37	3.43	1.11
293	DRC/CC-ICP-MS	0.66	1.62	0.34	3.01	1.09
324	ICP-MS	<1	1.720	<1	3.244	1.111
399	DRC/CC-ICP-MS	0.676	1.69	0.321	3.15	0.990
442	ICP-MS/MS	0.672	1.85	0.253	3.09	1.04
597	ICP-MS/MS	0.682	1.65	0.329	3.11	1.01
605	ICP-MS	0.630	1.71	0.324	3.12	1.01
606	ICP-MS/MS	0.596	1.61	0.284	2.89	0.928
686	ICP-MS	0.692	1.71	0.361	3.16	1.08

Based on the grading criteria for Cd 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.

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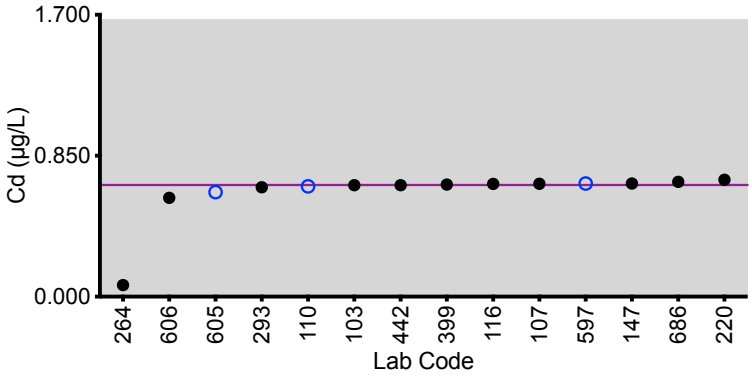
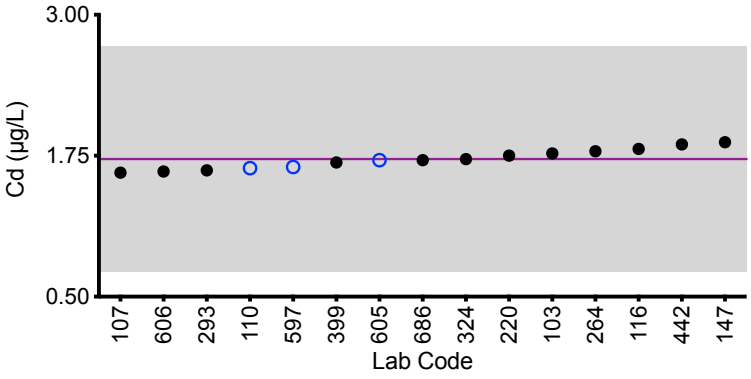
Results for Event #2, 2024: Summary Figures

Urine Cd

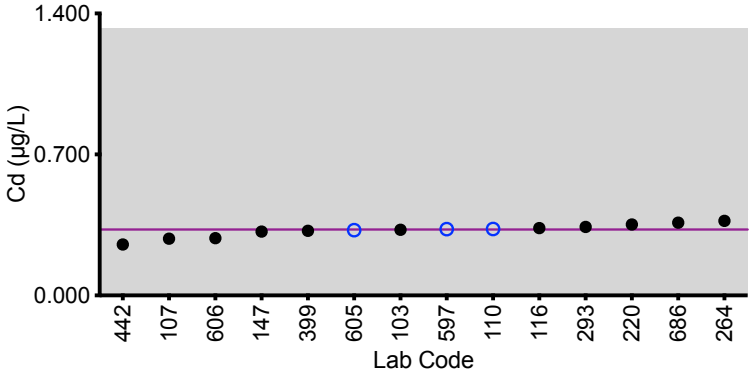
UE24-06



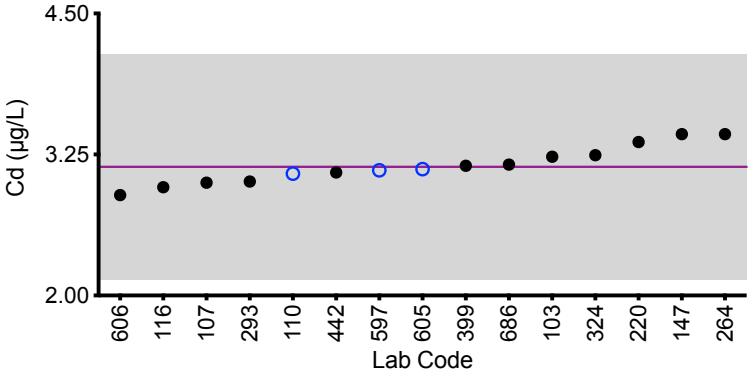
UE24-07



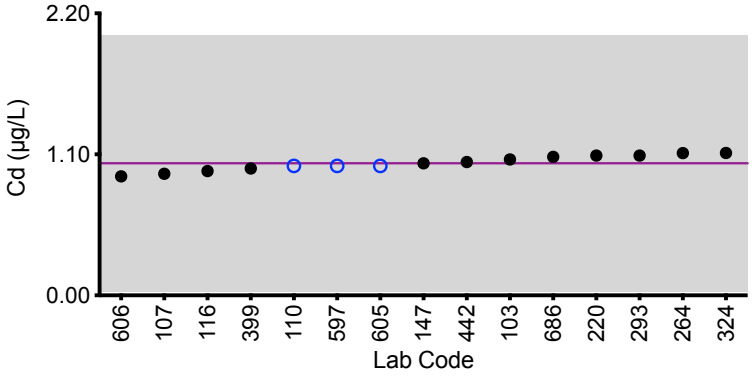
UE24-08



UE24-09



UE24-10



Legend:

o 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.

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Results for Event #2, 2024:
Summary Statistics

	Urine Co (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	0.828	1.79	4.61	1.019	15.7
Upper Limit	2.328	3.29	6.11	2.519	18.1
Lower Limit	0.000	0.29	3.11	0.000	13.3
Robust SD (s*)	0.026	0.06	0.07	0.019	0.4
Robust RSD (%)	3.1	3.4	1.5	1.9	2.5
Number of Sample Measurements (N)	12	13	13	13	13
Standard Uncertainty (*u*)	0.009	0.02	0.03	0.006	0.2

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

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Urine Co (µg/L)				
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**0.828**	**1.79**	**4.61**	**1.019**	**15.7**
103	ICP-MS/MS	0.799	1.82	4.62	1.02	16.1
107	DRC/CC-ICP-MS	0.822	1.68	4.26	0.915	15.3
110	ICP-MS/MS	0.818	1.77	4.57	0.995	15.5
116	ICP-MS/MS	0.86	1.73	4.46	1.01	15.0
147	ICP-MS	0.818	1.73	4.60	1.01	15.6
220	ICP-MS	0.925	1.88	4.89	1.07	16.6
264	ICP-MS	0.12	1.75	4.88	1.06	16.33
293	DRC/CC-ICP-MS	0.85	1.79	4.61	1.02	15.65
324	ICP-MS	<1	1.854	4.719	1.072	15.660
399	DRC/CC-ICP-MS	0.830	1.86	4.62	1.00	15.5
597	ICP-MS/MS	0.819	1.77	4.47	1.01	15.2
605	ICP-MS	0.823	1.81	4.62	1.02	15.6
606	ICP-MS/MS	0.927	1.79	4.57	1.03	16.0

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

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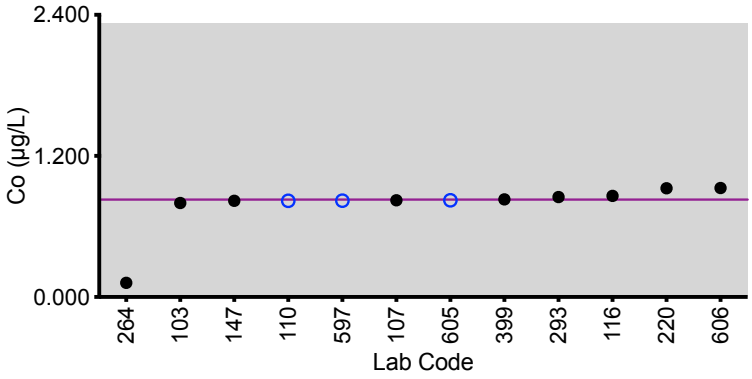
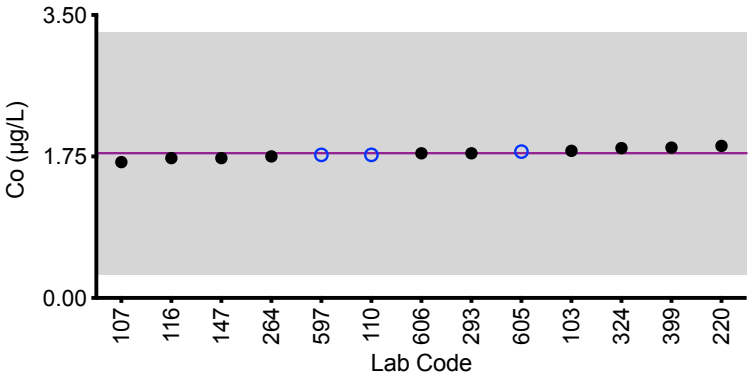
Results for Event #2, 2024: Summary Figures

Urine Co

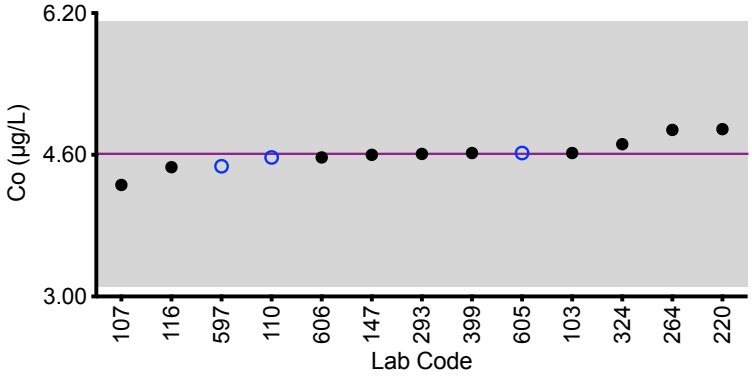
UE24-06



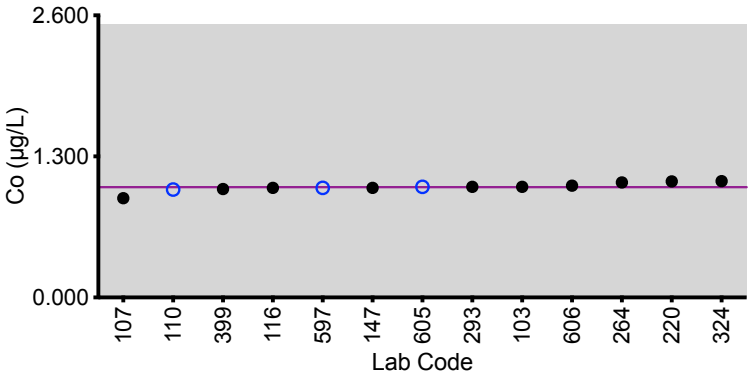
UE24-07



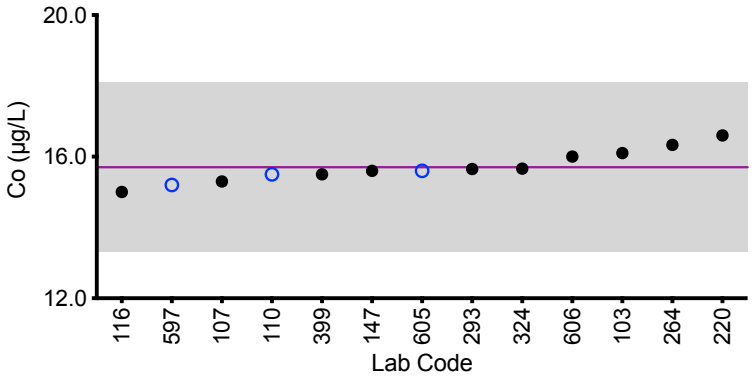
UE24-08



UE24-09



UE24-10



Legend:

o 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.

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Results for Event #2, 2024:
Summary Statistics

	Urine Cr (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	4.6	1.43	3.46	0.70	2.08
Upper Limit	7.6	4.43	6.46	3.70	5.08
Lower Limit	1.6	0.00	0.46	0.00	0.00
Robust SD (s*)	0.3	0.10	0.11	0.14	0.18
Robust RSD (%)	6.8	7.3	3.2	20	8.7
Number of Sample Measurements (N)	10	10	10	9	10
Standard Uncertainty (*u*)	0.1	0.04	0.04	NA	0.07

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

An arithmetic mean, SD, RSD and n are provided for sample UE24-09.

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**4.6**	**1.43**	**3.46**	**0.70**	**2.08**
103	ICP-MS/MS	4.83	1.51	3.61	0.693	2.16
107	DRC/CC-ICP-MS	4.68	1.59	3.49	0.848	2.20
110	ICP-MS/MS	4.83	1.51	3.40	0.93	2.06
116	ICP-MS/MS	4.4	1.29	3.49	0.569	1.96
147	DRC/CC-ICP-MS	4.17	1.32	2.94	0.475	1.82
264	ICP-MS	0.86 ↓	1.47	3.85	0.80	2.33
293	DRC/CC-ICP-MS	4.92	1.41	3.49	0.63	2.11
324	ICP-MS	4.253	1.364	2.915	<1	1.868
597	ICP-MS/MS	4.67	1.45	3.42	0.682	2.23
605	ICP-MS	4.79	1.42	3.46	0.691	2.05

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

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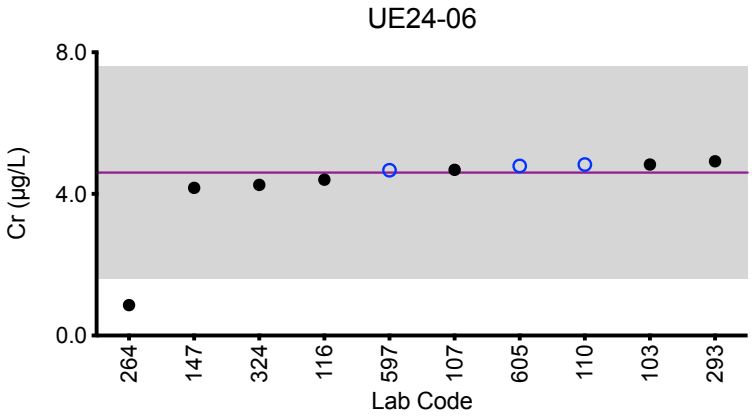
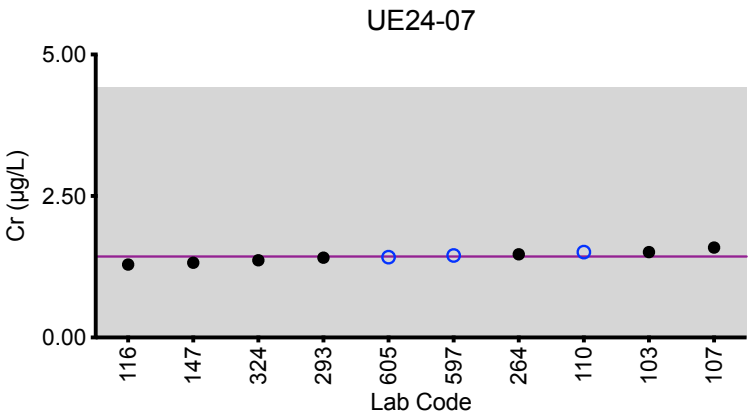
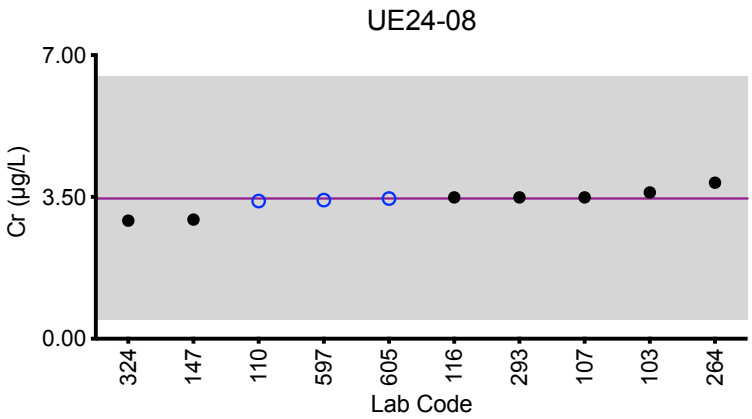
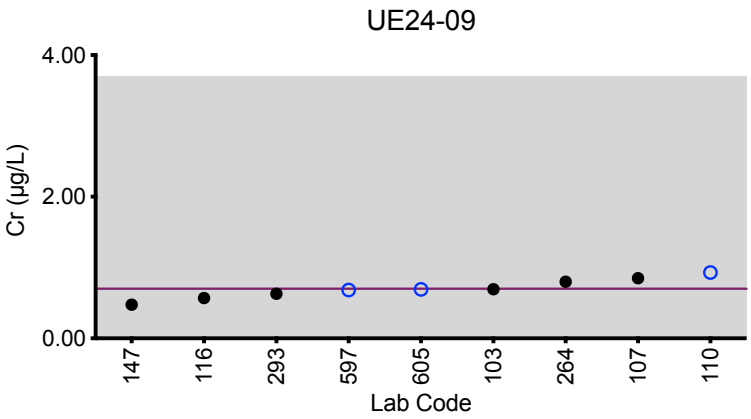
Results for Event #2, 2024: Summary Figures

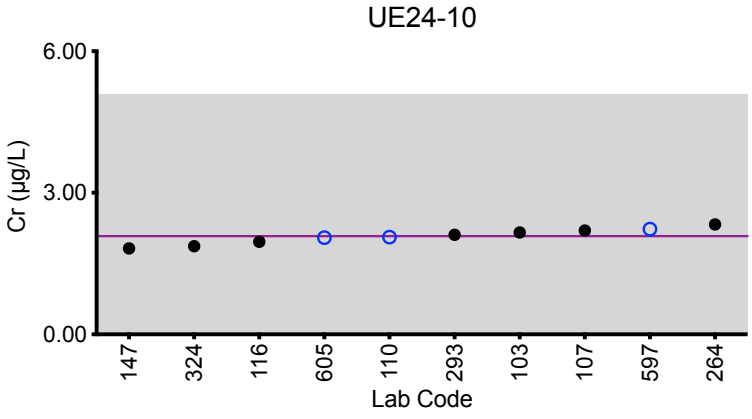
Urine Cr











Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

	Urine Hg (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	21.0	5.1	1.33	2.5	0.56
Upper Limit	27.3	8.1	4.33	5.5	3.56
Lower Limit	14.7	2.1	0.00	0.0	0.00
Robust SD (s*)	1.1	0.4	0.19	0.3	0.11
Robust RSD (%)	5.2	7.7	14	10	20
Number of Sample Measurements (N)	11	11	11	11	8
Standard Uncertainty (*u*)	0.4	0.1	0.07	0.1	NA

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.

An arithmetic mean, SD, RSD and n are provided for sample UE24-10.

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**21.0**	**5.1**	**1.33**	**2.5**	**0.56**
103	ICP-MS/MS	21.9	4.90	1.26	2.32	0.505
107	DRC/CC-ICP-MS	19.8	5.06	1.17	2.39	0.450
110	ICP-MS	20.7	5.21	1.48	2.59	0.58
116	ICP-MS/MS	24.2	5.31	1.15	2.61	<0.3
147	ICP-MS	17.8	4.49	1.28	2.14	0.430
264	ICP-MS	3.19 ↓	5.80	1.92	2.78	0.79
293	DRC/CC-ICP-MS	21.14	5.04	1.35	2.6	0.61
442	ICP-MS/MS	21.8	5.11	1.44	2.40	0.548
597	ICP-MS/MS	21.2	4.77	1.28	2.29	0.550
605	ICP-MS	20.7	4.77	1.08	2.15	<1.00
606	ICP-MS/MS	21.7	5.65	1.56	2.75	<1.00

Based on the grading criteria for Hg in Urine, 98% of results were satisfactory, with 0 of the 11 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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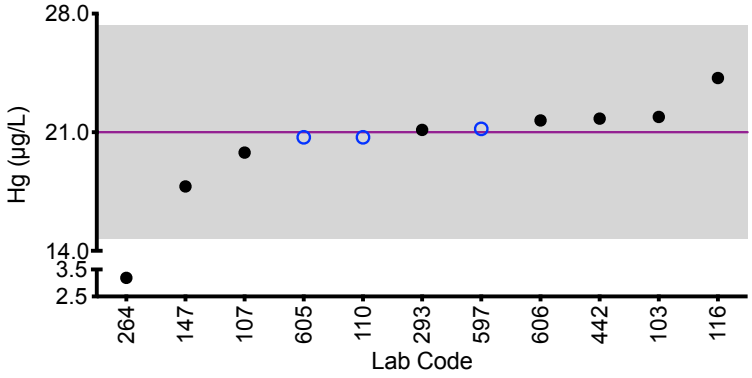
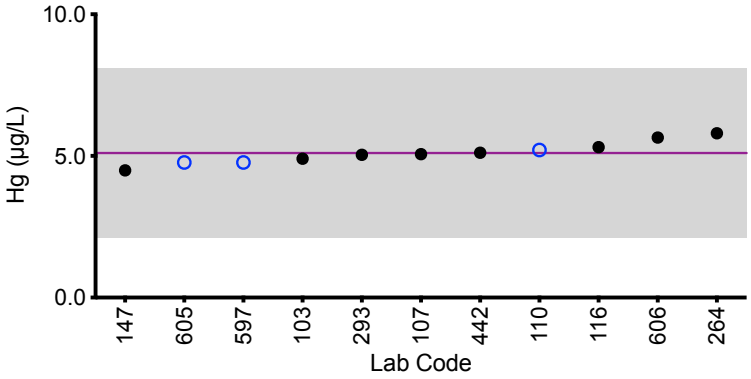
Results for Event #2, 2024: Summary Figures

Urine Hg

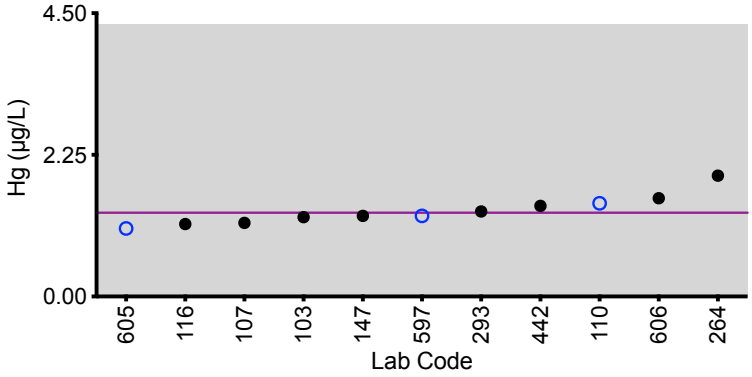
UE24-06



UE24-07



UE24-08



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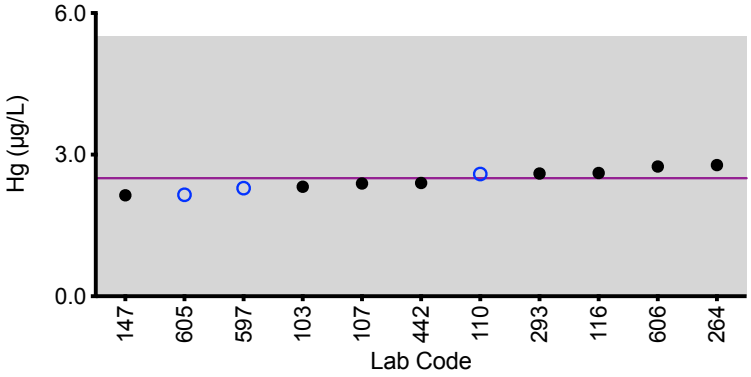
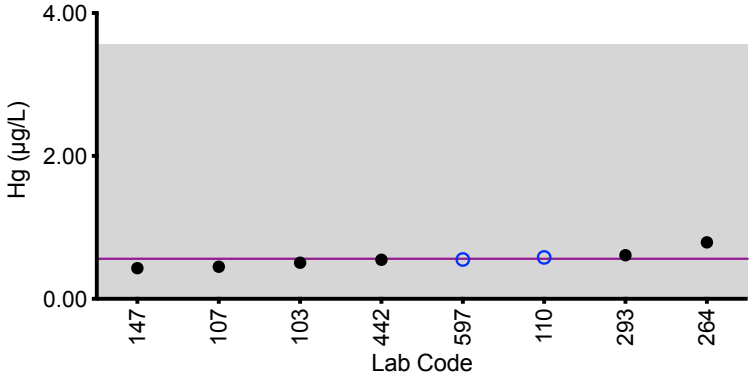


UE24-10



Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

	Urine Mn (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	1.27	4.68	0.91	2.43	8.3
Upper Limit	1.82	5.85	1.46	3.04	10.4
Lower Limit	0.72	3.51	0.36	1.82	6.2
Robust SD (s*)	0.05	0.17	0.06	0.11	0.3
Robust RSD (%)	3.9	3.6	6.6	4.5	4.1
Number of Sample Measurements (N)	13	13	12	13	13
Standard Uncertainty (*u*)	0.02	0.06	0.02	0.04	0.1

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).

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**1.27**	**4.68**	**0.91**	**2.43**	**8.3**
103	ICP-MS/MS	1.27	4.81	0.934	2.45	8.56
107	DRC/CC-ICP-MS	1.19	4.45	0.848	2.26	8.39
110	ICP-MS/MS	1.27	4.74	0.86	2.45	8.29
116	ICP-MS/MS	1.28	4.69	0.925	2.44	8.29
147	DRC/CC-ICP-MS	1.18	4.37	0.849	2.31	7.52
220	ICP-MS	1.29	4.96	0.919	2.57	8.75
264	ICP-MS	0.30 ↓	4.84	1.00	2.66	9.11
293	DRC/CC-ICP-MS	1.29	4.61	0.86	2.36	8.26
324	ICP-MS	1.307	4.687	<1	2.460	8.494
399	DRC/CC-ICP-MS	1.31	4.65	0.903	2.36	7.95
597	ICP-MS/MS	1.33	4.52	0.941	2.39	7.95
605	ICP-MS	1.23	4.63	0.882	2.38	8.11
606	ICP-MS/MS	2.24 ↑	4.80	1.18	2.54	8.50

Based on the grading criteria for Mn in Urine, 97% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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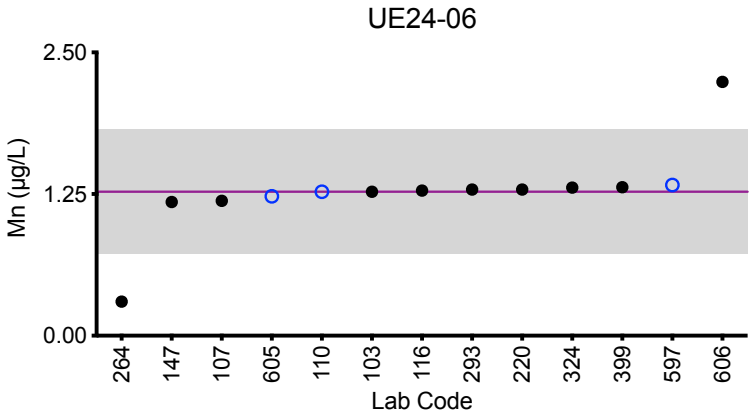
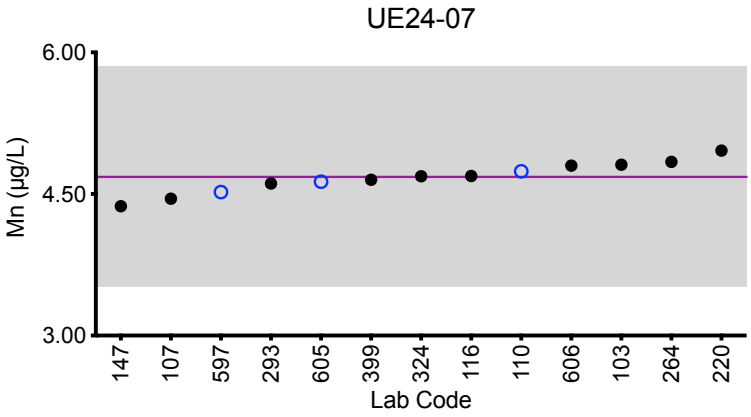
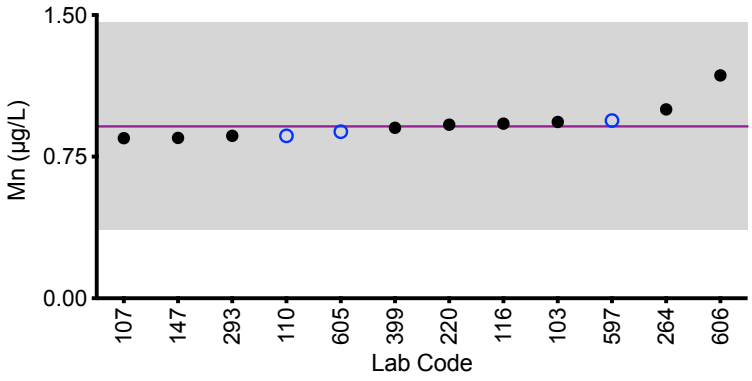
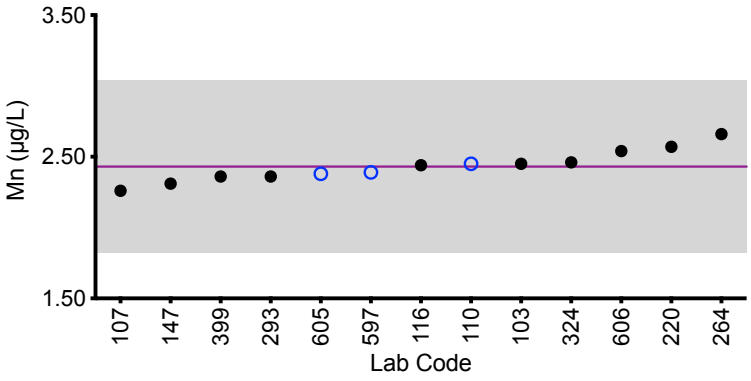
Results for Event #2, 2024: Summary Figures

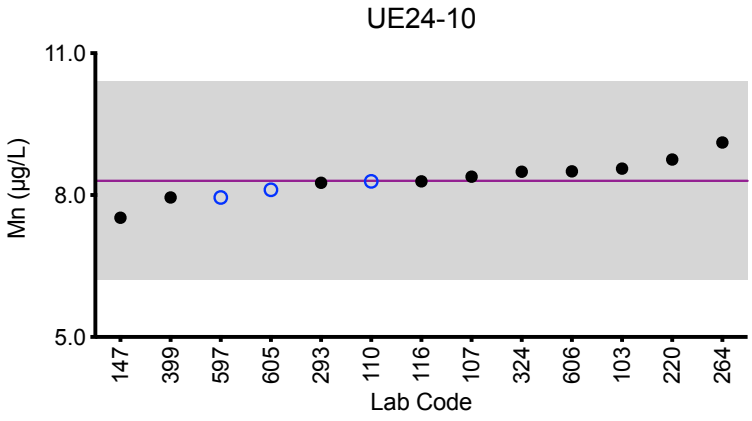
Urine Mn











Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

	Urine Pb (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	9.9	0.94	0.350	4.75	2.18
Upper Limit	11.9	1.94	1.350	5.75	3.18
Lower Limit	7.9	0.00	0.000	3.75	1.18
Robust SD (s*)	0.4	0.06	0.024	0.19	0.09
Robust RSD (%)	3.9	6.4	6.9	4.1	4.1
Number of Sample Measurements (N)	15	14	14	15	15
Standard Uncertainty (*u*)	0.1	0.02	0.008	0.06	0.03

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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

Urine Pb (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**9.9**	**0.94**	**0.350**	**4.75**	**2.18**
103	ICP-MS/MS	10.3	0.941	0.367	4.76	2.24
107	ICP-MS	10.4	0.869	0.325	4.54	2.20
110	ICP-MS/MS	9.95	0.951	0.354	4.84	2.17
116	ICP-MS/MS	9.65	0.872	0.333	4.54	2.06
147	ICP-MS	10.1	0.958	0.364	4.94	2.25
220	ICP-MS	9.98	0.934	0.337	4.74	2.15
264	ICP-MS	1.04 ↓	1.00	0.35	5.46	2.42
293	DRC/CC-ICP-MS	9.51	2.21 ↑	0.35	4.54	2.25
324	ICP-MS	9.365	<1	<1	4.773	2.120
399	ICP-MS/MS	9.68	0.919	0.361	4.59	2.09
442	ICP-MS/MS	9.92	0.864	0.298	4.74	2.10
597	ICP-MS/MS	11.5	1.12	0.417	5.24	2.64
605	ICP-MS	9.96	0.963	0.344	4.79	2.14
606	ICP-MS/MS	9.76	0.877	0.331	4.56	2.09
686	ICP-MS	9.99	0.913	0.502	4.76	2.18

Based on the grading criteria for Pb in Urine, 97% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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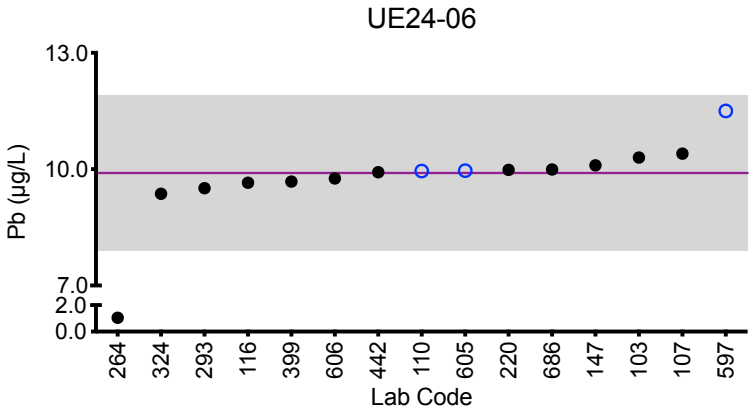
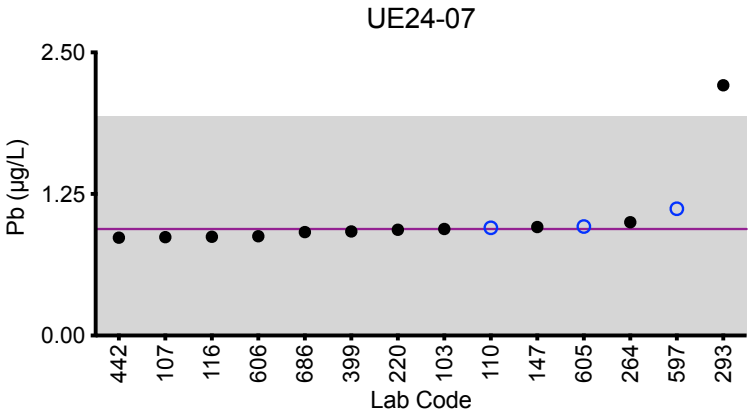
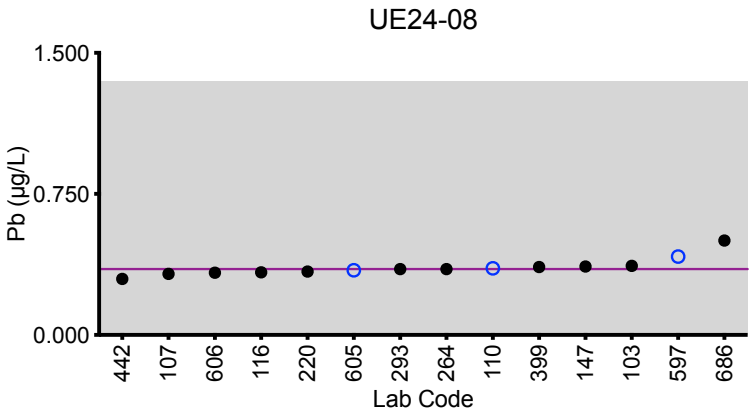
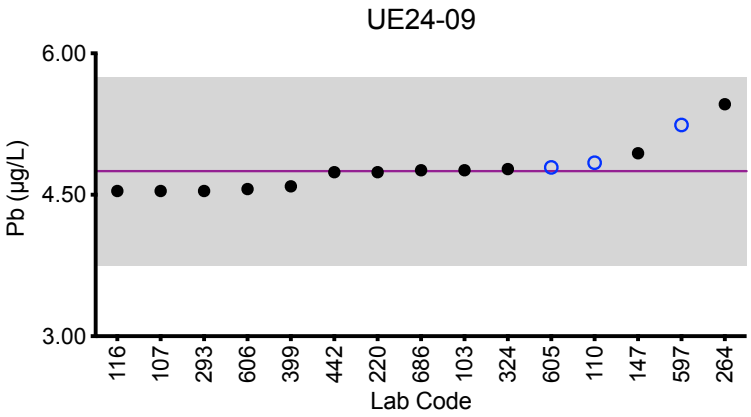
Results for Event #2, 2024: Summary Figures

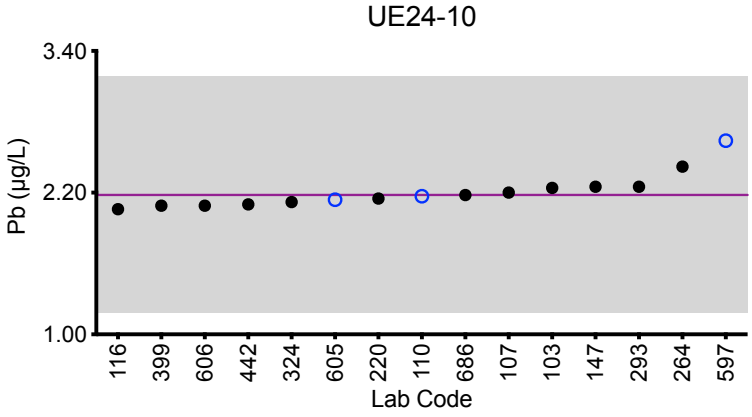
Urine Pb











Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

	Urine Tl (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	0.98	0.159	0.627	0.332	1.70
Upper Limit	1.18	0.359	0.827	0.532	2.04
Lower Limit	0.78	0.000	0.427	0.132	1.36
Robust SD (s*)	0.04	0.005	0.020	0.015	0.10
Robust RSD (%)	3.7	3.1	3.2	4.5	5.9
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (*u*)	0.01	0.002	0.007	0.005	0.03

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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Urine Tl (µg/L)				
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**0.98**	**0.159**	**0.627**	**0.332**	**1.70**
103	ICP-MS/MS	1.03	0.159	0.642	0.337	1.78
107	ICP-MS	0.990	0.150	0.592	0.322	1.72
110	ICP-MS/MS	0.963	0.157	0.628	0.341	1.76
116	ICP-MS/MS	0.949	0.271	0.616	0.501	1.53
147	ICP-MS	0.917	0.146	0.566	0.302	1.53
220	ICP-MS	0.984	0.161	0.618	0.327	1.71
264	ICP-MS	0.10 ↓	0.18	0.69	0.37	1.88
293	DRC/CC-ICP-MS	1	0.16	0.64	0.34	1.7
399	ICP-MS/MS	0.945	0.155	0.610	0.323	1.63
597	ICP-MS/MS	1.07	0.162	0.658	0.332	1.79
605	ICP-MS	1.00	0.159	0.636	0.341	1.72
606	ICP-MS/MS	0.968	0.156	0.629	0.314	1.64
686	ICP-MS	0.992	0.176	0.619	0.327	1.71

Based on the grading criteria for Tl in Urine, 98% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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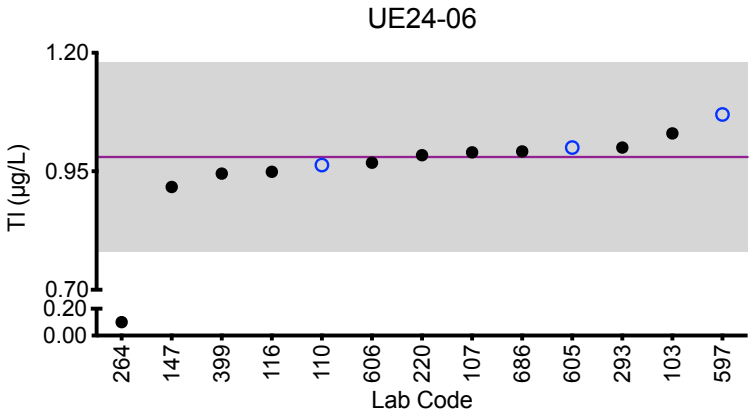
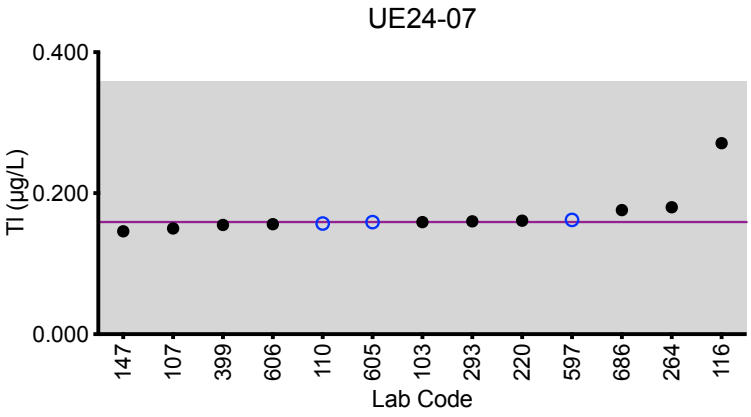
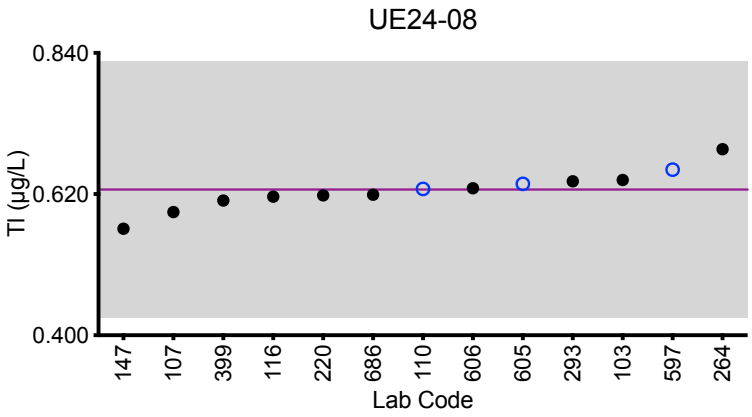
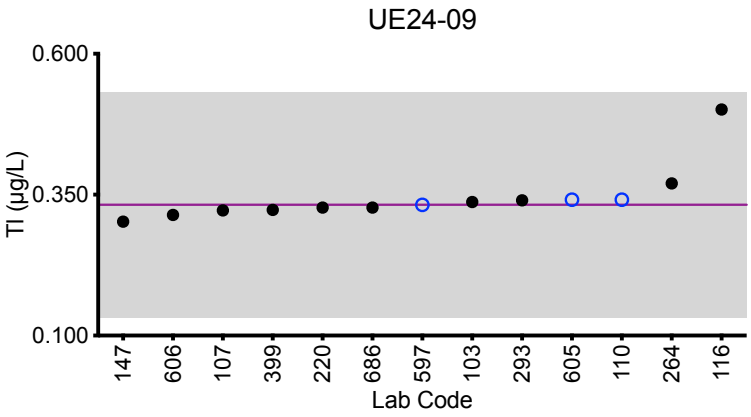
Results for Event #2, 2024: Summary Figures

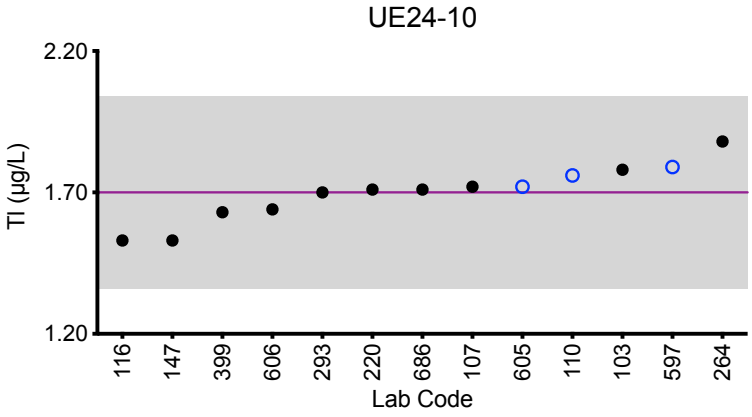
Urine Tl











Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

	Urine U (µg/L)				
	UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Target (Robust Mean (x*))	0.247	0.118	0.0189	0.0146	0.0355
Upper Limit	0.296	0.148	0.0489	0.0446	0.0655
Lower Limit	0.198	0.088	0.0000	0.0000	0.0055
Robust SD (s*)	0.024	0.008	0.0012	0.0015	0.0024
Robust RSD (%)	9.7	6.8	6.3	10	6.8
Number of Sample Measurements (N)	13	13	13	12	13
Standard Uncertainty (*u*)	0.008	0.003	0.0004	0.0005	0.0008

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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

Urine U (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
	Target	**0.247**	**0.118**	**0.0189**	**0.0146**	**0.0355**
103	ICP-MS/MS	0.289	0.127	0.0207	0.0168	0.0393
107	ICP-MS	0.258	0.111	0.0179	0.0138	0.0366
110	ICP-MS/MS	0.228	0.110	0.0177	0.0133	0.0307
116	ICP-MS/MS	0.258	0.11	0.0184	<0.0150	0.03
147	ICP-MS	0.231	0.120	0.0188	0.0154	0.0353
220	ICP-MS	0.262	0.126	0.0194	0.0147	0.0353
264	ICP-MS	0.02 ↓	0.12	0.02	0.01	0.04
324	ICP-MS	0.228	0.109	0.017	0.012	0.032
399	ICP-MS/MS	0.226	0.109	0.0190	0.0140	0.0360
597	ICP-MS/MS	0.244	0.114	0.0196	0.0152	0.3460 ↑
605	ICP-MS	0.266	0.126	0.0201	0.0153	0.0353
606	ICP-MS/MS	0.248	0.124	0.018	0.016	0.035
686	ICP-MS	0.267	0.124	0.0195	0.0155	0.0364

Based on the grading criteria for U in Urine, 97% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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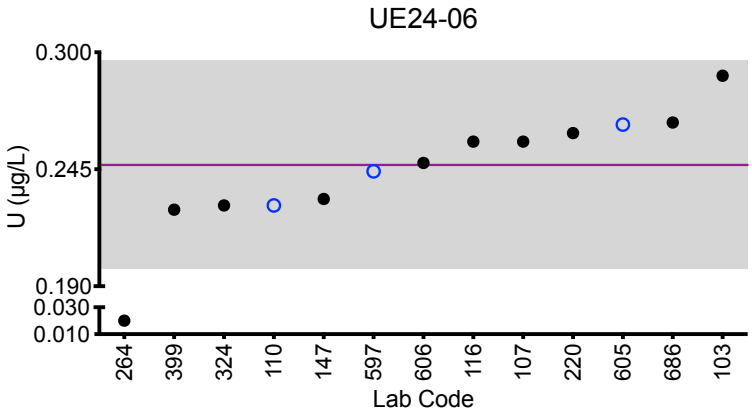
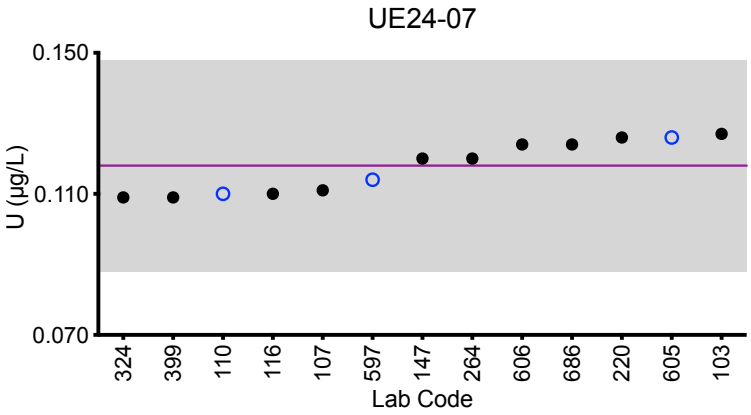
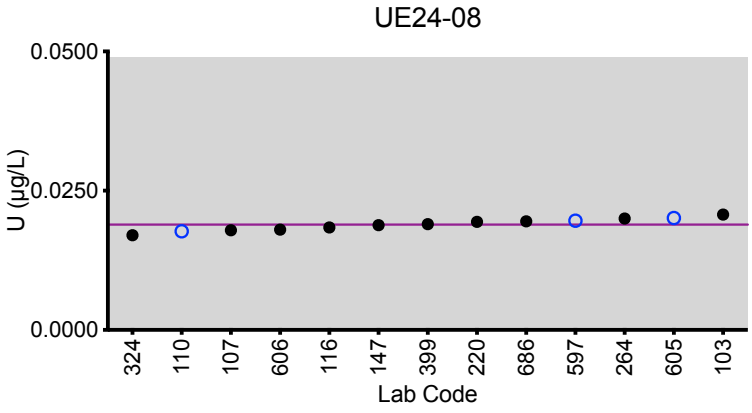
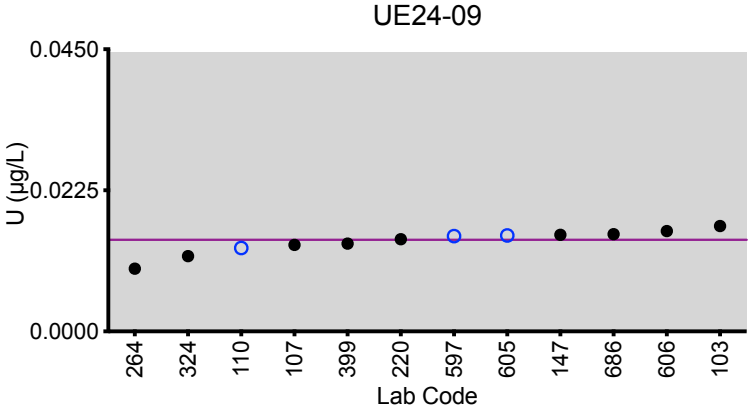
Results for Event #2, 2024: Summary Figures

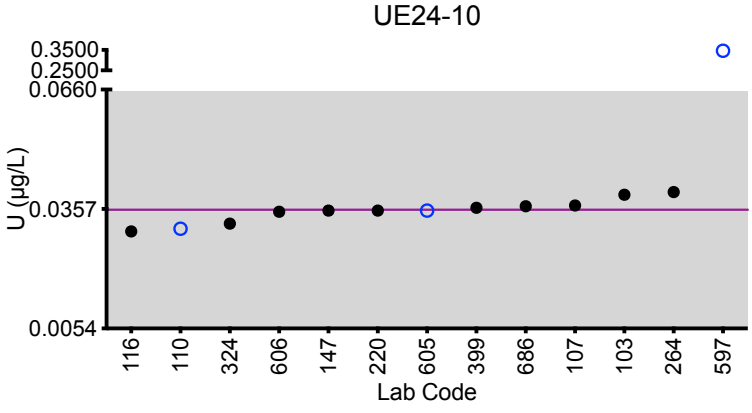
Urine U











Legend:

o 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.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Al (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
147	ICP-MS	<13.5	18.3	27.8	<13.5	<13.5
264	ICP-MS	*3.02	16.3	27.8	12.9	10.4
293	DRC/CC-ICP-MS	16.46	16.19	25.36	12.41	10.79
324	ICP-MS	12.481	13.954	21.479	10.718	9.290
597	ICP-MS/MS	13.7	15.4	25.4	11.0	9.26

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Arithmetic Mean ($\bar{x}$)	14.2	16.0	25.6	11.8	9.9
Arithmetic SD (s)	2.0	1.6	2.6	1.1	0.8
Arithmetic RSD (%)	14	10	10	9.3	8.1
Number of Sample Measurements (N)	3	5	5	4	4

*Denotes a statistical Outlier.

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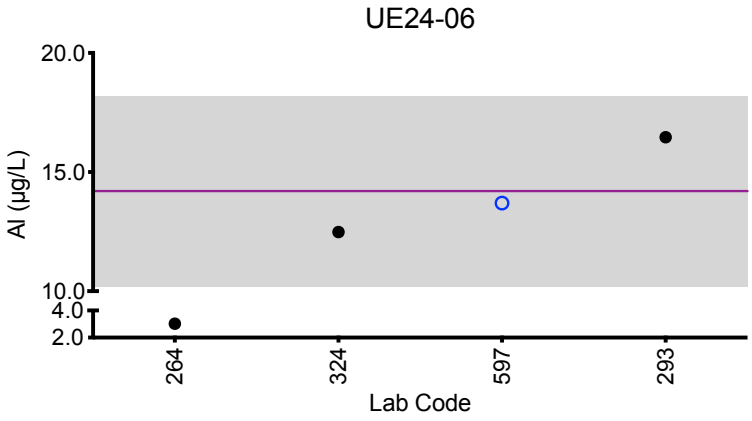
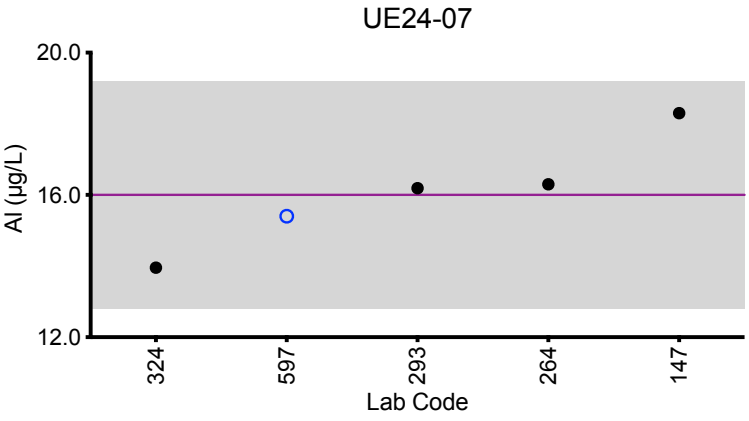
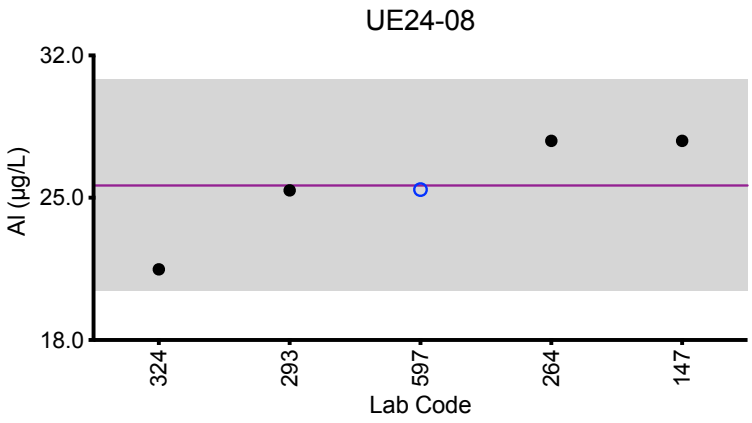
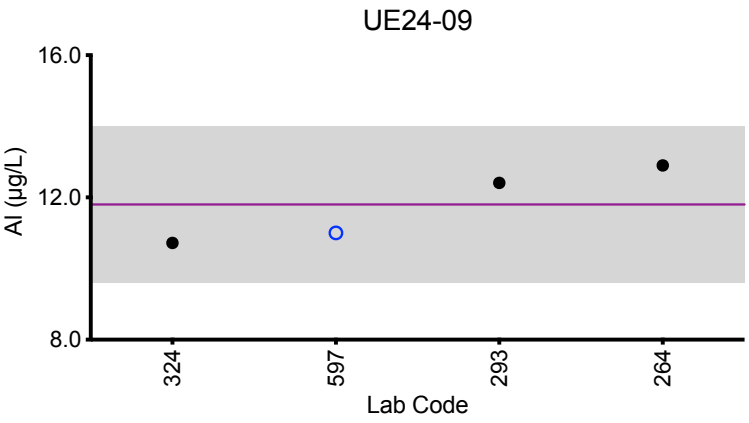
Results for Event #2, 2024: Summary Figures

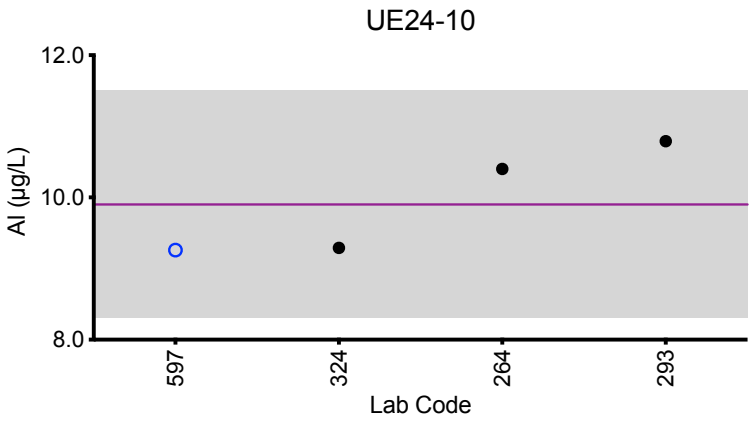
Urine Al











Legend:
o HHEAR Labs ● Other Labs
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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
107	ICP-MS	3.91	1.30	11.9	4.99	1.13
110	ICP-MS/MS	3.72	1.37	12.2	5.25	1.09
147	ICP-MS	3.89	1.37	12.4	5.28	1.11
220	ICP-MS	3.66	1.34	11.9	5.13	1.13
264	ICP-MS	*0.41	1.33	12.1	5.12	1.09
399	ICP-MS/MS	3.93	1.43	12.6	5.37	1.17
597	ICP-MS/MS	4.08	1.48	13.2	5.60	1.19
605	ICP-MS	3.87	1.42	12.6	5.33	1.13
606	ICP-MS/MS	4.04	1.43	12.9	5.46	1.22

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Arithmetic Mean ($\bar{x}$)	3.89	1.39	12.4	5.28	1.14
Arithmetic SD (s)	0.14	0.06	0.4	0.19	0.04
Arithmetic RSD (%)	3.6	4.3	3.6	3.6	3.9
Number of Sample Measurements (N)	8	9	9	9	9

*Denotes a statistical Outlier.

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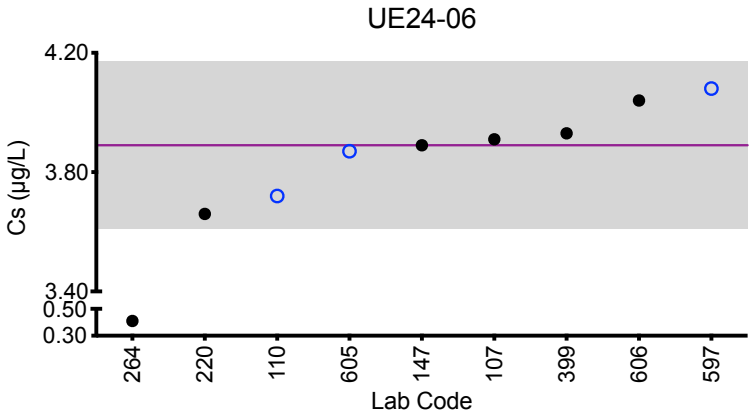
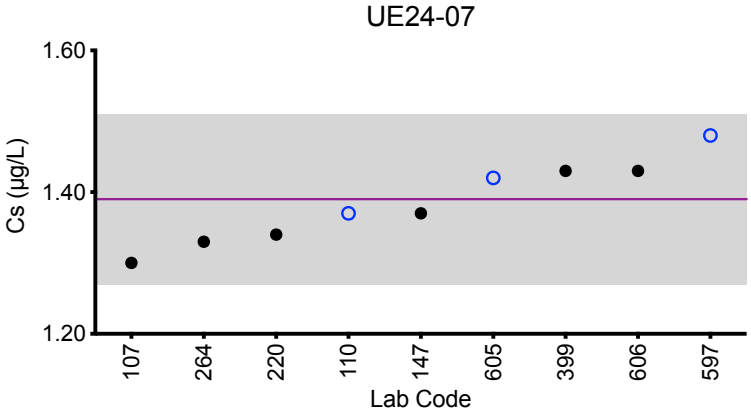
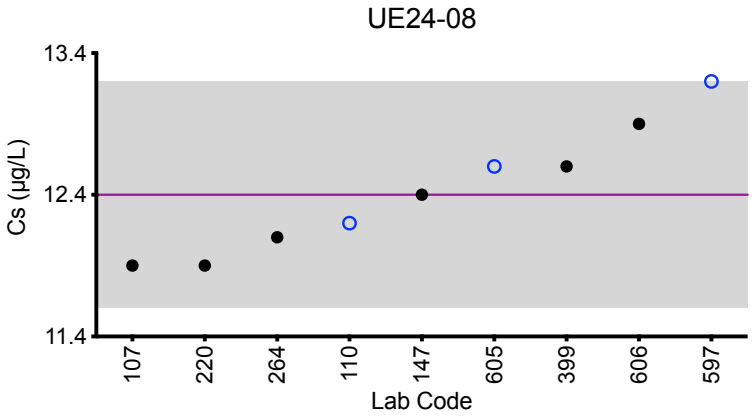
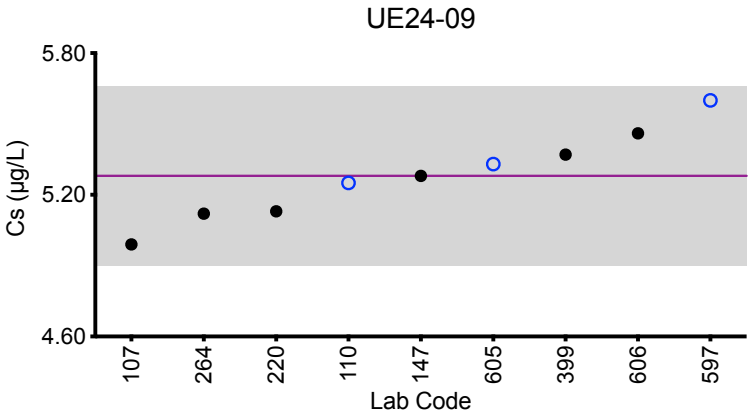
Results for Event #2, 2024: Summary Figures

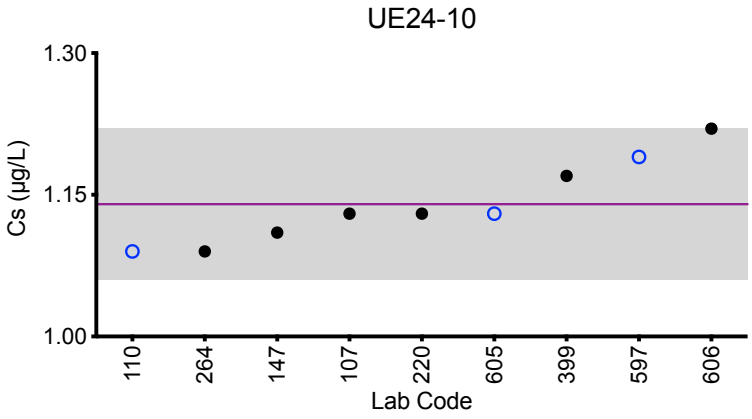
Urine Cs











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
110	ICP-MS/MS	19	90	5	23	65
116	ICP-MS/MS	20.0	96.0	<6.00	23.7	68.3
147	ICP-MS	35.8	113	*16.3	*32.3	86.2
264	ICP-MS	*2.66	102.00	6.25	27.03	75.2
293	DRC/CC-ICP-MS	19.07	90.27	5.09	22.25	64.84
324	ICP-MS	20.632	98.373	5.964	24.252	71.744
597	ICP-MS/MS	20.2	96.8	5.62	23.5	67.9

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Arithmetic Mean ($\bar{x}$)	22	98	5.6	24.0	71
Arithmetic SD (s)	7	8	0.5	1.7	8
Arithmetic RSD (%)	29	8.2	8.9	7.1	11
Number of Sample Measurements (N)	6	7	5	6	7

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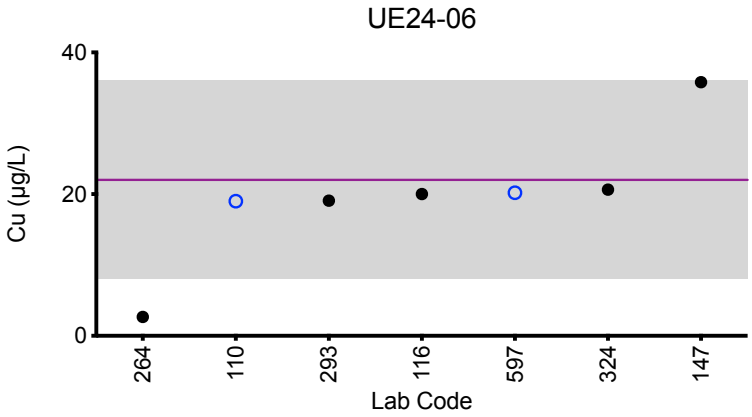
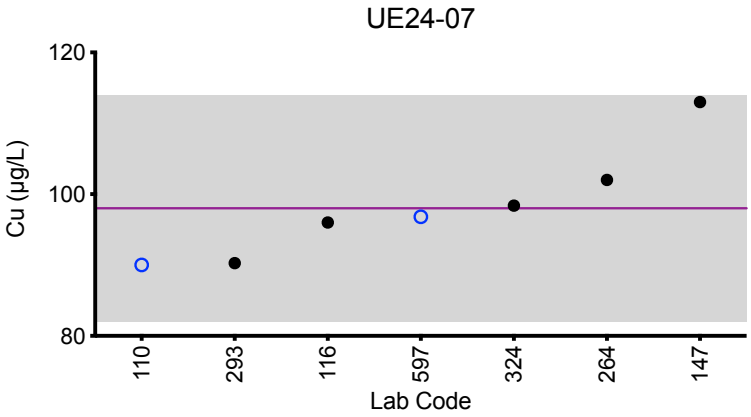
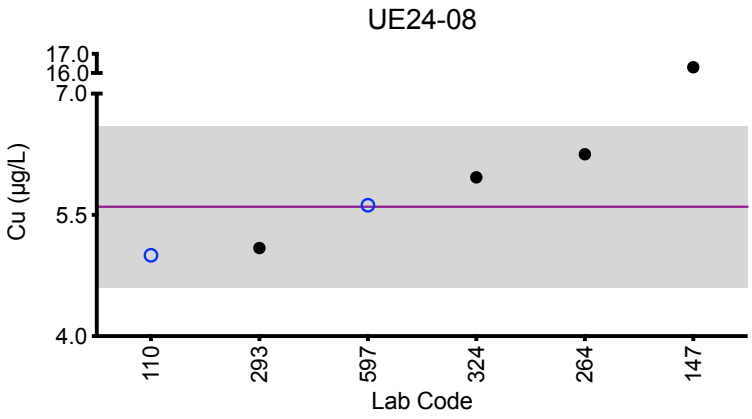
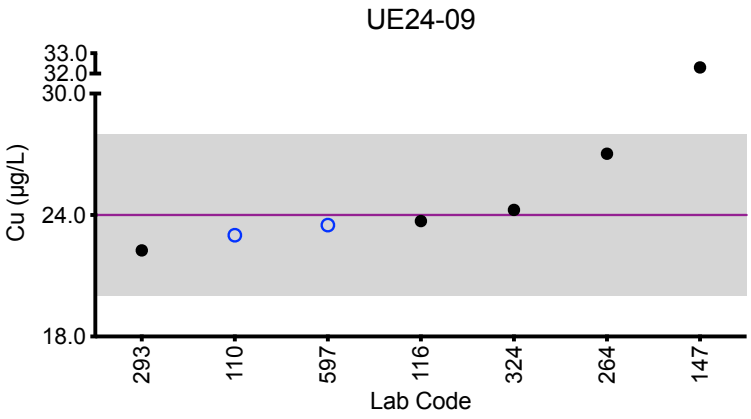
Results for Event #2, 2024: Summary Figures

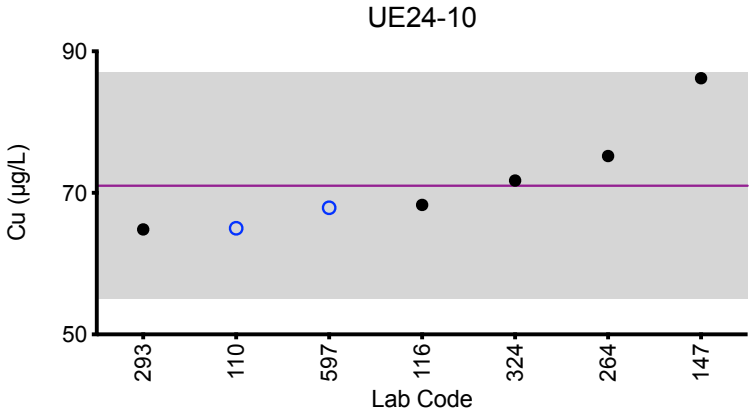
Urine Cu











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
103	ICP-MS/MS	45.7	6.88	40.4	56.9	94.6
107	ICP-MS	41.1	5.79	34.0	46.6	83.2
110	ICP-MS/MS	39.8	6.0	35.6	50.1	81.7
147	ICP-MS	40.2	6.17	35.8	49.9	82.4
220	ICP-MS	41.3	6.23	37.1	50.9	83.7
264	ICP-MS	1.81	3.04	27.1	37.0	65.7
293	DRC/CC-ICP-MS	41.09	6.64	37.08	52.99	85.28
324	ICP-MS	39.188	6.264	35.442	50.437	81.678
399	ICP-MS/MS	40.2	6.08	35.6	49.7	83.0
597	ICP-MS/MS	37.5	5.47	32.5	45.5	75.8
605	ICP-MS	40.9	<9.00	36.8	51.0	83.3
606	ICP-MS/MS	41.9	6.29	37.0	52.0	86.8

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Robust Mean (x*)	40.5	6.1	35.7	50.2	83.1
Robust SD (s*)	1.3	0.3	2.1	2.2	2.4
Robust RSD (%)	3.2	5.1	5.9	4.4	2.9
Number of Sample Measurements (N)	12	11	12	12	12
Standard Uncertainty (*u*)	0.5	0.1	0.7	0.8	0.9

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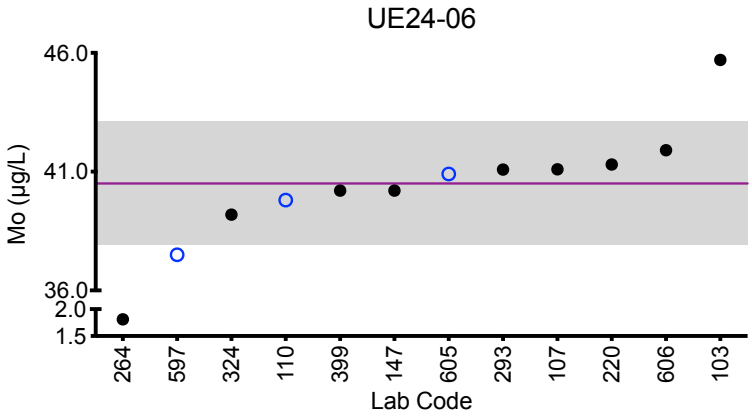
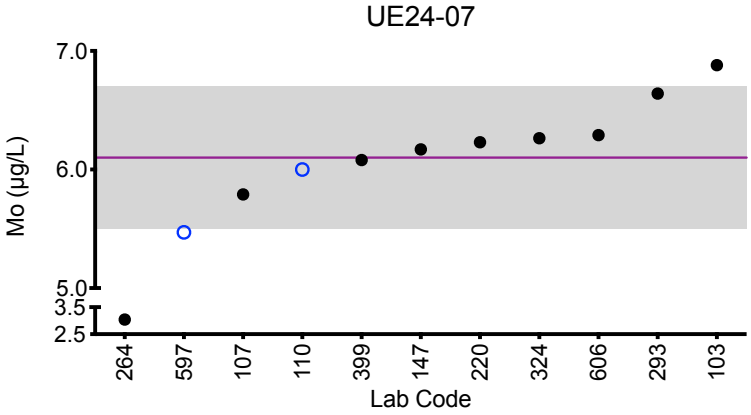
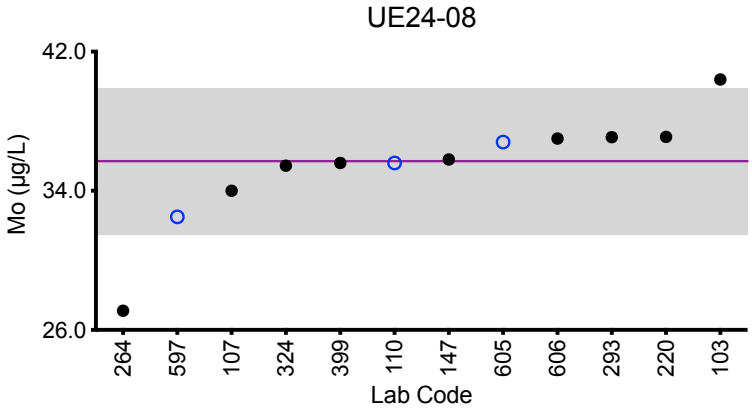
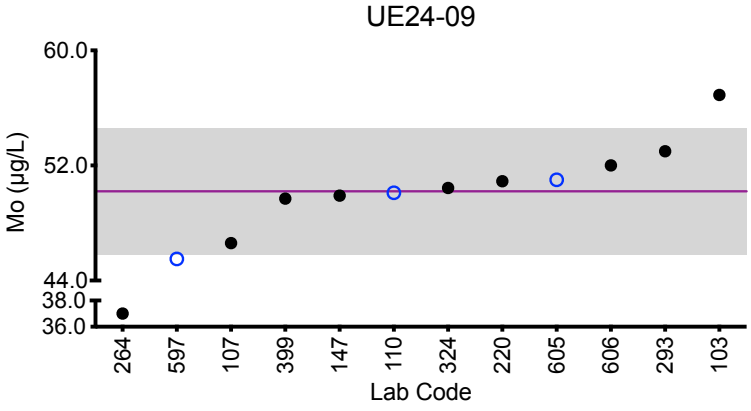
Results for Event #2, 2024: Summary Figures

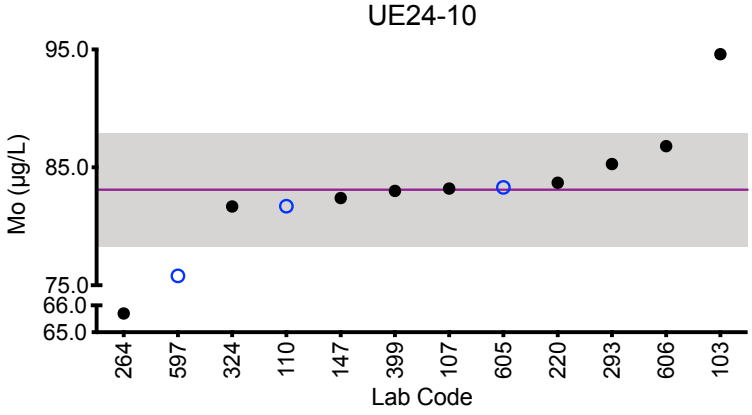
Urine Mo











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
103	ICP-MS/MS	7.09	4.82	4.47	8.63	6.75
107	DRC/CC-ICP-MS	7.59	5.12	4.79	8.95	7.20
110	ICP-MS/MS	7.5	4.8	4.7	8.8	6.7
147	ICP-MS	7.56	5.39	5.02	9.53	7.35
264	ICP-MS	1.25	5.00	4.76	9.40	6.93
293	DRC/CC-ICP-MS	7.52	5.09	4.81	9.14	7.19
324	ICP-MS	7.471	4.965	4.761	8.602	6.798
442	DRC/CC-ICP-MS	7.49	5.06	4.78	8.89	6.87
597	ICP-MS/MS	7.37	4.89	4.59	8.68	6.72
605	ICP-MS	7.26	4.91	4.65	8.90	6.72

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Robust Mean (x*)	7.43	4.99	4.74	8.9	6.88
Robust SD (s*)	0.14	0.15	0.09	0.3	0.18
Robust RSD (%)	1.9	3.0	1.9	3.7	2.6
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.06	0.06	0.04	0.1	0.07

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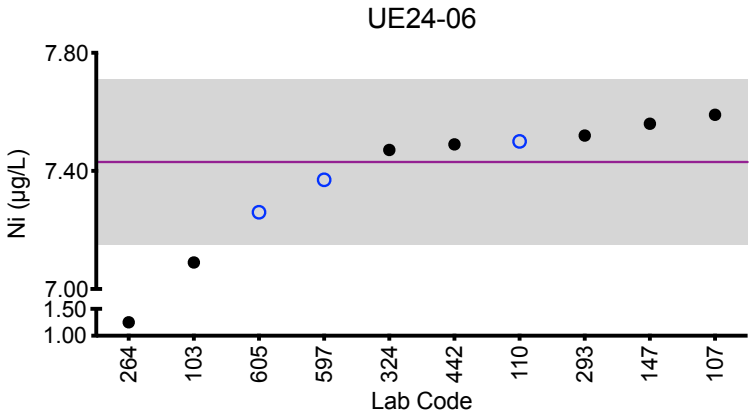
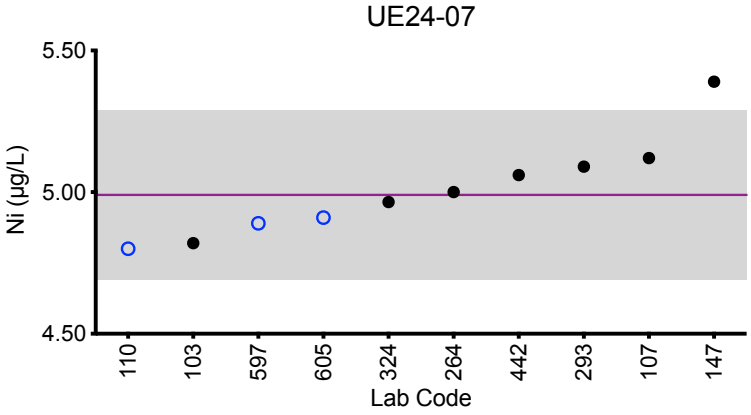
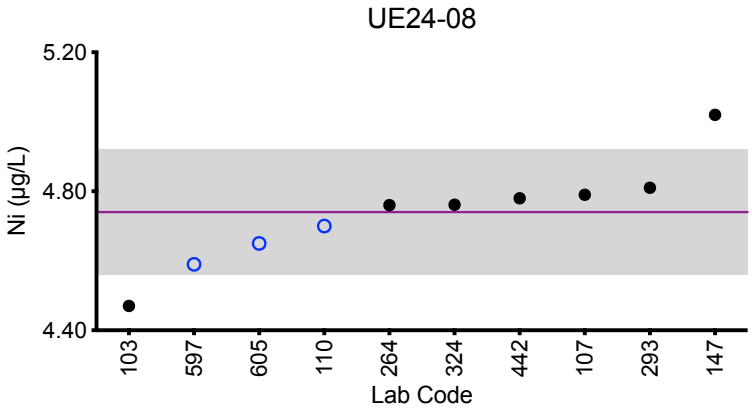
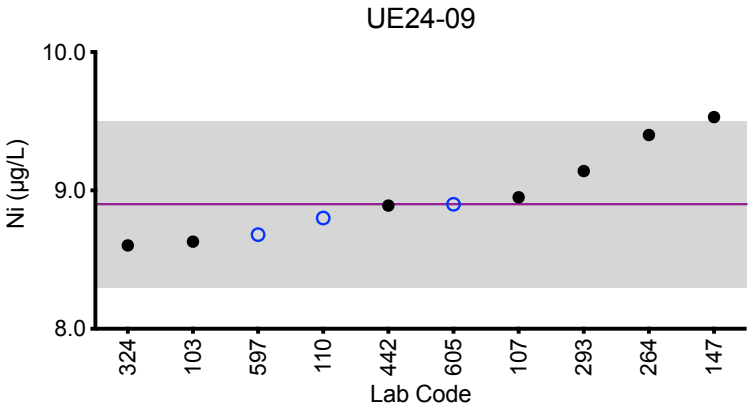
Results for Event #2, 2024: Summary Figures

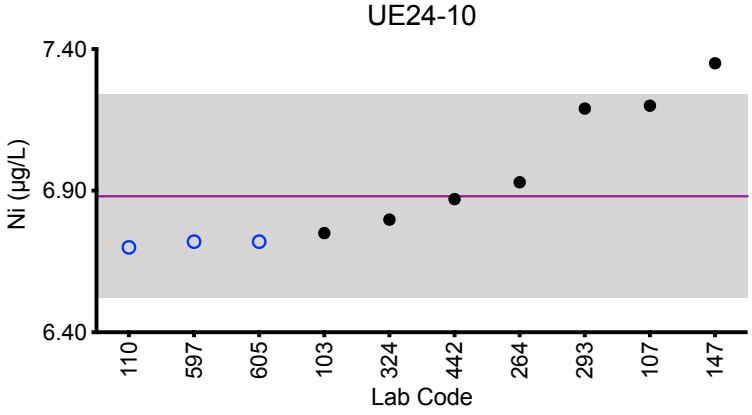
Urine Ni











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
107	ICP-MS	4.29	0.349	0.191	1.80	0.925
110	ICP-MS/MS	4.04	0.384	0.205	1.95	0.940
220	ICP-MS	4.13	0.384	0.211	1.89	0.933
264	ICP-MS	*0.41	0.37	0.19	1.90	0.92
293	DRC/CC-ICP-MS	4.02	0.38	0.2	1.85	0.89
399	ICP-MS/MS	4.06	0.368	0.182	1.88	0.899
605	ICP-MS	4.04	0.345	0.182	1.81	0.885

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Arithmetic Mean ($\bar{x}$)	4.10	0.369	0.194	1.87	0.913
Arithmetic SD (s)	0.10	0.016	0.011	0.05	0.022
Arithmetic RSD (%)	2.4	4.3	5.7	2.7	2.4
Number of Sample Measurements (N)	6	7	7	7	7

*Denotes a statistical Outlier.

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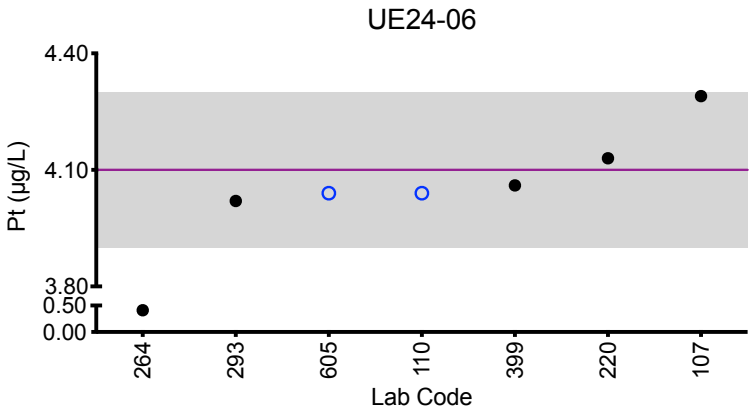
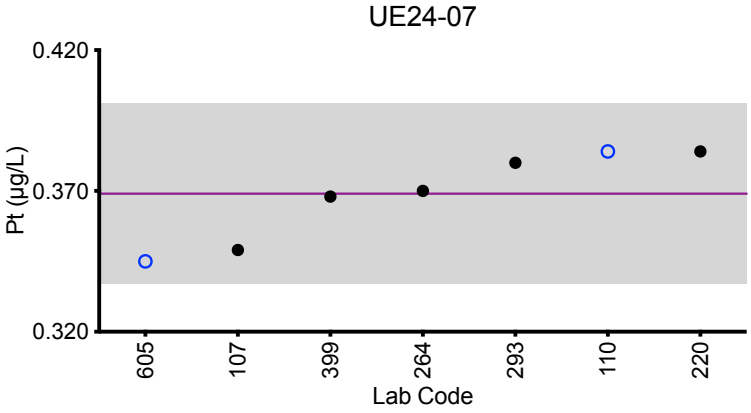
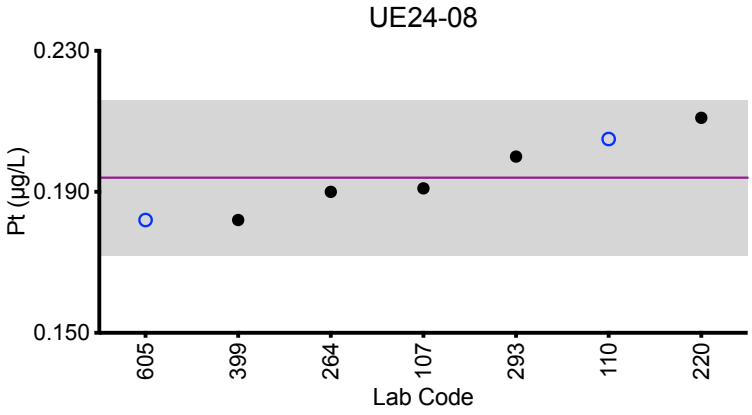
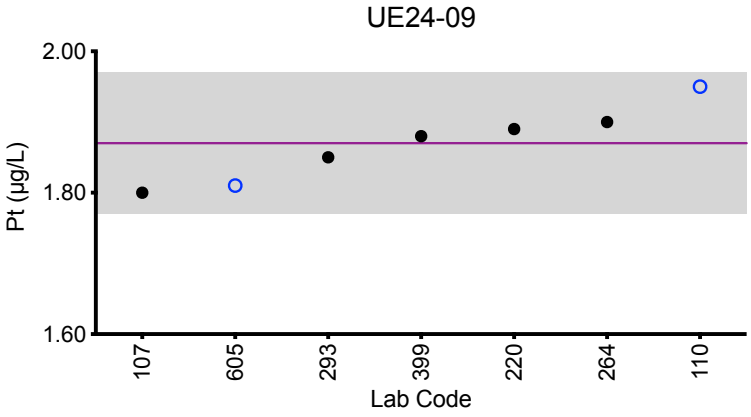
Results for Event #2, 2024: Summary Figures

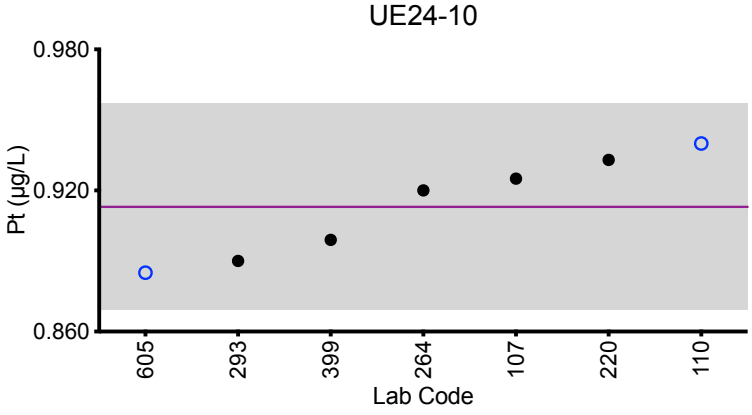
Urine Pt











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
103	ICP-MS/MS	3.00	0.365	1.71	0.644	0.971
107	ICP-MS	2.63	0.299	1.44	0.527	0.865
110	ICP-MS/MS	2.59	0.294	1.50	0.543	0.856
147	ICP-MS	2.70	0.344	1.62	0.591	0.956
220	ICP-MS	2.82	0.349	1.68	0.613	0.952
264	ICP-MS	0.26	0.25	1.39	0.47	0.81
293	DRC/CC-ICP-MS	2.71	0.39	1.65	0.62	0.94
324	ICP-MS	2.632	<1	1.550	<1	<1
399	ICP-MS/MS	2.67	0.331	1.52	0.578	0.908
597	ICP-MS/MS	2.43	0.326	1.41	0.552	0.836
605	ICP-MS	2.67	<0.800	1.57	<0.800	0.900
606	ICP-MS/MS	2.71	0.331	1.59	0.562	0.900

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Robust Mean (x*)	2.67	0.33	1.55	0.57	0.90
Robust SD (s*)	0.07	0.04	0.12	0.05	0.06
Robust RSD (%)	2.6	12	7.7	8.8	6.7
Number of Sample Measurements (N)	12	10	12	10	11
Standard Uncertainty (*u*)	0.03	0.02	0.04	0.02	0.02

*Denotes a statistical Outlier.

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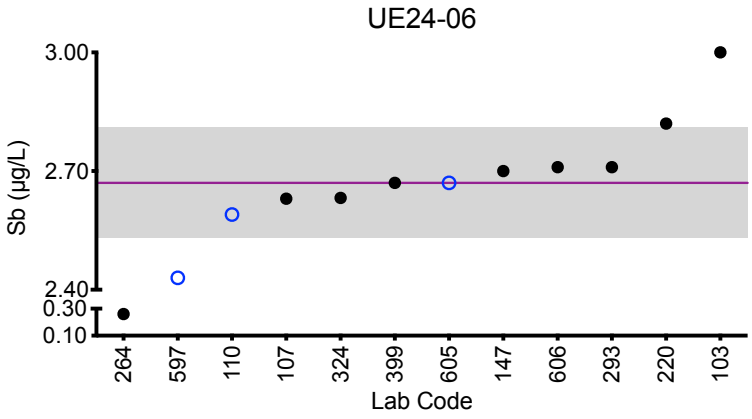
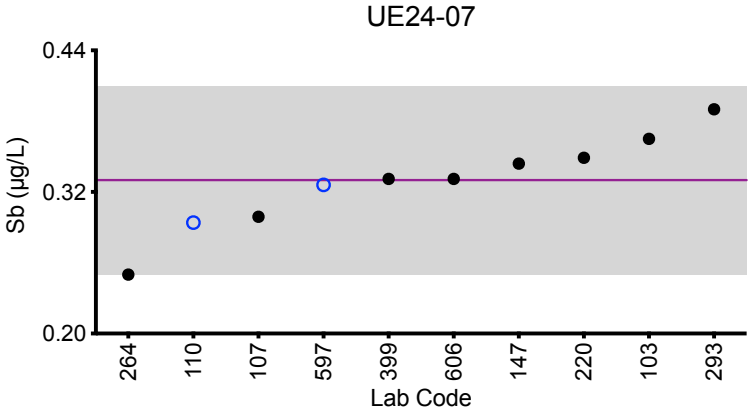
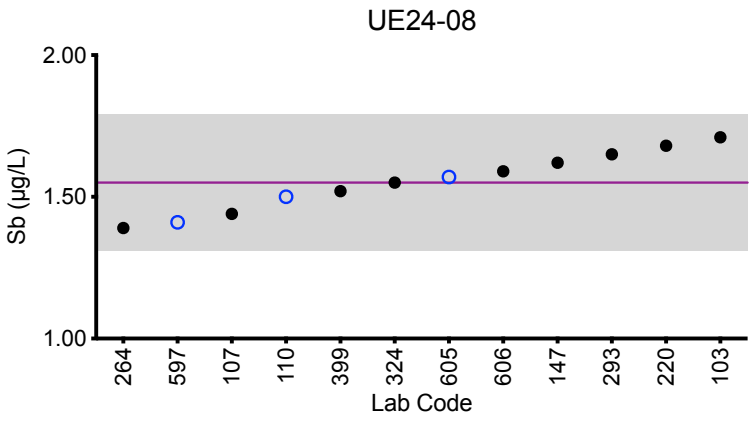
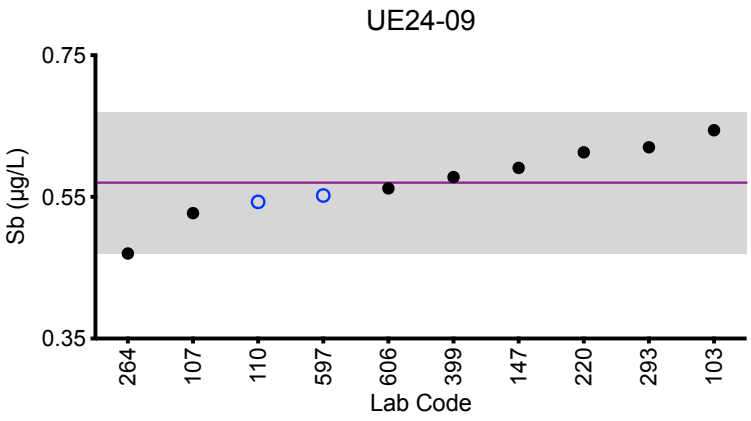
Results for Event #2, 2024: Summary Figures

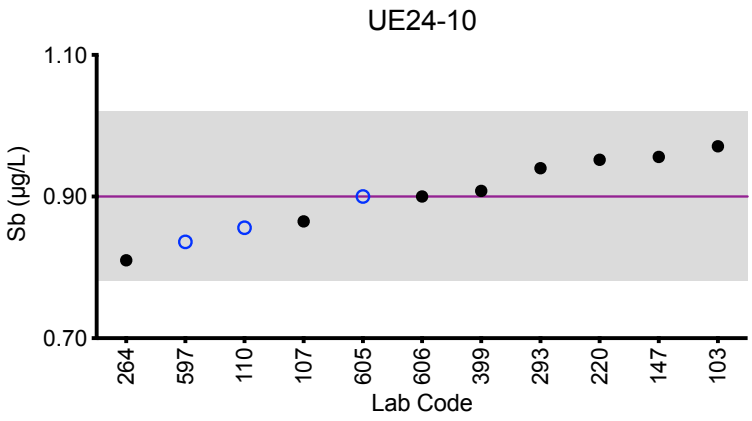
Urine Sb











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Se (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
103	ICP-MS/MS	154	12.0	198	62.1	257
110	ICP-MS/MS	148	11	181	54	222
147	ICP-MS	155	14.8	216	65.6	267
293	DRC/CC-ICP-MS	155.61	11.85	204.58	60.82	251.18
597	ICP-MS/MS	139	10.5	184	54.5	229
Summary Statistics						
		UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Arithmetic Mean ($\bar{x}$)		150	12.0	197	59	245
Arithmetic SD (s)		7	1.7	15	5	19
Arithmetic RSD (%)		4.7	14	7.6	8.5	7.8
Number of Sample Measurements (N)		5	5	5	5	5

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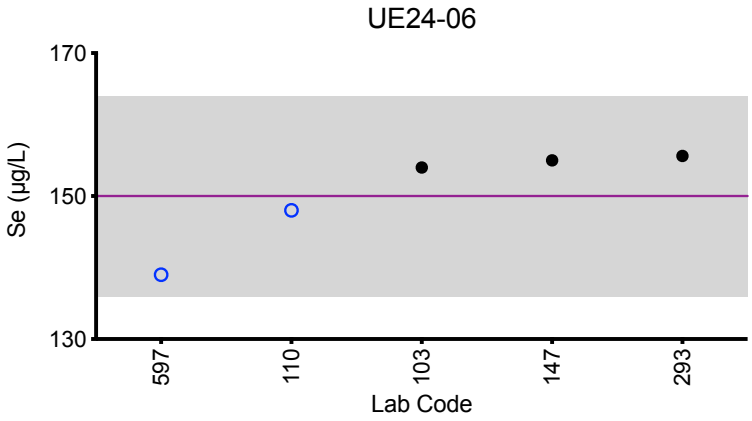
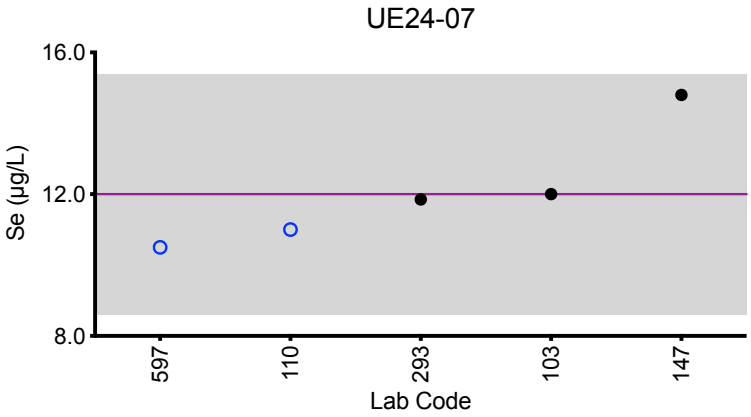
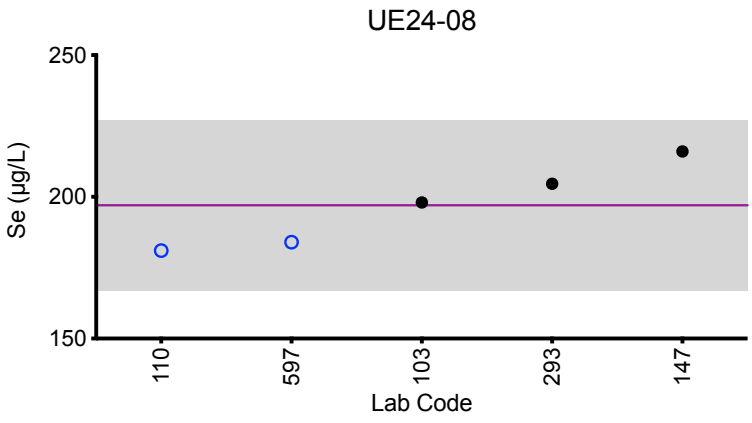
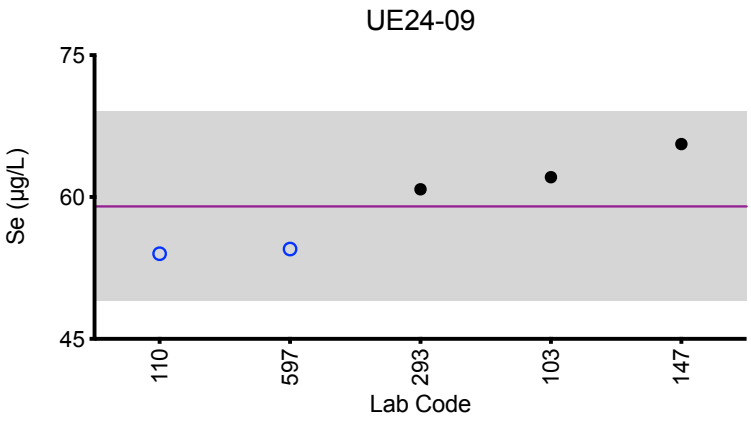
Results for Event #2, 2024: Summary Figures

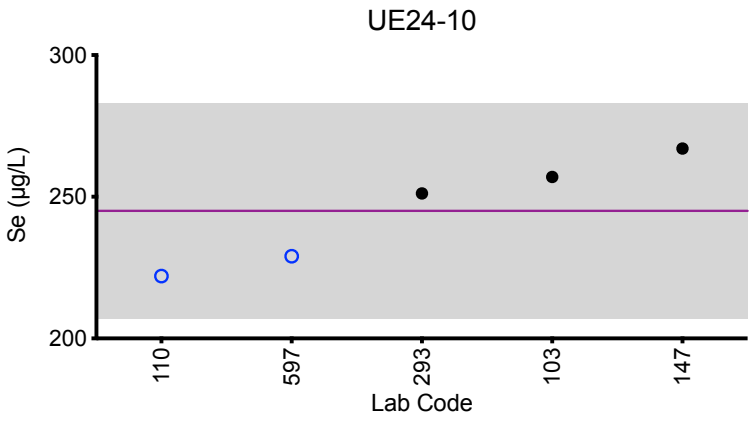
Urine Se











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
107	ICP-MS	1.78	7.22	0.694	0.389	3.19
110	ICP-MS/MS	1.46	7.59	0.66	0.43	3.11
147	ICP-MS	1.52	7.10	0.640	0.407	2.97
220	ICP-MS	1.85	8.10	0.684	0.395	3.28
264	ICP-MS	*0.13	7.13	0.62	0.34	2.88
324	ICP-MS	1.666	7.789	<1	<1	3.084
399	ICP-MS/MS	1.94	7.53	0.698	0.404	3.17
597	ICP-MS/MS	1.36	7.31	0.682	0.444	3.02
605	ICP-MS	1.83	7.60	<0.900	<0.900	3.00

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Arithmetic Mean ($\bar{x}$)	1.68	7.5	0.67	0.40	3.08
Arithmetic SD (s)	0.21	0.3	0.03	0.03	0.12
Arithmetic RSD (%)	13	4.4	4.3	8.3	3.9
Number of Sample Measurements (N)	8	9	7	7	9

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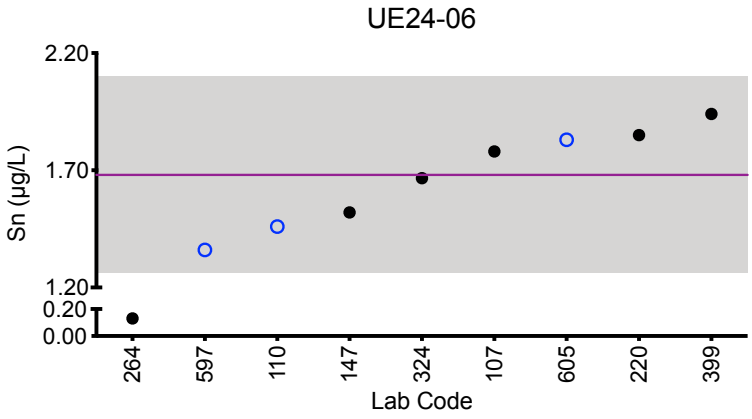
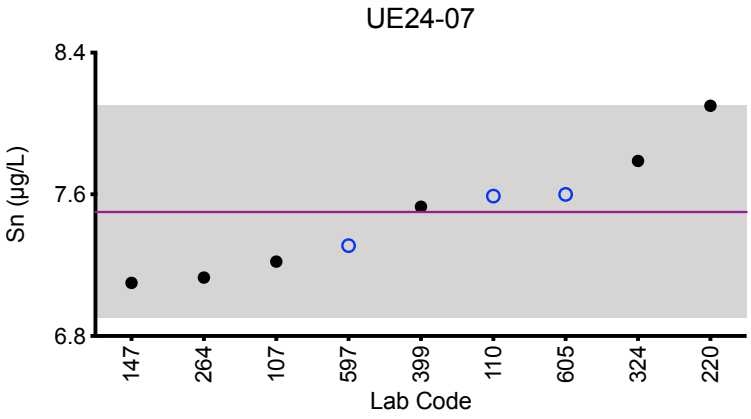
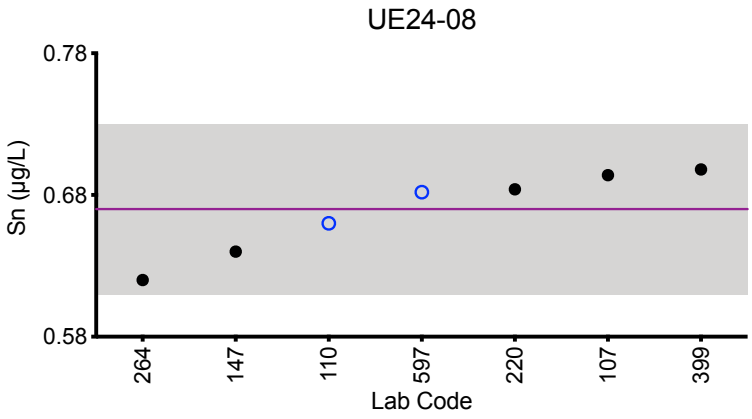
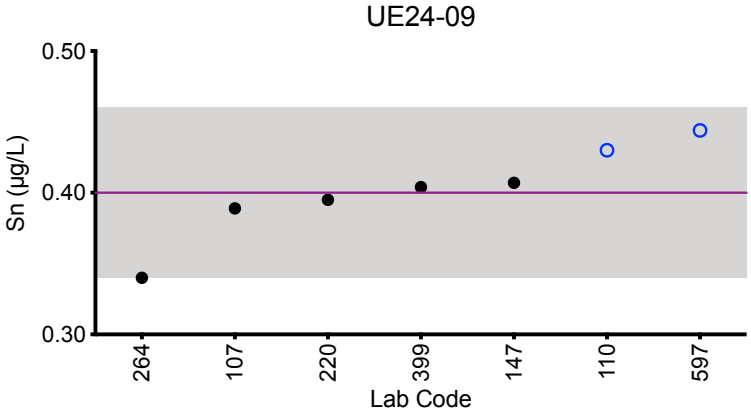
Results for Event #2, 2024: Summary Figures

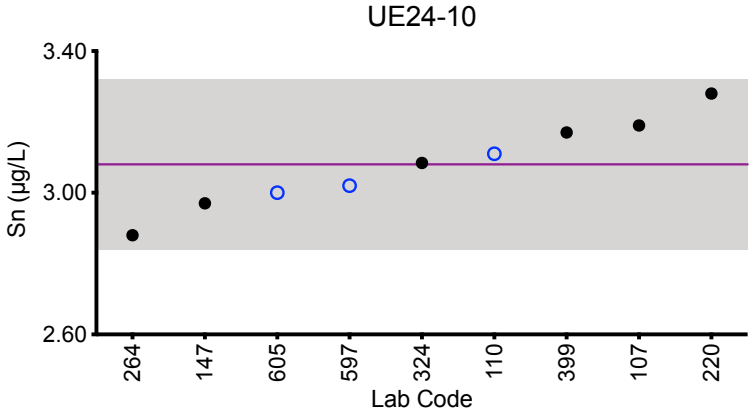
Urine Sn











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Sr (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
103	ICP-MS/MS	70.5	135	28.6	261	182
107	ICP-MS	68.9	119	25.8	226	170
110	ICP-MS/MS	69	138	27	257	180
200	ICP-MS	70.1	122.6	28	239.1	167.3
220	ICP-MS	69.7	126	27.3	242	168
264	ICP-MS	*11.6	112	24.4	260	155
399	DRC/CC-ICP-MS	70.9	131	27.7	245	170
597	ICP-MS/MS	69.2	127	27.0	244	171
605	ICP-MS	70.7	132	27.9	249	173

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Arithmetic Mean ($\bar{x}$)	69.9	127	27.1	247	171
Arithmetic SD (s)	0.8	8	1.3	11	8
Arithmetic RSD (%)	1.1	6.3	4.8	4.5	4.7
Number of Sample Measurements (N)	8	9	9	9	9

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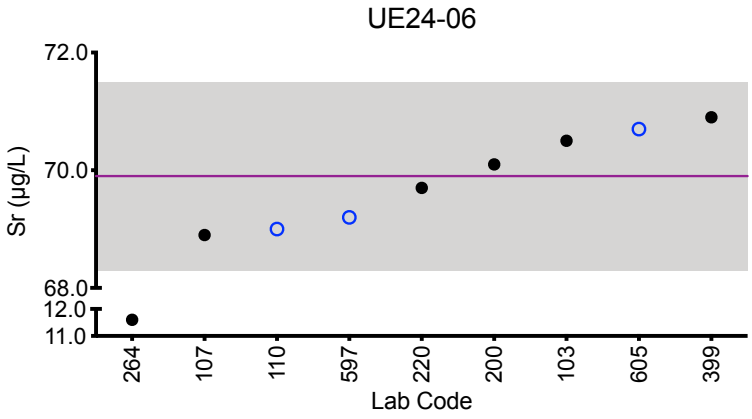
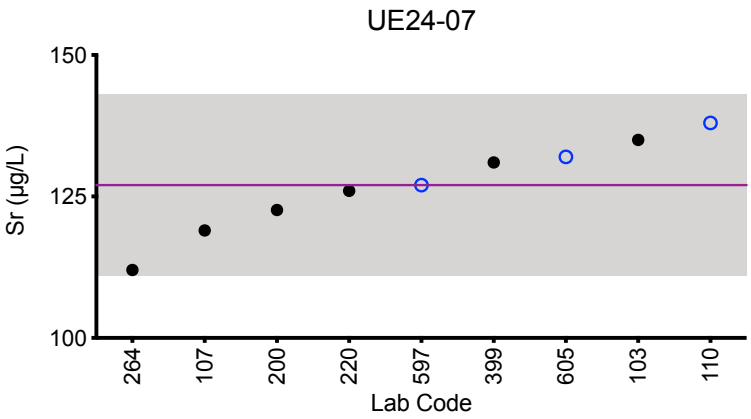
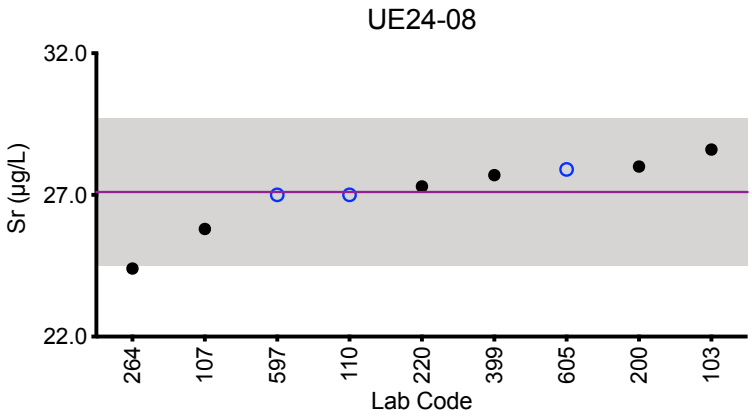
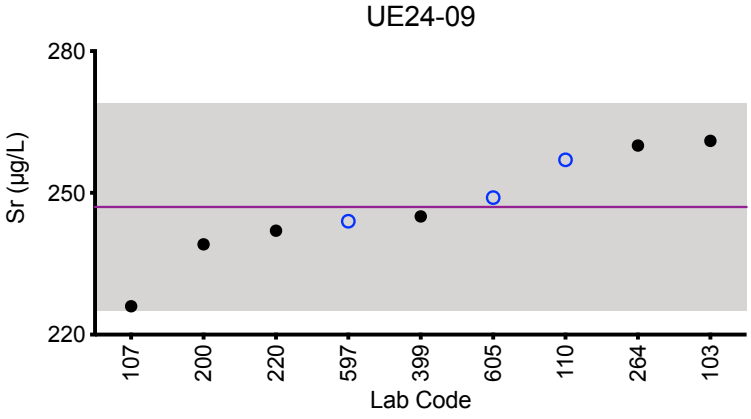
Results for Event #2, 2024: Summary Figures

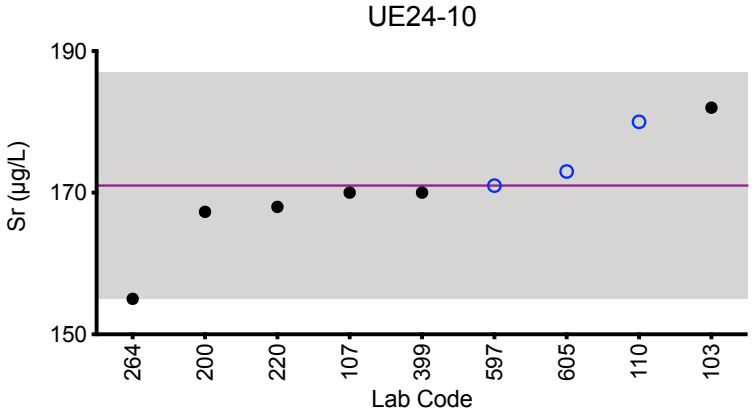
Urine Sr











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
110	ICP-MS/MS	1.51	0.47	3.95	0.72	2.82
116	ICP-MS/MS	1.41	0.432	3.72	0.679	2.66
147	DRC/CC-ICP-MS	1.45	0.510	3.82	0.745	2.67
293	DRC/CC-ICP-MS	1.57	0.5	3.96	0.75	2.87
597	ICP-MS/MS	1.67	0.563	3.91	0.797	2.83
605	ICP-MS	1.54	0.517	4.02	0.760	2.85

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Arithmetic Mean ($\bar{x}$)	1.52	0.50	3.90	0.74	2.78
Arithmetic SD (s)	0.09	0.04	0.11	0.04	0.09
Arithmetic RSD (%)	5.9	8.9	2.8	5.4	3.2
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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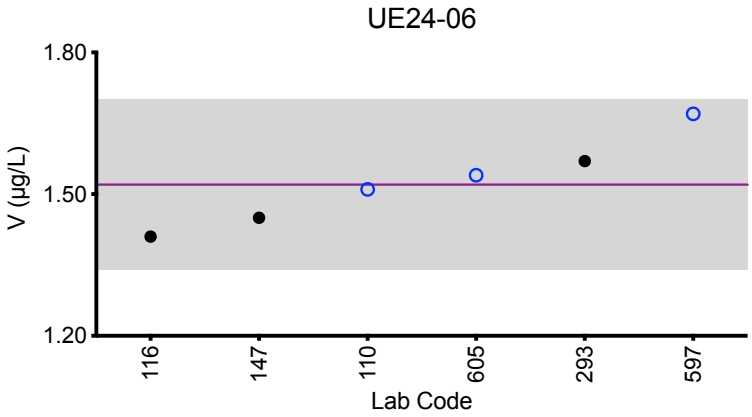
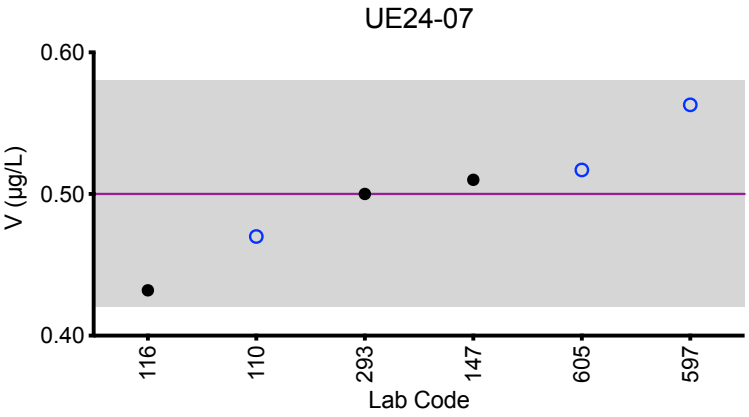
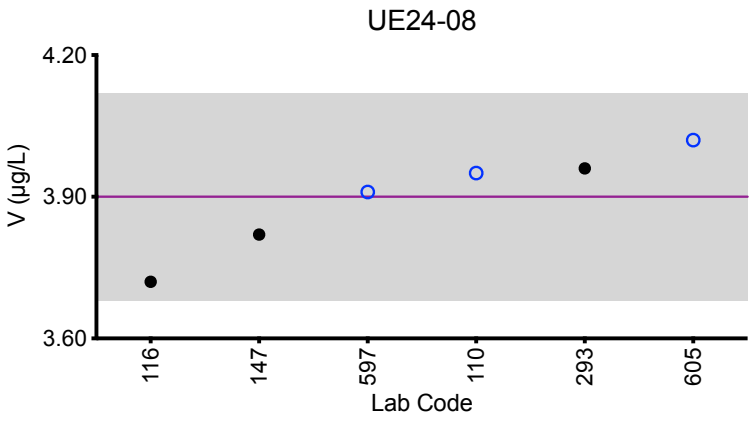
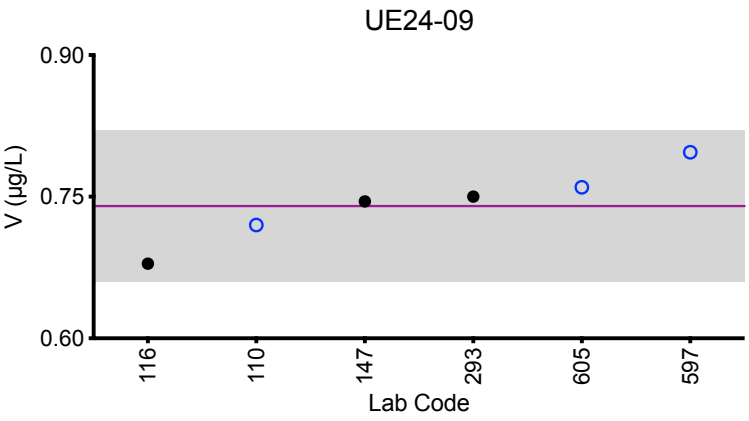
Results for Event #2, 2024: Summary Figures

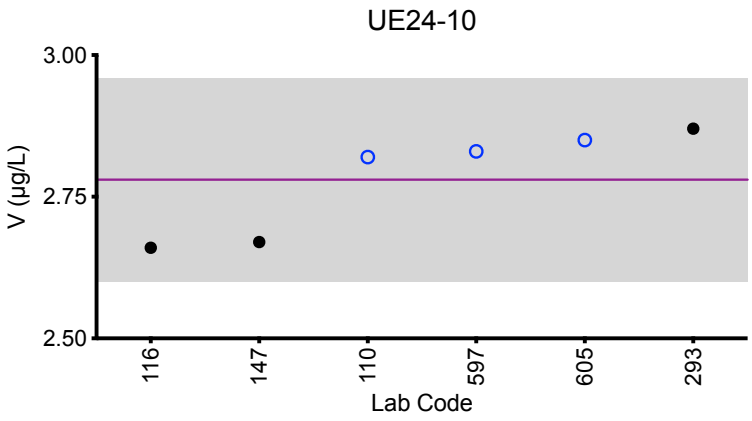
Urine V











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
107	ICP-MS	0.336	1.18	0.760	0.404	0.394
110	ICP-MS/MS	0.34	1.30	0.80	0.44	0.41
147	ICP-MS	0.338	1.20	0.793	0.393	0.370
200	ICP-MS	*0.55	1.27	1.05	0.5	0.57
220	ICP-MS	0.353	1.33	0.827	0.440	0.388
264	ICP-MS	<0.01	1.22	0.79	0.39	0.35
324	ICP-MS	<1	1.393	<1	<1	<1
399	ICP-MS/MS	0.346	1.28	0.821	0.412	0.388
597	ICP-MS/MS	0.336	1.27	0.790	0.435	0.421
605	ICP-MS	0.346	1.33	0.831	0.454	0.396
606	ICP-MS/MS	0.379	1.38	0.735	0.417	0.378

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Robust Mean (x*)	0.35	1.29	0.80	0.43	0.39
Robust SD (s*)	0.01	0.08	0.04	0.03	0.03
Robust RSD (%)	4.1	6.2	4.8	6.8	6.4
Number of Sample Measurements (N)	8	11	10	10	10
Standard Uncertainty (*u*)	NA	0.03	0.02	0.01	0.01

*Denotes a statistical Outlier.

An arithmetic mean, SD, RSD and n are provided for sample UE24-06.

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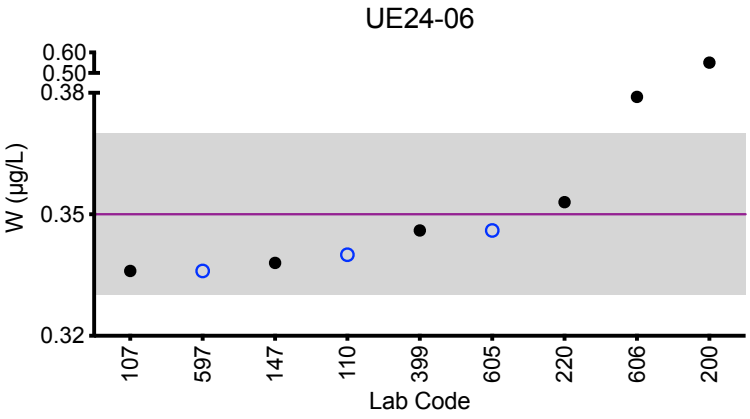
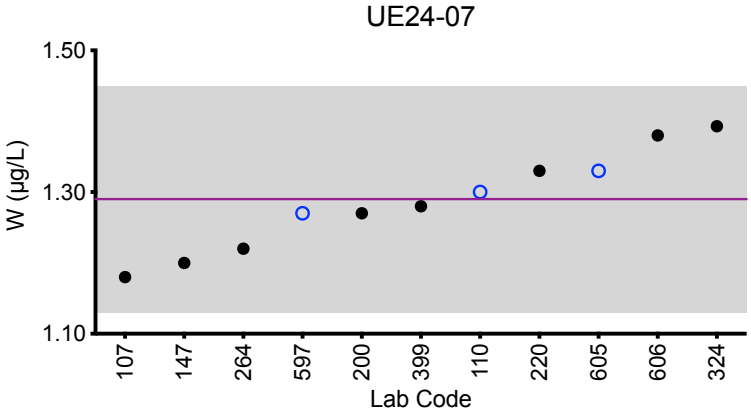
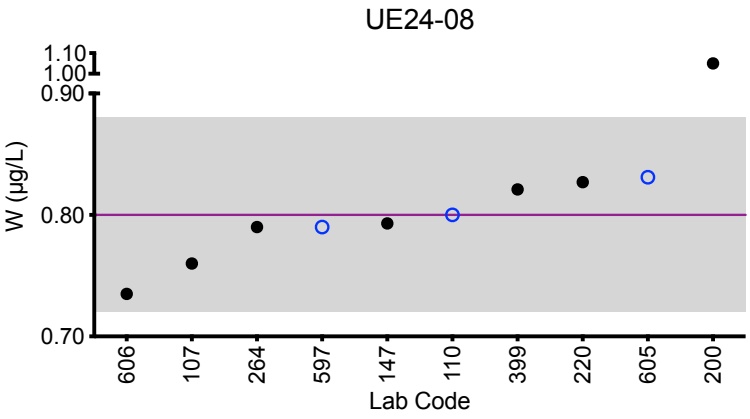
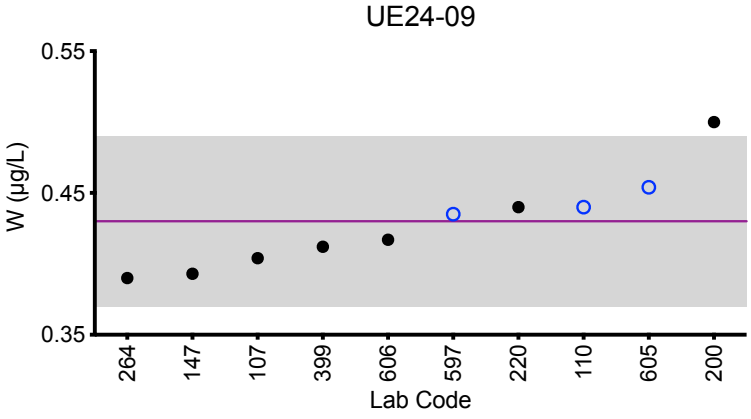
Results for Event #2, 2024: Summary Figures

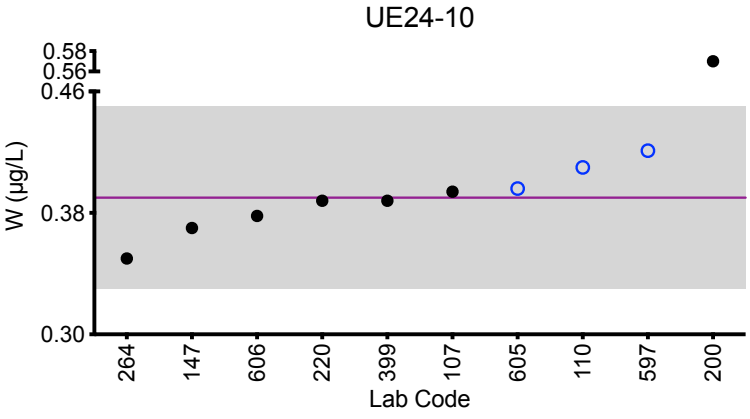
Urine W











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
110	ICP-MS/MS	281	80	513	216	733
147	ICP-MS	313	101	610	269	904
264	ICP-MS	*33.6	95.1	601	260	884
293	DRC/CC-ICP-MS	314.38	88.89	538.56	228.76	777.12
324	ICP-MS	291.578	83.998	532.088	218.542	769.213
597	ICP-MS/MS	295	94.2	536	226	779

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Arithmetic Mean ($\bar{x}$)	299	91	560	236	810
Arithmetic SD (s)	14	8	40	22	70
Arithmetic RSD (%)	4.7	8.8	7.1	9.3	8.6
Number of Sample Measurements (N)	5	6	6	6	6

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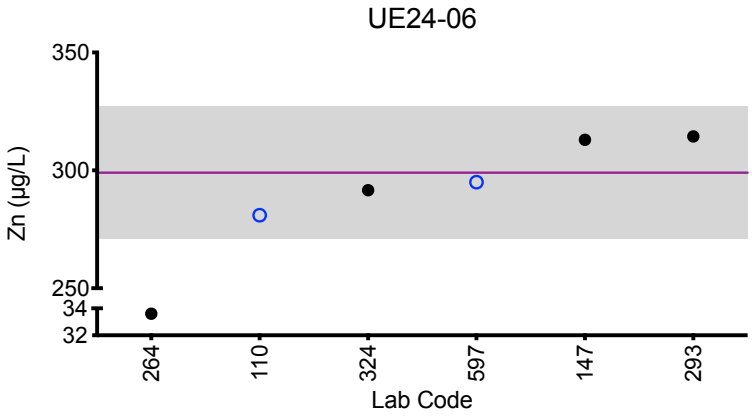
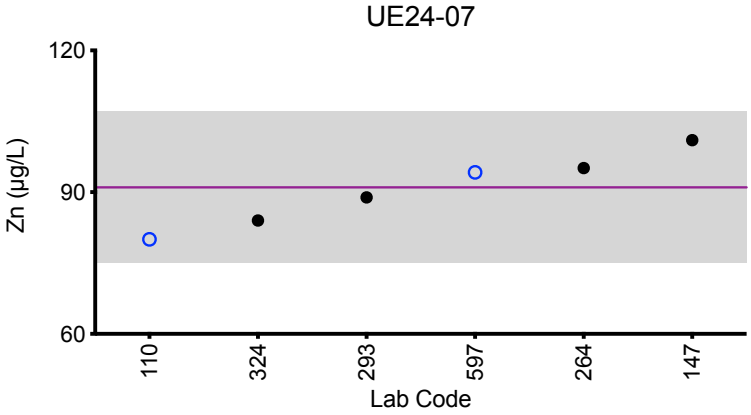
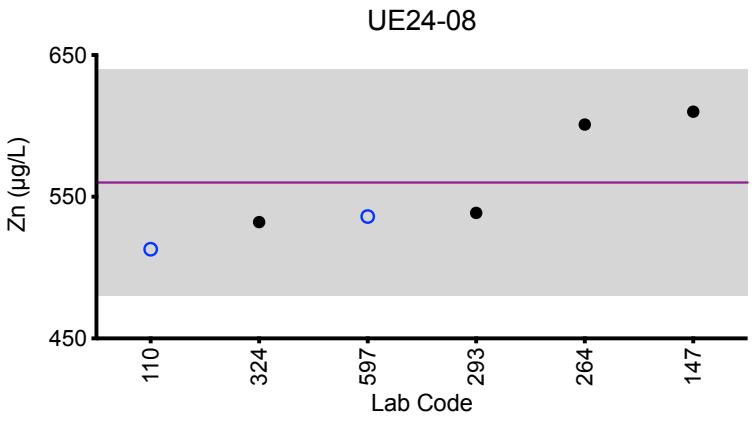
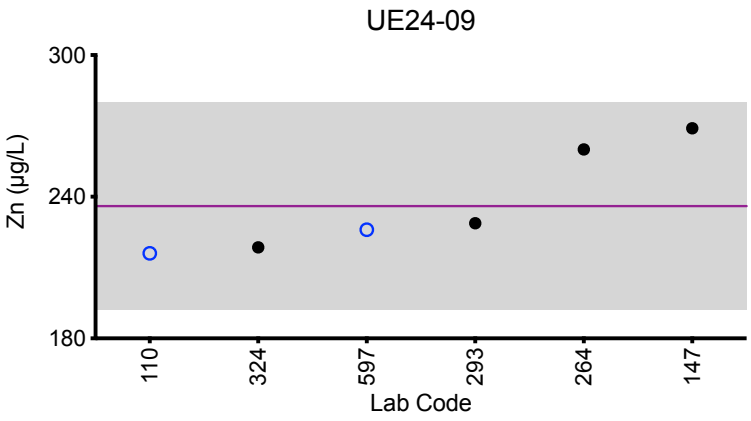
Results for Event #2, 2024: Summary Figures

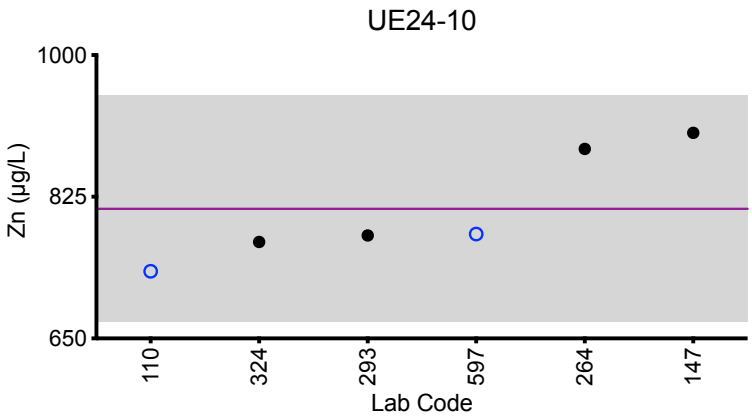
Urine Zn











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o 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.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine I (µg/L)

Lab Code	Method	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
110	ICP-MS	218	40	69	40	66
147	ICP-MS	216	41.4	68.3	40.9	69.0
597	ICP-MS/MS	209	36.6	64.4	35.6	62.4

Summary Statistics

	UE24-06	UE24-07	UE24-08	UE24-09	UE24-10
Arithmetic Mean ($\bar{x}$)	214	39	67	39	66
Arithmetic SD (s)	5	2	2	3	3
Arithmetic RSD (%)	2.3	6.4	3.7	7.7	4.5
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Li (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
110	ICP-MS/MS	20.0	44.8	32.9	3.4	9.3
147	ICP-MS	22.1	48.9	37.5	3.91	11.1
597	ICP-MS/MS	22.2	48.9	37.0	3.62	10.7
Summary Statistics						
		UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Arithmetic Mean ($\bar{x}$)		21.4	48	36	3.6	10.4
Arithmetic SD (s)		1.2	2	3	0.3	0.9
Arithmetic RSD (%)		5.6	5.1	7.3	7.1	8.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Te (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
110	ICP-MS/MS	0.3	1.0	2.1	0.9	0.5
147	ICP-MS	0.284	1.07	1.94	0.974	0.488
Summary Statistics						
		UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Arithmetic Mean ($\bar{x}$)		0.292	1.03	2.02	0.94	0.494
Arithmetic SD (s)		0.011	0.05	0.11	0.05	0.008
Arithmetic RSD (%)		3.8	4.9	5.4	5.3	1.6
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Urine Ti (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
442	ICP-MS/MS	3.69	1.61	7.49	0.882	2.25
597	ICP-MS/MS	5.54	2.36	8.78	1.42	3.19
Summary Statistics						
		UE24-06	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
Arithmetic Mean ($\bar{x}$)		4.6	2.0	8.1	1.2	2.7
Arithmetic SD (s)		1.3	0.5	0.9	0.4	0.7
Arithmetic RSD (%)		28	25	11	33	26
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2024: Additional Elements in Urine

Urine Ag (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
147	ICP-MS	<0.108	<0.108	<0.108	<0.108	<0.108

Urine Bi (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
147	ICP-MS	<0.0773	<0.0773	<0.0773	<0.0773	<0.0773
264	ICP-MS	<0.01	<0.01	<0.01	<0.01	<0.01
597	ICP-MS/MS	<0.00586	<0.00586	0.0138	<0.00586	0.0676

Urine Fe (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
324	ICP-MS	9.608	4.793	9.625	2.772	11.447

Urine Mg (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
597	ICP-MS/MS	47600	9910	17700	11800	20900

Urine Th (µg/L)						
Lab Code	**Method**	**UE24-06**	**UE24-07**	**UE24-08**	**UE24-09**	**UE24-10**
147	ICP-MS	<0.0951	<0.0951	<0.0951	<0.0951	<0.0951
597	ICP-MS/MS	0.310	0.191	0.176	<0.0625	<0.0625

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Event #2, 2024

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

NEW YORK STATE | Department of Health | Wadsworth Center

Event #2, 2024:
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, Ba, Be, Bi, Cd, Cs, Fe, Hg, I, Li, Mg, Mn, Mo, Ni, Pb, Pt, Sb, Sn, Sr, Te, 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.

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Results for Event #2, 2024: Summary Statistics

	Serum Al (µg/L)				
	SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Target (Arithmetic Mean ($\bar{x}$))	61	42	78	28	65
Upper Limit	73	50	94	34	78
Lower Limit	49	34	62	22	52
Arithmetic SD (s)	3	4	6	4	4
Arithmetic RSD (%)	4.8	9.5	7.7	14	6.2
Number of Sample Measurements (N)	5	5	5	5	5

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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

Serum Al (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
	Target	**61**	**42**	**78**	**28**	**65**
147	ICP-MS	61.5	47.4	83.2	32.9	71.5
264	ICP-MS	62.2	36.7	78.4	23.8	63.0
293	DRC/CC-ICP-MS	63.71	41.67	81.99	26.34	68.28
391	ETAAS-Z	61.18	45.29	69.61	33.03	60.92
597	ICP-MS/MS	56.0	40.7	74.3	25.5	63.6

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

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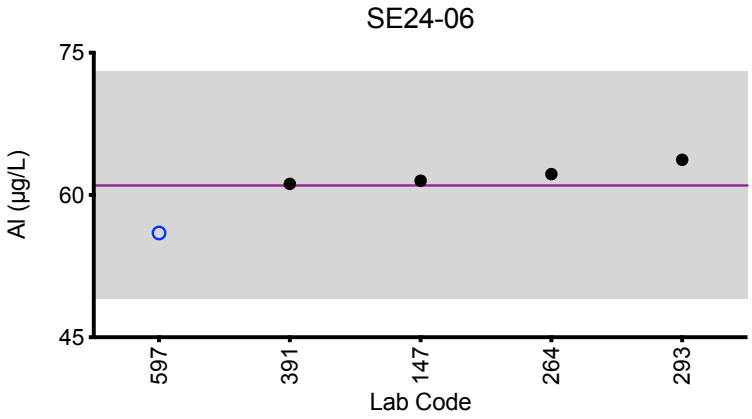
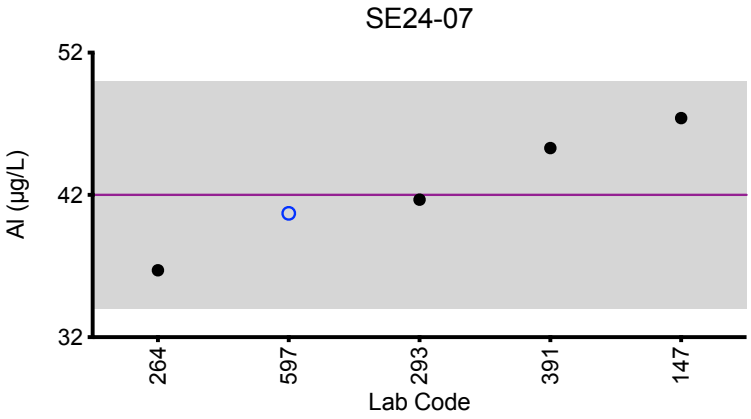
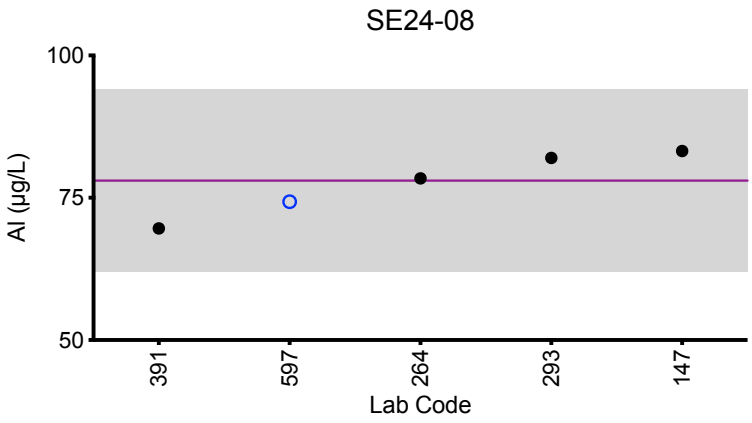
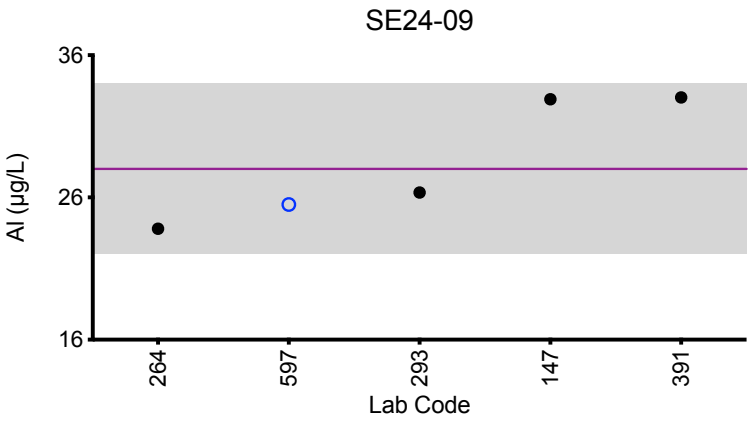
Results for Event #2, 2024: Summary Figures

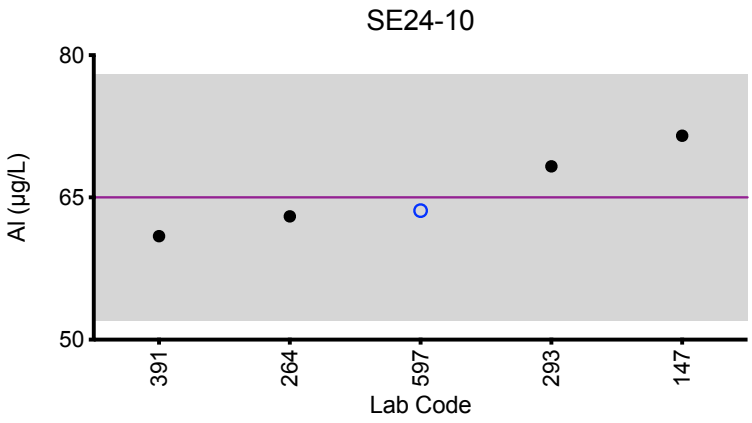
Serum Al











Legend:

o 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.

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Results for Event #2, 2024:
Summary Statistics

	Serum Co (µg/L)				
	SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Target (Arithmetic Mean ($\bar{x}$))	420	637	0.9	3.92	11.3
Upper Limit	483	733	2.4	5.42	13.0
Lower Limit	357	541	0.0	2.42	9.6
Arithmetic SD (s)	17	19	0.2	0.18	0.3
Arithmetic RSD (%)	4.0	3.0	29	4.6	2.6
Number of Sample Measurements (N)	6	6	6	6	6

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

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Results for Event #2, 2024:
Performance of Participating Laboratories

Serum Co (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
	Target	**420**	**637**	**0.9**	**3.92**	**11.3**
110	ICP-MS/MS	436	649	1.32	4.23	11.6
147	DRC/CC-ICP-MS	411	654	0.821	3.77	11.6
264	ICP-MS	411.0	613.0	0.68	3.95	11.1
293	DRC/CC-ICP-MS	445.1	636.30	0.77	3.90	11.22
442	DRC/CC-ICP-MS	416	654	0.893	3.98	11.50
597	ICP-MS/MS	401	614	0.621	3.71	10.9

Based on the grading criteria for Co 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.

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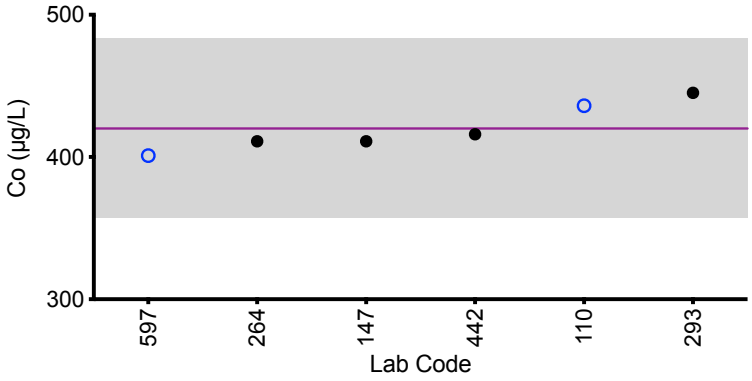
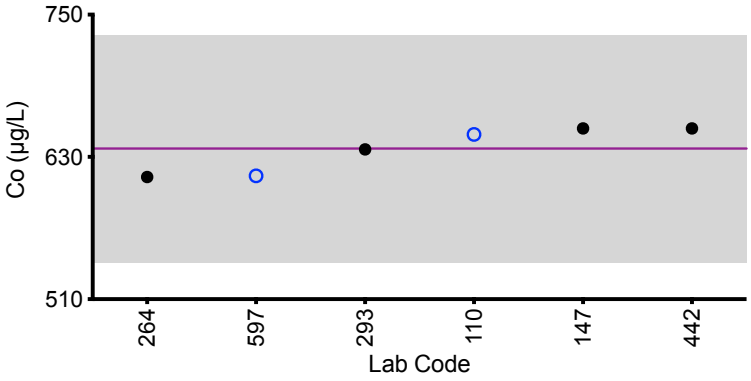
Results for Event #2, 2024: Summary Figures

Serum Co

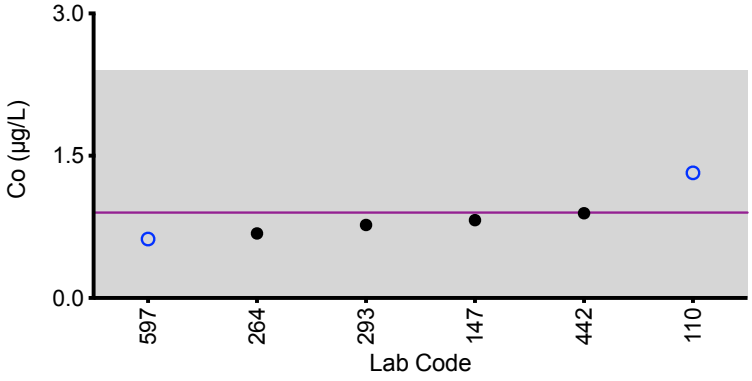
SE24-06



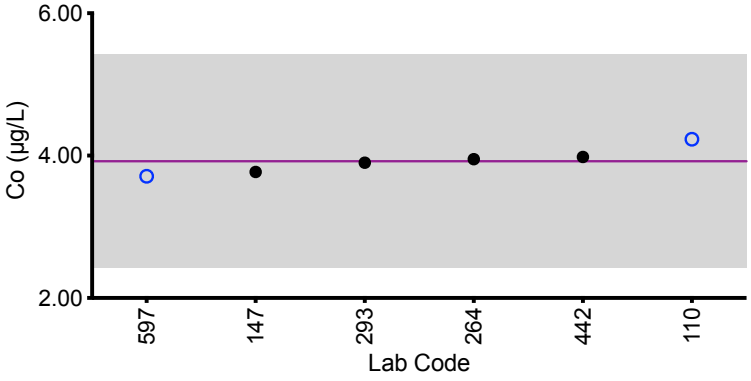
SE24-07



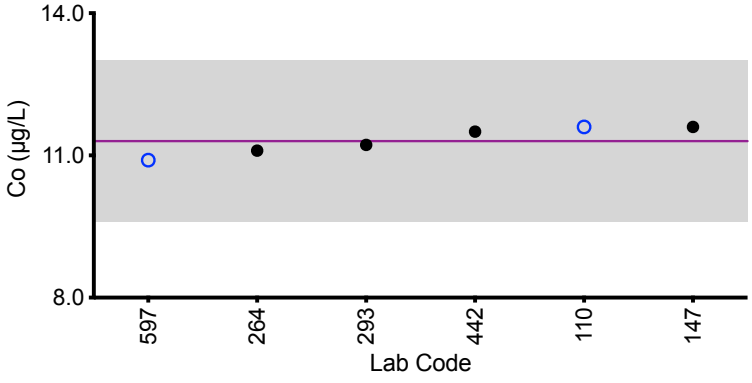
SE24-08



SE24-09



SE24-10



Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

	Serum Cr (µg/L)				
	SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Target (Arithmetic Mean ($\bar{x}$))	0.99	4.2	1.9	0.60	3.5
Upper Limit	2.99	6.2	3.9	2.60	5.5
Lower Limit	0.00	2.2	0.0	0.00	1.5
Arithmetic SD (s)	0.17	0.6	0.4	0.16	0.3
Arithmetic RSD (%)	17	14	21	27	8.7
Number of Sample Measurements (N)	5	6	6	5	6

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

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
	Target	**0.99**	**4.2**	**1.9**	**0.60**	**3.5**
103	ICP-MS/MS	1.17	4.49	2.06	0.625	3.75
110	ICP-MS/MS	0.977	4.07	1.59	0.634	3.40
147	DRC/CC-ICP-MS	0.731	3.46	1.40	*0.191	3.05
264	ICP-MS	*1.73	5.3	2.61	0.84	3.44
293	DRC/CC-ICP-MS	1.11	4.22	1.87	0.42	3.86
597	ICP-MS/MS	0.966	3.82	1.75	0.486	3.25

Based on the grading criteria for Cr 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.

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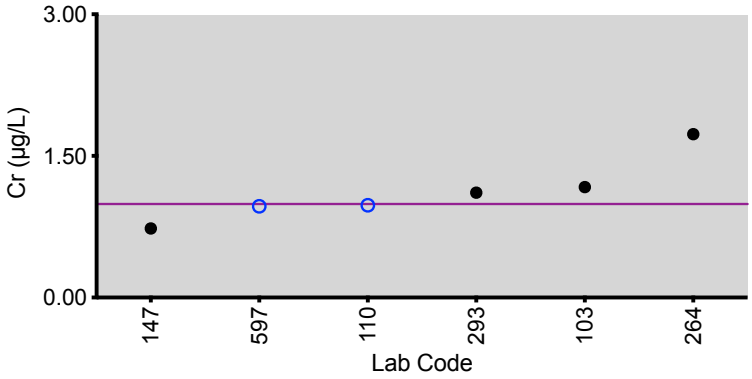
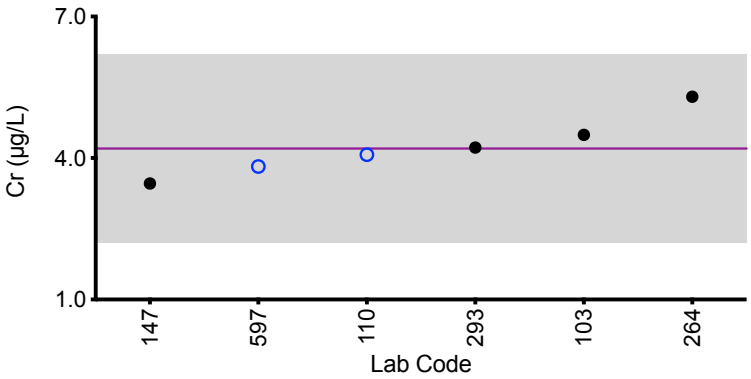
Results for Event #2, 2024: Summary Figures

Serum Cr

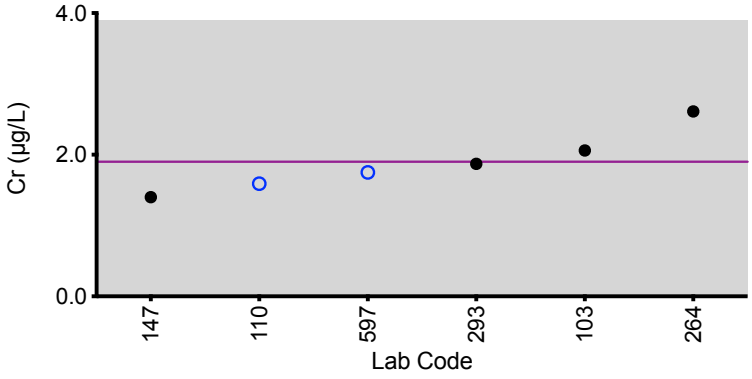
SE24-06



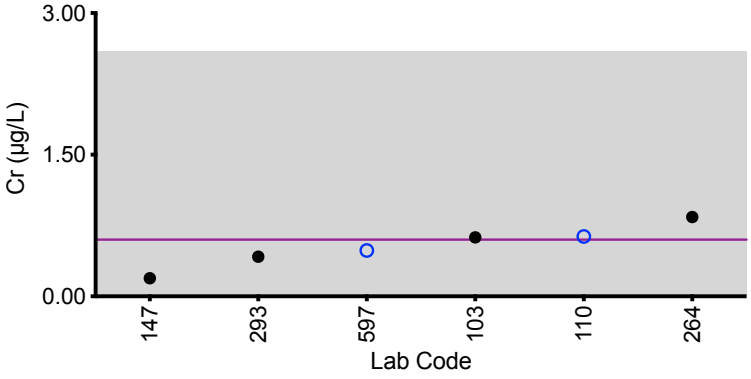
SE24-07



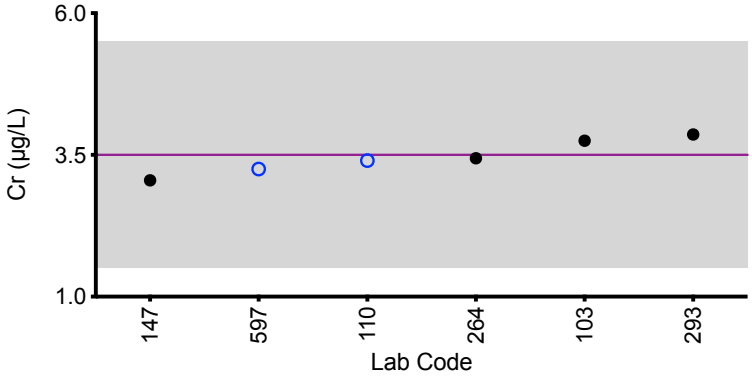
SE24-08



SE24-09



SE24-10



Legend:

o 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.

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Results for Event #2, 2024:
Summary Statistics

Serum Cu (µg/L)					
	SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Target (Arithmetic Mean ($\bar{x}$))	1246	1580	983	1470	1396
Upper Limit	1433	1820	1130	1690	1605
Lower Limit	1059	1340	836	1250	1187
Arithmetic SD (s)	25	90	21	50	24
Arithmetic RSD (%)	2.0	5.7	2.1	3.4	1.7
Number of Sample Measurements (N)	6	7	6	7	6

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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

Serum Cu (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
	Target	**1246**	**1580**	**983**	**1470**	**1396**
107	DRC/CC-ICP-MS	*1380	1750	*1090	1570	*1520
110	ICP-MS/MS	1270	1610	1020	1480	1430
147	DRC/CC-ICP-MS	1247	1635	981	1425	1384
264	ICP-MS	1224.0	1517.0	972.0	1446.0	1379.0
293	DRC/CC-ICP-MS	1271	1564	992	1449	1424
436	FAAS	1254	1461	965	1500	1381
597	ICP-MS/MS	1210	1540	968	1410	1380

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.

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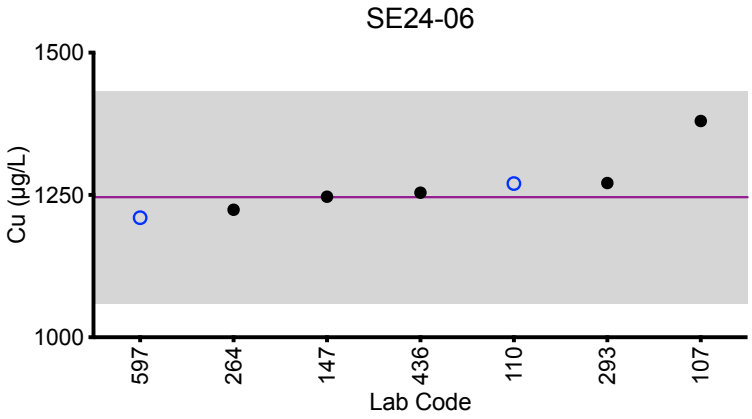
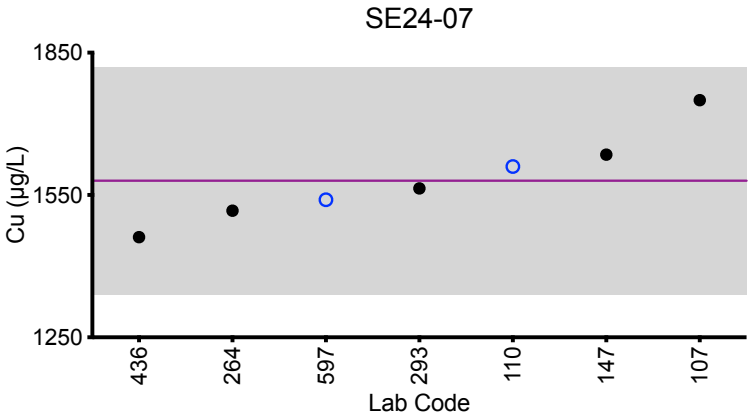
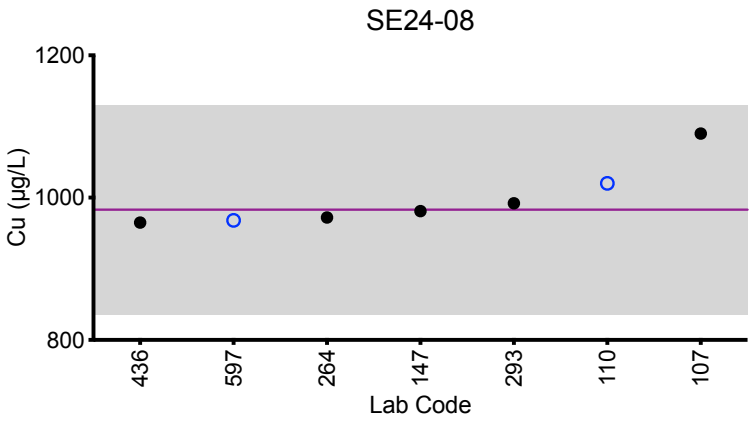
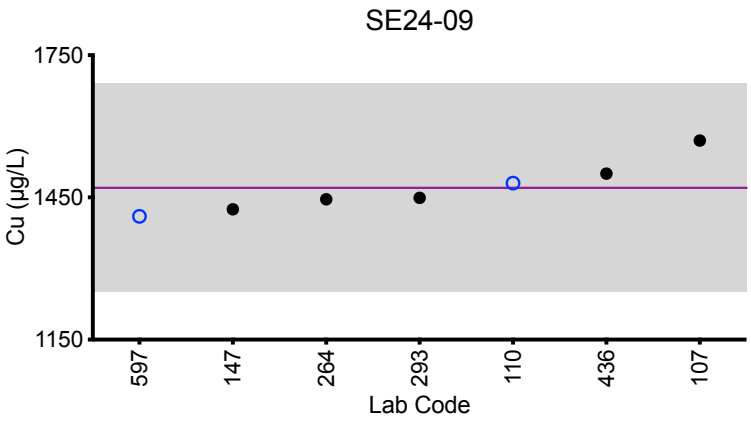
Results for Event #2, 2024: Summary Figures

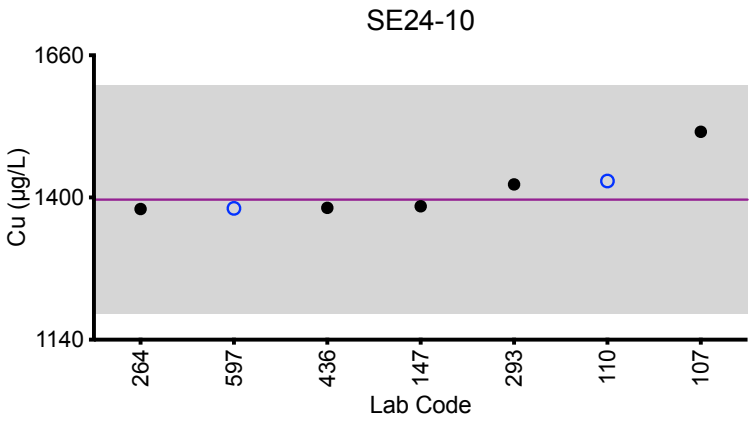
Serum Cu











Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

	Serum Se (µg/L)				
	SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Target (Arithmetic Mean ($\bar{x}$))	276	181	103	223	134
Upper Limit	331	217	124	268	161
Lower Limit	221	145	82	178	107
Arithmetic SD (s)	20	12	6	14	8
Arithmetic RSD (%)	7.2	6.6	5.8	6.3	5.7
Number of Sample Measurements (N)	8	8	8	8	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 by New York State Department of Health's Wadsworth Center, the PT Program organizer.

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
	Target	**276**	**181**	**103**	**223**	**134**
103	ICP-MS/MS	297	201	113	244	147
107	DRC/CC-ICP-MS	270	181	101	216	132
110	ICP-MS/MS	269	181	104	218	132
147	DRC/CC-ICP-MS	257	165	100	214	131
264	ICP-MS	270	181	100	227	136
293	DRC/CC-ICP-MS	304	193	111	235	141
436	ETAAS-Other	293	178	102	230	126
597	ICP-MS/MS	247	167	94.9	200	124

Based on the grading criteria for Se 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.

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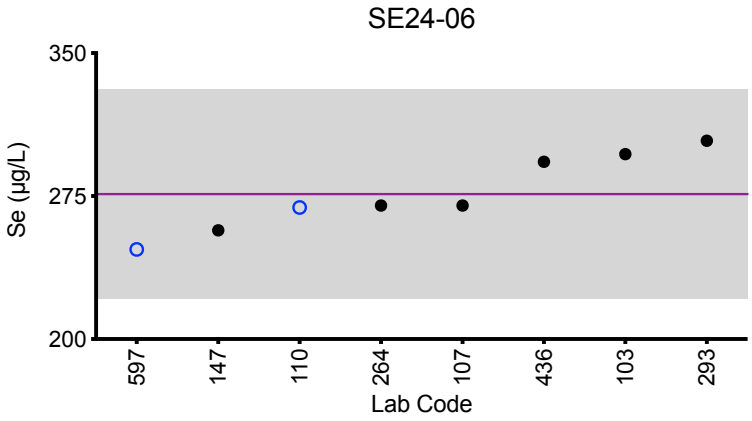
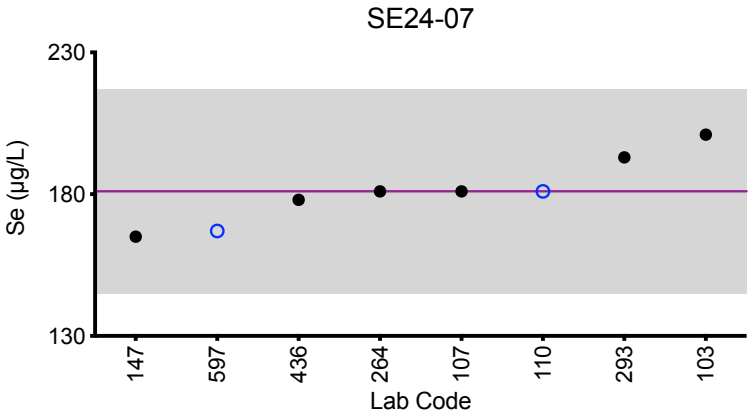
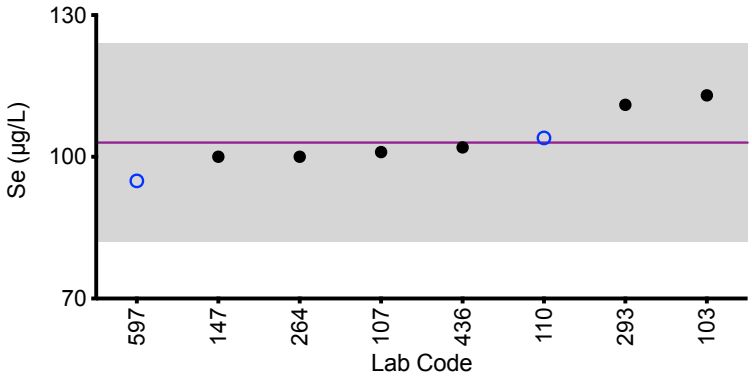
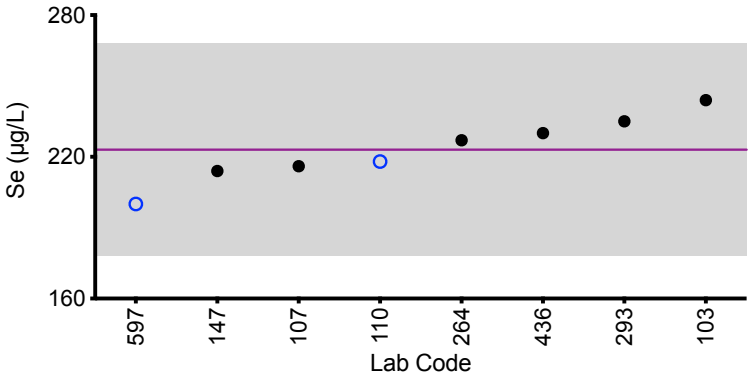
Results for Event #2, 2024: Summary Figures

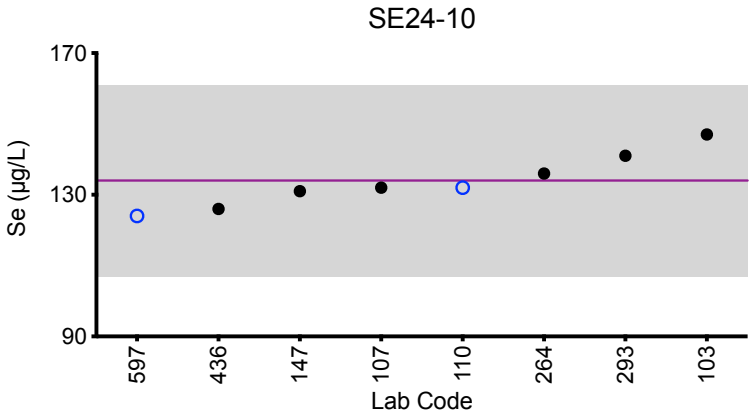
Serum Se











Legend:

o 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.

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Results for Event #2, 2024: Summary Statistics

Serum Zn (µg/L)					
	SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Target (Arithmetic Mean ($\bar{x}$))	940	650	1270	1520	2010
Upper Limit	1080	750	1460	1750	2310
Lower Limit	800	550	1080	1290	1710
Arithmetic SD (s)	60	50	80	80	110
Arithmetic RSD (%)	6.4	7.7	6.3	5.3	5.5
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.

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Results for Event #2, 2024:
Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
	Target	**940**	**650**	**1270**	**1520**	**2010**
107	DRC/CC-ICP-MS	1040	729	1360	1630	2120
110	ICP-MS/MS	929	655	1310	1550	2050
147	DRC/CC-ICP-MS	929	612	1221	1482	1963
264	ICP-MS	872	594	1158	1400	1817
293	DRC/CC-ICP-MS	928	627	1242	1490	1993
597	ICP-MS/MS	959	708	1330	1590	2090

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.

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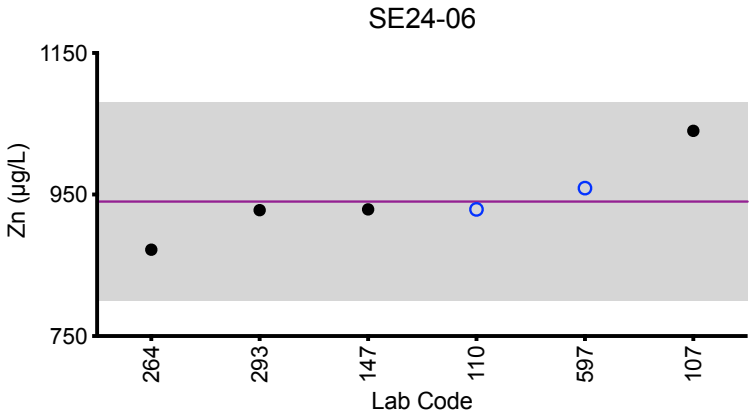
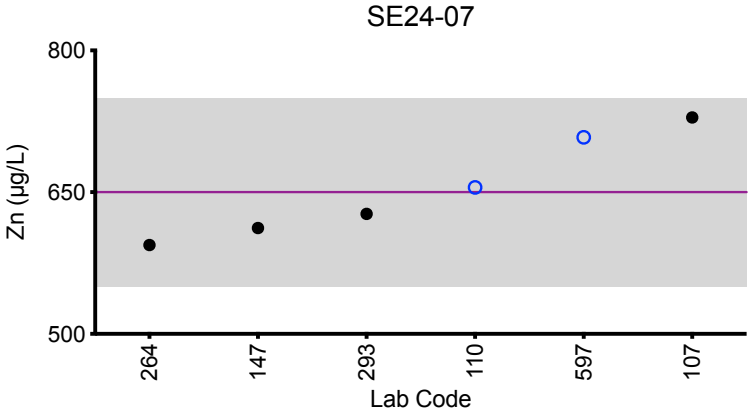
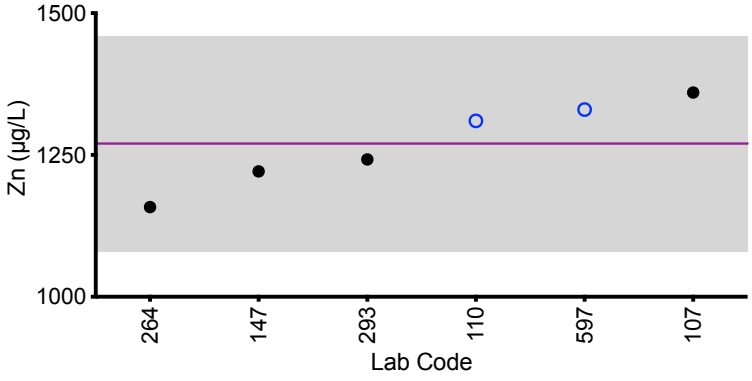
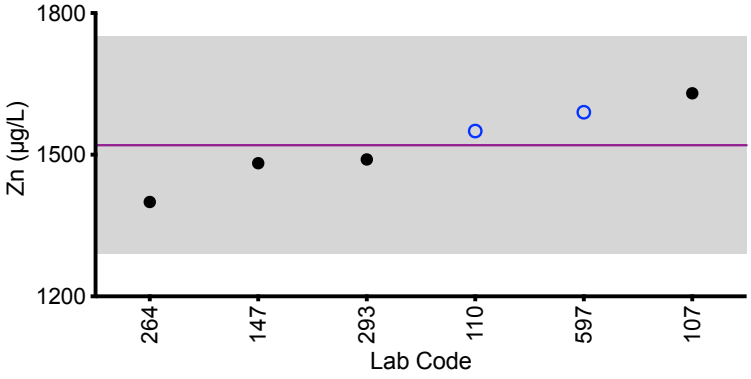
Results for Event #2, 2024: Summary Figures

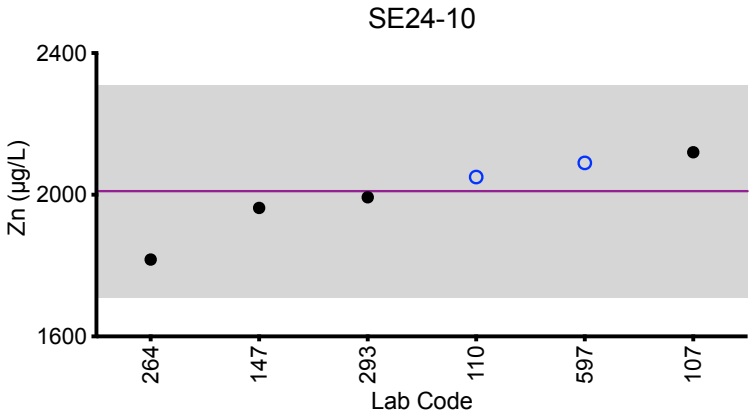
Serum Zn











Legend:
o 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.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
103	ICP-MS/MS	10.5	4.58	2.41	0.885	5.56
110	ICP-MS/MS	10.2	4.46	2.27	0.71	5.25
147	DRC/CC-ICP-MS	9.35	3.98	1.91	0.681	4.63
264	ICP-MS	10.14	4.36	2.31	0.93	5.05
293	DRC/CC-ICP-MS	10.980	4.38	2.28	0.84	5.450
597	ICP-MS/MS	9.68	4.36	2.51	1.07	5.23
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		10.1	4.35	2.28	0.85	5.2
Arithmetic SD (s)		0.6	0.20	0.20	0.14	0.3
Arithmetic RSD (%)		5.9	4.6	8.8	16	6.3
Number of Sample Measurements (N)		6	6	6	6	6

*Denotes a statistical Outlier.

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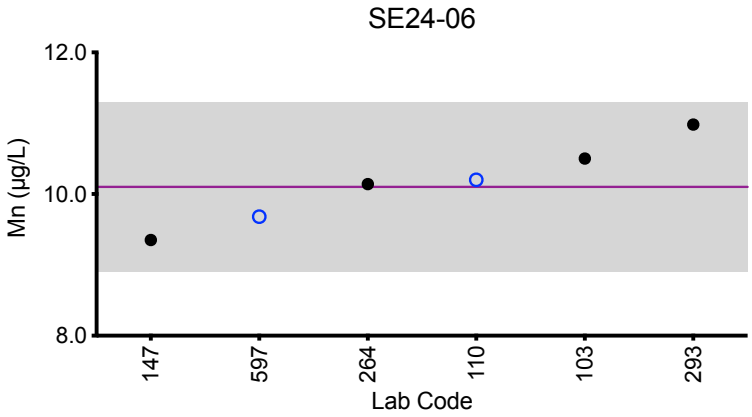
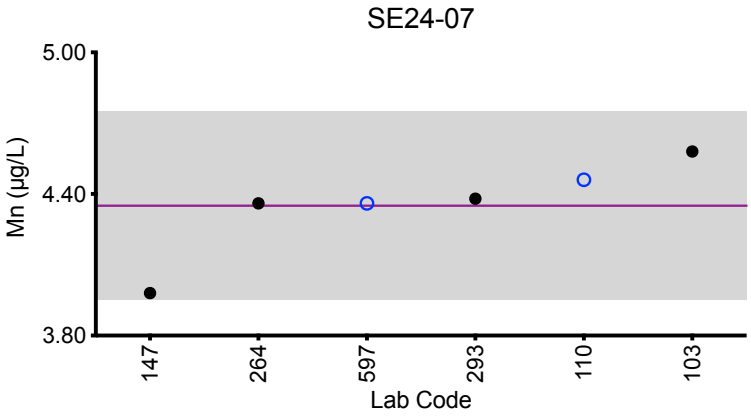
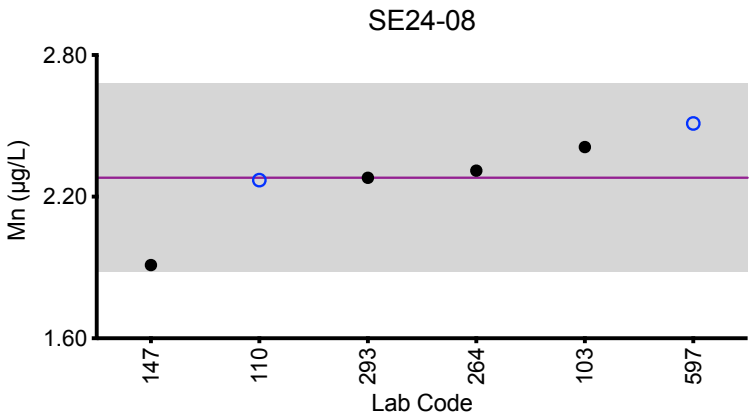
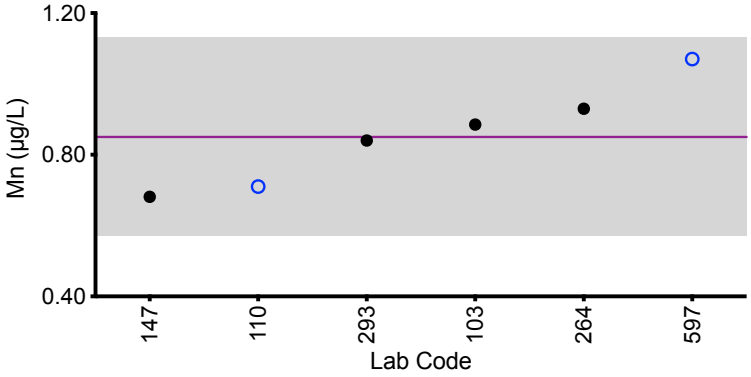
Results for Event #2, 2024: Summary Figures

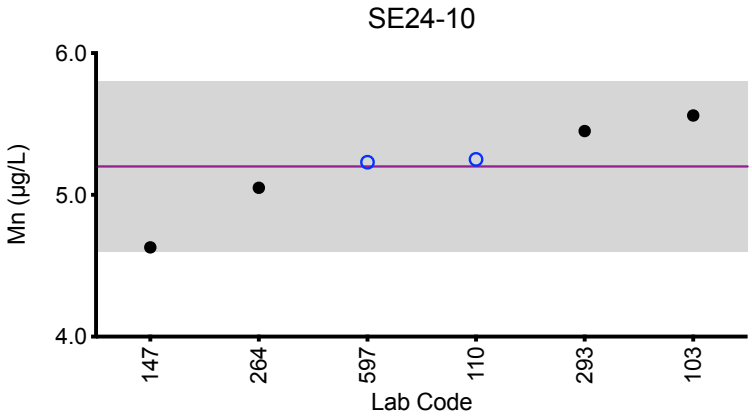
Serum Mn











Legend:
o 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, 2024:
Laboratory Data and Summary Statistics

Serum Mo (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
103	ICP-MS/MS	7.14	1.06	3.14	0.899	5.55
110	ICP-MS/MS	6.51	1.04	2.89	0.79	4.90
147	DRC/CC-ICP-MS	6.12	0.843	2.56	0.628	4.64
293	DRC/CC-ICP-MS	6.660	0.910	2.840	0.840	4.990
442	DRC/CC-ICP-MS	6.50	1.05	2.81	0.886	4.86
597	ICP-MS/MS	5.41	0.833	2.35	0.677	4.16
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		6.4	0.96	2.8	0.79	4.8
Arithmetic SD (s)		0.6	0.11	0.3	0.11	0.5
Arithmetic RSD (%)		9.4	11	10	14	10
Number of Sample Measurements (N)		6	6	6	6	6

*Denotes a statistical Outlier.

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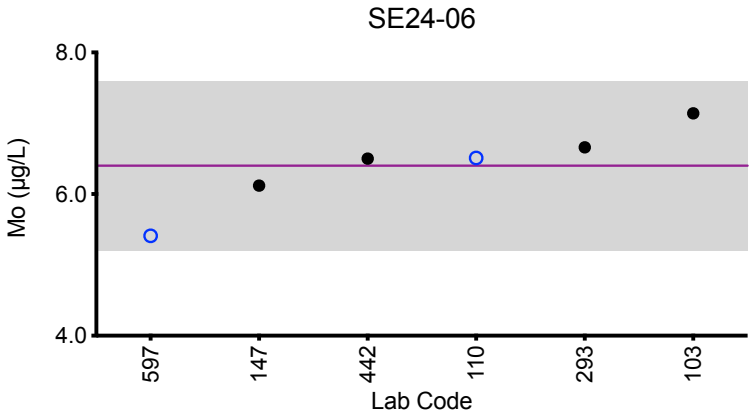
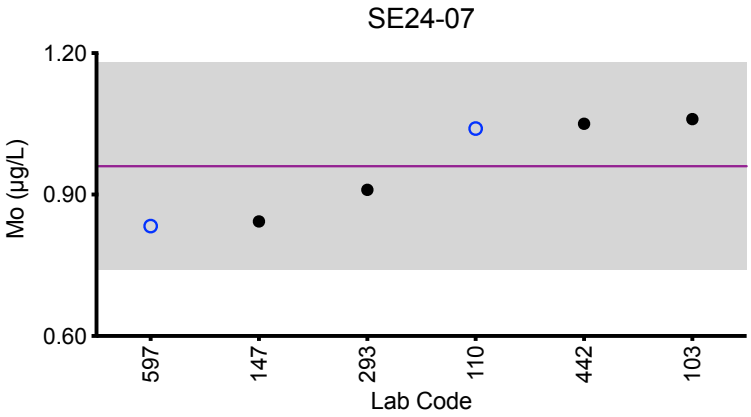
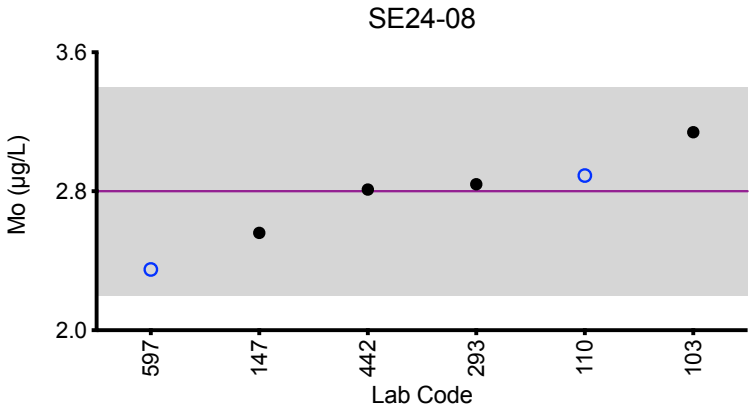
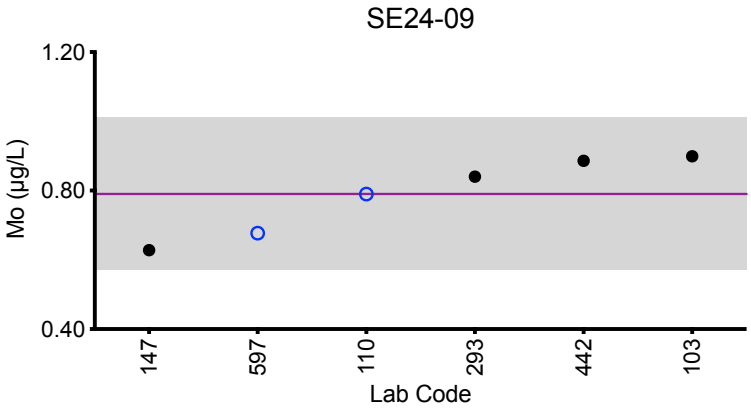
Results for Event #2, 2024: Summary Figures

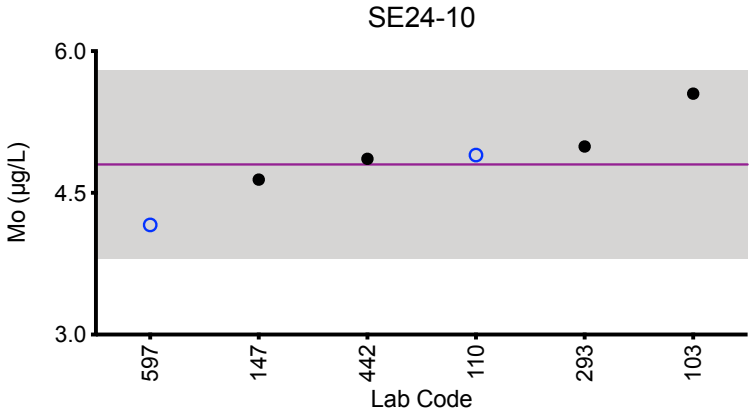
Serum Mo











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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
103	ICP-MS/MS	93.3	141	3.71	7.22	2.48
110	ICP-MS/MS	91.5	136	4.73	6.82	2.37
147	DRC/CC-ICP-MS	94.1	154	3.70	6.87	2.45
293	DRC/CC-ICP-MS	*105.54	151.58	4.07	7.73	2.93
597	ICP-MS/MS	93.4	141	3.70	7.21	2.62
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		93.1	145	4.0	7.2	2.6
Arithmetic SD (s)		1.1	8	0.4	0.4	0.2
Arithmetic RSD (%)		1.2	5.5	10	5.6	8.6
Number of Sample Measurements (N)		4	5	5	5	5

*Denotes a statistical Outlier.

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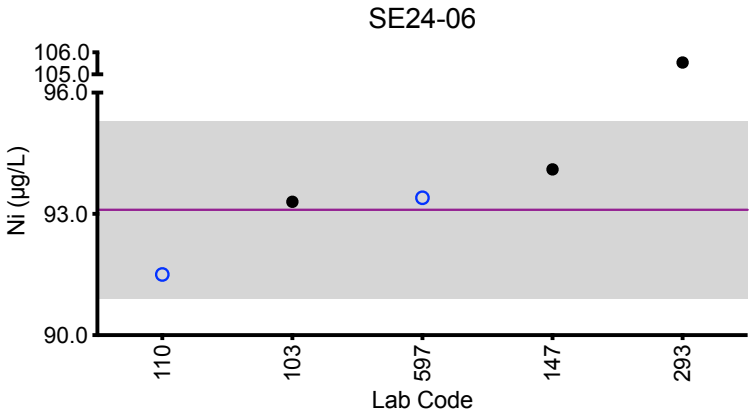
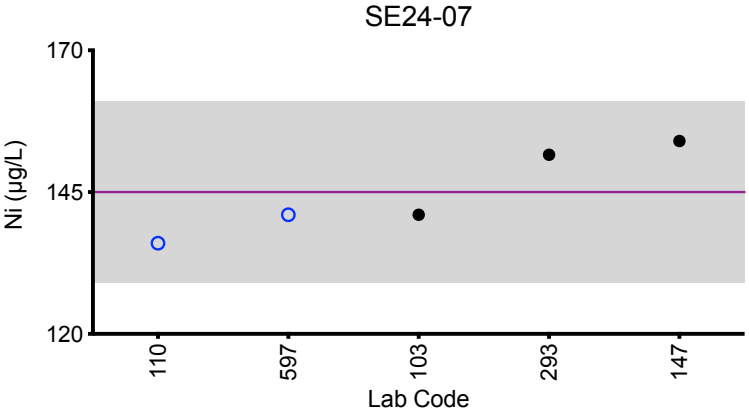
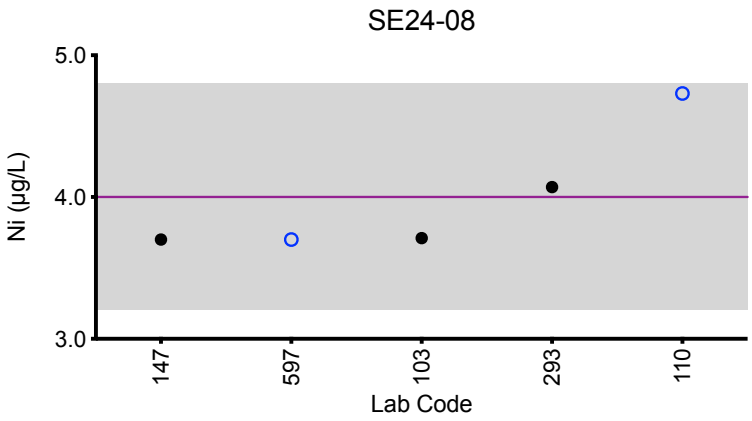
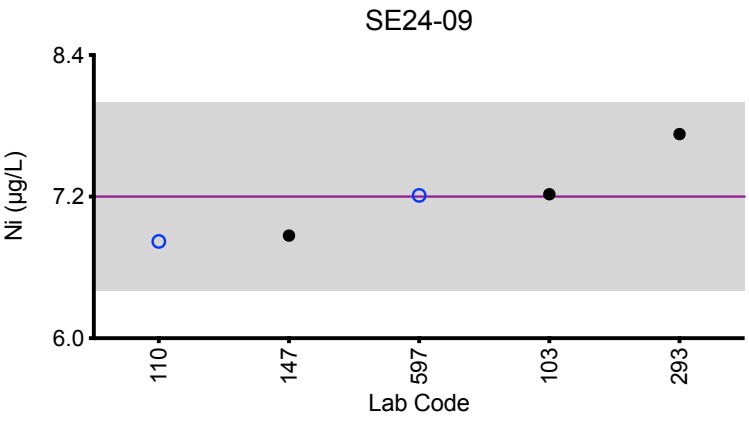
Results for Event #2, 2024: Summary Figures

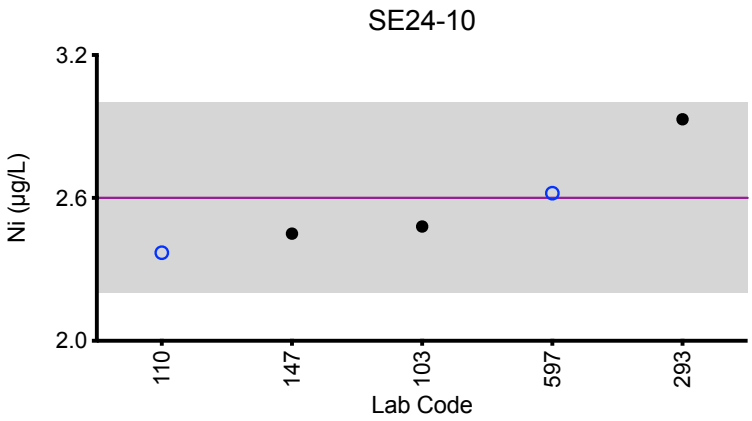
Serum Ni











Legend:
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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum As (µg/L)

Lab Code	Method	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
103	ICP-MS/MS	1.52	21.4	4.16	8.61	3.17
110	ICP-MS/MS	1.36	18.9	3.81	7.67	2.86
147	DRC/CC-ICP-MS	1.24	17.6	3.40	7.01	2.67
597	ICP-MS/MS	1.34	17.5	3.47	7.06	2.74

Summary Statistics

	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
Arithmetic Mean ($\bar{x}$)	1.37	18.9	3.7	7.6	2.9
Arithmetic SD (s)	0.12	1.8	0.3	0.7	0.2
Arithmetic RSD (%)	8.8	9.5	8.1	9.2	7.7
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
110	ICP-MS/MS	0.73	1.30	0.94	1.44	0.72
147	ICP-MS	0.681	1.12	0.619	1.25	0.622
597	ICP-MS/MS	0.784	1.36	0.808	1.47	0.831
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		0.73	1.26	0.79	1.39	0.72
Arithmetic SD (s)		0.05	0.12	0.16	0.12	0.10
Arithmetic RSD (%)		6.8	9.5	20	8.6	14
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Be (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
110	ICP-MS/MS	0.60	3.22	0.36	2.25	1.15
147	ICP-MS	0.720	3.17	0.431	1.81	1.19
293	ICP-MS	0.60	3.17	0.39	2.08	1.16
597	ICP-MS/MS	0.512	2.48	0.306	1.79	0.903
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		0.61	3.0	0.37	2.0	1.10
Arithmetic SD (s)		0.09	0.4	0.05	0.2	0.13
Arithmetic RSD (%)		15	13	14	11	12
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)

Lab Code	Method	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
103	ICP-MS/MS	0.277	2.09	0.494	3.37	0.968
110	ICP-MS/MS	0.28	2.01	0.49	3.32	0.98
147	ICP-MS	*0.558	2.18	0.507	3.35	1.07
597	ICP-MS/MS	0.289	2.06	0.468	3.32	0.984

Summary Statistics

	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
Arithmetic Mean ($\bar{x}$)	0.282	2.09	0.490	3.34	1.00
Arithmetic SD (s)	0.006	0.07	0.016	0.02	0.05
Arithmetic RSD (%)	2.1	3.3	3.3	0.72	4.7
Number of Sample Measurements (N)	3	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)

Lab Code	Method	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
110	ICP-MS/MS	0.72	0.66	0.57	0.49	1.45
597	ICP-MS/MS	0.666	0.621	0.531	0.455	1.36

Summary Statistics

	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
Arithmetic Mean ($\bar{x}$)	0.69	0.64	0.55	0.47	1.41
Arithmetic SD (s)	0.04	0.03	0.03	0.02	0.06
Arithmetic RSD (%)	5.8	4.7	5.5	4.3	4.3
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
103	ICP-MS/MS	0.774	1.56	7.30	0.497	2.97
110	ICP-MS/MS	0.70	1.51	6.30	0.56	2.86
597	ICP-MS/MS	0.923	1.68	6.74	0.612	3.02
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		0.80	1.58	6.8	0.56	2.95
Arithmetic SD (s)		0.11	0.09	0.5	0.06	0.08
Arithmetic RSD (%)		14	5.7	7.4	11	2.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum I (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
147	ICP-MS	42.4	68.1	50.0	46.4	41.7
597	ICP-MS/MS	42.9	67.1	51.3	45.9	42.3
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		42.7	67.6	50.7	46.2	42.0
Arithmetic SD (s)		0.4	0.7	0.9	0.4	0.4
Arithmetic RSD (%)		0.94	1.0	1.8	0.87	0.95
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Mg (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
264	ICP-MS	19393.0	21553.0	19810.0	18237.0	20568.0
597	ICP-MS/MS	18100	20500	18900	17000	19600
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		18700	21000	19400	17600	20100
Arithmetic SD (s)		900	700	600	900	700
Arithmetic RSD (%)		4.8	3.3	3.1	5.1	3.5
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
103	ICP-MS/MS	0.506	3.85	7.03	<0.100	2.70
110	ICP-MS/MS	0.66	3.95	8.25	0.11	2.56
597	ICP-MS/MS	0.617	3.87	7.03	0.147	2.72
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		0.59	3.89	7.4	0.13	2.66
Arithmetic SD (s)		0.08	0.05	0.7	0.03	0.09
Arithmetic RSD (%)		14	1.3	9.5	23	3.4
Number of Sample Measurements (N)		3	3	3	2	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)

Lab Code	Method	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
110	ICP-MS/MS	1.93	0.211	0.061	0.915	0.362
264	ICP-MS	1.44	0.11	*0.01	0.70	0.25
293	DRC/CC-ICP-MS	2.05	0.22	0.19	0.92	0.36

Summary Statistics

	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
Arithmetic Mean ($\bar{x}$)	1.8	0.18	NA	0.84	0.32
Arithmetic SD (s)	0.3	0.06	NA	0.13	0.06
Arithmetic RSD (%)	17	33	NA	15	19
Number of Sample Measurements (N)	3	3	NA	3	3

*Denotes a statistical Outlier.

Statistical data was not calculated for SE24-08 based on a lack of consensus among participating labs.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
103	ICP-MS/MS	4.47	1.16	6.97	1.98	2.53
110	ICP-MS/MS	4.21	1.11	6.55	1.76	2.37
147	ICP-MS	4.07	1.09	6.37	1.74	2.27
597	ICP-MS/MS	3.72	0.956	5.72	1.63	2.19
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		4.1	1.08	6.4	1.78	2.34
Arithmetic SD (s)		0.3	0.09	0.5	0.15	0.15
Arithmetic RSD (%)		7.3	8.3	7.8	8.4	6.4
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
110	ICP-MS/MS	2.78	0.93	3.56	1.63	4.21
597	ICP-MS/MS	2.59	0.941	3.22	1.67	3.85
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		2.69	0.936	3.4	1.65	4.0
Arithmetic SD (s)		0.13	0.008	0.2	0.03	0.3
Arithmetic RSD (%)		4.8	0.85	5.9	1.8	7.5
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
103	ICP-MS/MS	72.7	51.8	44.4	87.9	55.9
200	ICP-MS	73	50		85	55
597	ICP-MS/MS	66.0	46.6	40.5	78.2	51.2
Summary Statistics						
		SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)		71	49	42	84	54
Arithmetic SD (s)		4	3	3	5	2
Arithmetic RSD (%)		5.6	6.1	7.1	5.9	4.6
Number of Sample Measurements (N)		3	3	2	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
200	DRC/CC-ICP-MS	6.6	9.4		5.5	4.1
442	ICP-MS/MS	5.43	7.76	1.73	4.10	3.26
597	ICP-MS/MS	8.13	10.7	4.71	6.64	6.05

Summary Statistics					
	SE24-06	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
Arithmetic Mean ($\bar{x}$)	6.7	9.3	NA	5.4	4.5
Arithmetic SD (s)	1.4	1.5	NA	1.3	1.4
Arithmetic RSD (%)	21	16	NA	24	31
Number of Sample Measurements (N)	3	3	NA	3	3

*Denotes a statistical Outlier.

Statistical data was not calculated for SE24-08 based on a lack of consensus among participating labs.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)

Lab Code	Method	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
103	ICP-MS/MS	0.773	0.156	0.610	1.63	0.284
110	ICP-MS/MS	0.754	0.148	0.603	1.59	0.281
147	ICP-MS	0.741	0.164	0.575	1.54	0.272
597	ICP-MS/MS	0.803	0.175	0.625	1.65	0.292

Summary Statistics

	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
Arithmetic Mean ($\bar{x}$)	0.77	0.161	0.60	1.60	0.282
Arithmetic SD (s)	0.03	0.012	0.02	0.05	0.008
Arithmetic RSD (%)	3.5	7.5	3.5	3.1	2.8
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum U (µg/L)

Lab Code	Method	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
103	ICP-MS/MS	0.135	0.0928	0.179	0.0517	0.223
110	ICP-MS/MS	0.127	0.084	0.172	0.047	0.210
597	ICP-MS/MS	0.121	0.0817	0.159	0.0446	0.204

Summary Statistics

	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
Arithmetic Mean ($\bar{x}$)	0.128	0.086	0.170	0.048	0.212
Arithmetic SD (s)	0.007	0.006	0.010	0.004	0.010
Arithmetic RSD (%)	5.5	6.8	5.9	8.3	4.7
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum V (µg/L)

Lab Code	Method	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
110	ICP-MS/MS	1.21	0.57	2.47	0.39	3.45
147	DRC/CC-ICP-MS	1.14	0.534	2.21	0.301	3.28
293	DRC/CC-ICP-MS	1.37	0.66	2.57	0.54	3.6
597	ICP-MS/MS	1.17	0.575	2.25	0.402	3.25

Summary Statistics

	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
Arithmetic Mean ($\bar{x}$)	1.22	0.58	2.38	0.41	3.40
Arithmetic SD (s)	0.10	0.05	0.17	0.10	0.16
Arithmetic RSD (%)	8.2	8.6	7.1	24	4.7
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2024:
Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
110	ICP-MS/MS	0.68	0.29	0.21	0.98	0.45
200	ICP-MS	0.97	*0.44		1.25	0.59
597	ICP-MS/MS	0.676	0.288	0.205	0.936	0.427

Summary Statistics

	SE24-06	SE24-07	SE24-08	SE24-09	SE24-10
Arithmetic Mean ($\bar{x}$)	0.8	0.289	0.207	1.06	0.49
Arithmetic SD (s)	0.2	0.001	0.004	0.17	0.09
Arithmetic RSD (%)	22	0.48	1.9	16	18
Number of Sample Measurements (N)	3	2	2	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2024: Additional Elements in Serum

Serum Bi (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
147	ICP-MS	0.111	0.255	<0.0397	<0.0397	<0.0397
597	ICP-MS/MS	<0.00573	0.181	0.00594	<0.00573	<0.00573

Serum Fe (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
264	ICP-MS	5017.0	10264.0	2182.0	2154.0	3766.0

Serum Li (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
147	ICP-MS	1.26	0.656	0.490	0.568	0.569

Serum Te (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
110	ICP-MS/MS	<0.02	<0.02	<0.02	<0.02	<0.02

Serum Th (µg/L)						
Lab Code	**Method**	**SE24-06**	**SE24-07**	**SE24-08**	**SE24-09**	**SE24-10**
597	ICP-MS/MS	<0.00323	<0.00323	<0.00323	<0.00323	<0.00323

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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