



**Department
of Health**

**Wadsworth
Center**

New York State Biomonitoring Program for Trace Elements

Event #3, 2019

Trace Elements in Whole Blood, Urine, and Serum

December, 2019

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory



**Event #3, 2019:
Trace Elements in Whole Blood, Urine, and Serum**

12/13/2019

Dear Laboratory Director,

This report summarizes performance for the third 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 #1, 2020) will be shipped February 19, 2020. Comments about this report may be directed to trel@health.ny.gov. If you have not yet enrolled for next year, please contact PT program staff at trel@health.ny.gov.

Sincerely,

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

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



**Department
of Health**

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Center**

Event #3, 2019

**Trace Elements in
Whole Blood**

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory



**Event #3, 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 #3, 2019: Summary Statistics

Whole Blood As ($\mu\text{g/L}$)					
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Target (Arithmetic Mean (\bar{x}))	42.6	5.68	7.81	2.61	21.0
Upper Limit	51.1	11.68	13.81	8.61	27.0
Lower Limit	34.1	0.00	1.81	0.00	15.0
Arithmetic SD (s)	2.8	0.46	0.45	0.21	1.6
Arithmetic RSD (%)	6.6	8.1	5.1	8.4	7.6
Number of Sample Measurements (N)	9	9	9	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 #3, 2019: Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
	Target	42.6	5.68	7.81	2.61	21.0
103	DRC/CC-ICP-MS	44.6	5.64	7.84	2.49	21.8
110	DRC/CC-ICP-MS	41.0	5.8	8.1	3.00	21.8
147	ICP-MS	40.7	4.97	7.11	2.26	20.5
264	ICP-MS	41.09	5.04	7.23	2.63	19.39
293	DRC/CC-ICP-MS	42.82	5.48	7.65	2.56	*3.34 ↓
391	ICP-MS	37.847	6.37	7.793	2.622	19.071
597	ICP-MS/MS	43.3	5.75	8.35	2.54	19.67
598	DRC/CC-ICP-MS	47.9	6.07	8.41	2.89	23.7
599	DRC/CC-ICP-MS	44.4	5.98	7.80	2.53	22.46

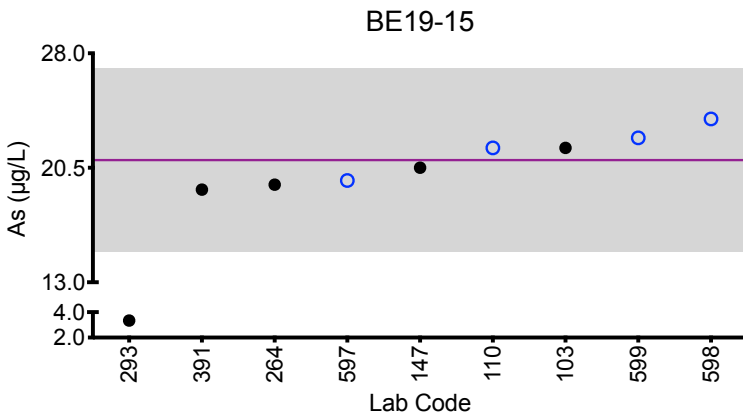
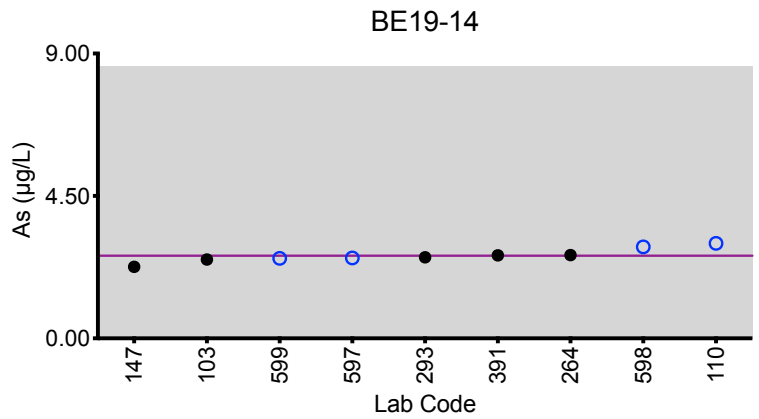
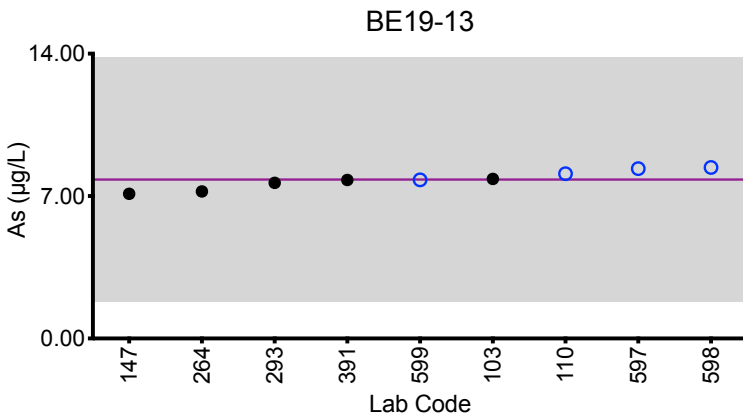
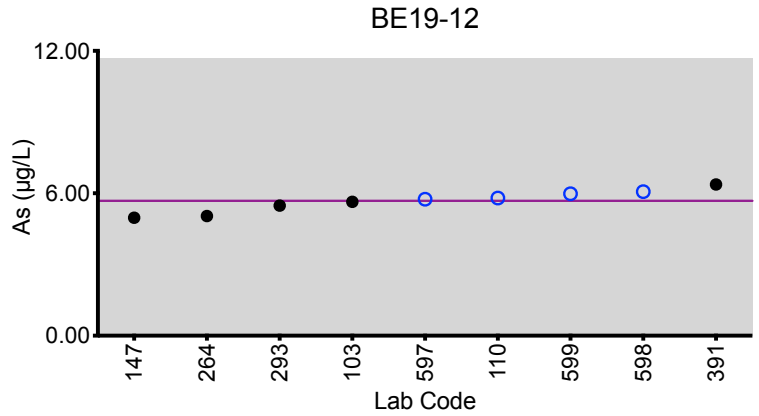
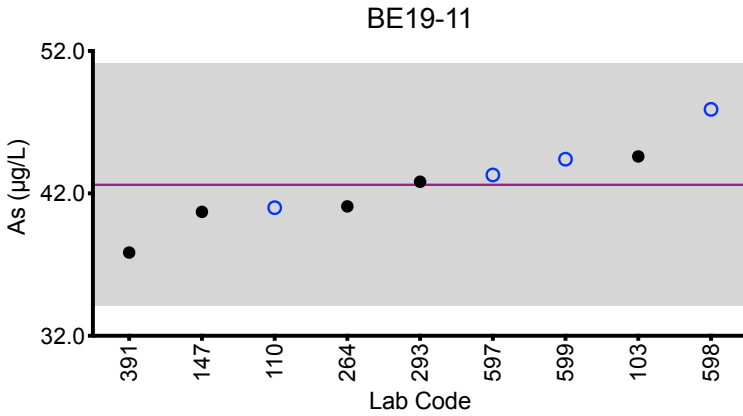
Based on the grading criteria for As in Whole Blood, 98% of results were satisfactory, with 0 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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 #3, 2019: Summary Statistics

Whole Blood Cd ($\mu\text{g/L}$)					
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Target (Robust Mean (x^*))	0.83	0.96	0.63	0.60	0.182
Upper Limit	1.83	1.96	1.63	1.60	1.182
Lower Limit	0.00	0.00	0.00	0.00	0.000
Robust SD (s^*)	0.08	0.04	0.07	0.08	0.021
Robust RSD (%)	9.4	4.4	11	13	11
Number of Sample Measurements (N)	14	14	14	14	11
Standard Uncertainty (u)	0.03	0.01	0.03	0.03	0.008

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 #3, 2019: Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
	Target	0.83	0.96	0.63	0.60	0.182
103	DRC/CC-ICP-MS	0.851	0.929	0.662	0.649	0.188
107	ICP-MS/MS	0.834	0.935	0.683	0.634	0.202
110	ICP-MS	0.83	0.95	0.62	0.61	0.20
116	ICP-MS/MS	<1.5	<1.5	<1.5	<1.5	<1.5
147	ICP-MS	0.778	0.964	0.631	0.611	0.19
264	ICP-MS	0.70	0.93	0.43	0.50	0.17
293	DRC/CC-ICP-MS	0.75	0.91	0.6	0.55	0.13
391	ICP-MS	0.696	0.94	0.54	0.51	0.161
401	DRC/CC-ICP-MS	0.8	0.9	0.7	0.6	0.2
597	ICP-MS/MS	0.920	1.14	0.791	0.689	0.191
598	DRC/CC-ICP-MS	0.89	1.07	0.52	0.68	0.25
599	DRC/CC-ICP-MS	0.874	0.957	0.609	0.492	0.105
605	ICP-MS	0.825	0.972	0.659	0.601	<0.500
606	ICP-MS/MS	0.986	1.17	0.827	0.747	<0.500
686	ICP-MS	0.782	1.03	0.665	0.654	<0.500

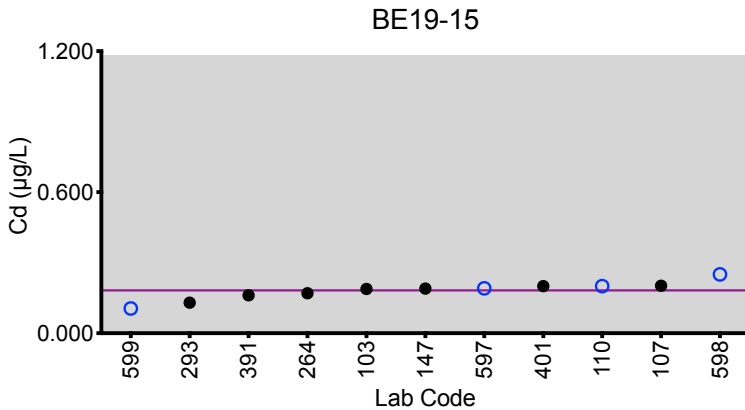
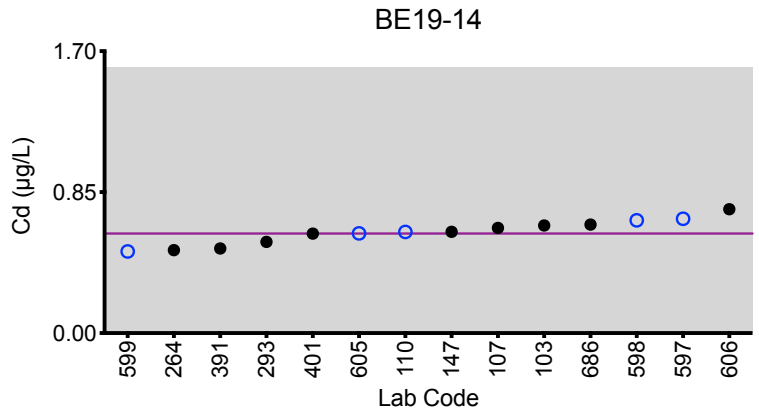
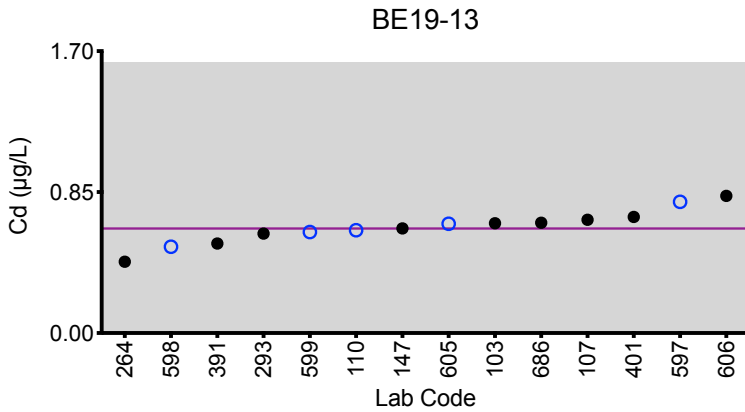
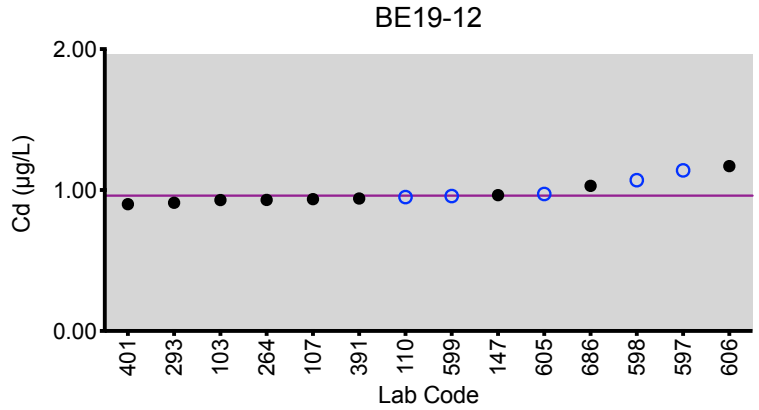
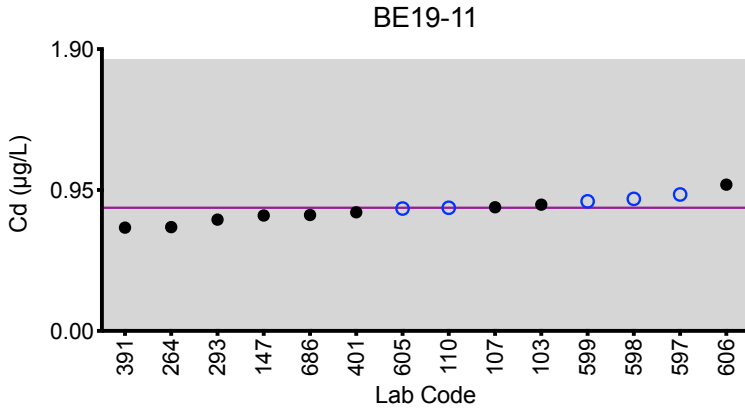
Based on the grading criteria for Cd in Whole Blood, 100% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:
 $\pm 1 \mu\text{g/L}$ 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 $6.7 \mu\text{g/L}$.



Results for Event #3, 2019: Summary Statistics

Whole Blood Co (µg/L)					
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Target (Robust Mean (x*))	7.0	4.11	2.65	16.5	13.4
Upper Limit	8.5	5.61	4.15	19.8	16.1
Lower Limit	5.5	2.61	1.15	13.2	10.7
Robust SD (s*)	0.4	0.21	0.20	0.8	0.7
Robust RSD (%)	5.3	5.3	7.5	4.9	5.4
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (u)	0.1	0.08	0.08	0.3	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 #3, 2019: Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Target		7.0	4.11	2.65	16.5	13.4
103	DRC/CC-ICP-MS	6.98	4.07	2.69	16.6	13.7
110	ICP-MS	6.7	4.0	2.5	15.7	13.0
147	ICP-MS	7.13	4.17	2.71	16.4	13.8
264	ICP-MS	6.55	3.82	2.42	15.44	12.76
293	DRC/CC-ICP-MS	6.67	3.82	2.5	16.15	12.77
391	ICP-MS	6.512	4.059	2.44	15.094	12.099
401	DRC/CC-ICP-MS	7.1	4.0	2.6	16.3	12.9
597	ICP-MS/MS	7.21	4.45	2.91	17.4	13.7
598	ICP-MS	6.59	4.23	2.85	16.6	13.5
599	DRC/CC-ICP-MS	7.73	4.33	2.79	17.7	14.3

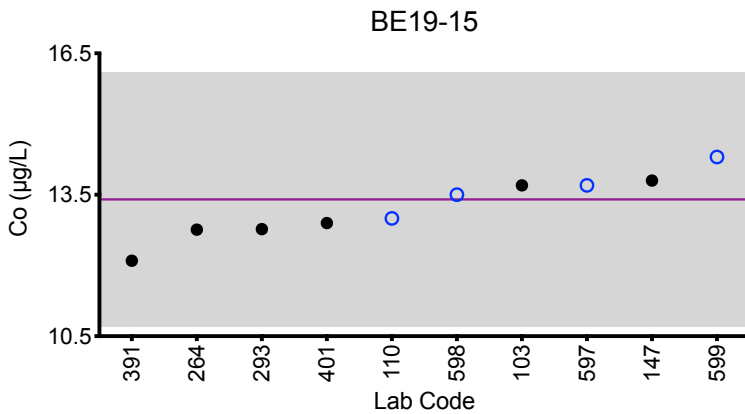
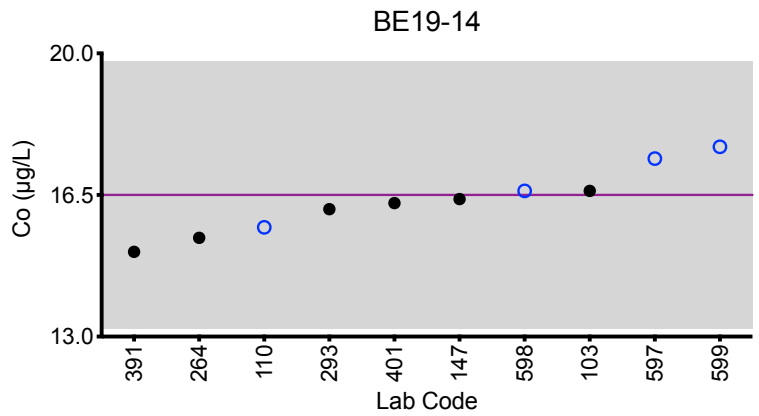
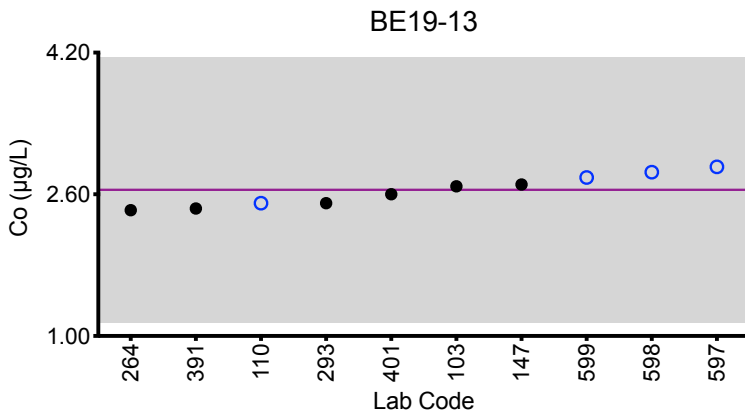
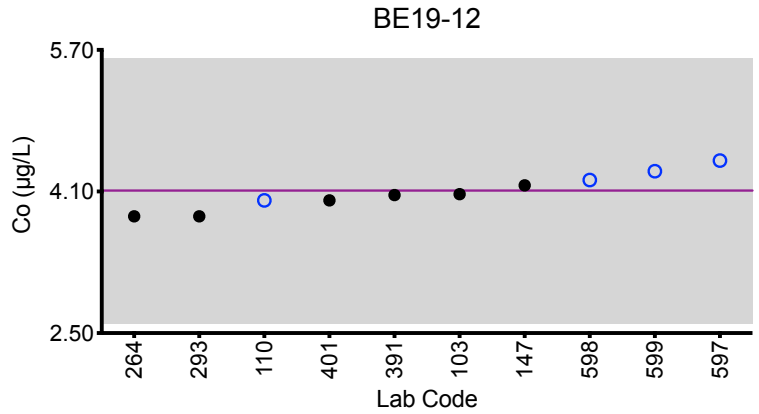
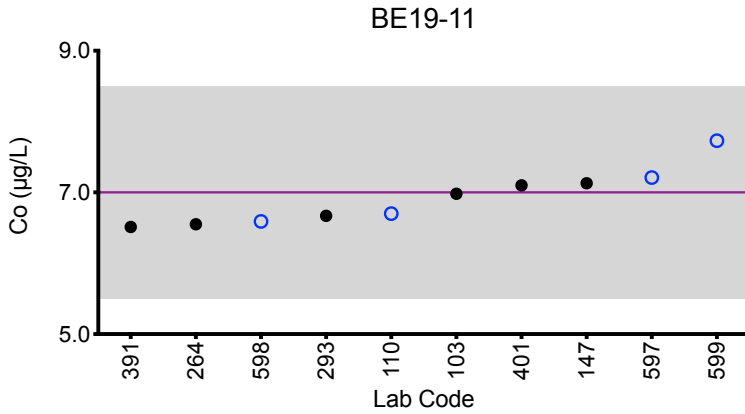
Based on the grading criteria for Co in Whole Blood, 100% of results were satisfactory, with 0 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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 #3, 2019: Summary Statistics

Whole Blood Cr (µg/L)					
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Target (Arithmetic Mean (\bar{x}))	2.86	NA	5.6	4.0	10.6
Upper Limit	4.86	NA	7.6	6.0	12.7
Lower Limit	0.86	NA	3.6	2.0	8.5
Arithmetic SD (s)	0.33	NA	0.7	0.4	0.6
Arithmetic RSD (%)	12	NA	13	10	5.7
Number of Sample Measurements (N)	8	NA	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

NA - Not Assigned

Statistical data were not calculated for BE19-12 based on a lack of consensus among participating labs.



Results for Event #3, 2019: Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
	Target	2.86	NA	5.6	4.0	10.6
110	DRC/CC-ICP-MS	2.5	0.4	4.7	3.5	10.5
147	DRC/CC-ICP-MS	2.42	<0.234	5.67	3.66	11.2
264	ICP-MS	3.23	1.10	5.87	4.60	10.81
293	DRC/CC-ICP-MS	2.68	0.33	5.33	3.71	10.33
391	ICP-MS	2.761	1.434	4.986	3.611	9.321
401	DRC/CC-ICP-MS	3.4	1.1	5.8	4.2	10.1
597	ICP-MS/MS	2.84	0.364	6.95	4.30	11.42
598	DRC/CC-ICP-MS	3.01	0.54	5.60	4.14	10.9

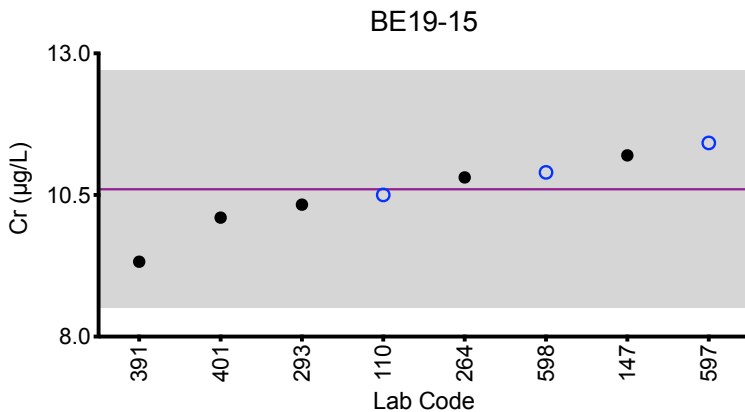
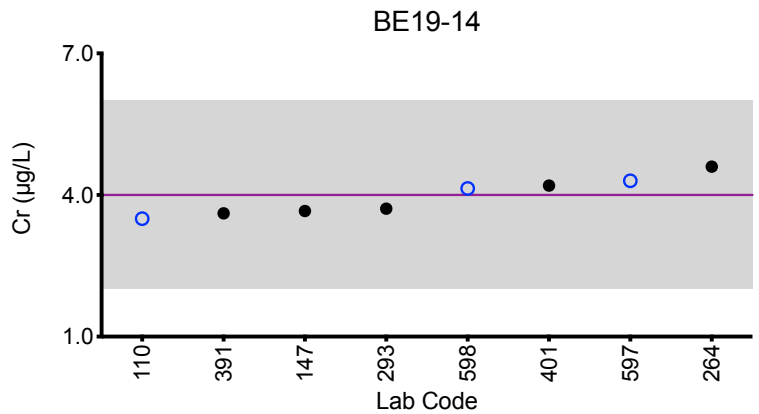
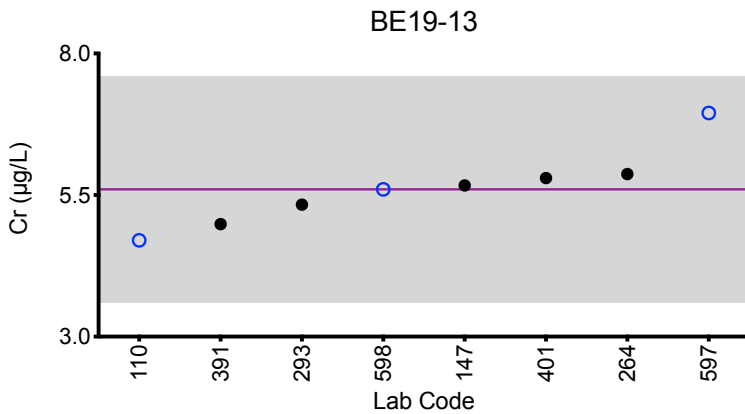
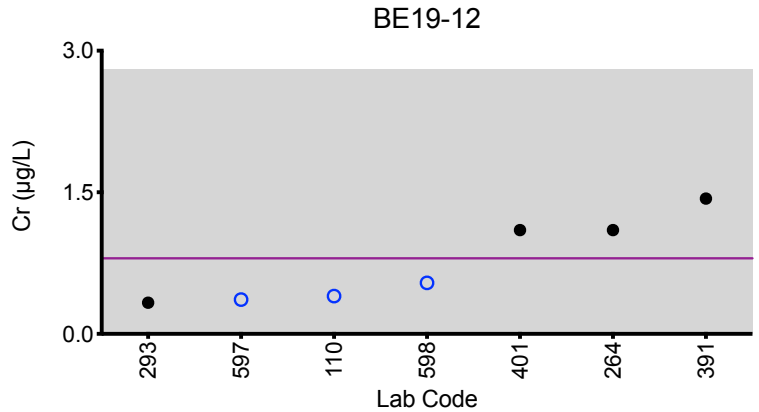
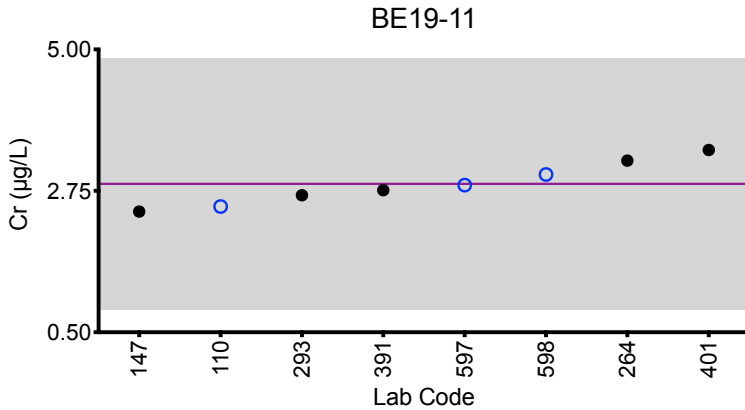
Based on the grading criteria for Cr in Whole Blood, 100% of results were satisfactory, with 0 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:

$\pm 2 \mu\text{g/L}$ 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 #3, 2019: Summary Statistics

	Whole Blood Hg (µg/L)				
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Target (Robust Mean (x*))	5.7	14.2	30.0	0.95	2.15
Upper Limit	8.7	18.5	39.0	3.95	5.15
Lower Limit	2.7	9.9	21.0	0.00	0.00
Robust SD (s*)	0.6	1.3	2.3	0.12	0.24
Robust RSD (%)	11	9.2	7.7	13	11
Number of Sample Measurements (N)	15	15	15	14	15
Standard Uncertainty (u)	0.2	0.4	0.7	0.04	0.08

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 #3, 2019: Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
	Target	5.7	14.2	30.0	0.95	2.15
103	DRC/CC-ICP-MS	5.44	14.4	28.8	0.895	2.04
107	ICP-MS/MS	6.01	14.30	32.74	0.90	2.25
110	ICP-MS	5.61	14.1	28.1	0.90	2.00
116	ICP-MS/MS	5.85	15.5	31.6	<1.5	2.38
147	ICP-MS	5.26	13.2	28.3	0.839	1.95
264	ICP-MS	6.36	15.13	29.72	1.01	2.07
293	DRC/CC-ICP-MS	4.83	12.44	26.17	0.72	1.72
391	CV-AAS	6.218	13.19	32.224	1.889	3.189
401	DRC/CC-ICP-MS	4.6	14.4	29.3	1.0	2.0
597	DMA	5.05	13.2	29.8	0.88	2.24
598	ICP-MS	8.48	18.5	36.6	1.38	2.84
599	DRC/CC-ICP-MS	5.40	13.3	28.3	1.06	1.86
605	ICP-MS	5.75	14.4	30.5	0.846	2.15
606	ICP-MS/MS	6.21	16.1	33.1	0.934	2.27
686	ICP-MS	5.72	13.8	28.7	1.07	2.25

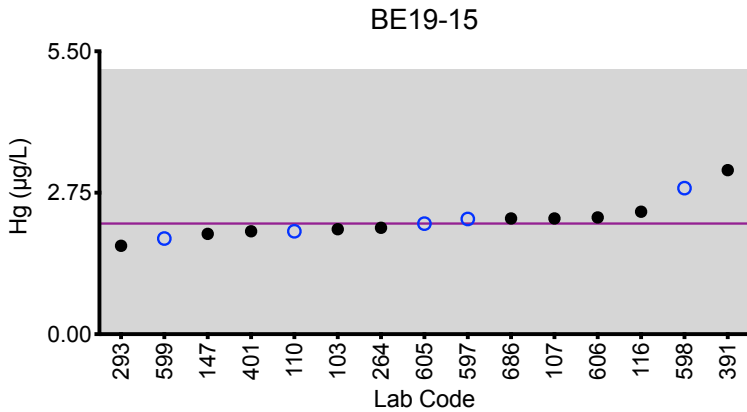
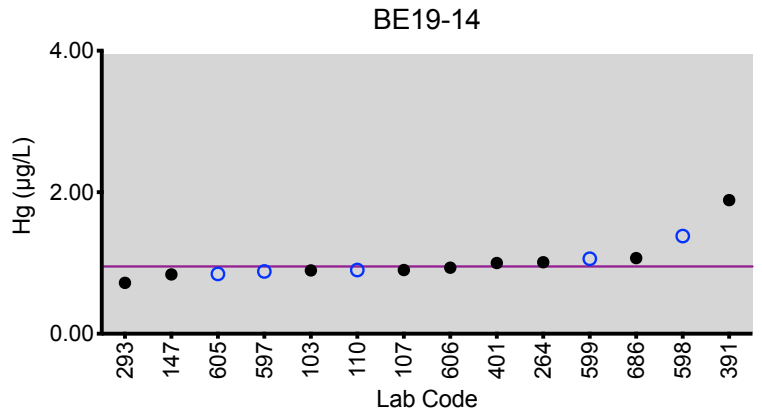
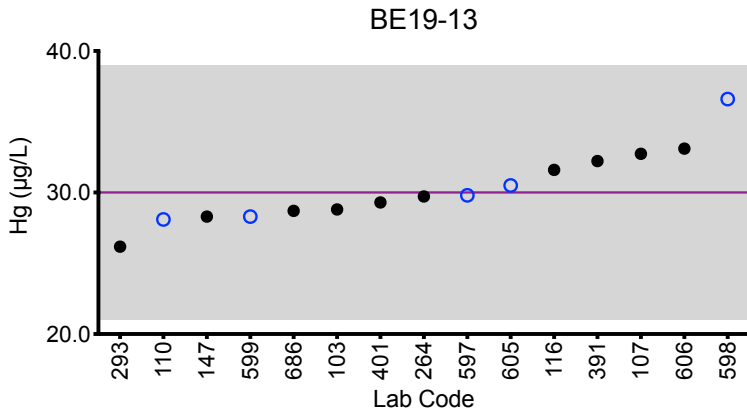
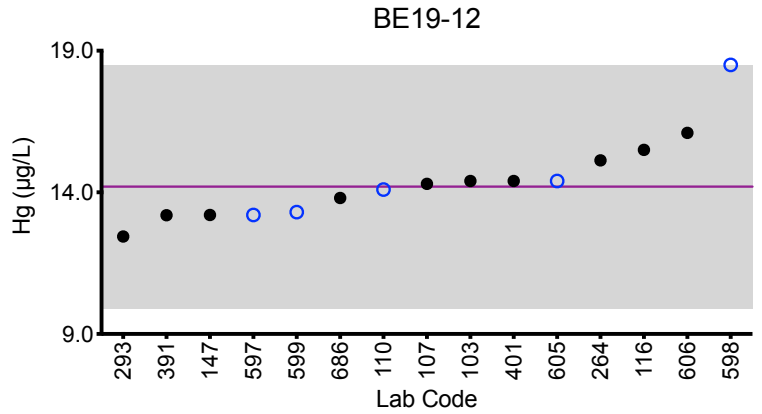
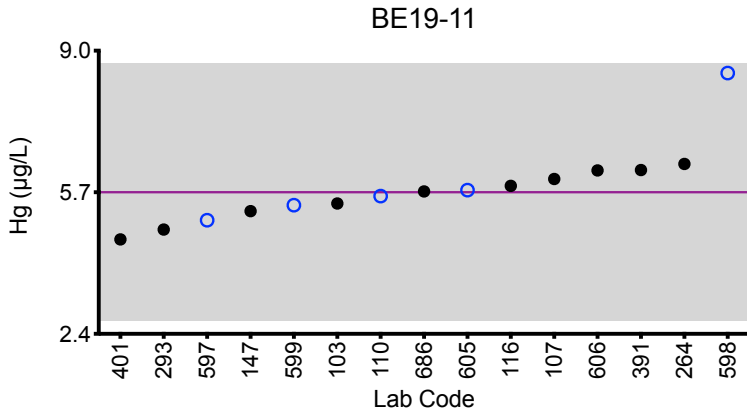
Based on the grading criteria for Hg in Whole Blood, 100% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:

±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 #3, 2019: Summary Statistics

Whole Blood Mn ($\mu\text{g/L}$)					
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Target (Robust Mean (x^*))	33.8	20.2	23.1	17.1	11.9
Upper Limit	39.5	23.6	27.0	20.1	14.9
Lower Limit	28.1	16.8	19.2	14.1	8.9
Robust SD (s^*)	2.6	1.8	1.7	1.9	1.1
Robust RSD (%)	7.7	8.9	7.4	11	9.2
Number of Sample Measurements (N)	12	12	12	12	12
Standard Uncertainty (u)	0.9	0.6	0.6	0.7	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 #3, 2019: Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
	Target	33.8	20.2	23.1	17.1	11.9
103	DRC/CC-ICP-MS	34.9	20.5	24.1	18.2	13.3
107	ICP-MS/MS	34.30	18.29	23.72	17.07	11.38
110	ICP-MS	32.0	18.2	21.1	15.5	11.2
147	ICP-MS	34.56	20.7	23.9	18.6	13.4
264	ICP-MS	36.50	21.77	24.39	19.03	13.72
293	DRC/CC-ICP-MS	31.3	17.68	19.11 ↓	14.44	10.32
391	ICP-MS	29.733	22.048	20.82	14.856	11.227
401	DRC/CC-ICP-MS	37.9	23.3	27.2 ↑	22.1 ↑	16.5 ↑
597	ICP-MS/MS	35.1	21.0	24.3	17.3	11.0
598	ICP-MS	31.0	20.1	22.7	16.9	11.9
599	DRC/CC-ICP-MS	32.9	19.8	20.6	16.5	11.0
606	ICP-MS/MS	34.9	19.8	23.1	17.3	12.0

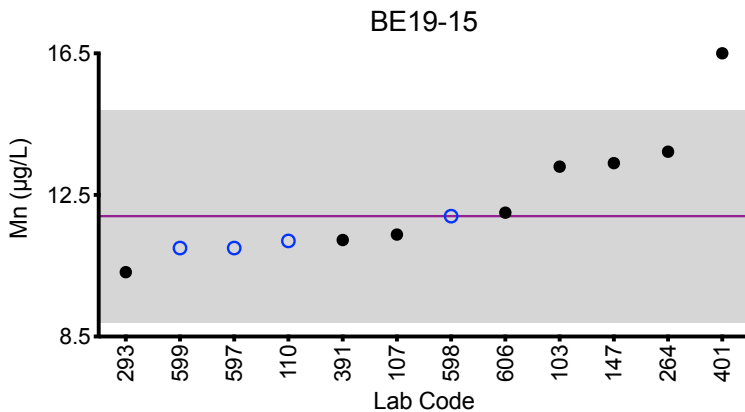
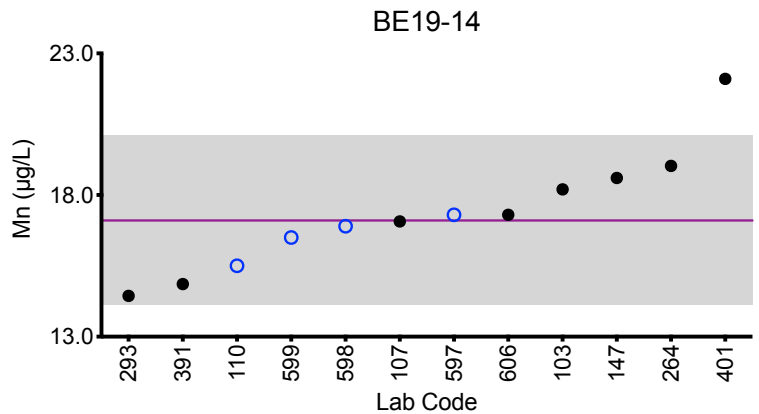
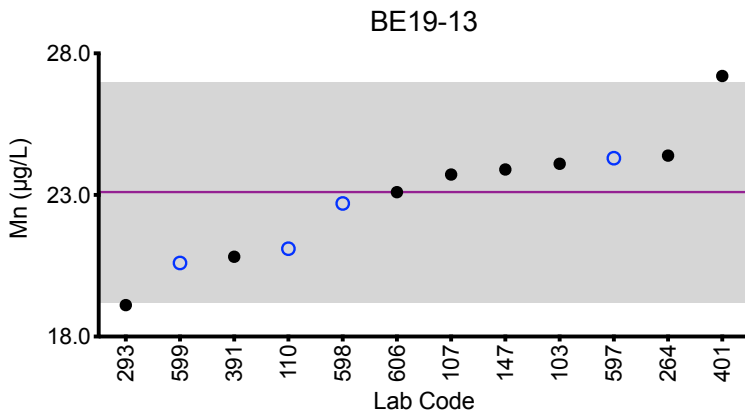
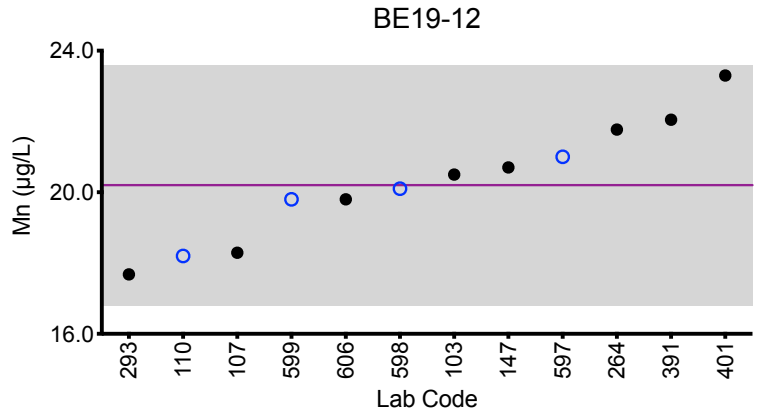
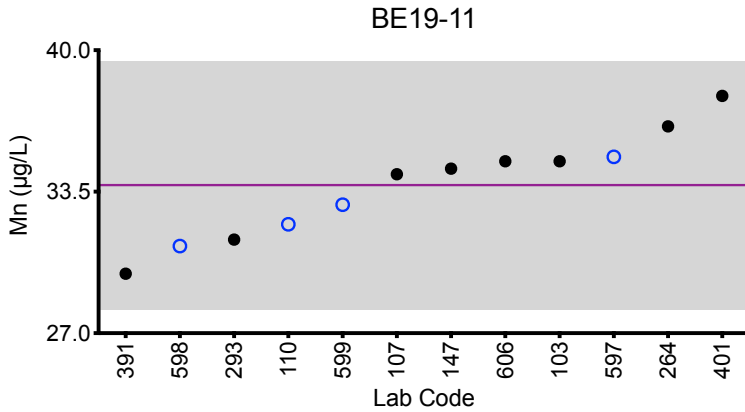
Based on the grading criteria for Mn in Whole Blood, 93% of results were satisfactory, with 1 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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 #3, 2019: Summary Statistics

Whole Blood Pb ($\mu\text{g}/\text{dL}$)					
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Target (Robust Mean (x^*))	26.3	7.7	17.7	3.38	0.61
Upper Limit	28.9	9.7	19.7	5.38	2.61
Lower Limit	23.7	5.7	15.7	1.38	0.00
Robust SD (s^*)	1.6	0.4	1.4	0.17	0.03
Robust RSD (%)	6.1	5.3	7.9	5.1	5.5
Number of Sample Measurements (N)	16	16	16	16	11
Standard Uncertainty (u)	0.5	0.1	0.4	0.05	0.01

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 #3, 2019: Performance of Participating Laboratories

Whole Blood Pb (µg/dL)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
	Target	26.3	7.7	17.7	3.38	0.61
103	DRC/CC-ICP-MS	26.6	7.85	18.0	3.46	0.631
107	ICP-MS/MS	27.521	7.611	19.032	3.556	0.649
110	ICP-MS	26.3	7.80	17.8	3.41	0.62
116	ICP-MS/MS	27.9	8.35	19.0	3.69	<3.0
147	ICP-MS	26.1	7.65	17.6	3.42	0.609
264	ICP-MS	25.25	7.36	16.72	3.23	0.57
293	DRC/CC-ICP-MS	23.57 ↓	6.82	15.51 ↓	3.1	0.62
343	ASV-LeadCare	24.2	6.5	16	3.3	<1.9
391	ETAAS-Z	26.4	7.55	17.6	2.86	0.22
401	DRC/CC-ICP-MS	24.2	7.3	16.4	3.3	0.6
597	ICP-MS/MS	28.7	8.86	20.7 ↑	3.80	0.631
598	ICP-MS	25.7	8.02	16.9	3.34	0.67
599	DRC/CC-ICP-MS	25.5	7.52	16.7	3.26	0.575
605	ICP-MS	26.6	7.71	17.8	3.30	<1.00
606	ICP-MS/MS	30.0 ↑	8.62	19.6	3.89	<1.00
686	ICP-MS	26.9	7.81	18.0	3.42	<1.00

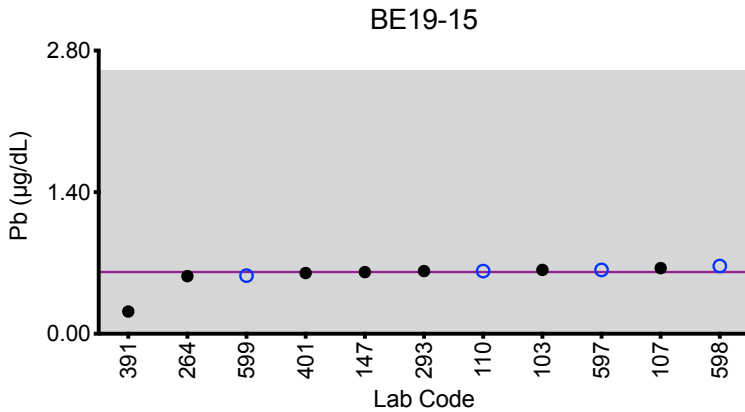
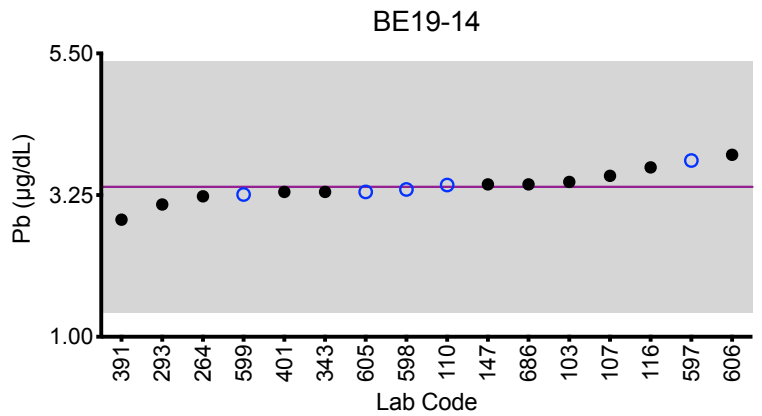
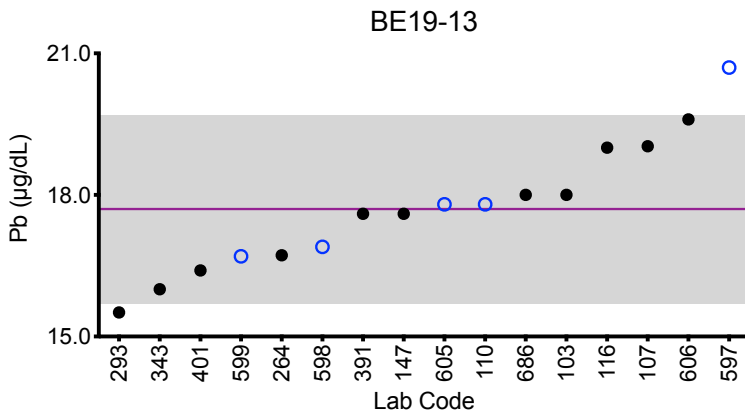
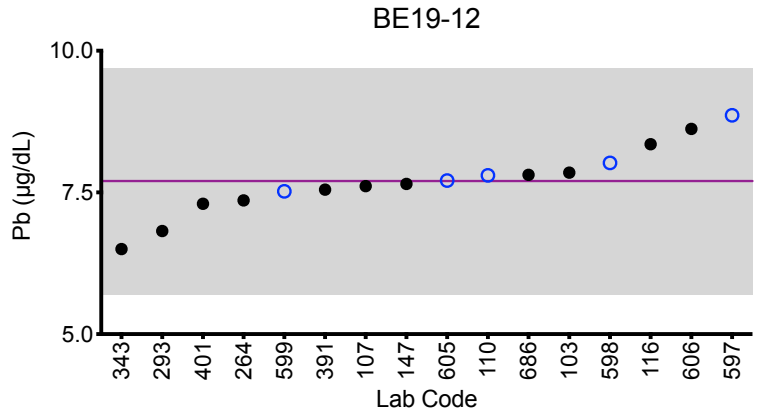
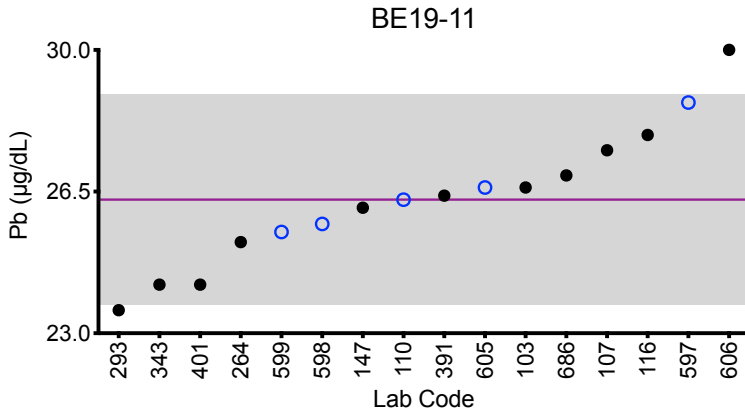
Based on the grading criteria for Pb in Whole Blood, 95% of results were satisfactory, with 1 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:

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



Results for Event #3, 2019: Laboratory Data and Summary Statistics

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

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	ICP-MS	990	752	1451	1175	2815
147	ICP-MS	991	762	1417	1182	2668
597	ICP-MS/MS	1071	886	*1692	1361	3014
598	ICP-MS	1048	818	1475	1287	3142
599	DRC/CC-ICP-MS	1024	792	1464	1223	3075

Summary Statistics

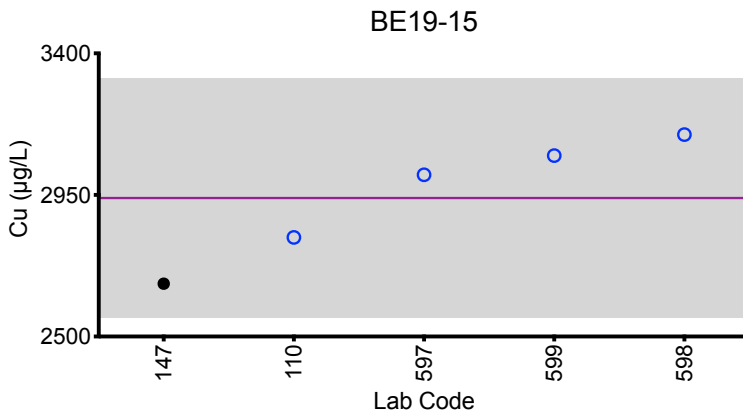
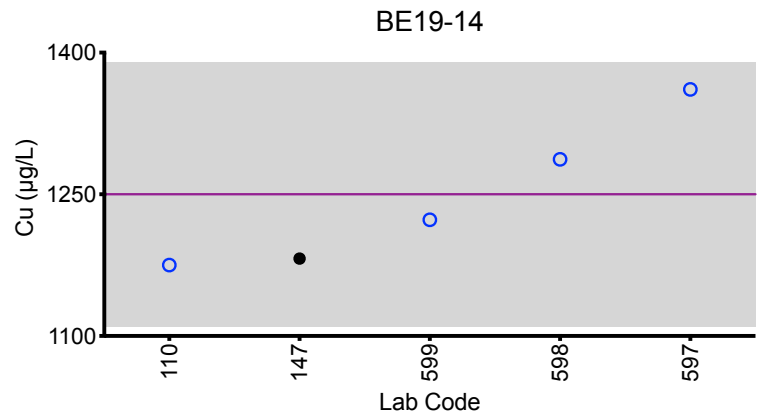
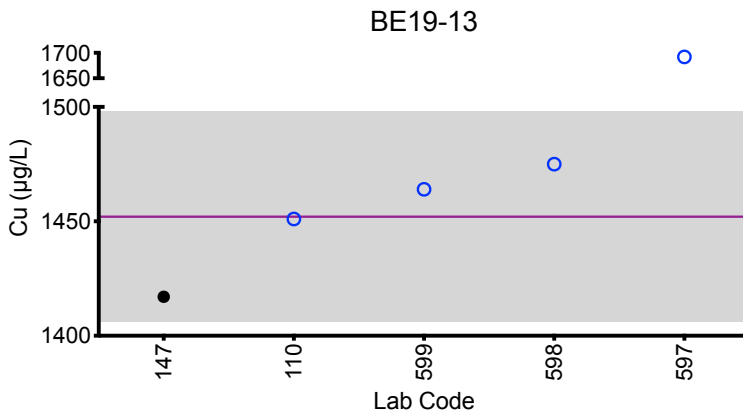
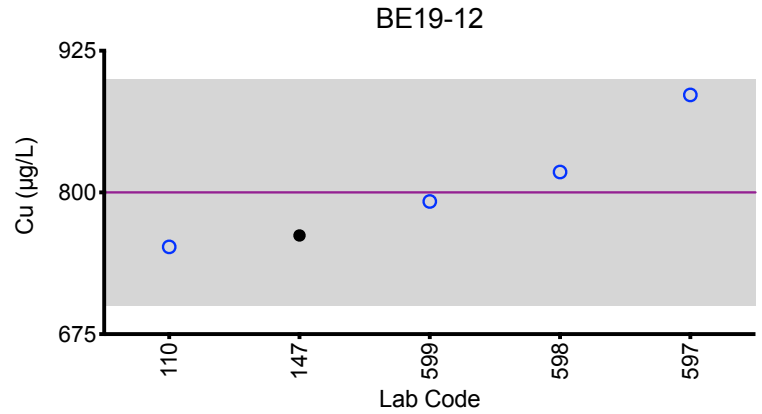
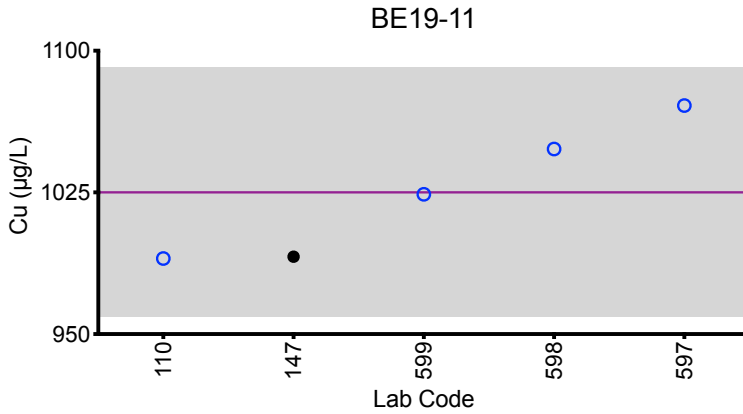
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})	1025	800	1452	1250	2940
Arithmetic SD (s)	33	50	23	70	190
Arithmetic RSD (%)	3.2	6.3	1.6	5.6	6.5
Number of Sample Measurements (N)	5	5	4	5	5

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Whole Blood Cu



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 #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
103	DRC/CC-ICP-MS	<1.50	4.06	3.70	<1.50	2.47
147	ICP-MS	0.934	4.01	3.68	0.516	2.51
264	ICP-MS	<0.01	*2.65	1.99	<0.01	*0.43
597	ICP-MS/MS	1.00	4.45	4.46	0.59	2.56
598	DRC/CC-ICP-MS	1.59	4.58	4.50	0.87	2.79
599	DRC/CC-ICP-MS	1.24	4.08	3.52	1.53	3.11

Summary Statistics

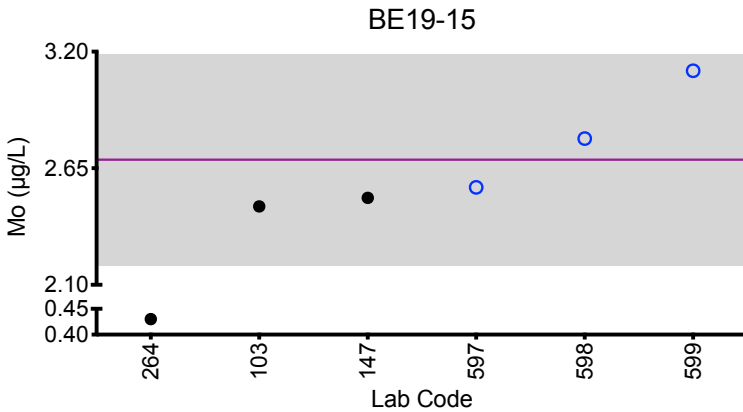
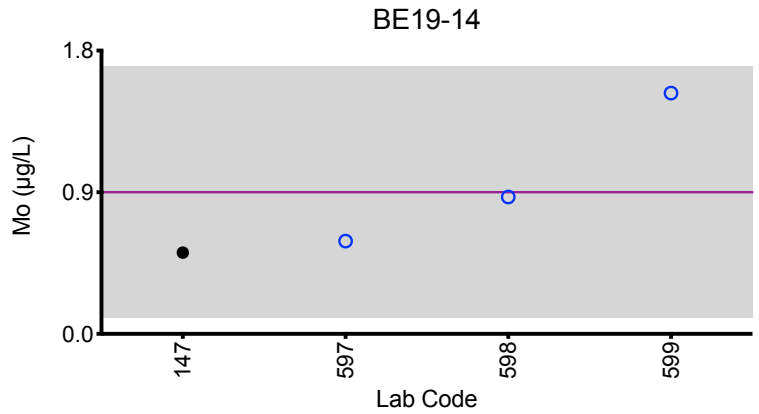
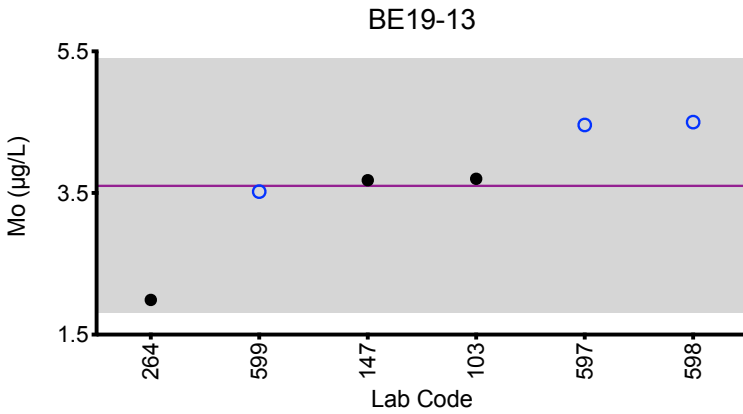
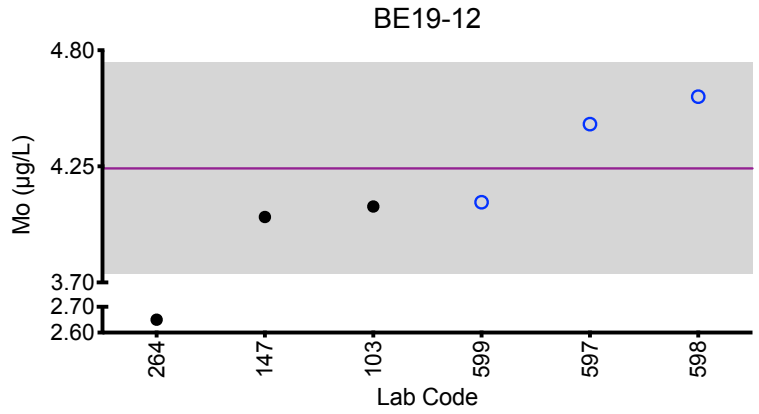
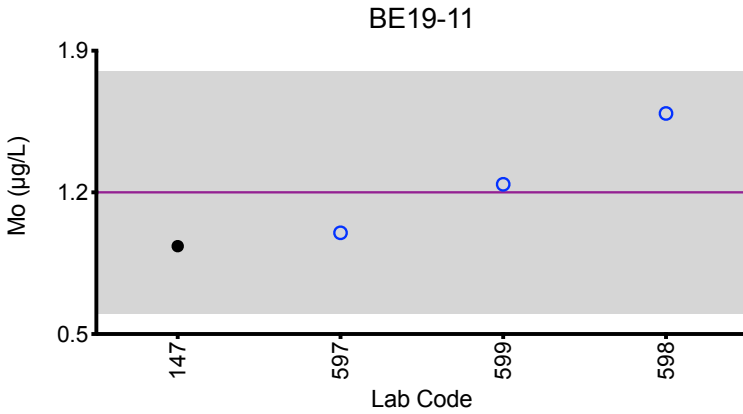
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})	1.2	4.24	3.6	0.9	2.69
Arithmetic SD (s)	0.3	0.25	0.9	0.4	0.25
Arithmetic RSD (%)	25	5.9	25	44	9.3
Number of Sample Measurements (N)	4	5	6	4	5

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Whole Blood 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 #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
103	DRC/CC-ICP-MS	0.505	4.02	<0.150	2.01	2.39
110	ICP-MS	0.52	3.81	0.02	1.99	2.24
147	ICP-MS	0.516	3.87	<0.0475	2.07	2.3
264	ICP-MS	0.52	3.95	<0.01	2.08	2.37
293	DRC/CC-ICP-MS	0.57	3.77	0.02	1.91	2.13
597	ICP-MS/MS	0.65	4.54	0.06	2.48	2.51
598	ICP-MS	0.60	4.80	0.12	2.59	*2.97

Summary Statistics

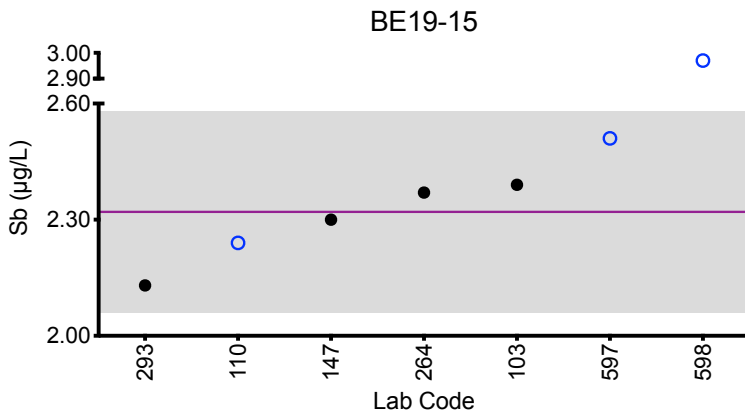
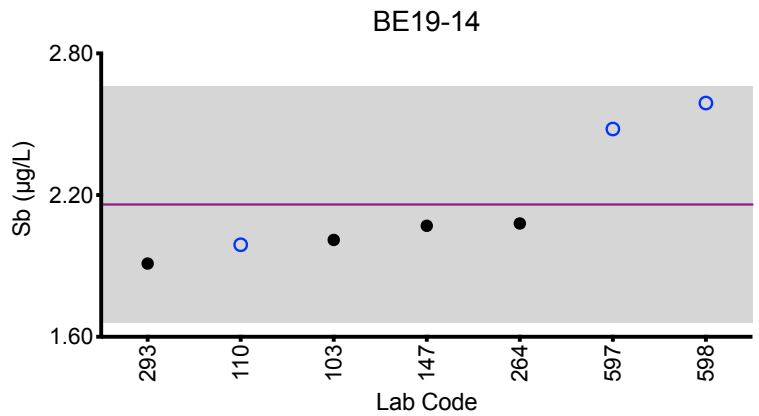
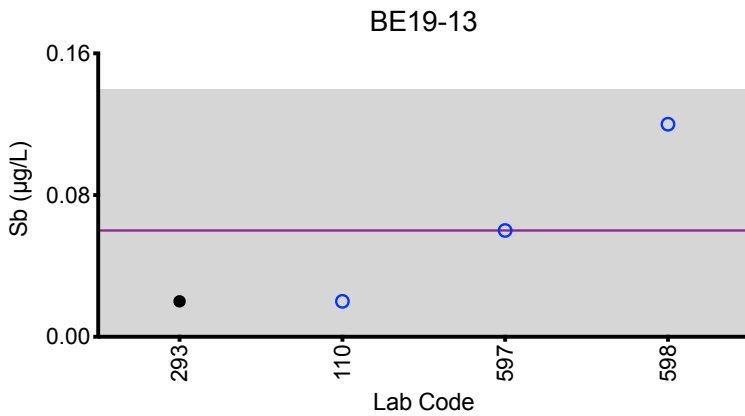
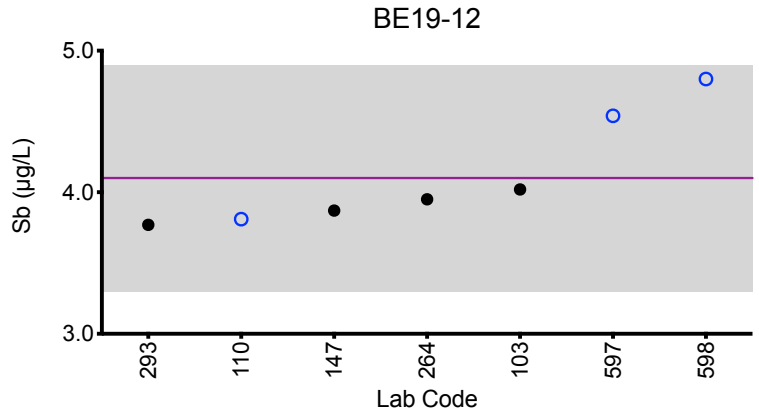
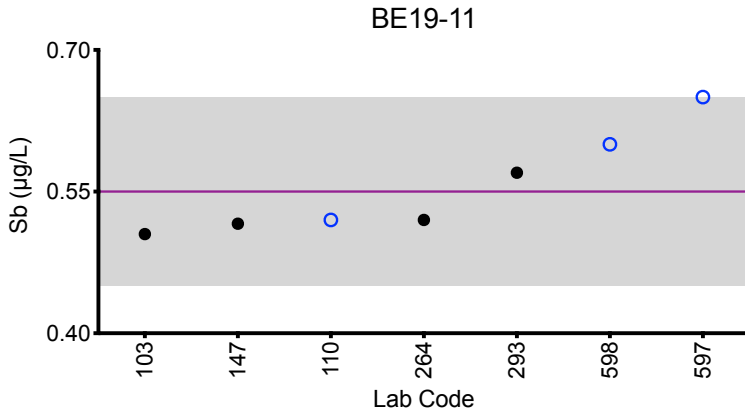
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})	0.55	4.1	0.06	2.16	2.32
Arithmetic SD (s)	0.05	0.4	0.04	0.25	0.13
Arithmetic RSD (%)	9.1	9.8	67	12	5.6
Number of Sample Measurements (N)	7	7	4	7	6

*Denotes a statistical Outlier.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
103	DRC/CC-ICP-MS	314	283	140	400	201
107	ICP-MS/MS	331.72	280.27	153.56	409.65	206.67
110	DRC/CC-ICP-MS	277	264	132	359	177
147	ICP-MS	295	267	134	362	184
264	ICP-MS	280.32	258.66	122.69	333.94	171.15
401	DRC/CC-ICP-MS	335	298	152	422	212
597	ICP-MS/MS	311	298	154	393	182
598	DRC/CC-ICP-MS	*406	*361	167	*513	*255
599	DRC/CC-ICP-MS	281	279	133	358	180

Summary Statistics

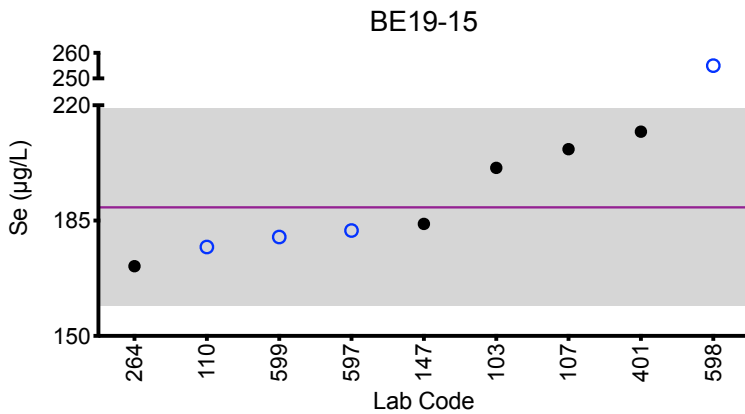
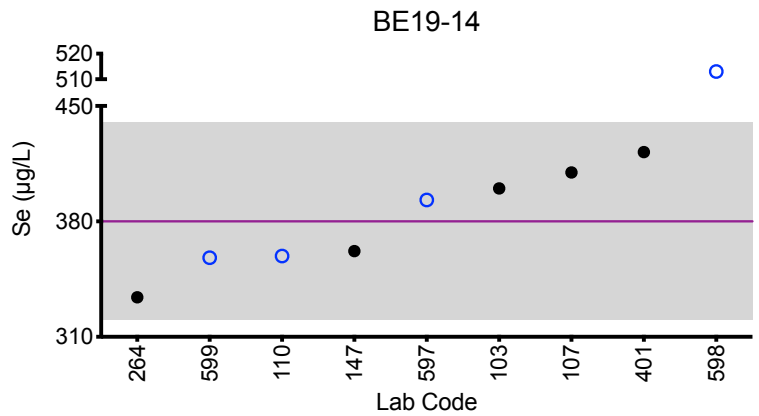
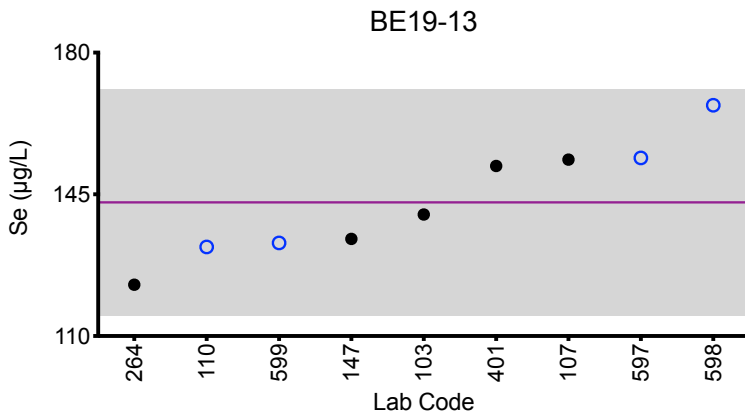
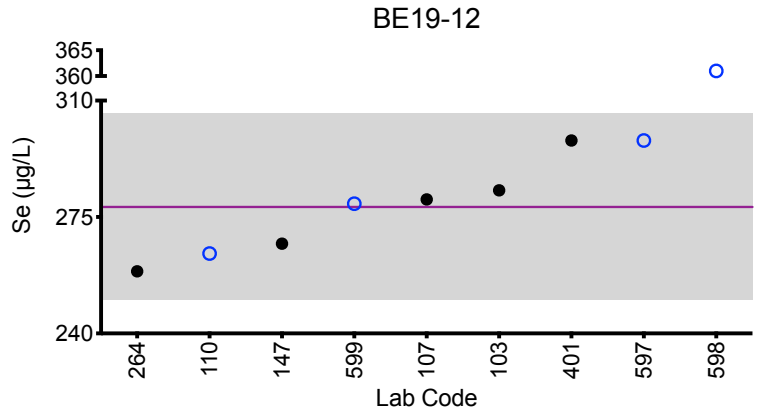
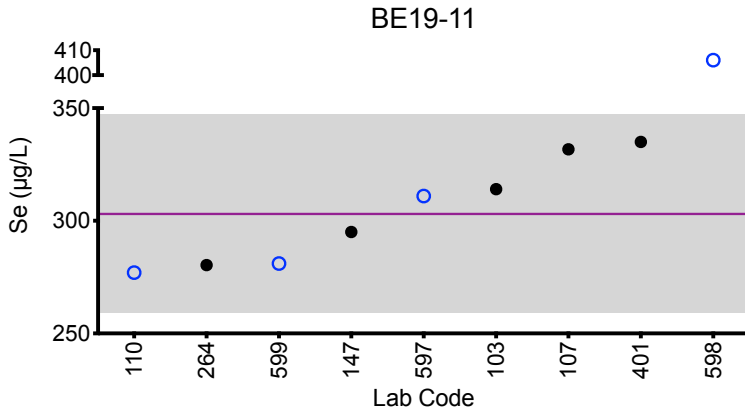
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})	303	278	143	380	189
Arithmetic SD (s)	22	14	14	30	15
Arithmetic RSD (%)	7.3	5.3	9.8	7.9	7.9
Number of Sample Measurements (N)	8	8	9	8	8

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Whole Blood Se



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 #3, 2019: Laboratory Data and Summary Statistics

Whole Blood TI (µg/L)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
103	DRC/CC-ICP-MS	0.399	3.04	1.50	0.127	2.13
110	ICP-MS	0.36	3.00	1.53	0.15	2.06
147	ICP-MS	0.397	3.07	1.53	0.138	2.17
264	ICP-MS	0.37	2.69	1.38	0.14	1.93
293	DRC/CC-ICP-MS	0.39	2.9	1.43	0.14	2.07
597	ICP-MS/MS	0.36	3.26	1.69	0.10	2.09
598	ICP-MS	*0.24	*1.28	*0.50	0.08	*0.80

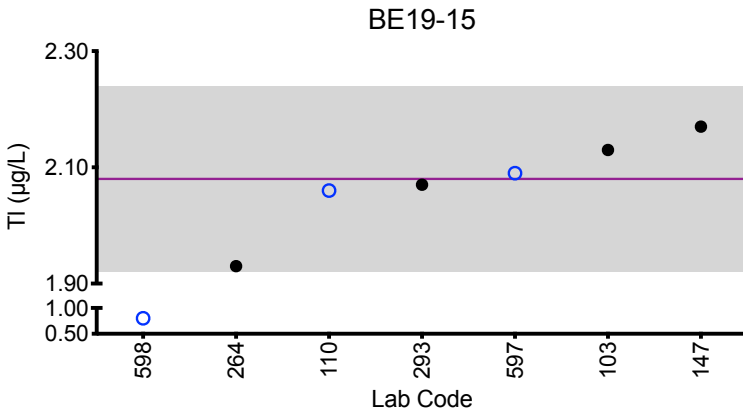
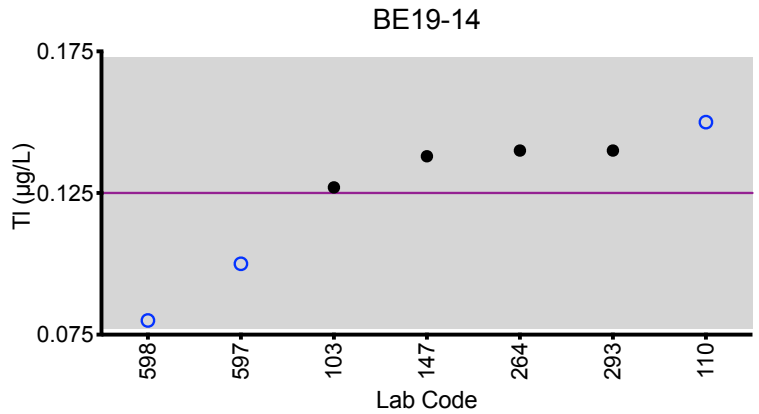
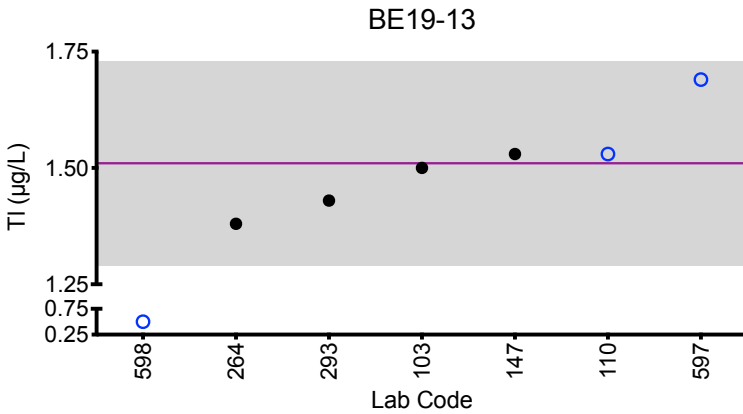
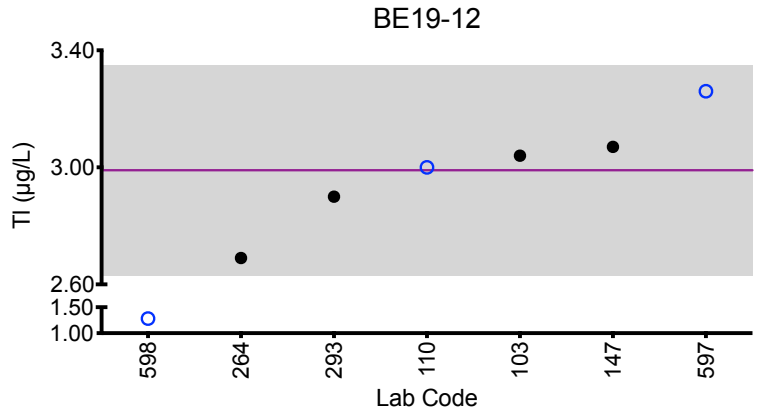
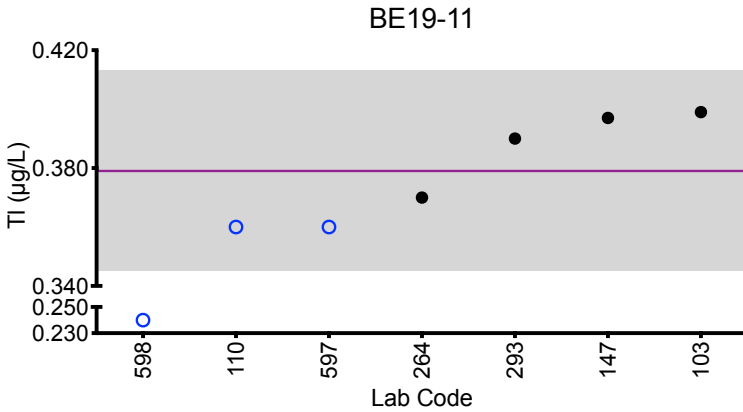
Summary Statistics						
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15	
Arithmetic Mean (\bar{x})	0.379	2.99	1.51	0.125	2.08	
Arithmetic SD (s)	0.017	0.18	0.11	0.024	0.08	
Arithmetic RSD (%)	4.5	6.3	6.6	19	3.8	
Number of Sample Measurements (N)	6	6	6	7	6	

*Denotes a statistical Outlier.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

Whole Blood U (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
103	DRC/CC-ICP-MS	0.0602	0.935	<0.0500	0.147	0.205
110	ICP-MS	0.068	0.894	0.034	0.132	0.211
147	ICP-MS	0.0674	0.943	0.036	0.153	0.22
598	ICP-MS	0.07	1.02	0.04	0.14	0.23
599	DRC/CC-ICP-MS	<0.100	1.11	<0.100	<0.100	*0.109

Summary Statistics

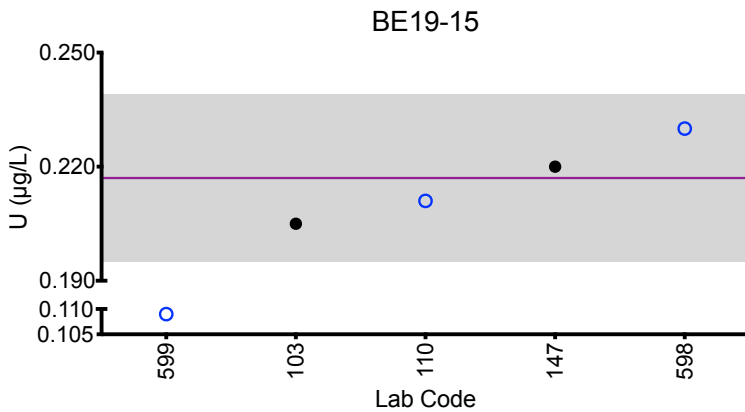
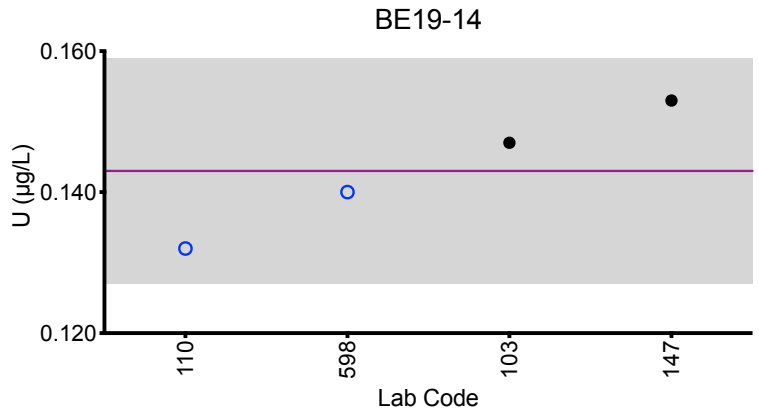
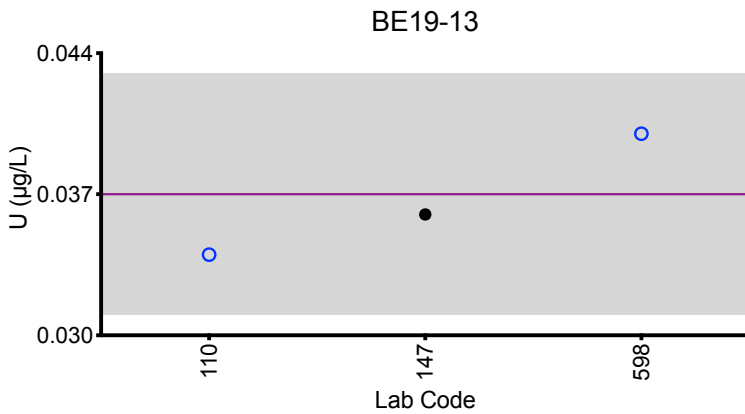
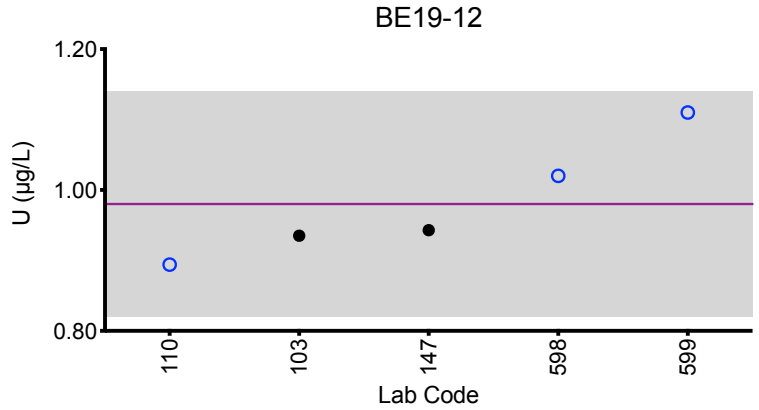
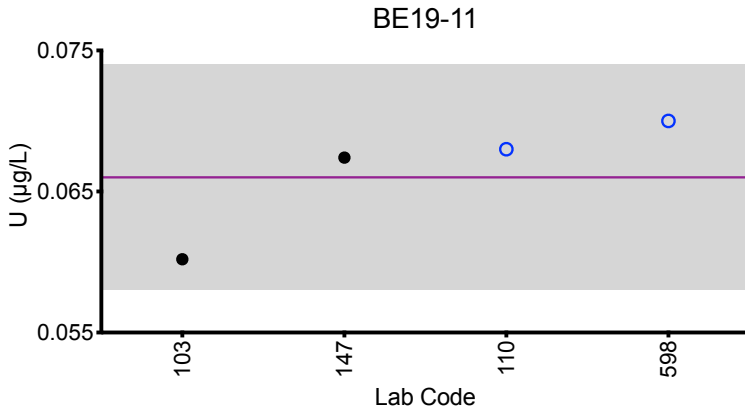
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})	0.066	0.98	0.037	0.143	0.217
Arithmetic SD (s)	0.004	0.08	0.003	0.008	0.011
Arithmetic RSD (%)	6.1	8.2	8.1	5.6	4.6
Number of Sample Measurements (N)	4	5	3	4	4

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Whole Blood U



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 #3, 2019: Laboratory Data and Summary Statistics

Whole Blood V (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	DRC/CC-ICP-MS	4.4	1.5	1.0	0.3	4.4
147	DRC/CC-ICP-MS	3.53	1.82	0.75	0.0243	4.53
293	DRC/CC-ICP-MS	3.37	1.7	0.75	0.07	4.18
597	ICP-MS/MS	3.66	2.03	0.95	0.16	4.36
598	DRC/CC-ICP-MS	3.32	1.71	0.60	<0.1	4.47

Summary Statistics

	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})	3.7	1.75	0.81	NA	4.39
Arithmetic SD (s)	0.4	0.18	0.15	NA	0.13
Arithmetic RSD (%)	11	10	19	NA	3.0
Number of Sample Measurements (N)	5	5	5	NA	5

*Denotes a statistical Outlier.

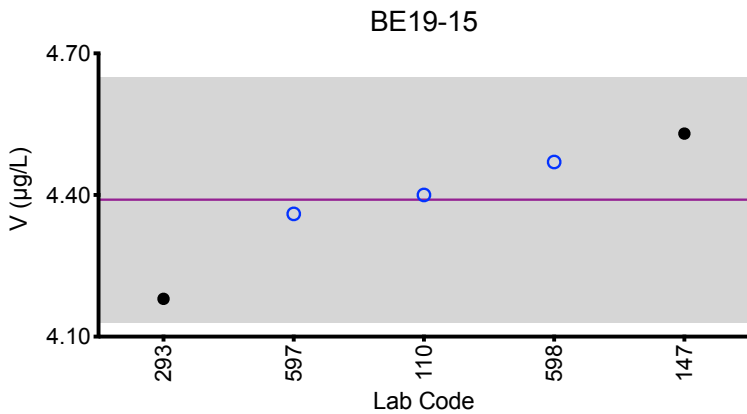
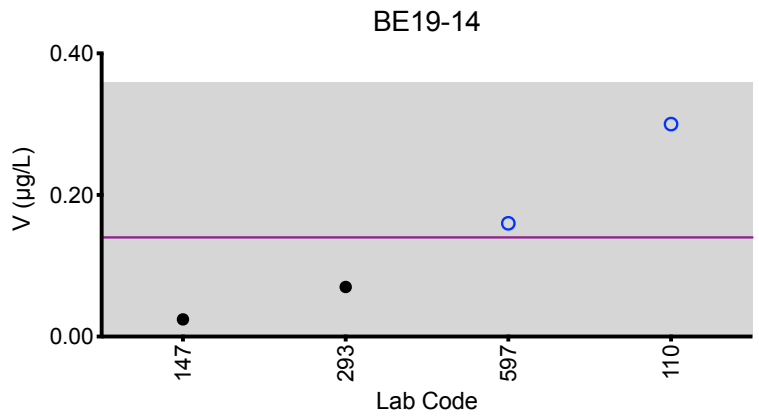
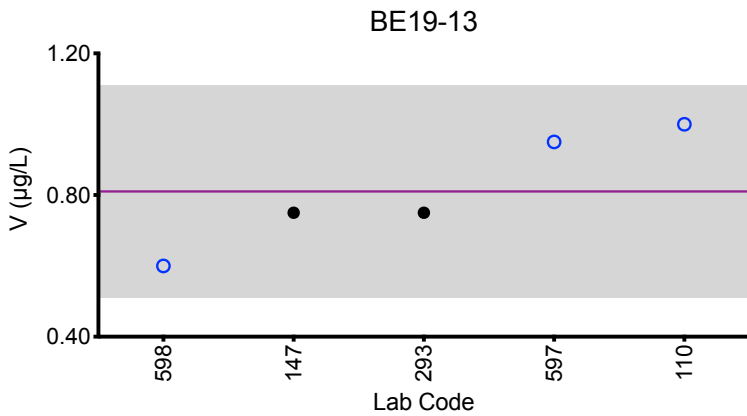
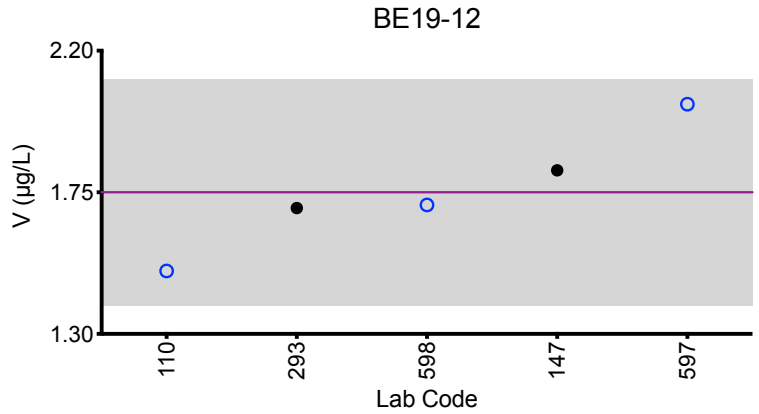
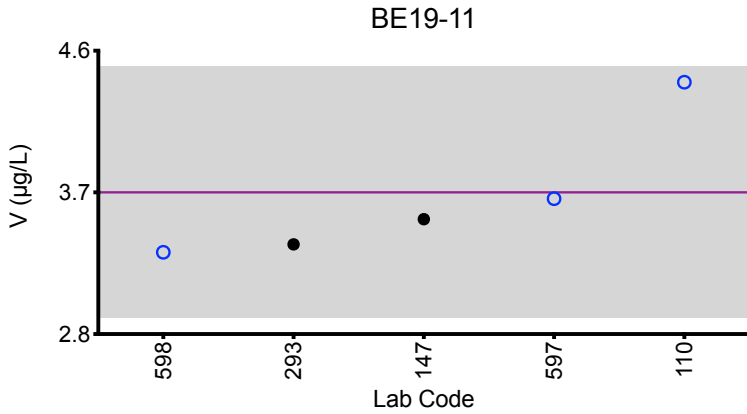
NA - Not Assigned

Statistical data were not calculated for BE19-14 based on a lack of consensus among participating labs.



Results for Event #3, 2019: Summary Figures

Whole Blood 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 #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	ICP-MS	5359	6699	5525	8642	4513
147	ICP-MS	5693	7190	5752	8431	4810
597	ICP-MS/MS	5780	7710	6400	9820	4740
598	ICP-MS	6008	7525	6050	9936	5429
599	DRC/CC-ICP-MS	5549	7044	5730	8853	4672

Summary Statistics

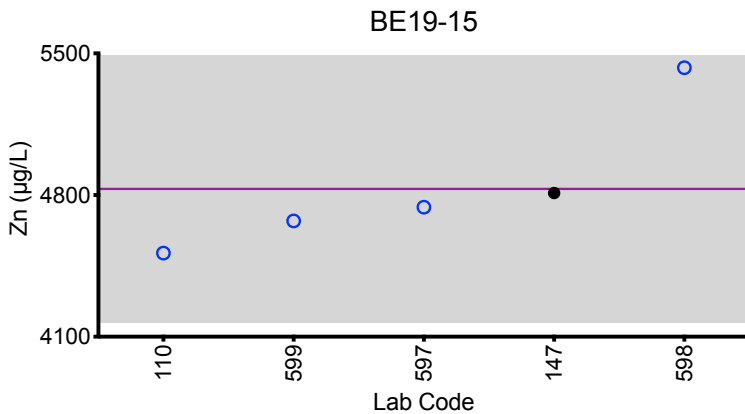
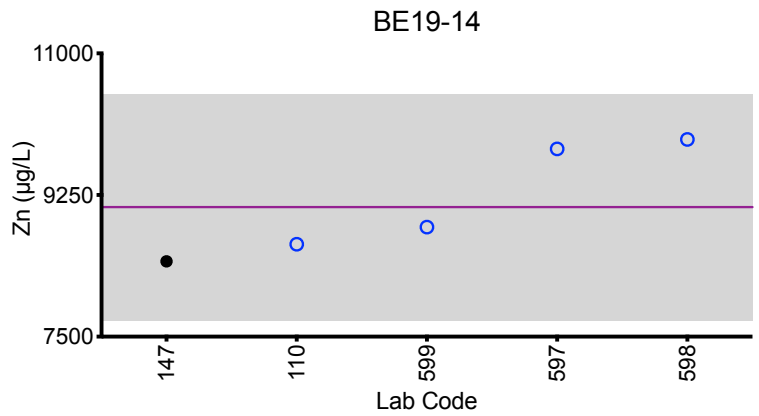
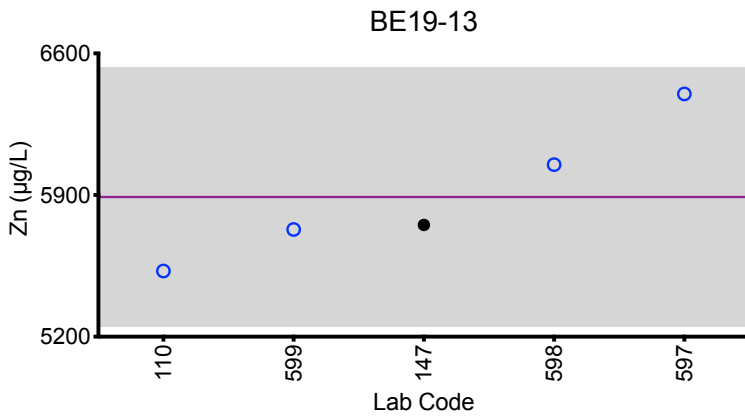
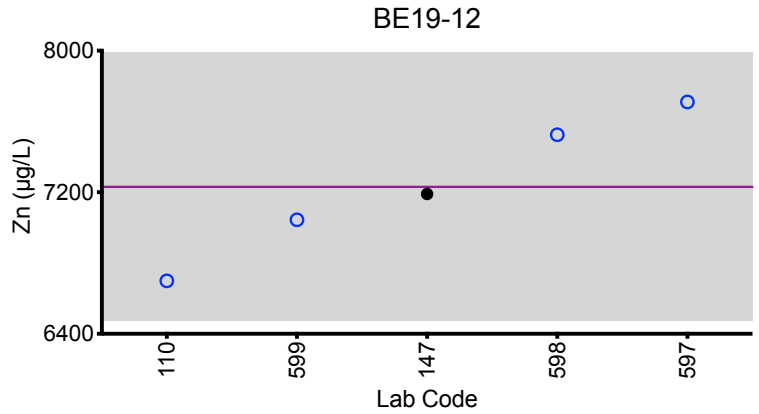
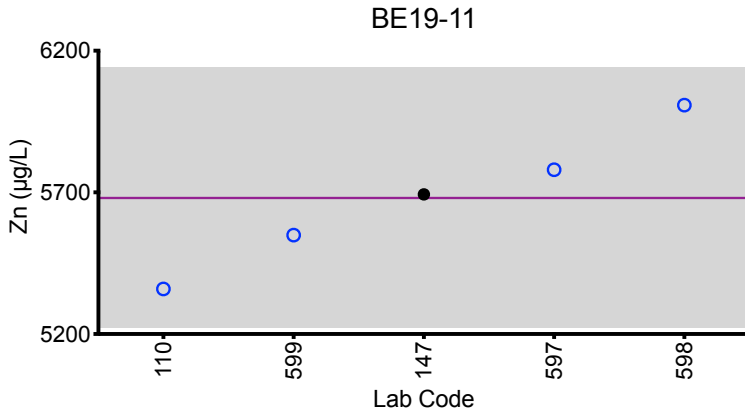
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})	5680	7230	5890	9100	4830
Arithmetic SD (s)	230	380	320	700	330
Arithmetic RSD (%)	4.3	5.3	5.4	7.7	6.8
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

Whole Blood AI (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
147	ICP-MS	<5.40	<5.40	<5.40	<5.40	<5.40
597	ICP-MS/MS	16.2	16.6	13.7	14.5	14.2

Summary Statistics

	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
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)	NA	NA	NA	NA	NA

*Denotes a statistical Outlier.

NA - Not Assigned

Statistical data were not calculated for BE19-11, BE19-12, BE19-13, BE19-14, or BE19-15 based on a lack of consensus among participating labs.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	ICP-MS	5.2	2.2	6.1	2.9	12.0
147	ICP-MS	4.34	2.29	5.74	2.8	12.9
597	ICP-MS/MS	4.7	2.76	6.57	3.05	12.5
598	ICP-MS	4.23	2.57	5.31	2.66	12.0
Summary Statistics						
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15	
Arithmetic Mean (\bar{x})	4.6	2.46	5.9	2.85	12.4	
Arithmetic SD (s)	0.4	0.24	0.5	0.15	0.4	
Arithmetic RSD (%)	8.7	9.8	8.5	5.3	3.2	
Number of Sample Measurements (N)	4	4	4	4	4	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	ICP-MS	0.70	2.72	4.80	0.98	1.76
147	ICP-MS	0.883	2.57	4.96	1	1.95
293	ICP-MS	0.6	2.31	4.45	0.88	1.67
598	ICP-MS	0.61	3.02	5.62	1.25	2.33
Summary Statistics						
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15	
Arithmetic Mean (\bar{x})	0.70	2.7	5.0	1.03	1.9	
Arithmetic SD (s)	0.12	0.3	0.5	0.15	0.3	
Arithmetic RSD (%)	17	11	10	15	16	
Number of Sample Measurements (N)	4	4	4	4	4	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	ICP-MS	1.44	1.44	1.61	1.56	1.27
597	ICP-MS/MS	1.52	1.54	1.80	1.74	1.27
598	ICP-MS	1.49	1.59	1.81	1.80	1.33
599	DRC/CC-ICP-MS	1.56	1.51	1.70	1.65	1.29

Summary Statistics

	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})	1.50	1.52	1.73	1.69	1.290
Arithmetic SD (s)	0.05	0.06	0.09	0.11	0.026
Arithmetic RSD (%)	3.3	3.9	5.2	5.9	2.2
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Mg (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
293	DRC/CC-ICP-MS	50.2	51.43	44.85	44.85	48.14
597	ICP-MS/MS	29300	30900	28000	26800	26400

Summary Statistics

	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
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)	NA	NA	NA	NA	NA

*Denotes a statistical Outlier.

NA - Not Assigned

Statistical data were not calculated for BE19-11, BE19-12, BE19-13, BE19-14, or BE19-15 based on a lack of consensus among participating labs.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Ni ($\mu\text{g/L}$)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	DRC/CC-ICP-MS	8.6	11.2	2.4	7.8	6.9
147	ICP-MS	7.87	10.7	1.5	6.4	6.11
597	ICP-MS/MS	8.44	12.0	2.00	7.15	6.47
598	ICP-MS	6.53	10.7	1.25	5.69	5.86
Summary Statistics						
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15	
Arithmetic Mean (\bar{x})	7.9	11.2	1.8	6.8	6.3	
Arithmetic SD (s)	0.9	0.6	0.5	0.8	0.4	
Arithmetic RSD (%)	11	5.4	28	12	6.3	
Number of Sample Measurements (N)	4	4	4	4	4	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Pt ($\mu\text{g/L}$)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	ICP-MS	2.16	2.56	4.13	0.72	6.24
598	ICP-MS	2.06	2.76	4.51	0.92	6.67
599	DRC/CC-ICP-MS	1.79	2.65	3.98	0.61	6.20

Summary Statistics						
	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15	
Arithmetic Mean (\bar{x})	2.00	2.66	4.21	0.75	6.37	
Arithmetic SD (s)	0.17	0.09	0.27	0.14	0.26	
Arithmetic RSD (%)	8.5	3.4	4.8	19	3.1	
Number of Sample Measurements (N)	3	3	3	3	3	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	ICP-MS	8.44	0.89	2.06	4.83	0.31
147	ICP-MS	8.11	0.901	2.08	4.83	0.38
597	ICP-MS/MS	9.69	1.13	2.66	5.99	0.46
598	ICP-MS	8.90	1.07	2.29	5.34	0.38

Summary Statistics

	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})	8.8	1.00	2.27	5.2	0.38
Arithmetic SD (s)	0.6	0.11	0.26	0.5	0.06
Arithmetic RSD (%)	6.8	11	11	9.6	16
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Whole Blood Te (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	ICP-MS	0.1	0.1	0.1	0.1	<0.1
147	ICP-MS	<0.0727	<0.0727	<0.0727	<0.0727	<0.0727

Summary Statistics

	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
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)	NA	NA	NA	NA	NA

*Denotes a statistical Outlier.

NA - Not Assigned

Statistical data were not calculated for BE19-11, BE19-12, BE19-13, BE19-14, or BE19-15 based on a lack of consensus among participating labs.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Whole Blood W ($\mu\text{g/L}$)						
Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
110	ICP-MS	2.08	0.38	1.35	0.21	0.83
200	ICP-MS	2.48	0.44	1.53	0.28	1.05
598	ICP-MS	2.46	0.46	1.66	0.32	1.04
Summary Statistics						
		BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
Arithmetic Mean (\bar{x})		2.34	0.43	1.51	0.27	0.97
Arithmetic SD (s)		0.23	0.04	0.14	0.05	0.11
Arithmetic RSD (%)		9.8	9.3	9.3	19	11
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.



Results for Event #3, 2019:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
147	ICP-MS	0.217	0.216	0.211	0.219	0.214

Whole Blood Bi (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
147	ICP-MS	<0.0502	<0.0502	<0.0502	<0.0502	<0.0502

Whole Blood I (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
147	ICP-MS	35.8	35.3	24.6	24.9	25.3

Whole Blood Li (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
147	ICP-MS	0.409	0.372	<0.222	<0.222	<0.222

Whole Blood Sr (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
103	DRC/CC-ICP-MS	24.8	24.7	16.4	16.8	22.3

Whole Blood Th (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
147	ICP-MS	<0.0371	<0.0371	<0.0371	<0.0371	<0.0371

Whole Blood Ti (µg/L)

Lab Code	Method	BE19-11	BE19-12	BE19-13	BE19-14	BE19-15
200	DRC/CC-ICP-MS	1.7	5.0	3.3	6.5	2.3



**Department
of Health**

**Wadsworth
Center**

Event #3, 2019

**Trace Elements in
Urine**

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory



Event #3, 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 22 elements were reported by at least one participant: Ag, Al, B, Bi, Cs, Cu, Fe, I, Li, Mg, Mo, Ni, Pt, Sb, Se, Sn, Sr, Te, Th, 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 #3, 2019: Summary Statistics

	Urine As (µg/L)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x*))	3.7	14.5	29.4	97	63.6
Upper Limit	9.7	20.5	35.4	116	76.3
Lower Limit	0.0	8.5	23.4	78	50.9
Robust SD (s*)	0.4	1.0	2.8	5	2.6
Robust RSD (%)	12	6.9	9.5	5.1	4.1
Number of Sample Measurements (N)	16	19	19	19	19
Standard Uncertainty (u)	0.1	0.3	0.8	1	0.7

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 #3, 2019: Performance of Participating Laboratories

Urine As (µg/L)						
Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
	Target	3.7	14.5	29.4	97	63.6
103	DRC/CC-ICP-MS	3.39	14.2	27.0	95.0	61.2
107	DRC/CC-ICP-MS	3.13	13.76	27.95	91.13	63.76
110	DRC/CC-ICP-MS	3.85	15.4	33.0	102	66.5
116	ICP-MS/MS	4.71	16.0	29.5	95.2	62.4
147	ICP-MS	3.27	14.2	30.3	97.4	62.6
264	ICP-MS	4.29	16.04	32.60	105.07	68.66
293	DRC/CC-ICP-MS	*21.48 ↑	13.48	27.76	91.17	60.47
324	ICP-MS	3.669	15.043	30.943	99.459	66.586
391	ICP-MS	3.757	14.905	29.328	93.443	63.757
399	DRC/CC-ICP-MS	3.76	13.9	24.0	98.8	64.1
401	DRC/CC-ICP-MS	*22.8 ↑	14.3	30.5	96.2	62.6
597	ICP-MS/MS	3.41	12.9	27.9	88.7	53.9
598	DRC/CC-ICP-MS	2.95	14.0	29.3	92.3	62.2
599	DRC/CC-ICP-MS	3.74	14.2	22.8 ↓	95.2	61.6
605	ICP-MS	3.88	13.5	21.3 ↓	99.3	63.2
606	ICP-MS/MS	4.06	16.3	33.1	110	71.7
630	DRC/CC-ICP-MS	3.81	15.6	33.4	104	67.9
676	DRC/CC-ICP-MS	4.11	14.2	28.9	94.6	61.8
686	DRC/CC-ICP-MS	<6.00	14.6	31.2	99.2	65.3

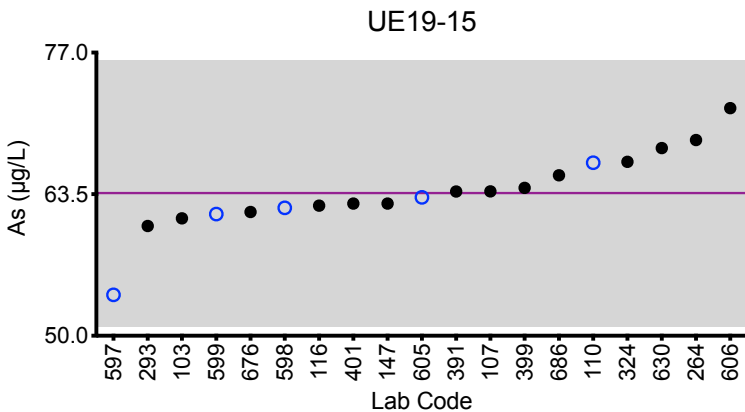
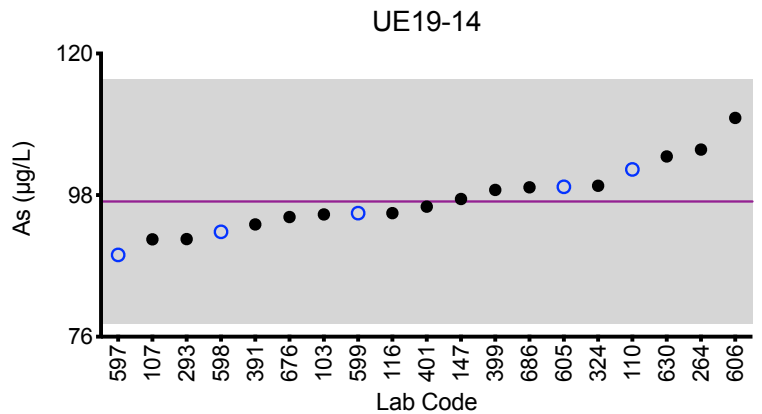
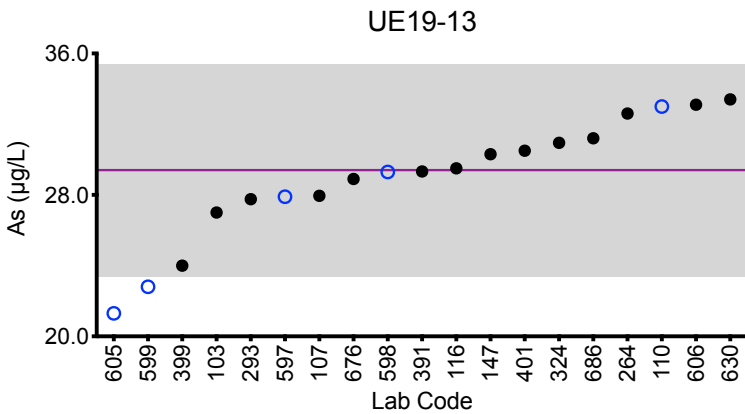
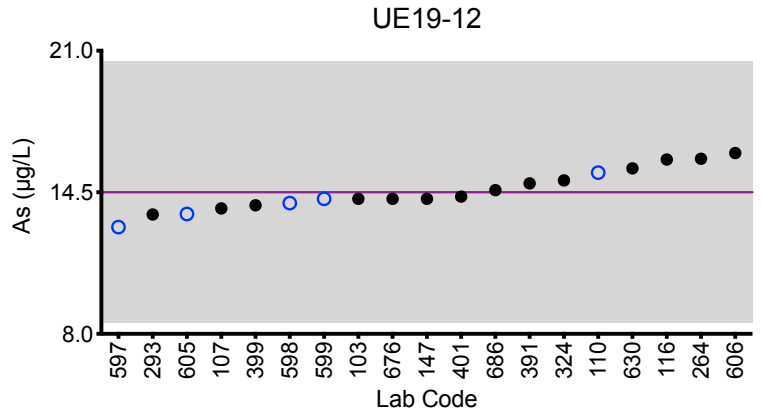
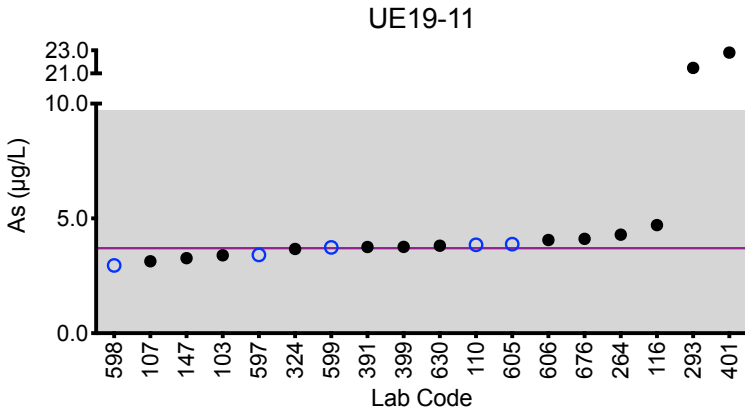
Based on the grading criteria for As in Urine, 96% of results were satisfactory, with 0 of the 19 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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 #3, 2019: Summary Statistics

	Urine Ba (µg/L)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x*))	0.71	1.10	4.52	9.8	2.58
Upper Limit	1.71	2.10	5.52	11.8	3.58
Lower Limit	0.00	0.10	3.52	7.8	1.58
Robust SD (s*)	0.05	0.11	0.20	0.5	0.12
Robust RSD (%)	7.1	10	4.4	5.1	4.7
Number of Sample Measurements (N)	13	14	14	14	13
Standard Uncertainty (u)	0.02	0.04	0.07	0.2	0.04

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 #3, 2019: Performance of Participating Laboratories

		Urine Ba (µg/L)				
Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
	Target	0.71	1.10	4.52	9.8	2.58
107	ICP-MS	0.739	1.119	4.464	9.514	2.613
110	ICP-MS	0.76	1.18	4.72	10.5	2.78
116	ICP-MS/MS	0.716	1.15	4.64	9.80	2.69
147	ICP-MS	0.777	1.07	4.52	9.3	2.45
264	ICP-MS	0.64	1.06	4.19	9.36	2.44
399	ICP-MS	0.712	1.11	4.60	9.99	2.63
597	ICP-MS/MS	0.774	1.25	4.39	9.47	2.86
598	ICP-MS	0.58	1.02	4.54	9.79	2.57
599	DRC/CC-ICP-MS	0.712	1.00	4.49	10.1	2.51
605	ICP-MS	0.703	1.16	4.73	10.1	2.58
606	ICP-MS/MS	0.677	0.835	4.27	9.64	2.58
607	ICP-MS	*3.92 ↑	2.76 ↑	6.02 ↑	11.9 ↑	*5.94 ↑
676	ICP-MS	0.681	0.994	4.17	8.95	2.41
686	ICP-MS	0.685	1.08	4.55	10.1	2.61

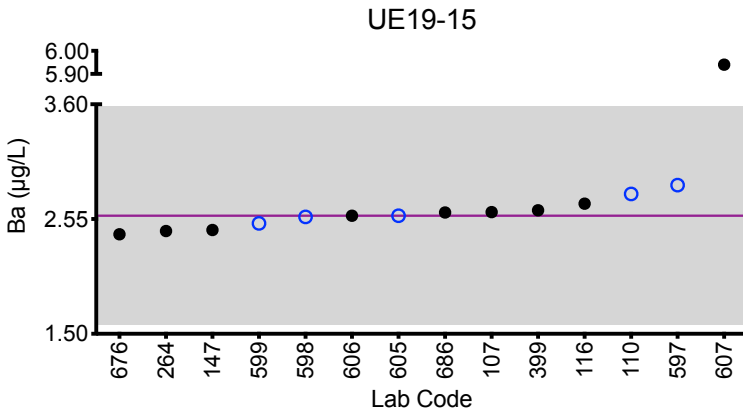
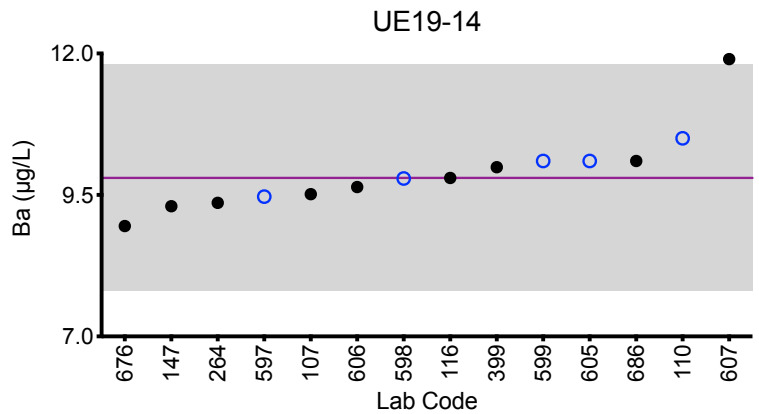
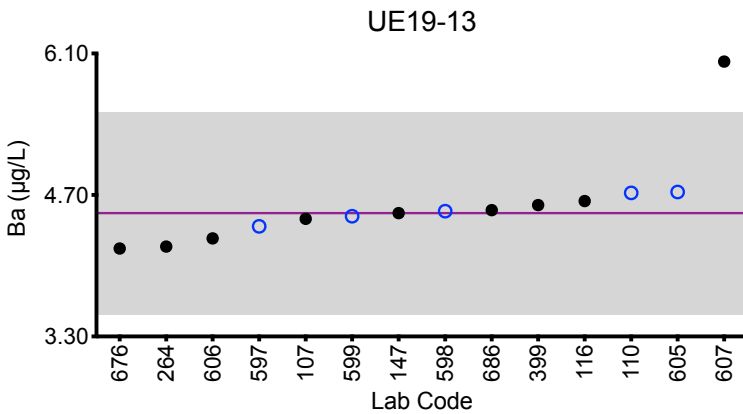
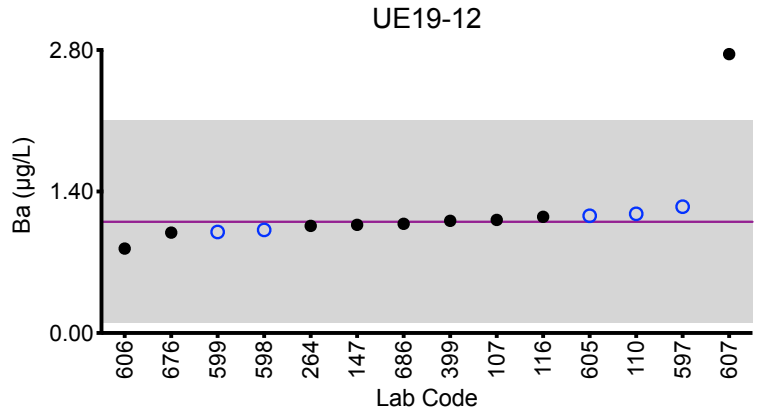
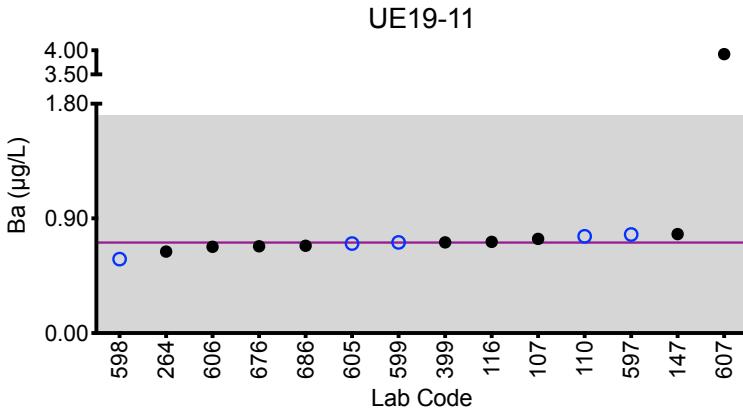
Based on the grading criteria for Ba in Urine, 93% of results were satisfactory, with 1 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:
 $\pm 1 \mu\text{g/L}$ 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 $5 \mu\text{g/L}$.



Results for Event #3, 2019: Summary Statistics

	Urine Be ($\mu\text{g/L}$)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x^*))	3.17	0.93	1.73	0.50	4.69
Upper Limit	4.17	1.93	2.73	1.50	5.69
Lower Limit	2.17	0.00	0.73	0.00	3.69
Robust SD (s^*)	0.08	0.04	0.09	0.03	0.22
Robust RSD (%)	2.5	4.5	5.2	6.6	4.7
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (u)	0.03	0.01	0.03	0.01	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 #3, 2019: Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target		3.17	0.93	1.73	0.50	4.69
107	ICP-MS	3.226	0.933	1.697	0.514	4.732
110	ICP-MS	3.12	0.939	1.77	0.520	4.75
116	ICP-MS/MS	3.20	0.902	1.66	0.476	4.62
147	ICP-MS	3.17	0.982	1.81	0.486	4.55
264	ICP-MS	3.10	0.94	1.71	0.49	4.85
293	ICP-MS	3.15	0.89	1.72	0.49	4.57
399	ICP-MS	3.21	0.925	1.80	0.536	4.76
598	ICP-MS	3.11	1.00	1.84	0.49	4.53
599	DRC/CC-ICP-MS	2.88	0.821	1.60	0.454	4.00
605	ICP-MS	3.29	0.956	1.80	0.519	4.84
607	ICP-MS	3.22	0.964	1.72	0.562	4.98
676	ICP-MS	3.12	0.861	1.59	0.458	4.41
686	ICP-MS	3.34	0.957	1.72	0.525	4.96

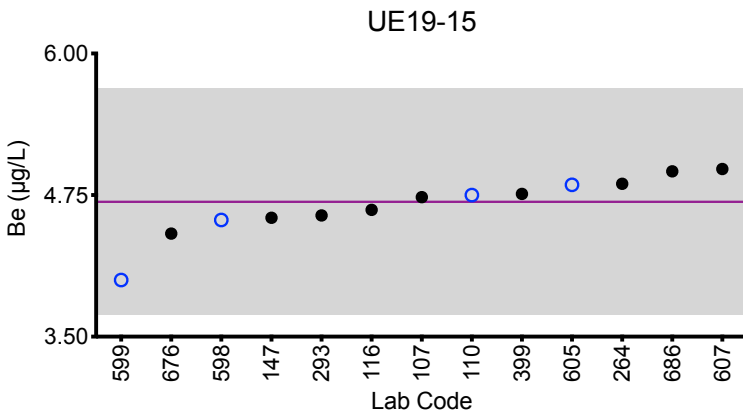
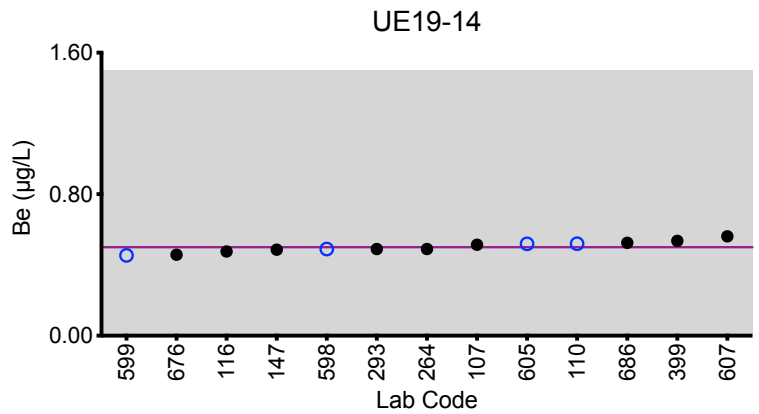
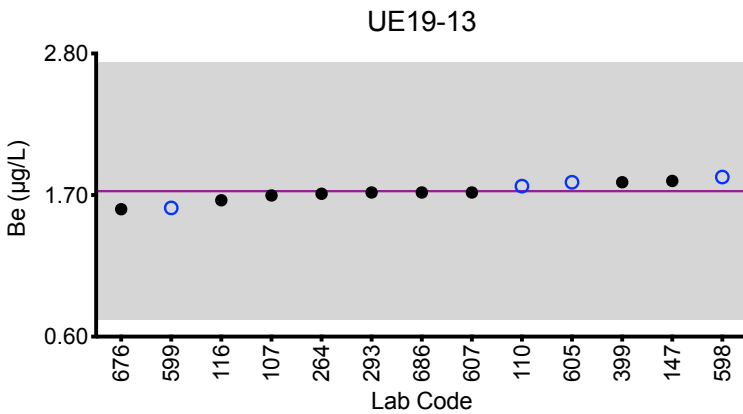
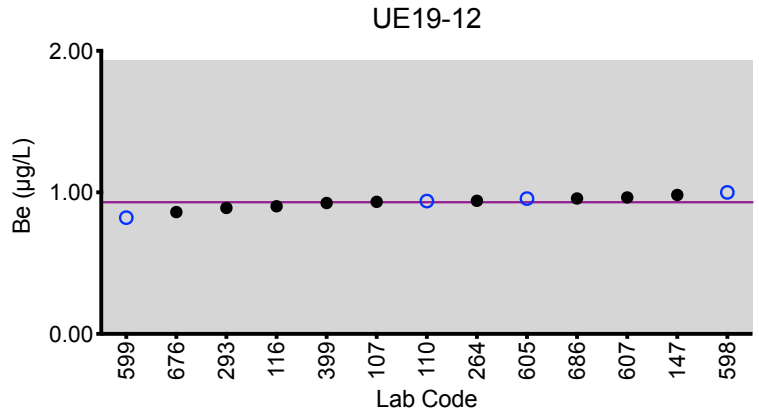
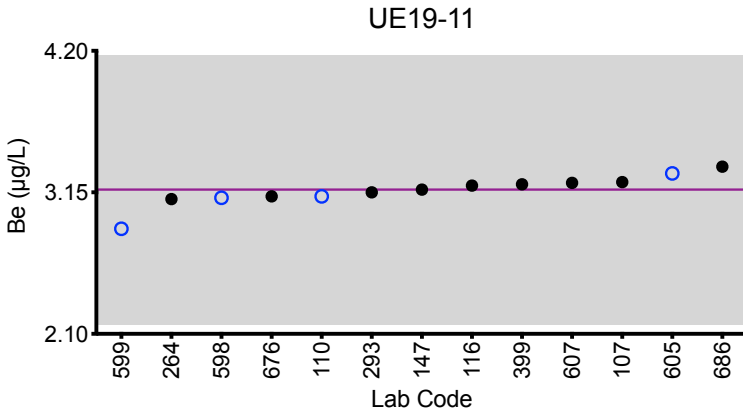
Based on the grading criteria for Be in Urine, 100% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:
 $\pm 1 \mu\text{g/L}$ 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 $5 \mu\text{g/L}$.



Results for Event #3, 2019: Summary Statistics

	Urine Cd (µg/L)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x*))	4.97	3.79	2.19	0.241	1.24
Upper Limit	5.97	4.79	3.19	1.241	2.24
Lower Limit	3.97	2.79	1.19	0.000	0.24
Robust SD (s*)	0.12	0.17	0.10	0.024	0.05
Robust RSD (%)	2.4	4.5	4.6	10	4.2
Number of Sample Measurements (N)	20	20	20	19	20
Standard Uncertainty (u)	0.03	0.05	0.03	0.007	0.01

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



Results for Event #3, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Cd (µg/L)				
		UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
	Target	4.97	3.79	2.19	0.241	1.24
103	DRC/CC-ICP-MS	4.97	4.00	2.18	0.258	1.26
107	DRC/CC-ICP-MS	4.944	3.555	2.269	0.229	1.174
110	ICP-MS	4.63	3.47	2.08	0.232	1.18
116	ICP-MS/MS	5.04	3.72	2.09	0.219	1.28
147	ICP-MS	5.02	3.84	2.34	0.241	1.27
264	ICP-MS	5.11	4.03	2.26	0.23	1.33
293	DRC/CC-ICP-MS	4.92	3.72	2.17	0.24	1.17
324	ICP-MS	4.680	3.669	2.102	<1	1.206
391	ICP-MS	5.005	3.841	2.244	0.242	1.242
399	DRC/CC-ICP-MS	4.99	3.82	2.19	0.255	1.25
401	DRC/CC-ICP-MS	5.06	3.93	2.25	0.22	1.35
597	ICP-MS/MS	4.49	3.51	2.14	0.266	1.23
598	DRC/CC-ICP-MS	4.58	3.43	2.19	0.18	1.07
599	DRC/CC-ICP-MS	5.00	3.90	2.10	0.226	1.23
605	ICP-MS	5.02	3.84	2.17	0.190	1.23
606	ICP-MS/MS	5.02	3.87	2.27	0.243	1.28
607	ICP-MS	4.5	3.49	1.93	0.321	1.24
630	ICP-MS	4.82	3.82	2.14	0.255	1.24
676	DRC/CC-ICP-MS	5.27	3.90	2.30	0.305	1.27
686	ICP-MS	5.20	3.97	2.31	0.264	1.31

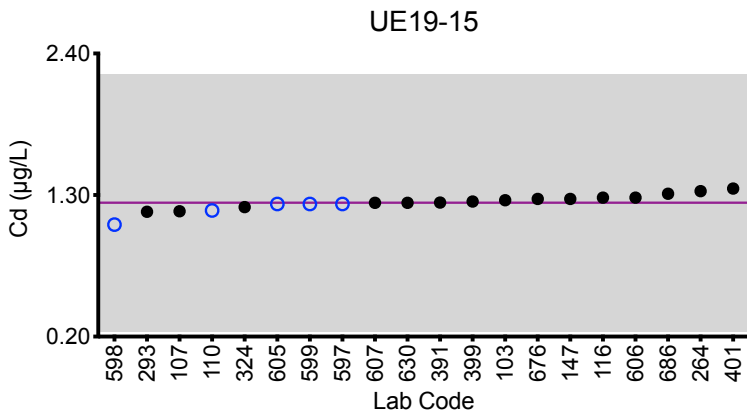
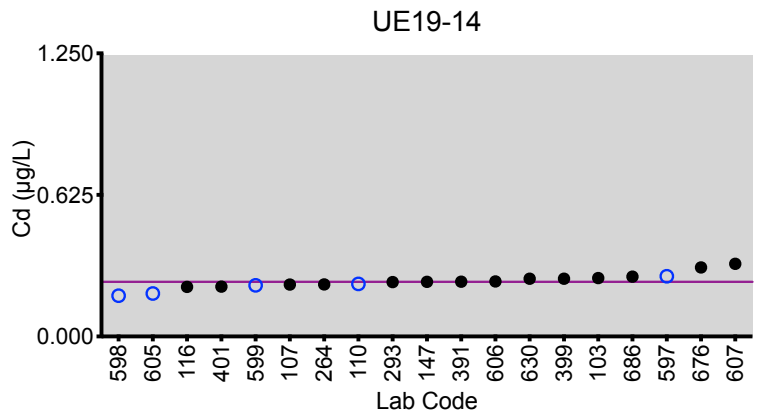
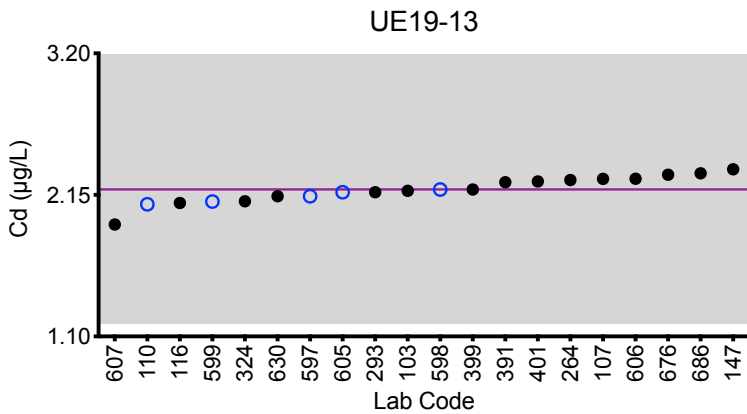
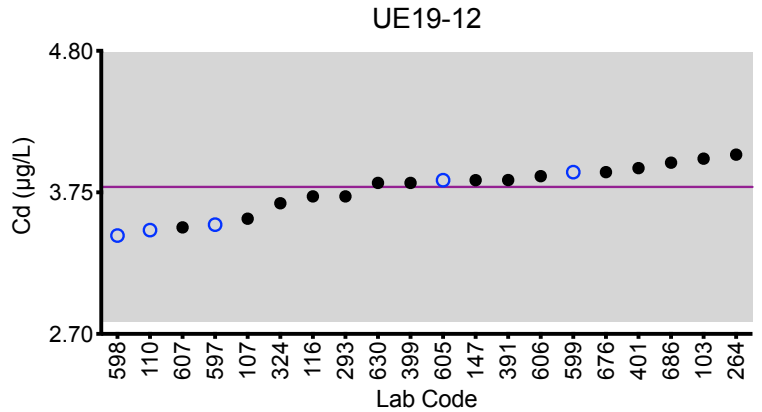
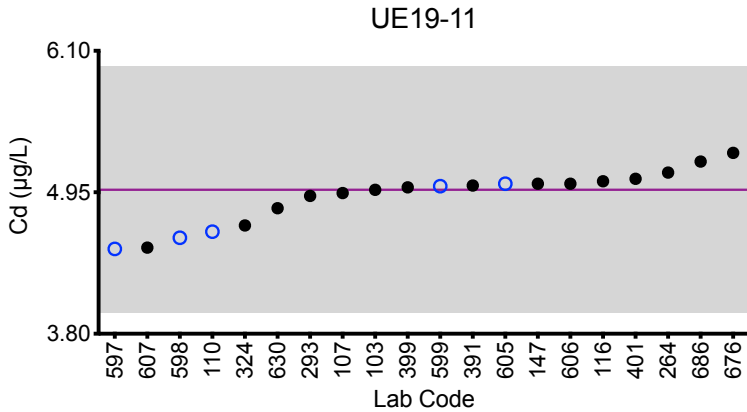
Based on the grading criteria for Cd in Urine, 100% of results were satisfactory, with 0 of the 20 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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 #3, 2019: Summary Statistics

	Urine Co (µg/L)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x*))	5.95	4.67	0.71	5.77	0.47
Upper Limit	7.45	6.17	2.21	7.27	1.97
Lower Limit	4.45	3.17	0.00	4.27	0.00
Robust SD (s*)	0.19	0.21	0.05	0.25	0.04
Robust RSD (%)	3.2	4.5	6.3	4.3	8.2
Number of Sample Measurements (N)	16	16	15	16	14
Standard Uncertainty (u)	0.06	0.06	0.01	0.08	0.01

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



Results for Event #3, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Co (µg/L)				
		UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
	Target	5.95	4.67	0.71	5.77	0.47
103	DRC/CC-ICP-MS	5.91	4.69	0.737	5.84	0.429
107	ICP-MS	5.939	4.670	0.690	5.594	0.441
110	ICP-MS	5.98	4.77	0.748	6.00	0.480
116	ICP-MS/MS	5.76	4.22	0.388	5.23	<0.2
147	ICP-MS	5.86	4.59	0.683	5.58	0.464
264	ICP-MS	5.84	4.77	0.71	5.74	0.46
324	ICP-MS	5.798	4.563	<1	5.626	<1
391	ICP-MS	5.821	4.452	0.662	5.592	0.462
399	DRC/CC-ICP-MS	6.18	4.78	0.738	6.07	0.450
401	DRC/CC-ICP-MS	5.82	4.36	0.64	5.58	0.39
597	ICP-MS/MS	5.35	4.18	0.685	5.54	0.424
598	ICP-MS	6.15	4.91	0.88	5.99	0.63
599	DRC/CC-ICP-MS	6.09	5.13	0.714	6.10	0.468
605	ICP-MS	6.11	4.80	0.735	6.03	0.541
606	ICP-MS/MS	6.48	4.91	0.784	6.23	0.491
676	ICP-MS	6.04	4.60	0.702	5.66	0.498

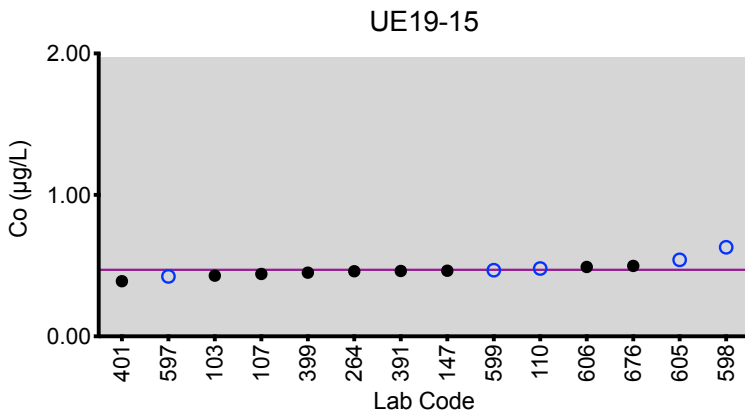
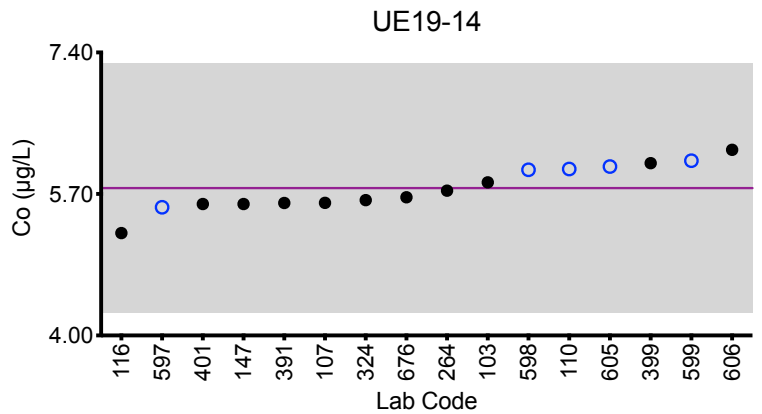
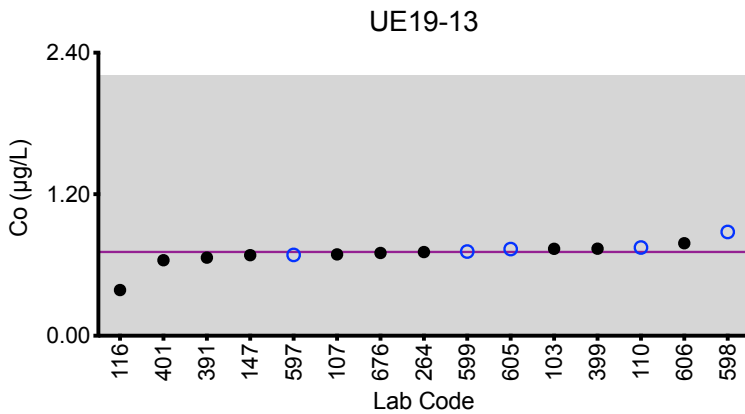
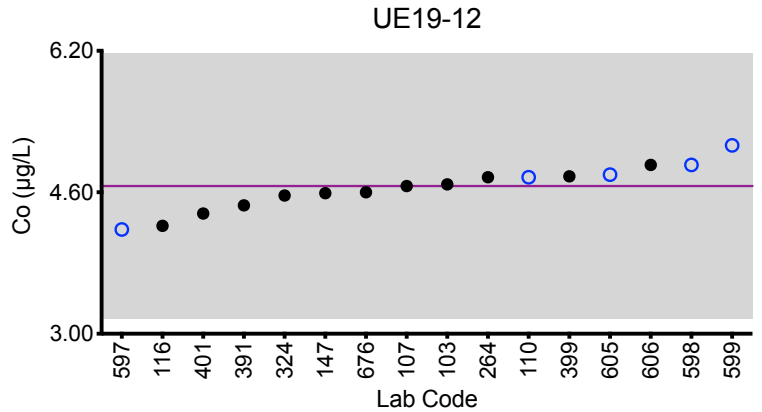
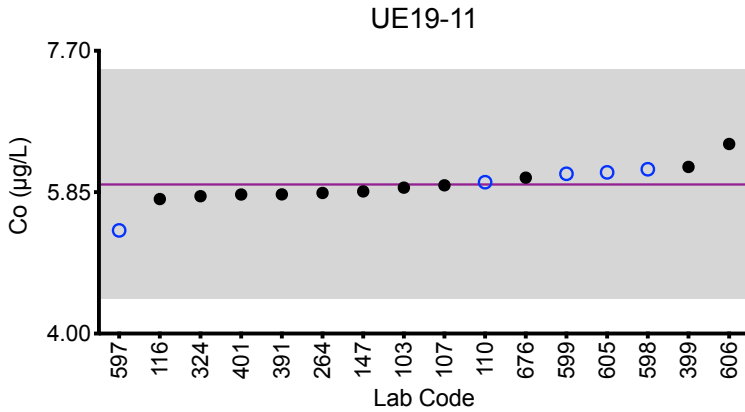
Based on the grading criteria for Co in Urine, 100% of results were satisfactory, with 0 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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 #3, 2019: Summary Statistics

	Urine Cr (µg/L)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x*))	0.61	3.60	2.02	17.6	5.61
Upper Limit	3.61	6.60	5.02	21.1	8.61
Lower Limit	0.00	0.60	0.00	14.1	2.61
Robust SD (s*)	0.24	0.19	0.18	0.6	0.19
Robust RSD (%)	39	5.3	8.9	3.4	3.4
Number of Sample Measurements (N)	11	12	12	12	12
Standard Uncertainty (u)	0.09	0.07	0.07	0.2	0.07

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 #3, 2019: Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target		0.61	3.60	2.02	17.6	5.61
107	DRC/CC-ICP-MS	0.75	3.51	1.93	17.28	5.69
110	DRC/CC-ICP-MS	0.93	4.13	2.26	19.4	6.23
116	ICP-MS/MS	0.438	3.54	2.01	18.0	5.56
147	DRC/CC-ICP-MS	0.446	3.37	1.81	16.2	5.06
264	ICP-MS	0.57	3.78	2.02	18.01	5.73
324	ICP-MS	<1	3.734	2.194	17.682	5.731
391	ICP-MS	0.445	3.397	1.857	17.821	5.777
401	DRC/CC-ICP-MS	0.85	3.42	2.31	16.6	5.43
597	ICP-MS/MS	1.08	3.70	2.38	17.1	5.14
598	DRC/CC-ICP-MS	0.39	3.57	1.94	17.60	5.41
599	DRC/CC-ICP-MS	0.571	3.72	1.94	17.28	5.72
605	ICP-MS	0.411	3.63	1.86	17.9	5.61

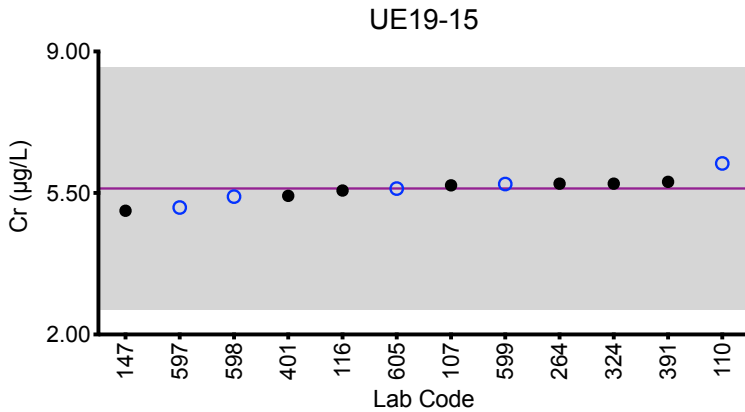
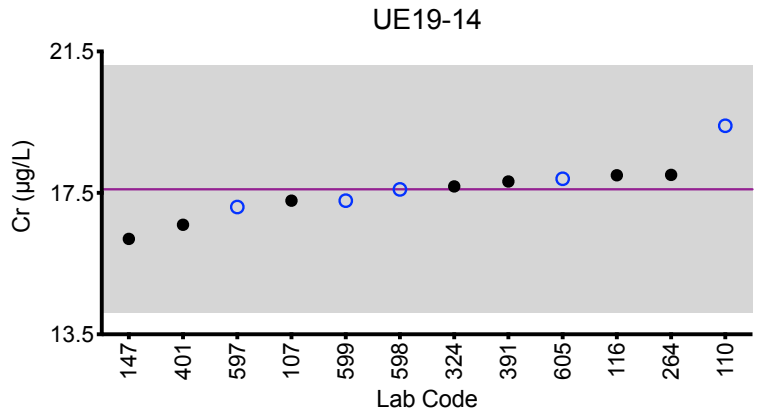
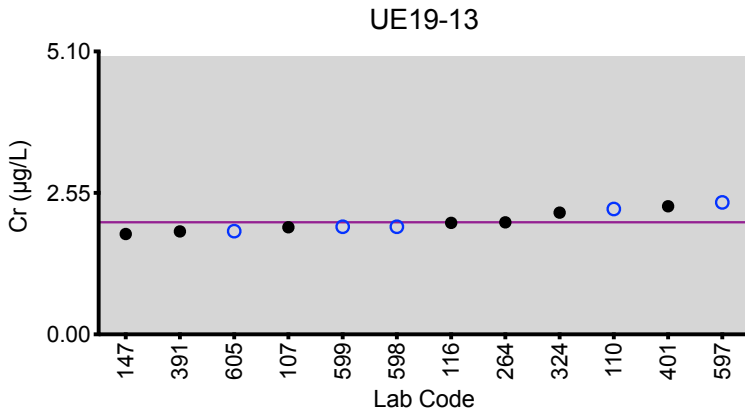
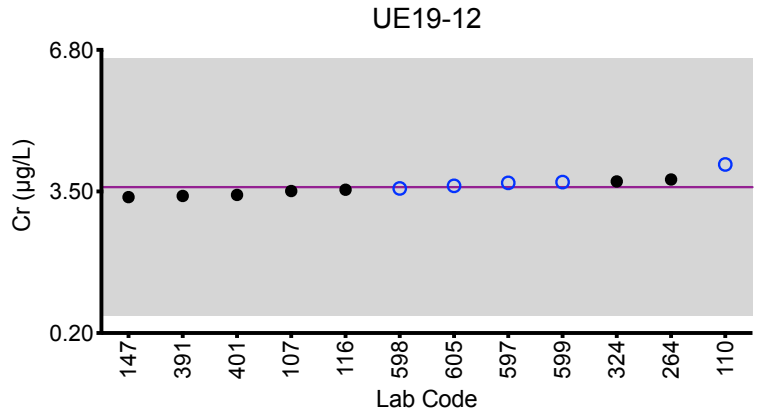
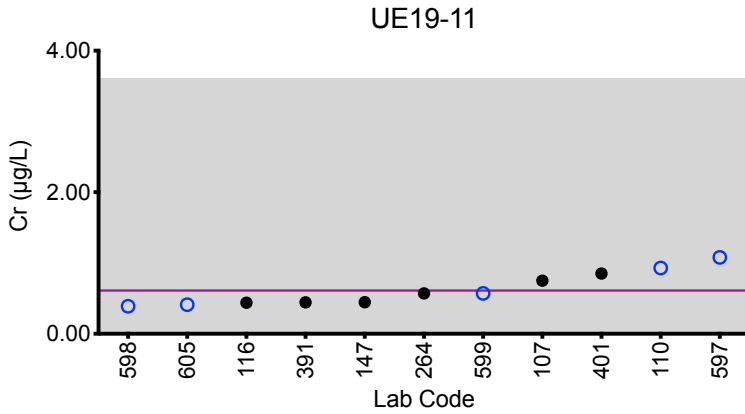
Based on the grading criteria for Cr in Urine, 100% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:

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



Results for Event #3, 2019: Summary Statistics

	Urine Hg (µg/L)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x*))	4.1	12.2	30.4	2.3	0.80
Upper Limit	7.1	15.9	39.5	5.3	3.80
Lower Limit	1.1	8.5	21.3	0.0	0.00
Robust SD (s*)	0.6	0.8	2.5	0.4	0.21
Robust RSD (%)	15	6.6	8.2	18	26
Number of Sample Measurements (N)	14	14	14	14	12
Standard Uncertainty (u)	0.2	0.3	0.8	0.1	0.08

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



Results for Event #3, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Hg (µg/L)				
		UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
	Target	4.1	12.2	30.4	2.3	0.80
103	DRC/CC-ICP-MS	3.55	11.2	22.1	2.03	0.682
107	DRC/CC-ICP-MS	4.08	12.26	32.03	2.06	0.88
110	ICP-MS	4.67	13.5	32.7	2.53	0.945
147	ICP-MS	3.83	11.7	30.9	2.09	0.73
200	ICP-MS	4.8	12.6	29.9	2.6	1.2
264	ICP-MS	9.78 ↑	15.66	39.60 ↑	3.09	1.16
293	DRC/CC-ICP-MS	4.12	12.08	29.22	2.14	0.72
391	ICP-MS	3.091	8.214 ↓	21.639	1.647	0.627
401	DRC/CC-ICP-MS	4.75	14.3	34.0	2.71	1.81
597	DMA	4.25	12.6	30.0	2.55	0.651
598	ICP-MS	3.77	12.11	30.6	2.29	0.79
605	ICP-MS	3.41	11.6	28.5	1.97	<1.00
606	ICP-MS/MS	3.70	11.7	29.4	2.41	<1.00
676	ICP-MS	3.96	12.1	31.7	1.83	0.364

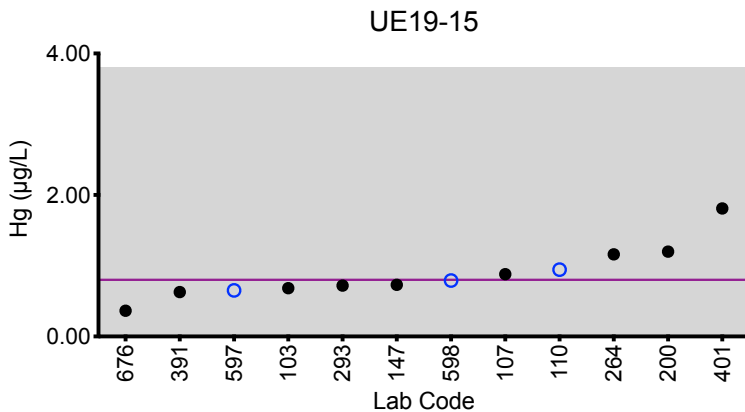
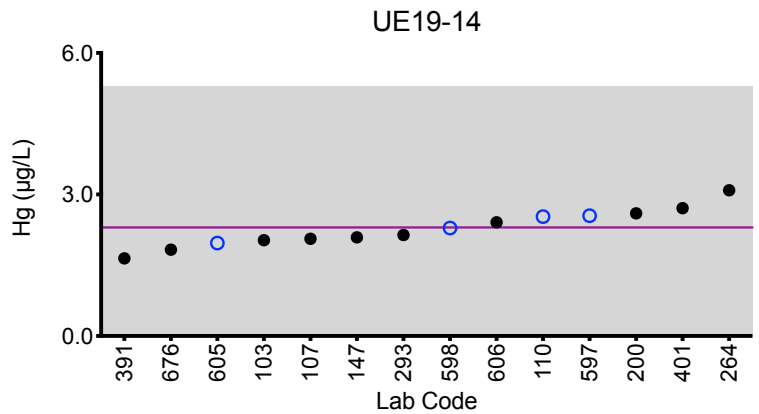
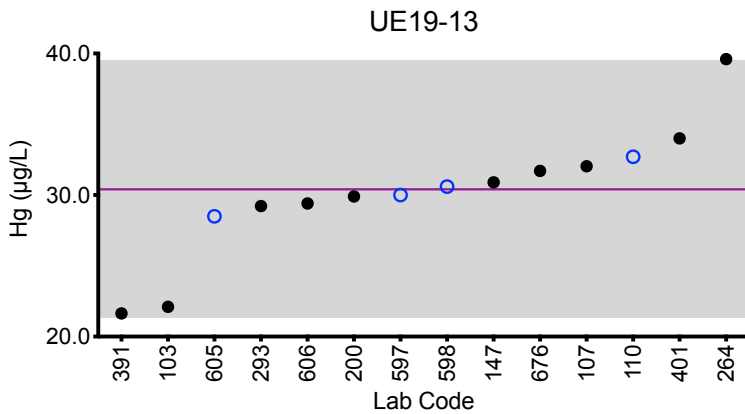
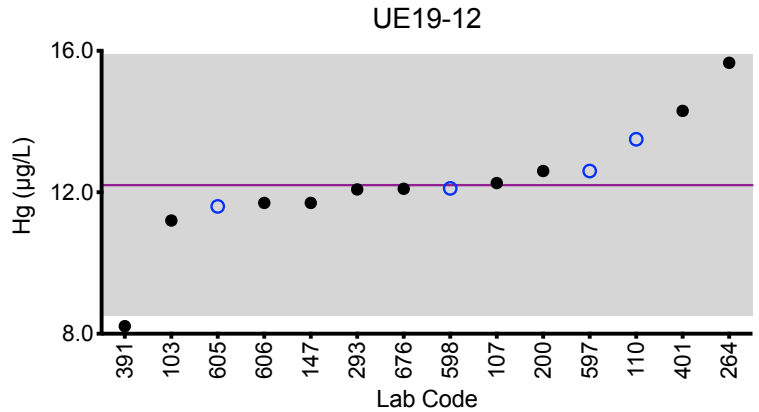
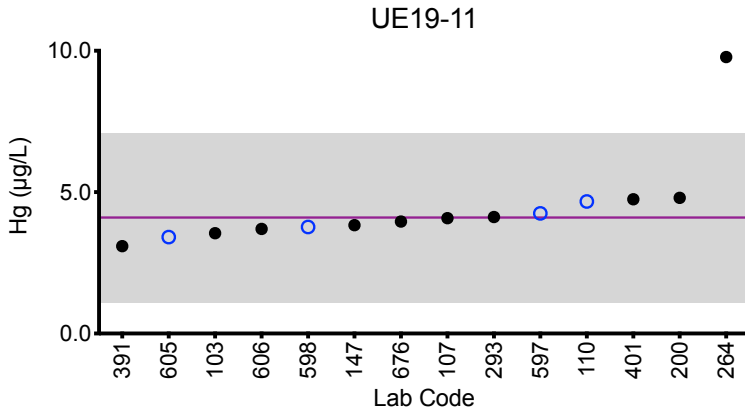
Based on the grading criteria for Hg in Urine, 96% of results were satisfactory, with 1 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:

$\pm 3 \mu\text{g/L}$ 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 #3, 2019: Summary Statistics

	Urine Mn ($\mu\text{g/L}$)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x^*))	1.88	0.78	4.37	2.70	7.93
Upper Limit	2.43	1.33	5.46	3.38	9.91
Lower Limit	1.33	0.23	3.28	2.03	5.95
Robust SD (s^*)	0.16	0.10	0.16	0.13	0.18
Robust RSD (%)	8.5	13	3.7	4.8	2.3
Number of Sample Measurements (N)	16	15	16	16	16
Standard Uncertainty (u)	0.05	0.03	0.05	0.04	0.06

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 #3, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Mn (µg/L)				
		UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
	Target	1.88	0.78	4.37	2.70	7.93
103	DRC/CC-ICP-MS	1.75	0.707	4.21	2.69	7.57
107	DRC/CC-ICP-MS	1.788	0.741	4.206	2.566	7.637
110	DRC/CC-ICP-MS	1.89	0.760	4.40	2.71	7.95
116	ICP-MS/MS	2.00	0.883	4.58	2.71	8.19
147	DRC/CC-ICP-MS	1.75	0.741	3.91	2.42	7.02
264	ICP-MS	1.61	0.81	4.27	2.54	7.93
324	ICP-MS	1.862	<1	4.211	2.717	8.029
391	ICP-MS	1.935	0.556	4.302	2.513	8.121
399	DRC/CC-ICP-MS	1.83	0.707	4.32	2.69	7.84
597	ICP-MS/MS	1.85	0.974	4.38	2.74	7.68
598	ICP-MS	2.03	0.95	4.44	2.96	7.92
599	DRC/CC-ICP-MS	2.65	↑ 0.914	4.47	2.86	7.98
605	ICP-MS	1.82	0.849	4.39	2.91	7.84
606	ICP-MS/MS	2.01	0.703	4.61	2.68	8.04
630	DRC/CC-ICP-MS	1.68	0.639	4.44	2.64	8.02
676	DRC/CC-ICP-MS	2.09	0.817	4.64	2.79	8.24

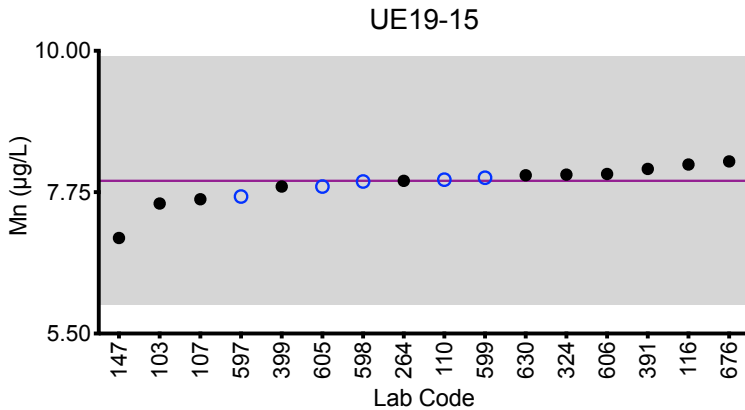
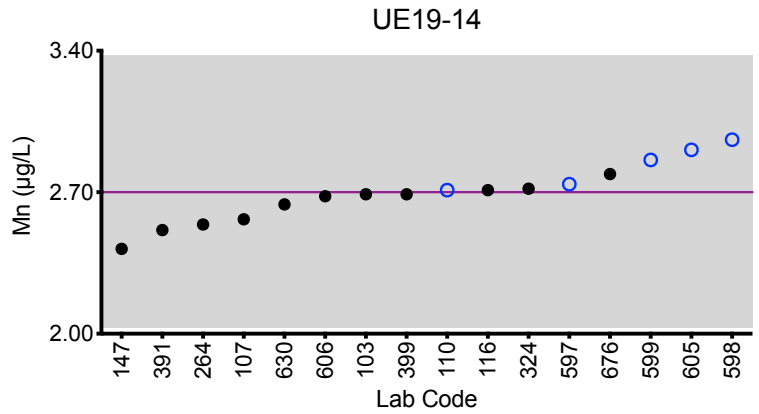
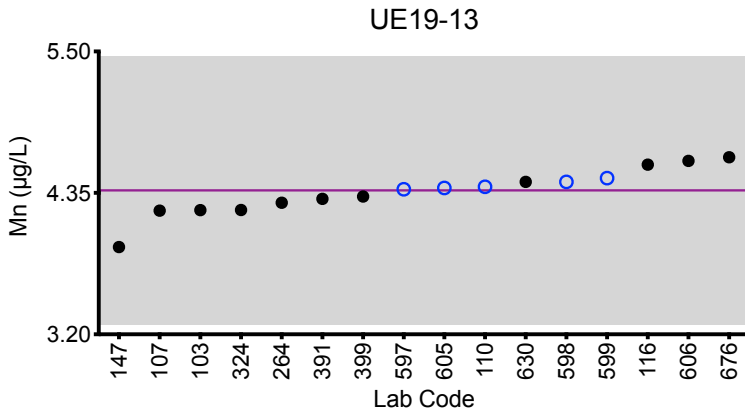
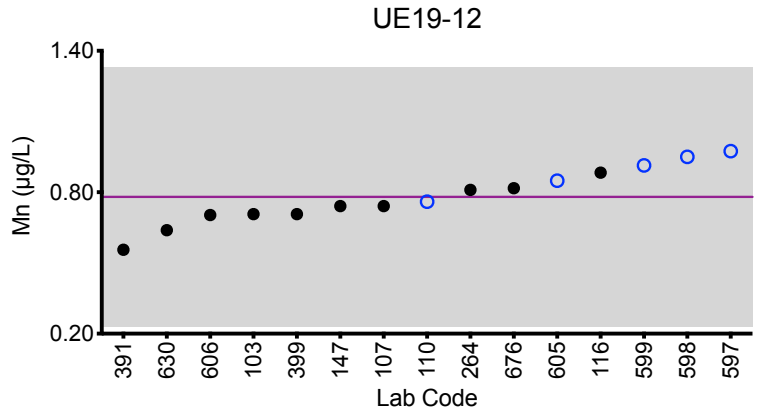
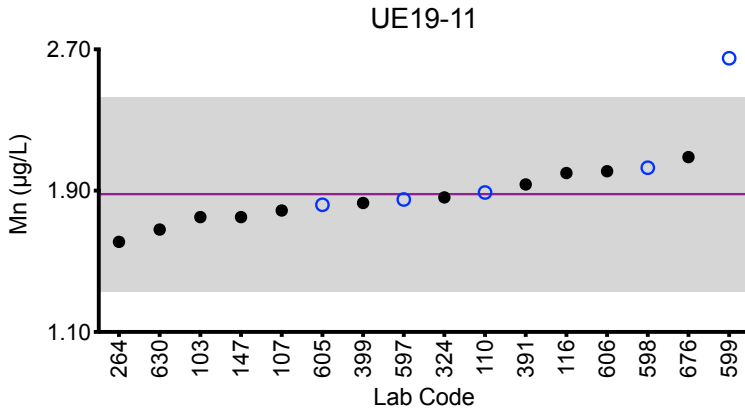
Based on the grading criteria for Mn in Urine, 99% of results were satisfactory, with 0 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:
 $\pm 0.55 \mu\text{g/L}$ 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 $2.2 \mu\text{g/L}$.



Results for Event #3, 2019: Summary Statistics

	Urine Pb ($\mu\text{g/L}$)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x^*))	3.49	0.94	0.49	6.98	14.5
Upper Limit	4.49	1.94	1.49	8.38	17.4
Lower Limit	2.49	0.00	0.00	5.58	11.6
Robust SD (s^*)	0.12	0.09	0.03	0.24	0.5
Robust RSD (%)	3.4	9.6	6.7	3.4	3.4
Number of Sample Measurements (N)	18	17	16	18	18
Standard Uncertainty (u)	0.04	0.03	0.01	0.07	0.1

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 #3, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine Pb (µg/L)					
		UE19-11	UE19-12	UE19-13	UE19-14	UE19-15	
	Target	3.49	0.94	0.49	6.98	14.5	
103	DRC/CC-ICP-MS	3.53	1.01	0.516	7.13	14.6	
107	ICP-MS	3.589	1.066	0.496	7.068	15.109	
110	ICP-MS	3.47	1.01	0.39	7.25	14.6	
116	ICP-MS/MS	3.53	0.932	0.508	6.91	14.6	
147	ICP-MS	3.56	0.932	0.497	7.05	14.8	
264	ICP-MS	3.41	0.96	0.50	7.07	14.89	
293	DRC/CC-ICP-MS	3.46	0.93	0.48	7.27	14.5	
324	ICP-MS	3.443	<1	<1	6.740	14.258	
391	ICP-MS	3.421	0.901	0.569	6.85	14.21	
399	ICP-MS	3.52	0.951	0.464	6.88	14.6	
597	ICP-MS/MS	3.28	0.842	0.407	6.97	13.7	
598	ICP-MS	3.09	0.82	0.47	6.04	12.9	
599	DRC/CC-ICP-MS	3.74	1.03	0.684	6.89	14.4	
605	ICP-MS	3.35	0.727	<0.3	7.03	14.6	
606	ICP-MS/MS	3.40	0.910	0.481	6.38	13.7	
607	ICP-MS	5.06	↑	1.19	0.753	7.56	16
676	ICP-MS	3.49	0.849	0.477	6.62	13.8	
686	ICP-MS	3.72	0.951	0.498	7.24	15.2	

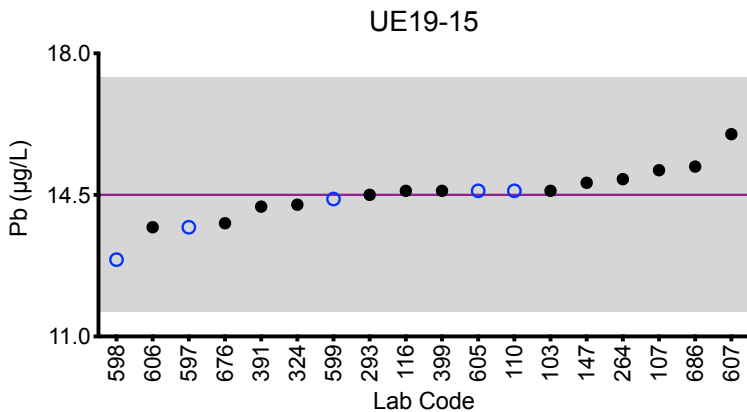
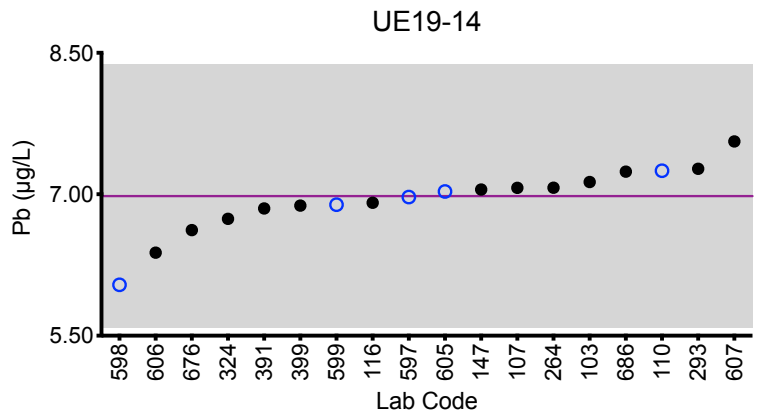
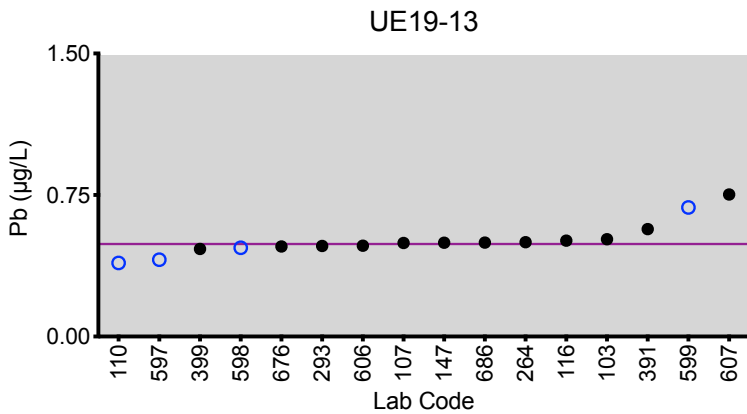
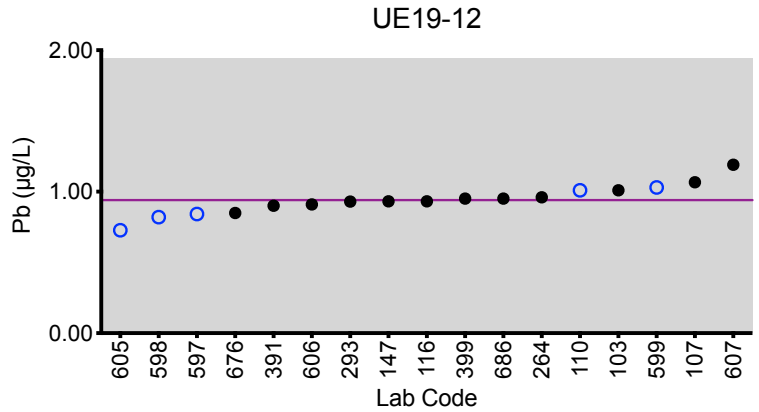
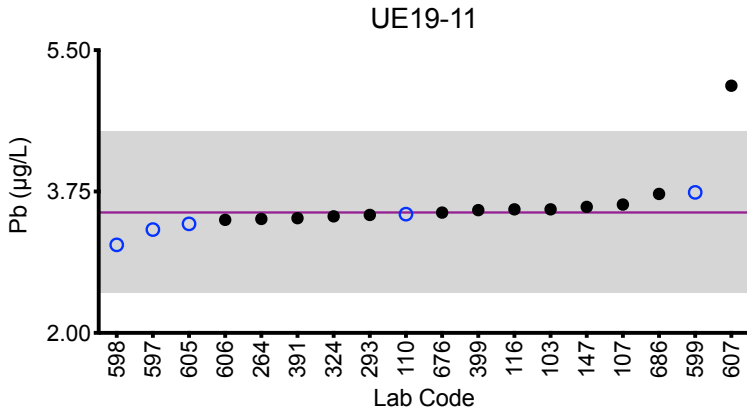
Based on the grading criteria for Pb in Urine, 99% of results were satisfactory, with 0 of the 18 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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 #3, 2019: Summary Statistics

	Urine TI (µg/L)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x*))	4.57	0.965	0.145	0.432	2.91
Upper Limit	5.48	1.165	0.345	0.632	3.49
Lower Limit	3.66	0.765	0.000	0.232	2.33
Robust SD (s*)	0.05	0.021	0.013	0.024	0.04
Robust RSD (%)	1.1	2.2	9.3	5.6	1.5
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (u)	0.02	0.007	0.004	0.008	0.01

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



Results for Event #3, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine TI (µg/L)				
		UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
	Target	4.57	0.965	0.145	0.432	2.91
103	DRC/CC-ICP-MS	4.57	1.01	0.135	0.437	2.96
107	ICP-MS	4.588	0.958	0.144	0.429	2.896
110	ICP-MS	4.54	0.964	0.133	0.434	2.93
116	ICP-MS/MS	4.55	0.974	0.155	0.449	2.92
147	ICP-MS	4.58	0.973	0.143	0.415	2.87
264	ICP-MS	4.35	0.96	0.14	0.43	2.89
293	DRC/CC-ICP-MS	4.57	0.98	0.15	0.42	2.92
399	ICP-MS	4.63	0.979	0.144	0.440	2.92
597	ICP-MS/MS	4.57	0.964	0.190	0.494	2.91
598	ICP-MS	4.16	0.95	0.17	0.40	2.83
605	ICP-MS	4.54	0.966	0.157	0.450	2.92
606	ICP-MS/MS	4.43	0.938	0.128	0.404	2.77
607	ICP-MS	4.66	0.942	0.15	0.451	2.96
676	ICP-MS	4.57	0.902	0.115	0.386	2.79
686	ICP-MS	4.76	1.00	0.147	0.452	3.03

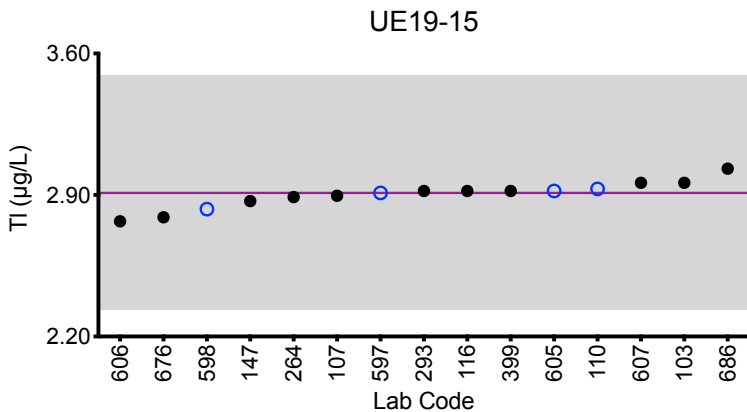
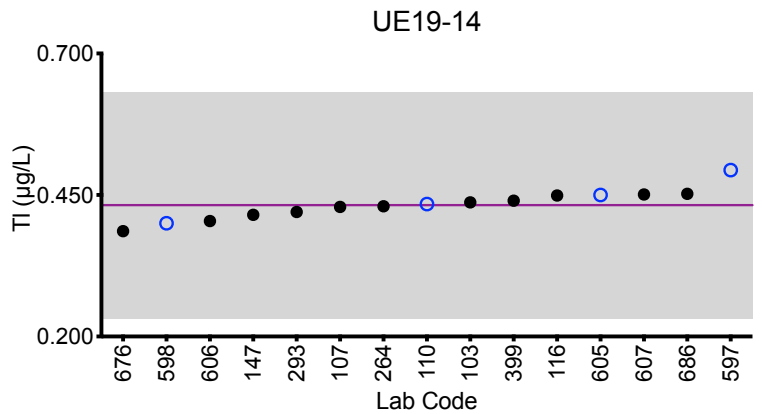
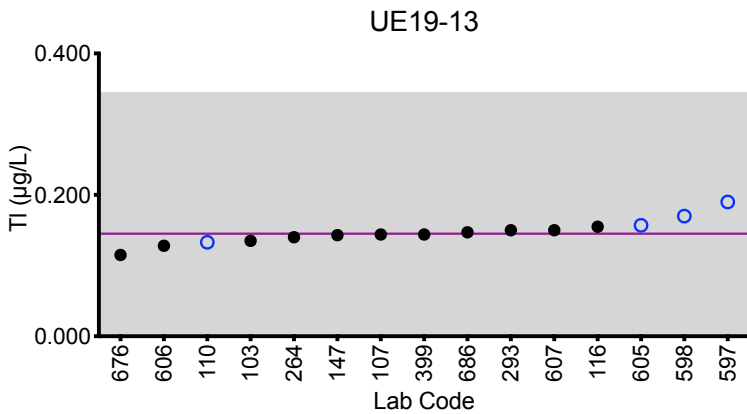
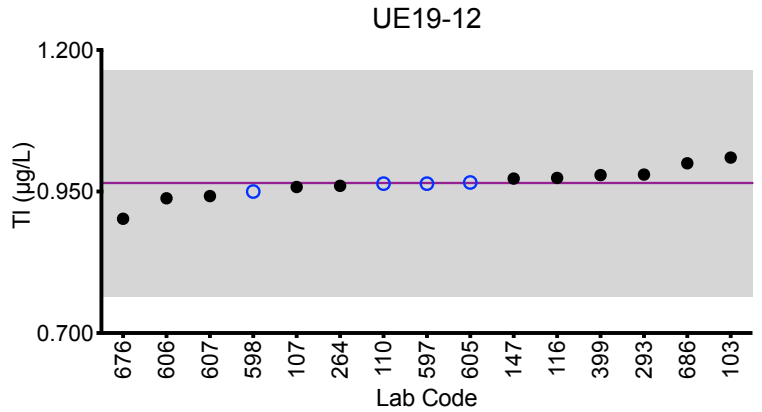
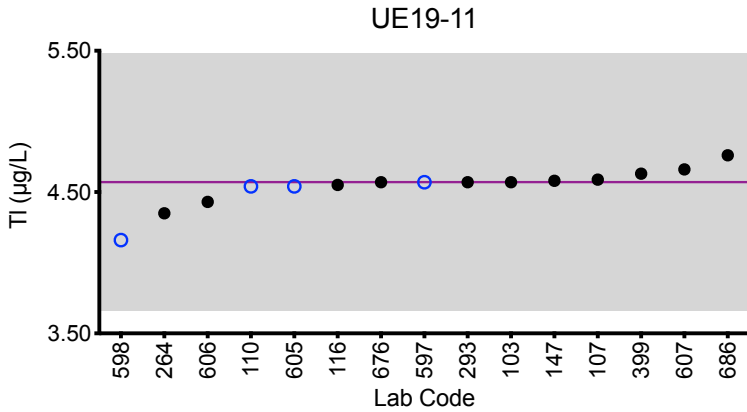
Based on the grading criteria for TI in Urine, 100% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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 #3, 2019: Summary Statistics

	Urine U (µg/L)				
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Target (Robust Mean (x*))	0.113	0.0082	0.064	0.193	0.0405
Upper Limit	0.143	0.0382	0.094	0.232	0.0705
Lower Limit	0.083	0.0000	0.034	0.154	0.0105
Robust SD (s*)	0.006	0.0004	0.004	0.014	0.0028
Robust RSD (%)	5.3	4.9	6.1	7.3	6.9
Number of Sample Measurements (N)	16	11	16	16	16
Standard Uncertainty (u)	0.002	0.0002	0.001	0.004	0.0009

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 #3, 2019: Performance of Participating Laboratories

Lab Code	Method	Urine U (µg/L)				
		UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
	Target	0.113	0.0082	0.064	0.193	0.0405
103	DRC/CC-ICP-MS	0.0955	<0.0200	0.0573	0.179	0.0378
107	ICP-MS	0.1122	0.0078	0.0623	0.1826	0.0400
110	ICP-MS	0.115	0.0077	0.0625	0.195	0.0401
116	ICP-MS/MS	0.102	<0.0150	0.063	0.187	0.0384
147	ICP-MS	0.13	<0.0117	0.0681	0.217	0.0438
264	ICP-MS	0.11	0.01	0.06	0.19	0.04
324	ICP-MS	0.107	0.008	0.061	0.18	0.038
399	ICP-MS	0.104	0.008	0.059	0.172	0.036
598	ICP-MS	0.11	<0.05	0.08	0.21	0.05
599	DRC/CC-ICP-MS	0.1123	0.0085	0.0638	0.1911	0.0408
605	ICP-MS	0.114	0.008	0.063	0.189	0.039
606	ICP-MS/MS	0.116	0.009	0.065	0.194	0.039
607	ICP-MS	0.132	0.0107	0.0726	0.211	0.046
630	ICP-MS	0.116	0.00975	0.0664	0.202	0.0425
676	ICP-MS	0.117	0.008	0.062	0.188	0.040
686	ICP-MS	0.127	<0.0150	0.0678	0.207	0.0440

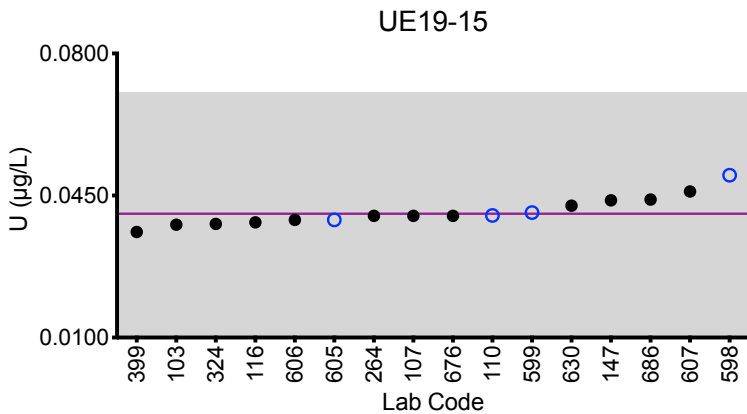
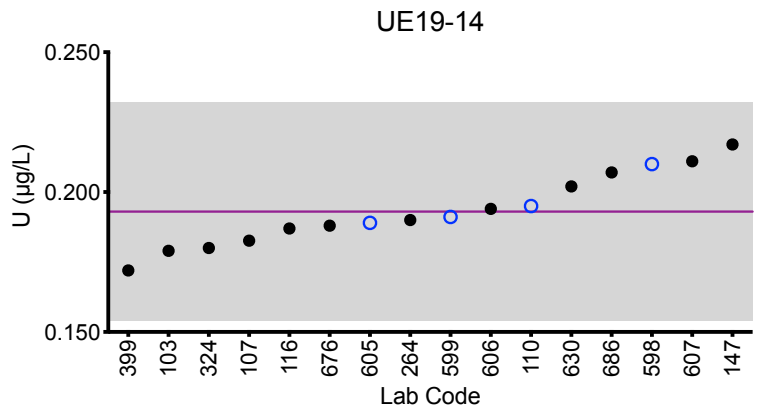
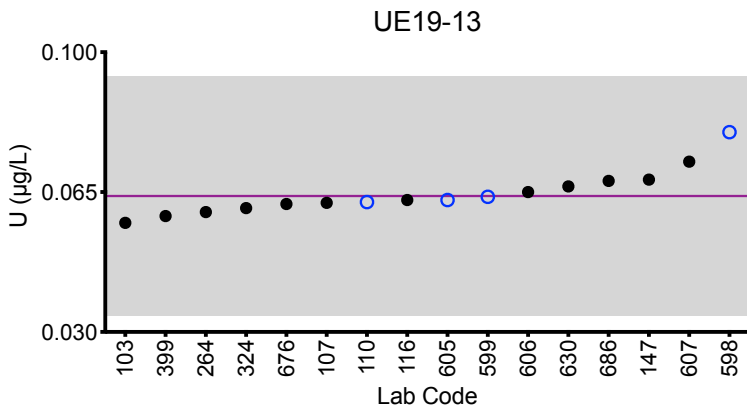
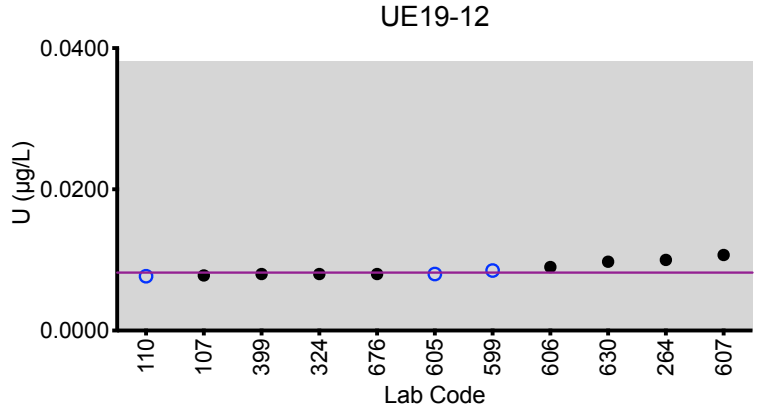
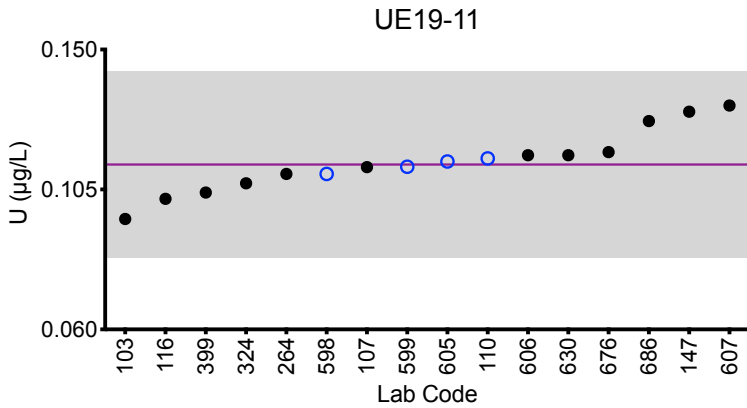
Based on the grading criteria for U in Urine, 100% of results were satisfactory, with 0 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:

$\pm 0.03 \mu\text{g/L}$ 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 $0.15 \mu\text{g/L}$.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Urine Cs (µg/L)						
Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
107	ICP-MS	6.43	4.13	11.43	2.20	3.14
110	ICP-MS	7.21	4.69	12.7	2.53	3.47
147	ICP-MS	6.48	4.18	11.6	2.19	3.05
264	ICP-MS	*0.06	4.11	10.78	2.13	2.92
399	ICP-MS	6.60	4.31	11.8	2.29	3.16
597	ICP-MS/MS	6.14	3.95	11.4	2.22	2.93
598	ICP-MS	6.58	4.31	11.8	2.28	3.18
599	DRC/CC-ICP-MS	6.63	4.38	11.4	2.26	3.02
605	ICP-MS	6.35	4.08	11.6	2.23	3.09
606	ICP-MS/MS	6.50	4.17	11.1	2.25	3.12
676	ICP-MS	6.20	3.86	10.6	2.05	2.89

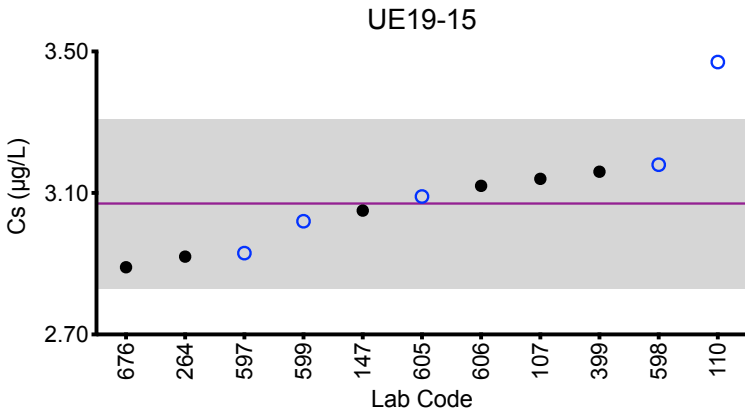
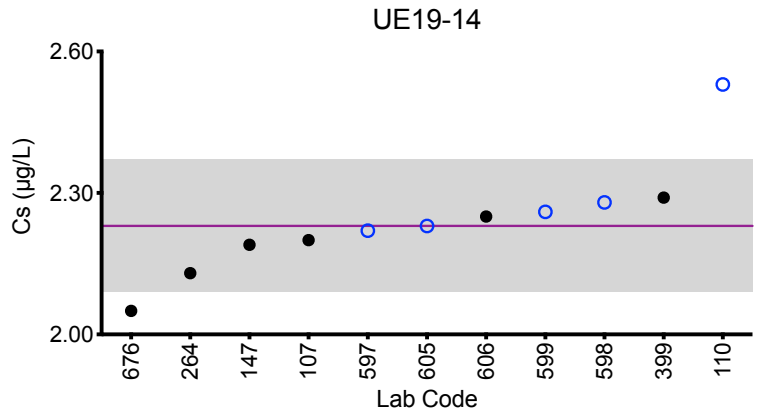
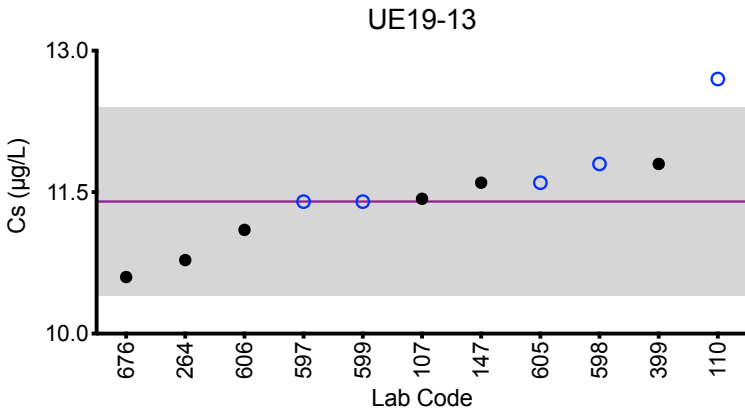
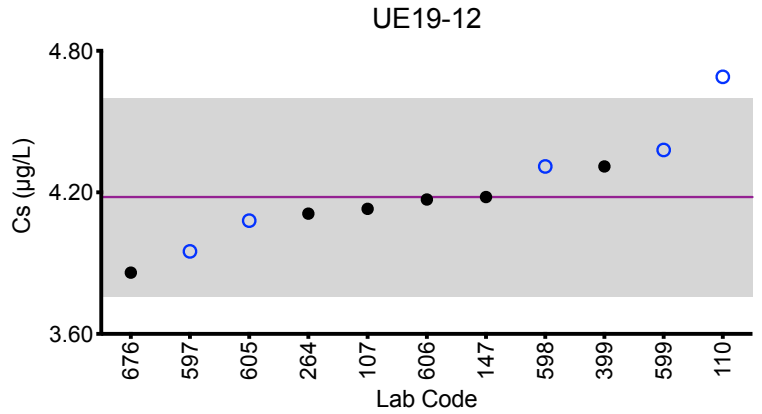
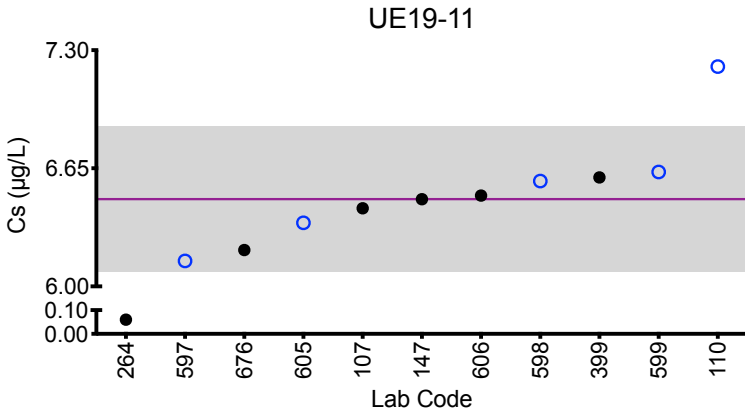
Summary Statistics						
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15	
Robust Mean (x*)	6.48	4.18	11.4	2.23	3.07	
Robust SD (s*)	0.20	0.21	0.5	0.07	0.12	
Robust RSD (%)	3.1	4.9	4.4	3.1	3.9	
Number of Sample Measurements (N)	10	11	11	11	11	
Standard Uncertainty (u)	0.08	0.08	0.2	0.02	0.05	

*Denotes a statistical Outlier.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
110	ICP-MS	5.54	48.3	34.1	90.3	114
116	ICP-MS/MS	<5.00	44.8	20.6	86.3	117
147	ICP-MS	8.07	51.7	23.8	94	121
264	ICP-MS	2.12	45.07	19.08	88.81	114.00
293	DRC/CC-ICP-MS	1.91	43.23	18.44	87.09	112.52
324	ICP-MS	1.464	39.837	17.298	77.546	100.618
391	ICP-MS	1.468	41.516	17.188	86.861	110.168
401	DRC/CC-ICP-MS	<3.81	41.3	15.9	82.0	107
597	ICP-MS/MS	2.45	40.5	19.9	86.6	105
598	ICP-MS	3.06	42.0	19.2	78.4	102
599	DRC/CC-ICP-MS	4.93	48.0	15.3	90.1	115

Summary Statistics

	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Robust Mean (x*)	3	44	19	86	111
Robust SD (s*)	2	3	3	5	7
Robust RSD (%)	66	7.6	15	5.8	6.3
Number of Sample Measurements (N)	9	11	11	11	11
Standard Uncertainty (u)	1	1	1	2	3

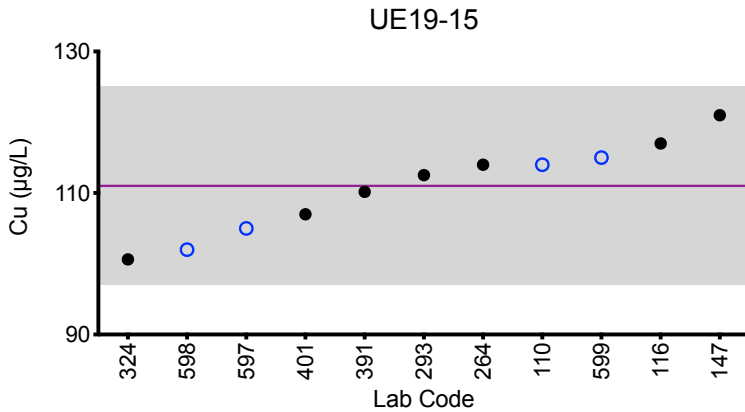
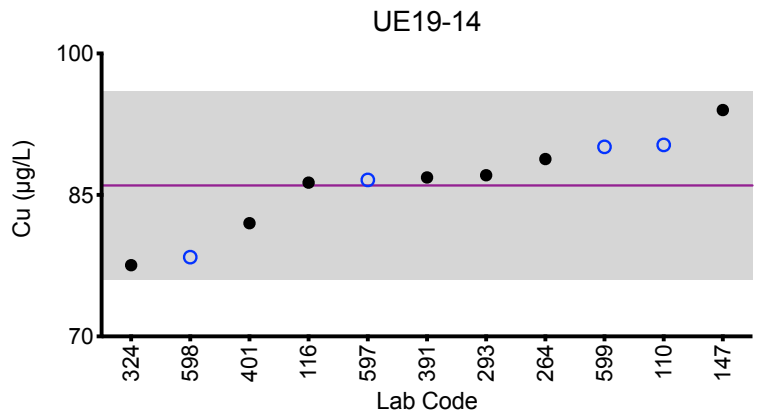
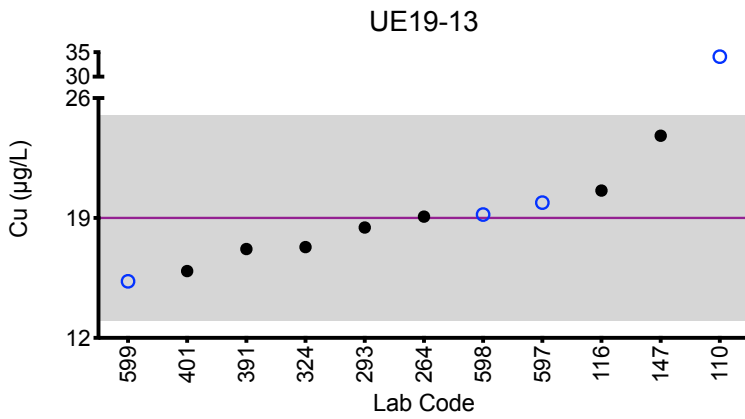
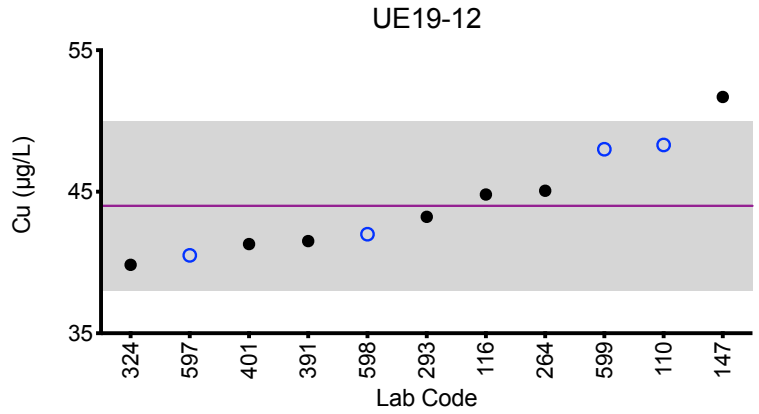
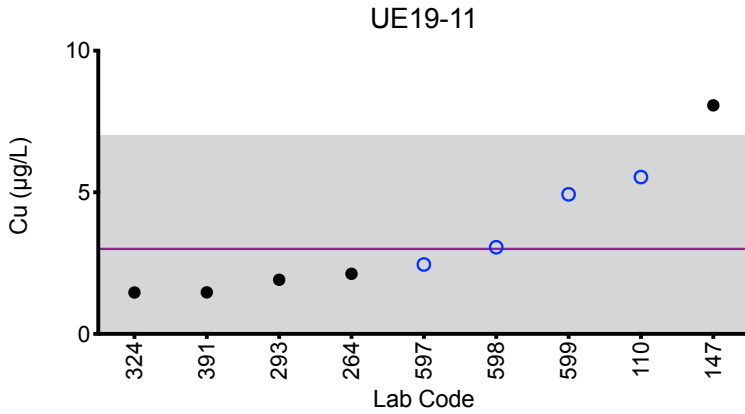
*Denotes a statistical Outlier.

An arithmetic mean, SD, RSD, and n are provided for sample UE19-11.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
103	DRC/CC-ICP-MS	94.4	146	30.8	16.1	31.1
107	ICP-MS	94.85	143.45	29.87	15.76	31.10
110	ICP-MS	99.7	153	32.4	17.4	33.4
147	ICP-MS	95	143	30.9	16.1	30.9
264	ICP-MS	82.31	132.92	28.66	15.32	28.01
293	DRC/CC-ICP-MS	101.72	151.91	33.97	16.81	32.83
324	ICP-MS	96.887	147.764	30.581	16.620	32.148
399	ICP-MS	97.1	149	31.1	16.8	32.1
597	ICP-MS/MS	85.1	126.3	27.9	15.7	28.2
598	DRC/CC-ICP-MS	107	165	34.4	18.7	35.2
605	ICP-MS	96.0	146	29.5	16.4	31.4
606	ICP-MS/MS	99.8	153	32.0	17.2	32.6
676	ICP-MS	90.8	133	28.1	15.1	28.9

Summary Statistics

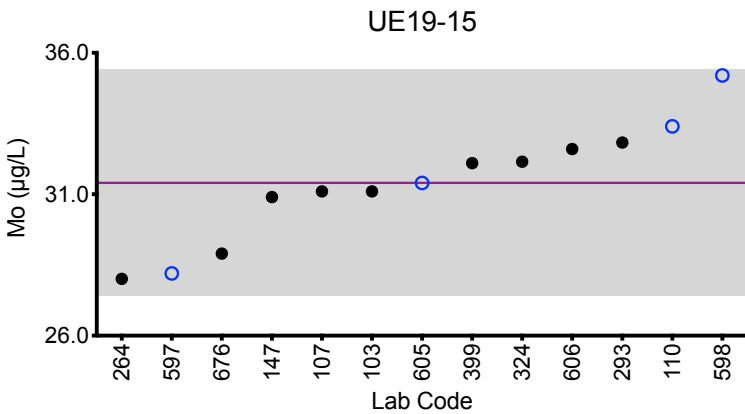
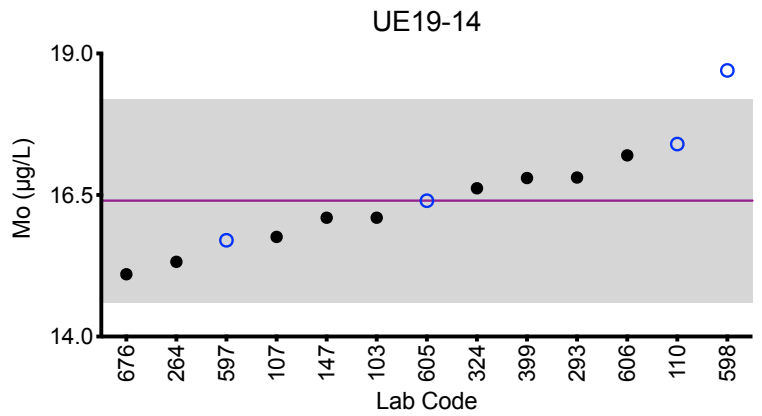
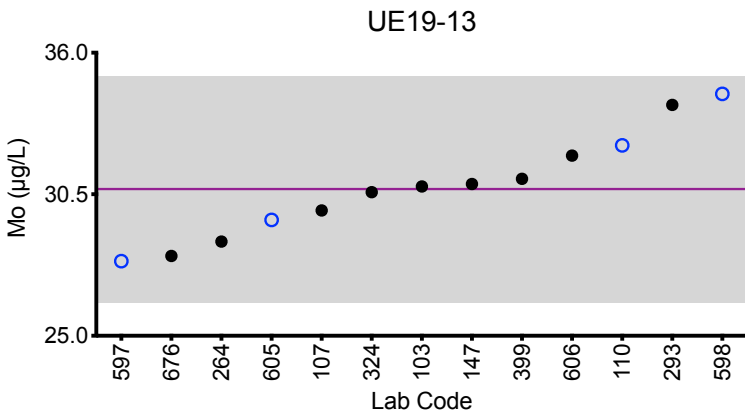
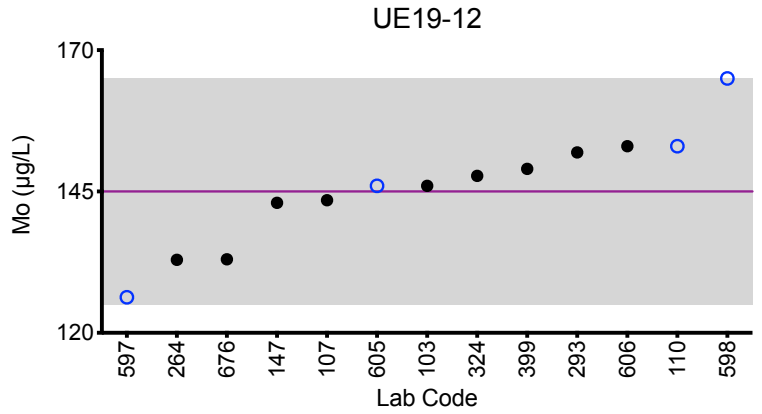
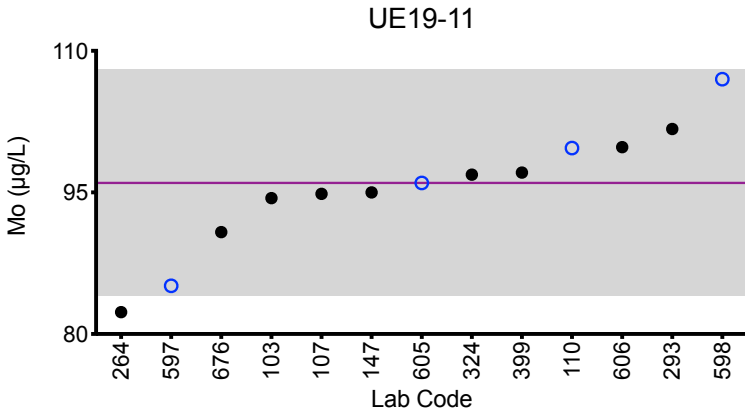
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Robust Mean (x*)	96	145	30.7	16.4	31.4
Robust SD (s*)	6	10	2.2	0.9	2.0
Robust RSD (%)	6.3	6.9	7.2	5.5	6.4
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (u)	2	3	0.7	0.3	0.7

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Urine Mo



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 #3, 2019: Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Table with 7 columns: Lab Code, Method, UE19-11, UE19-12, UE19-13, UE19-14, UE19-15. Rows include lab codes 107, 110, 147, 264, 293, 324, 391, 401, 597, 598, 599, 605.

Summary Statistics

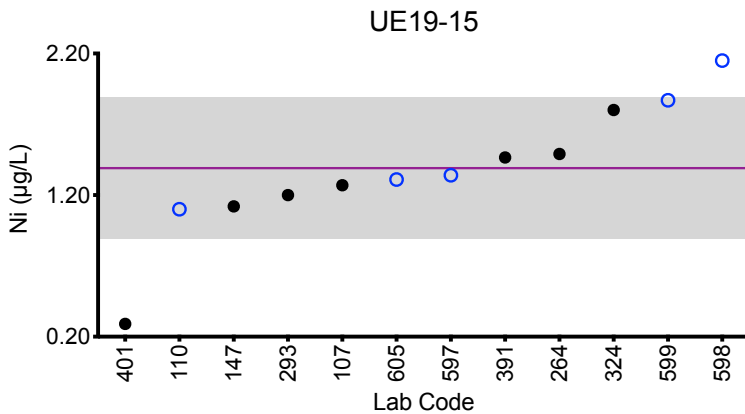
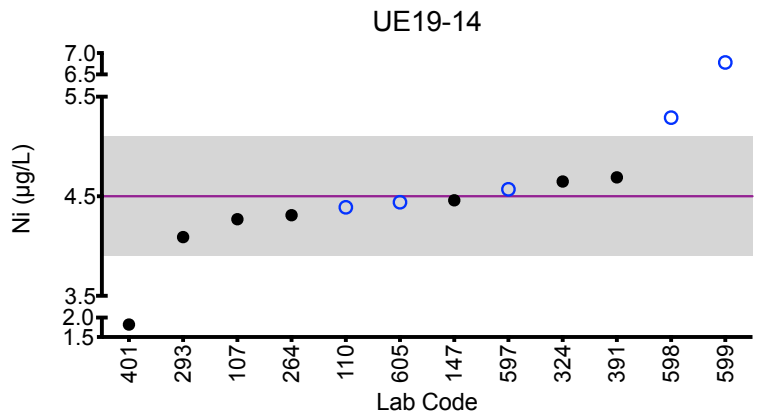
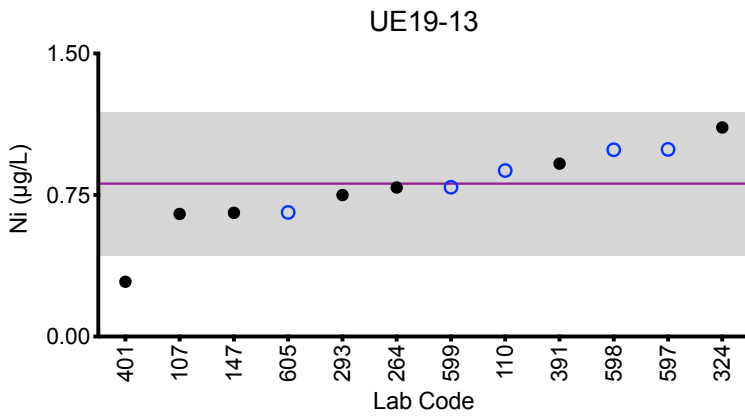
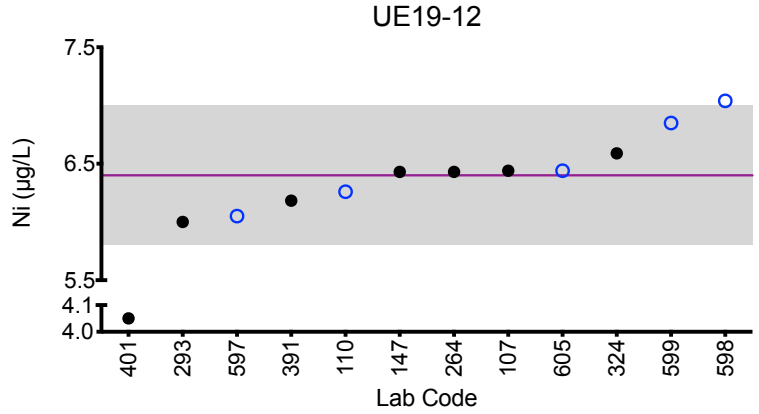
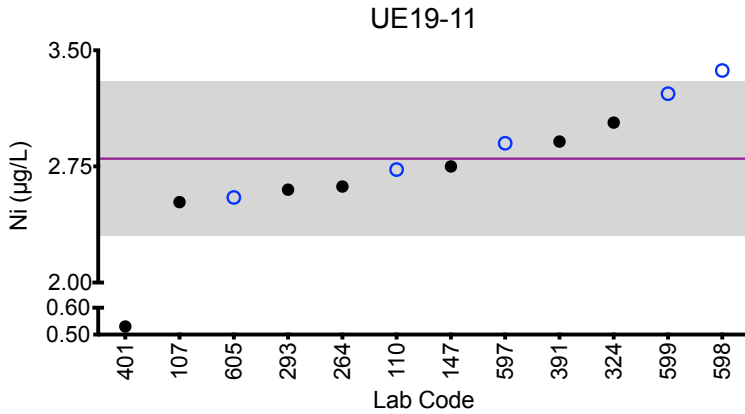
Table with 6 columns: UE19-11, UE19-12, UE19-13, UE19-14, UE19-15. Rows include Robust Mean (x*), Robust SD (s*), Robust RSD (%), Number of Sample Measurements (N), Standard Uncertainty (u).

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Urine Ni



Legend:

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

Gray area = ±2SD of the mean.

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Results for Event #3, 2019: Laboratory Data and Summary Statistics

Urine Pt (µg/L)						
Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
107	ICP-MS	0.8320	3.1107	0.2168	4.2695	3.5532
110	ICP-MS	0.888	3.28	0.227	4.55	3.83
264	ICP-MS	0.88	3.28	0.22	4.40	3.72
293	DRC/CC-ICP-MS	0.91	3.32	0.22	4.52	3.52
399	ICP-MS	0.841	3.02	0.188	4.23	3.44
598	ICP-MS	0.79	2.94	0.22	3.91	3.33
605	ICP-MS	0.716	2.63	*0.150	3.63	3.14
676	ICP-MS	0.829	2.98	0.207	4.08	3.39

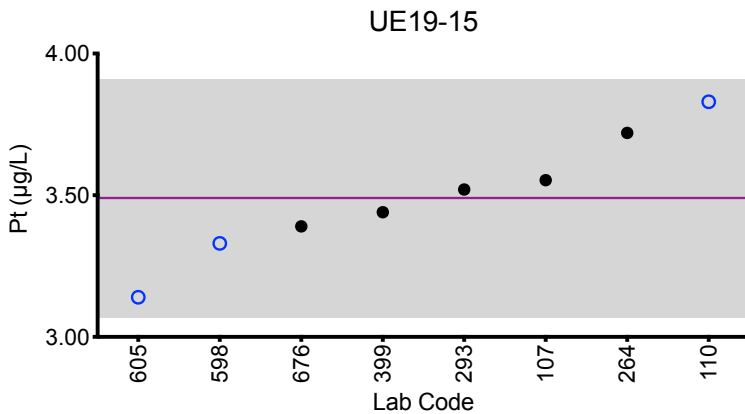
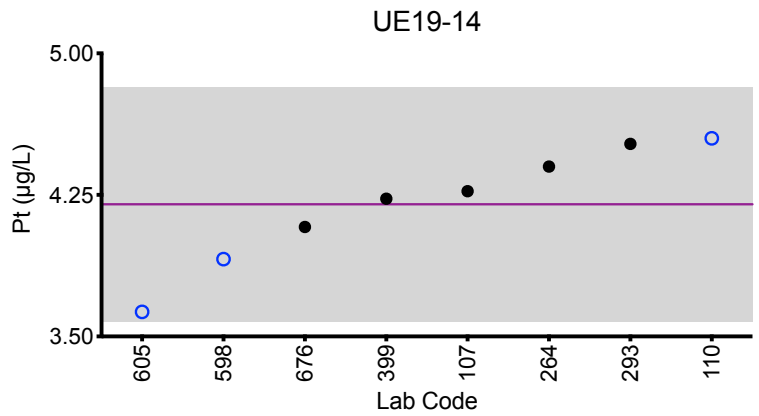
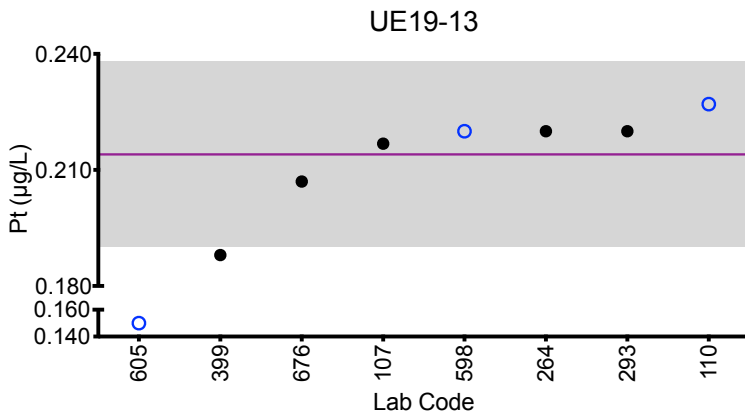
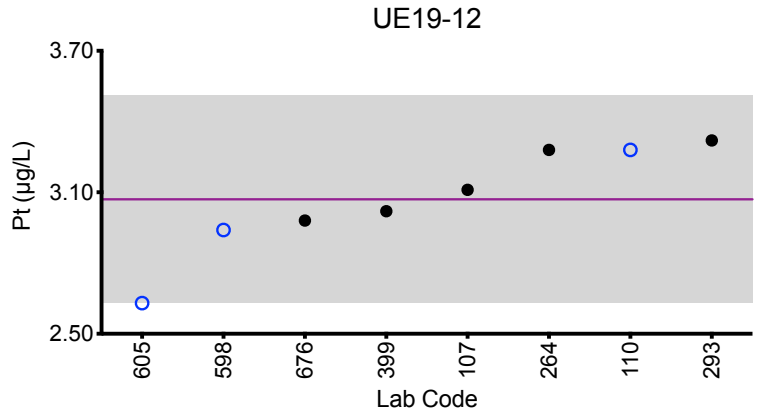
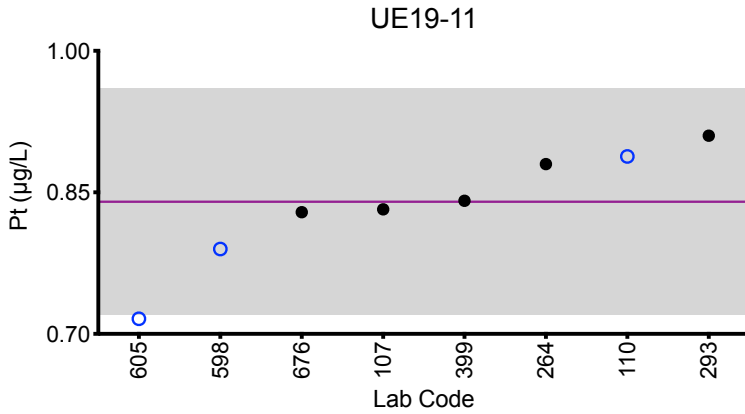
Summary Statistics						
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15	
Arithmetic Mean (\bar{x})	0.84	3.07	0.214	4.20	3.49	
Arithmetic SD (s)	0.06	0.22	0.012	0.31	0.21	
Arithmetic RSD (%)	7.1	7.2	5.6	7.1	6.3	
Number of Sample Measurements (N)	8	8	7	8	8	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Urine Pt



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 #3, 2019: Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
103	DRC/CC-ICP-MS	0.959	2.37	1.34	0.546	0.190
107	ICP-MS	0.963	2.345	1.503	0.527	0.233
110	ICP-MS	0.898	2.28	1.54	0.537	0.226
147	ICP-MS	0.97	2.59	1.83	0.598	0.236
264	ICP-MS	0.91	2.38	1.54	0.54	0.22
293	DRC/CC-ICP-MS	0.94	2.41	1.77	0.53	0.21
399	ICP-MS	0.927	2.27	1.40	0.582	0.245
597	ICP-MS/MS	0.985	2.36	1.50	0.565	0.271
598	ICP-MS	0.86	2.31	1.84	0.55	0.21
605	ICP-MS	0.842	2.04	1.10	<0.800	<0.800
606	ICP-MS/MS	0.977	2.38	1.54	0.539	0.224
676	ICP-MS	0.928	2.25	1.51	0.515	0.208

Summary Statistics

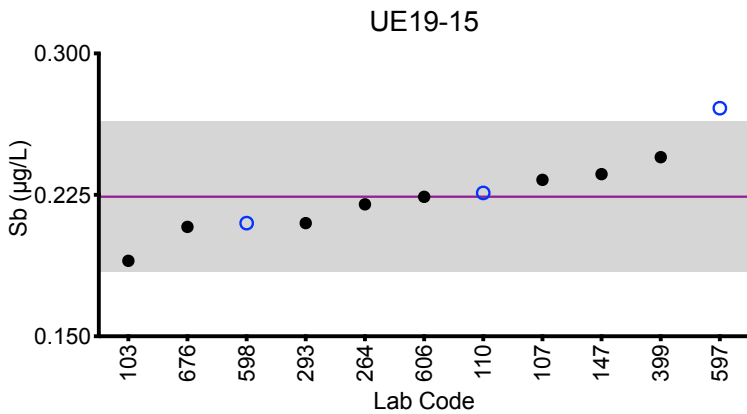
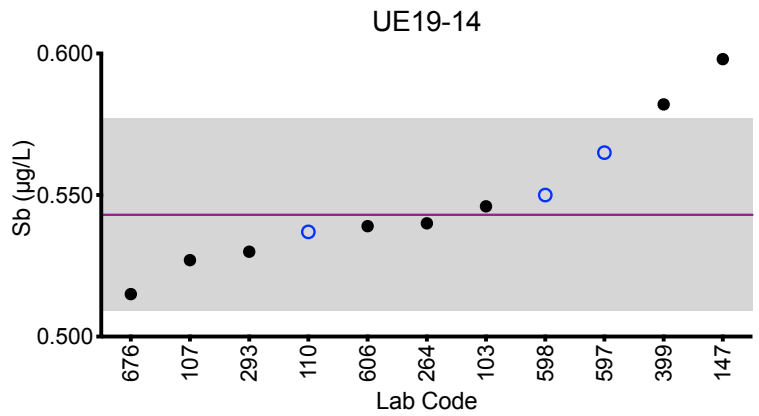
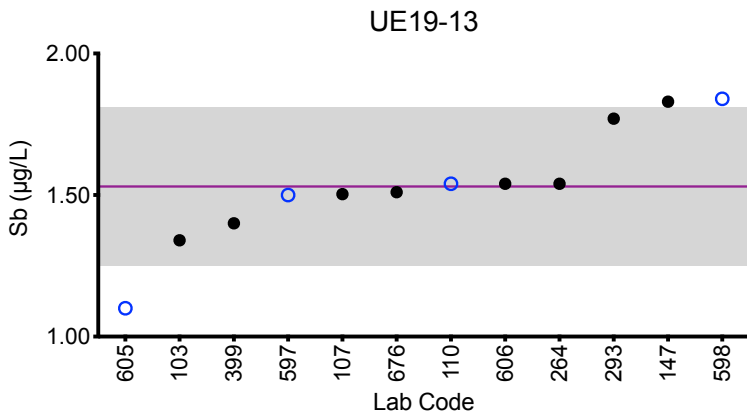
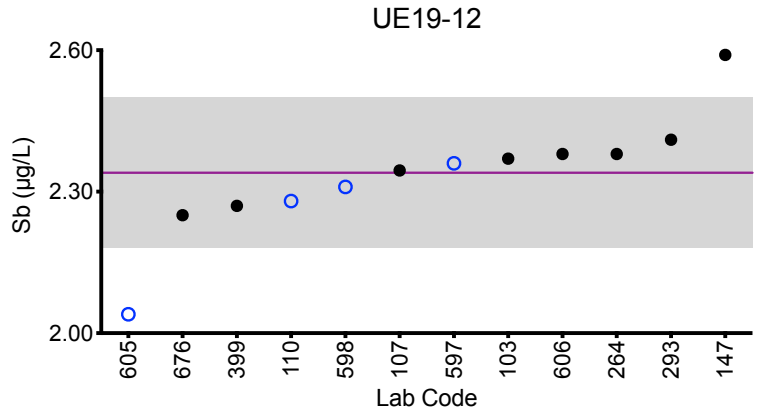
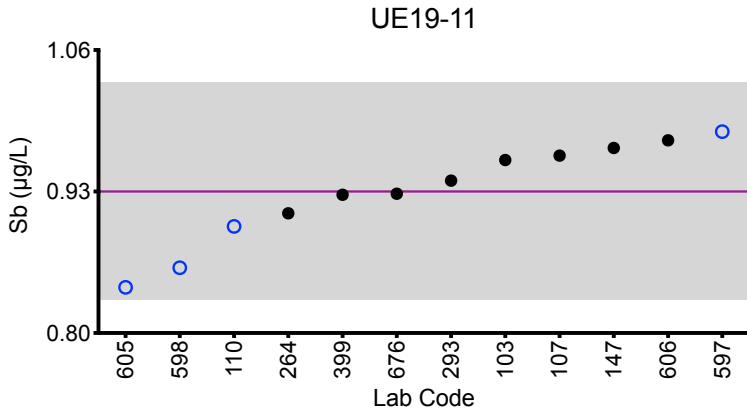
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Robust Mean (x*)	0.93	2.34	1.53	0.543	0.224
Robust SD (s*)	0.05	0.08	0.14	0.017	0.020
Robust RSD (%)	5.4	3.4	9.2	3.1	8.9
Number of Sample Measurements (N)	12	12	12	11	11
Standard Uncertainty (u)	0.02	0.03	0.05	0.006	0.008

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Urine Sb



Legend:

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

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Results for Event #3, 2019: Laboratory Data and Summary Statistics

Urine Se (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
103	DRC/CC-ICP-MS	33.5	106	129	20.1	139
110	DRC/CC-ICP-MS	33.8	108	139	20.6	145
147	ICP-MS	39.4	112	136	*26.3	145
598	DRC/CC-ICP-MS	30.8	99.0	139	20.5	128
599	DRC/CC-ICP-MS	33.1	105	111	21.4	135

Summary Statistics

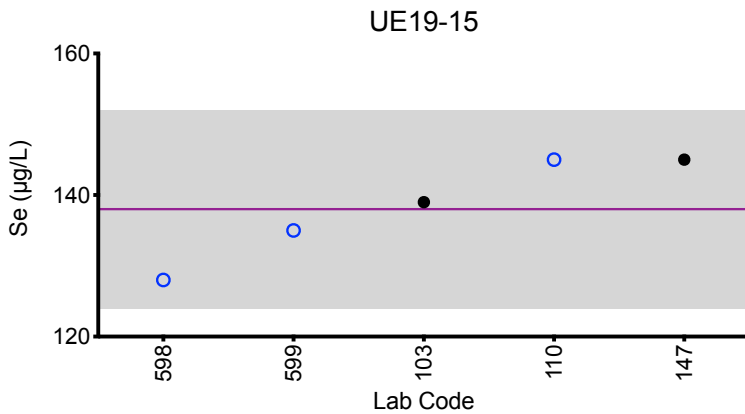
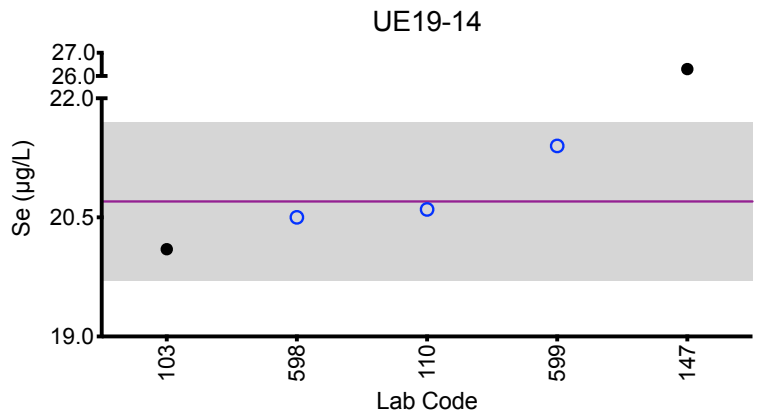
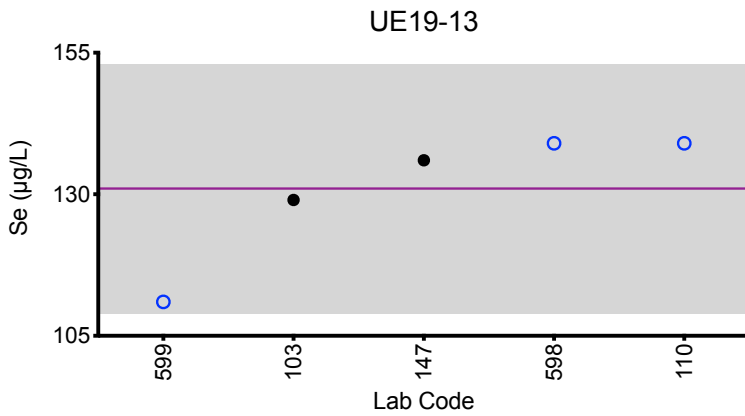
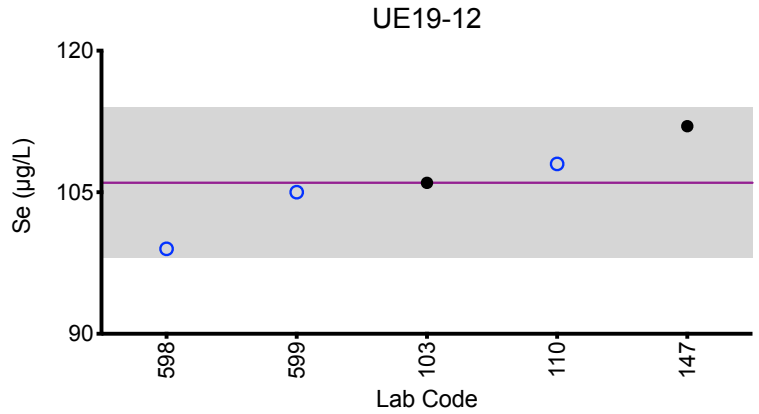
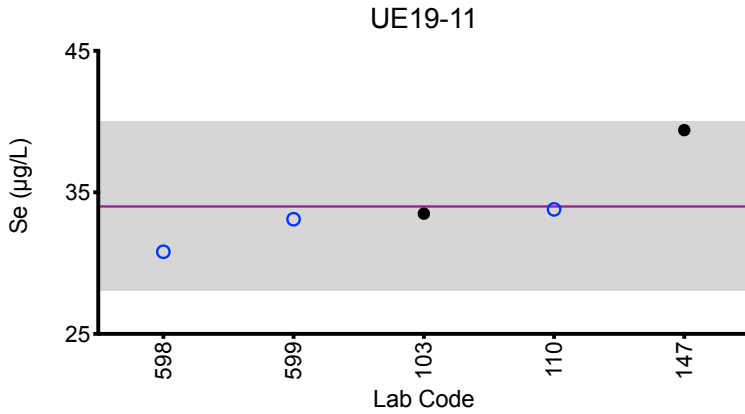
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Arithmetic Mean (\bar{x})	34	106	131	20.7	138
Arithmetic SD (s)	3	4	11	0.5	7
Arithmetic RSD (%)	9.4	3.8	8.4	2.4	5.1
Number of Sample Measurements (N)	5	5	5	4	5

*Denotes a statistical Outlier.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Table with 7 columns: Lab Code, Method, UE19-11, UE19-12, UE19-13, UE19-14, UE19-15. Rows include lab codes 107, 110, 147, 264, 399, 598, 605, and 676.

Summary Statistics

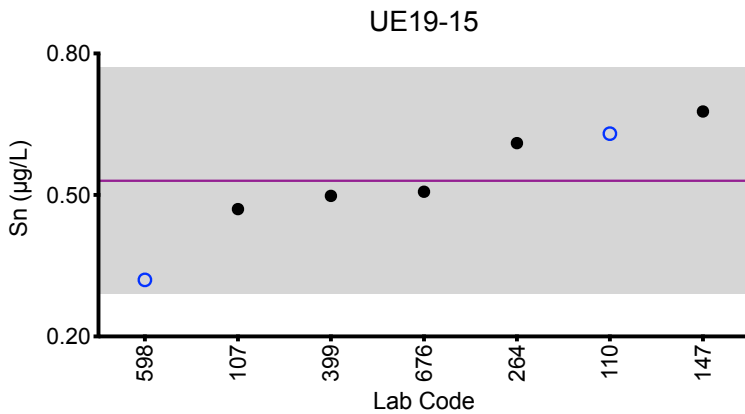
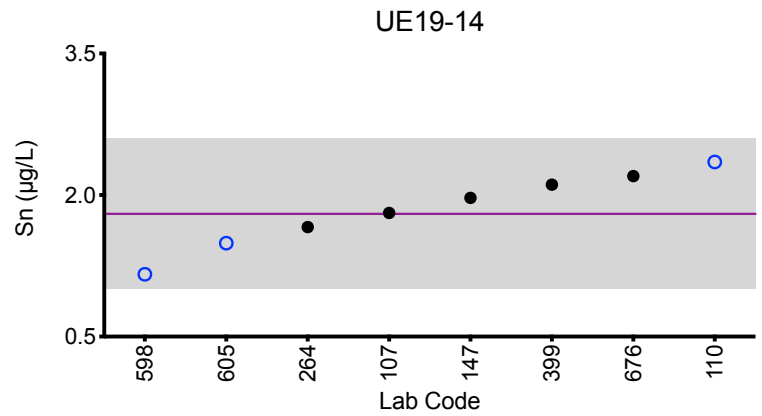
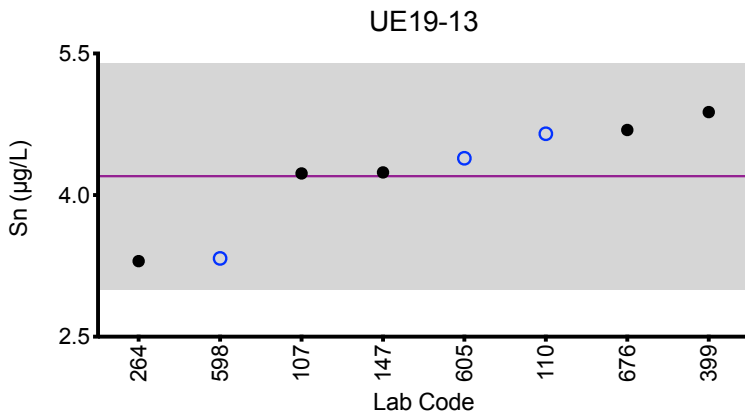
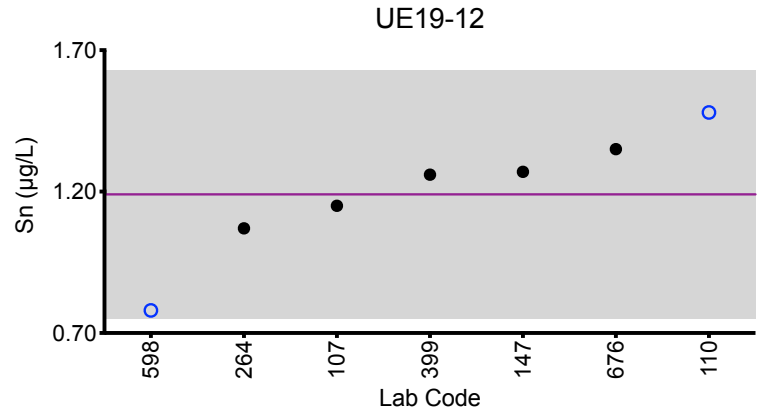
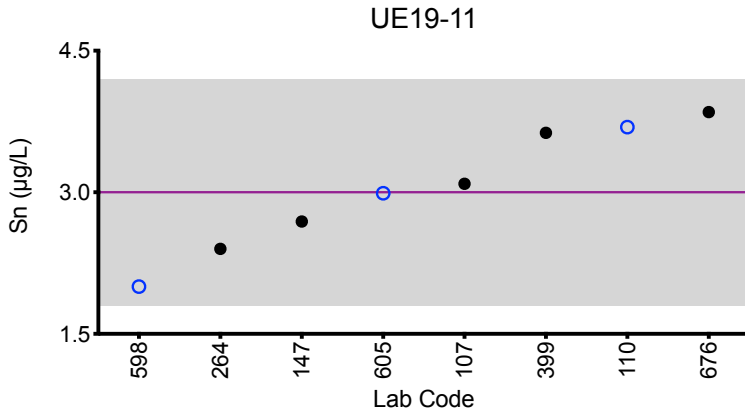
Table with 6 columns: UE19-11, UE19-12, UE19-13, UE19-14, UE19-15. Rows include Arithmetic Mean (x̄), Arithmetic SD (s), Arithmetic RSD (%), and Number of Sample Measurements (N).

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Urine Sn



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 #3, 2019: Laboratory Data and Summary Statistics

Urine Sr (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
103	DRC/CC-ICP-MS	352	54.2	190	103	259
107	ICP-MS	348.7	52.5	182.1	99.6	255.0
200	ICP-MS	335	48	170	90	236
264	ICP-MS	319.90	51.68	176.70	99.13	246.53
399	DRC/CC-ICP-MS	376	54.7	196	106	269
605	ICP-MS	368	54.8	191	109	269
676	ICP-MS	376	49.7	171	95.0	255

Summary Statistics

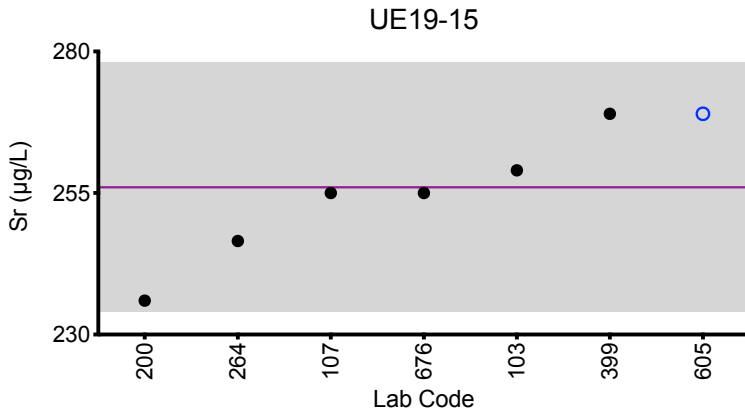
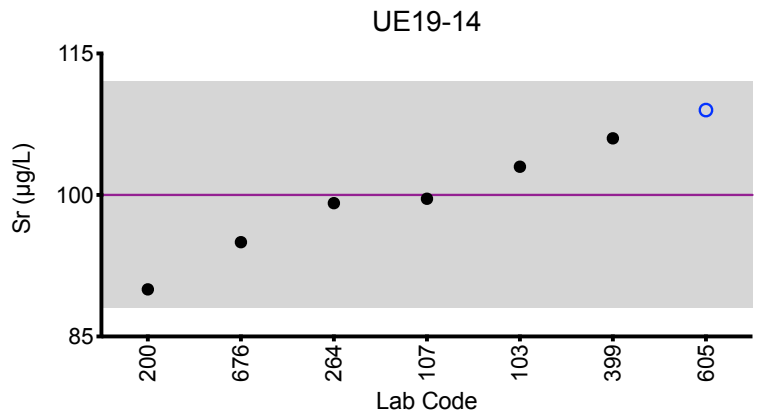
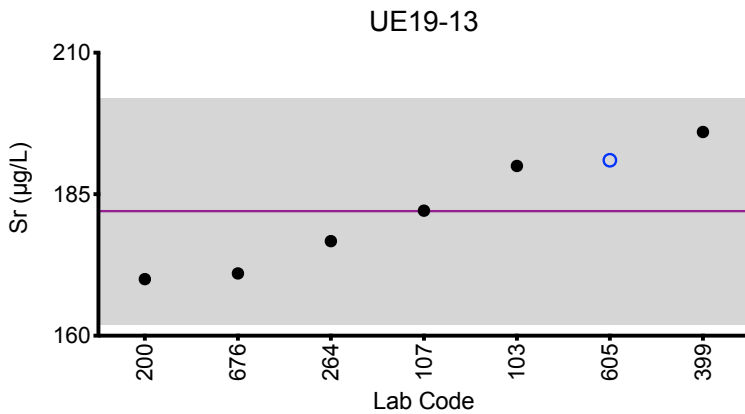
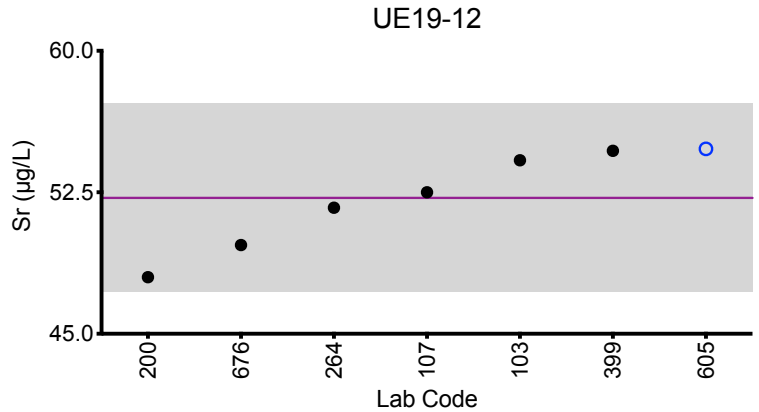
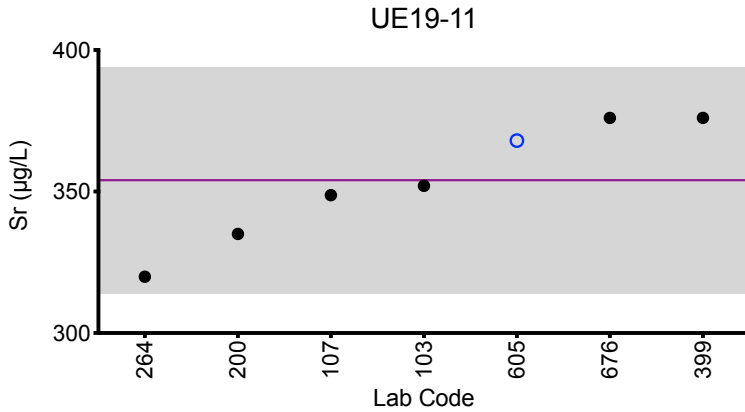
	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Arithmetic Mean (\bar{x})	354	52.2	182	100	256
Arithmetic SD (s)	20	2.5	10	6	11
Arithmetic RSD (%)	5.6	4.8	5.5	6.5	4.3
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Urine Sr



Legend:

○ CHEAR Labs ● Other Labs

Horizontal purple line = arithmetic mean of all laboratories.

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

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Results for Event #3, 2019: Laboratory Data and Summary Statistics

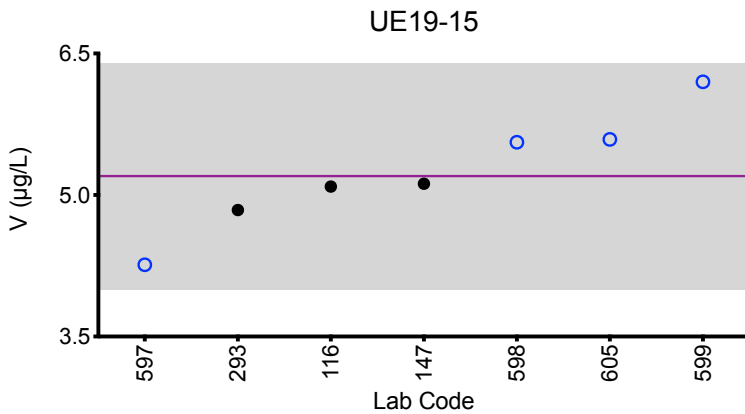
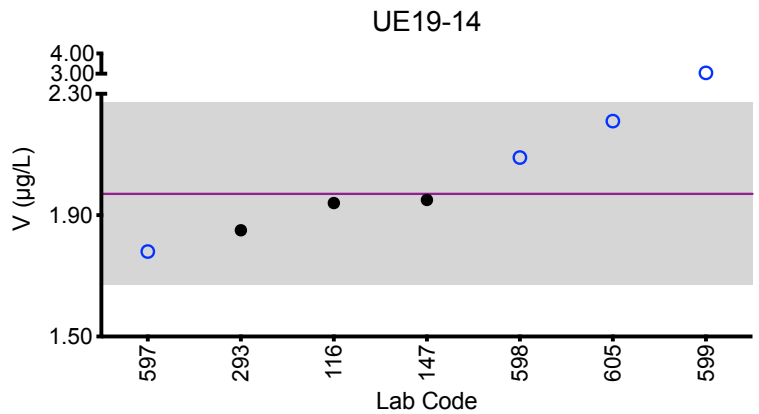
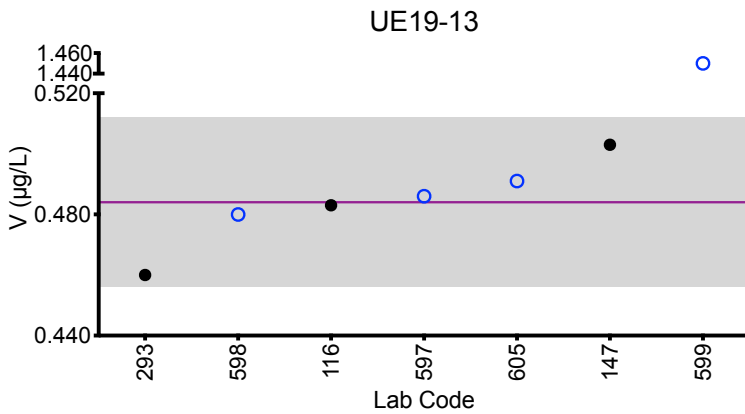
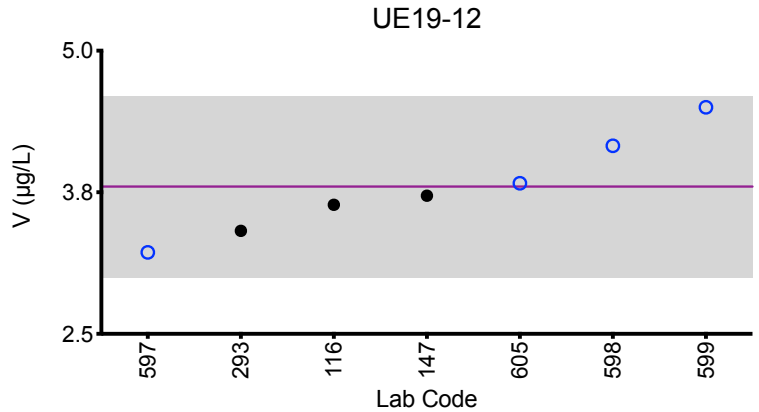
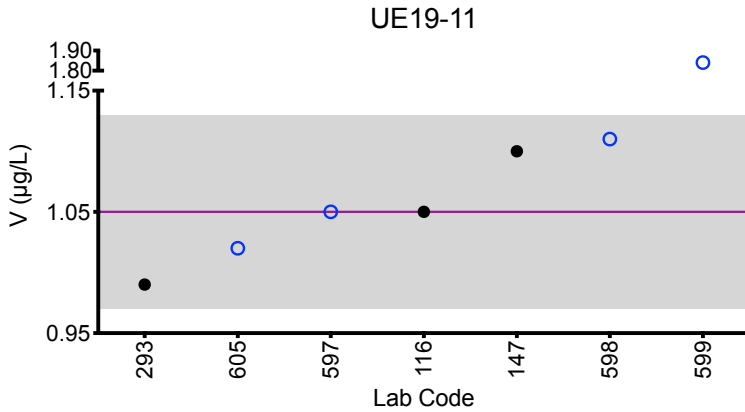
Urine V (µg/L)						
Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
116	ICP-MS/MS	1.05	3.64	0.483	1.94	5.09
147	DRC/CC-ICP-MS	1.1	3.72	0.503	1.95	5.12
293	DRC/CC-ICP-MS	0.99	3.41	0.46	1.85	4.84
597	ICP-MS/MS	1.05	3.22	0.486	1.78	4.26
598	DRC/CC-ICP-MS	1.11	4.16	0.48	2.09	5.56
599	DRC/CC-ICP-MS	*1.84	4.50	*1.45	*3.04	6.20
605	ICP-MS	1.02	3.83	0.491	2.21	5.59
Summary Statistics						
		UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Arithmetic Mean (\bar{x})		1.05	3.8	0.484	1.97	5.2
Arithmetic SD (s)		0.04	0.4	0.014	0.15	0.6
Arithmetic RSD (%)		3.8	11	2.9	7.6	12
Number of Sample Measurements (N)		6	7	6	6	7

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Urine V



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 #3, 2019: Laboratory Data and Summary Statistics

Urine W (µg/L)

Table with 7 columns: Lab Code, Method, UE19-11, UE19-12, UE19-13, UE19-14, UE19-15. Rows include lab codes 107, 110, 147, 200, 264, 324, 399, 598, 605, 606, 676.

Summary Statistics

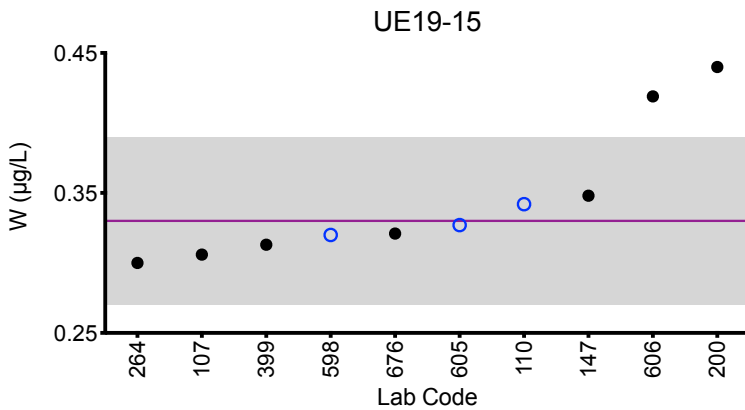
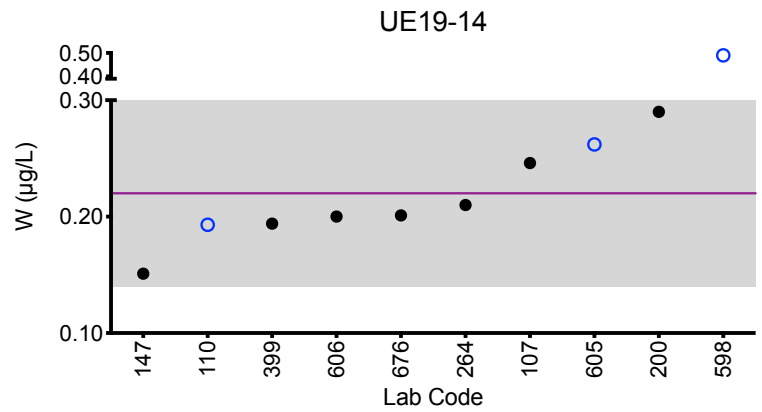
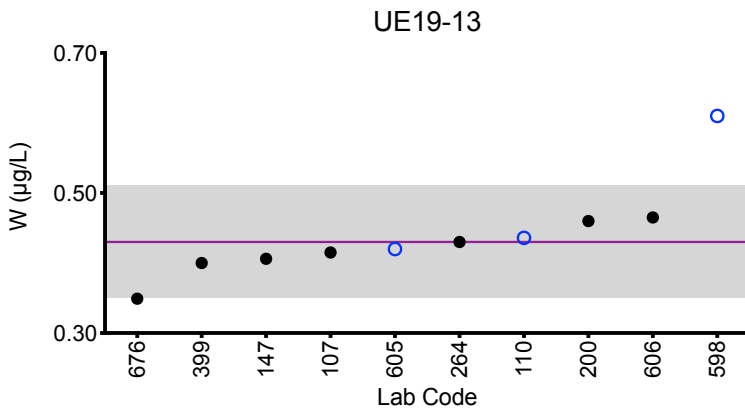
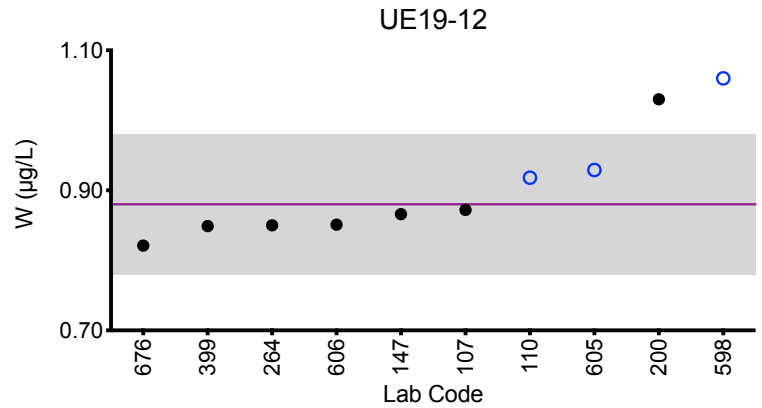
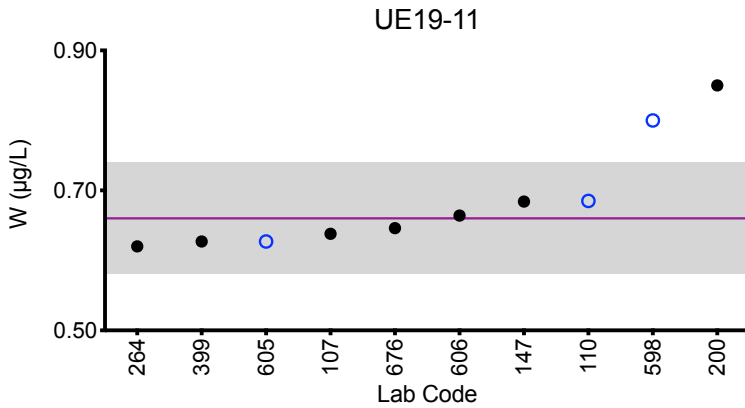
Table with 6 columns: UE19-11, UE19-12, UE19-13, UE19-14, UE19-15. Rows include Robust Mean (x*), Robust SD (s*), Robust RSD (%), Number of Sample Measurements (N), Standard Uncertainty (u).

*Denotes a statistical Outlier.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

Urine Zn (µg/L)

Table with 7 columns: Lab Code, Method, UE19-11, UE19-12, UE19-13, UE19-14, UE19-15. Rows include lab codes 110, 147, 264, 293, 324, 391, 401, 597, 598, 599.

Summary Statistics

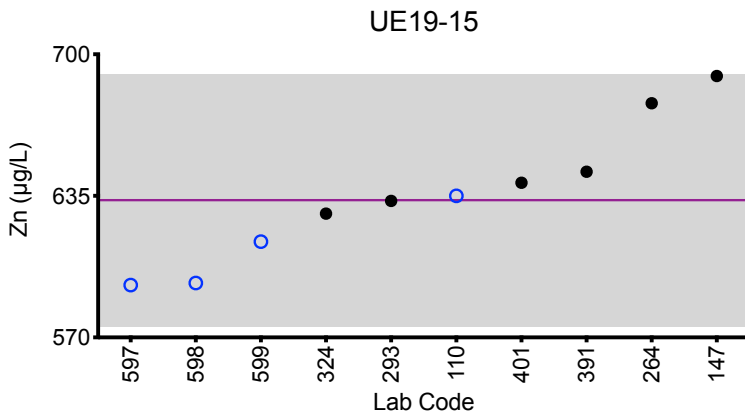
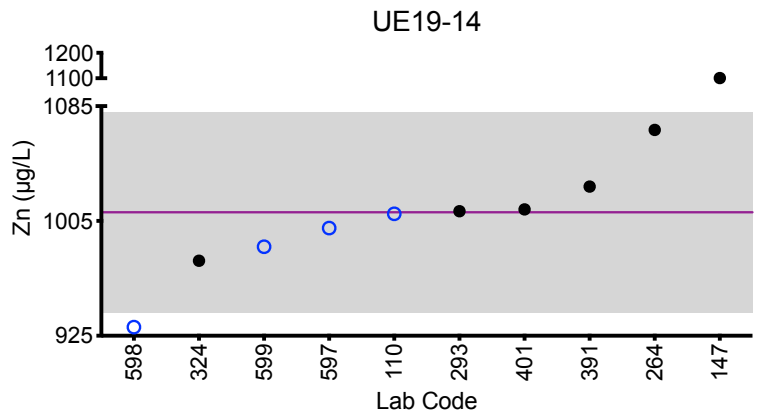
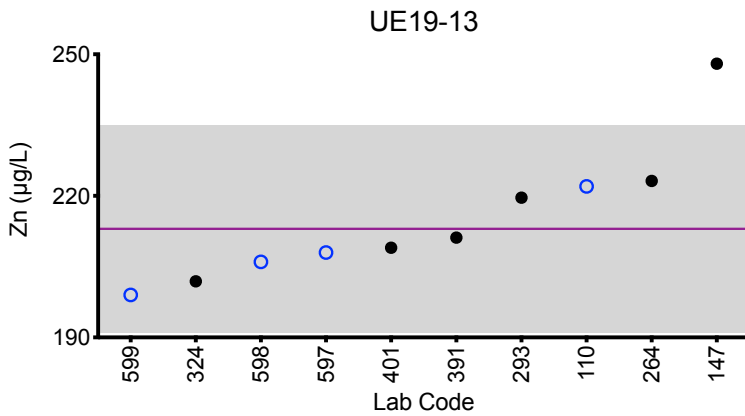
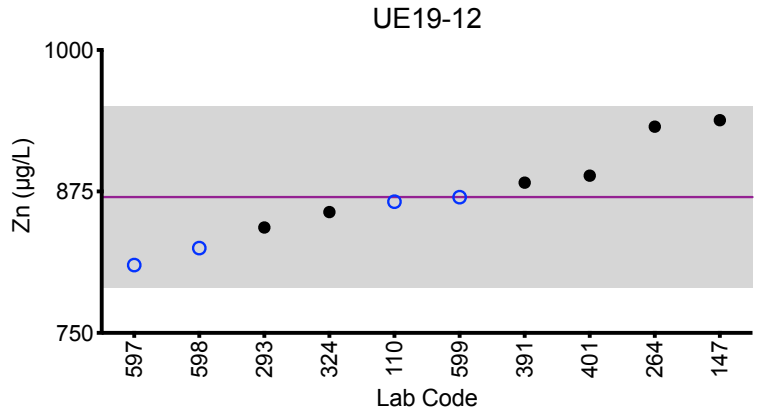
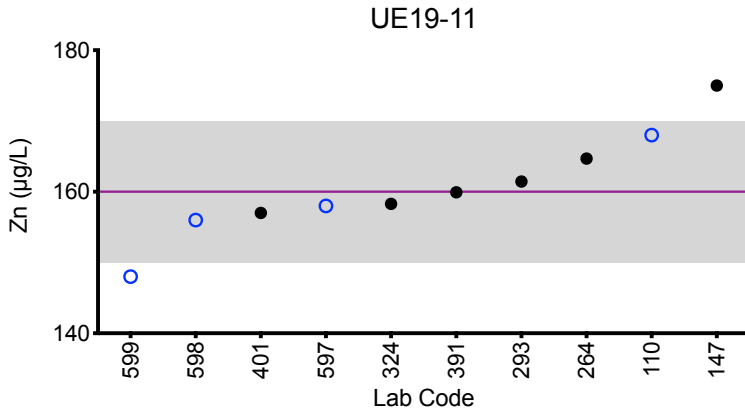
Table with 6 columns: UE19-11, UE19-12, UE19-13, UE19-14, UE19-15. Rows include Robust Mean (x*), Robust SD (s*), Robust RSD (%), Number of Sample Measurements (N), Standard Uncertainty (u).

*Denotes a statistical Outlier.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

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

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
147	ICP-MS	<8.36	<8.36	18.3	20.8	<8.36
264	ICP-MS	8.56	9.94	19.13	12.92	8.77
324	ICP-MS	10.991	12.260	18.267	16.772	10.487

Summary Statistics

	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Arithmetic Mean (\bar{x})	9.8	11.1	18.6	17	9.6
Arithmetic SD (s)	1.4	1.3	0.4	4	1.2
Arithmetic RSD (%)	14	12	2.2	24	10
Number of Sample Measurements (N)	2	2	3	3	2

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Urine Bi (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
147	ICP-MS	<0.0669	<0.0669	<0.0669	<0.0669	<0.0669
264	ICP-MS	0.06	0.03	0.01	0.01	0.01

Summary Statistics

	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
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)	NA	NA	NA	NA	NA

*Denotes a statistical Outlier.

NA - Not Assigned

Statistical data were not calculated for UE19-11, UE19-12, UE19-13, UE19-14, or UE19-15 based on a lack of consensus among participating labs.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Urine Te (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
110	ICP-MS	1.75	0.434	2.13	0.644	1.29
147	ICP-MS	1.71	0.407	2.27	0.731	1.33

Summary Statistics

	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
Arithmetic Mean (\bar{x})	1.73	0.421	2.20	0.69	1.31
Arithmetic SD (s)	0.02	0.016	0.08	0.05	0.02
Arithmetic RSD (%)	1.2	3.8	3.6	7.2	1.5
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.



Results for Event #3, 2019:
Additional Elements in Urine

Urine Ag (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
147	ICP-MS	<0.140	<0.140	<0.140	<0.140	<0.140

Urine B (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
200	ICP-MS	788	799	281	799	788

Urine Fe (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
324	ICP-MS	10.099	7.933	7.347	9.832	7.626

Urine I (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
147	ICP-MS	210	205	109	204	208

Urine Li (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
147	ICP-MS	15.3	15.1	8.47	15	15.2

Urine Mg (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
597	ICP-MS/MS	35000	36500	20600	38000	37500

Urine Th (µg/L)

Lab Code	Method	UE19-11	UE19-12	UE19-13	UE19-14	UE19-15
147	ICP-MS	<0.0626	<0.0626	<0.0626	<0.0626	<0.0626



**Department
of Health**

**Wadsworth
Center**

Event #3, 2019

**Trace Elements in
Serum**

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory



Event #3, 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

Five elements in serum are formally graded: 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. The data for serum Al in this event exhibit an unusually large scatter, which suggests these pools are inhomogeneous for this element. Consequently, there is a lack of consensus among participating labs and target values cannot be assigned with confidence. The raw data reported by participants are shown but without target values or grading.

Additional Elements

An additional 28 were reported by at least one participant: Ag, As, B, 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 #3, 2019: Summary Statistics

	Serum AI (µg/L)				
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target (Arithmetic Mean (\bar{x}))	NA	NA	NA	NA	NA
Upper Limit	NA	NA	NA	NA	NA
Lower Limit	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)	NA	NA	NA	NA	NA

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.

NA - Not Assigned

Statistical data were not calculated for SE19-11, SE19-12, SE19-13, SE19-14, or SE19-15 based on a lack of consensus among participating labs. Lack of consensus likely reflects sporadic contamination during production. Consequently, target values cannot be assigned with confidence.



Results for Event #3, 2019: Performance of Participating Laboratories

		Serum AI (µg/L)				
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target		NA	NA	NA	NA	NA
147	ETAAS-Z	15.10	16.9	32.6	29.1	76.4
264	ICP-MS	18.23	14.73	46.50	25.25	71.14
293	DRC/CC-ICP-MS	29.57	21.51	40.32	34.95	94.09
391	ETAAS-Z	24.38	24.39	43.45	38.35	119.1
485	HR-ICP-MS	17.0	20.1	36.8	32.6	89.4
590	ICP-MS	18.2	19.9	36.9	27.6	85.0
597	ICP-MS/MS	31.1	32.2	62.5	51.1	108
598	ICP-MS	28.1	42.3	50.5	44.6	96.8

Based on the lack of consensus among participating labs, laboratory performance cannot be determined.

* Denotes a statistical Outlier



Results for Event #3, 2019: Summary Statistics

	Serum Co ($\mu\text{g/L}$)				
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target (Arithmetic Mean (\bar{x}))	67.2	65.3	53.8	289	12.8
Upper Limit	77.3	75.1	61.9	332	14.7
Lower Limit	57.1	55.5	45.7	246	10.9
Arithmetic SD (s)	2.2	3.8	3.9	32	0.6
Arithmetic RSD (%)	3.3	5.8	7.2	11	4.7
Number of Sample Measurements (N)	8	9	9	9	9

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 #3, 2019: Performance of Participating Laboratories

		Serum Co (µg/L)				
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target		67.2	65.3	53.8	289	12.8
103	DRC/CC-ICP-MS	67.5	64.9	52.3	283	12.2
110	ICP-MS	70.2	63.0	53.2	288	13.0
147	ICP-MS	66.2	66.3	55.7	276	13.1
264	ICP-MS	66.15	62.61	49.90	272.50	11.67
293	DRC/CC-ICP-MS	67.53	63.79	53.57	281.24	12.95
485	HR-ICP-MS	69.6	69.7	55.2	317	12.9
590	ICP-MS	62.8	60.2	48.3	246	13.0
597	ICP-MS/MS	*77.0	73.0	62.5 ↑	362 ↑	14.0
598	ICP-MS	67.5	64.5	53.2	278	12.6

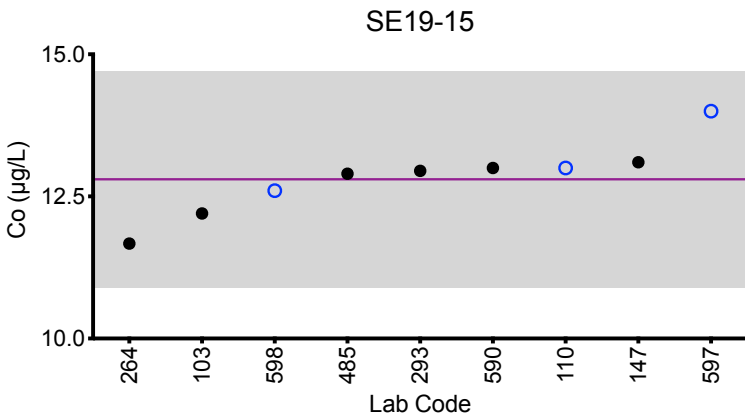
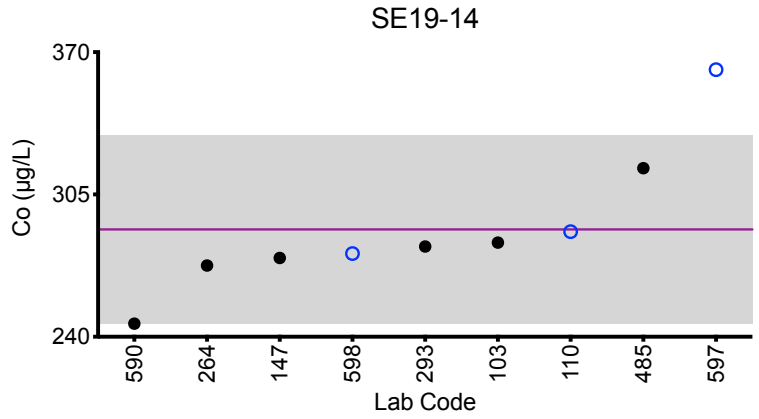
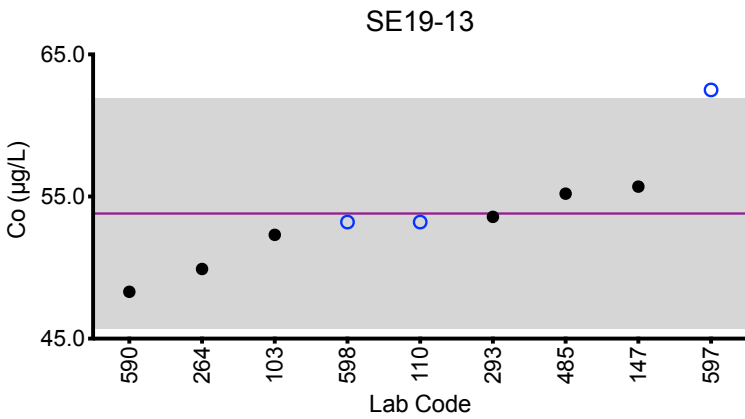
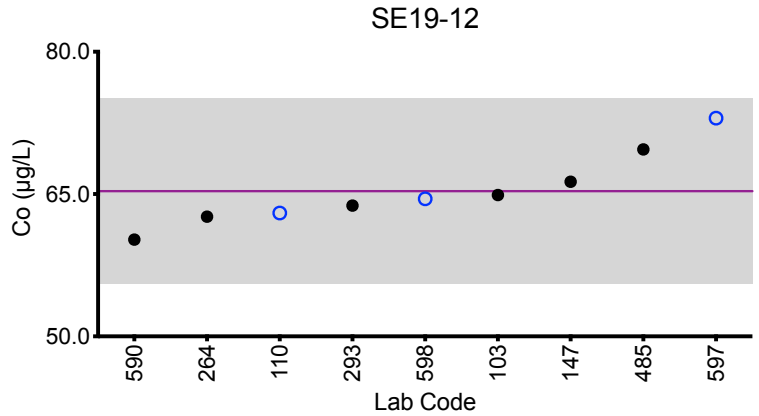
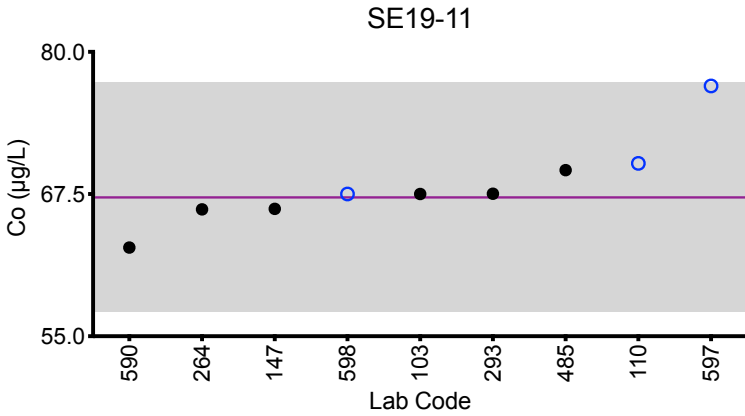
Based on the grading criteria for Co in Serum, 96% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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:

±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 #3, 2019: Summary Statistics

	Serum Cr (µg/L)				
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target (Arithmetic Mean (\bar{x}))	2.0	8.4	6.0	0.81	3.9
Upper Limit	4.0	10.4	8.0	2.81	5.9
Lower Limit	0.0	6.4	4.0	0.00	1.9
Arithmetic SD (s)	0.4	0.8	0.5	0.33	0.5
Arithmetic RSD (%)	20	9.5	8.3	41	13
Number of Sample Measurements (N)	8	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 #3, 2019: Performance of Participating Laboratories

Lab Code	Method	Serum Cr (µg/L)				
		SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
	Target	2.0	8.4	6.0	0.81	3.9
110	DRC/CC-ICP-MS	2.1	8.1	6.0	0.7	4.4
147	DRC/CC-ICP-MS	1.53	6.98	4.85	0.54	3.11
264	ICP-MS	1.39	7.51	5.65	0.43	3.33
293	DRC/CC-ICP-MS	1.89	8.25	5.9	0.63	3.75
485	HR-ICP-MS	2.05	8.48	6.04	0.656	3.86
590	ICP-MS	2.60	8.99	6.54	1.15	4.18
597	ICP-MS/MS	2.52	9.30	6.63	1.46	4.70
598	DRC/CC-ICP-MS	1.71	9.23	6.14	0.93	3.79

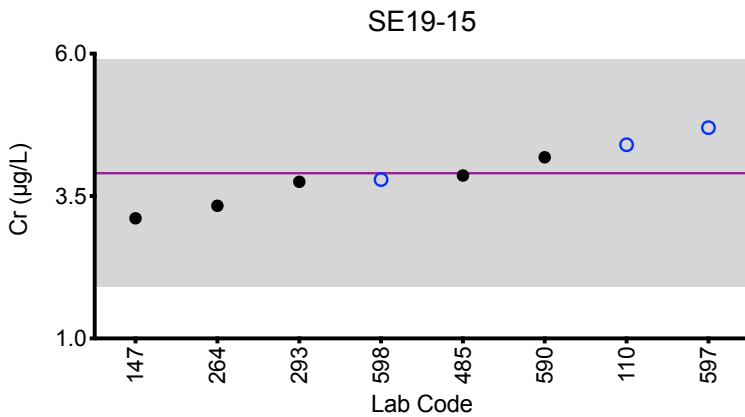
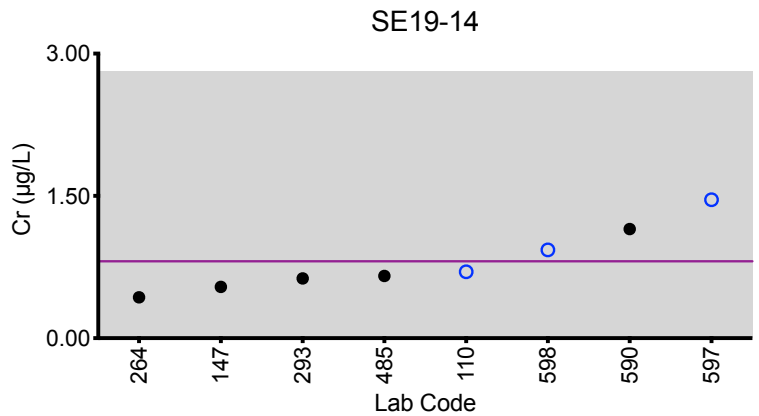
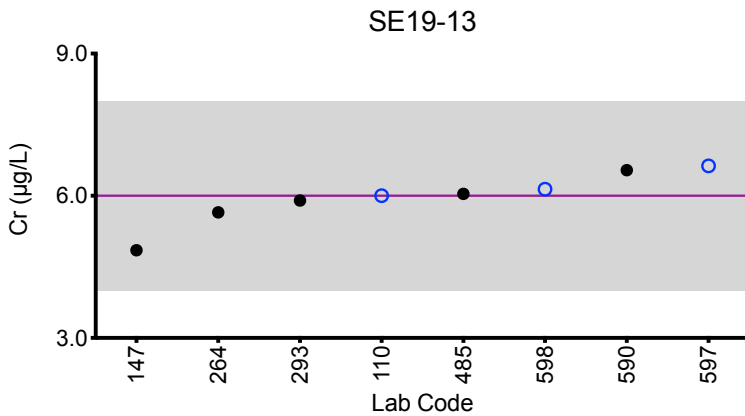
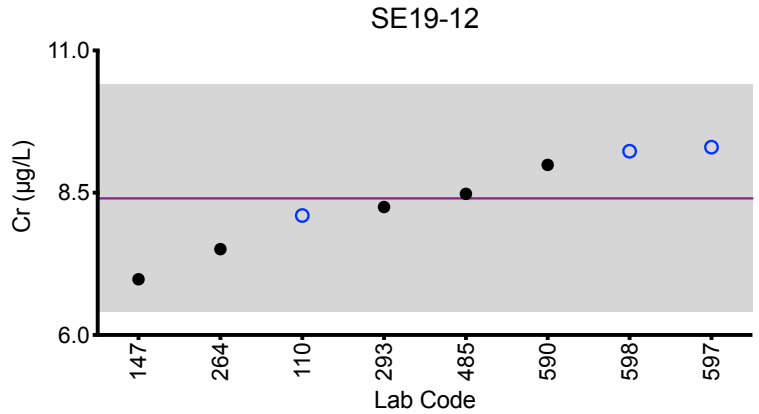
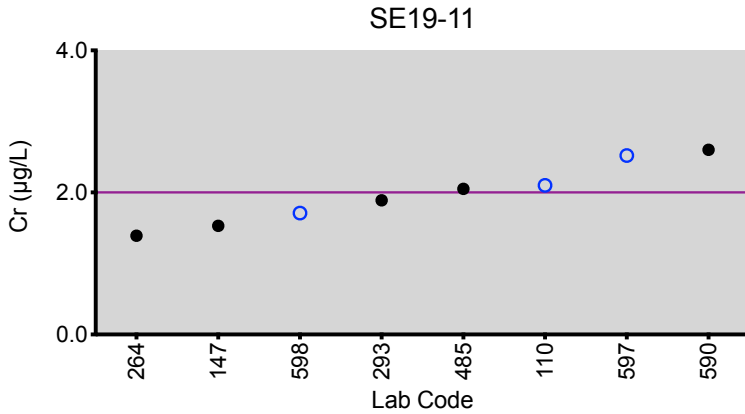
Based on the grading criteria for Cr in Serum, 100% of results were satisfactory, with 0 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 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 #3, 2019: Summary Statistics

	Serum Cu (µg/L)				
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target (Robust Mean (x*))	1780	840	2060	1370	1080
Upper Limit	2050	970	2370	1580	1240
Lower Limit	1510	710	1750	1160	920
Robust SD (s*)	120	60	40	110	60
Robust RSD (%)	6.7	7.1	1.9	8.1	5.6
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (u)	50	20	20	40	20

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



Results for Event #3, 2019: Performance of Participating Laboratories

Serum Cu (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target		1780	840	2060	1370	1080
107	DRC/CC-ICP-MS	1779	844	2068	1372	1053
110	ICP-MS	1776	777	2027	1362	1070
147	ICP-MS	1621	773	2047	1268	1058
264	ICP-MS	1700	791	1949	1310	995
293	DRC/CC-ICP-MS	1856.33	877.3	2091.54	1449.46	1118.88
457	ICP-AES/OES	1890	910	2078	1451	1155
483	ICP-MS	1820	860	2060	1420	1100
590	ICP-MS	1793	847	2083	1262	1079
597	ICP-MS/MS	1950	906	2330	1630 ↑	1230
598	ICP-MS	1663	775	1824	1236	967

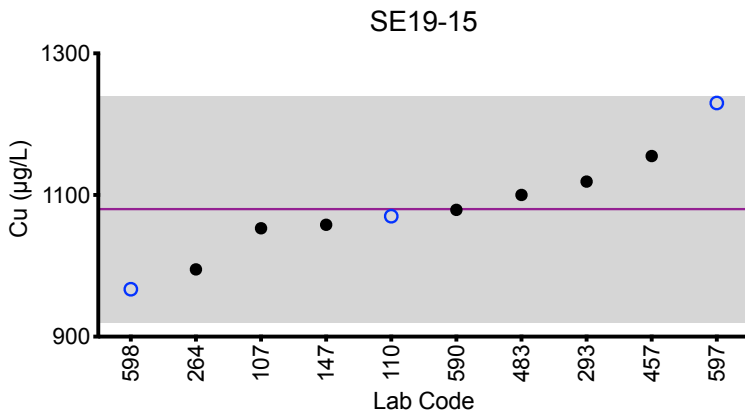
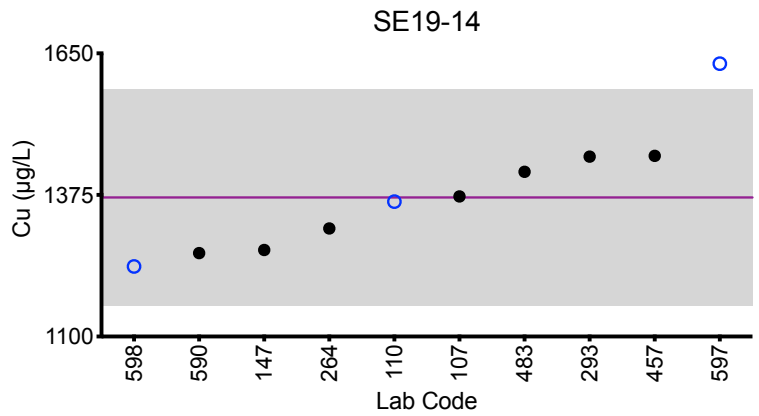
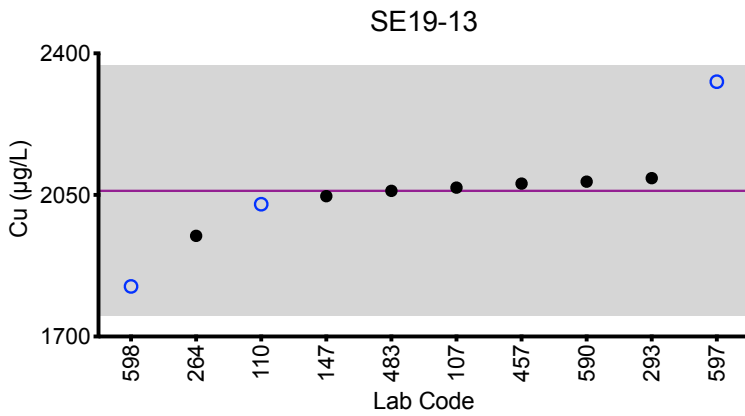
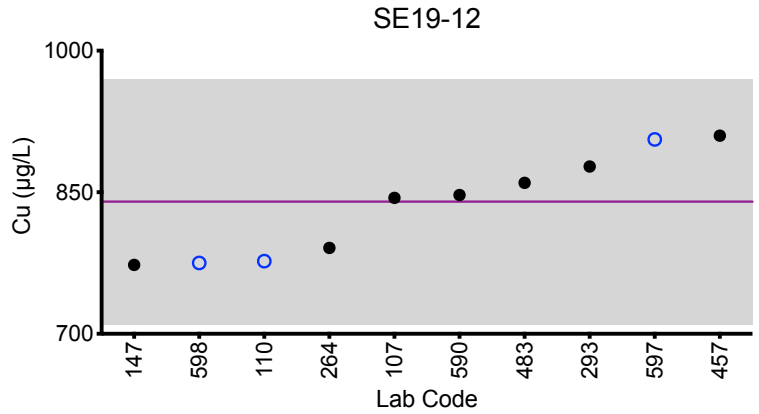
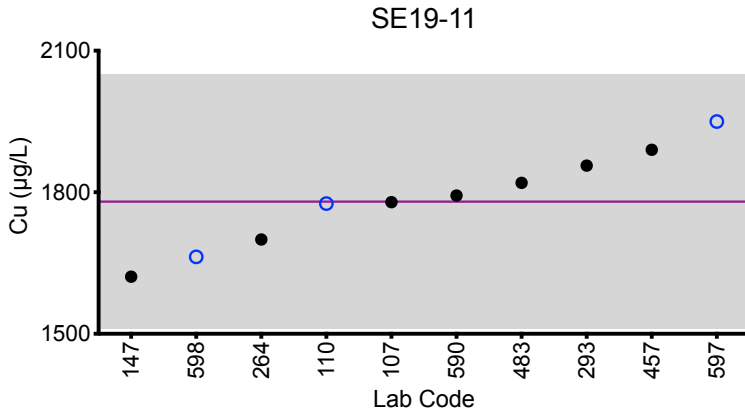
Based on the grading criteria for Cu in Serum, 98% of results were satisfactory, with 0 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 2019: Summary Figures

Serum Cu



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:

$\pm 95 \mu\text{g/L}$ 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 #3, 2019: Summary Statistics

	Serum Se (µg/L)				
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target (Robust Mean (x*))	114	169	285	206	214
Upper Limit	137	203	342	247	257
Lower Limit	91	135	228	165	171
Robust SD (s*)	8	11	10	11	13
Robust RSD (%)	7.1	6.5	3.5	5.3	6.1
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (u)	3	4	4	4	5

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 by New York State Department of Health's Wadsworth Center, the PT Program organizer.



Results for Event #3, 2019: Performance of Participating Laboratories

Serum Se (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
	Target	114	169	285	206	214
103	DRC/CC-ICP-MS	106	164	272	194	199
107	DRC/CC-ICP-MS	109.6	166.4	277.8	200.2	207.6
110	DRC/CC-ICP-MS	111	153	286	204	216
147	ICP-MS	109	166	286	195	207
264	ICP-MS	102.95	160.51	259.21	200.43	195.75
293	DRC/CC-ICP-MS	114.44	179.95	282.56	211.52	215.47
483	ICP-MS	118	175	286	215	223
590	ICP-MS	121	180	301	200	229
597	ICP-MS/MS	119	165	288	233	227
598	DRC/CC-ICP-MS	130	194	321	236	219

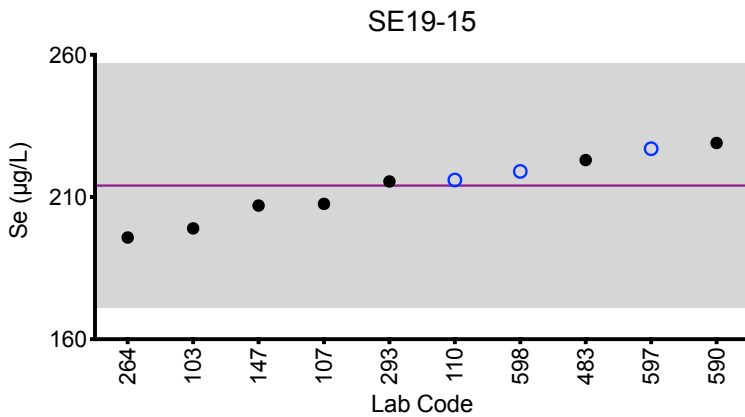
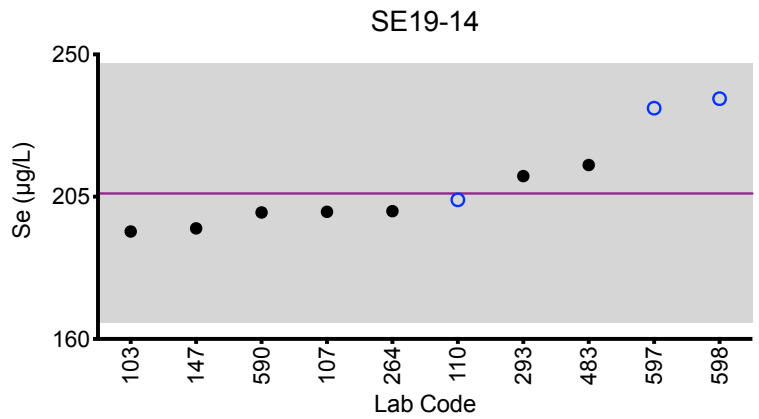
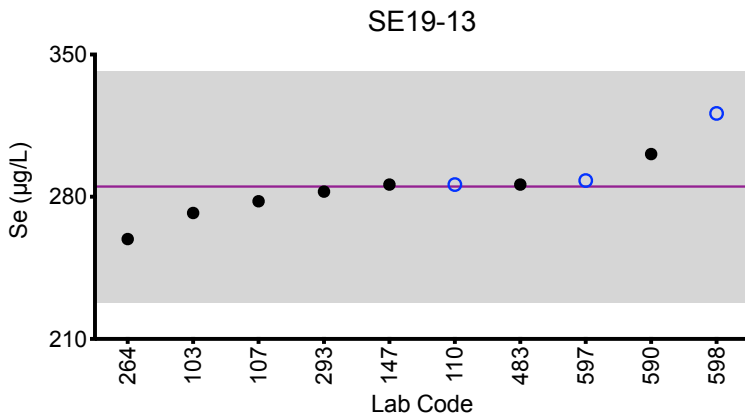
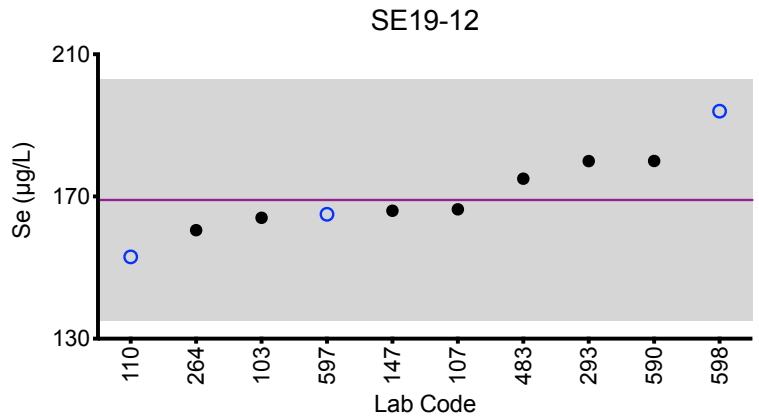
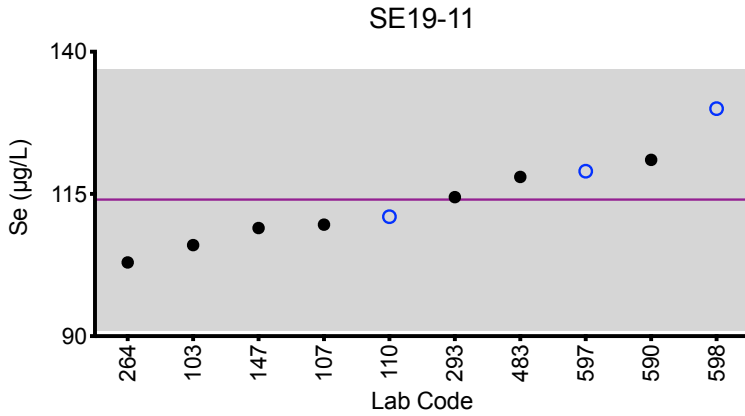
Based on the grading criteria for Se in Serum, 100% of results were satisfactory, with 0 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 2019: Summary Figures

Serum Se



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:

±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 #3, 2019: Summary Statistics

	Serum Zn ($\mu\text{g/L}$)				
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target (Robust Mean (x^*))	660	870	1060	1130	1190
Upper Limit	760	1000	1220	1300	1370
Lower Limit	560	740	900	960	1010
Robust SD (s^*)	50	50	70	50	80
Robust RSD (%)	7.6	5.7	6.6	4.4	6.7
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (u)	20	20	30	20	30

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 #3, 2019: Performance of Participating Laboratories

Serum Zn (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Target		660	870	1060	1130	1190
107	DRC/CC-ICP-MS	696	922	1110	1222	1225
110	ICP-MS	697	857	1079	1181	1217
147	ICP-MS	618	836	1088	1086	1265
264	ICP-MS	625	837	1011	1096	1152
293	DRC/CC-ICP-MS	633.99	856.21	993.46	1124.18	1143.79
457	ICP-AES/OES	610	811	980	1086	1117
483	ICP-MS	688	911	1060	1180	1200
590	ICP-MS	689	911	1110	1088	1230
597	ICP-MS/MS	758	1000	1240 ↑	1400 ↑	1390 ↑
598	ICP-MS	637	844	995	1111	1052

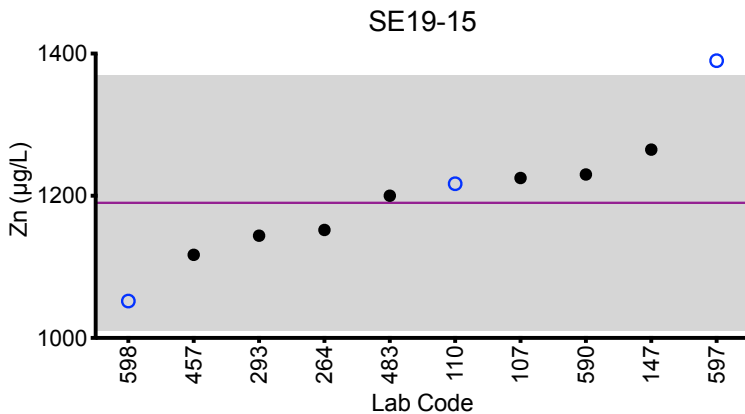
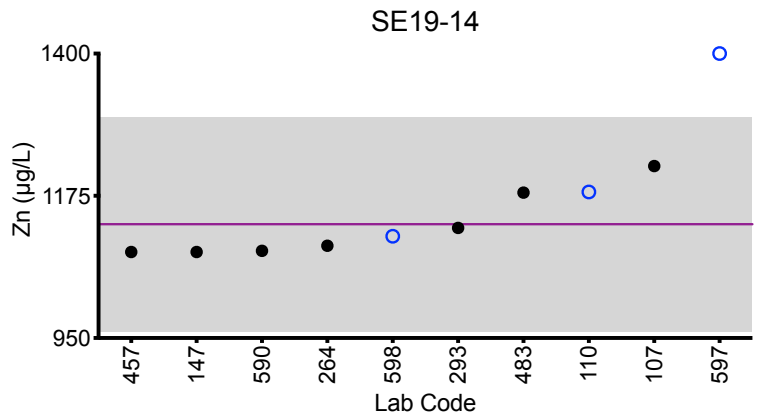
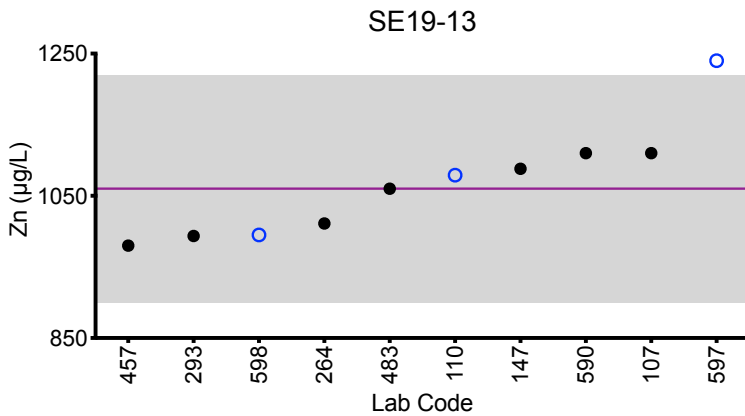
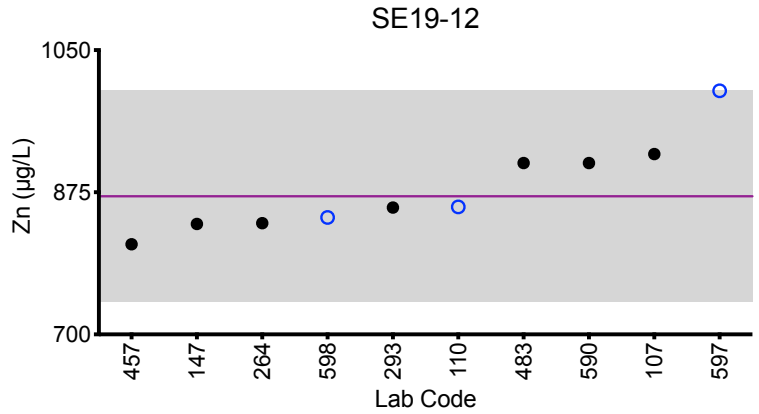
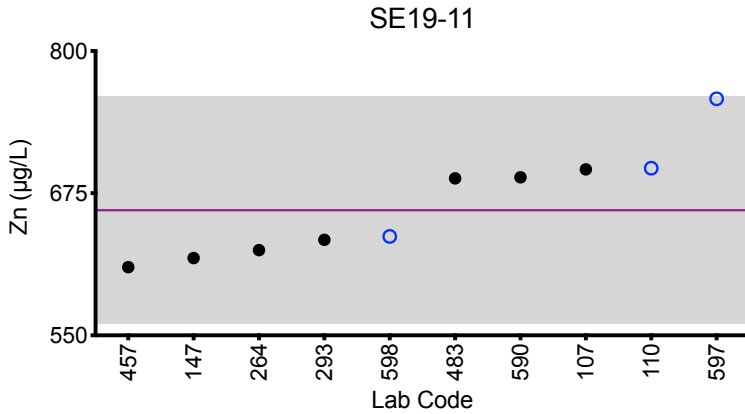
Based on the grading criteria for Zn in Serum, 94% of results were satisfactory, with 1 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier



Results for Event #3, 2019: Summary Figures

Serum Zn



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:

±15 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±15 µg/L at concentrations less than or equal to 100 µg/L.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum As (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	1.94	28.1	7.09	5.18	17.9
110	DRC/CC-ICP-MS	2.7	26.4	7.4	7.7	18.1
147	ICP-MS	1.67	26	6.93	4.74	17.6
597	ICP-MS/MS	2.20	27.3	7.10	5.64	19.0
598	DRC/CC-ICP-MS	2.08	30.5	7.07	5.85	17.4

Summary Statistics

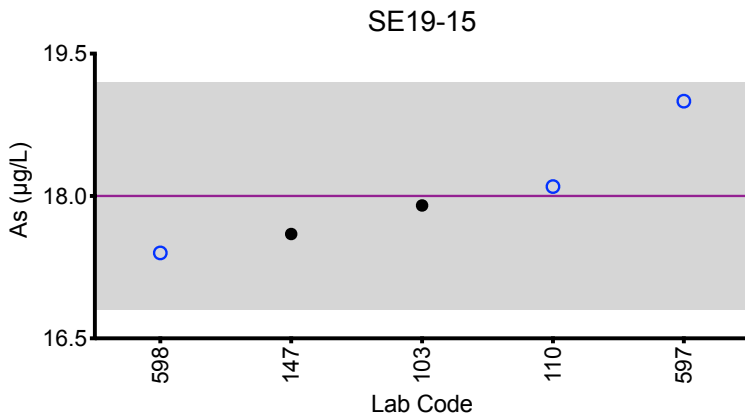
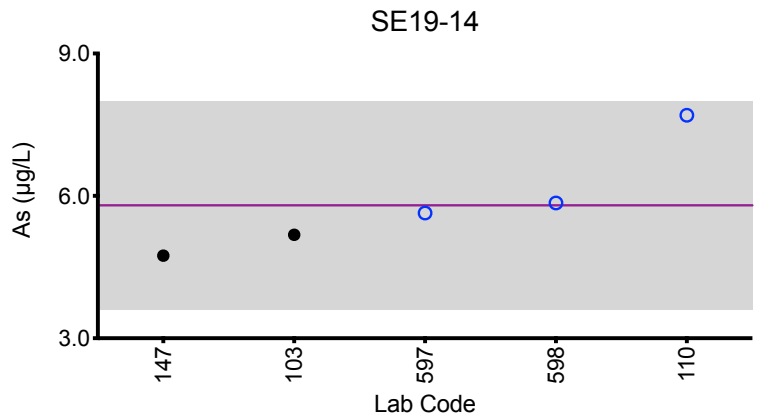
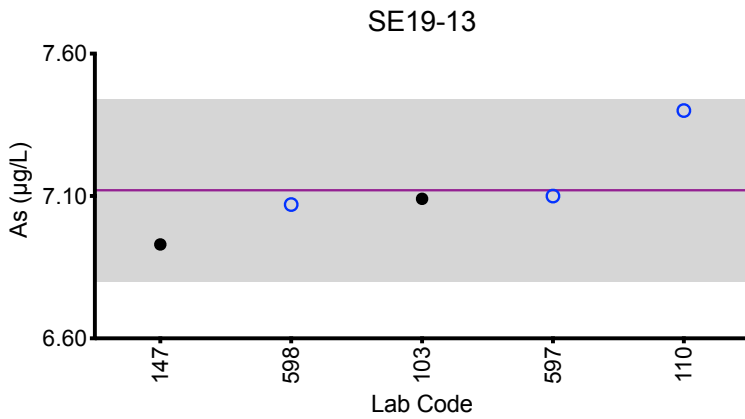
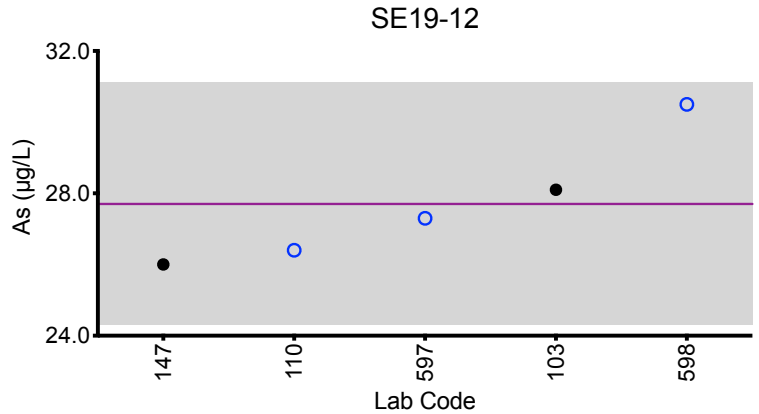
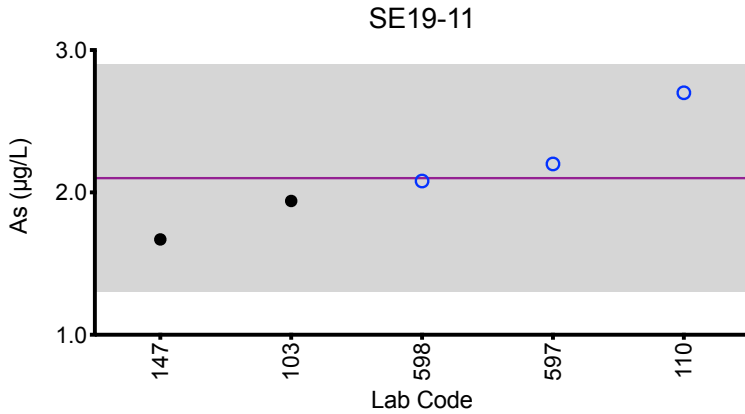
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	2.1	27.7	7.12	5.8	18.0
Arithmetic SD (s)	0.4	1.7	0.16	1.1	0.6
Arithmetic RSD (%)	19	6.1	2.2	19	3.3
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Serum As



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 #3, 2019: Laboratory Data and Summary Statistics

Serum Hg (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	0.499	0.0912	1.46	4.18	2.82
110	ICP-MS	0.5	0.1	1.4	4.2	3.0
147	ICP-MS	0.594	<0.281	1.5	4.01	2.77
597	DMA	0.48	<0.2	2.92	4.22	2.92
598	ICP-MS	0.82	*0.23	1.92	*4.95	3.20

Summary Statistics

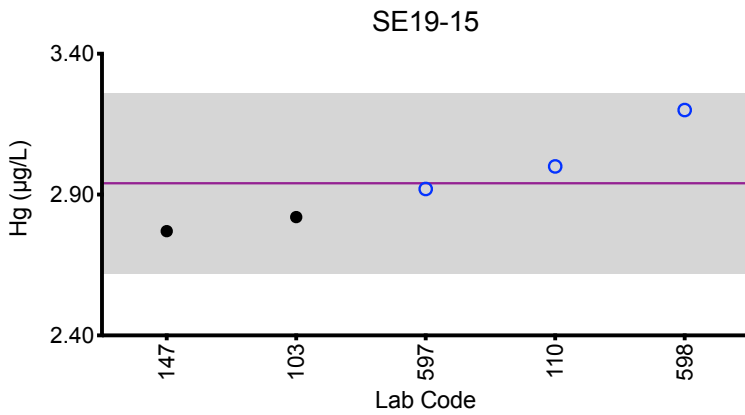
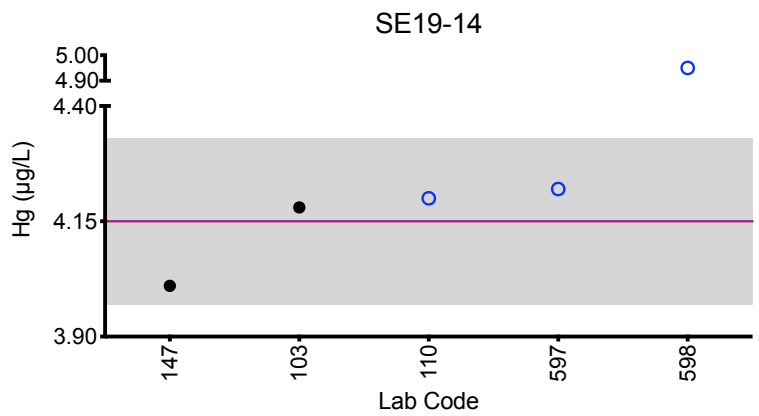
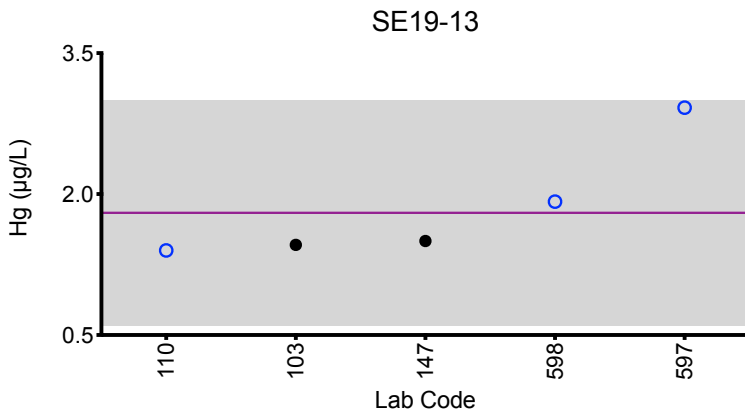
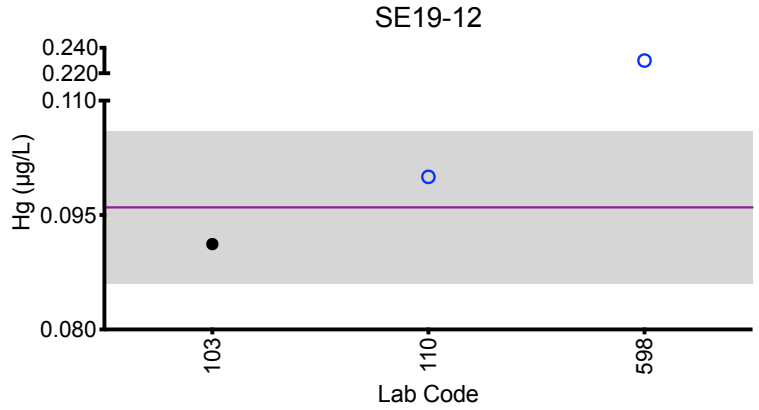
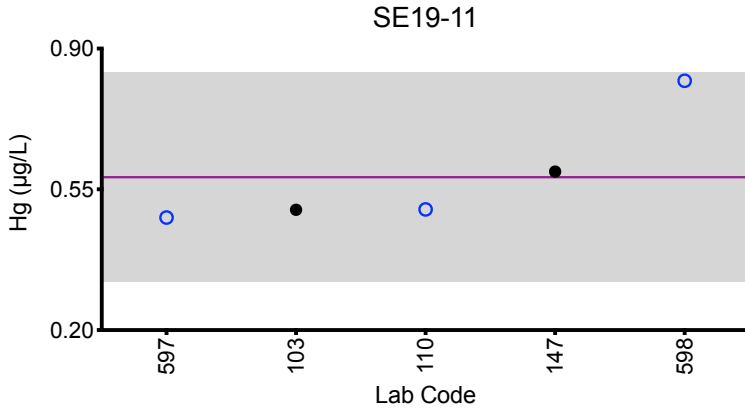
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	0.58	0.096	1.8	4.15	2.94
Arithmetic SD (s)	0.13	0.005	0.6	0.09	0.16
Arithmetic RSD (%)	22	5.2	33	2.2	5.4
Number of Sample Measurements (N)	5	2	5	4	5

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Serum Hg



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 #3, 2019: Laboratory Data and Summary Statistics

Serum Mn (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	23.7	9.81	4.71	14.4	2.62
110	ICP-MS	25.6	9.7	4.9	15.4	3.1
147	ICP-MS	24.5	10.3	4.86	14.8	3.77
264	ICP-MS	24.73	10.23	4.97	15.20	3.32
293	DRC/CC-ICP-MS	24.84	10.02	4.81	15.22	2.87
457	ICP-AES/OES	24.1	9.5	4.7	14.4	3.5
597	ICP-MS/MS	26.6	10.6	*6.12	*17.6	3.24
598	ICP-MS	23.8	9.70	4.85	14.5	2.70

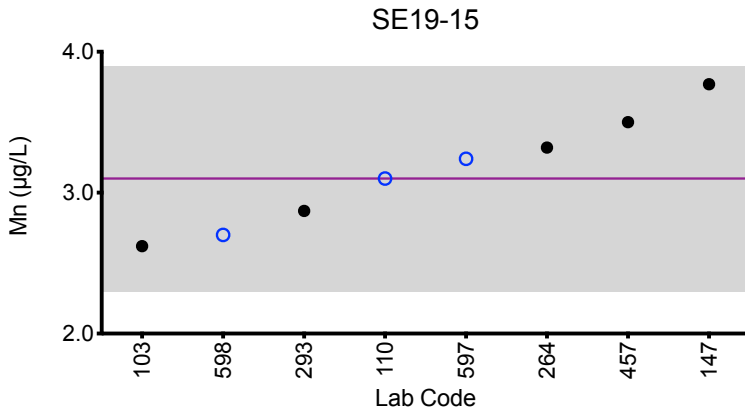
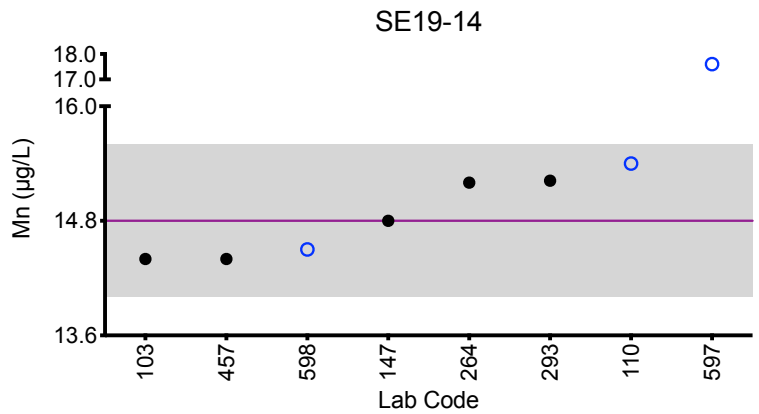
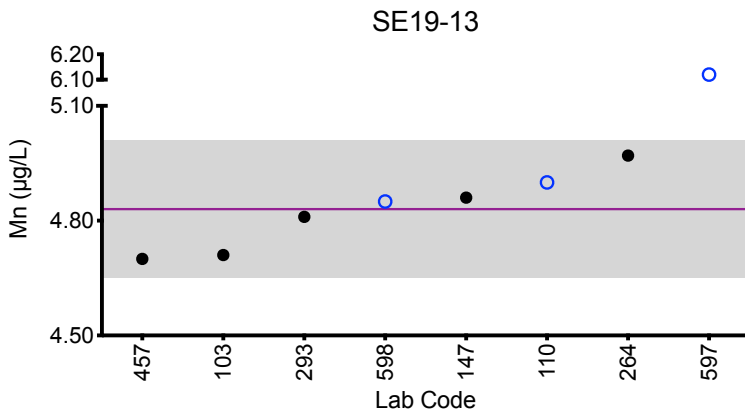
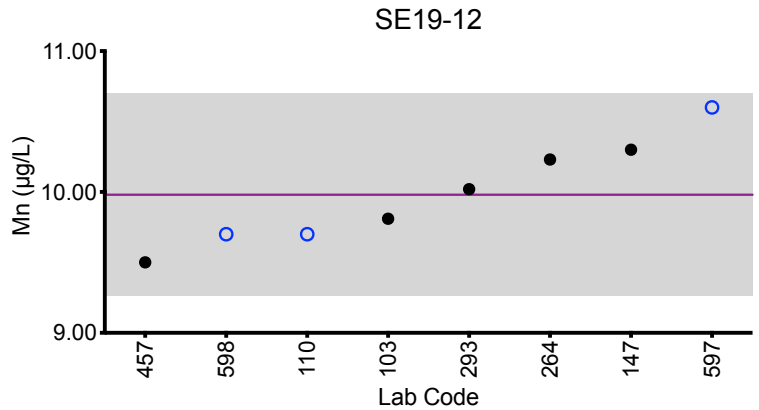
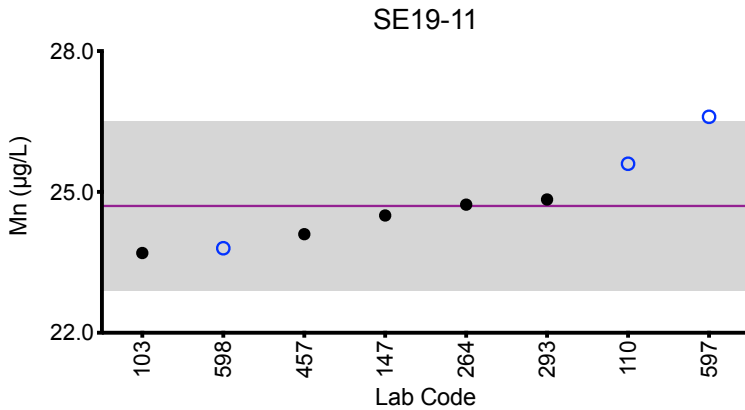
Summary Statistics						
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15	
Arithmetic Mean (\bar{x})	24.7	9.98	4.83	14.8	3.1	
Arithmetic SD (s)	0.9	0.36	0.09	0.4	0.4	
Arithmetic RSD (%)	3.6	3.6	1.9	2.7	13	
Number of Sample Measurements (N)	8	8	7	7	8	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Serum Mn



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 #3, 2019: Laboratory Data and Summary Statistics

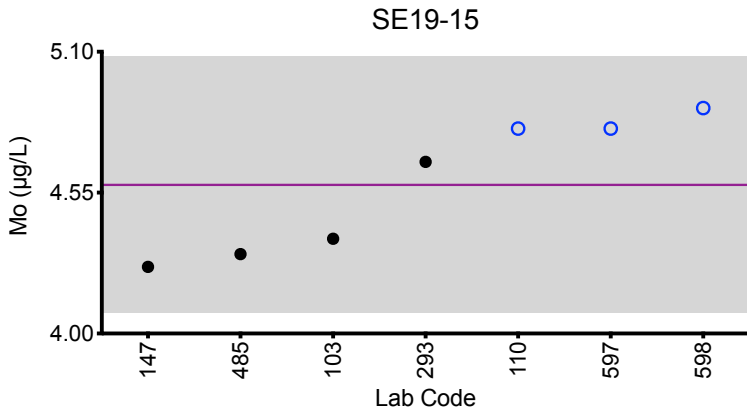
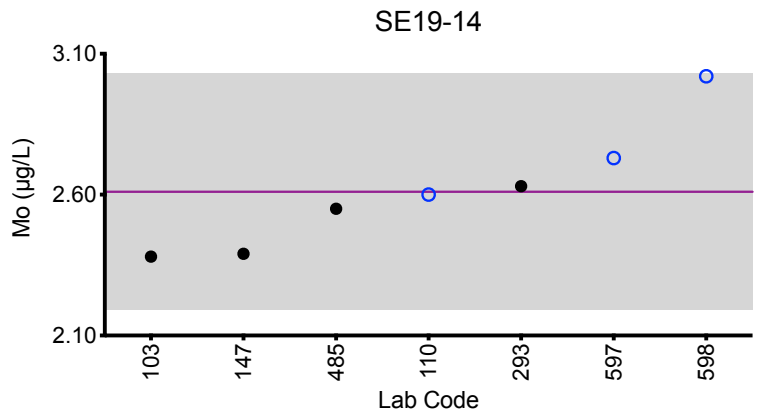
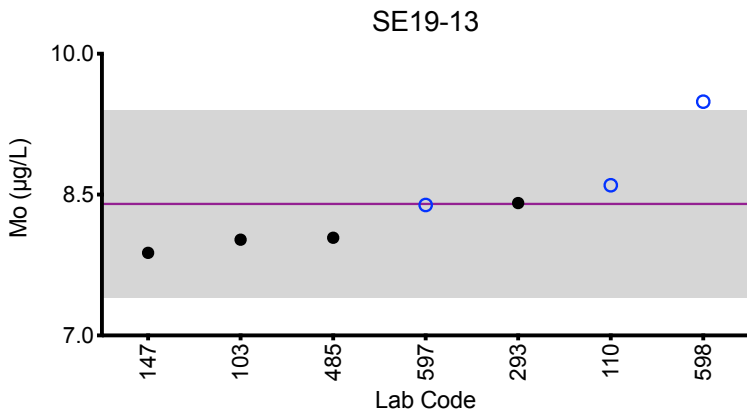
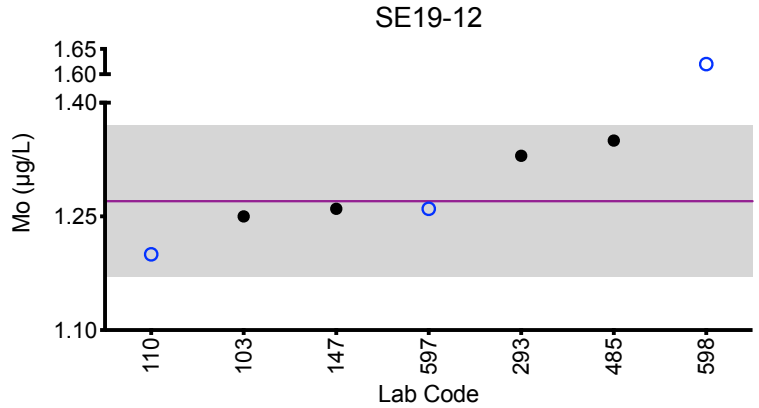
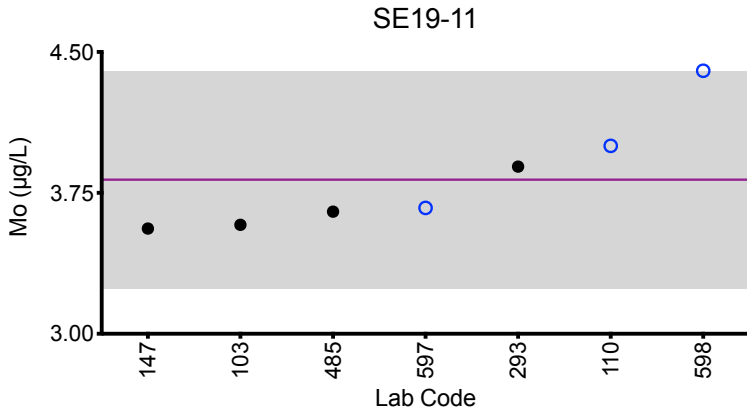
Serum Mo (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	3.58	1.25	8.02	2.38	4.37
110	ICP-MS	4.0	1.2	8.6	2.6	4.8
147	ICP-MS	3.56	1.26	7.88	2.39	4.26
293	DRC/CC-ICP-MS	3.89	1.33	8.41	2.63	4.67
485	HR-ICP-MS	3.65	1.35	8.04	2.55	4.31
597	ICP-MS/MS	3.67	1.26	8.39	2.73	4.80
598	DRC/CC-ICP-MS	4.40	*1.62	9.49	3.02	4.88
Summary Statistics						
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15	
Arithmetic Mean (\bar{x})	3.82	1.27	8.4	2.61	4.58	
Arithmetic SD (s)	0.29	0.05	0.5	0.21	0.25	
Arithmetic RSD (%)	7.6	3.9	6.5	8.4	5.5	
Number of Sample Measurements (N)	7	6	7	7	7	

*Denotes a statistical Outlier.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

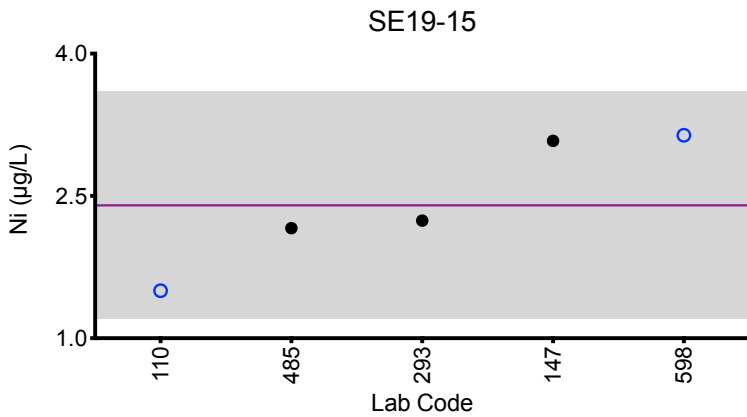
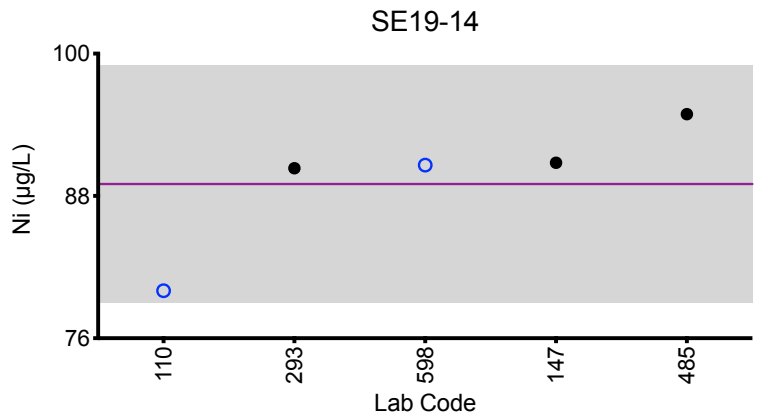
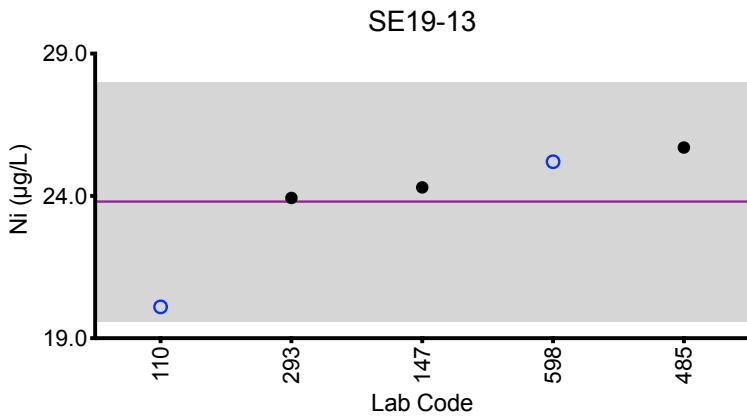
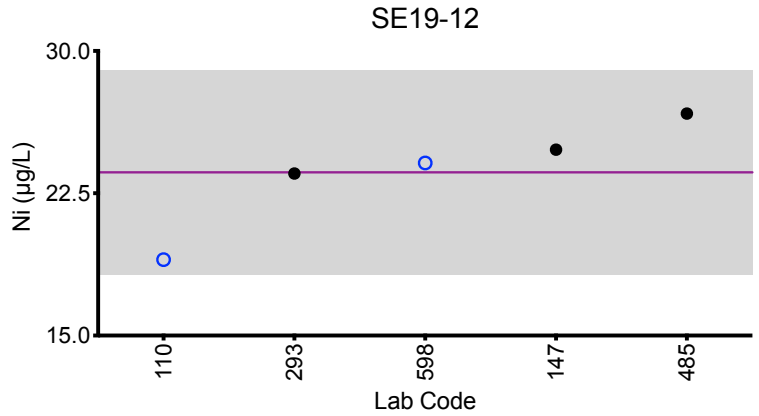
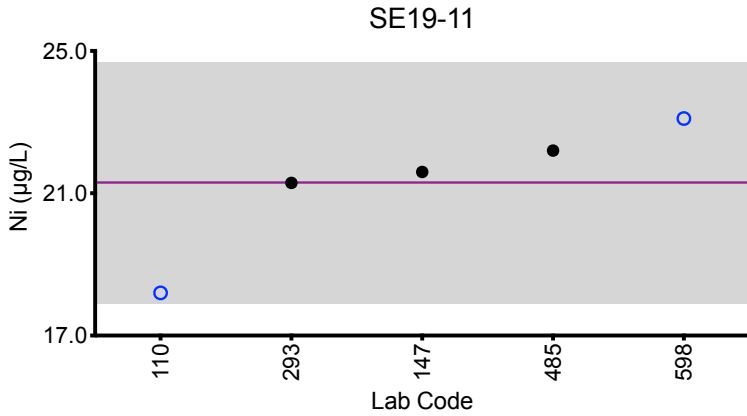
Serum Ni (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
110	DRC/CC-ICP-MS	18.2	19.0	20.1	80.0	1.5
147	ICP-MS	21.6	24.8	24.3	90.8	3.08
293	DRC/CC-ICP-MS	21.29	23.54	23.93	90.33	2.24
485	HR-ICP-MS	22.2	26.7	25.7	94.9	2.16
598	ICP-MS	23.1	24.1	25.2	90.6	3.14
Summary Statistics						
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15	
Arithmetic Mean (\bar{x})	21.3	23.6	23.8	89	2.4	
Arithmetic SD (s)	1.7	2.7	2.1	5	0.6	
Arithmetic RSD (%)	8.7	11	8.8	5.6	25	
Number of Sample Measurements (N)	5	5	5	5	5	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Serum Ni



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 #3, 2019: Laboratory Data and Summary Statistics

Serum Pb (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	4.49	2.75	5.35	1.16	28.0
110	ICP-MS	4.7	2.6	5.4	1.2	28.8
147	ICP-MS	4.64	2.91	5.92	1.2	32.7
597	ICP-MS/MS	5.59	3.32	6.70	*1.80	35.2
598	ICP-MS	4.13	2.52	5.11	1.11	23.46

Summary Statistics

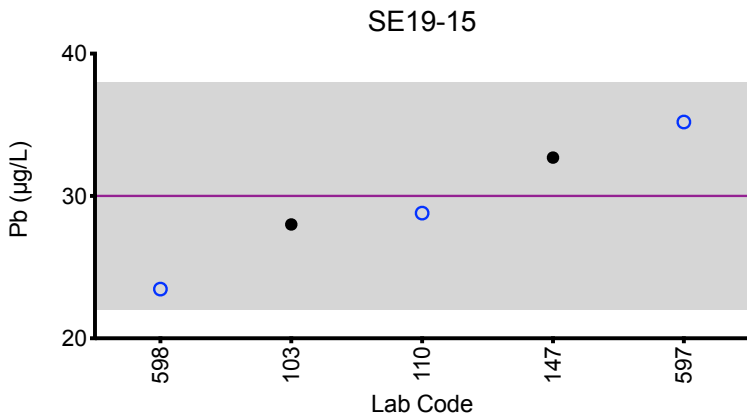
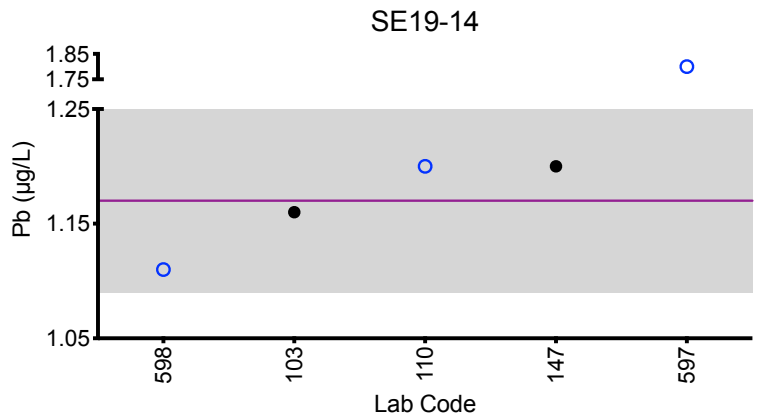
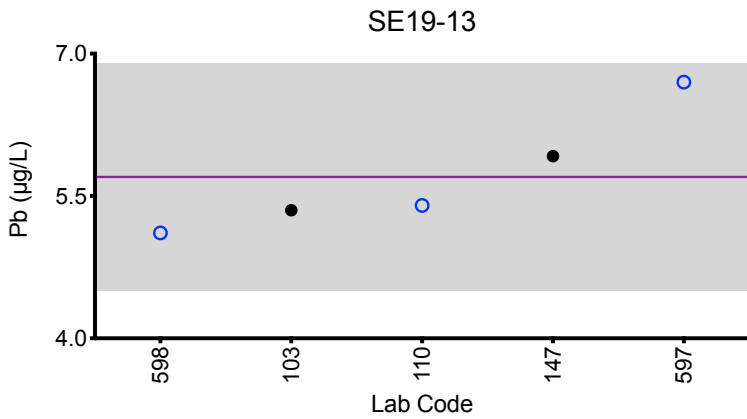
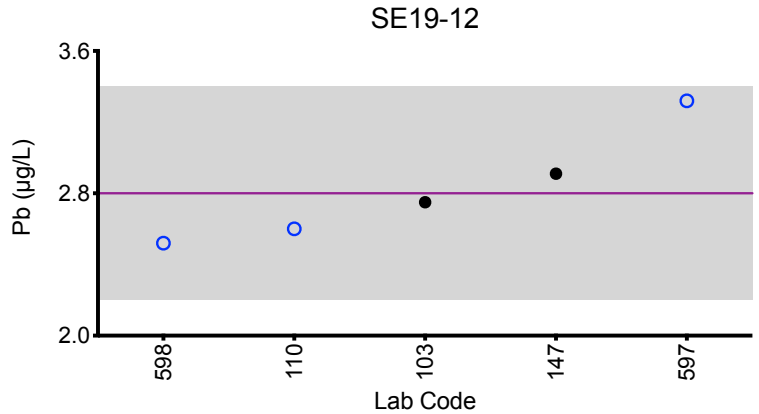
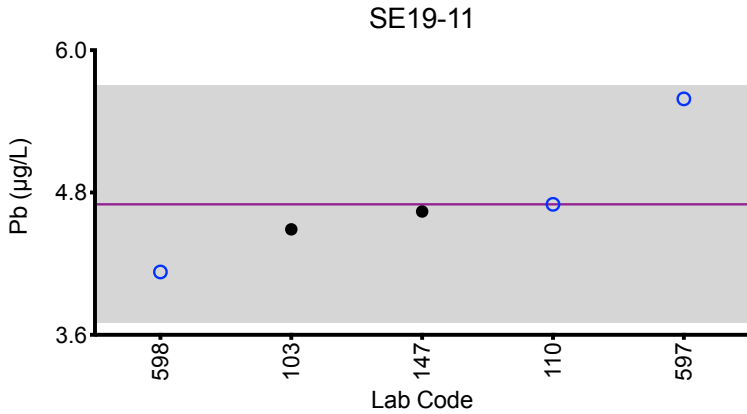
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	4.7	2.8	5.7	1.17	30
Arithmetic SD (s)	0.5	0.3	0.6	0.04	4
Arithmetic RSD (%)	11	11	11	3.4	13
Number of Sample Measurements (N)	5	5	5	4	5

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Serum Pb



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 #3, 2019: Laboratory Data and Summary Statistics

Serum Sb (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	6.49	1.37	3.72	0.434	1.98
110	ICP-MS	6.81	1.39	3.65	0.52	2.05
147	ICP-MS	6.72	1.45	3.88	0.452	2.08
597	ICP-MS/MS	7.44	1.65	4.37	0.619	2.49
598	ICP-MS	5.80	1.25	3.72	0.46	1.80

Summary Statistics

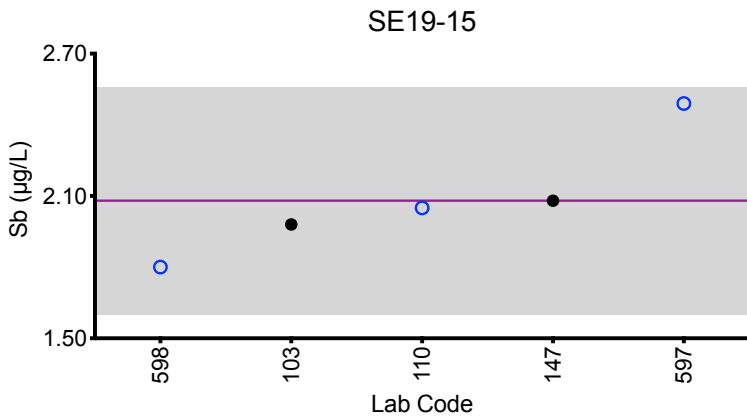
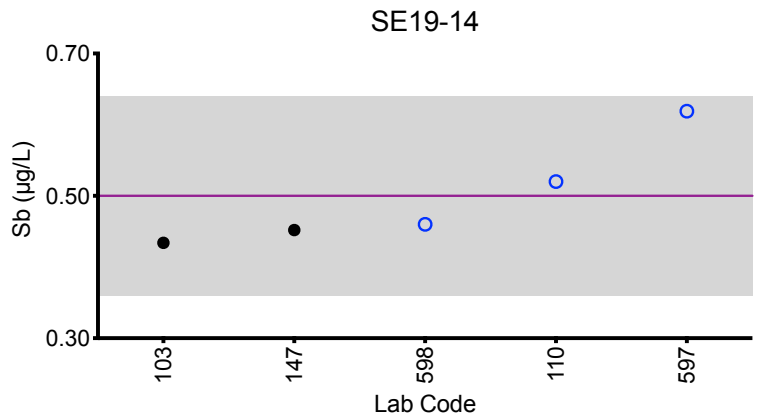
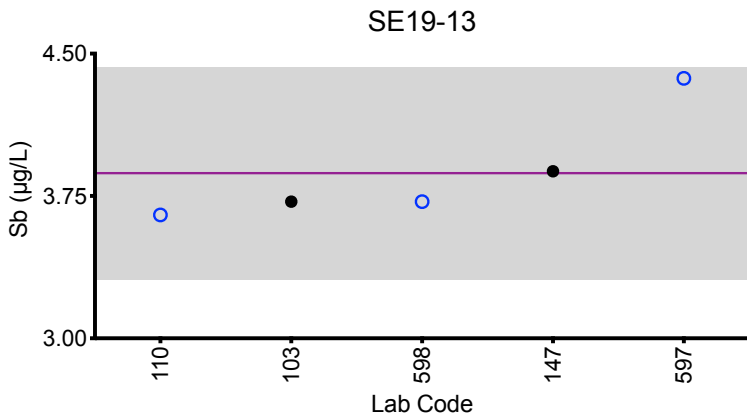
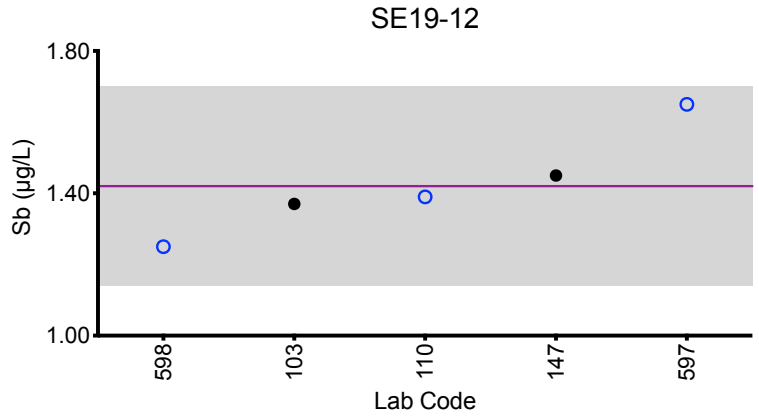
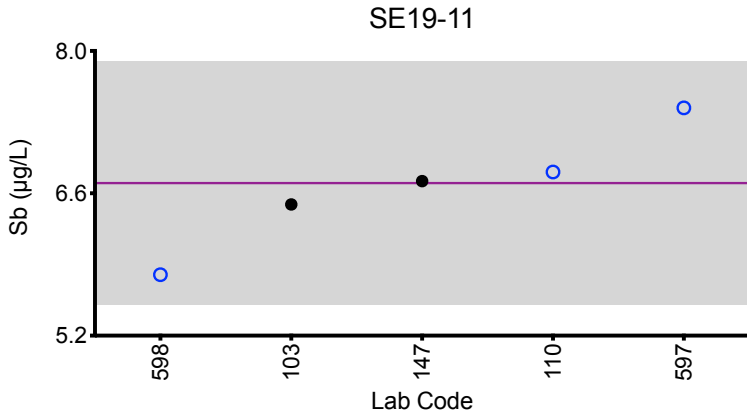
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	6.7	1.42	3.87	0.50	2.08
Arithmetic SD (s)	0.6	0.14	0.28	0.07	0.24
Arithmetic RSD (%)	8.9	9.9	7.2	14	12
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.



Results for Event #3, 2019: Summary Figures

Serum 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 #3, 2019: Laboratory Data and Summary Statistics

Serum V (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
110	DRC/CC-ICP-MS	3.9	3.9	2.9	10.5	1.5
147	DRC/CC-ICP-MS	2.76	3.36	2.1	8.4	1.02
293	DRC/CC-ICP-MS	3.18	3.74	2.47	10.01	1.23
485	HR-ICP-MS	3.22	3.83	2.43	10.1	1.18
597	ICP-MS/MS	3.30	3.60	2.52	10.2	1.42
598	DRC/CC-ICP-MS	3.68	4.60	2.82	11.1	1.31

Summary Statistics

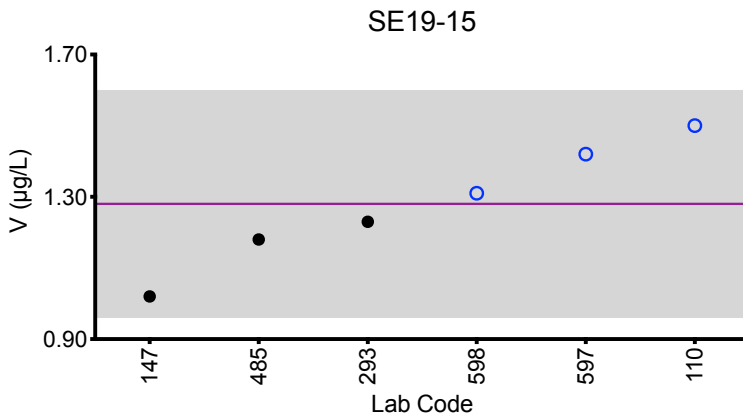
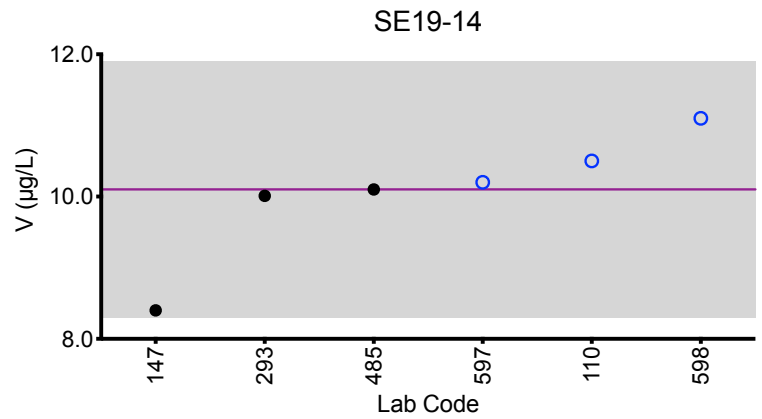
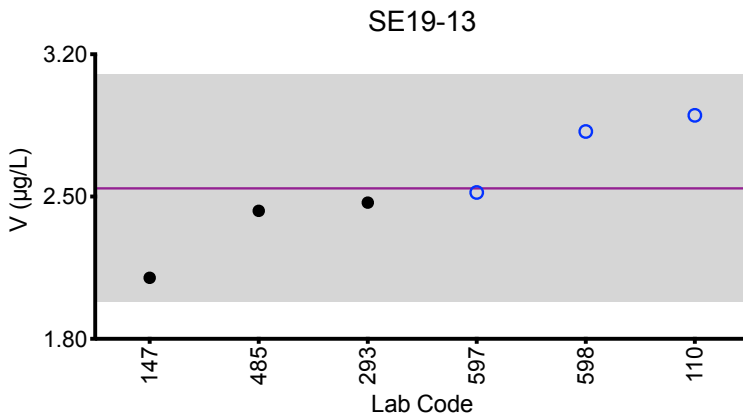
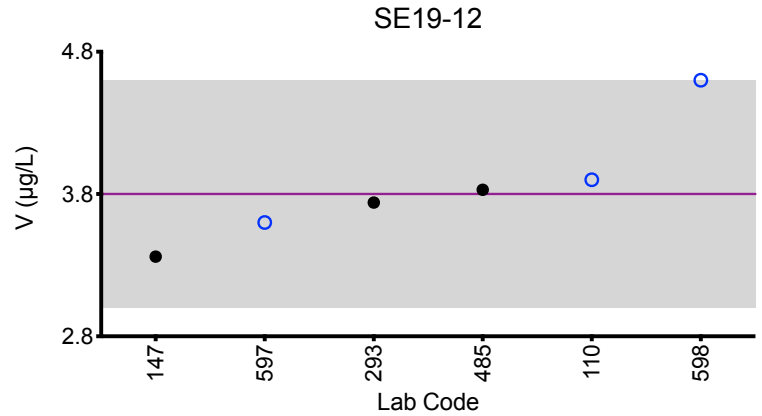
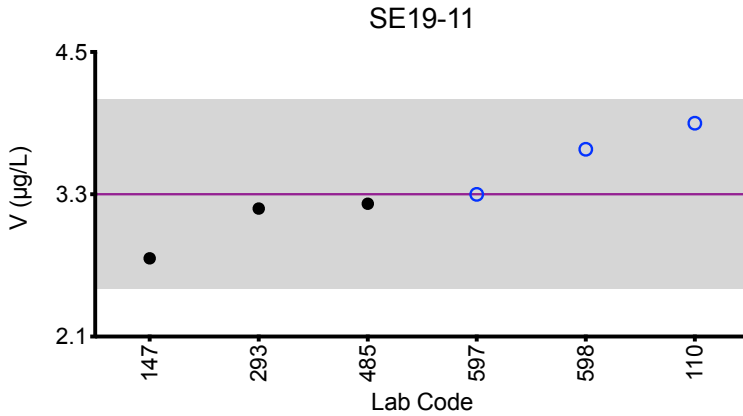
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	3.3	3.8	2.54	10.1	1.28
Arithmetic SD (s)	0.4	0.4	0.28	0.9	0.16
Arithmetic RSD (%)	12	11	11	8.9	13
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.



Results for Event #3, 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 #3, 2019: Laboratory Data and Summary Statistics

Serum Ba ($\mu\text{g/L}$)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
110	ICP-MS	2.3	2.0	1.1	1.3	5.6
147	ICP-MS	1.9	1.95	1.03	0.944	5.48
598	ICP-MS	2.07	2.09	1.13	1.18	5.16
Summary Statistics						
		SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})		2.09	2.01	1.09	1.14	5.41
Arithmetic SD (s)		0.18	0.06	0.05	0.16	0.23
Arithmetic RSD (%)		8.6	3.5	4.6	14	3.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum Be ($\mu\text{g/L}$)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
110	ICP-MS	1.8	2.0	4.6	1.1	3.3
147	ICP-MS	1.81	2.48	5.21	1.08	3.33
293	ICP-MS	1.85	2.35	4.59	1.10	3.14
598	ICP-MS	2.06	2.17	4.70	1.17	2.68

Summary Statistics					
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	1.88	2.25	4.8	1.11	3.1
Arithmetic SD (s)	0.11	0.19	0.3	0.04	0.3
Arithmetic RSD (%)	5.9	8.4	6.3	3.6	9.7
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	1.55	1.29	4.51	2.36	7.49
110	ICP-MS	1.63	1.12	4.38	2.38	7.81
147	ICP-MS	1.4	1.2	4.4	2.4	7.8
598	DRC/CC-ICP-MS	1.57	1.20	4.33	2.19	6.42

Summary Statistics						
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15	
Arithmetic Mean (\bar{x})	1.54	1.20	4.41	2.33	7.4	
Arithmetic SD (s)	0.09	0.06	0.07	0.09	0.6	
Arithmetic RSD (%)	5.8	5.8	1.6	3.9	8.1	
Number of Sample Measurements (N)	4	4	4	4	4	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum Cs ($\mu\text{g/L}$)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
110	ICP-MS	0.50	0.48	0.54	0.47	1.38
597	ICP-MS/MS	0.558	0.486	0.541	0.528	1.40
598	ICP-MS	0.50	0.49	0.52	0.53	1.26

Summary Statistics					
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	0.52	0.485	0.534	0.51	1.35
Arithmetic SD (s)	0.03	0.005	0.011	0.03	0.07
Arithmetic RSD (%)	5.8	1.0	2.1	5.9	5.2
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum Fe ($\mu\text{g/L}$)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
264	ICP-MS	1671	1634	389	406	628.0
457	ICP-AES/OES	1631.0	1593	365	384	592

Summary Statistics						
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15	
Arithmetic Mean (\bar{x})	1651	1614	377	395	610	
Arithmetic SD (s)	23	24	14	13	21	
Arithmetic RSD (%)	1.4	1.5	3.7	3.3	3.4	
Number of Sample Measurements (N)	2	2	2	2	2	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum Mg (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
264	ICP-MS	18358	17957	17971	18021	17014
457	ICP-AES/OES	17201	16909	16125	16242	15367

Summary Statistics

	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	17800	17400	17000	17100	16200
Arithmetic SD (s)	700	600	1100	1000	1000
Arithmetic RSD (%)	3.9	3.4	6.5	5.8	6.2
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum Pt (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
110	ICP-MS	0.80	0.15	1.29	1.92	0.42
264	ICP-MS	*0.53	<0.01	*0.98	*1.56	*0.02
293	DRC/CC-ICP-MS	0.91	0.14	1.40	1.99	0.46
598	ICP-MS	0.87	0.14	1.31	1.82	0.42

Summary Statistics					
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	0.86	0.143	1.33	1.91	0.433
Arithmetic SD (s)	0.05	0.005	0.05	0.08	0.021
Arithmetic RSD (%)	5.8	3.5	3.8	4.2	4.8
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
110	ICP-MS	2.57	5.59	12.1	3.63	4.68
147	ICP-MS	2.38	5.97	12.4	3.71	4.55
597	ICP-MS/MS	2.87	6.42	13.8	4.67	5.36
598	ICP-MS	2.71	5.79	12.3	3.67	4.30

Summary Statistics						
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15	
Arithmetic Mean (\bar{x})	2.63	5.9	12.7	3.9	4.7	
Arithmetic SD (s)	0.19	0.3	0.7	0.5	0.4	
Arithmetic RSD (%)	7.2	5.1	5.5	13	8.5	
Number of Sample Measurements (N)	4	4	4	4	4	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum Sr ($\mu\text{g/L}$)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	130	31.3	47.4	107	28.6
200	ICP-MS	123	32	43	104	26.0

Summary Statistics						
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15	
Arithmetic Mean (\bar{x})	127	31.7	45	105.5	27.3	
Arithmetic SD (s)	4	0.4	3	1.7	1.5	
Arithmetic RSD (%)	3.1	1.3	6.7	1.6	5.5	
Number of Sample Measurements (N)	2	2	2	2	2	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum Ti (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
200	DRC/CC-ICP-MS	6.7	1.9	8.1	3.1	6.5
485	HR-ICP-MS	8.48	2.21	5.02	1.35	3.04

Summary Statistics

	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
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)	NA	NA	NA	NA	NA

*Denotes a statistical Outlier.

Statistical data were not calculated for SE19-11, SE19-12, SE19-13, SE19-14, or SE19-15 based on a lack of consensus among participating labs.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum TI (µg/L)						
Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	0.491	3.55	0.164	0.972	2.92
110	ICP-MS	0.52	3.28	0.17	1.01	3.05
147	ICP-MS	0.475	3.47	0.196	0.941	3.07
598	ICP-MS	0.46	3.29	0.18	1.00	2.61
Summary Statistics						
	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15	
Arithmetic Mean (\bar{x})	0.486	3.40	0.178	0.98	2.91	
Arithmetic SD (s)	0.024	0.12	0.013	0.03	0.21	
Arithmetic RSD (%)	4.9	3.5	7.3	3.1	6.9	
Number of Sample Measurements (N)	4	4	4	4	4	

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum U (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
103	DRC/CC-ICP-MS	0.177	0.0752	0.0362	0.0491	0.0959
110	ICP-MS	0.184	0.071	0.038	0.054	0.103
147	ICP-MS	0.176	0.0635	0.0339	0.0401	0.0969
598	ICP-MS	0.19	0.09	0.05	0.06	0.09

Summary Statistics

	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	0.182	0.075	0.040	0.051	0.096
Arithmetic SD (s)	0.006	0.011	0.007	0.008	0.005
Arithmetic RSD (%)	3.3	15	18	16	5.2
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #3, 2019: Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
110	ICP-MS	0.09	1.53	0.55	0.91	0.25
147	ICP-MS	0.147	1.68	0.579	0.828	0.238
200	ICP-MS	0.07	1.58	0.61	0.96	0.24
598	ICP-MS	*1.73	2.02	0.84	0.93	0.32

Summary Statistics

	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
Arithmetic Mean (\bar{x})	0.10	1.70	0.64	0.91	0.26
Arithmetic SD (s)	0.04	0.22	0.12	0.05	0.04
Arithmetic RSD (%)	40	13	19	5.5	15
Number of Sample Measurements (N)	3	4	4	4	4

*Denotes a statistical Outlier.



Results for Event #3, 2019: Additional Elements in Serum

Serum Ag (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
147	ICP-MS	<0.227	<0.227	<0.227	<0.227	<0.227

Serum B (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
200	ICP-MS	69	45	109	108	51

Serum Bi (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
147	ICP-MS	<0.230	<0.230	<0.230	<0.230	<0.230

Serum I (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
147	ICP-MS	47.6	49.4	62.9	60.6	51.7

Serum Li (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
147	ICP-MS	0.923	1.03	0.791	0.749	0.5

Serum Te (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
147	ICP-MS	<0.153	<0.153	<0.153	<0.153	<0.153

Serum Th (µg/L)

Lab Code	Method	SE19-11	SE19-12	SE19-13	SE19-14	SE19-15
147	ICP-MS	<0.00882	<0.00882	<0.00882	<0.00882	<0.00882



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