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New York State Biomonitoring Program for Trace Elements

Event #1, 2025

Trace Elements in Whole Blood, Urine, and Serum

May, 2025

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #1, 2025:
Trace Elements in Whole Blood, Urine, and Serum

5/2/2025

Dear Laboratory Director,

This report summarizes performance for the first biomonitoring proficiency test (PT) event of 2025 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 #2, 2025) will be shipped May 14, 2025. Comments about this report may be directed to trel@health.ny.gov.

Sincerely,

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

Kayla Mehigan
Coordinator, Biomonitoring PT Program,
Division of Environmental Sciences
Wadsworth Center

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Event #1, 2025

Trace Elements in Whole Blood

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Trace Elements Laboratory

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Event #1, 2025:
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 31 elements were reported by at least one participant: Ag, Al, B, Ba, Be, Bi, Br, Cl, Cs, Cu, Fe, Ga, I, Li, Mg, Mo, Ni, Pt, S, 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 #1, 2025: Summary Statistics

Whole Blood As (µg/L)					
	BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Target (Arithmetic Mean ($\bar{x}$))	4.20	2.16	12.2	23.0	7.8
Upper Limit	10.20	8.16	18.2	29.0	13.8
Lower Limit	0.00	0.00	6.2	17.0	1.8
Arithmetic SD (s)	0.21	0.09	0.5	0.7	0.3
Arithmetic RSD (%)	5.0	4.6	4.1	3.1	3.8
Number of Sample Measurements (N)	8	8	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 #1, 2025:
Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
	Target	**4.20**	**2.16**	**12.2**	**23.0**	**7.8**
103	ICP-MS/MS	4.21	2.20	12.4	24.3	8.15
110	ICP-MS/MS	4.29	2.17	12.0	22.8	7.76
147	ICP-MS	4.04	2.07	11.7	22.6	7.38
247	ICP-MS/MS	3.94	2.11	11.5	22.2	7.55
264	ICP-MS	4.42	2.05	12.40	23.52	8.26
293	DRC/CC-ICP-MS	4.30	2.2	12.49	23.63	8.0
465	ICP-MS	4.49	2.35	13	22.3	7.7
597	ICP-MS/MS	3.94	2.12	11.9	22.8	7.73

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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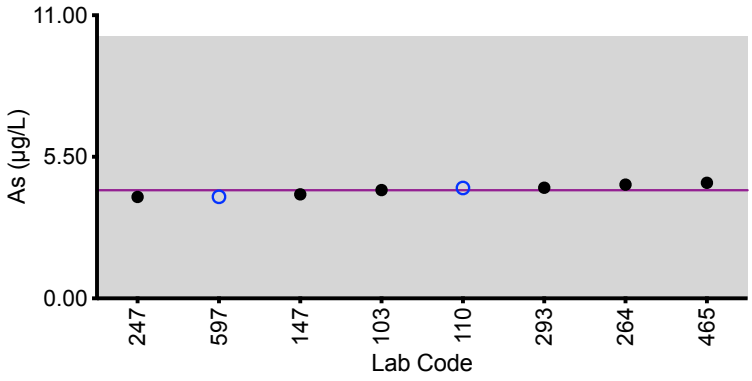
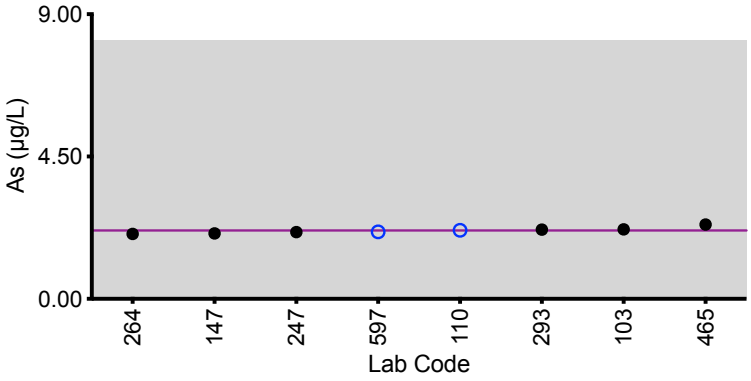
Results for Event #1, 2025: Summary Figures

Whole Blood As

BE25-01



BE25-02



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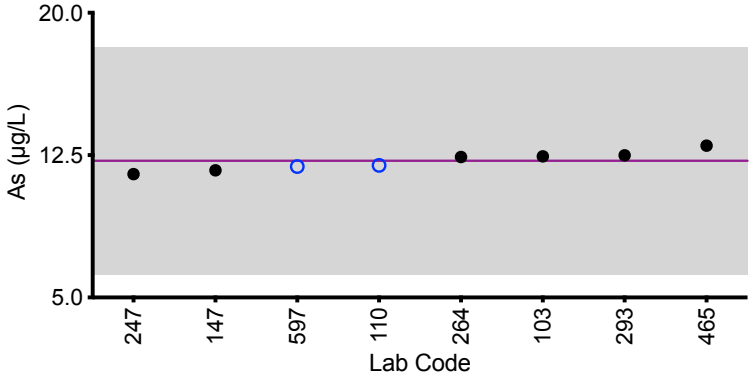

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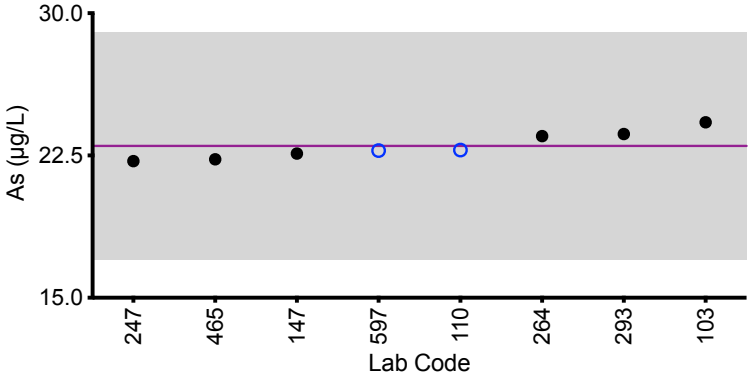

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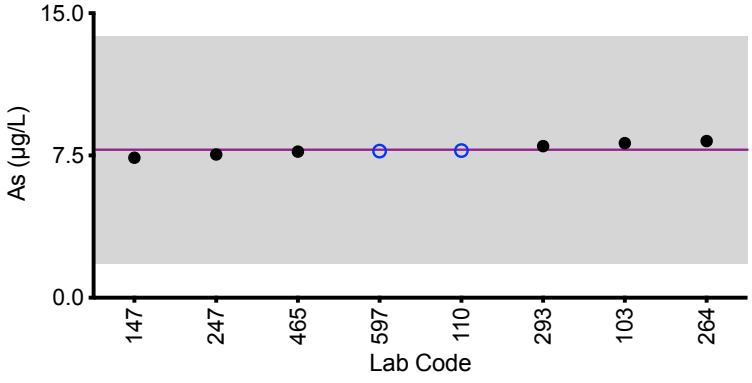

Legend:

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 #1, 2025: Summary Statistics

Whole Blood Cd (µg/L)					
	BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Target (Robust Mean (x*))	0.88	11.7	5.1	1.46	0.77
Upper Limit	1.88	13.5	6.1	2.46	1.77
Lower Limit	0.00	9.9	4.1	0.46	0.00
Robust SD (s*)	0.06	0.5	0.3	0.04	0.07
Robust RSD (%)	6.8	4.3	5.3	2.5	9.1
Number of Sample Measurements (N)	12	13	13	12	12
Standard Uncertainty (*u*)	0.02	0.2	0.1	0.01	0.03

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 #1, 2025:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
	Target	**0.88**	**11.7**	**5.1**	**1.46**	**0.77**
103	ICP-MS/MS	0.932	12.1	5.31	1.47	0.809
107	ICP-MS/MS	0.962	12.1	5.37	1.50	0.781
110	ICP-MS/MS	0.92	11.8	5.12	1.45	0.70
116	ICP-MS/MS	<1.50	11.5	4.97	<1.50	<1.50
147	ICP-MS	0.912	11.6	5.15	1.48	0.760
247	ICP-MS/MS	0.841	11.6	4.88	1.47	0.718
264	ICP-MS	1.02	12.30	5.37	1.49	0.86
293	DRC/CC-ICP-MS	0.88	11.42	4.840	1.5	0.76
465	ICP-MS	0.831	10.6	4.57	1.41	0.69
597	ICP-MS/MS	0.861	11.3	4.94	1.43	0.749
605	ICP-MS	0.685	11.1	5.20	1.27	0.897
606	ICP-MS/MS	0.876	12.4	5.59	1.46	0.861
686	ICP-MS	0.845	11.8	5.11	1.45	0.718

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

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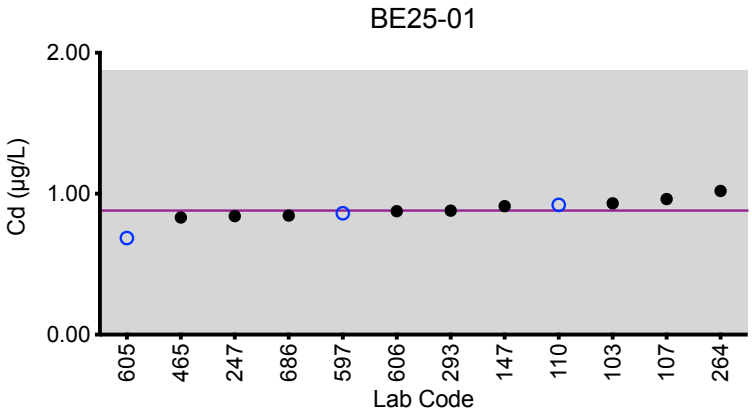
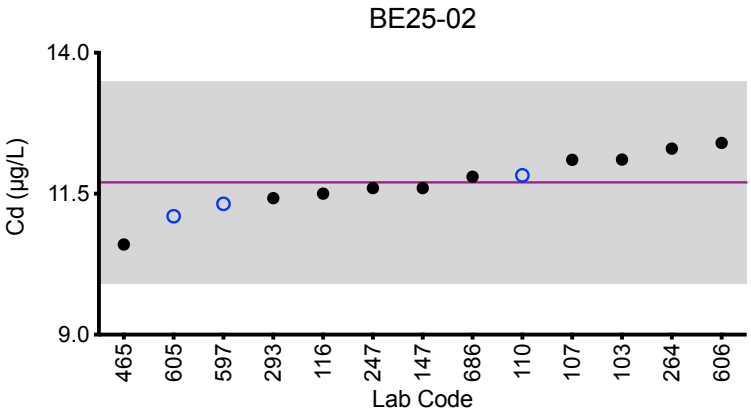
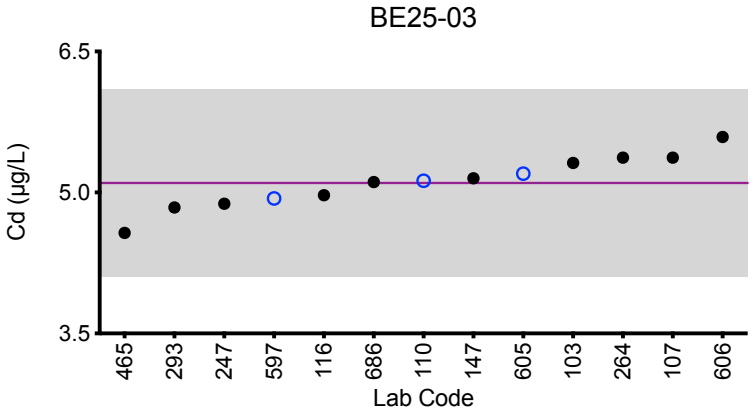
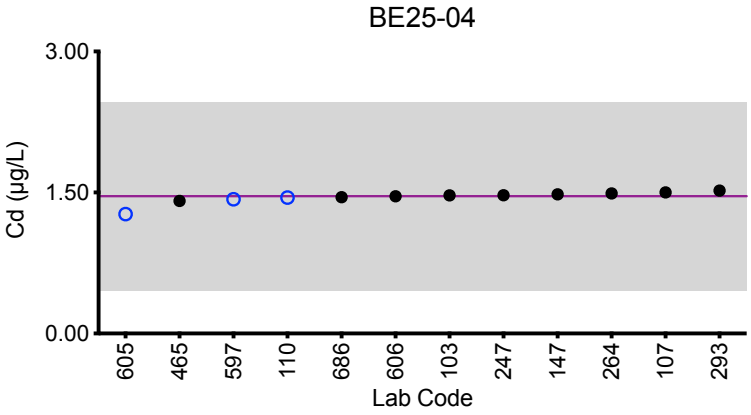
Results for Event #1, 2025: Summary Figures

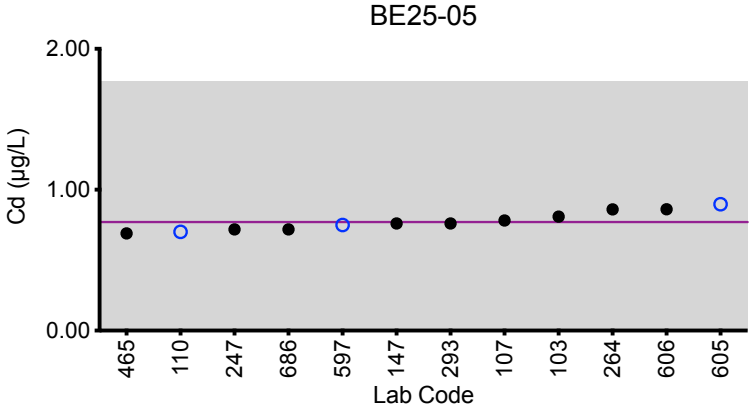
Whole Blood Cd











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 #1, 2025: Summary Statistics

Whole Blood Co (µg/L)					
	BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Target (Arithmetic Mean ($\bar{x}$))	2.37	1.19	8.3	14.7	0.55
Upper Limit	3.87	2.69	10.0	17.6	2.05
Lower Limit	0.87	0.00	6.6	11.8	0.00
Arithmetic SD (s)	0.13	0.12	0.3	0.5	0.07
Arithmetic RSD (%)	5.5	10	3.7	3.4	13
Number of Sample Measurements (N)	8	8	8	8	7

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 #1, 2025:
Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
	Target	**2.37**	**1.19**	**8.3**	**14.7**	**0.55**
103	ICP-MS/MS	2.31	1.15	8.47	15.1	0.543
110	ICP-MS/MS	2.5	1.3	8.5	15.1	0.6
147	ICP-MS	2.44	1.35	8.40	15.3	0.639
247	ICP-MS/MS	2.46	1.26	8.10	14.4	0.619
255	ICP-MS	2.2	1	8	14	<0.5
264	ICP-MS	2.50	1.21	8.80	15.01	0.46
293	DRC/CC-ICP-MS	2.40	1.15	8.27	14.71	0.51
597	ICP-MS/MS	2.16	1.06	7.86	14.0	0.500

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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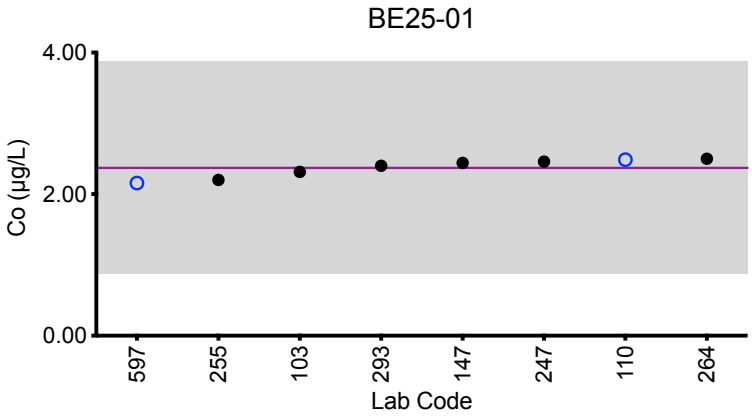
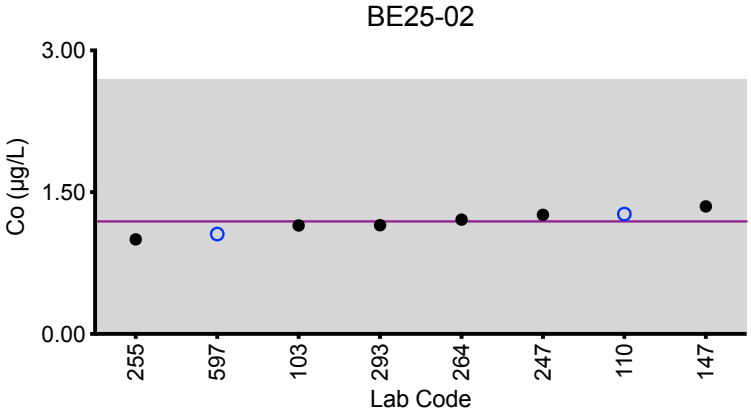
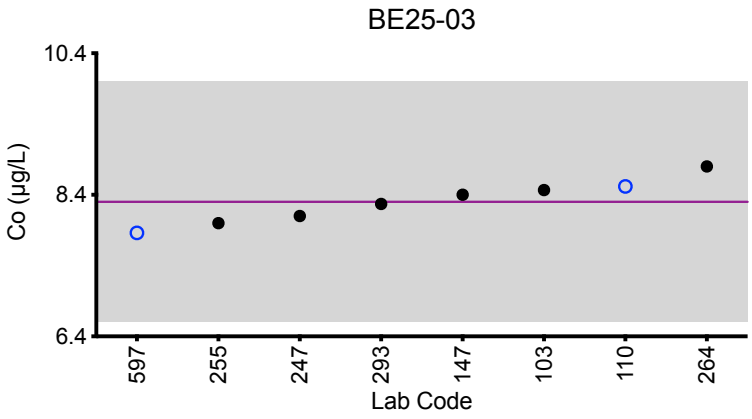
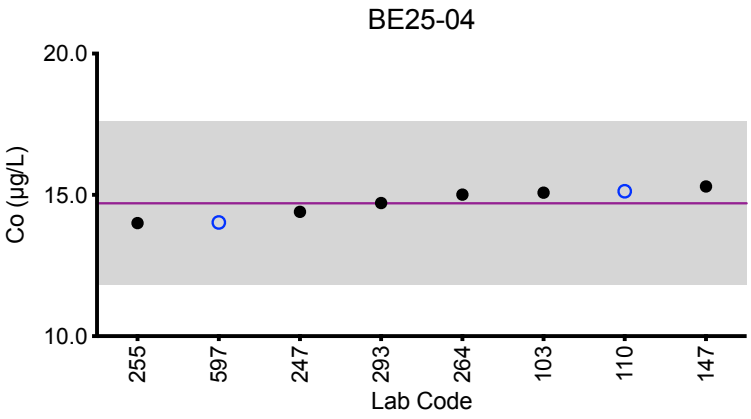
Results for Event #1, 2025: Summary Figures

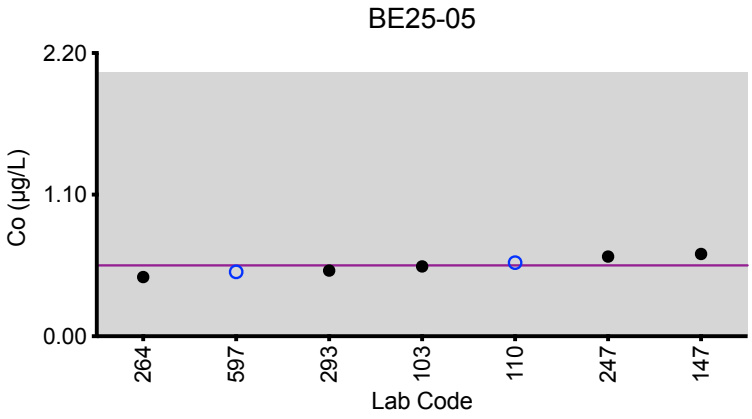
Whole Blood Co











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 #1, 2025:
Summary Statistics

Whole Blood Cr (µg/L)					
	BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Target (Arithmetic Mean ($\bar{x}$))	4.89	0.40	0.60	3.24	1.1
Upper Limit	6.89	2.40	2.60	5.24	3.1
Lower Limit	2.89	0.00	0.00	1.24	0.0
Arithmetic SD (s)	0.09	0.04	0.15	0.17	0.3
Arithmetic RSD (%)	1.8	10	25	5.2	25
Number of Sample Measurements (N)	7	6	6	7	6

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

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Results for Event #1, 2025:
Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
	Target	**4.89**	**0.40**	**0.60**	**3.24**	**1.1**
103	ICP-MS/MS	4.90	<1.50	<1.50	3.42	<1.50
110	ICP-MS/MS	5.0	0.4	0.7	3.4	1.4
147	DRC/CC-ICP-MS	4.97	0.401	0.561	3.31	1.06
247	ICP-MS/MS	4.76	0.383	0.451	3.33	0.954
255	ICP-MS	4.8	<1.0	<1.0	3	<1.0
264	ICP-MS	*3.46	0.45	0.84	*2.18	1.53
293	DRC/CC-ICP-MS	4.93	0.33	0.54	3.22	1.01
597	ICP-MS/MS	4.89	0.447	0.489	3.01	0.815

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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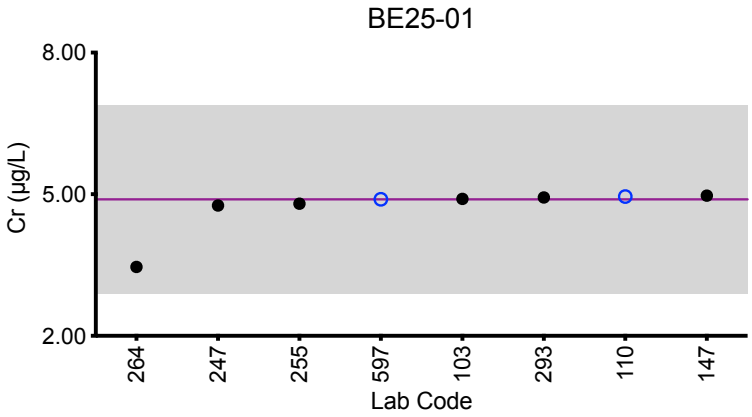
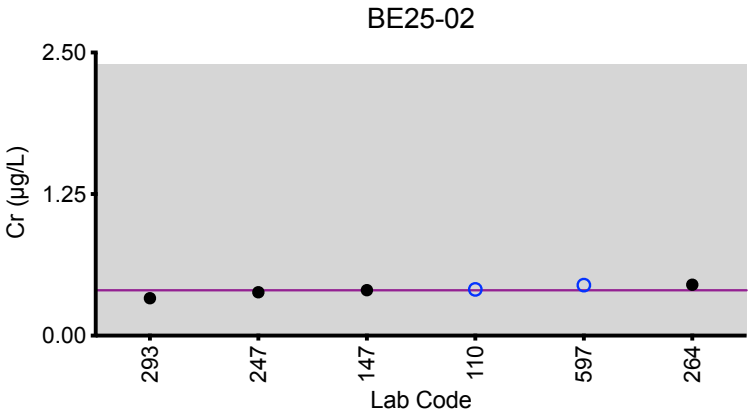
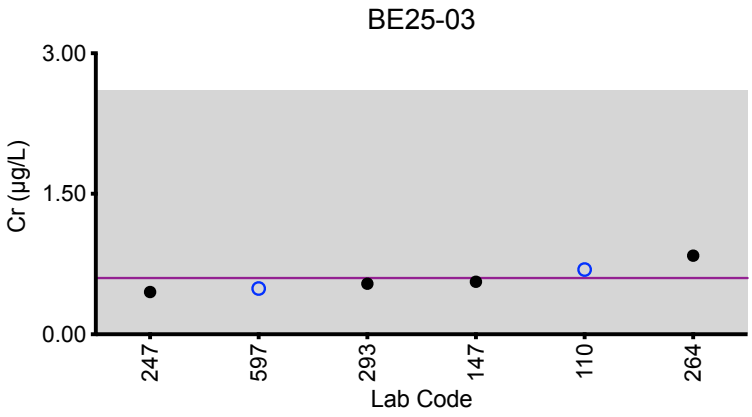
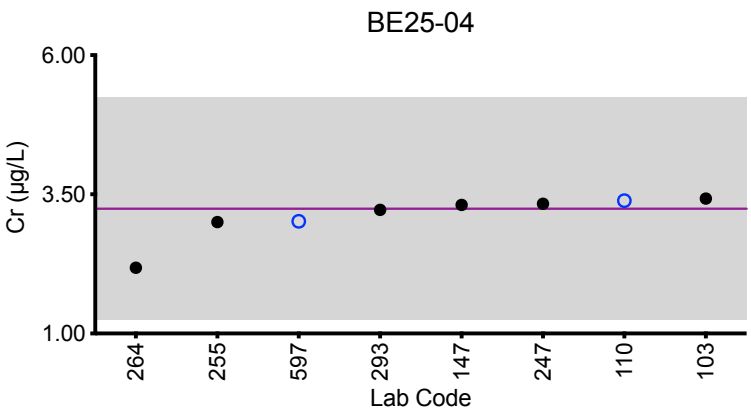
Results for Event #1, 2025: Summary Figures

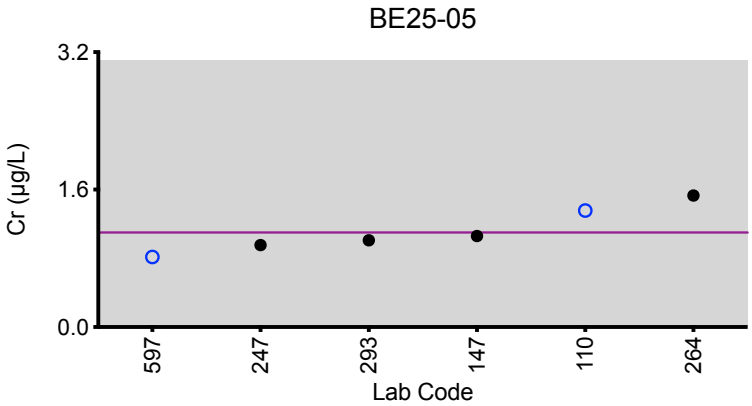
Whole Blood Cr











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 #1, 2025: Summary Statistics

Whole Blood Hg (µg/L)					
	BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Target (Robust Mean (x*))	5.1	8.0	17.9	2.77	0.59
Upper Limit	8.1	11.0	23.3	5.77	3.59
Lower Limit	2.1	5.0	12.5	0.00	0.00
Robust SD (s*)	0.4	0.5	1.6	0.15	0.06
Robust RSD (%)	6.9	6.3	8.9	5.4	10
Number of Sample Measurements (N)	14	14	14	14	13
Standard Uncertainty (*u*)	0.1	0.2	0.5	0.05	0.02

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 #1, 2025:
Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
	Target	**5.1**	**8.0**	**17.9**	**2.77**	**0.59**
103	ICP-MS/MS	5.01	8.07	18.0	2.83	0.580
107	ICP-MS/MS	5.27	8.03	18.1	2.87	0.619
110	ICP-MS/MS	5.17	8.06	17.5	2.79	0.57
116	ICP-MS/MS	4.97	8.06	18.5	2.87	<1.50
147	ICP-MS	5.01	8.03	16.7	2.75	0.594
247	ICP-MS/MS	4.56	7.38	16.2	2.72	0.508
264	ICP-MS	5.72	9.18	21.20	3.04	0.48
293	DRC/CC-ICP-MS	4.3	6.13	14.8	2.51	0.48
391	CV-AAS	5.2	9.09	28.2 ↑	2.56	2.40
465	ICP-MS	5.44	8.3	19	3.07	0.611
597	ICP-MS/MS	4.80	7.40	16.3	2.70	0.619
605	ICP-MS	4.81	7.66	17.9	2.69	0.640
606	ICP-MS/MS	5.10	7.93	17.7	2.60	0.660
686	ICP-MS	5.37	8.34	19.0	2.84	0.556

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

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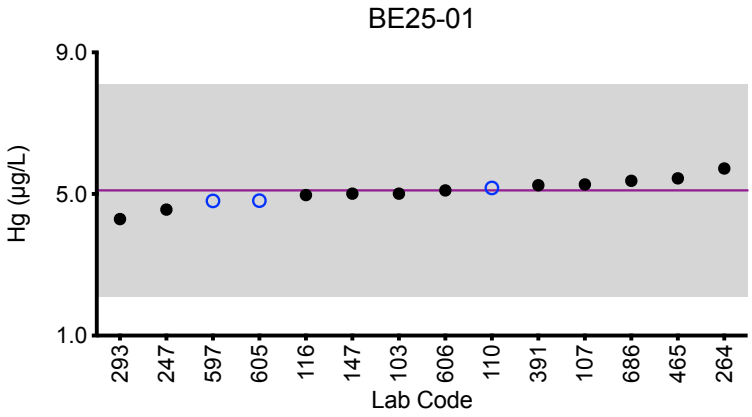
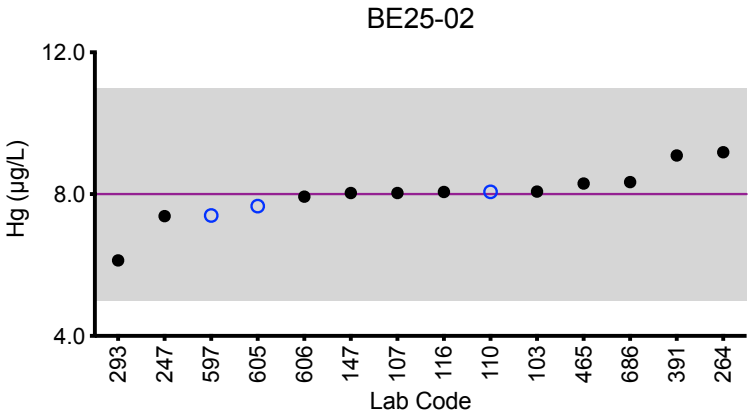
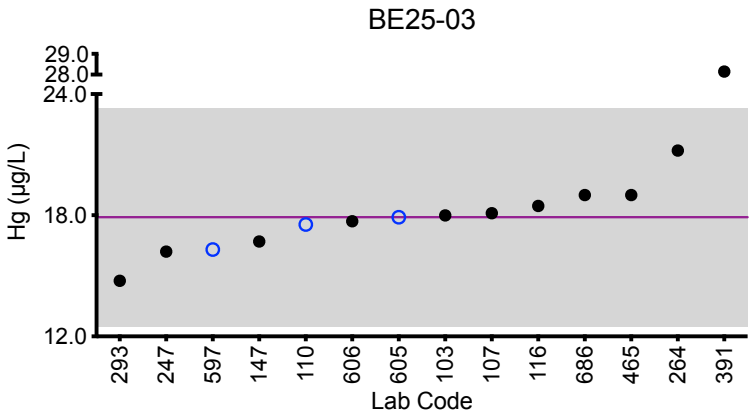
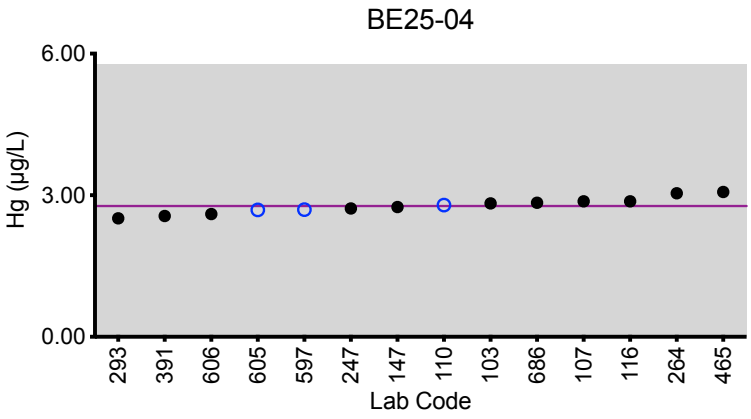
Results for Event #1, 2025: Summary Figures

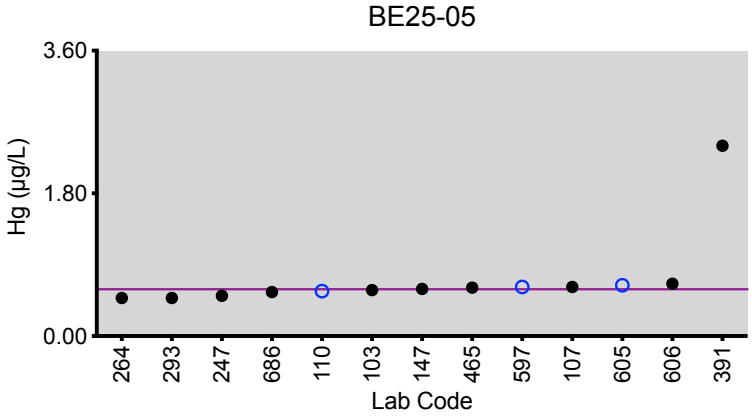
Whole Blood Hg











Legend:

o HHEAR Labs ● Other Labs

Horizontal purple line = assigned target value based on the robust mean of all laboratories.

Gray area = acceptable range based on quality specifications:

±3 µg/L or ±30% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 10 µg/L.

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Results for Event #1, 2025: Summary Statistics

Whole Blood Mn (µg/L)					
	BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Target (Arithmetic Mean ($\bar{x}$))	14.8	9.1	25.7	21.5	10.9
Upper Limit	17.8	12.1	30.1	25.2	13.9
Lower Limit	11.8	6.1	21.3	17.8	7.9
Arithmetic SD (s)	1.8	1.5	2.4	1.6	0.7
Arithmetic RSD (%)	12	16	9.3	7.4	6.4
Number of Sample Measurements (N)	9	9	9	9	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 #1, 2025:
Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
	Target	**14.8**	**9.1**	**25.7**	**21.5**	**10.9**
103	ICP-MS/MS	15.5	9.65	27.4	22.6	11.8
107	ICP-MS/MS	15.8	9.42	27.6	21.8	11.5
110	ICP-MS/MS	14.4	8.7	25.3	21.6	10.5
147	ICP-MS	18.3 ↑	12.3 ↑	29.3	24.6	*15.0 ↑
247	ICP-MS/MS	15.0	9.23	25.9	21.2	10.9
264	ICP-MS	13.65	8.38	21.28 ↓	18.79	11.17
293	DRC/CC-ICP-MS	12.5	6.86	23.7	19.9	9.83
597	ICP-MS/MS	12.5	7.92	24.2	20.8	10.2
606	ICP-MS/MS	15.3	9.48	26.9	22.0	11.4

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

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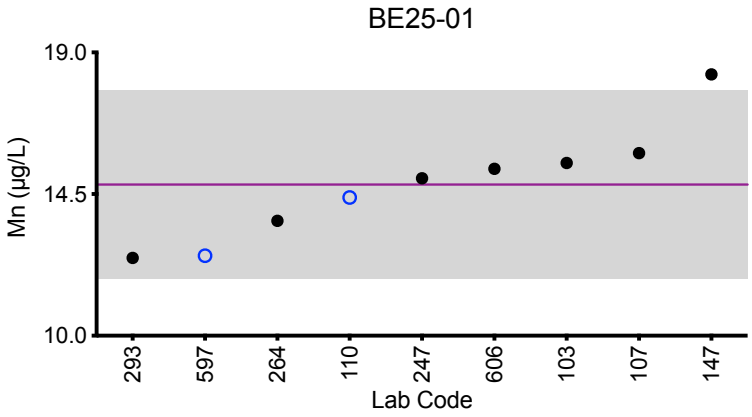
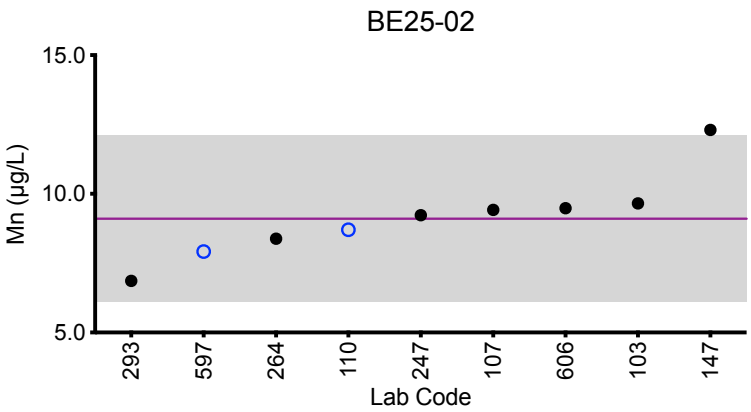
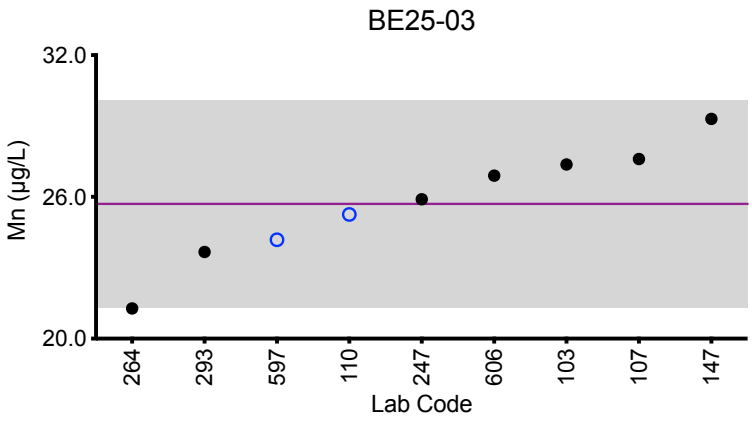
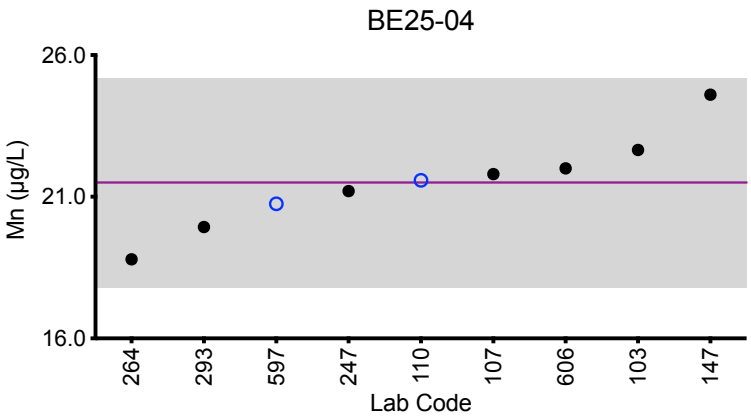
Results for Event #1, 2025: Summary Figures

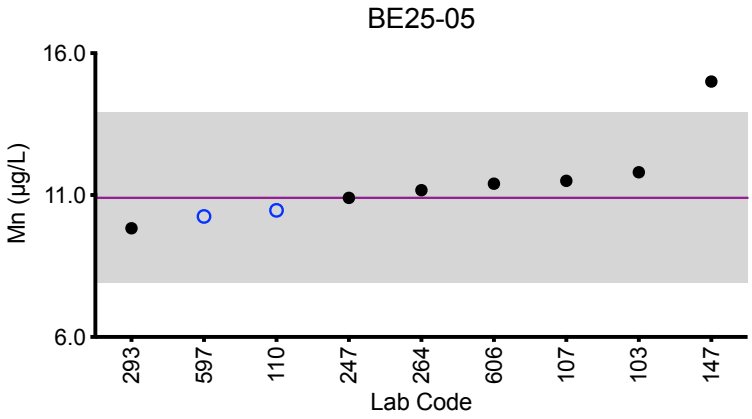
Whole Blood Mn











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 #1, 2025: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Target (Robust Mean (x*))	1.26	12.7	3.82	2.03	5.6
Upper Limit	3.26	14.7	5.82	4.03	7.6
Lower Limit	0.00	10.7	1.82	0.03	3.6
Robust SD (s*)	0.08	0.8	0.24	0.12	0.4
Robust RSD (%)	6.3	6.3	6.3	5.9	6.4
Number of Sample Measurements (N)	13	15	15	13	15
Standard Uncertainty (*u*)	0.03	0.3	0.08	0.04	0.1

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/)

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Results for Event #1, 2025:
Performance of Participating Laboratories

Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
	Target	**1.26**	**12.7**	**3.82**	**2.03**	**5.6**
103	ICP-MS/MS	1.33	13.5	4.01	2.16	5.93
107	ICP-MS/MS	1.37	13.3	4.14	2.11	5.82
110	ICP-MS/MS	1.27	12.3	3.69	1.99	5.40
116	ICP-MS/MS	<3.00	13.9	4.31	<3.00	6.27
147	ICP-MS	1.31	13.1	3.91	2.14	5.72
247	ICP-MS/MS	1.22	12.6	3.78	2.02	5.51
264	ICP-MS	1.20	11.00	3.60	1.80	5.30
293	DRC/CC-ICP-MS	1.24	13.03	3.93	2.1	5.79
343	ASV-LeadCare	<3.3	12.3	3.7	<3.3	5.6
391	ETAAS-Z	0.54	12.06	3.21	1.0	5.16
465	ICP-MS	1.06	10.4 ↓	3.28	1.74	4.69
597	ICP-MS/MS	1.22	12.1	3.67	1.96	5.38
605	ICP-MS	1.26	12.6	3.86	2.06	6.13
606	ICP-MS/MS	1.30	13.2	3.89	2.08	5.68
686	ICP-MS	1.35	13.2	3.95	2.15	5.77

Based on the grading criteria for Pb in Whole Blood, 99% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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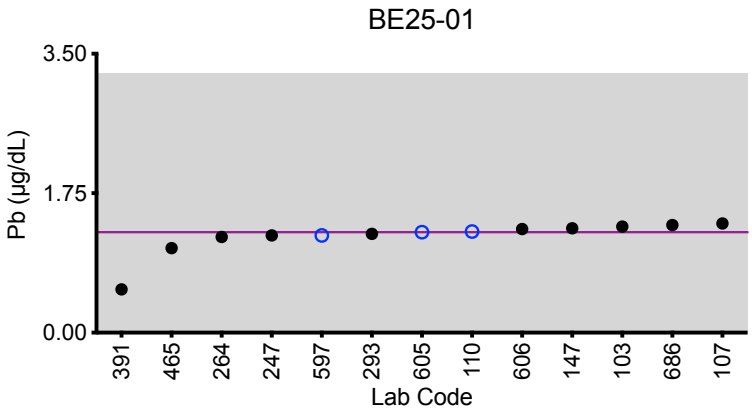
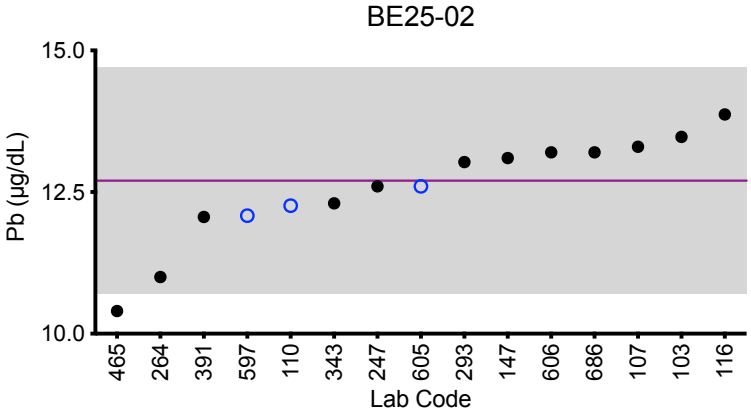
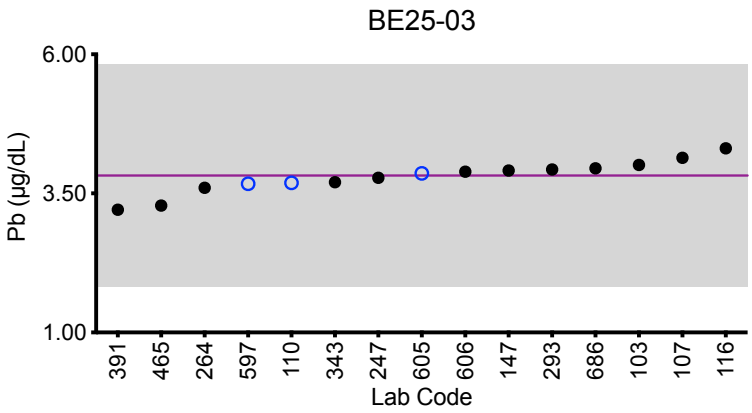
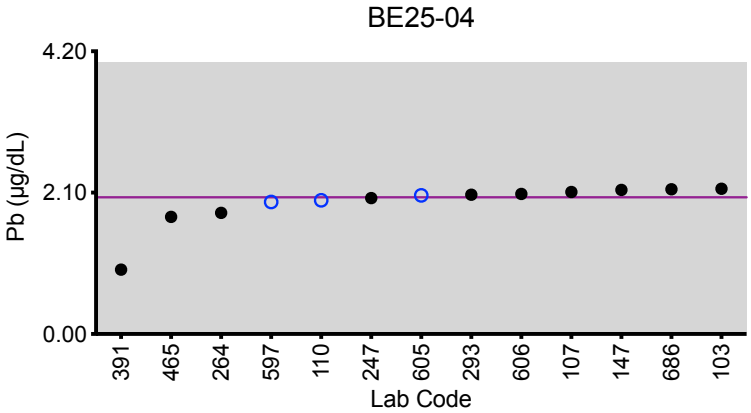
Results for Event #1, 2025: Summary Figures

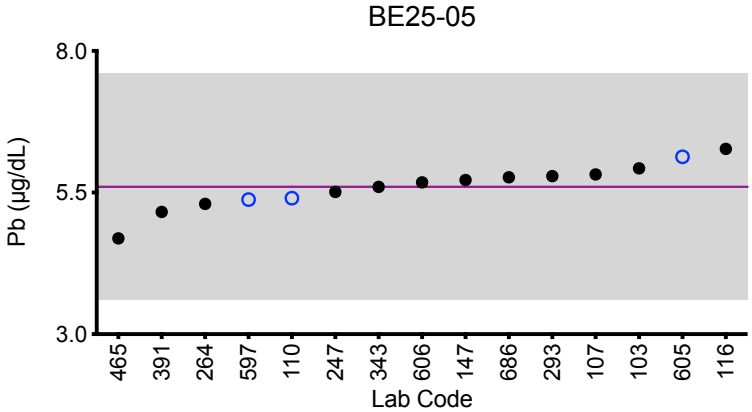
Whole Blood Pb











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 #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
103	ICP-MS/MS	6.05	2.14	3.78	0.765	1.41
110	ICP-MS/MS	6.32	2.19	3.97	0.82	1.51
147	ICP-MS	6.09	2.30	4.03	0.874	1.57
264	ICP-MS	6.82	2.21	3.89	1.05	1.79
597	ICP-MS/MS	5.11	1.91	3.29	0.701	1.28

Summary Statistics

	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
Arithmetic Mean ($\bar{x}$)	6.1	2.15	3.8	0.84	1.51
Arithmetic SD (s)	0.6	0.15	0.3	0.13	0.19
Arithmetic RSD (%)	9.8	6.9	7.9	15	13
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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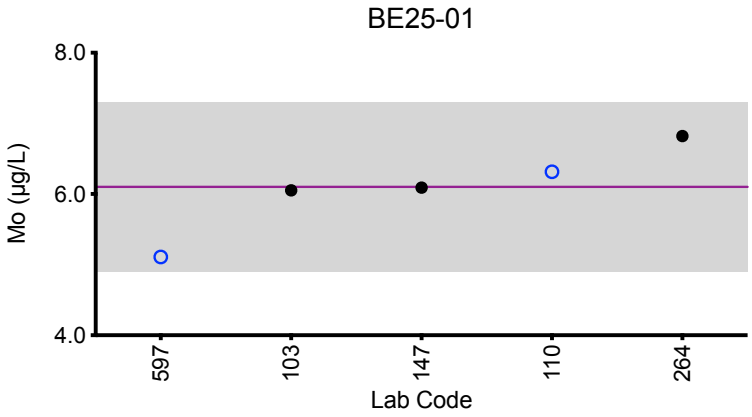
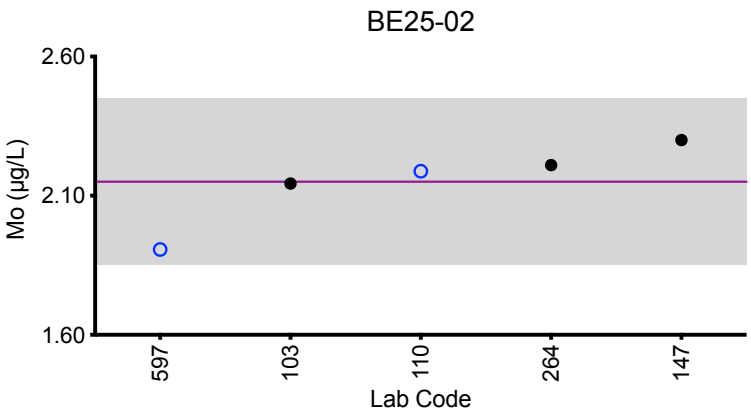
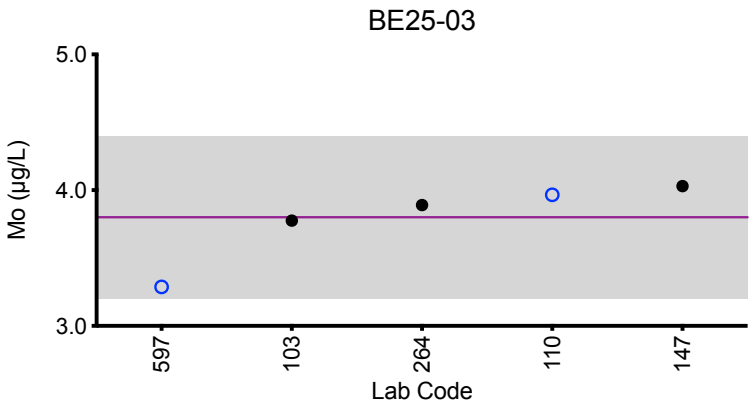
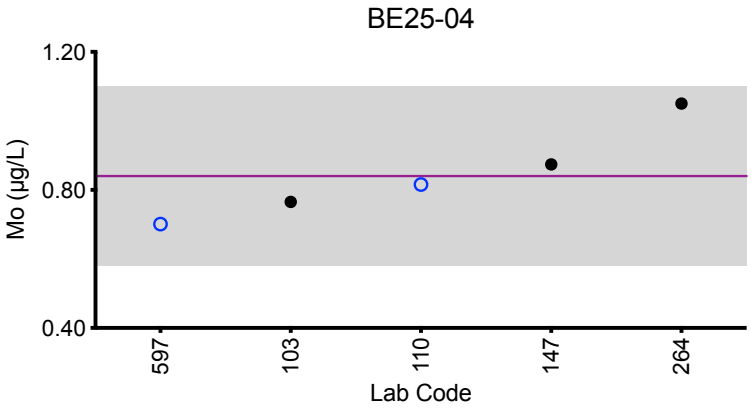
Results for Event #1, 2025: Summary Figures

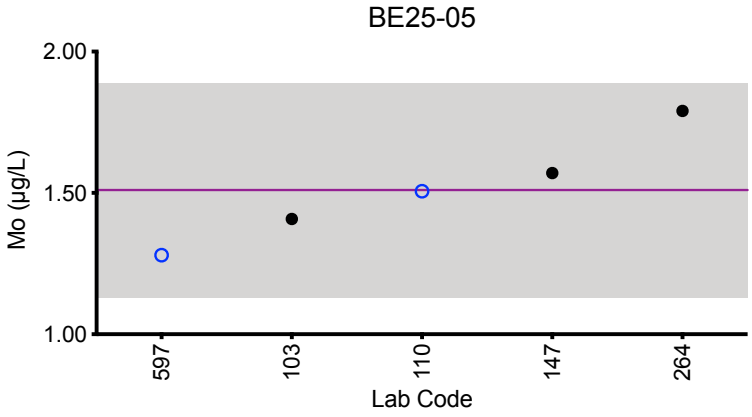
Whole Blood Mo











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

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

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
103	ICP-MS/MS	1.27	0.796	4.30	0.454	3.33
110	ICP-MS/MS	1.31	0.80	4.32	0.49	3.45
147	ICP-MS	1.26	0.802	4.10	0.492	3.22
264	ICP-MS	1.35	0.82	4.20	*0.67	3.65
293	DRC/CC-ICP-MS	1.2	*0.7	3.8	0.5	3.1
597	ICP-MS/MS	1.22	0.804	4.10	0.505	3.36
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		1.27	0.804	4.14	0.488	3.35
Arithmetic SD (s)		0.06	0.009	0.19	0.024	0.19
Arithmetic RSD (%)		4.7	1.1	4.6	4.1	5.7
Number of Sample Measurements (N)		6	5	6	5	6

*Denotes a statistical Outlier.

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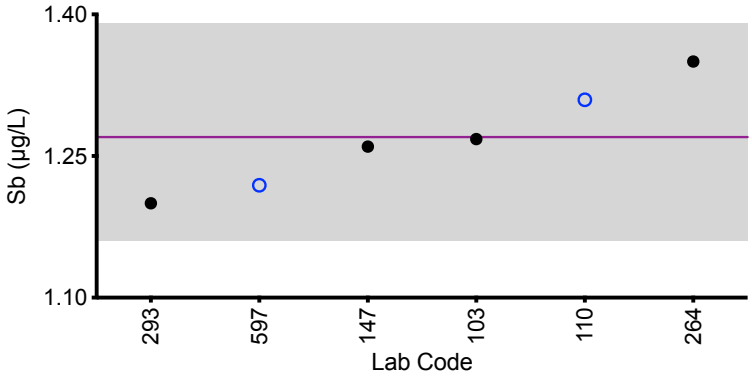
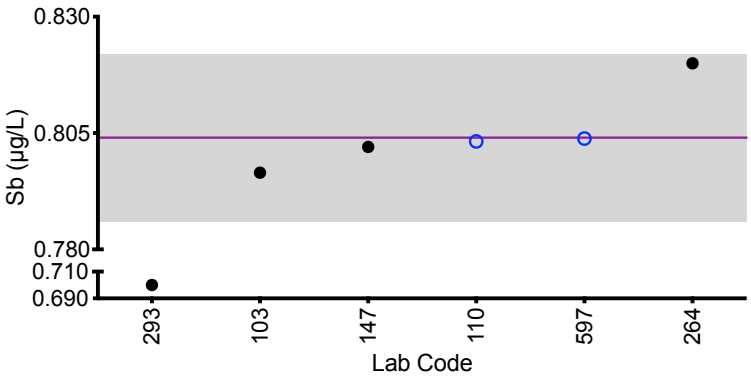
Results for Event #1, 2025: Summary Figures

Whole Blood Sb

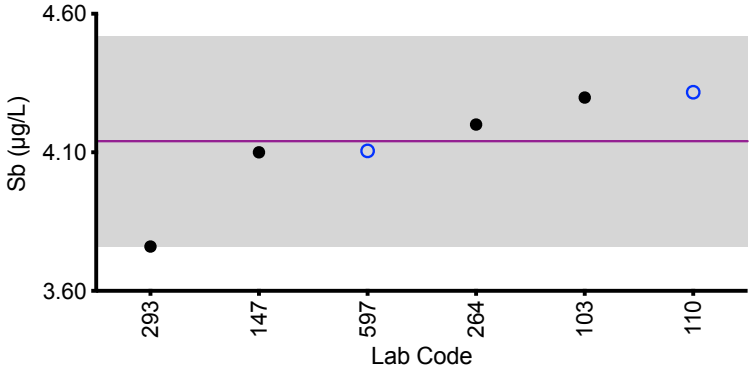
BE25-01



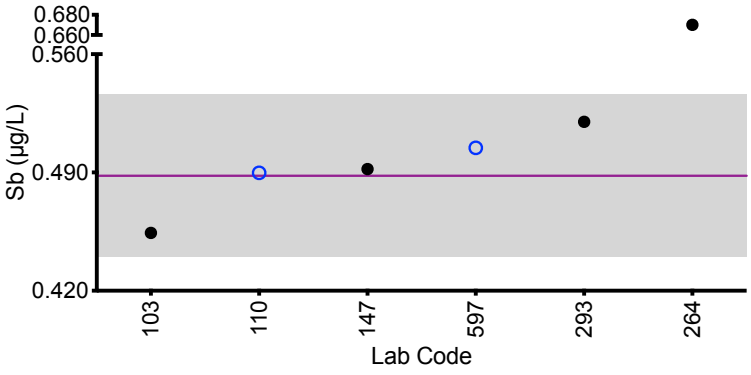
BE25-02



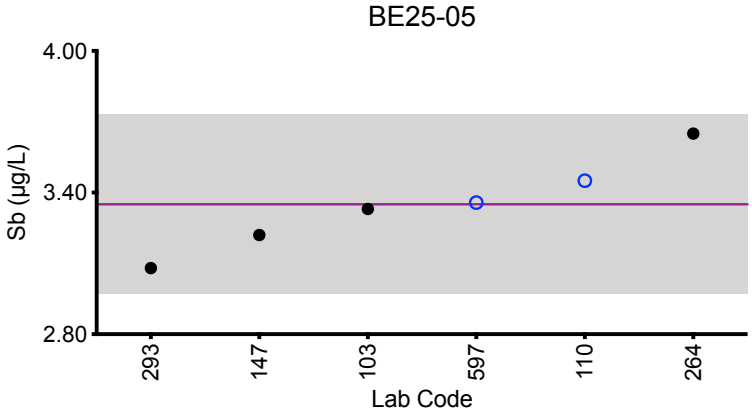
BE25-03



BE25-04



BE25-05



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 #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
103	ICP-MS/MS	243	185	125	302	112
107	ICP-MS/MS	249	178	128	306	112
110	ICP-MS/MS	230	175	118	272	104
147	ICP-MS	235	183	124	289	104
247	ICP-MS/MS	242	177	129	322	120
264	ICP-MS	238	175	122	305	113
293	DRC/CC-ICP-MS	*199	*136	107	279	96
597	ICP-MS/MS	228	183	130	291	123

Summary Statistics

	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
Arithmetic Mean ($\bar{x}$)	238	179	123	296	111
Arithmetic SD (s)	7	4	8	16	9
Arithmetic RSD (%)	2.9	2.2	6.5	5.4	8.1
Number of Sample Measurements (N)	7	7	8	8	8

*Denotes a statistical Outlier.

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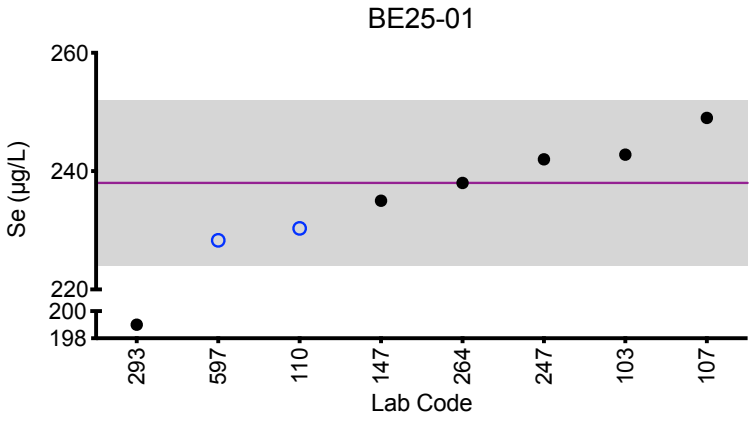
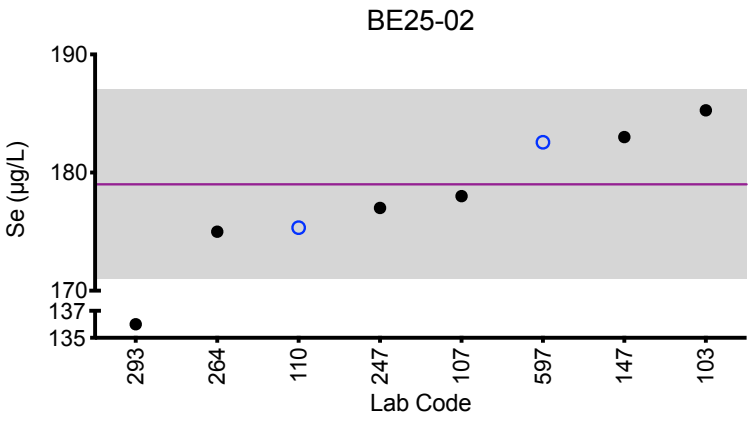
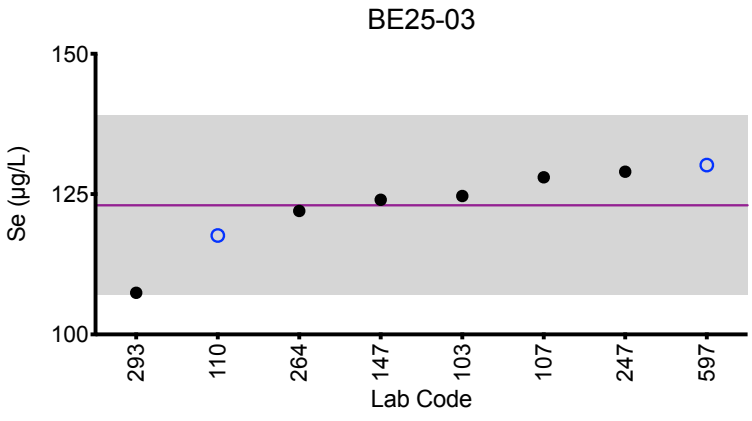
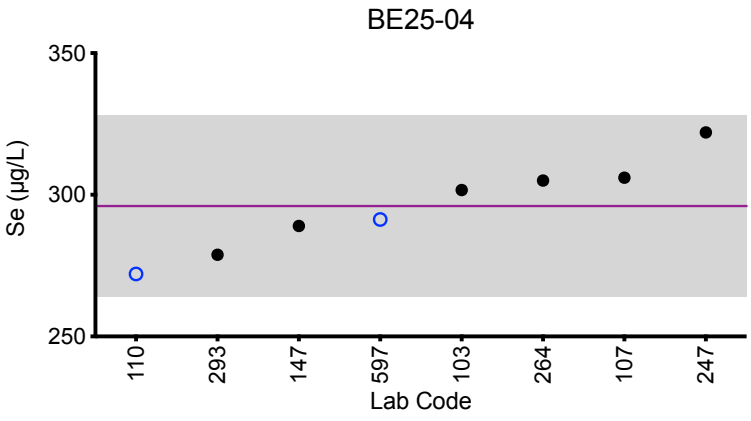
Results for Event #1, 2025: Summary Figures

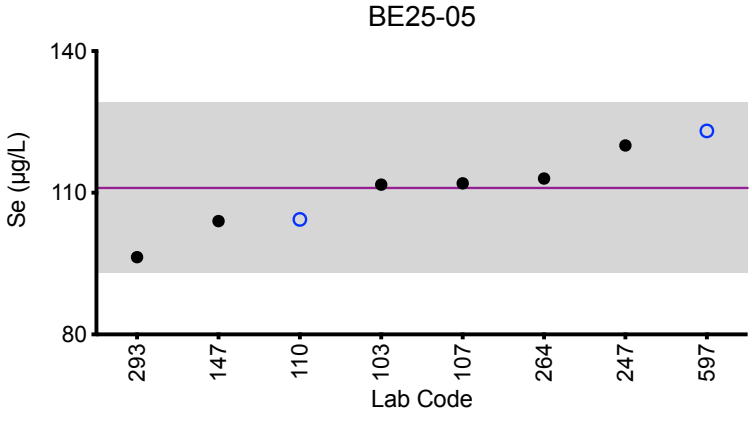
Whole Blood Se











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 #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Tl (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
103	ICP-MS/MS	0.212	1.23	0.0959	0.952	0.559
110	ICP-MS/MS	0.221	1.19	0.105	0.979	0.571
147	ICP-MS	0.227	1.24	0.0992	1.01	0.571
264	ICP-MS	0.23	1.19	0.11	0.95	0.57
293	DRC/CC-ICP-MS	0.21	1.17	0.100	0.93	0.54
597	ICP-MS/MS	0.216	1.14	0.0983	0.921	0.531

Summary Statistics

	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
Arithmetic Mean ($\bar{x}$)	0.219	1.19	0.101	0.96	0.557
Arithmetic SD (s)	0.008	0.04	0.005	0.03	0.017
Arithmetic RSD (%)	3.7	3.4	5.1	3.4	3.1
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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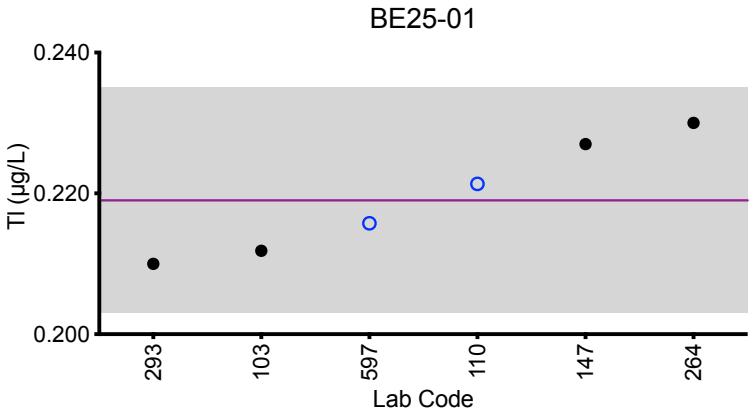
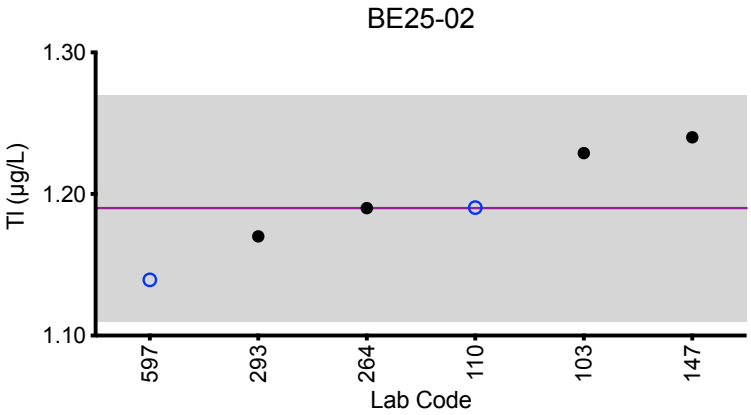
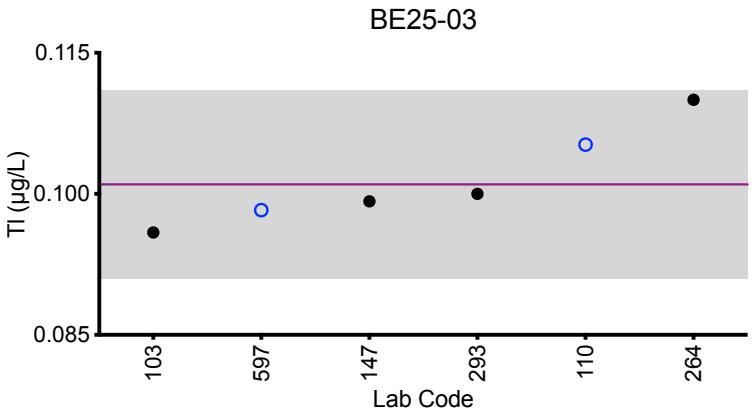
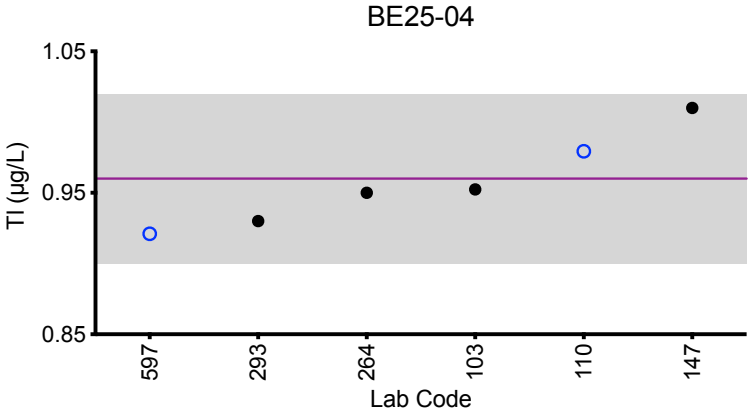
Results for Event #1, 2025: Summary Figures

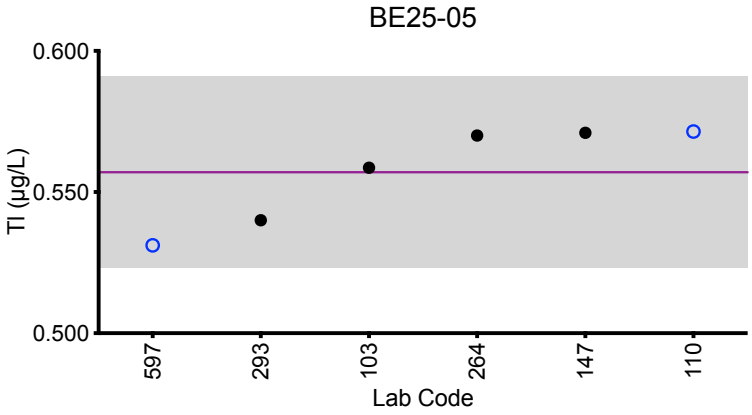
Whole Blood Tl











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 #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
110	ICP-MS/MS	5.16	1.76	9.95	1.38	7.37
147	ICP-MS	4.94	1.80	9.88	1.34	7.30
597	ICP-MS/MS	4.57	1.62	9.28	1.26	6.95
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		4.9	1.73	9.7	1.33	7.2
Arithmetic SD (s)		0.3	0.09	0.4	0.06	0.2
Arithmetic RSD (%)		6.1	5.2	4.1	4.5	3.2
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
110	ICP-MS/MS	0.57	4.48	0.99	2.58	2.04
147	ICP-MS	*0.991	4.00	0.991	2.11	1.80
597	ICP-MS/MS	0.450	3.97	0.927	2.24	1.73

Summary Statistics

	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
Arithmetic Mean ($\bar{x}$)	0.5	4.2	0.97	2.3	1.86
Arithmetic SD (s)	0.1	0.3	0.04	0.2	0.16
Arithmetic RSD (%)	17	7.1	4.1	10	8.6
Number of Sample Measurements (N)	2	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Bi (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
147	ICP-MS	0.840	0.0376	0.767	0.0376	0.0376
597	ICP-MS/MS	0.725	<0.00937	0.684	<0.00937	<0.00937
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		0.78	NA	0.73	NA	NA
Arithmetic SD (s)		0.08	NA	0.06	NA	NA
Arithmetic RSD (%)		10	NA	8.2	NA	NA
Number of Sample Measurements (N)		2	NA	2	NA	NA

*Denotes a statistical Outlier.

Statistical data was not calculated for BE25-02, BE25-04 and BE25-05 based on a lack of consensus among participating labs.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
110	ICP-MS/MS	2.57	2.02	2.52	1.65	1.70
147	ICP-MS	2.57	2.11	2.50	1.64	1.71
597	ICP-MS/MS	2.29	1.86	2.30	1.54	1.61
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		2.48	1.99	2.44	1.61	1.67
Arithmetic SD (s)		0.16	0.13	0.12	0.06	0.06
Arithmetic RSD (%)		6.5	6.5	4.9	3.7	3.6
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
110	ICP-MS/MS	1220	895	791	1270	613
147	ICP-MS	1322	996	850	1414	656
247	ICP-MS/MS	1193	901	838	1334	636
597	ICP-MS/MS	1140	869	790	1320	634

Summary Statistics

	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
Arithmetic Mean ($\bar{x}$)	1220	920	820	1330	635
Arithmetic SD (s)	80	60	30	60	18
Arithmetic RSD (%)	6.6	6.5	3.7	4.5	2.8
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood I (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
147	ICP-MS	26.3	29.7	28.6	40.4	16.9
597	ICP-MS/MS	32.8	37.1	33.5	49.2	19.9
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		30	33	31	45	18
Arithmetic SD (s)		5	5	3	6	2
Arithmetic RSD (%)		17	15	9.7	13	11
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Li (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
147	ICP-MS	0.401	0.528	0.404	0.616	1.21
597	ICP-MS/MS	0.370	0.487	0.394	0.582	1.199
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		0.39	0.51	0.399	0.60	1.20
Arithmetic SD (s)		0.02	0.03	0.007	0.02	0.01
Arithmetic RSD (%)		5.1	5.9	1.8	3.3	0.66
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
103	ICP-MS/MS	2.58	5.48	<1.50	7.14	<1.50
110	ICP-MS/MS	2.74	6.22	1.19	8.54	1.65
147	ICP-MS	1.99	5.35	0.573	6.15	0.817
597	ICP-MS/MS	1.76	4.45	<0.795	5.72	<0.795
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		2.3	5.4	NA	6.9	NA
Arithmetic SD (s)		0.5	0.7	NA	1.3	NA
Arithmetic RSD (%)		22	13	NA	19	NA
Number of Sample Measurements (N)		4	4	NA	4	NA

*Denotes a statistical Outlier.

Statistical data was not calculated for BE25-03 and BE25-05 based on a lack of consensus among participating labs.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Pt (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
110	ICP-MS/MS	0.818	0.183	1.18	0.366	3.27
293	DRC/CC-ICP-MS	0.67	0.16	1.02	0.33	2.99
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		0.74	0.17	1.10	0.35	3.1
Arithmetic SD (s)		0.10	0.02	0.11	0.03	0.2
Arithmetic RSD (%)		14	9.3	10	8.6	6.4
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
110	ICP-MS/MS	2.21	0.81	4.24	0.34	1.05
147	ICP-MS	2.13	0.821	4.06	0.439	1.01
597	ICP-MS/MS	2.08	0.804	4.10	0.387	1.07
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		2.14	0.812	4.13	0.39	1.04
Arithmetic SD (s)		0.07	0.009	0.09	0.05	0.03
Arithmetic RSD (%)		3.3	1.1	2.2	13	2.9
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
103	ICP-MS/MS	29.9	18.8	31.8	26.4	20.8
110	ICP-MS/MS	29.3	18.2	30.8	25.2	20.6
147	ICP-MS	28.6	18.0	30.3	26.1	20.4
597	ICP-MS/MS	26.1	16.2	28.3	24.1	19.3
Summary Statistics						
		BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)		28.5	17.8	30.3	25.5	20.3
Arithmetic SD (s)		1.7	1.1	1.5	1.0	0.7
Arithmetic RSD (%)		5.8	6.2	4.9	3.9	3.4
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
103	ICP-MS/MS	0.0399	0.170	0.715	1.18	0.115
110	ICP-MS/MS	0.0386	0.159	0.653	1.11	0.106
147	ICP-MS	0.0381	0.155	0.638	1.09	0.106
597	ICP-MS/MS	0.0374	0.147	0.612	1.04	0.100

Summary Statistics

	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
Arithmetic Mean ($\bar{x}$)	0.0385	0.158	0.65	1.11	0.107
Arithmetic SD (s)	0.0011	0.009	0.04	0.06	0.006
Arithmetic RSD (%)	2.9	6.3	6.2	5.4	5.6
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
110	ICP-MS/MS	0.87	1.46	0.56	3.34	0.26
147	DRC/CC-ICP-MS	0.794	1.40	0.501	3.46	0.188
597	ICP-MS/MS	0.823	1.27	0.502	3.08	0.204

Summary Statistics

	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
Arithmetic Mean ($\bar{x}$)	0.83	1.38	0.52	3.3	0.22
Arithmetic SD (s)	0.04	0.10	0.03	0.2	0.04
Arithmetic RSD (%)	4.8	7.2	5.8	5.8	18
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
110	ICP-MS/MS	0.13	0.66	1.07	0.22	1.36
200	ICP-MS	*0.3	0.8	1.3	*0.4	1.3
597	ICP-MS/MS	0.129	0.558	0.962	0.188	1.19

Summary Statistics					
	BE25-01	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
Arithmetic Mean ($\bar{x}$)	0.130	0.67	1.1	0.20	1.28
Arithmetic SD (s)	0.001	0.12	0.2	0.02	0.09
Arithmetic RSD (%)	0.55	18	15	11	6.6
Number of Sample Measurements (N)	2	3	3	2	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
110	ICP-MS/MS	5270	8390	7730	3970	4920
147	ICP-MS	5324	8692	7848	4098	4981
247	ICP-MS/MS	4615	7515	6920	3598	4338
597	ICP-MS/MS	4830	7700	7250	3800	4730

Summary Statistics

	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
Arithmetic Mean ($\bar{x}$)	5000	8100	7400	3870	4740
Arithmetic SD (s)	300	600	400	220	290
Arithmetic RSD (%)	6.9	7.4	5.4	5.7	6.1
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
147	ICP-MS	0.129	0.129	0.129	0.131	0.129

Whole Blood Al (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
147	ICP-MS	6.47	7.35	5.68	5.29	5.71
597	ICP-MS/MS	<10.2	<10.2	<10.2	<10.2	<10.2

Whole Blood B (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
597	ICP-MS/MS	<7.72	9.28	<7.72	11.7	13.8

Whole Blood Br (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
597	ICP-MS/MS	5700	6470	5610	6960	1470

Whole Blood Cl (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
597	ICP-MS/MS	3980000	3490000	3900000	4140000	4510000

Whole Blood Fe (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
597	ICP-MS/MS	452000	517000	421000	275000	407000

Whole Blood Ga (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
597	ICP-MS/MS	0.0131	0.0196	0.0164	0.0134	0.0129

Whole Blood Mg (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
597	ICP-MS/MS	28000	33200	27600	25400	25400

Whole Blood S (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
597	ICP-MS/MS	1330000	1430000	1320000	1270000	1100000

Whole Blood Te (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
110	ICP-MS/MS	<0.007	0.0187	<0.007	<0.007	<0.007
147	ICP-MS	0.0740	0.0740	0.0740	0.0740	0.0740

Whole Blood Th (µg/L)

Lab Code	Method	BE25-01	BE25-02	BE25-03	BE25-04	BE25-05
147	ICP-MS	0.0255	0.0255	0.0255	0.0255	0.0255
597	ICP-MS/MS	0.00542	0.00437	0.00340	0.00250	0.00458

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Results for Event #1, 2025:
Additional Elements in Whole Blood

Whole Blood Ti (µg/L)						
Lab Code	**Method**	**BE25-01**	**BE25-02**	**BE25-03**	**BE25-04**	**BE25-05**
597	ICP-MS/MS	4.13	9.07	3.09	7.50	5.67

Statistical data was not calculated for Te and Th for BE25-01, BE25-02, BE25-03, BE25-04 and BE25-05 based on a lack of consensus among participating labs.

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Event #1, 2025

Trace Elements in Urine

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Trace Elements Laboratory

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Event #1, 2025:
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 25 elements were reported by at least one participant: Ag, Al, B, Bi, Cl, Cs, Cu, Fe, I, Li, Mg, Mo, Ni, Pt, S, 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

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Results for Event #1, 2025: Summary Statistics

	Urine As (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Robust Mean (x*))	22.4	26.0	23.2	2.16	5.4
Upper Limit	28.4	32.0	29.2	8.16	11.4
Lower Limit	16.4	20.0	17.2	0.00	0.0
Robust SD (s*)	0.8	1.5	1.7	0.14	0.3
Robust RSD (%)	3.6	5.8	7.3	6.5	5.2
Number of Sample Measurements (N)	11	11	11	10	10
Standard Uncertainty (*u*)	0.3	0.6	0.7	0.06	0.1

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

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Results for Event #1, 2025:
Performance of Participating Laboratories

		Urine As (µg/L)				
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**22.4**	**26.0**	**23.2**	**2.16**	**5.4**
103	ICP-MS/MS	23.8	27.2	24.0	2.23	5.64
107	DRC/CC-ICP-MS	22.4	26.0	23.1	2.22	5.49
110	ICP-MS/MS	21.9	25.6	23.1	2.06	5.39
116	ICP-MS/MS	23.0	28.6	25.5	2.16	5.85
147	ICP-MS	21.4	22.9	20.9	1.72	4.60
264	ICP-MS	22.61	25.44	22.92	2.18	5.24
293	DRC/CC-ICP-MS	21.42	24.64	21.58	1.97	5.21
597	ICP-MS/MS	22.1	25.0	22.3	2.16	5.29
605	ICP-MS	21.8	25.3	21.9	<2.00	5.16
606	ICP-MS/MS	22.8	27.2	24.7	2.30	5.70
686	DRC/CC-ICP-MS	23.2	28.1	25.4	6.12	<6.00

Based on the grading criteria for As 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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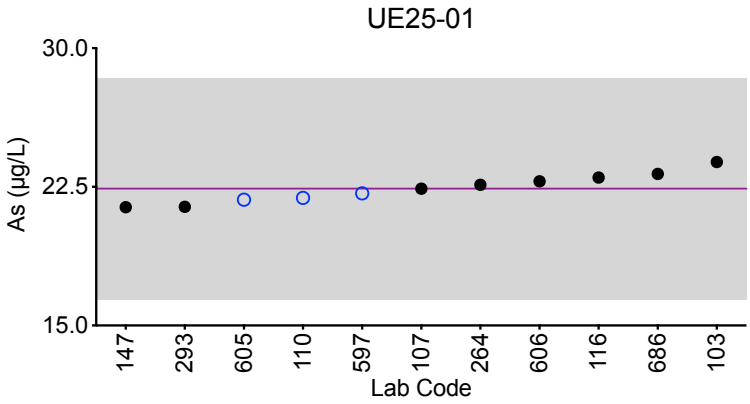
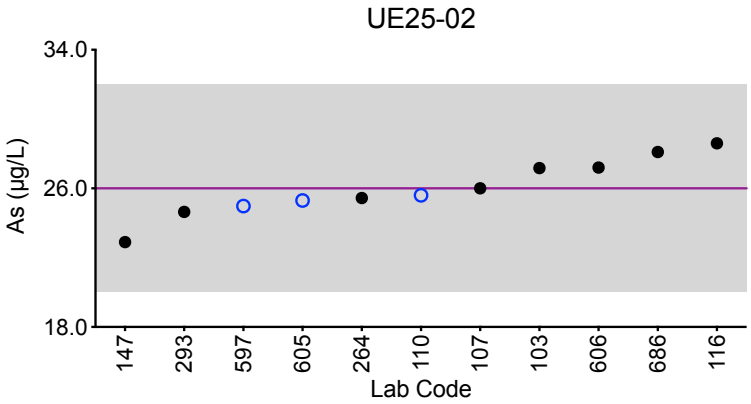
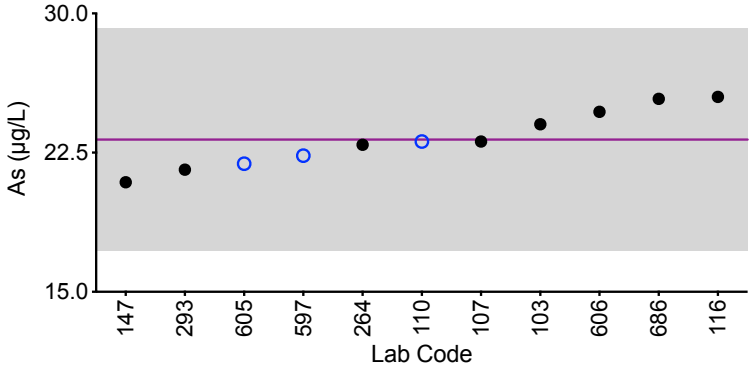
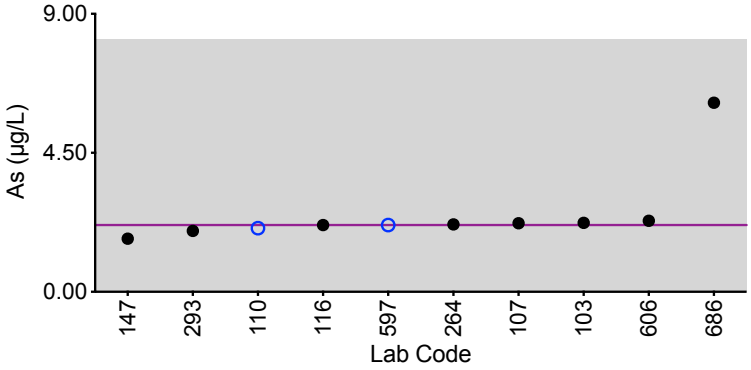
Results for Event #1, 2025: Summary Figures

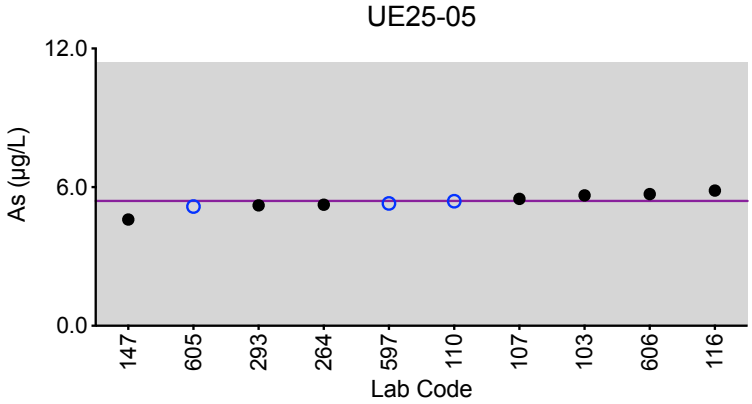
Urine As











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 #1, 2025: Summary Statistics

	Urine Ba (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Arithmetic Mean ($\bar{x}$))	0.36	5.2	1.66	2.33	3.40
Upper Limit	1.36	6.2	2.66	3.33	4.40
Lower Limit	0.00	4.2	0.66	1.33	2.40
Arithmetic SD (s)	0.06	0.3	0.06	0.05	0.22
Arithmetic RSD (%)	17	6.5	3.6	2.1	6.5
Number of Sample Measurements (N)	6	9	9	8	9

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 #1, 2025:
Performance of Participating Laboratories

Urine Ba (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**0.36**	**5.2**	**1.66**	**2.33**	**3.40**
107	ICP-MS	0.358	5.35	1.70	2.36	3.46
110	ICP-MS/MS	0.29	5.06	1.61	2.31	3.48
116	ICP-MS/MS	<0.600	5.55	1.79	2.26	3.70
147	ICP-MS	0.453	4.82	1.60	2.36	3.33
264	ICP-MS	0.29	4.90	1.60	*2.10	3.21
597	ICP-MS/MS	0.377	4.84	1.63	2.39	3.48
605	ICP-MS	<0.600	5.27	1.66	2.30	3.49
606	ICP-MS/MS	0.384	5.83	1.70	2.40	2.94
686	ICP-MS	<0.600	5.26	1.63	2.28	3.49

Based on the grading criteria for Ba 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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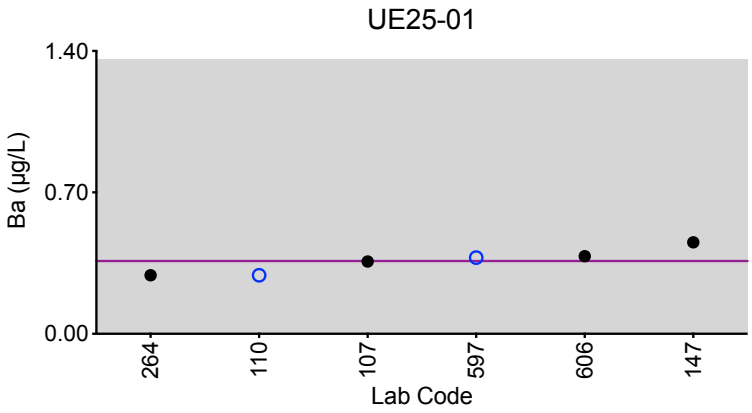
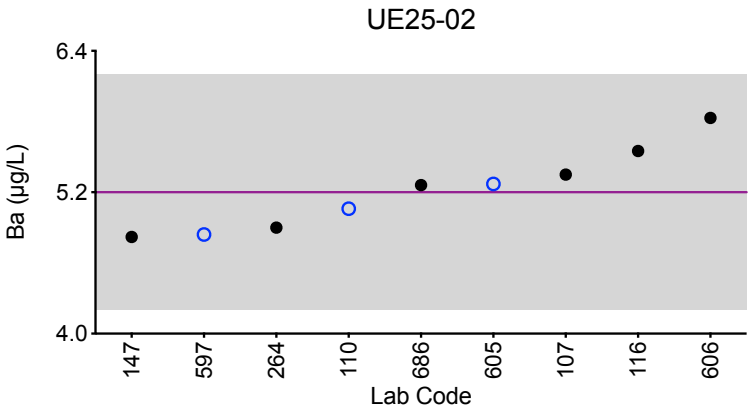
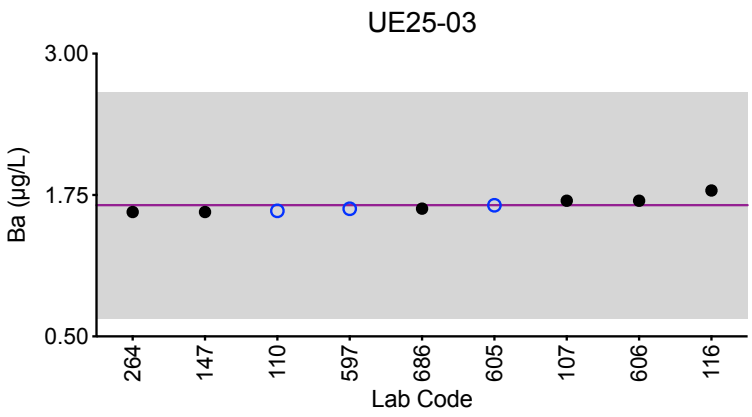
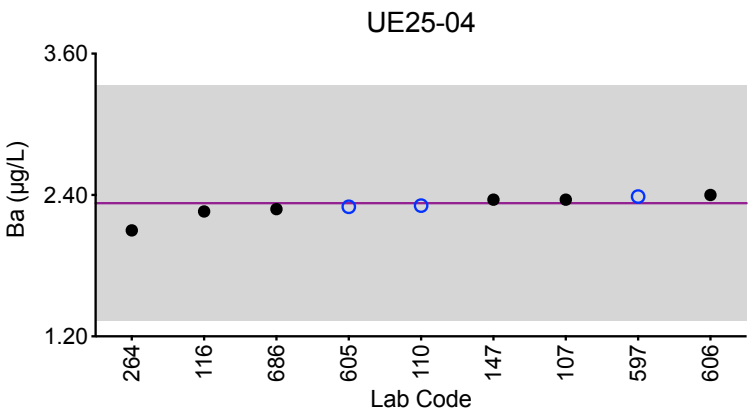
Results for Event #1, 2025: Summary Figures

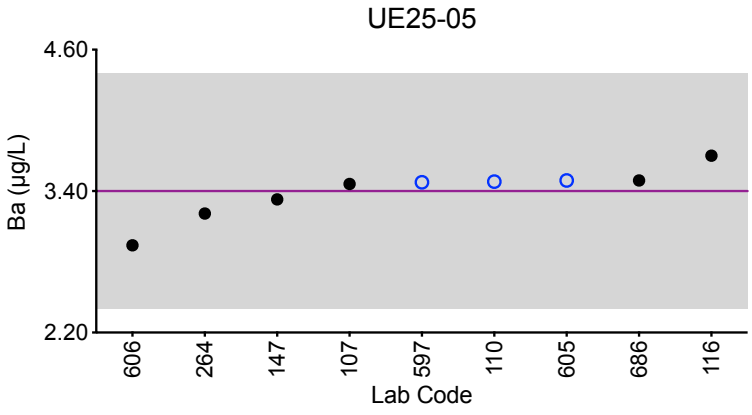
Urine Ba











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 #1, 2025: Summary Statistics

	Urine Be (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Arithmetic Mean ($\bar{x}$))	2.18	0.423	0.21	0.99	1.20
Upper Limit	3.18	1.423	1.21	1.99	2.20
Lower Limit	1.18	0.000	0.00	0.00	0.20
Arithmetic SD (s)	0.13	0.023	0.04	0.13	0.18
Arithmetic RSD (%)	5.7	5.4	17	13	15
Number of Sample Measurements (N)	9	8	7	9	9

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 #1, 2025:
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**2.18**	**0.423**	**0.21**	**0.99**	**1.20**
107	ICP-MS	2.20	0.432	0.216	0.935	1.21
110	ICP-MS/MS	1.97	*0.283	0.143	0.743	0.853
116	ICP-MS/MS	2.20	0.464	<0.300	1.03	1.40
147	ICP-MS	2.38	0.423	0.261	1.01	1.31
264	ICP-MS	2.15	0.43	0.22	0.93	1.28
293	ICP-MS	2.21	0.4	0.2	0.97	1.26
597	ICP-MS/MS	2.02	0.389	0.201	1.03	1.20
605	ICP-MS	2.29	0.433	0.221	0.988	1.29
686	ICP-MS	2.22	0.417	<0.300	1.26	0.955

Based on the grading criteria for Be 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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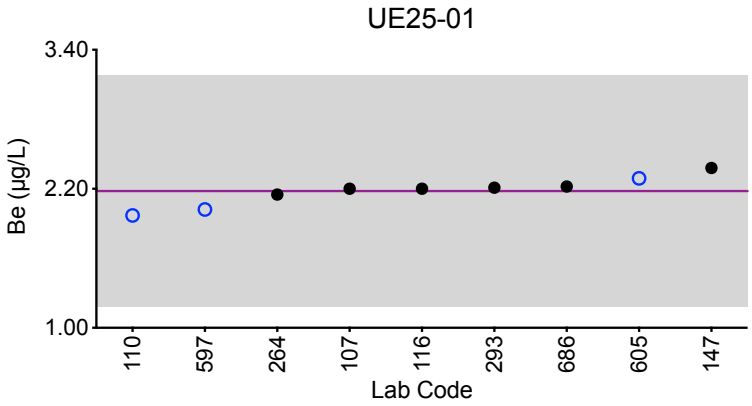
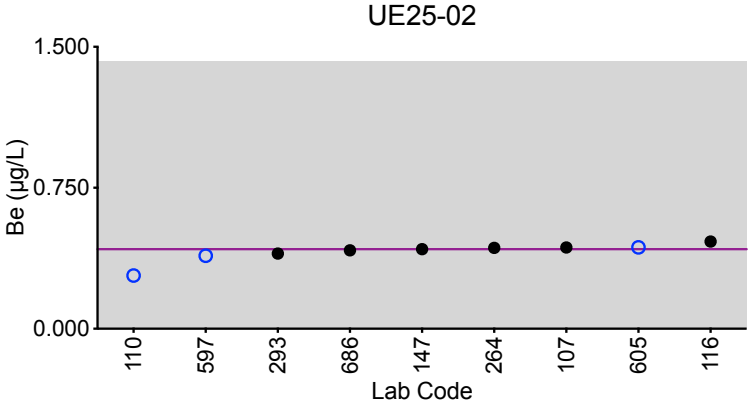
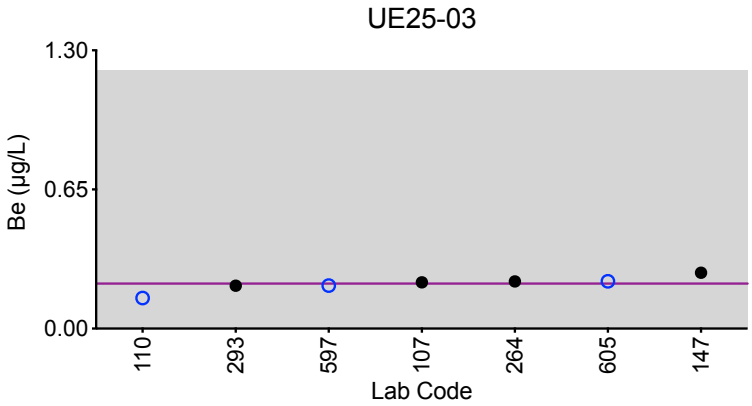
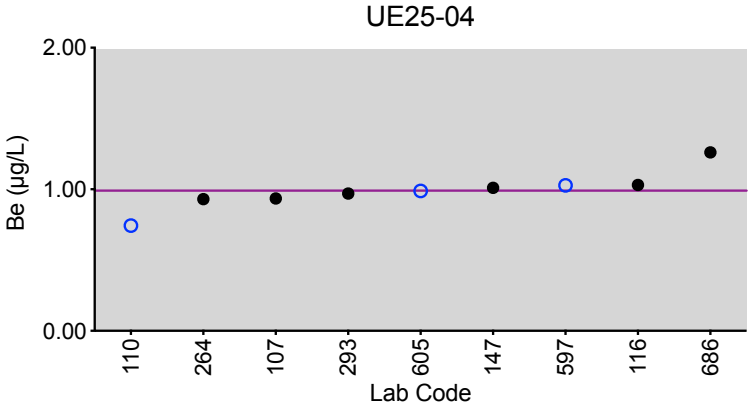
Results for Event #1, 2025: Summary Figures

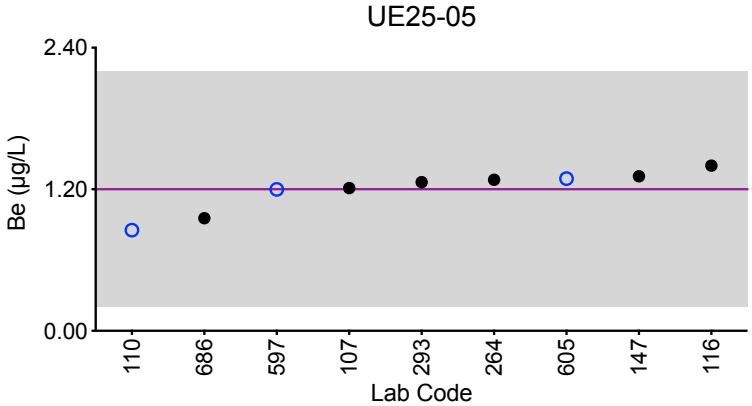
Urine Be











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 #1, 2025: Summary Statistics

	Urine Cd (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Robust Mean (x*))	2.78	0.80	0.507	1.95	0.279
Upper Limit	3.78	1.80	1.507	2.95	1.279
Lower Limit	1.78	0.00	0.000	0.95	0.000
Robust SD (s*)	0.08	0.04	0.009	0.09	0.018
Robust RSD (%)	2.9	4.5	1.8	4.6	6.5
Number of Sample Measurements (N)	12	11	11	12	11
Standard Uncertainty (*u*)	0.03	0.01	0.003	0.03	0.007

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 #1, 2025:
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**2.78**	**0.80**	**0.507**	**1.95**	**0.279**
103	ICP-MS/MS	2.93	0.822	0.515	2.08	0.280
107	DRC/CC-ICP-MS	2.83	0.765	0.456	1.89	0.290
110	ICP-MS/MS	2.77	0.81	0.52	1.94	0.30
116	ICP-MS/MS	2.62	0.780	0.504	1.86	0.261
147	ICP-MS	2.85	0.775	0.489	2.05	0.238
264	ICP-MS	2.84	0.84	0.50	1.99	0.29
293	DRC/CC-ICP-MS	2.76	0.81	0.51	1.88	0.23
324	ICP-MS	2.647	<1	<1	2.009	<1
597	ICP-MS/MS	2.76	0.819	0.510	2.01	0.270
605	ICP-MS	2.80	0.788	0.510	1.96	0.273
606	ICP-MS/MS	2.62	0.757	0.513	1.93	0.281
686	ICP-MS	2.81	0.862	0.478	0.287 ↓	2.02 ↑

Based on the grading criteria for Cd 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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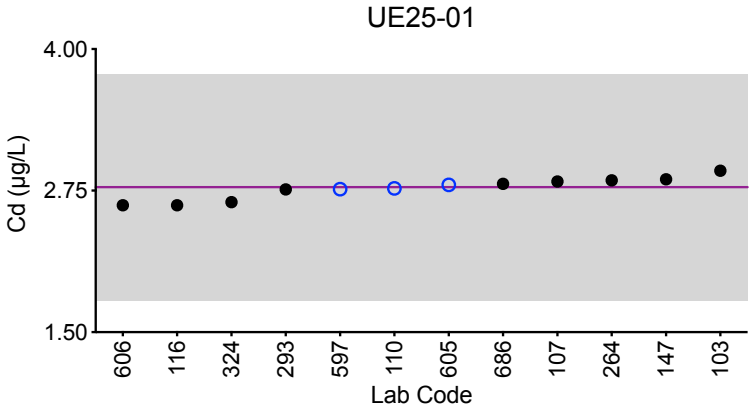
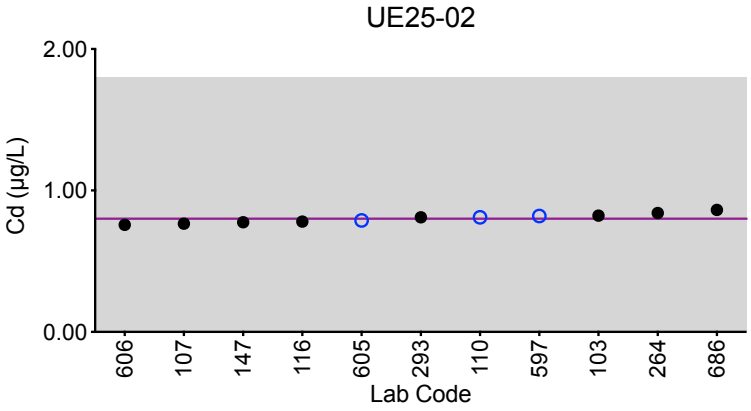
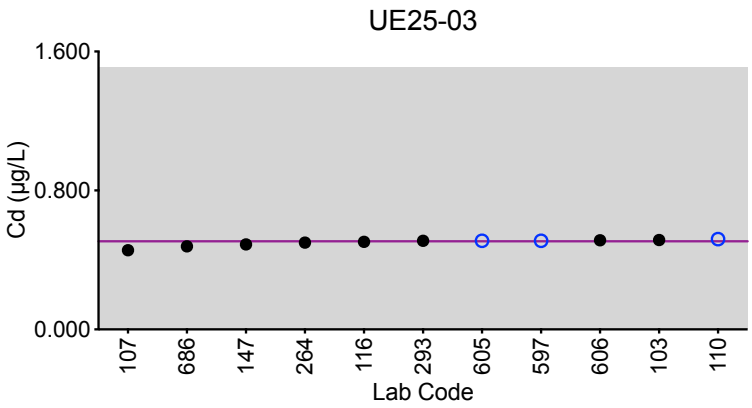
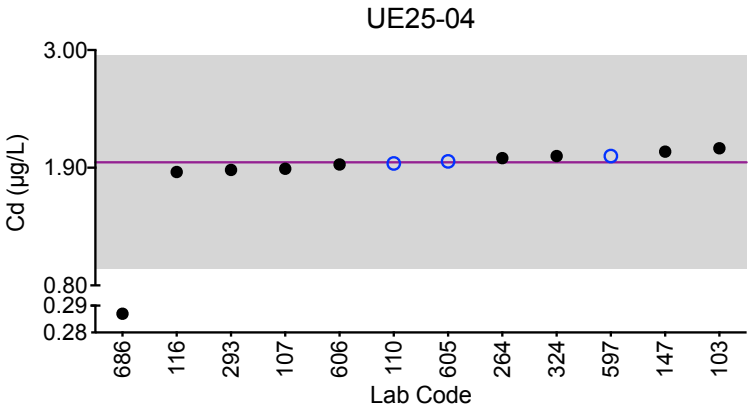
Results for Event #1, 2025: Summary Figures

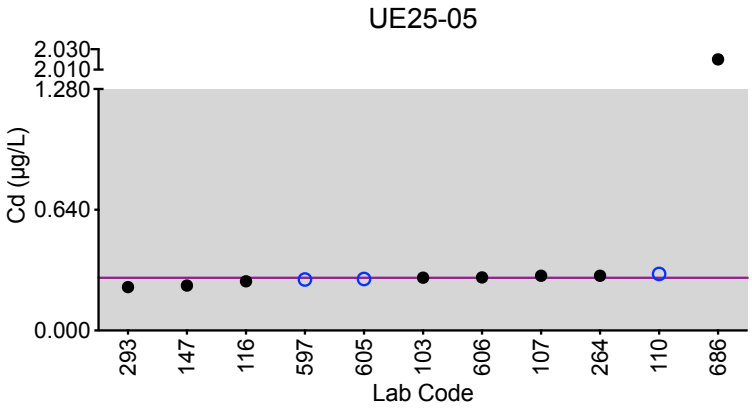
Urine Cd











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 #1, 2025: Summary Statistics

	Urine Co (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Robust Mean (x*))	0.534	0.94	3.02	2.75	4.52
Upper Limit	2.034	2.44	4.52	4.25	6.02
Lower Limit	0.000	0.00	1.52	1.25	3.02
Robust SD (s*)	0.001	0.05	0.09	0.09	0.19
Robust RSD (%)	0.25	5.3	2.9	3.3	4.2
Number of Sample Measurements (N)	8	10	10	10	10
Standard Uncertainty (*u*)	NA	0.02	0.04	0.04	0.07

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

An arithmetic mean, SD, RSD and n are provided for sample UE25-01.

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Results for Event #1, 2025:
Performance of Participating Laboratories

		Urine Co (µg/L)				
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**0.534**	**0.94**	**3.02**	**2.75**	**4.52**
103	ICP-MS/MS	0.545	0.946	3.15	2.95	4.77
107	DRC/CC-ICP-MS	0.540	0.923	2.97	2.75	4.53
110	ICP-MS/MS	0.534	0.914	2.95	2.69	4.29
147	ICP-MS	0.541	0.978	2.99	2.63	4.37
264	ICP-MS	0.52	0.93	3.02	2.72	4.41
293	DRC/CC-ICP-MS	0.53	0.88	2.97	2.8	4.51
324	ICP-MS	<1	1.259	3.249	2.801	4.589
597	ICP-MS/MS	0.520	0.890	2.84	2.68	4.35
605	ICP-MS	0.545	0.940	3.05	2.73	4.59
606	ICP-MS/MS	*0.684	1.27	3.34	2.88	4.75

Based on the grading criteria for Co 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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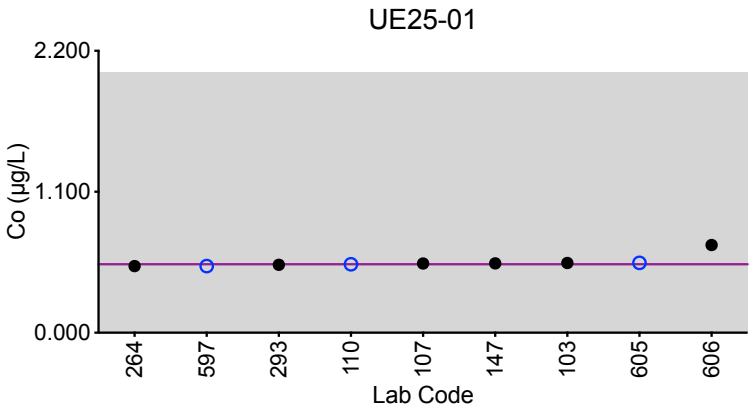
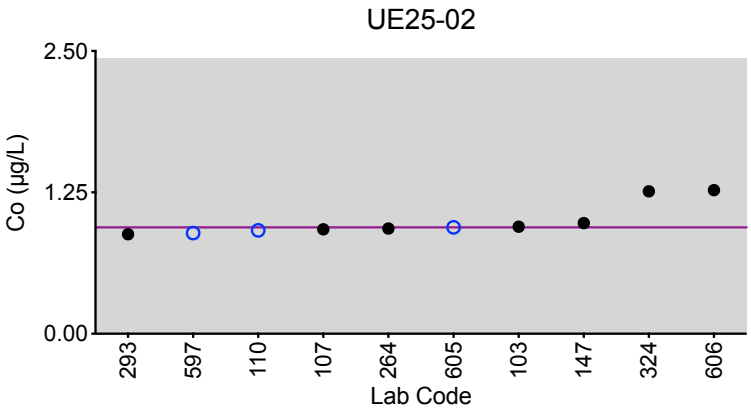
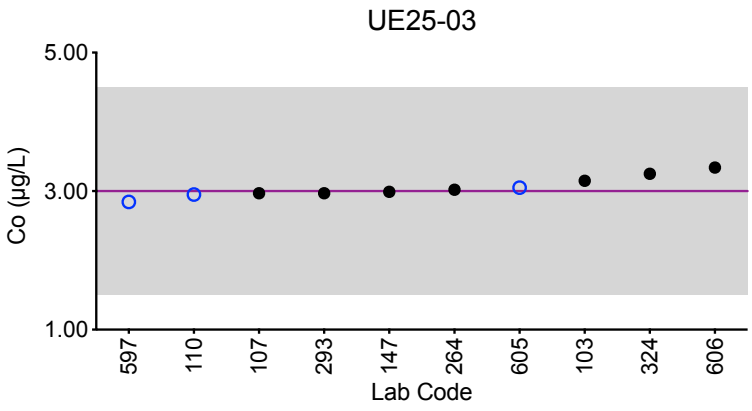
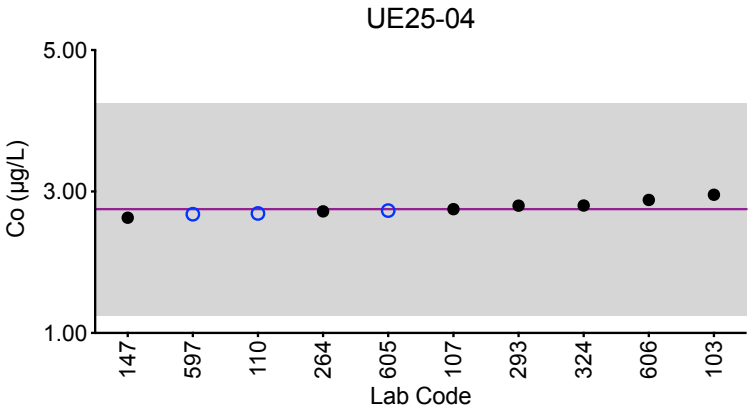
Results for Event #1, 2025: Summary Figures

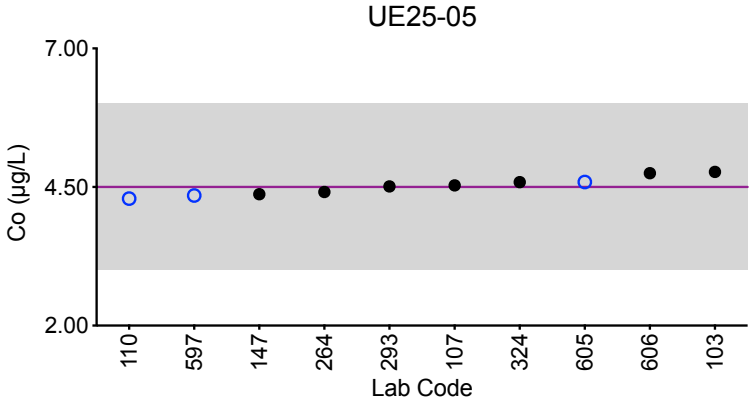
Urine Co











Legend:

o HHEAR Labs ● Other Labs

Horizontal purple line = assigned target value based on the robust mean of all laboratories.

Gray area = acceptable range based on quality specifications:

±1.5 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1.5 µg/L at concentrations less than or equal to 10 µg/L.

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Results for Event #1, 2025: Summary Statistics

	Urine Cr (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Robust Mean (x*))	0.65	1.68	5.5	3.20	3.4
Upper Limit	3.65	4.68	8.5	6.20	6.4
Lower Limit	0.00	0.00	2.5	0.20	0.4
Robust SD (s*)	0.02	0.22	0.8	0.17	0.6
Robust RSD (%)	3.7	13	15	5.3	18
Number of Sample Measurements (N)	8	10	10	10	10
Standard Uncertainty (*u*)	NA	0.09	0.3	0.07	0.2

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

An arithmetic mean, SD, RSD and n are provided for sample UE25-01.

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Results for Event #1, 2025:
Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**0.65**	**1.68**	**5.5**	**3.20**	**3.4**
103	ICP-MS/MS	0.666	1.84	5.87	3.63	4.47
107	DRC/CC-ICP-MS	0.640	1.70	5.39	3.27	3.63
110	ICP-MS/MS	0.65	1.63	5.18	3.10	3.02
116	ICP-MS/MS	0.633	1.99	6.02	3.02	4.35
147	DRC/CC-ICP-MS	0.662	1.82	6.63	3.16	2.98
264	ICP-MS	*0.51	1.66	5.60	3.29	2.87
293	DRC/CC-ICP-MS	0.63	1.64	6.8	3.13	3.39
324	ICP-MS	<1	1.308	4.665	3.525	4.392
597	ICP-MS/MS	0.677	1.81	5.09	3.25	2.77
605	ICP-MS	0.613	1.36	4.61	2.99	3.08

Based on the grading criteria for Cr 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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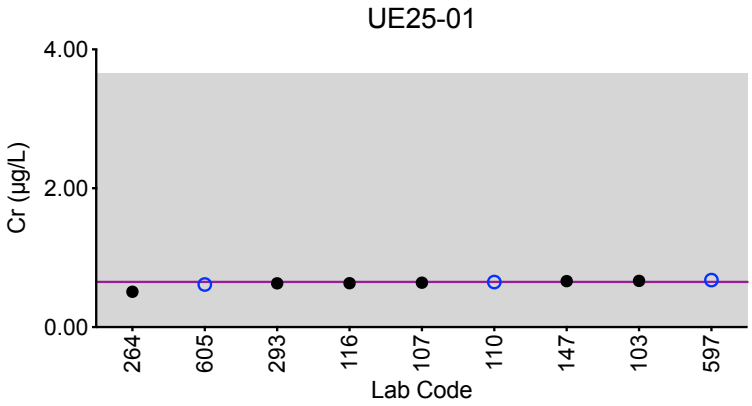
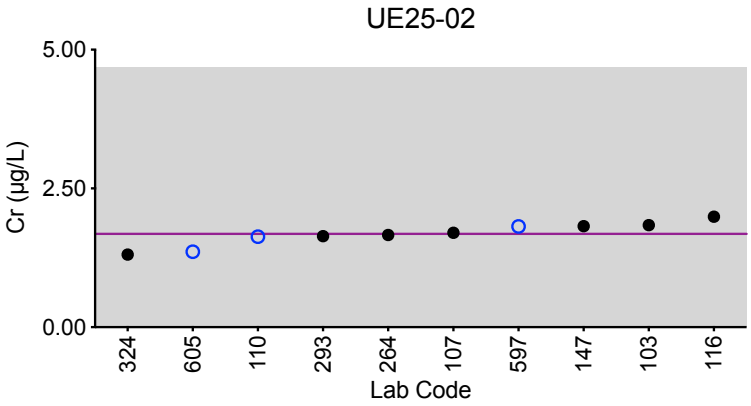
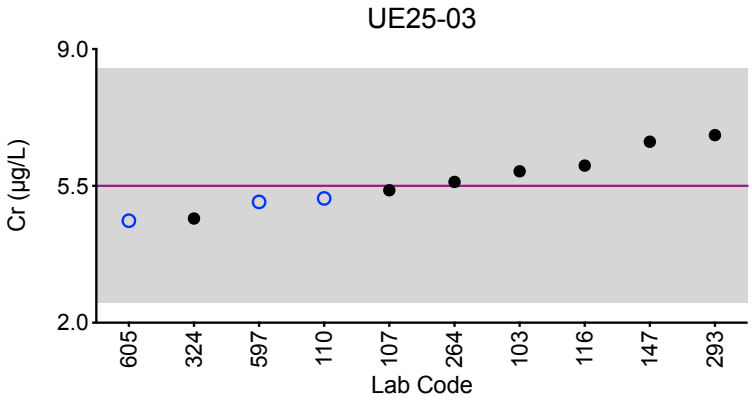
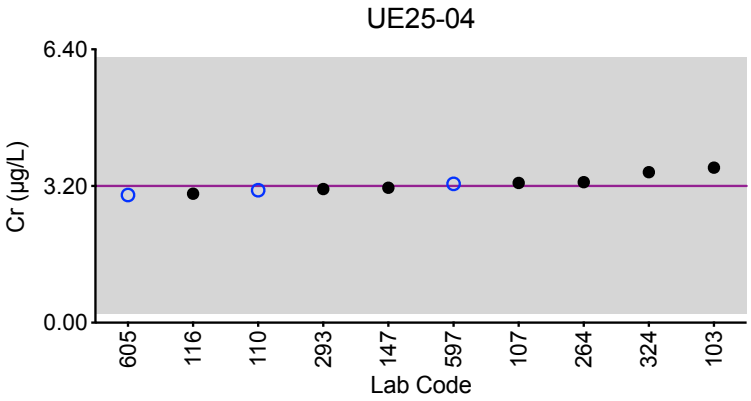
Results for Event #1, 2025: Summary Figures

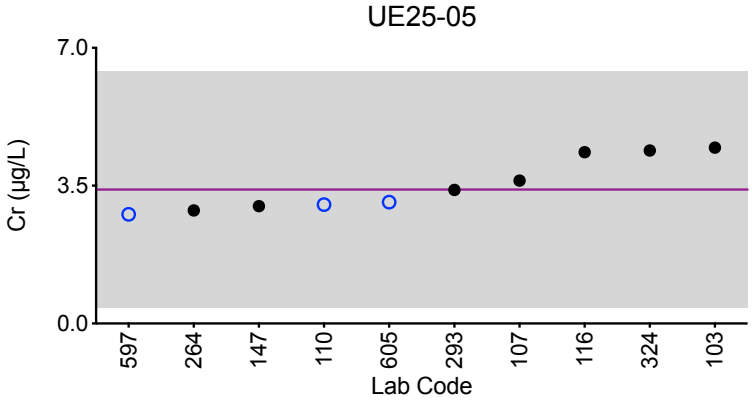
Urine Cr











Legend:

o HHEAR Labs ● Other Labs

Horizontal purple line = assigned target value based on the robust mean of all laboratories.

Gray area = acceptable range based on quality specifications:

±3 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 15 µg/L.

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Results for Event #1, 2025: Summary Statistics

	Urine Hg (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Robust Mean (x*))	2.19	10.6	4.6	1.29	0.58
Upper Limit	5.19	13.8	7.6	4.29	3.58
Lower Limit	0.00	7.4	1.6	0.00	0.00
Robust SD (s*)	0.24	1.1	0.5	0.07	0.09
Robust RSD (%)	11	10	11	5.4	15
Number of Sample Measurements (N)	11	11	11	11	7
Standard Uncertainty (*u*)	0.09	0.4	0.2	0.03	NA

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

An arithmetic mean, SD, RSD and n are provided for sample UE25-05.

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Results for Event #1, 2025:
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**2.19**	**10.6**	**4.6**	**1.29**	**0.58**
103	ICP-MS/MS	2.03	10.3	4.53	1.24	0.557
107	DRC/CC-ICP-MS	2.11	9.60	4.09	1.20	0.509
110	ICP-MS	3.02	11.8	5.40	1.46	0.70
116	ICP-MS/MS	1.56	8.55	3.69	0.849	<0.300
147	ICP-MS	2.13	10.1	4.45	1.26	0.488
264	ICP-MS	8.37 ↑	12.34	5.86	1.31	0.68
293	DRC/CC-ICP-MS	2.1	10.34	4.65	1.32	0.64
597	ICP-MS/MS	1.98	10.2	4.30	1.28	0.520
605	ICP-MS	2.22	10.6	4.21	1.30	<1.00
606	ICP-MS/MS	2.55	11.5	4.68	1.50	<1.00
686	ICP-MS	2.32	11.3	5.19	1.33	<1.00

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

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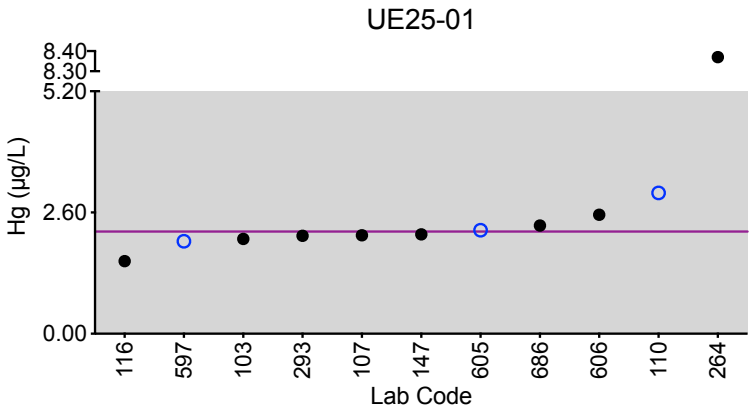
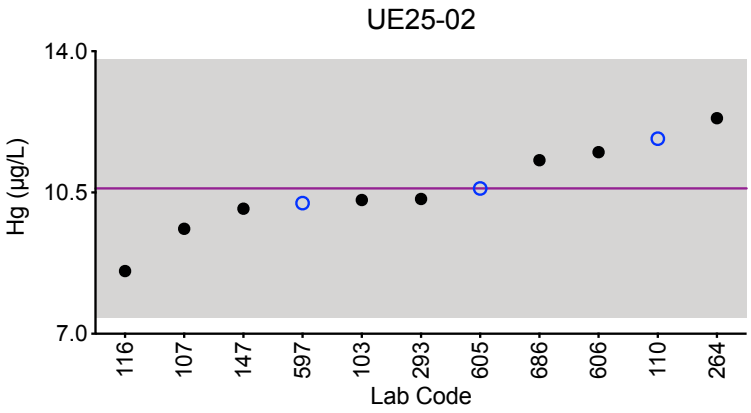
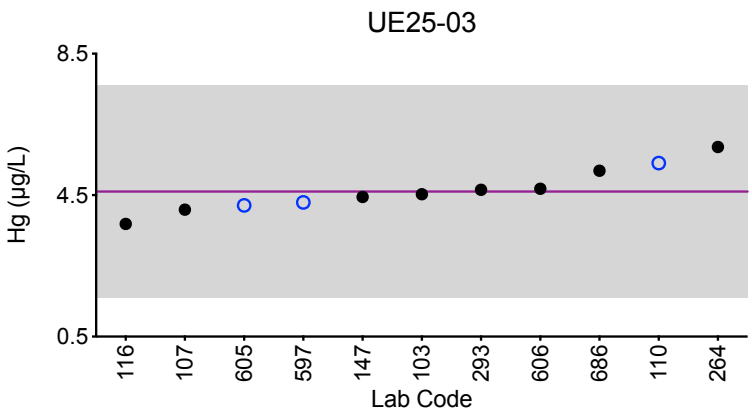
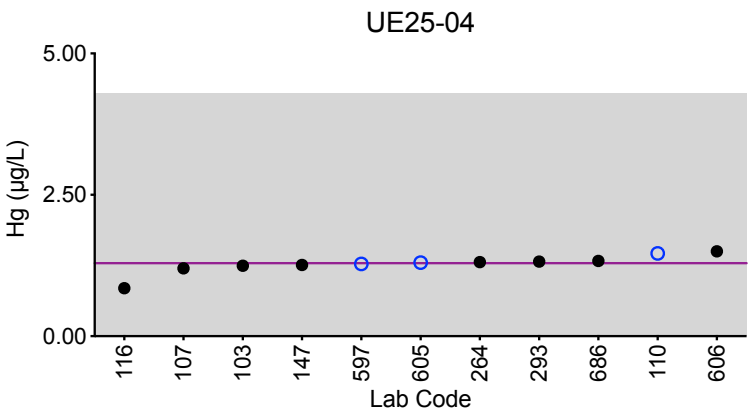
Results for Event #1, 2025: Summary Figures

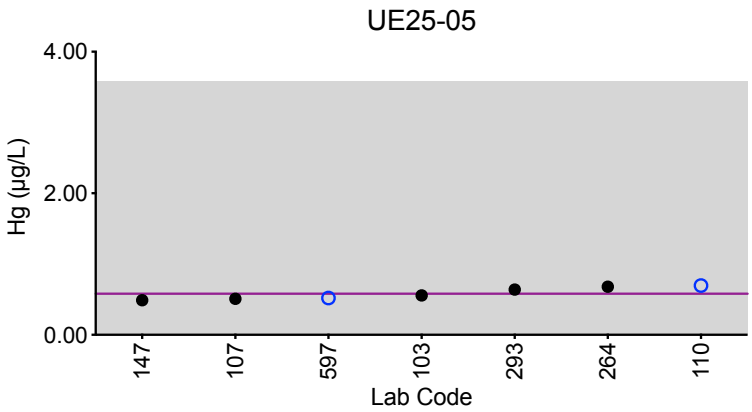
Urine Hg











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 #1, 2025: Summary Statistics

	Urine Mn (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Robust Mean (x*))	0.81	5.18	3.72	5.90	1.28
Upper Limit	1.36	6.48	4.65	7.38	1.83
Lower Limit	0.26	3.89	2.79	4.43	0.73
Robust SD (s*)	0.07	0.25	0.20	0.16	0.09
Robust RSD (%)	8.6	4.8	5.4	2.7	7.1
Number of Sample Measurements (N)	10	11	11	11	11
Standard Uncertainty (*u*)	0.03	0.09	0.07	0.06	0.03

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 #1, 2025:
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**0.81**	**5.18**	**3.72**	**5.90**	**1.28**
103	ICP-MS/MS	0.847	5.41	3.88	6.24	1.31
107	DRC/CC-ICP-MS	1.47 ↑	5.01	3.53	5.66	1.33
110	ICP-MS/MS	0.82	5.16	3.68	6.01	1.26
116	ICP-MS/MS	0.756	5.63	3.88	5.81	1.31
147	DRC/CC-ICP-MS	0.903	5.05	3.82	5.77	1.29
264	ICP-MS	0.70	5.14	3.64	5.88	1.15
293	DRC/CC-ICP-MS	0.77	4.95	3.58	5.87	1.18
324	ICP-MS	<1	5.708	4.204	6.349	1.392
597	ICP-MS/MS	0.815	4.77	3.42	5.86	1.20
605	ICP-MS	0.771	5.16	3.65	5.80	1.23
606	ICP-MS/MS	0.812	5.24	3.82	6.01	1.39

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

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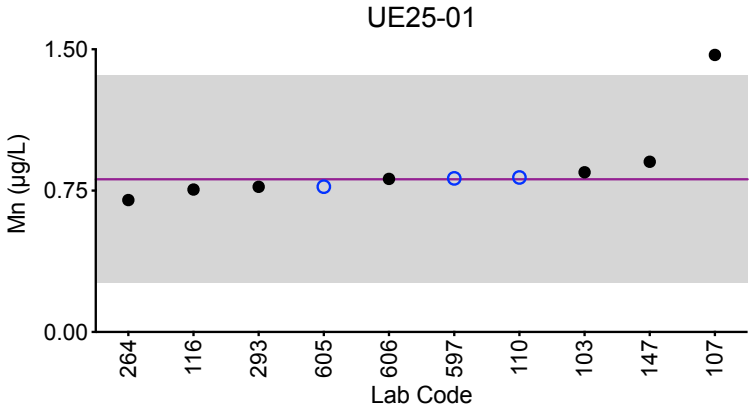
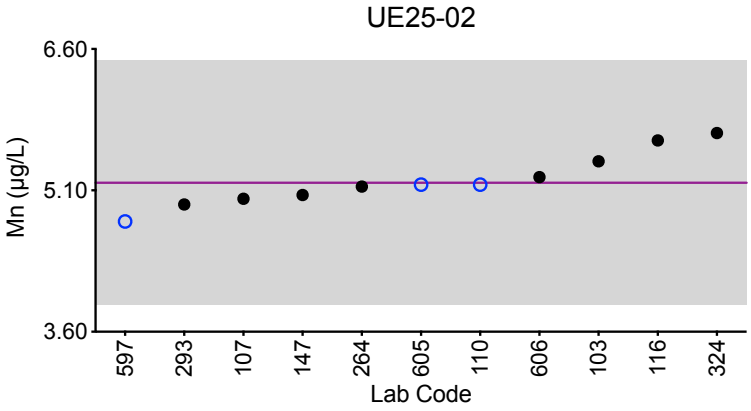
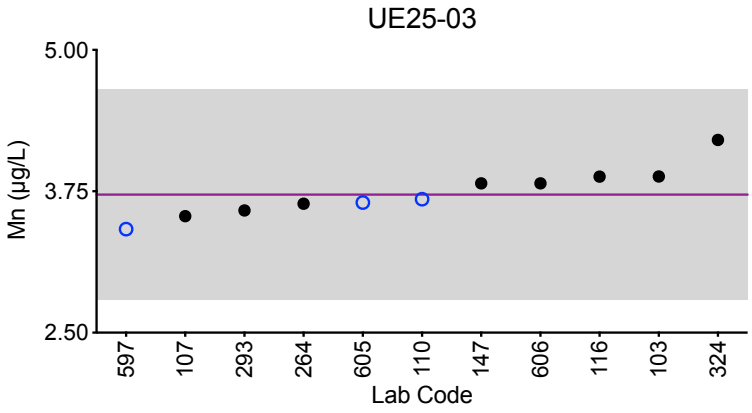
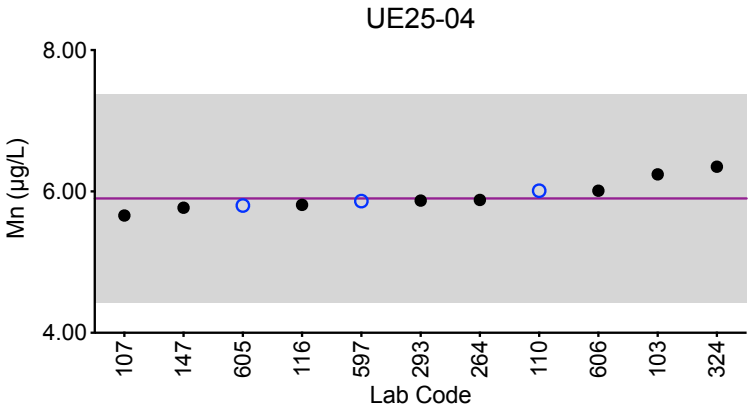
Results for Event #1, 2025: Summary Figures

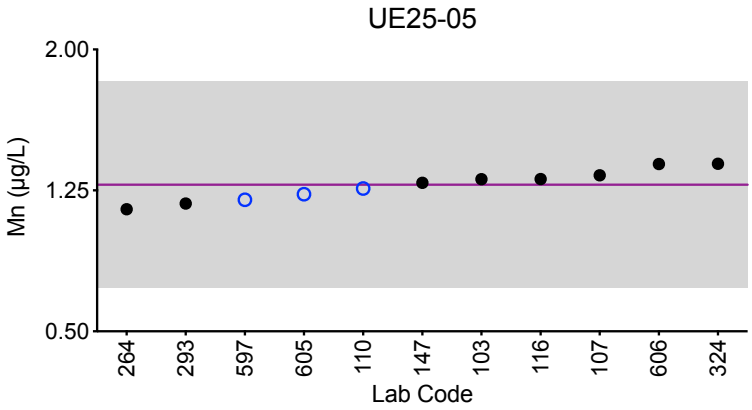
Urine Mn











Legend:

o HHEAR Labs ● Other Labs

Horizontal purple line = assigned target value based on the robust mean of all laboratories.

Gray area = acceptable range based on quality specifications:

±0.55 µg/L or ±25% around the target value, whichever is greater; thus, it is fixed at ±0.55 µg/L at concentrations less than or equal to 2.2 µg/L.

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Results for Event #1, 2025: Summary Statistics

	Urine Pb (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Robust Mean (x*))	11.6	1.56	6.48	3.77	0.68
Upper Limit	13.9	2.56	7.78	4.77	1.68
Lower Limit	9.3	0.56	5.18	2.77	0.00
Robust SD (s*)	0.4	0.06	0.26	0.14	0.03
Robust RSD (%)	3.4	3.8	4.0	3.7	3.8
Number of Sample Measurements (N)	12	12	12	12	11
Standard Uncertainty (*u*)	0.2	0.02	0.09	0.05	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 #1, 2025:
Performance of Participating Laboratories

		Urine Pb (µg/L)				
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**11.6**	**1.56**	**6.48**	**3.77**	**0.68**
103	ICP-MS/MS	12.0	1.65	6.77	3.94	0.689
107	ICP-MS	12.0	1.57	6.65	3.87	0.691
110	ICP-MS/MS	11.7	1.56	6.49	3.85	0.68
116	ICP-MS/MS	11.0	1.57	6.65	3.67	0.699
147	ICP-MS	11.9	1.58	6.64	3.97	0.694
264	ICP-MS	11.41	1.47	6.16	3.70	0.64
293	DRC/CC-ICP-MS	11.77	1.32	6.27	3.59	0.48
324	ICP-MS	10.910	1.517	6.234	3.773	<1
597	ICP-MS/MS	11.3	1.56	6.32	3.81	0.705
605	ICP-MS	11.7	1.57	6.35	3.77	0.657
606	ICP-MS/MS	11.3	1.46	6.41	3.72	0.670
686	ICP-MS	12.2	1.87	6.90	0.789 ↓	4.06 ↑

Based on the grading criteria for Pb 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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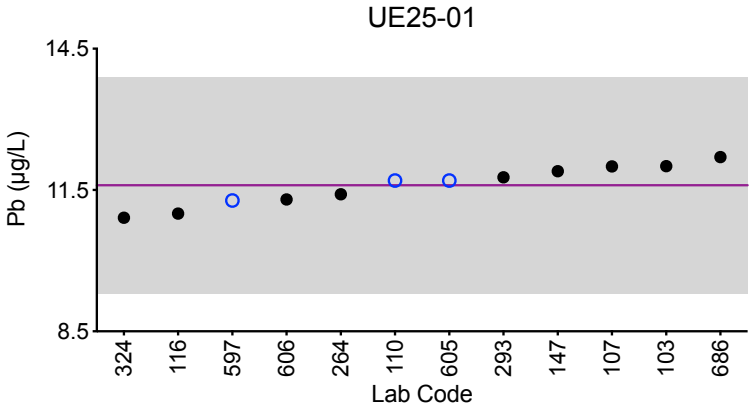
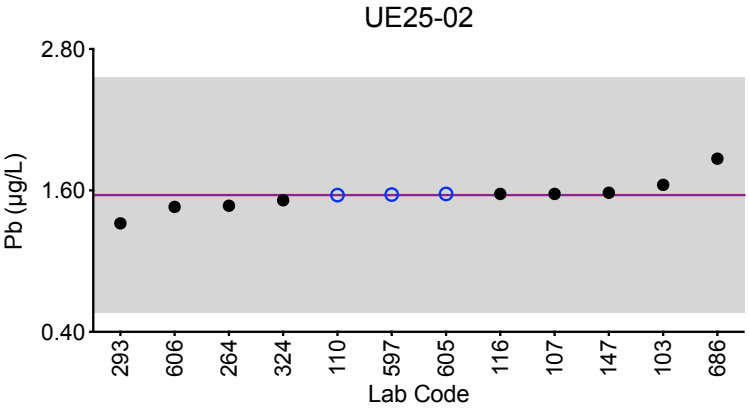
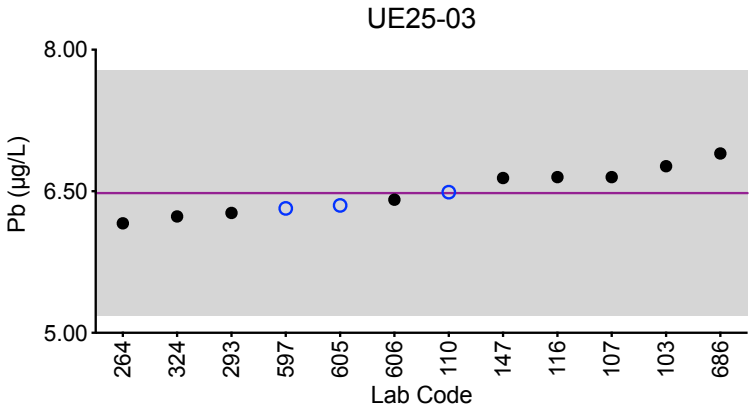
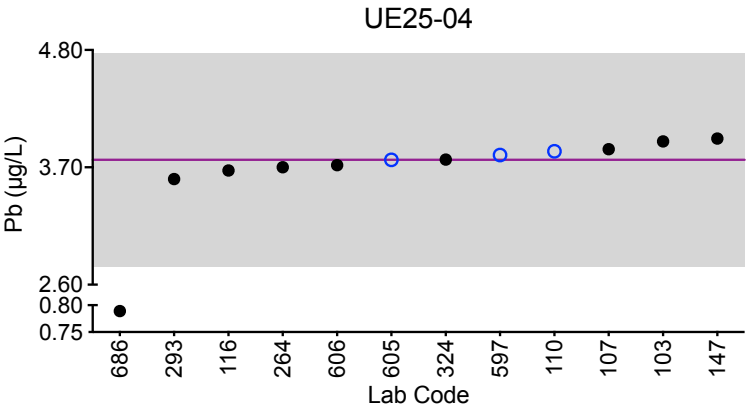
Results for Event #1, 2025: Summary Figures

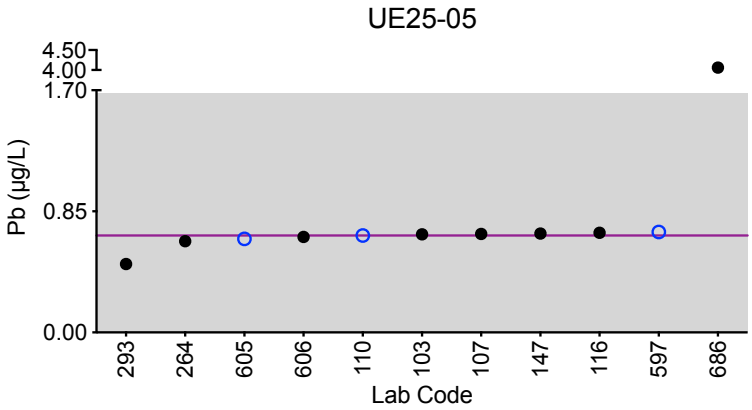
Urine Pb











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 #1, 2025: Summary Statistics

Urine Tl (µg/L)					
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Robust Mean (x*))	1.74	0.311	0.464	2.42	0.77
Upper Limit	2.08	0.511	0.664	2.90	0.97
Lower Limit	1.39	0.111	0.264	1.94	0.57
Robust SD (s*)	0.02	0.014	0.008	0.09	0.03
Robust RSD (%)	1.0	4.5	1.7	3.7	3.7
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.01	0.006	0.003	0.03	0.01

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

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Results for Event #1, 2025:
Performance of Participating Laboratories

Urine Tl (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**1.74**	**0.311**	**0.464**	**2.42**	**0.77**
103	ICP-MS/MS	1.78	0.332	0.483	2.55	0.802
107	ICP-MS	1.74	0.320	0.480	2.42	0.771
110	ICP-MS/MS	1.74	0.311	0.464	2.44	0.784
147	ICP-MS	1.74	0.296	0.461	2.48	0.748
264	ICP-MS	1.66	0.30	0.44	2.35	0.72
293	DRC/CC-ICP-MS	1.75	0.31	0.46	2.49	0.76
597	ICP-MS/MS	1.69	0.320	0.459	2.38	0.751
605	ICP-MS	1.75	0.321	0.468	2.41	0.773
606	ICP-MS/MS	1.68	0.293	0.460	2.36	0.749
686	ICP-MS	1.73	0.303	0.468	0.748 ↓	2.47 ↑

Based on the grading criteria for Tl in Urine, 96% of results were satisfactory, with 1 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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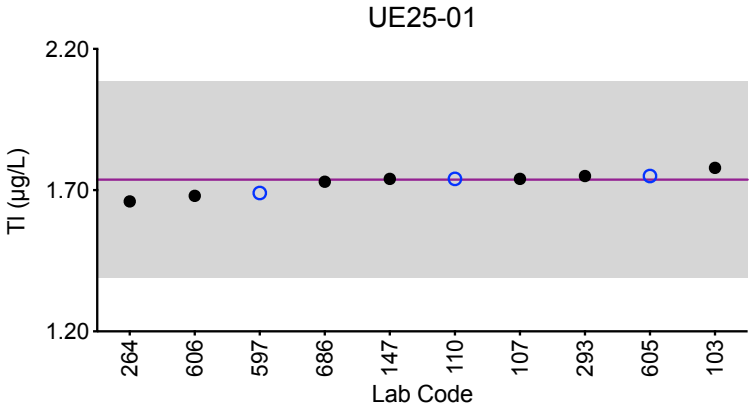
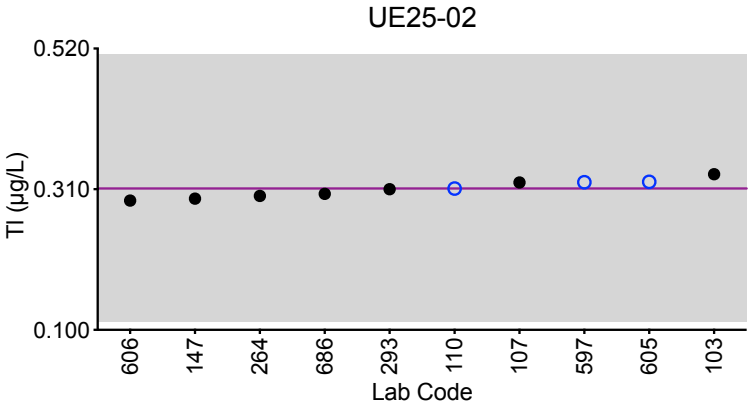
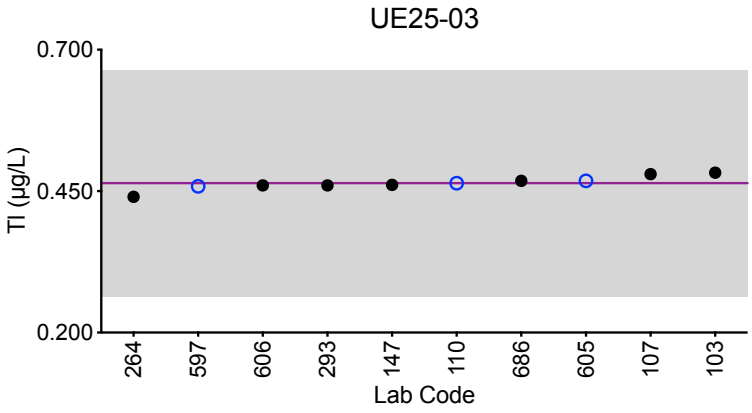
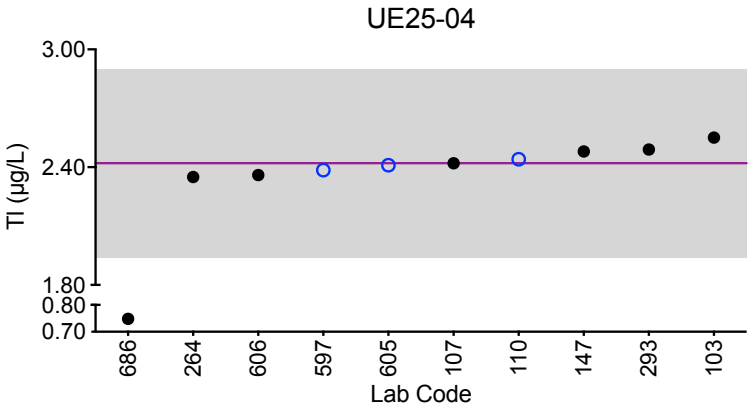
Results for Event #1, 2025: Summary Figures

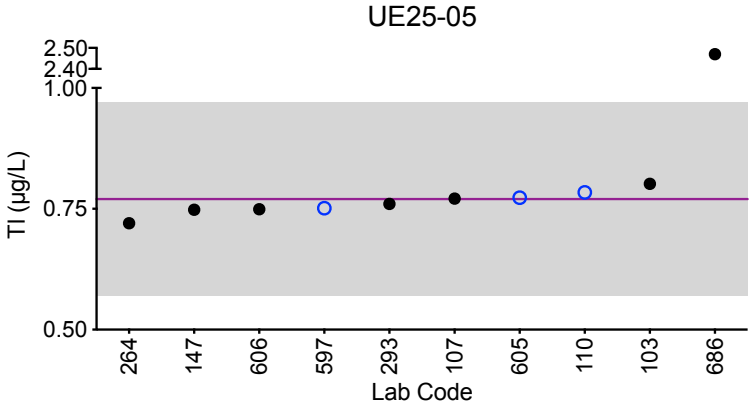
Urine Tl











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 #1, 2025: Summary Statistics

	Urine U (µg/L)				
	UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Target (Robust Mean (x*))	0.068	0.0074	0.0152	0.130	0.0409
Upper Limit	0.098	0.0374	0.0452	0.160	0.0709
Lower Limit	0.038	0.0000	0.0000	0.100	0.0109
Robust SD (s*)	0.005	0.0013	0.0010	0.008	0.0017
Robust RSD (%)	7.4	18	6.6	6.2	4.2
Number of Sample Measurements (N)	11	8	11	11	11
Standard Uncertainty (*u*)	0.002	NA	0.0004	0.003	0.0007

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 UE25-02.

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Results for Event #1, 2025:
Performance of Participating Laboratories

Urine U (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
	Target	**0.068**	**0.0074**	**0.0152**	**0.130**	**0.0409**
103	ICP-MS/MS	0.0631	<0.0100	0.0190	0.135	0.0408
107	ICP-MS	0.0684	0.00762	0.0162	0.130	0.0390
110	ICP-MS/MS	0.0720	0.0072	0.0154	0.127	0.0409
116	ICP-MS/MS	0.0646	<0.0150	0.0162	0.122	0.0396
147	ICP-MS	0.0677	0.00738	0.0149	0.143	0.0442
264	ICP-MS	0.06	0.01	0.01	0.12	0.04
324	ICP-MS	0.069	0.006	0.014	0.130	0.039
597	ICP-MS/MS	0.0647	0.00550	0.0153	0.167 ↑	0.0403
605	ICP-MS	0.0735	0.00684	0.0140	0.134	0.0423
606	ICP-MS/MS	0.068	0.008	0.015	0.135	0.041
686	ICP-MS	0.0722	<0.0150	0.0151	0.0415 ↓	0.142 ↑

Based on the grading criteria for U in Urine, 95% of results were satisfactory, with 1 of the 11 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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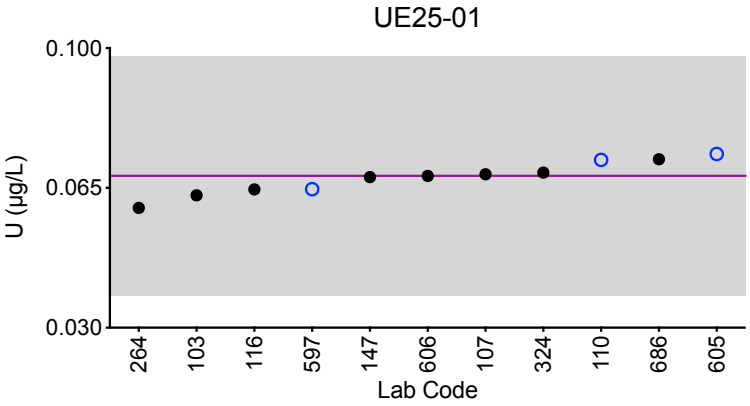
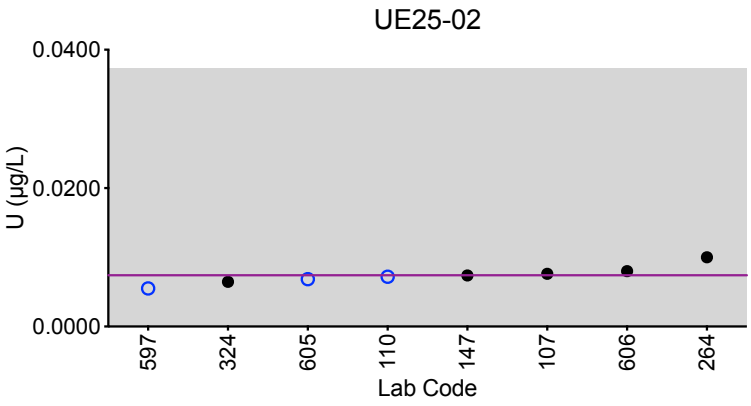
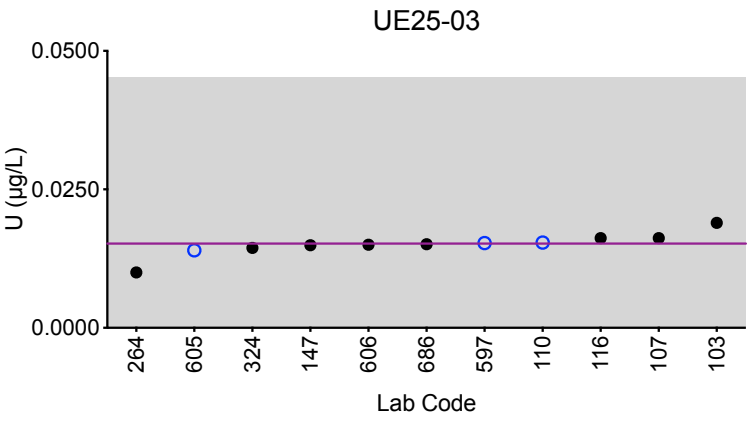
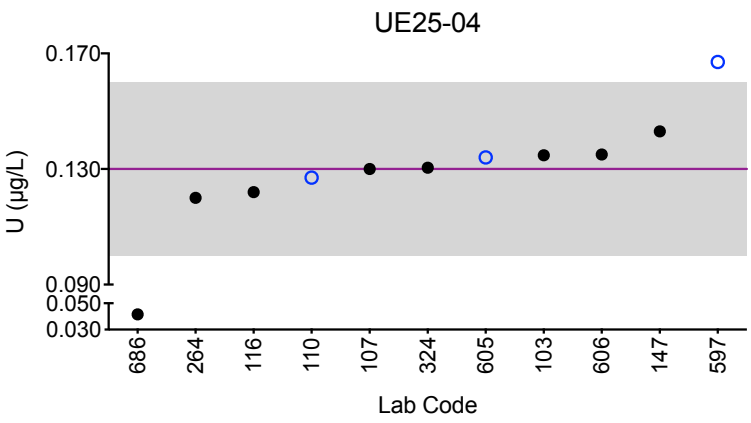
Results for Event #1, 2025: Summary Figures

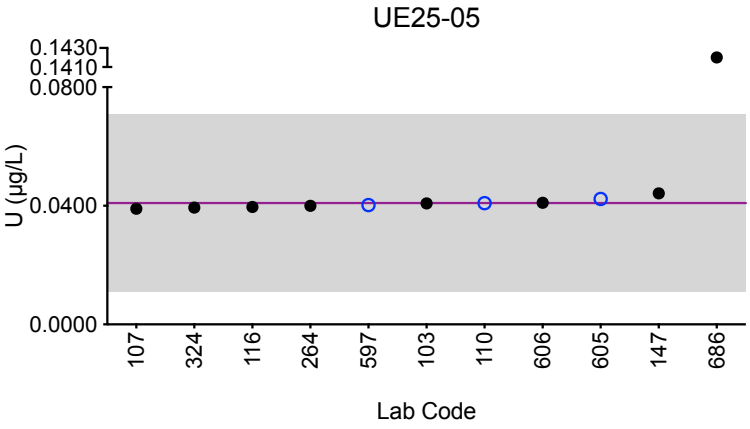
Urine U











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 #1, 2025:
Laboratory Data and Summary Statistics

Urine Al (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
147	ICP-MS	*13.5	13.5	13.5	20.1	13.5
264	ICP-MS	5.91	11.12	10.04	17.59	11.81
293	DRC/CC-ICP-MS	5.4	11.87	8.9	18.35	11.33
324	ICP-MS	6.230	12.213	12.085	17.776	12.456
597	ICP-MS/MS	9.03	11.1	7.77	21.9	13.7

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	6.6	12.0	10	19.1	12.6
Arithmetic SD (s)	1.6	1.0	2	1.8	1.0
Arithmetic RSD (%)	25	8.3	22	9.4	7.9
Number of Sample Measurements (N)	4	5	5	5	5

*Denotes a statistical Outlier.

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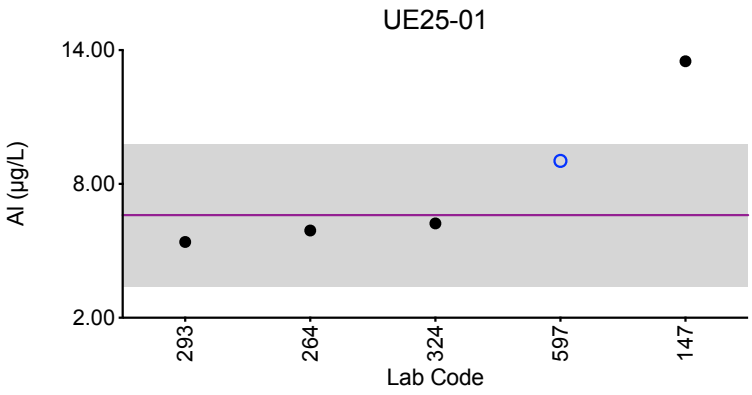
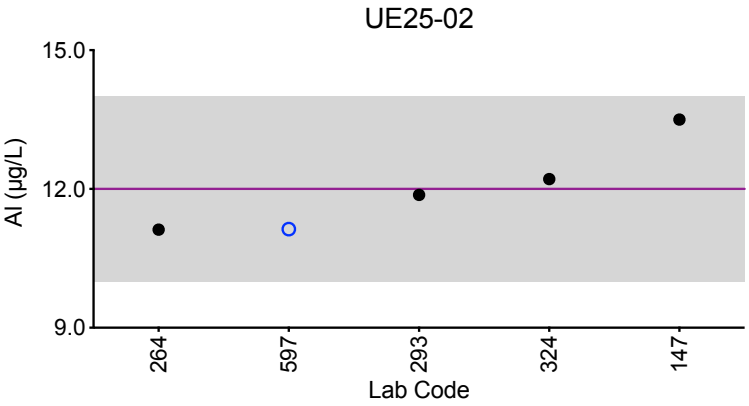
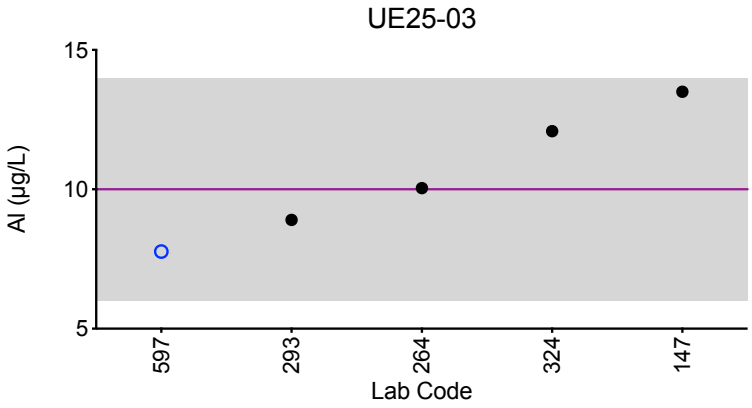
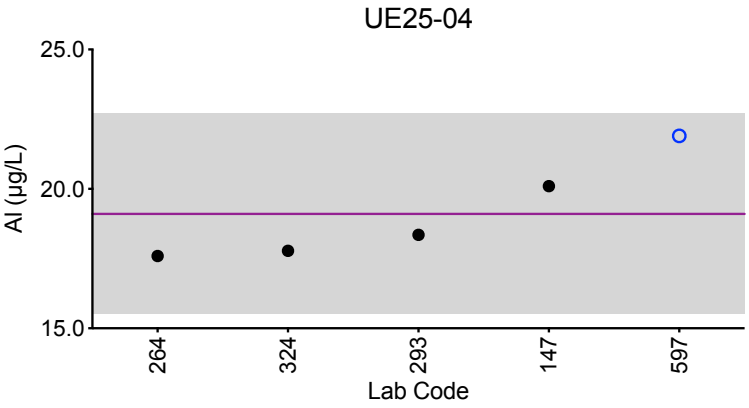
Results for Event #1, 2025: Summary Figures

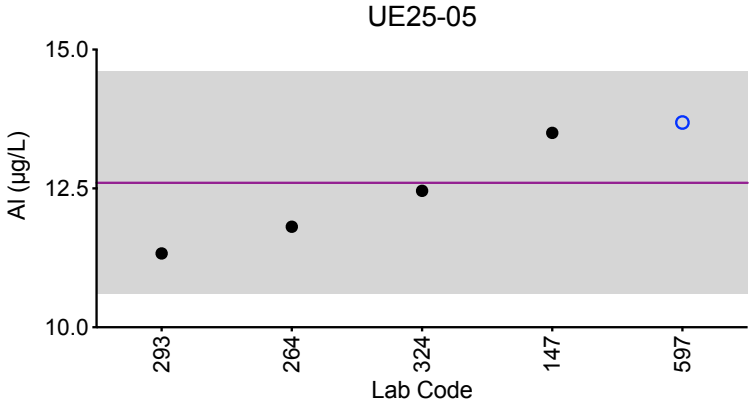
Urine Al











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

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
107	ICP-MS	1.18	4.87	12.4	1.31	5.35
110	ICP-MS/MS	1.11	4.49	11.7	1.29	5.28
147	ICP-MS	1.08	4.50	11.7	1.29	5.19
264	ICP-MS	1.10	4.60	12.20	1.24	5.17
597	ICP-MS/MS	1.08	4.30	11.5	1.34	5.06
605	ICP-MS	1.08	4.63	11.7	1.27	5.19
606	ICP-MS/MS	1.17	4.74	12.1	1.33	5.34

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	1.11	4.59	11.9	1.30	5.23
Arithmetic SD (s)	0.04	0.18	0.3	0.04	0.10
Arithmetic RSD (%)	3.6	3.9	2.8	2.7	1.9
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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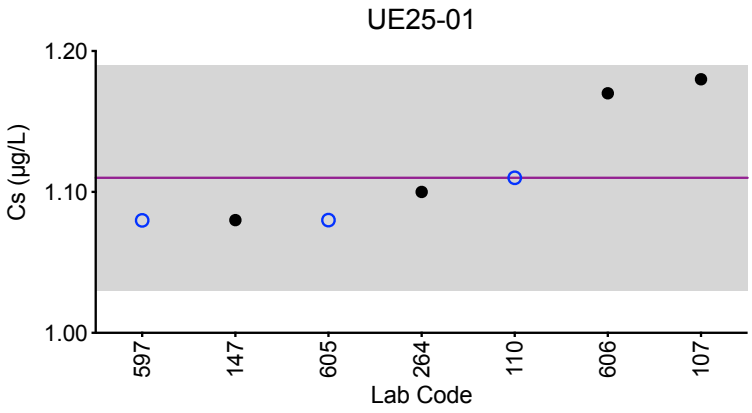
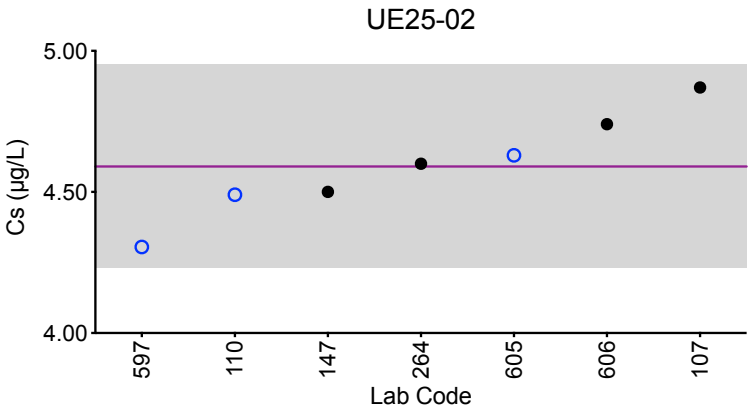
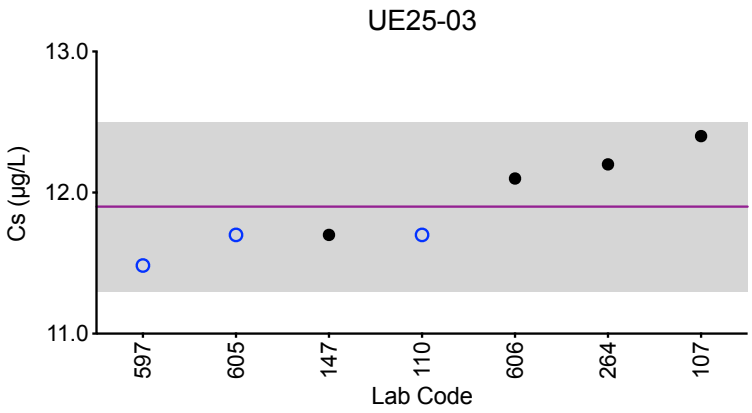
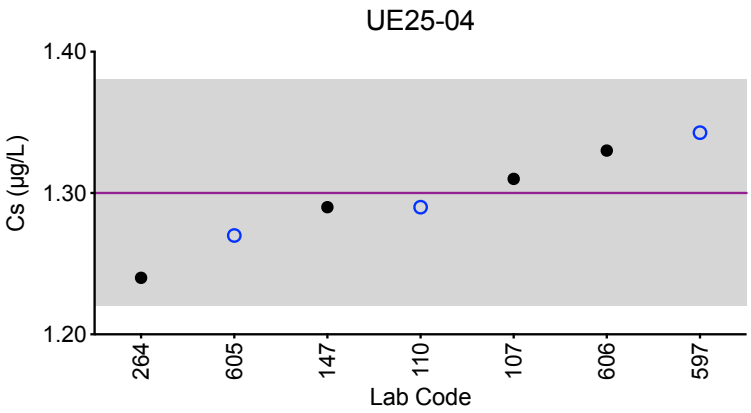
Results for Event #1, 2025: Summary Figures

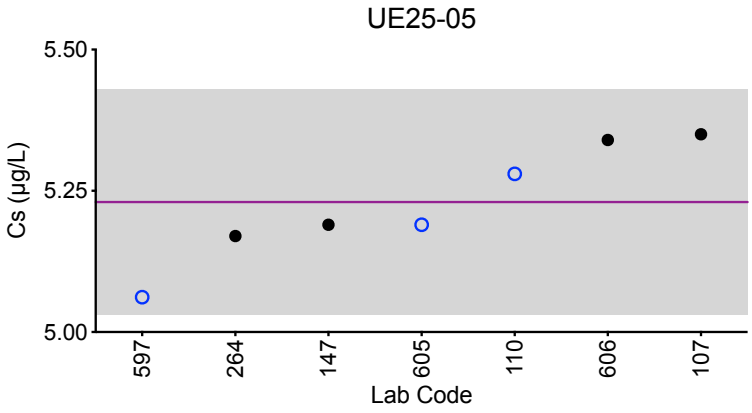
Urine Cs











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
110	ICP-MS/MS	92.3	9.13	20.9	43.3	60.2
116	ICP-MS/MS	87.4	9.11	20.5	40.7	60.3
147	ICP-MS	98.8	*15.1	*28.9	48.1	66.1
264	ICP-MS	96.49	9.46	20.98	45.59	61.85
293	DRC/CC-ICP-MS	91.54	11.44	17.8	41.32	59.76
324	ICP-MS	97.135	10.027	22.163	46.605	63.923
597	ICP-MS/MS	93.3	9.31	20.6	45.3	60.7

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	94	9.7	20.5	44.4	61.8
Arithmetic SD (s)	4	0.9	1.4	2.7	2.4
Arithmetic RSD (%)	4.2	9.3	6.8	6.1	3.9
Number of Sample Measurements (N)	7	6	6	7	7

*Denotes a statistical Outlier.

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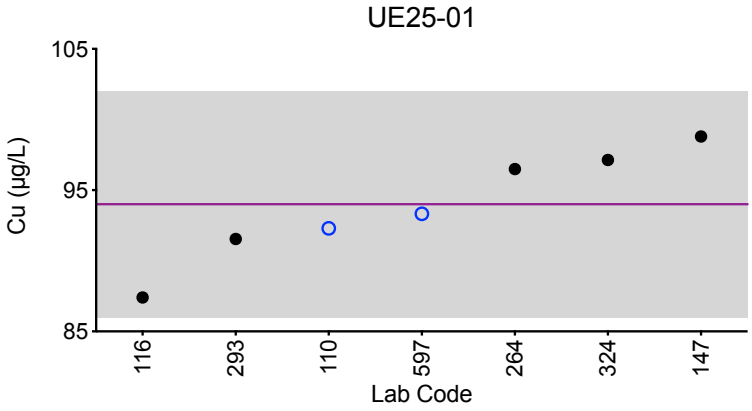
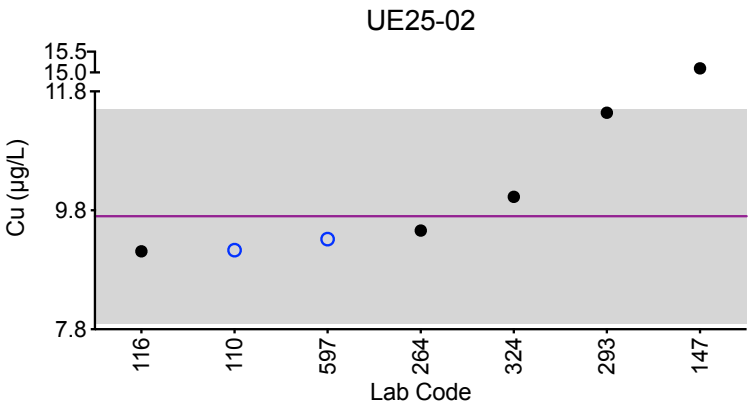
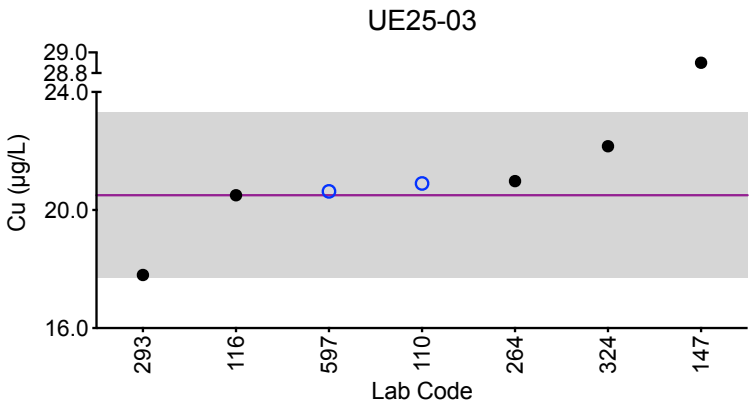
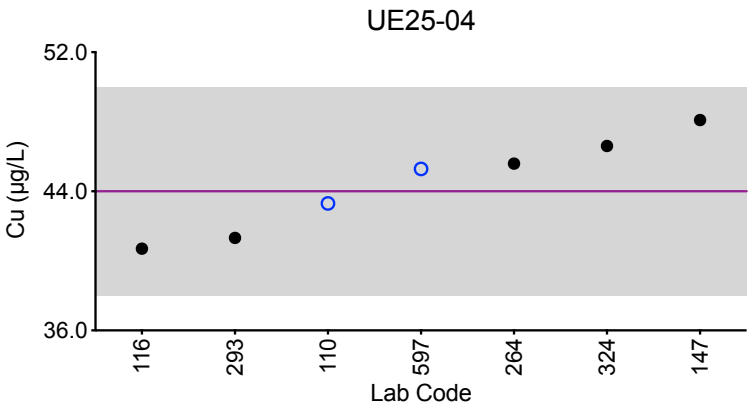
Results for Event #1, 2025: Summary Figures

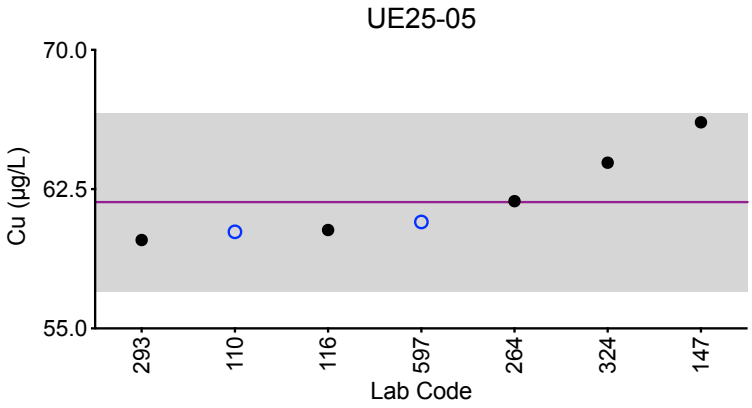
Urine Cu











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
103	ICP-MS/MS	36.8	30.9	28.0	87.9	49.2
107	ICP-MS	35.7	29.7	26.7	82.8	46.4
110	ICP-MS/MS	35.0	29.7	27.0	82.2	46.9
147	ICP-MS	33.5	29.2	26.3	79.1	45.4
264	ICP-MS	32.78	29.63	26.47	78.86	45.53
293	DRC/CC-ICP-MS	36.06	29.35	26.63	85.02	47.9
324	ICP-MS	33.253	28.285	24.951	79.468	44.317
597	ICP-MS/MS	31.3	27.8	24.9	77.1	42.7
605	ICP-MS	36.1	31.7	28.2	87.0	49.0
606	ICP-MS/MS	35.8	31.1	27.9	85.9	47.9

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Robust Mean (x*)	34.8	29.7	26.7	83	46.6
Robust SD (s*)	1.7	1.4	1.3	4	2.1
Robust RSD (%)	4.9	4.7	4.9	4.8	4.5
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.7	0.5	0.5	2	0.8

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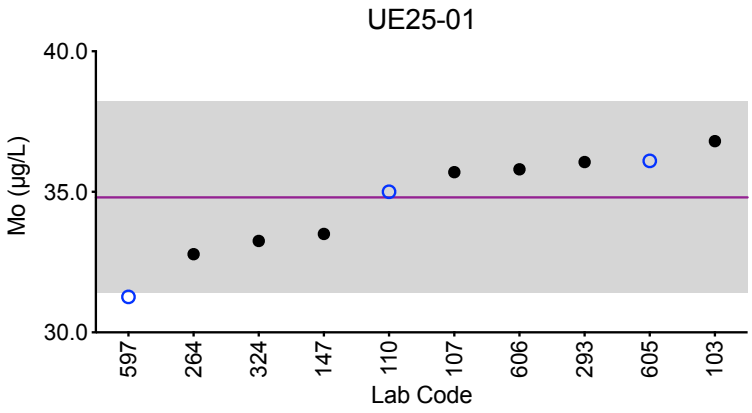
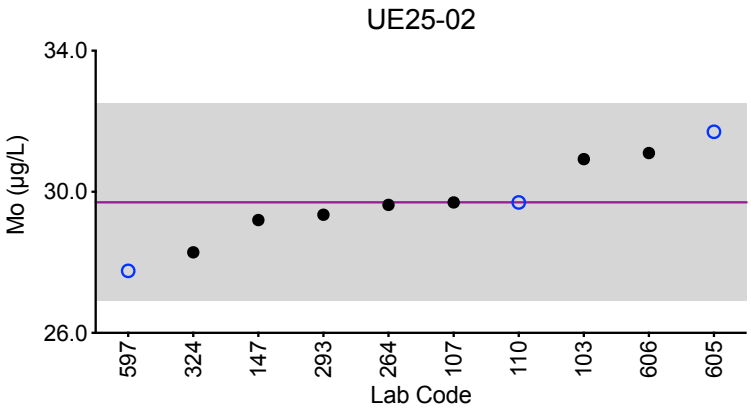
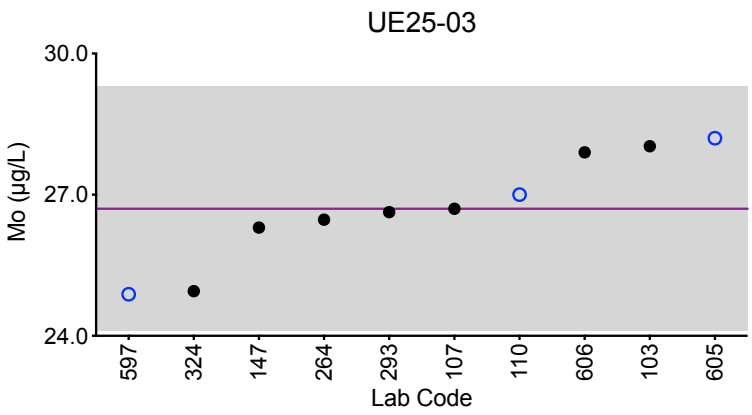
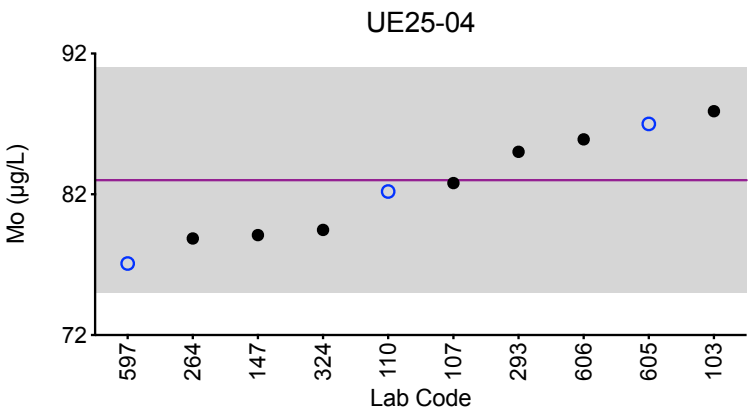
Results for Event #1, 2025: Summary Figures

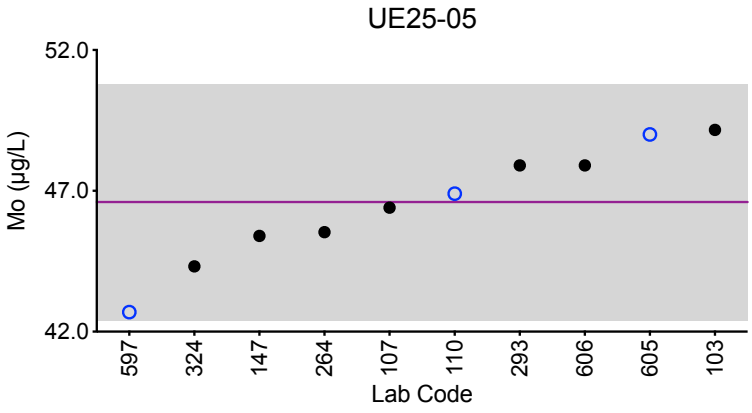
Urine Mo











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
103	ICP-MS/MS	8.38	3.25	3.24	5.48	1.82
107	DRC/CC-ICP-MS	7.86	3.16	3.10	5.12	1.28
110	ICP-MS/MS	7.83	3.19	3.24	5.04	1.32
147	ICP-MS	7.39	2.92	3.77	4.67	1.08
264	ICP-MS	7.65	2.95	2.87	4.94	0.93
293	DRC/CC-ICP-MS	*10.04	*4.04	3.8	4.76	1.55
324	ICP-MS	7.864	3.402	3.671	5.160	1.927
597	ICP-MS/MS	7.70	2.97	2.69	4.81	0.904
605	ICP-MS	8.03	2.95	2.93	4.95	1.09

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	7.8	3.12	3.3	4.99	1.3
Arithmetic SD (s)	0.3	0.18	0.4	0.24	0.4
Arithmetic RSD (%)	3.7	5.8	13	4.8	28
Number of Sample Measurements (N)	8	8	9	9	9

*Denotes a statistical Outlier.

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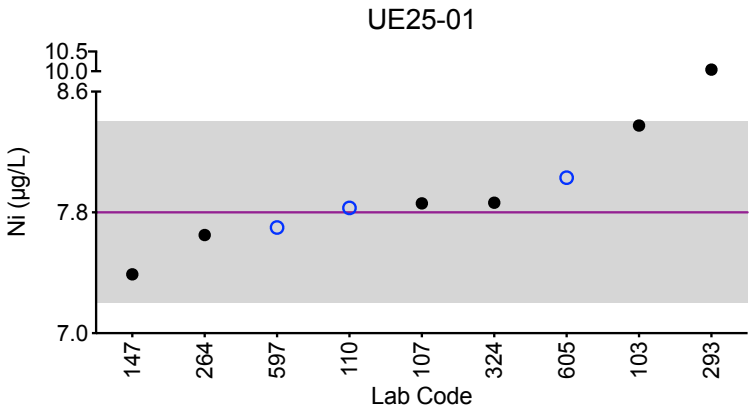
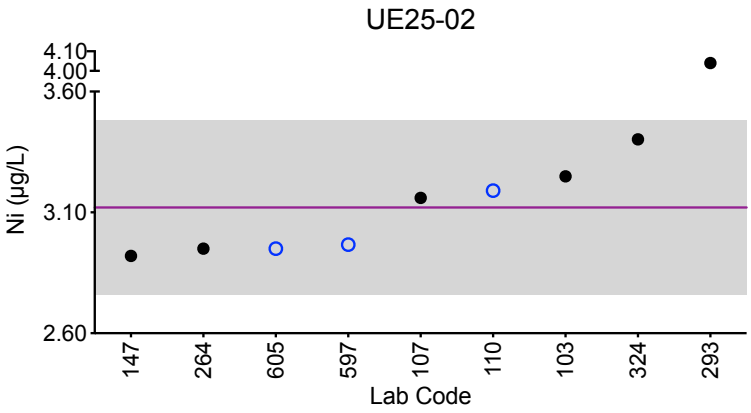
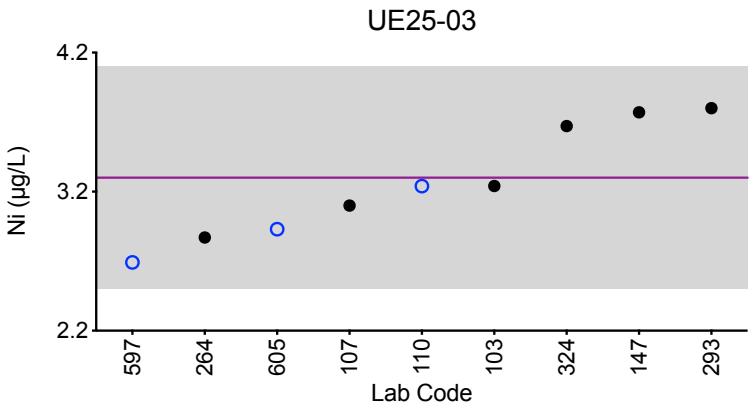
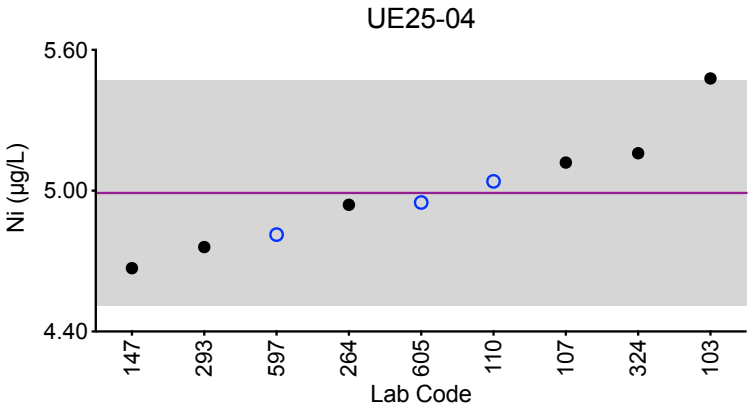
Results for Event #1, 2025: Summary Figures

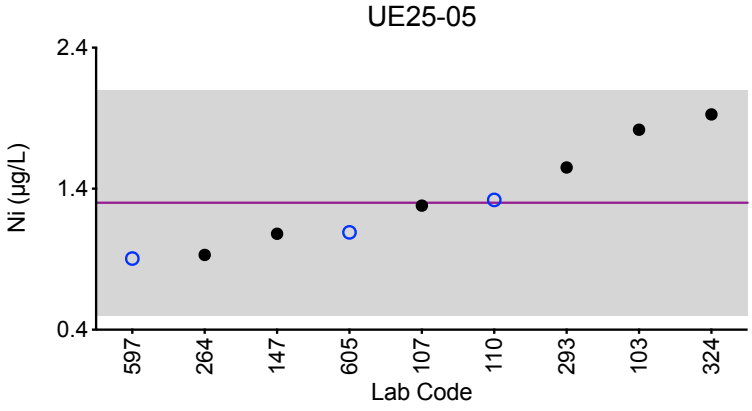
Urine Ni











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
107	ICP-MS	2.64	0.160	1.61	0.843	0.591
110	ICP-MS/MS	2.54	0.163	1.51	0.824	0.604
264	ICP-MS	2.60	0.18	1.57	0.89	0.63
293	DRC/CC-ICP-MS	2.46	0.16	1.48	0.8	0.6
605	ICP-MS	2.52	0.154	1.51	0.798	0.571

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	2.55	0.163	1.54	0.83	0.599
Arithmetic SD (s)	0.07	0.010	0.05	0.04	0.021
Arithmetic RSD (%)	2.7	6.1	3.2	4.8	3.5
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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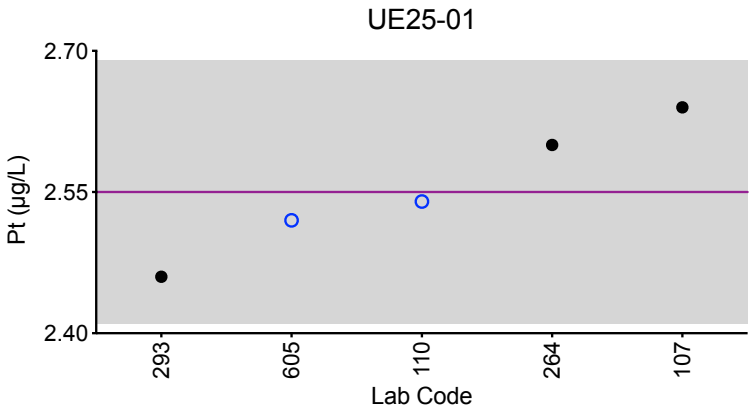
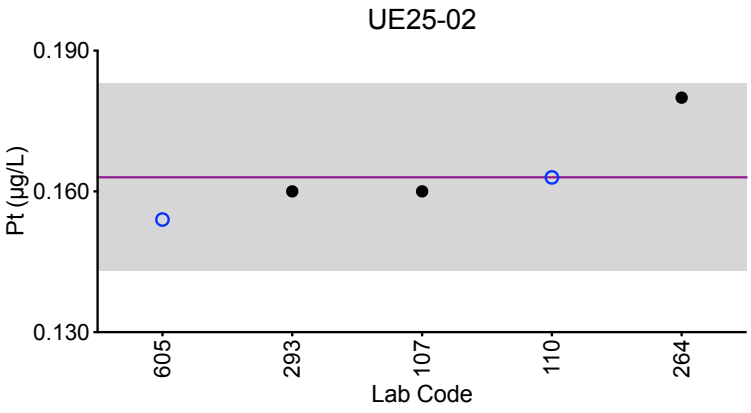
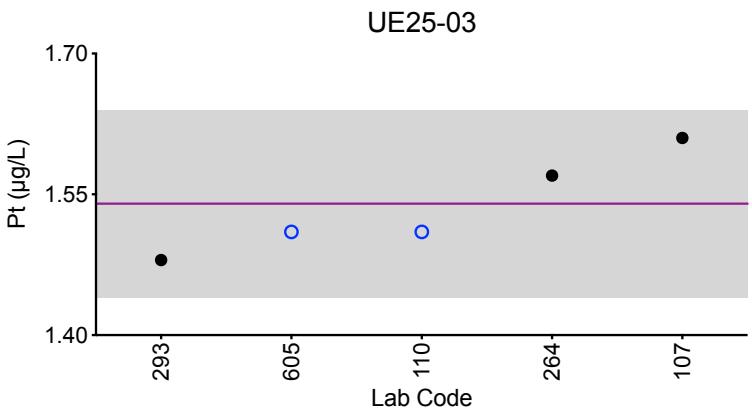
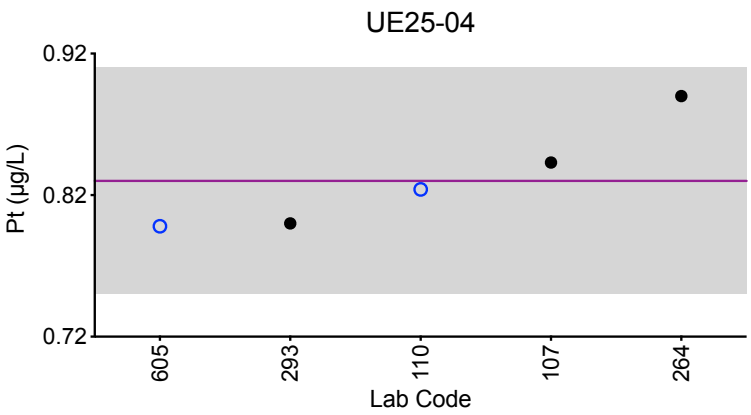
Results for Event #1, 2025: Summary Figures

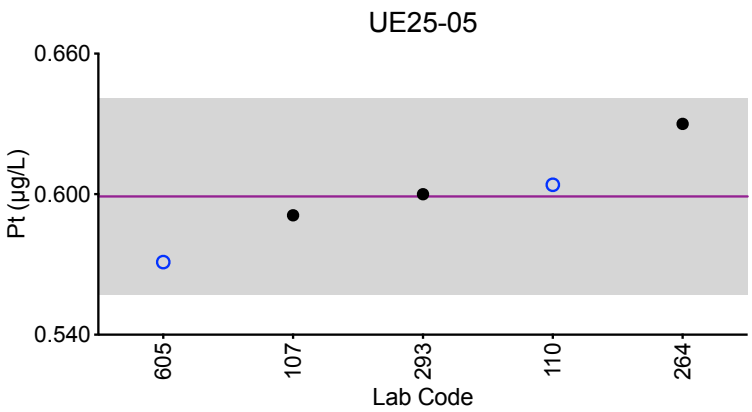
Urine Pt











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
103	ICP-MS/MS	0.335	0.956	1.56	1.25	0.478
107	ICP-MS	0.331	0.982	1.60	1.20	0.466
110	ICP-MS/MS	0.345	0.927	1.58	0.884	0.420
147	ICP-MS	0.312	0.961	1.54	1.18	0.466
264	ICP-MS	0.30	*0.84	1.38	0.97	0.42
293	DRC/CC-ICP-MS	0.33	0.97	1.55	1.12	0.45
324	ICP-MS	<1	<1	1.440	<1	<1
597	ICP-MS/MS	0.371	0.928	1.53	1.16	0.509
605	ICP-MS	<0.800	0.959	1.57	1.14	<0.800
606	ICP-MS/MS	0.360	0.941	1.56	1.11	0.513

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Robust Mean (x*)	0.34	0.95	1.55	1.11	0.47
Robust SD (s*)	0.02	0.02	0.04	0.12	0.04
Robust RSD (%)	6.9	2.1	2.3	10	7.6
Number of Sample Measurements (N)	8	8	10	9	8
Standard Uncertainty (*u*)	NA	NA	0.01	NA	NA

*Denotes a statistical Outlier.

A Robust mean, SD, RSD, n and *u* are provided for sample UE25-03.

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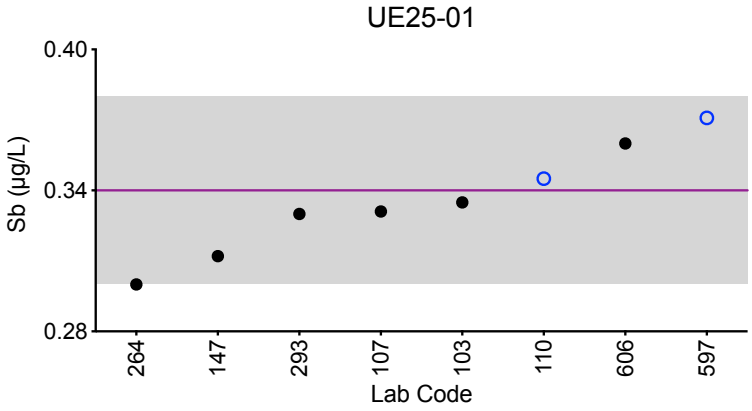
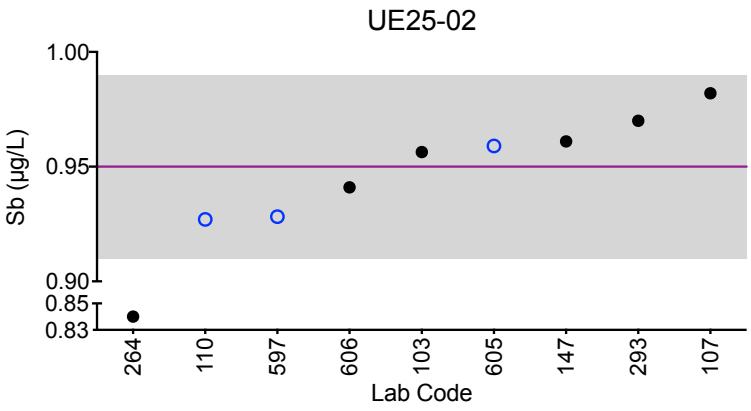
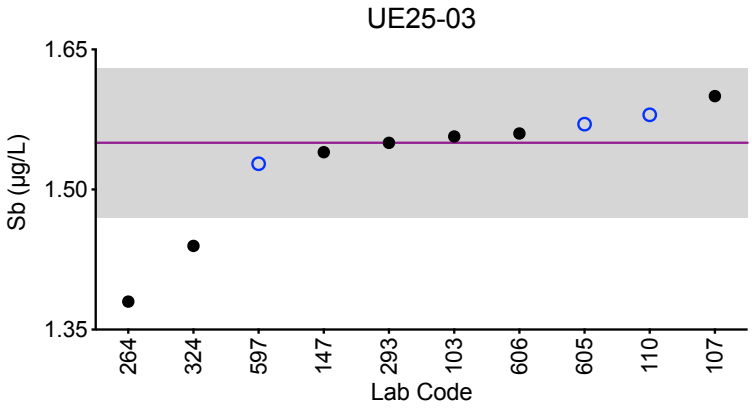
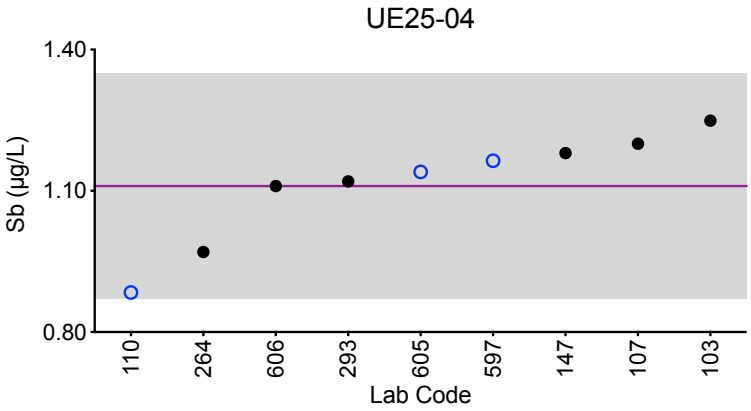
Results for Event #1, 2025: Summary Figures

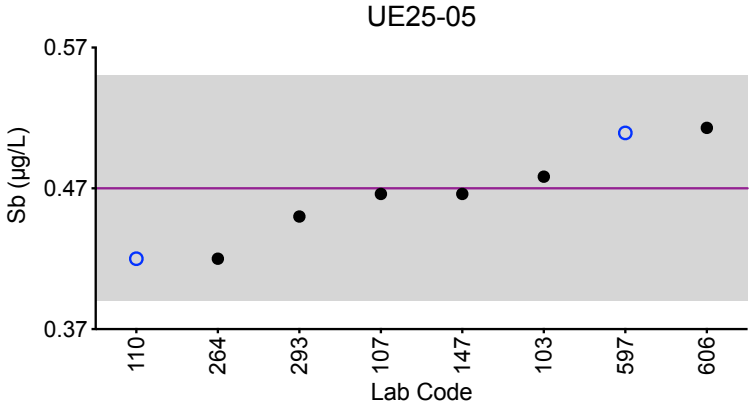
Urine Sb











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Se (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
103	ICP-MS/MS	150	31.5	130	71.5	36.3
110	ICP-MS/MS	131	26.1	118	63.5	32.7
147	ICP-MS	139	29.8	117	72.3	36.9
293	DRC/CC-ICP-MS	139.81	24.49	112.95	67.14	33.97
597	ICP-MS/MS	138	27.3	119	70.5	34.6

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	140	28	119	69	34.9
Arithmetic SD (s)	7	3	6	4	1.7
Arithmetic RSD (%)	4.8	10	5.2	5.8	4.9
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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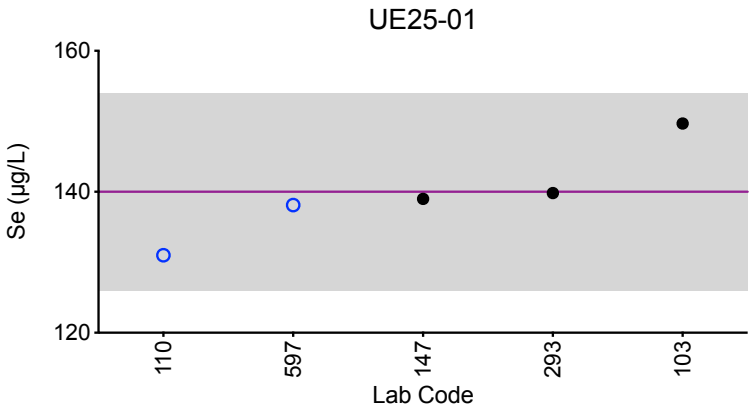
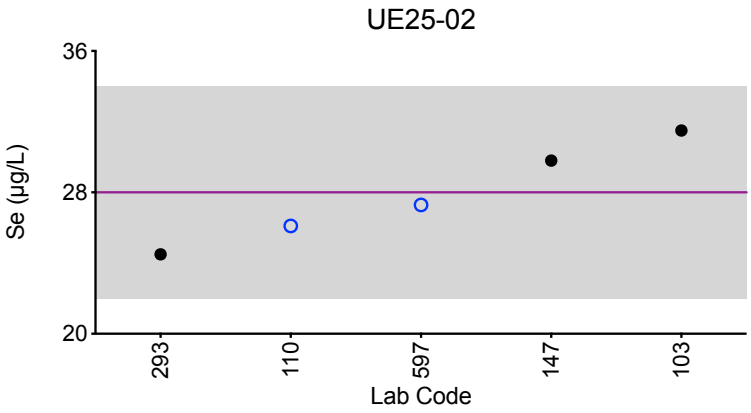
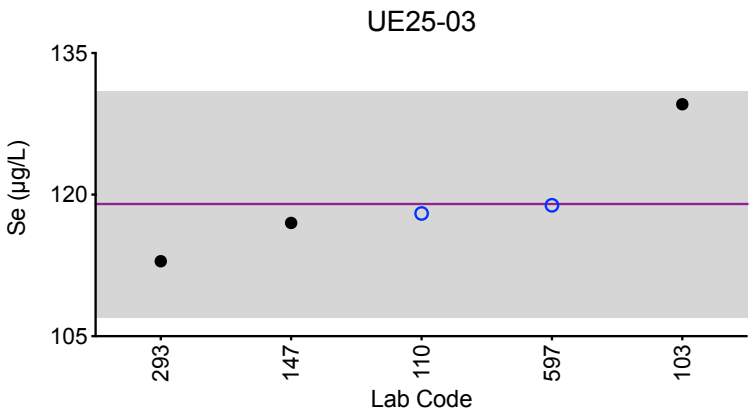
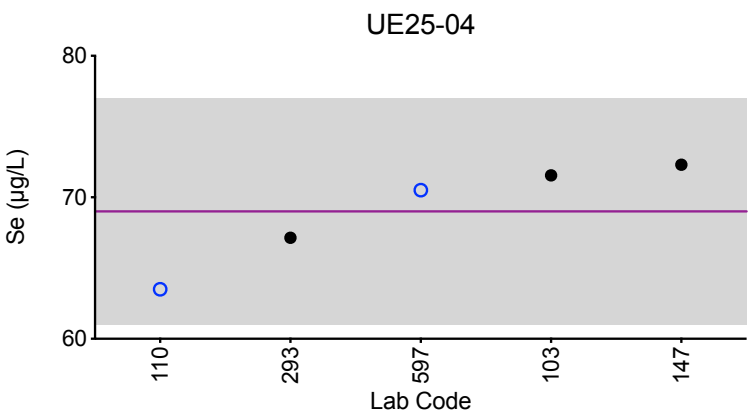
Results for Event #1, 2025: Summary Figures

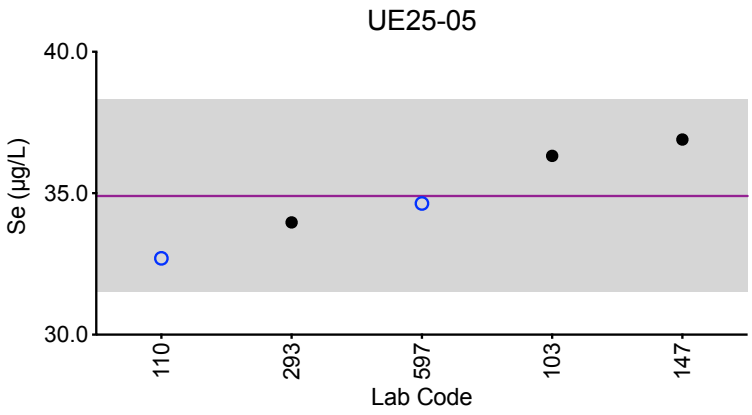
Urine Se











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
107	ICP-MS	5.30	0.608	2.15	0.476	0.901
110	ICP-MS/MS	5.26	0.33	1.37	0.59	0.58
147	ICP-MS	5.25	0.477	1.82	0.459	0.700
264	ICP-MS	5.28	0.50	1.90	0.35	0.79
324	ICP-MS	*4.85	<1	1.687	<1	<1
597	ICP-MS/MS	5.46	0.333	1.33	0.294	0.466
605	ICP-MS	5.23	<0.900	2.25	<0.900	<0.900

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	5.30	0.45	1.8	0.43	0.69
Arithmetic SD (s)	0.08	0.12	0.4	0.12	0.17
Arithmetic RSD (%)	1.5	27	20	28	25
Number of Sample Measurements (N)	6	5	7	5	5

*Denotes a statistical Outlier.

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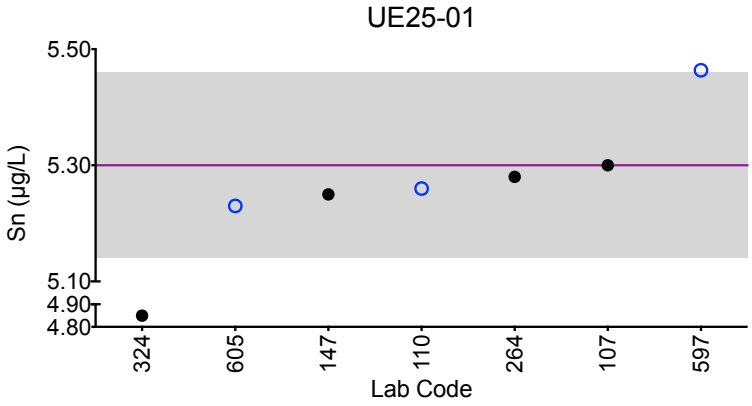
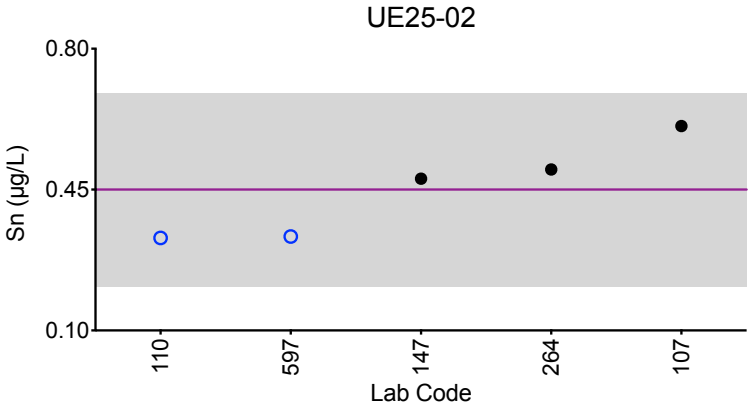
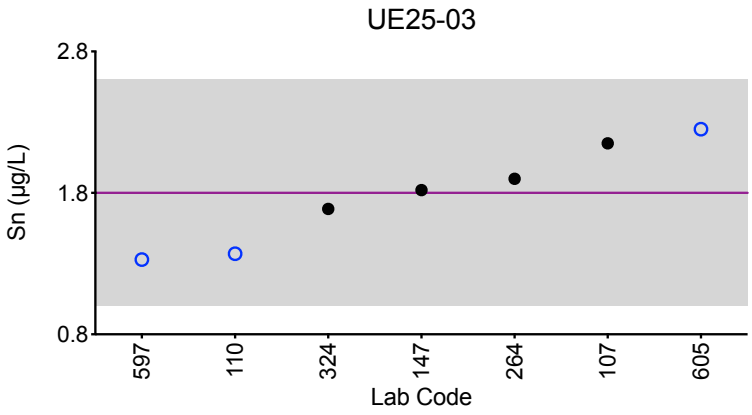
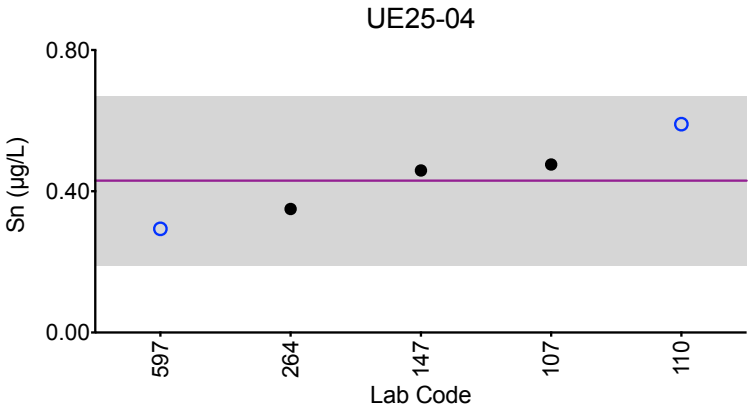
Results for Event #1, 2025: Summary Figures

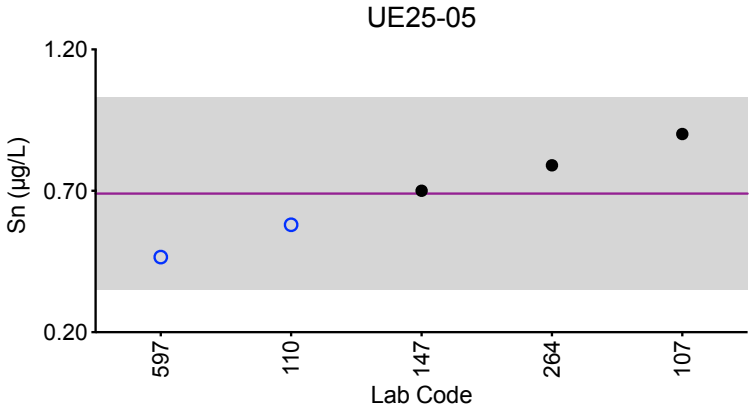
Urine Sn











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Sr (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
103	ICP-MS/MS	45.4	86.7	247	126	57.6
107	ICP-MS	44.2	85.8	253	124	56.9
110	ICP-MS/MS	44.3	89.8	250	129	57.3
264	ICP-MS	38.88	85.30	244	120	52.85
597	ICP-MS/MS	41.8	83.5	237	122	54.5
605	ICP-MS	44.2	88.1	247	125	56.9
Summary Statistics						
		UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Arithmetic Mean ($\bar{x}$)		43	86.5	246	124	56.0
Arithmetic SD (s)		2	2.2	6	3	1.9
Arithmetic RSD (%)		5.6	2.5	2.4	2.5	3.4
Number of Sample Measurements (N)		6	6	6	6	6

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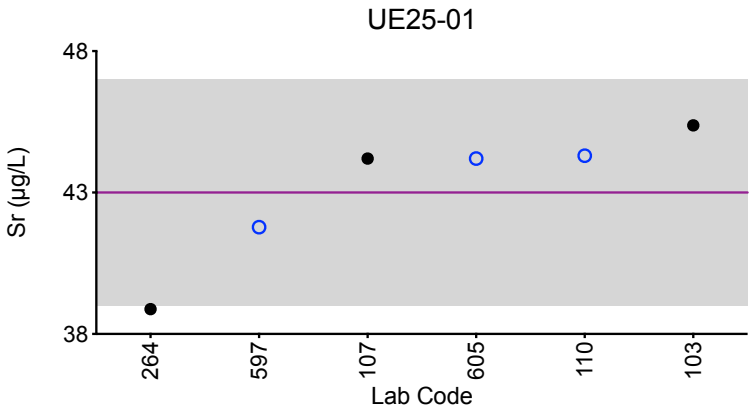
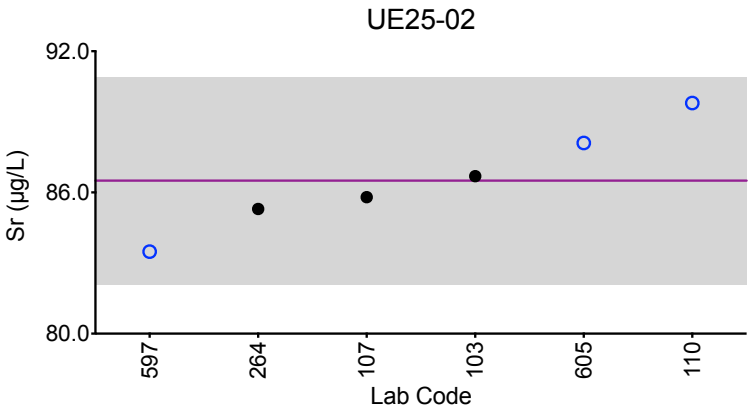
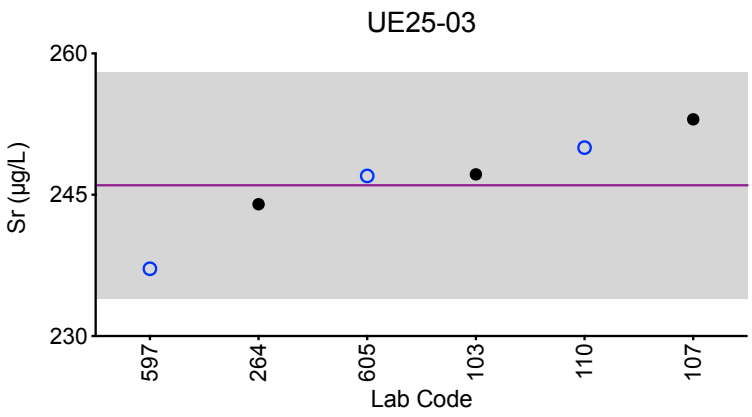
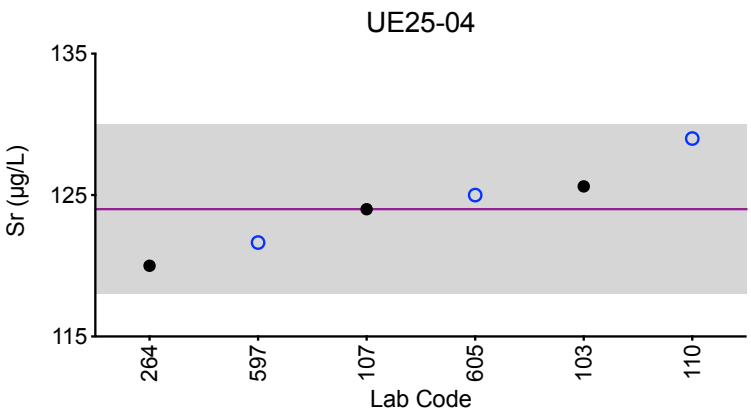
Results for Event #1, 2025: Summary Figures

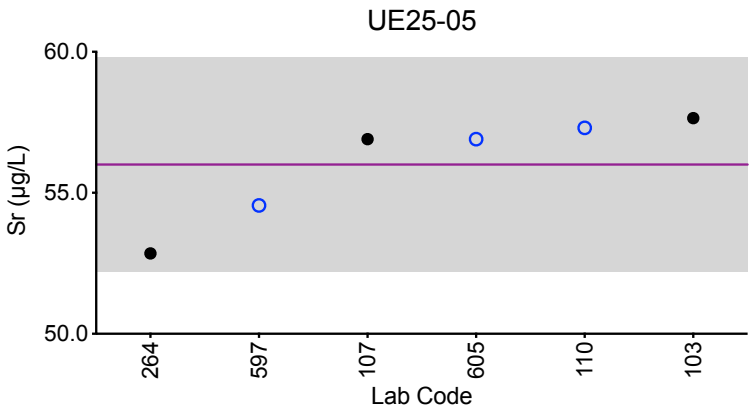
Urine Sr











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
110	ICP-MS/MS	0.321	5.28	0.776	2.12	1.58
116	ICP-MS/MS	0.333	5.61	0.805	2.03	1.64
147	DRC/CC-ICP-MS	0.321	5.08	0.820	1.87	1.49
293	DRC/CC-ICP-MS	0.43	5.43	0.92	2.21	1.75
324	ICP-MS	<1	4.490	<1	2.378	1.796
597	ICP-MS/MS	0.436	5.02	0.807	2.13	1.57
605	ICP-MS	0.363	5.51	0.882	2.19	1.71

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	0.37	5.2	0.83	2.13	1.65
Arithmetic SD (s)	0.05	0.4	0.05	0.16	0.11
Arithmetic RSD (%)	14	7.3	6.5	7.5	6.7
Number of Sample Measurements (N)	6	7	6	7	7

*Denotes a statistical Outlier.

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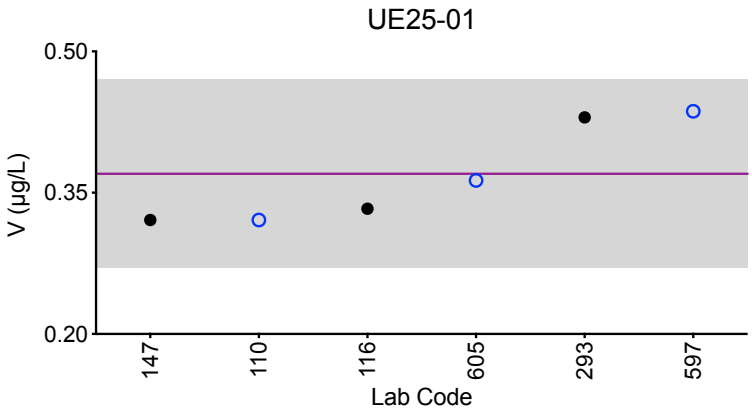
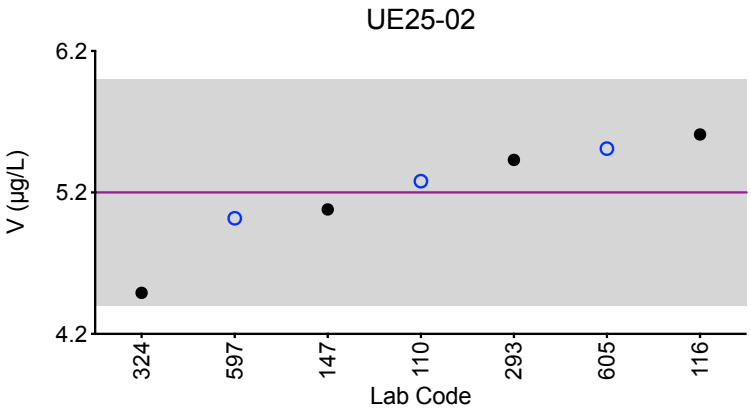
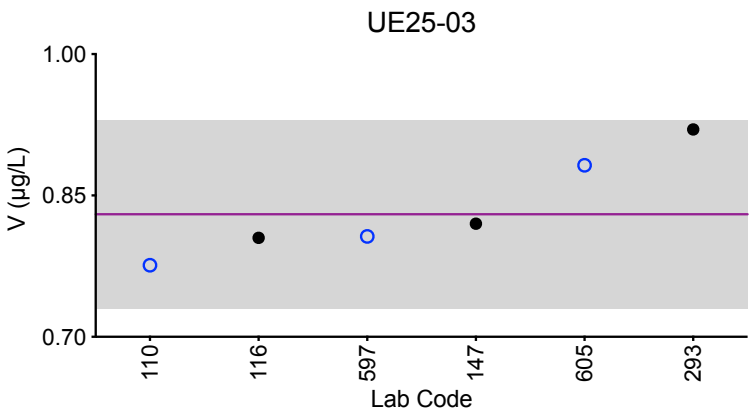
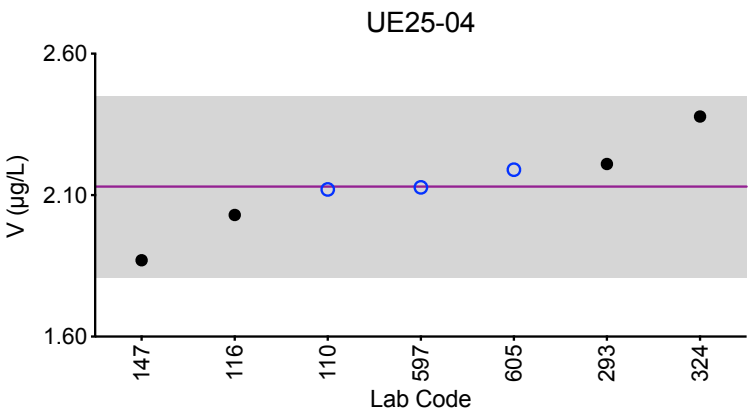
Results for Event #1, 2025: Summary Figures

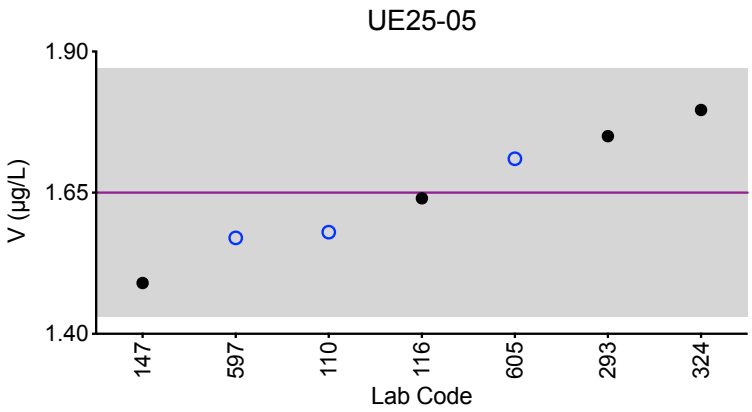
Urine V











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
107	ICP-MS	1.97	0.771	0.294	0.460	1.12
110	ICP-MS/MS	1.88	0.67	0.29	0.61	0.95
147	ICP-MS	1.84	0.726	0.288	0.543	1.22
200	ICP-MS	1.74	*1.19	0.653	0.595	1.19
264	ICP-MS	1.75	0.58	0.23	0.29	0.99
324	ICP-MS	1.841	<1	<1	<1	<1
597	ICP-MS/MS	1.85	0.691	0.424	0.426	0.952
605	ICP-MS	1.86	0.692	0.413	0.436	1.06
606	ICP-MS/MS	1.89	0.775	0.457	*1.36	1.03

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	1.85	0.69	0.38	0.48	1.06
Arithmetic SD (s)	0.07	0.07	0.14	0.11	0.10
Arithmetic RSD (%)	3.8	10	37	23	9.4
Number of Sample Measurements (N)	9	7	8	7	8

*Denotes a statistical Outlier.

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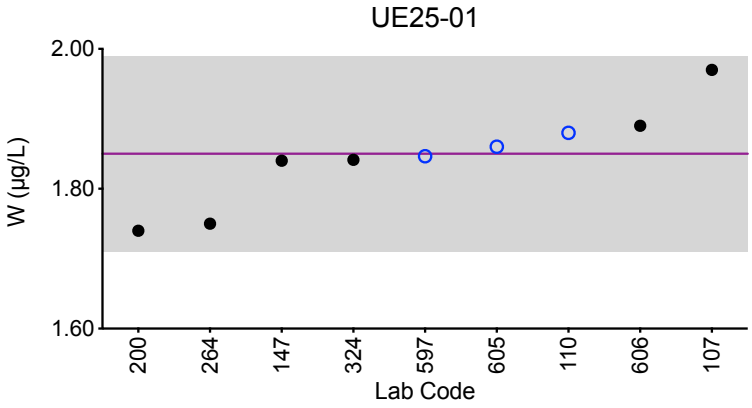
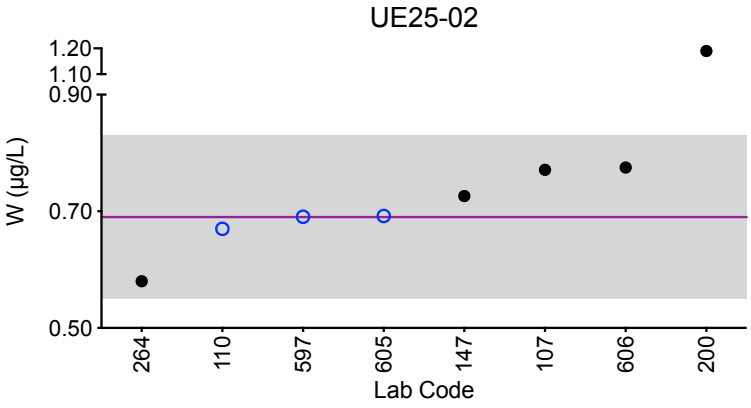
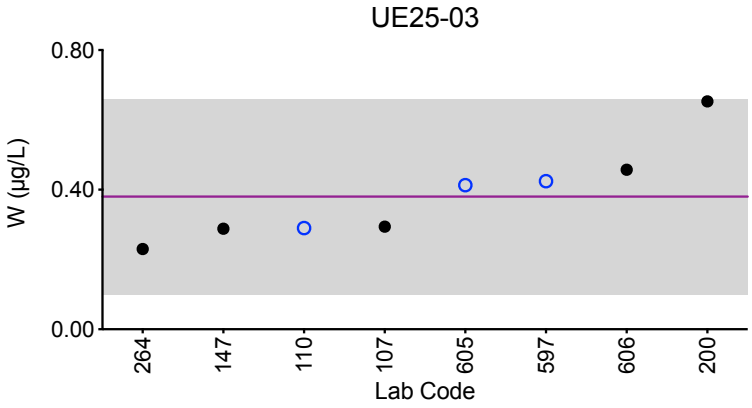
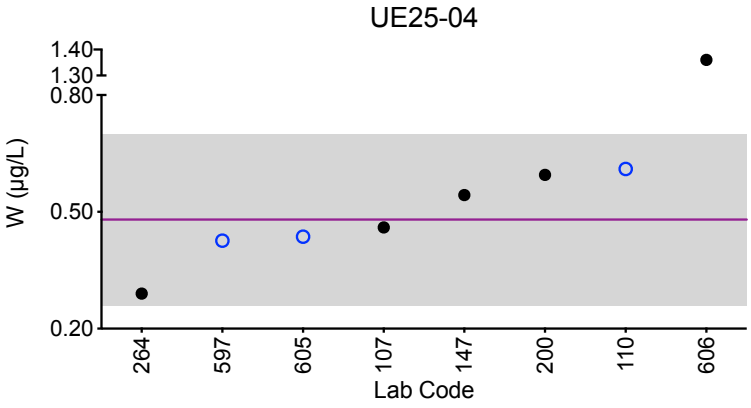
Results for Event #1, 2025: Summary Figures

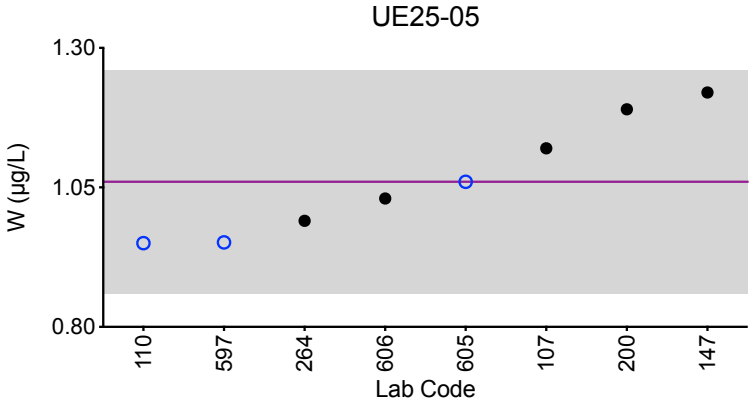
Urine W











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
110	ICP-MS/MS	293	261	305	105	329
147	ICP-MS	312	269	302	123	364
264	ICP-MS	302	259	296	109	334
293	DRC/CC-ICP-MS	300	262.75	306.54	112.42	341.18
324	ICP-MS	285.409	257.915	292.853	106.437	318.708
597	ICP-MS/MS	301	263	301	121	344
Summary Statistics						
		UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Arithmetic Mean ($\bar{x}$)		299	262	301	113	338
Arithmetic SD (s)		9	4	5	8	15
Arithmetic RSD (%)		3.0	1.5	1.7	7.1	4.4
Number of Sample Measurements (N)		6	6	6	6	6

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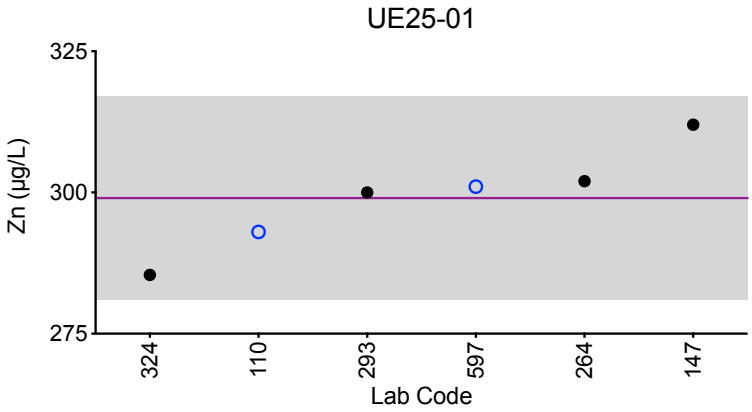
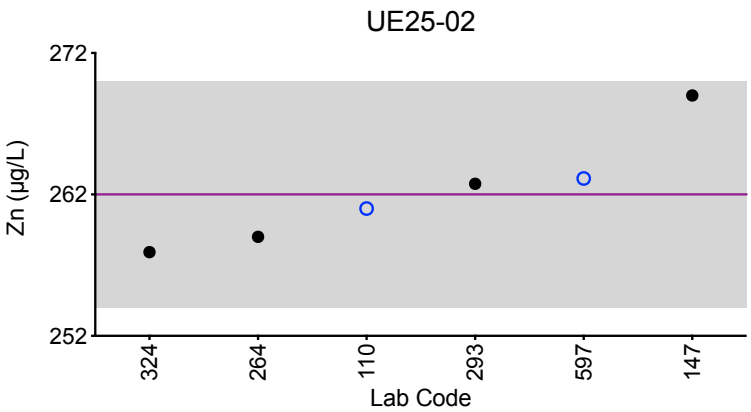
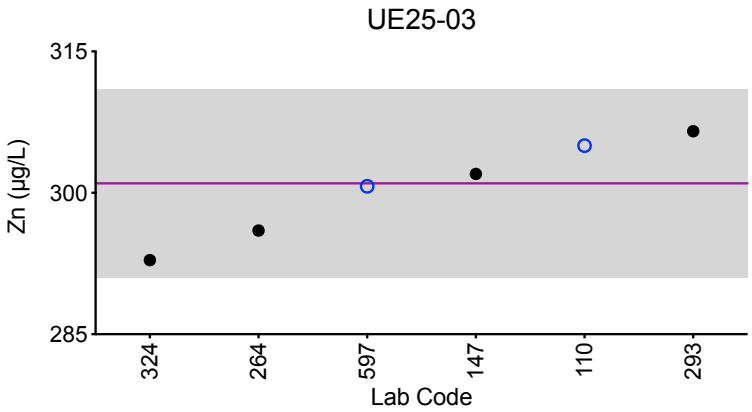
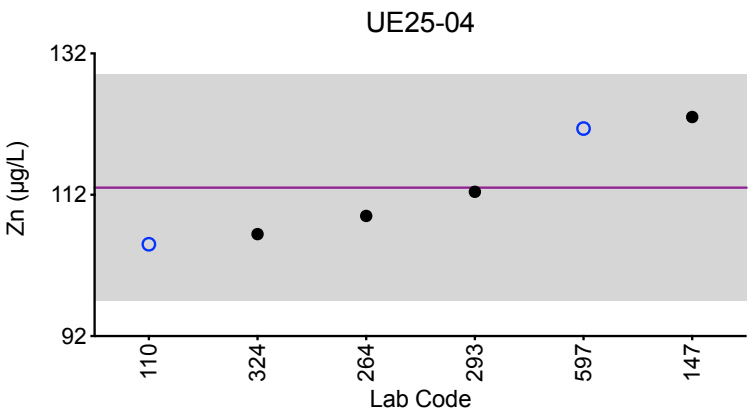
Results for Event #1, 2025: Summary Figures

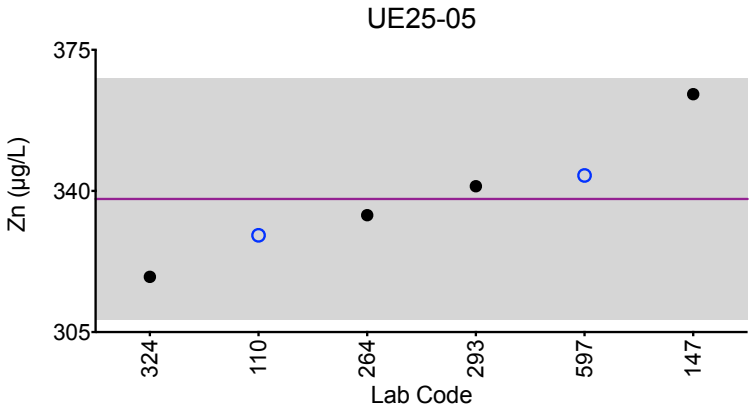
Urine Zn











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine I (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
110	ICP-MS	71.6	79.8	137	127	188
147	ICP-MS	73.2	79.9	133	139	193
597	ICP-MS/MS	74.4	82.9	138	133	193

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	73.1	81	136	133	191
Arithmetic SD (s)	1.4	2	3	6	3
Arithmetic RSD (%)	1.9	2.2	2.2	4.5	1.6
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Li (µg/L)

Lab Code	Method	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
110	ICP-MS/MS	21.1	25.5	21.8	18.0	7.49
147	ICP-MS	20.7	25.9	21.9	17.6	8.05
597	ICP-MS/MS	18.0	22.9	19.5	16.0	7.25

Summary Statistics

	UE25-01	UE25-02	UE25-03	UE25-04	UE25-05
Arithmetic Mean ($\bar{x}$)	20	24.8	21.1	17.2	7.6
Arithmetic SD (s)	2	1.6	1.4	1.1	0.4
Arithmetic RSD (%)	8.5	6.5	6.6	6.4	5.3
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Urine Te (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
110	ICP-MS/MS	1.46	0.341	1.27	0.372	1.03
147	ICP-MS	1.54	0.299	1.18	0.419	0.903
Summary Statistics						
		UE25-01	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
Arithmetic Mean ($\bar{x}$)		1.50	0.32	1.23	0.40	0.97
Arithmetic SD (s)		0.06	0.03	0.06	0.03	0.09
Arithmetic RSD (%)		3.8	9.4	4.9	7.5	9.3
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2025: Additional Elements in Urine

Urine Ag (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
147	ICP-MS	0.108	0.108	0.108	0.108	0.108

Urine B (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
597	ICP-MS/MS	317	674	1420	338	515

Urine Bi (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
147	ICP-MS	0.0773	0.0773	0.0773	0.0773	0.0773
597	ICP-MS/MS	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102

Urine Cl (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
597	ICP-MS/MS	1420000	5000000	3890000	1270000	1680000

Urine Fe (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
324	ICP-MS	3.051	5.501	15.570	8.322	13.239

Urine Mg (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
597	ICP-MS/MS	21200	49500	52100	18500	28700

Urine S (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
597	ICP-MS/MS	444000	948000	1310000	560000	850000

Urine Th (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
147	ICP-MS	0.0951	0.0951	0.0951	0.0951	0.0951
597	ICP-MS/MS	0.0231	0.0287	0.0113	0.0172	0.00585

Urine Ti (µg/L)						
Lab Code	**Method**	**UE25-01**	**UE25-02**	**UE25-03**	**UE25-04**	**UE25-05**
597	ICP-MS/MS	3.39	6.82	6.46	3.09	4.47

Statistical data was not calculated for Th for UE25-01, UE25-02, UE25-03, UE25-04 and UE25-05 based on a lack of consensus among participating labs.

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Event #1, 2025

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

NEW YORK STATE | Department of Health | Wadsworth Center

Event #1, 2025:
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 29 were reported by at least one participant: As, B, Ba, Be, Bi, Cd, Cs, Fe, Ga, Hg, I, Li, Mg, Mn, Mo, Ni, Pb, Pt, S, 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 #1, 2025:
Summary Statistics

	Serum Al (µg/L)				
	SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Target (Arithmetic Mean ($\bar{x}$))	47	18.3	25.0	89	45
Upper Limit	56	23.3	30.0	107	54
Lower Limit	38	13.3	20.0	71	36
Arithmetic SD (s)	3	1.7	0.9	3	6
Arithmetic RSD (%)	7.2	9.3	3.6	3.5	13
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 #1, 2025:
Performance of Participating Laboratories

		Serum Al (µg/L)				
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
	Target	**47**	**18.3**	**25.0**	**89**	**45**
147	ETAAS-Z	43.6	17.8	24.9	85.1	51.7
264	ICP-MS	48.73	15.31	25.02	89.78	39.88
293	DRC/CC-ICP-MS	50.00	19.62	25.27	93.55	45.7
391	ETAAS-Z	41.67	18.34	23.53	*69.53 ↓	37.41
485	HR-ICP-MS	49.6	18.9	24.6	87.8	49.7
597	ICP-MS/MS	47.6	19.9	26.4	87.9	46.7

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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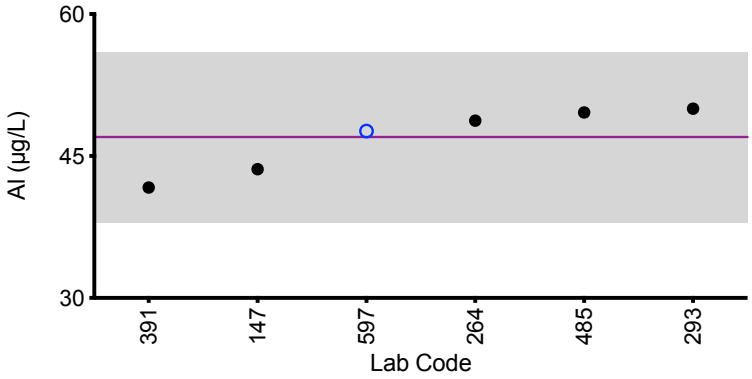
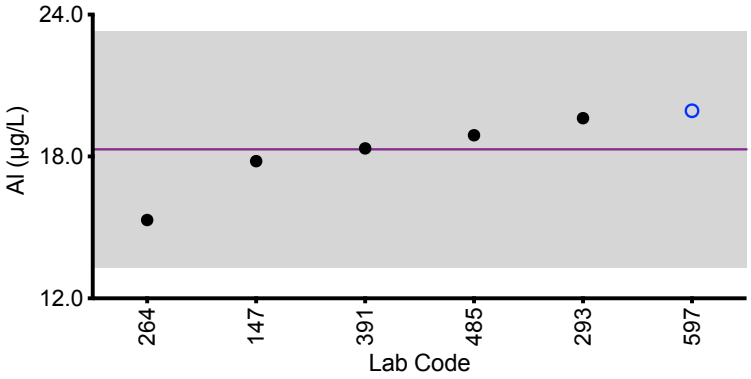
Results for Event #1, 2025: Summary Figures

Serum AI

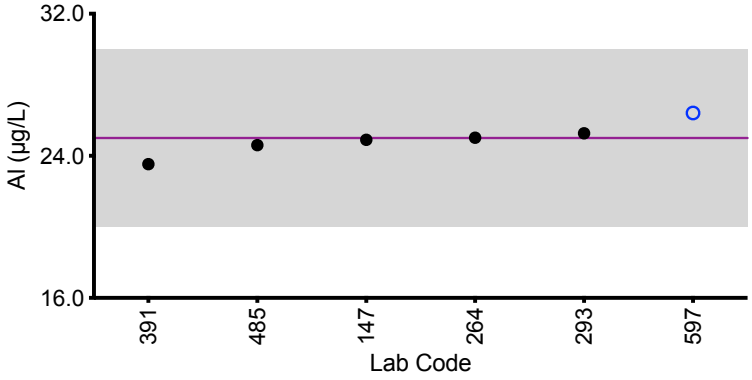
SE25-01



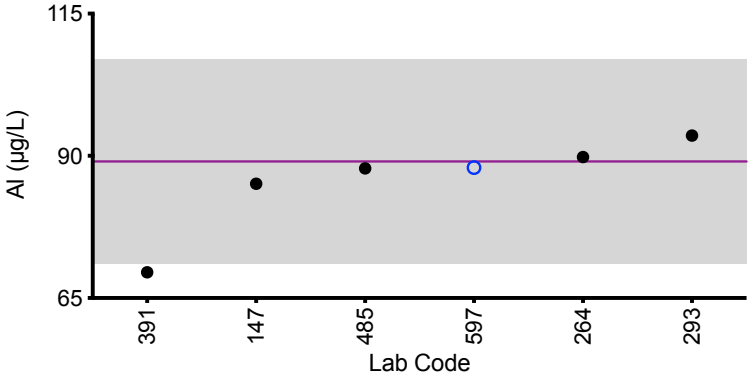
SE25-02



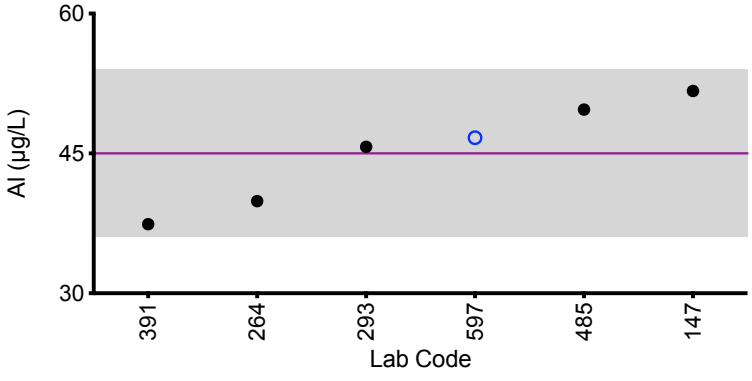
SE25-03



SE25-04



SE25-05



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 #1, 2025: Summary Statistics

	Serum Co (µg/L)				
	SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Target (Arithmetic Mean ($\bar{x}$))	0.65	3.39	7.49	0.86	4.81
Upper Limit	2.15	4.89	8.99	2.36	6.31
Lower Limit	0.00	1.89	5.99	0.00	3.31
Arithmetic SD (s)	0.04	0.16	0.20	0.06	0.25
Arithmetic RSD (%)	5.5	4.7	2.7	7.1	5.2
Number of Sample Measurements (N)	7	7	6	7	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 #1, 2025:
Performance of Participating Laboratories

Serum Co (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
	Target	**0.65**	**3.39**	**7.49**	**0.86**	**4.81**
103	ICP-MS/MS	0.649	3.52	7.76	0.871	4.98
110	ICP-MS/MS	0.66	3.44	7.64	0.88	4.83
147	DRC/CC-ICP-MS	0.642	3.21	7.30	0.805	4.54
264	ICP-MS	0.60	3.27	7.40	0.80	4.68
293	DRC/CC-ICP-MS	0.7	3.46	7.55	0.86	4.79
485	HR-ICP-MS	0.685	3.63	*8.68	0.981	5.26
597	ICP-MS/MS	0.613	3.22	7.26	0.836	4.59

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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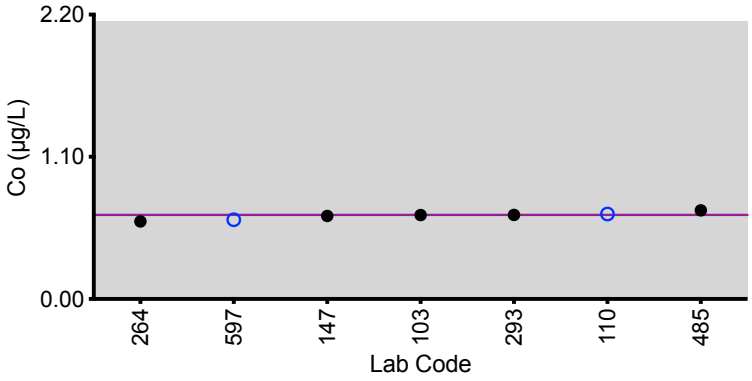
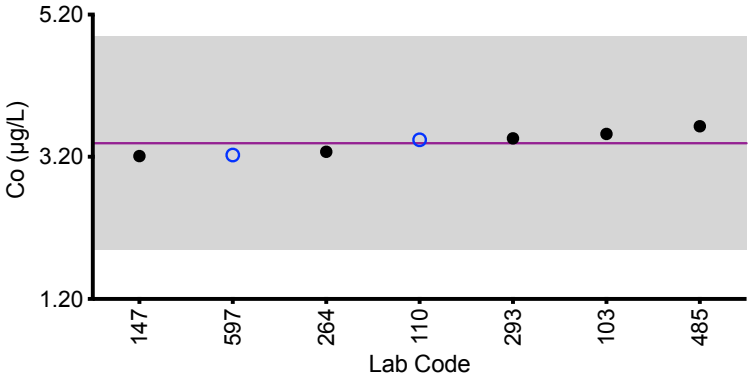
Results for Event #1, 2025: Summary Figures

Serum Co

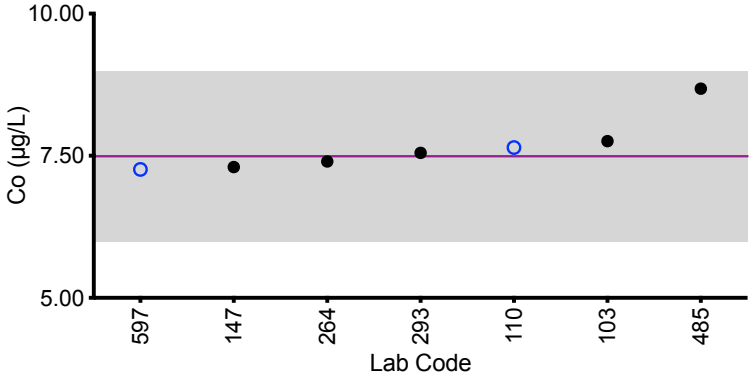
SE25-01



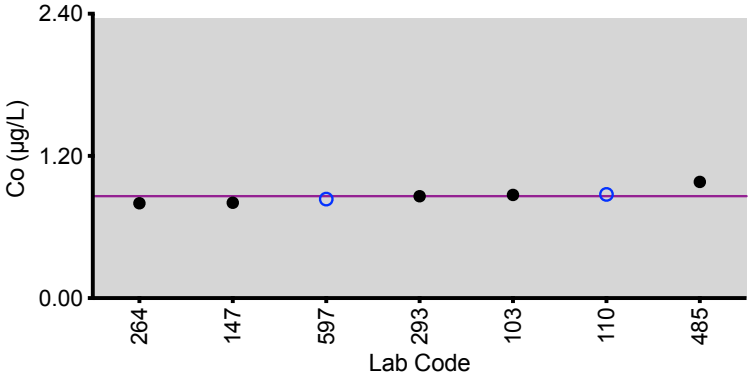
SE25-02



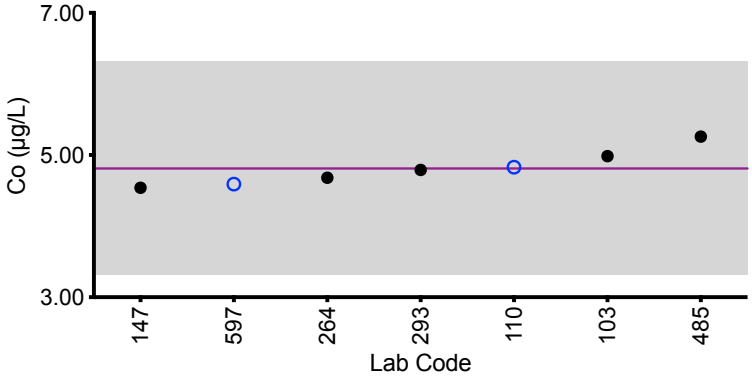
SE25-03



SE25-04



SE25-05



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 #1, 2025: Summary Statistics

	Serum Cr (µg/L)				
	SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Target (Arithmetic Mean ($\bar{x}$))	0.40	1.09	0.56	2.20	0.63
Upper Limit	2.40	3.09	2.56	4.20	2.63
Lower Limit	0.00	0.00	0.00	0.20	0.00
Arithmetic SD (s)	0.07	0.10	0.09	0.11	0.05
Arithmetic RSD (%)	18	9.2	16	5.2	7.9
Number of Sample Measurements (N)	6	6	6	6	5

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 #1, 2025:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
	Target	**0.40**	**1.09**	**0.56**	**2.20**	**0.63**
103	ICP-MS/MS	<0.600	1.01	<0.600	2.14	<0.600
110	ICP-MS/MS	0.50	*2.02	0.50	*2.75	*1.02
147	DRC/CC-ICP-MS	0.336	1.07	0.489	2.11	0.574
264	ICP-MS	0.48	1.25	0.69	2.21	0.62
293	DRC/CC-ICP-MS	0.37	1.14	0.56	2.28	0.69
485	HR-ICP-MS	0.34	1.06	0.487	2.37	0.601
597	ICP-MS/MS	0.401	0.992	0.642	2.07	0.675

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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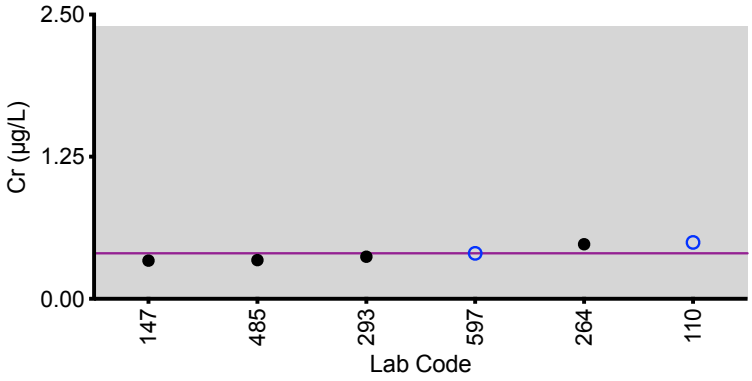
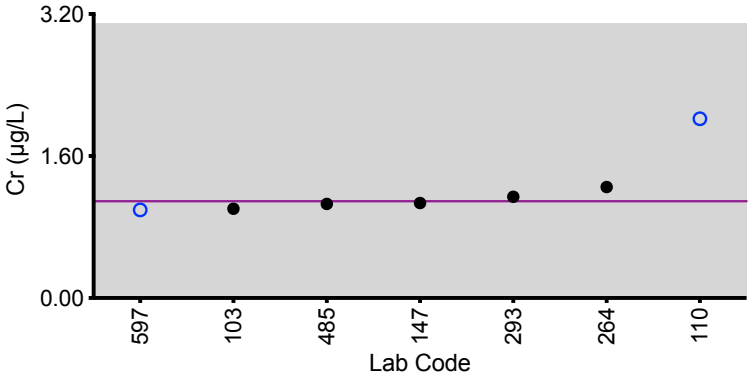
Results for Event #1, 2025: Summary Figures

Serum Cr

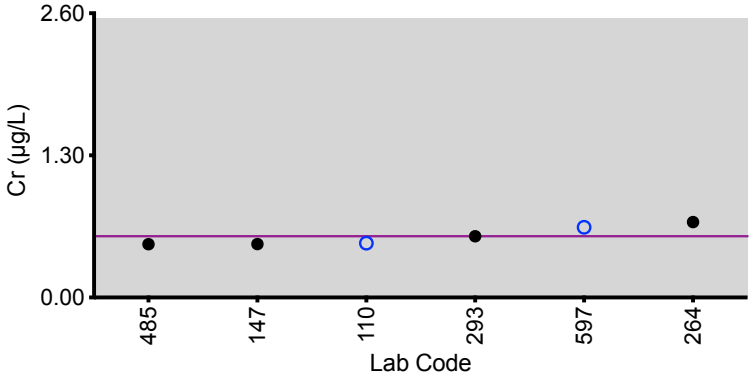
SE25-01



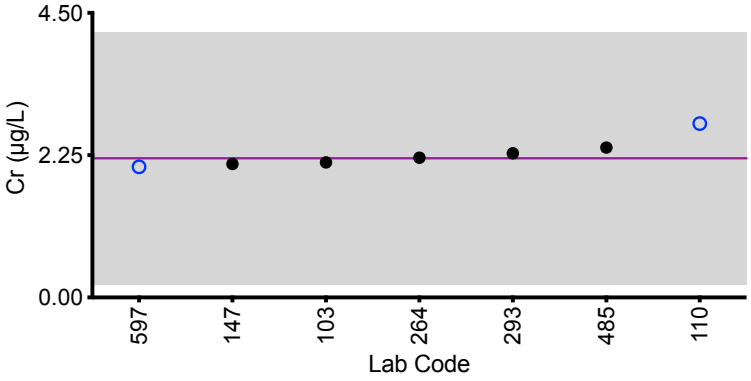
SE25-02



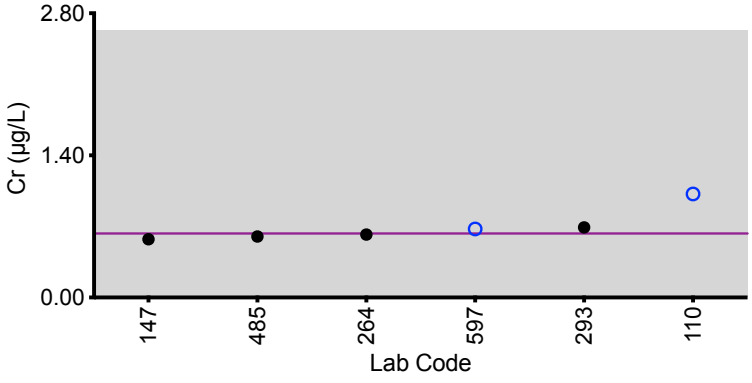
SE25-03



SE25-04



SE25-05



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 #1, 2025: Summary Statistics

	Serum Cu (µg/L)				
	SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Target (Arithmetic Mean ($\bar{x}$))	950	1140	1040	1380	1560
Upper Limit	1090	1310	1200	1590	1790
Lower Limit	810	970	880	1170	1330
Arithmetic SD (s)	60	90	70	100	80
Arithmetic RSD (%)	6.3	7.9	6.7	7.2	5.1
Number of Sample Measurements (N)	7	7	7	7	7

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

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Results for Event #1, 2025:
Performance of Participating Laboratories

Serum Cu (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
	Target	**950**	**1140**	**1040**	**1380**	**1560**
107	DRC/CC-ICP-MS	1070	1290	1160	1500	1660
110	ICP-MS/MS	952	1170	1050	1420	1610
147	DRC/CC-ICP-MS	931	1118	1008	1351	1540
264	ICP-MS	944	1142	1037	1404	1539
293	DRC/CC-ICP-MS	966	1202	1074	1443	1627
436	FAAS	889	1000	953	1207	1461
597	ICP-MS/MS	879	1080	968	1310	1470

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

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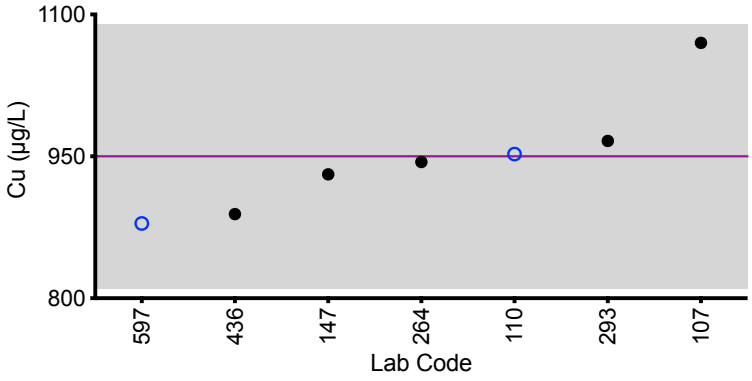
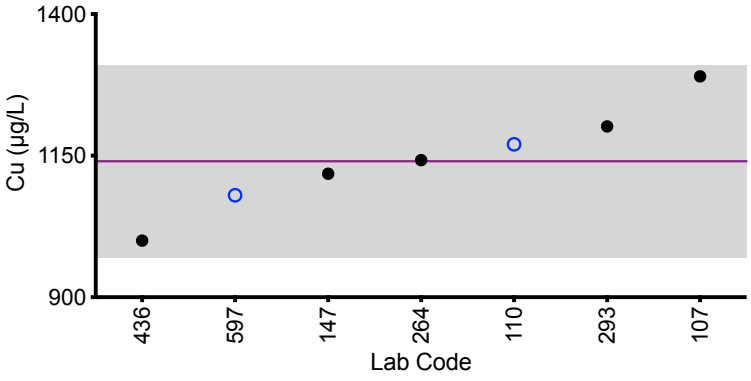
Results for Event #1, 2025: Summary Figures

Serum Cu

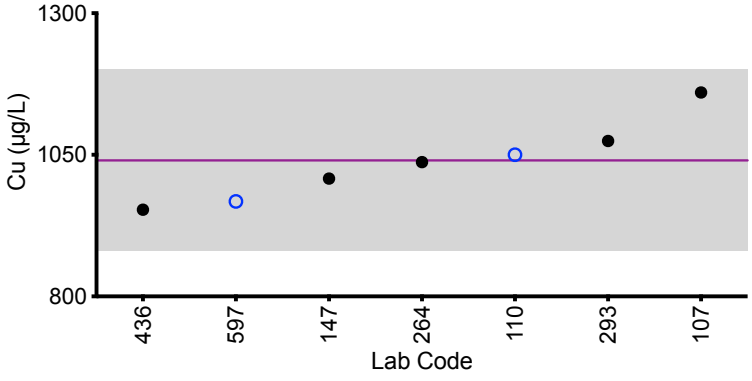
SE25-01



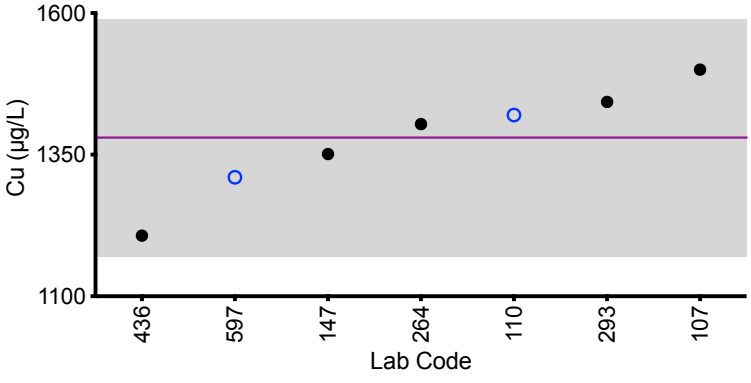
SE25-02



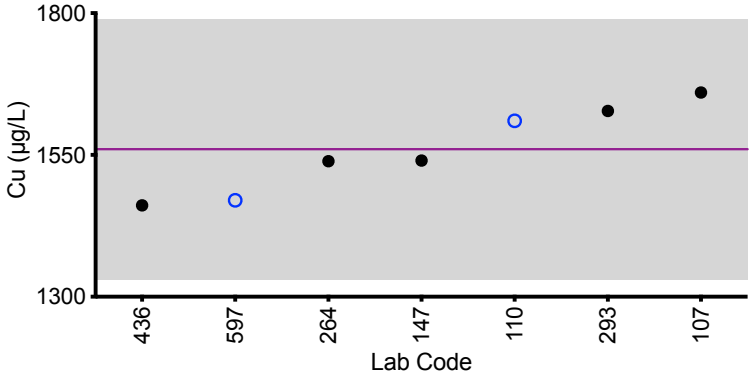
SE25-03



SE25-04



SE25-05



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 #1, 2025:
Summary Statistics

Serum Se (µg/L)					
	SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Target (Arithmetic Mean ($\bar{x}$))	129	106	256	217	170
Upper Limit	155	127	307	260	204
Lower Limit	103	85	205	174	136
Arithmetic SD (s)	7	7	14	14	10
Arithmetic RSD (%)	5.4	6.6	5.5	6.5	5.9
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 by New York State Department of Health's Wadsworth Center, the PT Program organizer.

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Results for Event #1, 2025:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
	Target	**129**	**106**	**256**	**217**	**170**
103	ICP-MS/MS	132	109	264	228	175
107	DRC/CC-ICP-MS	129	105	258	217	171
110	ICP-MS/MS	127	104	254	214	169
147	DRC/CC-ICP-MS	118	94.3	232	196	152
264	ICP-MS	135	113	261	231	179
293	DRC/CC-ICP-MS	136	114	278	235	180
436	ETAAS-Other	*94 ↓	*71 ↓	260	205	*126 ↓
597	ICP-MS/MS	123	101	242	208	163

Based on the grading criteria for Se in Serum, 93% of results were satisfactory, with 1 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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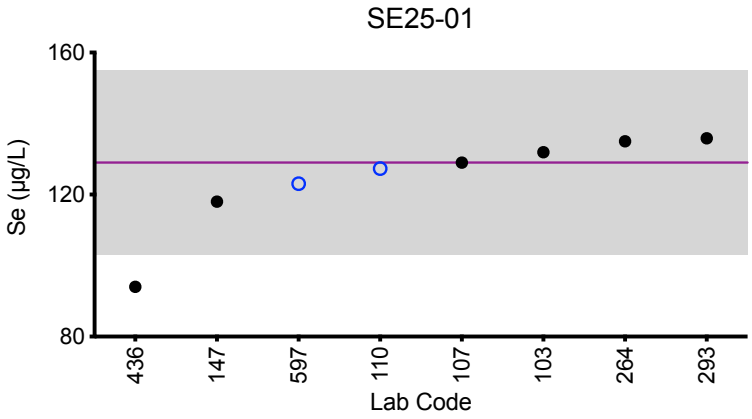
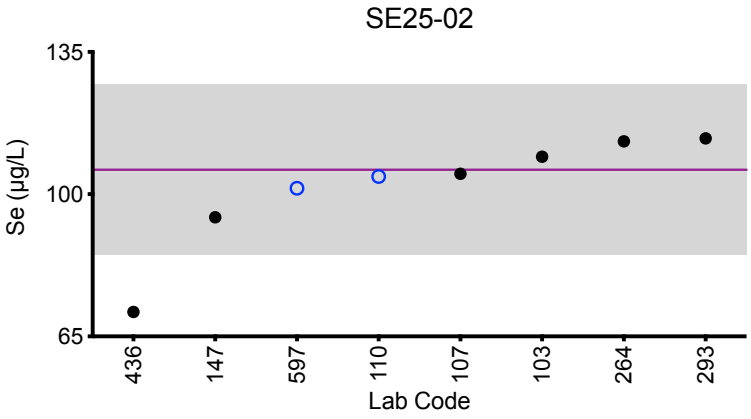
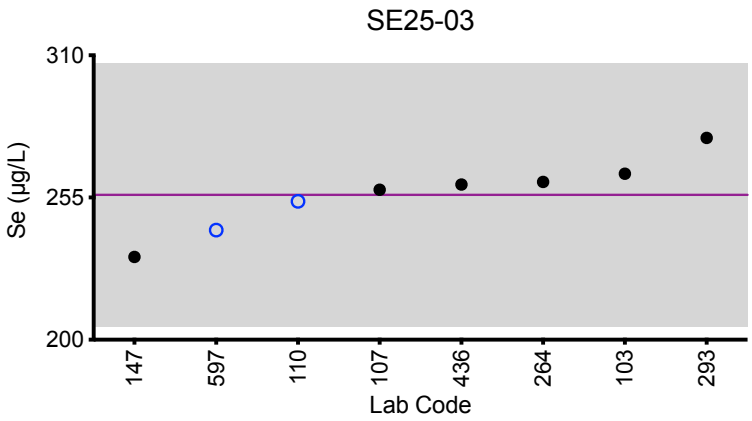
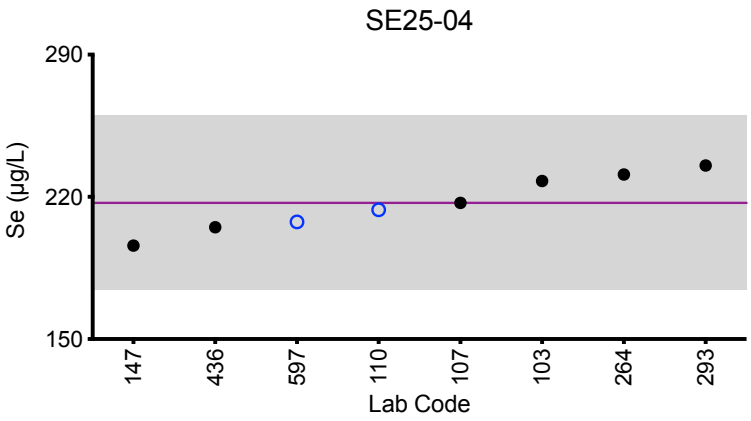
Results for Event #1, 2025: Summary Figures

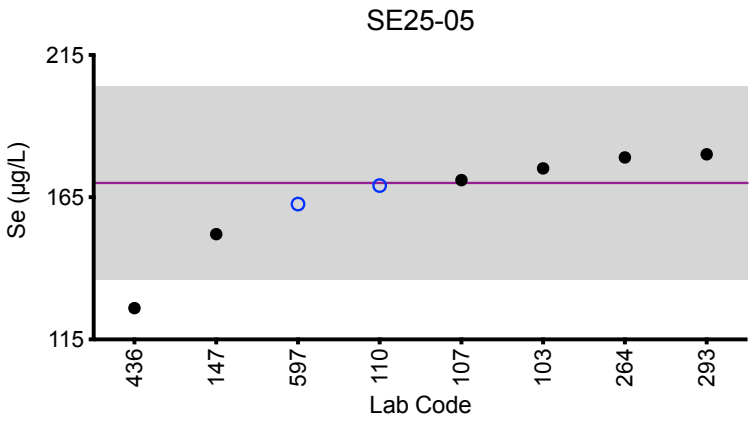
Serum Se











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 #1, 2025: Summary Statistics

	Serum Zn (µg/L)				
	SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Target (Arithmetic Mean ($\bar{x}$))	1510	1490	870	1570	1620
Upper Limit	1740	1710	1000	1810	1860
Lower Limit	1280	1270	740	1330	1380
Arithmetic SD (s)	90	80	60	60	40
Arithmetic RSD (%)	6.1	5.4	6.9	3.8	2.5
Number of Sample Measurements (N)	6	6	6	6	6

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

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Results for Event #1, 2025:
Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
	Target	**1510**	**1490**	**870**	**1570**	**1620**
107	DRC/CC-ICP-MS	1670	1630	965	1650	1670
110	ICP-MS/MS	1490	1480	853	1570	1620
147	DRC/CC-ICP-MS	1398	1403	822	1497	1560
264	ICP-MS	1449	1425	815	1496	1577
293	DRC/CC-ICP-MS	1529	1497	895	1614	1647
597	ICP-MS/MS	1510	1500	868	1590	1640

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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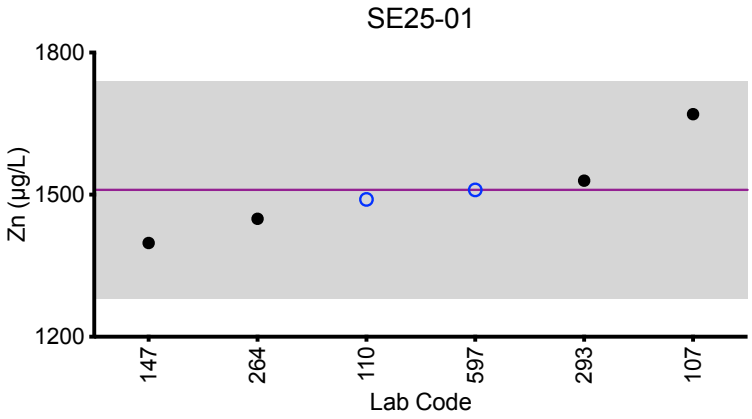
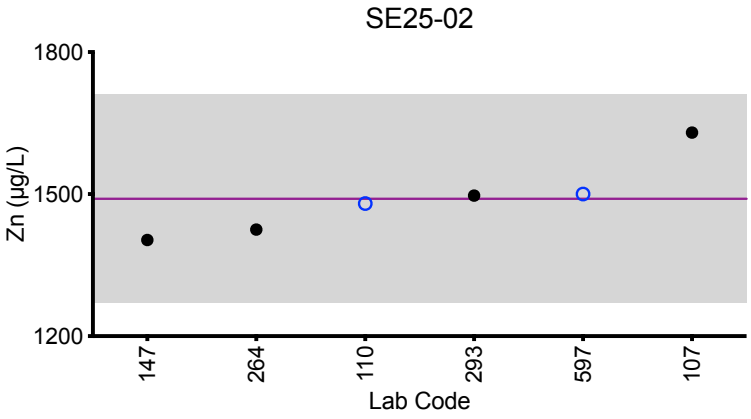
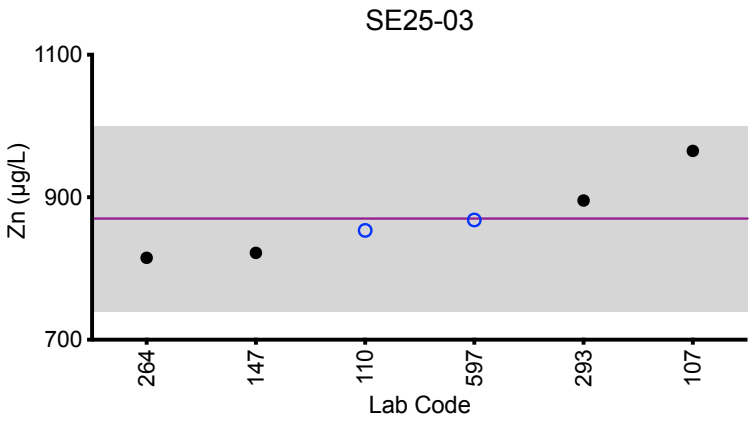
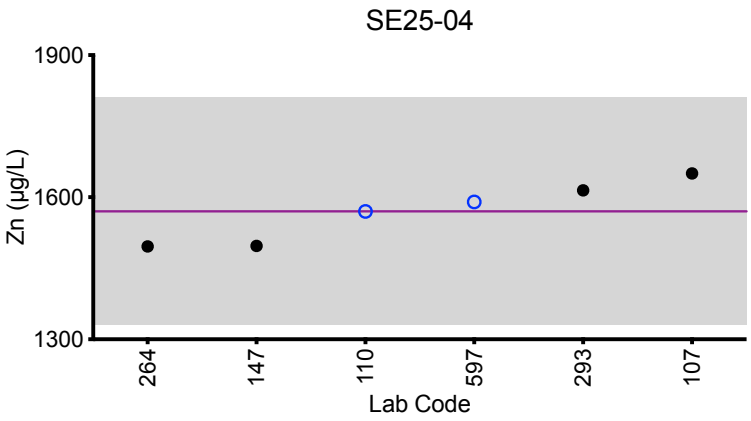
Results for Event #1, 2025: Summary Figures

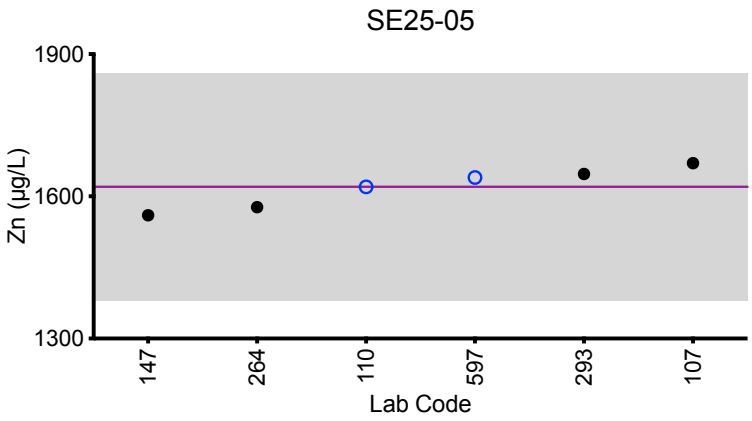
Serum Zn











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 #1, 2025:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
103	ICP-MS/MS	13.3	2.88	3.08	7.06	7.98
110	ICP-MS/MS	12.3	2.90	2.94	6.56	7.72
147	DRC/CC-ICP-MS	11.1	2.50	2.74	6.27	7.31
264	ICP-MS	11.72	2.52	2.71	6.01	6.84
293	DRC/CC-ICP-MS	11.970	2.63	2.81	6.52	7.380
597	ICP-MS/MS	11.7	2.59	2.85	6.28	7.27
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		12.0	2.67	2.86	6.4	7.4
Arithmetic SD (s)		0.7	0.18	0.14	0.4	0.4
Arithmetic RSD (%)		5.8	6.7	4.9	5.6	5.4
Number of Sample Measurements (N)		6	6	6	6	6

*Denotes a statistical Outlier.

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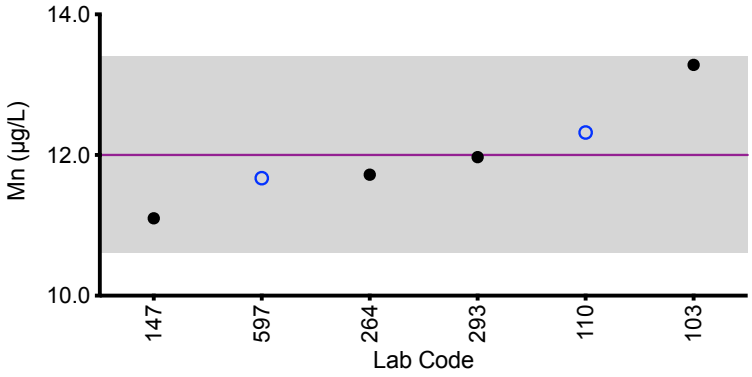
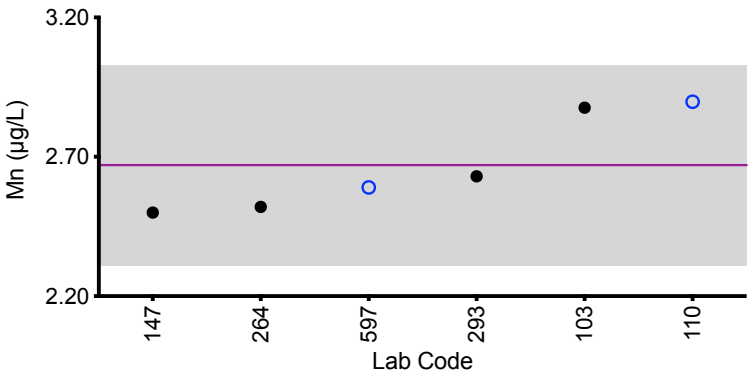
Results for Event #1, 2025: Summary Figures

Serum Mn

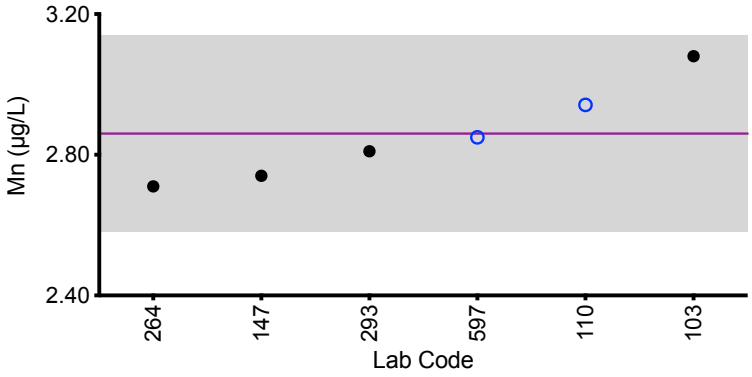
SE25-01



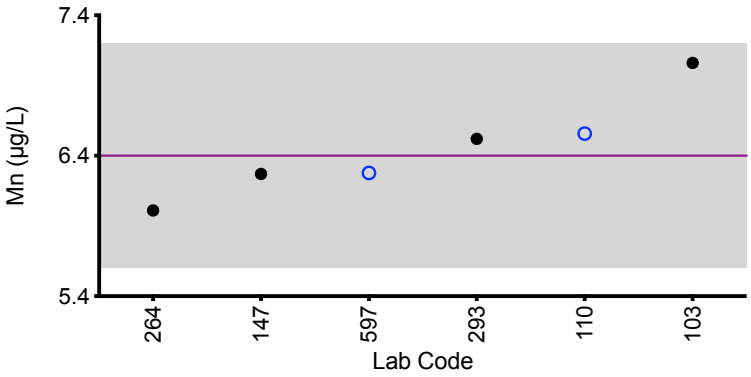
SE25-02



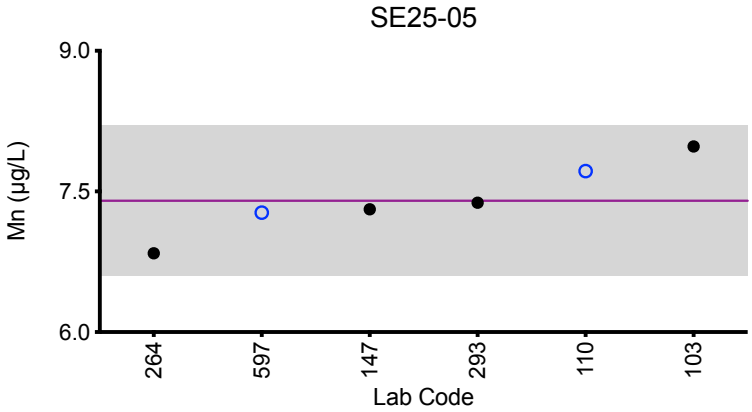
SE25-03



SE25-04



SE25-05



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 #1, 2025:
Laboratory Data and Summary Statistics

Serum Mo (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
103	ICP-MS/MS	1.85	3.69	7.26	1.99	4.98
110	ICP-MS/MS	1.74	3.57	7.07	1.93	4.73
147	DRC/CC-ICP-MS	1.73	3.35	6.77	1.83	4.44
293	DRC/CC-ICP-MS	1.720	3.590	7.040	1.920	4.570
485	HR-ICP-MS	1.88	3.73	6.83	2.40	4.72
597	ICP-MS/MS	*1.36	*2.73	*5.92	1.73	3.71

Summary Statistics

	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
Arithmetic Mean ($\bar{x}$)	1.78	3.59	6.99	1.97	4.5
Arithmetic SD (s)	0.08	0.15	0.20	0.23	0.4
Arithmetic RSD (%)	4.5	4.2	2.9	12	8.9
Number of Sample Measurements (N)	5	5	5	6	6

*Denotes a statistical Outlier.

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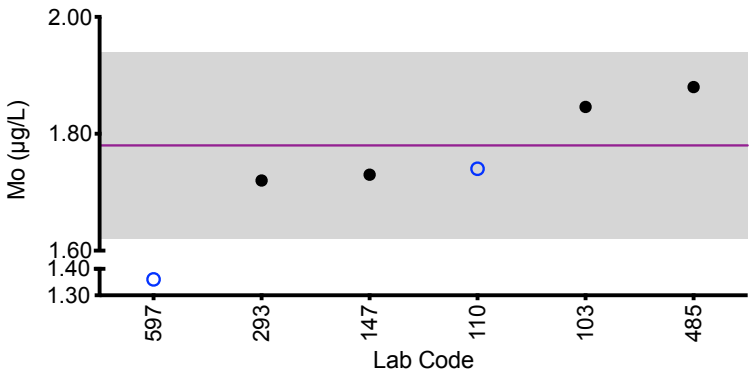
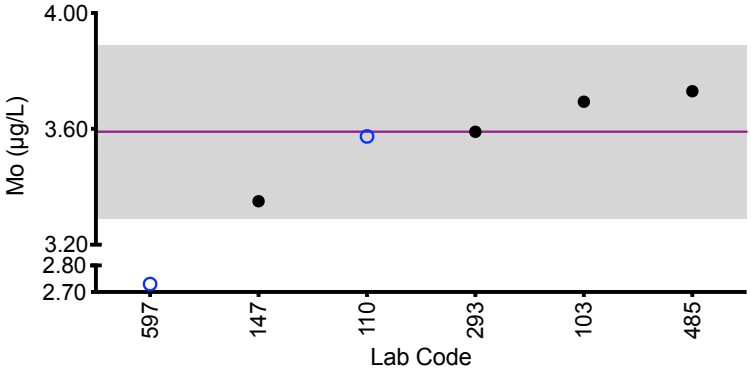
Results for Event #1, 2025: Summary Figures

Serum Mo

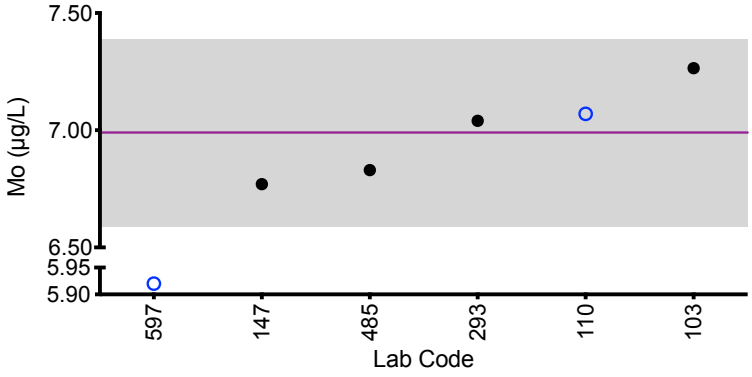
SE25-01



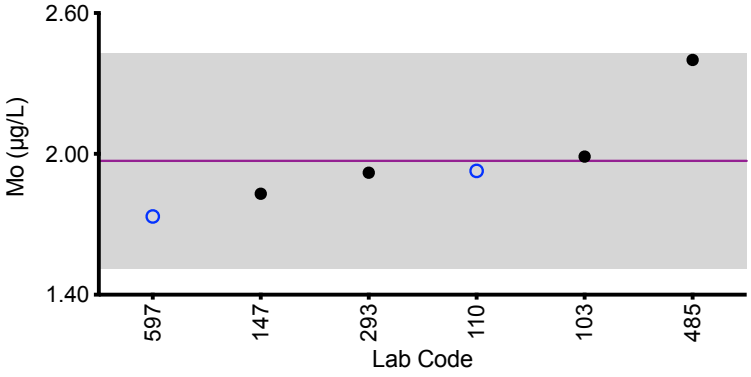
SE25-02



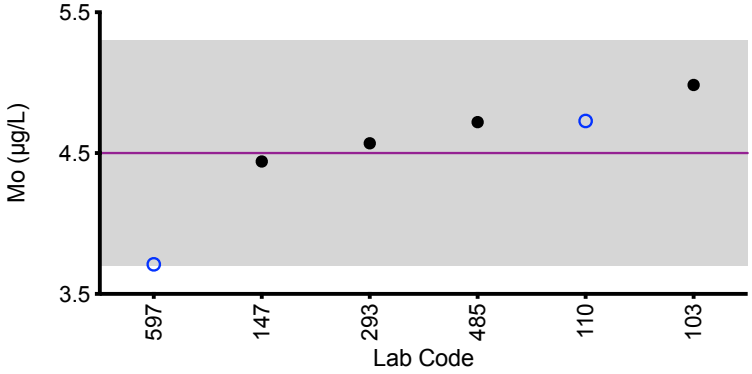
SE25-03



SE25-04



SE25-05



Legend:
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Gray area = ±2SD of the mean.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
103	ICP-MS/MS	2.47	0.840	6.10	4.19	3.06
110	ICP-MS/MS	3.19	0.70	5.89	3.97	2.65
147	DRC/CC-ICP-MS	2.00	0.408	5.45	3.27	2.27
293	DRC/CC-ICP-MS	*4.49	0.82	5.73	4.48	*4.84
485	HR-ICP-MS	2.25	0.473	5.97	3.87	2.77
597	ICP-MS/MS	2.03	0.392	5.76	3.67	2.40
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		2.4	0.61	5.82	3.9	2.6
Arithmetic SD (s)		0.5	0.21	0.23	0.4	0.3
Arithmetic RSD (%)		20	34	3.9	10	12
Number of Sample Measurements (N)		5	6	6	6	5

*Denotes a statistical Outlier.

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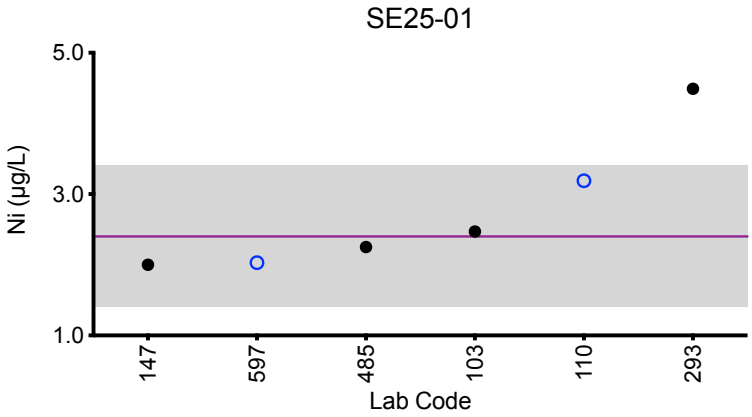
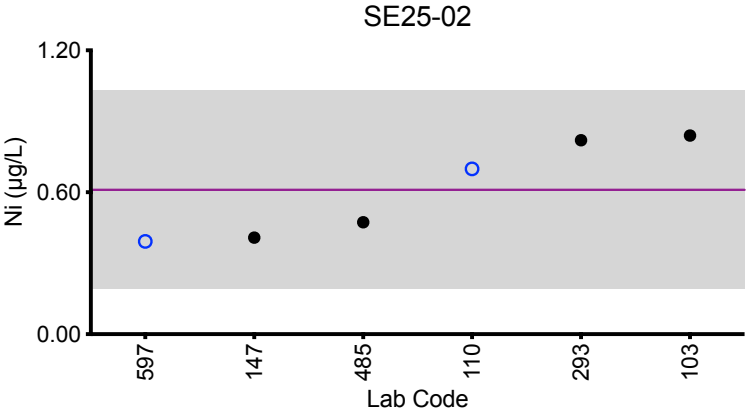
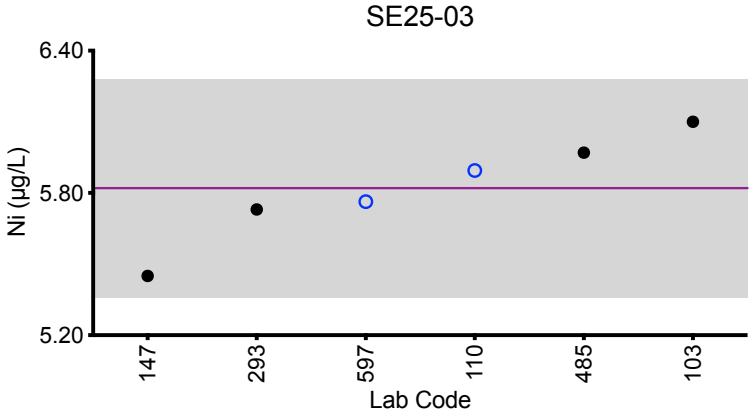
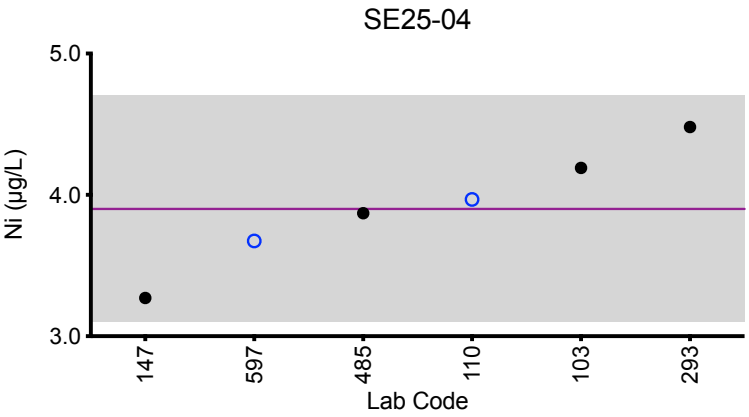
Results for Event #1, 2025: Summary Figures

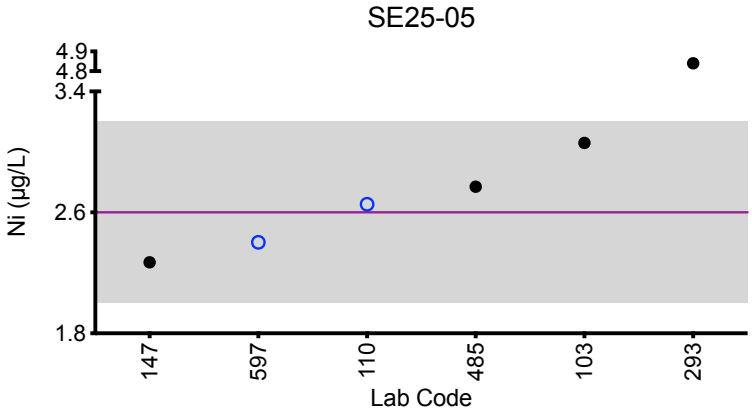
Serum Ni











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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum V (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
110	ICP-MS/MS	3.91	0.27	0.39	1.45	2.71
147	DRC/CC-ICP-MS	3.54	0.128	0.239	1.25	2.40
293	DRC/CC-ICP-MS	3.83	*0.37	0.47	1.48	2.8
485	HR-ICP-MS	3.94	0.149	0.273	1.49	2.68
597	ICP-MS/MS	3.47	0.247	0.334	1.29	2.36

Summary Statistics

	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
Arithmetic Mean ($\bar{x}$)	3.7	0.20	0.34	1.39	2.59
Arithmetic SD (s)	0.2	0.07	0.09	0.11	0.18
Arithmetic RSD (%)	5.9	35	26	7.9	7.7
Number of Sample Measurements (N)	5	4	5	5	5

*Denotes a statistical Outlier.

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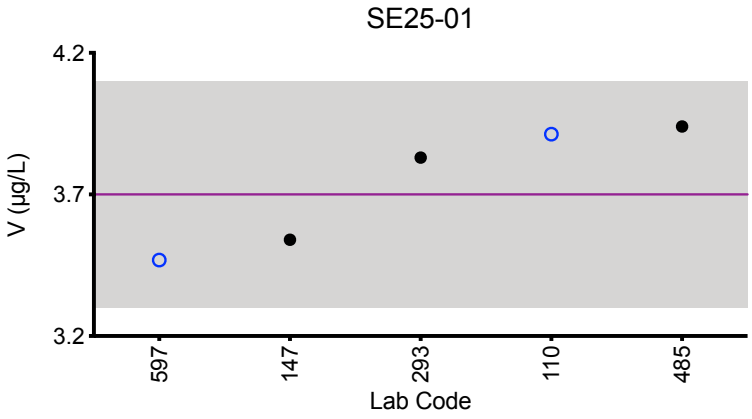
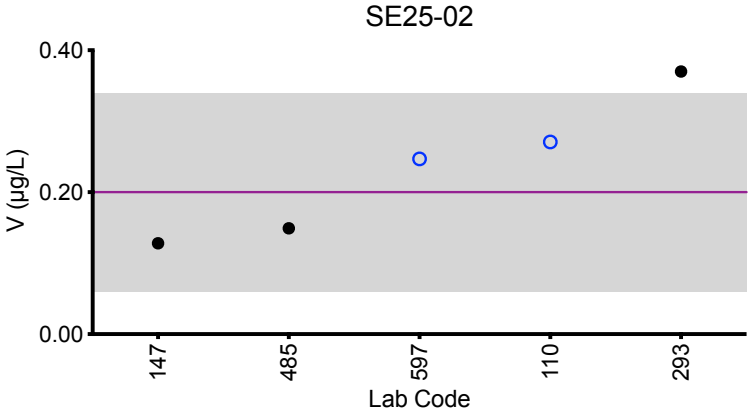
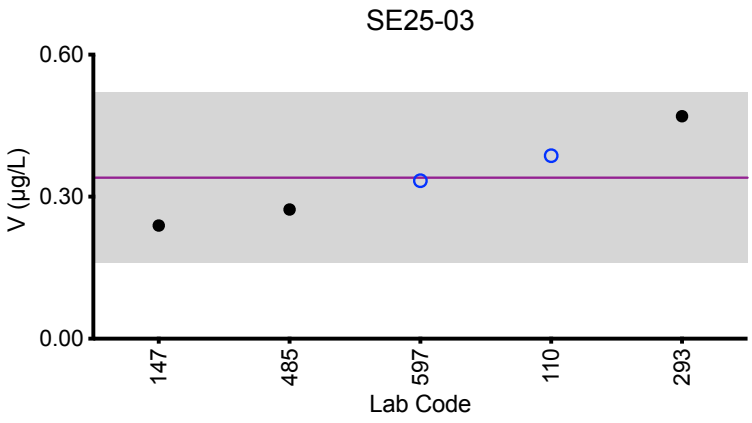
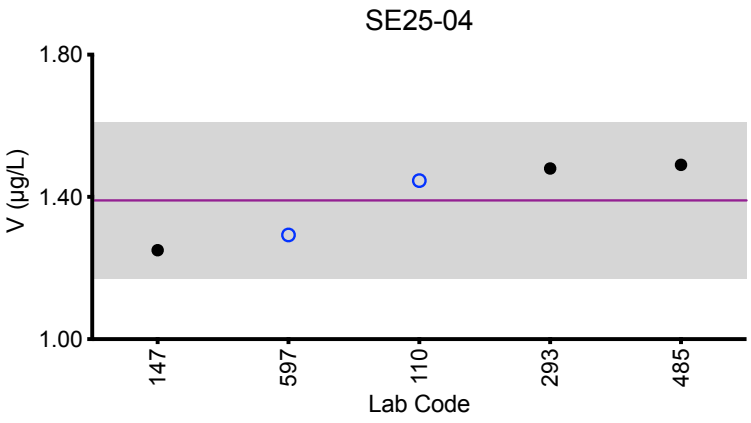
Results for Event #1, 2025: Summary Figures

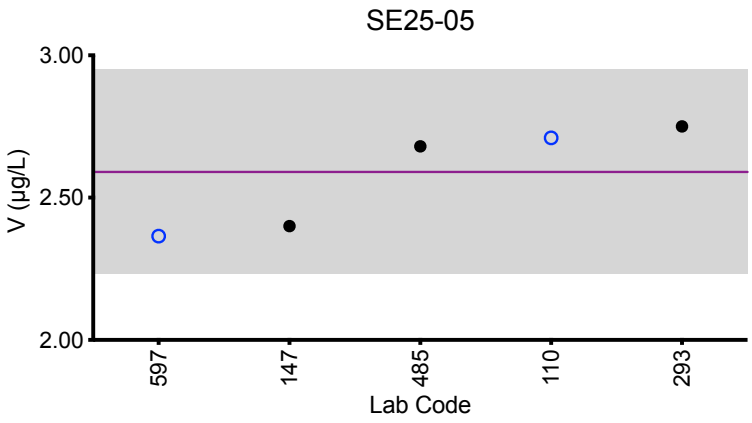
Serum V











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

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum As (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
103	ICP-MS/MS	2.13	12.0	15.2	4.40	7.47
110	ICP-MS/MS	1.89	11.2	13.8	3.75	6.69
147	DRC/CC-ICP-MS	1.89	10.3	12.8	3.73	6.31
597	ICP-MS/MS	1.92	10.9	13.8	4.00	6.79

Summary Statistics

	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
Arithmetic Mean ($\bar{x}$)	1.96	11.1	13.9	4.0	6.8
Arithmetic SD (s)	0.12	0.7	1.0	0.3	0.5
Arithmetic RSD (%)	6.1	6.3	7.2	7.5	7.4
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
110	ICP-MS/MS	0.91	1.22	1.39	1.29	0.90
147	ICP-MS	0.609	0.827	1.07	0.916	0.601
597	ICP-MS/MS	0.888	1.16	1.49	1.38	0.971
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		0.8	1.1	1.3	1.2	0.8
Arithmetic SD (s)		0.2	0.2	0.2	0.2	0.2
Arithmetic RSD (%)		21	20	17	21	24
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Be (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
110	ICP-MS/MS	2.59	1.90	0.89	0.35	1.11
147	ICP-MS	2.43	1.76	0.790	0.302	1.06
293	ICP-MS	2.49	1.85	0.87	0.33	1.15
597	ICP-MS/MS	2.35	1.76	0.812	0.324	1.10

Summary Statistics

	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
Arithmetic Mean ($\bar{x}$)	2.46	1.82	0.84	0.33	1.11
Arithmetic SD (s)	0.10	0.07	0.05	0.02	0.04
Arithmetic RSD (%)	4.1	3.8	5.6	6.1	3.6
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Bi (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
147	ICP-MS	0.0397	0.0397	0.0397	0.271	0.0397
597	ICP-MS/MS	<0.00494	<0.00494	<0.00494	0.294	0.0315
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		NA	NA	NA	0.28	0.036
Arithmetic SD (s)		NA	NA	NA	0.02	0.006
Arithmetic RSD (%)		NA	NA	NA	5.7	17
Number of Sample Measurements (N)		NA	NA	NA	2	2

*Denotes a statistical Outlier.

Statistical data was not calculated for SE25-01, SE25-02 and SE25-03 based on a lack of consensus among participating labs.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
103	ICP-MS/MS	4.37	1.67	2.86	0.801	0.534
110	ICP-MS/MS	4.13	1.65	2.75	0.72	0.46
147	ICP-MS	3.95	1.44	2.61	0.641	0.418
597	ICP-MS/MS	4.14	1.63	2.76	0.759	0.501
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		4.15	1.60	2.75	0.73	0.48
Arithmetic SD (s)		0.17	0.11	0.10	0.07	0.05
Arithmetic RSD (%)		4.1	6.9	3.6	9.6	10
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
110	ICP-MS/MS	0.47	0.42	0.36	0.50	0.61
597	ICP-MS/MS	0.482	0.444	0.438	0.564	0.624
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		0.476	0.43	0.40	0.53	0.617
Arithmetic SD (s)		0.008	0.02	0.06	0.05	0.012
Arithmetic RSD (%)		1.7	3.9	15	9.4	1.6
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
103	ICP-MS/MS	6.29	0.412	3.38	1.75	0.804
110	ICP-MS/MS	6.53	0.45	3.24	1.66	0.80
597	ICP-MS/MS	6.27	0.436	3.20	1.64	0.793
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		6.36	0.43	3.27	1.68	0.799
Arithmetic SD (s)		0.14	0.02	0.09	0.06	0.006
Arithmetic RSD (%)		2.2	4.4	2.8	3.6	0.75
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum I (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
147	ICP-MS	46.4	50.1	47.0	60.7	66.1
597	ICP-MS/MS	52.1	57.3	53.7	69.5	74.5

Summary Statistics

	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
Arithmetic Mean ($\bar{x}$)	49	54	50	65	70
Arithmetic SD (s)	4	5	5	6	6
Arithmetic RSD (%)	8.2	9.3	10	9.2	8.6
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Li (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
147	ICP-MS	0.894	1.15	0.984	0.558	0.357
597	ICP-MS/MS	0.924	1.26	1.04	0.577	0.376
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		0.91	1.21	1.01	0.568	0.366
Arithmetic SD (s)		0.02	0.08	0.04	0.013	0.013
Arithmetic RSD (%)		2.3	6.6	4.0	2.3	3.6
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Mg (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
264	ICP-MS	19606	17199	18613	19412	16864
597	ICP-MS/MS	19300	17500	18400	19300	16900
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		19500	17300	18510	19360	16880
Arithmetic SD (s)		200	200	150	80	30
Arithmetic RSD (%)		1.1	1.2	0.81	0.41	0.18
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
103	ICP-MS/MS	5.29	1.98	3.55	2.57	0.899
110	ICP-MS/MS	5.26	1.96	3.49	2.49	0.87
597	ICP-MS/MS	5.04	2.01	3.71	2.65	0.938

Summary Statistics

	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
Arithmetic Mean ($\bar{x}$)	5.20	1.98	3.58	2.57	0.90
Arithmetic SD (s)	0.14	0.02	0.11	0.08	0.03
Arithmetic RSD (%)	2.7	1.3	3.1	3.1	3.3
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
110	ICP-MS/MS	1.73	0.241	0.421	1.30	0.918
264	ICP-MS	2.12	0.17	0.39	1.54	0.95
293	DRC/CC-ICP-MS	1.79	0.24	0.43	1.32	0.91
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		1.9	0.22	0.41	1.39	0.93
Arithmetic SD (s)		0.2	0.04	0.02	0.13	0.02
Arithmetic RSD (%)		11	18	5.1	9.4	2.3
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
103	ICP-MS/MS	1.08	2.89	1.67	0.952	2.56
110	ICP-MS/MS	1.01	2.74	1.65	0.98	2.40
147	ICP-MS	0.971	2.64	1.54	0.864	2.28
597	ICP-MS/MS	1.11	2.70	1.64	0.964	2.28
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		1.04	2.74	1.63	0.94	2.38
Arithmetic SD (s)		0.06	0.11	0.06	0.05	0.13
Arithmetic RSD (%)		5.8	3.8	3.7	5.3	5.5
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
110	ICP-MS/MS	0.80	2.10	1.95	0.36	4.56
597	ICP-MS/MS	0.905	3.14	2.42	0.676	5.16
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		0.85	2.6	2.2	NA	4.9
Arithmetic SD (s)		0.07	0.7	0.3	NA	0.4
Arithmetic RSD (%)		8.2	27	14	NA	8.2
Number of Sample Measurements (N)		2	2	2	NA	2

*Denotes a statistical Outlier.

Statistical data was not calculated for SE25-04 based on a lack of consensus among participating labs.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
103	ICP-MS/MS	76.4	68.5	86.2	107	66.4
200	ICP-MS	96.30	78.90	96.30	113.90	70.10
597	ICP-MS/MS	75.1	67.0	86.3	105	64.8
Summary Statistics						
		SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)		83	71	90	109	67
Arithmetic SD (s)		12	6	6	5	3
Arithmetic RSD (%)		14	8.5	6.7	4.6	4.5
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)						
Lab Code	**Method**	**SE25-01**	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
200	DRC/CC-ICP-MS	11.400	3.00	5.17	5.37	8.340
485	HR-ICP-MS	11.2	2.77	4.54	5.47	7.0
597	ICP-MS/MS	13.1	5.34	6.66	6.82	9.78

Summary Statistics					
	SE25-01	**SE25-02**	**SE25-03**	**SE25-04**	**SE25-05**
Arithmetic Mean ($\bar{x}$)	11.9	NA	5.5	5.9	8.4
Arithmetic SD (s)	1.0	NA	1.1	0.8	1.4
Arithmetic RSD (%)	8.4	NA	20	14	17
Number of Sample Measurements (N)	3	NA	3	3	3

*Denotes a statistical Outlier.

Statistical data was not calculated for SE25-02 based on a lack of consensus among participating labs.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
103	ICP-MS/MS	1.02	0.257	1.77	0.545	2.33
110	ICP-MS/MS	0.965	0.242	1.67	0.510	2.24
147	ICP-MS	0.944	0.230	1.62	0.480	2.12
597	ICP-MS/MS	0.933	0.246	1.61	0.492	2.07

Summary Statistics

	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
Arithmetic Mean ($\bar{x}$)	0.97	0.244	1.67	0.51	2.19
Arithmetic SD (s)	0.04	0.011	0.07	0.03	0.12
Arithmetic RSD (%)	4.1	4.5	4.2	5.5	5.5
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum U (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
103	ICP-MS/MS	0.185	0.0309	0.0787	0.0318	0.0995
110	ICP-MS/MS	0.191	0.036	0.079	0.032	0.105
597	ICP-MS/MS	0.176	0.0283	0.0625	0.0251	0.0921

Summary Statistics

	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
Arithmetic Mean ($\bar{x}$)	0.184	0.032	0.073	0.030	0.099
Arithmetic SD (s)	0.008	0.004	0.009	0.004	0.006
Arithmetic RSD (%)	4.3	13	12	13	6.1
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025:
Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
110	ICP-MS/MS	1.85	0.22	1.16	0.48	0.89
200	ICP-MS	1.860	0.328	1.230	0.540	1.000
597	ICP-MS/MS	1.71	0.219	1.05	0.433	0.785

Summary Statistics

	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
Arithmetic Mean ($\bar{x}$)	1.81	0.26	1.15	0.48	0.89
Arithmetic SD (s)	0.08	0.06	0.09	0.05	0.11
Arithmetic RSD (%)	4.4	23	7.8	10	12
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2025: Additional Elements in Serum

Serum B (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
597	ICP-MS/MS	<13.1	<13.1	21.0	<13.1	<13.1

Serum Fe (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
264	ICP-MS	7564.00	5086.00	6546.00	3115.00	10896.00
597	ICP-MS/MS	766	472	614	284	1010

Serum Ga (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
597	ICP-MS/MS	0.0133	<0.0119	<0.0119	<0.0119	<0.0119

Serum S (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
597	ICP-MS/MS	1050000	1110000	1060000	1030000	1130000

Serum Te (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
110	ICP-MS/MS	<0.02	<0.02	<0.02	<0.02	<0.02

Serum Th (µg/L)

Lab Code	Method	SE25-01	SE25-02	SE25-03	SE25-04	SE25-05
597	ICP-MS/MS	0.00264	0.00260	0.00267	0.00245	0.00278

Statistical data was not calculated for Fe for SE25-01, SE25-02, SE25-03, SE25-04 and SE25-05 based on a lack of consensus among participating labs.

References

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

2. Taylor A, Angerer J, Arnaud J, Claeys F, Jones RL, Mazarrasa O, Mairiaux E, Menditto A, Parsons PJ, Patriarca M, Pineau A, Valkonen S, Weber J-P, Weykamp C. Occupational and environmental laboratory medicine: A network of EQAS organisers. Accreditation and Quality Assurance. 2006;11(8-9):435-9. PubMed PMID: 086NJ-0011.