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New York State Biomonitoring Program for Trace Elements

Event #3, 2024

Trace Elements in Whole Blood, Urine, and Serum

November, 2024

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #3, 2024:
Trace Elements in Whole Blood, Urine, and Serum

11/26/2024

Dear Laboratory Director,

This report summarizes performance for the third 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 #1, 2025) will be shipped February 5, 2025. Comments about this report may be directed to trel@health.ny.gov. If you have not yet enrolled for next year, please contact PT program staff at 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 #3, 2024

Trace Elements in Whole Blood

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Trace Elements Laboratory

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Event #3, 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 #3, 2024: Summary Statistics

Whole Blood As (µg/L)					
	BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Target (Arithmetic Mean ($\bar{x}$))	3.6	0.63	33.6	6.4	17.3
Upper Limit	9.6	6.63	40.3	12.4	23.3
Lower Limit	0.0	0.00	26.9	0.4	11.3
Arithmetic SD (s)	0.5	0.06	1.9	0.5	0.6
Arithmetic RSD (%)	14	9.5	5.7	7.8	3.5
Number of Sample Measurements (N)	8	7	8	8	8

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 #3, 2024:
Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
	Target	**3.6**	**0.63**	**33.6**	**6.4**	**17.3**
103	ICP-MS/MS	3.72	0.690	34.7	6.62	18.2
110	ICP-MS/MS	3.43	0.631	33.2	6.39	17.3
147	ICP-MS	3.34	0.573	33.4	6.17	17.6
247	ICP-MS/MS	3.86	0.577	33.7	6.23	17.0
264	ICP-MS	2.77	0.57	31.05	5.66	16.36
293	DRC/CC-ICP-MS	3.56	0.7	33.40	6.46	17.5
465	ICP-MS	4.51	*1.14	37.3	7.38	17.8
597	ICP-MS/MS	3.43	0.649	32.0	6.11	16.7

Based on the grading criteria for As 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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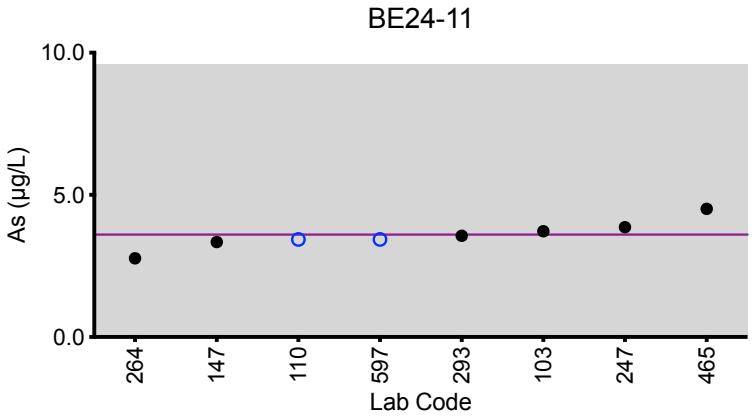
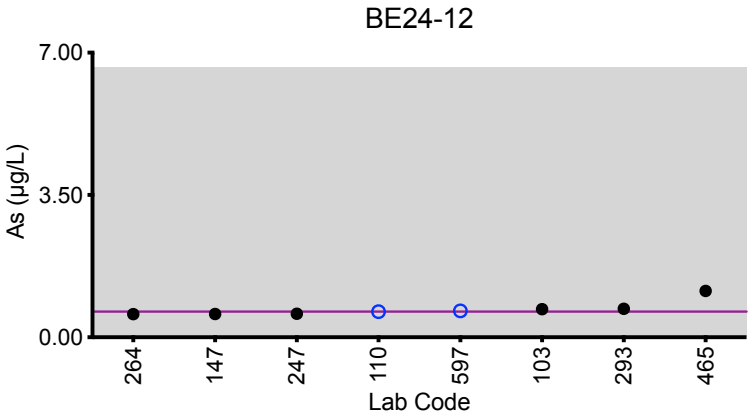
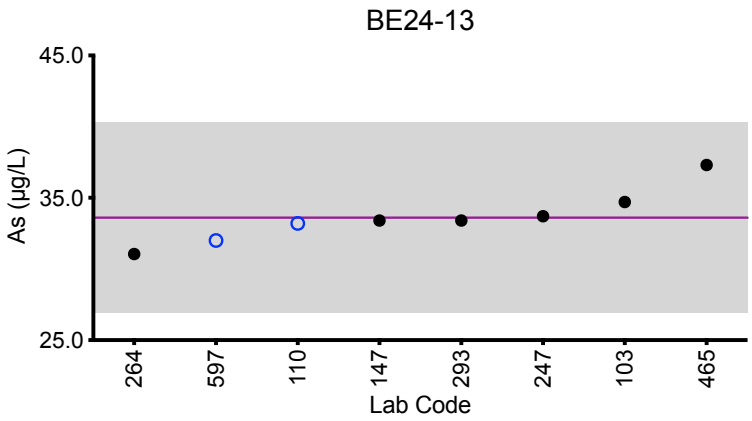
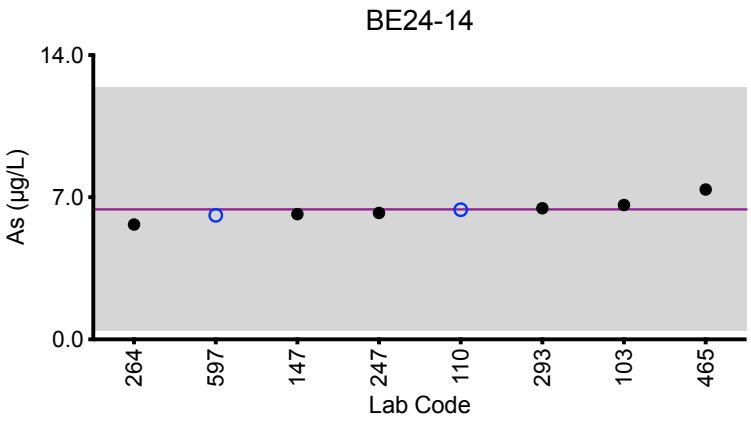
Results for Event #3, 2024: Summary Figures

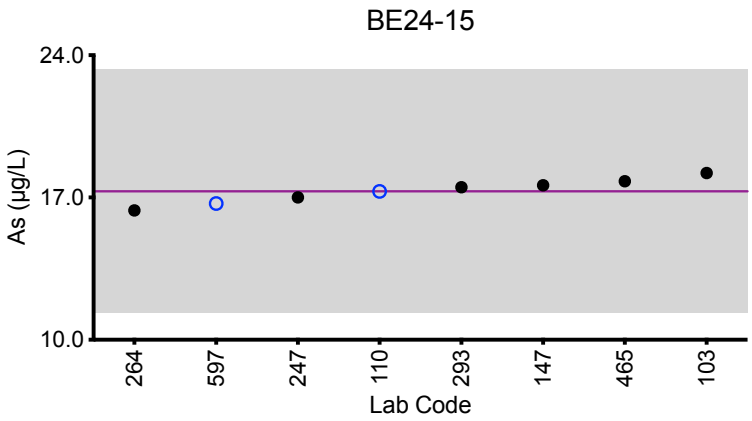
Whole Blood As











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 #3, 2024: Summary Statistics

Whole Blood Cd (µg/L)					
	BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Target (Robust Mean (x*))	0.53	1.99	0.94	8.00	3.65
Upper Limit	1.53	2.99	1.94	9.20	4.65
Lower Limit	0.00	0.99	0.00	6.80	2.65
Robust SD (s*)	0.03	0.11	0.04	0.27	0.15
Robust RSD (%)	5.5	5.5	4.3	3.4	4.1
Number of Sample Measurements (N)	11	12	11	12	12
Standard Uncertainty (*u*)	0.01	0.04	0.02	0.09	0.05

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.

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Results for Event #3, 2024:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
	Target	**0.53**	**1.99**	**0.94**	**8.00**	**3.65**
103	ICP-MS/MS	0.513	2.00	0.902	7.94	3.57
107	ICP-MS/MS	0.491	1.90	0.916	7.91	3.63
110	ICP-MS/MS	0.51	1.96	0.93	7.92	3.57
116	ICP-MS/MS	<1.50	2.00	<1.50	8.63	3.34
147	ICP-MS	0.532	2.05	0.930	7.98	3.68
247	ICP-MS/MS	0.543	2.09	0.959	7.94	3.87
264	ICP-MS	0.37	1.80	0.98	7.37	3.49
293	DRC/CC-ICP-MS	0.54	1.88	0.880	7.6	3.66
465	ICP-MS	1.14	1.89	0.98	8.21	3.54
597	ICP-MS/MS	0.524	1.99	0.916	8.01	3.68
605	ICP-MS	0.542	2.13	0.964	8.41	3.80
686	ICP-MS	0.552	2.12	0.983	8.70	4.03

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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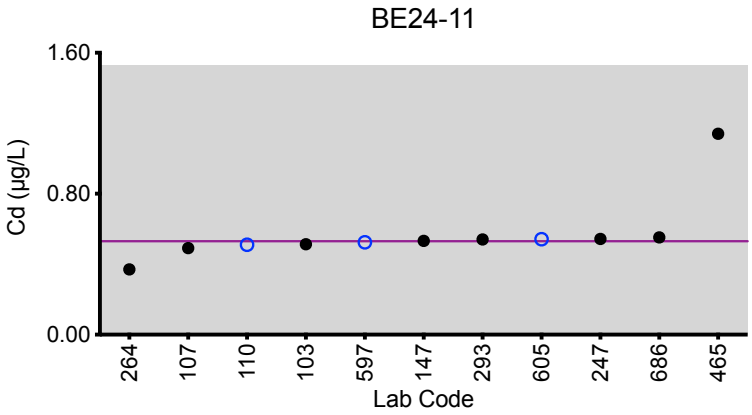
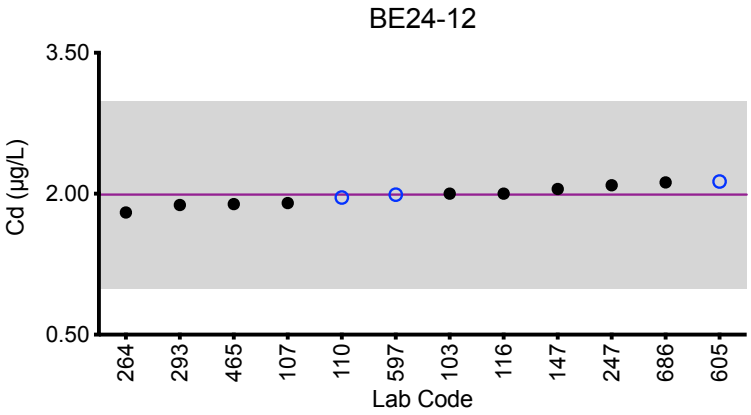
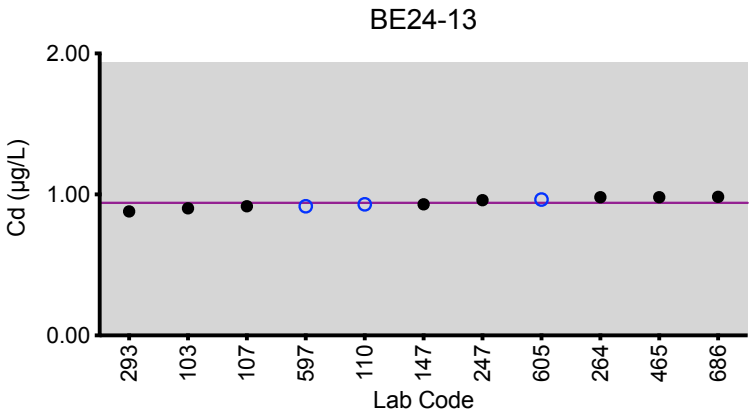
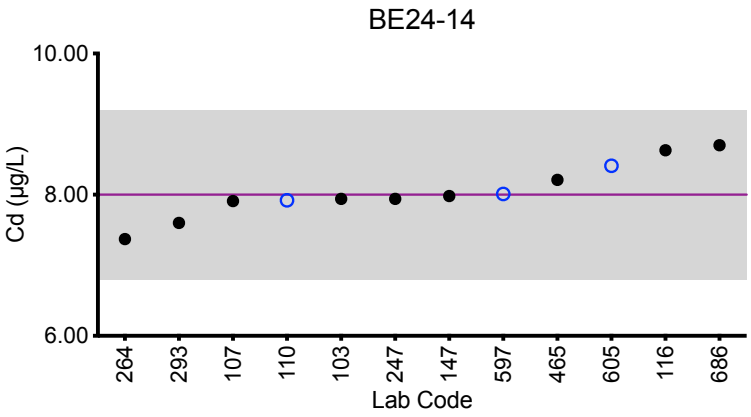
Results for Event #3, 2024: Summary Figures

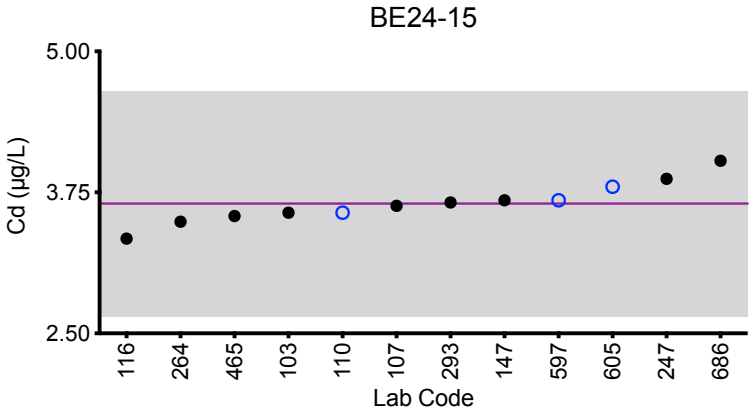
Whole Blood Cd











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 #3, 2024: Summary Statistics

Whole Blood Co (µg/L)					
	BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Target (Arithmetic Mean ($\bar{x}$))	0.60	5.38	31.6	9.79	3.65
Upper Limit	2.10	6.88	37.9	11.75	5.15
Lower Limit	0.00	3.88	25.3	7.83	2.15
Arithmetic SD (s)	0.06	0.13	1.4	0.24	0.13
Arithmetic RSD (%)	10	2.4	4.4	2.5	3.6
Number of Sample Measurements (N)	8	8	8	7	8

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

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Results for Event #3, 2024:
Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
	Target	**0.60**	**5.38**	**31.6**	**9.79**	**3.65**
103	ICP-MS/MS	0.580	5.26	31.0	9.67	3.54
110	ICP-MS/MS	0.6	5.4	32.4	10.0	3.8
147	ICP-MS	0.670	5.56	32.9	10.1	3.81
247	ICP-MS/MS	0.670	5.57	33.4	9.68	3.73
255	ICP-MS	0.58	5.3	31	9.8	3.6
264	ICP-MS	0.50	5.21	30.87	9.38	3.45
293	DRC/CC-ICP-MS	0.57	5.36	28.89	*8.66	3.57
597	ICP-MS/MS	0.638	5.40	32.1	9.87	3.68

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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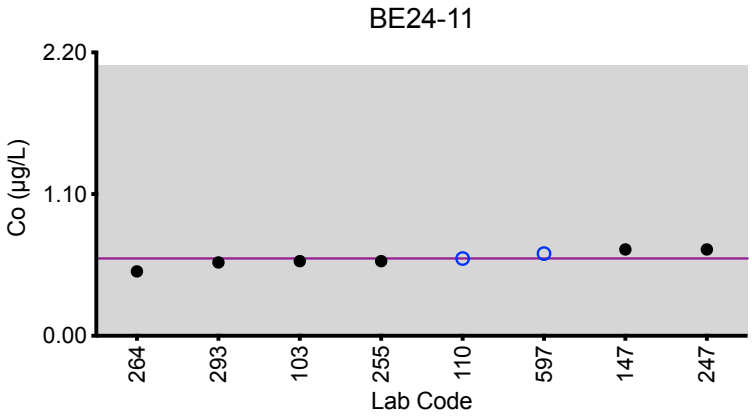
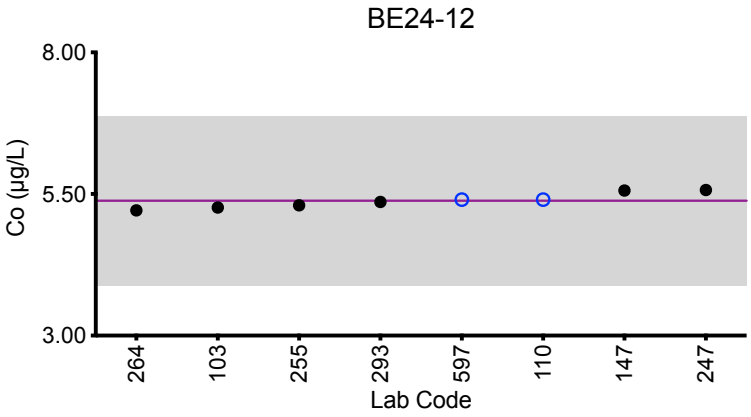
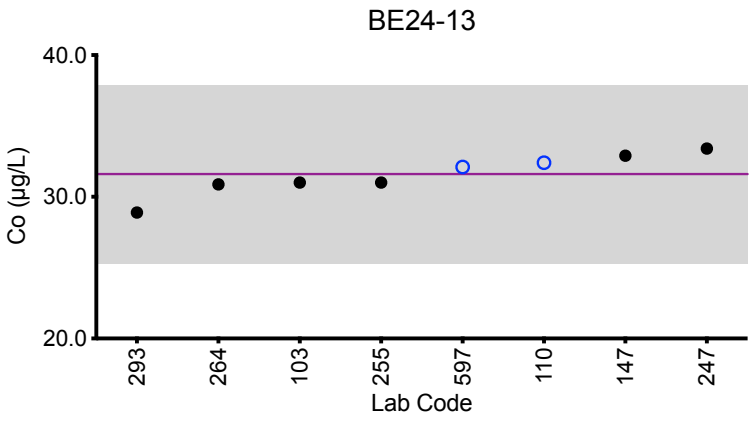
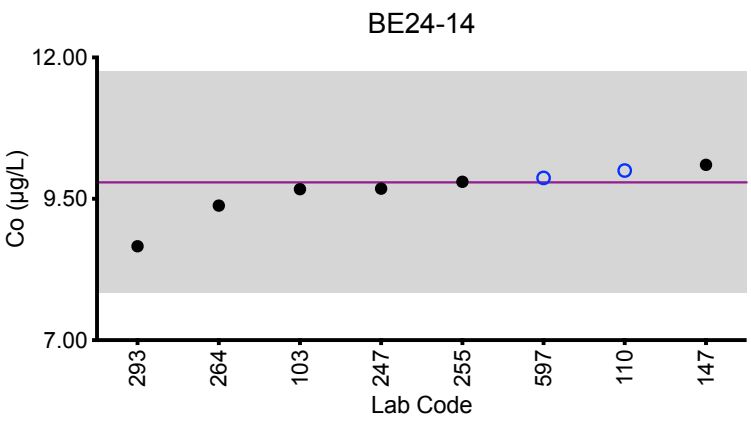
Results for Event #3, 2024: Summary Figures

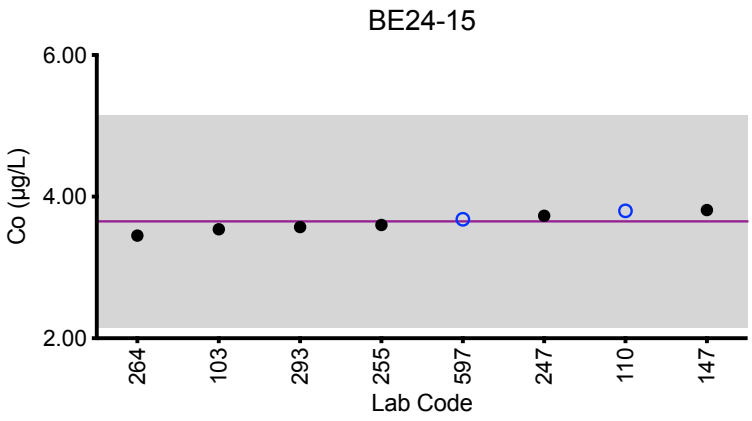
Whole Blood Co











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 #3, 2024:
Summary Statistics

Whole Blood Cr (µg/L)					
	BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Target (Arithmetic Mean ($\bar{x}$))	0.73	5.73	8.6	3.4	1.65
Upper Limit	2.73	7.73	10.6	5.4	3.65
Lower Limit	0.00	3.73	6.6	1.4	0.00
Arithmetic SD (s)	0.15	0.14	0.5	0.5	0.15
Arithmetic RSD (%)	21	2.4	5.8	15	9.1
Number of Sample Measurements (N)	7	7	8	8	7

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

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Results for Event #3, 2024:
Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
	Target	**0.73**	**5.73**	**8.6**	**3.4**	**1.65**
103	ICP-MS/MS	0.818	5.60	8.48	3.43	1.56
110	ICP-MS/MS	0.5	5.7	8.3	4.0	1.5
147	DRC/CC-ICP-MS	0.879	5.91	9.27	3.75	1.79
247	ICP-MS/MS	0.847	5.90	8.79	3.41	1.82
255	ICP-MS	<1.0	5.7	9.4	3.5	1.7
264	ICP-MS	0.70	*4.63	8.07	2.32	*0.67
293	DRC/CC-ICP-MS	0.82	5.73	7.87	3.21	1.75
597	ICP-MS/MS	0.574	5.54	8.41	3.27	1.46

Based on the grading criteria for Cr 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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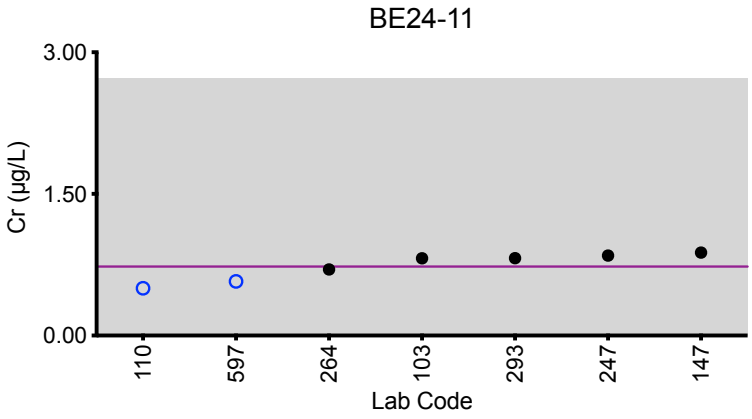
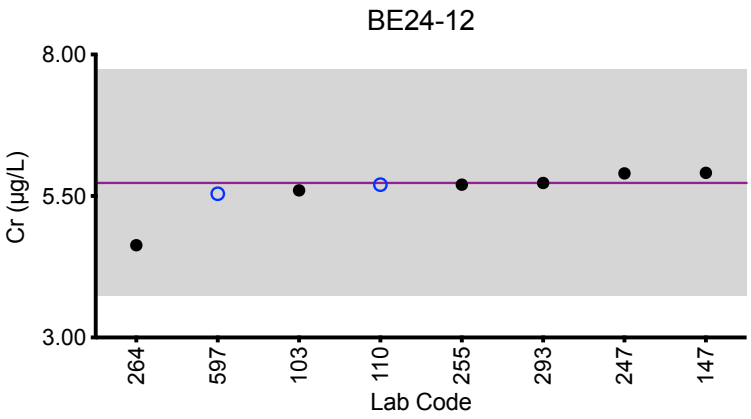
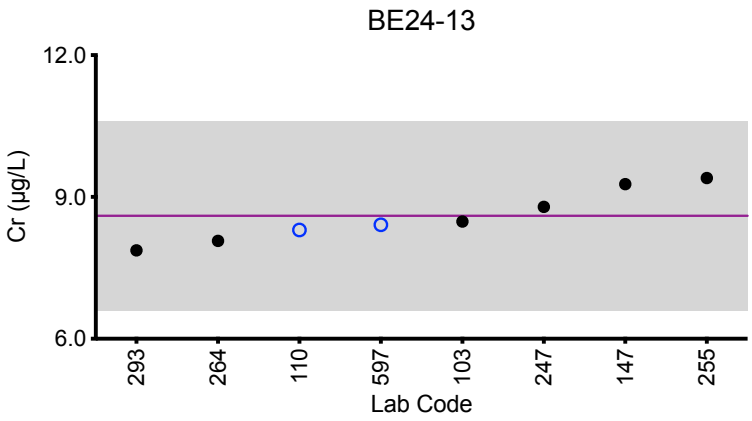
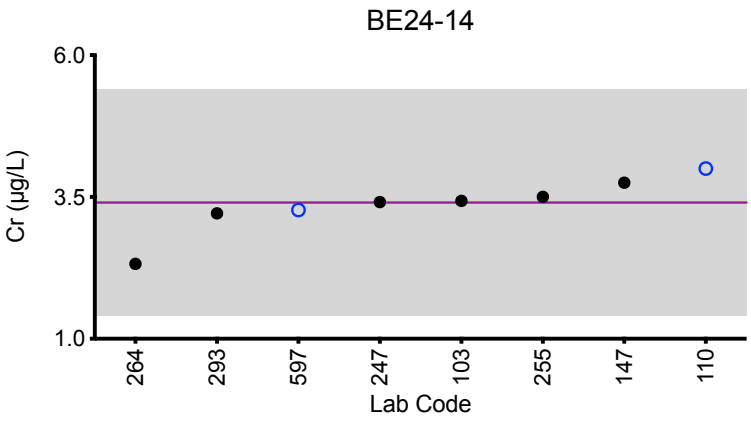
Results for Event #3, 2024: Summary Figures

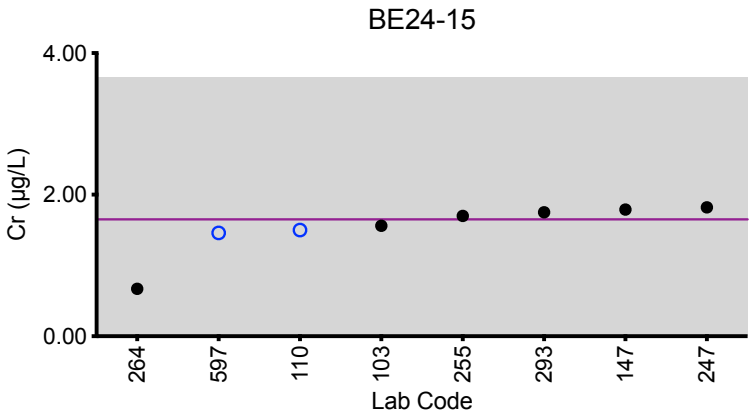
Whole Blood Cr











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 #3, 2024: Summary Statistics

Whole Blood Hg (µg/L)					
	BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Target (Robust Mean (x*))	11.3	2.6	5.6	0.64	8.3
Upper Limit	14.7	5.6	8.6	3.64	11.3
Lower Limit	7.9	0.0	2.6	0.00	5.3
Robust SD (s*)	1.0	0.3	0.3	0.05	0.9
Robust RSD (%)	8.8	11	6.3	7.8	11
Number of Sample Measurements (N)	14	14	14	13	14
Standard Uncertainty (*u*)	0.3	0.1	0.1	0.02	0.3

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 #3, 2024:
Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
	Target	**11.3**	**2.6**	**5.6**	**0.64**	**8.3**
103	ICP-MS/MS	11.8	2.77	5.78	0.623	8.55
107	ICP-MS/MS	11.7	2.67	5.65	0.638	8.48
110	ICP-MS/MS	11.1	2.60	5.51	0.66	8.13
116	ICP-MS/MS	12.6	2.88	6.29	<1.50	9.25
147	ICP-MS	11.5	2.84	5.75	0.647	8.81
247	ICP-MS/MS	11.7	2.45	5.61	0.568	8.93
264	ICP-MS	8.40	2.31	5.01	0.58	7.54
293	DRC/CC-ICP-MS	9.8	2.28	4.7	0.50	6.95
391	CV-AAS	14.5	3.41	7.6	0.82	10.22
465	ICP-MS	10.8	2.47	5.41	0.63	7.38
490	CV-AAS	9.6655	1.4677	3.4444	0.7210	5.3279
597	ICP-MS/MS	9.95	2.35	4.81	0.61	7.26
605	ICP-MS	11.8	2.79	5.80	0.652	8.69
686	ICP-MS	11.9	2.74	5.72	0.669	8.65

Based on the grading criteria for Hg 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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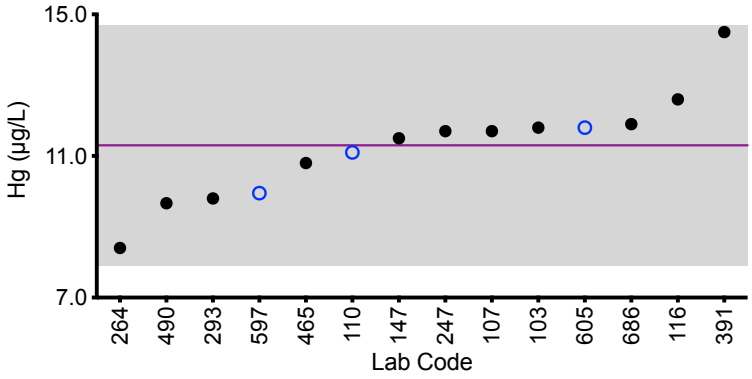
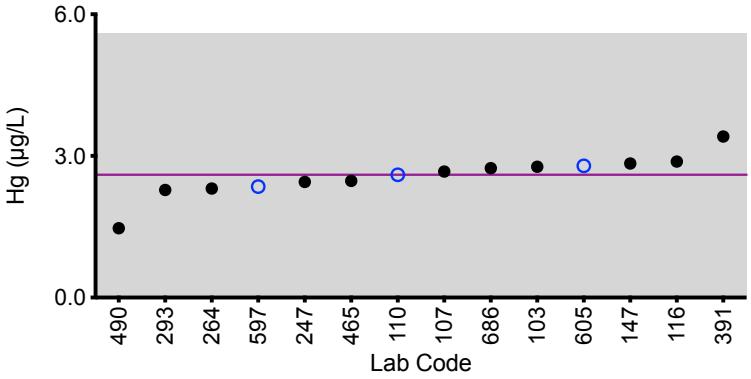
Results for Event #3, 2024: Summary Figures

Whole Blood Hg

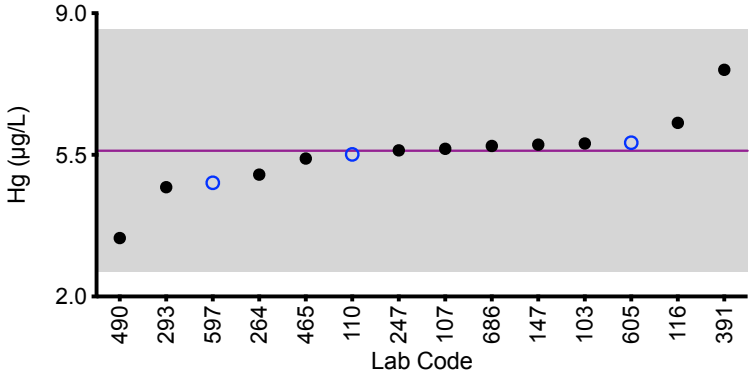
BE24-11



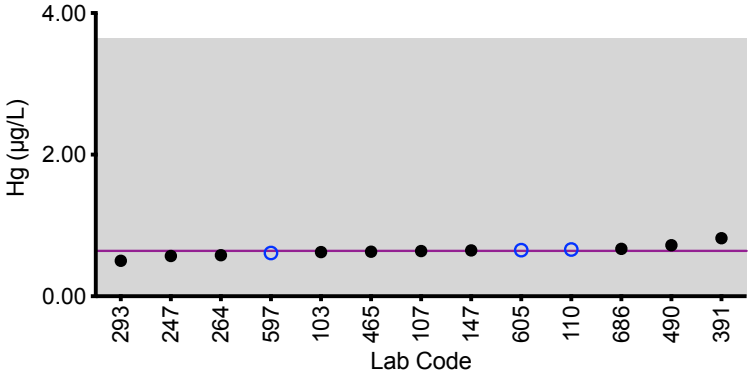
BE24-12



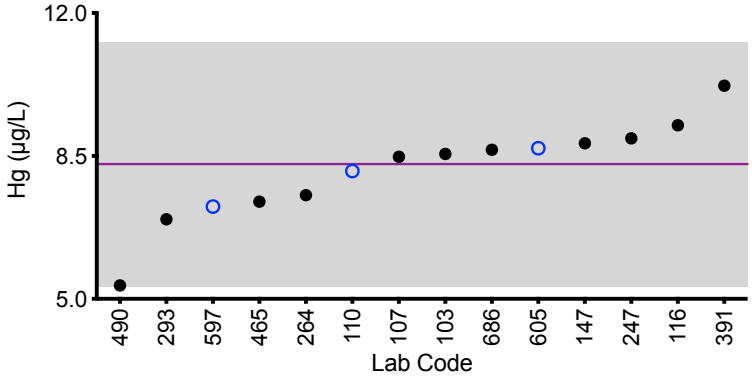
BE24-13



BE24-14



BE24-15



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 #3, 2024: Summary Statistics

Whole Blood Mn (µg/L)					
	BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Target (Arithmetic Mean ($\bar{x}$))	20.4	28.4	11.1	36.6	18.3
Upper Limit	23.9	33.2	14.1	42.8	21.4
Lower Limit	16.9	23.6	8.1	30.4	15.2
Arithmetic SD (s)	1.5	1.3	2.0	2.4	1.6
Arithmetic RSD (%)	7.4	4.6	18	6.6	8.7
Number of Sample Measurements (N)	8	8	8	8	8

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 #3, 2024:
Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
	Target	**20.4**	**28.4**	**11.1**	**36.6**	**18.3**
103	ICP-MS/MS	19.3	27.4	10.5	35.4	17.3
107	ICP-MS/MS	19.8	27.7	10.7	36.7	17.7
110	ICP-MS/MS	19.8	27.5	10.3	36.1	17.4
147	ICP-MS	22.5	30.7	13.2	39.7	20.5
247	ICP-MS/MS	21.1	28.9	11.1	36.5	18.1
264	ICP-MS	22.53	29.98	14.67 ↑	39.51	21.06
293	DRC/CC-ICP-MS	18.7	27.46	8.4	32.2	16.75
597	ICP-MS/MS	19.6	27.6	9.90	36.5	17.2

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

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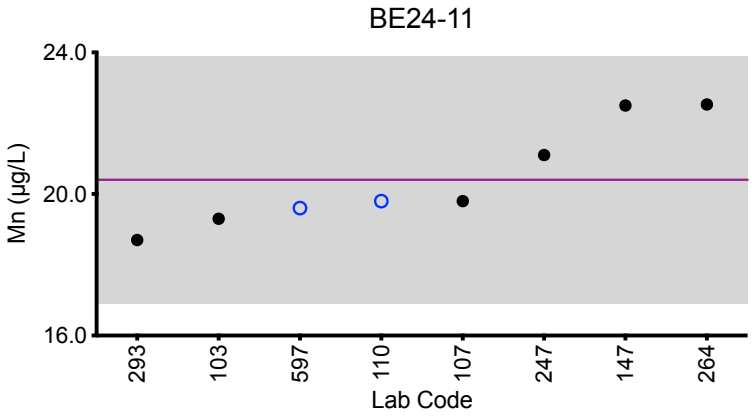
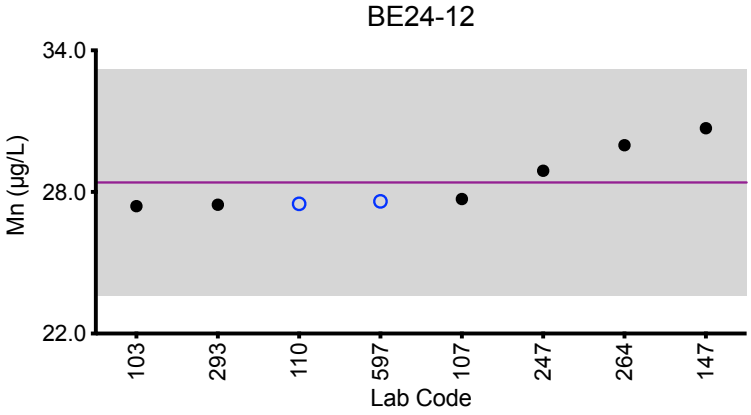
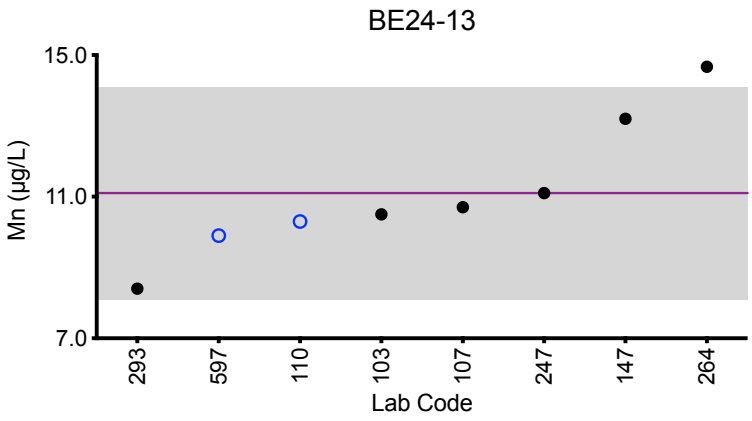
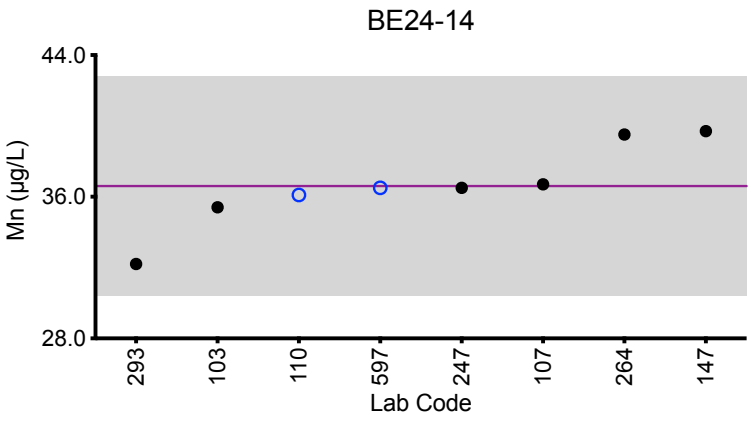
Results for Event #3, 2024: Summary Figures

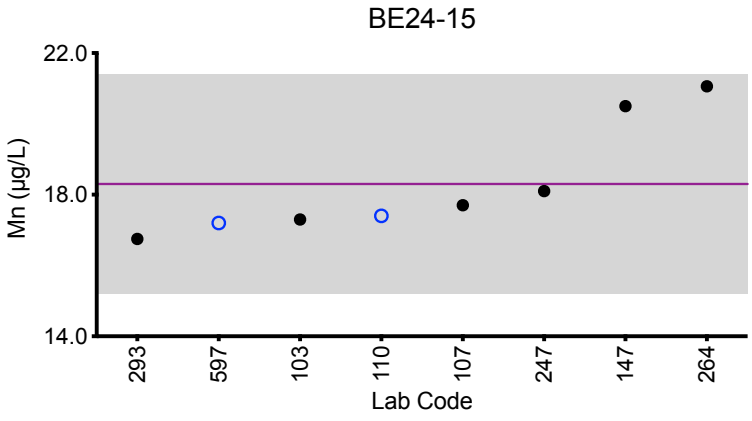
Whole Blood Mn











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 #3, 2024: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Target (Robust Mean (x*))	2.51	0.71	5.58	21.9	9.7
Upper Limit	4.51	2.71	7.58	24.1	11.7
Lower Limit	0.51	0.00	3.58	19.7	7.7
Robust SD (s*)	0.13	0.07	0.27	1.4	0.7
Robust RSD (%)	5.2	9.9	4.8	6.4	7.2
Number of Sample Measurements (N)	12	9	13	14	14
Standard Uncertainty (*u*)	0.05	0.03	0.09	0.5	0.2

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 BE24-12.

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Results for Event #3, 2024:
Performance of Participating Laboratories

Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
	Target	**2.51**	**0.71**	**5.58**	**21.9**	**9.7**
103	ICP-MS/MS	2.58	0.728	5.70	22.2	9.82
107	ICP-MS/MS	2.58	0.716	5.72	22.9	10.1
110	ICP-MS/MS	2.44	0.66	5.51	22.2	9.75
116	ICP-MS/MS	<3.00	<3.00	5.84	23.0	10.4
147	ICP-MS	2.68	0.767	5.82	23.0	10.6
247	ICP-MS/MS	2.55	0.719	5.67	22.3	9.94
264	ICP-MS	2.30	0.65	5.15	20.55	9.19
293	DRC/CC-ICP-MS	2.48	0.62	4.96	19.4 ↓	9.51
343	ASV-LeadCare	<3.3	<3.3	<3.3 ↓	18.8 ↓	7.6 ↓
391	ETAAS-Z	1.42	<0.500	4.21	19.1 ↓	7.80
465	ICP-MS	2.38	0.86	5.31	20.4	8.58
597	ICP-MS/MS	2.46	0.693	5.40	21.5	9.59
605	ICP-MS	2.67	<1.00	5.96	23.9	10.4
686	ICP-MS	2.58	<1.00	5.71	23.1	10.1

Based on the grading criteria for Pb in Whole Blood, 93% of results were satisfactory, with 1 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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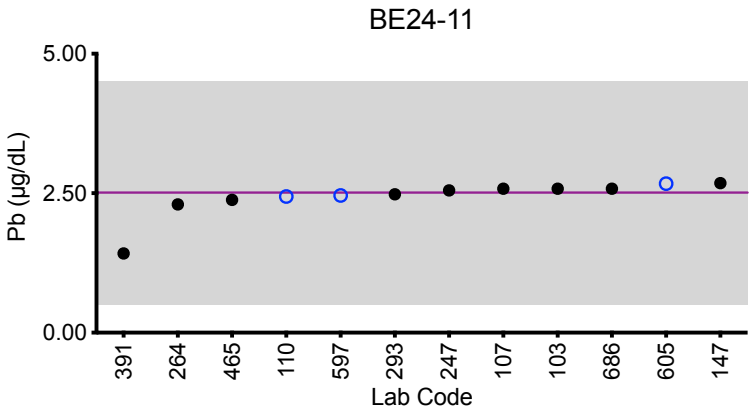
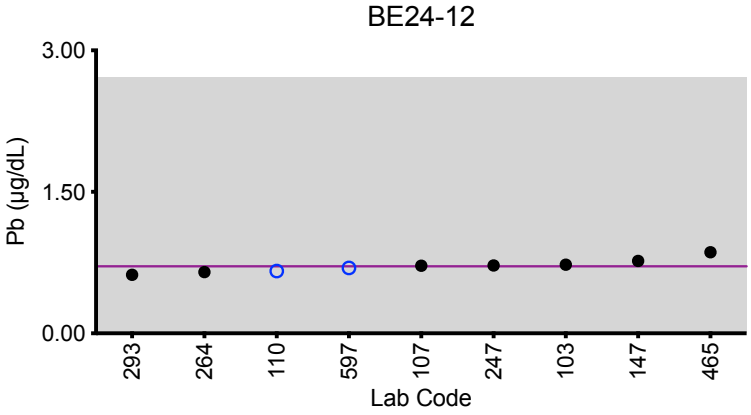
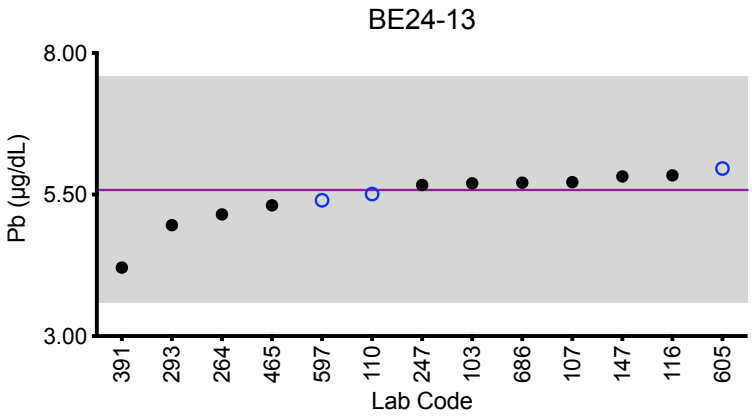
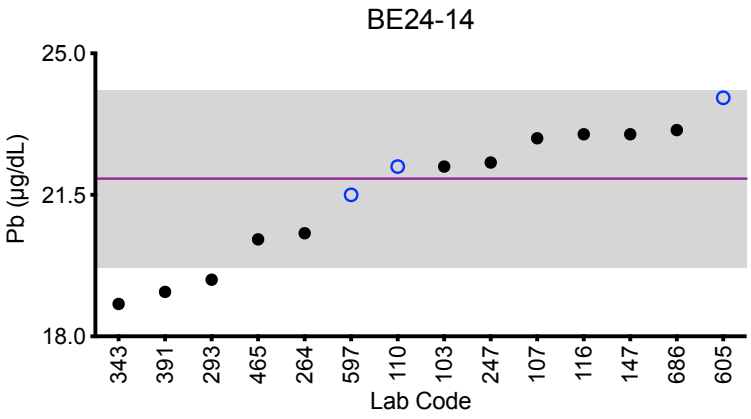
Results for Event #3, 2024: Summary Figures

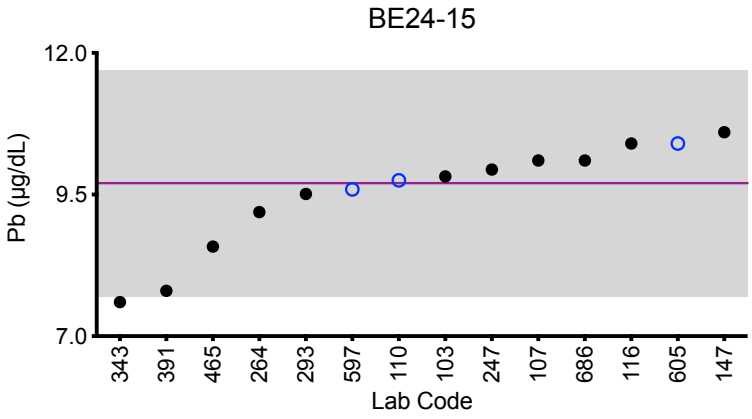
Whole Blood Pb











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:

±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 #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
103	ICP-MS/MS	11.3	7.16	0.510	4.13	2.05
110	ICP-MS/MS	11.4	7.46	0.42	4.42	2.28
147	ICP-MS	11.9	7.56	0.536	4.41	2.32
264	ICP-MS	*23.59	*20.05	*12.87	*15.92	*14.23
442	DRC/CC-ICP-MS	11.7	7.47	0.395	4.37	2.13
597	ICP-MS/MS	9.87	6.56	0.556	3.82	2.22

Summary Statistics

	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
Arithmetic Mean ($\bar{x}$)	11.2	7.2	0.48	4.2	2.20
Arithmetic SD (s)	0.8	0.4	0.07	0.3	0.11
Arithmetic RSD (%)	7.1	5.6	15	6.1	5.0
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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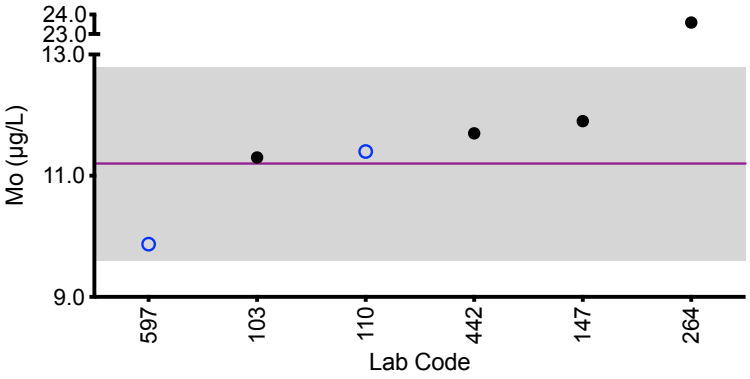
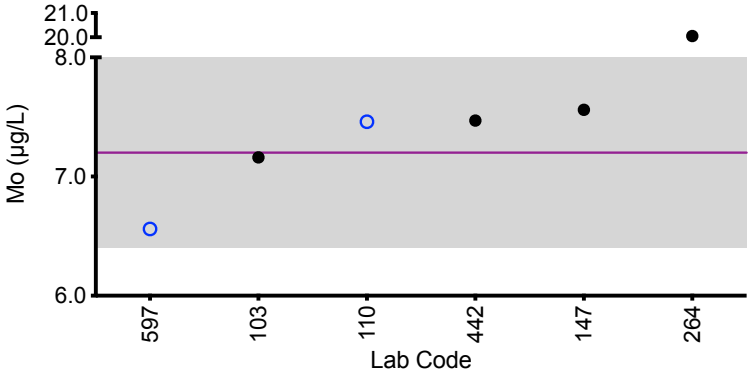
Results for Event #3, 2024: Summary Figures

Whole Blood Mo

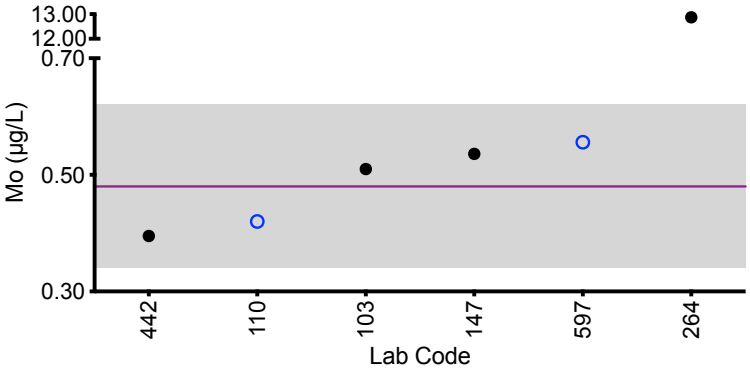
BE24-11



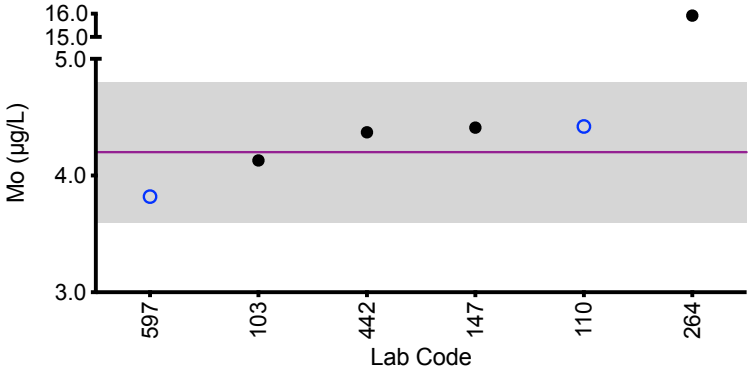
BE24-12



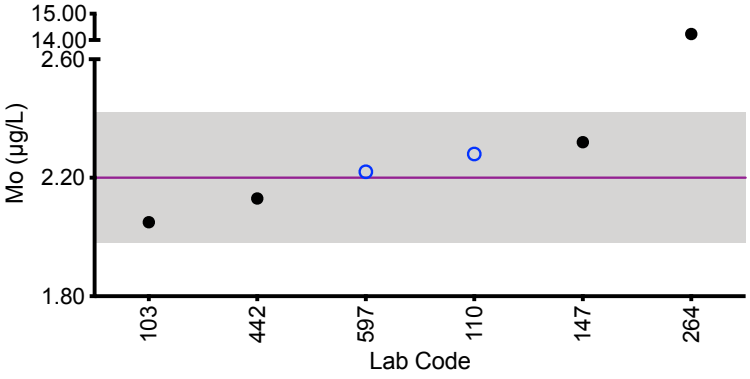
BE24-13



BE24-14



BE24-15



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 #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
103	ICP-MS/MS	2.12	6.05	0.698	3.16	1.34
110	ICP-MS/MS	2.10	6.02	0.73	3.28	1.32
147	ICP-MS	2.15	6.27	0.704	3.27	1.40
264	ICP-MS	*1.82	*4.79	0.58	2.70	*1.03
293	DRC/CC-ICP-MS	2.2	6.2	0.7	3.4	1.4
442	DRC/CC-ICP-MS	2.08	6.31	0.596	*4.82	1.31
597	ICP-MS/MS	2.12	6.07	0.783	3.25	1.39

Summary Statistics

	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
Arithmetic Mean ($\bar{x}$)	2.13	6.15	0.68	3.2	1.36
Arithmetic SD (s)	0.04	0.12	0.07	0.3	0.04
Arithmetic RSD (%)	1.9	2.0	10	7.9	2.9
Number of Sample Measurements (N)	6	6	7	6	6

*Denotes a statistical Outlier.

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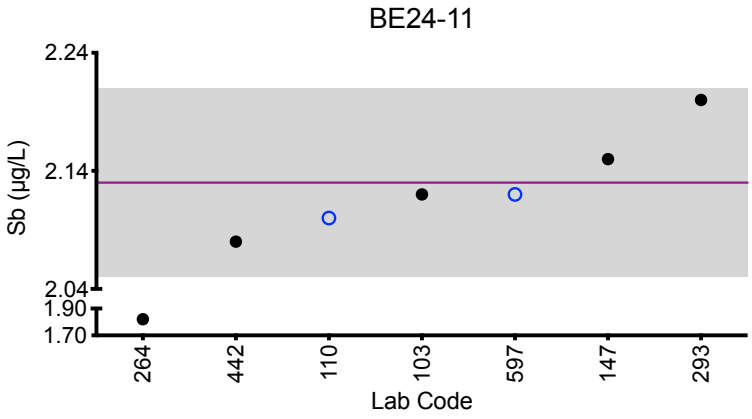
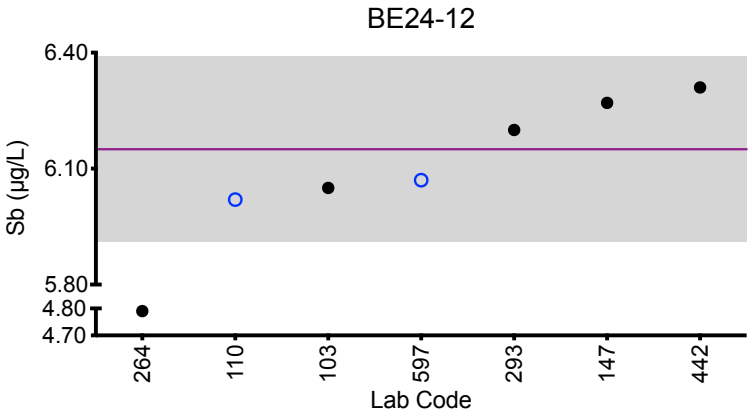
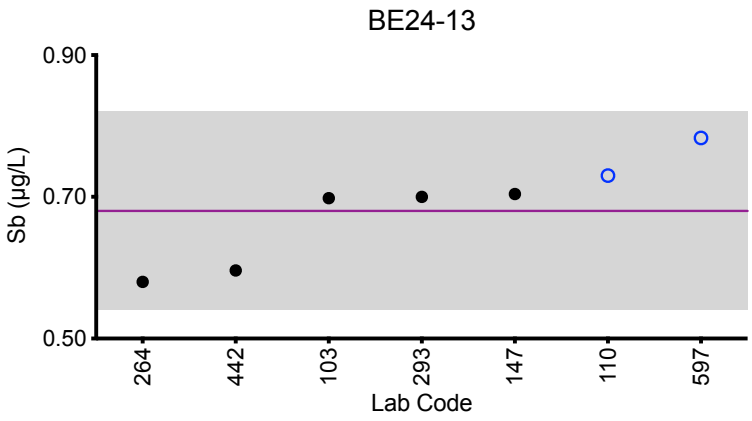
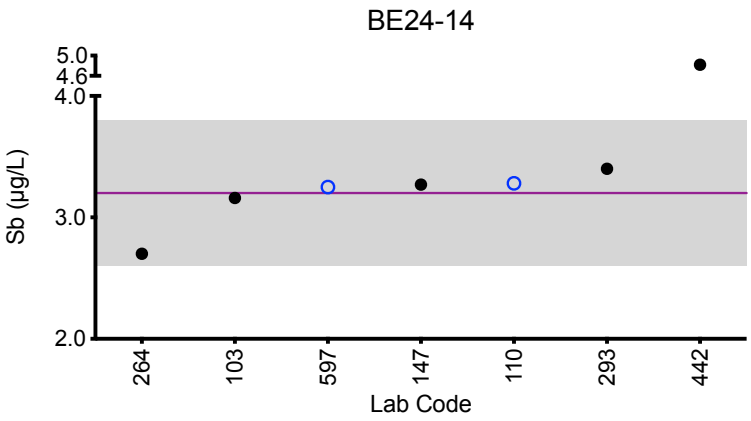
Results for Event #3, 2024: Summary Figures

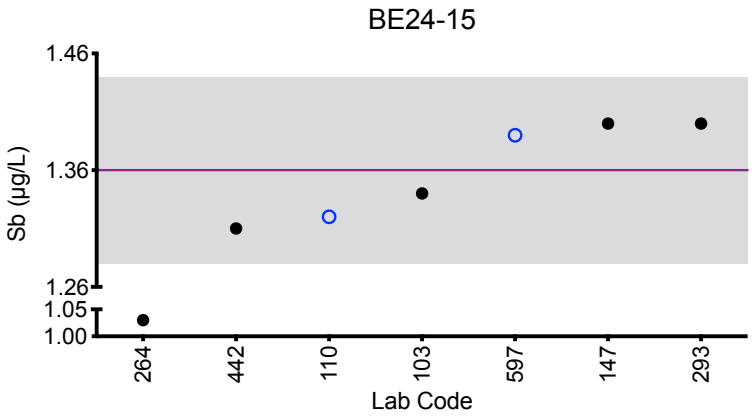
Whole Blood Sb











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 #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
103	ICP-MS/MS	205	142	375	247	232
107	ICP-MS/MS	205	138	372	249	228
110	ICP-MS/MS	193	132	355	240	219
147	ICP-MS	192	131	356	231	222
247	ICP-MS/MS	232	155	407	260	247
264	ICP-MS	*137	106	284	196	*172
293	DRC/CC-ICP-MS	209	140	358	235	221
597	ICP-MS/MS	193	132	348	231	216

Summary Statistics					
	BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)	204	135	357	236	226
Arithmetic SD (s)	14	14	35	19	11
Arithmetic RSD (%)	6.9	10	9.8	8.1	4.9
Number of Sample Measurements (N)	7	8	8	8	7

*Denotes a statistical Outlier.

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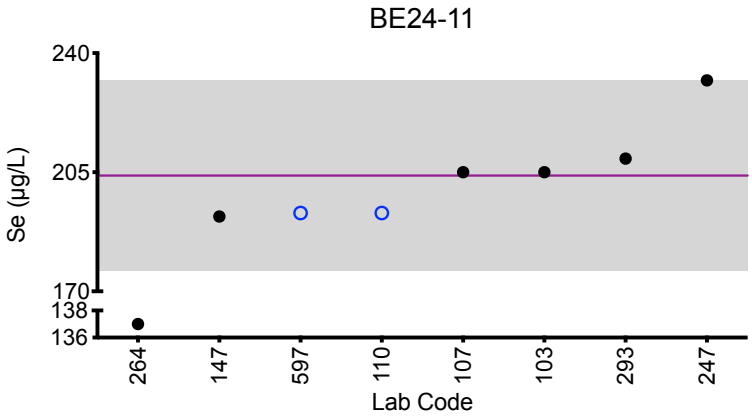
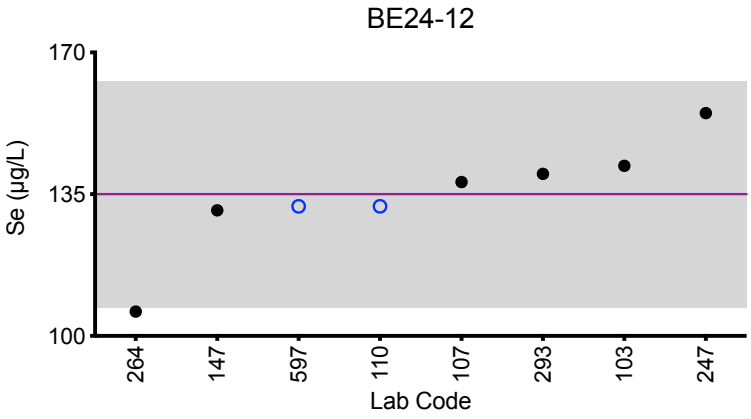
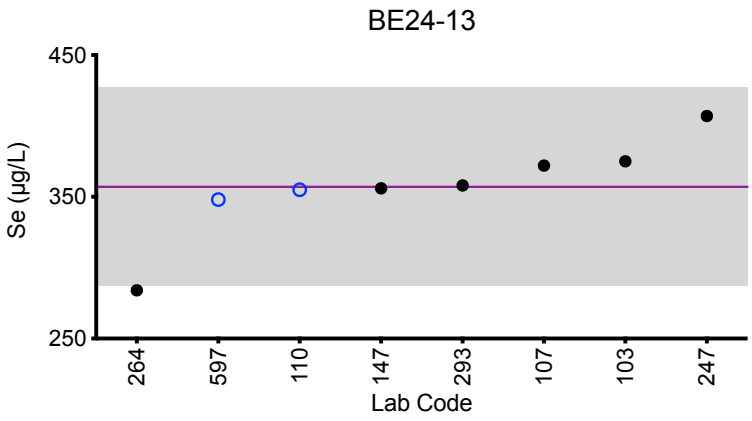
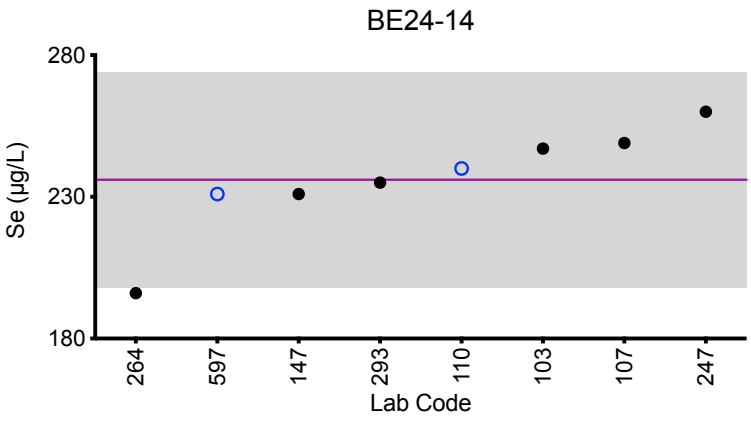
Results for Event #3, 2024: Summary Figures

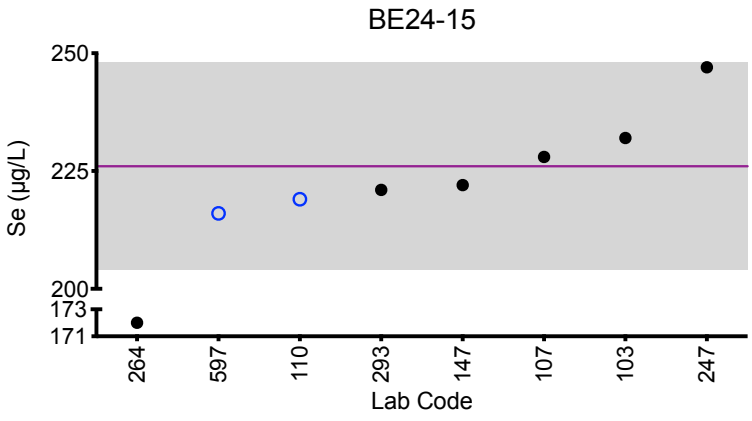
Whole Blood Se











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 #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Tl (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
103	ICP-MS/MS	2.09	0.777	0.167	0.361	1.13
110	ICP-MS/MS	2.10	0.765	0.171	0.359	1.15
147	ICP-MS	2.24	0.852	0.178	0.379	1.24
264	ICP-MS	1.92	0.71	0.15	0.34	1.05
293	DRC/CC-ICP-MS	1.97	0.71	0.160	0.34	1.07
597	ICP-MS/MS	2.05	0.761	0.175	0.360	1.12

Summary Statistics

	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
Arithmetic Mean ($\bar{x}$)	2.06	0.76	0.167	0.356	1.13
Arithmetic SD (s)	0.11	0.05	0.010	0.015	0.07
Arithmetic RSD (%)	5.3	6.6	6.0	4.2	6.2
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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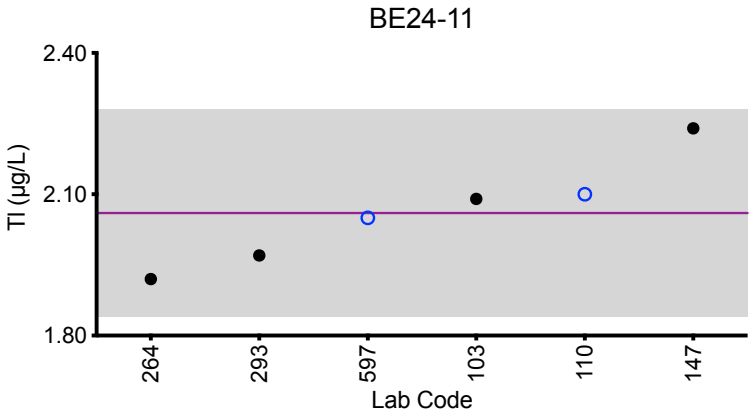
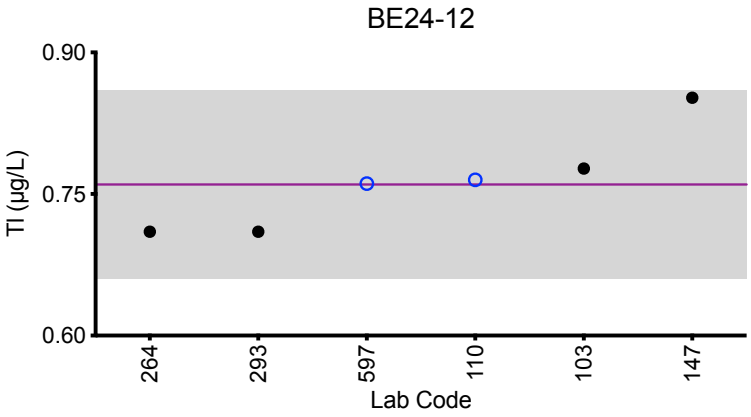
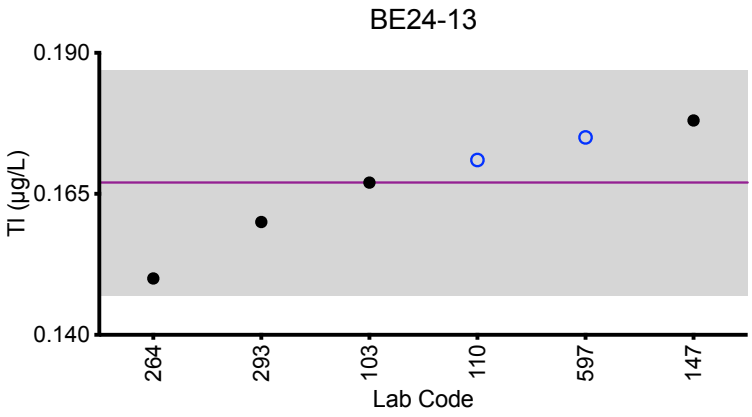
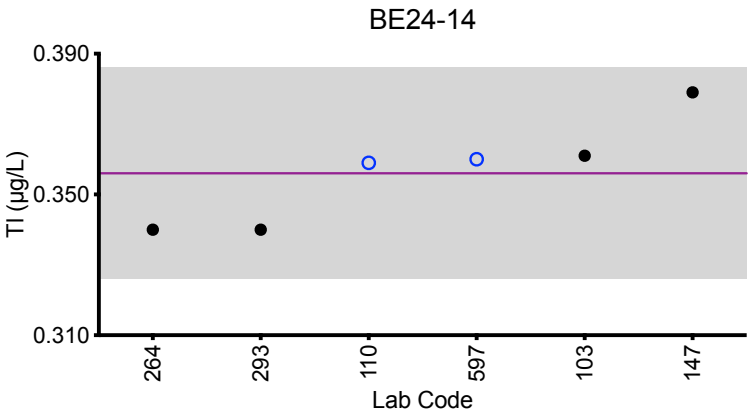
Results for Event #3, 2024: Summary Figures

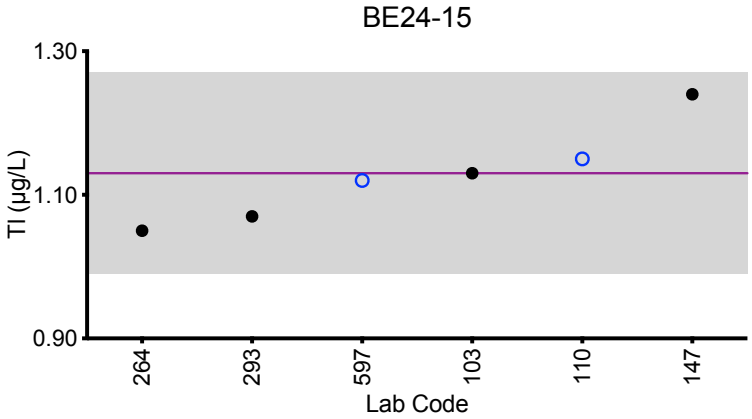
Whole Blood Tl











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 #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
110	ICP-MS/MS	1.51	2.58	4.61	8.75	0.95
147	ICP-MS	1.47	2.53	4.40	8.31	0.862
597	ICP-MS/MS	1.55	2.72	4.57	8.53	0.993
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		1.51	2.61	4.53	8.5	0.94
Arithmetic SD (s)		0.04	0.10	0.11	0.2	0.07
Arithmetic RSD (%)		2.6	3.8	2.4	2.6	7.4
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
110	ICP-MS/MS	1.13	1.05	2.04	0.69	0.60
147	ICP-MS	1.22	1.00	2.15	<0.991	<0.991
597	ICP-MS/MS	1.14	0.947	2.04	0.730	0.582
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		1.16	1.00	2.08	0.71	0.591
Arithmetic SD (s)		0.05	0.05	0.06	0.03	0.013
Arithmetic RSD (%)		4.3	5.0	2.9	4.2	2.2
Number of Sample Measurements (N)		3	3	3	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
110	ICP-MS/MS	1.29	1.27	2.29	2.28	0.79
147	ICP-MS	1.33	1.30	2.33	2.28	0.813
597	ICP-MS/MS	1.30	1.31	2.24	2.28	0.790

Summary Statistics

	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
Arithmetic Mean ($\bar{x}$)	1.31	1.29	2.29	2.28	0.798
Arithmetic SD (s)	0.02	0.02	0.05	0.00	0.013
Arithmetic RSD (%)	1.6	1.6	2.2	0.0	1.6
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
110	ICP-MS/MS	1130	1530	885	1310	1180
147	ICP-MS	1218	1616	966	1370	1280
247	ICP-MS/MS	1252	1674	987	1359	1280
597	ICP-MS/MS	1080	1460	846	1240	1130
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		1170	1570	920	1320	1220
Arithmetic SD (s)		80	90	70	60	80
Arithmetic RSD (%)		6.8	5.7	7.6	4.5	6.6
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood I (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
147	ICP-MS	21.1	20.7	22.8	22.5	36.1
597	ICP-MS/MS	23.2	22.7	24.6	24.9	39.8

Summary Statistics

	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
Arithmetic Mean ($\bar{x}$)	22	22	23.7	24	38
Arithmetic SD (s)	2	1	1.3	2	3
Arithmetic RSD (%)	6.8	6.5	5.5	7.2	7.9
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
103	ICP-MS/MS	2.92	1.70	13.3	1.13	2.47
110	ICP-MS/MS	4.21	1.98	15.9	1.07	3.01
147	ICP-MS	2.79	1.42	14.8	0.719	2.60
597	ICP-MS/MS	3.09	1.76	15.2	0.885	2.79
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		3.3	1.7	14.8	0.95	2.7
Arithmetic SD (s)		0.7	0.2	1.1	0.19	0.2
Arithmetic RSD (%)		21	13	7.4	20	8.8
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Pt (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
110	ICP-MS/MS	0.114	1.25	0.329	1.02	0.719
293	DRC/CC-ICP-MS	0.09	1.21	0.29	0.93	0.68
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		0.10	1.23	0.31	0.97	0.70
Arithmetic SD (s)		0.02	0.03	0.03	0.06	0.03
Arithmetic RSD (%)		17	2.4	9.7	6.2	4.3
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
110	ICP-MS/MS	2.91	2.04	0.87	5.35	0.62
147	ICP-MS	3.03	2.12	0.903	5.21	0.688
597	ICP-MS/MS	2.95	2.10	0.990	5.30	0.655
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		2.96	2.09	0.92	5.29	0.65
Arithmetic SD (s)		0.06	0.04	0.06	0.07	0.03
Arithmetic RSD (%)		2.0	1.9	6.5	1.3	4.6
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
103	ICP-MS/MS	28.9	28.1	40.3	40.8	32.7
110	ICP-MS/MS	28.5	28.6	40.7	41.4	32.4
147	ICP-MS	29.1	28.4	42.3	41.1	33.2
597	ICP-MS/MS	28.4	28.2	40.5	40.5	32.4
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		28.7	28.3	41.0	41.0	32.7
Arithmetic SD (s)		0.3	0.2	0.9	0.4	0.4
Arithmetic RSD (%)		1.0	0.78	2.2	0.98	1.2
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Ti (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
442	ICP-MS/MS	1.13	11.3	2.63	6.85	4.68
597	ICP-MS/MS	3.45	14.0	4.38	8.75	6.61
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		NA	13	3.5	8	6
Arithmetic SD (s)		NA	2	1.2	1	1
Arithmetic RSD (%)		NA	15	34	17	25
Number of Sample Measurements (N)		NA	2	2	2	2

*Denotes a statistical Outlier.

Statistical data was not calculated for BE24-11 based on a lack of consensus among participating labs.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
103	ICP-MS/MS	0.0345	0.230	0.0708	0.119	0.0261
110	ICP-MS/MS	0.0333	0.217	0.0661	0.114	0.0253
147	ICP-MS	0.0340	0.205	0.0635	0.114	0.0255
597	ICP-MS/MS	0.0375	0.211	0.0670	0.117	0.0304
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		0.0348	0.216	0.067	0.116	0.027
Arithmetic SD (s)		0.0019	0.011	0.003	0.002	0.002
Arithmetic RSD (%)		5.5	5.1	4.5	2.1	9.0
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
110	ICP-MS/MS	0.44	1.69	3.49	0.28	0.81
147	DRC/CC-ICP-MS	0.445	1.75	3.63	0.252	0.842
597	ICP-MS/MS	0.397	1.59	3.32	0.228	0.749
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		0.43	1.68	3.48	0.25	0.80
Arithmetic SD (s)		0.03	0.08	0.16	0.03	0.05
Arithmetic RSD (%)		7.0	4.8	4.6	12	6.3
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
110	ICP-MS/MS	0.37	1.65	1.01	0.69	0.23
200	ICP-MS	0.35	1.46	0.91	0.62	0.22
597	ICP-MS/MS	0.398	1.60	0.966	0.667	0.255

Summary Statistics

	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
Arithmetic Mean ($\bar{x}$)	0.37	1.57	0.96	0.66	0.24
Arithmetic SD (s)	0.02	0.10	0.05	0.04	0.02
Arithmetic RSD (%)	6.4	6.4	5.2	6.1	7.7
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)						
Lab Code	**Method**	**BE24-11**	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
110	ICP-MS/MS	4980	6780	12300	3810	6290
147	ICP-MS	5750	7558	13266	4362	7199
247	ICP-MS/MS	4976	6693	12148	3743	6183
597	ICP-MS/MS	5020	6840	13800	3820	6330
Summary Statistics						
		BE24-11	**BE24-12**	**BE24-13**	**BE24-14**	**BE24-15**
Arithmetic Mean ($\bar{x}$)		5200	7000	12900	3930	6500
Arithmetic SD (s)		400	400	800	290	500
Arithmetic RSD (%)		7.7	5.7	6.2	7.4	7.7
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
147	ICP-MS	<0.129	<0.129	<0.129	<0.129	<0.129

Whole Blood Al (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
147	ICP-MS	<5.13	<5.13	<5.13	<5.13	<5.13
597	ICP-MS/MS	2.18	2.67	3.94	5.41	3.93

Whole Blood Bi (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
147	ICP-MS	<0.0376	<0.0376	<0.0376	<0.0376	<0.0376
597	ICP-MS/MS	<0.00598	<0.00598	0.0116	0.00608	<0.00598

Whole Blood Li (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
147	ICP-MS	0.427	0.387	0.707	0.740	0.510

Whole Blood Mg (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
597	ICP-MS/MS	25100	24800	29000	29000	28200

Whole Blood Te (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
110	ICP-MS/MS	<0.007	<0.007	<0.007	0.013	<0.007
147	ICP-MS	<0.0740	<0.0740	<0.0740	<0.0740	<0.0740

Whole Blood Th (µg/L)

Lab Code	Method	BE24-11	BE24-12	BE24-13	BE24-14	BE24-15
147	ICP-MS	<0.0255	<0.0255	<0.0255	<0.0255	<0.0255
597	ICP-MS/MS	<0.00458	<0.00458	<0.00458	<0.00458	<0.00458

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Event #3, 2024

Trace Elements in Urine

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Trace Elements Laboratory

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Event #3, 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 #3, 2024: Summary Statistics

	Urine As (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Robust Mean (x*))	35.0	27.5	5.9	1.97	10.5
Upper Limit	42.0	33.5	11.9	7.97	16.5
Lower Limit	28.0	21.5	0.0	0.00	4.5
Robust SD (s*)	1.0	0.9	0.4	0.14	0.5
Robust RSD (%)	2.9	3.3	6.3	7.0	4.8
Number of Sample Measurements (N)	12	12	11	8	12
Standard Uncertainty (*u*)	0.4	0.3	0.1	NA	0.2

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.

An arithmetic mean, SD, RSD and n are provided for sample UE24-14.

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Urine As (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**35.0**	**27.5**	**5.9**	**1.97**	**10.5**
103	ICP-MS/MS	35.4	27.8	5.93	1.85	10.2
107	DRC/CC-ICP-MS	35.5	27.9	5.92	2.01	10.3
110	ICP-MS/MS	36.0	28.3	5.97	1.95	10.5
116	ICP-MS/MS	39.0	30.3	6.54	<6.00	11.5
147	ICP-MS	35.3	28.3	6.17	2.24	11.2
264	ICP-MS	35.17	26.94	5.87	1.92	10.44
293	DRC/CC-ICP-MS	34.01	26.37	5.64	1.8	9.86
399	DRC/CC-ICP-MS	33.6	27.2	5.37	<2	10.2
442	ICP-MS/MS	35.7	27.9	6.09	1.90	10.5
597	ICP-MS/MS	32.5	26.6	5.39	2.05	11.4
605	ICP-MS	33.2	25.8	5.56	<2.00	9.95
686	DRC/CC-ICP-MS	34.9	27.7	<6.00	<6.00	10.8

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

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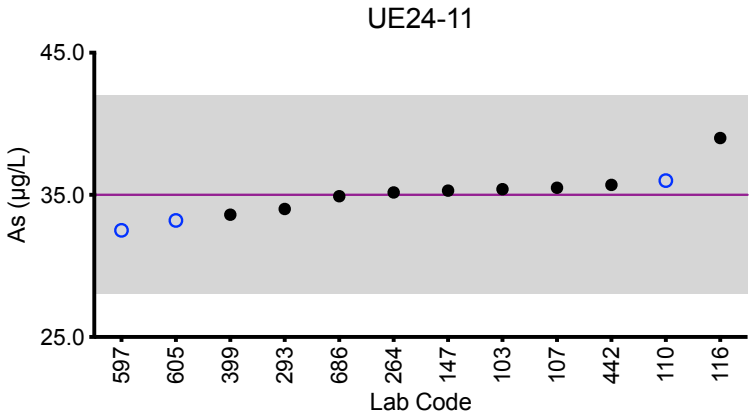
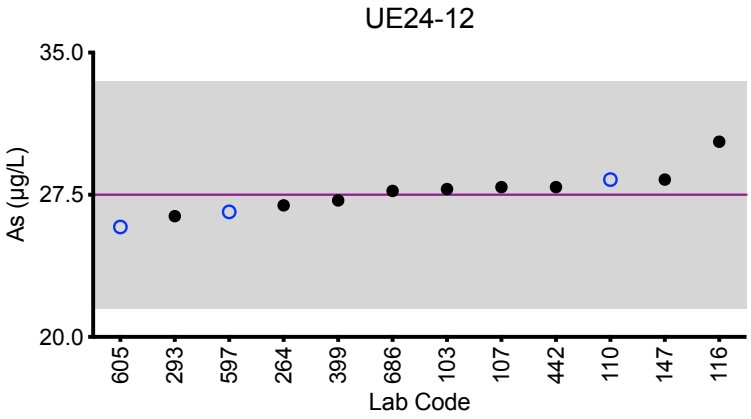
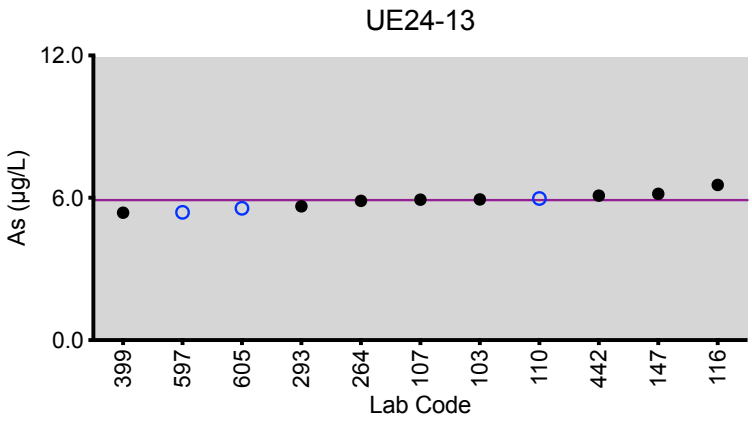
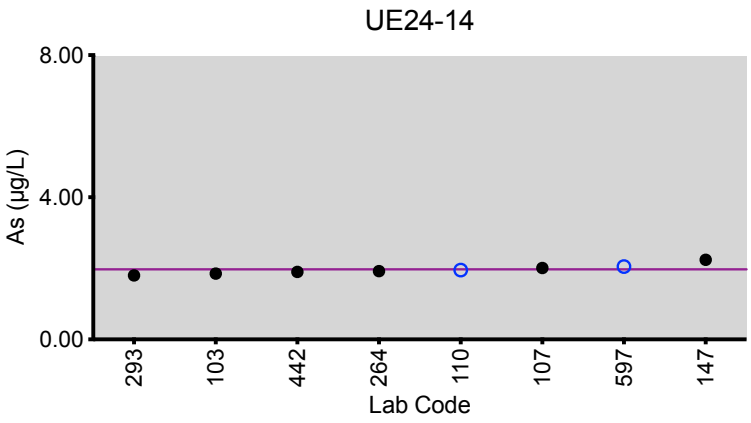
Results for Event #3, 2024: Summary Figures

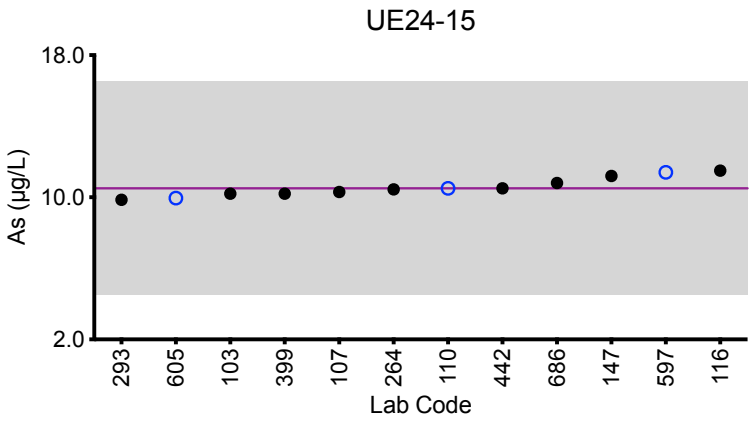
Urine As











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 #3, 2024: Summary Statistics

	Urine Ba (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Arithmetic Mean ($\bar{x}$))	3.02	5.54	2.13	1.86	0.53
Upper Limit	4.02	6.65	3.13	2.86	1.53
Lower Limit	2.02	4.43	1.13	0.86	0.00
Arithmetic SD (s)	0.11	0.22	0.07	0.13	0.05
Arithmetic RSD (%)	3.6	4.0	3.3	7.0	9.4
Number of Sample Measurements (N)	8	8	8	8	6

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 #3, 2024:
Performance of Participating Laboratories

		Urine Ba (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**3.02**	**5.54**	**2.13**	**1.86**	**0.53**
107	ICP-MS	2.83	5.22	2.02	1.68	0.484
110	ICP-MS/MS	3.08	5.77	2.22	1.88	0.51
147	ICP-MS	3.04	5.51	2.18	1.72	0.478
264	ICP-MS	3.12	5.79	2.17	1.99	0.52
399	ICP-MS/MS	3.17	5.68	2.14	1.82	0.605
597	ICP-MS/MS	2.98	5.56	2.16	2.04	0.557
605	ICP-MS	2.90	5.21	2.03	1.75	<0.600
686	ICP-MS	3.06	5.62	2.14	1.97	<0.600

Based on the grading criteria for Ba in Urine, 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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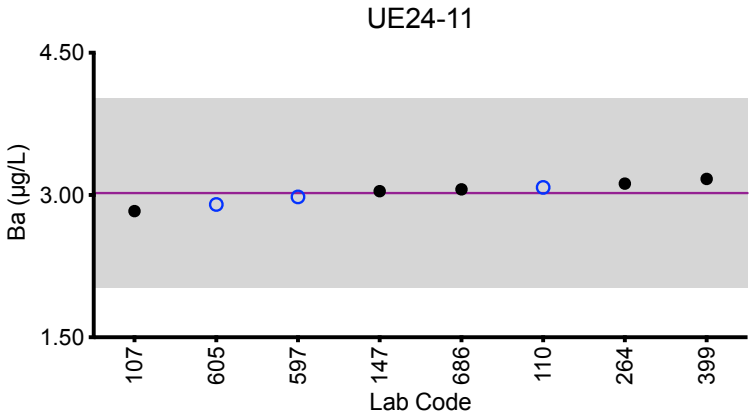
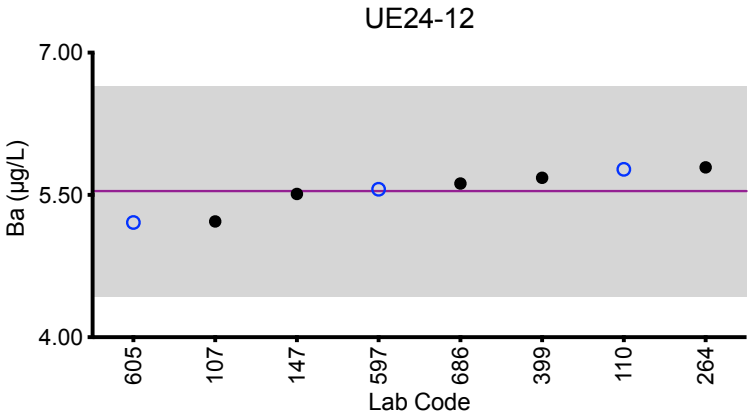
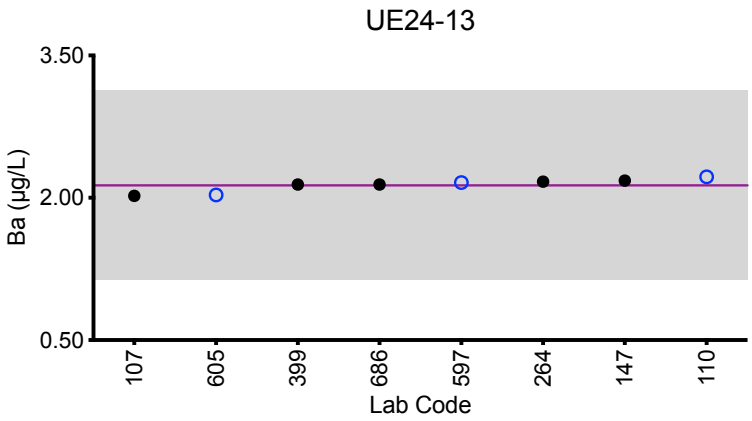
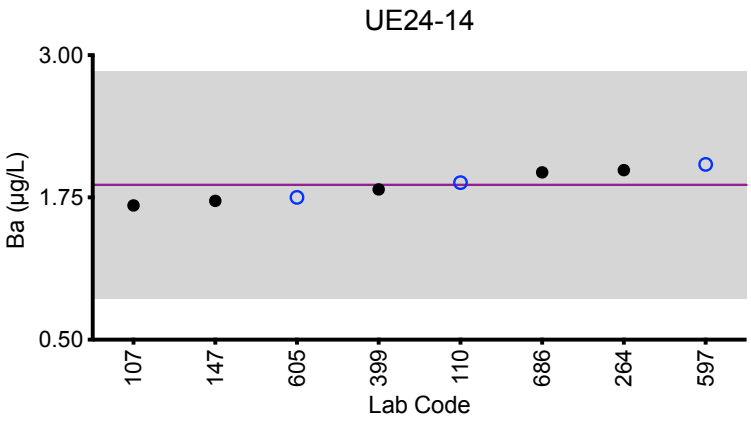
Results for Event #3, 2024: Summary Figures

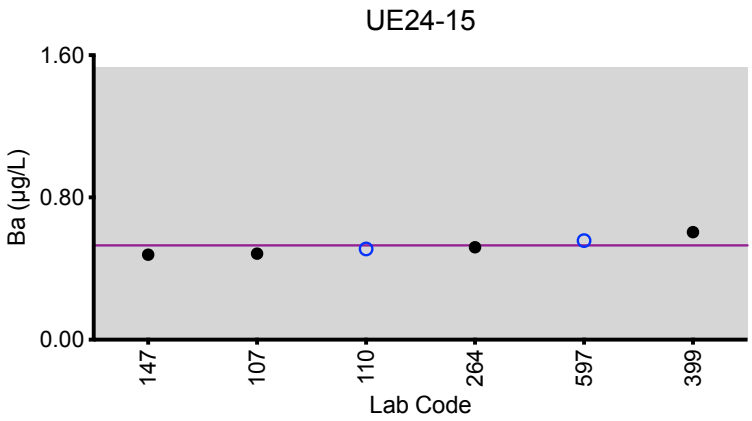
Urine Ba











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 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 #3, 2024: Summary Statistics

	Urine Be (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Robust Mean (x*))	0.322	1.35	0.80	5.8	3.40
Upper Limit	1.322	2.35	1.80	7.0	4.40
Lower Limit	0.000	0.35	0.00	4.7	2.40
Robust SD (s*)	0.014	0.05	0.05	0.4	0.12
Robust RSD (%)	4.3	3.7	6.3	6.0	3.5
Number of Sample Measurements (N)	9	9	10	10	10
Standard Uncertainty (*u*)	NA	NA	0.02	0.1	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 samples UE24-11 and UE24-12.

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**0.322**	**1.35**	**0.80**	**5.8**	**3.40**
107	ICP-MS	0.302	1.28	0.757	5.43	3.34
110	ICP-MS/MS	0.322	1.32	0.763	5.29	3.18
116	ICP-MS/MS	0.326	1.37	0.843	6.00	3.46
147	ICP-MS	0.340	1.40	0.859	5.92	3.38
264	ICP-MS	0.34	1.44	0.85	6.34	3.43
293	ICP-MS	0.33	1.31	0.82	5.93	3.4
399	ICP-MS/MS			0.710	5.54	3.30
597	ICP-MS/MS	0.304	1.33	0.778	6.11	3.76
605	ICP-MS	0.312	1.31	0.761	5.64	3.32
686	ICP-MS	0.324	1.35	0.806	5.96	3.54

Based on the grading criteria for Be in Urine, 100% 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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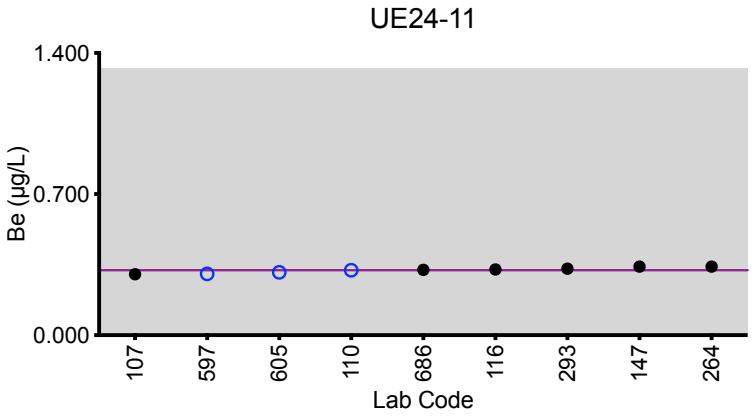
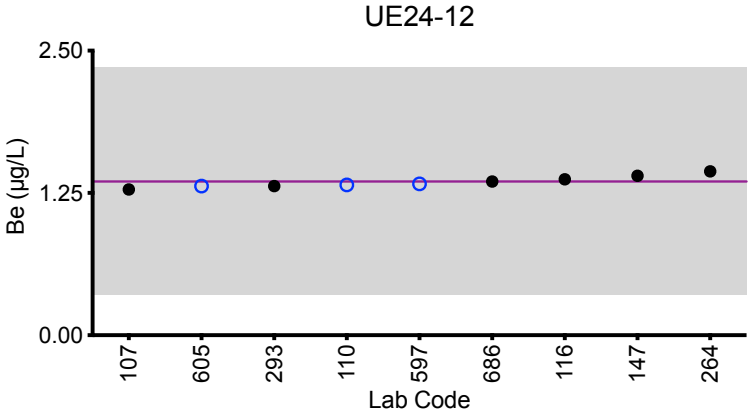
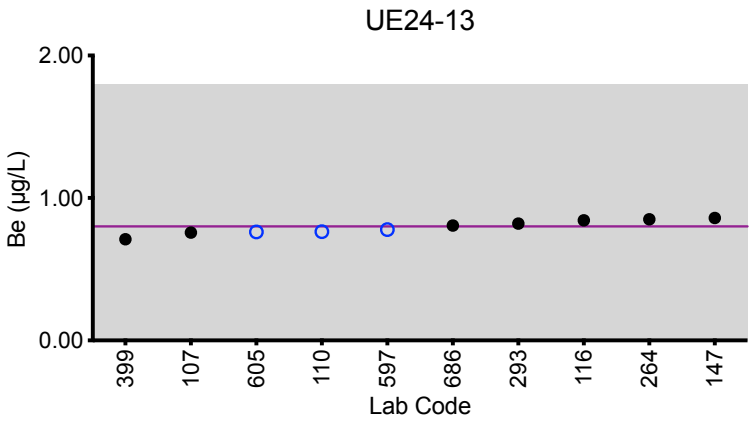
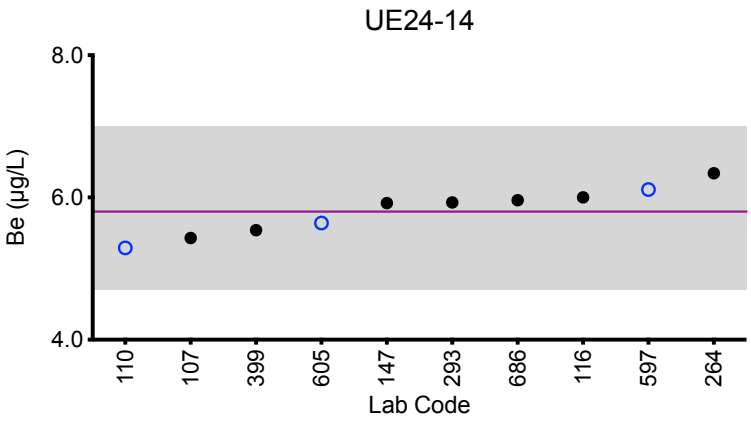
Results for Event #3, 2024: Summary Figures

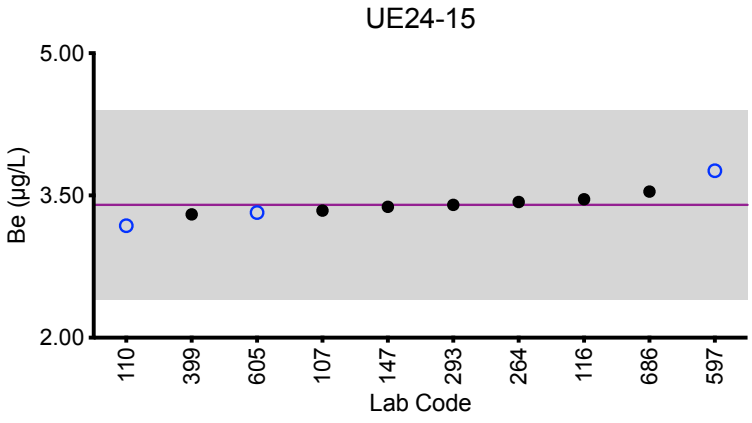
Urine Be











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 #3, 2024:
Summary Statistics

	Urine Cd (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Robust Mean (x*))	1.42	0.49	2.85	0.96	5.63
Upper Limit	2.42	1.49	3.85	1.96	6.63
Lower Limit	0.42	0.00	1.85	0.00	4.63
Robust SD (s*)	0.05	0.03	0.10	0.04	0.20
Robust RSD (%)	3.5	5.7	3.5	4.0	3.6
Number of Sample Measurements (N)	13	12	13	12	13
Standard Uncertainty (*u*)	0.02	0.01	0.04	0.01	0.07

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 #3, 2024:
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**1.42**	**0.49**	**2.85**	**0.96**	**5.63**
103	ICP-MS/MS	1.39	0.476	2.83	0.928	5.46
107	DRC/CC-ICP-MS	1.39	0.476	2.91	0.950	5.72
110	ICP-MS/MS	1.44	0.49	2.86	0.98	5.53
116	ICP-MS/MS	1.44	0.519	2.94	0.880	5.68
147	ICP-MS	1.48	0.493	2.93	0.995	5.84
264	ICP-MS	1.54	0.55	3.04	0.98	5.53
293	DRC/CC-ICP-MS	1.43	0.5	2.84	0.98	5.67
324	ICP-MS	1.455	<1	2.767	<1	5.226
399	DRC/CC-ICP-MS	1.39	0.458	2.77	0.909	5.56
442	ICP-MS/MS	1.44	0.497	2.80	0.945	5.77
597	ICP-MS/MS	1.36	0.521	2.78	0.994	6.33
605	ICP-MS	1.34	0.446	2.66	0.896	5.33
686	ICP-MS	1.45	0.500	2.98	0.978	5.76

Based on the grading criteria for Cd 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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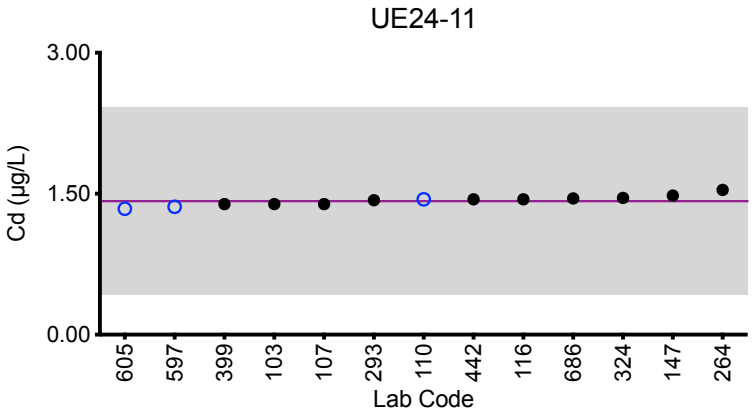
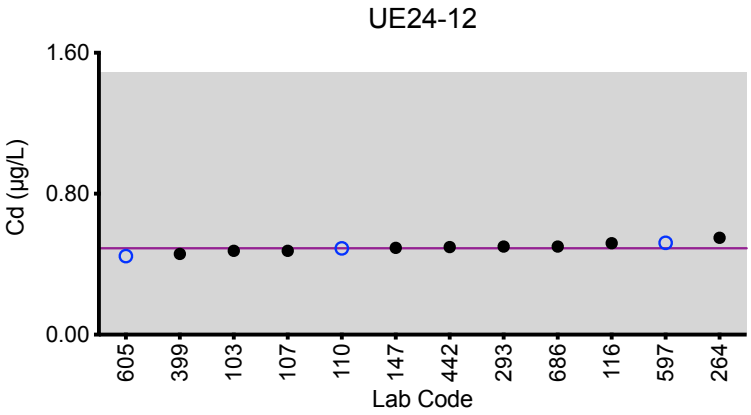
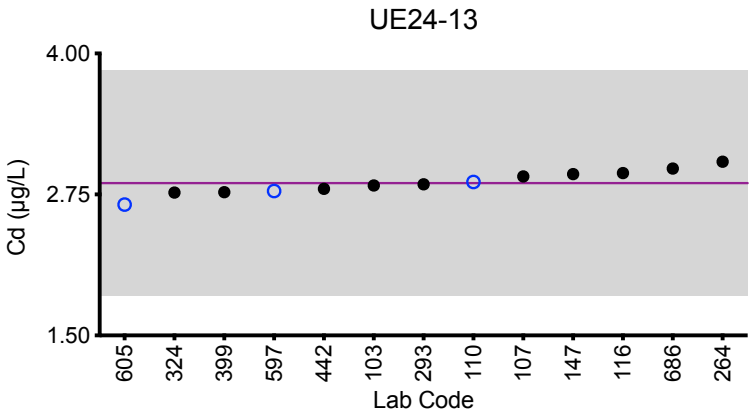
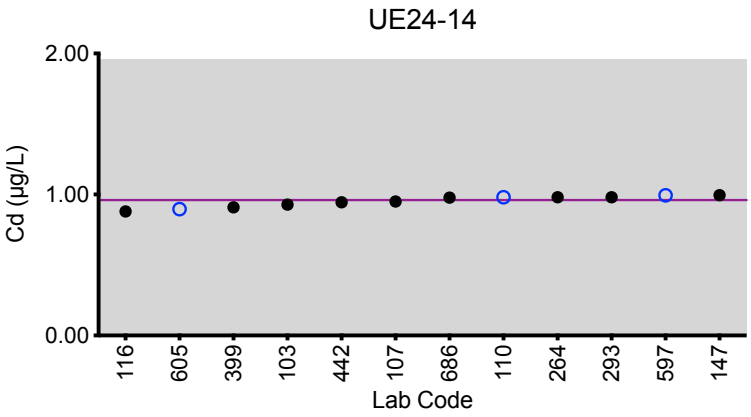
Results for Event #3, 2024: Summary Figures

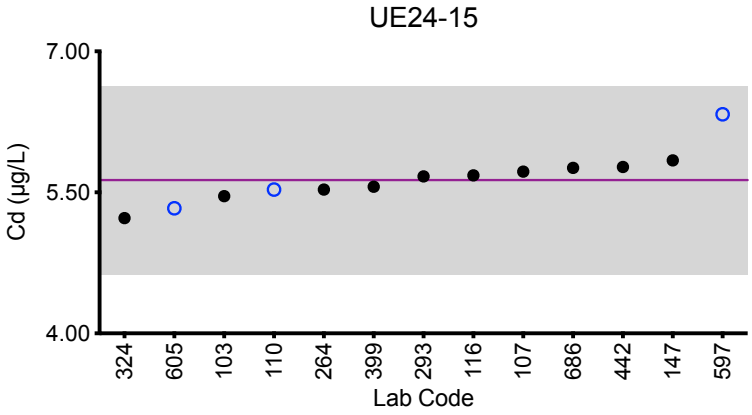
Urine Cd











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 #3, 2024: Summary Statistics

	Urine Co (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Arithmetic Mean ($\bar{x}$))	11.2	3.03	7.39	0.313	5.21
Upper Limit	12.9	4.53	8.89	1.813	6.71
Lower Limit	9.5	1.53	5.89	0.000	3.71
Arithmetic SD (s)	0.4	0.09	0.19	0.016	0.09
Arithmetic RSD (%)	3.4	3.0	2.6	5.1	1.7
Number of Sample Measurements (N)	9	9	9	8	8

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

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Urine Co (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**11.2**	**3.03**	**7.39**	**0.313**	**5.21**
103	ICP-MS/MS	11.2	3.01	7.51	0.302	5.15
107	DRC/CC-ICP-MS	11.6	3.05	7.36	0.332	5.27
110	ICP-MS/MS	11.4	3.01	7.52	0.312	5.23
147	ICP-MS	11.1	3.00	7.25	0.303	5.29
264	ICP-MS	11.78	3.20	7.76	0.33	5.17
324	ICP-MS	11.444	3.033	7.388	<1	5.290
399	DRC/CC-ICP-MS	10.7	3.07	7.25	0.301	5.28
597	ICP-MS/MS	10.8	3.08	7.35	0.333	*5.81
605	ICP-MS	10.8	2.86	7.13	0.293	5.03

Based on the grading criteria for Co in Urine, 100% of results were satisfactory, with 0 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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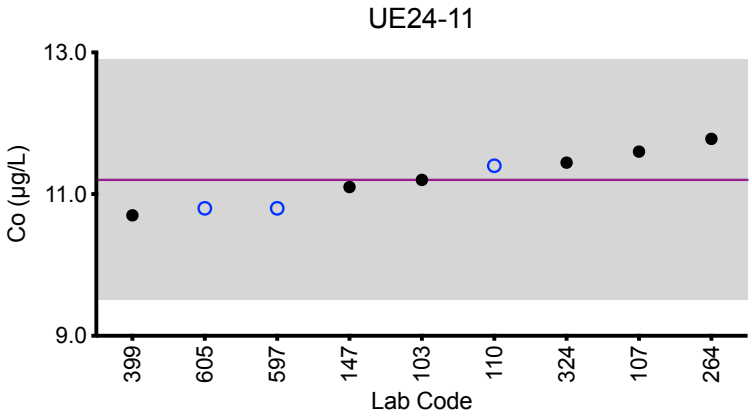
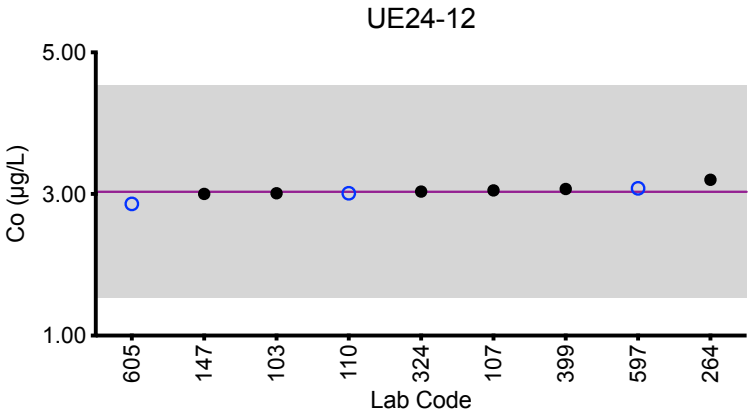
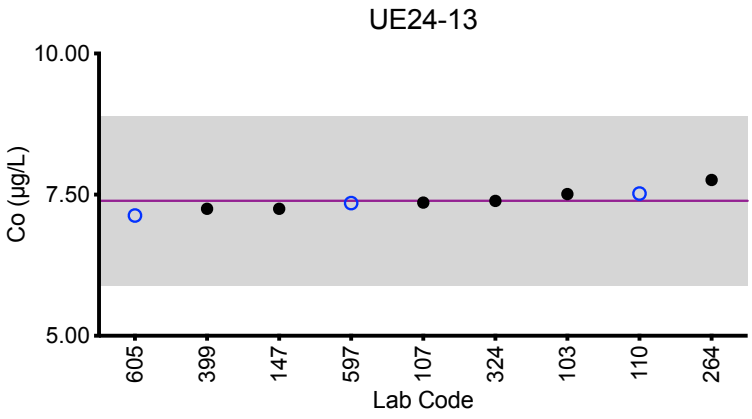
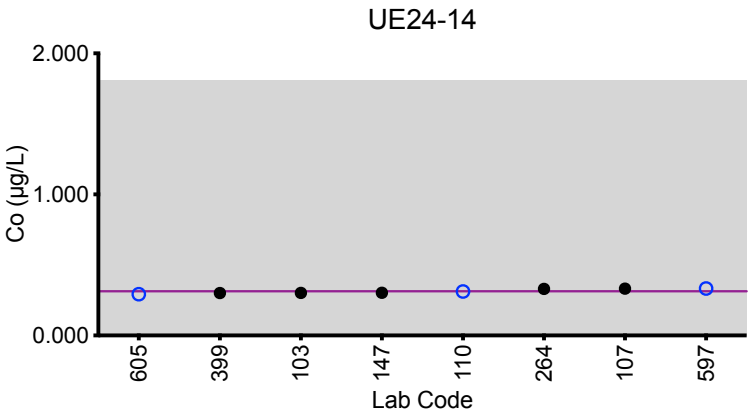
Results for Event #3, 2024: Summary Figures

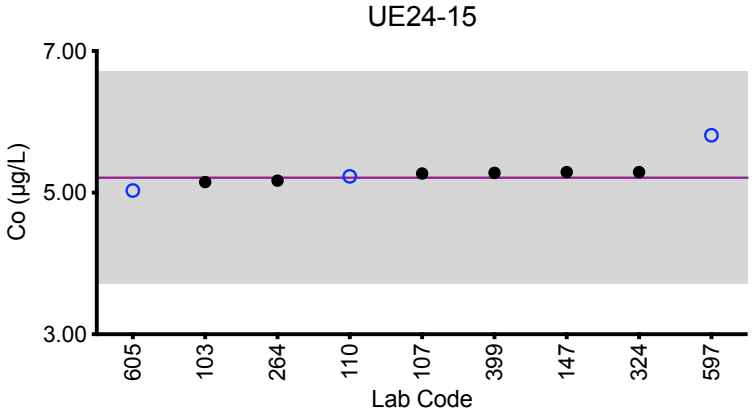
Urine Co











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 #3, 2024: Summary Statistics

	Urine Cr (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Arithmetic Mean ($\bar{x}$))	0.95	3.09	1.19	6.5	2.6
Upper Limit	3.95	6.09	4.19	9.5	5.6
Lower Limit	0.00	0.09	0.00	3.5	0.0
Arithmetic SD (s)	0.20	0.25	0.12	0.4	0.3
Arithmetic RSD (%)	21	8.1	10	6.6	11
Number of Sample Measurements (N)	8	9	9	9	9

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

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**0.95**	**3.09**	**1.19**	**6.5**	**2.6**
103	ICP-MS/MS	0.920	3.18	1.13	6.80	2.63
107	DRC/CC-ICP-MS	0.908	3.30	1.21	6.45	2.52
110	ICP-MS/MS	0.97	3.12	1.22	6.68	2.56
116	ICP-MS/MS	0.569	2.83	0.937	6.40	2.28
147	DRC/CC-ICP-MS	0.978	3.02	1.22	6.33	2.67
264	ICP-MS	1.11	3.39	1.37	7.03	2.73
324	ICP-MS	<1	2.670	1.165	5.574	2.084
597	ICP-MS/MS	1.26	3.35	1.31	6.94	3.11
605	ICP-MS	0.901	2.93	1.13	6.37	2.53

Based on the grading criteria for Cr in Urine, 100% of results were satisfactory, with 0 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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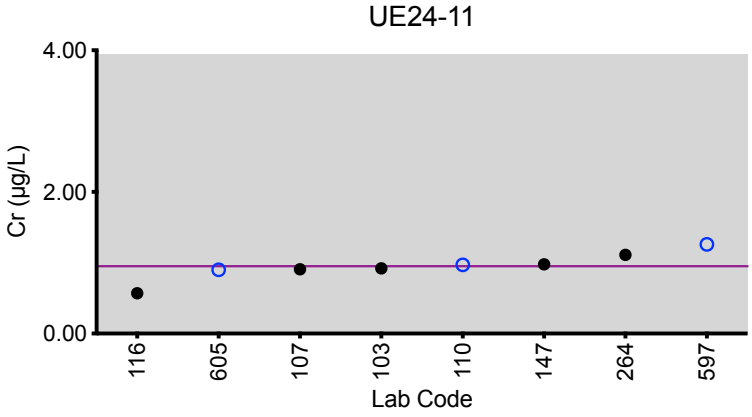
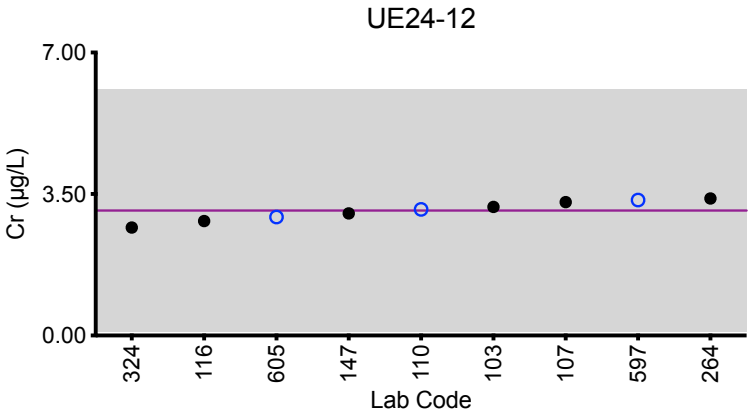
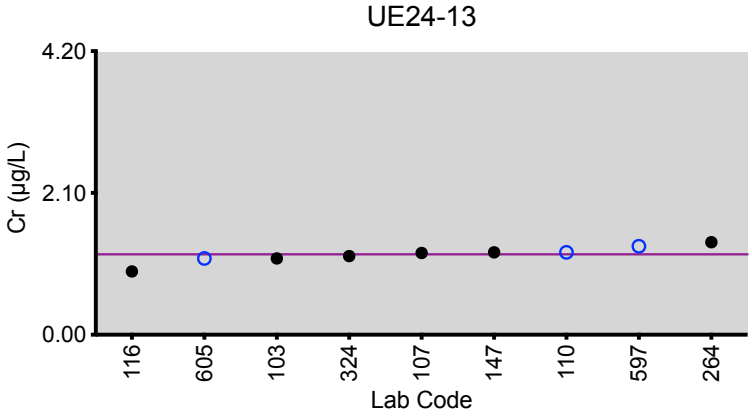
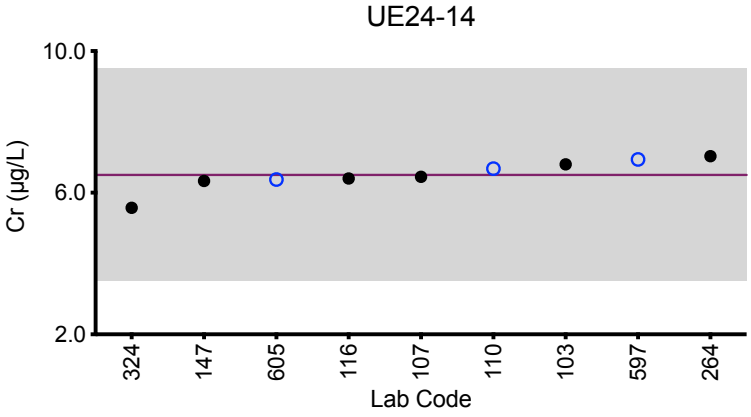
Results for Event #3, 2024: Summary Figures

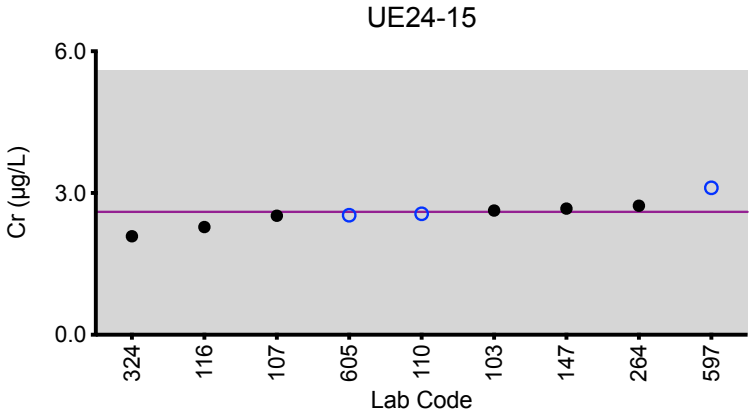
Urine Cr











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 ±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 #3, 2024: Summary Statistics

	Urine Hg (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Robust Mean (x*))	0.82	4.8	18.0	1.56	13.6
Upper Limit	3.82	7.8	23.4	4.56	17.7
Lower Limit	0.00	1.8	12.6	0.00	9.5
Robust SD (s*)	0.18	0.4	1.9	0.23	1.3
Robust RSD (%)	22	8.3	11	15	9.6
Number of Sample Measurements (N)	9	12	12	12	12
Standard Uncertainty (*u*)	NA	0.2	0.7	0.08	0.5

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 UE24-11.

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**0.82**	**4.8**	**18.0**	**1.56**	**13.6**
103	ICP-MS/MS	0.804	5.03	18.4	1.58	13.5
107	DRC/CC-ICP-MS	0.714	4.49	17.1	1.40	12.6
110	ICP-MS	0.67	4.54	17.0	1.45	12.6
116	ICP-MS/MS	0.566	3.80	14.2	1.17	10.8
147	ICP-MS	0.852	4.81	18.6	1.52	14.1
264	ICP-MS	*7.00 ↑	7.23	24.67 ↑	2.37	17.53
293	DRC/CC-ICP-MS	0.85	4.91	17.83	1.71	13.8
442	ICP-MS/MS	0.856	5.14	18.6	1.57	13.7
490	CV-AAS	1.2088	4.3658	15.3681	1.7659	11.3824
597	ICP-MS/MS	0.818	4.68	16.7	1.59	14.2
605	ICP-MS	<1.00	5.08	21.2	1.27	15.1
686	ICP-MS	<1.00	5.29	19.3	1.74	14.3

Based on the grading criteria for Hg in Urine, 97% of results were satisfactory, with 1 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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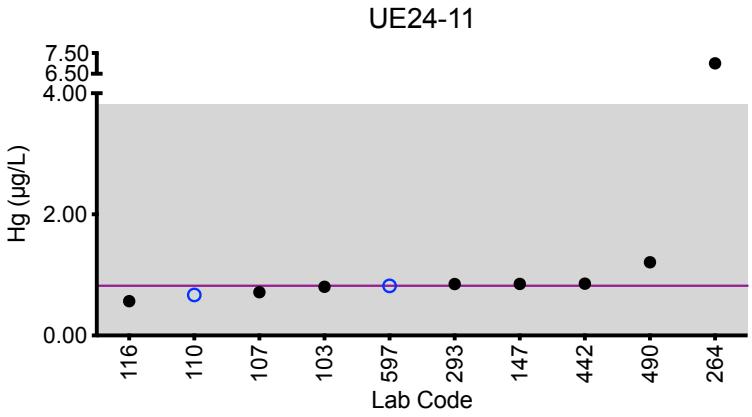
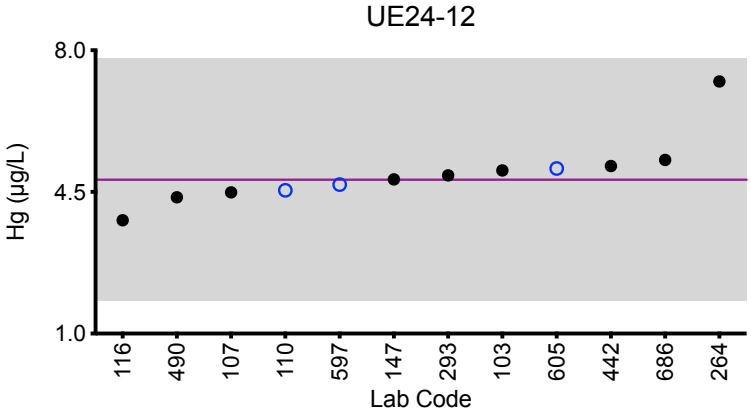
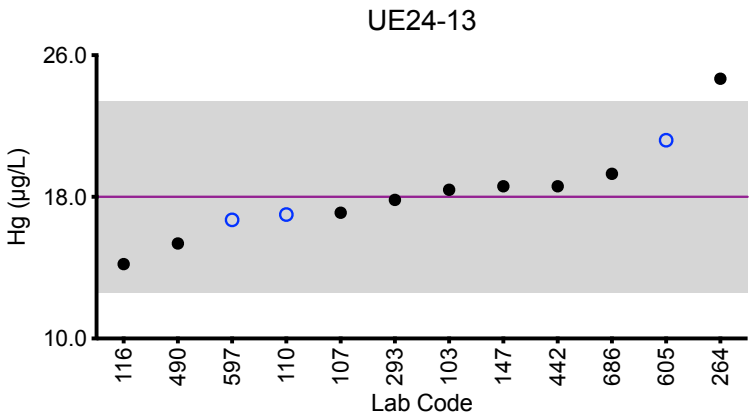
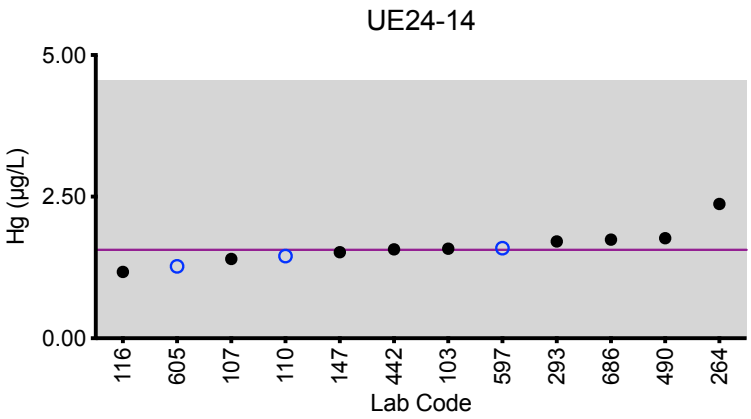
Results for Event #3, 2024: Summary Figures

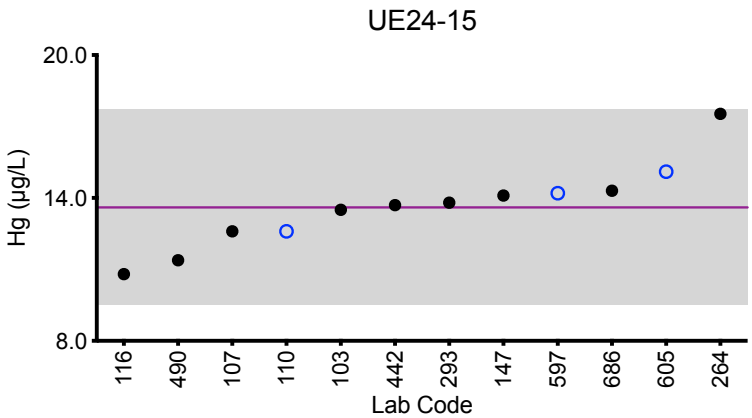
Urine Hg











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 #3, 2024: Summary Statistics

	Urine Mn (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Arithmetic Mean ($\bar{x}$))	0.91	3.75	7.97	0.46	1.78
Upper Limit	1.46	4.69	9.96	1.01	2.33
Lower Limit	0.36	2.81	5.98	0.00	1.23
Arithmetic SD (s)	0.12	0.24	0.32	0.12	0.17
Arithmetic RSD (%)	13	6.4	4.0	26	9.6
Number of Sample Measurements (N)	9	9	9	8	9

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 #3, 2024:
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**0.91**	**3.75**	**7.97**	**0.46**	**1.78**
103	ICP-MS/MS	0.850	3.57	7.80	0.431	1.64
107	DRC/CC-ICP-MS	0.842	3.55	7.71	0.499	1.60
110	ICP-MS/MS	0.88	3.78	8.34	0.42	1.76
147	DRC/CC-ICP-MS	0.711	3.46	7.46	0.213	1.57
264	ICP-MS	0.96	4.19	8.35	0.56	1.81
324	ICP-MS	1.012	3.913	8.374	<1	1.841
399	DRC/CC-ICP-MS	1.15	3.77	7.99	0.582	1.94
597	ICP-MS/MS	0.905	3.97	7.96	0.521	2.11
605	ICP-MS	0.842	3.54	7.77	0.441	1.76

Based on the grading criteria for Mn in Urine, 100% of results were satisfactory, with 0 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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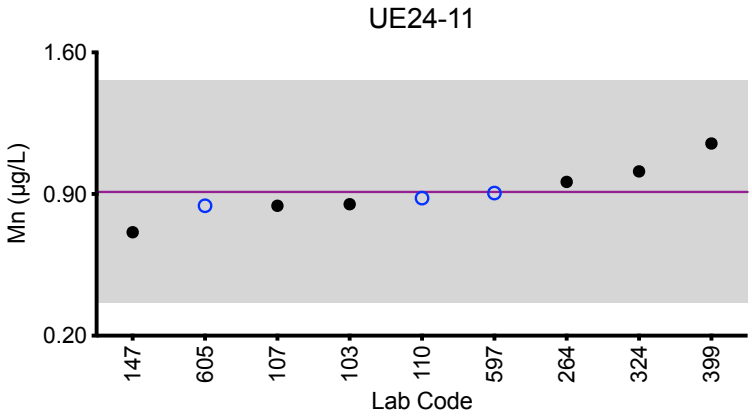
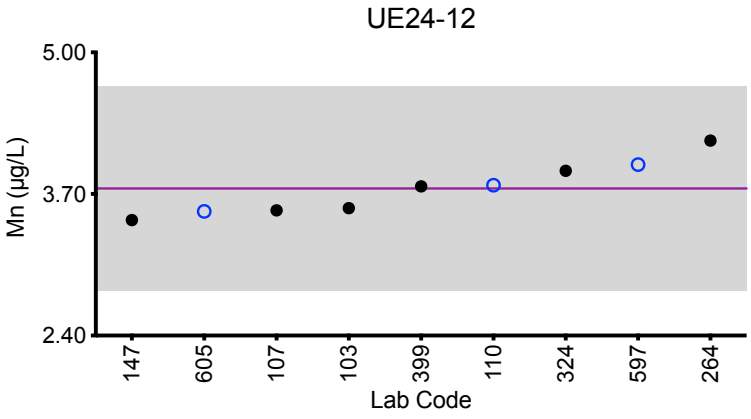
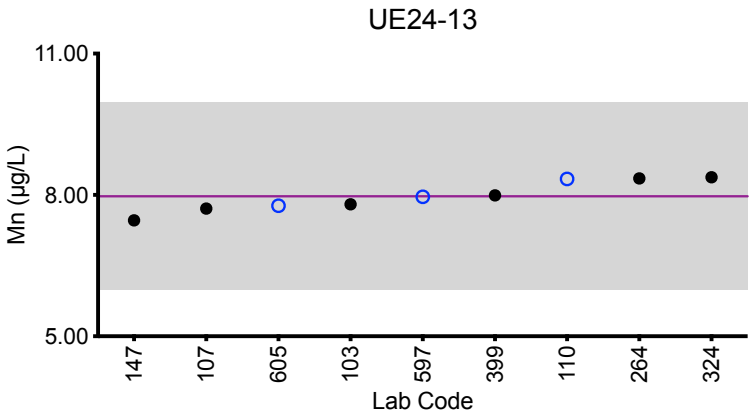
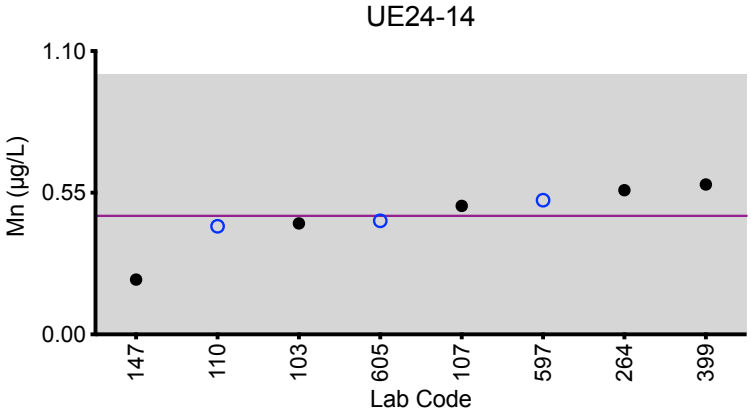
Results for Event #3, 2024: Summary Figures

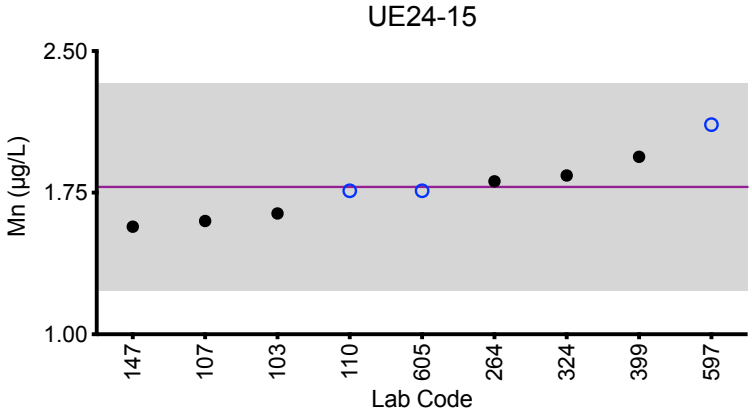
Urine Mn











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:

±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 #3, 2024: Summary Statistics

	Urine Pb (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Robust Mean (x*))	0.85	1.86	8.2	5.40	0.51
Upper Limit	1.85	2.86	9.8	6.48	1.51
Lower Limit	0.00	0.86	6.5	4.32	0.00
Robust SD (s*)	0.05	0.05	0.4	0.18	0.04
Robust RSD (%)	5.9	2.7	4.5	3.3	7.7
Number of Sample Measurements (N)	12	13	13	13	12
Standard Uncertainty (*u*)	0.02	0.02	0.1	0.06	0.01

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

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Urine Pb (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**0.85**	**1.86**	**8.2**	**5.40**	**0.51**
103	ICP-MS/MS	0.856	1.88	8.15	5.36	0.502
107	ICP-MS	0.894	1.91	8.45	5.46	0.514
110	ICP-MS/MS	0.85	1.86	8.14	5.36	0.49
116	ICP-MS/MS	0.843	1.83	8.11	5.39	0.556
147	ICP-MS	0.886	1.90	8.41	5.59	0.524
264	ICP-MS	0.94	2.01	9.07	5.91	0.50
293	DRC/CC-ICP-MS	0.86	1.89	8.53	5.48	0.51
324	ICP-MS	<1	1.782	7.616	4.957	<1
399	ICP-MS/MS	0.900	1.86	7.98	5.30	0.534
442	ICP-MS/MS	0.785	1.82	8.12	5.27	0.461
597	ICP-MS/MS	0.814	1.84	7.95	5.61	0.553
605	ICP-MS	0.802	1.73	7.68	5.00	0.463
686	ICP-MS	0.831	1.83	8.43	5.50	0.445

Based on the grading criteria for Pb 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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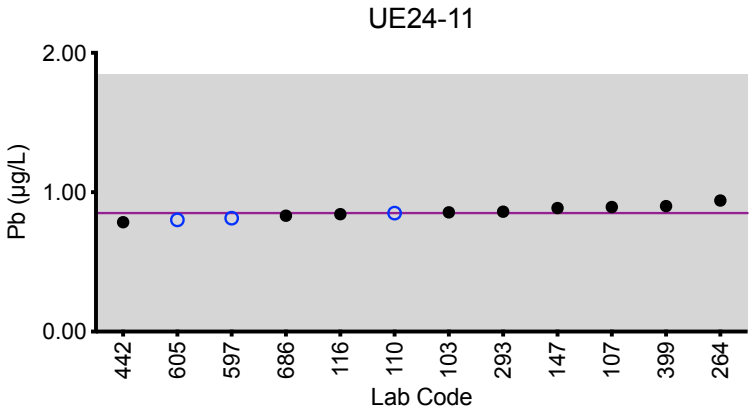
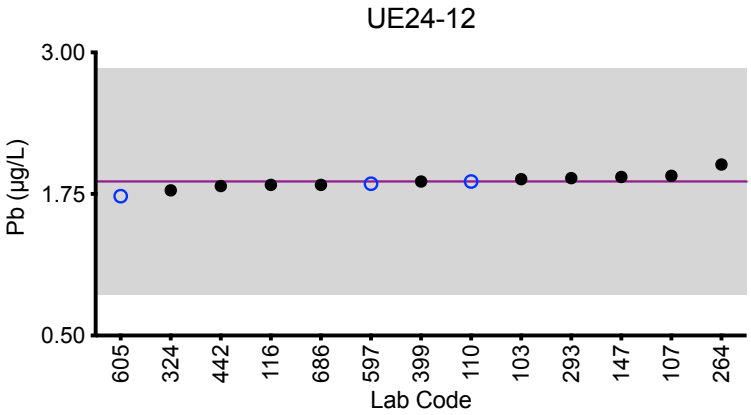
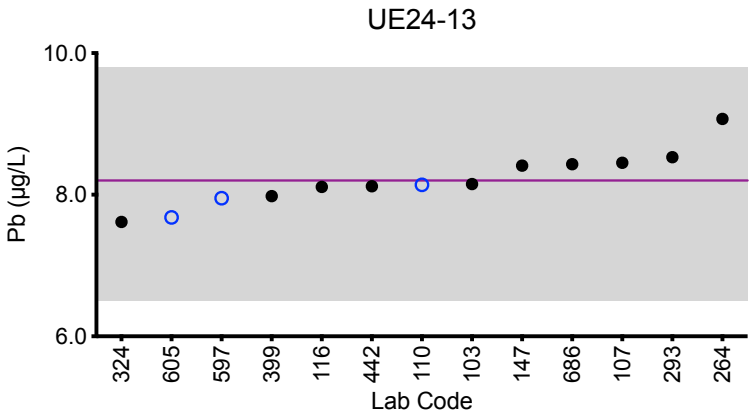
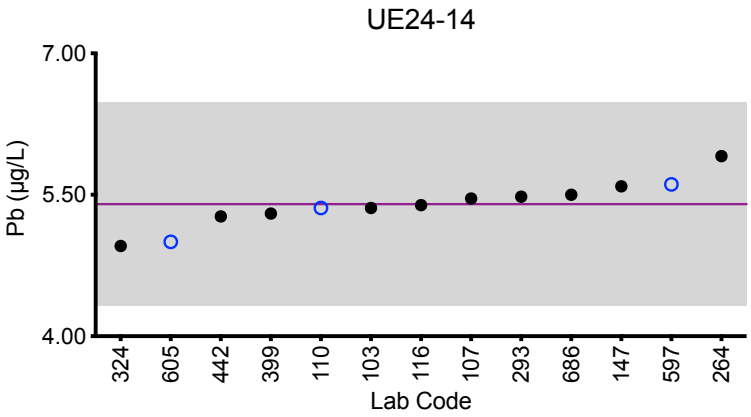
Results for Event #3, 2024: Summary Figures

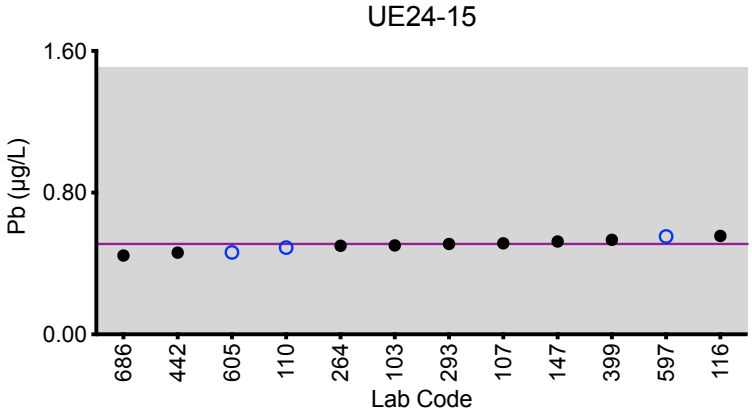
Urine Pb











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 #3, 2024: Summary Statistics

	Urine Tl (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Robust Mean (x*))	0.506	0.87	0.106	1.42	0.525
Upper Limit	0.706	1.07	0.306	1.70	0.725
Lower Limit	0.306	0.67	0.000	1.14	0.325
Robust SD (s*)	0.014	0.04	0.008	0.08	0.018
Robust RSD (%)	2.8	4.1	8.0	5.6	3.4
Number of Sample Measurements (N)	11	11	9	11	11
Standard Uncertainty (*u*)	0.005	0.01	NA	0.03	0.007

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.

An arithmetic mean, SD, RSD and n are provided for sample UE24-13.

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Urine Tl (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**0.506**	**0.87**	**0.106**	**1.42**	**0.525**
103	ICP-MS/MS	0.501	0.862	0.106	1.41	0.518
107	ICP-MS	0.515	0.895	0.112	1.47	0.548
110	ICP-MS/MS	0.515	0.878	0.110	1.42	0.530
116	ICP-MS/MS	0.510	0.899	<0.120	1.60	0.460
147	ICP-MS	0.498	0.823	0.111	1.35	0.515
264	ICP-MS	0.54	0.94	0.12	1.54	0.53
293	DRC/CC-ICP-MS	0.51	0.89	0.11	1.39	0.53
399	ICP-MS/MS	0.475	0.849	0.0960	1.35	0.517
597	ICP-MS/MS	0.468	0.825	0.0954	1.42	0.566
605	ICP-MS	0.473	0.807	0.0974	1.31	0.499
686	ICP-MS	0.516	0.883	<0.120	1.44	0.529

Based on the grading criteria for Tl 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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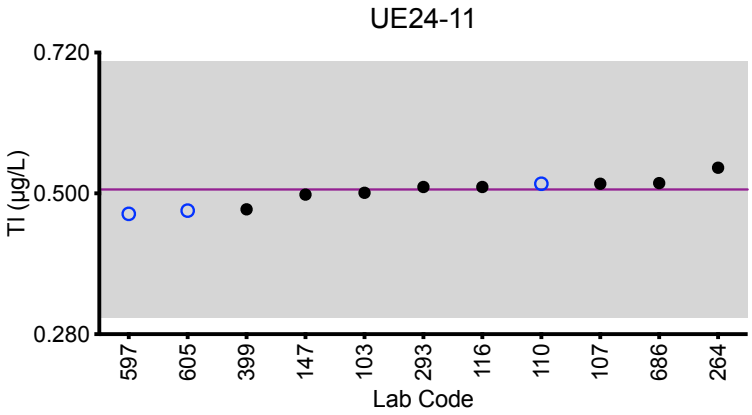
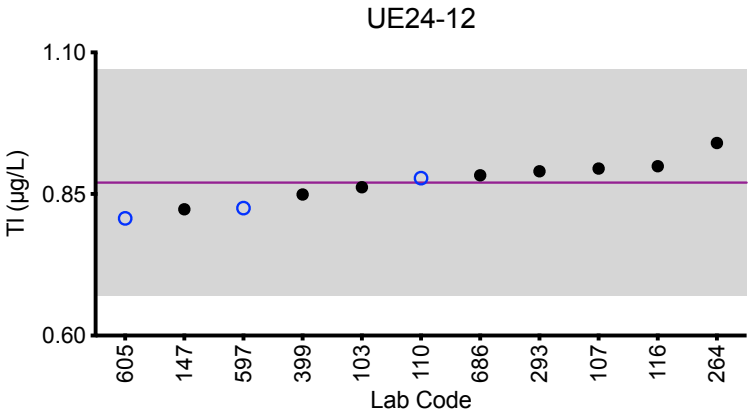
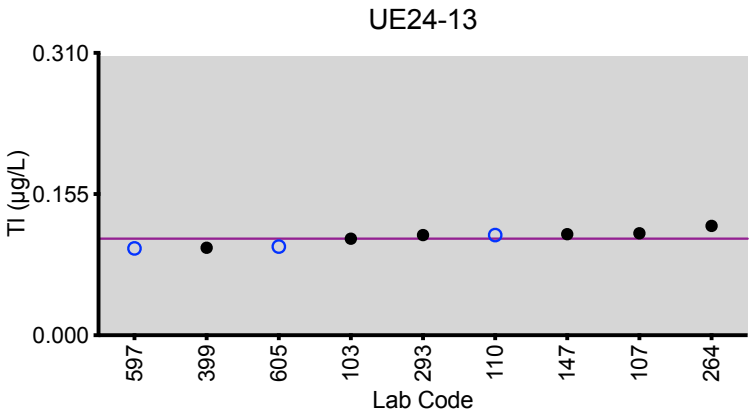
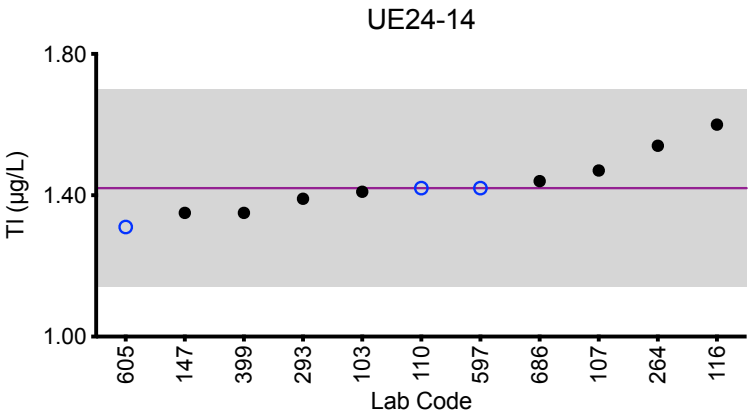
Results for Event #3, 2024: Summary Figures

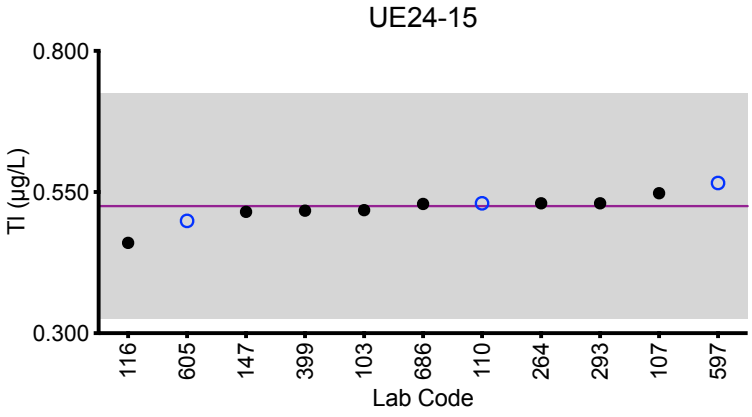
Urine Tl











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 #3, 2024: Summary Statistics

	Urine U (µg/L)				
	UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Target (Robust Mean (x*))	0.282	0.0111	0.168	0.033	0.0162
Upper Limit	0.338	0.0411	0.202	0.063	0.0462
Lower Limit	0.226	0.0000	0.134	0.003	0.0000
Robust SD (s*)	0.012	0.0010	0.007	0.003	0.0009
Robust RSD (%)	4.3	8.9	4.2	7.7	5.6
Number of Sample Measurements (N)	11	9	11	11	11
Standard Uncertainty (*u*)	0.004	NA	0.003	0.001	0.0003

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.

An arithmetic mean, SD, RSD and n are provided for sample UE24-12.

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Urine U (µg/L)				
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
	Target	**0.282**	**0.0111**	**0.168**	**0.033**	**0.0162**
103	ICP-MS/MS	0.282	0.0115	0.166	0.0351	0.0157
107	ICP-MS	0.292	0.0118	0.181	0.0330	0.0166
110	ICP-MS/MS	0.268	0.0110	0.159	0.0296	0.0147
116	ICP-MS/MS	0.276	<0.0150	0.172	0.0326	0.0167
147	ICP-MS	0.291	0.0115	0.161	0.0315	0.0162
264	ICP-MS	0.29	0.01	0.17	0.04	0.02
324	ICP-MS	0.27	0.010	0.161	0.030	0.014
399	ICP-MS/MS	0.287	0.0130	0.173	0.0330	0.0180
597	ICP-MS/MS	0.275	0.0108	0.164	0.0310	0.0153
605	ICP-MS	0.271	0.0102	0.165	0.0309	0.0160
686	ICP-MS	0.299	<0.0150	0.181	0.0352	0.0167

Based on the grading criteria for U 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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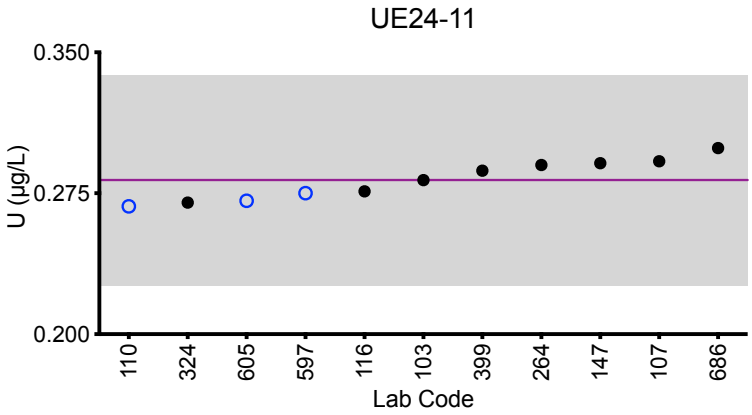
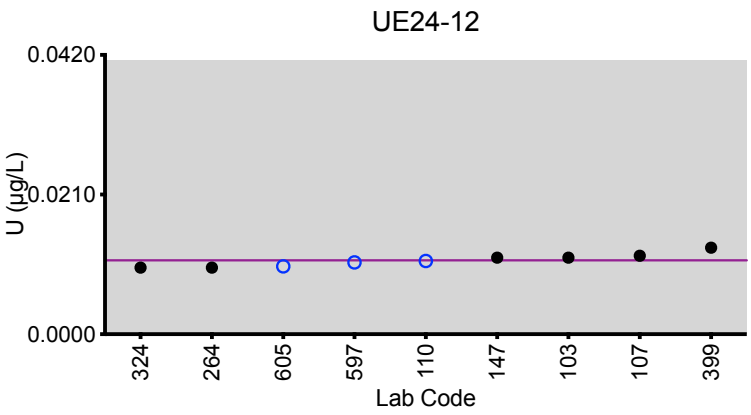
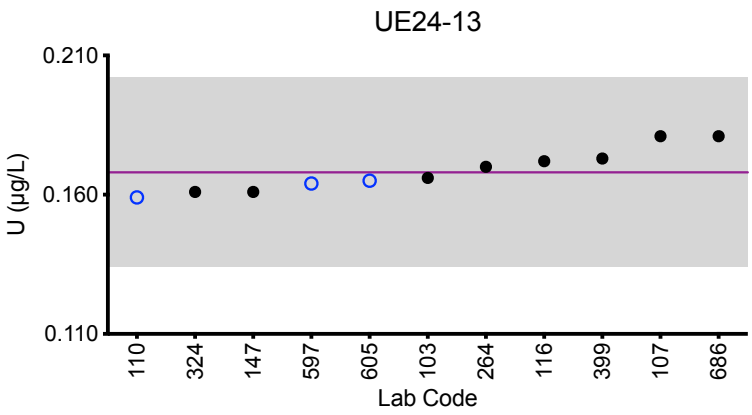
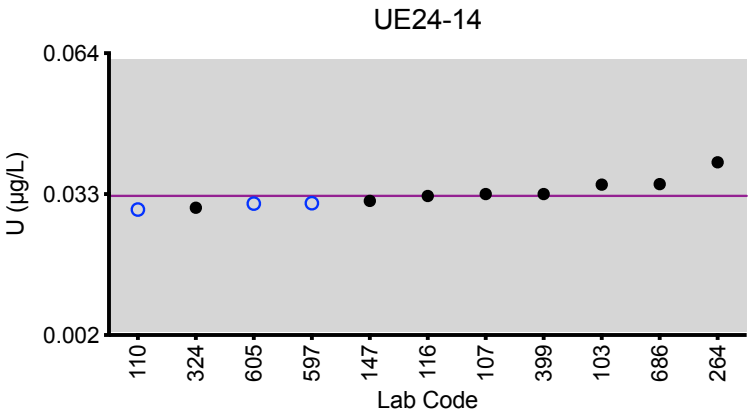
Results for Event #3, 2024: Summary Figures

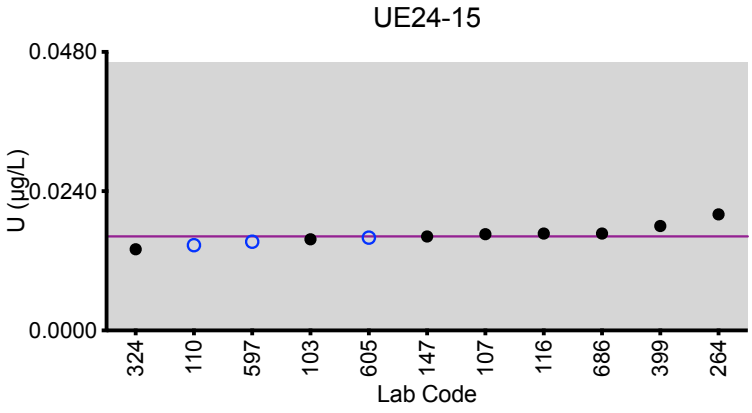
Urine U











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 #3, 2024:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
107	ICP-MS	6.35	1.52	8.07	3.02	1.62
110	ICP-MS/MS	6.47	1.53	8.36	3.18	1.58
147	ICP-MS	6.89	1.60	8.66	3.27	1.66
264	ICP-MS	7.01	1.64	8.78	3.51	1.61
399	ICP-MS/MS	6.90	1.65	8.58	3.24	1.75
597	ICP-MS/MS	6.36	1.58	8.39	3.29	1.74
605	ICP-MS	6.46	1.50	8.13	3.04	1.60

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	6.6	1.57	8.4	3.22	1.65
Arithmetic SD (s)	0.3	0.06	0.3	0.17	0.07
Arithmetic RSD (%)	4.4	3.8	3.2	5.3	4.2
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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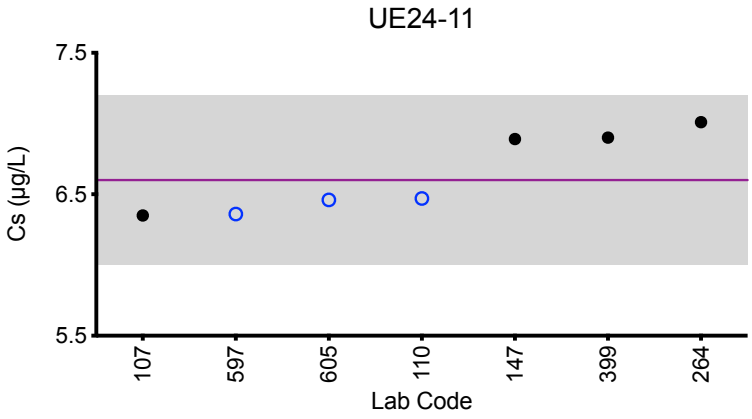
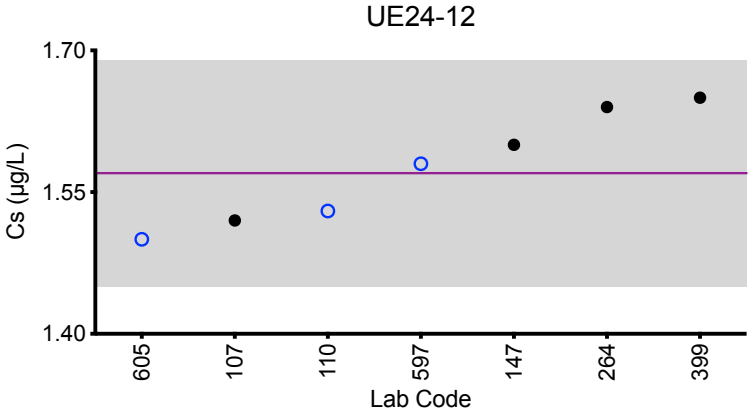
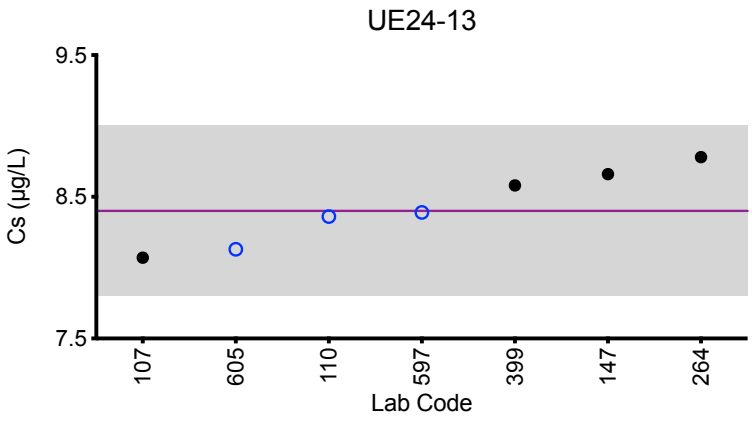
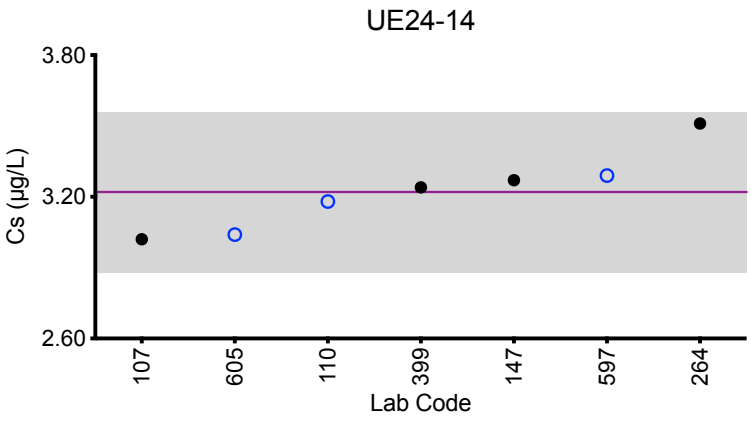
Results for Event #3, 2024: Summary Figures

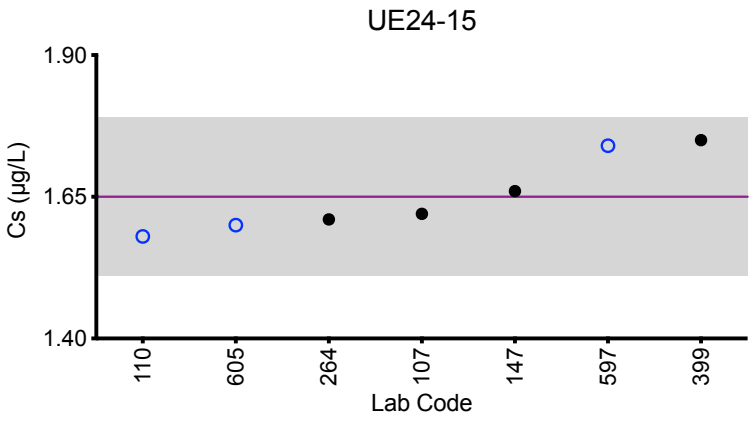
Urine Cs











Legend:
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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
110	ICP-MS/MS	51.2	67.9	3.52	17.0	27.6
147	ICP-MS	55.7	74.0	5.53	20.8	30.6
264	ICP-MS	57.36	76.41	4.18	19.00	28.92
293	DRC/CC-ICP-MS	52.77	70.57	3.18	17.16	27.34
324	ICP-MS	53.280	68.770	3.592	17.337	28.017
597	ICP-MS/MS	47.6	67.9	3.81	18.5	30.0

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	53	71	4.0	18.3	28.7
Arithmetic SD (s)	3	4	0.8	1.5	1.3
Arithmetic RSD (%)	6.4	4.9	20	8.2	4.5
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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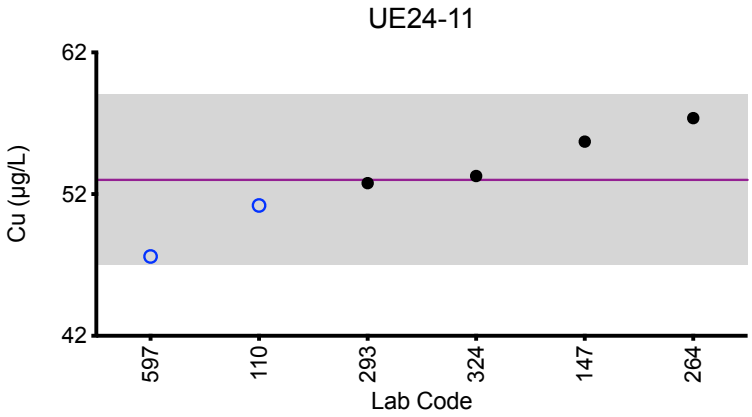
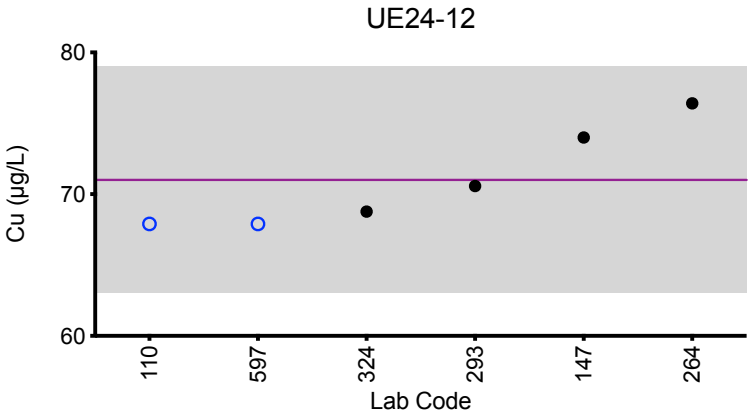
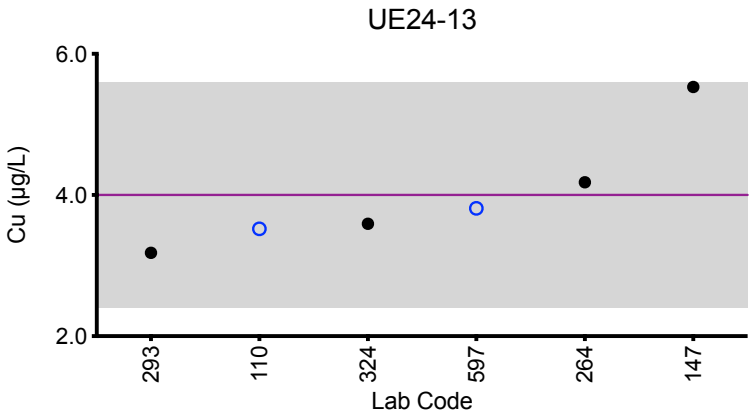
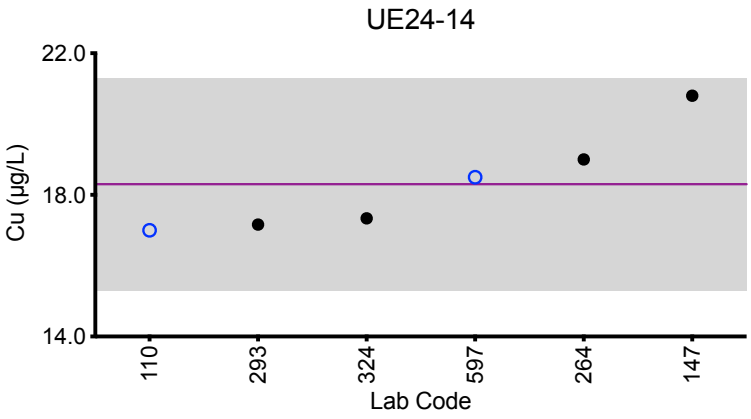
Results for Event #3, 2024: Summary Figures

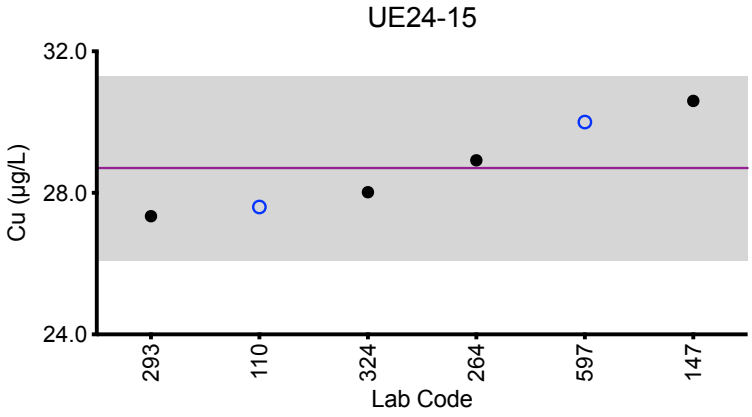
Urine Cu











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
103	ICP-MS/MS	45.9	19.8	62.6	14.6	17.9
107	ICP-MS	43.1	18.6	58.0	13.4	17.5
110	ICP-MS/MS	46.5	19.7	62.5	14.5	17.8
147	ICP-MS	44.1	19.2	59.7	14.3	18.2
264	ICP-MS	31.43	11.89	42.21	8.64	9.64
293	DRC/CC-ICP-MS	45.73	20.29	63.35	14.8	18.65
324	ICP-MS	45.248	19.301	59.429	13.882	17.231
399	ICP-MS/MS	44.1	19.2	57.4	13.4	17.9
597	ICP-MS/MS	39.2	18.1	54.1	13.7	18.1
605	ICP-MS	43.0	18.5	58.2	13.2	17.1

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Robust Mean (x*)	44.0	19.1	59	13.8	17.7
Robust SD (s*)	2.2	0.9	4	0.8	0.6
Robust RSD (%)	5.0	4.7	6.8	5.8	3.4
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.9	0.3	2	0.3	0.2

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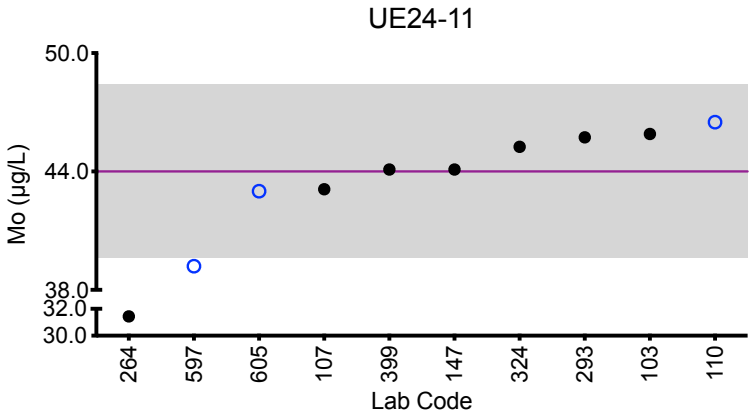
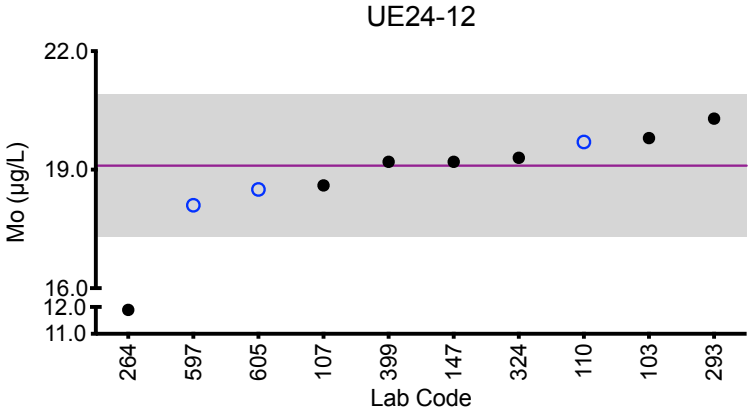
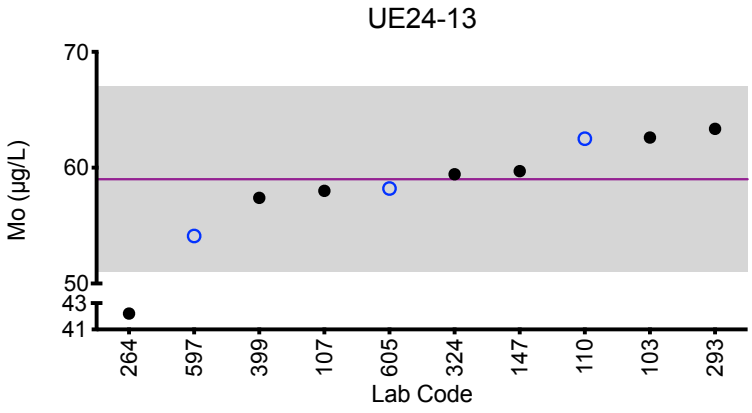
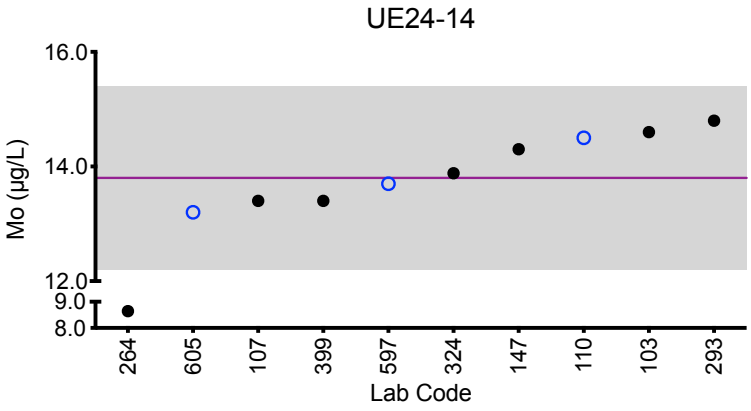
Results for Event #3, 2024: Summary Figures

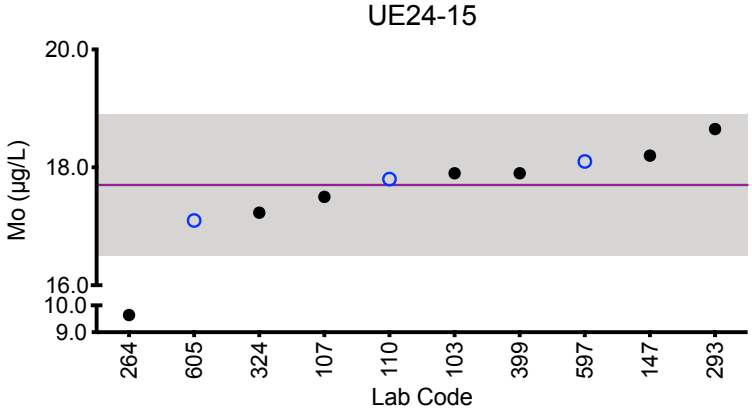
Urine Mo











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
103	ICP-MS/MS	7.59	7.68	6.44	0.960	0.797
107	DRC/CC-ICP-MS	8.26	8.00	6.85	1.16	1.12
110	ICP-MS/MS	8.35	8.94	7.89	0.79	0.68
147	ICP-MS	7.62	7.67	6.43	<0.646	<0.646
264	ICP-MS	7.65	8.19	6.73	0.93	0.68
293	DRC/CC-ICP-MS	7.67	7.8	6.6	0.9	0.76
324	ICP-MS	7.783	7.698	6.527	1.137	<1
442	DRC/CC-ICP-MS	8.05	8.14	6.72	0.841	0.702
597	ICP-MS/MS	7.38	8.07	6.30	0.909	0.87
605	ICP-MS	6.84	7.00	5.88	0.637	0.562

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Robust Mean (x*)	7.7	7.9	6.6	0.92	0.77
Robust SD (s*)	0.3	0.3	0.3	0.16	0.17
Robust RSD (%)	4.4	4.4	4.1	18	22
Number of Sample Measurements (N)	10	10	10	9	8
Standard Uncertainty (*u*)	0.1	0.1	0.1	NA	NA

*Denotes a statistical Outlier.

An arithmetic mean, SD, RSD and n are provided for samples UE24-14 and UE24-15.

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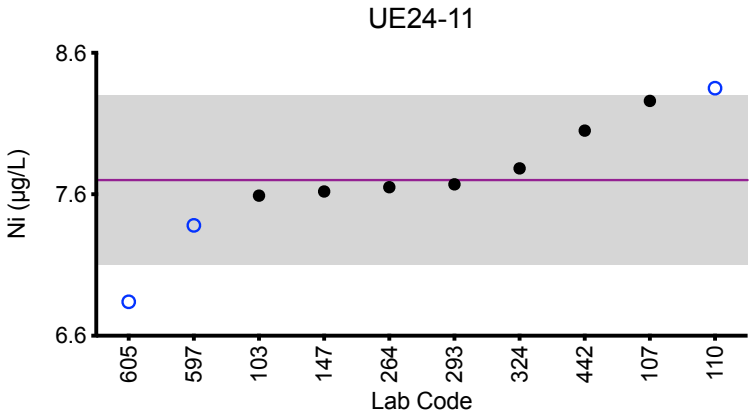
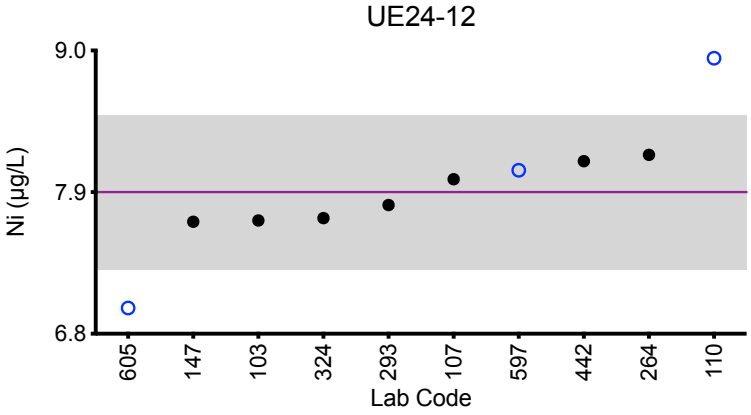
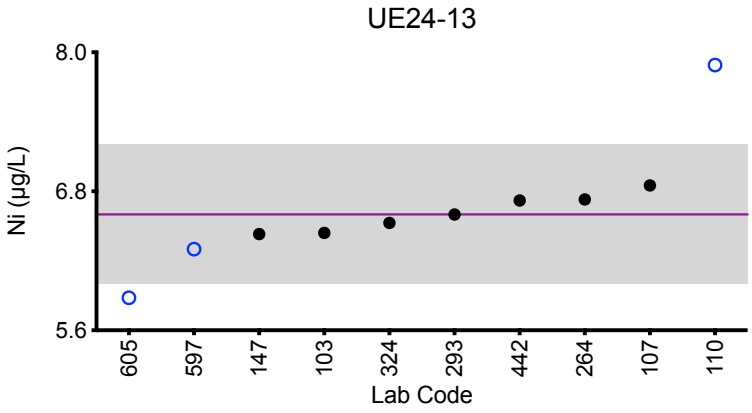
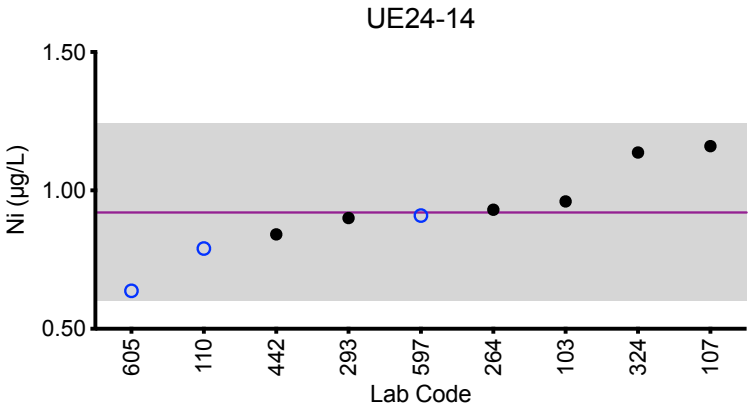
Results for Event #3, 2024: Summary Figures

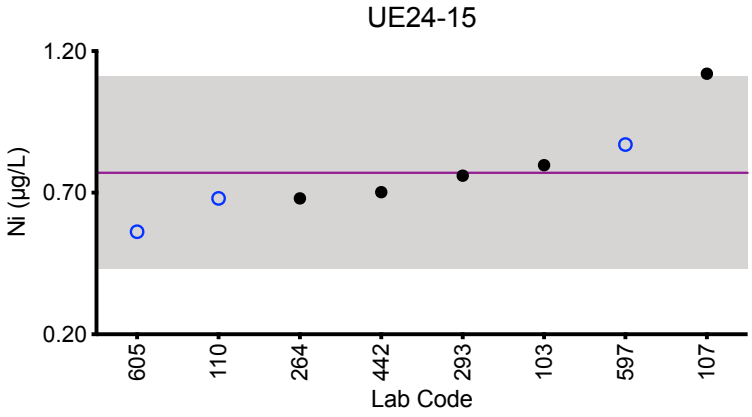
Urine Ni











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
107	ICP-MS	0.329	2.72	0.726	1.08	0.577
110	ICP-MS/MS	0.354	2.76	0.723	1.13	0.597
264	ICP-MS	0.33	2.74	0.68	1.07	0.54
293	DRC/CC-ICP-MS	0.34	2.74	0.72	1.07	0.58
399	ICP-MS/MS	0.310	2.62	0.671	1.02	0.601
605	ICP-MS	0.315	2.53	0.641	0.995	0.546

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	0.330	2.69	0.69	1.06	0.57
Arithmetic SD (s)	0.016	0.09	0.04	0.05	0.03
Arithmetic RSD (%)	4.8	3.3	5.0	4.7	4.4
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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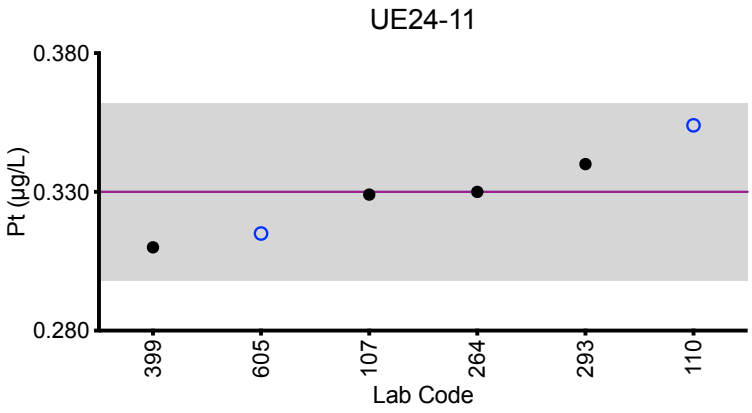
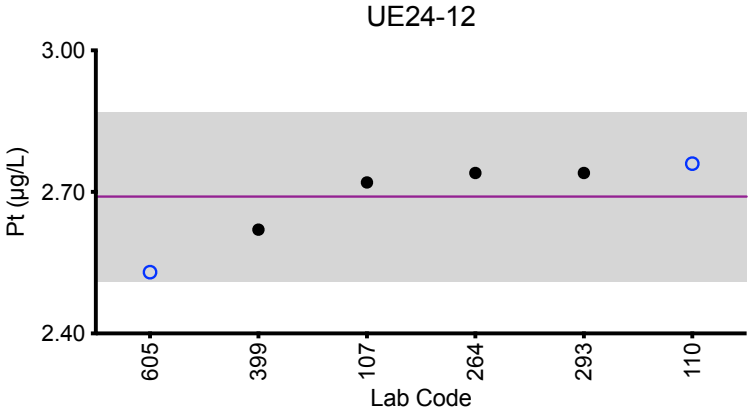
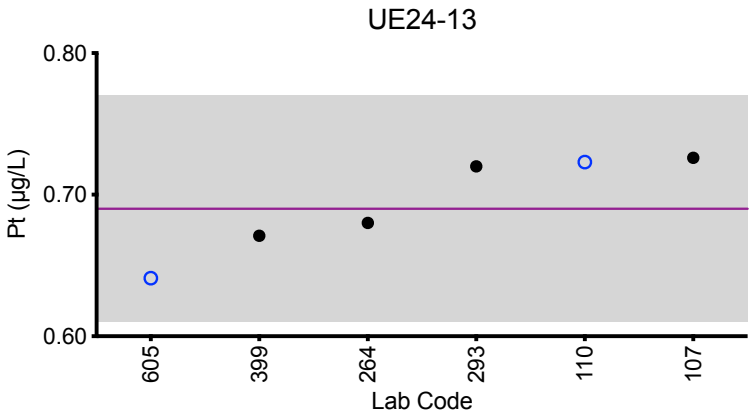
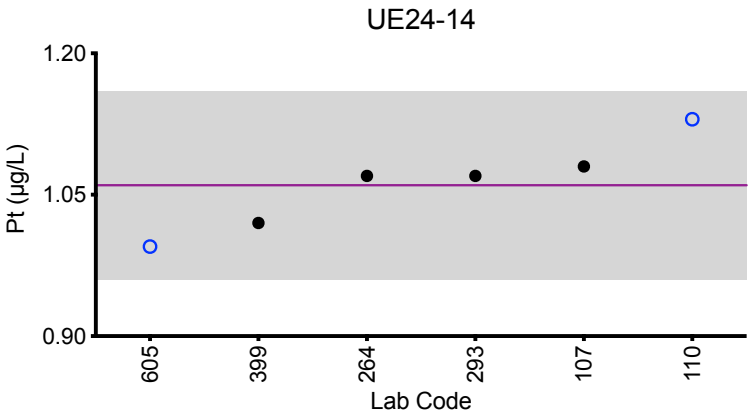
Results for Event #3, 2024: Summary Figures

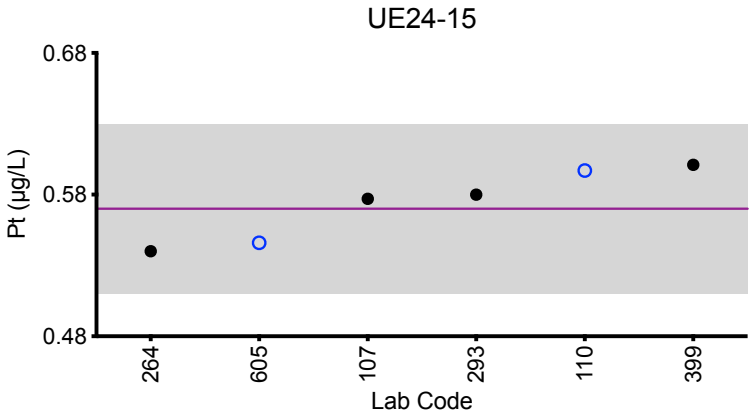
Urine Pt











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
103	ICP-MS/MS	0.534	1.42	0.270	0.878	3.35
107	ICP-MS	0.509	1.41	0.263	0.809	3.27
110	ICP-MS/MS	0.547	1.46	0.257	0.838	3.22
147	ICP-MS	0.568	1.51	0.289	0.904	3.51
264	ICP-MS	0.59	1.51	0.26	0.87	3.01
293	DRC/CC-ICP-MS	0.66	1.56	0.32	0.85	3.35
324	ICP-MS	<1	1.496	<1	<1	3.125
399	ICP-MS/MS	0.500	1.46	0.246	0.804	3.34
597	ICP-MS/MS	0.509	1.37	0.289	0.860	3.34
605	ICP-MS	<0.800	1.35	<0.800	<0.800	3.07

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	0.55	1.45	0.274	0.85	3.26
Arithmetic SD (s)	0.05	0.07	0.024	0.03	0.15
Arithmetic RSD (%)	9.1	4.8	8.8	4.0	4.6
Number of Sample Measurements (N)	8	10	8	8	10

*Denotes a statistical Outlier.

A Robust mean, SD, RSD and n are provided for samples UE24-12 and UE24-15.

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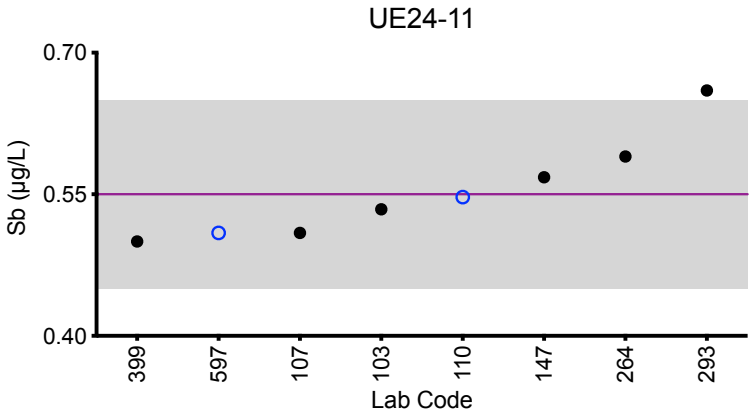
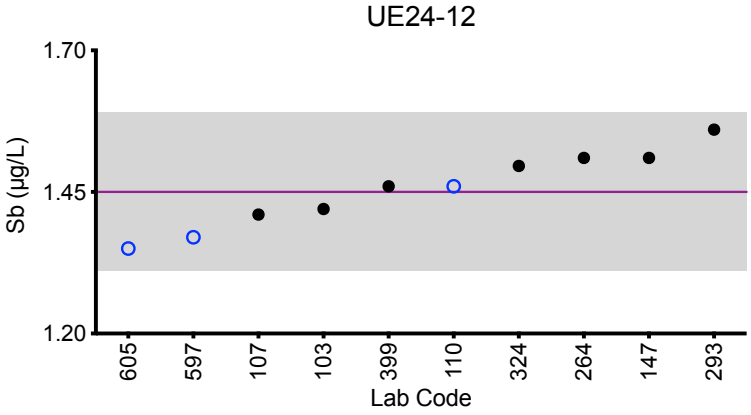
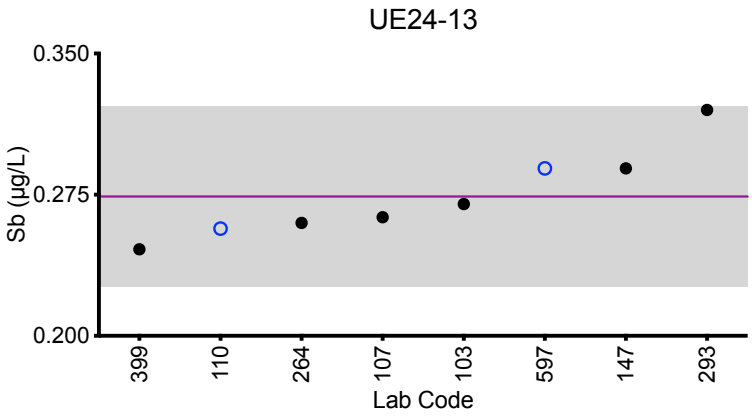
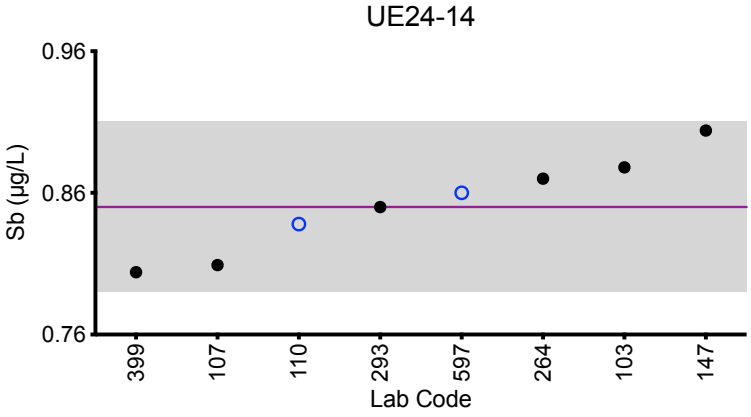
Results for Event #3, 2024: Summary Figures

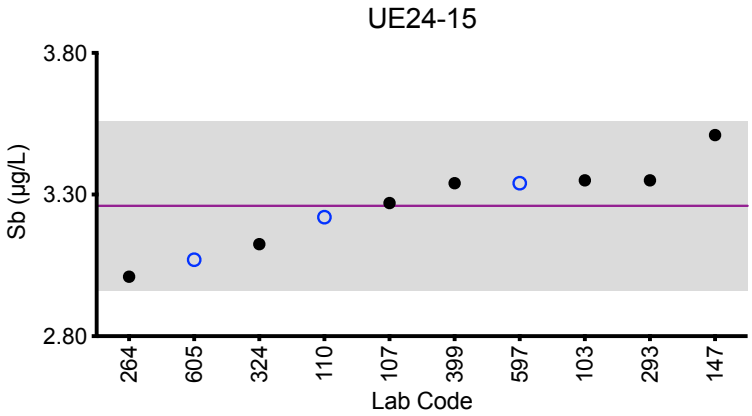
Urine Sb











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Se (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
103	ICP-MS/MS	180	128	62.5	256	16.1
110	ICP-MS/MS	159	113	56.4	232	16.3
147	ICP-MS	201	141	65.1	264	19.4
293	DRC/CC-ICP-MS	171.41	119.27	56.87	236.97	15.8
597	ICP-MS/MS	166	125	56.4	247	17.8

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	175	125	59	247	17.1
Arithmetic SD (s)	16	11	4	13	1.5
Arithmetic RSD (%)	9.1	8.8	6.8	5.3	8.8
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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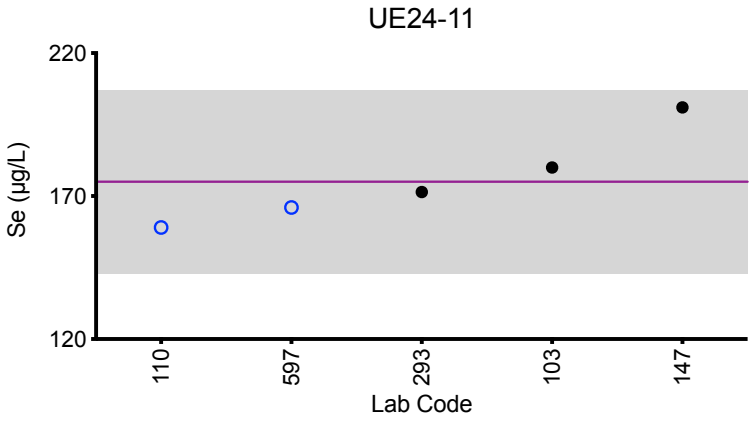
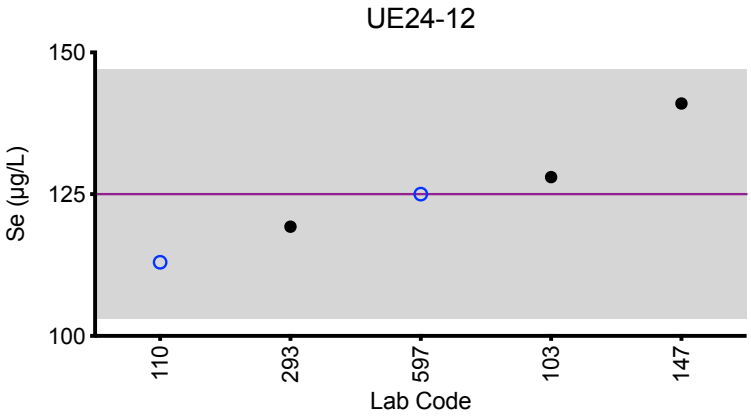
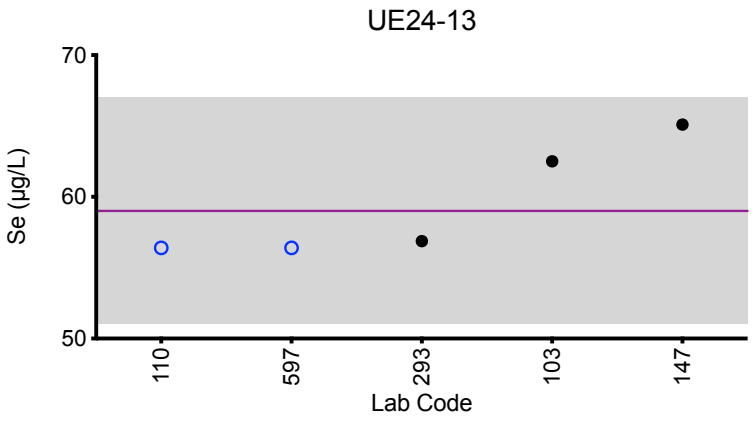
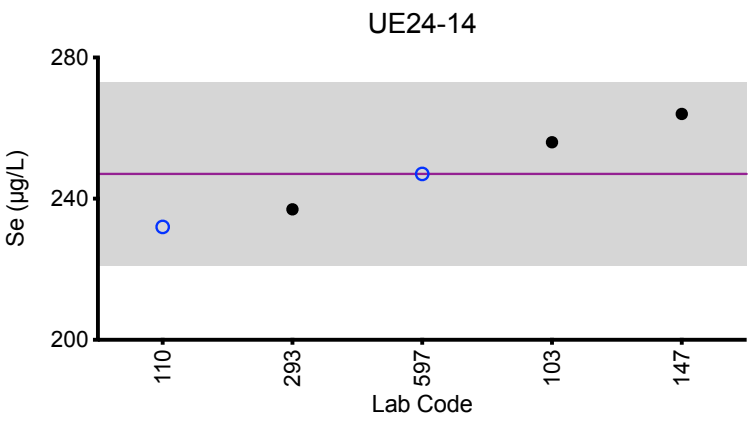
Results for Event #3, 2024: Summary Figures

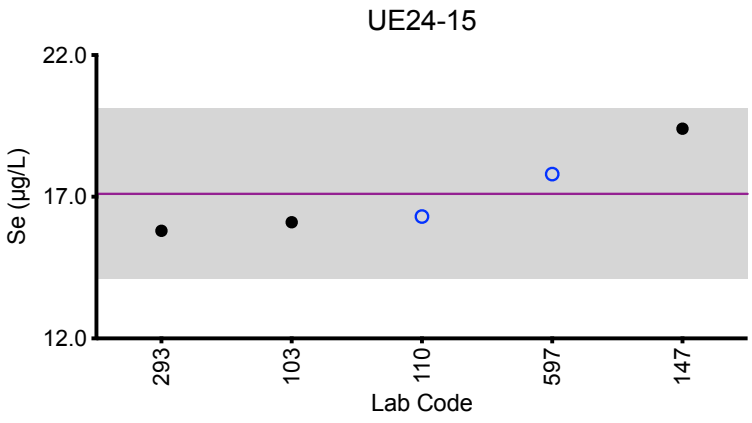
Urine Se











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
107	ICP-MS	0.678	3.23	0.484	5.33	3.81
110	ICP-MS/MS	0.71	3.36	0.48	4.92	3.23
147	ICP-MS	0.641	3.18	0.413	5.04	3.63
264	ICP-MS	0.69	3.15	0.41	3.92	2.92
324	ICP-MS	<1	3.179	<1	4.912	3.507
399	ICP-MS/MS	0.628	3.28	0.536	6.12	3.99
597	ICP-MS/MS	0.656	3.18	0.446	4.54	3.11
605	ICP-MS	<0.900	3.10	<0.900	5.53	3.80

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	0.67	3.21	0.46	5.0	3.5
Arithmetic SD (s)	0.03	0.08	0.05	0.7	0.4
Arithmetic RSD (%)	4.6	2.5	11	14	11
Number of Sample Measurements (N)	6	8	6	8	8

*Denotes a statistical Outlier.

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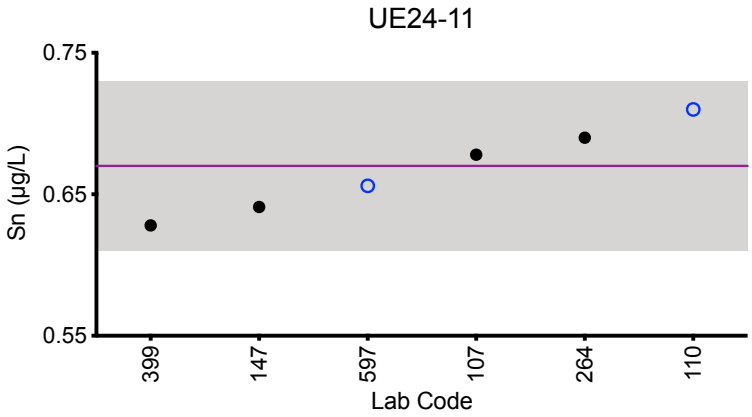
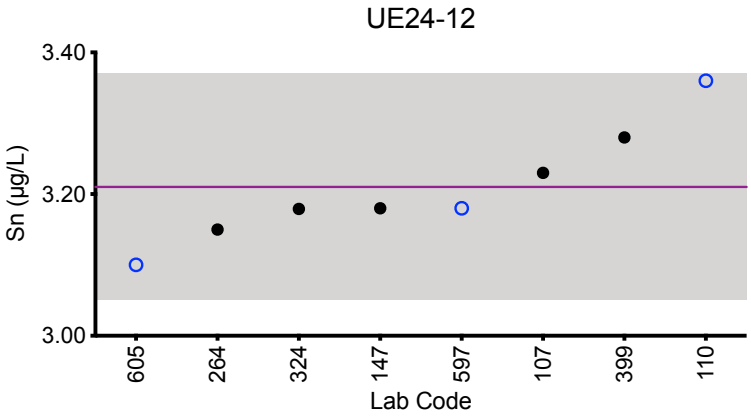
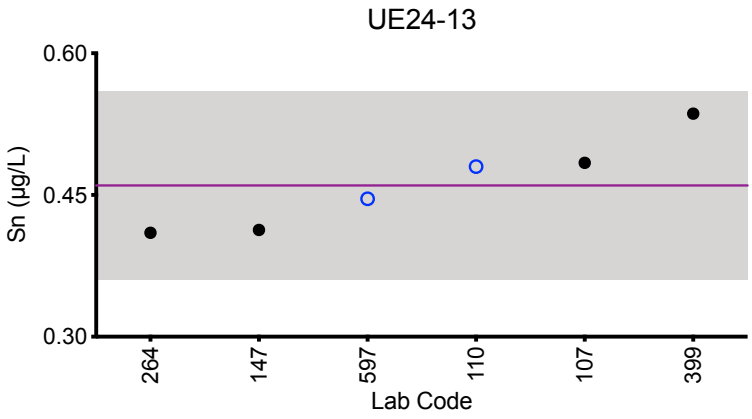
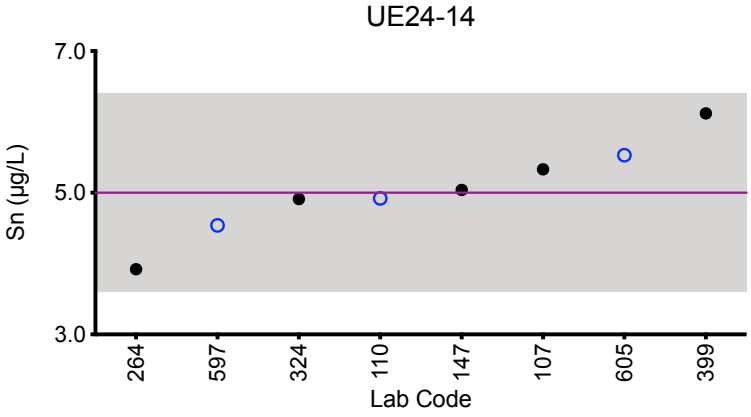
Results for Event #3, 2024: Summary Figures

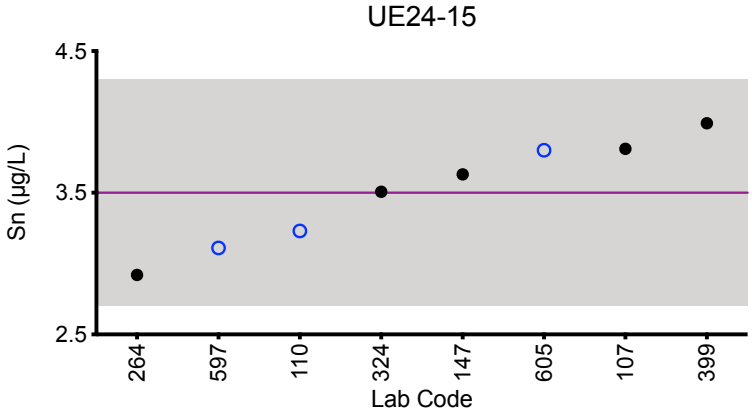
Urine Sn











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Sr (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
103	ICP-MS/MS	187	25.6	23.3	127	51.4
107	ICP-MS	167	24.1	21.7	110	49.1
110	ICP-MS/MS	197	26.5	23.8	134	53.5
264	ICP-MS	149	20.44	18.20	101	*38.97
399	DRC/CC-ICP-MS	176	24.3	21.2	116	50.2
597	ICP-MS/MS	175	25.4	22.0	127	56.3
605	ICP-MS	177	24.2	22.2	118	50.3

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	175	24.4	21.8	119	52
Arithmetic SD (s)	15	1.9	1.8	11	3
Arithmetic RSD (%)	8.6	7.8	8.3	9.2	5.2
Number of Sample Measurements (N)	7	7	7	7	6

*Denotes a statistical Outlier.

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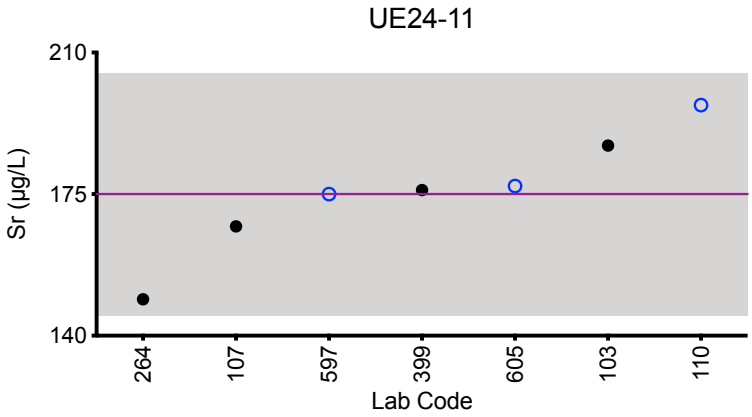
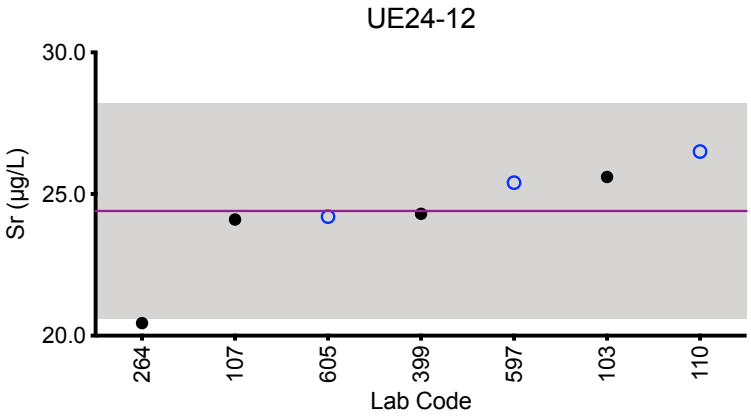
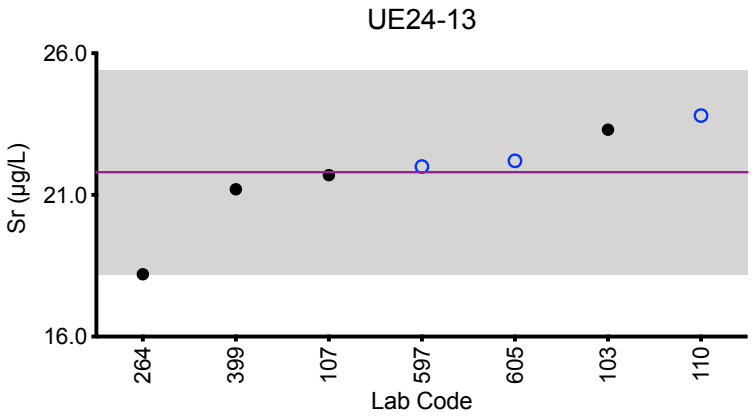
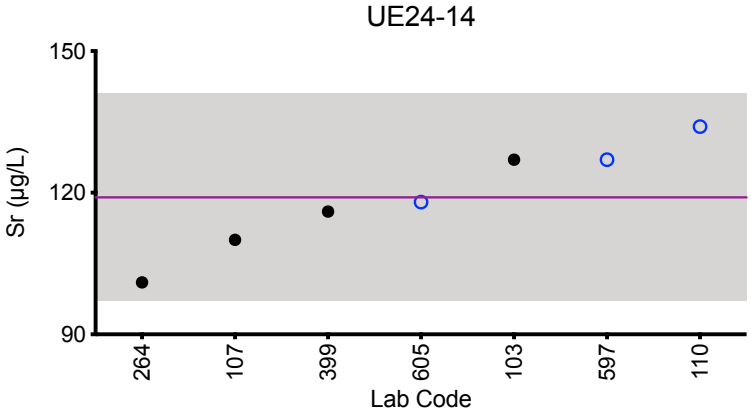
Results for Event #3, 2024: Summary Figures

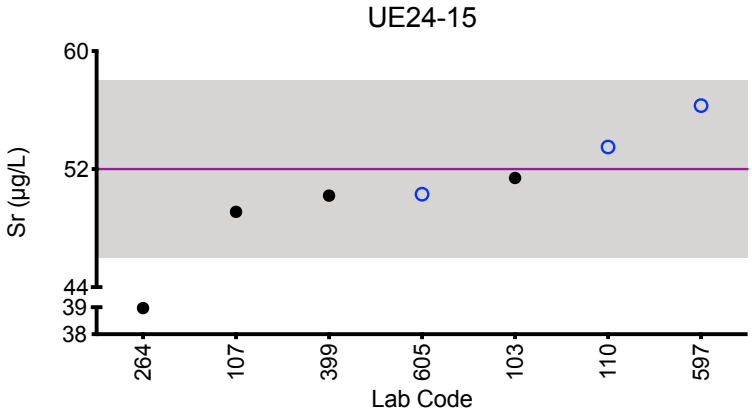
Urine Sr











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
110	ICP-MS/MS	0.289	1.11	0.719	4.63	3.30
116	ICP-MS/MS	0.274	1.05	0.7	4.53	3.22
147	DRC/CC-ICP-MS	0.339	0.882	0.591	*3.67	2.80
293	DRC/CC-ICP-MS	0.36	1.12	0.77	4.43	3.33
597	ICP-MS/MS	0.380	1.18	0.780	4.67	3.64
605	ICP-MS	0.409	1.16	0.759	4.37	3.32

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	0.34	1.08	0.72	4.53	3.3
Arithmetic SD (s)	0.05	0.11	0.07	0.13	0.3
Arithmetic RSD (%)	15	10	9.7	2.9	8.3
Number of Sample Measurements (N)	6	6	6	5	6

*Denotes a statistical Outlier.

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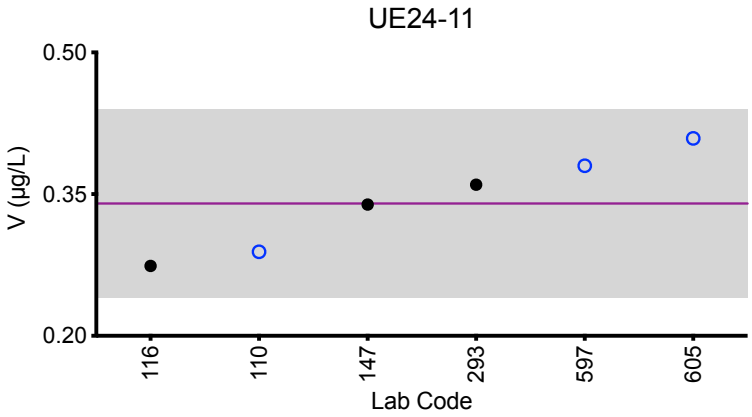
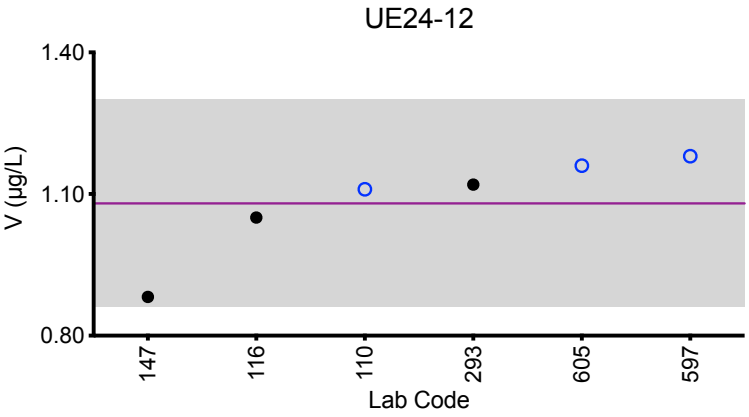
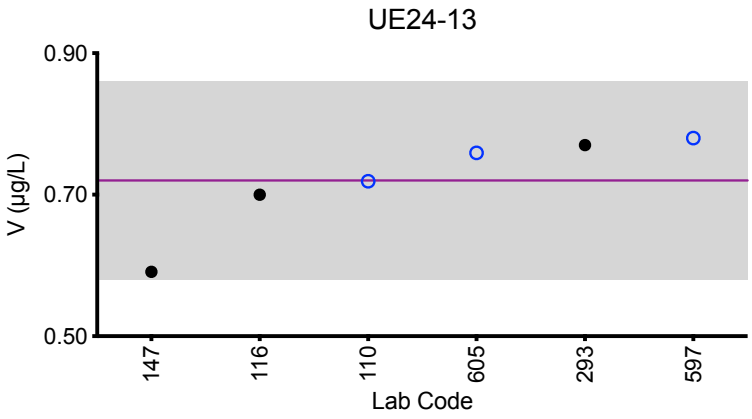
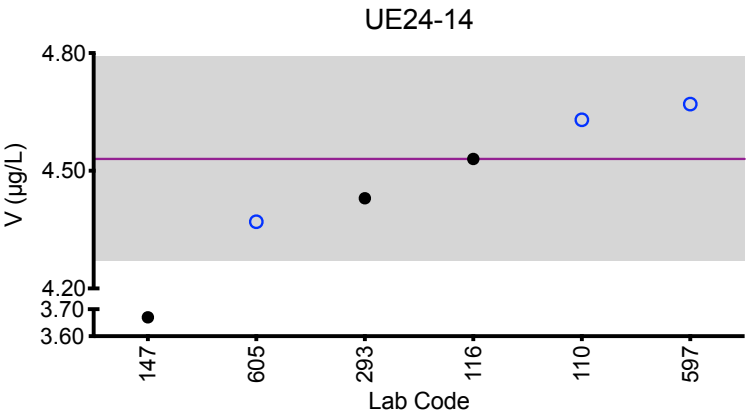
Results for Event #3, 2024: Summary Figures

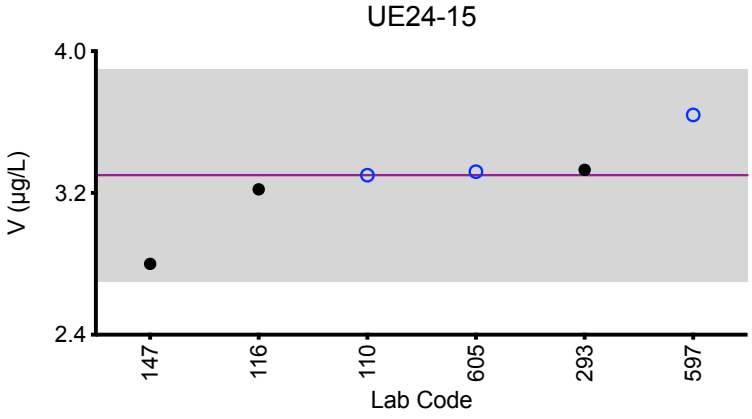
Urine V











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
107	ICP-MS	0.945	0.319	1.97	0.458	0.597
110	ICP-MS/MS	0.98	0.36	1.96	0.50	0.64
147	ICP-MS	0.905	0.374	1.90	0.466	0.595
200	ICP-MS	0.88	0.29	1.73	0.56	0.60
264	ICP-MS	0.87	0.21	1.86	0.40	0.51
324	ICP-MS	<1	<1	1.848	<1	<1
399	ICP-MS/MS	0.906	0.332	1.92	0.439	0.618
597	ICP-MS/MS	0.869	0.294	1.83	0.474	0.687
605	ICP-MS	0.886	0.285	1.81	0.419	0.562

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	0.91	0.31	1.87	0.46	0.60
Arithmetic SD (s)	0.04	0.05	0.08	0.05	0.05
Arithmetic RSD (%)	4.3	16	4.3	11	8.3
Number of Sample Measurements (N)	8	8	9	8	8

*Denotes a statistical Outlier.

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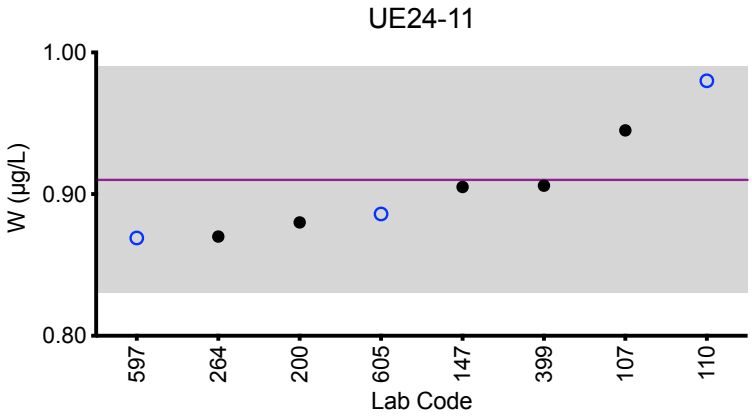
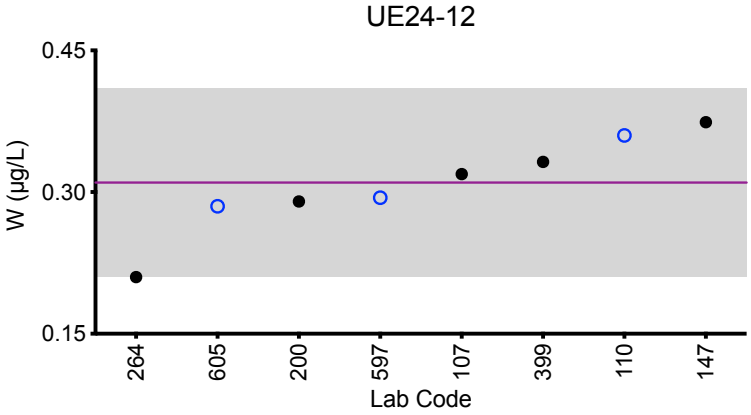
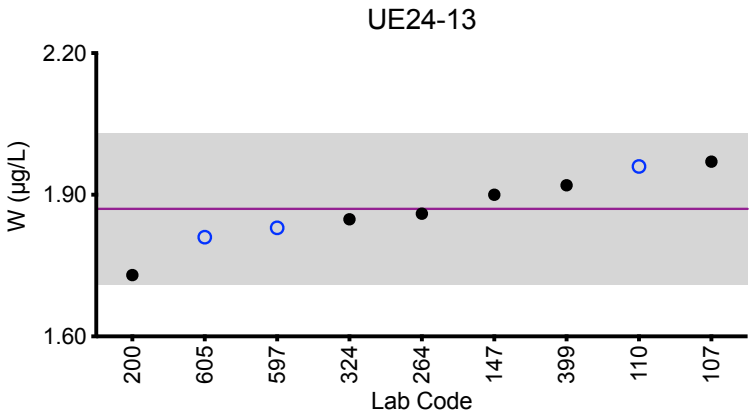
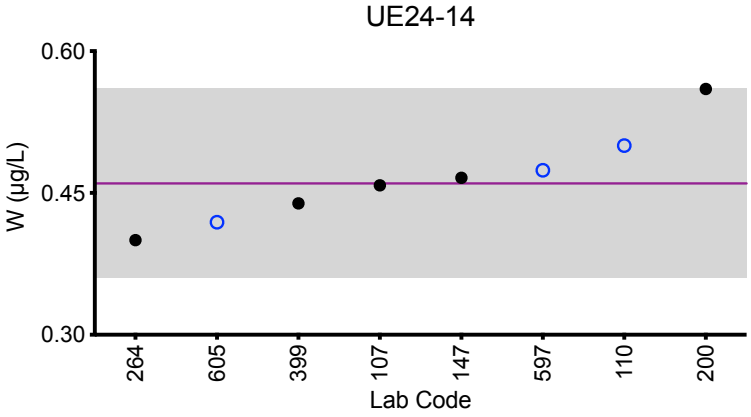
Results for Event #3, 2024: Summary Figures

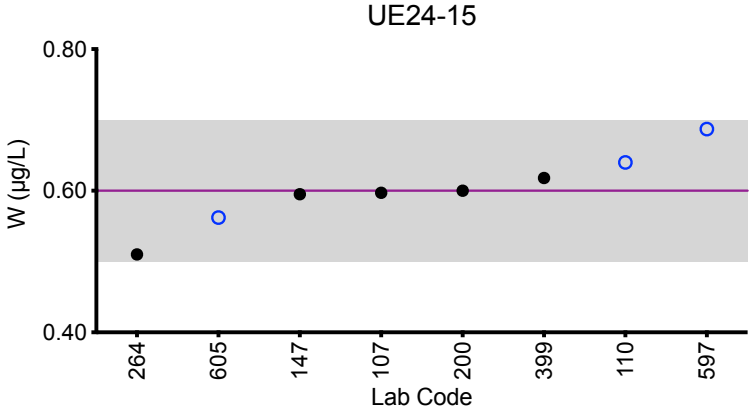
Urine W











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)						
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
110	ICP-MS/MS	433	120	124	645	220
147	ICP-MS	473	127	140	688	231
264	ICP-MS	470	132	140	666	205
293	DRC/CC-ICP-MS	437.91	124.18	119.61	604.58	195.42
324	ICP-MS	451.498	124.469	129.684	633.584	207.770
597	ICP-MS/MS	440	132	130	680	237
Summary Statistics						
		UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Arithmetic Mean ($\bar{x}$)		451	127	131	653	216
Arithmetic SD (s)		17	5	8	31	16
Arithmetic RSD (%)		3.8	3.9	6.1	4.7	7.4
Number of Sample Measurements (N)		6	6	6	6	6

*Denotes a statistical Outlier.

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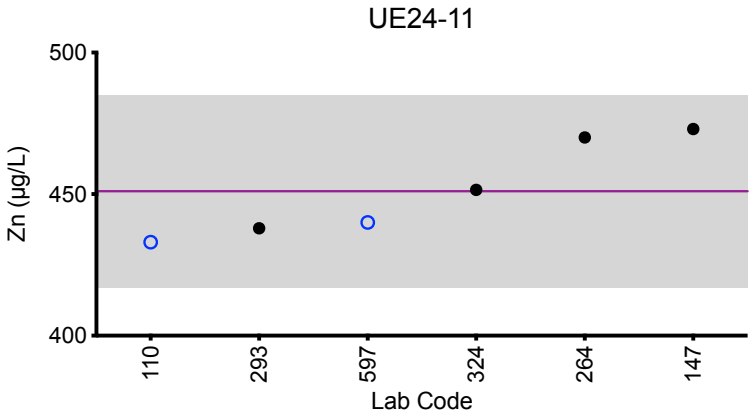
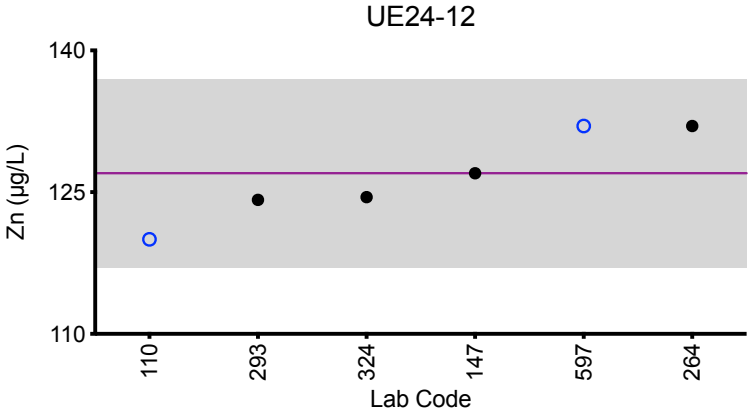
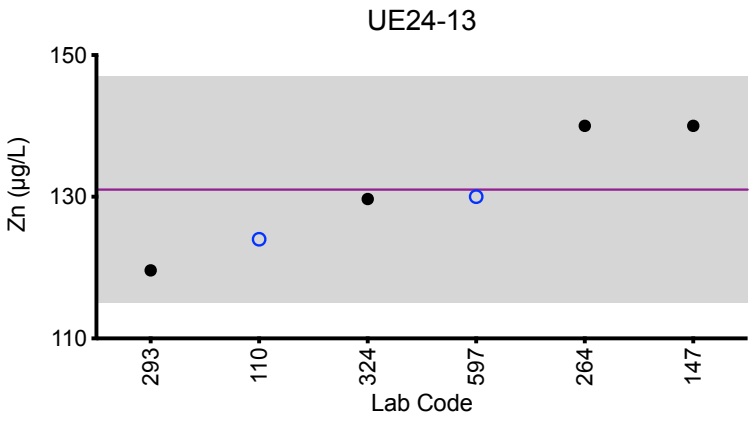
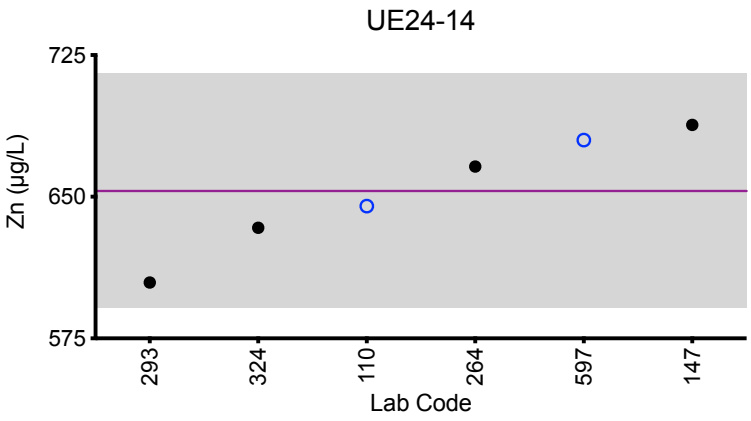
Results for Event #3, 2024: Summary Figures

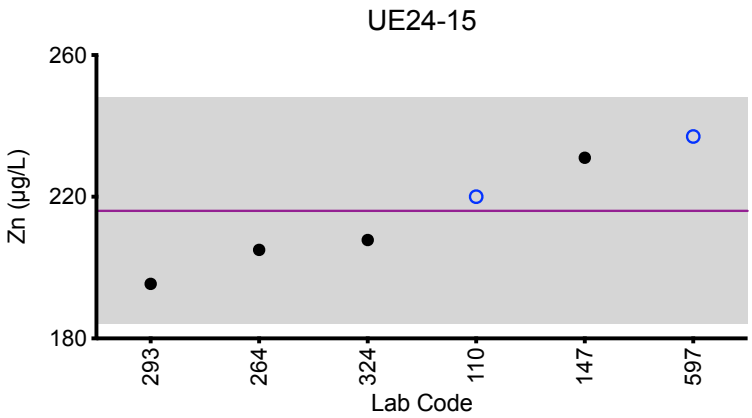
Urine Zn











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Al (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
147	ICP-MS	<13.5	19.4	13.6	<13.5	23.7
264	ICP-MS	6.83	19.78	14.93	10.99	24.13
293	DRC/CC-ICP-MS	*12.14	17.81	15.92	13.22	28.06
324	ICP-MS	6.428	17.394	12.343	9.699	23.174

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	6.6	18.6	14.2	11.3	24.8
Arithmetic SD (s)	0.3	1.2	1.6	1.8	2.2
Arithmetic RSD (%)	4.5	6.5	11	16	8.9
Number of Sample Measurements (N)	2	4	4	3	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine I (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
110	ICP-MS	29.4	26.7	60.2	102	47.0
147	ICP-MS	30.4	29.5	67.2	113	48.8
597	ICP-MS/MS	27.7	25.6	60.3	97.2	46.6

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	29.2	27	63	104	47.5
Arithmetic SD (s)	1.4	2	4	8	1.2
Arithmetic RSD (%)	4.8	7.3	6.3	7.7	2.5
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Li (µg/L)						
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
110	ICP-MS/MS	8.80	42.8	4.45	16.9	13.5
147	ICP-MS	9.39	46.6	4.97	20.2	15.9
597	ICP-MS/MS	9.29	46.7	5.17	20.1	16.0
Summary Statistics						
		UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Arithmetic Mean ($\bar{x}$)		9.2	45	4.9	19	15.1
Arithmetic SD (s)		0.3	2	0.4	2	1.4
Arithmetic RSD (%)		3.3	4.8	8.2	9.9	9.3
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Te (µg/L)						
Lab Code	**Method**	**UE24-11**	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
110	ICP-MS/MS	1.00	0.103	0.352	1.93	0.658
147	ICP-MS	0.983	<0.128	0.343	1.73	0.679
Summary Statistics						
		UE24-11	**UE24-12**	**UE24-13**	**UE24-14**	**UE24-15**
Arithmetic Mean ($\bar{x}$)		0.992	NA	0.347	1.8	0.67
Arithmetic SD (s)		0.012	NA	0.006	0.1	0.02
Arithmetic RSD (%)		1.2	NA	1.7	7.7	2.2
Number of Sample Measurements (N)		2	NA	2	2	2

*Denotes a statistical Outlier.

Statistical data was not calculated for UE24-12 based on a lack of consensus among participating labs.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Urine Ti (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
442	ICP-MS/MS	4.03	1.11	9.03	5.67	2.00
597	ICP-MS/MS	5.25	2.22	9.51	7.10	5.34

Summary Statistics

	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
Arithmetic Mean ($\bar{x}$)	4.6	NA	9.3	6.4	NA
Arithmetic SD (s)	0.9	NA	0.3	1.0	NA
Arithmetic RSD (%)	20	NA	3.2	16	NA
Number of Sample Measurements (N)	2	NA	2	2	NA

*Denotes a statistical Outlier.

Statistical data was not calculated for UE24-12 and UE24-15 based on a lack of consensus among participating labs.

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Results for Event #3, 2024: Additional Elements in Urine

Urine Ag (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
147	ICP-MS	<0.108	<0.108	<0.108	<0.108	<0.108

Urine Bi (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
147	ICP-MS	<0.0773	<0.0773	<0.0773	<0.0773	<0.0773
264	ICP-MS	0.06	0.01	<0.01	<0.01	<0.01
597	ICP-MS/MS	<0.0122	<0.0122	<0.0122	<0.0122	<0.0122

Urine Fe (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
324	ICP-MS	8.441	10.215	3.114	5.633	1.970

Urine Mg (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
597	ICP-MS/MS	13500	13200	13700	26000	35100

Urine Th (µg/L)

Lab Code	Method	UE24-11	UE24-12	UE24-13	UE24-14	UE24-15
147	ICP-MS	<0.0951	<0.0951	<0.0951	<0.0951	<0.0951
597	ICP-MS/MS	0.236	0.0903	0.0408	0.0672	0.0671

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Event #3, 2024

Trace Elements in Serum

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Trace Elements Laboratory

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Event #3, 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 #3, 2024: Summary Statistics

	Serum Al (µg/L)				
	SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Target (Arithmetic Mean ($\bar{x}$))	36	47	68	19.6	97
Upper Limit	43	56	81	24.6	116
Lower Limit	29	38	54	14.6	78
Arithmetic SD (s)	5	4	3	1.2	7
Arithmetic RSD (%)	14	8.5	3.8	6.1	7.2
Number of Sample Measurements (N)	6	6	6	5	6

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

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Serum Al (µg/L)				
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
	Target	**36**	**47**	**68**	**19.6**	**97**
147	ETAAS-Z	31.5	46.4	65.9	21.1	94.8
264	ICP-MS	31.22	39.74	64.49	17.90	94.83
293	DRC/CC-ICP-MS	40.59	49.46	65.86	19.62	94.89
391	ETAAS-Z	42.89	51.14	71.07	*27.04 ↑	88.67
485	HR-ICP-MS	34.4	45.1	69.4	19.4	103
597	ICP-MS/MS	33.8	49.3	69.6	20.0	108

Based on the grading criteria for Al in Serum, 97% 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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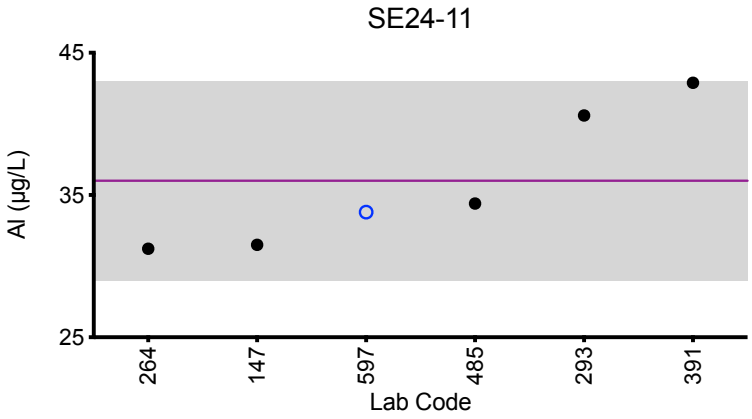
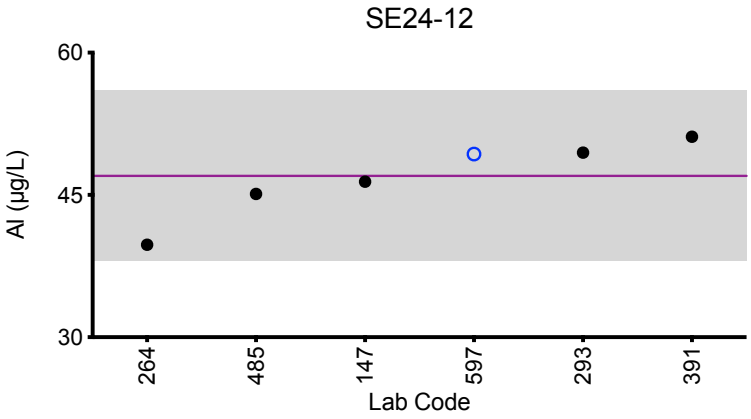
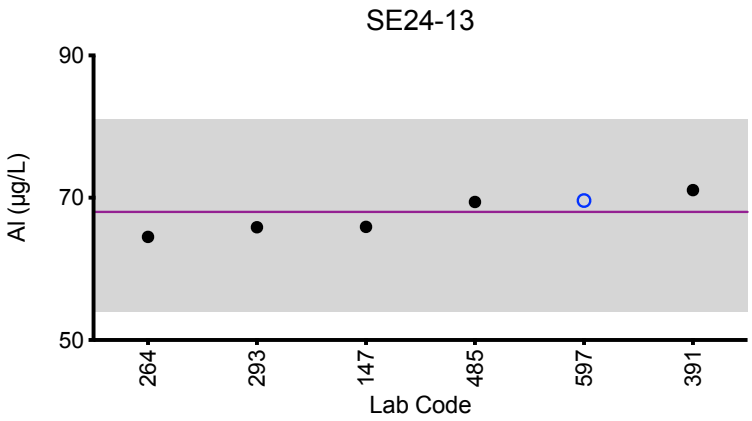
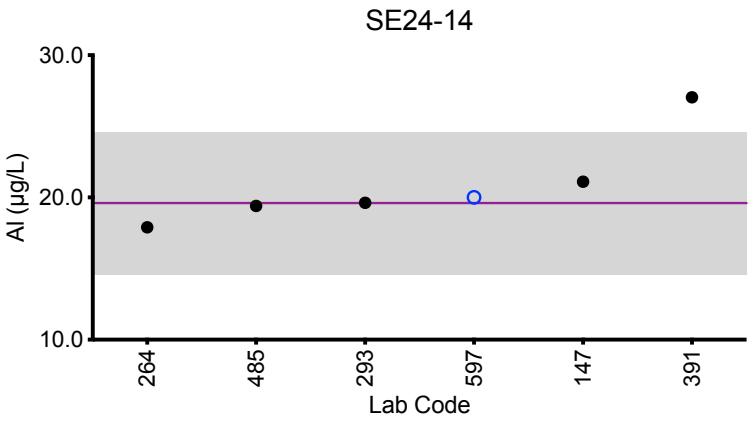
Results for Event #3, 2024: Summary Figures

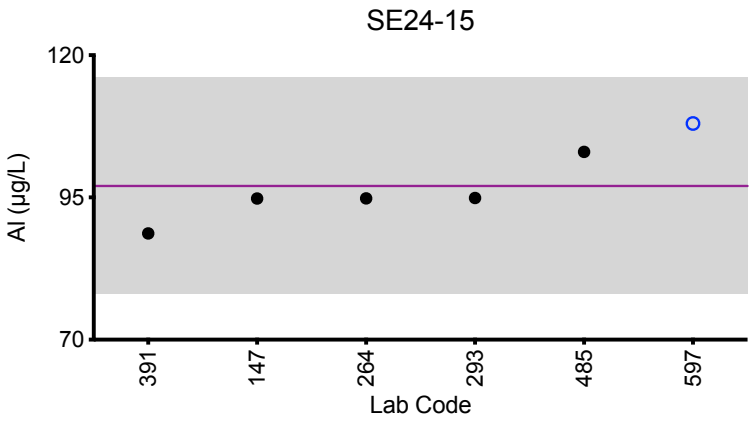
Serum Al











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 #3, 2024:
Summary Statistics

	Serum Co (µg/L)				
	SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Target (Arithmetic Mean ($\bar{x}$))	1.94	0.353	4.67	18.1	4.64
Upper Limit	3.44	1.853	6.17	20.8	6.14
Lower Limit	0.44	0.000	3.17	15.4	3.14
Arithmetic SD (s)	0.10	0.020	0.19	0.3	0.20
Arithmetic RSD (%)	5.2	5.7	4.1	1.9	4.3
Number of Sample Measurements (N)	7	7	7	6	7

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 #3, 2024:
Performance of Participating Laboratories

Serum Co (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
	Target	**1.94**	**0.353**	**4.67**	**18.1**	**4.64**
103	ICP-MS/MS	1.95	0.339	4.67	18.4	4.55
110	ICP-MS/MS	1.97	0.35	4.61	18.4	4.65
147	DRC/CC-ICP-MS	1.90	0.341	4.47	18.3	4.40
264	ICP-MS	1.80	0.34	4.48	17.86	4.67
293	DRC/CC-ICP-MS	1.9	0.34	4.58	17.90	4.42
485	HR-ICP-MS	1.94	0.366	4.87	17.6	4.9
597	ICP-MS/MS	2.14	0.392	4.98	*20.0	4.88

Based on the grading criteria for Co 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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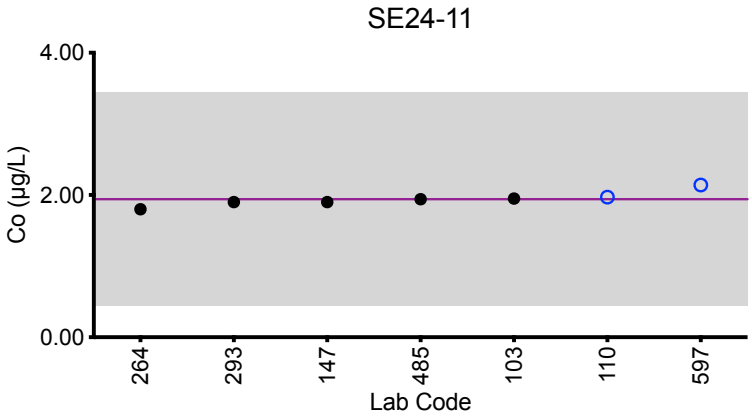
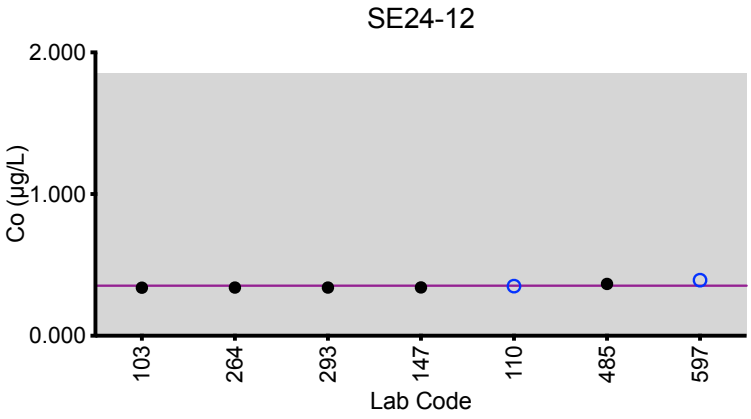
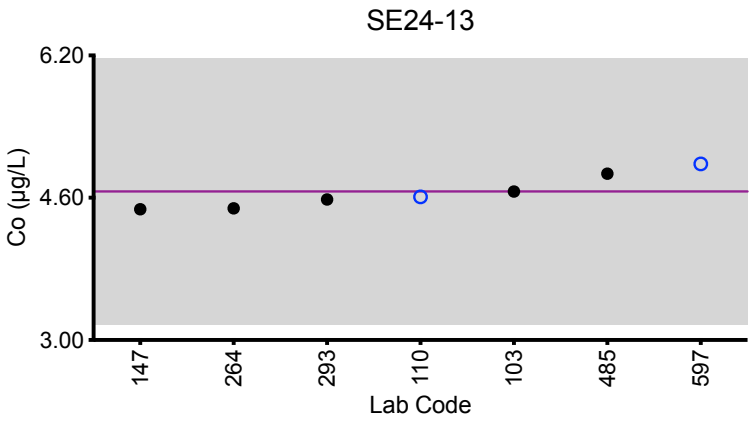
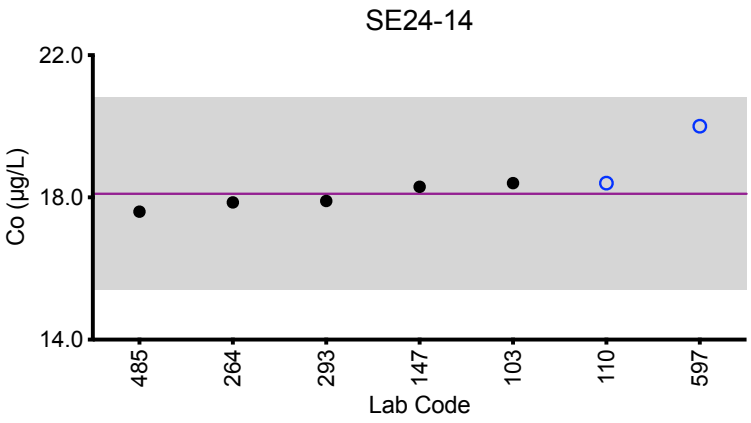
Results for Event #3, 2024: Summary Figures

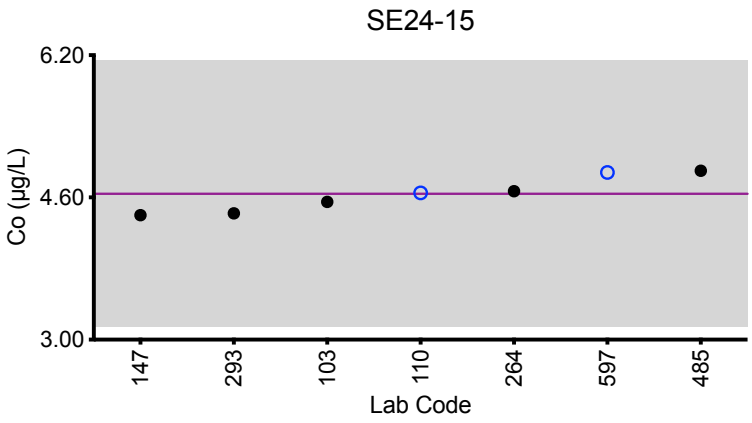
Serum Co











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 #3, 2024:
Summary Statistics

	Serum Cr (µg/L)				
	SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Target (Arithmetic Mean ($\bar{x}$))	1.22	0.42	4.7	0.80	3.1
Upper Limit	3.22	2.42	6.7	2.80	5.1
Lower Limit	0.00	0.00	2.7	0.00	1.1
Arithmetic SD (s)	0.11	0.11	0.4	0.04	0.3
Arithmetic RSD (%)	8.6	26	8.5	5.6	11
Number of Sample Measurements (N)	6	6	7	6	7

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

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Results for Event #3, 2024:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
	Target	**1.22**	**0.42**	**4.7**	**0.80**	**3.1**
103	ICP-MS/MS	1.21	0.335	5.09	0.812	3.34
110	ICP-MS/MS	1.11	0.31	4.22	0.82	2.79
147	DRC/CC-ICP-MS	1.17	0.365	4.55	0.782	2.98
264	ICP-MS	*0.47	*0.15	4.11	0.73	2.48
293	DRC/CC-ICP-MS	1.28	0.46	4.83	0.86	3.17
485	HR-ICP-MS	1.13	0.449	4.62	0.773	3.14
597	ICP-MS/MS	1.39	0.608	5.21	*1.15	3.43

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

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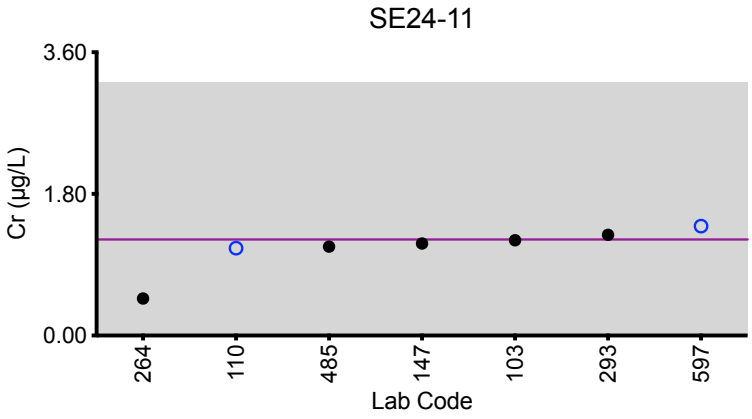
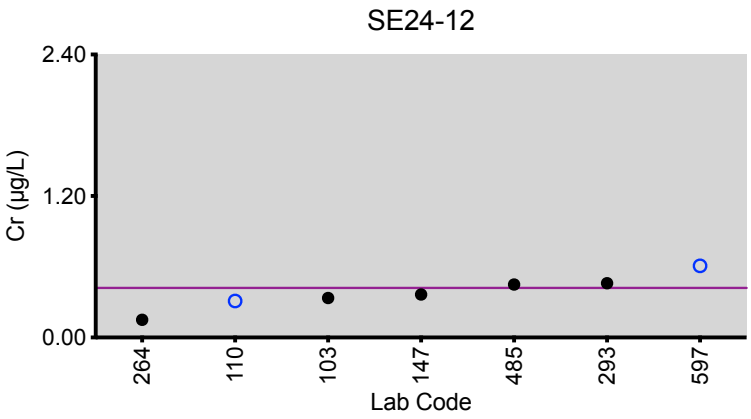
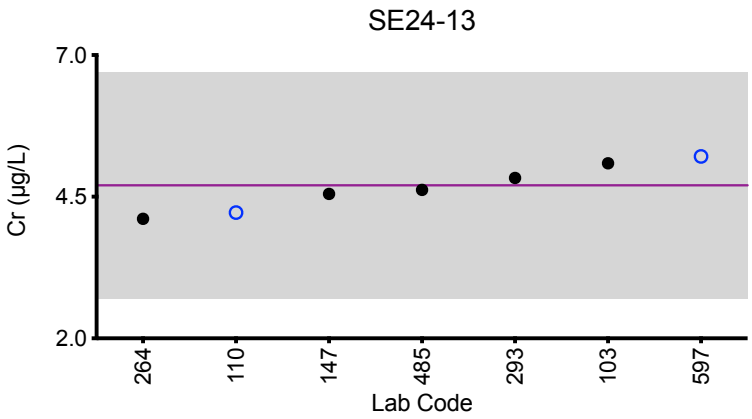
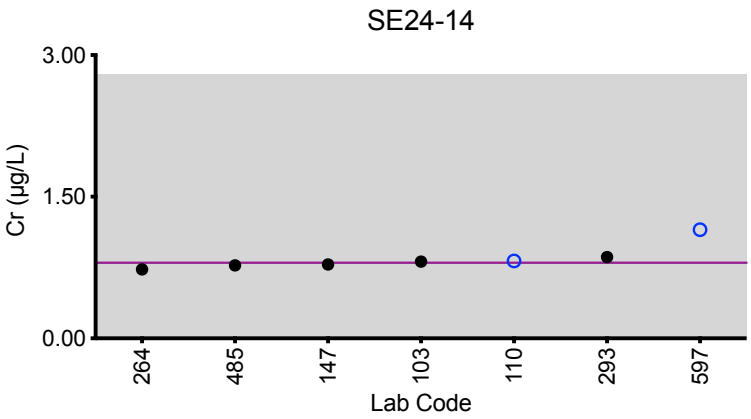
Results for Event #3, 2024: Summary Figures

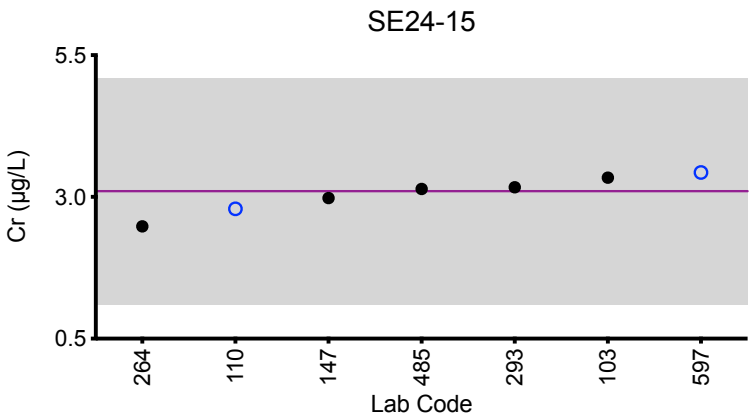
Serum Cr











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 #3, 2024:
Summary Statistics

	Serum Cu (µg/L)				
	SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Target (Arithmetic Mean ($\bar{x}$))	1280	1032	1650	728	1341
Upper Limit	1470	1187	1900	837	1542
Lower Limit	1090	877	1400	619	1140
Arithmetic SD (s)	50	27	40	32	28
Arithmetic RSD (%)	3.9	2.6	2.4	4.4	2.1
Number of Sample Measurements (N)	7	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 #3, 2024:
Performance of Participating Laboratories

Serum Cu (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
	Target	**1280**	**1032**	**1650**	**728**	**1341**
107	DRC/CC-ICP-MS	1290	1070	1610	677	1310
110	ICP-MS/MS	1260	1010	1630	735	1360
147	DRC/CC-ICP-MS	1335	1051	1717	772	1371
264	ICP-MS	1290	993	1658	726	1367
293	DRC/CC-ICP-MS	1329	1043	1672	744	1316
436	FAAS	1175	1016	*1334 ↓	698	*1143
597	ICP-MS/MS	1280	1040	1640	745	1320

Based on the grading criteria for Cu in Serum, 97% 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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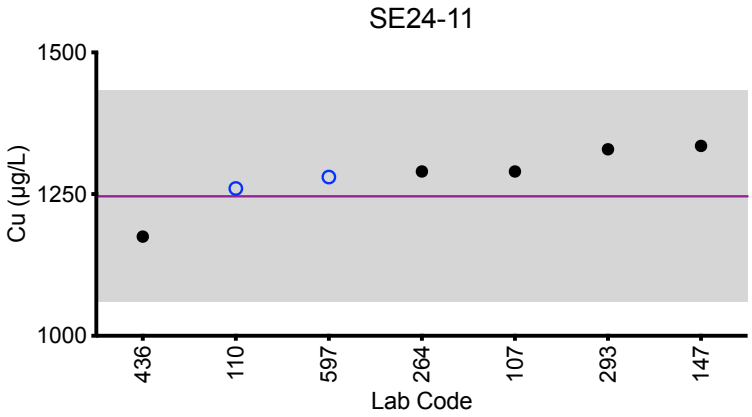
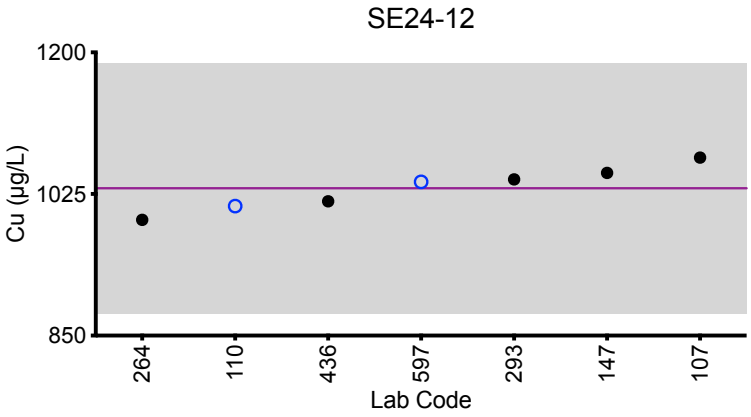
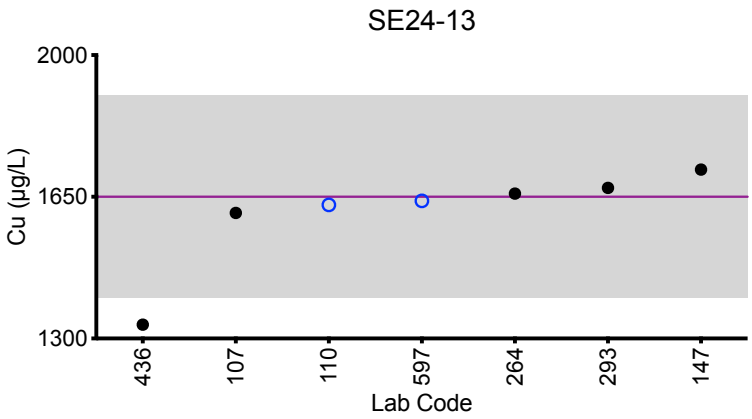
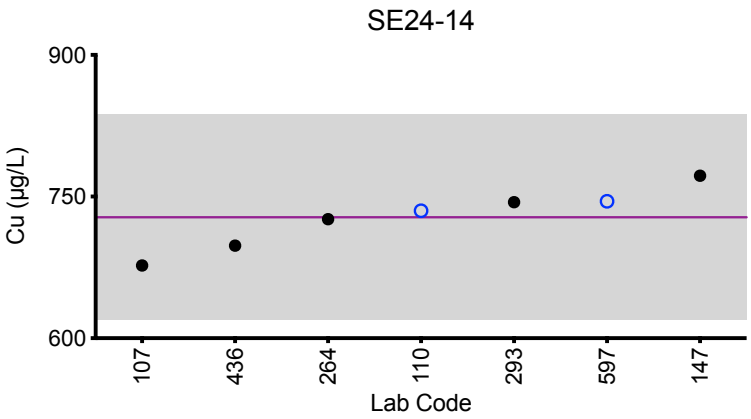
Results for Event #3, 2024: Summary Figures

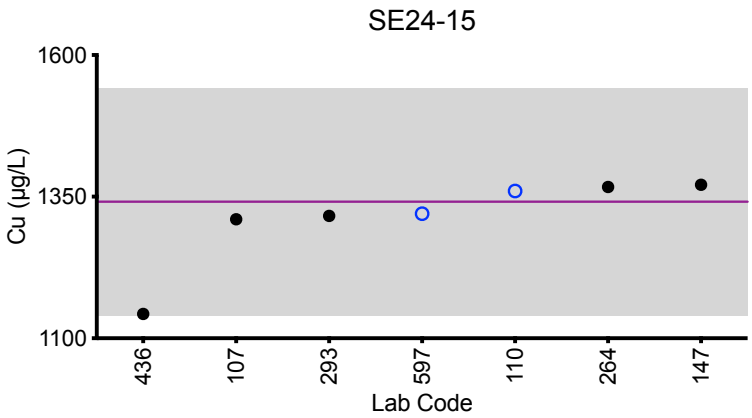
Serum Cu











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 #3, 2024: Summary Statistics

Serum Se (µg/L)					
	SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Target (Arithmetic Mean ($\bar{x}$))	149	97	205	131	285
Upper Limit	179	116	246	157	342
Lower Limit	119	78	164	105	228
Arithmetic SD (s)	10	9	8	9	11
Arithmetic RSD (%)	6.7	9.3	3.9	6.9	3.9
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 #3, 2024:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
	Target	**149**	**97**	**205**	**131**	**285**
103	ICP-MS/MS	153	101	209	138	284
107	DRC/CC-ICP-MS	151	95.4	201	129	285
110	ICP-MS/MS	147	92.0	199	126	288
147	DRC/CC-ICP-MS	148	92.6	200	127	285
264	ICP-MS	133	80.8	191	114	263
293	DRC/CC-ICP-MS	163	103	214	139	298
436	ETAAS-Other	140	100	213	134	280
597	ICP-MS/MS	160	110	209	141	295

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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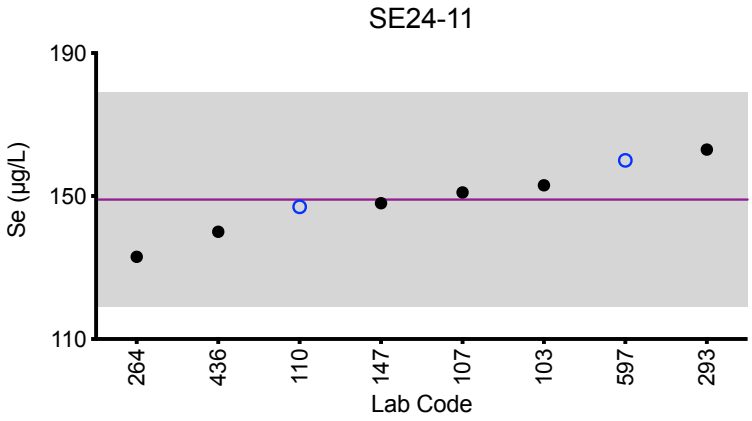
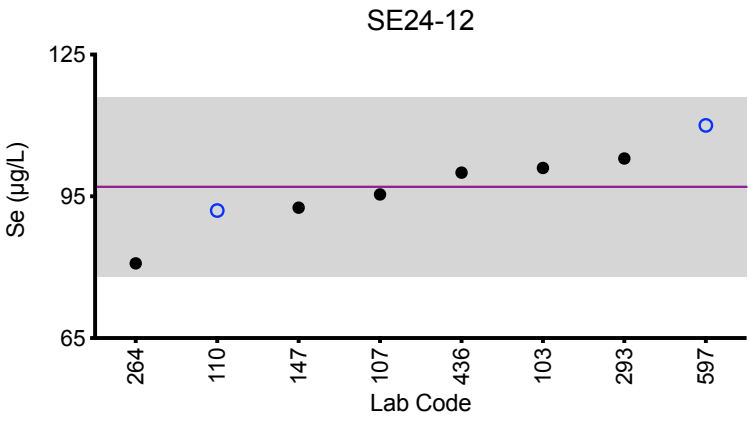
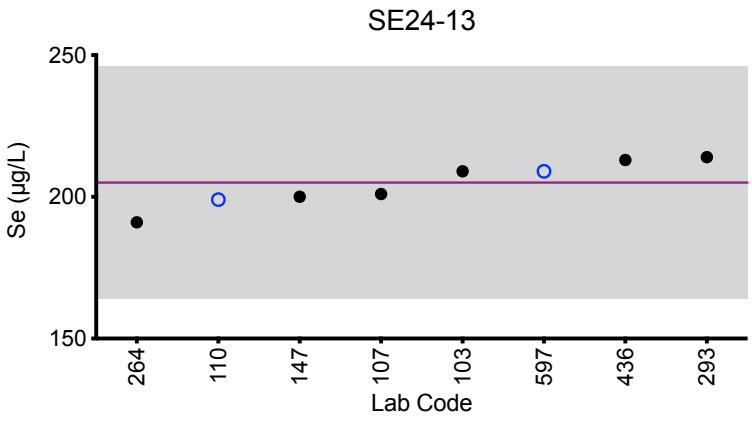
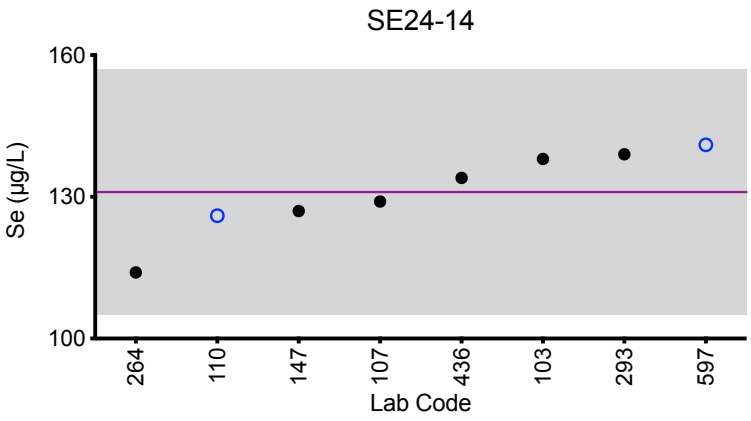
Results for Event #3, 2024: Summary Figures

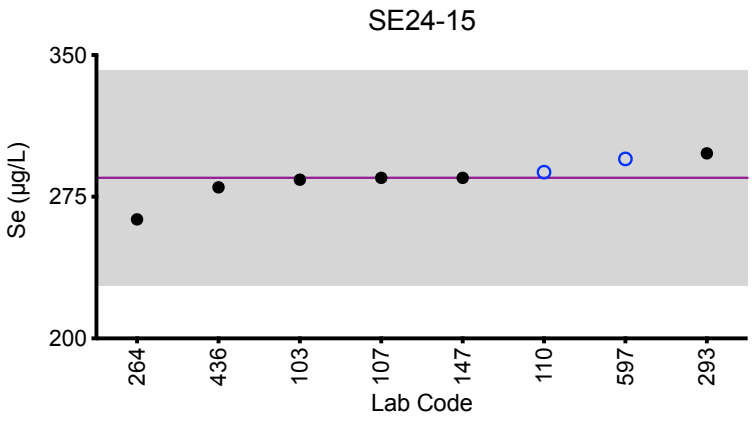
Serum Se











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 #3, 2024: Summary Statistics

Serum Zn (µg/L)					
	SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Target (Arithmetic Mean ($\bar{x}$))	1810	2450	1360	970	840
Upper Limit	2080	2820	1560	1120	970
Lower Limit	1540	2080	1160	820	710
Arithmetic SD (s)	50	130	60	50	40
Arithmetic RSD (%)	2.8	5.3	4.4	5.2	4.8
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 #3, 2024:
Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
	Target	**1810**	**2450**	**1360**	**970**	**840**
107	DRC/CC-ICP-MS	1810	2630	1280	893	792
110	ICP-MS/MS	1870	2470	1430	1020	900
147	DRC/CC-ICP-MS	1797	2389	1374	985	834
264	ICP-MS	1744	2291	1335	927	835
293	DRC/CC-ICP-MS	1765	2353	1320	948	797
597	ICP-MS/MS	1860	2540	1400	1020	876

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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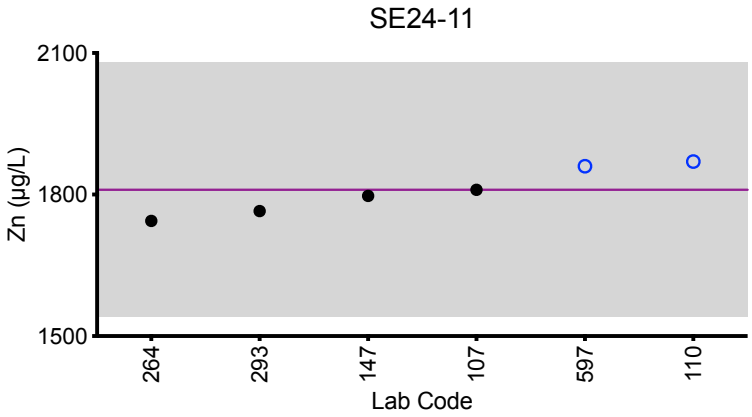
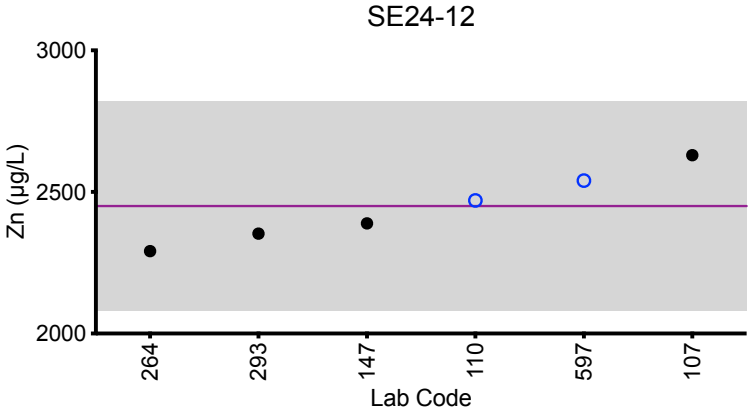
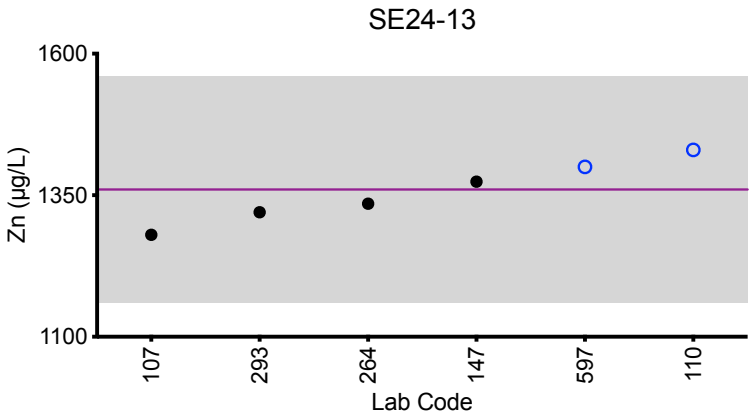
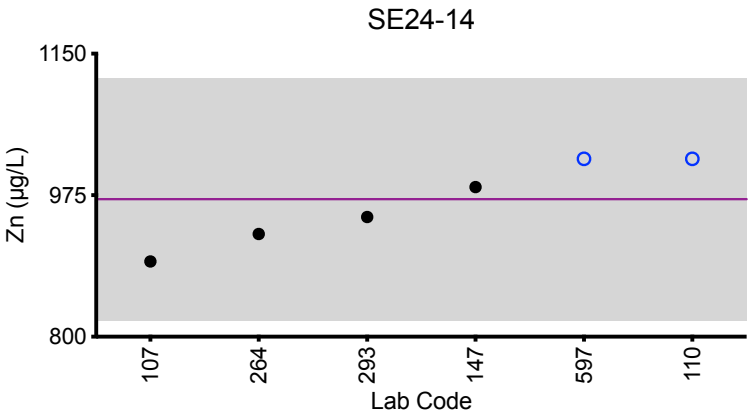
Results for Event #3, 2024: Summary Figures

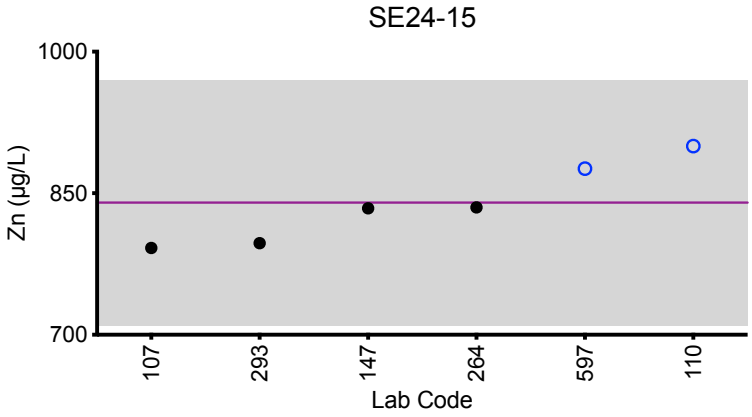
Serum Zn











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 #3, 2024:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
103	ICP-MS/MS	2.45	3.83	8.76	1.22	6.37
110	ICP-MS/MS	2.51	3.84	8.63	1.26	6.57
147	DRC/CC-ICP-MS	2.39	3.61	8.29	1.11	6.03
264	ICP-MS	2.43	3.93	8.48	1.43	6.12
293	DRC/CC-ICP-MS	2.410	3.70	8.50	1.20	6.290
597	ICP-MS/MS	*2.76	4.25	9.17	1.37	6.95

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	2.44	3.86	8.6	1.26	6.4
Arithmetic SD (s)	0.05	0.22	0.3	0.12	0.3
Arithmetic RSD (%)	1.9	5.7	3.5	9.5	5.2
Number of Sample Measurements (N)	5	6	6	6	6

*Denotes a statistical Outlier.

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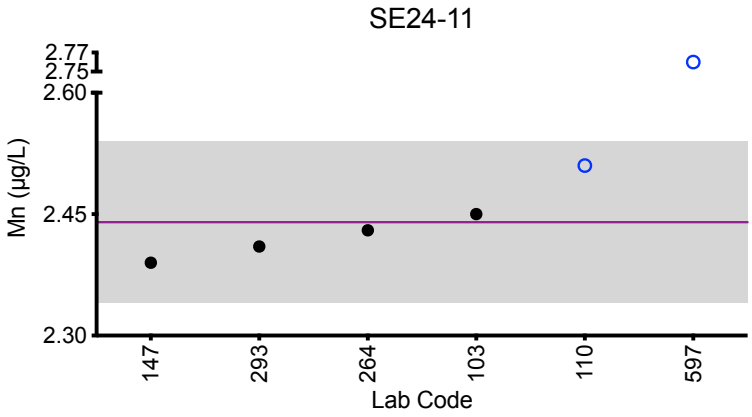
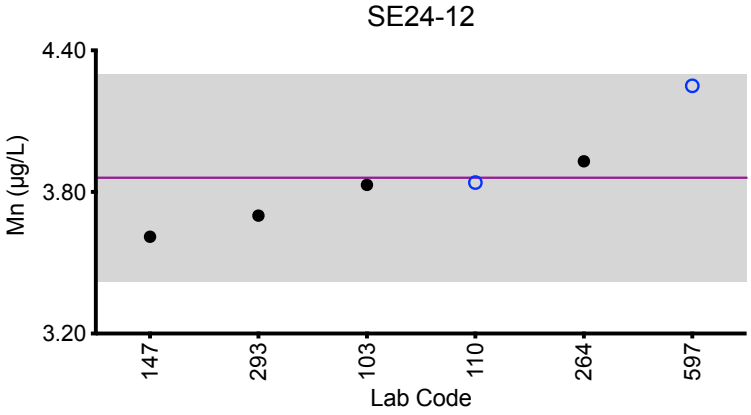
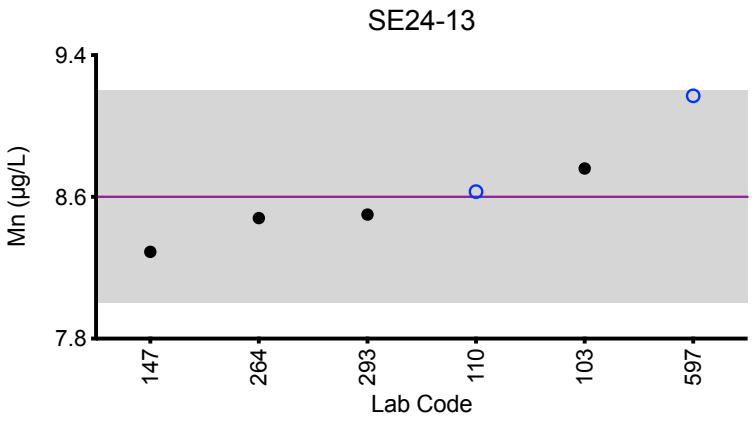
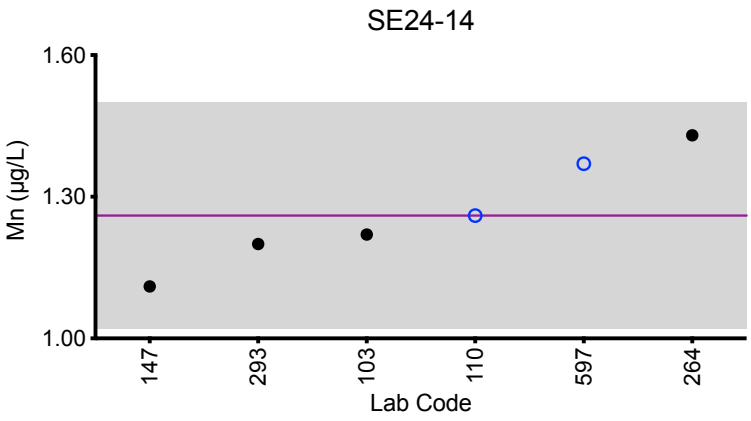
Results for Event #3, 2024: Summary Figures

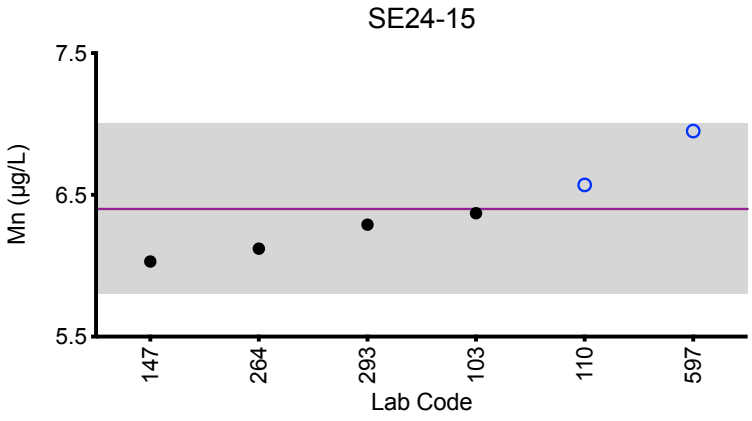
Serum Mn











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

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Mo (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
103	ICP-MS/MS	3.06	0.903	8.19	1.61	4.79
110	ICP-MS/MS	3.04	0.90	8.06	1.65	5.00
147	DRC/CC-ICP-MS	2.98	*0.757	8.26	1.56	4.74
293	DRC/CC-ICP-MS	*3.840	0.950	8.130	1.680	4.760
485	HR-ICP-MS	2.92	0.902	8.53	1.57	5.06
597	ICP-MS/MS	2.98	0.919	7.85	1.58	4.62

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	3.00	0.915	8.17	1.61	4.83
Arithmetic SD (s)	0.06	0.021	0.23	0.05	0.17
Arithmetic RSD (%)	1.9	2.3	2.8	3.1	3.5
Number of Sample Measurements (N)	5	5	6	6	6

*Denotes a statistical Outlier.

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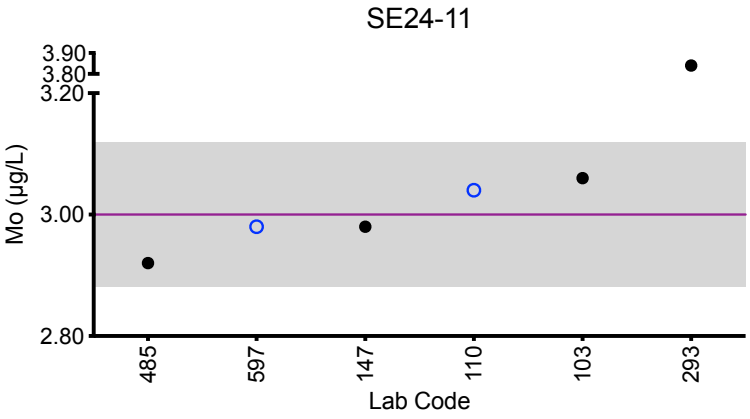
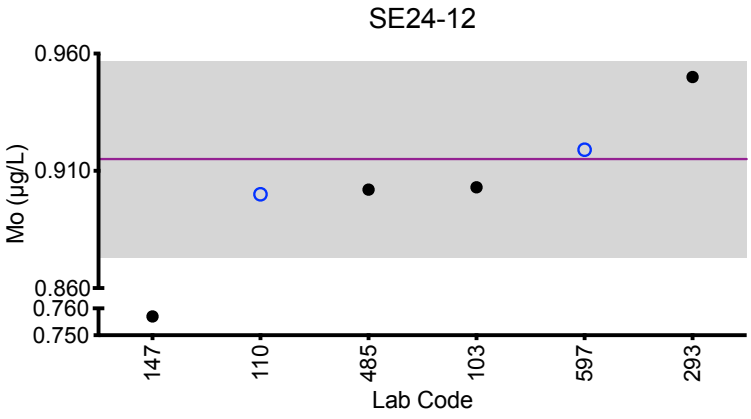
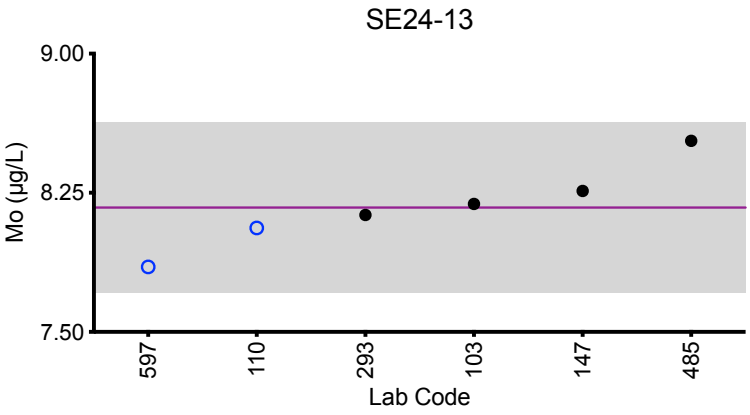
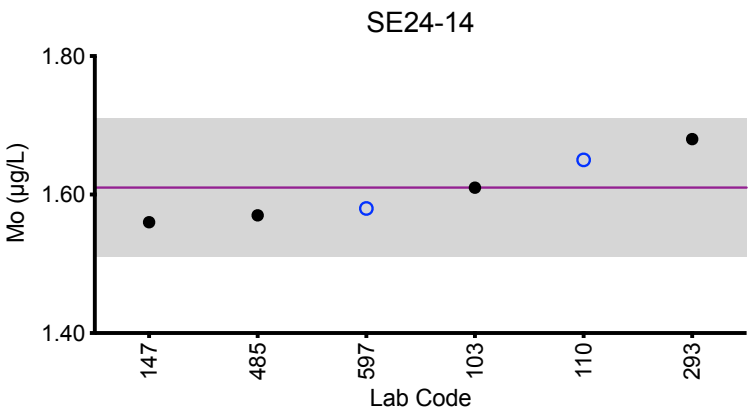
Results for Event #3, 2024: Summary Figures

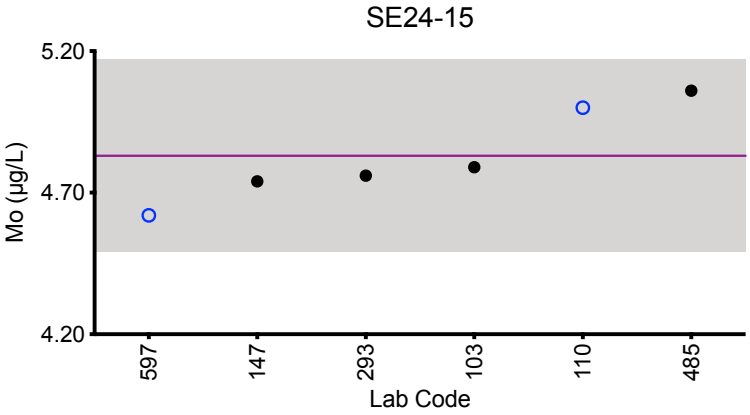
Serum Mo











Legend:
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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
103	ICP-MS/MS	5.83	1.16	4.39	8.36	2.35
110	ICP-MS/MS	5.92	1.18	4.13	8.44	2.43
147	DRC/CC-ICP-MS	5.33	0.851	3.77	7.94	1.99
293	DRC/CC-ICP-MS	5.73	0.95	4.13	8.25	2.21
442	DRC/CC-ICP-MS	5.66	0.898	4.14	8.50	2.21
485	HR-ICP-MS	5.89	0.918	3.96	7.85	2.02
597	ICP-MS/MS	5.98	1.03	4.33	8.99	2.25

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	5.76	1.00	4.12	8.3	2.21
Arithmetic SD (s)	0.22	0.13	0.21	0.4	0.16
Arithmetic RSD (%)	3.8	13	5.1	4.6	7.2
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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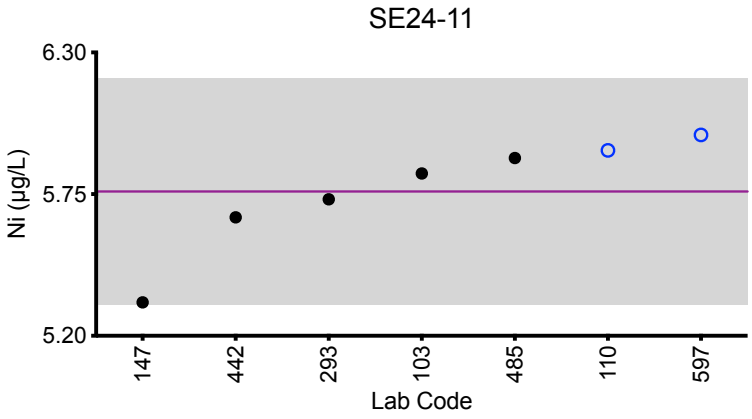
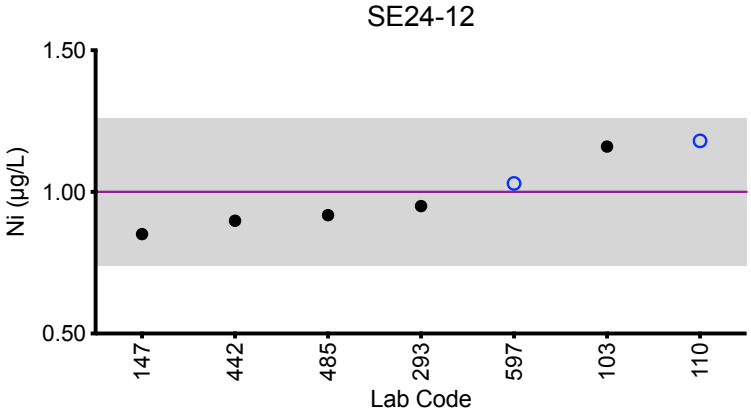
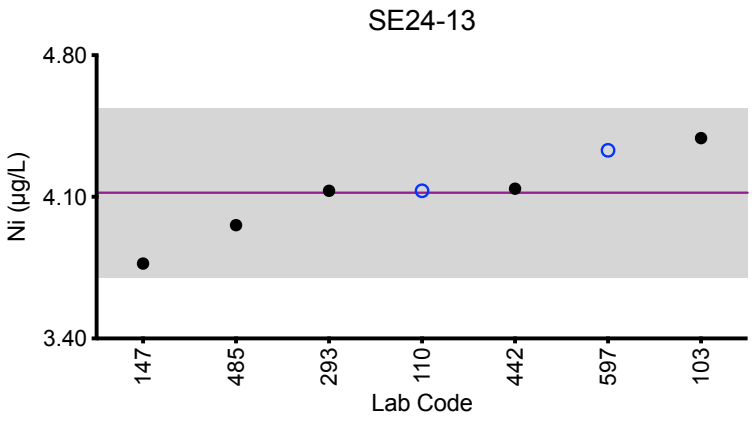
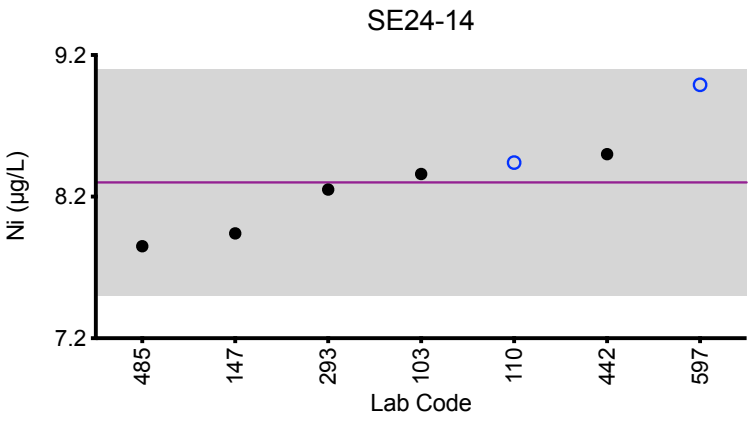
Results for Event #3, 2024: Summary Figures

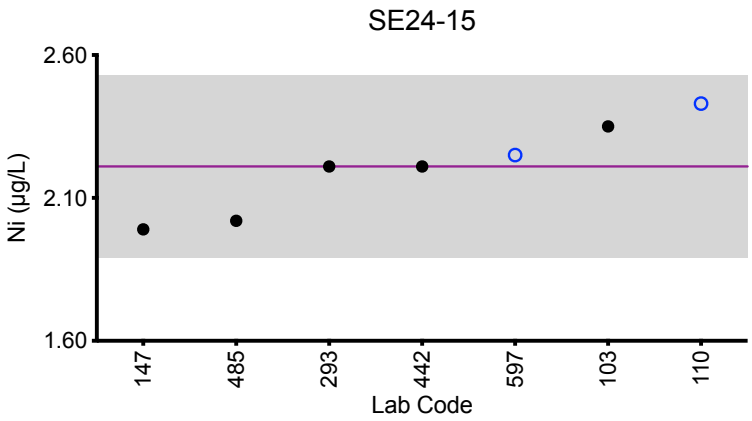
Serum Ni











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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum V (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
110	ICP-MS/MS	3.12	1.24	0.48	3.98	1.01
147	DRC/CC-ICP-MS	2.88	1.13	0.395	3.72	0.821
293	DRC/CC-ICP-MS	3.13	1.37	0.62	4.05	1.1
485	HR-ICP-MS	3.32	1.23	0.427	3.64	0.943
597	ICP-MS/MS	3.37	1.36	0.473	4.17	0.957
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		3.16	1.27	0.48	3.9	0.97
Arithmetic SD (s)		0.19	0.10	0.09	0.2	0.10
Arithmetic RSD (%)		6.1	7.9	19	5.6	10
Number of Sample Measurements (N)		5	5	5	5	5

*Denotes a statistical Outlier.

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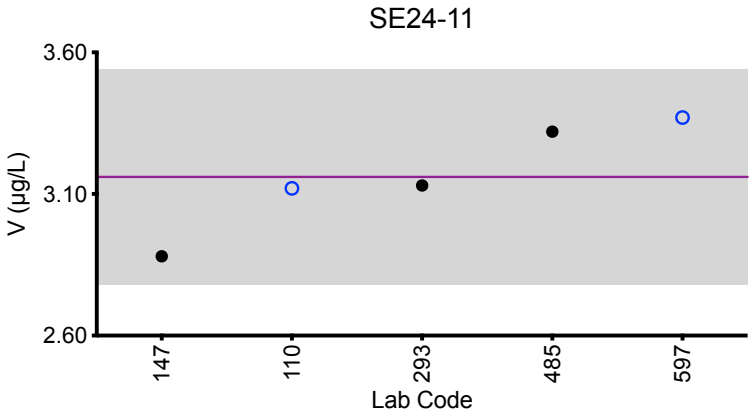
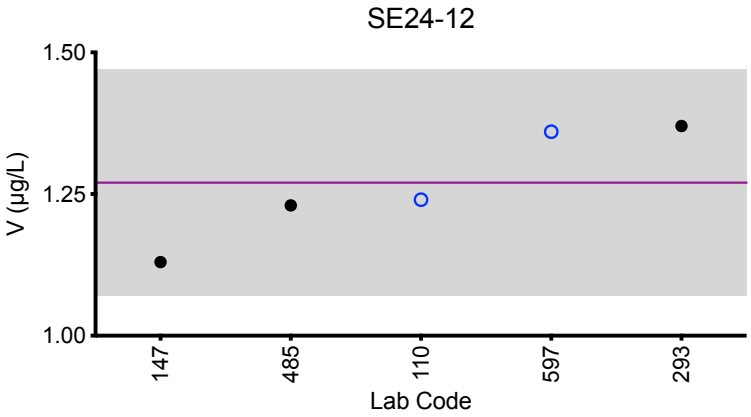
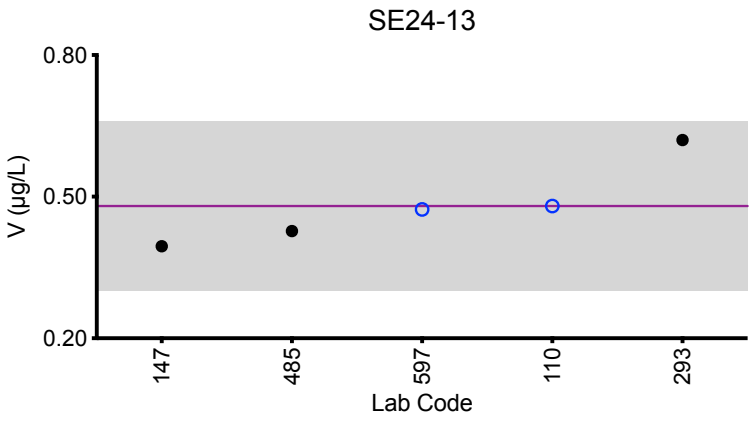
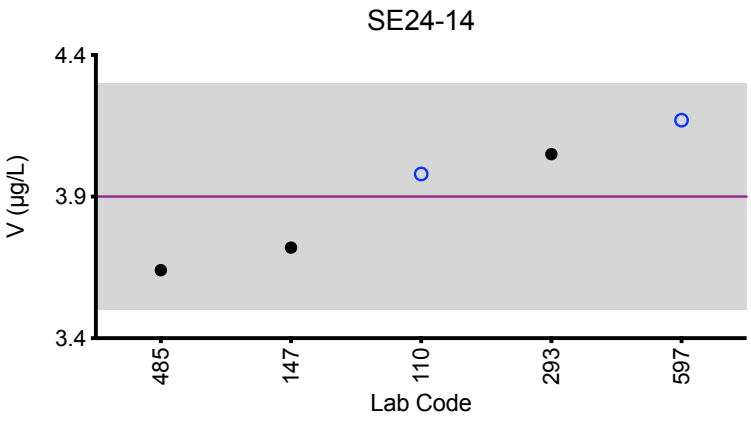
Results for Event #3, 2024: Summary Figures

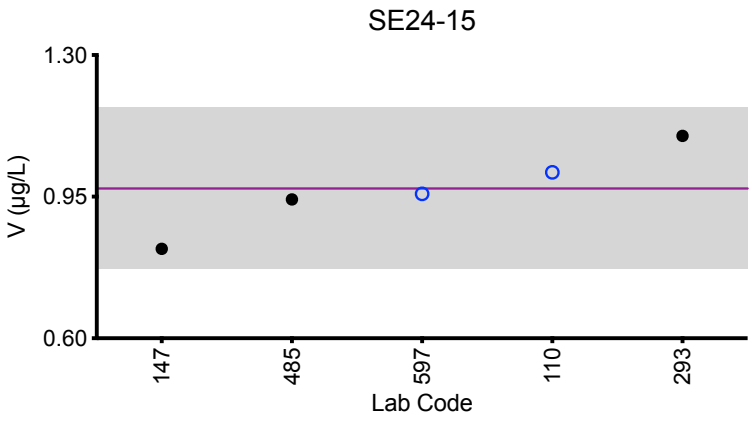
Serum V











Legend:
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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum As (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
103	ICP-MS/MS	16.2	5.54	2.60	8.91	1.12
110	ICP-MS/MS	14.9	4.91	2.47	8.00	1.09
147	DRC/CC-ICP-MS	14.8	5.04	2.42	8.10	0.984
597	ICP-MS/MS	16.0	5.71	2.84	8.80	1.57

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	15.5	5.3	2.58	8.5	1.2
Arithmetic SD (s)	0.7	0.4	0.19	0.5	0.3
Arithmetic RSD (%)	4.5	7.5	7.4	5.9	22
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
110	ICP-MS/MS	1.18	2.65	1.41	1.76	1.15
147	ICP-MS	0.970	2.33	1.14	1.61	0.877
597	ICP-MS/MS	1.37	2.99	1.79	2.06	1.49
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		1.2	2.7	1.4	1.8	1.2
Arithmetic SD (s)		0.2	0.3	0.3	0.2	0.3
Arithmetic RSD (%)		17	11	21	13	25
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Be (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
110	ICP-MS/MS	2.85	0.22	0.75	1.90	0.44
147	ICP-MS	2.89	0.306	0.713	1.66	0.451
293	ICP-MS	2.61	0.20	0.65	1.72	0.39
597	ICP-MS/MS	3.09	0.242	0.827	2.05	0.457

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	2.9	0.24	0.73	1.83	0.43
Arithmetic SD (s)	0.2	0.05	0.07	0.18	0.03
Arithmetic RSD (%)	6.9	21	9.6	9.8	7.0
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Bi (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
147	ICP-MS	<0.0397	<0.0397	0.0865	0.0482	<0.0397
597	ICP-MS/MS	0.00755	0.0590	0.0965	0.0513	<0.00698
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		NA	NA	0.091	0.050	NA
Arithmetic SD (s)		NA	NA	0.007	0.002	NA
Arithmetic RSD (%)		NA	NA	7.7	4.4	NA
Number of Sample Measurements (N)		NA	NA	2	2	NA

*Denotes a statistical Outlier.

Statistical data was not calculated for SE24-11, SE24-12, and SE24-15 based on a lack of consensus among participating labs.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
103	ICP-MS/MS	0.695	0.219	3.93	0.377	1.98
110	ICP-MS/MS	0.71	0.22	4.10	0.42	2.15
147	ICP-MS	0.675	0.199	4.08	0.373	2.03
597	ICP-MS/MS	0.806	0.239	4.34	0.435	2.20
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		0.72	0.219	4.11	0.40	2.09
Arithmetic SD (s)		0.06	0.016	0.17	0.03	0.10
Arithmetic RSD (%)		8.3	7.3	4.1	7.5	4.8
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
110	ICP-MS/MS	0.49	1.11	0.45	0.50	0.30
597	ICP-MS/MS	0.531	1.24	0.572	0.577	0.351
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		0.51	1.18	0.51	0.54	0.33
Arithmetic SD (s)		0.03	0.09	0.09	0.05	0.04
Arithmetic RSD (%)		5.9	7.6	18	9.3	12
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
103	ICP-MS/MS	3.91	0.515	2.02	0.742	6.25
110	ICP-MS/MS	3.84	0.54	1.92	0.79	5.98
597	ICP-MS/MS	4.10	0.635	2.04	0.882	6.14
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		3.95	0.56	1.99	0.80	6.12
Arithmetic SD (s)		0.13	0.06	0.06	0.07	0.14
Arithmetic RSD (%)		3.3	11	3.2	8.8	2.3
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum I (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
147	ICP-MS	50.1	56.1	38.6	56.6	52.0
442	ICP-MS	60.2	68.4	48.6	70.8	65.5
597	ICP-MS/MS	59.4	66.1	45.0	65.2	60.1

Summary Statistics					
	SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)	57	64	44	64	59
Arithmetic SD (s)	6	7	5	7	7
Arithmetic RSD (%)	9.9	10	11	11	11
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Mg (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
264	ICP-MS	19970.0	19927.0	16873.0	16725.0	17846.0
597	ICP-MS/MS	21700	22900	17700	18100	18700

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	20800	21400	17300	17400	18300
Arithmetic SD (s)	1200	2100	600	1000	600
Arithmetic RSD (%)	5.8	9.8	3.5	5.7	3.3
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
103	ICP-MS/MS	2.25	0.890	4.70	1.13	7.28
110	ICP-MS/MS	2.36	0.81	4.67	1.09	7.69
597	ICP-MS/MS	2.58	1.05	5.87	1.30	8.88
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		2.4	0.92	5.1	1.17	8.0
Arithmetic SD (s)		0.2	0.12	0.7	0.11	0.8
Arithmetic RSD (%)		7.1	13	14	9.4	10
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
110	ICP-MS/MS	0.209	0.972	0.310	1.59	0.154
264	ICP-MS	*0.60	1.07	0.39	1.66	0.20
293	DRC/CC-ICP-MS	0.21	0.96	0.31	1.56	0.15

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	0.210	1.00	0.34	1.60	0.17
Arithmetic SD (s)	0.001	0.06	0.05	0.05	0.03
Arithmetic RSD (%)	0.33	6.0	15	3.1	18
Number of Sample Measurements (N)	2	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
103	ICP-MS/MS	3.39	0.776	2.41	6.38	1.73
110	ICP-MS/MS	3.21	0.75	2.35	6.16	1.64
147	ICP-MS	3.15	0.719	2.32	6.00	1.59
597	ICP-MS/MS	3.27	0.820	2.34	6.40	1.67
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		3.25	0.77	2.36	6.2	1.66
Arithmetic SD (s)		0.10	0.04	0.04	0.2	0.06
Arithmetic RSD (%)		3.1	5.2	1.7	3.1	3.6
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
110	ICP-MS/MS	4.26	1.35	2.01	2.09	0.67
597	ICP-MS/MS	4.64	1.42	2.34	2.27	0.758
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		4.5	1.39	2.2	2.18	0.71
Arithmetic SD (s)		0.3	0.05	0.2	0.13	0.06
Arithmetic RSD (%)		6.7	3.6	9.1	5.8	8.5
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
103	ICP-MS/MS	51.4	81.1	55.1	107	66.6
597	ICP-MS/MS	53.2	87.3	54.8	109	67.1
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		52.3	84	55.0	108	66.8
Arithmetic SD (s)		1.3	4	0.2	1	0.4
Arithmetic RSD (%)		2.5	4.8	0.36	1.3	0.6
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
442	ICP-MS/MS	4.02	5.25	3.05	7.19	1.62
485	HR-ICP-MS	3.81	4.91	2.69	6.47	1.65
597	ICP-MS/MS	*6.93	*8.22	*5.52	9.11	*4.19

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	3.9	5.1	2.9	7.6	1.64
Arithmetic SD (s)	0.1	0.2	0.3	1.4	0.02
Arithmetic RSD (%)	3.8	3.9	8.9	18	1.3
Number of Sample Measurements (N)	2	2	2	3	2

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
103	ICP-MS/MS	0.394	0.862	0.139	1.19	0.260
110	ICP-MS/MS	0.392	0.839	0.141	1.18	0.264
147	ICP-MS	0.376	0.794	0.129	1.11	0.236
597	ICP-MS/MS	0.454	0.925	0.165	1.25	0.294

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	0.40	0.85	0.143	1.18	0.26
Arithmetic SD (s)	0.03	0.05	0.015	0.06	0.02
Arithmetic RSD (%)	7.5	5.9	10	5.1	9.1
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum U (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
103	ICP-MS/MS	0.184	0.0508	0.213	0.145	0.0898
110	ICP-MS/MS	0.175	0.049	0.201	0.139	0.084
597	ICP-MS/MS	0.197	0.0551	0.202	0.149	0.0824
Summary Statistics						
		SE24-11	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
Arithmetic Mean ($\bar{x}$)		0.185	0.052	0.205	0.144	0.085
Arithmetic SD (s)		0.011	0.003	0.007	0.005	0.004
Arithmetic RSD (%)		5.9	5.8	3.4	3.5	4.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024:
Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
110	ICP-MS/MS	0.30	1.48	0.62	0.44	1.07
200	ICP-MS	0.31	1.36	0.63	0.38	0.94
597	ICP-MS/MS	0.325	1.57	0.651	0.460	1.08

Summary Statistics

	SE24-11	SE24-12	SE24-13	SE24-14	SE24-15
Arithmetic Mean ($\bar{x}$)	0.312	1.47	0.634	0.43	1.03
Arithmetic SD (s)	0.013	0.11	0.016	0.04	0.08
Arithmetic RSD (%)	4.2	7.5	2.5	9.3	7.8
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2024: Additional Elements in Serum

Serum Fe (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
264	ICP-MS	1357.0	6544.0	8792.0	9151.0	2472.0

Serum Li (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
147	ICP-MS	0.785	0.281	0.381	0.382	0.506

Serum Te (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
110	ICP-MS/MS	<0.02	<0.02	<0.02	<0.02	<0.02

Serum Th (µg/L)						
Lab Code	**Method**	**SE24-11**	**SE24-12**	**SE24-13**	**SE24-14**	**SE24-15**
597	ICP-MS/MS	<0.106	<0.106	<0.106	<0.106	<0.106

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

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