



**Department
of Health**

**Wadsworth
Center**

New York State Biomonitoring Program for Trace Elements

Event #2, 2019

Trace Elements in Whole Blood, Urine, and Serum

August, 2019

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory



**Event #2, 2019:
Trace Elements in Whole Blood, Urine, and Serum**

8/23/2019

Dear Laboratory Director,

This report summarizes performance for the second biomonitoring proficiency test (PT) event of 2019 for Trace Elements in Whole Blood, Urine, and Serum. One of the key goals of this PT program is to achieve harmonization of biomonitoring data for trace elements.

Target Value Assignment and Performance Evaluation:

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

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

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

Samples for the next PT event (Event #3, 2019) will be shipped September 18, 2019. Comments about this report may be directed to trel@health.ny.gov.

Sincerely,

Patrick J. Parsons, PhD
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Division of Environmental Sciences
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Kayla Mehigan
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Wadsworth Center



**Department
of Health**

**Wadsworth
Center**

Event #2, 2019

**Trace Elements in
Whole Blood**

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory



**Event #2, 2019:
Trace Elements in Whole Blood**

PT Materials

Human whole blood was purchased from Zen-Bio, Inc. and preserved with K₂EDTA. 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 for analysis.

Graded Elements

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

Additional Elements

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

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



Results for Event #2, 2019: Summary Statistics

Whole Blood As ($\mu\text{g/L}$)					
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target (Arithmetic Mean (\bar{x}))	45.0	3.9	18.0	23.5	11.7
Upper Limit	54.0	9.9	24.0	29.5	17.7
Lower Limit	36.0	0.0	12.0	17.5	5.7
Arithmetic SD (s)	2.0	0.4	0.9	2.0	0.6
Arithmetic RSD (%)	4.4	9.9	4.8	8.5	5.1
Number of Sample Measurements (N)	8	8	8	9	8

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



Results for Event #2, 2019: Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target		45.0	3.9	18.0	23.5	11.7
103	DRC/CC-ICP-MS	45.5	3.62	18.1	22.2	11.9
110	DRC/CC-ICP-MS	45.9	3.9	17.3	23.1	11.9
147	ICP-MS	42.5	3.84	17.8	21.9	11.1
264	ICP-MS	46.173	3.753	16.843	23.139	11.028
293	DRC/CC-ICP-MS	47.66	3.9	18.49	23.55	12.13
391	DRC/CC-ICP-MS	42.378	4.339	17.484	21.836	11.303
597	DRC/CC-ICP-MS	*57.6 ↑	*5.7	*23.3	27.7	*15.2
598	DRC/CC-ICP-MS	46.41	4.64	19.7	25.6	12.7
599	DRC/CC-ICP-MS	43.3	3.45	18.0	22.4	11.6

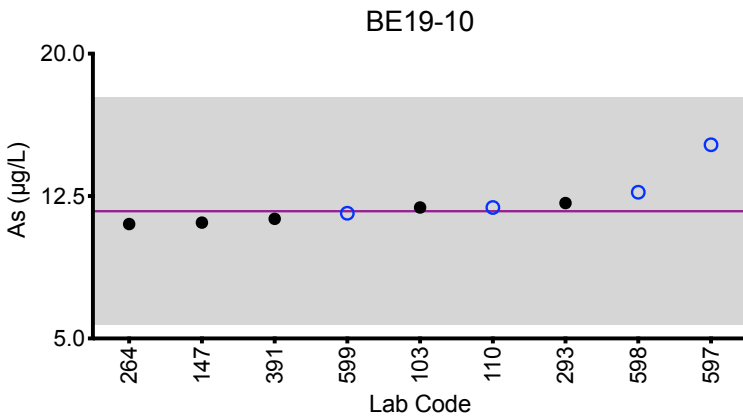
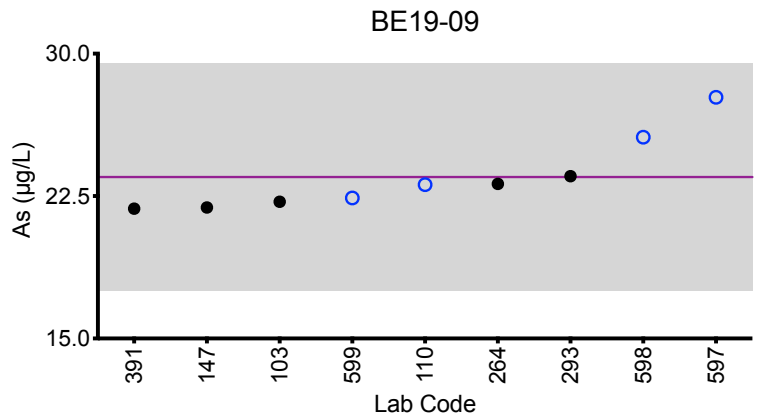
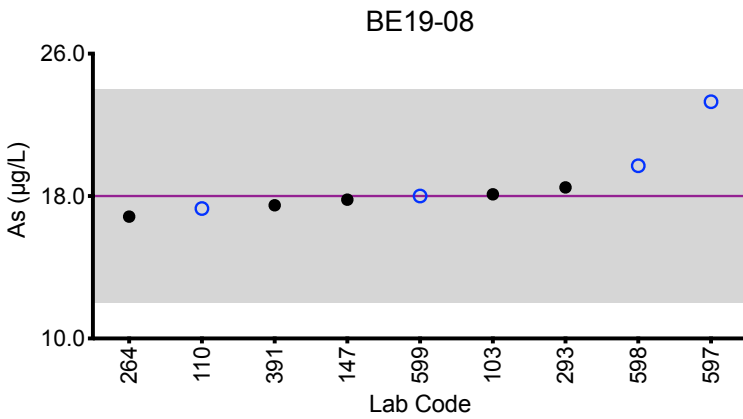
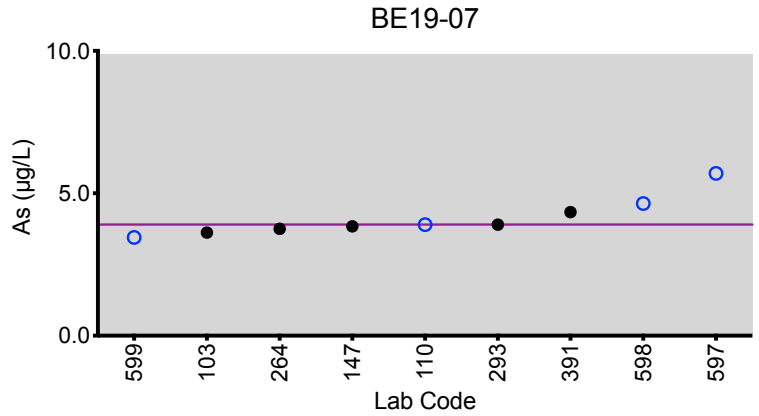
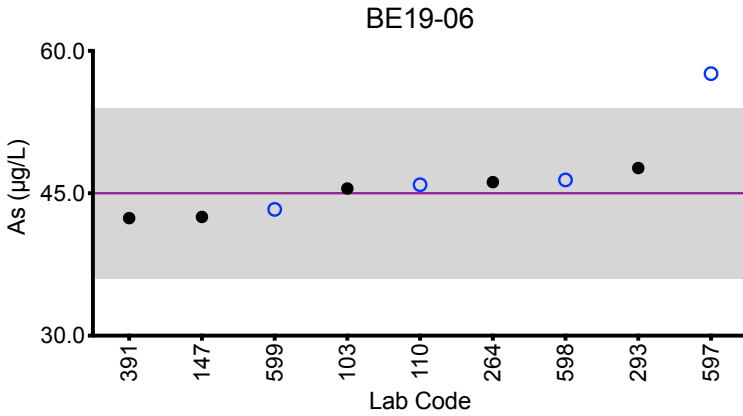
Based on the grading criteria for As in Whole Blood, 98% of results were satisfactory, with 0 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Whole Blood As



Legend:
 ○ CHEAR 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:
 $\pm 6 \mu\text{g/L}$ or $\pm 20\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 6 \mu\text{g/L}$ at concentrations less than or equal to $30 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

Whole Blood Cd ($\mu\text{g/L}$)					
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target (Robust Mean (x^*))	1.09	8.4	2.91	5.1	11.6
Upper Limit	2.09	9.7	3.91	6.1	13.3
Lower Limit	0.09	7.1	1.91	4.1	9.9
Robust SD (s^*)	0.05	0.5	0.16	0.3	0.5
Robust RSD (%)	4.1	6.3	5.5	6.1	4.3
Number of Sample Measurements (N)	14	15	15	15	15
Standard Uncertainty (u)	0.01	0.2	0.05	0.1	0.2

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



Results for Event #2, 2019: Performance of Participating Laboratories

Table with 7 columns: Lab Code, Method, BE19-06, BE19-07, BE19-08, BE19-09, BE19-10. Title: Whole Blood Cd (µg/L). Includes target values and individual lab results with arrows indicating outliers.

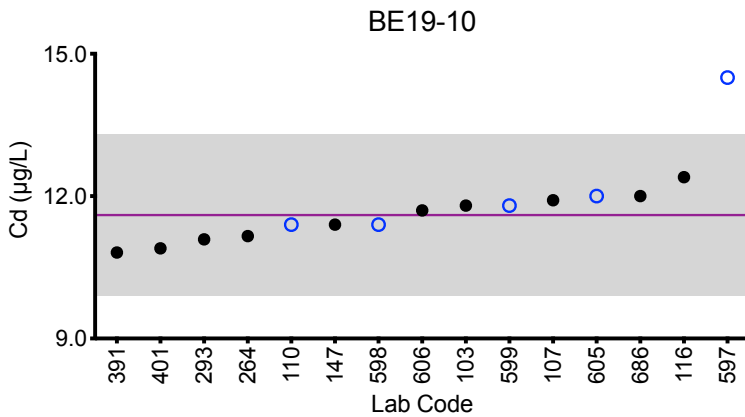
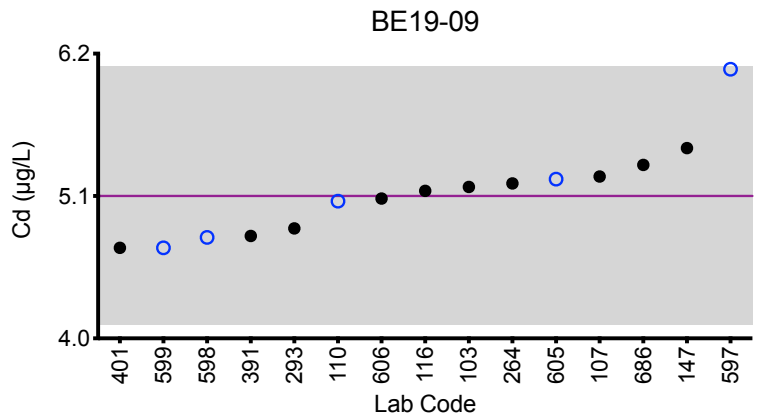
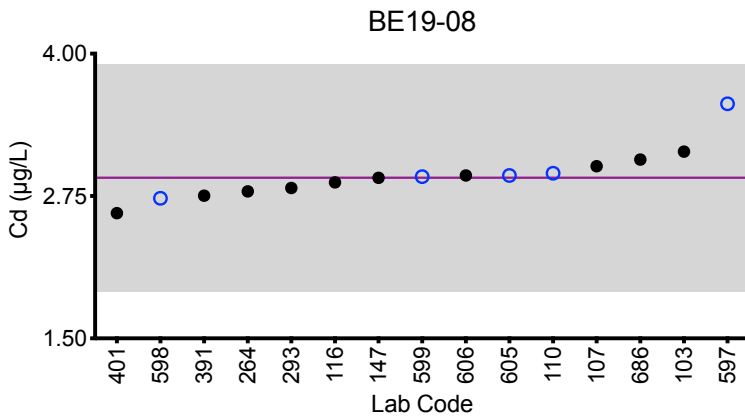
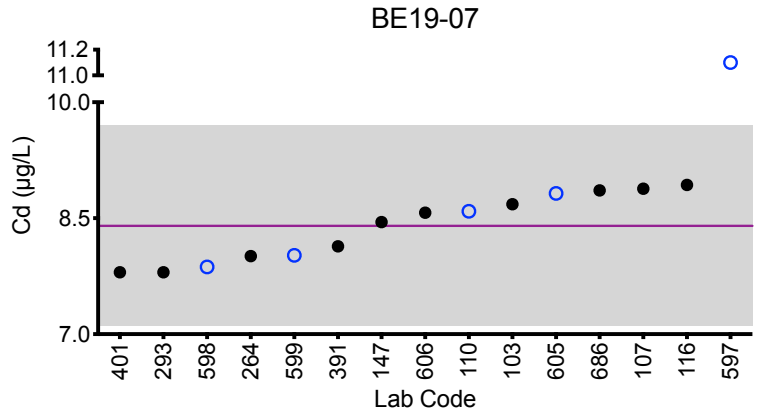
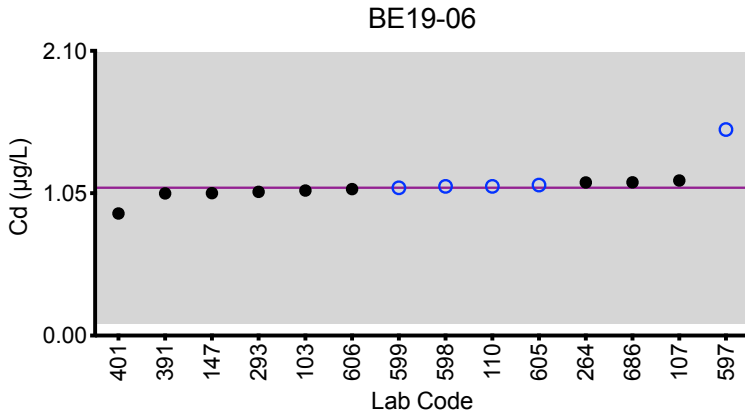
Based on the grading criteria for Cd in Whole Blood, 97% of results were satisfactory, with 1 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Whole Blood Cd



Legend:

○ CHEAR Labs ● Other Labs

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



Results for Event #2, 2019: Summary Statistics

	Whole Blood Co (µg/L)				
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target (Robust Mean (x*))	5.76	0.51	3.02	13.0	15.9
Upper Limit	7.26	2.01	4.52	15.6	19.1
Lower Limit	4.26	0.00	1.52	10.4	12.7
Robust SD (s*)	0.22	0.05	0.11	0.6	0.7
Robust RSD (%)	3.8	9.8	3.6	4.6	4.4
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (u)	0.09	0.02	0.04	0.2	0.3

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



Results for Event #2, 2019: Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target		5.76	0.51	3.02	13.0	15.9
103	DRC/CC-ICP-MS	5.77	0.468	3.05	13.1	15.9
110	ICP-MS	5.6	0.5	3.0	12.9	15.8
147	ICP-MS	5.72	0.477	2.93	12.4	15
264	ICP-MS	5.646	0.448	2.957	13.233	15.609
293	DRC/CC-ICP-MS	5.61	0.48	2.96	12.55	15.7
391	DRC/CC-ICP-MS	5.349	0.515	2.693	12.308	15.056
401	DRC/CC-ICP-MS	5.8	0.5	3.0	12.7	15.6
597	DRC/CC-ICP-MS	7.20	0.699	3.6	15.3	19.9 ↑
598	ICP-MS	6.74	0.7	4.35	15	18.9
599	DRC/CC-ICP-MS	5.88	0.599	3.23	13.0	16.6

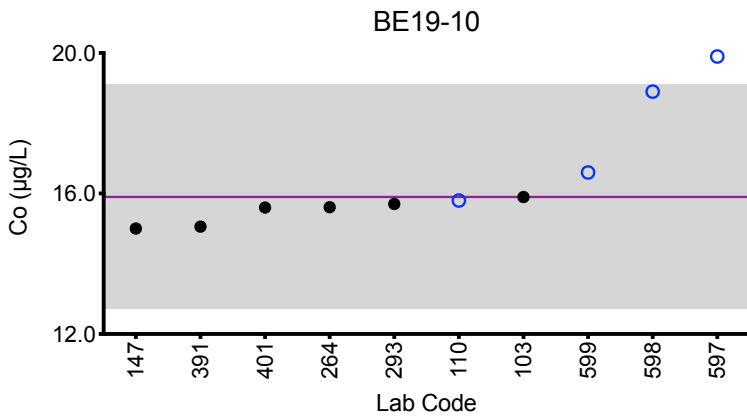
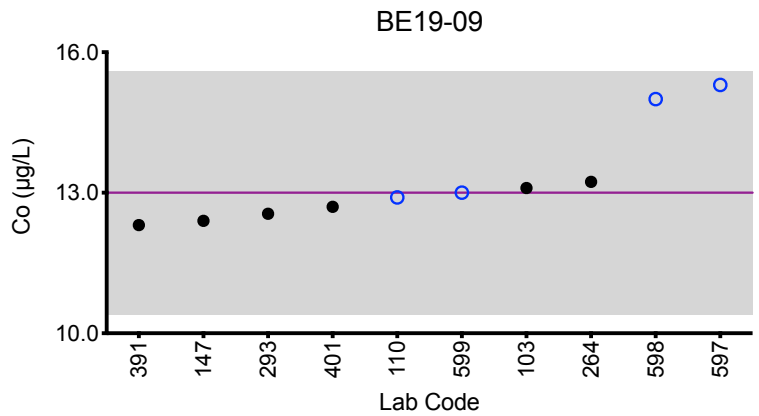
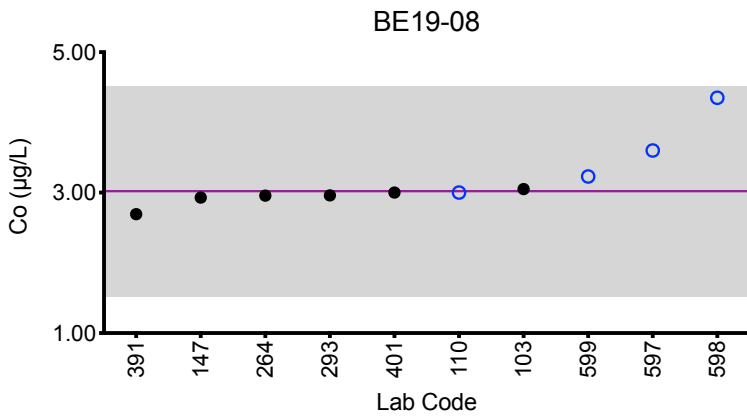
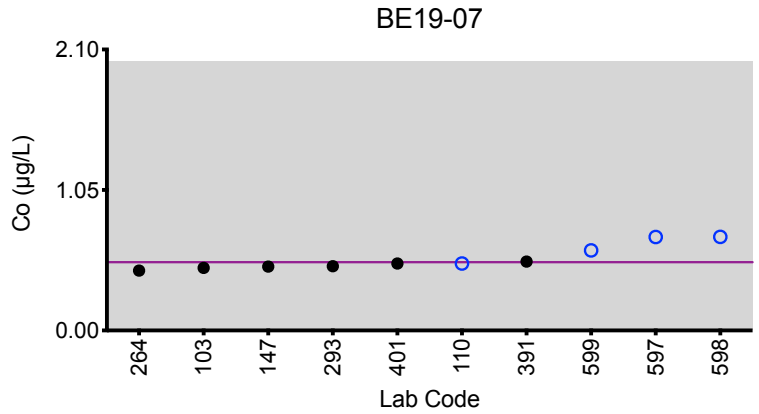
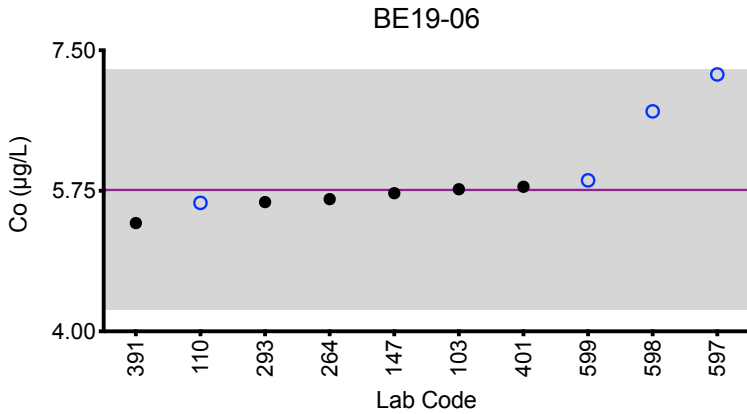
Based on the grading criteria for Co in Whole Blood, 98% of results were satisfactory, with 0 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Whole Blood Co



Legend:

○ CHEAR 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:

$\pm 1.5 \mu\text{g/L}$ or $\pm 20\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 1.5 \mu\text{g/L}$ at concentrations less than or equal to $7.5 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

Whole Blood Cr ($\mu\text{g/L}$)					
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target (Arithmetic Mean (\bar{x}))	15.5	3.6	1.6	12.6	8.8
Upper Limit	18.6	5.6	3.6	15.1	10.8
Lower Limit	12.4	1.6	0.0	10.1	6.8
Arithmetic SD (s)	0.9	0.7	0.4	1.1	0.7
Arithmetic RSD (%)	5.8	19	25	8.7	8.9
Number of Sample Measurements (N)	7	8	8	8	8

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



Results for Event #2, 2019: Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target		15.5	3.6	1.6	12.6	8.8
110	DRC/CC-ICP-MS	16.2	3.3	1.2	12.2	8.1
147	DRC/CC-ICP-MS	15.3	3.07	1.06	12.1	7.8
264	ICP-MS	15.079	3.856	1.943	12.191	7.822
293	DRC/CC-ICP-MS	16.24	3.68	1.32	12.17	8.28
391	DRC/CC-ICP-MS	13.73	2.489	1.797	11.568	7.58
401	DRC/CC-ICP-MS	15.8	4.5	2.3	12.3	8.5
597	DRC/CC-ICP-MS	*21.1 ↑	4.63	1.9	15.0	9.82
598	DRC/CC-ICP-MS	16.4	3.67	1.33	13.2	9.05
599	DRC/CC-ICP-MS	NR	*7.62 ↑	*5.28 ↑	*22.3 ↑	*12.0 ↑

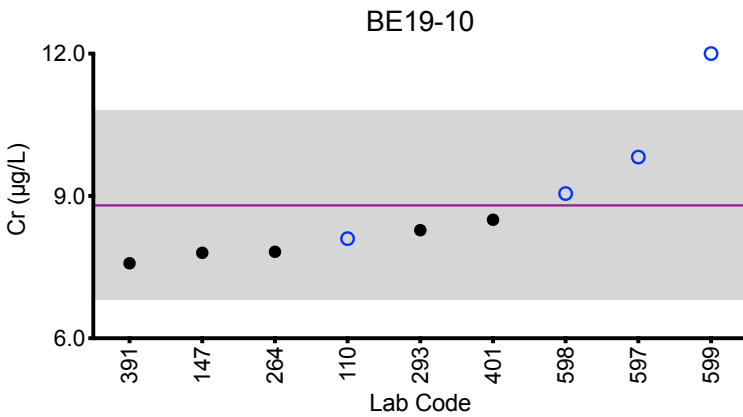
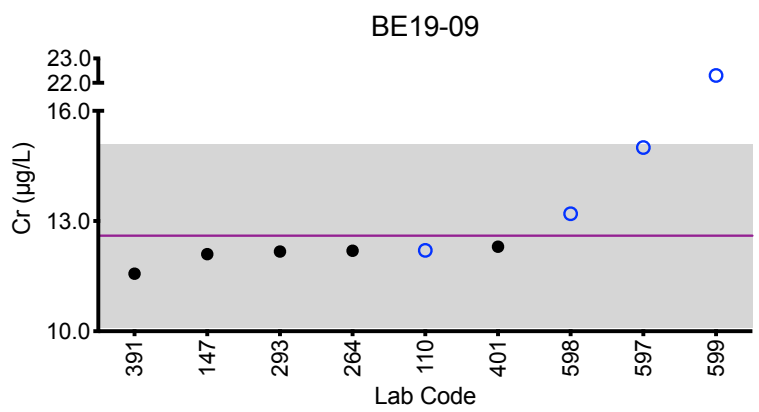
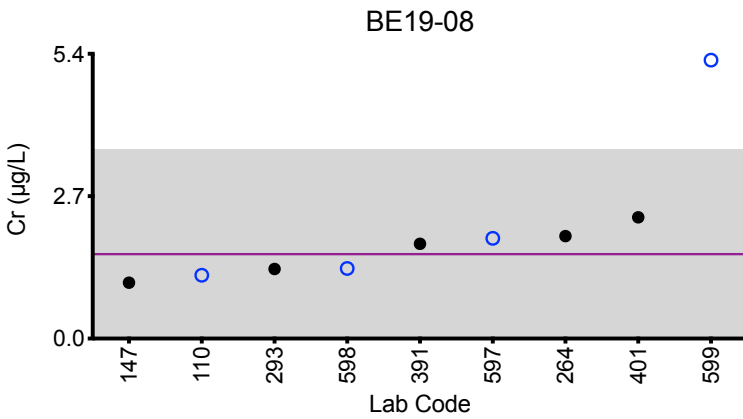
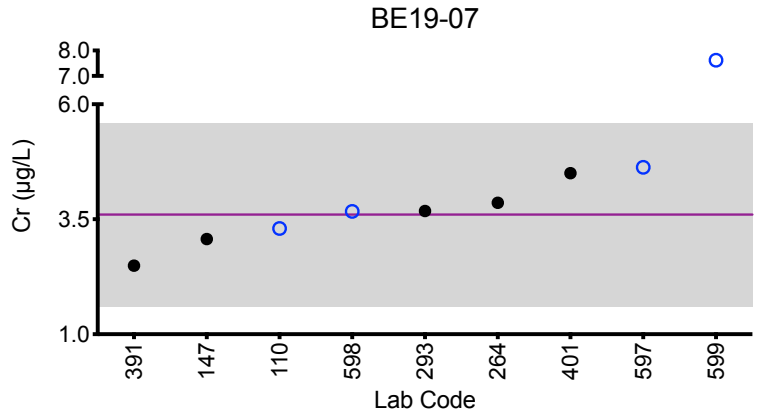
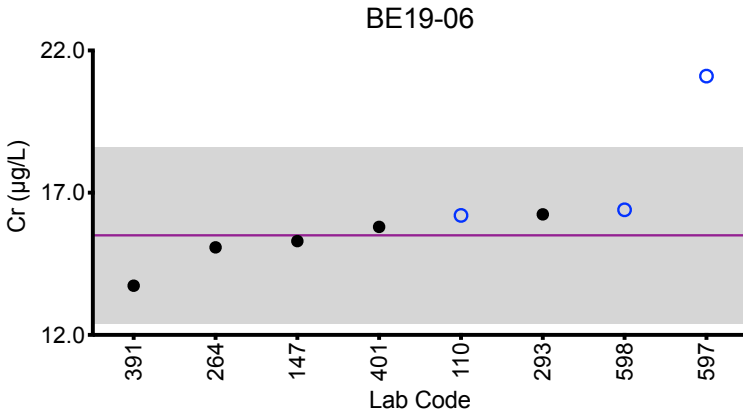
Based on the grading criteria for Cr in Whole Blood, 89% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Whole Blood Cr



Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±2 µg/L at concentrations less than or equal to 10 µg/L.



Results for Event #2, 2019: Summary Statistics

Whole Blood Hg (µg/L)					
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target (Robust Mean (x*))	21.5	11.4	3.35	7.3	32.0
Upper Limit	28.0	14.8	6.35	10.3	41.6
Lower Limit	15.1	8.0	0.35	4.3	22.4
Robust SD (s*)	1.8	0.9	0.19	0.5	1.5
Robust RSD (%)	8.4	7.9	5.7	6.8	4.7
Number of Sample Measurements (N)	16	16	16	15	14
Standard Uncertainty (u)	0.6	0.3	0.06	0.2	0.5

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



Results for Event #2, 2019: Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
	Target	21.5	11.4	3.35	7.3	32.0
103	DRC/CC-ICP-MS	22.7	11.7	3.37	7.65	33.0
107	ICP-MS/MS	22.13	11.47	3.31	7.24	32.14
110	ICP-MS	21.1	11.4	3.39	7.56	31.1
116	ICP-MS/MS	22.8	12.2	3.63	7.50	33.8
147	ICP-MS	19.5	11	3.25	6.72	29.5
200	ICP-MS	19.5	10.6	3	7.2	29.3
264	ICP-MS	46.344 ↑	23.869 ↑	7.784 ↑	16.449 ↑	*65.885 ↑
293	DRC/CC-ICP-MS	21.2	10.76	3.49	6.69	31.2
391	CV-AAS	14.875 ↓	8.926	9.124 ↑	*38.87 ↑	*4.092 ↓
401	DRC/CC-ICP-MS	17.1	10.2	3.2	7.0	29.9
597	A-7 DMA	23.7	11.7	3.29	7.54	33.0
598	ICP-MS	21.8	12.6	4	8.46	32.9
599	DRC/CC-ICP-MS	21.4	10.8	3.06	6.73	33.2
605	ICP-MS	22.2	11.7	3.24	7.26	32.5
606	ICP-MS/MS	21.3	11.3	3.25	7.29	31.8
686	ICP-MS	22.8	12.0	3.35	7.68	33.5

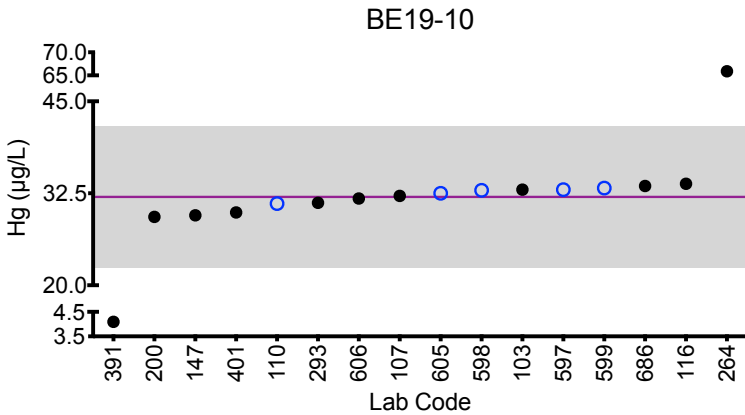
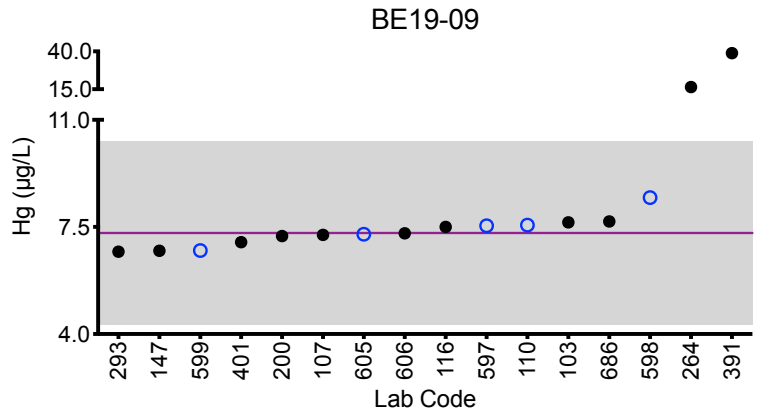
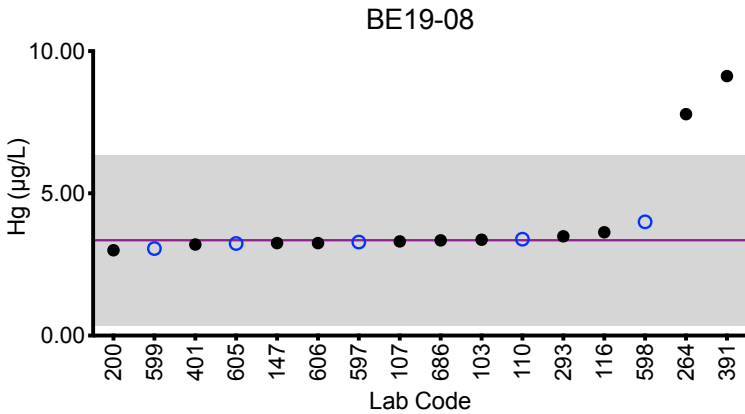
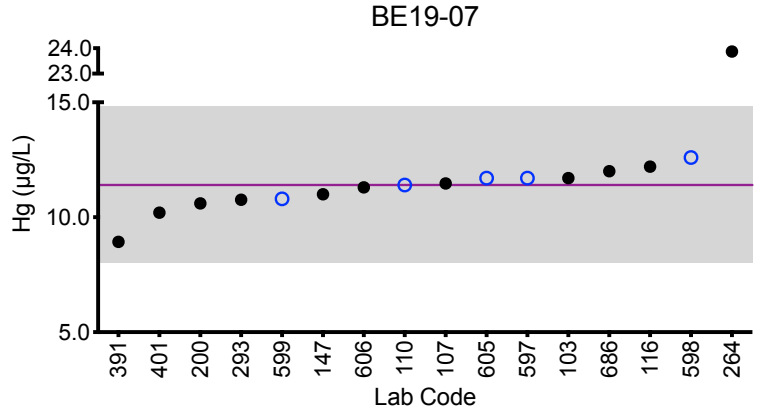
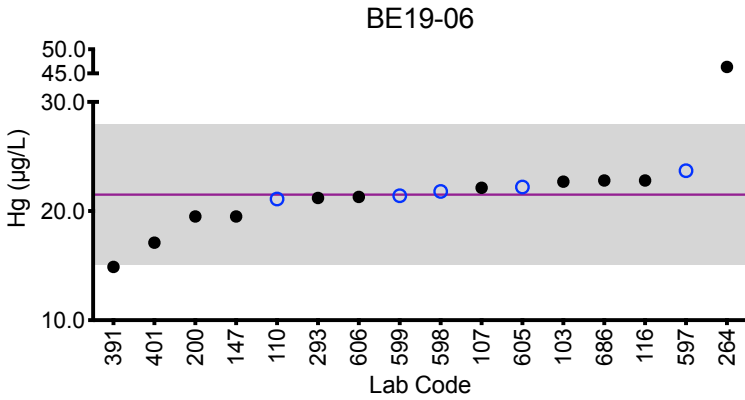
Based on the grading criteria for Hg in Whole Blood, 89% of results were satisfactory, with 2 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Whole Blood Hg



Legend:

- CHEAR 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:
 $\pm 3 \mu\text{g/L}$ or $\pm 30\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 3 \mu\text{g/L}$ at concentrations less than or equal to $10 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

Whole Blood Mn (µg/L)					
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target (Robust Mean (x*))	31.8	23.3	19.0	34.7	16.4
Upper Limit	37.2	27.3	22.2	40.6	19.4
Lower Limit	26.4	19.3	15.8	28.8	13.4
Robust SD (s*)	2.0	1.5	1.6	2.4	1.1
Robust RSD (%)	6.3	6.4	8.4	6.9	6.7
Number of Sample Measurements (N)	12	12	12	12	12
Standard Uncertainty (u)	0.7	0.5	0.6	0.9	0.4

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



Results for Event #2, 2019: Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target		31.8	23.3	19.0	34.7	16.4
103	DRC/CC-ICP-MS	32.4	23.6	18.7	34.5	16.2
107	ICP-MS/MS	30.63	21.59	17.91	32.12	15.01
110	ICP-MS	31.4	24.1	19.7	37.4	16.9
147	ICP-MS	32.2	24.1	20.6	34.4	17.1
264	ICP-MS	34.113	25.53	20.628	36.742	18.046
293	DRC/CC-ICP-MS	28.17	22.08	15.87	32.95	15.21
391	DRC/CC-ICP-MS	28.266	22.962	18.284	31.145	15.292
401	DRC/CC-ICP-MS	32.1	23.7	19.5	34.6	16.8
597	DRC/CC-ICP-MS	38.2 ↑	30.3 ↑	23.2 ↑	39.2	20.2 ↑
598	ICP-MS	30.7	23.2	17.2	34.7	16.1
599	DRC/CC-ICP-MS	48.9 ↑	21.6	19.2	36.2	16.7
606	ICP-MS/MS	30.7	22.3	17.9	33.4	15.9

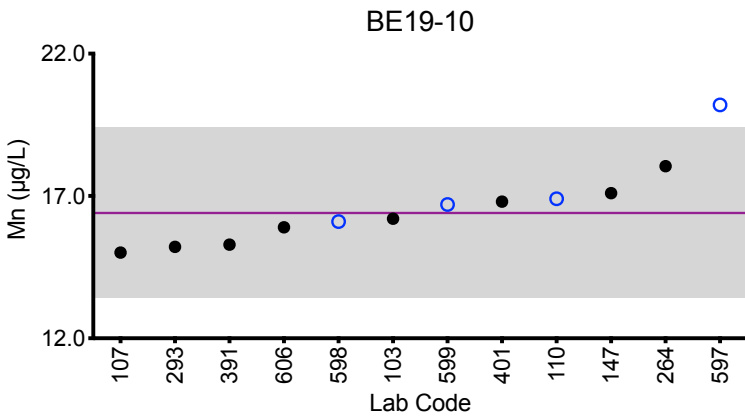
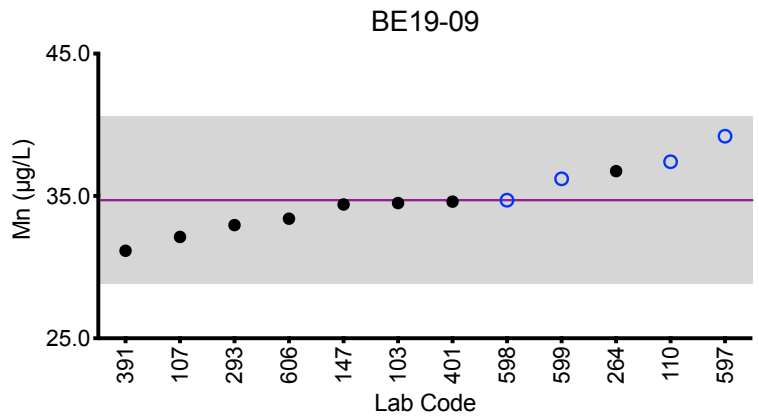
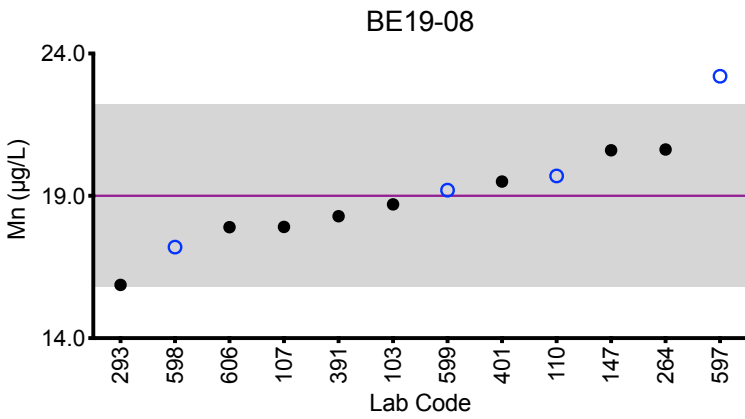
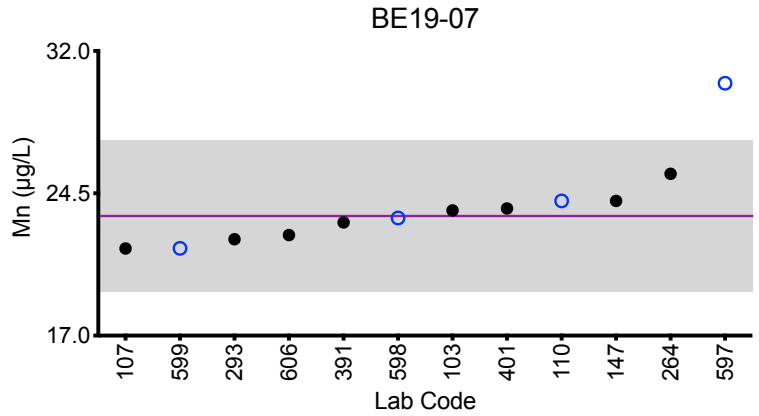
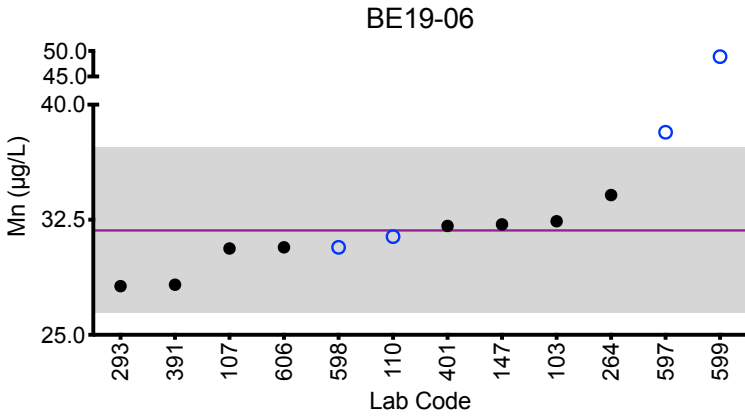
Based on the grading criteria for Mn in Whole Blood, 92% of results were satisfactory, with 1 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Whole Blood Mn



Legend:
 ○ CHEAR 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:
 $\pm 3 \mu\text{g/L}$ or $\pm 17\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 3 \mu\text{g/L}$ at concentrations less than or equal to $17.7 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

Whole Blood Pb ($\mu\text{g}/\text{dL}$)					
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Target (Robust Mean (x^*))	11.4	71	31.5	21.3	2.35
Upper Limit	13.4	78	34.7	23.4	4.35
Lower Limit	9.4	64	28.4	19.2	0.35
Robust SD (s^*)	0.7	3	1.8	1.4	0.10
Robust RSD (%)	6.1	4.8	5.7	6.6	4.3
Number of Sample Measurements (N)	16	15	16	16	14
Standard Uncertainty (u)	0.2	1	0.6	0.5	0.03

The acceptable range is based on quality specifications:

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



Results for Event #2, 2019: Performance of Participating Laboratories

Table with 7 columns: Lab Code, Method, BE19-06, BE19-07, BE19-08, BE19-09, BE19-10. Includes a 'Target' row and 16 data rows for various laboratories.

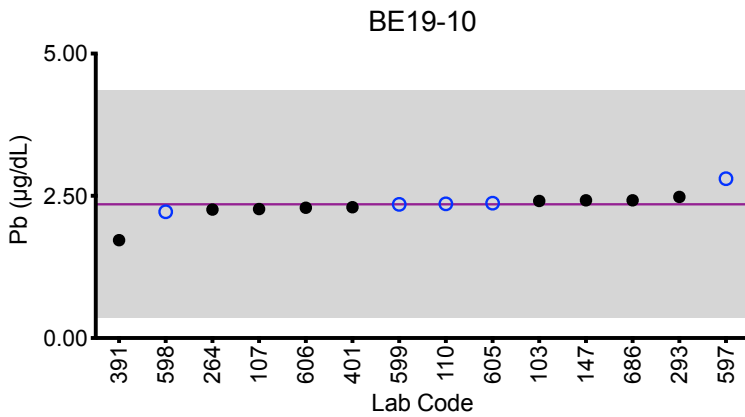
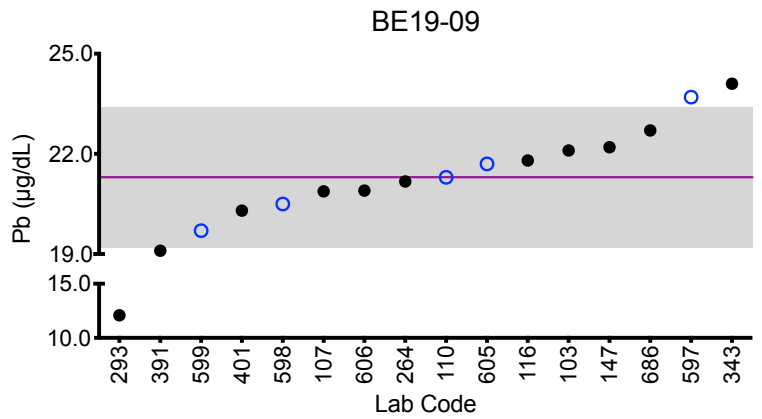
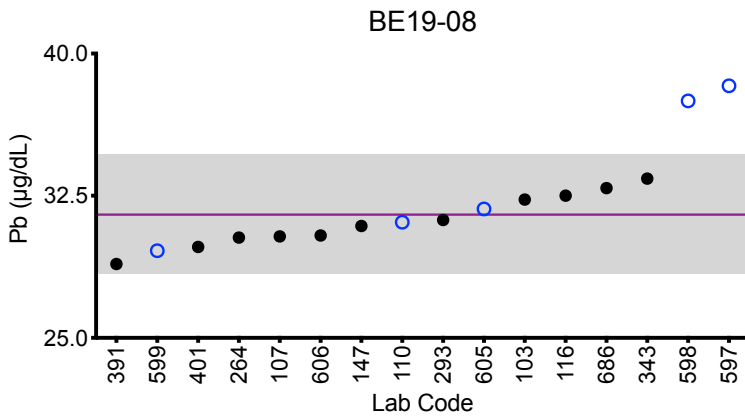
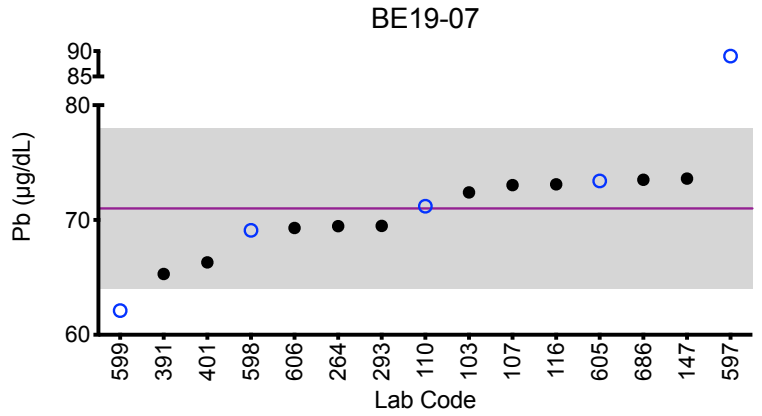
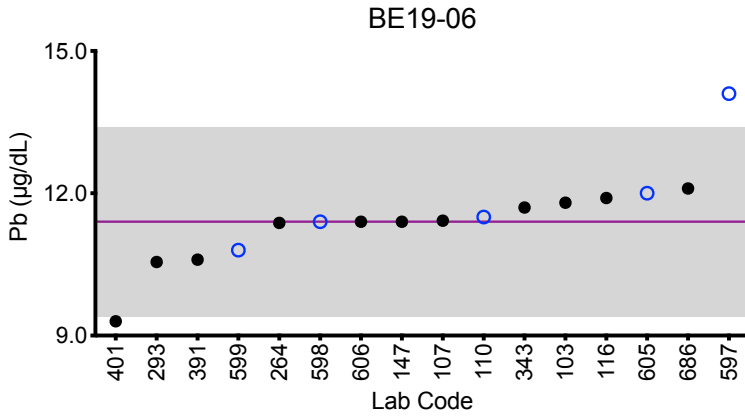
Based on the grading criteria for Pb in Whole Blood, 88% of results were satisfactory, with 1 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Whole Blood Pb



Legend:
 ○ CHEAR 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:
 $\pm 2 \mu\text{g/dL}$ or $\pm 10\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 2 \mu\text{g/dL}$ at concentrations less than or equal to $20 \mu\text{g/dL}$.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood Cu ($\mu\text{g/L}$)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
110	ICP-MS	1600	1850	1010	861	2550
147	ICP-MS	1607	1849	1017	832	2605
597	DRC/CC-ICP-MS	2050	2460	1310	983	3150
598	ICP-MS	1962	2196	1547	982	2904
599	DRC/CC-ICP-MS	1570	1710	1010	770	2540

Summary Statistics

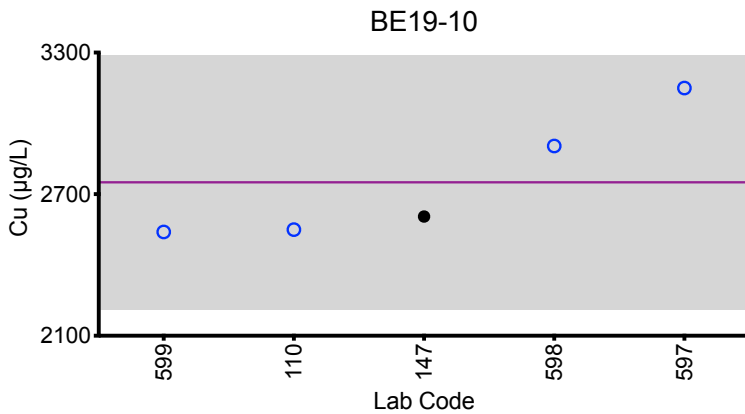
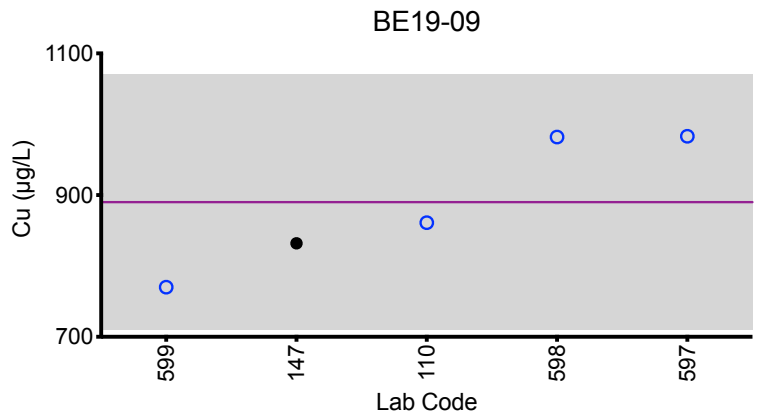
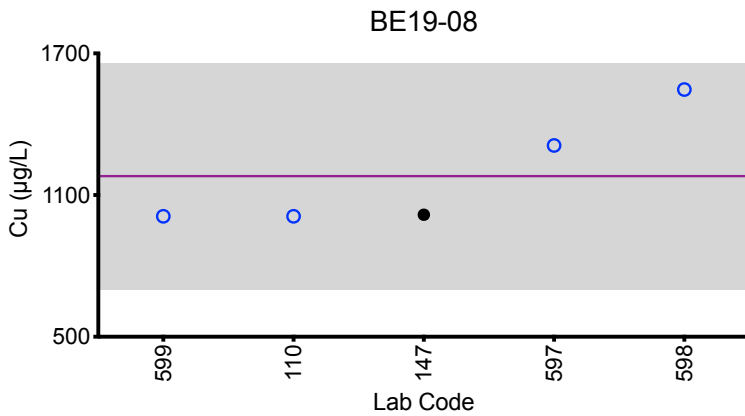
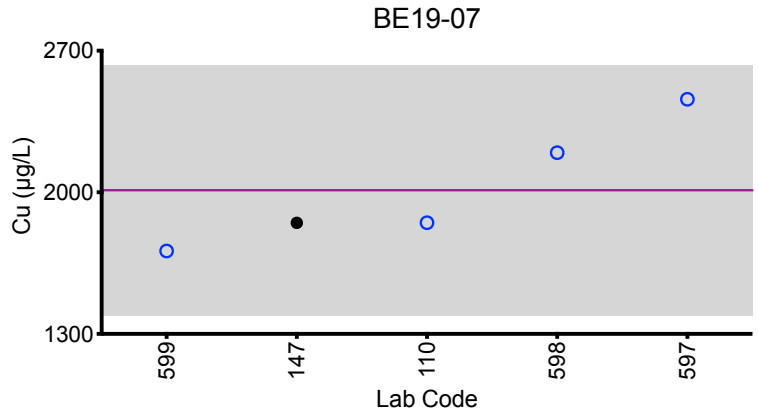
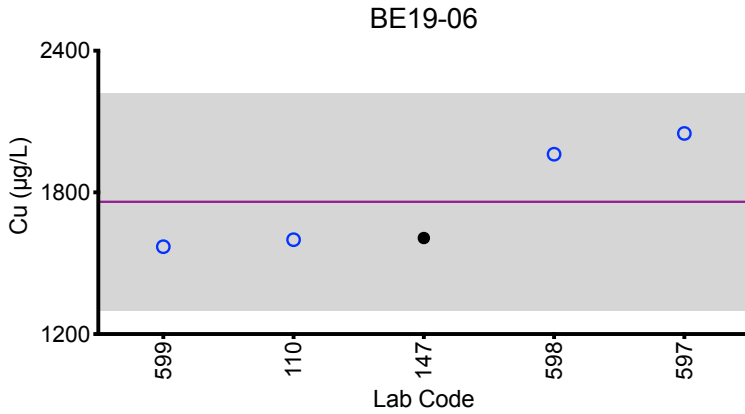
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})	1760	2010	1180	890	2750
Arithmetic SD (s)	230	310	240	90	270
Arithmetic RSD (%)	13	15	20	10	9.8
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Whole Blood Cu



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = ±2SD of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

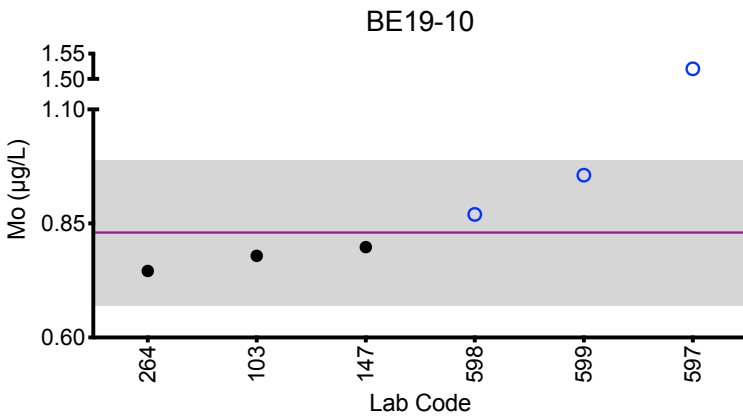
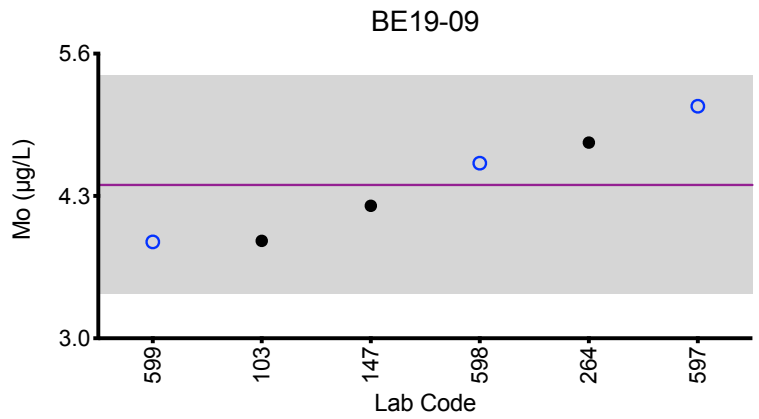
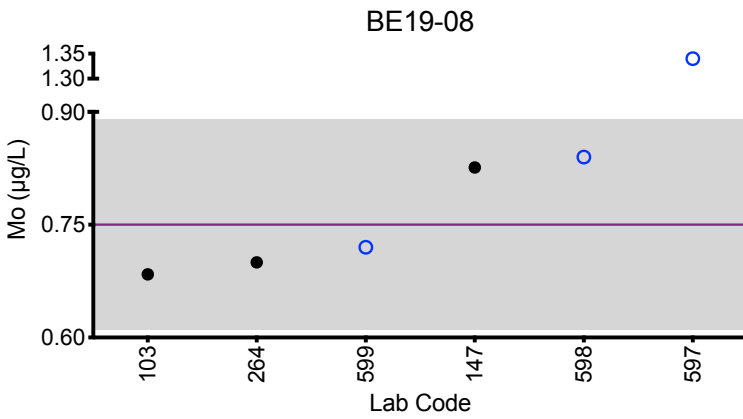
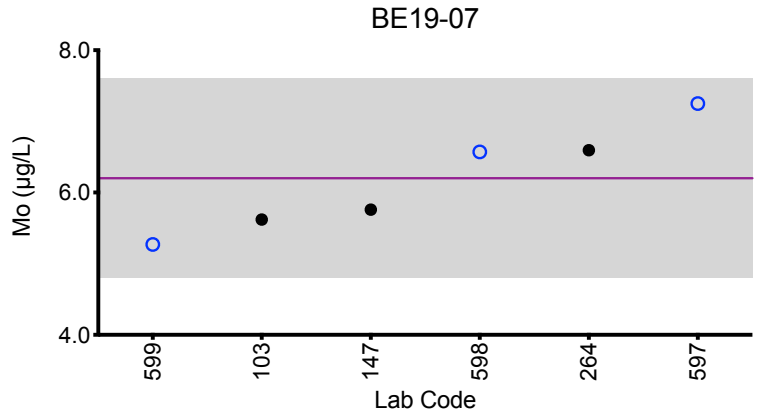
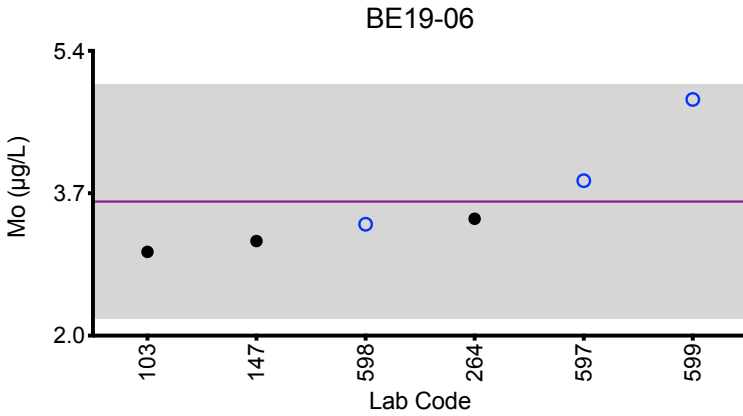
Whole Blood Mo ($\mu\text{g/L}$)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
103	DRC/CC-ICP-MS	3.00	5.62	0.684	3.89	0.779
147	ICP-MS	3.13	5.76	0.826	4.21	0.798
264	ICP-MS	3.395	6.594	0.7	4.787	0.746
597	DRC/CC-ICP-MS	3.85	7.25	*1.34	5.12	*1.52
598	DRC/CC-ICP-MS	3.33	6.57	0.84	4.6	0.87
599	DRC/CC-ICP-MS	4.82	5.27	0.720	3.88	0.956
Summary Statistics						
		BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})		3.6	6.2	0.75	4.4	0.83
Arithmetic SD (s)		0.7	0.7	0.07	0.5	0.08
Arithmetic RSD (%)		19	11	9.3	11	9.6
Number of Sample Measurements (N)		6	6	5	6	5

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Whole Blood Mo



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = ±2SD of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

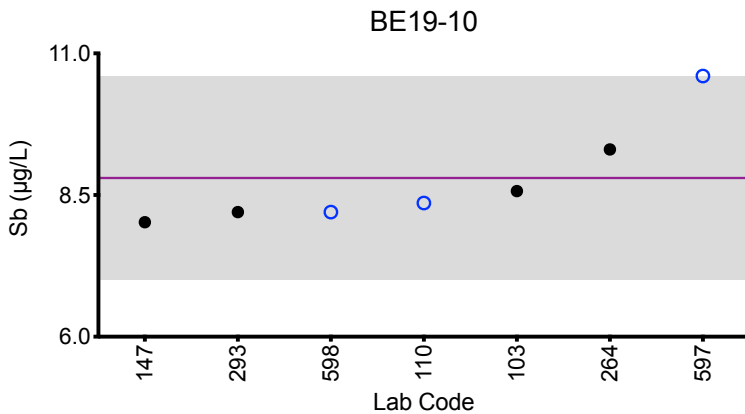
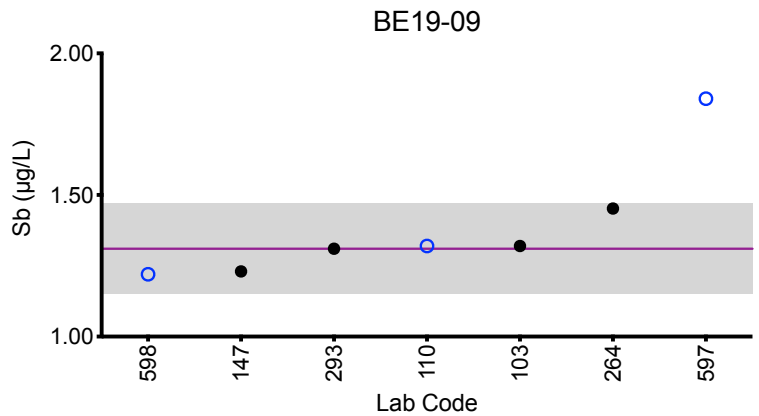
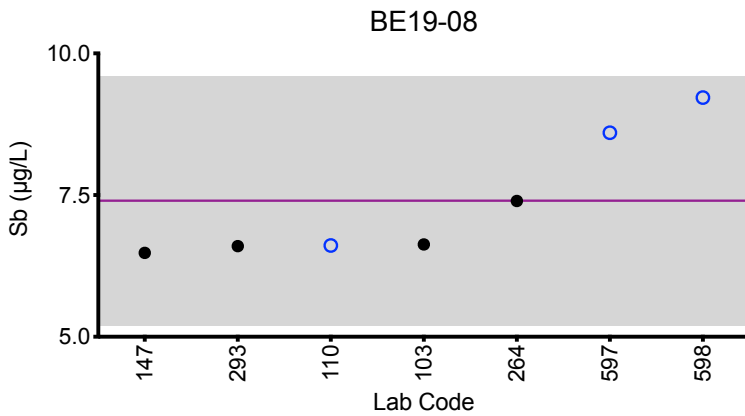
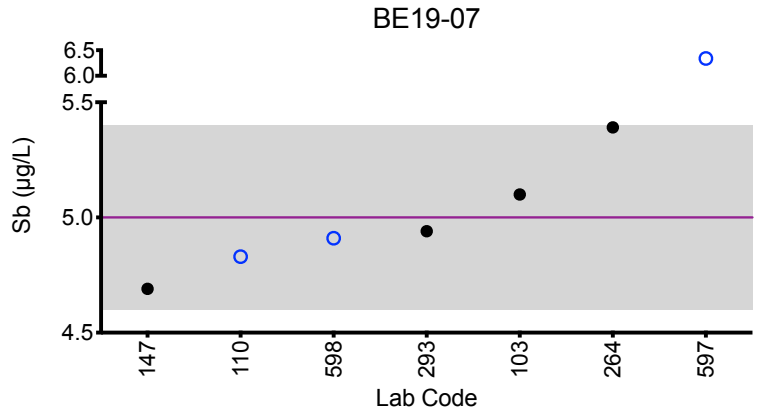
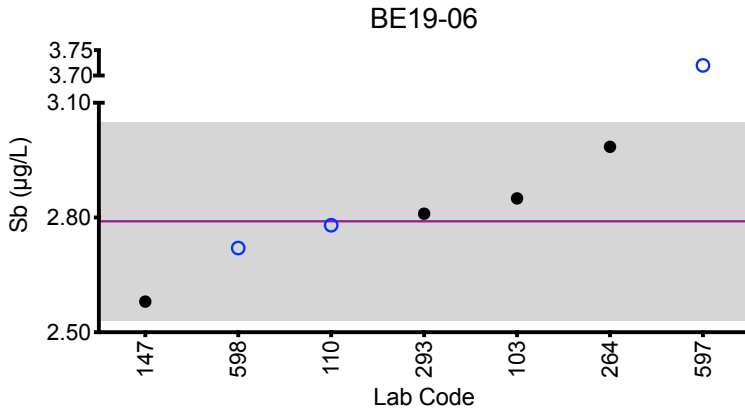
Whole Blood Sb (µg/L)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
103	DRC/CC-ICP-MS	2.85	5.10	6.63	1.32	8.57
110	ICP-MS	2.78	4.83	6.61	1.32	8.36
147	ICP-MS	2.58	4.69	6.48	1.23	8.02
264	ICP-MS	2.985	5.391	7.396	1.452	9.305
293	DRC/CC-ICP-MS	2.81	4.94	6.6	1.31	8.2
597	DRC/CC-ICP-MS	*3.72	*6.34	8.60	*1.84	10.6
598	ICP-MS	2.72	4.91	9.22	1.22	8.2
Summary Statistics						
		BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})		2.79	5.0	7.4	1.31	8.8
Arithmetic SD (s)		0.13	0.2	1.1	0.08	0.9
Arithmetic RSD (%)		4.7	4.8	15	6.1	10
Number of Sample Measurements (N)		6	6	7	6	7

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Whole Blood Sb



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

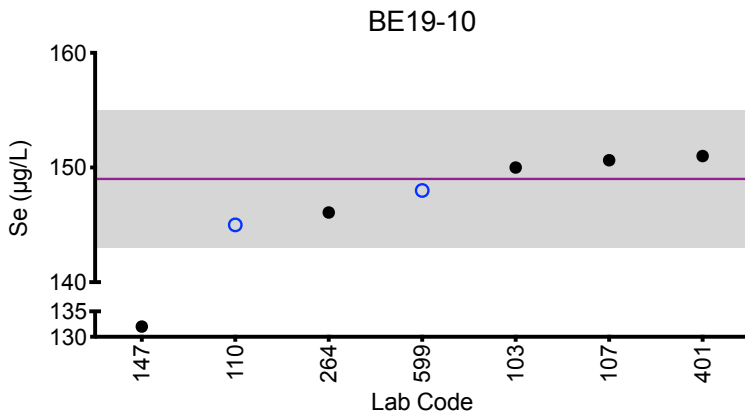
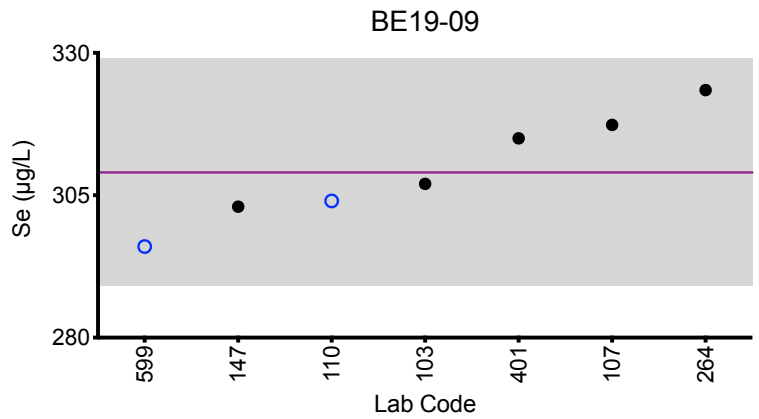
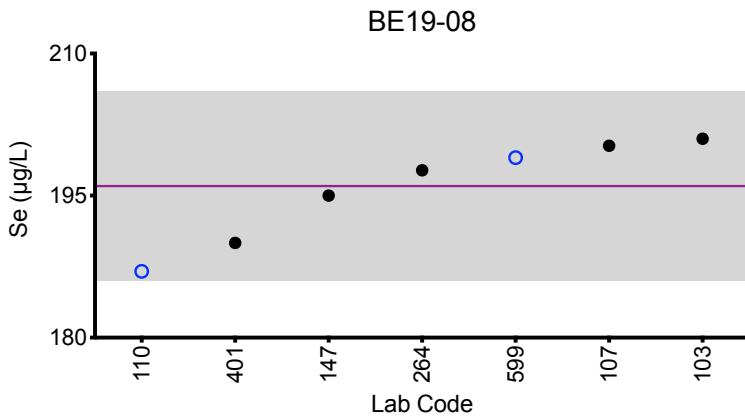
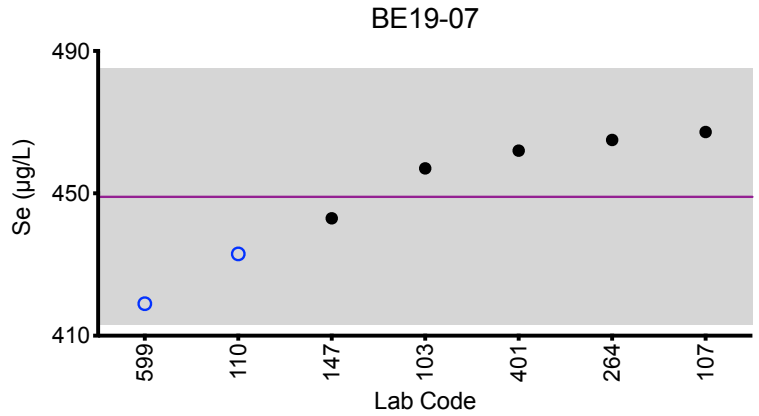
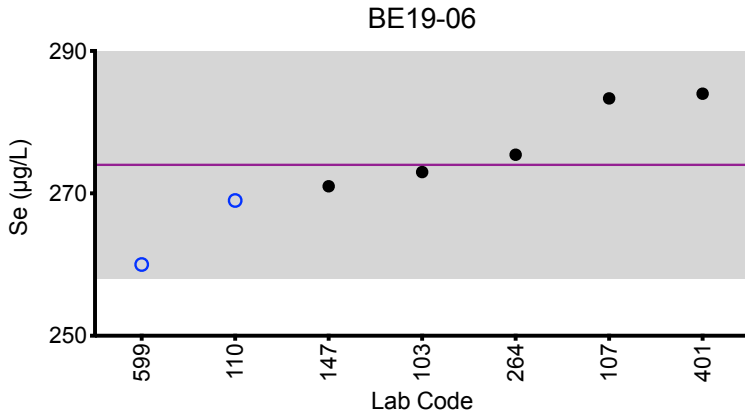
Whole Blood Se (µg/L)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
103	DRC/CC-ICP-MS	273	457	201	307	150
107	ICP-MS/MS	283.34	467.23	200.26	317.36	150.64
110	DRC/CC-ICP-MS	269	433	187	304	145
147	ICP-MS	271	443	195	303	*132
264	ICP-MS	275.437	464.993	197.672	323.466	146.077
401	DRC/CC-ICP-MS	284	462	190	315	151
599	DRC/CC-ICP-MS	260	419	199	296	148
Summary Statistics						
		BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})		274	449	196	309	149
Arithmetic SD (s)		8	18	5	10	3
Arithmetic RSD (%)		2.9	4.1	2.6	3.2	1.7
Number of Sample Measurements (N)		7	7	7	7	6

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Whole Blood Se



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

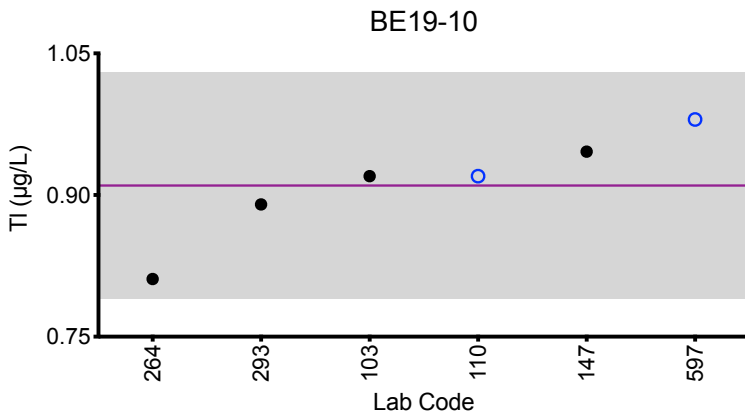
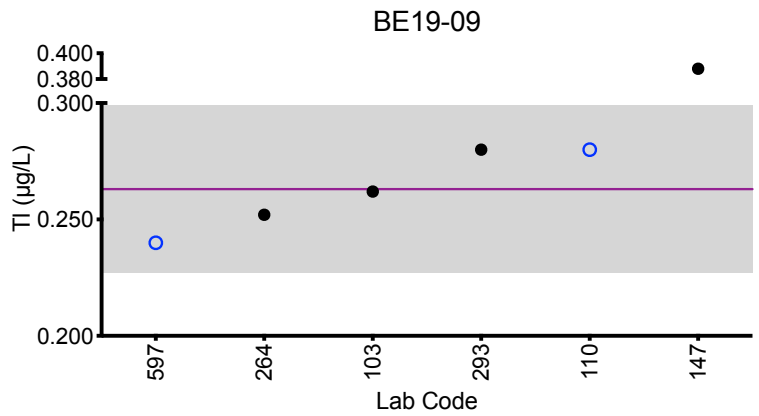
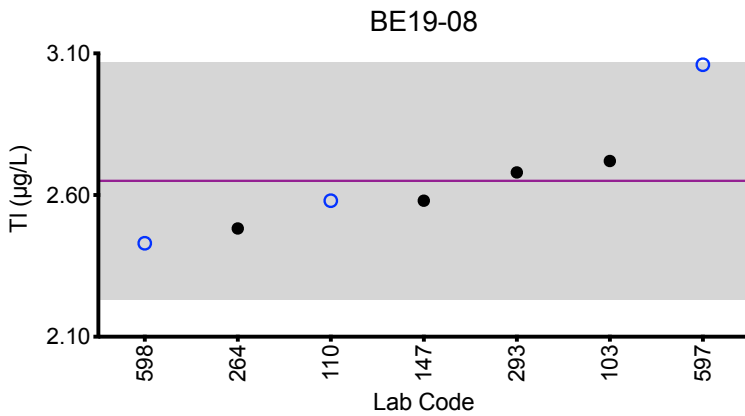
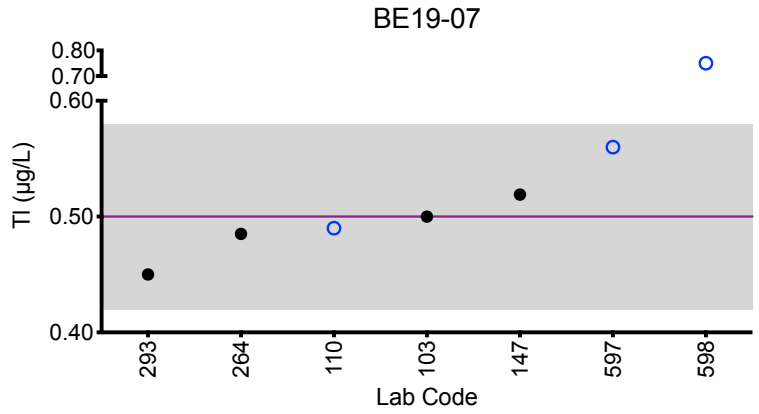
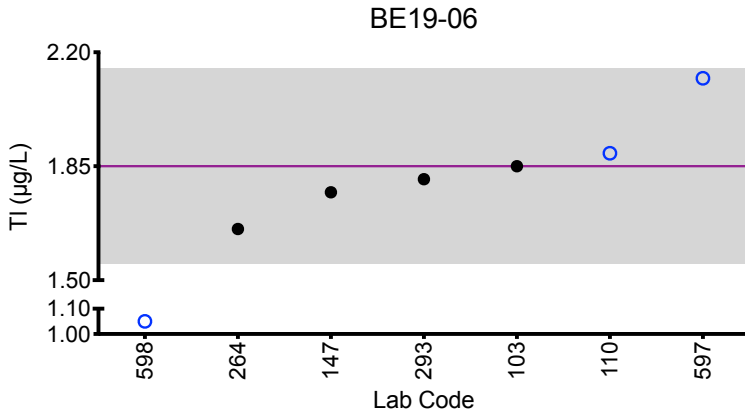
Whole Blood TI ($\mu\text{g/L}$)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
103	DRC/CC-ICP-MS	1.85	0.500	2.72	0.262	0.920
110	ICP-MS	1.89	0.49	2.58	0.28	0.92
147	ICP-MS	1.77	0.519	2.58	*0.388	0.946
264	ICP-MS	1.657	0.485	2.482	0.252	0.811
293	DRC/CC-ICP-MS	1.81	0.45	2.68	0.28	0.89
597	DRC/CC-ICP-MS	2.12	0.56	3.06	0.24	0.98
598	ICP-MS	*1.05	*0.75	2.43	<0.05	<0.05
Summary Statistics						
		BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})		1.85	0.50	2.65	0.263	0.91
Arithmetic SD (s)		0.15	0.04	0.21	0.018	0.06
Arithmetic RSD (%)		8.1	7.4	7.9	6.8	6.6
Number of Sample Measurements (N)		6	6	7	5	6

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Whole Blood TI



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = ±2SD of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)

Table with 7 columns: Lab Code, Method, BE19-06, BE19-07, BE19-08, BE19-09, BE19-10. Rows include lab codes 110, 147, 597, 598, and 599 with their respective methods and values.

Summary Statistics

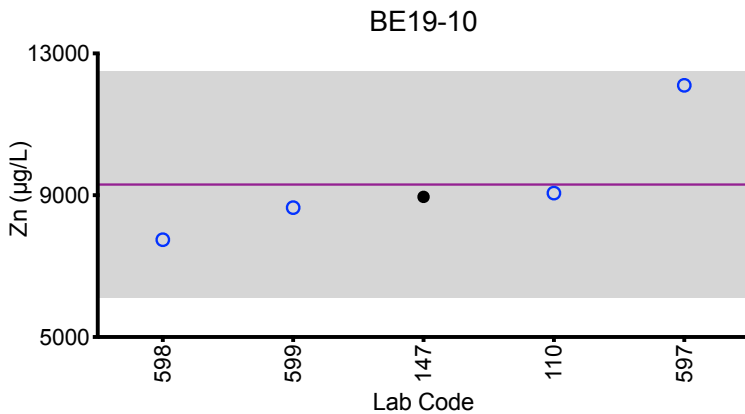
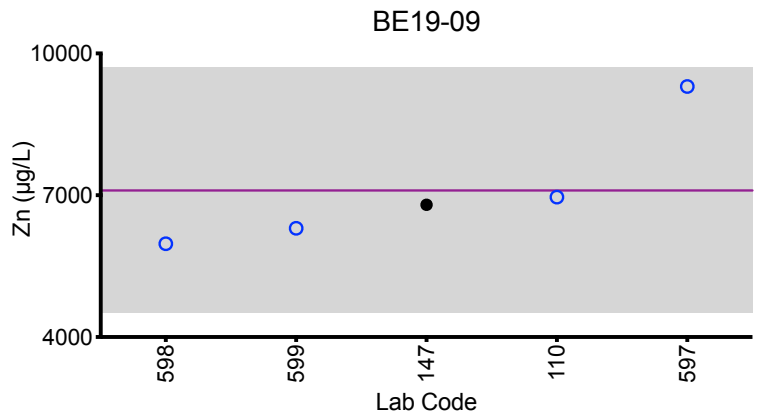
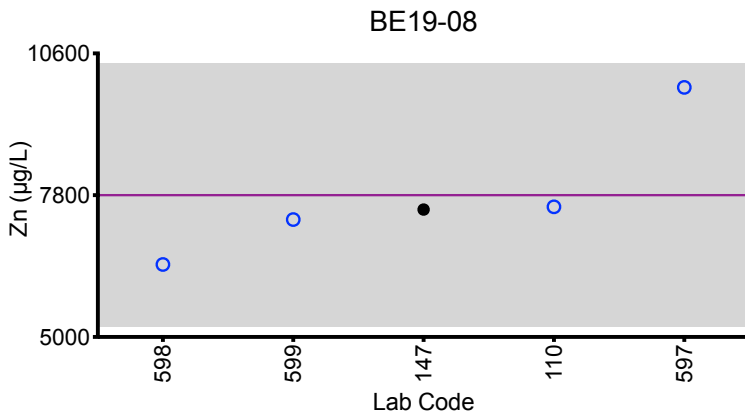
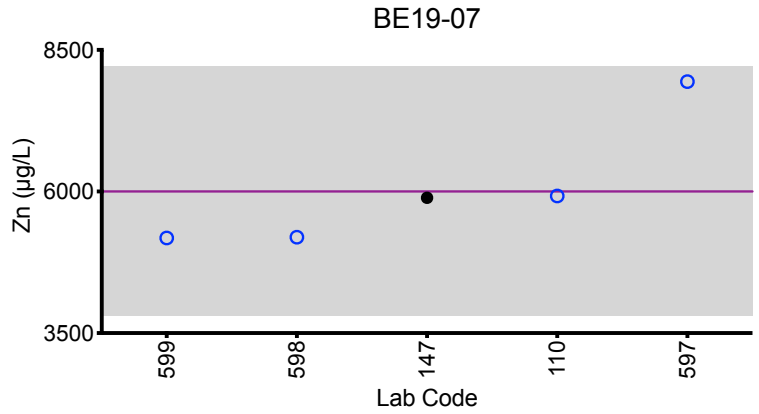
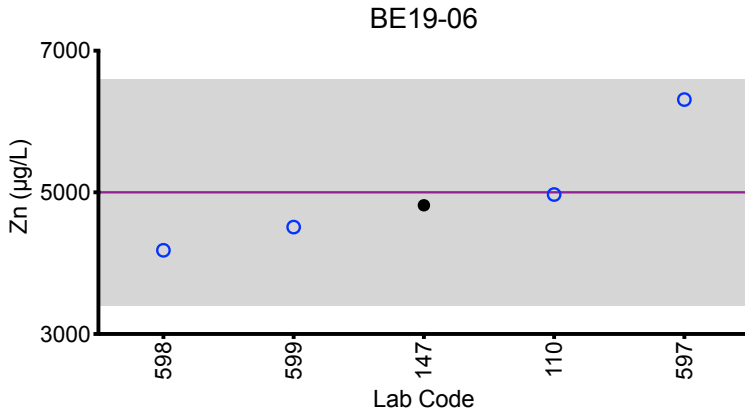
Table with 6 columns: BE19-06, BE19-07, BE19-08, BE19-09, BE19-10. Rows include Arithmetic Mean (x̄), Arithmetic SD (s), Arithmetic RSD (%), and Number of Sample Measurements (N).

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Whole Blood Zn



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
110	ICP-MS	11.7	7.1	4.0	5.0	5.7
147	ICP-MS	11.4	7.31	3.9	4.49	5.6
597	DRC/CC-ICP-MS	14.8	9.64	5.20	6.00	8.10
598	ICP-MS	16.7	8.66	5.74	4.28	6.18

Summary Statistics

	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})	14	8.2	4.7	4.9	6.4
Arithmetic SD (s)	3	1.2	0.9	0.8	1.2
Arithmetic RSD (%)	18	15	19	16	19
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
110	ICP-MS	3.34	6.30	0.94	4.56	2.43
147	ICP-MS	3.5	6.2	<1.53	5.14	2.59
293	DRC/CC-ICP-MS	3.17	5.72	0.99	4.4	2.6
598	ICP-MS	4.48	10.1	1.31	5.42	3.13

Summary Statistics

	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})	3.6	7	1.1	4.9	2.7
Arithmetic SD (s)	0.6	2	0.2	0.5	0.3
Arithmetic RSD (%)	17	28	19	10	11
Number of Sample Measurements (N)	4	4	3	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
110	ICP-MS	2.54	2.01	2.51	1.98	1.13
597	DRC/CC-ICP-MS	3.32	2.80	3.35	2.49	1.53
598	ICP-MS	2.66	1.98	3.47	2.01	0.91
599	DRC/CC-ICP-MS	2.54	1.88	2.63	2.23	1.18

Summary Statistics

	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})	2.8	2.2	3.0	2.2	1.2
Arithmetic SD (s)	0.4	0.4	0.5	0.2	0.3
Arithmetic RSD (%)	14	18	17	11	22
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood Ni ($\mu\text{g/L}$)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
110	DRC/CC-ICP-MS	1.1	8.5	3.0	13.5	5.8
147	ICP-MS	1.16	8.04	2.84	12.3	5.07
597	DRC/CC-ICP-MS	1.46	11.28	3.78	16.4	6.68
598	ICP-MS	*9.4	15.4	*8.99	19.5	10.6
Summary Statistics						
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10	
Arithmetic Mean (\bar{x})	1.2	11	3.2	15	7	
Arithmetic SD (s)	0.2	3	0.5	3	3	
Arithmetic RSD (%)	15	27	16	20	36	
Number of Sample Measurements (N)	3	4	3	4	4	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood Pt ($\mu\text{g/L}$)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
110	ICP-MS	8.00	5.62	0.90	5.57	2.04
598	ICP-MS	7.94	5.04	0.62	4.75	1.17
599	DRC/CC-ICP-MS	8.85	5.16	0.857	5.25	1.74
Summary Statistics						
		BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})		8.3	5.3	0.79	5.2	1.7
Arithmetic SD (s)		0.5	0.3	0.15	0.4	0.4
Arithmetic RSD (%)		6.0	5.7	19	7.7	24
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood Sn ($\mu\text{g/L}$)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
110	ICP-MS	5.45	6.10	0.17	1.58	2.80
147	ICP-MS	5.43	6.28	0.21	1.71	2.89
597	DRC/CC-ICP-MS	6.52	8.10	<0.26	1.85	3.56
598	ICP-MS	6.65	6.31	<1	1.17	2.58

Summary Statistics					
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})	6.0	6.7	0.19	1.6	3.0
Arithmetic SD (s)	0.7	0.9	0.03	0.3	0.4
Arithmetic RSD (%)	12	13	16	18	13
Number of Sample Measurements (N)	4	4	2	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood U ($\mu\text{g/L}$)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
103	DRC/CC-ICP-MS	0.170	<0.0500	<0.0500	0.0666	0.273
110	ICP-MS	0.165	0.027	0.039	0.067	0.256
147	ICP-MS	0.152	<0.020	0.0371	0.0643	0.267
598	ICP-MS	<0.04	<0.04	<0.04	<0.04	<0.04
Summary Statistics						
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10	
Arithmetic Mean (\bar{x})	0.162	NA	0.0381	0.0660	0.265	
Arithmetic SD (s)	0.009	NA	0.0013	0.0015	0.009	
Arithmetic RSD (%)	5.6	NA	3.4	2.3	3.4	
Number of Sample Measurements (N)	3	1	2	3	3	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood V (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
110	DRC/CC-ICP-MS	2.6	6.2	0.8	5.6	4.9
147	DRC/CC-ICP-MS	2.74	6.28	0.796	5.46	5.05
597	DRC/CC-ICP-MS	3.20	7.47	1.16	5.96	5.75
598	DRC/CC-ICP-MS	3.1	6.41	1.01	6.38	5.43

Summary Statistics

	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
Arithmetic Mean (\bar{x})	2.9	6.6	0.94	5.9	5.3
Arithmetic SD (s)	0.3	0.6	0.18	0.4	0.4
Arithmetic RSD (%)	10	9.1	19	6.8	7.5
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Whole Blood W ($\mu\text{g/L}$)						
Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
110	ICP-MS	0.32	0.52	0.10	0.94	0.73
200	ICP-MS	0.37	0.57	0.13	0.97	0.79
598	ICP-MS	<1	<1	<1	<1	<1

Summary Statistics						
	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10	
Arithmetic Mean (\bar{x})	0.34	0.54	0.12	0.96	0.76	
Arithmetic SD (s)	0.04	0.04	0.02	0.02	0.04	
Arithmetic RSD (%)	12	7.4	18	2.2	5.3	
Number of Sample Measurements (N)	2	2	2	2	2	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Additional Elements in Whole Blood

Whole Blood Ag (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
147	ICP-MS	<0.173	<0.173	<0.173	<0.173	<0.173

Whole Blood Al (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
147	ICP-MS	<5.40	<5.40	<5.40	<5.40	<5.40
597	DRC/CC-ICP-MS	15.4	14.5	15.5	20.4	20.8

Whole Blood Bi (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
147	ICP-MS	<0.025	<0.025	<0.025	<0.025	0.322

Whole Blood I (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
147	ICP-MS	25.2	35.1	27.5	33.9	38.2

Whole Blood Li (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
147	ICP-MS	0.944	0.812	0.944	0.77	0.569

Whole Blood Mg (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
597	DRC/CC-ICP-MS	38700	35800	39300	32100	33000

Whole Blood Sr (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
103	DRC/CC-ICP-MS	22.3	17.7	22.7	17.1	26.1

Whole Blood Te (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
147	ICP-MS	<0.0791	<0.0791	<0.0791	<0.0791	<0.0791

Whole Blood Th (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
147	ICP-MS	<0.017	<0.017	<0.017	<0.017	<0.017

Whole Blood Ti (µg/L)

Lab Code	Method	BE19-06	BE19-07	BE19-08	BE19-09	BE19-10
200	DRC/CC-ICP-MS	3.2	4.8	2.5	6.7	8.4



**Department
of Health**

**Wadsworth
Center**

Event #2, 2019

**Trace Elements in
Urine**

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory



Event #2, 2019: Trace Elements in Urine

PT Materials

Urine was collected from volunteer donors into polyethylene containers and stored at 4°C. Following collection, urine was acidified to 1% (v/v) with nitric acid and mixed with a sulfamic acid solution (stock solution contained 200 mg/mL sulfamic acid and 10% (v/v) Triton-X 100) to a final concentration of 1% (v/v) to stabilize Hg. Urine was stored frozen at -80°C pending further preparation. The urine was thawed at room temperature and precipitated salts removed by centrifugation. Urine supernatants were combined into five separate pools. Each urine pool was supplemented with arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), cobalt (Co), chromium (Cr), mercury (Hg), manganese (Mn), lead (Pb), thallium (Tl), uranium (U), aluminum (Al), cesium (Cs), copper (Cu), molybdenum (Mo), nickel (Ni), platinum (Pt), antimony (Sb), selenium (Se), tin (Sn), strontium (Sr), tellurium (Te), vanadium (V), tungsten (W), and zinc (Zn) and were homogenized overnight prior to aliquoting 10-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 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 20 elements were reported by at least one participant: Ag, Al, Bi, Cs, Cu, Fe, Li, Mg, Mo, Ni, Pt, Sb, Se, Sn, Sr, Te, Th, V, W, and Zn. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

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



Results for Event #2, 2019: Summary Statistics

	Urine As (µg/L)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x*))	66.8	77	26.7	9.7	188
Upper Limit	80.2	92	32.7	15.7	226
Lower Limit	53.4	61	20.7	3.7	150
Robust SD (s*)	2.8	4	1.0	0.6	8
Robust RSD (%)	4.2	4.6	3.7	6.2	4.3
Number of Sample Measurements (N)	20	20	20	20	20
Standard Uncertainty (u)	0.8	1	0.3	0.2	2

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine As (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	66.8	77	26.7	9.7	188
103	DRC/CC-ICP-MS	64.9	74.6	26.2	9.24	178
107	DRC/CC-ICP-MS	65.36	75.59	25.85	9.18	179.81
110	DRC/CC-ICP-MS	70.0	79.4	28.3	10.4	197
116	ICP-MS/MS	67.8	78.8	26.8	9.60	189
147	ICP-MS	64.8	74.2	25.5	8.99	185
264	ICP-MS	69.369	84.809	27.576	9.818	197.204
293	DRC/CC-ICP-MS	65.87	75.54	26.54	9.42	183.97
324	ICP-MS	66.984	77.888	27.783	9.968	189.761
391	DRC/CC-ICP-MS	61.131	68.344	24.302	8.784	161.559
399	DRC/CC-ICP-MS	66.3	73.2	26.2	9.73	185
401	DRC/CC-ICP-MS	66.2	74.8	26.2	9.44	183
597	DRC/CC-ICP-MS	76.6	88.6	34.4 ↑	12.6	224
598	DRC/CC-ICP-MS	63.1	73.7	26.5	9.62	184.1
599	DRC/CC-ICP-MS	65.1	75.2	25.3	9.58	180
604	DRC/CC-ICP-MS	62.9	73.2	26.6	10.4	185
605	ICP-MS	67.5	76.8	26.4	9.93	192
606	ICP-MS/MS	80.9 ↑	101 ↑	33.0 ↑	12.1	232 ↑
630	DRC/CC-ICP-MS	67.4	78.4	28.7	10.8	208
676	DRC/CC-ICP-MS	69.4	85.8	26.1	8.93	189
686	DRC/CC-ICP-MS	68.4	76.7	27.1	9.88	190

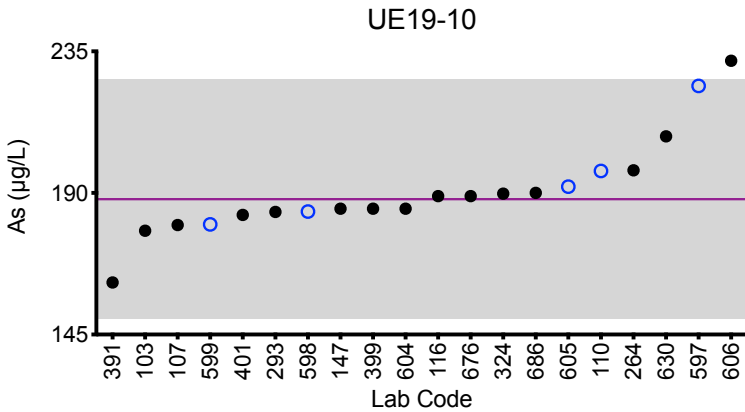
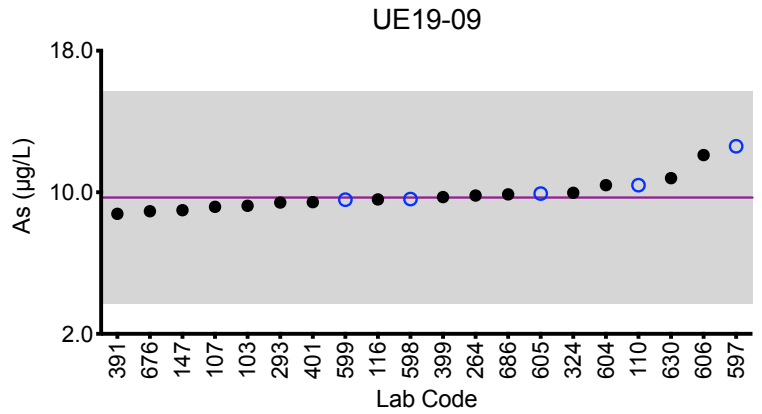
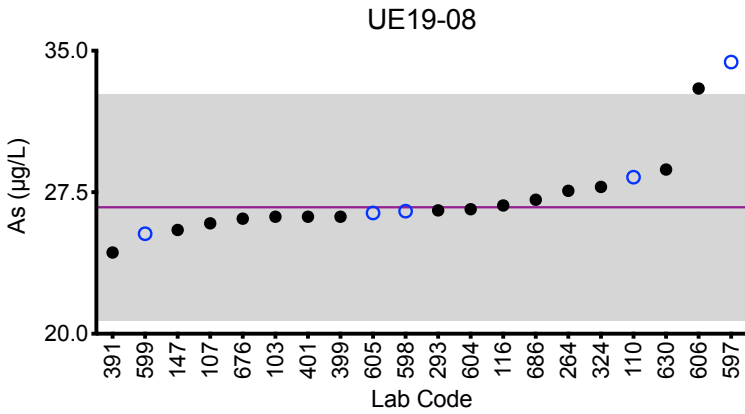
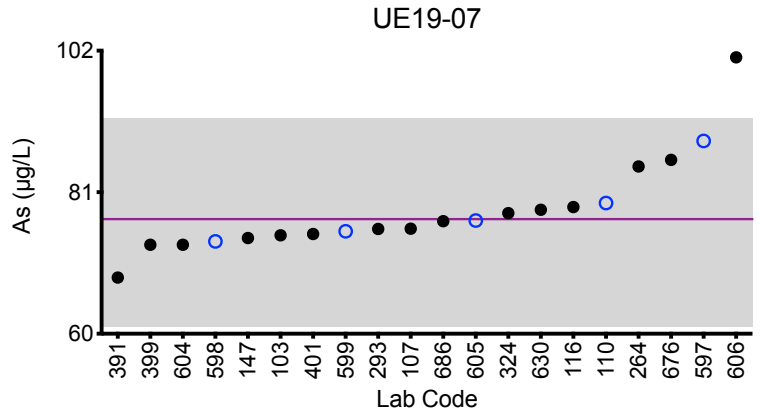
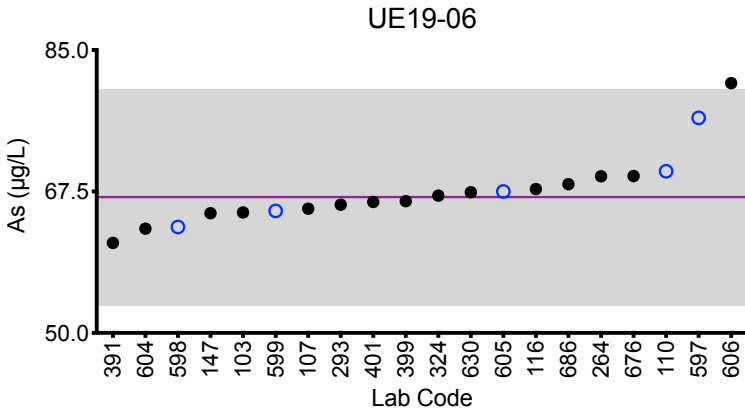
Based on the grading criteria for As in Urine, 95% of results were satisfactory, with 1 of the 20 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine As



Legend:
 ○ CHEAR 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:
 $\pm 6 \mu\text{g/L}$ or $\pm 20\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 6 \mu\text{g/L}$ at concentrations less than or equal to $30 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

	Urine Ba (µg/L)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x*))	14.4	8.2	0.41	9.7	3.82
Upper Limit	17.3	9.8	1.41	11.6	4.82
Lower Limit	11.5	6.6	0.00	7.8	2.82
Robust SD (s*)	0.8	0.7	0.09	0.5	0.25
Robust RSD (%)	5.6	8.5	22	5.2	6.5
Number of Sample Measurements (N)	14	14	12	14	14
Standard Uncertainty (u)	0.3	0.2	0.03	0.2	0.08

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Ba (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	14.4	8.2	0.41	9.7	3.82
107	ICP-MS	12.70	8.47	0.44	9.46	3.77
110	ICP-MS	15.0	8.52	0.42	10.3	4.10
116	ICP-MS/MS	14.1	8.20	0.559	10.2	3.81
147	ICP-MS	13.5	7.47	0.444	9.09	3.62
264	ICP-MS	13.202	7.259	0.364	8.988	3.439
399	ICP-MS	14.5	7.92	0.405	9.71	3.8
597	DRC/CC-ICP-MS	15.8	9.36	0.49	10.1	4.05
598	ICP-MS	13.5	5.06	↓	0.23	3.56
599	DRC/CC-ICP-MS	14.2	7.76	0.406	9.42	3.56
605	ICP-MS	14.6	7.83	<0.600	10.1	3.92
606	ICP-MS/MS	14.4	8.50	0.356	9.82	3.94
607	ICP-MS	16.8	10.2	↑	0.51	4.22
676	ICP-MS	14.8	8.33	0.276	9.54	3.70
686	ICP-MS	14.6	8.42	<0.600	9.87	3.96

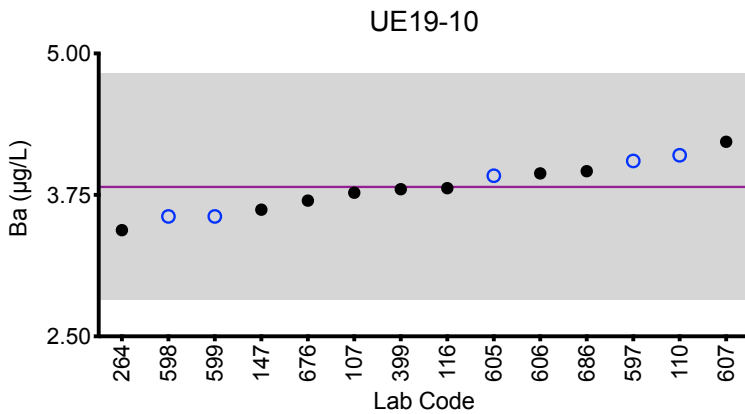
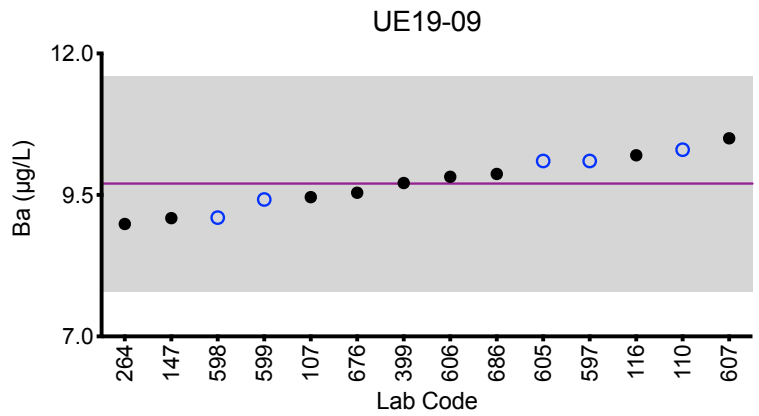
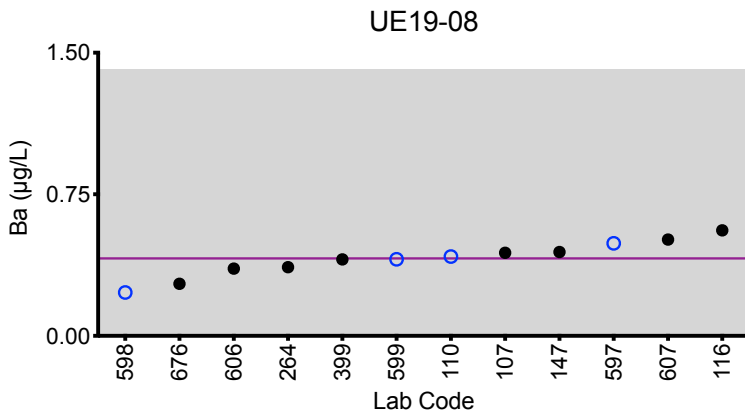
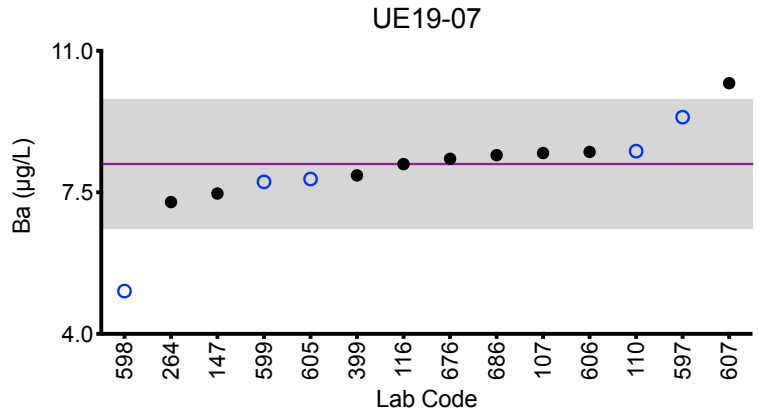
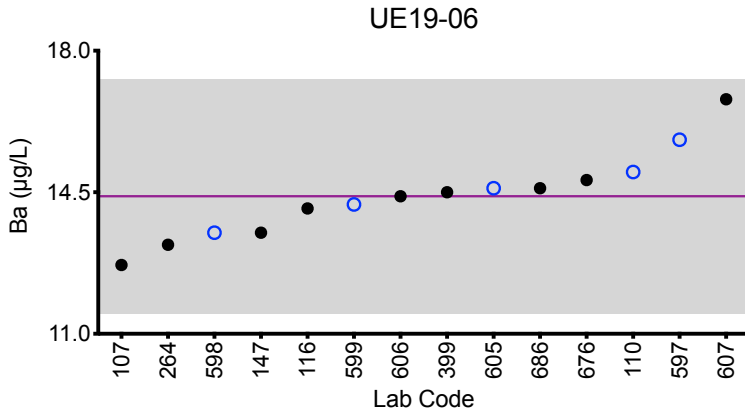
Based on the grading criteria for Ba in Urine, 97% of results were satisfactory, with 0 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine Ba



Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±1 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 5 µg/L.



Results for Event #2, 2019: Summary Statistics

	Urine Be ($\mu\text{g/L}$)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x^*))	2.61	5.4	1.48	0.79	4.63
Upper Limit	3.61	6.5	2.48	1.79	5.63
Lower Limit	1.61	4.3	0.48	0.00	3.63
Robust SD (s^*)	0.10	0.3	0.06	0.04	0.14
Robust RSD (%)	3.8	5.6	4.1	5.3	3.0
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (u)	0.04	0.1	0.02	0.01	0.05

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



Results for Event #2, 2019: Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target		2.61	5.4	1.48	0.79	4.63
107	ICP-MS	2.474	5.559	1.492	0.796	4.589
110	ICP-MS	2.63	5.09	1.49	0.833	4.80
116	ICP-MS/MS	2.35	5.13	1.42	0.708	4.26
147	ICP-MS	2.68	5.23	1.51	0.793	4.73
264	ICP-MS	2.569	5.208	1.424	0.783	4.366
293	DRC/CC-ICP-MS	2.67	5.3	1.5	0.83	4.63
399	ICP-MS	2.52	5.08	1.46	0.807	4.65
598	ICP-MS	2.68	5.78	1.53	0.84	4.81
599	DRC/CC-ICP-MS	2.46	5.32	1.41	0.697	4.35
605	ICP-MS	2.72	5.54	1.53	0.828	4.73
607	ICP-MS	2.78	6.05	1.55	0.789	4.65
676	ICP-MS	2.59	5.72	1.39	0.758	4.48
686	ICP-MS	2.64	5.45	1.62	0.780	4.69

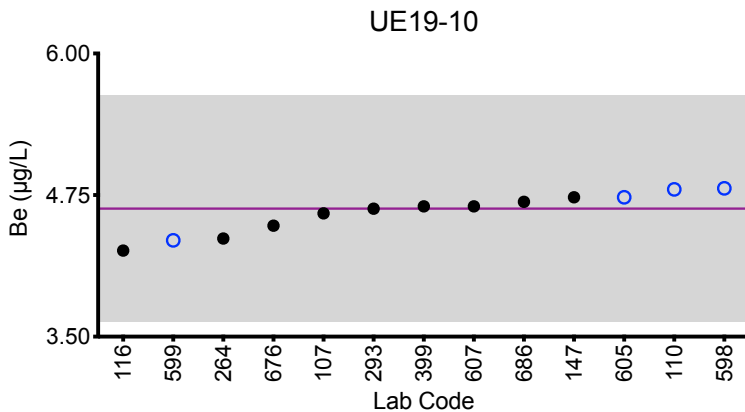
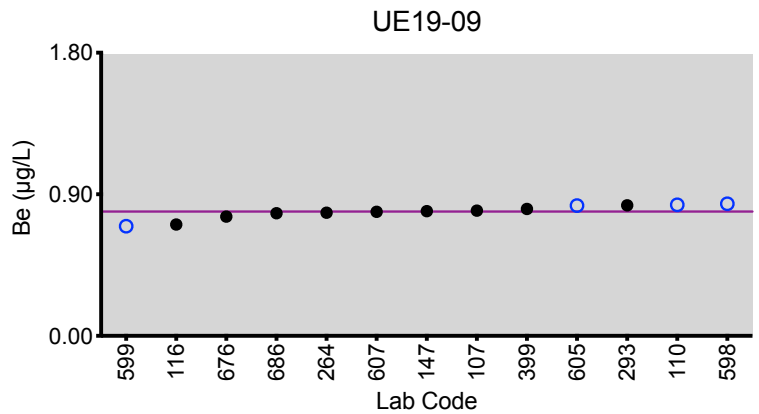
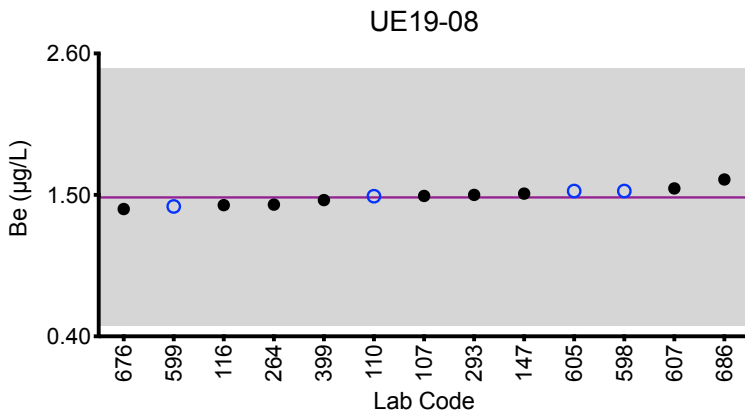
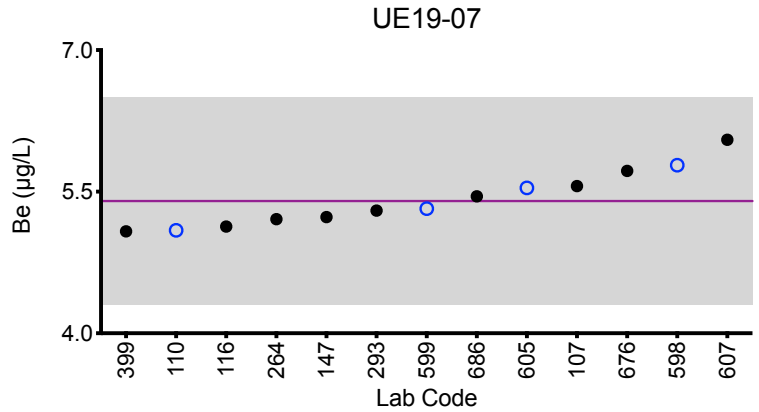
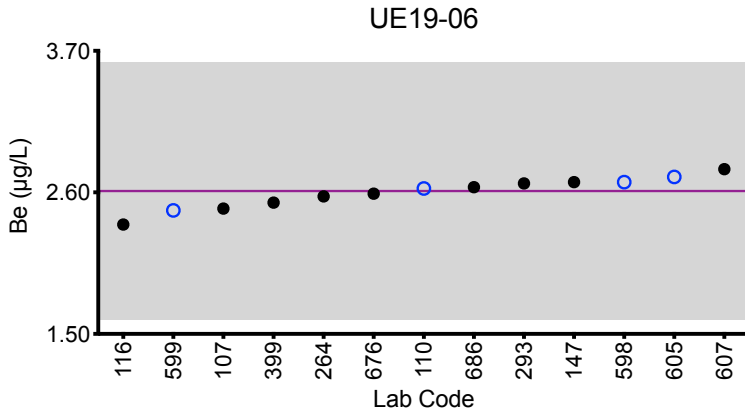
Based on the grading criteria for Be in Urine, 100% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine Be



Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±1 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 5 µg/L.



Results for Event #2, 2019: Summary Statistics

	Urine Cd ($\mu\text{g/L}$)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x^*))	0.89	3.07	1.78	4.8	6.0
Upper Limit	1.89	4.07	2.78	5.8	7.0
Lower Limit	0.00	2.07	0.78	3.8	5.0
Robust SD (s^*)	0.06	0.21	0.11	0.4	0.5
Robust RSD (%)	6.7	6.8	6.2	7.3	7.5
Number of Sample Measurements (N)	20	21	21	21	21
Standard Uncertainty (u)	0.02	0.06	0.03	0.1	0.1

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Cd (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	0.89	3.07	1.78	4.8	6.0
103	DRC/CC-ICP-MS	0.923	3.29	1.79	5.01	6.19
107	DRC/CC-ICP-MS	0.835	3.212	1.873	5.025	6.293
110	ICP-MS	0.906	3.01	1.81	4.79	6.02
116	ICP-MS/MS	0.798	2.90	1.68	4.56	5.60
147	ICP-MS	0.861	3.04	1.8	4.86	6.06
264	ICP-MS	0.905	3.105	1.721	4.595	5.983
293	DRC/CC-ICP-MS	0.95	3	1.75	4.73	5.91
324	ICP-MS	<1	2.628	1.609	4.399	5.168
391	DRC/CC-ICP-MS	0.828	2.771	1.627	4.232	5.013
399	DRC/CC-ICP-MS	0.908	3.16	1.85	4.87	6.19
401	DRC/CC-ICP-MS	0.90	3.15	1.80	4.95	6.29
597	DRC/CC-ICP-MS	1.04	3.68	2.29	5.42	7.50 ↑
598	DRC/CC-ICP-MS	0.826	2.88	1.63	4.44	5.54
599	DRC/CC-ICP-MS	0.888	3.05	1.86	4.69	5.97
604	DRC/CC-ICP-MS	0.814	2.92	1.84	5.14	6.21
605	ICP-MS	0.934	3.26	1.88	5.31	6.62
606	ICP-MS/MS	0.946	3.34	1.90	5.16	6.41
607	ICP-MS	0.927	3.25	1.81	4.6	5.41
630	ICP-MS	0.87	2.84	1.71	4.60	5.55
676	DRC/CC-ICP-MS	0.789	2.92	1.60	4.22	5.21
686	ICP-MS	0.938	3.14	1.85	5.03	6.16

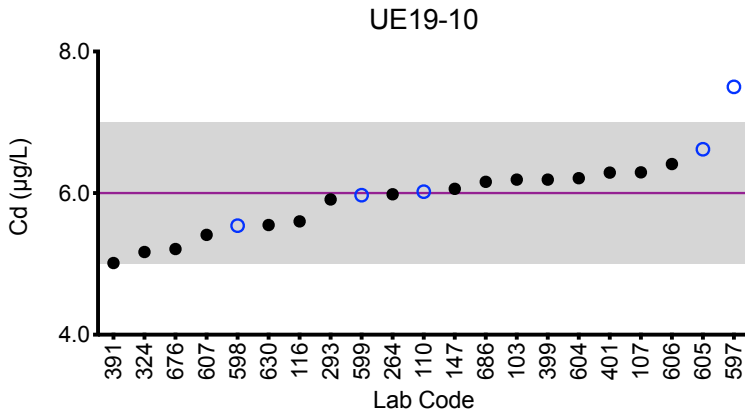
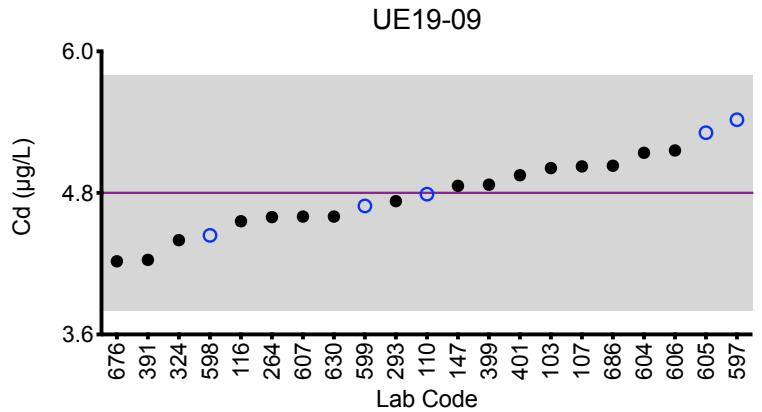
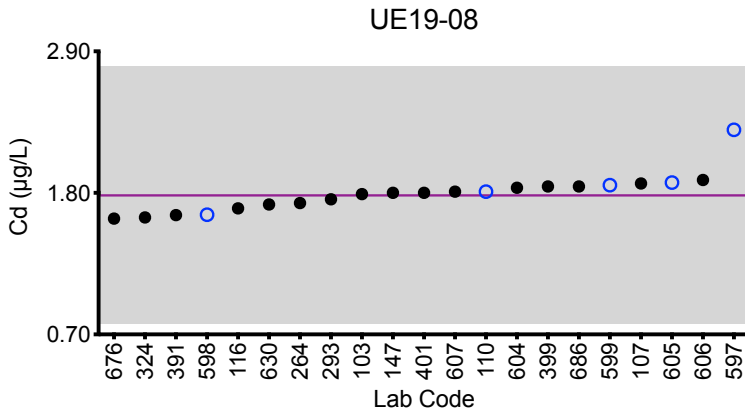
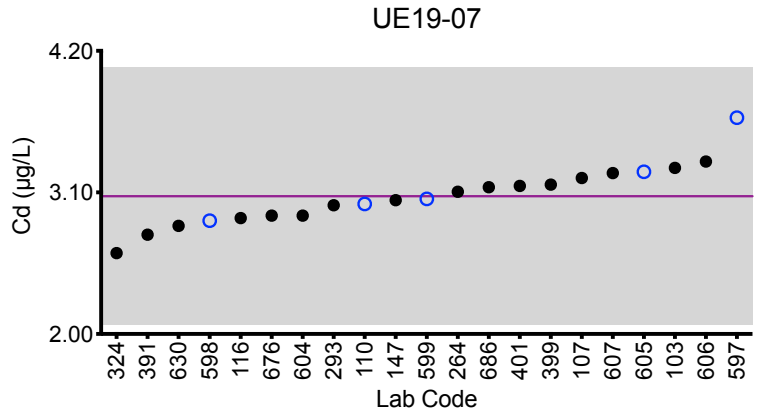
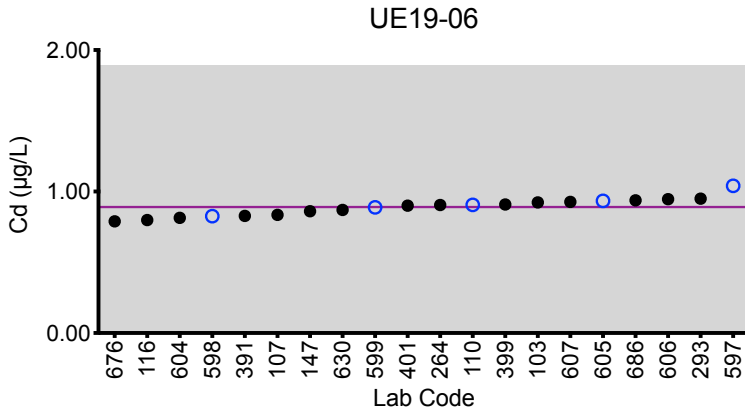
Based on the grading criteria for Cd in Urine, 99% of results were satisfactory, with 0 of the 21 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine Cd



Legend:
 ○ CHEAR 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:
 $\pm 1 \mu\text{g/L}$ or $\pm 15\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 1 \mu\text{g/L}$ at concentrations less than or equal to $6.6 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

	Urine Co (µg/L)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x*))	4.2	7.7	2.66	5.16	7.0
Upper Limit	5.7	9.2	4.16	6.66	8.5
Lower Limit	2.7	6.2	1.16	3.66	5.5
Robust SD (s*)	0.3	0.5	0.17	0.24	0.5
Robust RSD (%)	7.1	6.5	6.4	4.7	6.6
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (u)	0.1	0.2	0.06	0.08	0.1

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Co (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	4.2	7.7	2.66	5.16	7.0
103	DRC/CC-ICP-MS	4.29	7.75	2.65	5.18	6.70
107	ICP-MS	4.019	7.184	2.747	5.268	7.151
110	ICP-MS	4.43	7.75	2.79	5.43	7.30
147	ICP-MS	4.18	7.56	2.6	5.04	6.83
264	ICP-MS	3.901	7.182	2.354	4.734	6.47
324	ICP-MS	4.447	8.261	2.776	5.116	7.107
391	DRC/CC-ICP-MS	3.551	6.31	2.315	4.606	5.845
399	DRC/CC-ICP-MS	4.26	7.61	2.66	5.25	7
401	DRC/CC-ICP-MS	3.87	7.04	2.41	4.90	6.40
597	DRC/CC-ICP-MS	4.53	8.09	2.83	5.55	7.71
598	ICP-MS	4.19	7.66	2.56	5.06	6.96
599	DRC/CC-ICP-MS	4.05	7.42	2.68	5.01	6.66
605	ICP-MS	4.67	8.41	2.83	5.3	7.33
606	ICP-MS/MS	4.34	8.10	2.87	5.57	7.58
676	ICP-MS	4.50	8.17	2.67	5.20	7.09

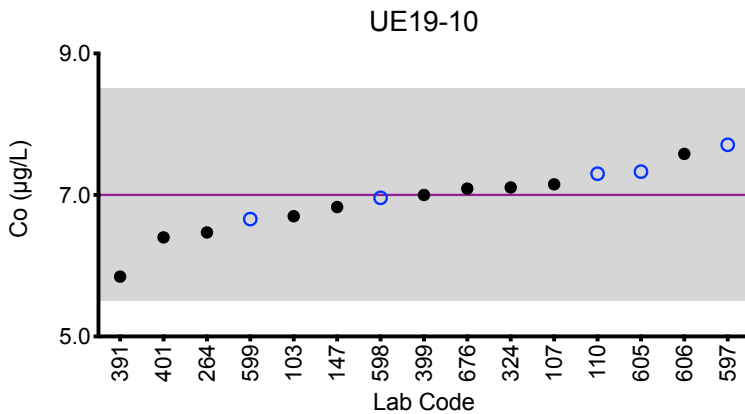
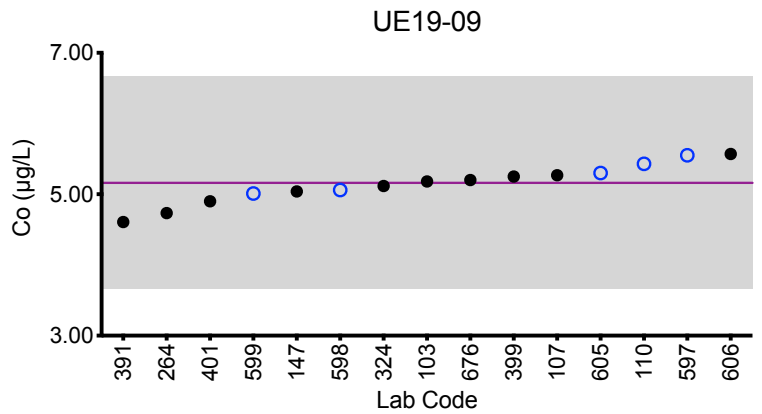
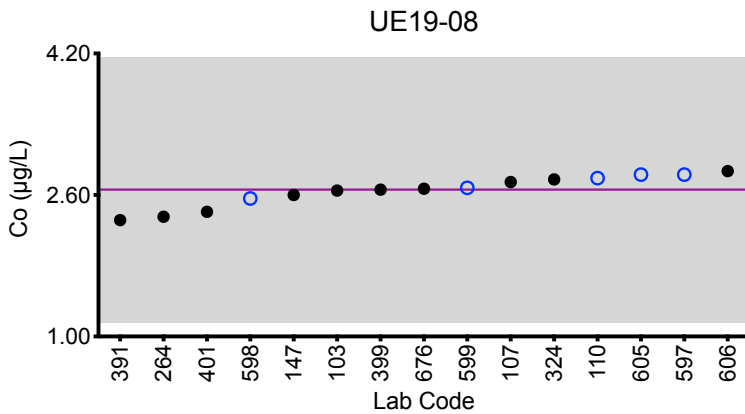
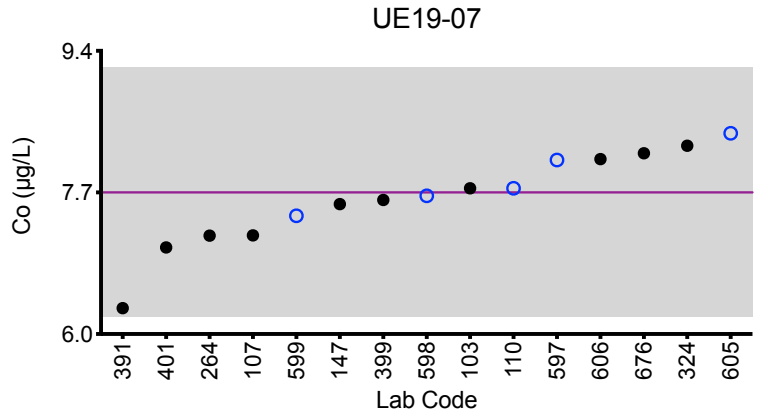
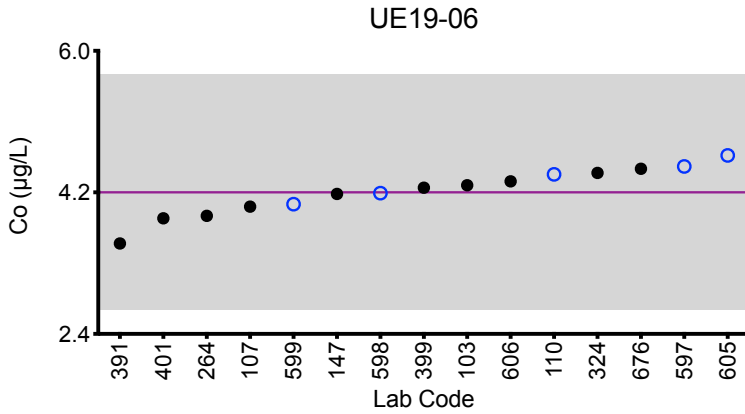
Based on the grading criteria for Co in Urine, 100% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine Co



Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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



Results for Event #2, 2019: Summary Statistics

	Urine Cr (µg/L)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x*))	11.7	3.2	16.9	6.2	0.54
Upper Limit	14.7	6.2	20.3	9.2	3.54
Lower Limit	8.7	0.2	13.5	3.2	0.00
Robust SD (s*)	0.7	0.3	0.9	0.4	0.17
Robust RSD (%)	6.0	9.5	5.3	6.0	31
Number of Sample Measurements (N)	12	12	12	11	11
Standard Uncertainty (u)	0.2	0.1	0.3	0.1	0.06

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Cr (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	11.7	3.2	16.9	6.2	0.54
107	DRC/CC-ICP-MS	12.31	3.16	16.95	5.93	0.45
110	DRC/CC-ICP-MS	12.4	3.49	17.8	6.58	0.72
116	ICP-MS/MS	11.9	4.31	17.0	6.24	0.668
147	DRC/CC-ICP-MS	11.3	3.03	16.5	5.76	0.469
264	ICP-MS	11.149	3.195	15.443	5.753	0.726
324	ICP-MS	11.764	3.287	17.399	7.234	<1
391	DRC/CC-ICP-MS	10.677	2.684	15.397	*0.407 ↓	0.201
401	DRC/CC-ICP-MS	11.0	2.70	16.3	5.99	0.46
597	DRC/CC-ICP-MS	13.0	3.94	18.8	7.41	1.16
598	DRC/CC-ICP-MS	11.4	2.95	18.1	6.05	0.41
599	DRC/CC-ICP-MS	11.6	3.03	16.9	6.15	0.530
605	ICP-MS	11.8	3.1	16.8	6.2	0.506

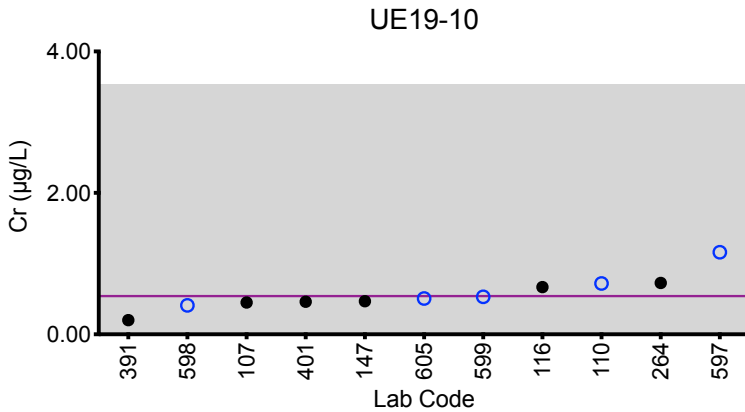
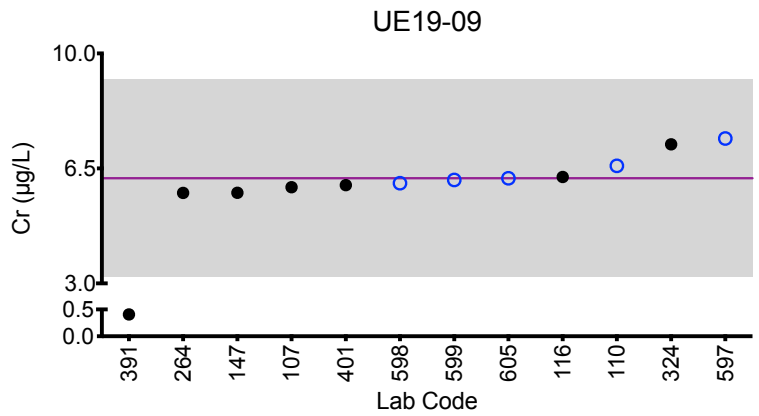
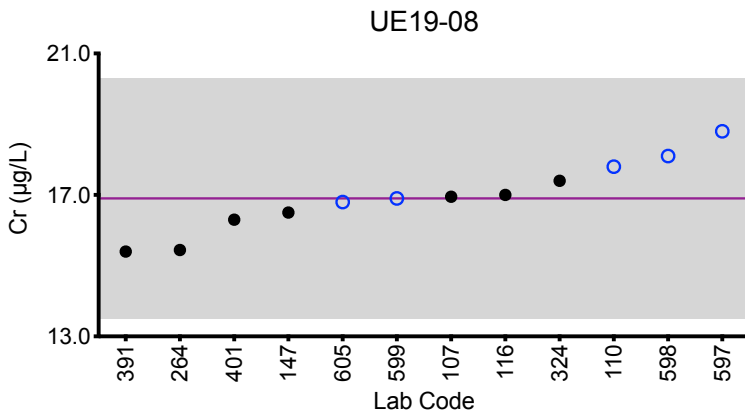
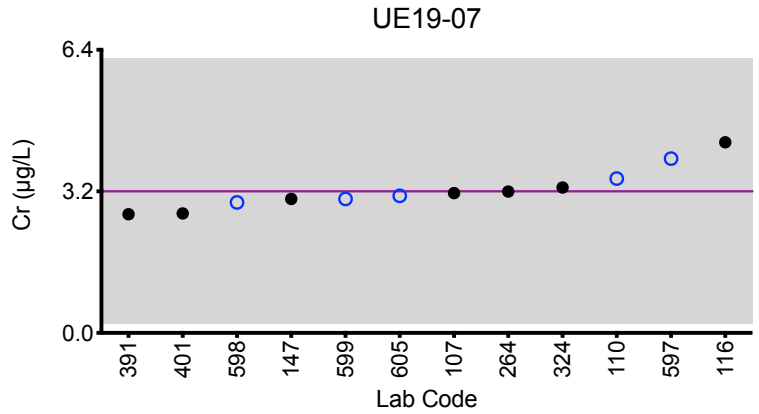
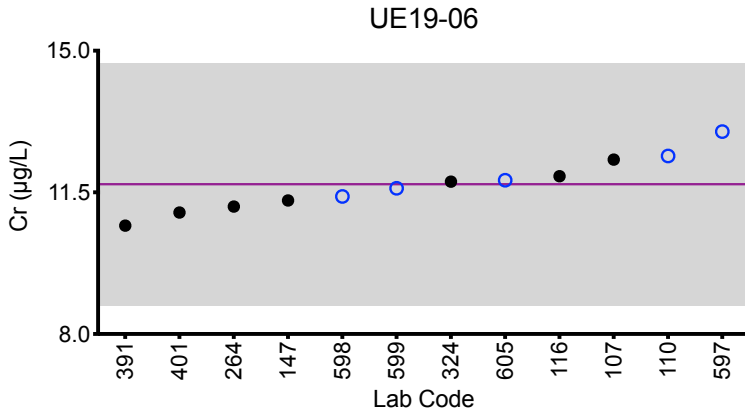
Based on the grading criteria for Cr in Urine, 98% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine Cr



Legend:
 ○ CHEAR 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:
 $\pm 3 \mu\text{g/L}$ or $\pm 20\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 3 \mu\text{g/L}$ at concentrations less than or equal to $15 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

	Urine Hg (µg/L)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x*))	16.0	1.9	30	6.1	42
Upper Limit	20.8	4.9	39	9.1	55
Lower Limit	11.2	0.0	21	3.1	29
Robust SD (s*)	1.3	0.6	8	0.7	7
Robust RSD (%)	8.1	32	27	11	17
Number of Sample Measurements (N)	15	16	16	16	15
Standard Uncertainty (u)	0.4	0.2	3	0.2	2

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Hg (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	16.0	1.9	30	6.1	42
103	DRC/CC-ICP-MS	15.5	1.80	23.5	5.77	42.3
107	DRC/CC-ICP-MS	13.65	1.74	31.78	5.50	44.82
110	ICP-MS	16.5	2.33	33.3	6.31	44.4
147	ICP-MS	14.5	1.44	28.9	6.03	37.8
200	ICP-MS	16.4	8 ↑	21.7	5.4	35.1
264	ICP-MS	*46.032 ↑	5.865 ↑	78.932 ↑	18.317 ↑	*132.036 ↑
293	DRC/CC-ICP-MS	15.58	0.96	5.27 ↓	5.67	31.71
391	DRC/CC-ICP-MS	13.441	1.429	17.386 ↓	4.917	22.641 ↓
401	DRC/CC-ICP-MS	18.6	1.85	38.6	7.18	56.7 ↑
597	A-7 DMA	17.9	2.21	35.5	6.96	49.3
598	ICP-MS	15.6	2.68	56.2 ↑	6.34	42.7
599	DRC/CC-ICP-MS	17.5	1.84	34.1	6.81	46.0
604	DRC/CC-ICP-MS	14.5	1.63	25.3	5.71	40.1
605	ICP-MS	16.4	1.38	29.8	5.95	47.1
606	ICP-MS/MS	16.2	2.14	31.2	6.71	47.8
676	ICP-MS	16.5	1.58	26.7	5.57	35.3

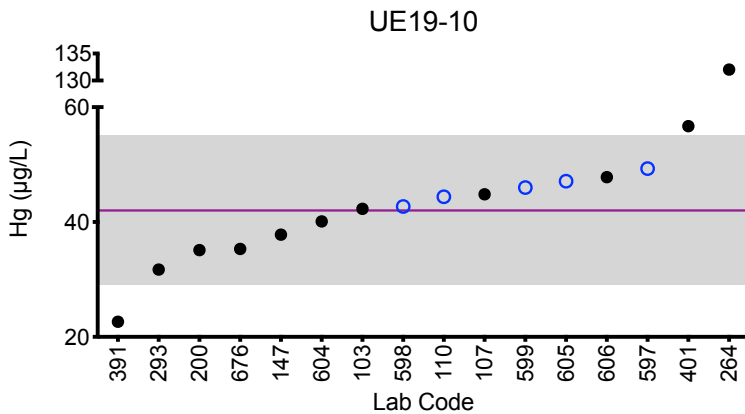
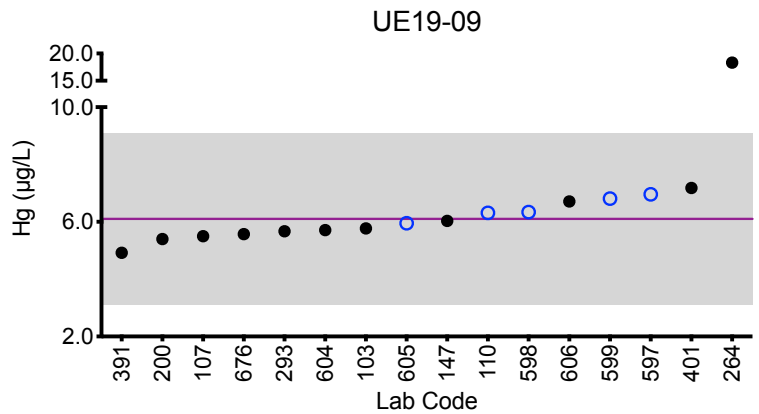
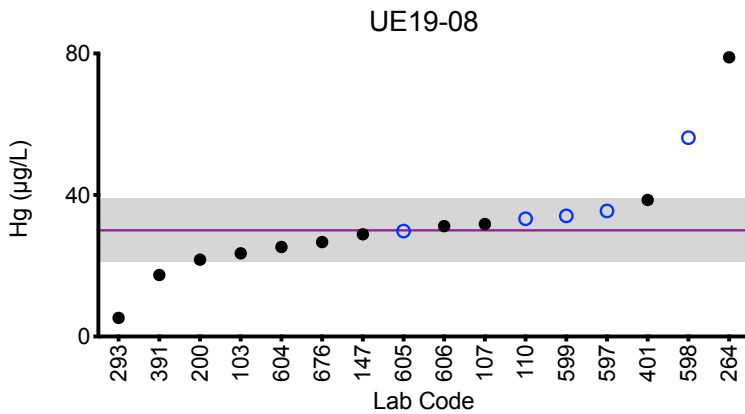
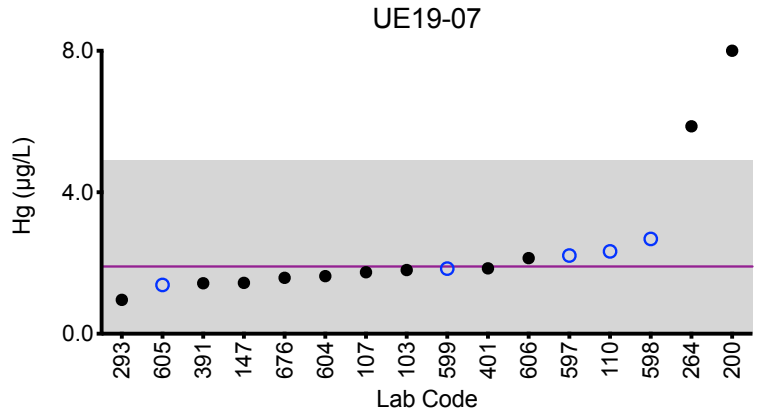
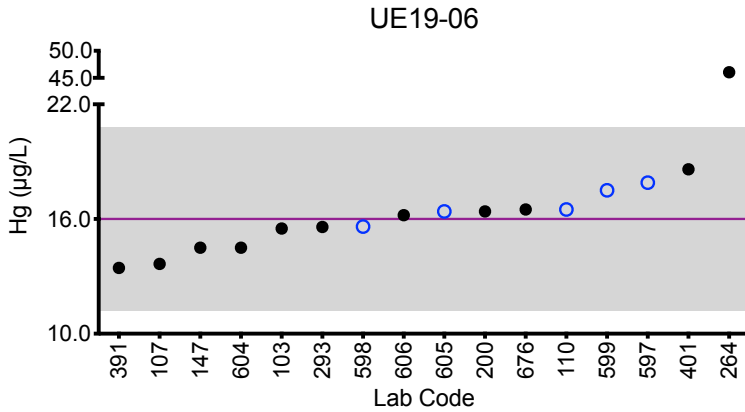
Based on the grading criteria for Hg in Urine, 86% of results were satisfactory, with 2 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine Hg



Legend:

• CHEAR Labs • Other Labs

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

Gray area = acceptable range based on quality specifications:

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



Results for Event #2, 2019: Summary Statistics

	Urine Mn (µg/L)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x*))	3.22	9.1	5.1	1.26	6.9
Upper Limit	4.03	11.4	6.3	1.81	8.6
Lower Limit	2.42	6.8	3.8	0.71	5.2
Robust SD (s*)	0.25	0.7	0.4	0.15	0.4
Robust RSD (%)	7.8	7.7	7.3	12	5.4
Number of Sample Measurements (N)	17	17	17	17	17
Standard Uncertainty (u)	0.08	0.2	0.1	0.05	0.1

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Mn (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	3.22	9.1	5.1	1.26	6.9
103	DRC/CC-ICP-MS	3.04	8.86	4.95	1.14	6.78
107	DRC/CC-ICP-MS	3.37	8.51	5.36	1.05	6.21
110	DRC/CC-ICP-MS	3.21	8.99	5.06	1.29	6.97
116	ICP-MS/MS	2.92	9.31	4.65	1.15	6.23
147	DRC/CC-ICP-MS	3.4	9.5	5.02	1.28	7.02
264	ICP-MS	2.946	8.286	4.64	1.099	6.356
324	ICP-MS	3.550	9.825	5.285	1.399	6.973
391	DRC/CC-ICP-MS	2.731	8.192	4.652	1.255	5.955
399	DRC/CC-ICP-MS	3.27	9.15	5.23	1.3	7.15
597	DRC/CC-ICP-MS	3.57	9.34	5.52	1.41	7.66
598	ICP-MS	3.27	9.76	5.26	1.49	7.12
599	DRC/CC-ICP-MS	3.06	8.12	4.41	1.03	6.03
604	DRC/CC-ICP-MS	3.13	8.74	5.01	1.24	7.07
605	ICP-MS	3.44	10.2	5.43	1.3	7.39
606	ICP-MS/MS	3.34	9.58	5.50	1.29	7.18
630	DRC/CC-ICP-MS	3.29	8.97	5.15	1.45	7.05
676	DRC/CC-ICP-MS	2.96	8.82	4.71	1.29	6.54

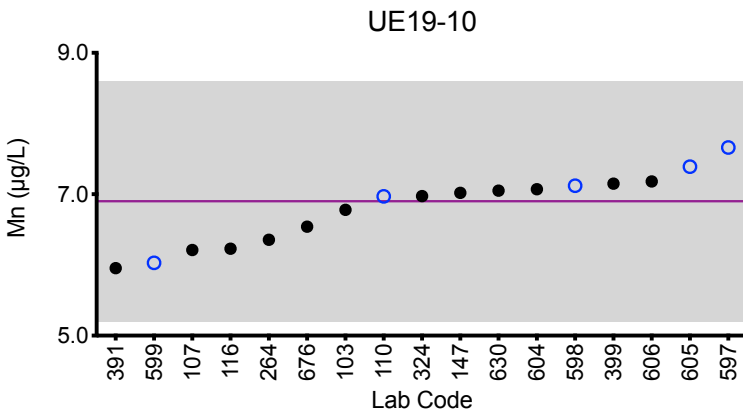
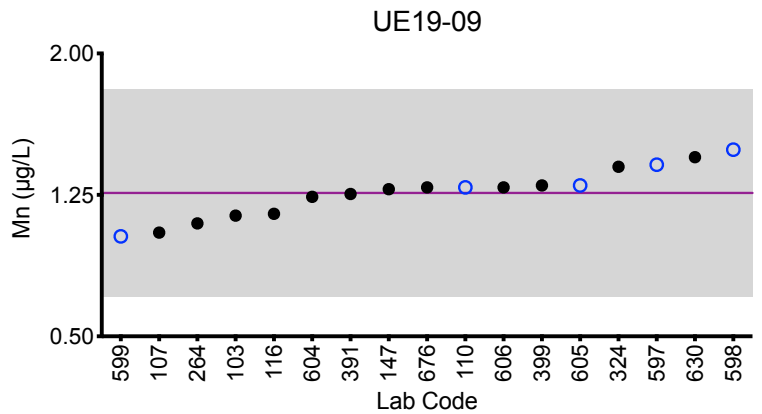
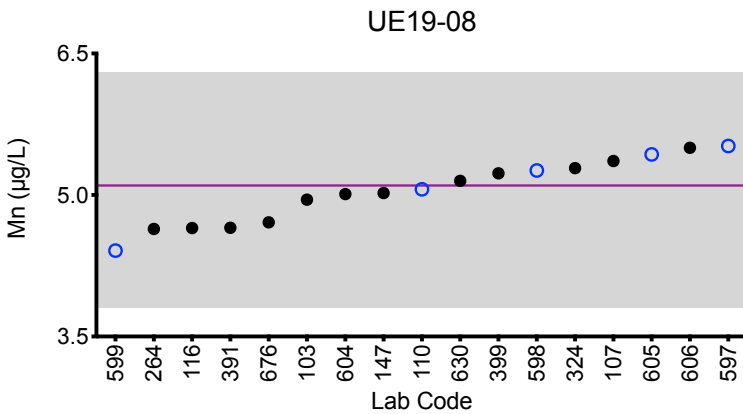
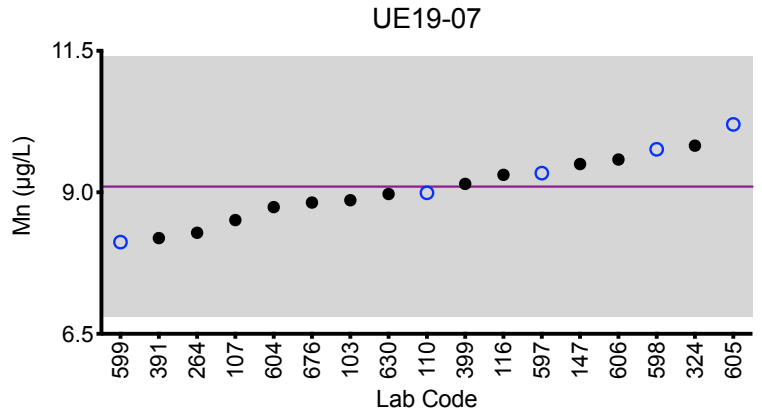
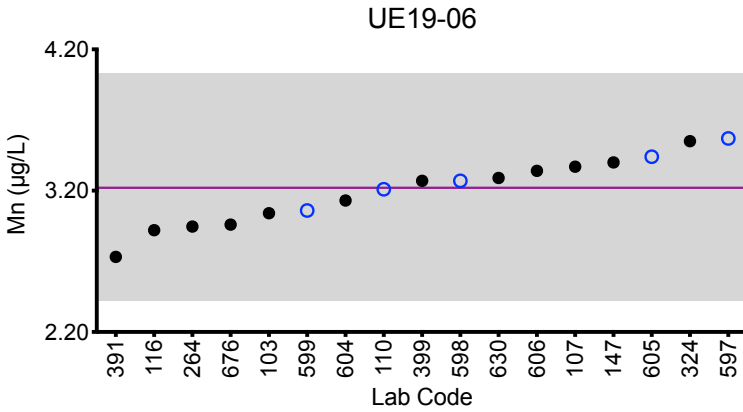
Based on the grading criteria for Mn in Urine, 100% of results were satisfactory, with 0 of the 17 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine Mn



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



Results for Event #2, 2019: Summary Statistics

	Urine Pb ($\mu\text{g/L}$)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x^*))	4.25	11.0	1.77	8.6	14.6
Upper Limit	5.25	13.2	2.77	10.3	17.5
Lower Limit	3.25	8.8	0.77	6.9	11.7
Robust SD (s^*)	0.27	0.6	0.13	0.5	0.8
Robust RSD (%)	6.4	5.5	7.3	5.7	5.5
Number of Sample Measurements (N)	18	18	18	18	18
Standard Uncertainty (u)	0.08	0.2	0.04	0.1	0.2

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Pb (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	4.25	11.0	1.77	8.6	14.6
103	DRC/CC-ICP-MS	4.38	11.7	1.79	8.93	15.1
107	ICP-MS	3.96	11.20	1.83	8.77	15.29
110	ICP-MS	4.18	10.6	1.67	8.78	14.3
116	ICP-MS/MS	4.06	11.3	1.74	7.73	13.6
147	ICP-MS	4.35	11.2	1.78	8.91	15.1
264	ICP-MS	4.857	10.625	1.711	8.321	14.083
293	DRC/CC-ICP-MS	3.95	10.06	0.75 ↓	7.46	13.27
324	ICP-MS	4.202	10.824	1.965	8.459	14.340
391	DRC/CC-ICP-MS	3.843	9.55	1.575	7.485	12.069
399	ICP-MS	4.42	11.6	1.89	9.12	14.6
597	DRC/CC-ICP-MS	4.74	12.4	1.93	9.49	17.0
598	ICP-MS	4.32	11.1	1.62	8.52	15.4
599	DRC/CC-ICP-MS	4.00	10.4	1.67	8.08	13.6
605	ICP-MS	4.24	10.8	1.77	8.93	14.8
606	ICP-MS/MS	4.13	10.9	1.78	8.54	14.5
607	ICP-MS	4.14	10.6	1.76	8.46	14.6
676	ICP-MS	4.42	11.4	1.79	8.67	14.8
686	ICP-MS	4.66	11.3	1.97	8.98	15.1

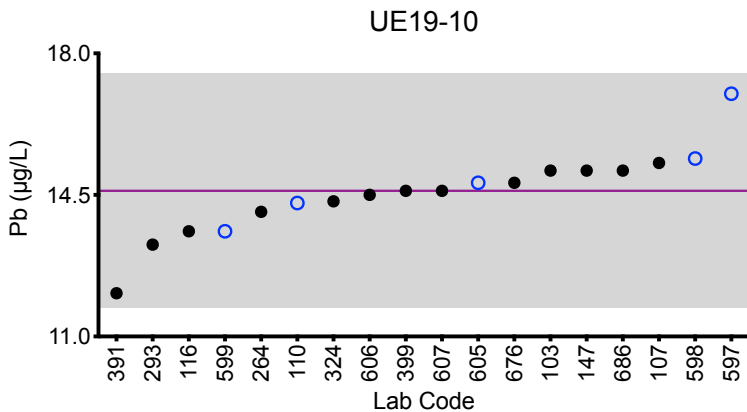
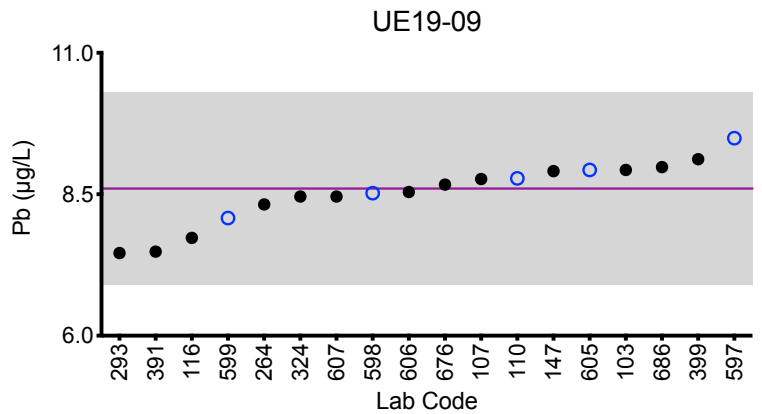
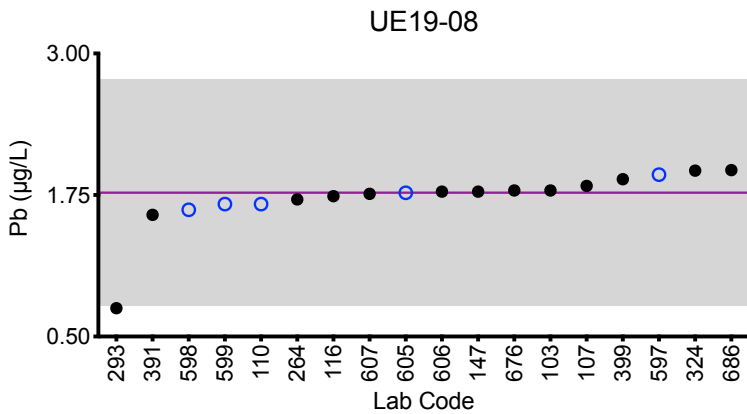
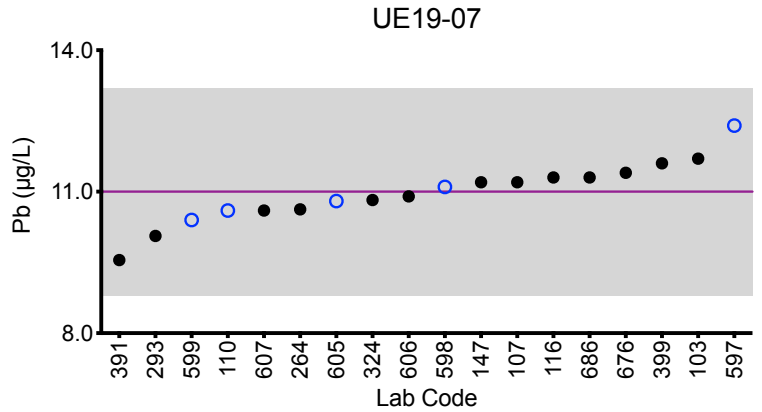
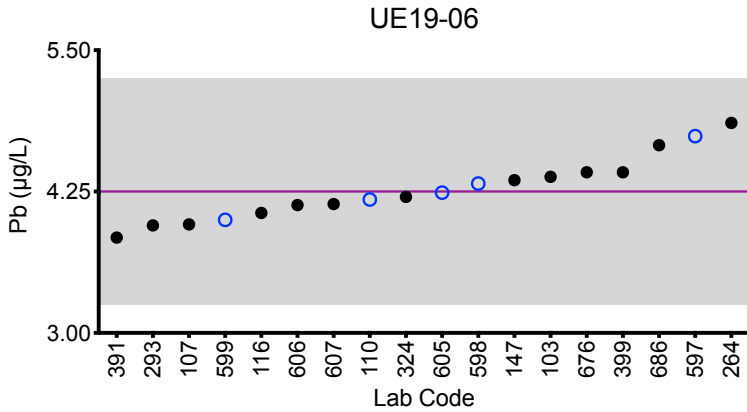
Based on the grading criteria for Pb in Urine, 99% of results were satisfactory, with 0 of the 18 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine Pb



Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±1 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 5 µg/L.



Results for Event #2, 2019: Summary Statistics

	Urine TI ($\mu\text{g/L}$)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x^*))	0.177	2.13	4.38	1.13	3.48
Upper Limit	0.377	2.56	5.26	1.36	4.18
Lower Limit	0.000	1.70	3.50	0.90	2.78
Robust SD (s^*)	0.015	0.12	0.19	0.05	0.13
Robust RSD (%)	8.5	5.6	4.3	4.4	3.7
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (u)	0.005	0.04	0.06	0.02	0.04

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine TI (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	0.177	2.13	4.38	1.13	3.48
103	DRC/CC-ICP-MS	0.191	2.22	4.56	1.18	3.57
107	ICP-MS	0.157	2.121	4.459	1.157	3.527
110	ICP-MS	0.186	2.04	4.31	1.13	3.41
116	ICP-MS/MS	0.163	2.04	4.12	0.995	3.15
147	ICP-MS	0.166	2.01	4.31	1.09	3.35
264	ICP-MS	0.139	1.966	4.137	1.052	3.266
293	DRC/CC-ICP-MS	0.19	2.34	4.45	1.16	3.56
399	ICP-MS	0.174	2.23	4.54	1.18	3.61
597	DRC/CC-ICP-MS	0.315	2.41	4.73	1.33	3.88
598	ICP-MS	0.19	2.06	4.01	1.05	3.07
605	ICP-MS	0.177	2.12	4.46	1.16	3.54
606	ICP-MS/MS	0.170	2.05	4.27	1.10	3.36
607	ICP-MS	0.183	2.18	4.38	1.13	3.54
676	ICP-MS	0.180	2.15	4.30	1.13	3.47
686	ICP-MS	0.174	2.19	4.57	1.16	3.56

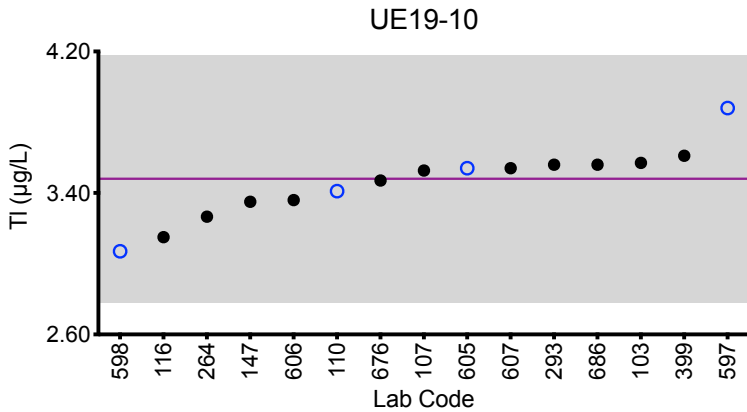
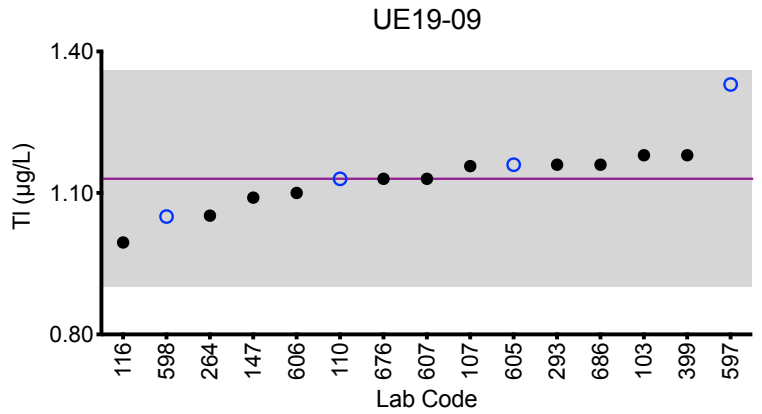
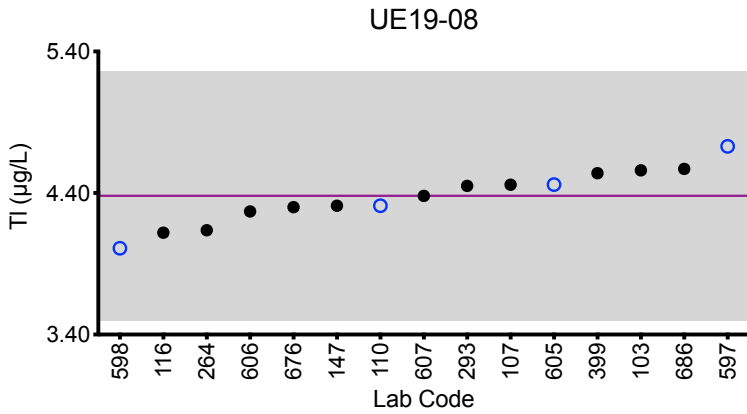
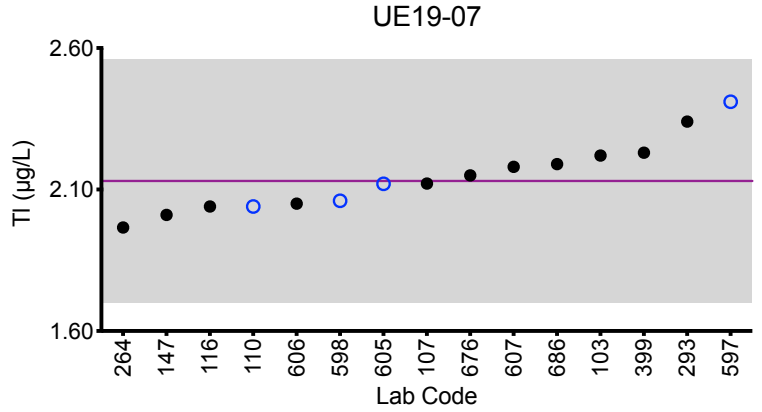
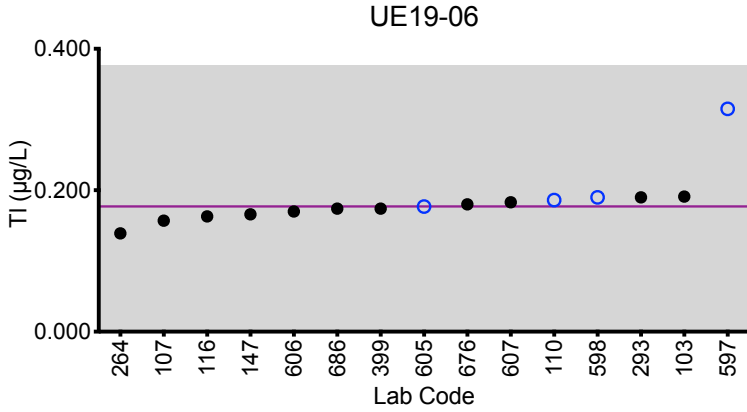
Based on the grading criteria for TI in Urine, 100% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine TI



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



Results for Event #2, 2019: Summary Statistics

	Urine U ($\mu\text{g/L}$)				
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Target (Robust Mean (x^*))	0.151	0.187	0.032	0.222	0.078
Upper Limit	0.181	0.224	0.062	0.266	0.108
Lower Limit	0.121	0.150	0.002	0.178	0.048
Robust SD (s^*)	0.009	0.012	0.003	0.014	0.005
Robust RSD (%)	6.1	6.4	9.6	6.3	6.4
Number of Sample Measurements (N)	17	17	16	17	16
Standard Uncertainty (u)	0.003	0.004	0.001	0.004	0.002

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine U (µg/L)				
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
	Target	0.151	0.187	0.032	0.222	0.078
103	DRC/CC-ICP-MS	0.159	0.194	0.0321	0.237	0.0787
107	ICP-MS	0.1455	0.1772	0.0341	0.2297	0.0795
110	ICP-MS	0.155	0.183	0.0326	0.224	0.0772
116	ICP-MS/MS	0.152	0.190	0.0299	0.203	0.0744
147	ICP-MS	0.15	0.173	0.0321	0.231	0.0776
264	ICP-MS	0.136	0.176	<0.10	0.206	<0.10
324	ICP-MS	0.135	0.164	0.027	0.195	0.068
399	ICP-MS	0.152	0.19	0.032	0.221	0.082
598	ICP-MS	0.14	0.21	0.05	0.21	0.08
599	DRC/CC-ICP-MS	0.141	0.176	0.032	0.213	0.070
604	ICP-MS	0.146	0.176	0.028	0.209	0.072
605	ICP-MS	0.176	0.209	0.034	0.249	0.088
606	ICP-MS/MS	0.154	0.192	0.033	0.233	0.079
607	ICP-MS	0.157	0.195	0.032	0.232	0.083
630	ICP-MS	0.161	0.196	0.0342	0.231	0.0848
676	ICP-MS	0.155	0.185	0.027	0.220	0.073
686	ICP-MS	0.158	0.189	0.0427	0.233	0.0793

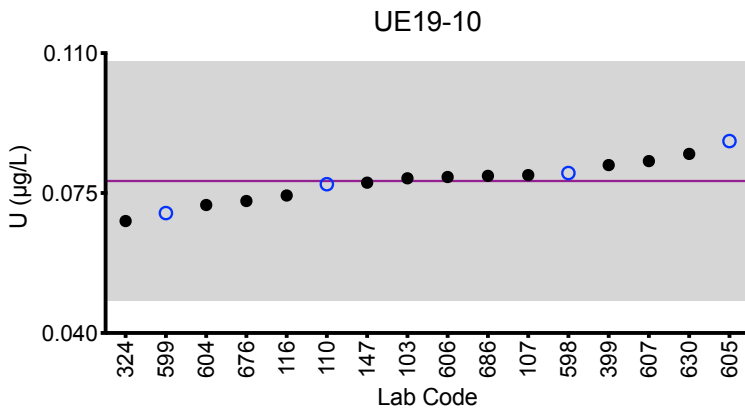
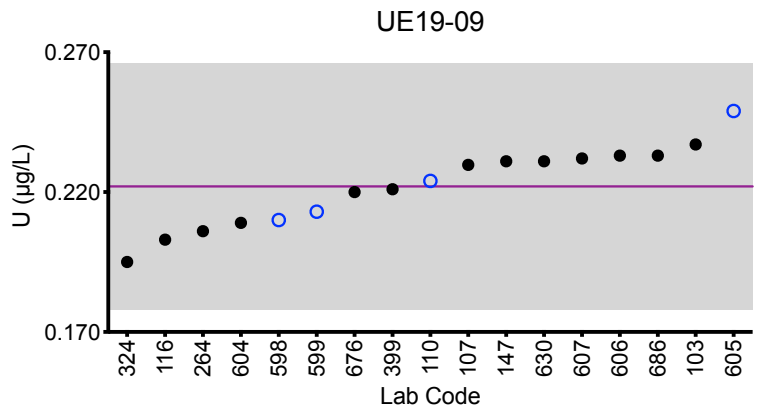
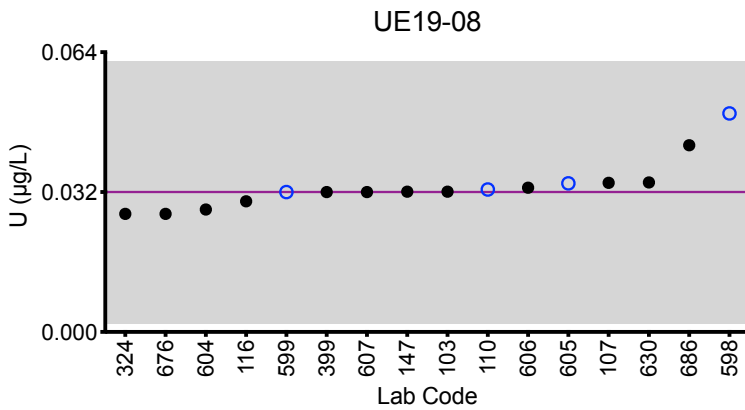
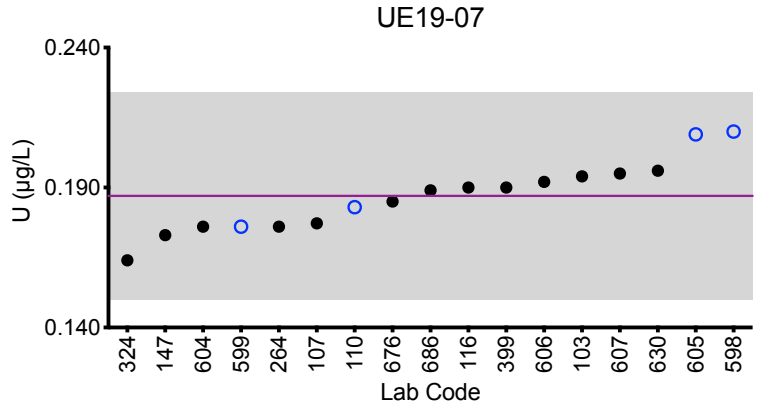
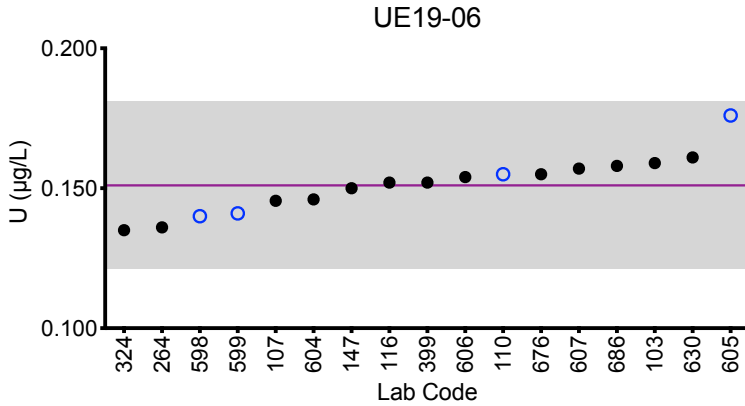
Based on the grading criteria for U in Urine, 100% of results were satisfactory, with 0 of the 17 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Urine U



Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±0.03 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±0.03 µg/L at concentrations less than or equal to 0.15 µg/L.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

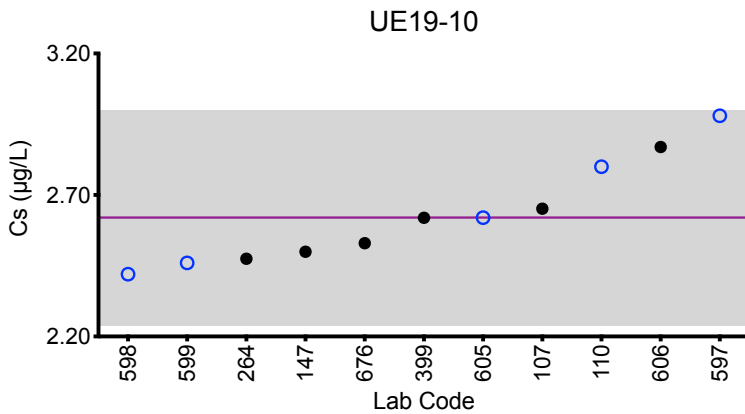
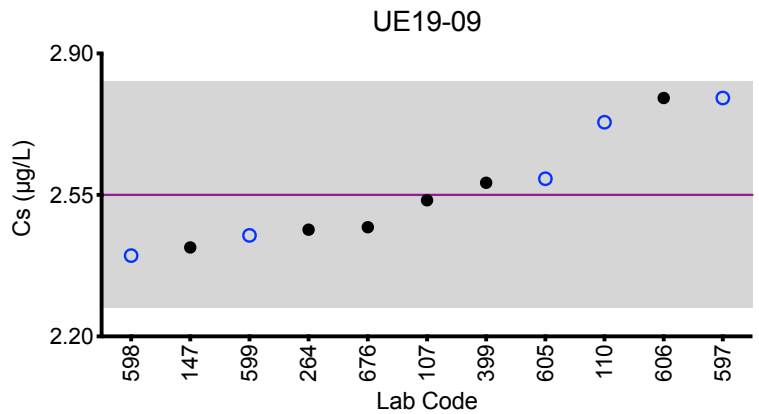
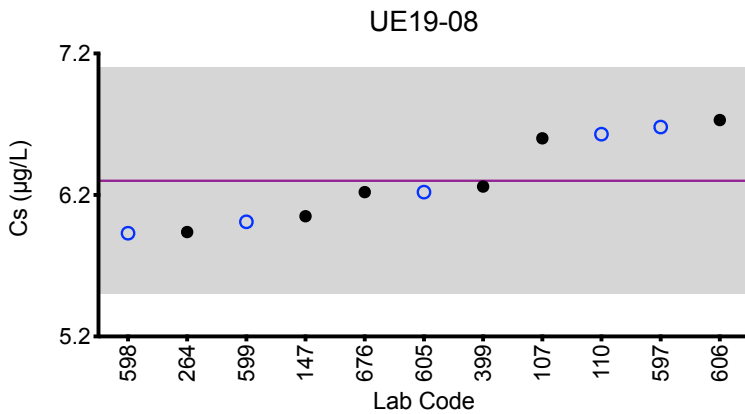
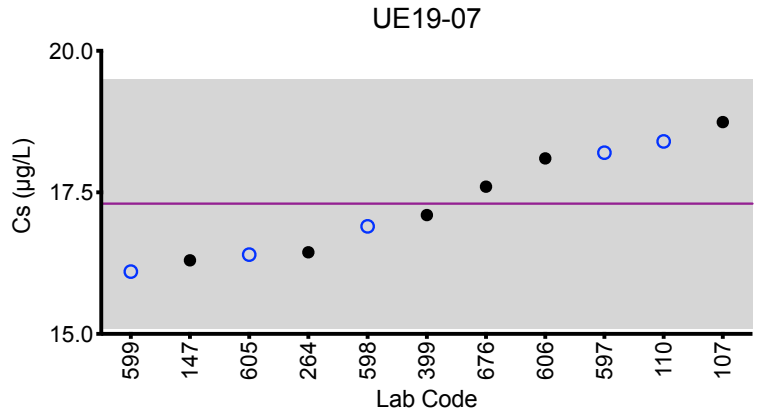
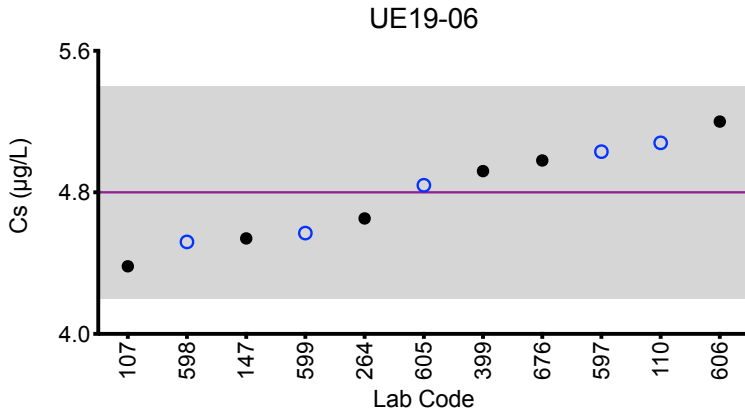
Urine Cs ($\mu\text{g/L}$)						
Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
107	ICP-MS	4.382	18.742	6.600	2.537	2.652
110	ICP-MS	5.08	18.4	6.63	2.73	2.80
147	ICP-MS	4.54	16.3	6.05	2.42	2.5
264	ICP-MS	4.653	16.442	5.938	2.464	2.475
399	ICP-MS	4.92	17.1	6.26	2.58	2.62
597	DRC/CC-ICP-MS	5.03	18.2	6.68	2.79	2.98
598	ICP-MS	4.52	16.9	5.93	2.4	2.42
599	DRC/CC-ICP-MS	4.57	16.1	6.01	2.45	2.46
605	ICP-MS	4.84	16.4	6.22	2.59	2.62
606	ICP-MS/MS	5.20	18.1	6.73	2.79	2.87
676	ICP-MS	4.98	17.6	6.22	2.47	2.53

Summary Statistics					
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Robust Mean (\bar{x}^*)	4.8	17.3	6.3	2.55	2.62
Robust SD (s^*)	0.3	1.1	0.4	0.14	0.19
Robust RSD (%)	6.5	6.4	5.6	5.5	7.3
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (u)	0.1	0.4	0.1	0.05	0.07



Results for Event #2, 2019: Summary Figures

Urine Cs



Legend:

○ CHEAR Labs ● Other Labs
Horizontal purple line = robust mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
110	ICP-MS	90.6	119	24.9	110	45.1
116	ICP-MS/MS	79.4	119	13.1	93.0	32.7
147	ICP-MS	93.9	126	22	114	46.2
264	ICP-MS	87.163	118.331	18.82	101.474	39.619
293	DRC/CC-ICP-MS	93.45	123.33	20.34	107.44	43.23
324	ICP-MS	94.267	134.545	22.517	111.524	44.037
391	DRC/CC-ICP-MS	81.701	107.564	17.928	97.201	35.195
401	DRC/CC-ICP-MS	83.9	112	17.8	102	39.4
597	DRC/CC-ICP-MS	95.9	126	21.2	116	47.1
598	ICP-MS	81.8	122	21.9	99.8	39.5
599	DRC/CC-ICP-MS	88.2	121	19.2	104.8	40.3

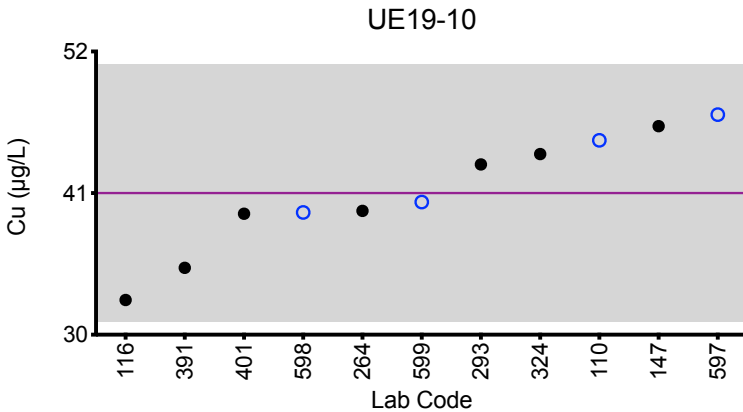
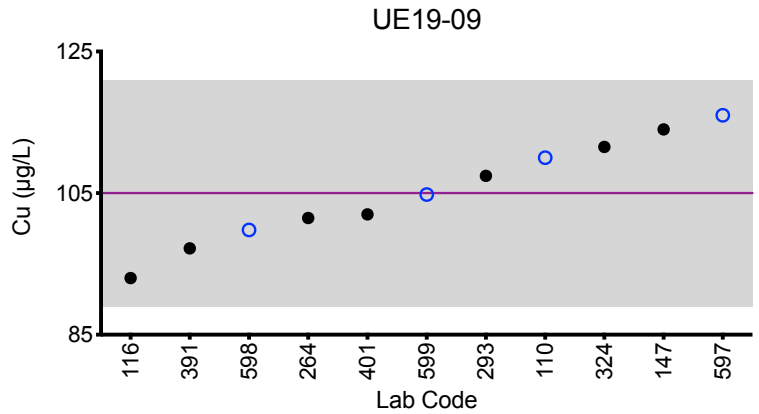
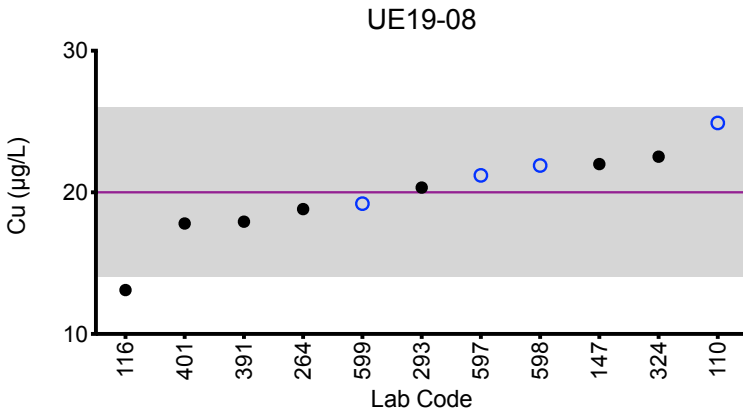
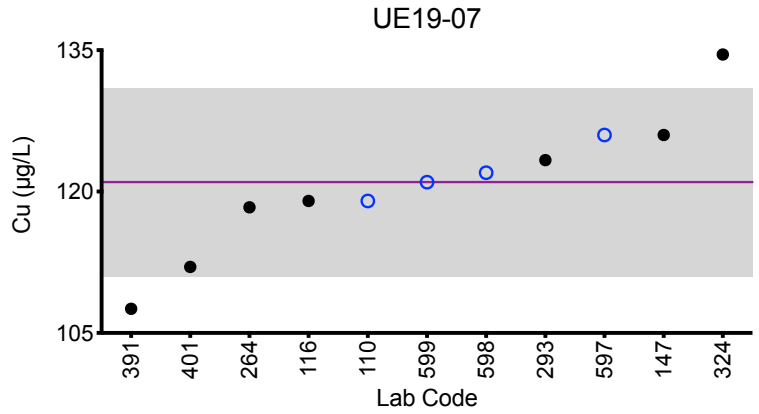
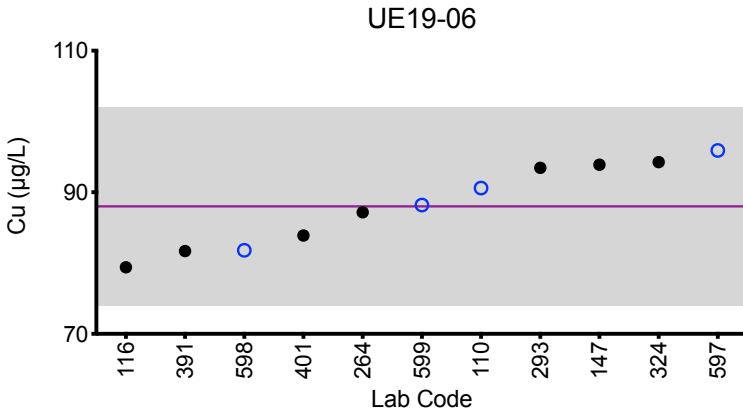
Summary Statistics

	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Robust Mean (x*)	88	121	20	105	41
Robust SD (s*)	7	5	3	8	5
Robust RSD (%)	8.0	4.1	13	7.6	12
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (u)	2	2	1	3	2



Results for Event #2, 2019: Summary Figures

Urine Cu



Legend:

- CHEAR Labs ● Other Labs
- Horizontal purple line = robust mean of all laboratories.
- Gray area = ±2SD of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
103	DRC/CC-ICP-MS	55.9	54.2	27.1	93.7	27.1
107	ICP-MS	50.91	54.43	27.11	92.89	27.62
110	ICP-MS	59.0	55.6	28.6	98.5	29.1
147	ICP-MS	53.8	52.7	25.8	87.7	25.8
264	ICP-MS	48.827	45.72	23.375	80.901	23.524
293	DRC/CC-ICP-MS	55.83	53.9	27.76	94.19	27.79
324	ICP-MS	56.291	54.486	27.639	94.052	27.531
399	ICP-MS	55.4	52.2	26.6	92.9	27
597	DRC/CC-ICP-MS	54.6	55.3	28.0	93.2	30.2
598	DRC/CC-ICP-MS	54.2	52.4	23	91.8	27.5
605	ICP-MS	56.5	53.3	26.9	93.1	27.4
606	ICP-MS/MS	60.3	58.6	30.4	102	29.9
676	ICP-MS	56.3	55.6	25.7	91.4	26.1

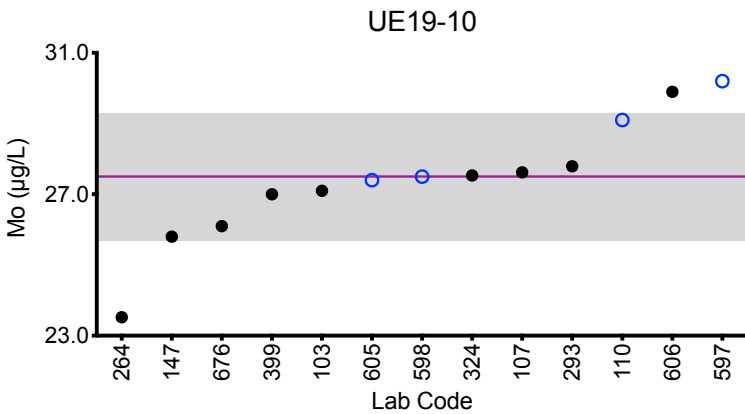
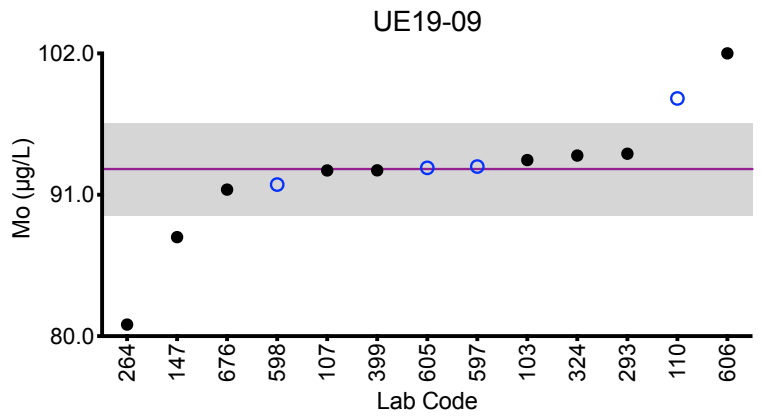
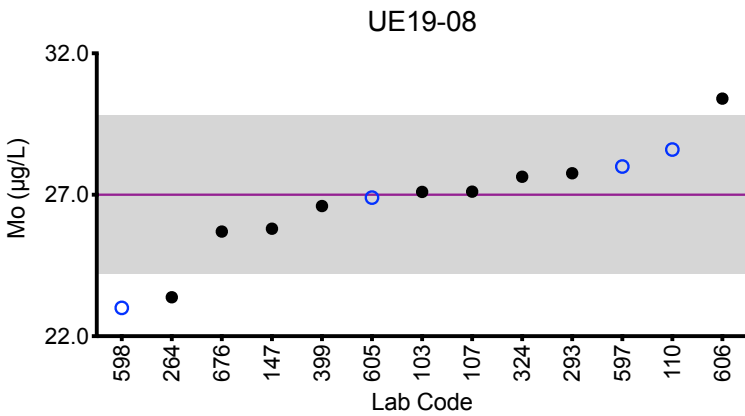
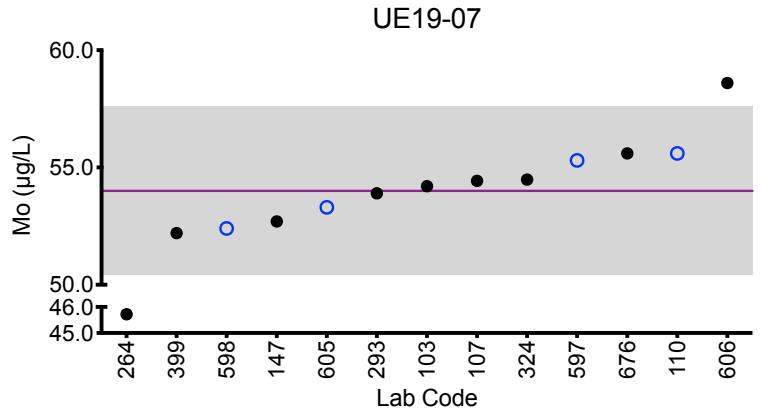
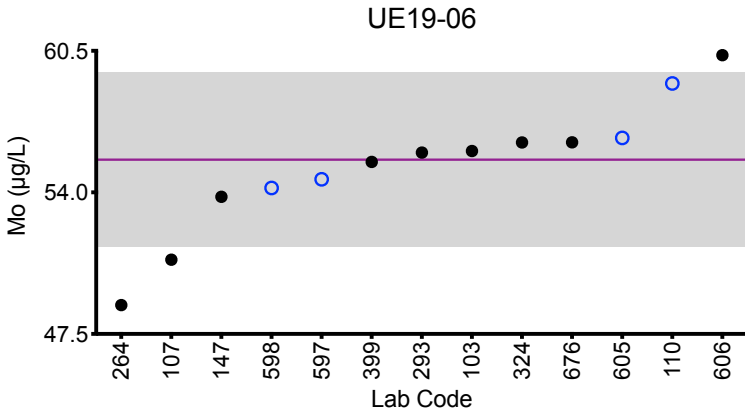
Summary Statistics

	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Robust Mean (x*)	55.5	54.0	27.0	93.0	27.5
Robust SD (s*)	2.0	1.8	1.4	1.8	0.9
Robust RSD (%)	3.6	3.3	5.2	1.9	3.3
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (u)	0.7	0.6	0.5	0.6	0.3



Results for Event #2, 2019: Summary Figures

Urine Mo



Legend:

- CHEAR Labs ● Other Labs
- Horizontal purple line = robust mean of all laboratories.
- Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

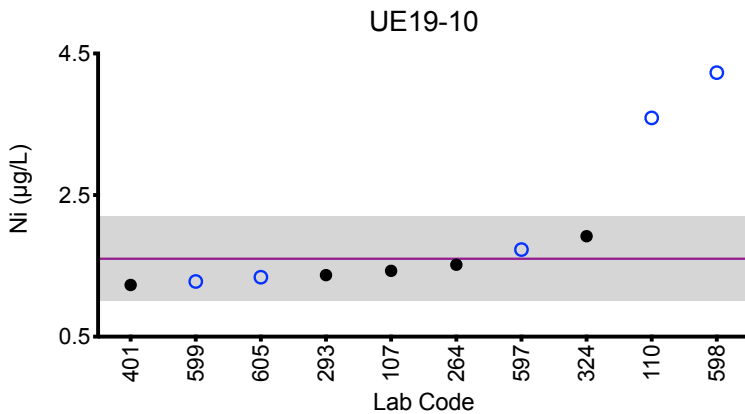
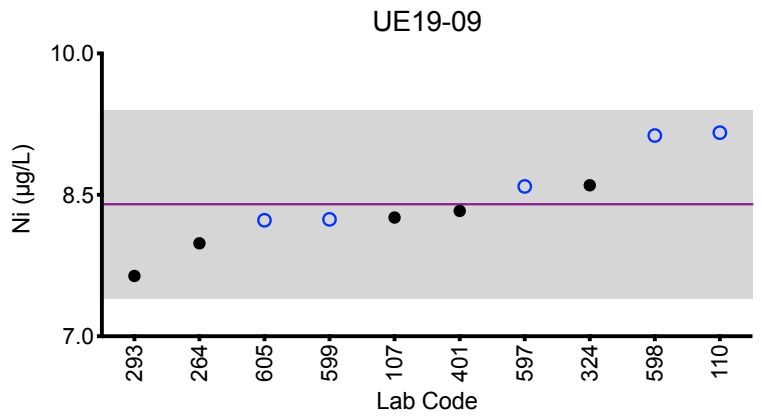
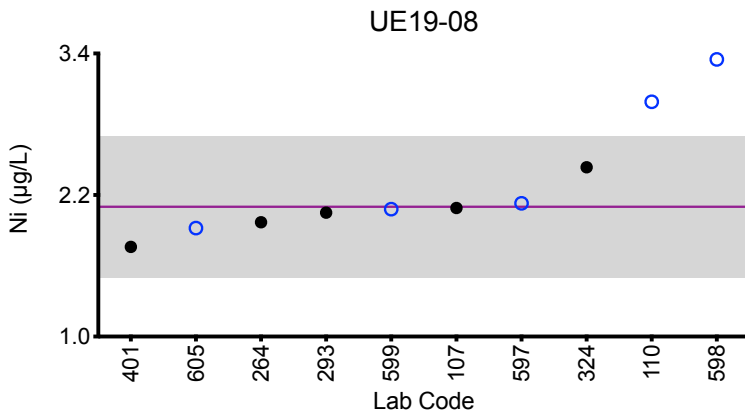
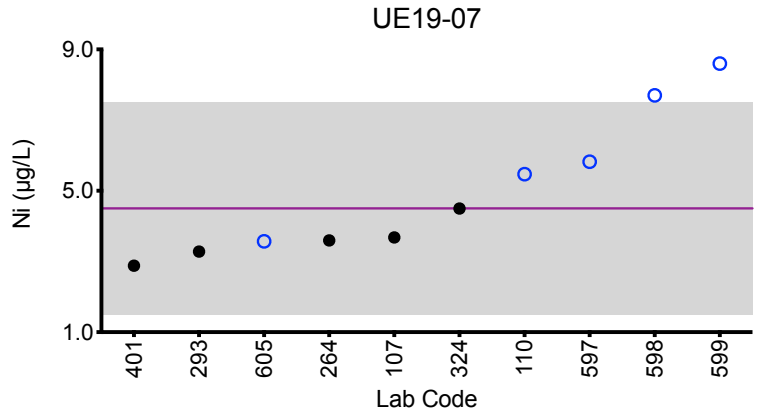
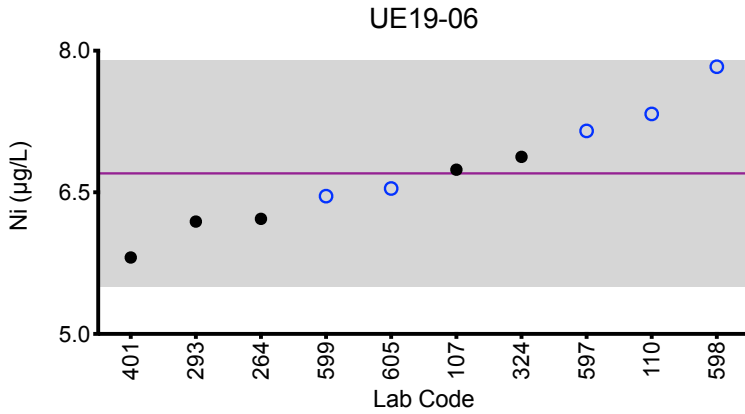
Urine Ni ($\mu\text{g/L}$)						
Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
107	DRC/CC-ICP-MS	6.74	3.68	2.09	8.26	1.43
110	ICP-MS	7.33	5.47	2.99	9.16	3.59
264	ICP-MS	6.219	3.596	1.969	7.986	1.516
293	DRC/CC-ICP-MS	6.19	3.28	2.05	7.64	1.37
324	ICP-MS	6.876	4.498	2.435	8.602	1.920
401	DRC/CC-ICP-MS	5.81	2.88	1.76	8.33	1.23
597	DRC/CC-ICP-MS	7.15	5.82	2.13	8.59	1.73
598	ICP-MS	7.83	7.7	3.35	9.13	4.23
599	DRC/CC-ICP-MS	6.46	8.60	2.08	8.24	1.28
605	ICP-MS	6.54	3.57	1.92	8.23	1.34

Summary Statistics					
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Robust Mean (x^*)	6.7	4.5	2.1	8.4	1.6
Robust SD (s^*)	0.6	1.5	0.3	0.5	0.3
Robust RSD (%)	9.5	33	12	5.4	21
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (u)	0.3	0.6	0.1	0.2	0.1



Results for Event #2, 2019: Summary Figures

Urine Ni



Legend:

- CHEAR Labs
- Other Labs
- Horizontal purple line = robust mean of all laboratories.
- Gray area = ±2SD of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine Pt ($\mu\text{g/L}$)						
Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
107	ICP-MS	1.718	0.611	4.168	2.958	0.173
110	ICP-MS	1.99	0.641	4.46	3.05	0.162
264	ICP-MS	1.88	0.611	4.348	2.968	0.17
399	ICP-MS	1.92	0.614	4.18	2.92	0.154
598	ICP-MS	1.89	0.69	*5.4	2.79	*0.12
605	ICP-MS	1.98	0.583	4.06	2.88	0.167
676	ICP-MS	1.93	0.607	4.15	2.88	0.158

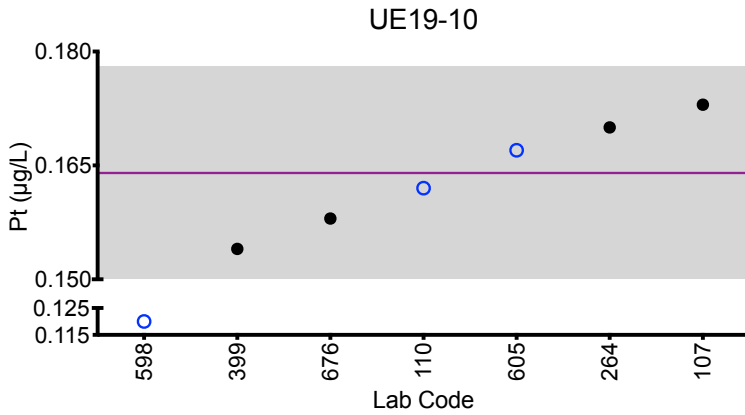
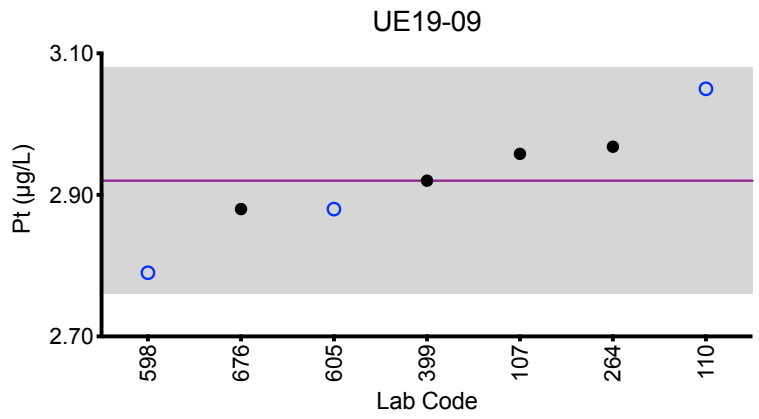
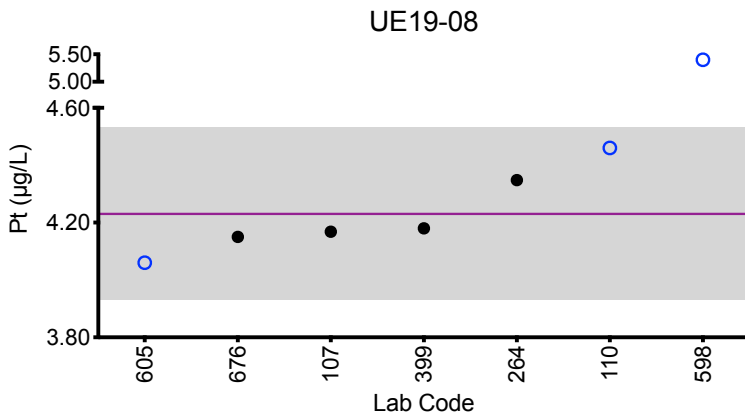
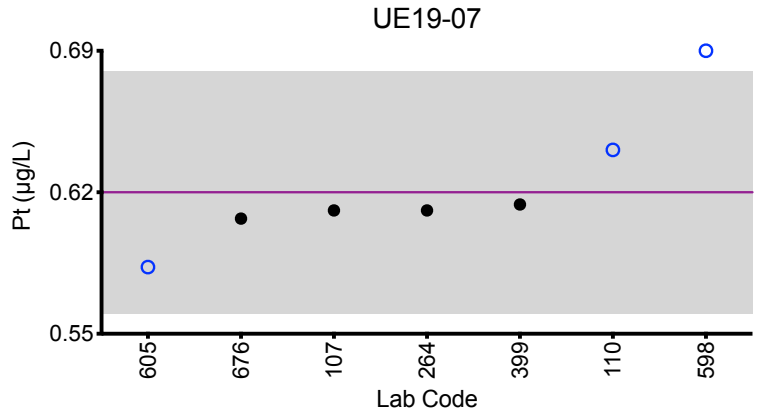
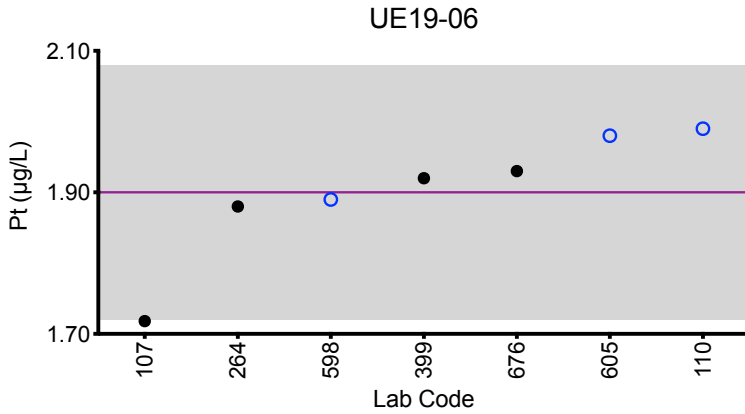
Summary Statistics					
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Arithmetic Mean (\bar{x})	1.90	0.62	4.23	2.92	0.164
Arithmetic SD (s)	0.09	0.03	0.15	0.08	0.007
Arithmetic RSD (%)	4.7	5.5	3.5	2.7	4.3
Number of Sample Measurements (N)	7	7	6	7	6

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Urine Pt



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine Sb ($\mu\text{g/L}$)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
103	DRC/CC-ICP-MS	1.56	2.27	0.409	2.94	0.853
107	ICP-MS	1.422	2.276	0.418	2.866	0.885
110	ICP-MS	1.63	2.25	0.411	2.92	0.883
147	ICP-MS	1.64	2.3	0.446	3.01	0.901
264	ICP-MS	1.654	2.151	0.387	2.724	0.834
293	DRC/CC-ICP-MS	1.6	2.12	0.35	2.78	0.74
399	ICP-MS	1.65	2.24	0.426	2.89	0.881
597	DRC/CC-ICP-MS	1.69	2.46	0.50	3.03	1.08
598	ICP-MS	1.48	2.37	0.42	2.72	0.87
606	ICP-MS/MS	1.69	2.51	0.475	3.18	0.985
676	ICP-MS	1.92	2.52	0.410	3.30	0.938

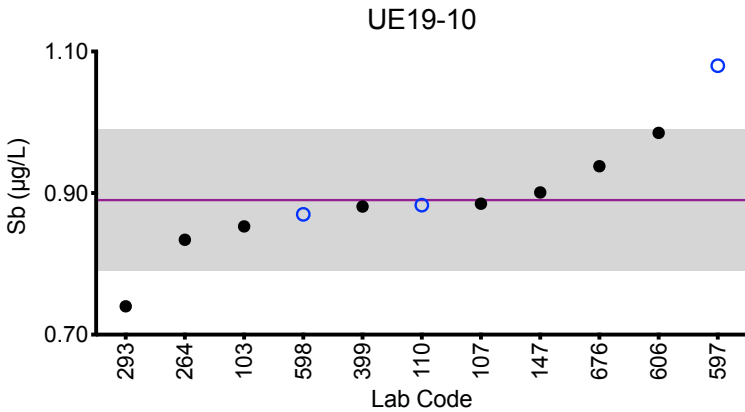
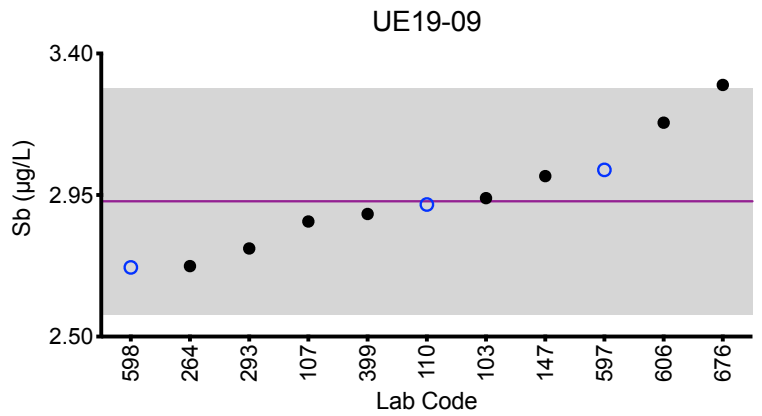
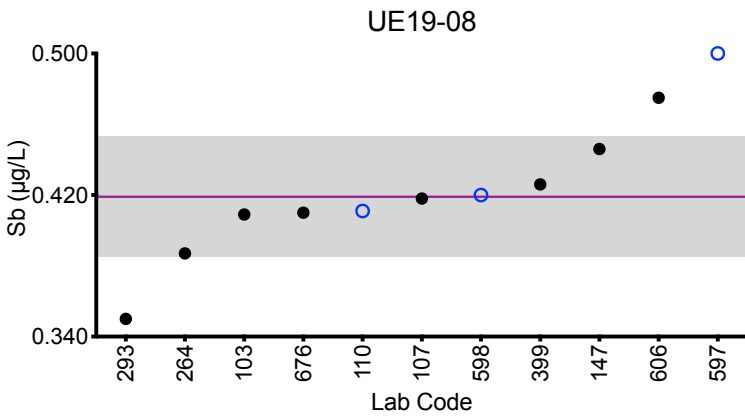
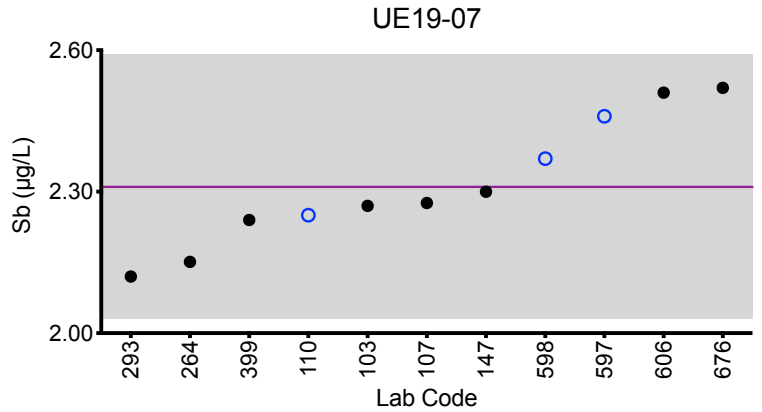
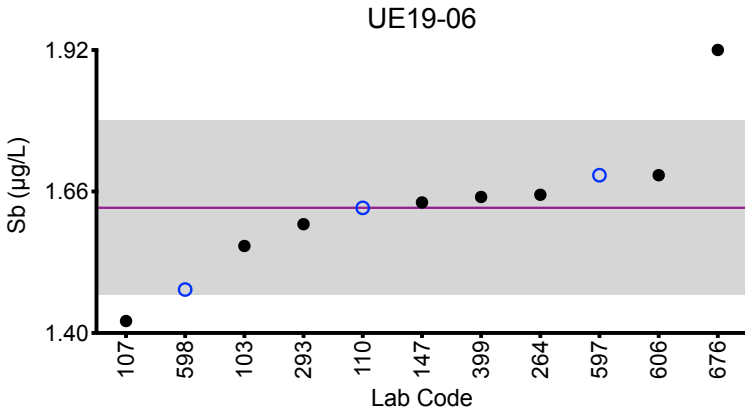
Summary Statistics

	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Robust Mean (\bar{x}^*)	1.63	2.31	0.419	2.93	0.89
Robust SD (s^*)	0.08	0.14	0.017	0.18	0.05
Robust RSD (%)	4.9	6.1	4.1	6.1	5.6
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (u)	0.03	0.05	0.006	0.07	0.02



Results for Event #2, 2019: Summary Figures

Urine Sb



Legend:

- CHEAR Labs ● Other Labs
- Horizontal purple line = robust mean of all laboratories.
- Gray area = ±2SD of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine Se (µg/L)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
103	DRC/CC-ICP-MS	176	94.4	56.2	190	49.8
110	DRC/CC-ICP-MS	172	116	67.2	201	53.9
147	ICP-MS	167	96.4	58.8	201	50.4
391	DRC/CC-ICP-MS	172.714	98.359	58.843	185.885	45.738
598	DRC/CC-ICP-MS	131	69.3	48.9	172	43.1
599	DRC/CC-ICP-MS	155	89.9	55.0	177	46.9

Summary Statistics

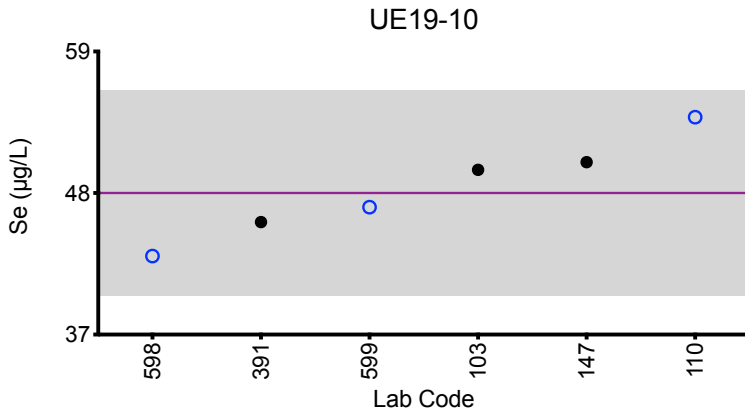
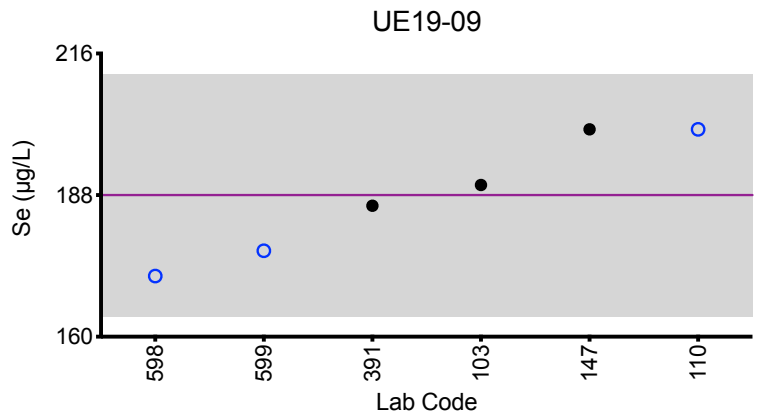
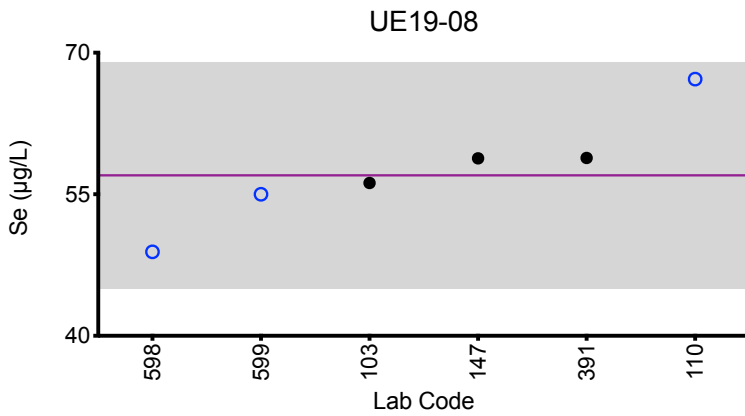
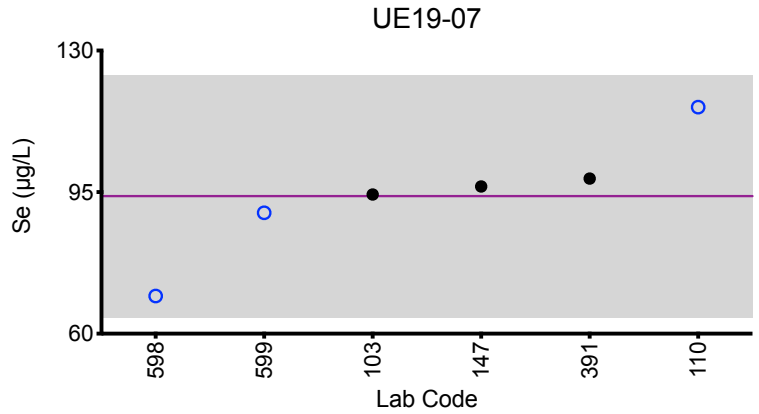
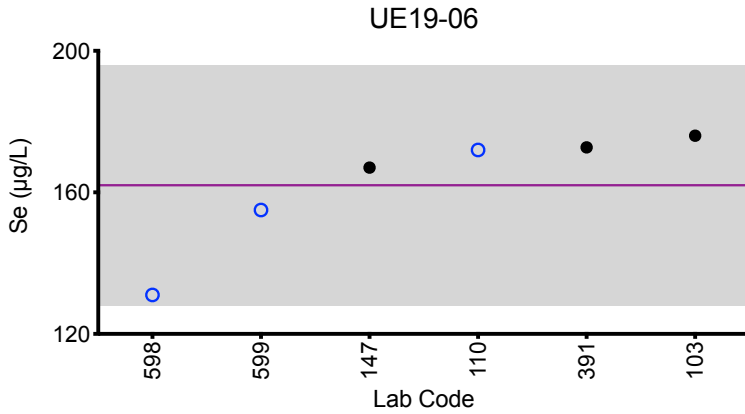
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Arithmetic Mean (\bar{x})	162	94	57	188	48
Arithmetic SD (s)	17	15	6	12	4
Arithmetic RSD (%)	10	16	11	6.4	8.3
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Urine Se



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

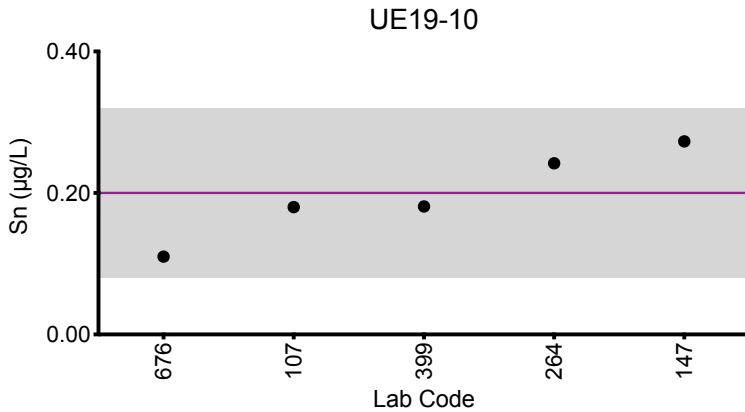
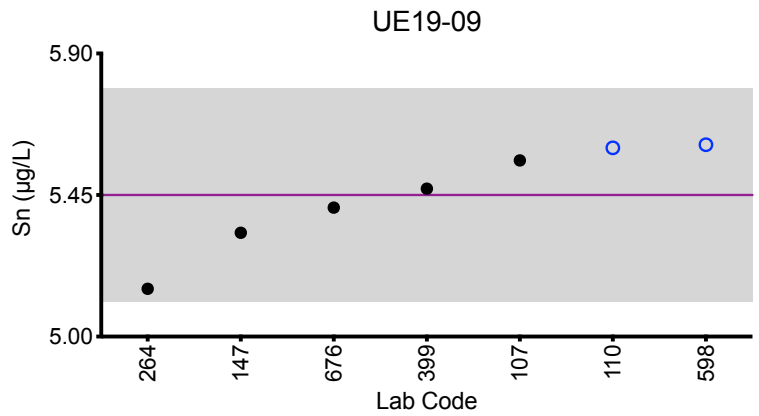
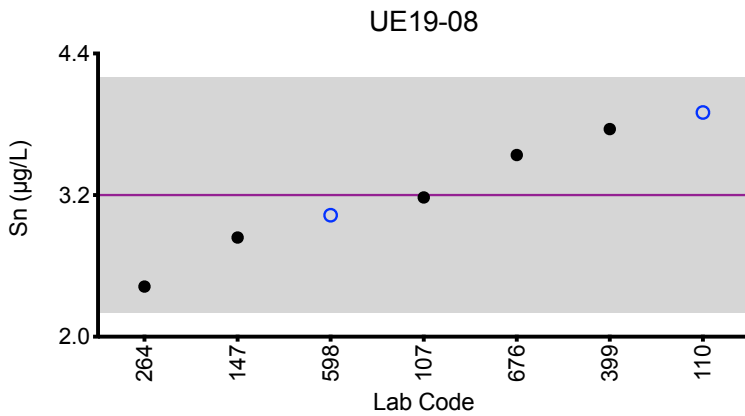
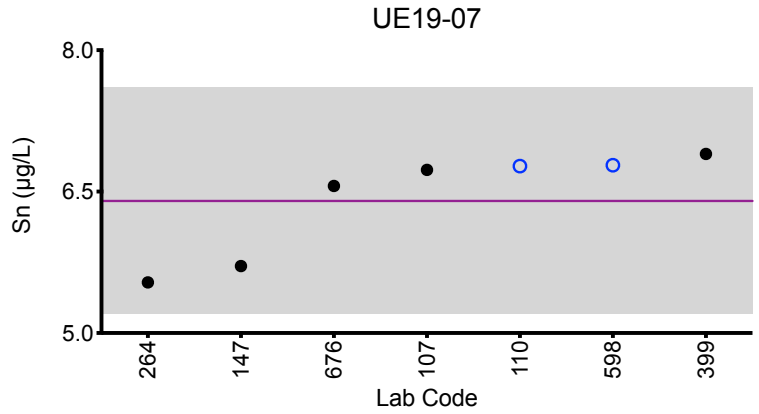
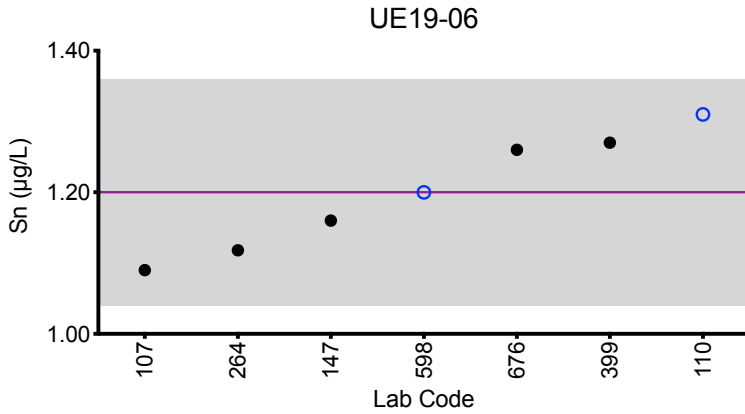
Urine Sn (µg/L)						
Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
107	ICP-MS	1.09	6.73	3.18	5.56	0.18
110	ICP-MS	1.31	6.77	3.90	5.60	<0.21
147	ICP-MS	1.16	5.71	2.84	5.33	0.273
264	ICP-MS	1.118	5.537	2.425	5.152	0.242
399	ICP-MS	1.27	6.9	3.76	5.47	0.181
598	ICP-MS	1.2	6.78	3.03	5.61	<0.1
676	ICP-MS	1.26	6.56	3.54	5.41	0.110
Summary Statistics						
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Arithmetic Mean (\bar{x})		1.20	6.4	3.2	5.45	0.20
Arithmetic SD (s)		0.08	0.6	0.5	0.17	0.06
Arithmetic RSD (%)		6.7	9.4	16	3.1	30
Number of Sample Measurements (N)		7	7	7	7	5

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Urine Sn



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = ±2SD of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine Sr (µg/L)						
Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
103	DRC/CC-ICP-MS	454	243	492	205	607
107	ICP-MS	456.23	237.81	477.10	197.24	610.68
200	ICP-MS	419	222	471	192	554
264	ICP-MS	430.014	207.998	458.243	179.734	576.542
399	DRC/CC-ICP-MS	469	239	521	209	657
605	ICP-MS	453	236	486	204	625
676	ICP-MS	476	250	488	205	628

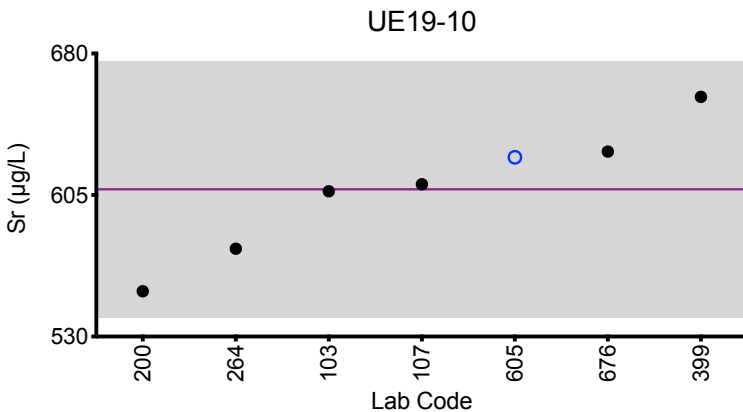
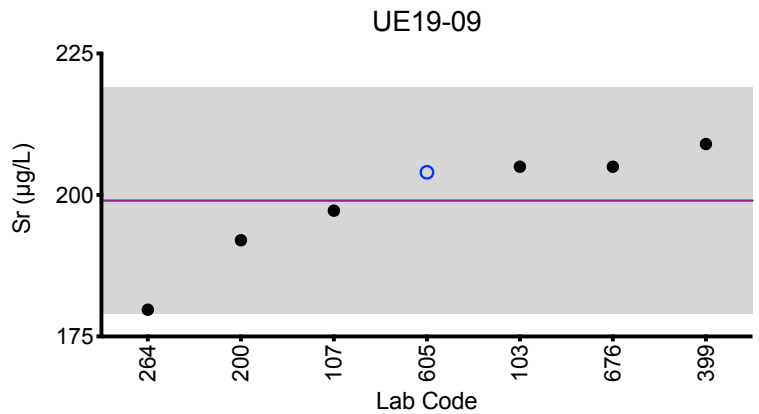
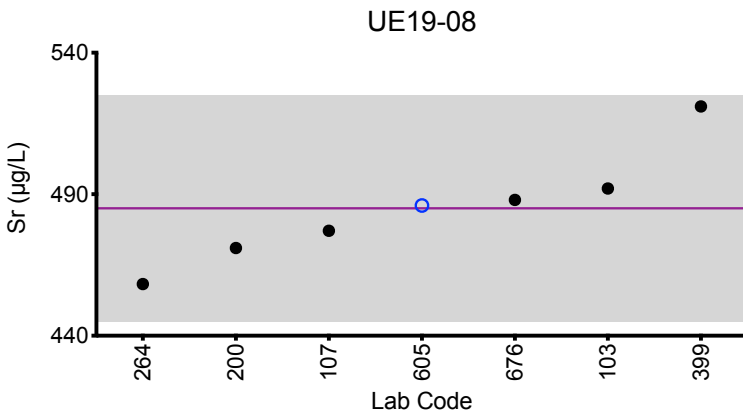
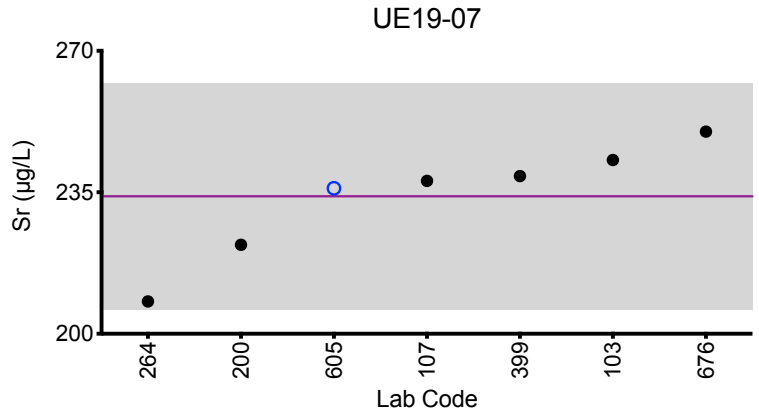
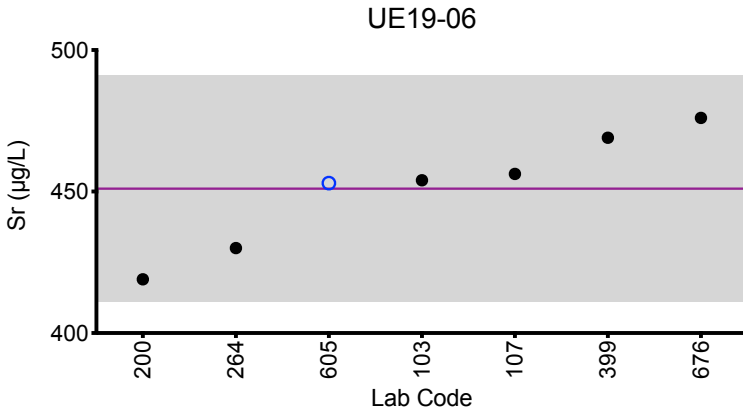
Summary Statistics					
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Arithmetic Mean (\bar{x})	451	234	485	199	608
Arithmetic SD (s)	20	14	20	10	34
Arithmetic RSD (%)	4.4	6.1	4.1	5.1	5.6
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Urine Sr



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = ±2SD of the mean.

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Results for Event #2, 2019: Laboratory Data and Summary Statistics

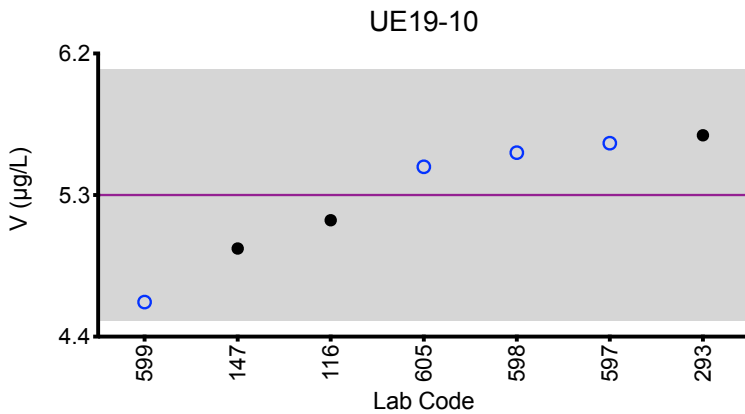
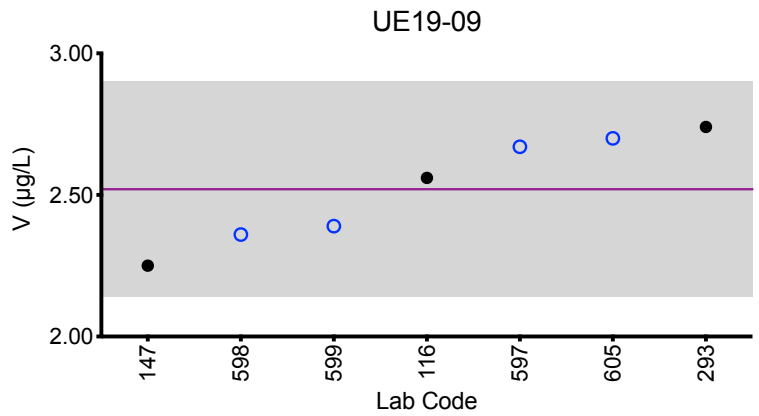
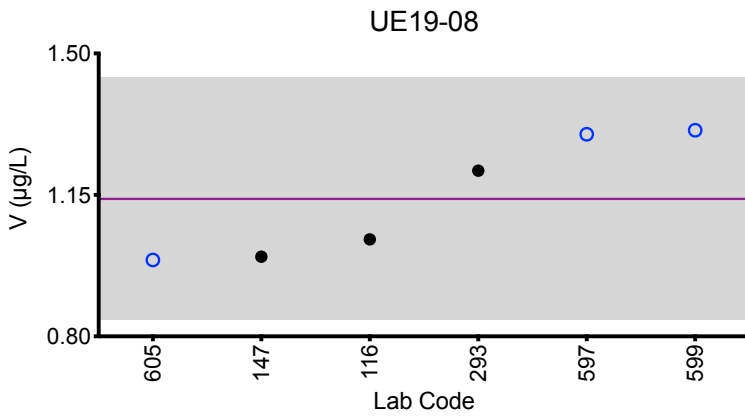
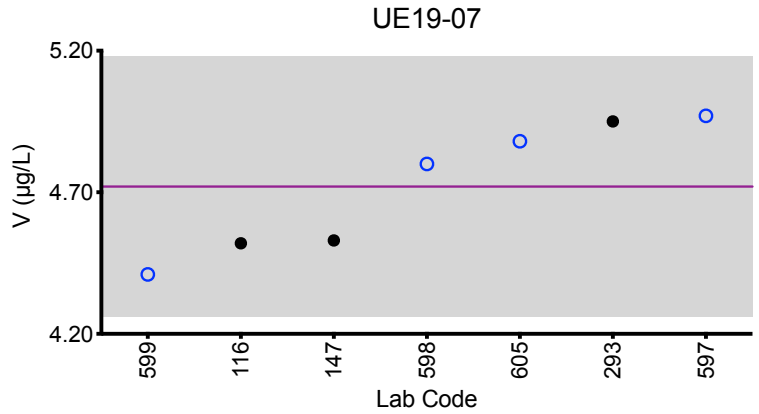
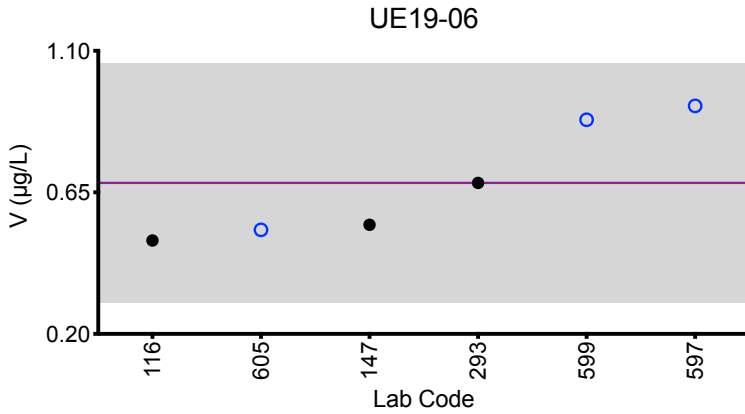
Urine V ($\mu\text{g/L}$)						
Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
116	ICP-MS/MS	0.497	4.52	1.04	2.56	5.14
147	DRC/CC-ICP-MS	0.547	4.53	0.997	2.25	4.96
293	DRC/CC-ICP-MS	0.68	4.95	1.21	2.74	5.68
597	DRC/CC-ICP-MS	0.925	4.97	1.30	2.67	5.63
598	DRC/CC-ICP-MS	<0.6	4.8	<0.6	2.36	5.57
599	DRC/CC-ICP-MS	0.881	4.41	1.31	2.39	4.62
605	ICP-MS	0.531	4.88	0.989	2.7	5.48
Summary Statistics						
		UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Arithmetic Mean (\bar{x})		0.68	4.72	1.14	2.52	5.3
Arithmetic SD (s)		0.19	0.23	0.15	0.19	0.4
Arithmetic RSD (%)		28	4.9	13	7.5	7.5
Number of Sample Measurements (N)		6	7	6	7	7

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Urine V



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine W ($\mu\text{g/L}$)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
107	ICP-MS	0.714	0.464	0.636	0.393	1.141
110	ICP-MS	0.811	0.463	0.524	0.279	1.54
147	ICP-MS	0.742	0.436	0.484	0.252	1.1
200	ICP-MS	0.9	0.48	0.51	0.31	1.27
264	ICP-MS	0.724	0.403	0.462	0.242	1.058
324	ICP-MS	<1	<1	<1	<1	1.067
399	ICP-MS	0.796	0.449	0.491	0.28	1.15
598	ICP-MS	0.8	0.47	0.49	0.26	1.17
605	ICP-MS	0.783	0.945	0.498	0.266	1.17
606	ICP-MS/MS	0.801	0.441	0.525	0.281	1.24
676	ICP-MS	0.803	0.437	0.482	0.266	1.12

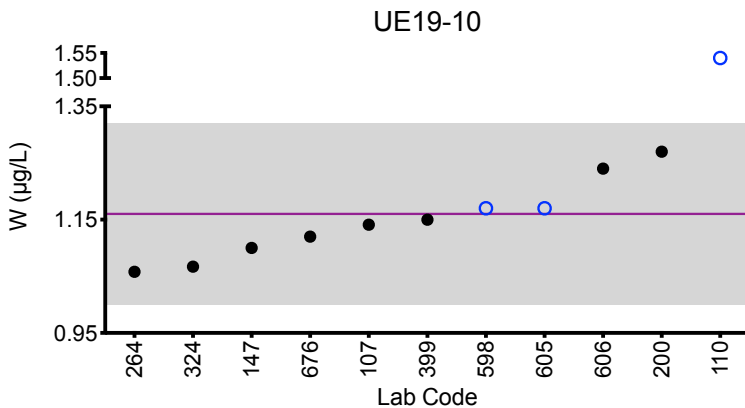
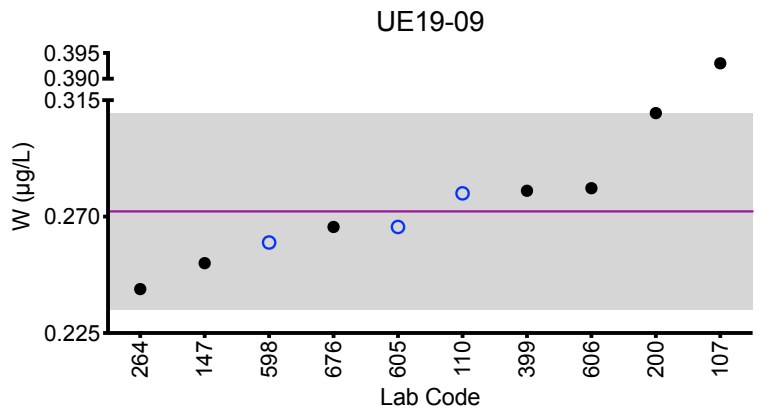
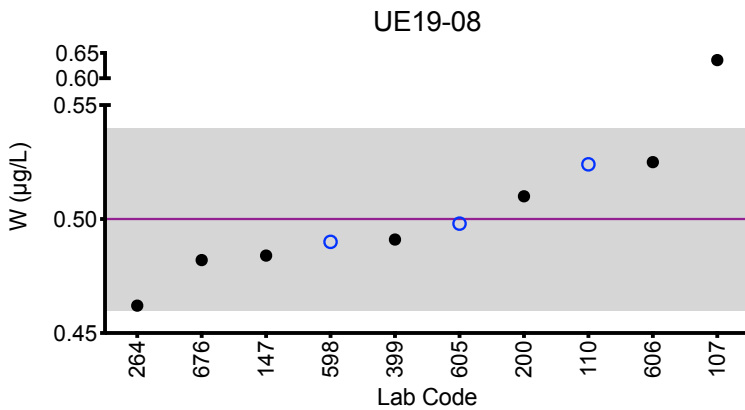
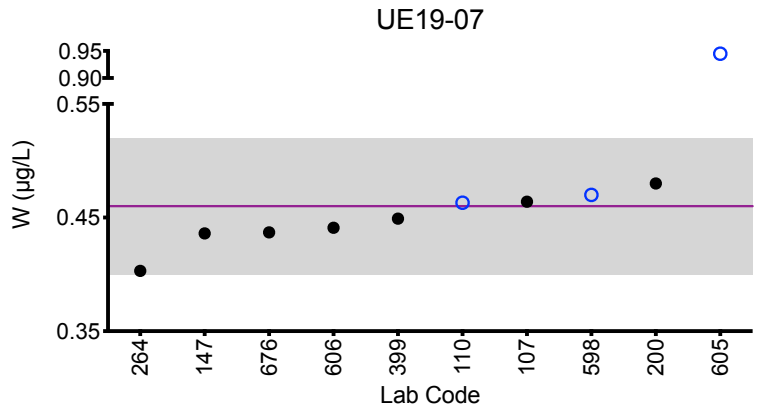
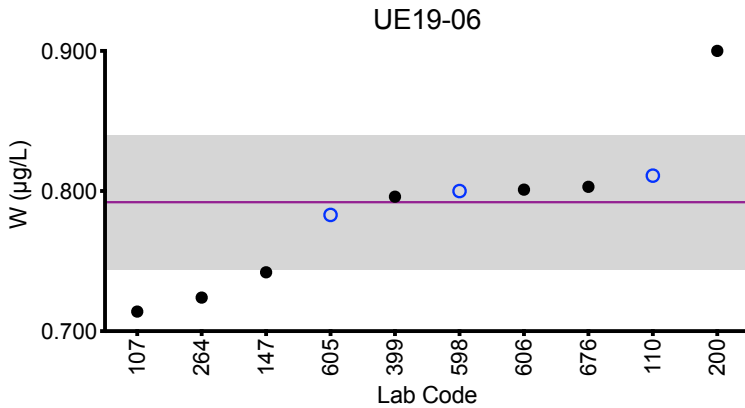
Summary Statistics

	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Robust Mean (\bar{x}^*)	0.792	0.46	0.50	0.272	1.16
Robust SD (s^*)	0.024	0.03	0.02	0.019	0.08
Robust RSD (%)	3.0	5.7	4.8	7.0	6.9
Number of Sample Measurements (N)	10	10	10	10	11
Standard Uncertainty (u)	0.009	0.01	0.01	0.007	0.03



Results for Event #2, 2019: Summary Figures

Urine W



Legend:

- CHEAR Labs
- Other Labs
- Horizontal purple line = robust mean of all laboratories.
- Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine Zn (µg/L)

Table with 7 columns: Lab Code, Method, UE19-06, UE19-07, UE19-08, UE19-09, UE19-10. Rows include lab codes 110, 147, 264, 293, 324, 391, 401, 597, 598, 599 with their respective methods and values.

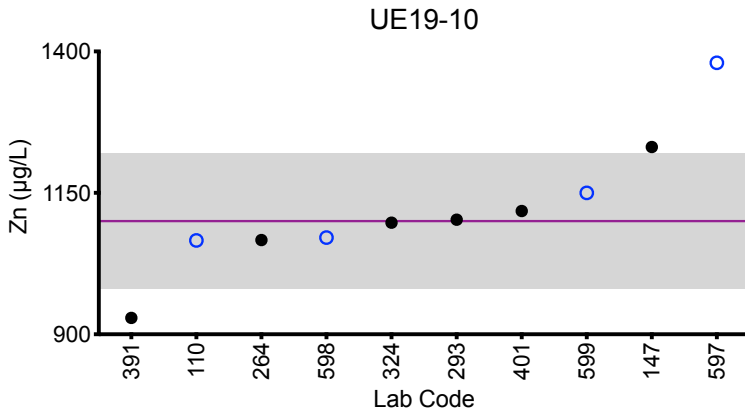
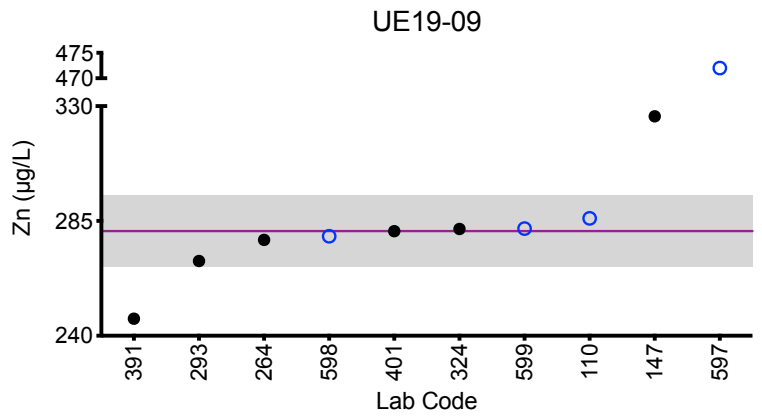
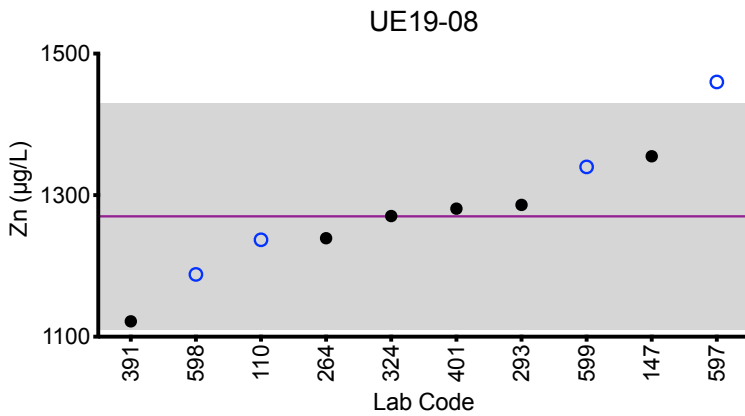
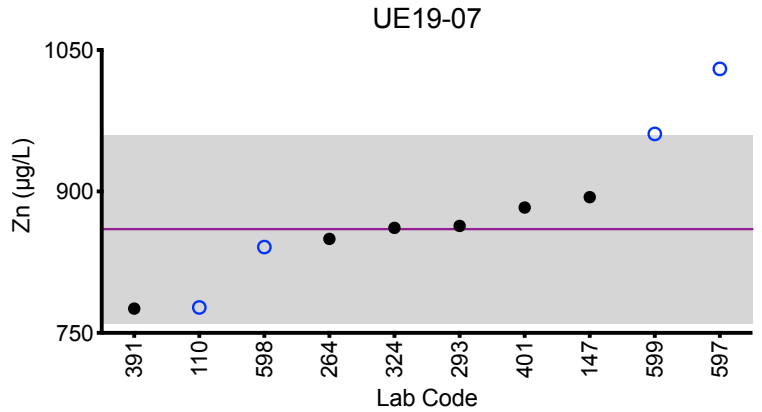
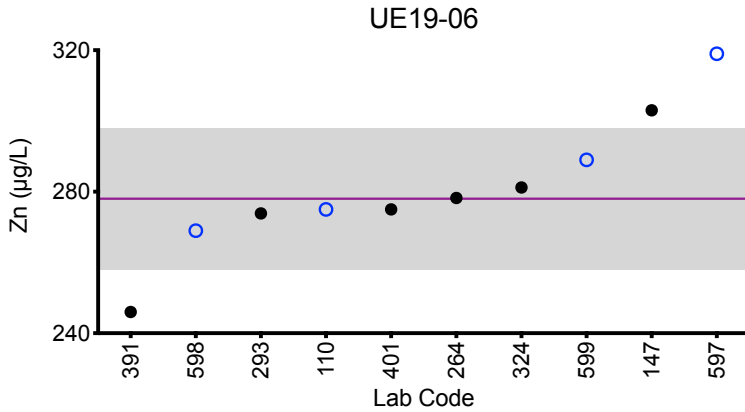
Summary Statistics

Table with 6 columns: UE19-06, UE19-07, UE19-08, UE19-09, UE19-10. Rows include Robust Mean (x*), Robust SD (s*), Robust RSD (%), Number of Sample Measurements (N), and Standard Uncertainty (u).



Results for Event #2, 2019: Summary Figures

Urine Zn



Legend:

- CHEAR Labs
- Other Labs
- Horizontal purple line = robust mean of all laboratories.
- Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine AI ($\mu\text{g/L}$)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
147	DRC/CC-ICP-MS	23.5	14.3	10.36	27.5	21.6
264	ICP-MS	19.217	12.727	8.246	25.488	15.472
324	ICP-MS	24.530	23.621	15.731	24.872	21.037

Summary Statistics

	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Arithmetic Mean (\bar{x})	22	17	11	26.0	19
Arithmetic SD (s)	3	6	4	1.4	3
Arithmetic RSD (%)	14	35	36	5.4	16
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine Bi (µg/L)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
147	ICP-MS	<0.0669	<0.0669	<0.0669	0.14	<0.0669
264	ICP-MS	<0.10	<0.10	<0.10	0.124	<0.10

Summary Statistics

	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
Arithmetic Mean (\bar{x})	NA	NA	NA	0.132	NA
Arithmetic SD (s)	NA	NA	NA	0.011	NA
Arithmetic RSD (%)	NA	NA	NA	8.3	NA
Number of Sample Measurements (N)	0	0	0	2	0

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Urine Te ($\mu\text{g/L}$)						
Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
110	ICP-MS	0.829	2.03	0.382	2.87	1.65
147	ICP-MS	0.757	2.05	0.325	2.76	1.52

Summary Statistics						
	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10	
Arithmetic Mean (\bar{x})	0.79	2.04	0.35	2.81	1.59	
Arithmetic SD (s)	0.05	0.01	0.04	0.08	0.09	
Arithmetic RSD (%)	6.3	0.69	11	2.8	5.7	
Number of Sample Measurements (N)	2	2	2	2	2	

*Denotes a statistical Outlier.



Results for Event #2, 2019:
Additional Elements in Urine

Urine Ag (µg/L)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
147	ICP-MS	<0.140	<0.140	<0.140	<0.140	<0.140

Urine Fe (µg/L)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
324	ICP-MS	12.124	11.343	26.582	15.448	8.826

Urine Li (µg/L)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
147	ICP-MS	33.5	52.5	23.3	25	42

Urine Mg (µg/L)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
597	DRC/CC-ICP-MS	72700	109000	47900	44300	78300

Urine Th (µg/L)

Lab Code	Method	UE19-06	UE19-07	UE19-08	UE19-09	UE19-10
147	ICP-MS	<0.0626	<0.0626	<0.0626	<0.0626	<0.0626



**Department
of Health**

**Wadsworth
Center**

Event #2, 2019

**Trace Elements in
Serum**

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory



Event #2, 2019: 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 1Z2 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). Serum units 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 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 27 were reported by at least one participant: Ag, As, Ba, Be, Bi, Cd, Cs, Fe, Hg, I, Li, Mg, Mn, Mo, Ni, Pb, Pt, Sb, Sn, Sr, Te, Th, Ti, Tl, U, V, and W. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

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



Results for Event #2, 2019: Summary Statistics

	Serum AI (µg/L)				
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Target (Arithmetic Mean (\bar{x}))	160	205	124	123	78
Upper Limit	192	246	149	148	94
Lower Limit	128	164	99	98	63
Arithmetic SD (s)	40	31	11	27	3
Arithmetic RSD (%)	25	15	8.9	22	3.4
Number of Sample Measurements (N)	6	6	5	6	5

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



Results for Event #2, 2019: Performance of Participating Laboratories

		Serum AI (µg/L)				
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
	Target	160	205	124	123	78
147	ETAAS-Z	109.00 ↓	164	109	89 ↓	74
293	DRC/CC-ICP-MS	169.35	206.99	139.78	120.97	77.96
391	ETAAS-Z	199.50 ↑	201	124.4	136.8	78.38
485	HR-ICP-MS	144	199	126	116	81.2
590	ICP-MS	138	201	123	109	80.0
598	ICP-MS	204 ↑	259 ↑	*184 ↑	168 ↑	*120 ↑

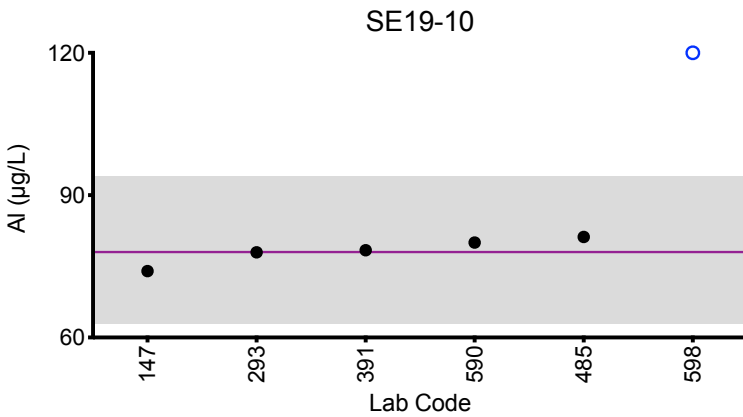
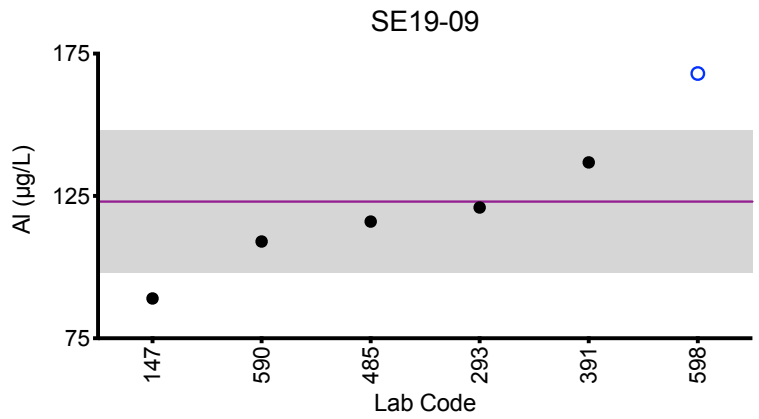
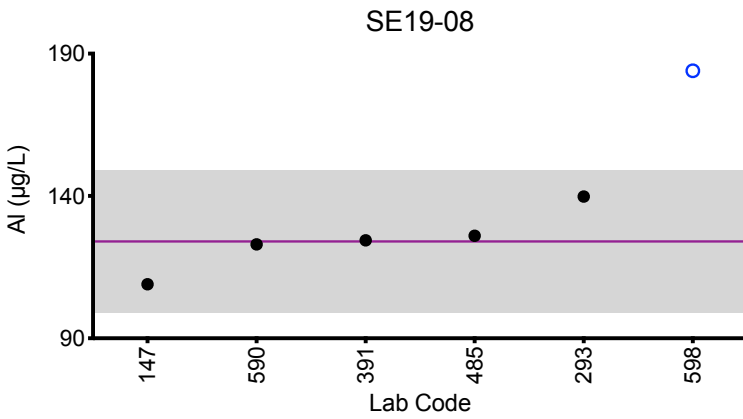
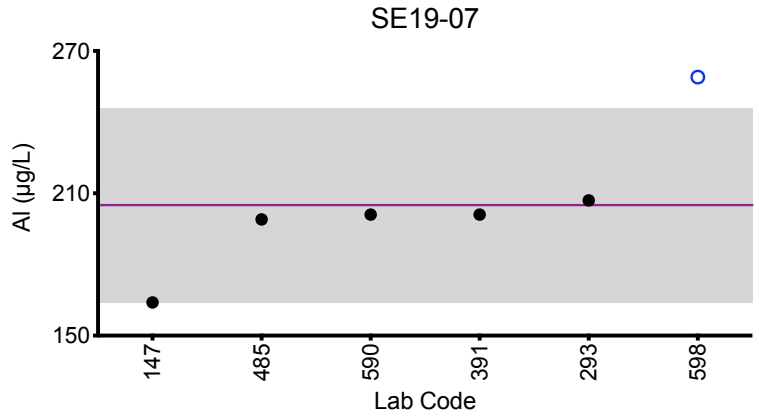
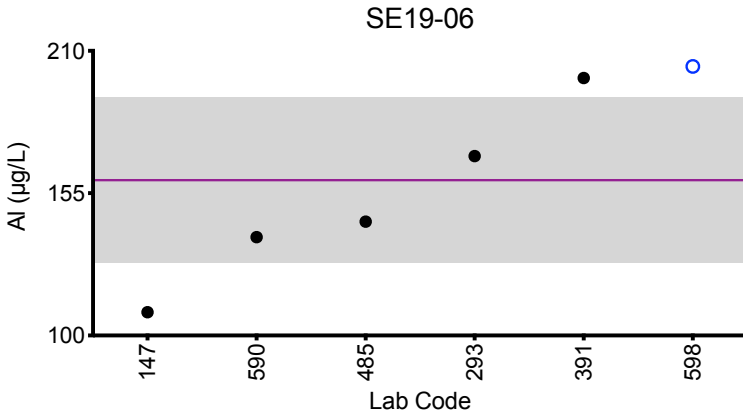
Based on the grading criteria for AI in Serum, 73% of results were satisfactory, with 2 of the 6 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Serum AI



Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±5 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±5 µg/L at concentrations less than or equal to 25 µg/L.



Results for Event #2, 2019: Summary Statistics

	Serum Co (µg/L)				
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Target (Arithmetic Mean (\bar{x}))	12.2	1.5	13.2	33.3	9.0
Upper Limit	14.0	3.0	15.2	38.3	10.5
Lower Limit	10.4	0.0	11.2	28.3	7.5
Arithmetic SD (s)	0.6	0.5	0.6	2.0	0.5
Arithmetic RSD (%)	4.9	33	4.5	6.0	5.6
Number of Sample Measurements (N)	7	8	7	7	7

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



Results for Event #2, 2019: Performance of Participating Laboratories

		Serum Co (µg/L)				
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Target		12.2	1.5	13.2	33.3	9.0
103	DRC/CC-ICP-MS	12.3	1.16	12.5	33.4	8.47
110	ICP-MS	12.2	1.3	13.7	34.4	9.1
147	ICP-MS	12	1.24	13.3	33.4	9.02
264	ICP-MS	*23.13 ↑	2.38	*25.69 ↑	*64.33 ↑	*17.38 ↑
293	DRC/CC-ICP-MS	12.48	1.31	13.29	33.02	9.46
485	HR-ICP-MS	12.5	1.28	13.6	32.4	8.85
590	ICP-MS	11.0	1.14	12.3	30.0	8.39
598	ICP-MS	12.9	2.21	13.9	36.6	9.8

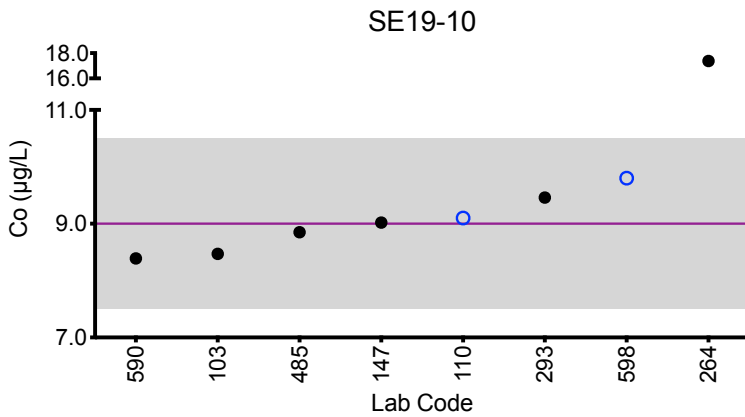
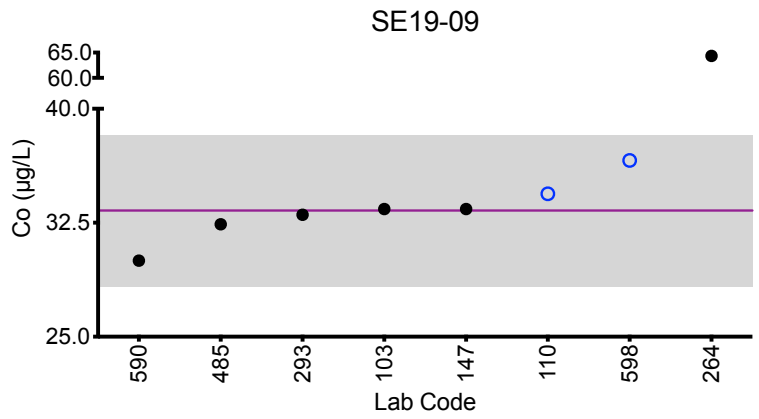
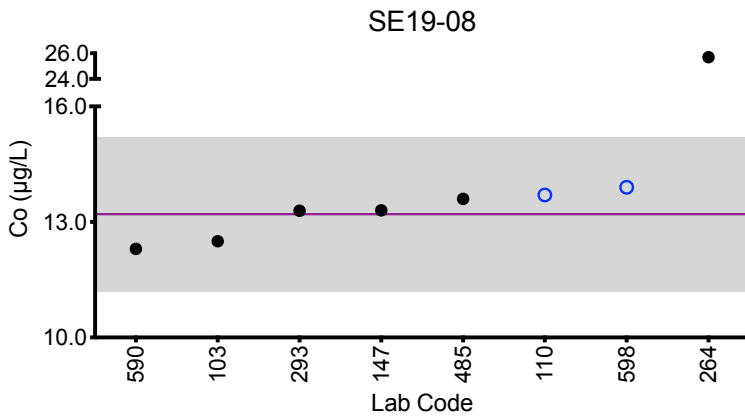
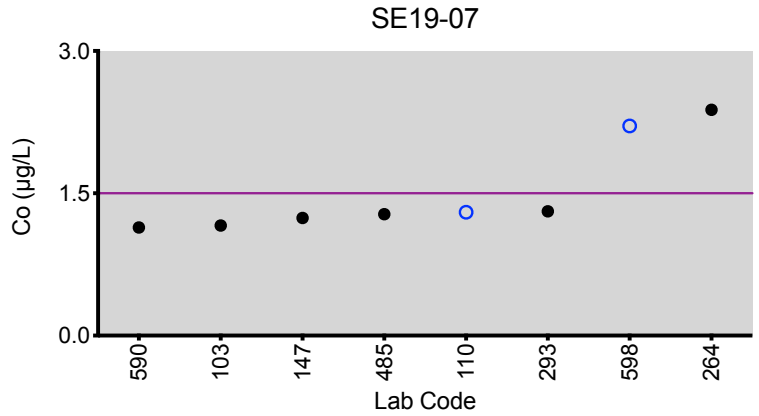
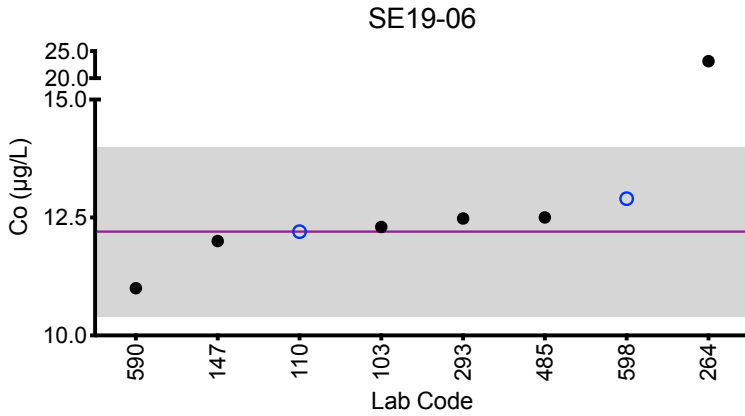
Based on the grading criteria for Co in Serum, 90% of results were satisfactory, with 1 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Serum Co



Legend:
 ○ CHEAR 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:
 $\pm 1.5 \mu\text{g/L}$ or $\pm 15\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 1.5 \mu\text{g/L}$ at concentrations less than or equal to $10 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

	Serum Cr (µg/L)				
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Target (Arithmetic Mean (\bar{x}))	7.9	10.4	5.2	4.9	2.32
Upper Limit	9.9	12.5	7.2	6.9	4.32
Lower Limit	5.9	8.3	3.2	2.9	0.32
Arithmetic SD (s)	1.0	1.0	0.3	0.5	0.13
Arithmetic RSD (%)	13	9.6	5.6	10	5.6
Number of Sample Measurements (N)	6	6	6	6	6

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Serum Cr (µg/L)				
		SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
	Target	7.9	10.4	5.2	4.9	2.32
110	DRC/CC-ICP-MS	8.0	11.1	5.1	4.7	2.3
147	DRC/CC-ICP-MS	6.34	8.53	4.71	4.41	2.15
264	ICP-MS	*15.76 ↑	*20.26 ↑	*9.9 ↑	*9.47 ↑	*4.97 ↑
293	DRC/CC-ICP-MS	8.97	10.62	5.59	4.97	2.45
485	HR-ICP-MS	7.90	10.7	5.3	4.78	2.21
590	ICP-MS	7.28	10.1	5.23	4.52	2.33
598	DRC/CC-ICP-MS	8.69	11.4	5.34	5.79	2.47

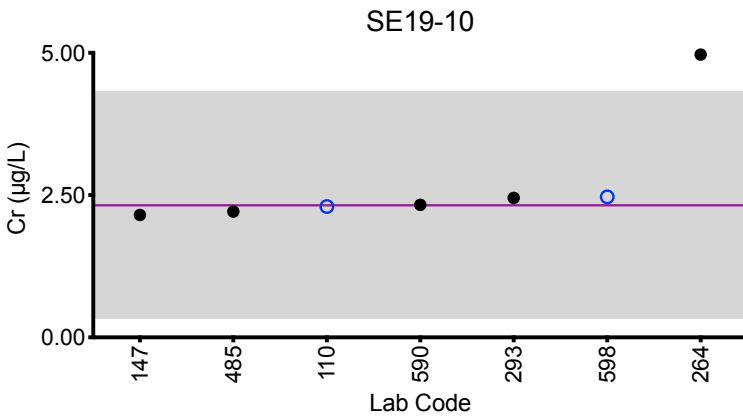
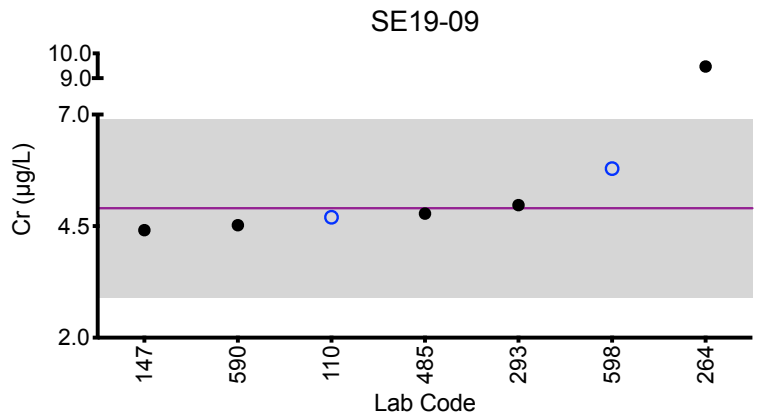
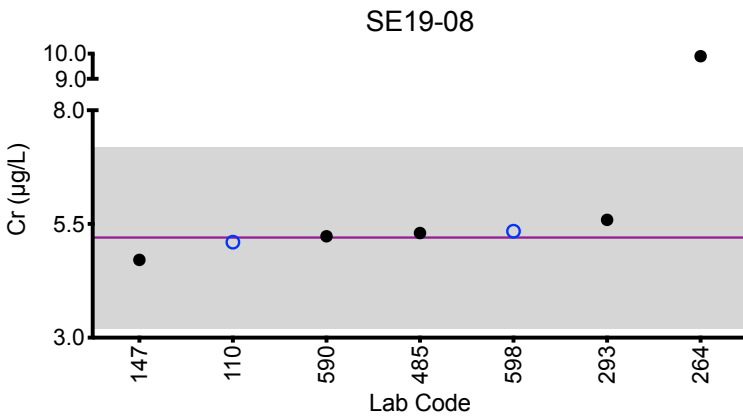
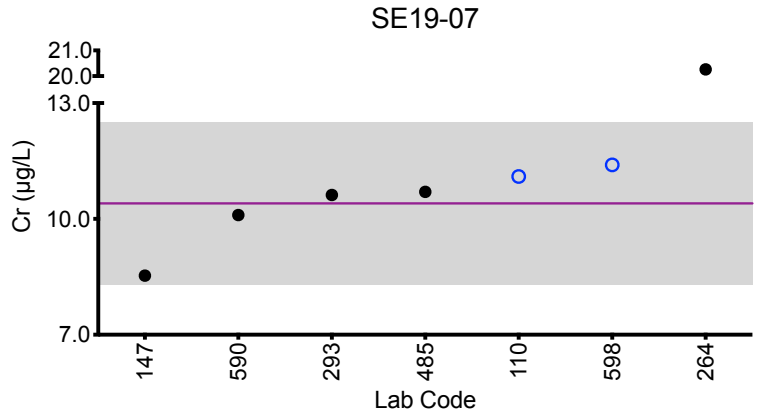
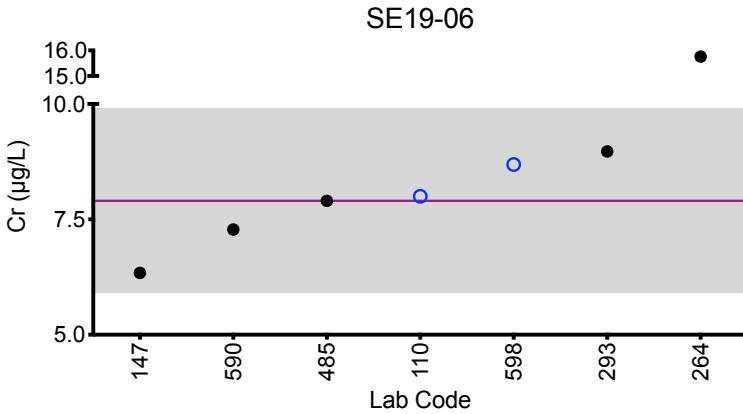
Based on the grading criteria for Cr in Serum, 86% of results were satisfactory, with 1 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Serum Cr



Legend:
 ○ CHEAR 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:
 $\pm 2 \mu\text{g/L}$ or $\pm 20\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 2 \mu\text{g/L}$ at concentrations less than or equal to $10 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

	Serum Cu ($\mu\text{g/L}$)				
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Target (Arithmetic Mean (\bar{x}))	2780	1250	3030	803	1320
Upper Limit	3200	1440	3490	923	1510
Lower Limit	2360	1070	2580	683	1120
Arithmetic SD (s)	140	38	110	23	34
Arithmetic RSD (%)	5.0	3.1	3.6	2.9	2.6
Number of Sample Measurements (N)	8	8	8	8	8

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



Results for Event #2, 2019: Performance of Participating Laboratories

Serum Cu (µg/L)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Target		2780	1250	3030	803	1320
107	DRC/CC-ICP-MS	2975	1322	3199	828	1341
110	ICP-MS	2730	1230	3100	798	1300
147	ICP-MS	2783	1252	3113	788	1347
264	ICP-MS	2692.64	1197.91	2909.93	757.39	1248.05
293	DRC/CC-ICP-MS	3013.35	1277.81	3095.99	820.09	1322.31
483	ICP-MS	2770	1230	2970	803	1290
590	ICP-MS	2628	1281	2891	808	1322
598	DRC/CC-ICP-MS	2638	1245	2946	823	1347

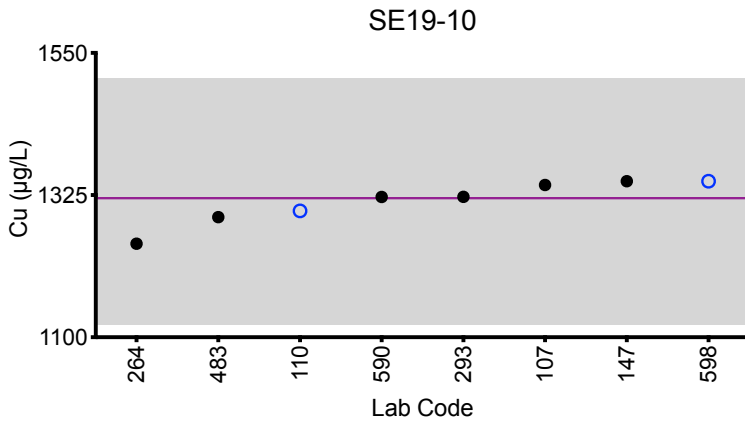
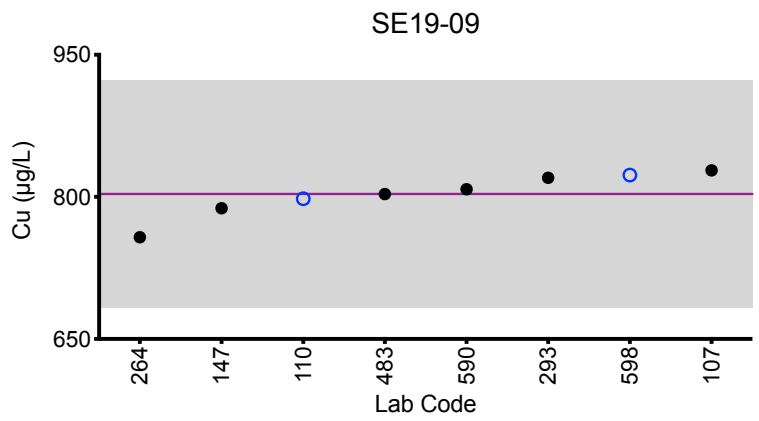
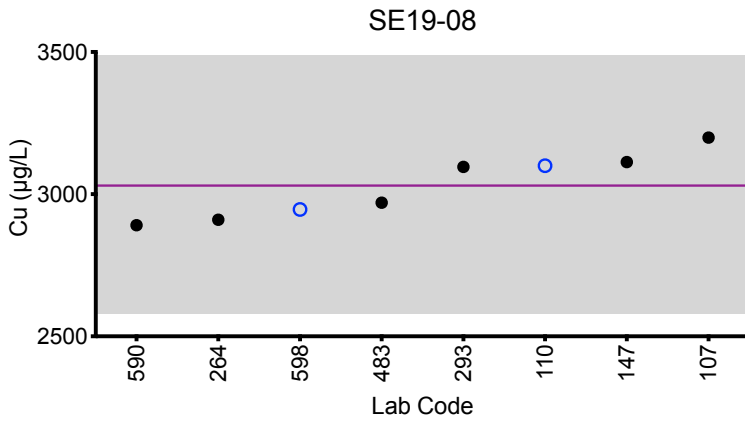
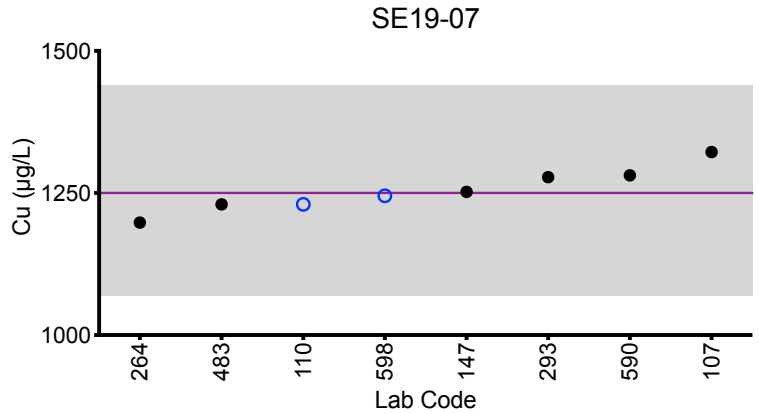
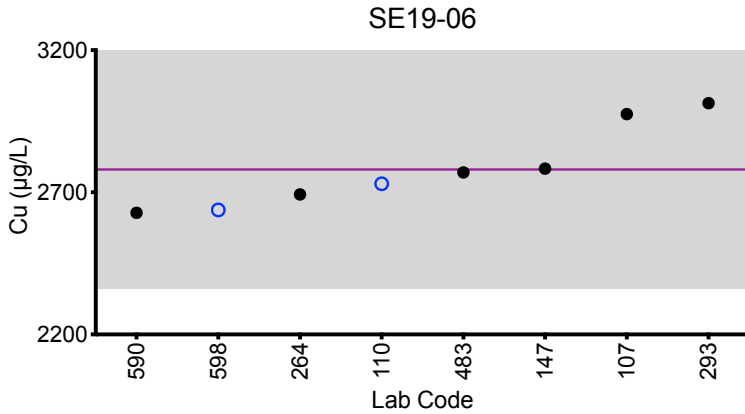
Based on the grading criteria for Cu in Serum, 100% of results were satisfactory, with 0 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Serum Cu



Legend:

○ CHEAR 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:

$\pm 95 \mu\text{g/L}$ or $\pm 15\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 95 \mu\text{g/L}$ at concentrations less than or equal to $635 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

	Serum Se (µg/L)				
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Target (Arithmetic Mean (\bar{x}))	109	271	157	251	222
Upper Limit	131	325	188	301	266
Lower Limit	87	217	126	201	178
Arithmetic SD (s)	9	9	8	9	10
Arithmetic RSD (%)	8.3	3.3	5.1	3.6	4.5
Number of Sample Measurements (N)	8	8	8	8	8

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



Results for Event #2, 2019: Performance of Participating Laboratories

Lab Code	Method	Serum Se (µg/L)				
		SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
	Target	109	271	157	251	222
103	DRC/CC-ICP-MS	109	273	154	249	217
107	DRC/CC-ICP-MS	108.7	274.1	151.8	256.9	219.1
110	DRC/CC-ICP-MS	106	262	154	250	226
147	ICP-MS	95.6	265	163	239	228
264	ICP-MS	*51.2 ↓	*130.65 ↓	*77.86 ↓	*122.85 ↓	*110.54 ↓
293	DRC/CC-ICP-MS	123.91	291.24	172.85	265.19	241.52
483	ICP-MS	111	270	153	257	220
590	ICP-MS	100	264	150	240	214
598	DRC/CC-ICP-MS	120	266	159	247	210

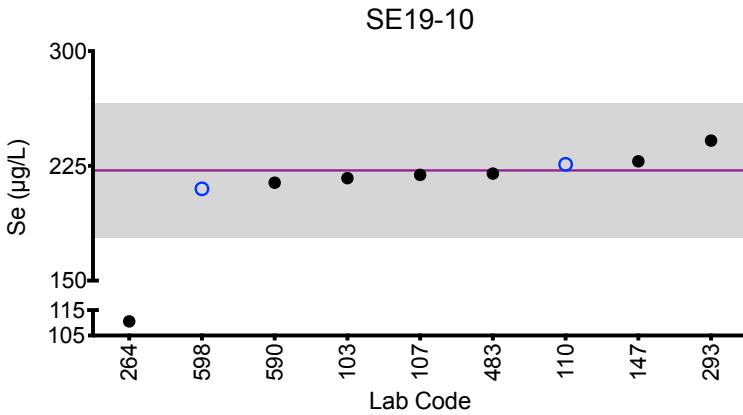
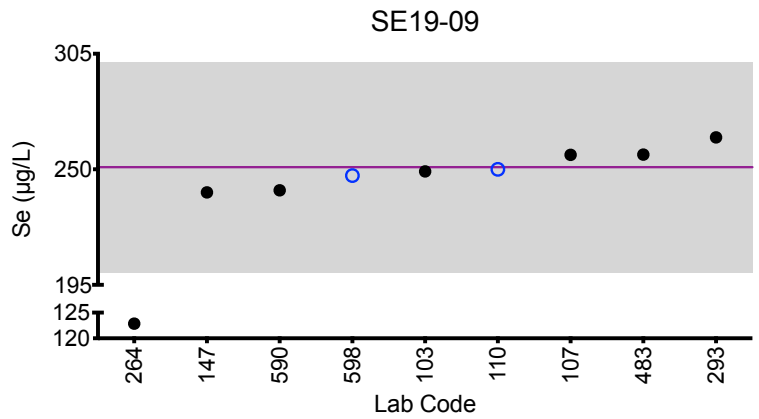
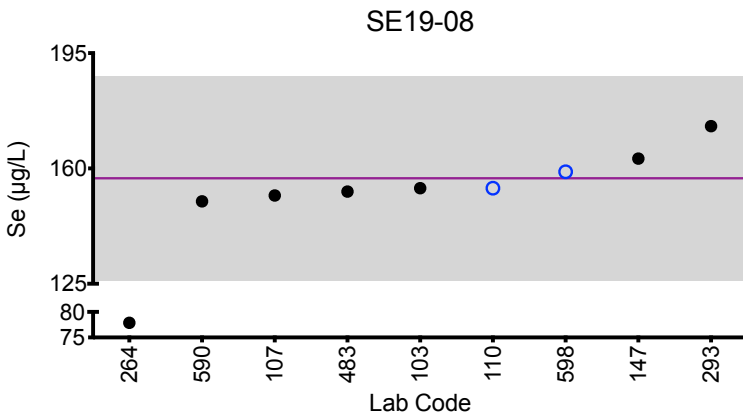
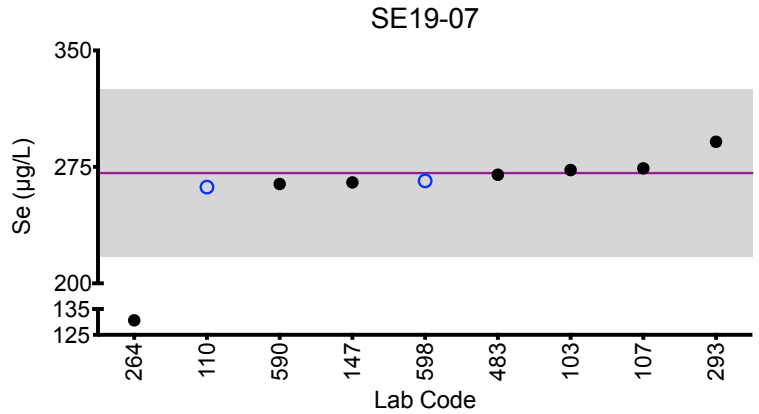
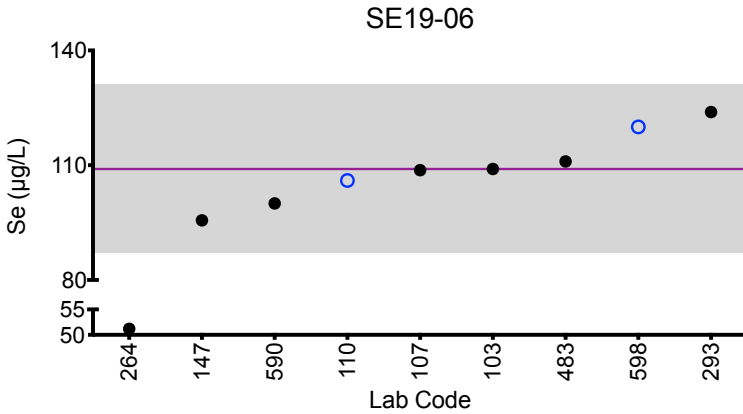
Based on the grading criteria for Se in Serum, 89% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Serum Se



Legend:

○ CHEAR 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:
 $\pm 2 \mu\text{g/L}$ or $\pm 20\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 2 \mu\text{g/L}$ at concentrations less than or equal to $10 \mu\text{g/L}$.



Results for Event #2, 2019: Summary Statistics

	Serum Zn (µg/L)				
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Target (Arithmetic Mean (\bar{x}))	1090	846	4140	1240	1490
Upper Limit	1250	973	4760	1430	1710
Lower Limit	930	719	3520	1050	1270
Arithmetic SD (s)	80	42	190	60	90
Arithmetic RSD (%)	7.3	5.0	4.6	4.8	6.0
Number of Sample Measurements (N)	8	8	8	8	8

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



Results for Event #2, 2019: Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
	Target	1090	846	4140	1240	1490
107	DRC/CC-ICP-MS	1176	910	4425	1334	1568
110	ICP-MS	1170	861	4260	1240	1470
147	ICP-MS	1092	869	4386	1288	1562
264	ICP-MS	1008.68	779.62	3972.01	1179.02	1388.77
293	DRC/CC-ICP-MS	1189.54	836.6	4071.9	1196.08	1411.76
483	ICP-MS	1060	832	4050	1220	1440
590	ICP-MS	993	805	3979	1172	1419
598	ICP-MS	995	876	3989	1296	1631

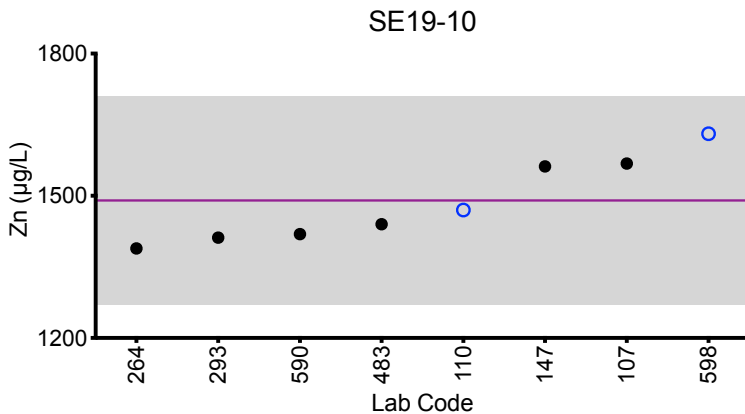
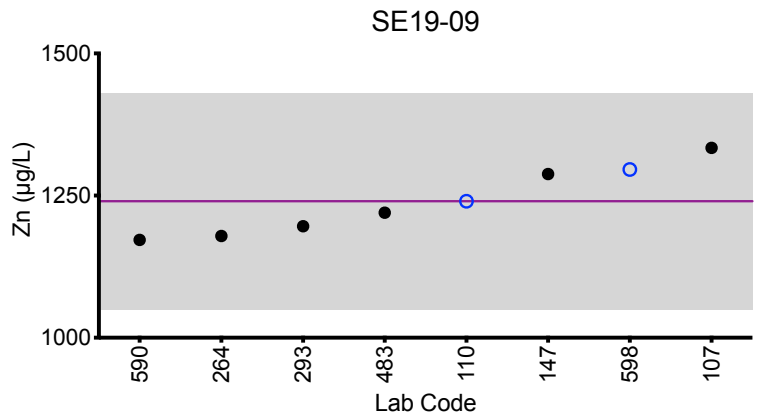
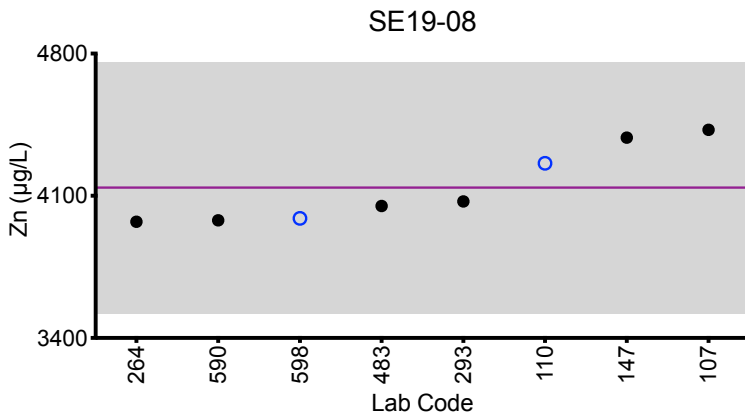
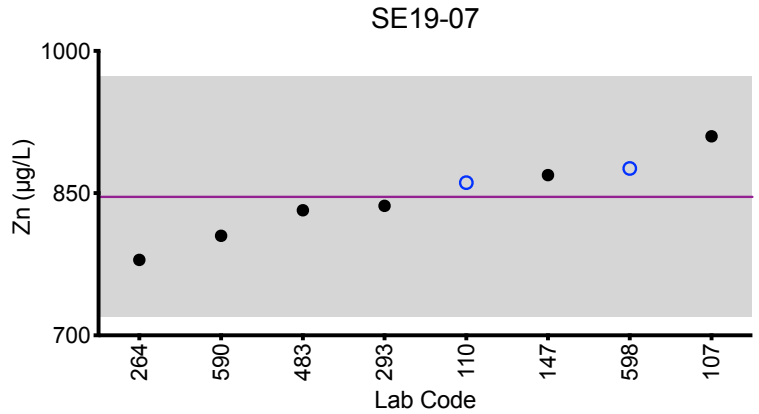
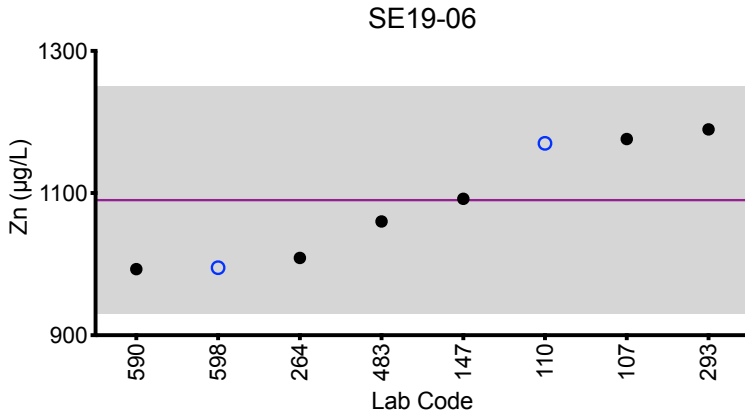
Based on the grading criteria for Zn in Serum, 100% of results were satisfactory, with 0 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #2, 2019: Summary Figures

Serum Zn



Legend:

○ CHEAR 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:

$\pm 15 \mu\text{g/L}$ or $\pm 15\%$ around the target value, whichever is greater; thus, it is fixed at $\pm 15 \mu\text{g/L}$ at concentrations less than or equal to $100 \mu\text{g/L}$.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Hg (µg/L)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	4.47	1.76	0.0987	3.05	8.27
110	ICP-MS	4.6	1.9	0.2	3.2	8.5
147	ICP-MS	4.43	2.03	0.337	3.01	8.26
264	ICP-MS	*12.01	*4.68	0.26	*7.96	*20.38
598	ICP-MS	4.95	1.91	0.166	2.72	8.31

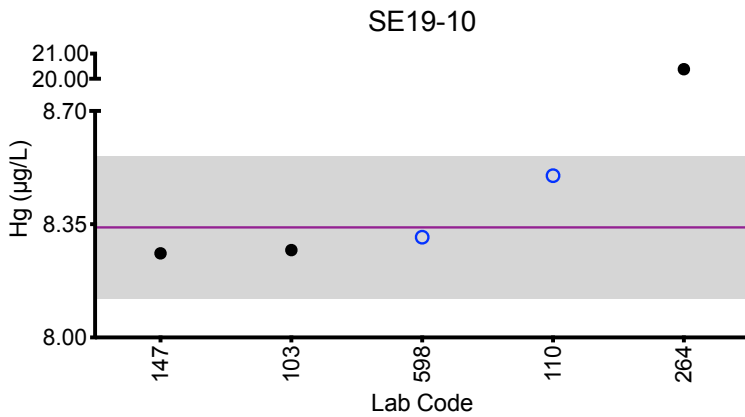
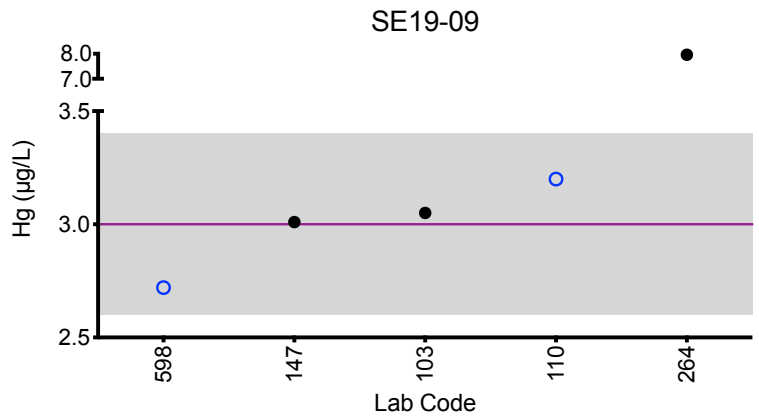
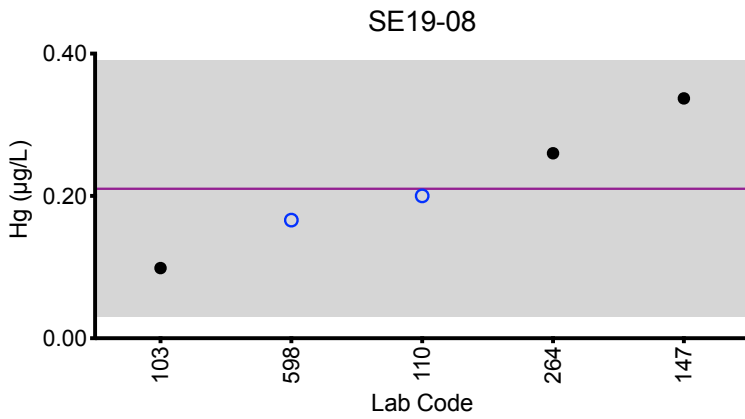
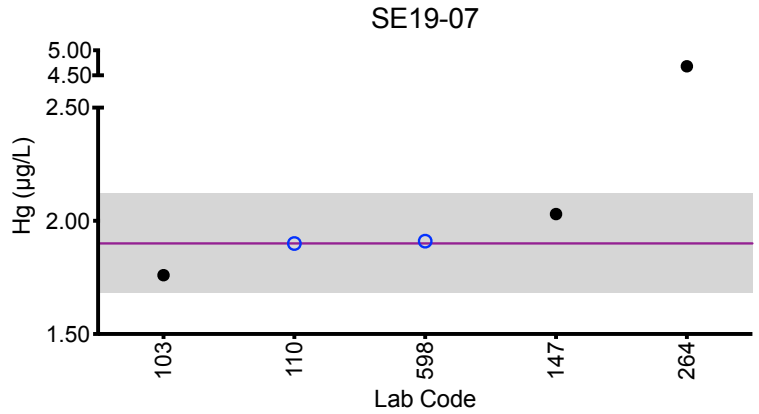
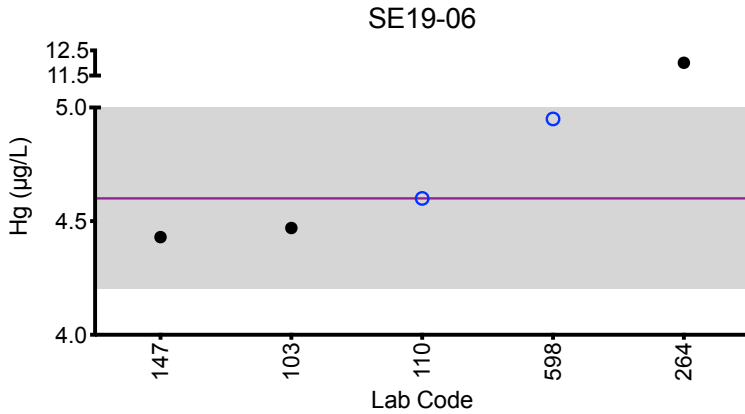
Summary Statistics					
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})	4.6	1.90	0.21	3.0	8.34
Arithmetic SD (s)	0.2	0.11	0.09	0.2	0.11
Arithmetic RSD (%)	5.2	5.8	43	6.7	1.3
Number of Sample Measurements (N)	4	4	5	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Serum Hg



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

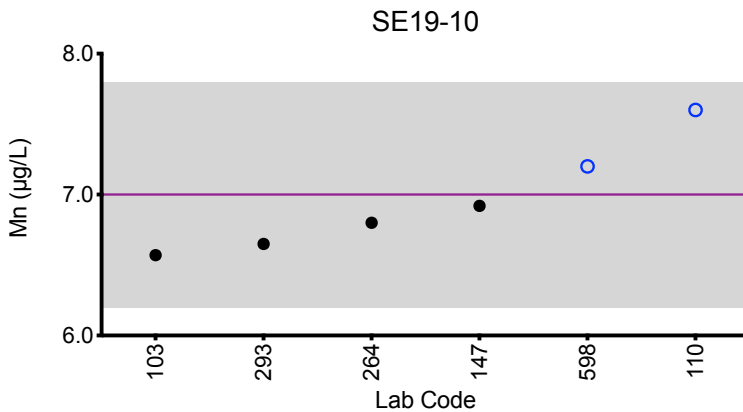
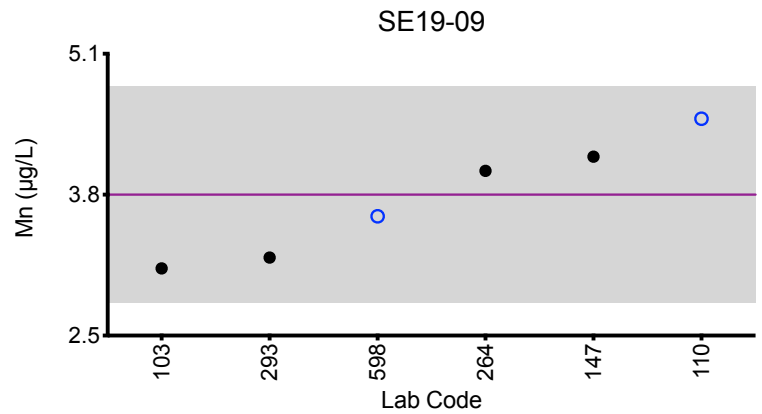
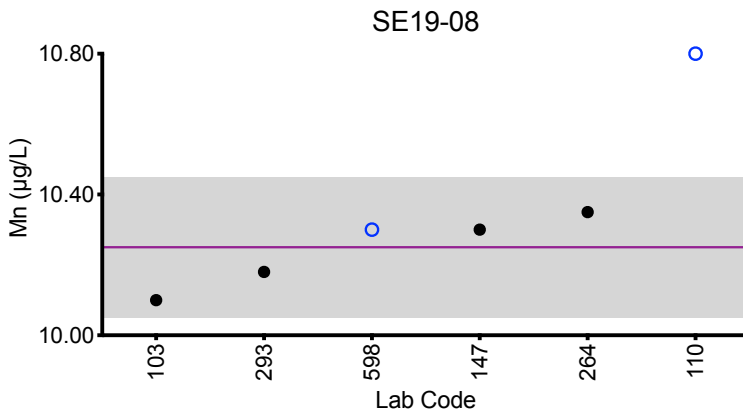
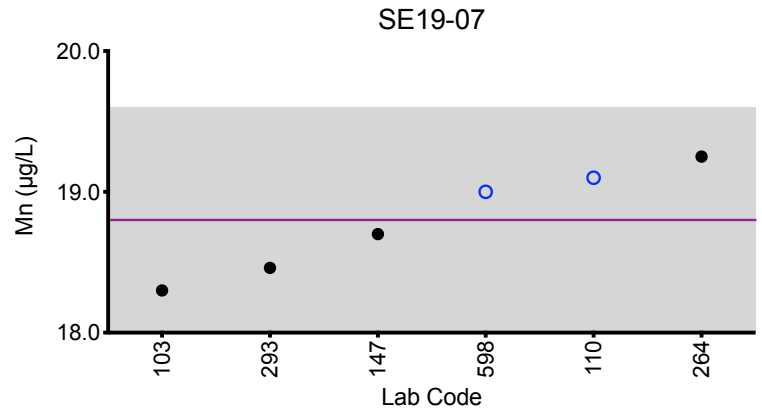
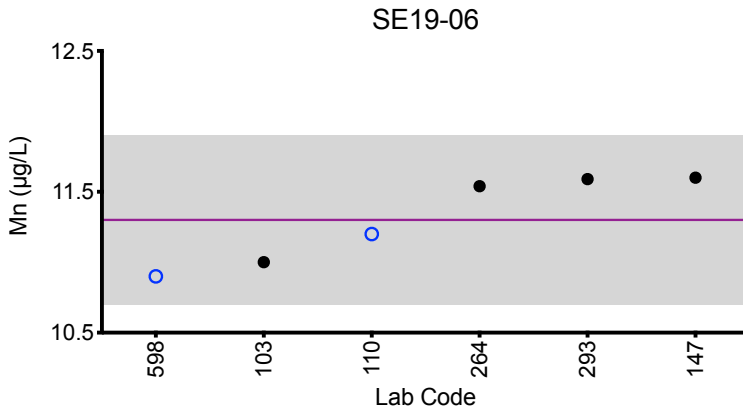
Serum Mn (µg/L)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	11.0	18.3	10.1	3.12	6.57
110	ICP-MS	11.2	19.1	*10.8	4.5	7.6
147	ICP-MS	11.6	18.7	10.3	4.15	6.92
264	ICP-MS	11.54	19.25	10.35	4.02	6.8
293	DRC/CC-ICP-MS	11.59	18.46	10.18	3.22	6.65
598	ICP-MS	10.9	19.0	10.3	3.6	7.2
Summary Statistics						
		SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})		11.3	18.8	10.25	3.8	7.0
Arithmetic SD (s)		0.3	0.4	0.10	0.5	0.4
Arithmetic RSD (%)		2.7	2.1	0.98	13	5.7
Number of Sample Measurements (N)		6	6	5	6	6

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Serum Mn



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

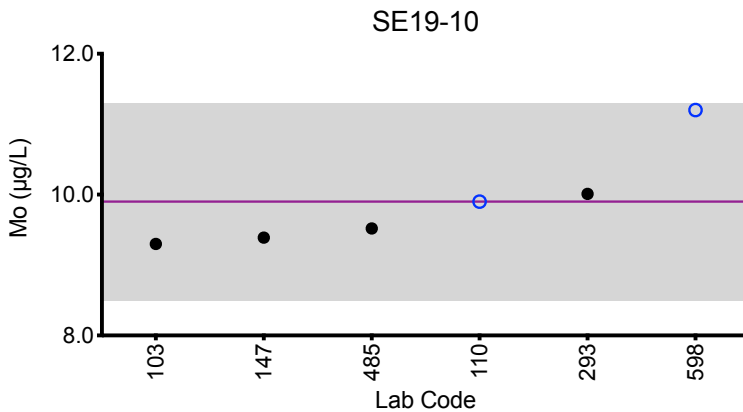
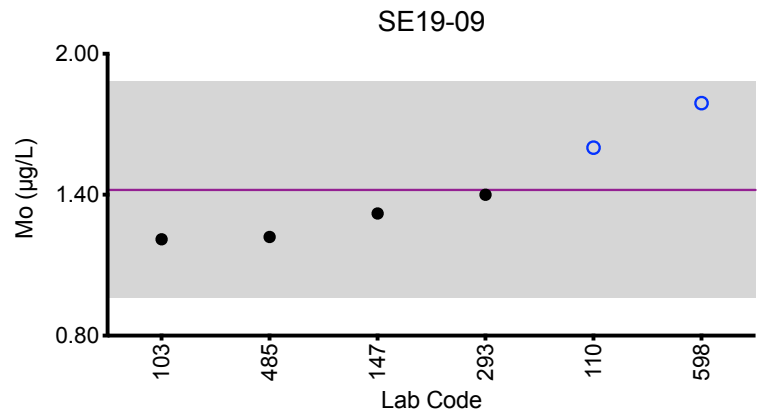
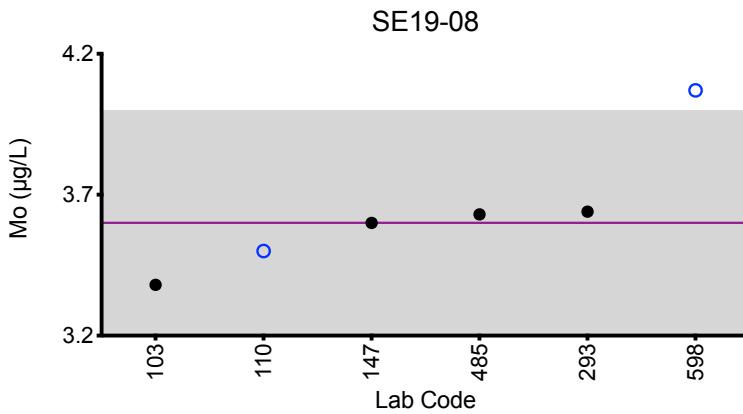
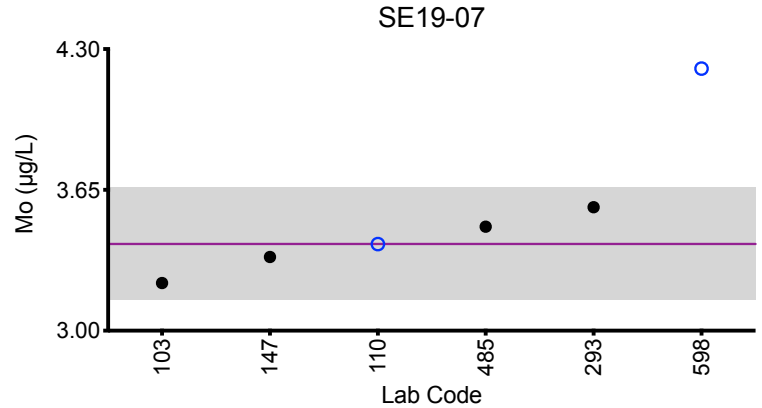
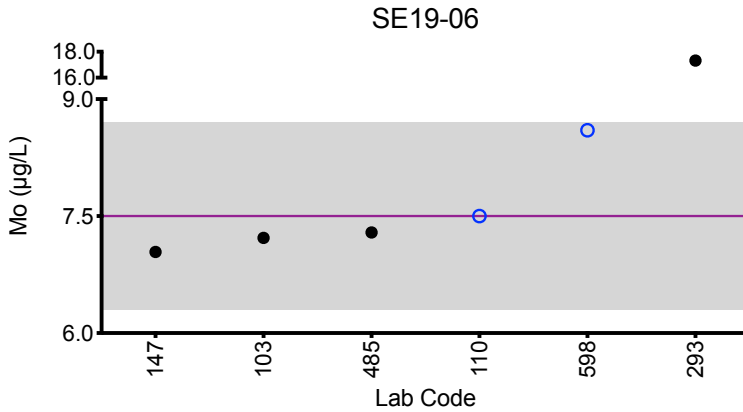
Serum Mo (µg/L)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	7.22	3.22	3.38	1.21	9.30
110	ICP-MS	7.5	3.4	3.5	1.6	9.9
147	ICP-MS	7.04	3.34	3.6	1.32	9.39
293	DRC/CC-ICP-MS	*17.32	3.57	3.64	1.4	10.01
485	HR-ICP-MS	7.29	3.48	3.63	1.22	9.52
598	DRC/CC-ICP-MS	8.6	*4.21	4.07	1.79	11.2
Summary Statistics						
		SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})		7.5	3.40	3.6	1.42	9.9
Arithmetic SD (s)		0.6	0.13	0.2	0.23	0.7
Arithmetic RSD (%)		8.0	3.8	6.3	16	7.1
Number of Sample Measurements (N)		5	5	6	6	6

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Serum Mo



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Ni (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
110	DRC/CC-ICP-MS	17.3	22.9	17.8	14.0	4.1
147	ICP-MS	17.1	22.8	19.1	13.9	4.4
293	DRC/CC-ICP-MS	18.84	23.39	18.14	13.66	4.31
485	HR-ICP-MS	17.3	22.5	18.3	14.0	4.04
598	ICP-MS	18.7	*46.3	*27.2	*24.6	*10

Summary Statistics

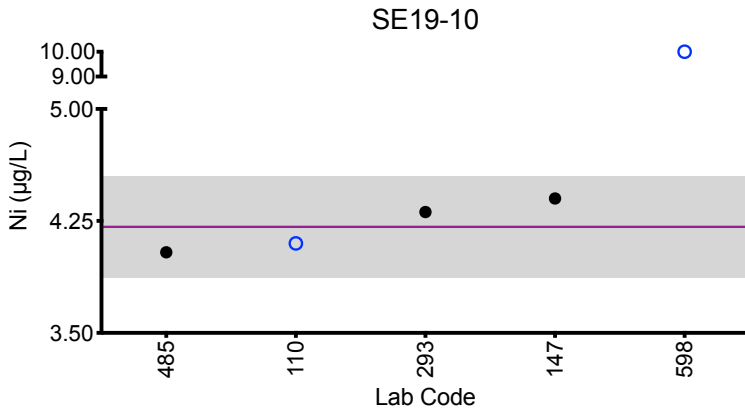
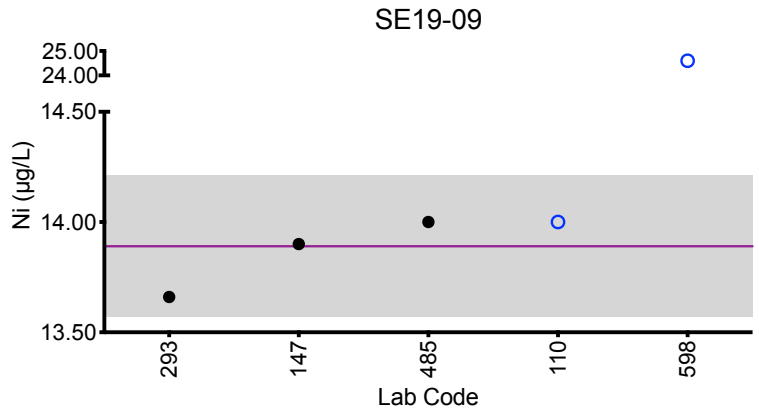
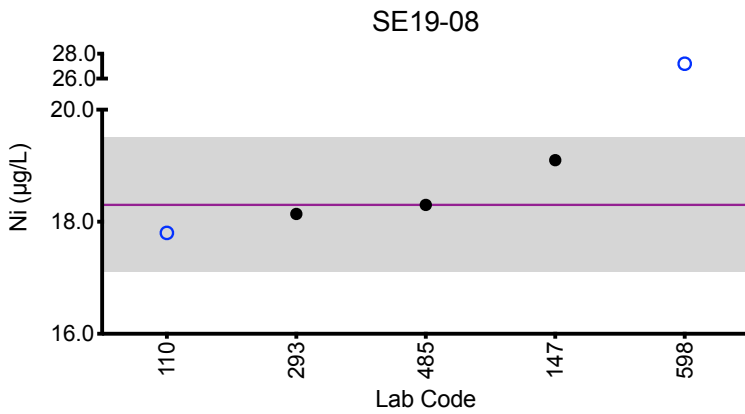
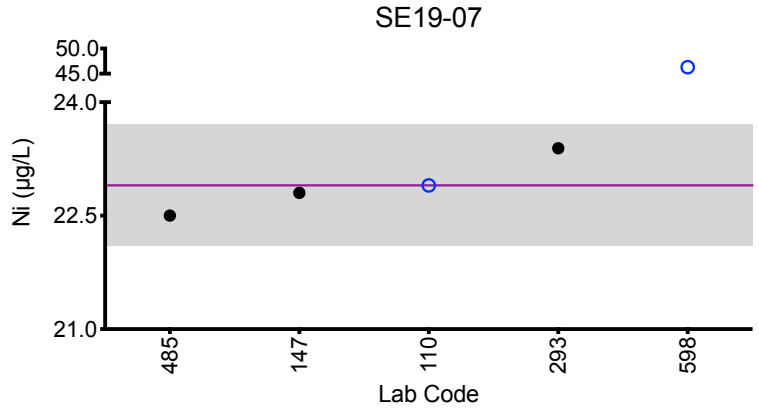
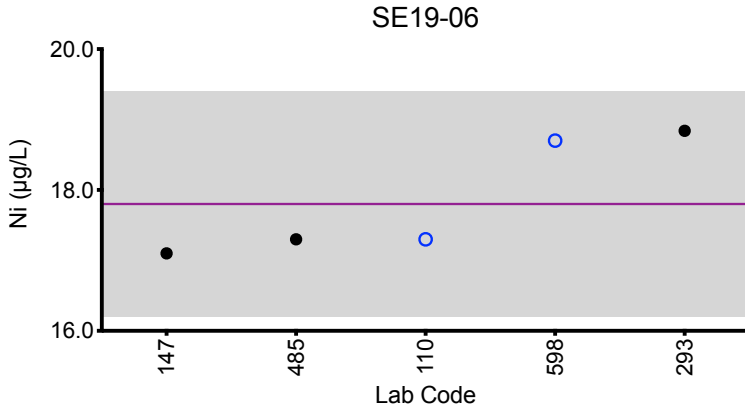
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})	17.8	22.9	18.3	13.89	4.21
Arithmetic SD (s)	0.8	0.4	0.6	0.16	0.17
Arithmetic RSD (%)	4.5	1.7	3.3	1.2	4.0
Number of Sample Measurements (N)	5	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Serum Ni



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = ±2SD of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

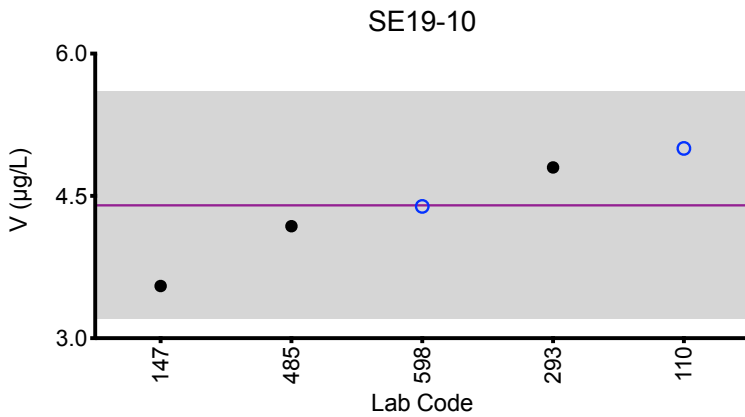
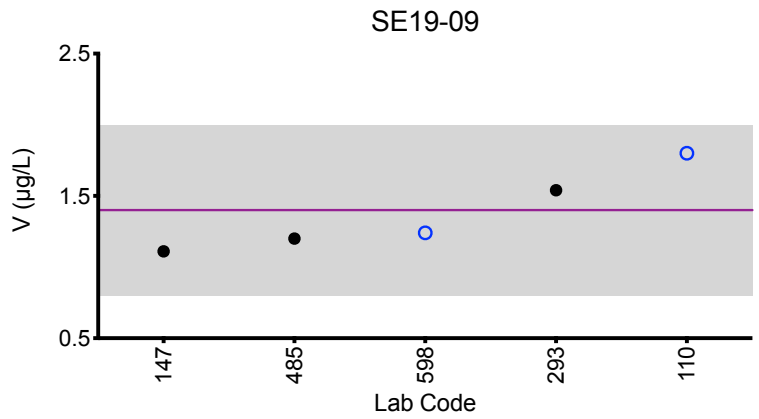
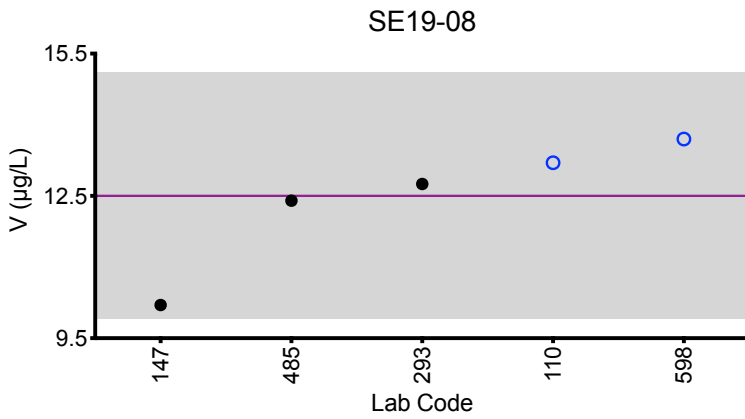
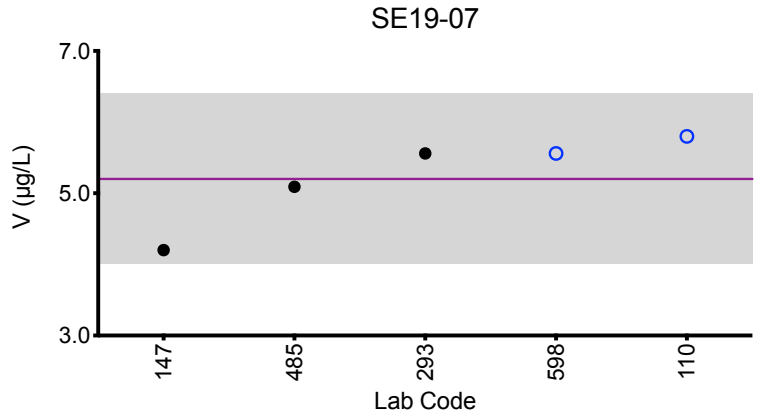
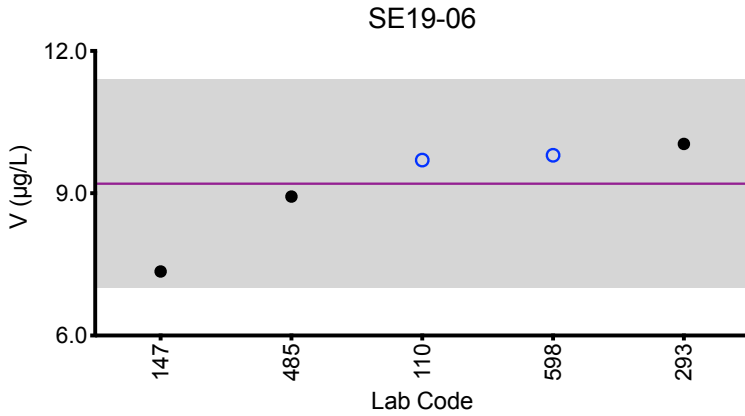
Serum V ($\mu\text{g/L}$)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
110	DRC/CC-ICP-MS	9.7	5.8	13.2	1.8	5.0
147	DRC/CC-ICP-MS	7.35	4.2	10.2	1.11	3.55
293	DRC/CC-ICP-MS	10.04	5.56	12.75	1.54	4.8
485	HR-ICP-MS	8.93	5.09	12.4	1.20	4.18
598	DRC/CC-ICP-MS	9.8	5.56	13.7	1.24	4.39
Summary Statistics						
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10	
Arithmetic Mean (\bar{x})	9.2	5.2	12.5	1.4	4.4	
Arithmetic SD (s)	1.1	0.6	1.3	0.3	0.6	
Arithmetic RSD (%)	12	12	10	21	14	
Number of Sample Measurements (N)	5	5	5	5	5	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Summary Figures

Serum V



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

Gray area = $\pm 2SD$ of the mean.

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



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum As ($\mu\text{g/L}$)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	9.50	20.0	27.1	0.991	6.66
110	DRC/CC-ICP-MS	9.7	19.8	27.6	1.2	7.2
147	ICP-MS	8.84	22.4	32.1	1.57	6.14
598	DRC/CC-ICP-MS	9.26	20.8	28.6	1.26	7.64
Summary Statistics						
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10	
Arithmetic Mean (\bar{x})	9.3	20.8	29	1.3	6.9	
Arithmetic SD (s)	0.4	1.2	2	0.2	0.7	
Arithmetic RSD (%)	4.3	5.8	7.8	19	10	
Number of Sample Measurements (N)	4	4	4	4	4	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
110	ICP-MS	6.5	0.9	1.0	6.2	1.0
147	ICP-MS	6.17	0.63	0.975	6.2	1.0
598	ICP-MS	6.42	*8.62	*2.15	*9.37	*2.42

Summary Statistics						
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10	
Arithmetic Mean (\bar{x})	6.4	0.8	1.0	6.2	1.0	
Arithmetic SD (s)	0.2	0.2	0.02	0.0	0.0	
Arithmetic RSD (%)	2.7	25	1.8	0.0	0.0	
Number of Sample Measurements (N)	3	2	2	2	2	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Be (µg/L)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
110	ICP-MS	2.8	1.0	2.6	4.7	9.9
147	ICP-MS	3.19	1.03	2.69	4.66	10.5
293	DRC/CC-ICP-MS	2.97	0.95	2.54	4.56	9.7
598	ICP-MS	3.16	*2.76	*3.59	*7.45	11.4

Summary Statistics						
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10	
Arithmetic Mean (\bar{x})	3.03	0.99	2.61	4.64	10.4	
Arithmetic SD (s)	0.18	0.04	0.08	0.07	0.8	
Arithmetic RSD (%)	6.0	4.1	2.9	1.6	7.4	
Number of Sample Measurements (N)	4	3	3	3	4	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	6.34	0.839	6.47	2.31	12.8
110	ICP-MS	6.48	0.91	6.84	2.15	12.8
147	ICP-MS	6.4	0.9	7.0	2.4	12.6
598	DRC/CC-ICP-MS	6.01	1.28	6.59	3.1	13.3

Summary Statistics						
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10	
Arithmetic Mean (\bar{x})	6.3	1.0	6.7	2.5	12.9	
Arithmetic SD (s)	0.2	0.2	0.2	0.4	0.3	
Arithmetic RSD (%)	3.3	20	3.6	16	2.3	
Number of Sample Measurements (N)	4	4	4	4	4	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Cs ($\mu\text{g/L}$)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
110	ICP-MS	0.98	0.40	0.33	1.00	0.34
598	ICP-MS	0.98	0.51	0.32	1.08	0.33

Summary Statistics						
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10	
Arithmetic Mean (\bar{x})	0.98	0.46	0.325	1.04	0.335	
Arithmetic SD (s)	0.00	0.08	0.007	0.06	0.007	
Arithmetic RSD (%)	0.0	17	2.2	5.8	2.1	
Number of Sample Measurements (N)	2	2	2	2	2	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Pb (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	37.8	4.97	15.7	41.4	5.75
110	ICP-MS	36.8	5.3	15.6	41.0	6.0
147	ICP-MS	40.2	5.18	16.2	43.7	6.0
598	ICP-MS	30.6	4.82	14.0	39.3	4.92

Summary Statistics

	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})	36	5.1	15.4	41.4	5.7
Arithmetic SD (s)	4	0.2	1.0	1.8	0.5
Arithmetic RSD (%)	11	4.1	6.5	4.3	8.8
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Pt ($\mu\text{g/L}$)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
110	ICP-MS	1.12	0.53	3.05	0.32	0.30
264	ICP-MS	1.14	0.56	3.06	0.22	0.23
598	ICP-MS	1.05	0.44	2.62	0.26	0.2

Summary Statistics						
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10	
Arithmetic Mean (\bar{x})	1.10	0.51	2.9	0.27	0.24	
Arithmetic SD (s)	0.05	0.06	0.3	0.05	0.05	
Arithmetic RSD (%)	4.5	12	8.6	19	21	
Number of Sample Measurements (N)	3	3	3	3	3	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Sb (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	6.38	1.24	8.79	3.11	6.27
110	ICP-MS	6.42	1.22	8.72	2.96	6.04
147	ICP-MS	6.2	1.29	8.88	3.01	6.22
598	ICP-MS	3.34	1.63	8.96	3.38	6.59

Summary Statistics

	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})	5.6	1.4	8.84	3.12	6.3
Arithmetic SD (s)	1.5	0.2	0.10	0.19	0.2
Arithmetic RSD (%)	27	14	1.1	6.1	3.7
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Sn ($\mu\text{g/L}$)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
110	ICP-MS	3.25	6.64	2.83	8.09	15.9
147	ICP-MS	2.99	6.47	2.96	7.97	16.1
598	ICP-MS	3.99	8.96	3.44	9.91	19.1

Summary Statistics					
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})	3.4	7.4	3.1	8.7	17
Arithmetic SD (s)	0.5	1.4	0.3	1.1	2
Arithmetic RSD (%)	15	19	9.7	13	11
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Sr (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	28.6	94.9	46.4	44.5	84.6
200	ICP-MS	26.3	93.7	43.8	42.9	77.1

Summary Statistics

	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})	28	94.3	45	43.7	81
Arithmetic SD (s)	2	0.8	2	1.1	5
Arithmetic RSD (%)	5.8	0.85	4.1	2.5	6.2
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum Ti (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
200	DRC/CC-ICP-MS	5.1	2.7	5.9	3.3	7.0
485	HR-ICP-MS	2.87	6.76	9.47	9.32	14.5

Summary Statistics

	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})	NA	NA	NA	NA	NA
Arithmetic SD (s)	NA	NA	NA	NA	NA
Arithmetic RSD (%)	NA	NA	NA	NA	NA
Number of Sample Measurements (N)	0	0	0	0	0

*Denotes a statistical Outlier.

Statistical data were not calculated for SE19-06, SE19-07, SE19-08, SE19-09, or SE19-10 based on a lack of consensus among participating labs.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum TI (µg/L)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	2.17	4.27	6.53	1.62	5.04
110	ICP-MS	2.19	4.52	6.58	1.65	5.23
147	ICP-MS	2.25	4.17	6.36	1.660	4.89
598	ICP-MS	1.71	*1.65	*3.95	*5.24	*2.27

Summary Statistics						
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10	
Arithmetic Mean (\bar{x})	2.1	4.3	6.5	1.64	5.1	
Arithmetic SD (s)	0.3	0.2	0.1	0.02	0.2	
Arithmetic RSD (%)	12	4.2	1.8	1.3	3.4	
Number of Sample Measurements (N)	4	3	3	3	3	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum U ($\mu\text{g/L}$)						
Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
103	DRC/CC-ICP-MS	0.0126	0.183	0.0361	0.0459	0.0525
110	ICP-MS	0.012	0.181	0.029	0.047	0.049
147	ICP-MS	<0.0169	0.181	0.029	0.0457	0.049
598	ICP-MS	<0.05	*0.4	<0.05	*0.1	<0.05
Summary Statistics						
	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10	
Arithmetic Mean (\bar{x})	0.0123	0.1817	0.031	0.0462	0.050	
Arithmetic SD (s)	0.0004	0.0012	0.004	0.0007	0.002	
Arithmetic RSD (%)	3.3	0.66	13	1.5	4.0	
Number of Sample Measurements (N)	2	3	3	3	3	

*Denotes a statistical Outlier.



Results for Event #2, 2019: Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
110	ICP-MS	3.31	1.37	3.27	0.56	1.67
147	ICP-MS	3.62	1.41	3.44	0.554	1.68
200	ICP-MS	3.79	1.49	3.29	0.61	1.62
598	ICP-MS	3.69	1.62	3.05	0.45	1.36

Summary Statistics

	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
Arithmetic Mean (\bar{x})	3.6	1.47	3.26	0.54	1.58
Arithmetic SD (s)	0.2	0.11	0.16	0.07	0.15
Arithmetic RSD (%)	5.8	7.5	4.9	13	9.5
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #2, 2019: Additional Elements in Serum

Serum Ag (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
147	ICP-MS	<0.227	<0.227	<0.227	<0.227	<0.227

Serum Bi (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
147	ICP-MS	<0.230	<0.230	<0.230	<0.230	<0.230

Serum Fe (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
264	ICP-MS	1135.0	677.99	688.62	1143.16	687.73

Serum I (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
147	ICP-MS	49.2	40	49	50.4	49.9

Serum Li (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
147	ICP-MS	0.604	1.19	0.659	0.618	0.652

Serum Mg (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
264	ICP-MS	16662.14	16437.09	17108.61	16628.54	17067.09

Serum Te (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
147	ICP-MS	<0.153	<0.153	<0.153	<0.153	<0.153

Serum Th (µg/L)

Lab Code	Method	SE19-06	SE19-07	SE19-08	SE19-09	SE19-10
147	ICP-MS	<0.00882	<0.00882	<0.00882	<0.00882	<0.00882



References

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