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New York State Biomonitoring Program for Trace Elements

Event #1, 2019

Trace Elements in Whole Blood, Urine, and Serum

May, 2019

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #1, 2019:
Trace Elements in Whole Blood, Urine, and Serum

5/8/2019

Dear Laboratory Director,

This report summarizes performance for the first 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 #2, 2019) will be shipped June 12, 2019. Comments about this report may be directed to trel@health.ny.gov.

Sincerely,

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

Kayla Mehigan
Coordinator, Biomonitoring PT Program,
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Wadsworth Center

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Event #1, 2019

Trace Elements in Whole Blood

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NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #1, 2019:
Trace Elements in Whole Blood

PT Materials

Human whole blood was purchased from Zen-Bio, Inc. and preserved with K_2EDTA. The company certifies that this material was "non-reactive" for HBsAg, HBV DNA, HIV-1,2 Ab, HIV-1 RNA, HCV Ab, HCV RNA, and STS. Units of whole blood were filtered into polypropylene containers through cheesecloth to remove particulates and supplemented with arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), mercury (Hg), manganese (Mn), lead (Pb), barium (Ba), beryllium (Be), copper (Cu), molybdenum (Mo), nickel (Ni), platinum (Pt), antimony (Sb), selenium (Se), tin (Sn), titanium (Ti), thallium (Tl), uranium (U), vanadium (V), tungsten (W), and zinc (Zn). Whole blood samples were homogenized overnight prior to aliquoting 2-mL into polypropylene vials. PT samples were stored at -80°C until the week of the PT event, when they were thawed at 4°C prior to circulation to laboratories 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.

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Results for Event #1, 2019: Summary Statistics

Whole Blood As (µg/L)					
	BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Target (Arithmetic Mean ($\bar{x}$))	6.8	37.7	68.7	13.3	27.4
Upper Limit	12.8	45.2	82.4	19.3	33.4
Lower Limit	0.8	30.2	55.0	7.3	21.4
Arithmetic SD (s)	0.5	2.9	3.7	1.3	1.6
Arithmetic RSD (%)	7.4	7.7	5.4	9.8	5.8
Number of Sample Measurements (N)	6	7	7	7	6

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
	Target	**6.8**	**37.7**	**68.7**	**13.3**	**27.4**
103	DRC/CC-ICP-MS	7.05	39.0	68.1	13.0	27.0
110	DRC/CC-ICP-MS	6.9	39.7	69.9	14.3	28.9
147	ICP-MS	6.89	38	67.0	13.5	27.9
293	DRC/CC-ICP-MS	7.33	39.82	71.22	13.45	28
391	DRC/CC-ICP-MS	5.921	34.039	63.869	12.017	23.71
597	DRC/CC-ICP-MS	*9.03	39.5	73.4	14.9	28.1
598	DRC/CC-ICP-MS	5.97	32.0	61.8	10.8	*19.1 ↓
599	DRC/CC-ICP-MS	6.87	35.9	69.2	13.2	24.3

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

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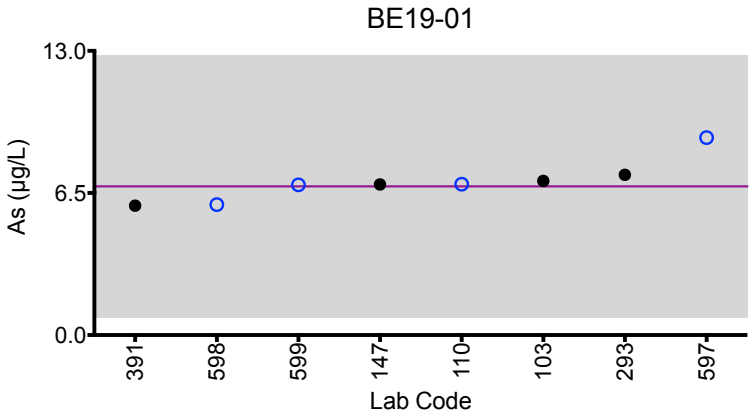
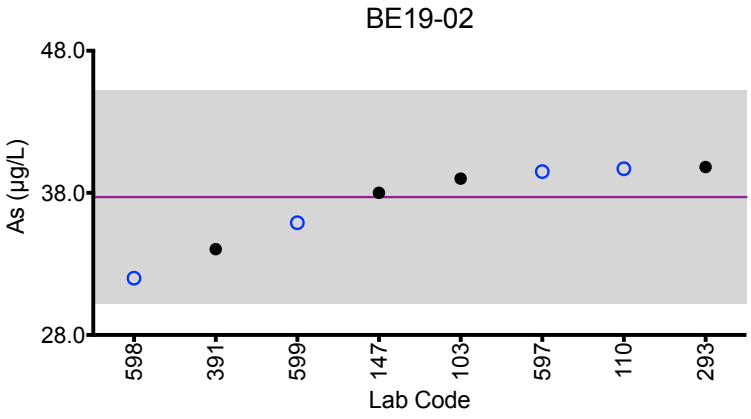
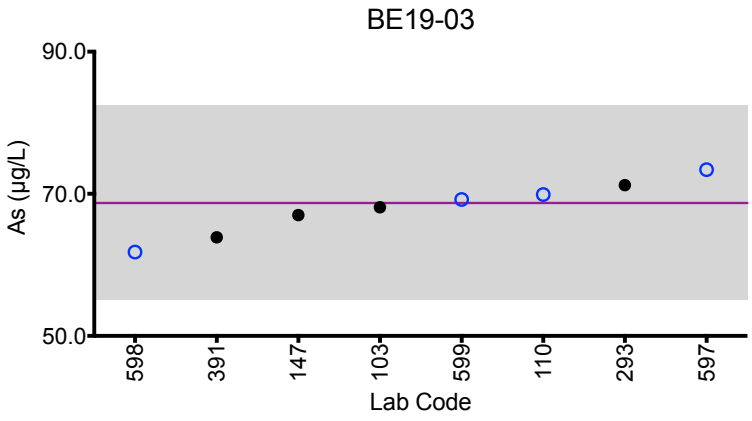
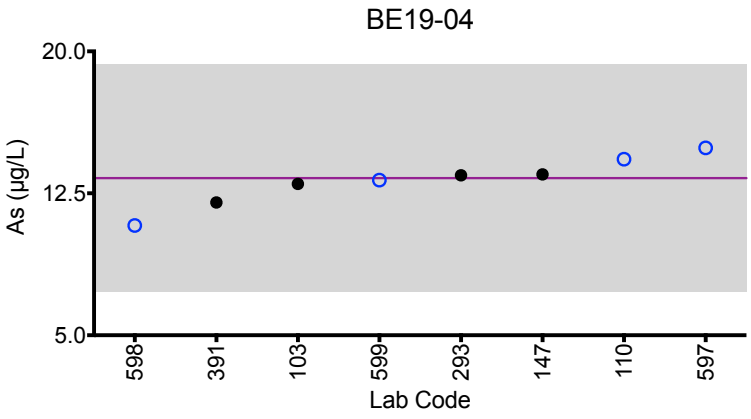
Results for Event #1, 2019: Summary Figures

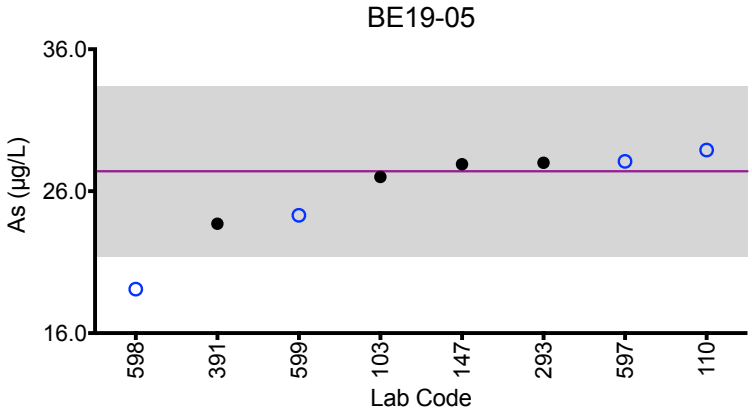
Whole Blood As











Legend:

o 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:

±6 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±6 µg/L at concentrations less than or equal to 30 µg/L.

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Results for Event #1, 2019: Summary Statistics

Whole Blood Cd (µg/L)					
	BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Target (Robust Mean (x*))	0.29	0.85	0.36	1.34	0.92
Upper Limit	1.29	1.85	1.36	2.34	1.92
Lower Limit	0.00	0.00	0.00	0.34	0.00
Robust SD (s*)	0.04	0.07	0.04	0.08	0.07
Robust RSD (%)	14	8.2	10	6.0	7.6
Number of Sample Measurements (N)	10	13	10	13	13
Standard Uncertainty (*u*)	0.02	0.02	0.01	0.03	0.02

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
	Target	**0.29**	**0.85**	**0.36**	**1.34**	**0.92**
103	DRC/CC-ICP-MS	0.262	0.863	0.373	1.36	0.897
107	ICP-MS/MS	0.3	0.9	0.39	1.48	0.99
110	ICP-MS	0.28	0.80	0.29	1.28	0.88
116	ICP-MS/MS	0.299	0.839	0.341	1.43	0.951
147	ICP-MS	0.257	0.815	0.359	1.37	1.01
293	DRC/CC-ICP-MS	0.26	0.92	0.35	1.33	0.91
391	DRC/CC-ICP-MS	0.676	1.143	0.748	1.657	1.21
401	DRC/CC-ICP-MS	0.3	0.9	0.3	1.3	1.0
597	DRC/CC-ICP-MS	0.382	0.943	0.367	1.41	1.07
598	DRC/CC-ICP-MS	0.260	0.566	0.403	0.938	0.624
599	DRC/CC-ICP-MS	0.546	0.752	0.390	1.28	0.863
605	ICP-MS	<0.50	0.898	<0.50	1.33	0.887
606	DRC/CC-ICP-MS	<0.500	0.838	<0.500	1.26	0.881
686	ICP-MS	<0.5	0.821	<0.5	1.37	0.911

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

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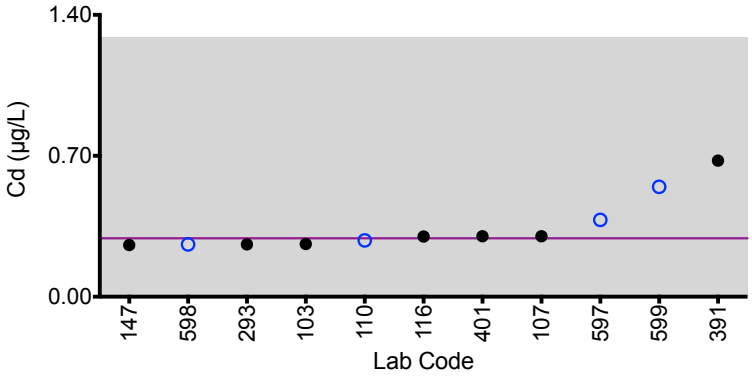
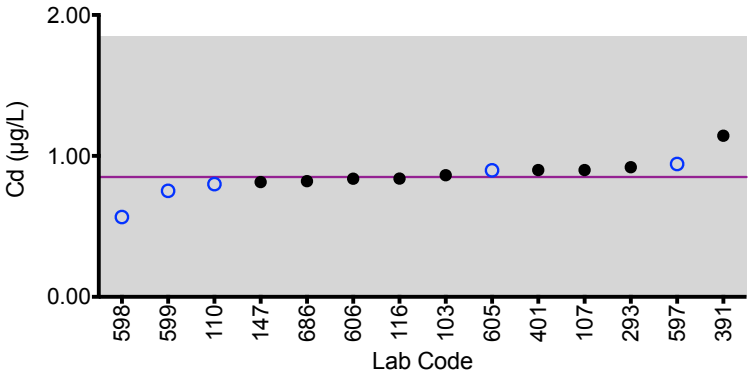
Results for Event #1, 2019: Summary Figures

Whole Blood Cd

BE19-01



BE19-02



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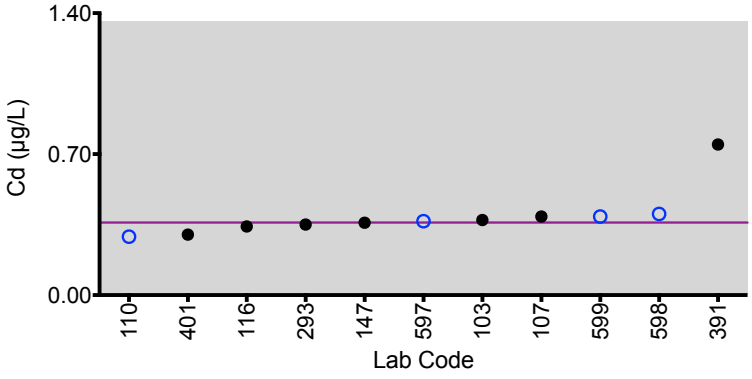
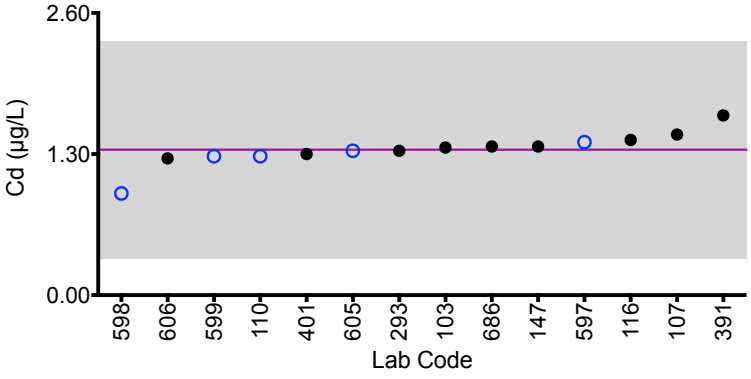


BE19-04



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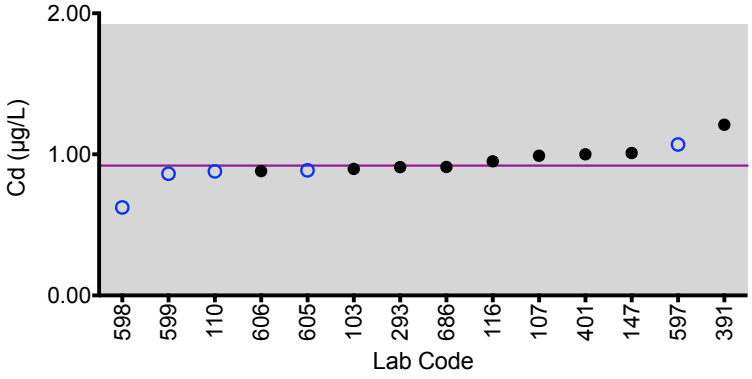

Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±1 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 6.7 µg/L.

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Results for Event #1, 2019: Summary Statistics

Whole Blood Co (µg/L)					
	BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Target (Arithmetic Mean ($\bar{x}$))	3.7	3.85	0.55	0.41	0.40
Upper Limit	5.2	5.35	2.05	1.91	1.90
Lower Limit	2.2	2.35	0.00	0.00	0.00
Arithmetic SD (s)	0.3	0.22	0.09	0.11	0.04
Arithmetic RSD (%)	8.4	5.7	16	27	9.5
Number of Sample Measurements (N)	8	7	8	8	7

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
	Target	**3.7**	**3.85**	**0.55**	**0.41**	**0.40**
103	DRC/CC-ICP-MS	3.52	3.70	0.460	0.360	0.336
110	ICP-MS	3.74	4.18	0.69	0.49	0.44
147	ICP-MS	3.67	3.87	0.619	0.513	0.434
293	DRC/CC-ICP-MS	4.08	3.66	0.55	0.42	0.37
391	DRC/CC-ICP-MS	3.789	3.347	1.079	1.011	1.076
401	DRC/CC-ICP-MS	3.5	3.8	0.4	0.2	*0.2
597	DRC/CC-ICP-MS	4.08	4.13	0.589	0.519	0.380
598	ICP-MS	3.17	3.62	0.583	0.465	0.422
599	DRC/CC-ICP-MS	3.81	*4.88	0.526	0.340	0.402

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

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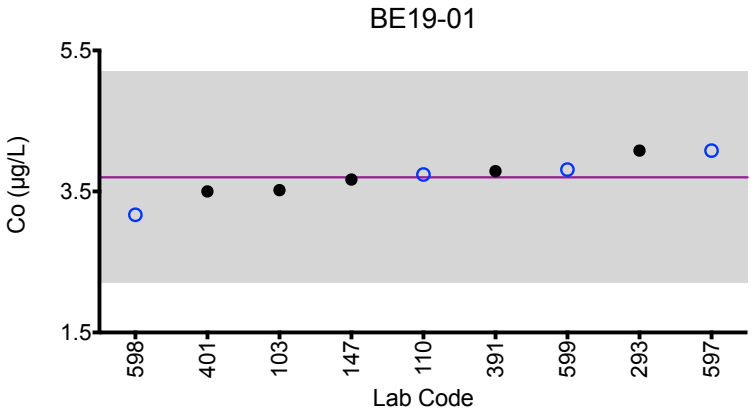
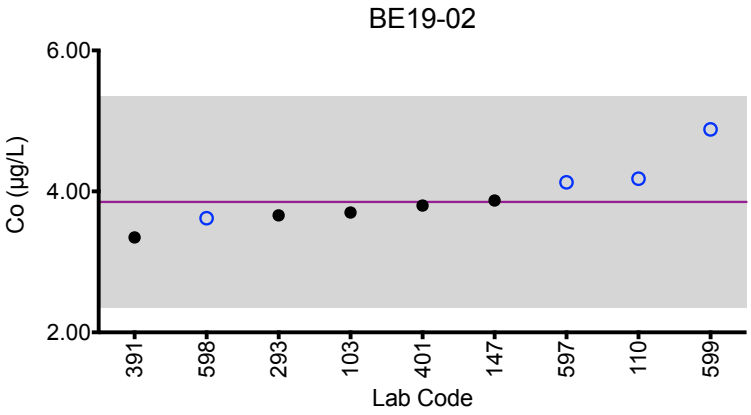
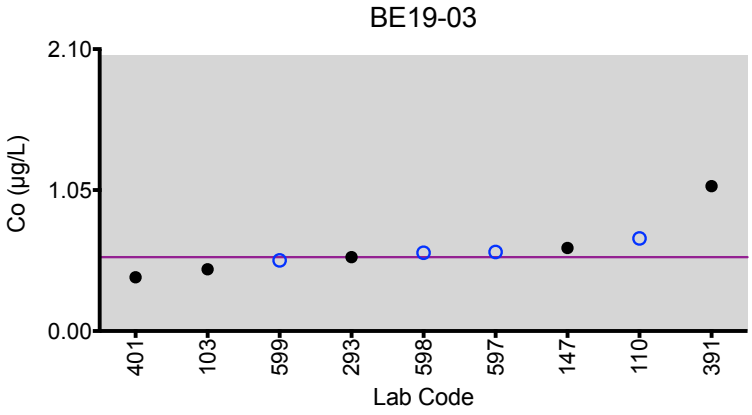
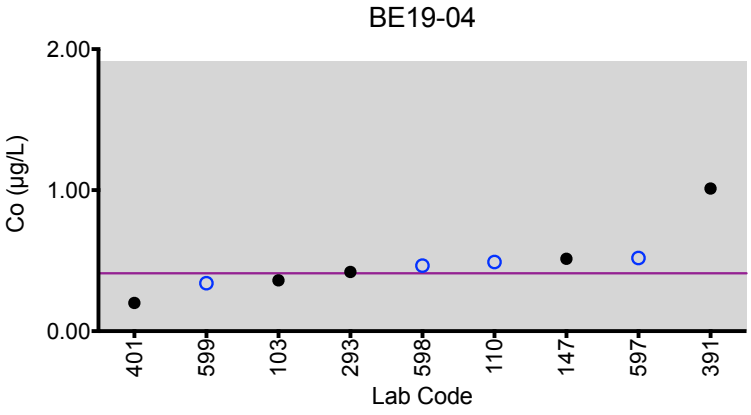
Results for Event #1, 2019: Summary Figures

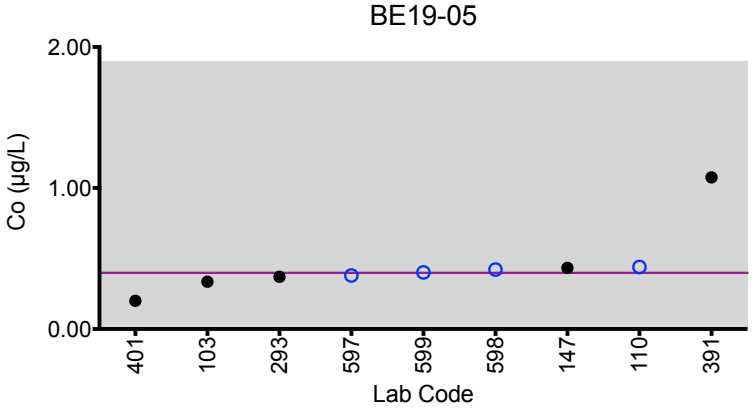
Whole Blood Co











Legend:

o 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 ±20% around the target value, whichever is greater; thus, it is fixed at ±1.5 µg/L at concentrations less than or equal to 7.5 µg/L.

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Results for Event #1, 2019: Summary Statistics

Whole Blood Cr (µg/L)					
	BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Target (Arithmetic Mean ($\bar{x}$))	4.7	0.8	10.2	7.4	13.8
Upper Limit	6.7	2.8	12.2	9.4	16.6
Lower Limit	2.7	0.0	8.2	5.4	11.0
Arithmetic SD (s)	0.8	0.6	0.3	0.3	0.4
Arithmetic RSD (%)	17	75	2.9	4.5	2.9
Number of Sample Measurements (N)	6	6	5	5	5

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
	Target	**4.7**	**0.8**	**10.2**	**7.4**	**13.8**
110	DRC/CC-ICP-MS	4.7	0.7	10.3	7.5	14.4
147	DRC/CC-ICP-MS	4.60	0.450	9.72	6.97	14.1
293	DRC/CC-ICP-MS	5.65	0.83	9.96	7.31	13.5
391	DRC/CC-ICP-MS	4.97	2.311	9.196	6.977	12.175
401	DRC/CC-ICP-MS	5.2	2.0	10.3	7.3	13.3
597	DRC/CC-ICP-MS	4.94	0.771	10.6	7.86	13.8
598	DRC/CC-ICP-MS	3.21	0.168	*6.80 ↓	*4.21 ↓	*7.75 ↓

Based on the grading criteria for Cr in Whole Blood, 91% of results were satisfactory, with 1 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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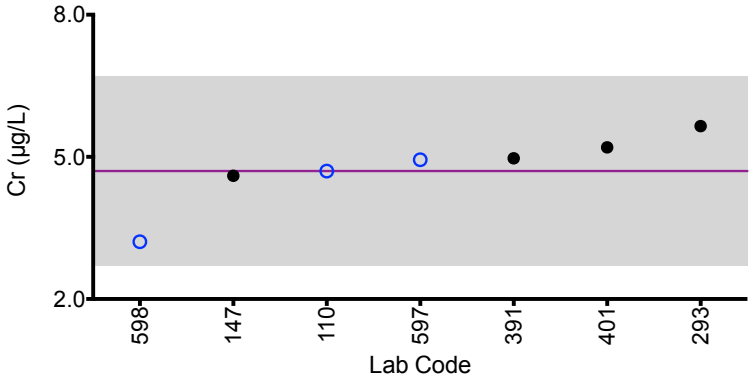
Results for Event #1, 2019: Summary Figures

Whole Blood Cr

BE19-01



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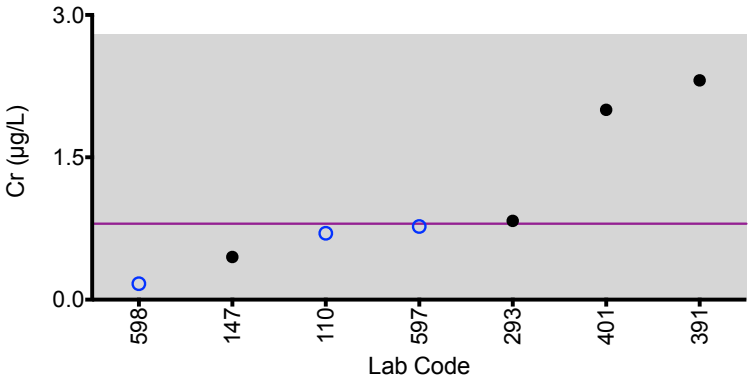

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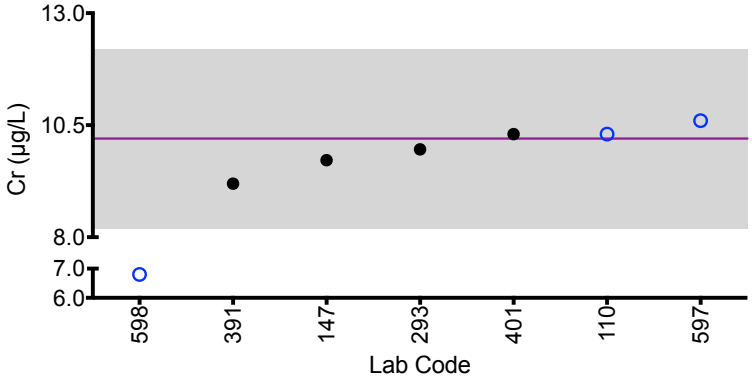

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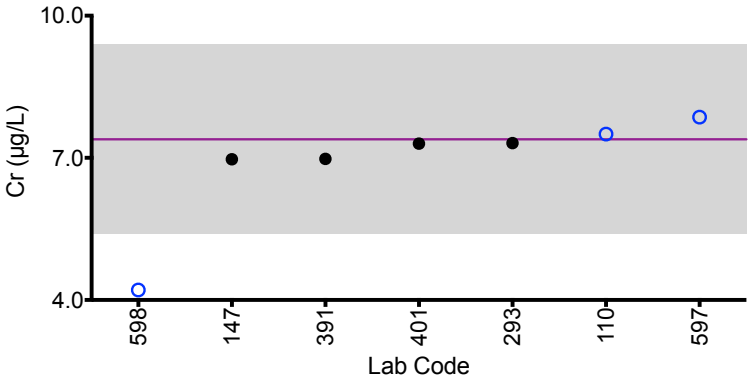

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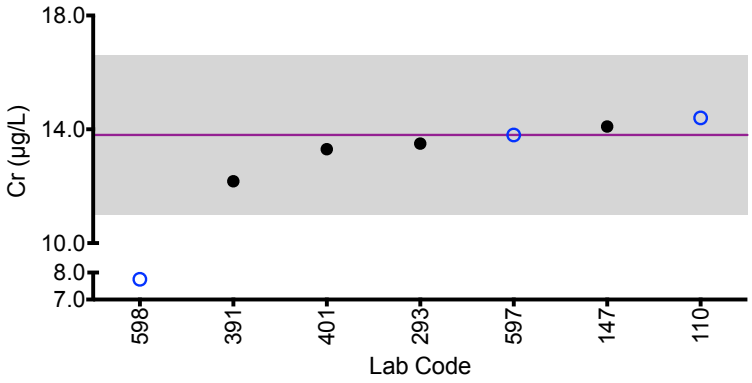

Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2019: Summary Statistics

Whole Blood Hg (µg/L)					
	BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Target (Robust Mean (x*))	1.28	25.2	37	16.0	8.8
Upper Limit	4.28	32.8	48	20.8	11.8
Lower Limit	0.00	17.6	26	11.2	5.8
Robust SD (s*)	0.19	2.4	3	1.3	0.7
Robust RSD (%)	15	9.5	7.9	8.1	8.0
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.06	0.8	1	0.4	0.2

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
	Target	**1.28**	**25.2**	**37**	**16.0**	**8.8**
103	DRC/CC-ICP-MS	1.28	27.0	38.3	16.7	9.40
107	ICP-MS/MS	1.23	25.37	37.57	16.18	8.8
110	ICP-MS	1.04	23.3	34.2	15.2	7.64
116	ICP-MS/MS	1.50	29.7	43.7	18.9	10.5
147	ICP-MS	1.18	23.1	33.5	15.1	8.69
200	ICP-MS	1.4	23.2	32.6	15.4	8.2
293	DRC/CC-ICP-MS	1.18	24.07	34.81	15.47	8.26
391	CV-AAS	1.664	25.484	26.54	9.411 ↓	3.737 ↓
401	DRC/CC-ICP-MS	1.0	23.9	35.9	14.4	8.8
597	DMA	1.58	25.1	36.6	16.5	9.01
598	ICP-MS	1.48	21.3	30.0	13.0	6.99
599	DRC/CC-ICP-MS	1.40	25.7	37.2	17.0	8.78
605	ICP-MS	1.20	26.3	37.4	15.8	9.04
606	DRC/CC-ICP-MS	1.20	26.6	37.9	16.8	9.19
686	ICP-MS	1.36	28.5	41.8	17.8	9.86

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

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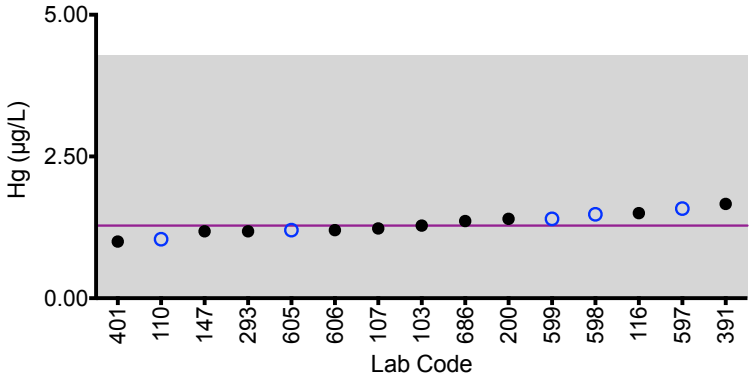
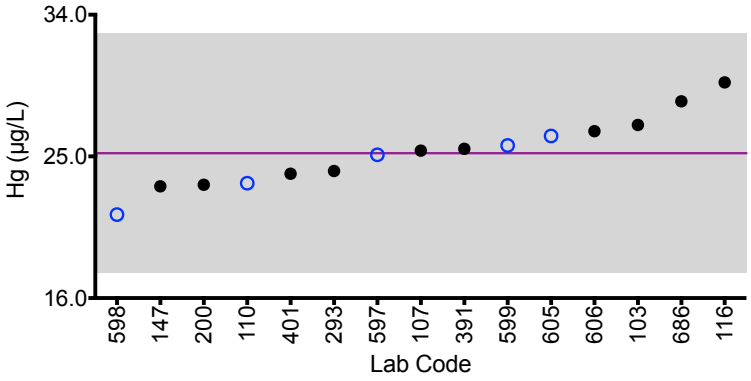
Results for Event #1, 2019: Summary Figures

Whole Blood Hg

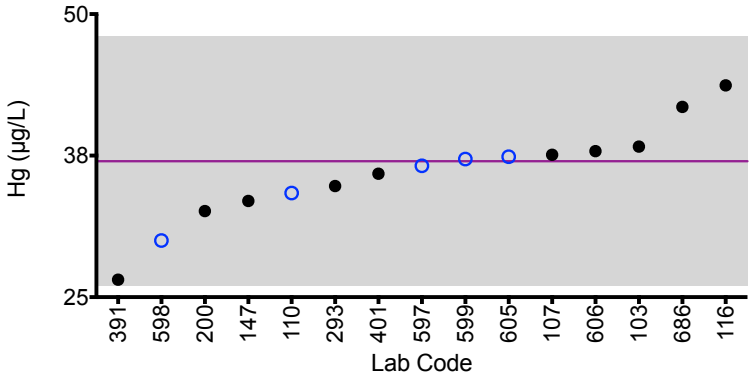
BE19-01



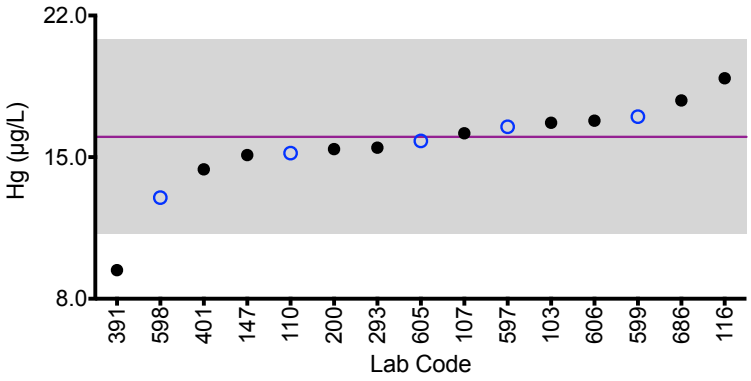
BE19-02



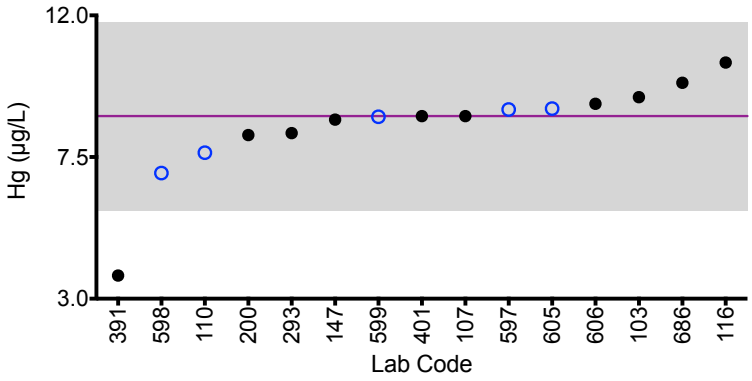
BE19-03



BE19-04



BE19-05



Legend:

o 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.

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Results for Event #1, 2019: Summary Statistics

Whole Blood Mn (µg/L)					
	BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Target (Robust Mean (x*))	15.6	20.8	30.1	12.9	34.0
Upper Limit	18.6	24.3	35.2	15.9	39.8
Lower Limit	12.6	17.3	25.0	9.9	28.2
Robust SD (s*)	1.3	1.4	1.1	1.1	0.7
Robust RSD (%)	8.3	6.7	3.7	8.5	2.1
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.5	0.5	0.4	0.4	0.3

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
	Target	**15.6**	**20.8**	**30.1**	**12.9**	**34.0**
103	DRC/CC-ICP-MS	15.4	21.4	30.1	12.8	34.1
107	ICP-MS/MS	15.08	20.58	30.43	12.71	33.42
110	ICP-MS	15.2	20.0	30.3	13.2	34.8
147	ICP-MS	16.6	22.4	29.8	14.1	35.5
293	DRC/CC-ICP-MS	38.87 ↑	19.14	29.35	11.53	33.54
391	DRC/CC-ICP-MS	17.399	20.659	28.069	14.525	30.894
401	DRC/CC-ICP-MS	17.4	24.3	33.5	15.0	36.9
597	DRC/CC-ICP-MS	15.7	21.2	32.3	13.4	34.2
598	ICP-MS	12.9	20.0	27.7	11.9	33.1
599	DRC/CC-ICP-MS	15.63	21.20	30.44	13.28	33.57
606	DRC/CC-ICP-MS	14.3	19.5	28.5	12.0	33.4

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

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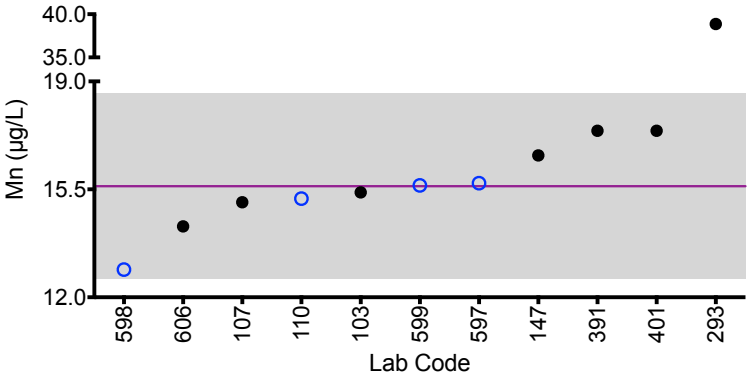
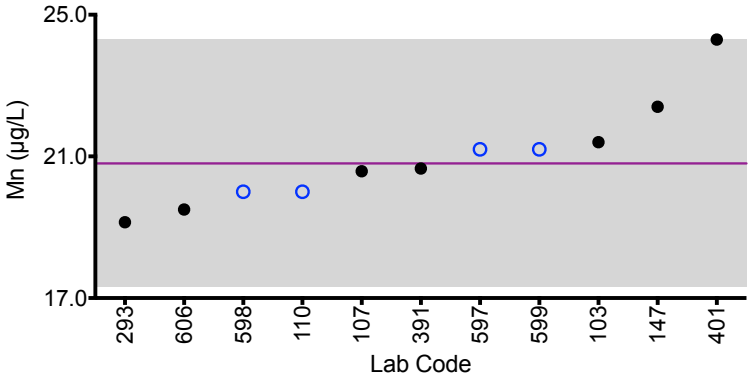
Results for Event #1, 2019: Summary Figures

Whole Blood Mn

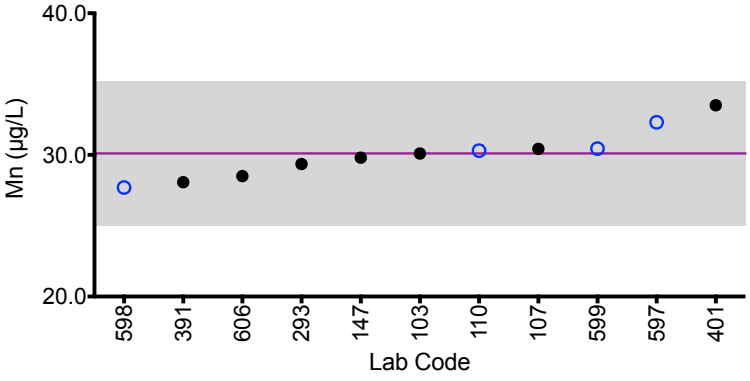
BE19-01



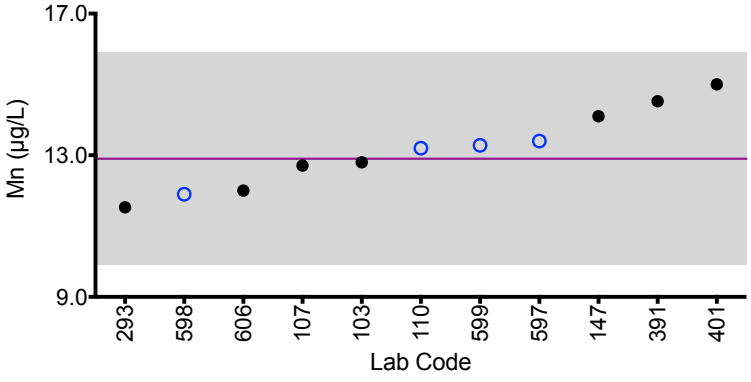
BE19-02



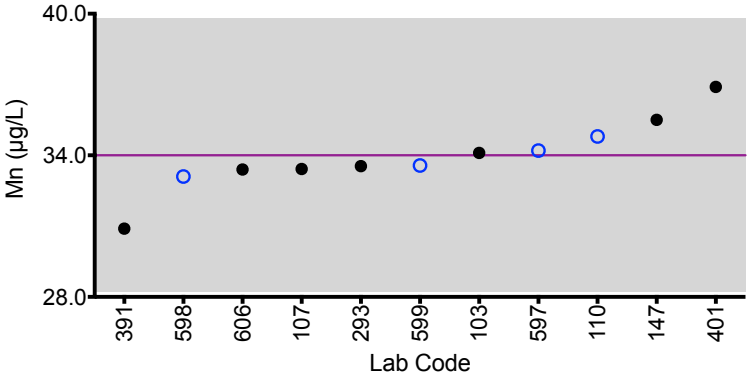
BE19-03



BE19-04



BE19-05



Legend:

o 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 ±17% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 17.7 µg/L.

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Results for Event #1, 2019: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Target (Robust Mean (x*))	0.84	5.5	2.29	1.80	9.3
Upper Limit	2.84	7.5	4.29	3.80	11.3
Lower Limit	0.00	3.5	0.29	0.00	7.3
Robust SD (s*)	0.06	0.4	0.19	0.13	0.6
Robust RSD (%)	7.1	7.6	8.3	7.2	6.5
Number of Sample Measurements (N)	11	14	14	14	14
Standard Uncertainty (*u*)	0.02	0.1	0.06	0.04	0.2

The acceptable range is based on quality specifications:
±2 µg/dL or ±10% around the target value, whichever is greater; thus, it is fixed at ±2 µg/dL at concentrations less than or equal to 20 µg/dL. These quality specifications are recommended by the Clinical Laboratory Standards Institute (CLSI, C40-A2) and have been proposed for use in proficiency testing programs approved under CLIA by the Centers for Medicare and Medicaid Services (CMS) in the USA. (http://shop.clsi.org/C40.html)

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Results for Event #1, 2019:
Performance of Participating Laboratories

Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
	Target	**0.84**	**5.5**	**2.29**	**1.80**	**9.3**
103	DRC/CC-ICP-MS	0.836	5.69	2.32	1.79	9.55
107	ICP-MS/MS	0.83	5.56	2.32	1.81	9.29
110	ICP-MS	0.83	5.56	2.33	1.82	9.34
116	ICP-MS/MS	0.870	6.08	2.45	1.91	10.1
147	ICP-MS	0.787	5.08	2.03	1.64	8.89
293	DRC/CC-ICP-MS	0.83	5.58	2.27	1.86	9.51
343	ASV-LeadCare	2.1	5.2	3	1.9	9.3
391	ETAAS-Z	0.44	3.91	1.22	0.99	7.36
401	DRC/CC-ICP-MS	0.8	5.4	2.3	1.7	8.9
597	DRC/CC-ICP-MS	0.915	5.98	2.47	1.99	9.69
598	ICP-MS	0.694	4.71	1.92	1.48	7.79
599	DRC/CC-ICP-MS	0.941	5.22	2.15	1.71	8.65
605	ICP-MS	<1.00	5.89	2.27	1.84	9.84
606	DRC/CC-ICP-MS	<1.00	5.22	2.13	1.73	8.96
686	ICP-MS	<1	6.00	2.45	1.92	9.96

Based on the grading criteria for Pb 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.

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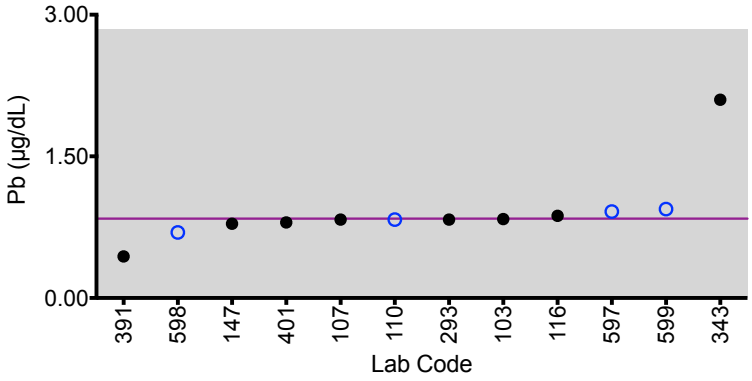
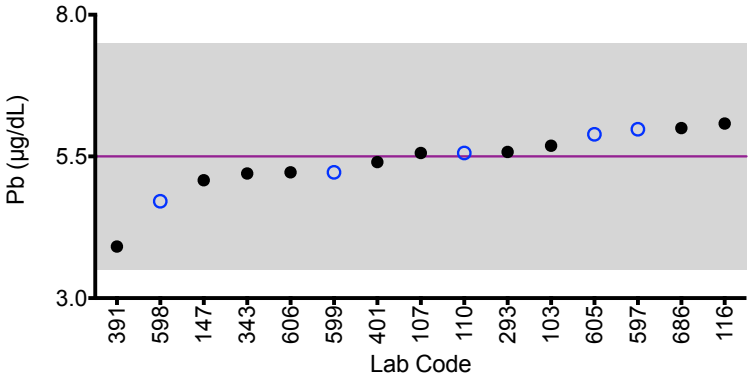
Results for Event #1, 2019: Summary Figures

Whole Blood Pb

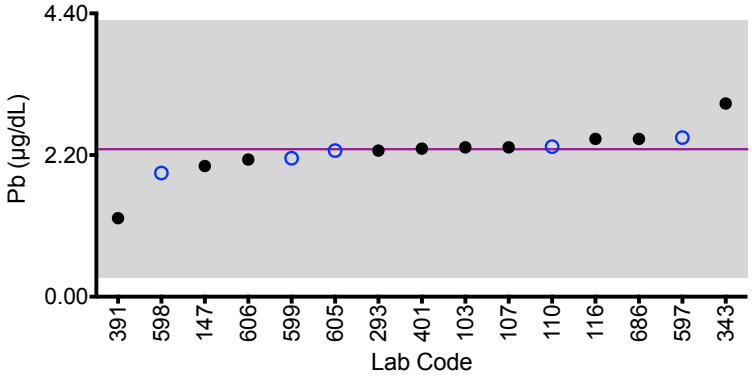
BE19-01



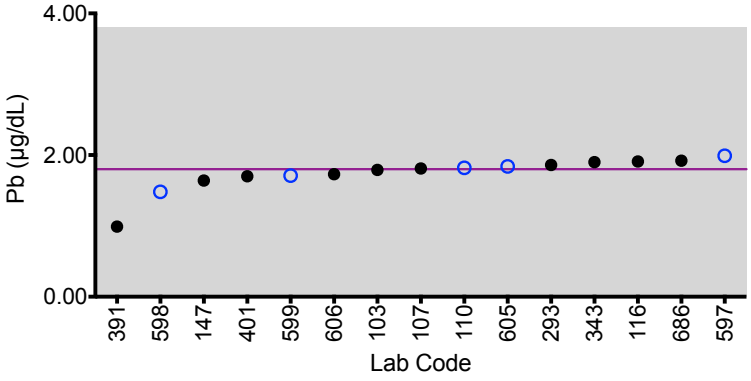
BE19-02



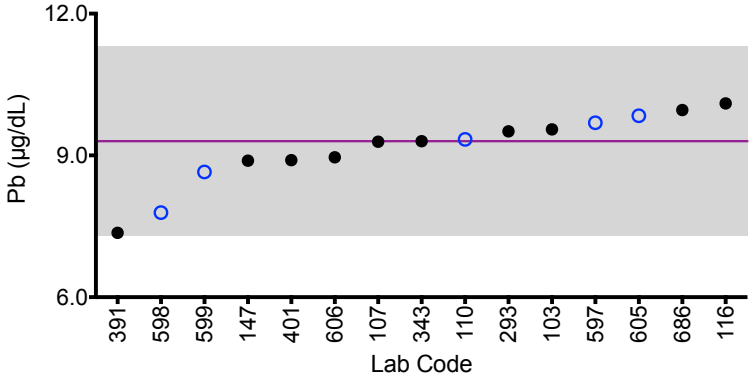
BE19-03



BE19-04



BE19-05



Legend:

o 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.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)

Lab Code	Method	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
110	ICP-MS	1060	1450	969	825	2430
147	ICP-MS	1055	1398	909	801	2382
597	DRC/CC-ICP-MS	1150	1480	978	866	2410
598	ICP-MS	872	1235	811	703	2131
599	DRC/CC-ICP-MS	1040	1380	905	797	2280

Summary Statistics

	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
Arithmetic Mean ($\bar{x}$)	1040	1390	910	800	2330
Arithmetic SD (s)	100	90	70	60	120
Arithmetic RSD (%)	9.6	6.5	7.7	7.5	5.2
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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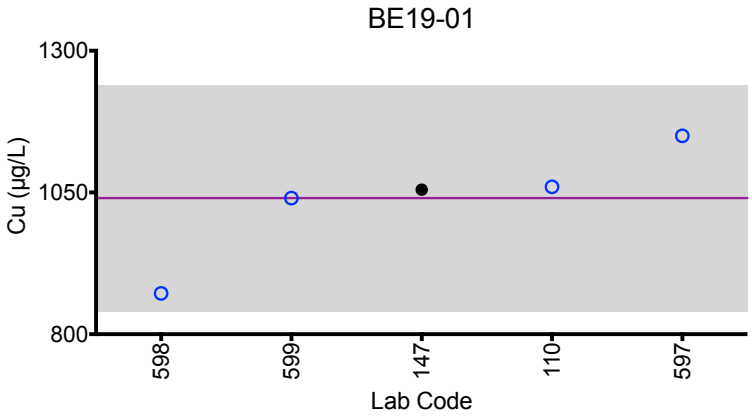
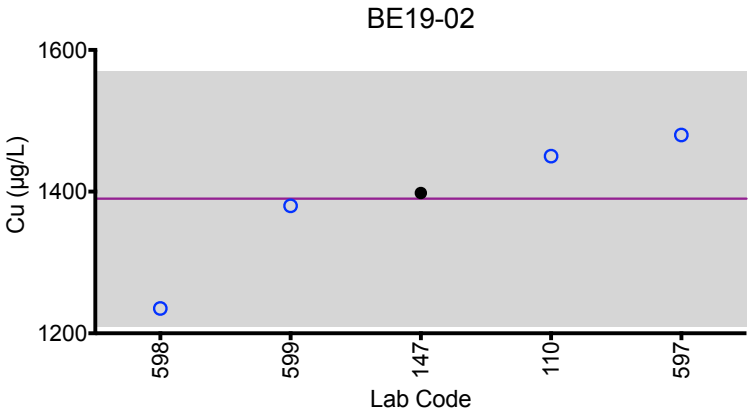
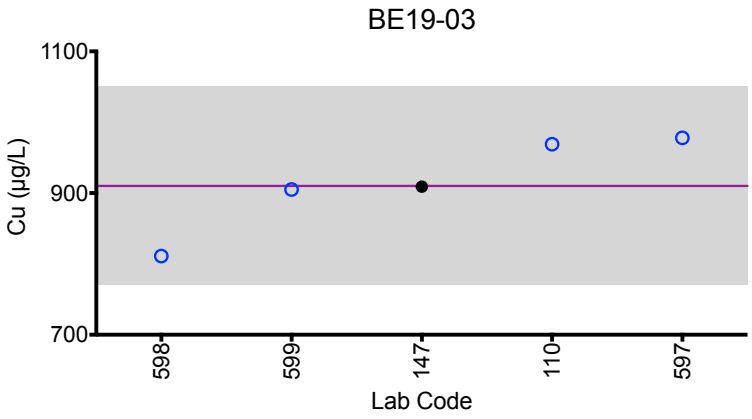
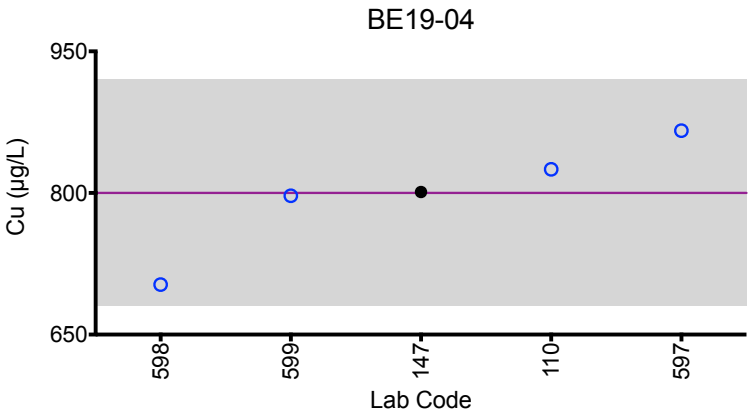
Results for Event #1, 2019: Summary Figures

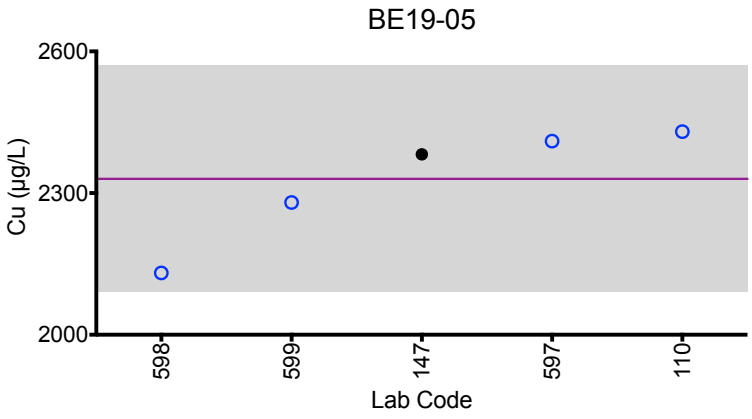
Whole Blood Cu











Legend:
o 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.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
103	DRC/CC-ICP-MS	3.10	<1.50	<1.50	<1.50	6.01
147	ICP-MS	3.47	1.43	0.403	0.540	6.47
597	DRC/CC-ICP-MS	4.04	1.52	0.463	0.672	6.19
598	DRC/CC-ICP-MS	3.37	1.31	0.205	0.428	*3.95
599	DRC/CC-ICP-MS	3.09	1.66	0.507	0.601	5.97
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Arithmetic Mean ($\bar{x}$)		3.4	1.48	0.39	0.56	6.2
Arithmetic SD (s)		0.4	0.15	0.13	0.10	0.2
Arithmetic RSD (%)		12	10	33	18	3.7
Number of Sample Measurements (N)		5	4	4	4	4

*Denotes a statistical Outlier.

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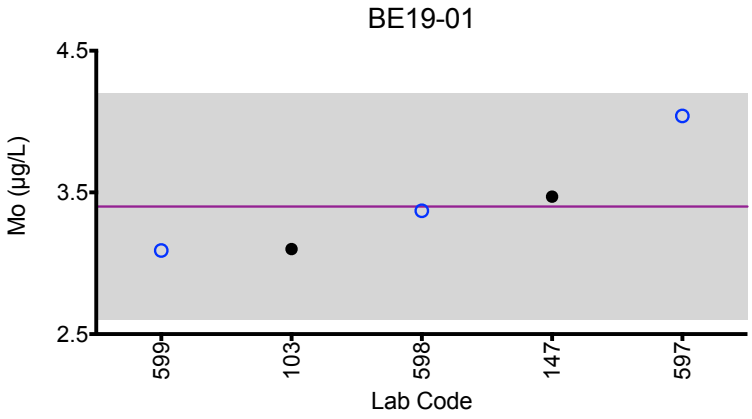
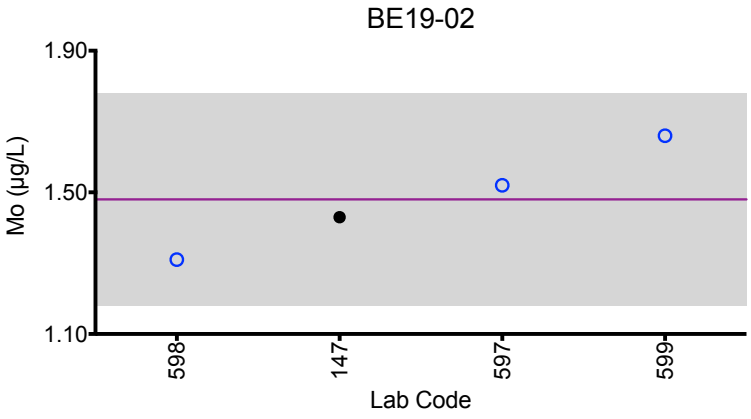
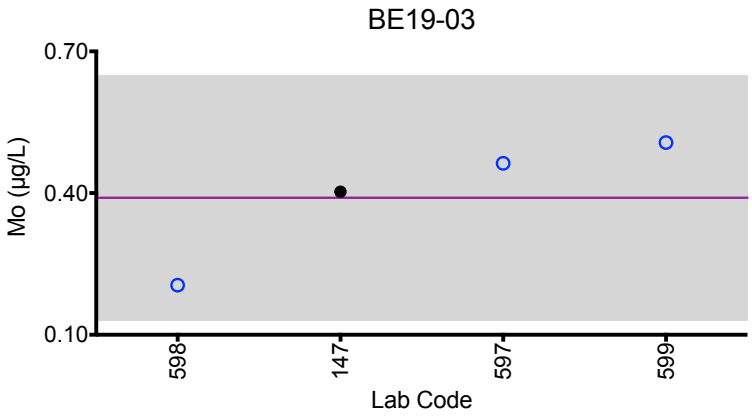
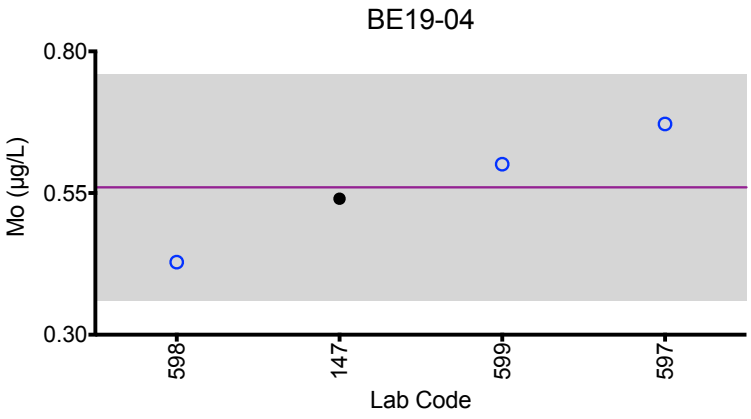
Results for Event #1, 2019: Summary Figures

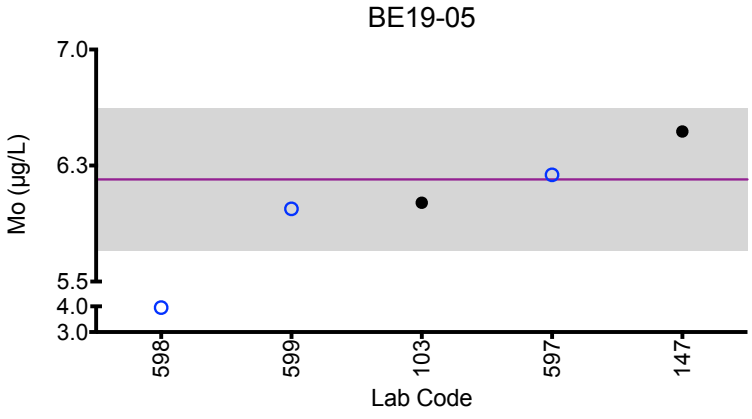
Whole Blood Mo











Legend:
o 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.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
103	DRC/CC-ICP-MS	0.552	0.562	1.278	<0.150	2.48
110	ICP-MS	0.60	0.57	1.36	0.05	2.54
147	ICP-MS	0.569	0.544	1.16	<0.0548	2.30
293	DRC/CC-ICP-MS	*1.59	*0.94	1.57	0.09	2.37
597	DRC/CC-ICP-MS	0.678	0.674	1.51	0.0580	2.57
598	ICP-MS	0.56	0.53	1.33	<0.2	2.39
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Arithmetic Mean ($\bar{x}$)		0.59	0.58	1.37	0.07	2.44
Arithmetic SD (s)		0.05	0.06	0.15	0.02	0.11
Arithmetic RSD (%)		8.5	10	11	32	4.5
Number of Sample Measurements (N)		5	5	6	3	6

*Denotes a statistical Outlier.

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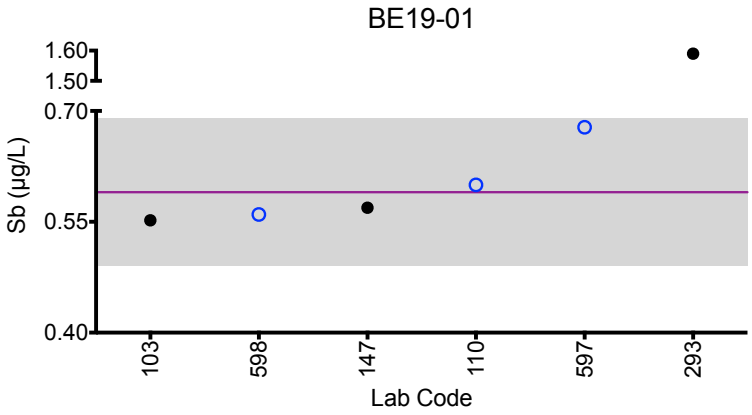
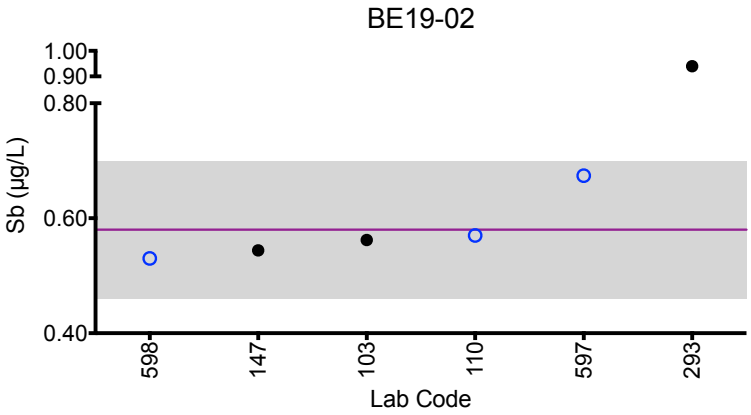
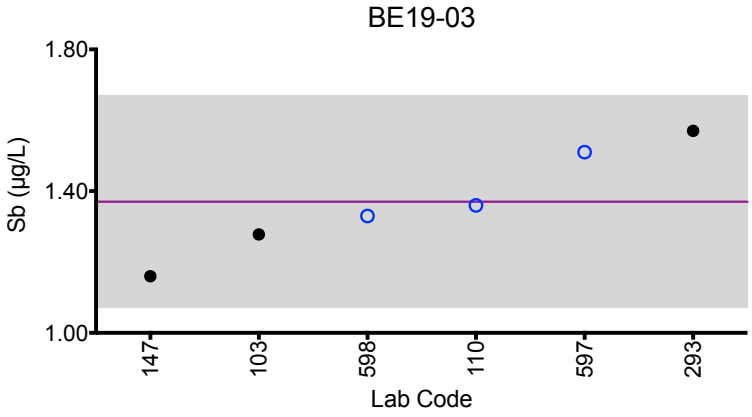
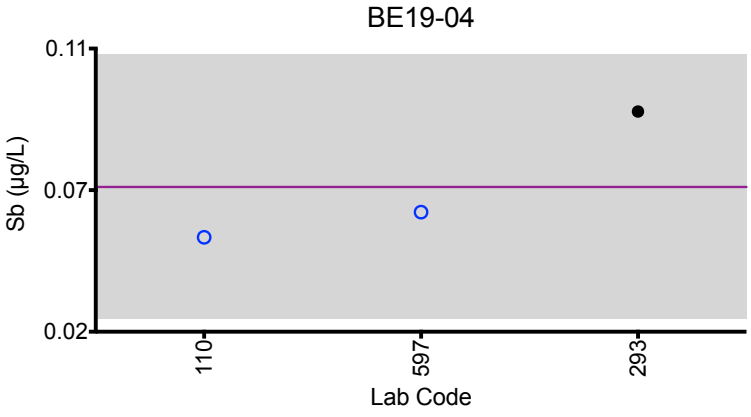
Results for Event #1, 2019: Summary Figures

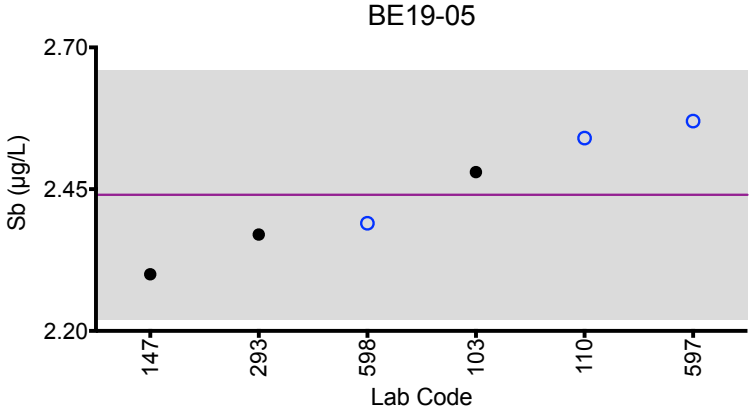
Whole Blood Sb











Legend:
o 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 #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)

Lab Code	Method	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
103	DRC/CC-ICP-MS	157	323	244	480	147
107	ICP-MS/MS	164.93	330.79	259.56	506.71	151.78
110	DRC/CC-ICP-MS	158	305	245	466	152
147	ICP-MS	160	310	247	506	157
401	DRC/CC-ICP-MS	177	362	268	461	167
598	DRC/CC-ICP-MS	128	257	*204	397	*89.4
599	DRC/CC-ICP-MS	159	297	249	462	148

Summary Statistics

	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
Arithmetic Mean ($\bar{x}$)	158	312	252	468	154
Arithmetic SD (s)	15	32	10	37	7
Arithmetic RSD (%)	9.5	10	3.8	7.9	4.5
Number of Sample Measurements (N)	7	7	6	7	6

*Denotes a statistical Outlier.

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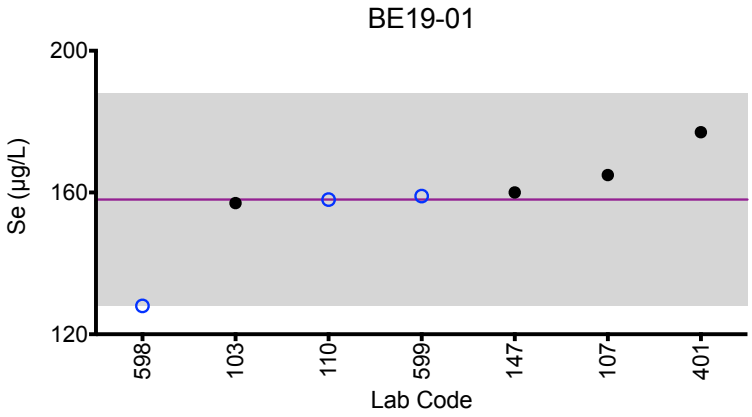
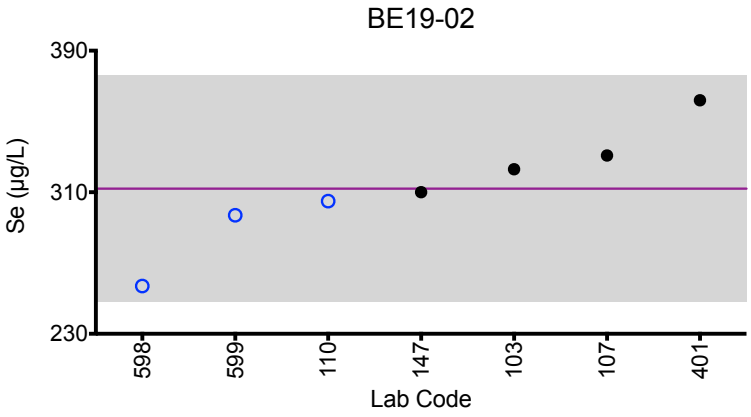
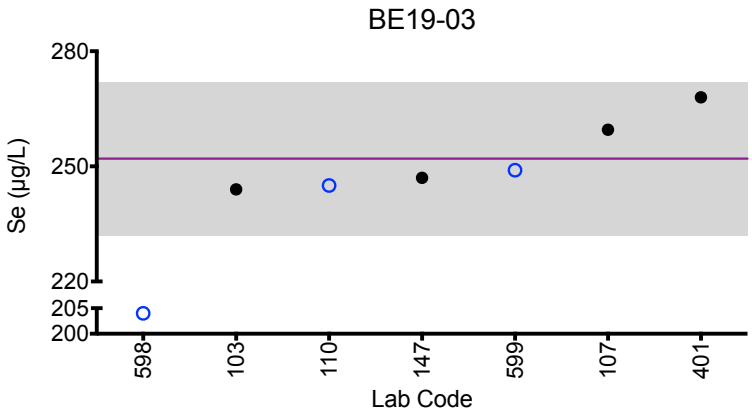
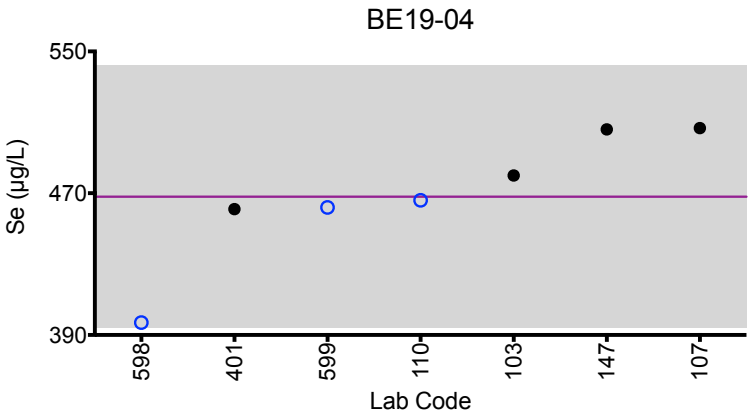
Results for Event #1, 2019: Summary Figures

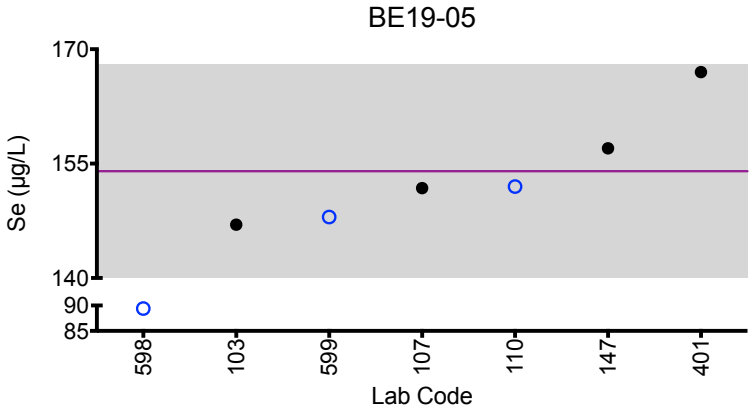
Whole Blood Se











Legend:
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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Tl (µg/L)

Lab Code	Method	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
103	DRC/CC-ICP-MS	0.507	2.26	3.01	<0.0500	1.24
110	ICP-MS	0.48	2.22	3.07	0.02	1.24
147	ICP-MS	0.550	2.19	2.90	<0.0388	1.26
293	DRC/CC-ICP-MS	0.5	2.14	2.9	0.01	1.17
597	DRC/CC-ICP-MS	0.542	2.23	3.02	0.0369	1.16
598	ICP-MS	0.47	*1.93	2.69	<0.05	1.03

Summary Statistics

	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
Arithmetic Mean ($\bar{x}$)	0.51	2.21	2.93	0.022	1.18
Arithmetic SD (s)	0.03	0.05	0.14	0.014	0.09
Arithmetic RSD (%)	6.3	2.3	4.8	64	7.6
Number of Sample Measurements (N)	6	5	6	3	6

*Denotes a statistical Outlier.

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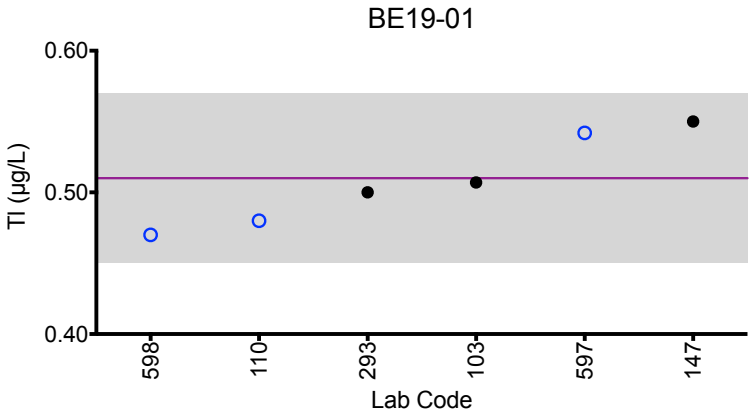
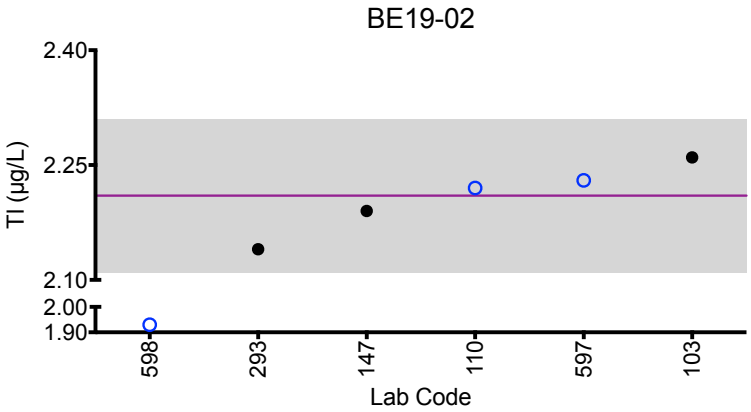
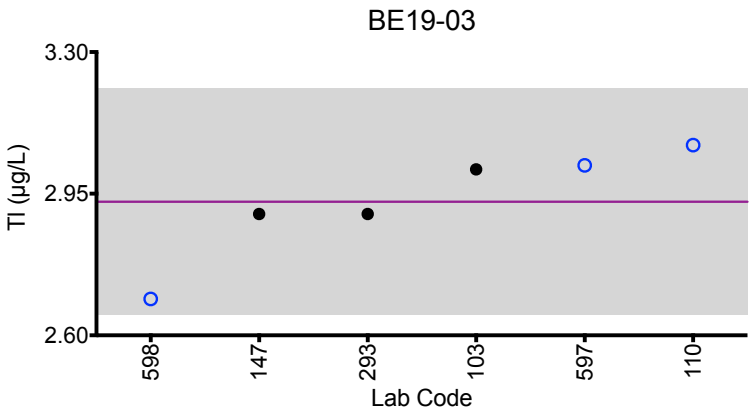
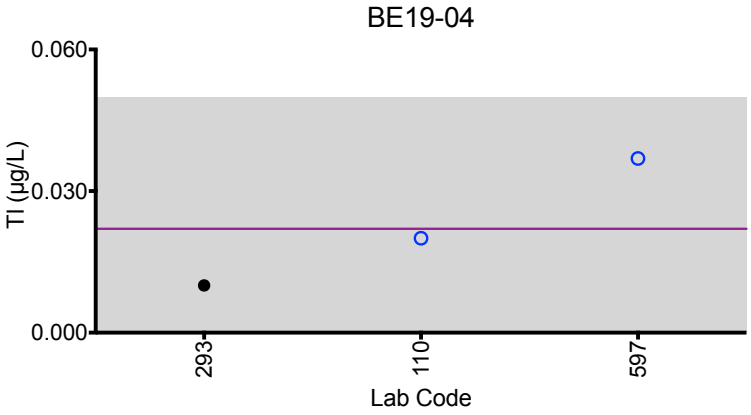
Results for Event #1, 2019: Summary Figures

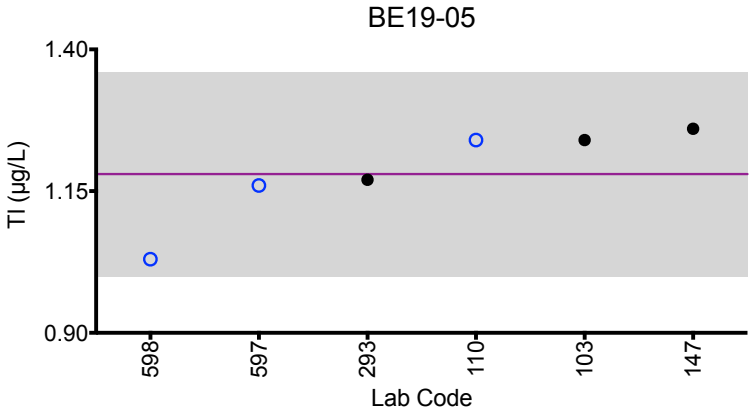
Whole Blood Tl











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)

Lab Code	Method	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
110	DRC/CC-ICP-MS	4.3	7.1	1.7	0.6	5.2
147	DRC/CC-ICP-MS	4.23	6.79	1.40	0.622	5.20
293	DRC/CC-ICP-MS	4.42	7.45	1.76	0.72	5.32
597	DRC/CC-ICP-MS	4.44	6.68	1.67	0.830	5.02
598	DRC/CC-ICP-MS	*2.82	4.90	*0.462	<0.2	*3.21

Summary Statistics

	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
Arithmetic Mean ($\bar{x}$)	4.35	6.6	1.63	0.69	5.18
Arithmetic SD (s)	0.10	1.0	0.16	0.11	0.12
Arithmetic RSD (%)	2.3	15	9.8	16	2.3
Number of Sample Measurements (N)	4	5	4	4	4

*Denotes a statistical Outlier.

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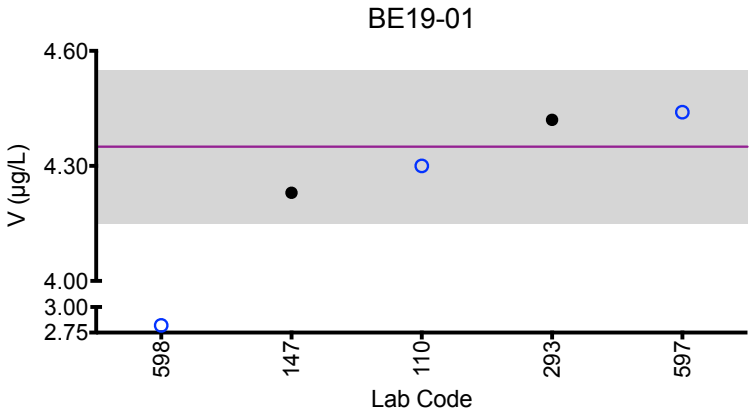
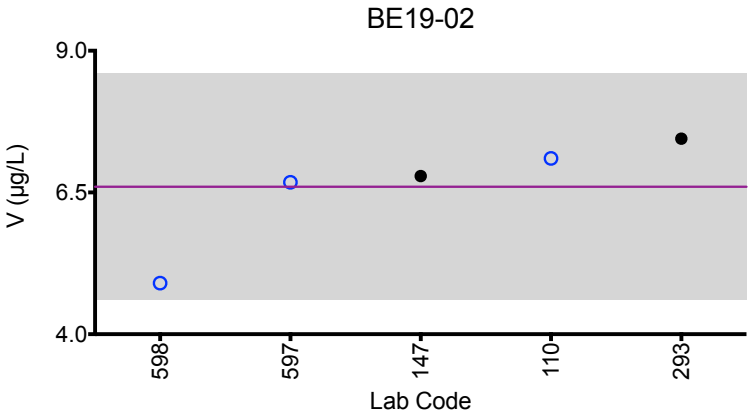
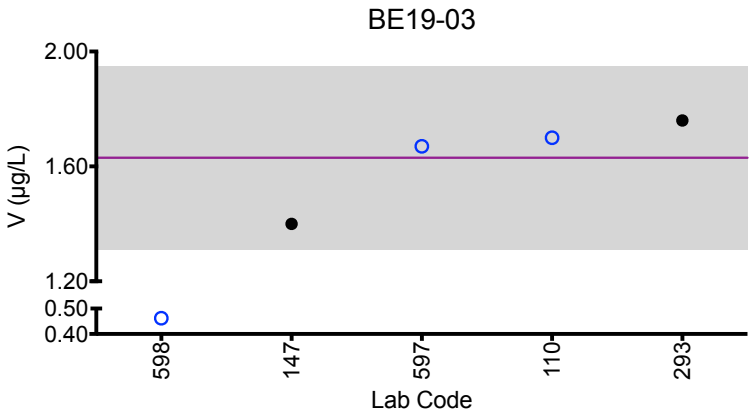
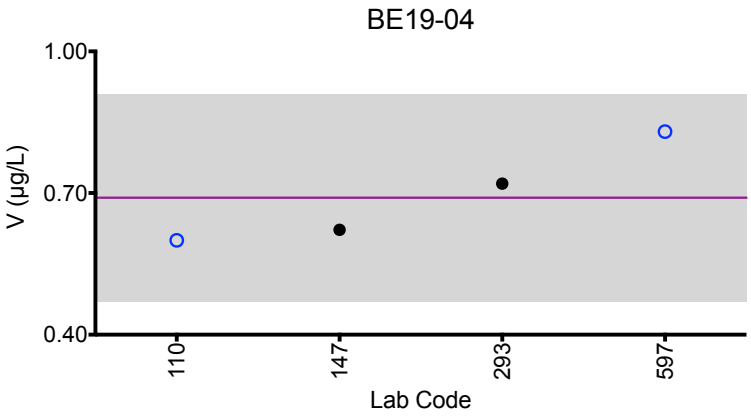
Results for Event #1, 2019: Summary Figures

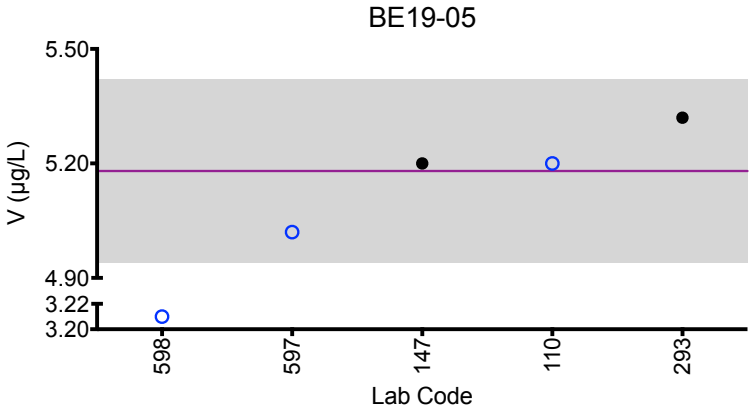
Whole Blood V











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
110	ICP-MS	5210	9260	6040	7550	6640
147	ICP-MS	4784	8301	5020	6863	5987
597	DRC/CC-ICP-MS	5520	9460	6040	8020	6570
598	ICP-MS	3945	7380	4740	6102	5379
599	DRC/CC-ICP-MS	4510	7970	5180	6840	5660
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Arithmetic Mean ($\bar{x}$)		4800	8500	5400	7100	6000
Arithmetic SD (s)		600	900	600	700	600
Arithmetic RSD (%)		13	11	11	9.9	10
Number of Sample Measurements (N)		5	5	5	5	5

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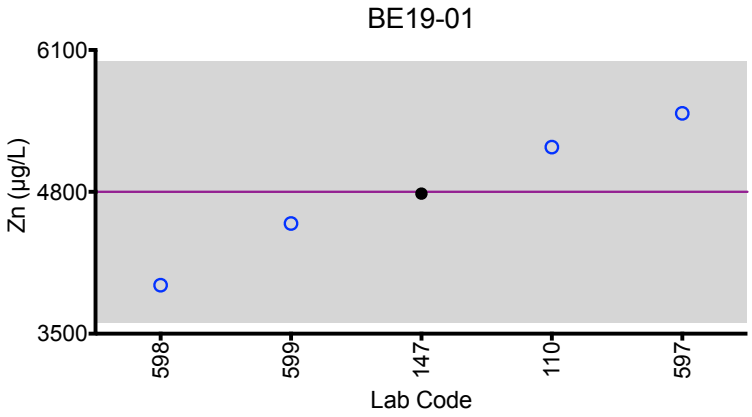
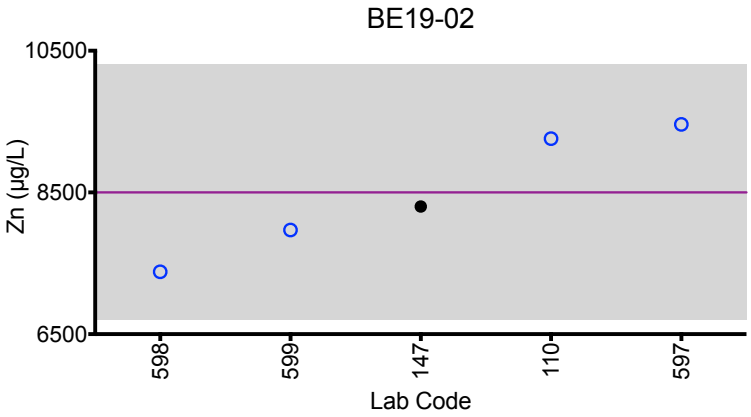
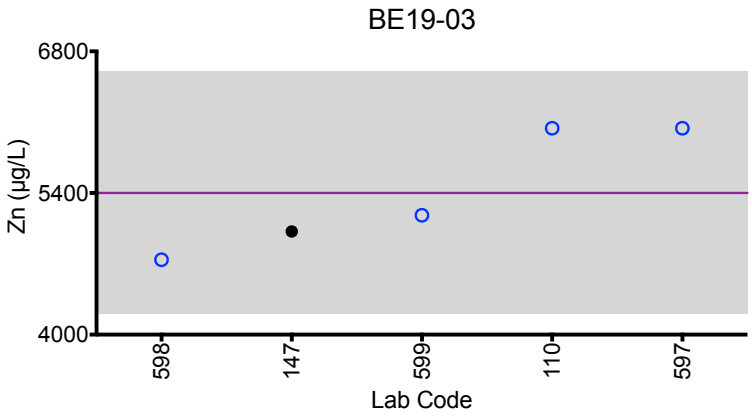
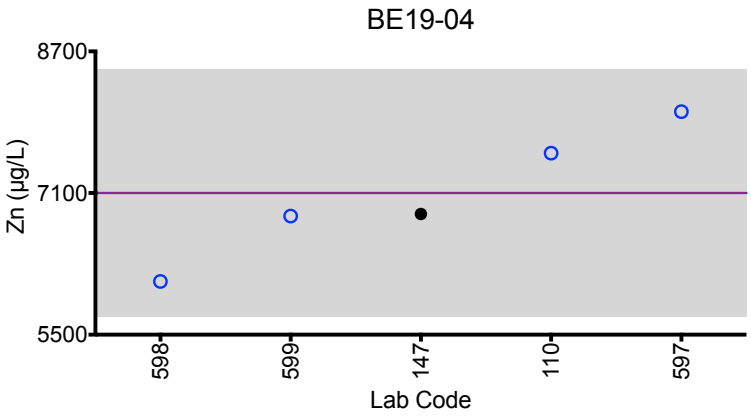
Results for Event #1, 2019: Summary Figures

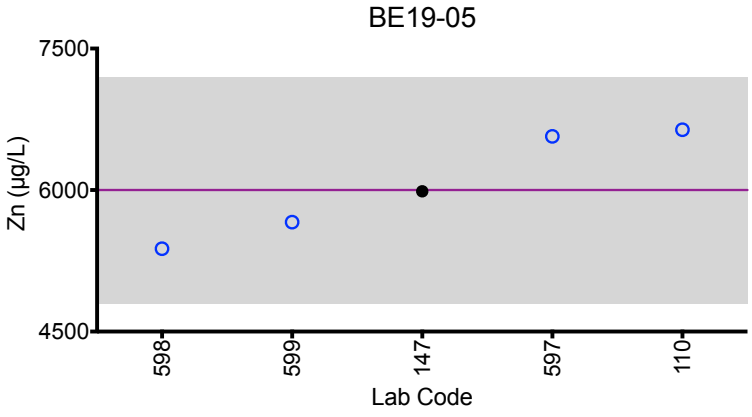
Whole Blood Zn











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
110	ICP-MS	1.7	6.9	6.2	4.2	9.6
147	ICP-MS	1.24	6.54	5.37	4.20	8.94
597	DRC/CC-ICP-MS	1.54	7.57	6.24	5.01	9.90
598	ICP-MS	1.29	6.32	5.57	4.06	8.52
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Arithmetic Mean ($\bar{x}$)		1.4	6.8	5.8	4.4	9.2
Arithmetic SD (s)		0.2	0.5	0.4	0.4	0.6
Arithmetic RSD (%)		15	7.4	6.9	9.1	6.5
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
110	ICP-MS	0.05	0.02	0.03	0.09	0.02
147	ICP-MS	<1.53	<1.53	<1.53	<1.53	<1.53
293	ICP-MS	0.03	0.06	0.02	0.06	0.03
598	ICP-MS	<0.2	0.09	0.11	0.05	<0.2
599	DRC/CC-ICP-MS	0.173	<0.1	<0.1	<0.1	<0.1
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
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 BE19-01, BE19-02, BE19-03, BE19-04, or BE19-05 based on a lack of consensus among participating labs.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
110	ICP-MS	1.13	1.82	1.14	1.34	1.86
597	DRC/CC-ICP-MS	1.21	1.89	1.33	1.40	1.80
598	ICP-MS	1.10	1.73	1.13	1.23	1.75
599	DRC/CC-ICP-MS	1.02	1.54	1.10	1.26	1.50
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Arithmetic Mean ($\bar{x}$)		1.12	1.75	1.18	1.31	1.73
Arithmetic SD (s)		0.08	0.15	0.10	0.08	0.16
Arithmetic RSD (%)		7.1	8.6	8.5	6.1	9.2
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
110	DRC/CC-ICP-MS	3.6	10.5	7.6	*0.8	5.4
147	ICP-MS	3.02	9.81	7.28	0.361	4.36
597	DRC/CC-ICP-MS	3.50	10.86	8.29	0.386	4.48
598	ICP-MS	2.17	8.07	5.90	0.31	3.42
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Arithmetic Mean ($\bar{x}$)		3.1	9.8	7.3	0.35	4.4
Arithmetic SD (s)		0.7	1.2	1.0	0.04	0.8
Arithmetic RSD (%)		23	12	14	11	18
Number of Sample Measurements (N)		4	4	4	3	4

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Pt (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
110	ICP-MS	0.25	4.75	1.26	7.48	3.03
598	ICP-MS	0.29	4.20	1.12	6.29	2.64
599	DRC/CC-ICP-MS	0.303	4.16	1.11	7.45	2.55
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Arithmetic Mean ($\bar{x}$)		0.28	4.4	1.16	7.1	2.7
Arithmetic SD (s)		0.03	0.3	0.08	0.7	0.3
Arithmetic RSD (%)		11	6.8	6.9	9.9	9.5
Number of Sample Measurements (N)		3	3	3	3	3

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
110	ICP-MS	0.24	0.35	0.36	0.24	0.34
147	ICP-MS	<0.190	<0.190	<0.190	<0.190	<0.190
597	DRC/CC-ICP-MS	0.240	0.358	0.268	0.298	0.329
598	ICP-MS	*0.08	*0.16	*0.07	0.15	*0.18
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Arithmetic Mean ($\bar{x}$)		0.24	0.35	0.33	0.23	0.33
Arithmetic SD (s)		0.00	0.01	0.04	0.07	0.01
Arithmetic RSD (%)		0.0	1.6	13	30	2.3
Number of Sample Measurements (N)		2	2	2	3	2

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
103	DRC/CC-ICP-MS	0.173	0.0562	<0.0500	0.114	0.210
110	ICP-MS	0.188	0.070	0.038	0.137	0.201
147	ICP-MS	0.170	0.0531	0.0350	0.109	0.206
598	ICP-MS	0.18	0.06	0.04	0.11	0.20
Summary Statistics						
		BE19-01	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
Arithmetic Mean ($\bar{x}$)		0.178	0.060	0.038	0.117	0.204
Arithmetic SD (s)		0.008	0.007	0.002	0.013	0.005
Arithmetic RSD (%)		4.5	12	6.6	11	2.5
Number of Sample Measurements (N)		4	4	3	4	4

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)

Lab Code	Method	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
110	ICP-MS	0.85	1.86	0.15	0.14	0.62
200	ICP-MS	0.97	2.11	0.2	0.2	0.68
598	ICP-MS	0.95	1.80	0.14	0.17	0.58

Summary Statistics

	BE19-01	BE19-02	BE19-03	BE19-04	BE19-05
Arithmetic Mean ($\bar{x}$)	0.92	1.92	0.16	0.17	0.63
Arithmetic SD (s)	0.06	0.16	0.03	0.03	0.05
Arithmetic RSD (%)	6.5	8.3	19	18	7.9
Number of Sample Measurements (N)	3	3	3	3	3

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Results for Event #1, 2019:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
147	ICP-MS	<0.173	0.323	<0.173	<0.173	0.369

Whole Blood Al (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
147	ICP-MS	<5.40	<5.40	<5.40	<5.4	<5.40

Whole Blood Bi (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
147	ICP-MS	<0.0251	<0.0251	<0.0251	<0.0251	<0.0251

Whole Blood I (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
147	ICP-MS	35.2	18.4	34.4	23.9	20.4

Whole Blood Li (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
147	ICP-MS	0.590	1.52	0.645	0.560	1.73

Whole Blood Mg (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
597	DRC/CC-ICP-MS	28400	27000	27500	32800	26000

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
103	DRC/CC-ICP-MS	17.2	20.7	17.6	16.3	21.4

Whole Blood Te (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
147	ICP-MS	<0.0791	<0.0791	<0.0791	<0.0791	<0.0791

Whole Blood Th (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
147	ICP-MS	<0.0169	<0.0169	<0.0169	<0.0169	<0.0169

Whole Blood Ti (µg/L)						
Lab Code	**Method**	**BE19-01**	**BE19-02**	**BE19-03**	**BE19-04**	**BE19-05**
200	DRC/CC-ICP-MS	5.5	6.7	2.1	4.7	8.5

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Event #1, 2019

Trace Elements in Urine

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Event #1, 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 21 elements were reported by at least one participant: Ag, Al, B, Bi, Cs, Cu, Fe, Li, Mg, Mo, Ni, Pt, Sb, Se, Sn, Sr, Te, Th, V, W, and Zn. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

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

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Results for Event #1, 2019: Summary Statistics

	Urine As (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	177	59	72	119	11.7
Upper Limit	212	71	86	143	17.7
Lower Limit	142	47	58	95	5.7
Robust SD (s*)	7	4	5	4	0.6
Robust RSD (%)	4.0	7.2	6.9	3.1	5.1
Number of Sample Measurements (N)	18	18	18	18	18
Standard Uncertainty (*u*)	2	1	2	1	0.2

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Urine As (µg/L)				
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**177**	**59**	**72**	**119**	**11.7**
103	DRC/CC-ICP-MS	177	56.8	71.3	117	11.3
107	DRC/CC-ICP-MS	169.77	54.88	66.79	120.24	11.06
110	DRC/CC-ICP-MS	186	61.6	76.6	126	12.4
116	ICP-MS/MS	178	62.4	75.5	119	11.7
147	ICP-MS	169	52.2	64.7	108	10.4
293	DRC/CC-ICP-MS	172.93	56.65	69.04	118.95	11.57
324	ICP-MS	175.083	56.216	71.373	119.148	11.756
391	DRC/CC-ICP-MS	175.318	58.103	72.668	114.343	12.436
399	DRC/CC-ICP-MS	183	58.8	73.1	117	12.0
401	DRC/CC-ICP-MS	181	57.6	72.5	121	11.8
597	DRC/CC-ICP-MS	171	56.4	69.0	114	11.6
598	DRC/CC-ICP-MS	150	48.9	62.8	103	10.2
599	DRC/CC-ICP-MS	174	60.2	73.6	119.0	11.7
604	DRC/CC-ICP-MS	174	56.5	69.7	109	11.3
605	ICP-MS	183	63.8	76.7	127	12.1
606	DRC/CC-ICP-MS	191	66.5	83.3	131	13.1
630	DRC/CC-ICP-MS	185	62.5	78.6	129	13.3
676	DRC/CC-ICP-MS	175	61.6	77.4	120	12.0
686	DRC/CC-ICP-MS	177	60.8	73.4	120	12.2

Based on the grading criteria for As in Urine, 100% of results were satisfactory, with 0 of the 19 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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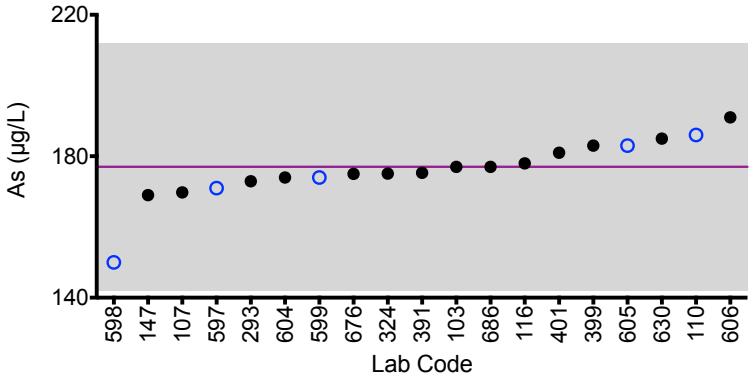
Results for Event #1, 2019: Summary Figures

Urine As

UE19-01



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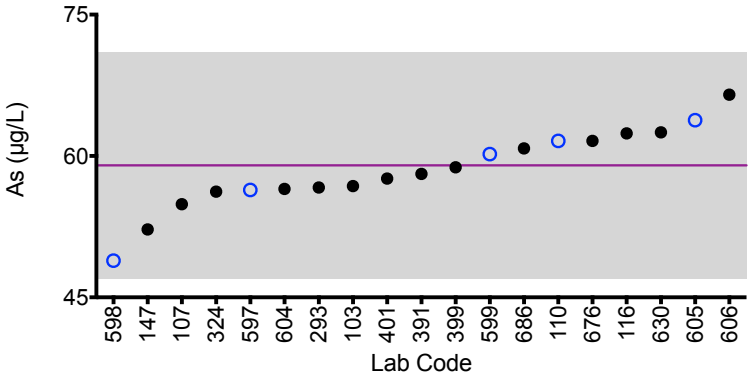

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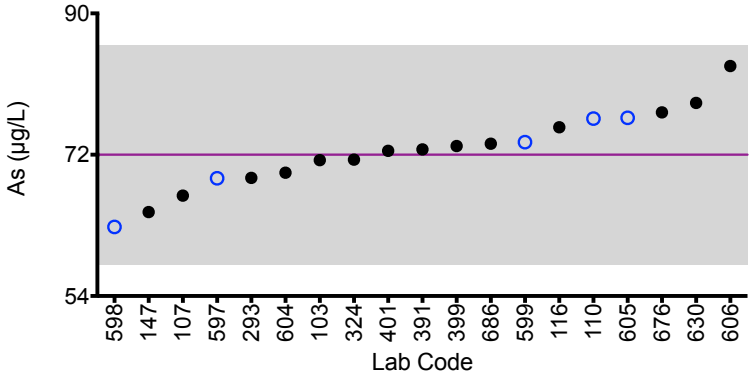

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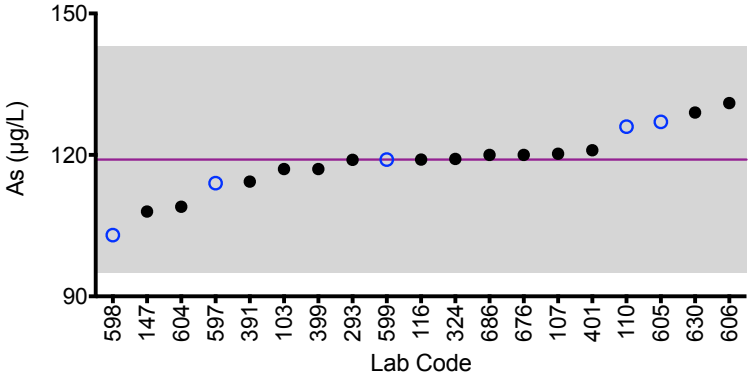

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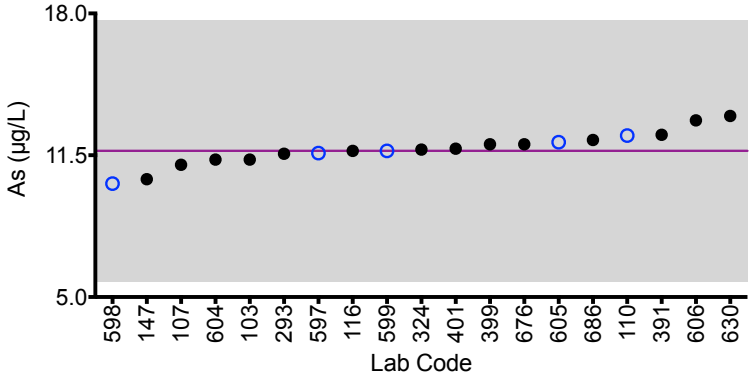

Legend:

o 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:

±6 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±6 µg/L at concentrations less than or equal to 30 µg/L.

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Results for Event #1, 2019: Summary Statistics

	Urine Ba (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	10.2	3.2	7.8	14.6	5.7
Upper Limit	12.2	4.2	9.4	17.5	6.8
Lower Limit	8.2	2.2	6.2	11.7	4.6
Robust SD (s*)	0.7	0.3	0.5	1.2	0.5
Robust RSD (%)	6.9	9.0	6.4	8.2	8.8
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (*u*)	0.3	0.1	0.2	0.4	0.2

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Urine Ba (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**10.2**	**3.2**	**7.8**	**14.6**	**5.7**
107	ICP-MS	10.51	3.37	7.91	14.41	5.76
110	ICP-MS	11.0	3.44	8.37	15.5	5.84
116	ICP-MS/MS	9.78	3.00	7.39	13.5	5.35
147	ICP-MS	9.27	3.20	7.42	14.1	5.14
399	ICP-MS	10.3	3.13	7.72	14.4	5.57
597	DRC/CC-ICP-MS	11.4	3.46	8.03	15.3	6.33
598	ICP-MS	9.15	2.71	6.68	12.7	4.84
599	DRC/CC-ICP-MS	10.2	3.24	7.53	14.3	5.72
605	ICP-MS	10.4	3.18	7.73	14.9	5.57
606	DRC/CC-ICP-MS	10.8	3.48	8.29	16.0	6.03
607	ICP-MS	10.5	3.83	9.34	19.0 ↑	6.69
676	ICP-MS	9.49	2.84	7.35	13.5	5.16
686	ICP-MS	10.2	3.25	8.01	15.2	5.78

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

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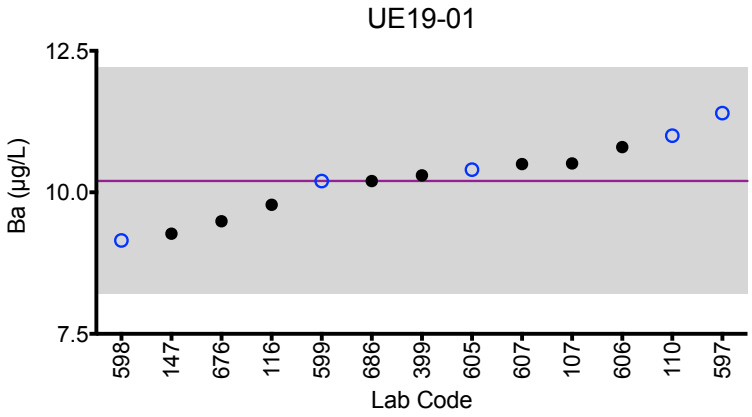
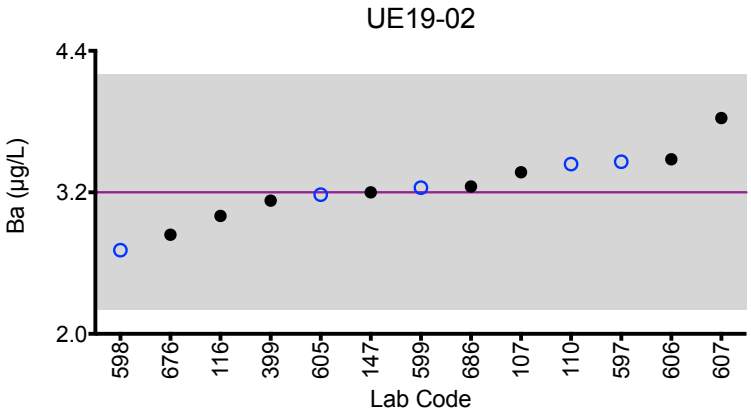
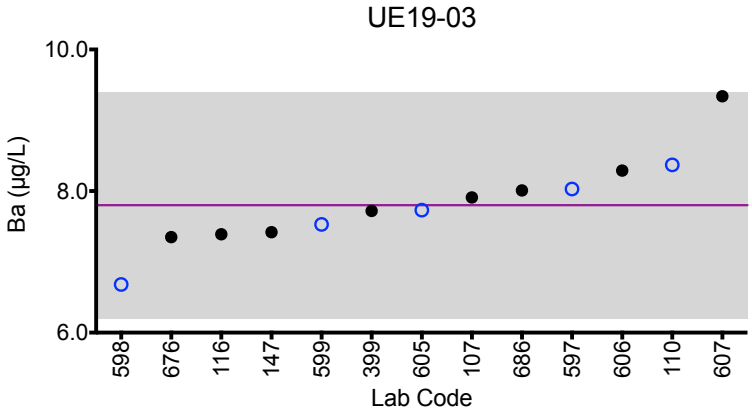
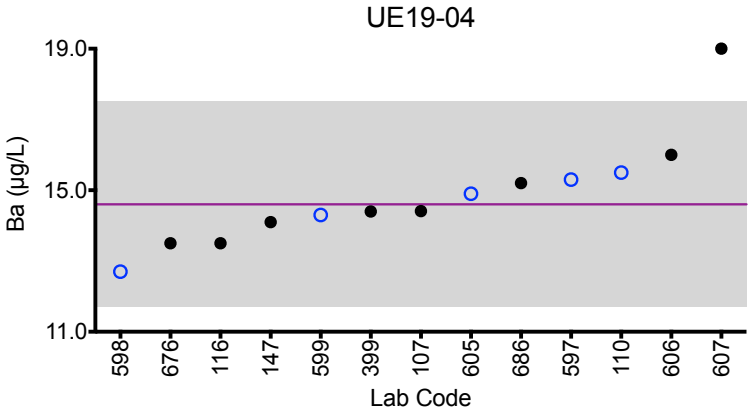
Results for Event #1, 2019: Summary Figures

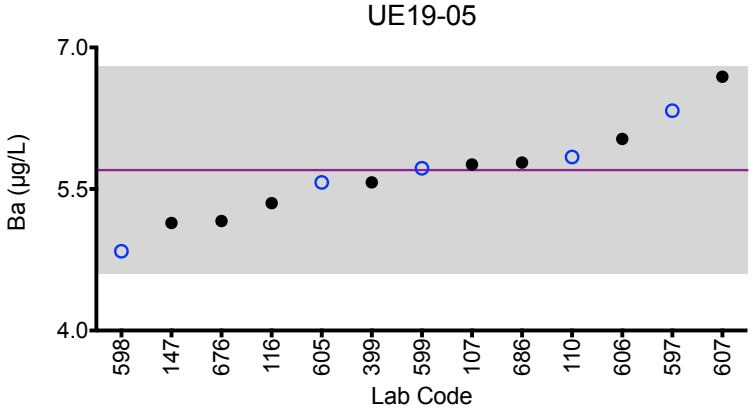
Urine Ba











Legend:

o 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.

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Results for Event #1, 2019: Summary Statistics

	Urine Be (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	1.83	0.56	3.47	5.24	1.07
Upper Limit	2.83	1.56	4.47	6.29	2.07
Lower Limit	0.83	0.00	2.47	4.19	0.07
Robust SD (s*)	0.09	0.05	0.21	0.20	0.05
Robust RSD (%)	4.9	8.9	6.1	3.8	4.7
Number of Sample Measurements (N)	12	12	12	12	12
Standard Uncertainty (*u*)	0.03	0.02	0.07	0.07	0.02

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**1.83**	**0.56**	**3.47**	**5.24**	**1.07**
107	ICP-MS	2.011	0.568	3.72	5.37	1.094
110	ICP-MS	1.88	0.533	3.3	4.87	1.00
116	ICP-MS/MS	1.72	0.496	3.21	5.12	0.943
147	ICP-MS	1.77	0.554	3.23	4.77	1.05
293	ICP-MS	1.78	0.58	3.37	5.28	1.23
399	ICP-MS	1.87	0.527	3.54	5.30	1.10
598	ICP-MS	1.90	0.605	3.53	5.44	1.06
599	DRC/CC-ICP-MS	1.75	0.629	3.63	5.23	1.08
605	ICP-MS	1.84	0.524	3.50	5.32	1.04
607	ICP-MS	1.90	0.663	4.09	6.39 ↑	1.17
676	ICP-MS	1.72	0.495	3.36	5.10	1.03
686	ICP-MS	1.88	0.550	3.45	5.23	1.09

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

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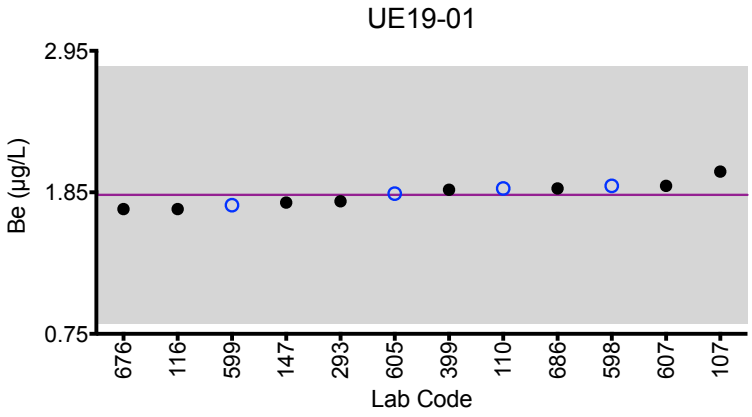
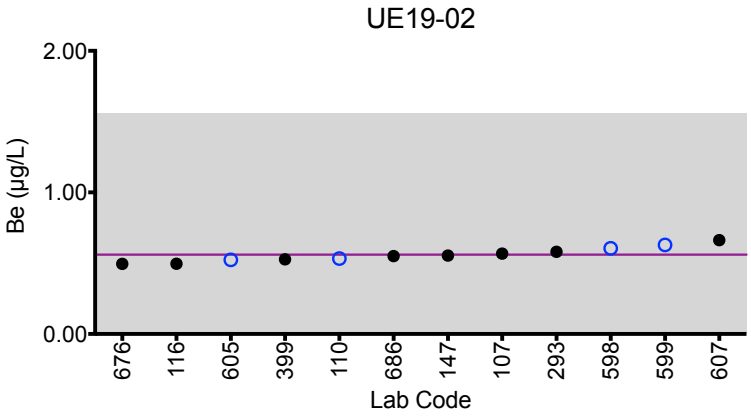
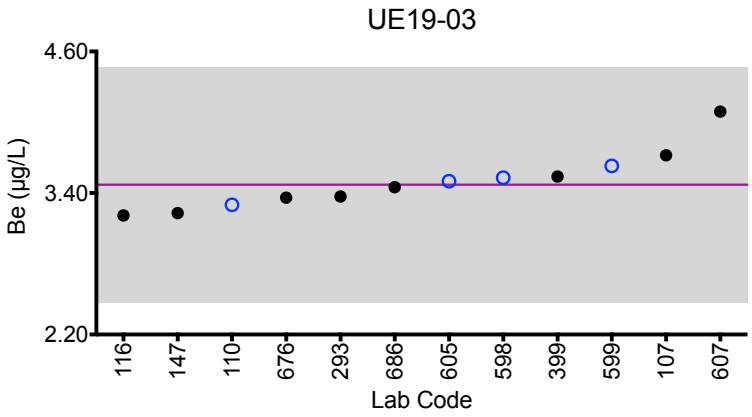
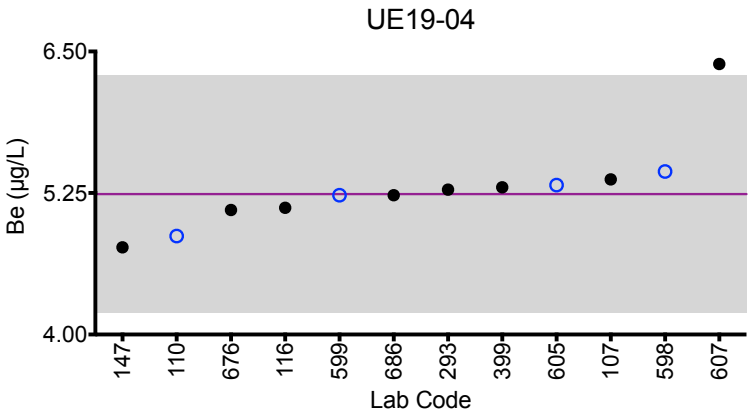
Results for Event #1, 2019: Summary Figures

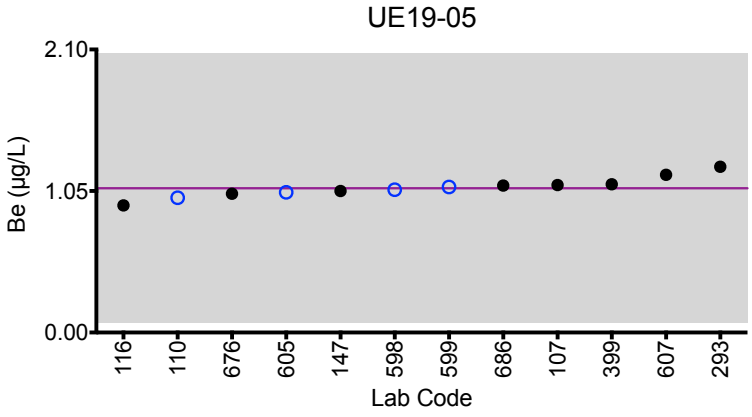
Urine Be











Legend:

o 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.

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Results for Event #1, 2019: Summary Statistics

	Urine Cd (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	1.22	0.54	4.63	2.65	3.66
Upper Limit	2.22	1.54	5.63	3.65	4.66
Lower Limit	0.22	0.00	3.63	1.65	2.66
Robust SD (s*)	0.05	0.04	0.25	0.20	0.20
Robust RSD (%)	4.0	7.8	5.4	7.5	5.5
Number of Sample Measurements (N)	19	18	19	19	19
Standard Uncertainty (*u*)	0.01	0.01	0.07	0.06	0.06

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**1.22**	**0.54**	**4.63**	**2.65**	**3.66**
103	DRC/CC-ICP-MS	1.26	0.577	5.07	2.83	3.89
107	DRC/CC-ICP-MS	1.178	0.539	4.654	2.526	3.823
110	ICP-MS	1.21	0.48	4.43	2.54	3.51
116	ICP-MS/MS	1.14	0.493	4.24	2.59	3.60
147	ICP-MS	1.24	0.537	4.20	2.50	3.39
293	DRC/CC-ICP-MS	1.3	0.63	4.98	2.85	3.97
324	ICP-MS	1.211	<1	4.575	2.653	3.598
391	DRC/CC-ICP-MS	0.739	<0.000	4.72	2.384	3.258
399	DRC/CC-ICP-MS	1.23	0.536	4.76	2.79	3.76
401	DRC/CC-ICP-MS	1.24	0.56	4.83	2.81	3.82
597	DRC/CC-ICP-MS	1.26	0.601	4.70	2.71	3.80
598	DRC/CC-ICP-MS	1.14	0.492	3.95	2.35	3.19
599	DRC/CC-ICP-MS	1.30	0.561	4.89	2.88	3.72
604	DRC/CC-ICP-MS	1.23	0.430	4.62	2.47	3.64
605	ICP-MS	1.17	0.529	4.53	2.55	3.57
606	DRC/CC-ICP-MS	1.20	0.530	4.58	2.60	3.63
607	ICP-MS	1.20	0.551	4.61	2.87	3.68
630	ICP-MS	1.20	0.563	4.60	2.61	3.62
676	DRC/CC-ICP-MS	1.29	0.513	4.50	2.32	3.10
686	ICP-MS	1.18	0.586	5.05	2.99	3.94

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.

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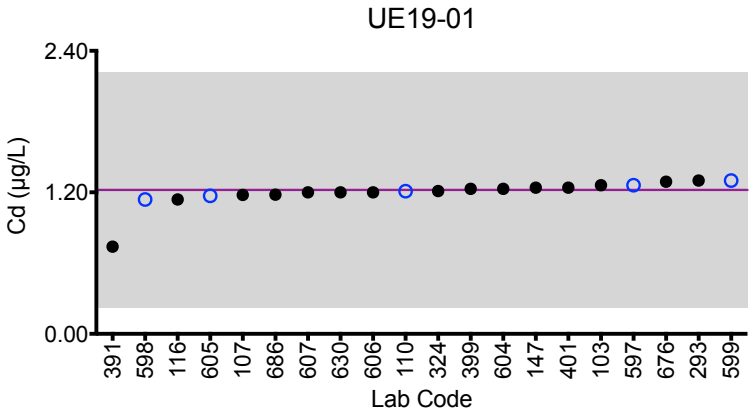
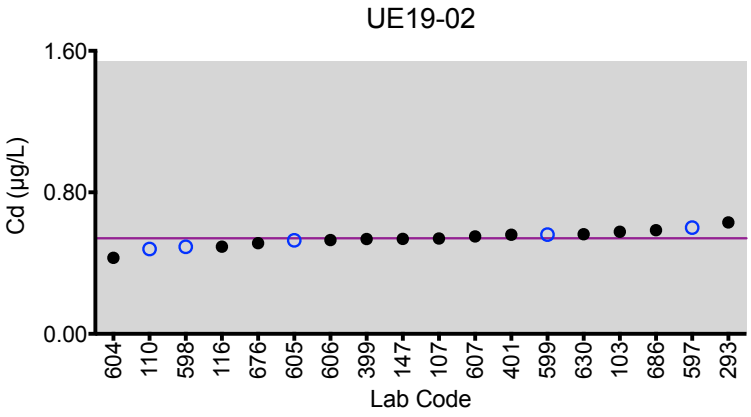
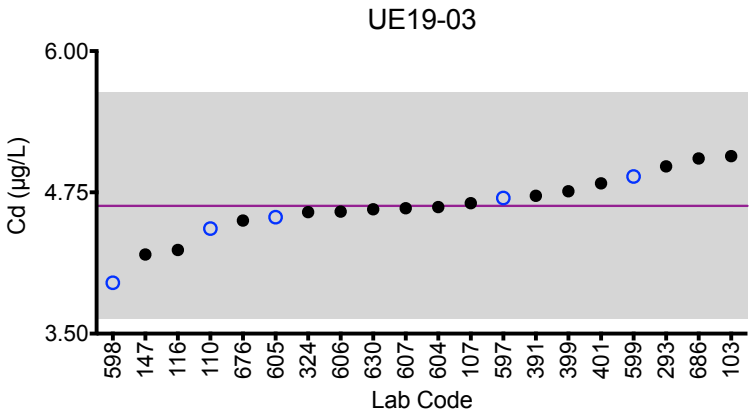
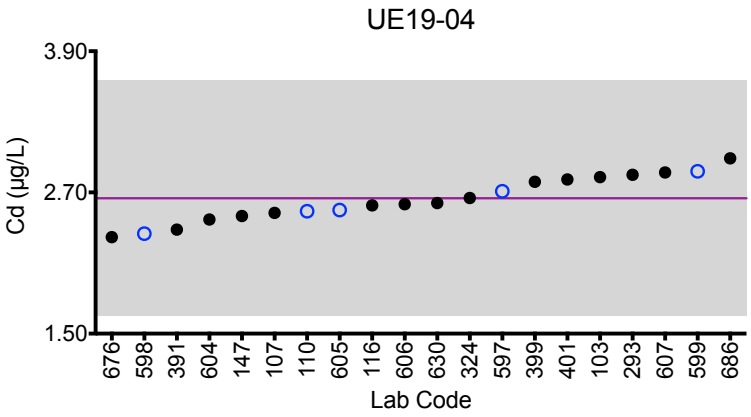
Results for Event #1, 2019: Summary Figures

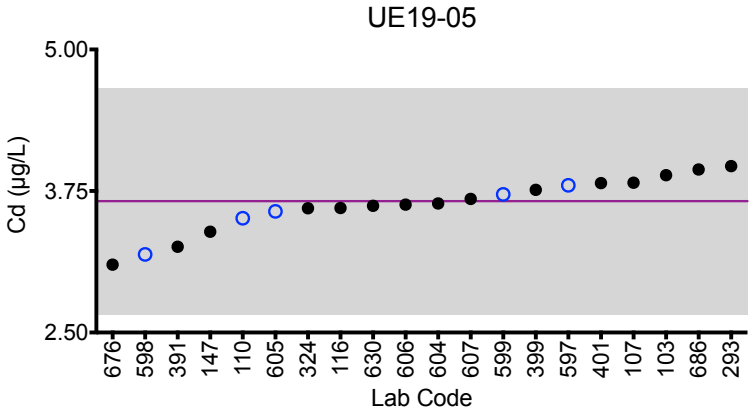
Urine Cd











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±1 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 6.6 µg/L.

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Results for Event #1, 2019: Summary Statistics

	Urine Co (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	2.91	0.34	1.40	6.3	9.2
Upper Limit	4.41	1.84	2.90	7.8	10.7
Lower Limit	1.41	0.00	0.00	4.8	7.7
Robust SD (s*)	0.14	0.14	0.20	0.5	0.4
Robust RSD (%)	4.8	41	14	7.9	4.1
Number of Sample Measurements (N)	14	13	14	14	14
Standard Uncertainty (*u*)	0.05	0.05	0.07	0.2	0.1

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Urine Co (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**2.91**	**0.34**	**1.40**	**6.3**	**9.2**
103	DRC/CC-ICP-MS	2.95	0.238	1.31	6.15	9.29
107	ICP-MS	3.052	0.622	1.728	6.937	9.289
110	ICP-MS	3.08	0.708	1.78	6.74	9.38
116	ICP-MS/MS	2.73	0.468	1.46	6.13	8.55
147	ICP-MS	2.86	0.208	1.11	5.95	8.84
324	ICP-MS	2.874	<1	1.858	6.563	9.206
391	DRC/CC-ICP-MS	2.949	0.097	1.183	5.592	8.62
399	DRC/CC-ICP-MS	2.98	0.259	1.30	6.41	9.13
401	DRC/CC-ICP-MS	2.84	0.24	1.21	5.95	9.11
597	DRC/CC-ICP-MS	2.86	0.239	1.22	5.67	9.47
598	ICP-MS	2.62	0.394	1.34	5.98	8.42
599	DRC/CC-ICP-MS	3.02	0.179	1.27	6.70	10.1
605	ICP-MS	3.00	0.557	1.64	6.82	9.52
606	DRC/CC-ICP-MS	3.07	0.269	1.34	6.72	9.59
676	ICP-MS	2.77	0.482	1.52	6.13	8.89

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

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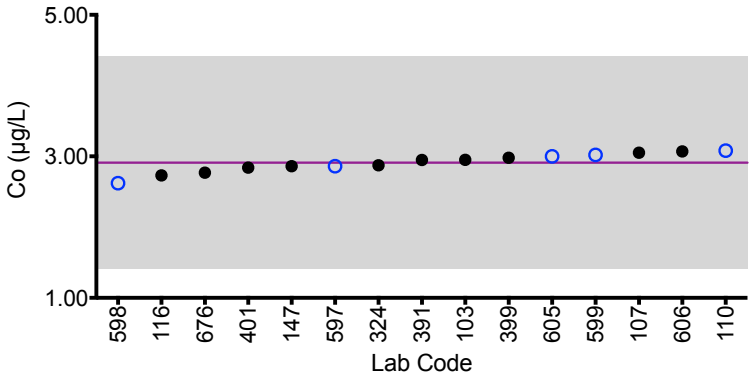
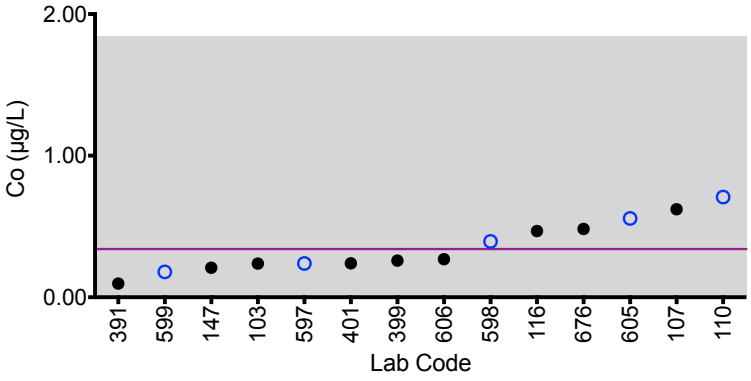
Results for Event #1, 2019: Summary Figures

Urine Co

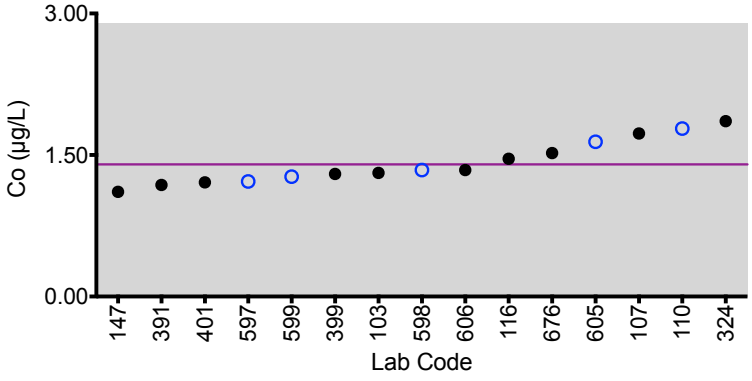
UE19-01



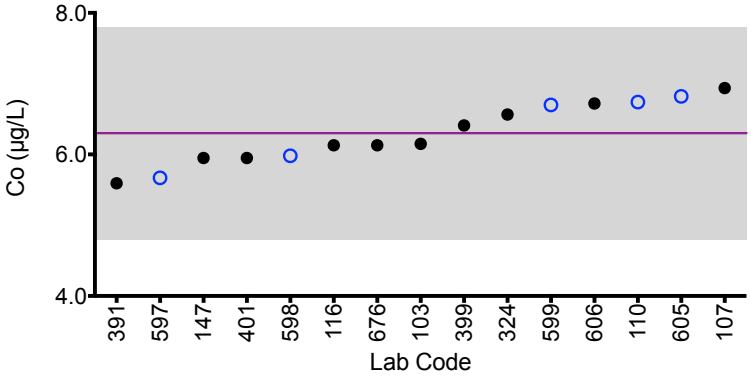
UE19-02



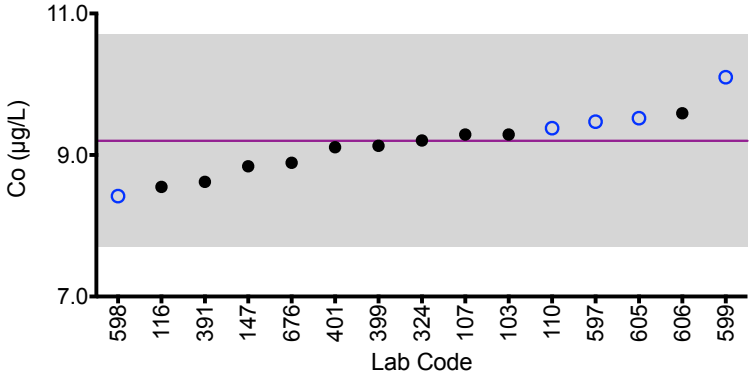
UE19-03



UE19-04



UE19-05



Legend:

o 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.

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Results for Event #1, 2019: Summary Statistics

	Urine Cr (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	1.02	17.4	7.9	12.9	4.0
Upper Limit	4.02	20.9	10.9	15.9	7.0
Lower Limit	0.00	13.9	4.9	9.9	1.0
Robust SD (s*)	0.18	1.7	0.7	1.1	0.3
Robust RSD (%)	18	9.8	8.9	8.5	6.8
Number of Sample Measurements (N)	9	10	10	10	10
Standard Uncertainty (*u*)	NA	0.7	0.3	0.4	0.1

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

An arithmetic mean, SD, RSD, and n are provided for sample UE19-01.

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**1.02**	**17.4**	**7.9**	**12.9**	**4.0**
107	DRC/CC-ICP-MS	0.9	19.3	8.8	14.5	3.92
110	DRC/CC-ICP-MS	1.09	19.4	8.89	14.5	4.24
116	ICP-MS/MS	0.790	15.8	7.35	11.9	3.32
147	DRC/CC-ICP-MS	1.26	17.8	8.22	12.9	4.31
324	ICP-MS	<1	15.509	6.797	11.558	3.807
391	DRC/CC-ICP-MS	0.821	16.044	7.87	12.243	3.78
401	DRC/CC-ICP-MS	0.97	17.2	7.87	12.9	4.12
597	DRC/CC-ICP-MS	1.30	17.4	7.83	12.63	4.04
598	DRC/CC-ICP-MS	0.820	16.2	7.35	12.3	3.56
599	DRC/CC-ICP-MS	1.12	16.5	7.83	12.3	3.85
605	ICP-MS	0.921	19.2	8.36	14.1	4.01

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

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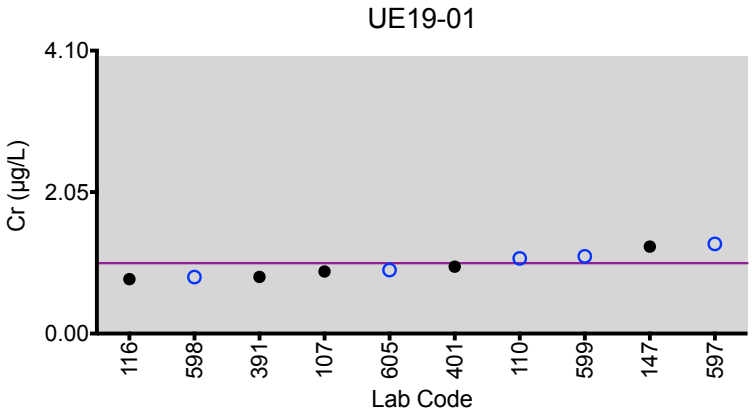
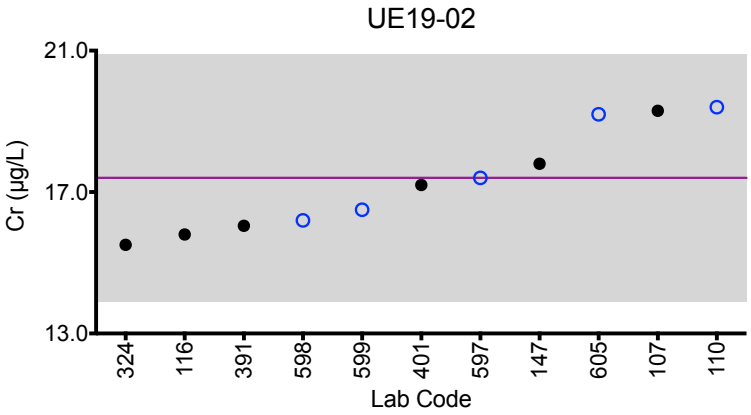
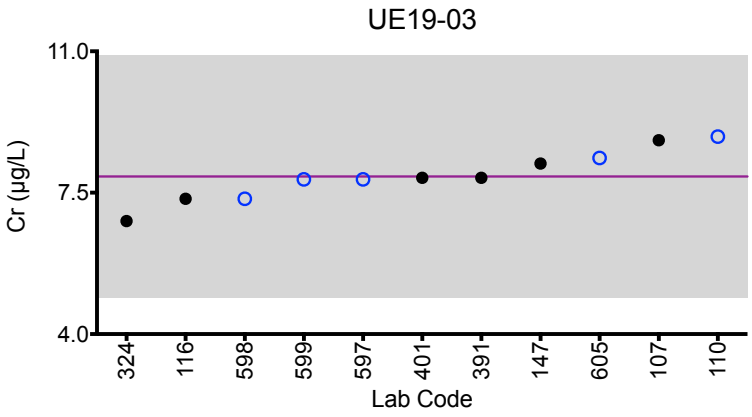
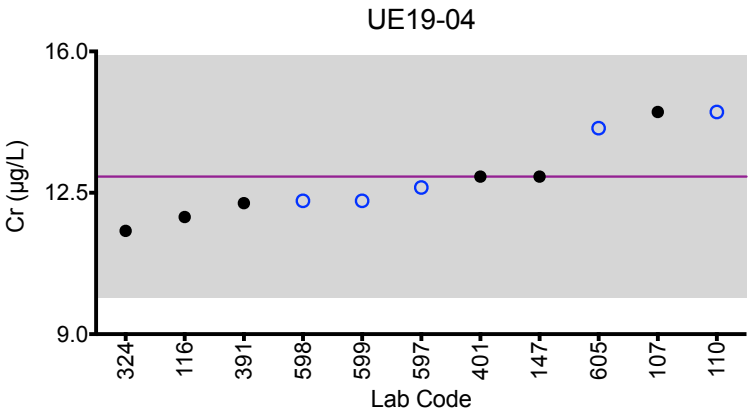
Results for Event #1, 2019: Summary Figures

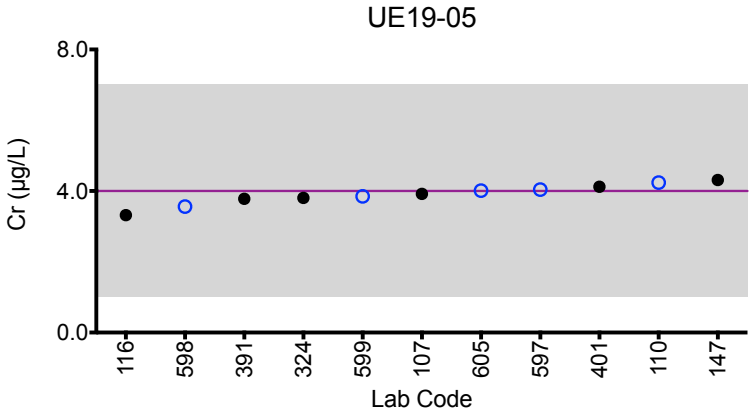
Urine Cr











Legend:

o 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.

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Results for Event #1, 2019: Summary Statistics

	Urine Hg (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	4.1	45	7.6	15.7	21
Upper Limit	7.1	59	10.6	20.4	27
Lower Limit	1.1	32	4.6	11.0	15
Robust SD (s*)	0.5	11	1.4	1.6	4
Robust RSD (%)	12	24	18	10	19
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.2	4	0.5	0.5	1

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**4.1**	**45**	**7.6**	**15.7**	**21**
103	DRC/CC-ICP-MS	4.15	47.5	7.01	15.5	17.9
107	DRC/CC-ICP-MS	3.36	39.22	6.72	15.15	15.7
110	ICP-MS	4.56	36.3	7.45	15.1	21.4
147	CV-AAS	4.19	47.7	7.42	17.2	22.9
200	ICP-MS	4.2	56.6	9.6	20.6 ↑	25.6
293	DRC/CC-ICP-MS	4.36	47.02	7.23	15.99	22.24
391	DRC/CC-ICP-MS	6.691	57.268	7.776	17.019	21.53
401	DRC/CC-ICP-MS	6.02	63.2 ↑	9.85	21.3 ↑	26.2
597	DMA	3.80	41.2	7.35	15.3	19.4
598	ICP-MS	3.31	31.0 ↓	4.83	10.7 ↓	14.8 ↓
599	DRC/CC-ICP-MS	3.74	21.6 ↓	9.11	14.6	20.7
604	DRC/CC-ICP-MS	3.97	39.8	5.92	13.5	19.8
605	ICP-MS	3.79	42.6	6.87	15.2	17.8
606	DRC/CC-ICP-MS	4.45	56.8	8.41	16.5	24.5
676	ICP-MS	4.74	58.8	8.98	19.3	23.3

Based on the grading criteria for Hg in Urine, 91% of results were satisfactory, with 2 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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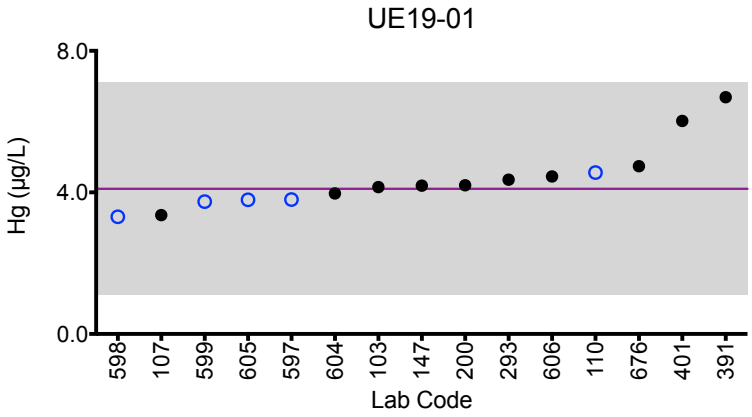
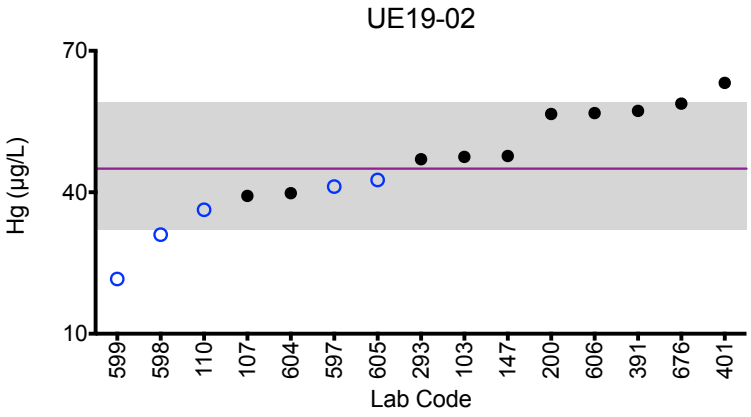
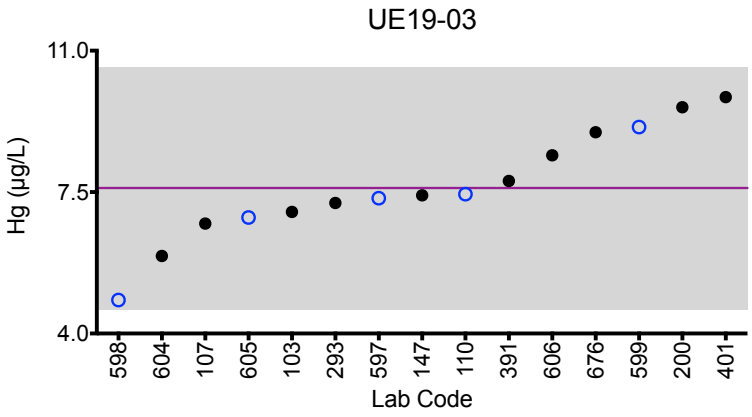
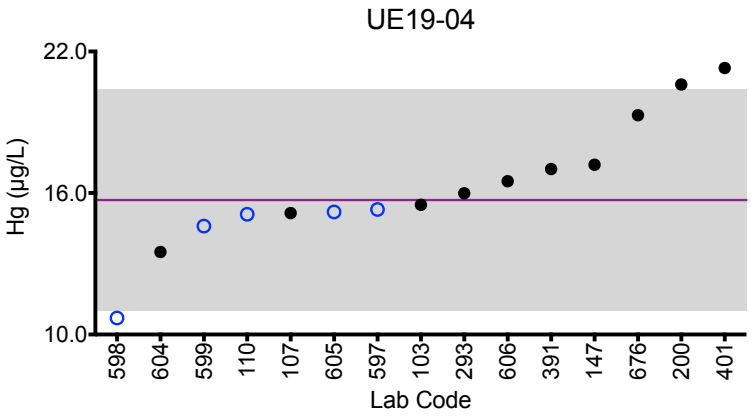
Results for Event #1, 2019: Summary Figures

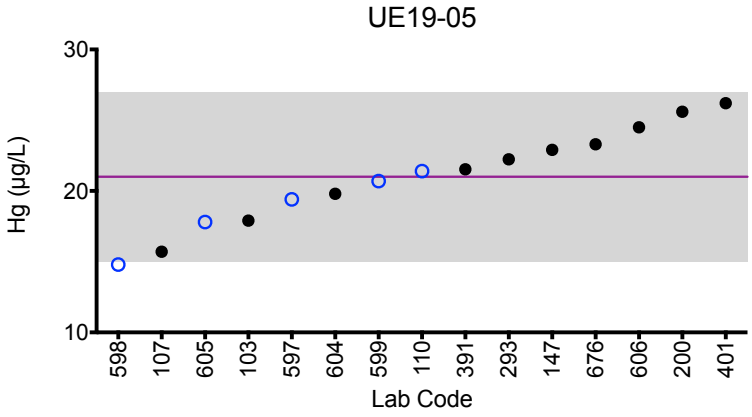
Urine Hg











Legend:

o 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.

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Results for Event #1, 2019: Summary Statistics

	Urine Mn (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	0.77	4.33	8.4	2.18	6.5
Upper Limit	1.32	5.41	10.5	2.73	8.1
Lower Limit	0.22	3.25	6.3	1.63	4.9
Robust SD (s*)	0.08	0.28	0.6	0.17	0.4
Robust RSD (%)	10	6.5	7.1	7.8	5.4
Number of Sample Measurements (N)	13	14	14	14	14
Standard Uncertainty (*u*)	0.03	0.09	0.2	0.06	0.1

The acceptable range is based on quality specifications:
±0.55 µg/L or ±25% around the target value, whichever is greater; thus, it is fixed at ±0.55 µg/L at concentrations less than or equal to 2.2 µg/L. Quality specifications for Mn are consistent with those used by other External Quality Assessment Schemes for trace elements. (Praamsma M, et al. Clinical Chemistry and Laboratory Medicine.2016; 54(12): 1921-1928)

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**0.77**	**4.33**	**8.4**	**2.18**	**6.5**
103	DRC/CC-ICP-MS	0.704	3.99	8.14	2.00	6.38
107	DRC/CC-ICP-MS	0.73	4.43	8.68	2.17	7
110	DRC/CC-ICP-MS	0.740	4.11	8.26	2.15	6.59
116	ICP-MS/MS	5.39 ↑	3.76	7.68	1.83	5.96
147	DRC/CC-ICP-MS	0.687	4.06	7.86	2.11	6.43
324	ICP-MS	<1	4.625	8.946	2.699	7.226
391	DRC/CC-ICP-MS	0.129 ↓	3.581	8.755	2.092	7.312
399	DRC/CC-ICP-MS	0.689	4.09	8.27	2.08	6.57
597	DRC/CC-ICP-MS	1.23	4.50	7.47	2.12	6.34
598	ICP-MS	0.787	4.53	8.02	2.60	6.06
604	DRC/CC-ICP-MS	0.742	4.58	8.96	2.32	6.50
605	ICP-MS	0.667	4.39	8.49	2.18	6.44
606	DRC/CC-ICP-MS	0.984	4.67	9.08	2.36	7.09
630	DRC/CC-ICP-MS	0.782	4.28	8.54	2.26	6.75
676	DRC/CC-ICP-MS	0.906	4.44	9.45	2.04	6.15

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

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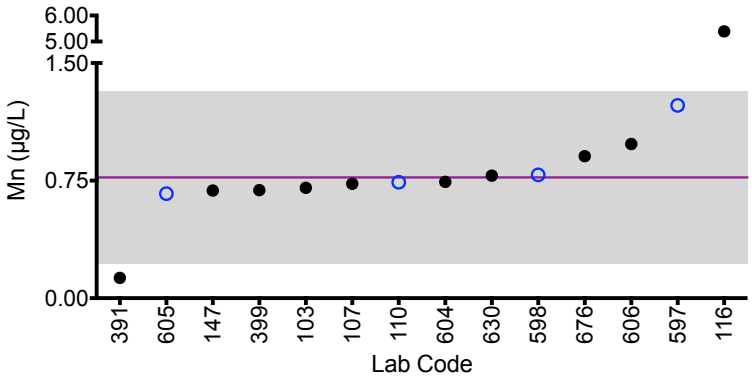
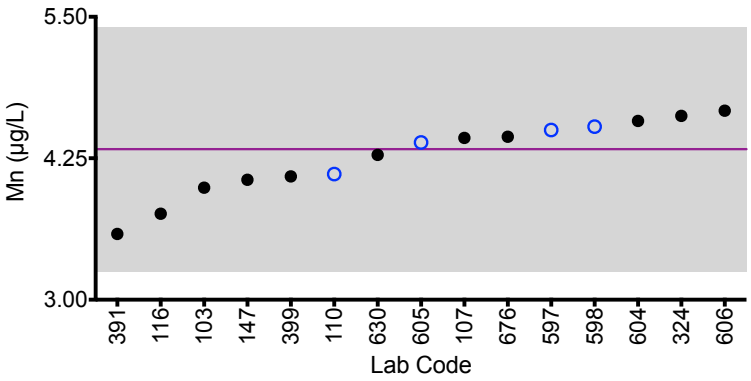
Results for Event #1, 2019: Summary Figures

Urine Mn

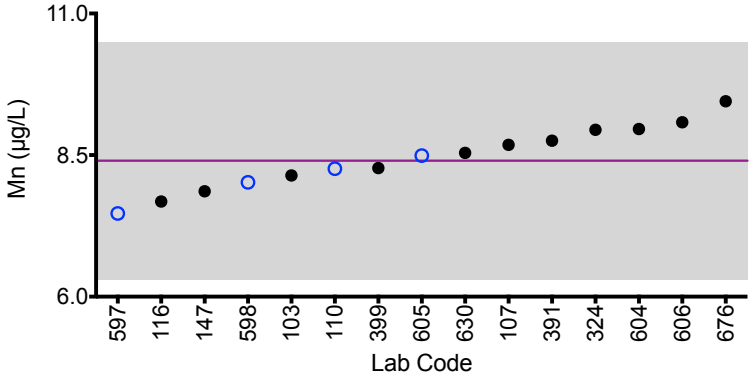
UE19-01



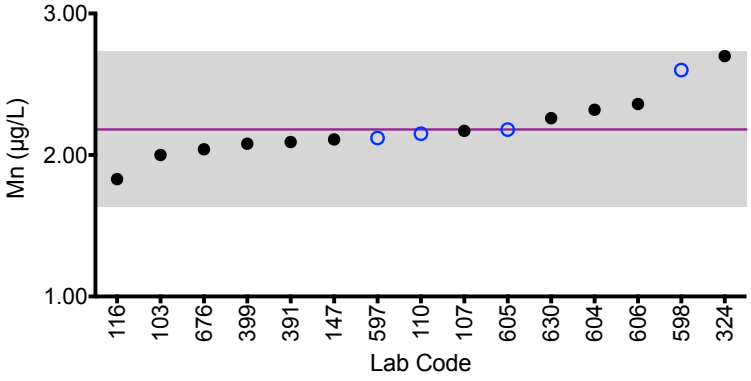
UE19-02



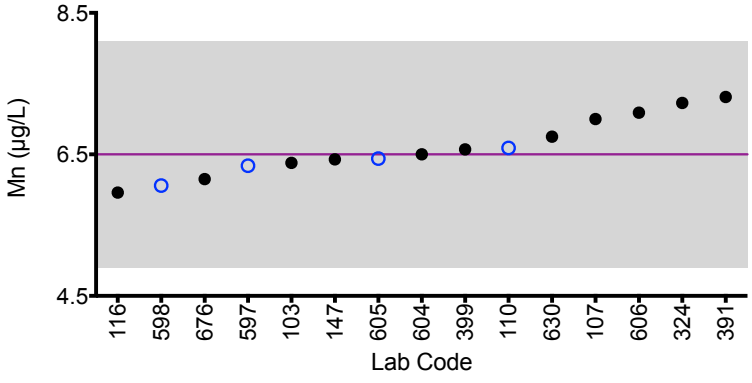
UE19-03



UE19-04



UE19-05



Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2019: Summary Statistics

	Urine Pb (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	7.9	2.67	5.02	12.3	0.63
Upper Limit	9.5	3.67	6.02	14.8	1.63
Lower Limit	6.3	1.67	4.02	9.8	0.00
Robust SD (s*)	0.3	0.11	0.21	0.5	0.05
Robust RSD (%)	4.2	4.1	4.2	3.8	7.9
Number of Sample Measurements (N)	16	16	16	16	15
Standard Uncertainty (*u*)	0.1	0.04	0.07	0.1	0.02

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Urine Pb (µg/L)				
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**7.9**	**2.67**	**5.02**	**12.3**	**0.63**
103	DRC/CC-ICP-MS	8.55	2.88	5.50	13.2	0.672
107	ICP-MS	8.22	2.81	5.17	12.01	0.68
110	ICP-MS	7.92	2.61	5.05	12.2	0.59
116	ICP-MS/MS	7.43	2.58	4.80	12.0	0.613
147	ICP-MS	7.87	2.71	4.97	12.5	0.626
293	DRC/CC-ICP-MS	7.83	2.53	4.78	11.74	0.68
324	ICP-MS	7.625	2.672	4.961	12.027	<1
391	DRC/CC-ICP-MS	7.5	2.537	4.688	11.996	0.387
399	ICP-MS	7.77	2.80	5.47	12.8	0.677
597	DRC/CC-ICP-MS	7.89	2.60	4.95	12.03	0.610
598	ICP-MS	6.38	1.89	3.56 ↓	8.77 ↓	0.460
599	DRC/CC-ICP-MS	8.01	2.66	5.13	12.7	0.525
605	ICP-MS	7.65	2.66	4.82	11.9	0.638
606	ICP-MS	7.61	2.61	4.92	12.2	0.581
607	ICP-MS	8.10	2.74	5.10	13.3	0.679
676	ICP-MS	7.91	2.68	5.06	12.2	0.635
686	ICP-MS	8.33	2.80	5.22	12.7	0.672

Based on the grading criteria for Pb in Urine, 98% of results were satisfactory, with 1 of the 17 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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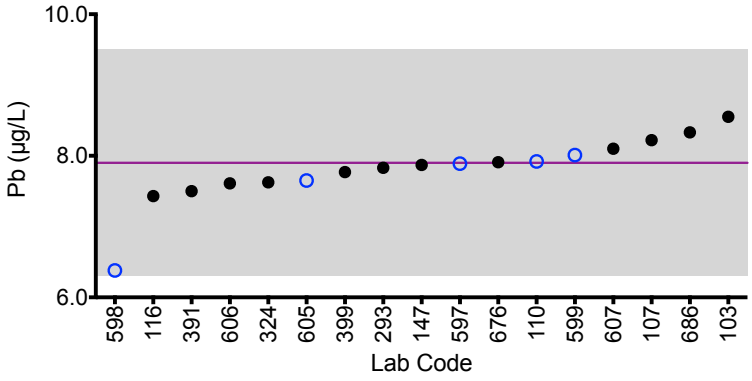
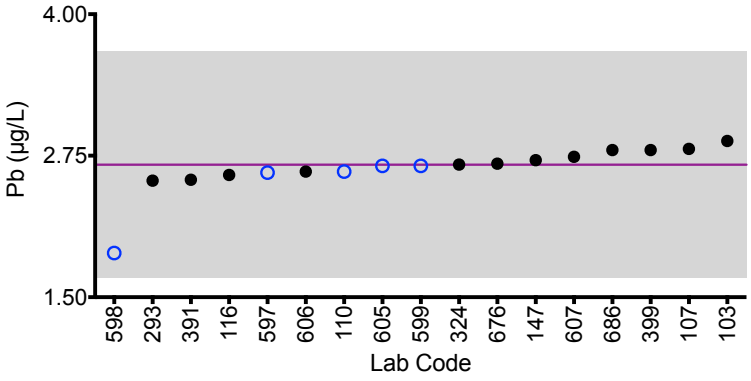
Results for Event #1, 2019: Summary Figures

Urine Pb

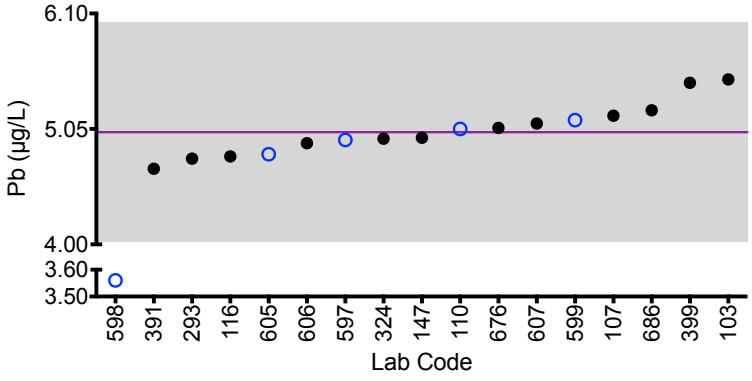
UE19-01



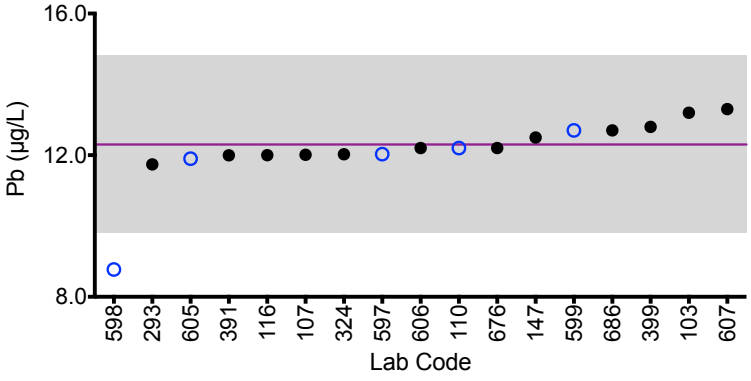
UE19-02



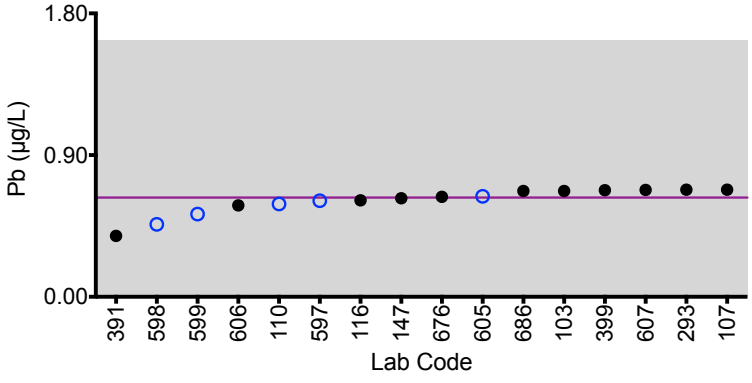
UE19-03



UE19-04



UE19-05



Legend:

o 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.

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Results for Event #1, 2019: Summary Statistics

Urine Tl (µg/L)					
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	0.65	2.34	4.17	1.54	3.31
Upper Limit	0.85	2.81	5.00	1.85	3.97
Lower Limit	0.45	1.87	3.34	1.23	2.65
Robust SD (s*)	0.04	0.12	0.15	0.07	0.12
Robust RSD (%)	6.2	5.1	3.6	4.5	3.6
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.01	0.04	0.05	0.02	0.04

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Urine Tl (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**0.65**	**2.34**	**4.17**	**1.54**	**3.31**
103	DRC/CC-ICP-MS	0.695	2.48	4.38	1.60	3.44
107	ICP-MS	0.68	2.448	4.249	1.563	3.466
110	ICP-MS	0.646	2.28	4.10	1.52	3.34
116	ICP-MS/MS	0.599	2.18	3.90	1.49	3.08
147	ICP-MS	0.612	2.41	4.13	1.57	3.33
293	DRC/CC-ICP-MS	0.7	2.31	4.21	1.48	3.35
399	ICP-MS	0.680	2.45	4.32	1.64	3.40
597	DRC/CC-ICP-MS	0.65	2.23	3.82	1.46	3.23
598	ICP-MS	0.539	1.69 ↓	2.92 ↓	1.06 ↓	2.47 ↓
605	ICP-MS	0.619	2.31	4.21	1.57	3.24
606	ICP-MS	0.636	2.30	4.10	1.51	3.25
607	ICP-MS	0.657	2.40	4.27	1.62	3.35
676	ICP-MS	0.640	2.34	4.11	1.52	3.28
686	ICP-MS	0.677	2.46	4.33	1.59	3.45

Based on the grading criteria for Tl in Urine, 94% of results were satisfactory, with 1 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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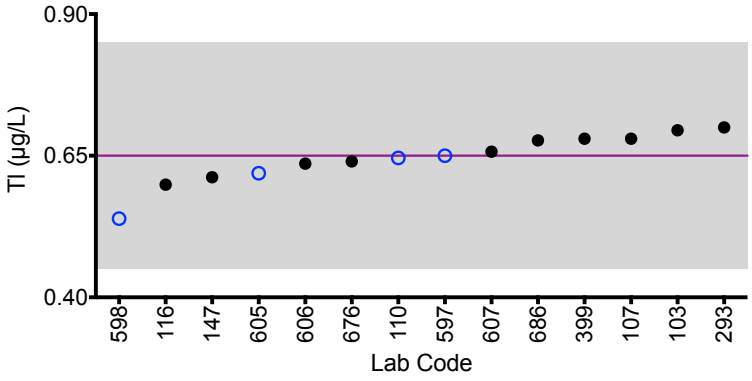
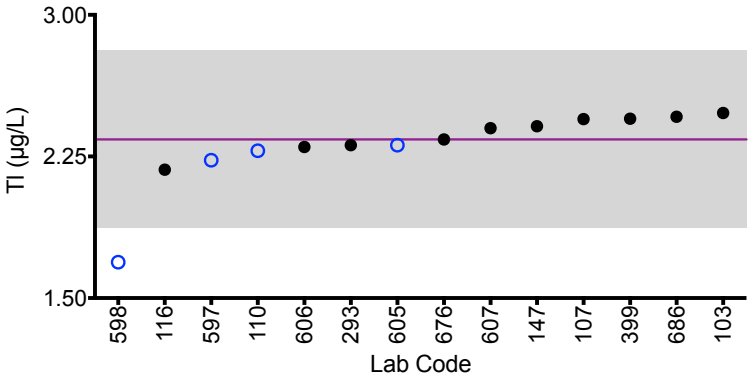
Results for Event #1, 2019: Summary Figures

Urine Tl

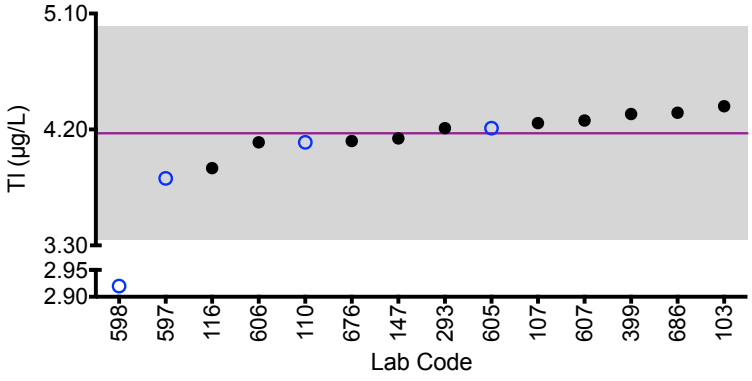
UE19-01



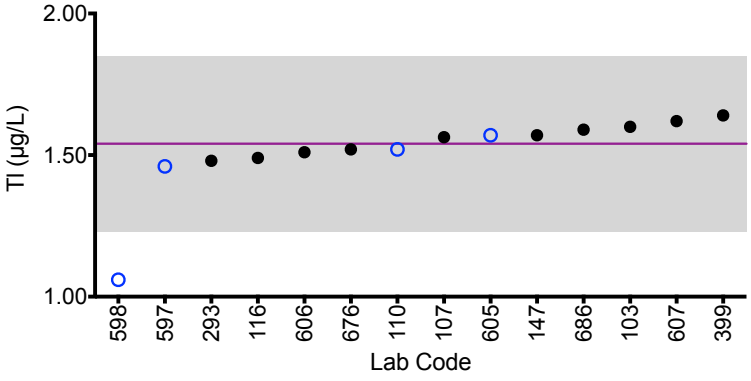
UE19-02



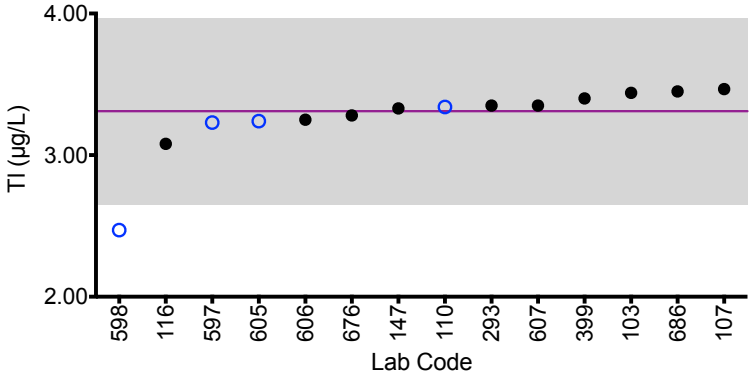
UE19-03



UE19-04



UE19-05



Legend:

o 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.

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Results for Event #1, 2019: Summary Statistics

	Urine U (µg/L)				
	UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Target (Robust Mean (x*))	0.0116	0.234	0.089	0.157	0.0520
Upper Limit	0.0416	0.281	0.119	0.188	0.0820
Lower Limit	0.0000	0.187	0.059	0.126	0.0220
Robust SD (s*)	0.0010	0.017	0.006	0.013	0.0028
Robust RSD (%)	8.6	7.3	6.7	8.3	5.4
Number of Sample Measurements (N)	11	16	15	16	15
Standard Uncertainty (*u*)	0.0004	0.005	0.002	0.004	0.0009

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Urine U (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
	Target	**0.0116**	**0.234**	**0.089**	**0.157**	**0.0520**
103	DRC/CC-ICP-MS	<0.0200	0.238	0.0929	0.151	0.0537
107	ICP-MS	0.0248	0.2819 ↑	0.1143	0.1913 ↑	0.0687
110	ICP-MS	0.0107	0.229	0.0857	0.159	0.0539
116	ICP-MS/MS	<0.015	0.216	0.0814	0.149	0.0502
147	ICP-MS	<0.0164	0.250	0.0893	0.159	0.0524
324	ICP-MS	0.011	0.218	0.082	0.140	0.049
399	ICP-MS	0.010	0.230	0.092	0.161	0.049
598	ICP-MS	0.013	0.184 ↓	0.071	0.124 ↓	0.044
599	DRC/CC-ICP-MS	<0.1	0.294 ↑	<0.1	0.187	<0.1
604	ICP-MS	0.012	0.218	0.083	0.146	0.051
605	ICP-MS	0.012	0.26	0.097	0.182	0.058
606	ICP-MS	0.012	0.240	0.093	0.161	0.054
607	ICP-MS	0.0111	0.232	0.0911	0.151	0.0513
630	ICP-MS	0.0111	0.229	0.0891	0.159	0.0533
676	ICP-MS	0.0117	0.228	0.0859	0.146	0.0493
686	ICP-MS	<0.015	0.238	0.0896	0.157	0.0525

Based on the grading criteria for U in Urine, 94% of results were satisfactory, with 2 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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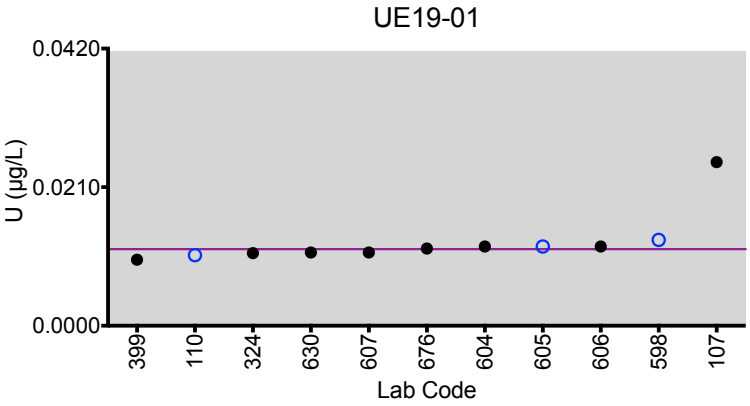
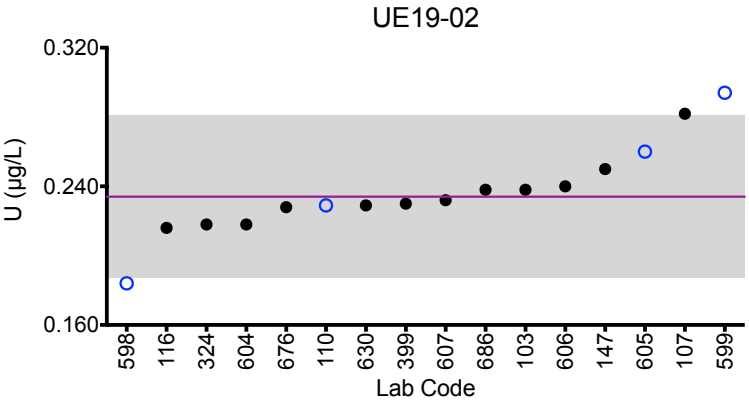
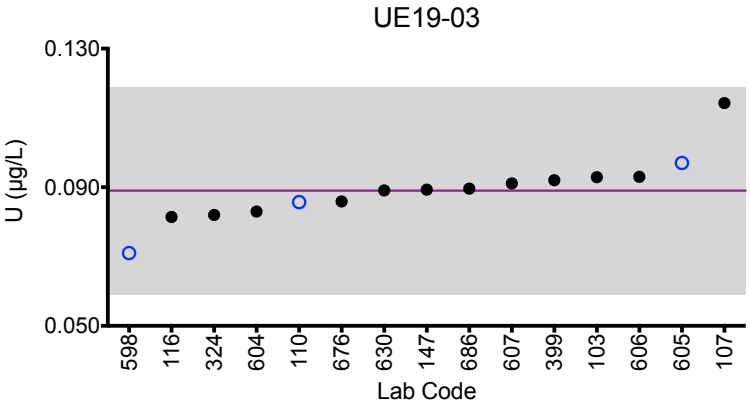
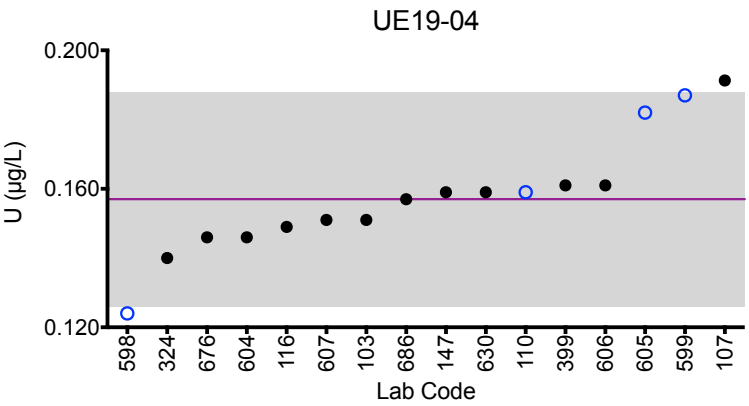
Results for Event #1, 2019: Summary Figures

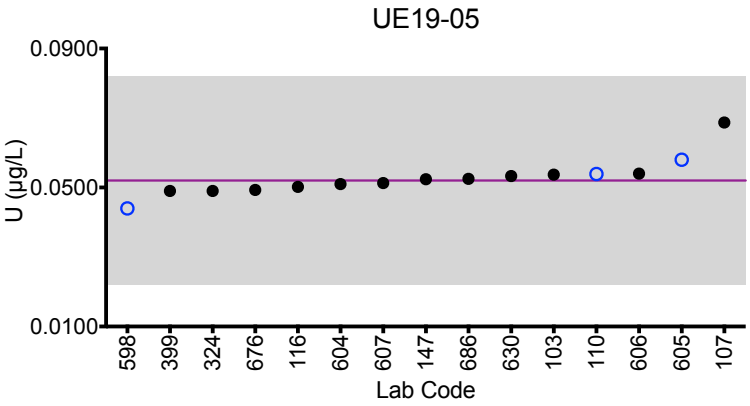
Urine U











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
107	ICP-MS	1.96	12.532	4.489	7.571	2.881
110	ICP-MS	2.08	12.9	4.69	8.04	2.96
147	ICP-MS	1.75	12.5	4.35	7.7	2.62
399	ICP-MS	1.99	11.9	4.36	7.53	2.80
597	DRC/CC-ICP-MS	2.11	12.7	4.49	7.68	3.26
598	ICP-MS	1.75	10.98	4.02	6.98	2.53
599	DRC/CC-ICP-MS	1.91	12.1	4.32	7.44	2.77
605	ICP-MS	1.87	11.3	4.00	6.87	2.67
606	DRC/CC-ICP-MS	2.11	13.2	4.67	8.01	2.99
676	ICP-MS	1.77	10.9	4.16	7.12	2.60

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Robust Mean (x*)	1.93	12.2	4.4	7.5	2.79
Robust SD (s*)	0.16	0.8	0.3	0.4	0.22
Robust RSD (%)	8.3	6.6	6.2	5.3	7.9
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.06	0.3	0.1	0.2	0.09

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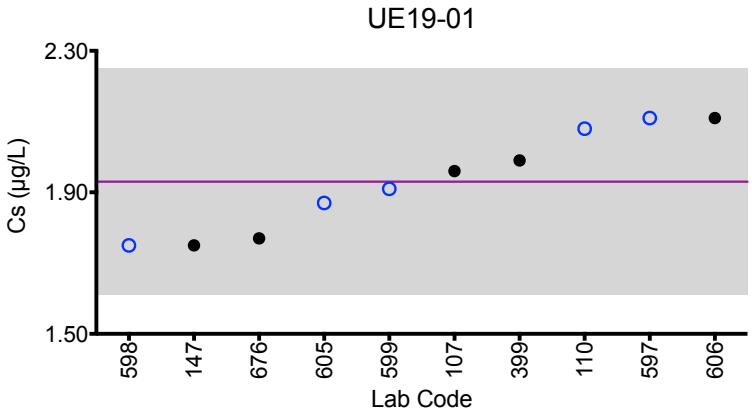
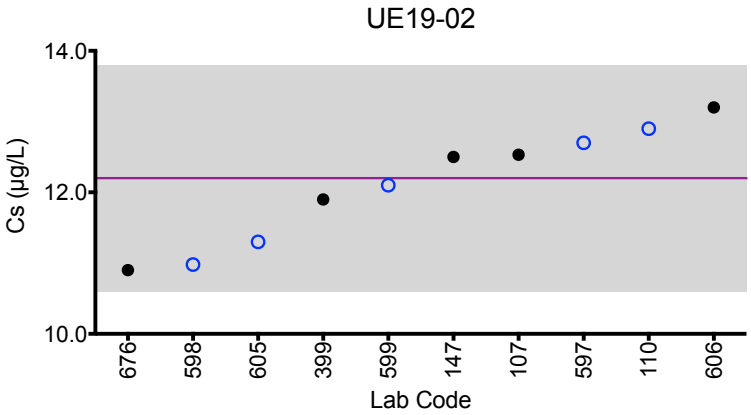
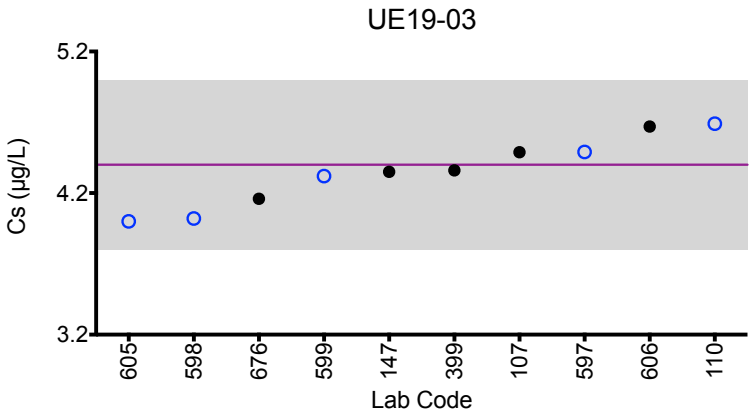
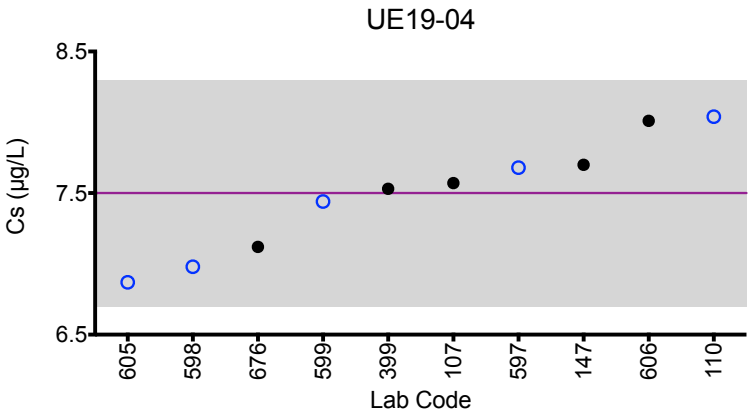
Results for Event #1, 2019: Summary Figures

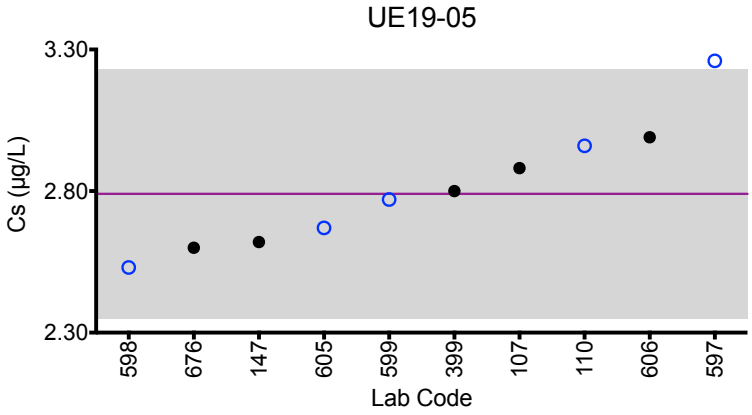
Urine Cs











Legend:
o 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.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
110	ICP-MS	74.8	63.4	91.9	5.4	4.7
116	ICP-MS/MS	72.5	55.4	87.6	<5.00	<5.00
147	ICP-MS	78.8	63.4	90.9	8.45	7.12
293	DRC/CC-ICP-MS	73.74	57.85	88.37	3.18	2.54
324	ICP-MS	77.042	61.340	95.582	4.119	*23.016
391	DRC/CC-ICP-MS	79.375	60.761	92.729	1.378	1.823
401	DRC/CC-ICP-MS	79.4	59.1	92.1	<3.81	<3.81
597	DRC/CC-ICP-MS	78.4	59.7	86.9	5.77	2.99
598	ICP-MS	66.8	53.0	81.9	5.09	3.80
599	DRC/CC-ICP-MS	80.5	63.8	96.0	6.8	6.9

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Arithmetic Mean ($\bar{x}$)	75.8	59.7	90.1	5.5	4.7
Arithmetic SD (s)	4.3	3.8	4.5	1.7	2.0
Arithmetic RSD (%)	5.7	6.4	5.0	31	43
Number of Sample Measurements (N)	9	9	9	7	6

*Denotes a statistical Outlier.

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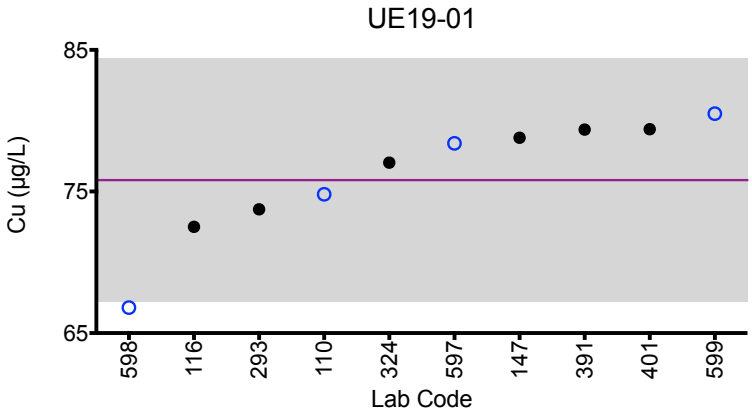
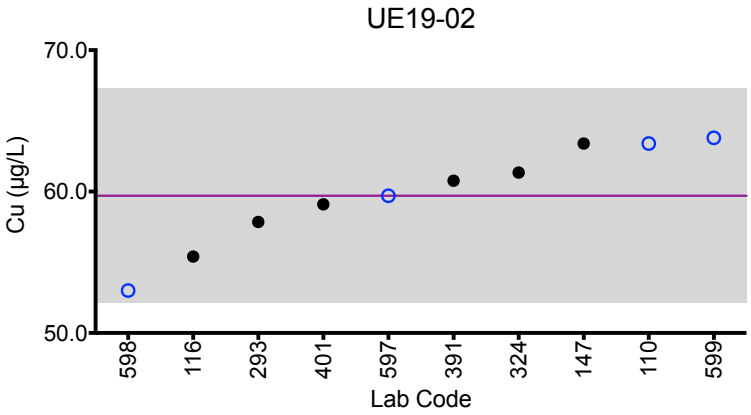
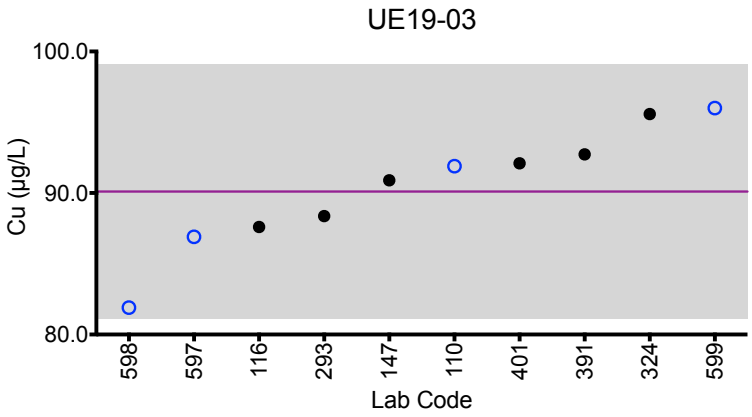
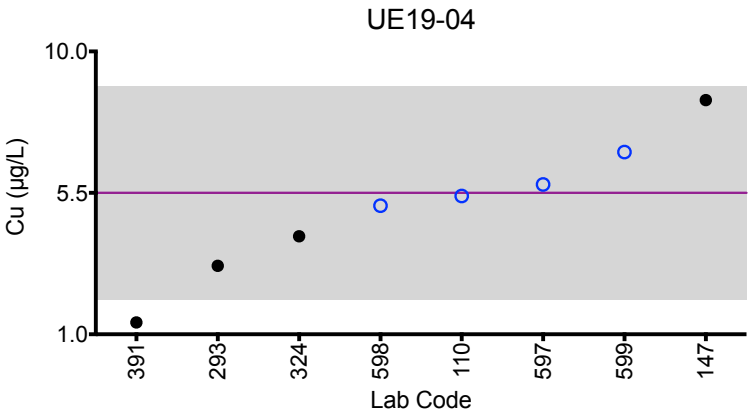
Results for Event #1, 2019: Summary Figures

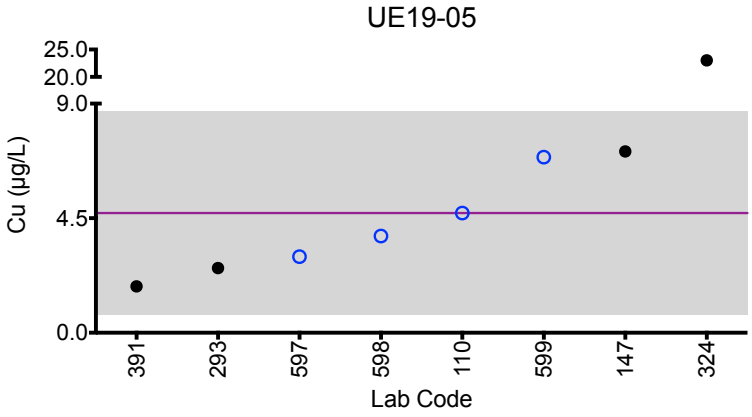
Urine Cu











Legend:
o 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 #1, 2019:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
103	DRC/CC-ICP-MS	22.6	75.9	247	135	98.6
107	ICP-MS	23.72	80.15	256.06	136.14	102.94
110	ICP-MS	24.1	81.2	264	142	103
147	ICP-MS	23.2	76.8	246	135	103
293	DRC/CC-ICP-MS	23.46	77.04	250.98	142.91	107.86
324	ICP-MS	24.528	82.072	264.761	146.846	108.499
399	ICP-MS	23.2	76.4	257	137	101
597	DRC/CC-ICP-MS	22.1	74.9	235	128	99.9
598	DRC/CC-ICP-MS	19.9	66.3	217	117	87.1
605	ICP-MS	21.5	78.2	255	141	99.2
606	DRC/CC-ICP-MS	23.7	80.6	266	144	104
676	ICP-MS	21.9	74.1	242	131	98.8

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Robust Mean (x*)	23.0	77	251	137	102
Robust SD (s*)	1.2	3	13	7	4
Robust RSD (%)	5.2	4.4	5.2	5.1	3.8
Number of Sample Measurements (N)	12	12	12	12	12
Standard Uncertainty (*u*)	0.4	1	5	3	1

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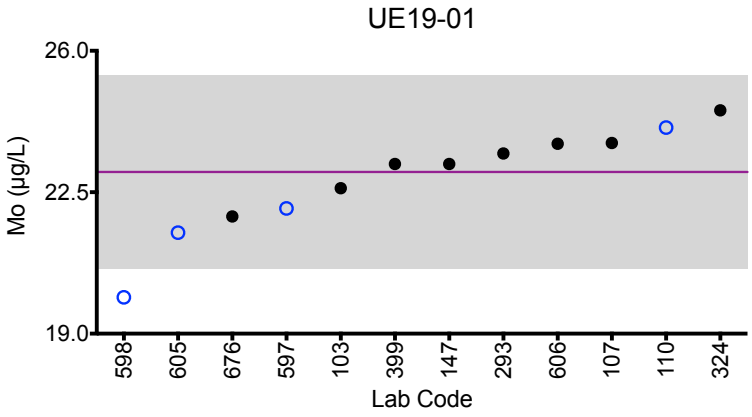
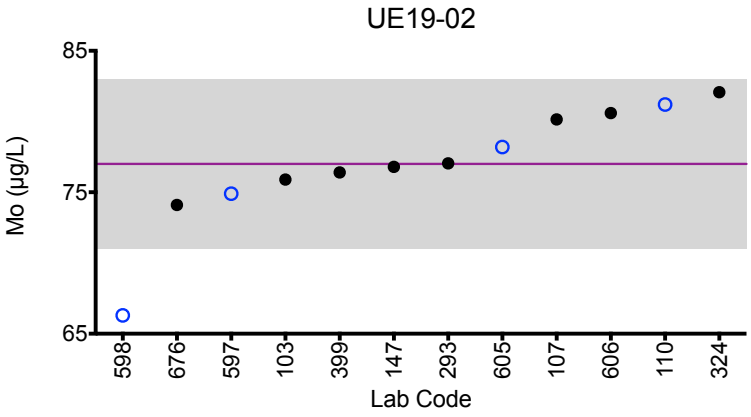
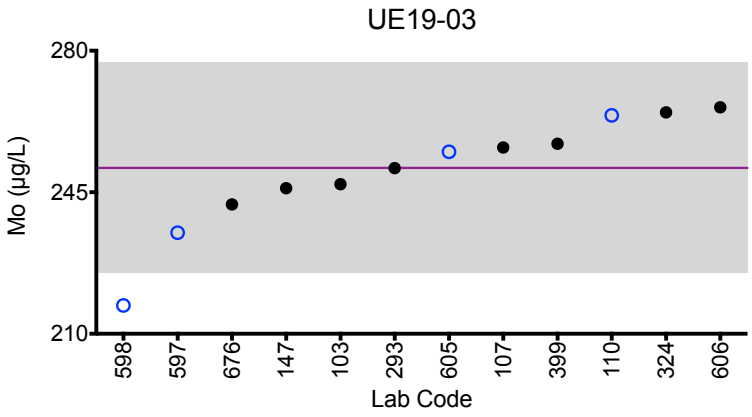
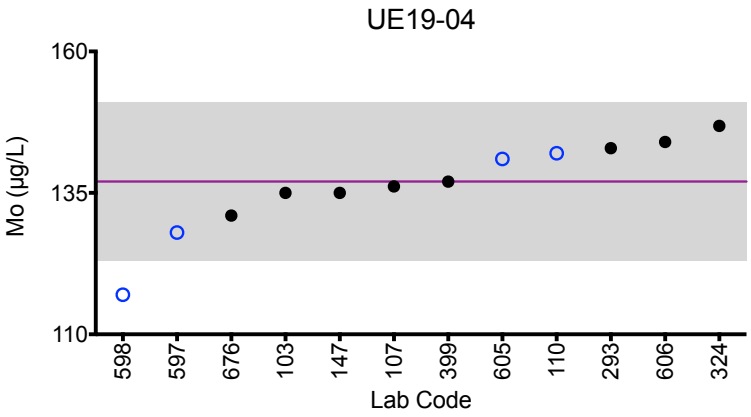
Results for Event #1, 2019: Summary Figures

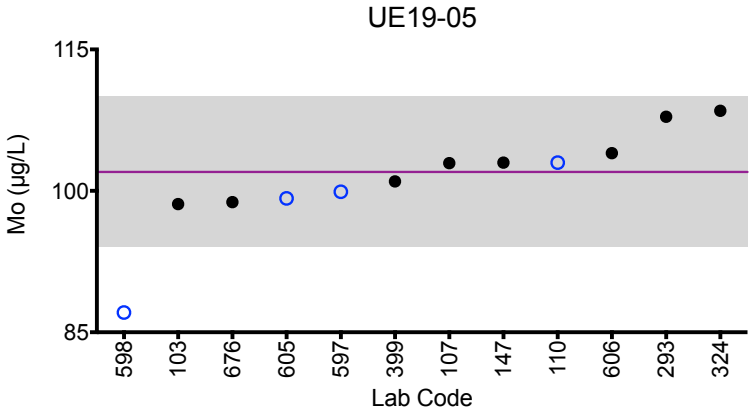
Urine Mo











Legend:
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Horizontal purple line = robust mean of all laboratories.
Gray area = ±2SD of the mean.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
107	DRC/CC-ICP-MS	1.3	1.25	4.43	5.97	2.62
110	ICP-MS	1.84	*4.95	7.88	9.76	5.15
293	DRC/CC-ICP-MS	1.82	1.77	5.17	7.23	3.14
324	ICP-MS	2.040	2.719	6.285	7.401	3.603
401	DRC/CC-ICP-MS	*3.17	3.11	7.34	9.63	5.11
597	DRC/CC-ICP-MS	1.41	1.57	4.50	6.76	2.64
598	ICP-MS	1.16	2.09	4.73	6.52	2.93
599	DRC/CC-ICP-MS	1.26	1.27	4.62	6.97	2.70
605	ICP-MS	1.29	1.44	4.45	6.68	2.73

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Arithmetic Mean ($\bar{x}$)	1.5	1.9	5.5	7.4	3.4
Arithmetic SD (s)	0.3	0.7	1.3	1.3	1.0
Arithmetic RSD (%)	22	37	24	18	29
Number of Sample Measurements (N)	8	8	9	9	9

*Denotes a statistical Outlier.

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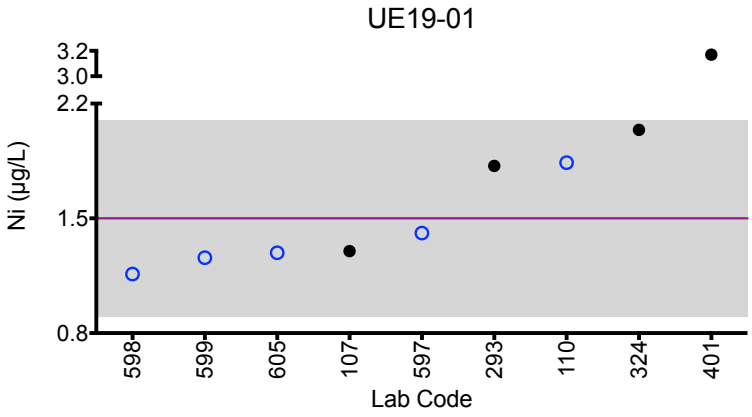
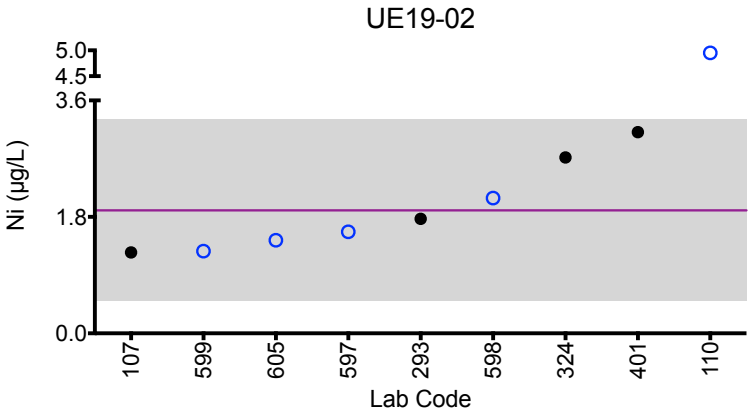
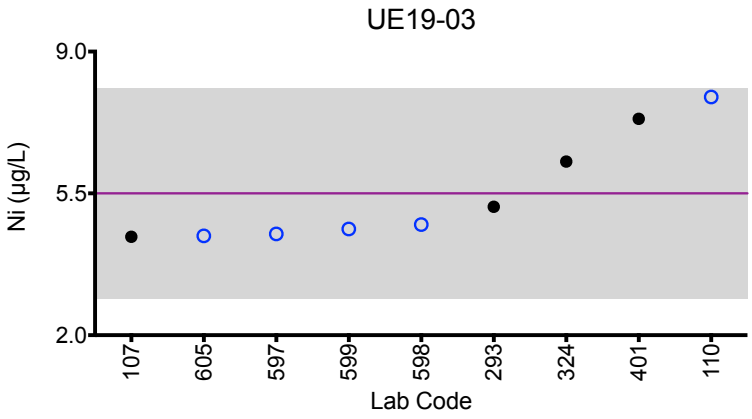
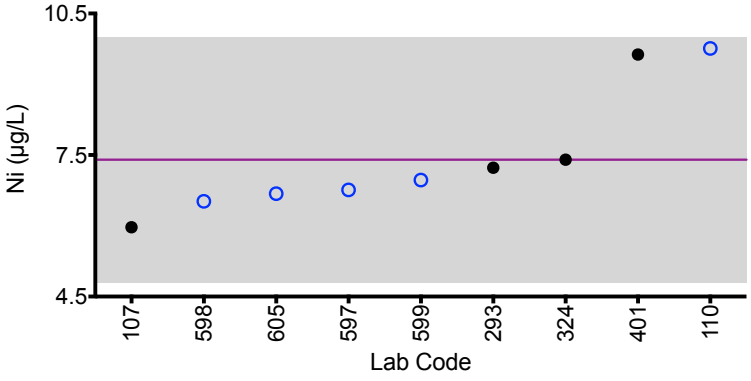
Results for Event #1, 2019: Summary Figures

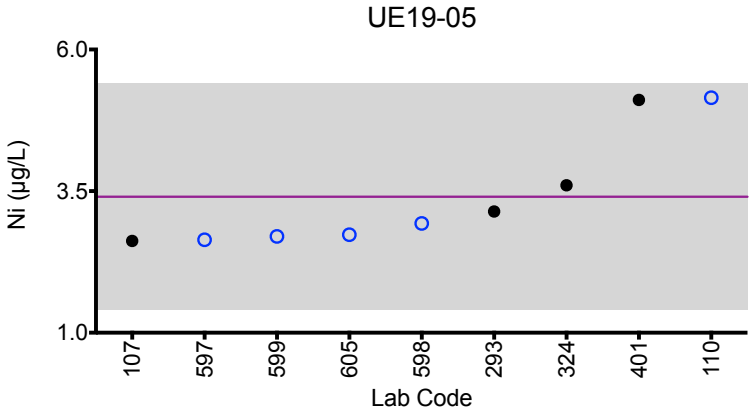
Urine Ni











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
107	ICP-MS	2.316	0.211	1.094	3.629	0.502
110	ICP-MS	2.33	0.183	1.13	4.01	0.492
147	ICP-MS	2.26	0.224	1.04	3.88	0.480
399	ICP-MS	2.30	0.177	1.14	3.90	0.494
598	ICP-MS	2.06	0.23	*0.90	3.17	*0.42
605	ICP-MS	2.46	0.177	1.16	4.15	0.480
676	ICP-MS	2.20	0.185	1.10	3.73	0.478

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Arithmetic Mean ($\bar{x}$)	2.28	0.198	1.11	3.8	0.488
Arithmetic SD (s)	0.12	0.023	0.04	0.3	0.010
Arithmetic RSD (%)	5.3	12	3.6	8.5	2.0
Number of Sample Measurements (N)	7	7	6	7	6

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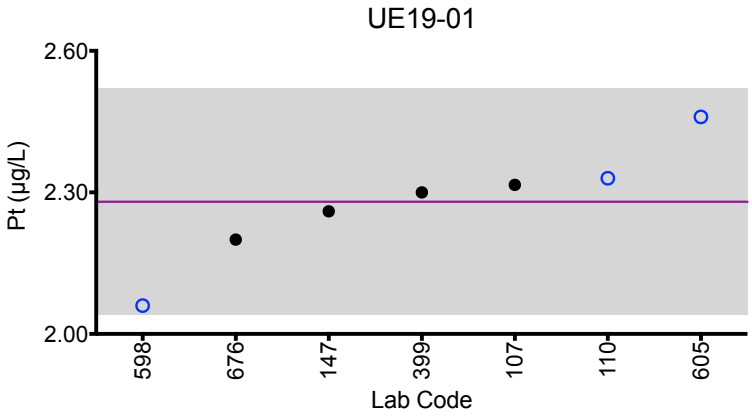
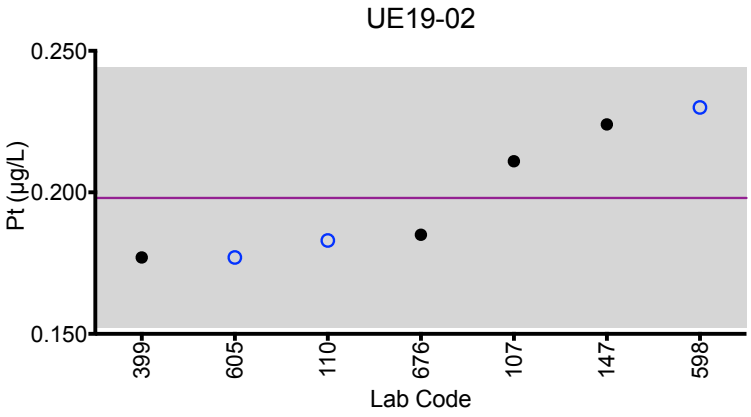
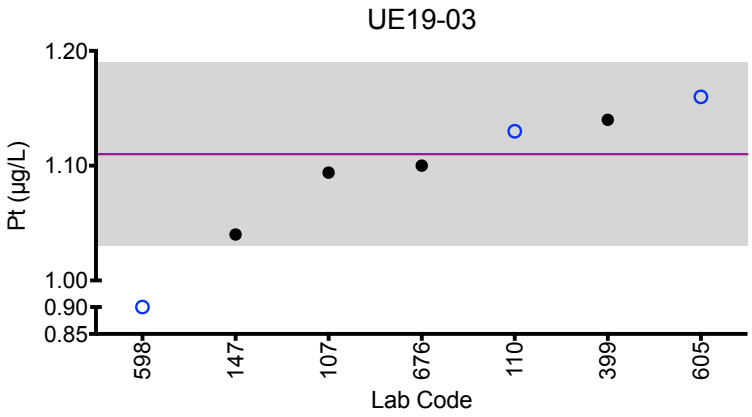
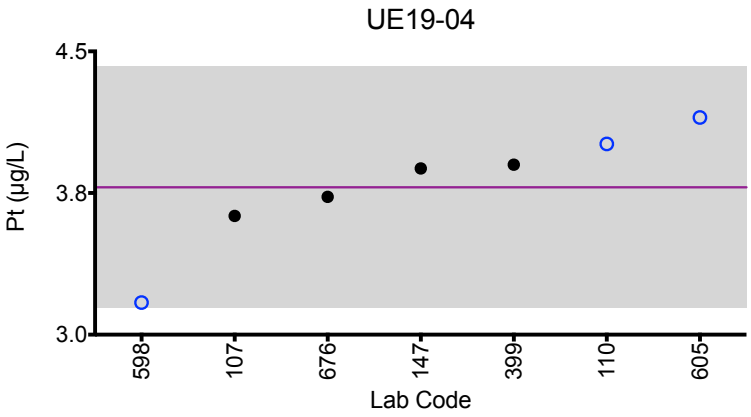
Results for Event #1, 2019: Summary Figures

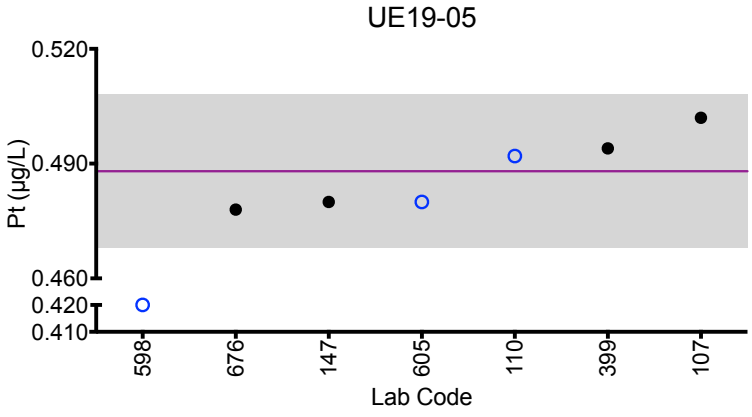
Urine Pt











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
103	DRC/CC-ICP-MS	0.646	1.91	2.40	0.499	1.02
107	ICP-MS	0.7	1.924	2.476	0.517	1.098
110	ICP-MS	0.708	1.91	2.43	0.516	1.06
147	ICP-MS	0.662	1.92	2.28	0.558	1.02
293	DRC/CC-ICP-MS	0.83	1.87	2.29	0.53	1.08
399	ICP-MS	0.702	1.89	2.44	0.516	1.09
597	DRC/CC-ICP-MS	0.638	1.83	2.36	0.54	1.03
598	ICP-MS	0.63	1.62	2.07	0.47	0.95
606	DRC/CC-ICP-MS	0.706	1.97	2.55	0.507	1.06
676	ICP-MS	0.638	1.64	2.26	0.463	0.952

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Robust Mean (x*)	0.68	1.89	2.37	0.51	1.04
Robust SD (s*)	0.04	0.05	0.13	0.03	0.05
Robust RSD (%)	5.9	2.6	5.5	5.1	4.8
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.02	0.02	0.05	0.01	0.02

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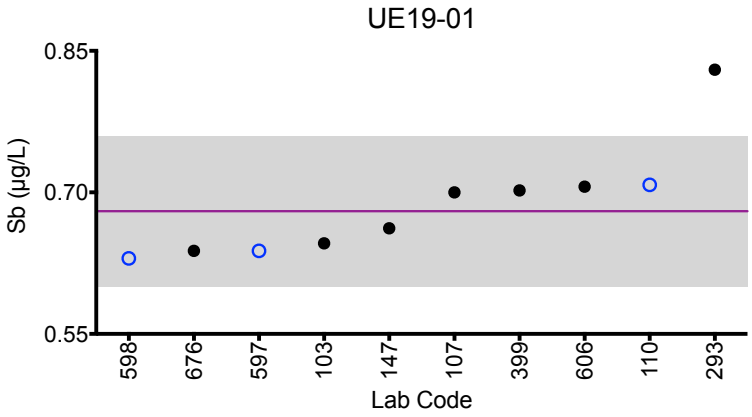
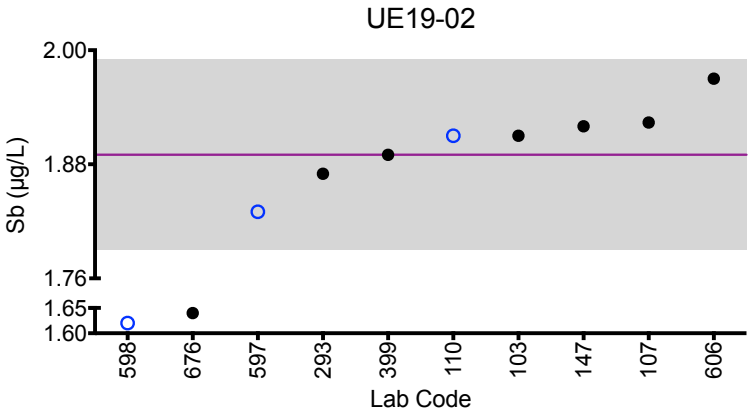
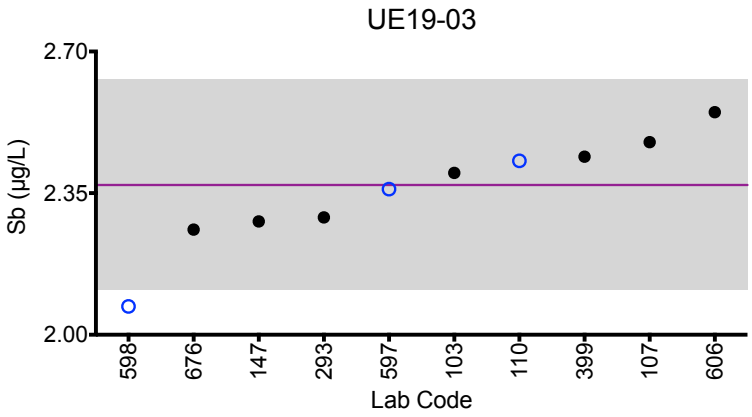
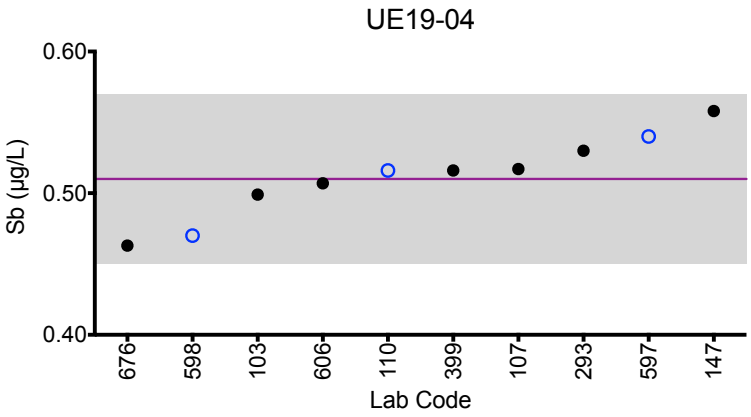
Results for Event #1, 2019: Summary Figures

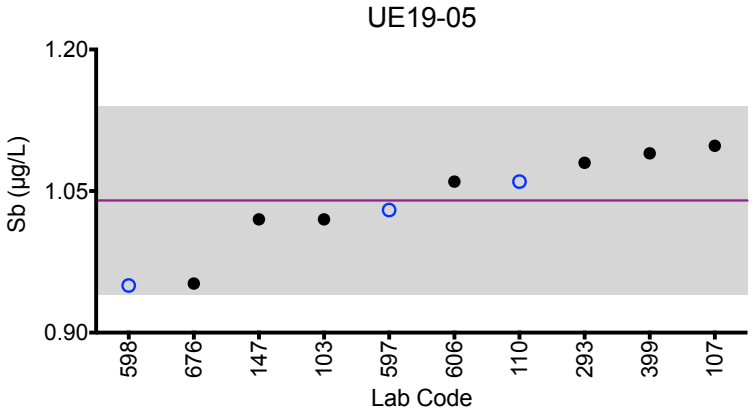
Urine Sb











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Se (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
103	DRC/CC-ICP-MS	148	110	106	202	37.0
110	DRC/CC-ICP-MS	140	110	130	236	50
147	ICP-MS	149	98.0	103	196	36.7
598	DRC/CC-ICP-MS	101	66.9	84.5	161	26.0
599	DRC/CC-ICP-MS	133	93.3	101	206	33.33

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Arithmetic Mean ($\bar{x}$)	134	96	105	200	37
Arithmetic SD (s)	20	18	16	27	9
Arithmetic RSD (%)	15	19	15	14	24
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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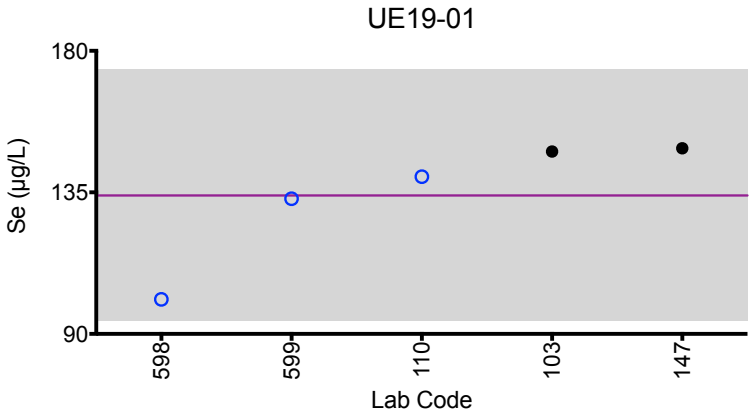
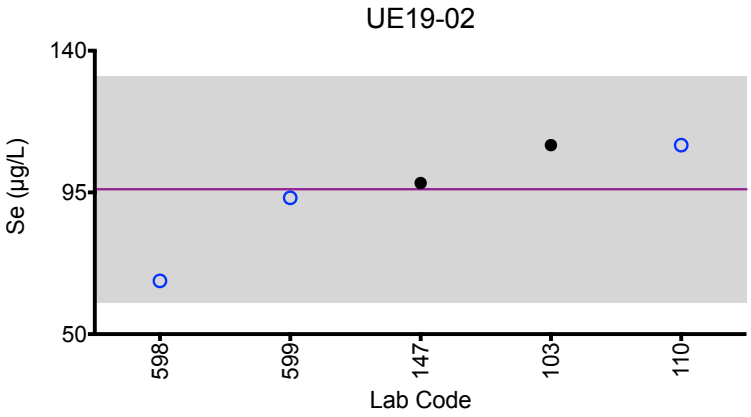
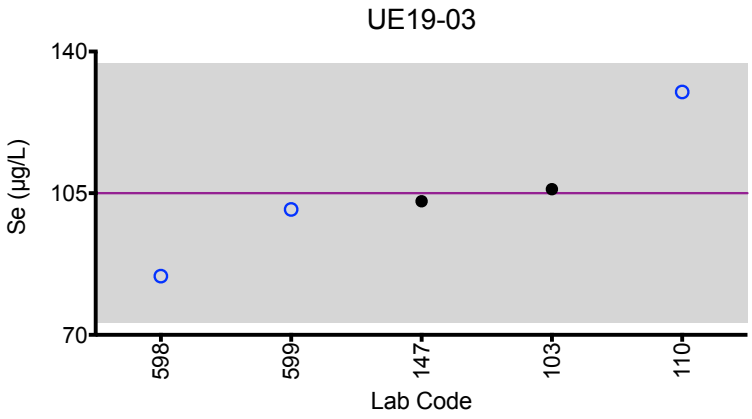
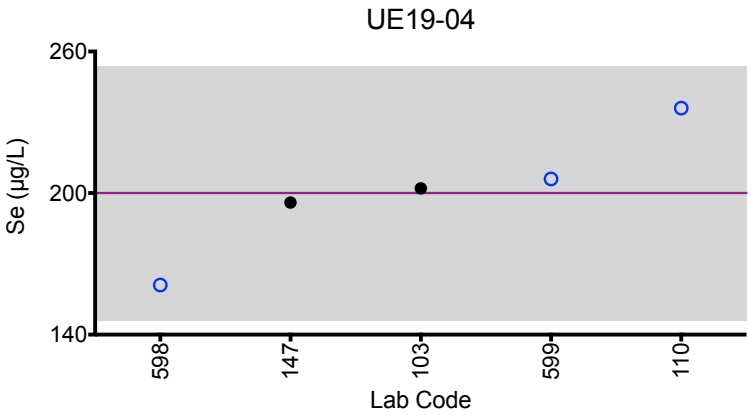
Results for Event #1, 2019: Summary Figures

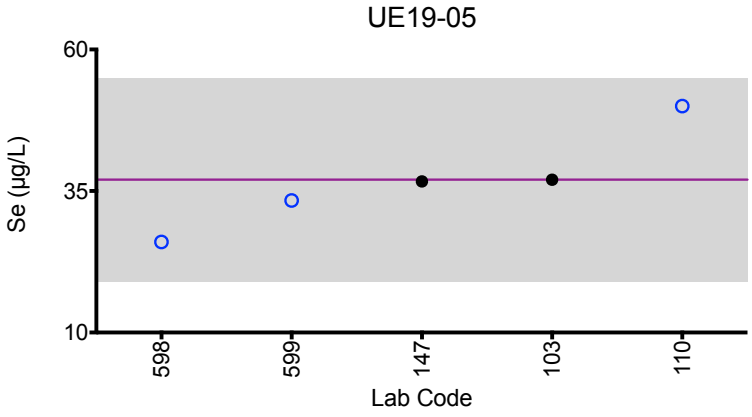
Urine Se











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
107	ICP-MS	*5.86	*1.62	6.89	6.51	2.61
110	ICP-MS	4.34	0.87	6.48	6.49	2.68
147	ICP-MS	4.37	0.834	5.90	5.84	2.51
399	ICP-MS	4.50	0.891	6.57	6.37	2.82
597	DRC/CC-ICP-MS	4.27	0.554	3.51	3.53	1.25
598	ICP-MS	3.91	0.64	4.45	4.45	1.69
676	ICP-MS	3.99	0.777	5.96	5.60	2.44

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Arithmetic Mean ($\bar{x}$)	4.23	0.76	5.7	5.5	2.3
Arithmetic SD (s)	0.23	0.14	1.2	1.1	0.6
Arithmetic RSD (%)	5.4	18	21	20	26
Number of Sample Measurements (N)	6	6	7	7	7

*Denotes a statistical Outlier.

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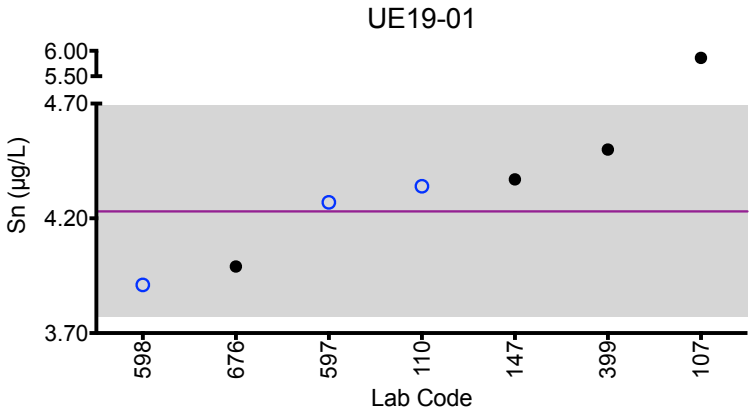
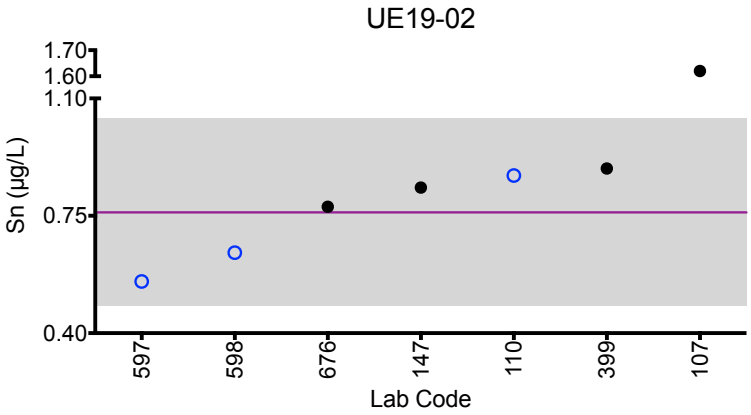
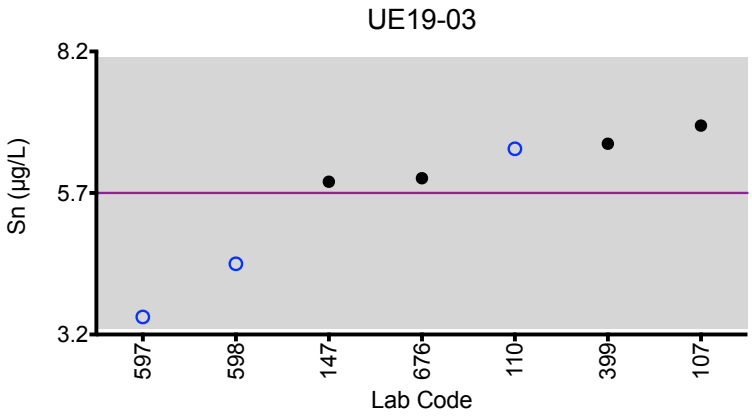
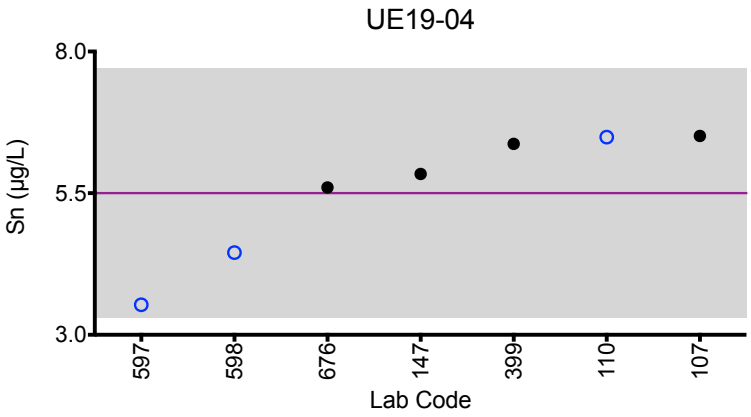
Results for Event #1, 2019: Summary Figures

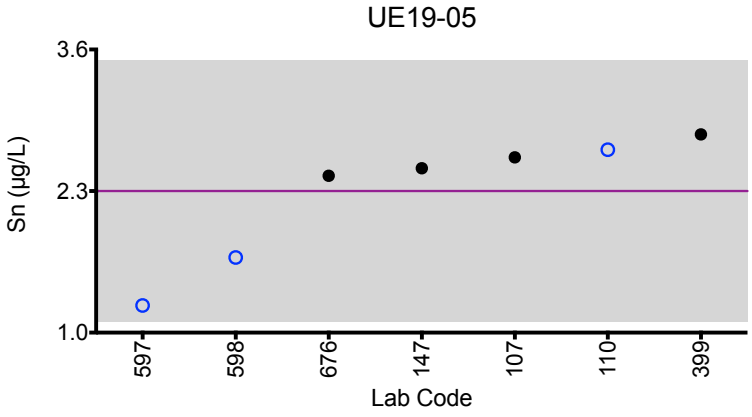
Urine Sn











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Sr (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
103	DRC/CC-ICP-MS	88.7	333	145	451	457
107	ICP-MS	91.26	368.69	151.43	484.23	490.84
200	ICP-MS	83	312	137	427	417
399	DRC/CC-ICP-MS	92.6	348	154	493	491
605	ICP-MS	89.8	360	158	505	482
676	ICP-MS	86.2	323	144	449	450
Summary Statistics						
		UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Arithmetic Mean ($\bar{x}$)		89	341	148	468	465
Arithmetic SD (s)		4	22	8	30	29
Arithmetic RSD (%)		4.0	6.5	5.4	6.4	6.2
Number of Sample Measurements (N)		6	6	6	6	6

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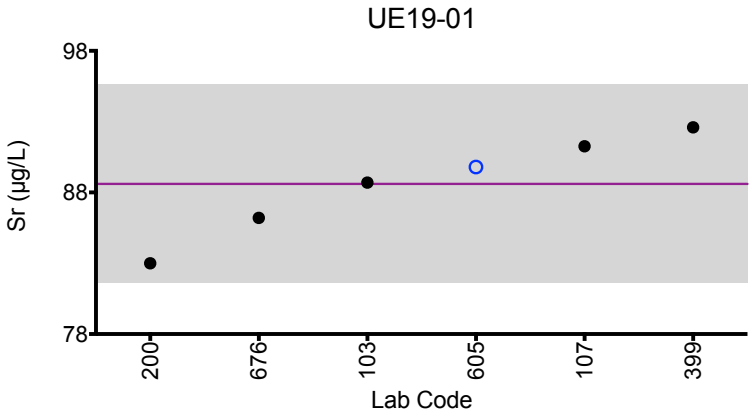
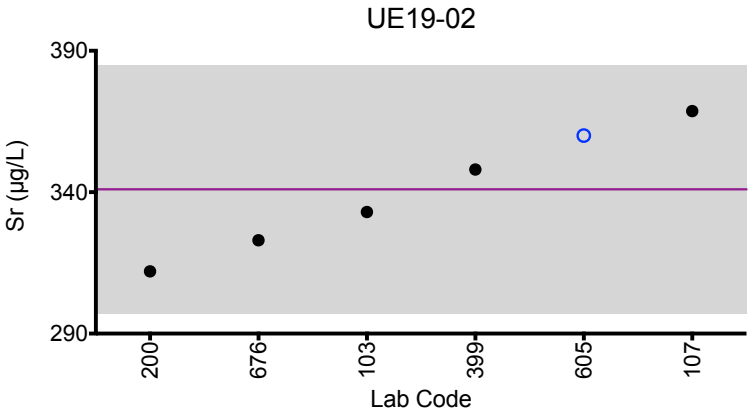
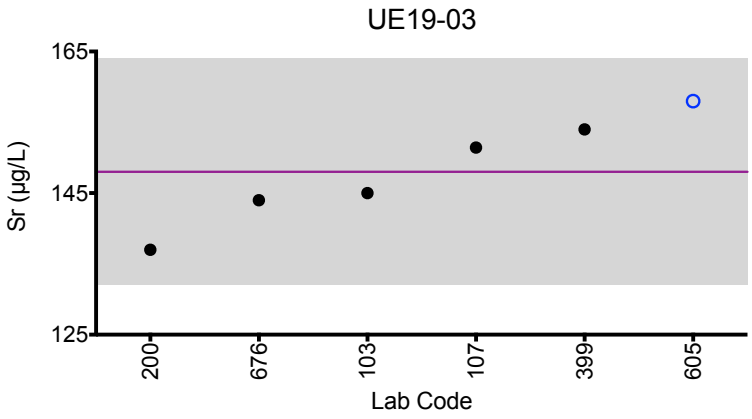
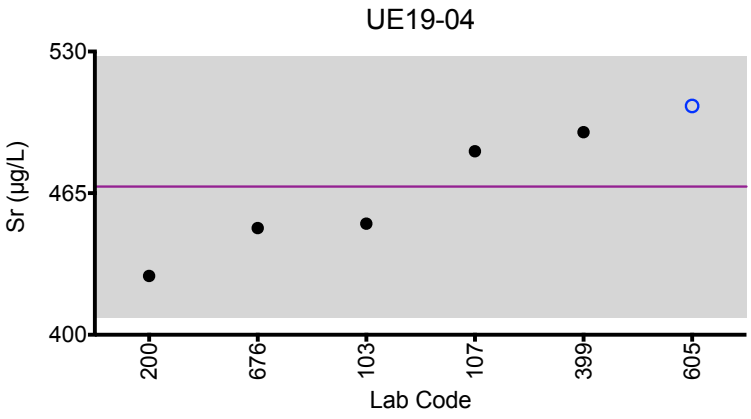
Results for Event #1, 2019: Summary Figures

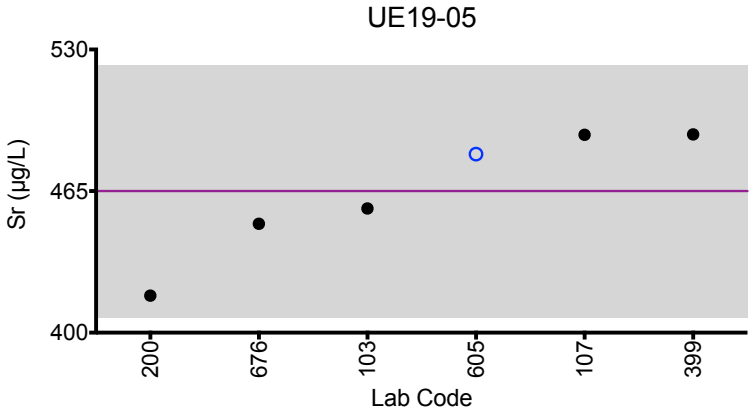
Urine Sr











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
116	ICP-MS/MS	0.280	2.02	3.44	0.797	4.07
147	DRC/CC-ICP-MS	0.229	2.06	3.43	0.816	4.52
293	DRC/CC-ICP-MS	0.31	2.23	3.79	1.17	4.53
597	DRC/CC-ICP-MS	0.411	1.97	3.10	1.11	3.81
598	DRC/CC-ICP-MS	0.232	1.83	3.42	0.892	4.21
599	DRC/CC-ICP-MS	0.206	*3.12	4.87	*2.73	5.65
605	ICP-MS	0.404	2.41	4.03	1.16	4.50

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Arithmetic Mean ($\bar{x}$)	0.30	2.09	3.7	0.99	4.5
Arithmetic SD (s)	0.08	0.20	0.6	0.17	0.6
Arithmetic RSD (%)	27	9.6	16	17	13
Number of Sample Measurements (N)	7	6	7	6	7

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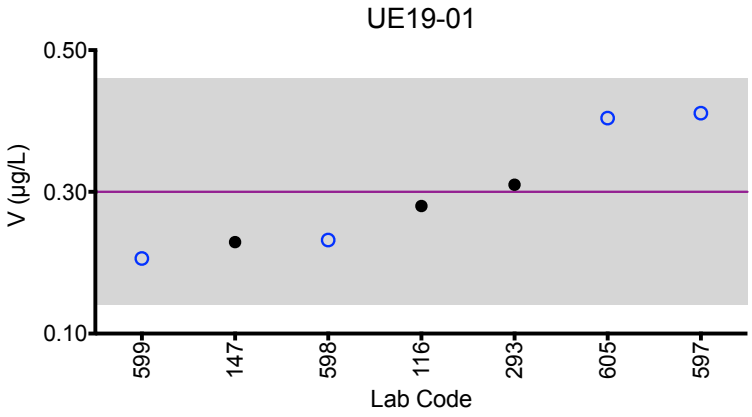
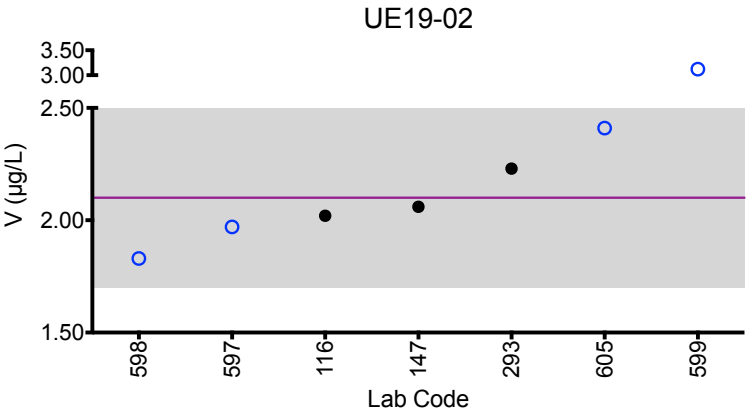
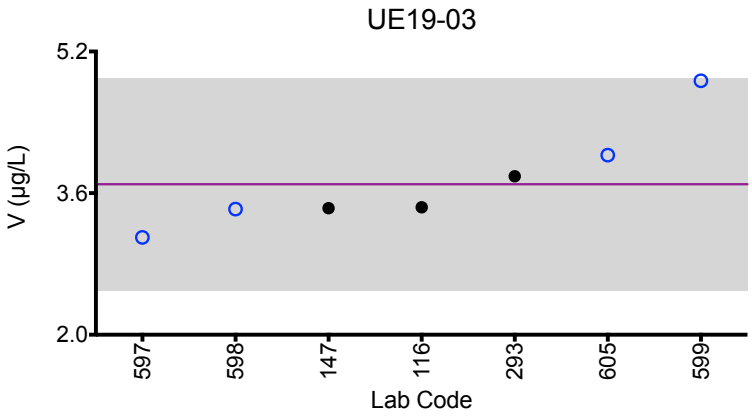
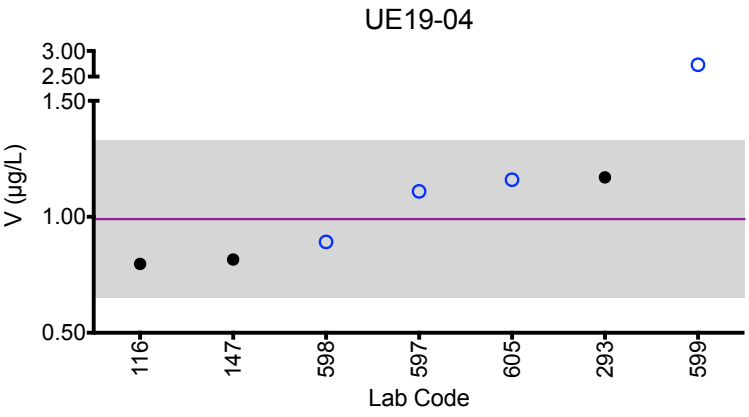
Results for Event #1, 2019: Summary Figures

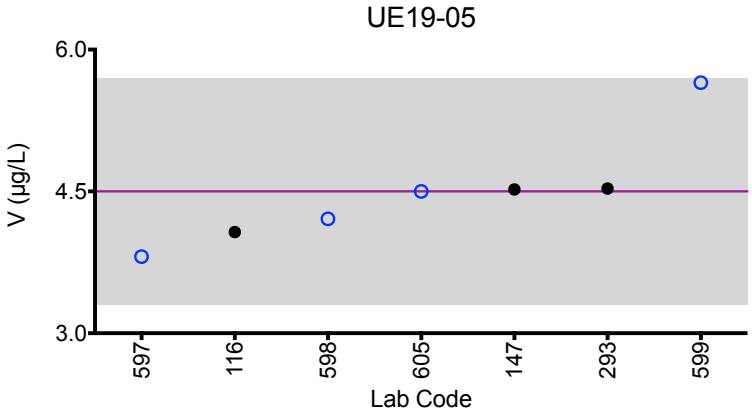
Urine V











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
107	ICP-MS	1.558	0.66	0.329	1.23	0.884
110	ICP-MS	1.62	0.659	0.329	1.30	0.886
147	ICP-MS	1.54	0.655	0.320	1.26	0.872
200	ICP-MS	1.27	0.74	0.31	1.32	0.86
324	ICP-MS	1.523	<1	<1	1.181	<1
399	ICP-MS	1.54	0.660	0.346	1.34	0.907
598	ICP-MS	1.47	0.56	0.26	1.10	0.79
599	DRC/CC-ICP-MS	1.70	0.841	0.387	1.34	0.914
605	ICP-MS	1.46	0.594	0.27	1.25	0.817
606	DRC/CC-ICP-MS	1.54	1.00	0.348	1.29	0.874
676	ICP-MS	1.50	0.653	0.290	1.21	0.835

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Robust Mean (x*)	1.53	0.67	0.32	1.26	0.87
Robust SD (s*)	0.07	0.06	0.04	0.07	0.04
Robust RSD (%)	4.6	9.0	12	5.6	4.4
Number of Sample Measurements (N)	11	10	10	11	10
Standard Uncertainty (*u*)	0.03	0.03	0.01	0.03	0.01

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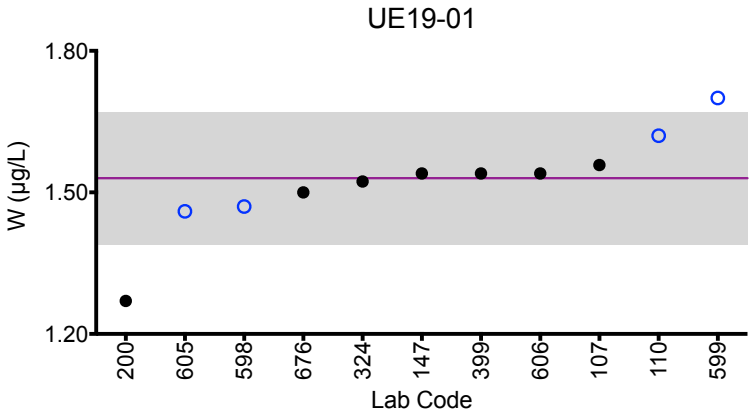
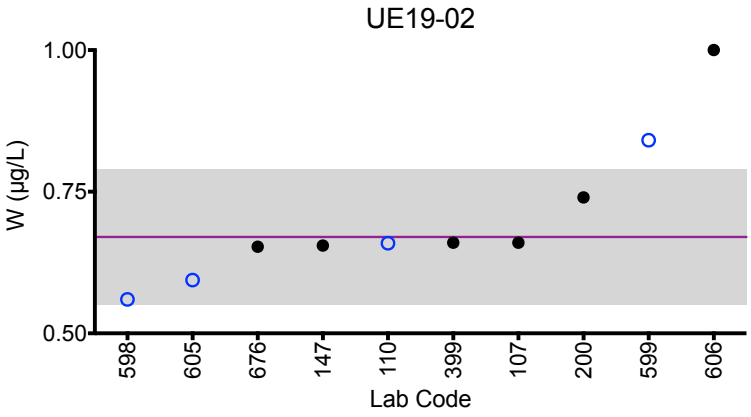
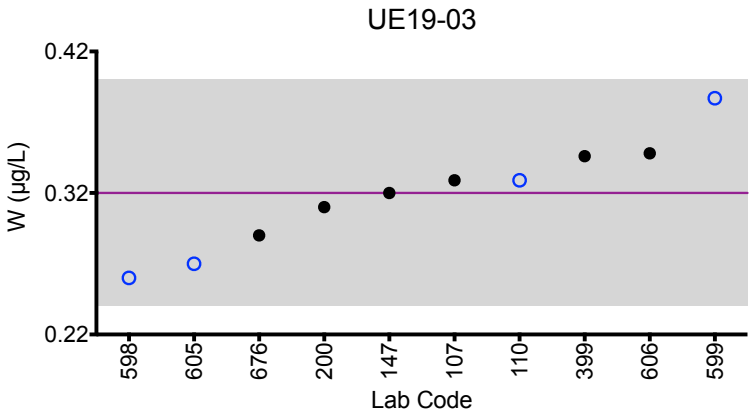
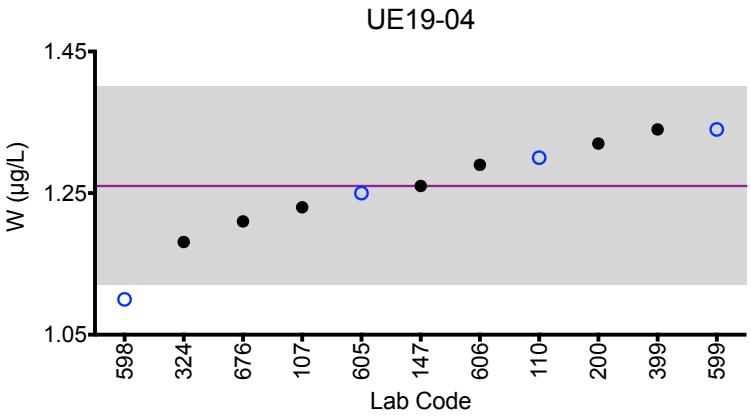
Results for Event #1, 2019: Summary Figures

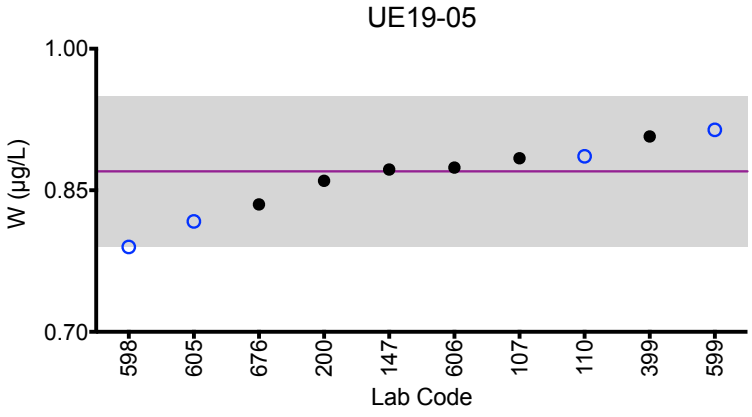
Urine W











Legend:
o 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.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)

Lab Code	Method	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
110	ICP-MS	170	521	677	1076	358
147	ICP-MS	182	541	680	1098	342
293	DRC/CC-ICP-MS	*240.52	638.56	771.9	1237.91	406.54
324	ICP-MS	171.449	575.369	754.487	1212.439	359.931
401	DRC/CC-ICP-MS	157	575	745	1229	333
597	DRC/CC-ICP-MS	179	601	758	1188	369
598	ICP-MS	146	448	582	942	283
599	DRC/CC-ICP-MS	164	600	784	1250	355

Summary Statistics

	UE19-01	UE19-02	UE19-03	UE19-04	UE19-05
Arithmetic Mean ($\bar{x}$)	167	560	720	1150	351
Arithmetic SD (s)	13	60	70	110	35
Arithmetic RSD (%)	7.8	11	9.7	9.6	10
Number of Sample Measurements (N)	7	8	8	8	8

*Denotes a statistical Outlier.

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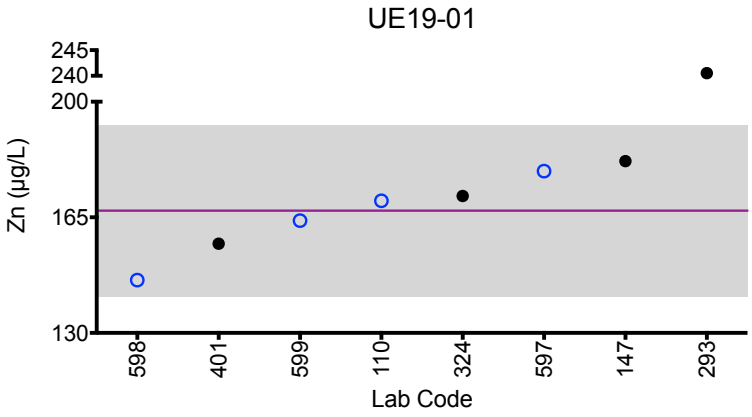
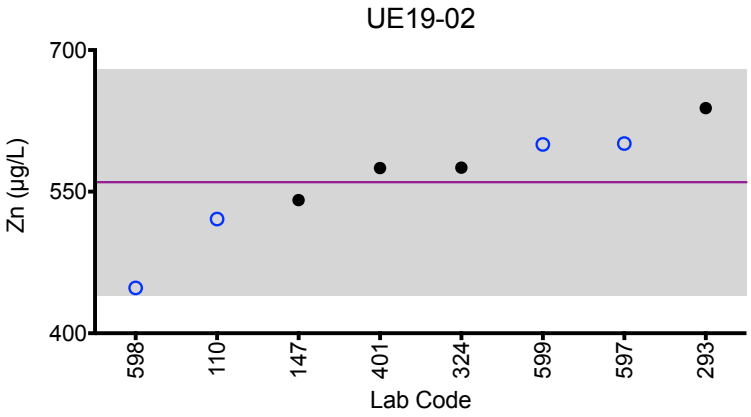
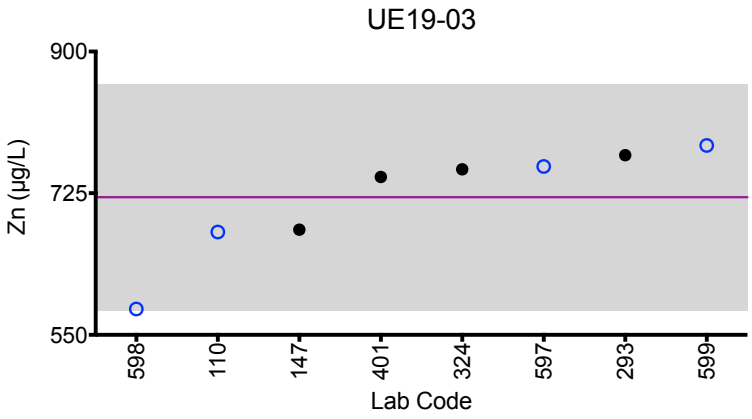
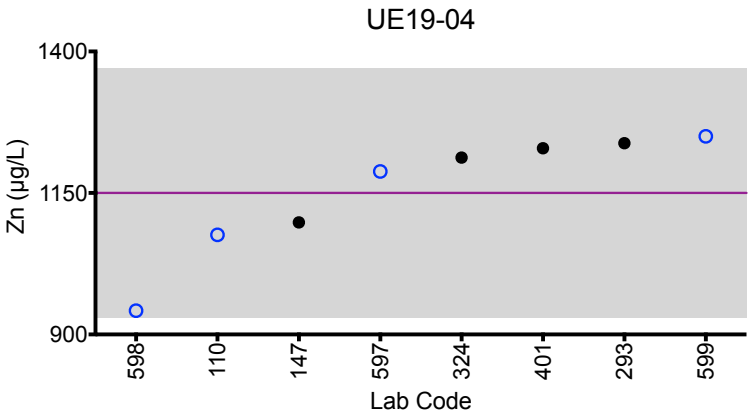
Results for Event #1, 2019: Summary Figures

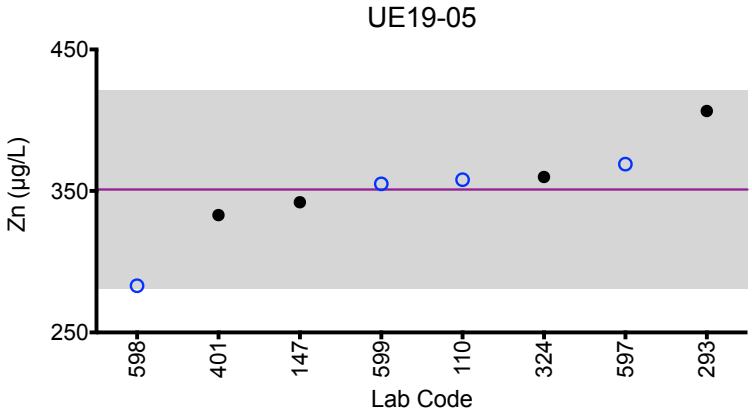
Urine Zn











Legend:
o 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.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Urine Al (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
147	DRC/CC-ICP-MS	*40.5	*40.2	*57.2	*44.8	<18.1
324	ICP-MS	16.253	17.471	20.128	29.554	17.607
598	ICP-MS	18.2	12.4	20.3	30.5	14.6
Summary Statistics						
		UE19-01	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
Arithmetic Mean ($\bar{x}$)		17.2	15	20.21	30.0	16
Arithmetic SD (s)		1.4	4	0.12	0.7	2
Arithmetic RSD (%)		8.1	27	0.59	2.3	13
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2019: Additional Elements in Urine

Urine Ag (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
147	ICP-MS	<0.507	<0.507	<0.507	<0.507	<0.507

Urine B (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
200	ICP-MS	611	1760	1350	1469	1296

Urine Bi (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
147	ICP-MS	<0.293	<0.293	<0.293	<0.293	<0.293

Urine Fe (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
324	ICP-MS	6.712	14.469	10.670	13.509	18.944

Urine Li (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
147	ICP-MS	18.0	40.2	43.4	43.3	21.3

Urine Mg (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
597	DRC/CC-ICP-MS	35900	95600	90800	72700	58000

Urine Te (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
110	ICP-MS	2.18	0.458	1.12	<0.08	0.584

Urine Th (µg/L)						
Lab Code	**Method**	**UE19-01**	**UE19-02**	**UE19-03**	**UE19-04**	**UE19-05**
147	ICP-MS	<0.00719	<0.00719	<0.00719	<0.00719	<0.00719

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Event #1, 2019

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #1, 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 1Ž2 and HIV-1 RNA, and non-reactive to HBsAg, HCV3 and STS. Units of serum were filtered into polypropylene containers through cheesecloth to remove particulates and supplemented with aluminum (Al), cobalt (Co), chromium (Cr), copper (Cu), selenium (Se), zinc, (Zn), arsenic (As), beryllium (Be), cadmium (Cd), mercury (Hg), manganese (Mn), molybdenum (Mo), nickel (Ni), lead (Pb), platinum (Pt), antimony (Sb), tin (Sn), strontium (Sr), titanium (Ti), thallium (Tl), uranium (U), vanadium (V) and tungsten (W). Serum units were homogenized overnight prior to aliquoting 2-mL into polypropylene vials. PT samples were stored at -80°C until the week of the PT event, when they were thawed at 4°C prior to circulation to laboratories for analysis.

Graded Elements

Six elements in serum are formally graded: Al, Co, Cr, Cu, Se, and Zn. Target values for the graded elements are assigned to these pools based on (a) the robust mean calculated from data reported by all laboratories, or (b) if a robust mean is not possible, the arithmetic mean after outlier deletion.

Additional Elements

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

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

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Results for Event #1, 2019: Summary Statistics

	Serum Al (µg/L)				
	SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Target (Arithmetic Mean ($\bar{x}$))	169	42	122	103	68
Upper Limit	203	50	146	124	82
Lower Limit	135	34	98	82	54
Arithmetic SD (s)	10	6	8	7	8
Arithmetic RSD (%)	5.9	14	6.6	6.8	12
Number of Sample Measurements (N)	6	6	6	6	6

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Serum Al (µg/L)				
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
	Target	**169**	**42**	**122**	**103**	**68**
147	ETAAS-Z	157	42.3	107	96.3	62.7
293	DRC/CC-ICP-MS	161.29	34.95	118.28	94.09	61.83
391	ETAAS-Z	205.70 ↑	49.341	150.8 ↑	128.6 ↑	83.45 ↑
485	HR-ICP-MS	173.00	36.1	124	103	62.8
590	ICP-MS	178	43.3	132	109	71.6
597	DRC/CC-ICP-MS	181	49.5	125	112	82.1 ↑
598	ICP-MS	162	45.5	124	106	66.7

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

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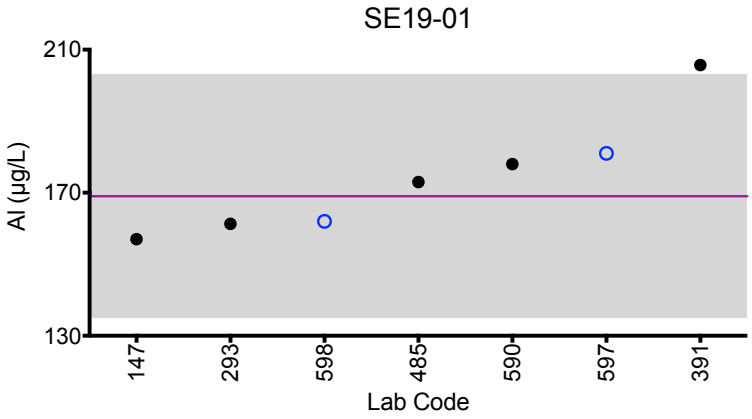
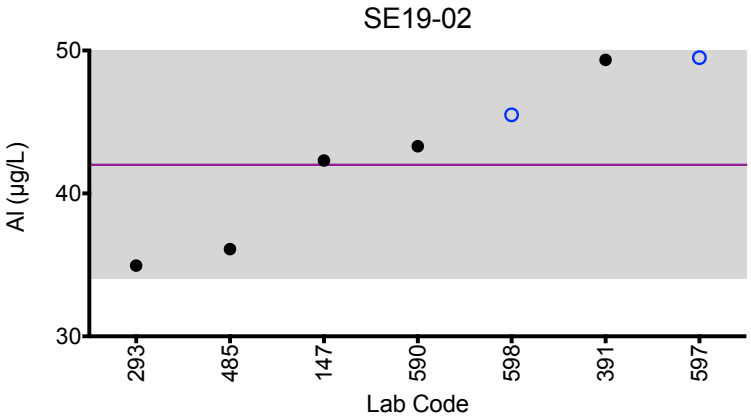
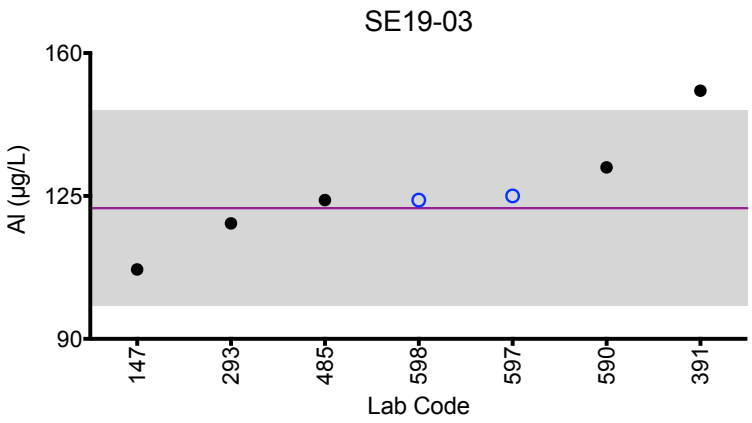
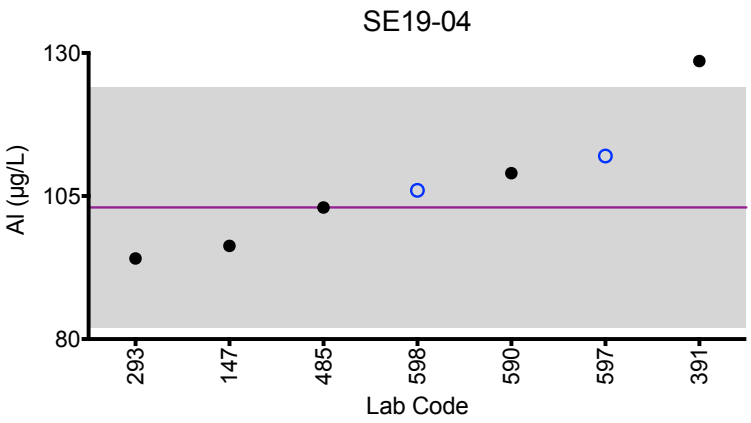
Results for Event #1, 2019: Summary Figures

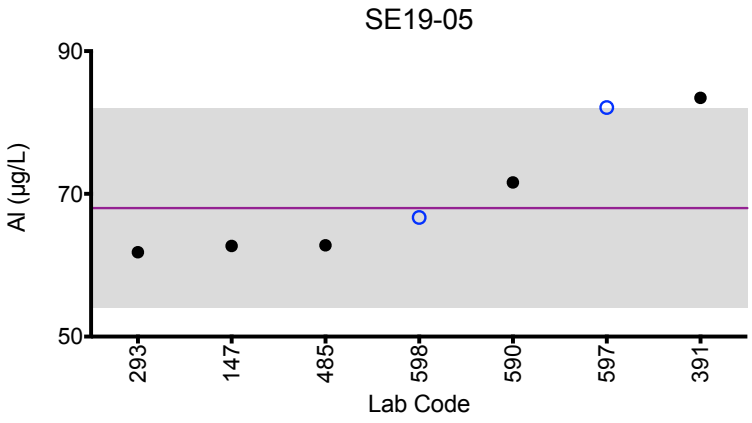
Serum Al











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2019: Summary Statistics

	Serum Co (µg/L)				
	SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Target (Arithmetic Mean ($\bar{x}$))	2.32	13.2	16.5	6.4	3.7
Upper Limit	3.82	15.2	19.0	7.9	5.2
Lower Limit	0.82	11.2	14.0	4.9	2.2
Arithmetic SD (s)	0.04	0.5	0.7	0.3	0.3
Arithmetic RSD (%)	1.7	3.8	4.2	5.0	9.1
Number of Sample Measurements (N)	7	8	8	8	8

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Serum Co (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
	Target	**2.32**	**13.2**	**16.5**	**6.4**	**3.7**
103	DRC/CC-ICP-MS	2.32	13.0	16.6	6.26	3.62
110	ICP-MS	*2.56	14.0	18.0	6.91	3.86
147	ICP-MS	2.32	13.1	16.1	6.19	3.45
293	DRC/CC-ICP-MS	2.29	13.57	16.31	6.7	3.75
485	HR-ICP-MS	2.40	13.2	17.1	6.46	3.83
590	ICP-MS	2.30	12.7	16.3	6.12	3.56
597	DRC/CC-ICP-MS	2.34	13.51	16.07	6.30	4.46
598	ICP-MS	2.29	12.3	15.6	5.95	3.34

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

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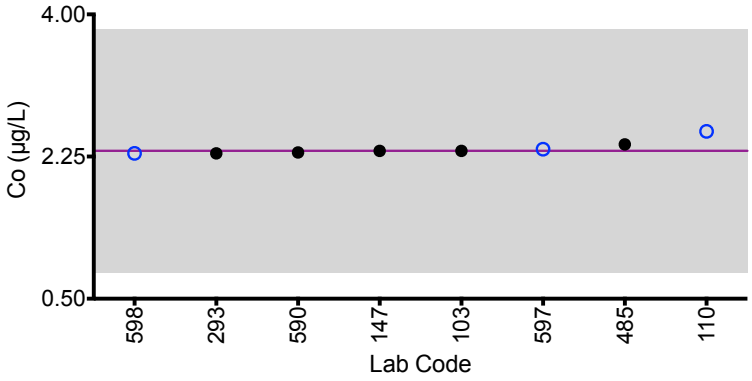
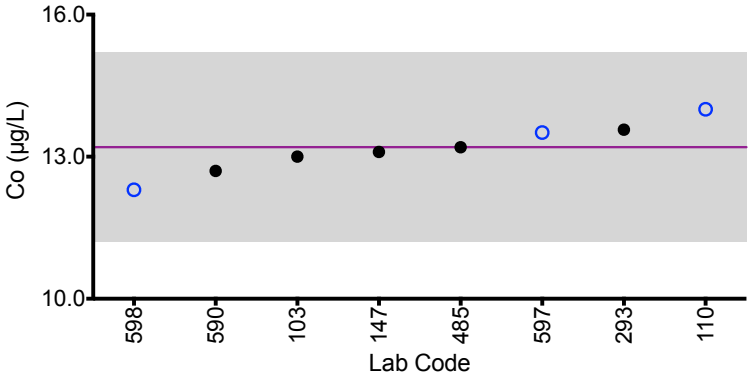
Results for Event #1, 2019: Summary Figures

Serum Co

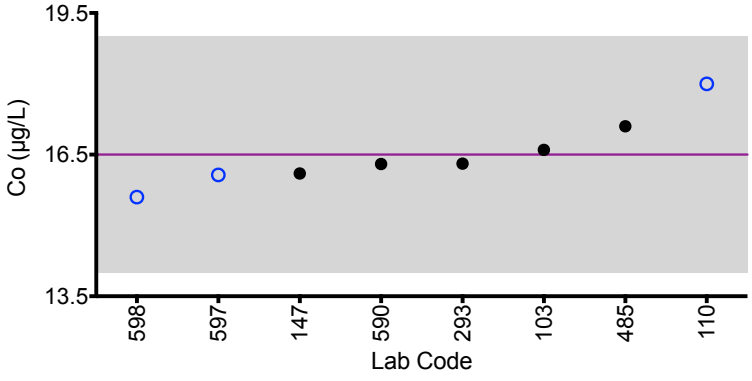
SE19-01



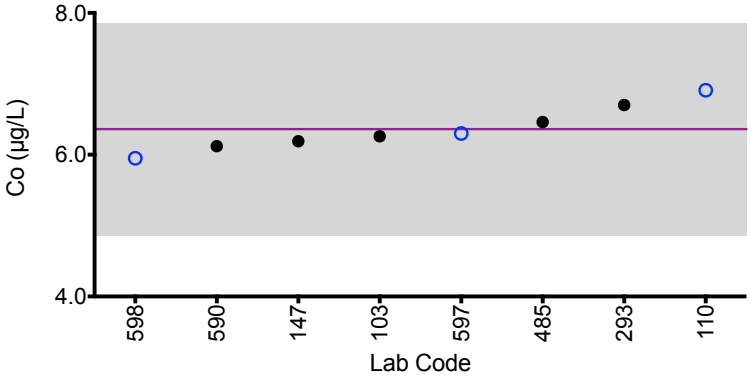
SE19-02



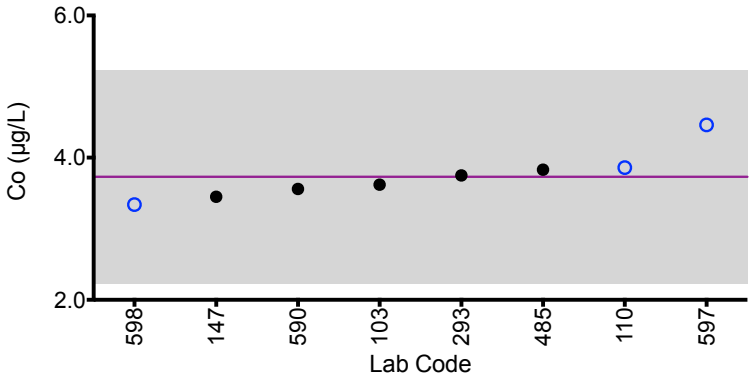
SE19-03



SE19-04



SE19-05



Legend:

o 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.

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Results for Event #1, 2019: Summary Statistics

	Serum Cr (µg/L)				
	SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Target (Arithmetic Mean ($\bar{x}$))	3.7	0.57	0.3	8.4	6.1
Upper Limit	5.7	2.57	2.3	10.4	8.1
Lower Limit	1.7	0.00	0.0	6.4	4.1
Arithmetic SD (s)	0.5	0.17	0.2	1.0	0.4
Arithmetic RSD (%)	14	30	61	12	6.6
Number of Sample Measurements (N)	7	7	4	7	6

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
	Target	**3.7**	**0.57**	**0.3**	**8.4**	**6.1**
110	DRC/CC-ICP-MS	3.8	0.5	0.1	9.1	5.5
147	DRC/CC-ICP-MS	3.68	0.676	<0.166	7.75	6.03
293	DRC/CC-ICP-MS	3.9	0.57	0.28	9.11	6.12
485	HR-ICP-MS	3.75	0.372	<0.1	8.46	5.81
590	ICP-MS	3.89	0.789	0.592	8.68	6.17
597	DRC/CC-ICP-MS	4.44	0.72	0.36	9.14	6.74
598	DRC/CC-ICP-MS	2.67	0.366	<0.1	6.29 ↓	*3.69 ↓

Based on the grading criteria for Cr in Serum, 94% of results were satisfactory, with 1 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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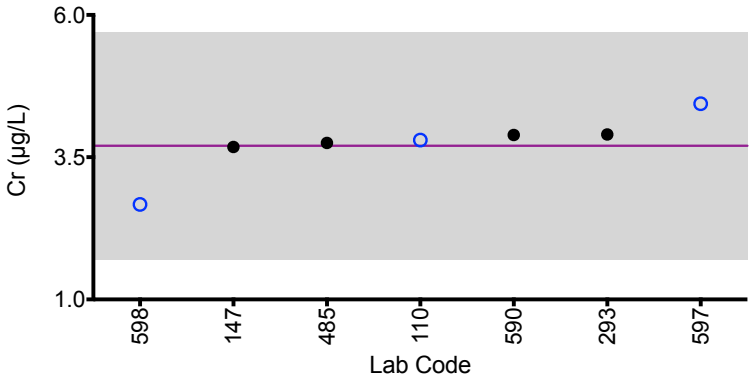
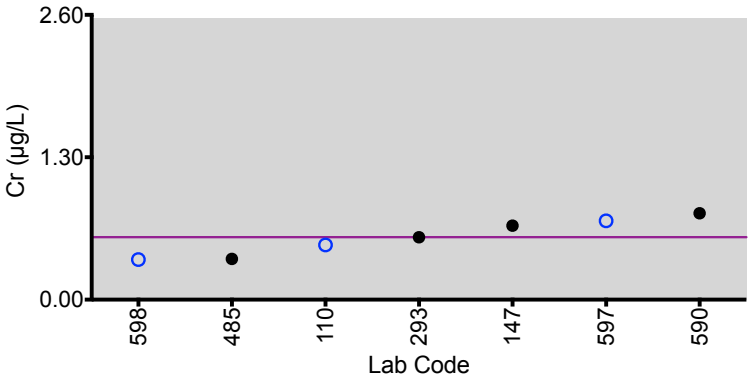
Results for Event #1, 2019: Summary Figures

Serum Cr

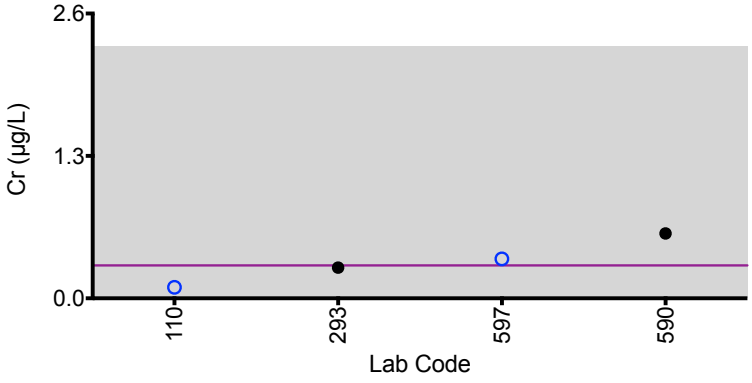
SE19-01



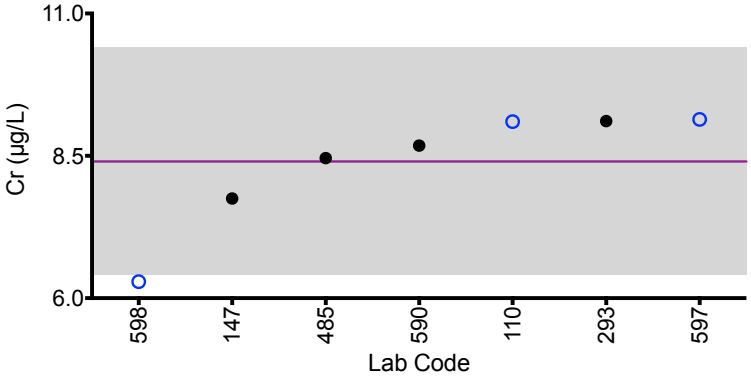
SE19-02



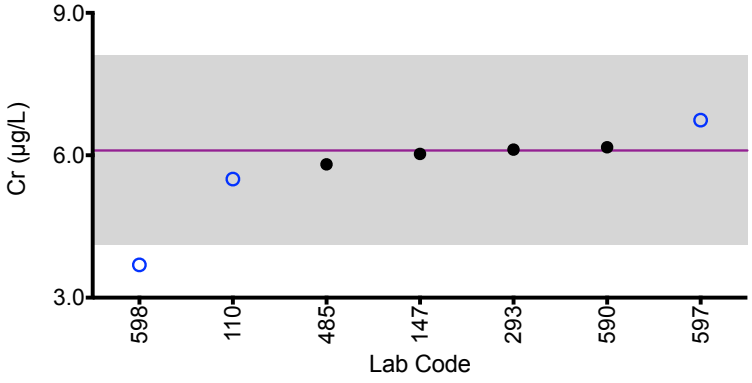
SE19-03



SE19-04



SE19-05



Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2019: Summary Statistics

Serum Cu (µg/L)					
	SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Target (Arithmetic Mean ($\bar{x}$))	1100	2900	800	2370	1830
Upper Limit	1270	3340	920	2730	2100
Lower Limit	940	2470	680	2010	1560
Arithmetic SD (s)	80	180	50	170	180
Arithmetic RSD (%)	7.3	6.2	6.3	7.2	9.8
Number of Sample Measurements (N)	9	9	9	9	9

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

Serum Cu (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
	Target	**1100**	**2900**	**800**	**2370**	**1830**
107	DRC/CC-ICP-MS	1217	2831	865	2538	1727
110	ICP-MS	1210	3120	889	2560	1960
147	ICP-MS	1099	2986	807	2363	1792
293	DRC/CC-ICP-MS	1061.67	2911.63	775.59	2275.91	1786.4
457	ICP-AES/OES	1111.4	3045.7	804.7	2499.6	1890.6
483	DRC/CC-ICP-MS	1100	2890	819	2380	1800
590	ICP-MS	1028	2701	754	2168	1717
597	DRC/CC-ICP-MS	1100	3050	780	2440	2220 ↑
598	ICP-MS	982	2578	725	2070	1575

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

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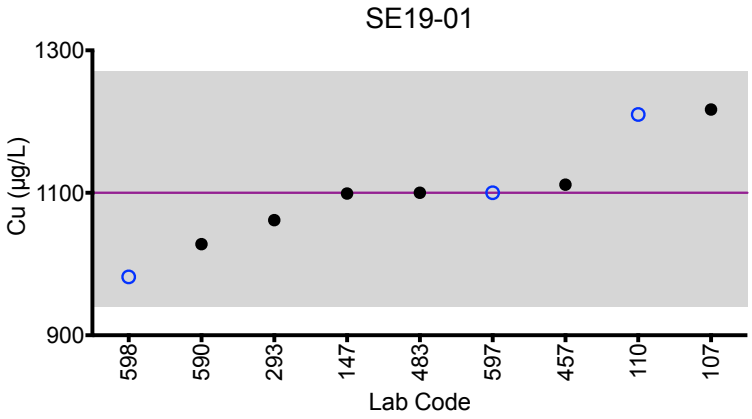
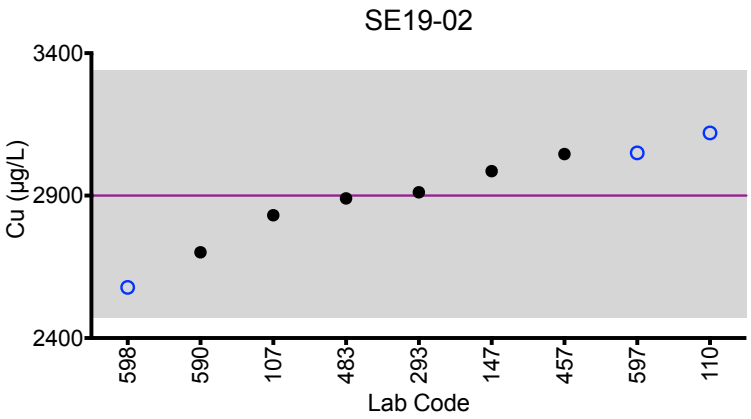
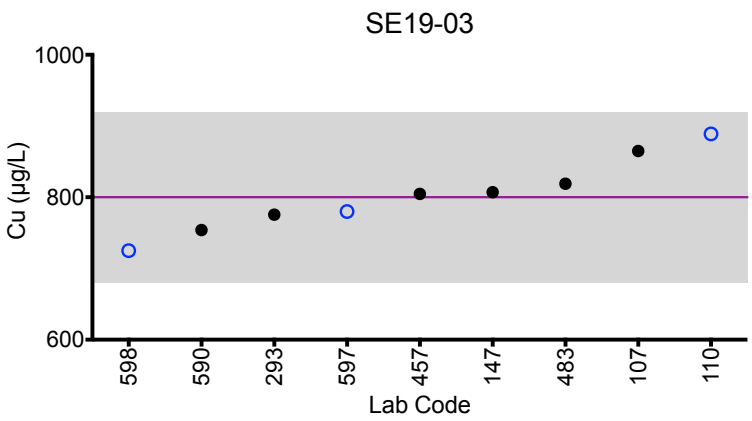
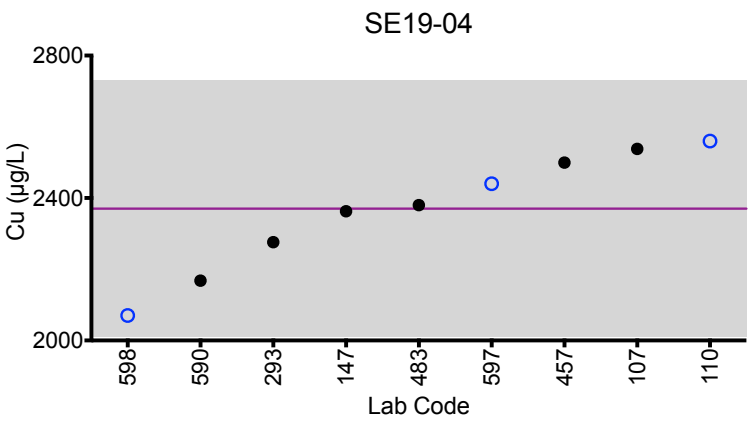
Results for Event #1, 2019: Summary Figures

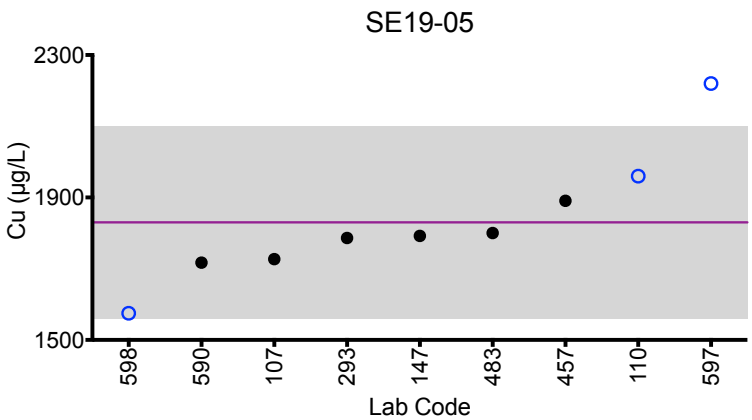
Serum Cu











Legend:

o 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:

±95 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±95 µg/L at concentrations less than or equal to 635 µg/L.

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Results for Event #1, 2019: Summary Statistics

	Serum Se (µg/L)				
	SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Target (Arithmetic Mean ($\bar{x}$))	116	301	263	208	159
Upper Limit	139	361	316	250	191
Lower Limit	93	241	210	166	127
Arithmetic SD (s)	4	11	6	7	27
Arithmetic RSD (%)	3.4	3.7	2.3	3.4	17
Number of Sample Measurements (N)	8	8	8	8	9

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
	Target	**116**	**301**	**263**	**208**	**159**
103	DRC/CC-ICP-MS	117	302	267	207	161
107	DRC/CC-ICP-MS	110.9	291.5	260.3	201.8	157.9
110	DRC/CC-ICP-MS	115	290	265	204	157
147	ICP-MS	110	295	253	202	155
293	DRC/CC-ICP-MS	118.39	314.13	272.3	213.1	167.32
483	DRC/CC-ICP-MS	119	291	267	206	162
590	ICP-MS	118	304	264	208	164
597	DRC/CC-ICP-MS	121	319	256	224	206 ↑
598	DRC/CC-ICP-MS	*83.3 ↓	*207 ↓	*192 ↓	*132 ↓	101 ↓

Based on the grading criteria for Se in Serum, 87% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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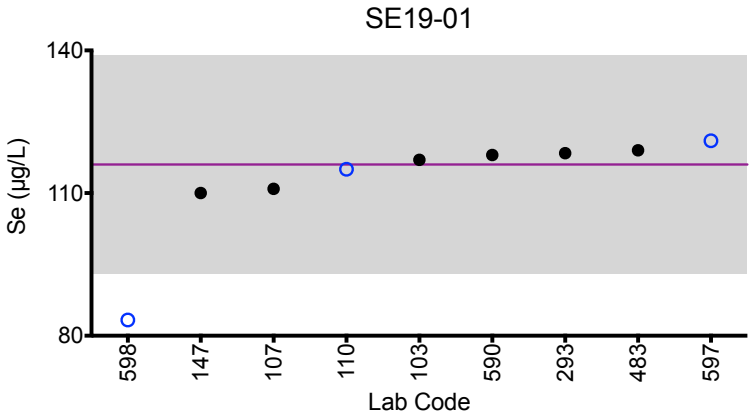
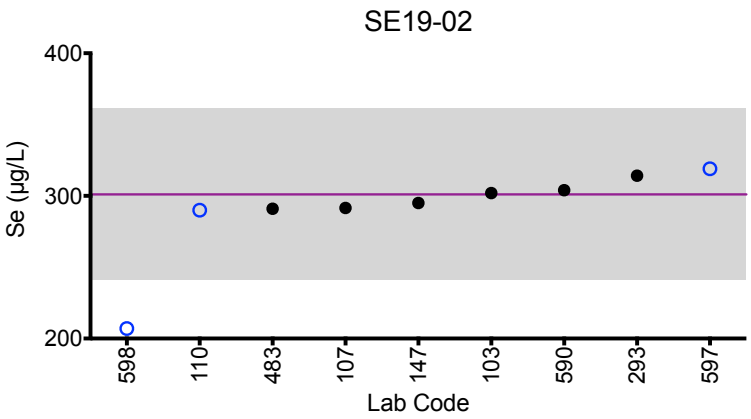
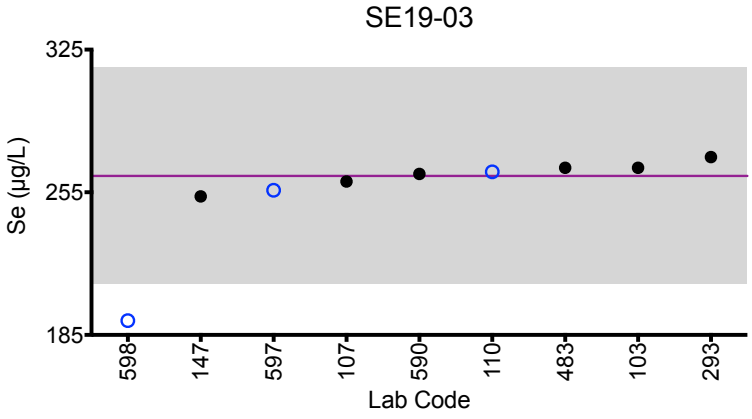
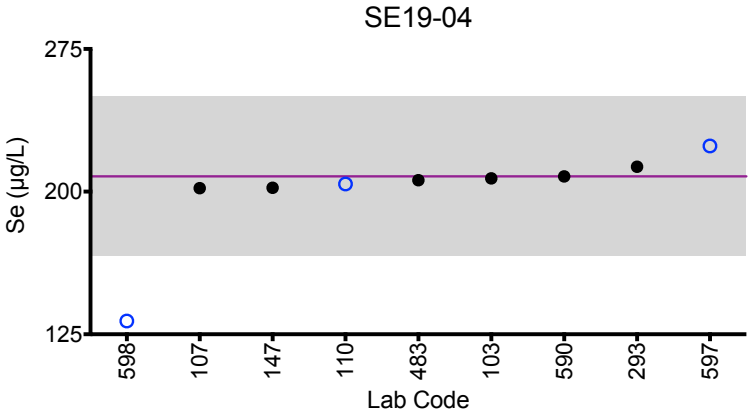
Results for Event #1, 2019: Summary Figures

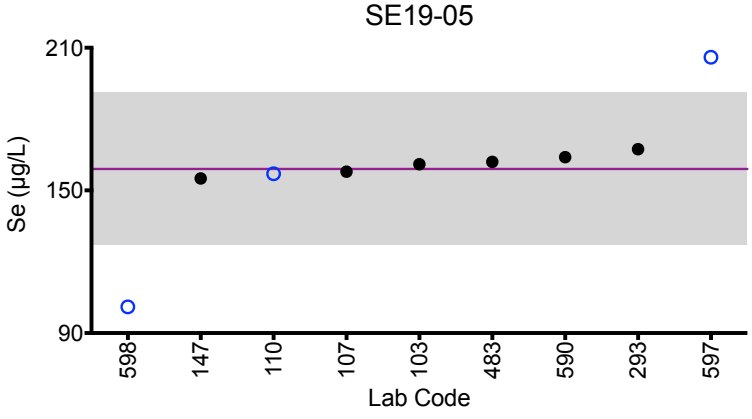
Serum Se











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2019: Summary Statistics

Serum Zn (µg/L)					
	SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Target (Arithmetic Mean ($\bar{x}$))	710	2830	1620	2430	1080
Upper Limit	820	3250	1860	2790	1240
Lower Limit	600	2410	1380	2070	920
Arithmetic SD (s)	60	230	180	230	90
Arithmetic RSD (%)	8.5	8.1	11	9.5	8.3
Number of Sample Measurements (N)	9	9	9	9	8

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

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Results for Event #1, 2019:
Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
	Target	**710**	**2830**	**1620**	**2430**	**1080**
107	DRC/CC-ICP-MS	805	2749	1790	2712	1046
110	ICP-MS	736	3010	1960 ↑	2580	1180
147	ICP-MS	712	2974	1621	2484	1131
293	DRC/CC-ICP-MS	718.95	2843.14	1562.09	2359.48	1124.18
457	ICP-AES/OES	707.8	2897.3	1597.6	2381.5	1071.5
483	DRC/CC-ICP-MS	695	2810	1610	2430	1100
590	ICP-MS	665	2698	1545	2301	1098
597	DRC/CC-ICP-MS	755	3160	1650	2668	*1467 ↑
598	ICP-MS	575 ↓	2343 ↓	1287 ↓	1949 ↓	891 ↓

Based on the grading criteria for Zn in Serum, 84% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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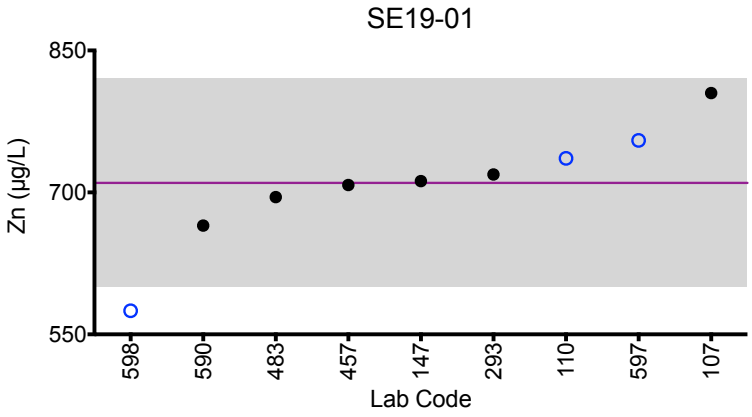
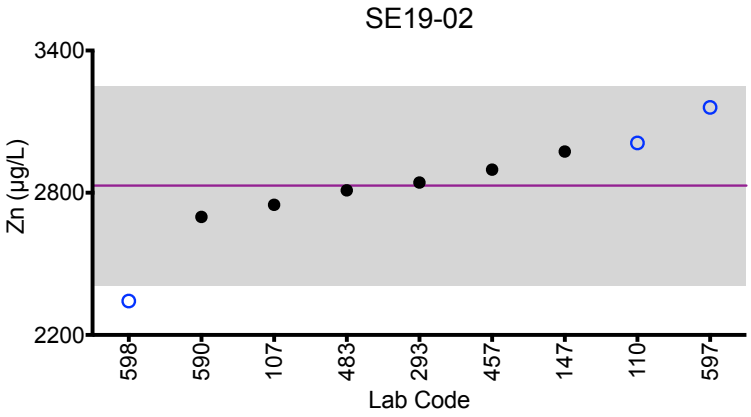
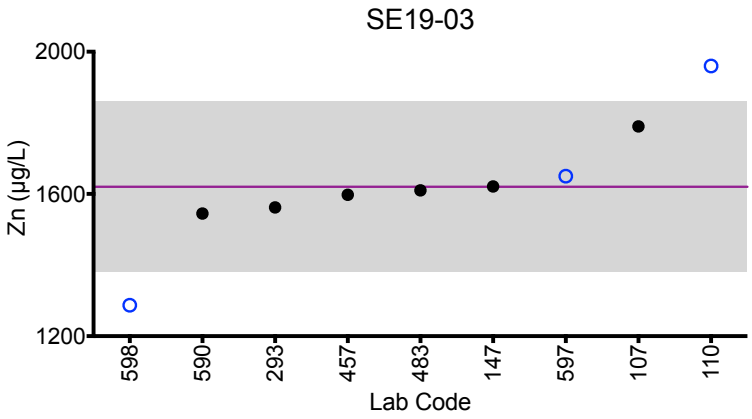
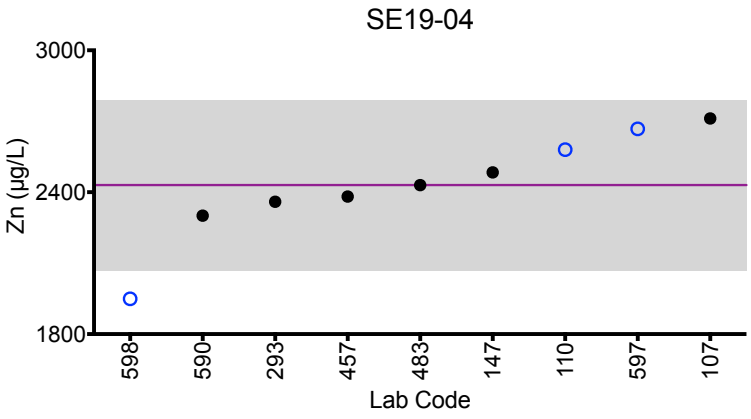
Results for Event #1, 2019: Summary Figures

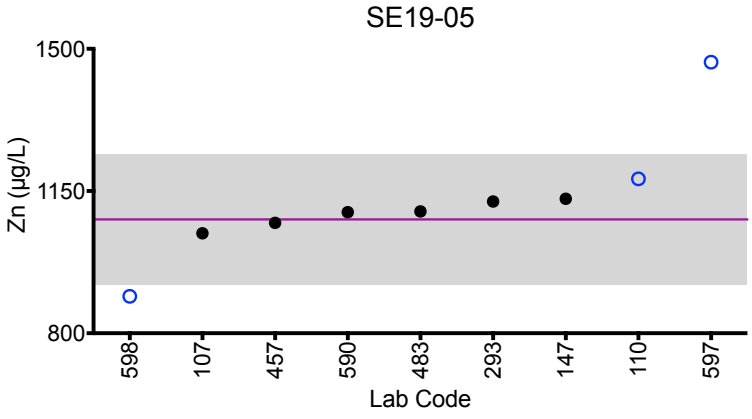
Serum Zn











Legend:

o 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:

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

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum As (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
103	DRC/CC-ICP-MS	23.8	11.8	28.8	3.28	8.35
110	DRC/CC-ICP-MS	25.9	12.4	29.7	3.9	8.7
147	ICP-MS	21.9	11.6	26.8	3.36	7.72
597	DRC/CC-ICP-MS	23.6	12.6	27.2	4.69	10.5
598	DRC/CC-ICP-MS	17.0	9.09	21.4	2.15	5.21
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		22	11.5	26.8	3.5	8.1
Arithmetic SD (s)		3	1.4	3.2	0.9	1.9
Arithmetic RSD (%)		14	12	12	26	23
Number of Sample Measurements (N)		5	5	5	5	5

*Denotes a statistical Outlier.

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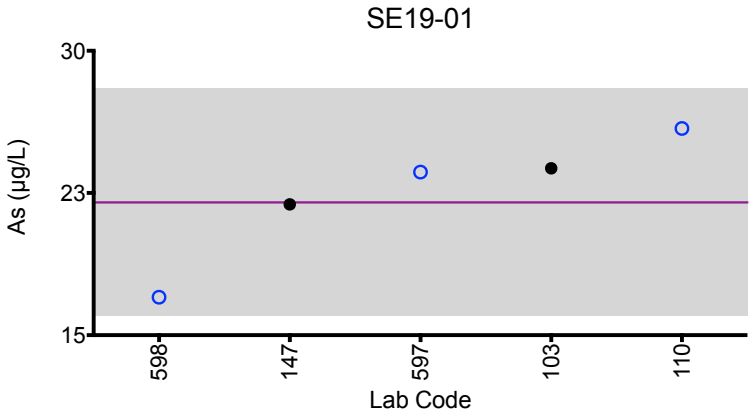
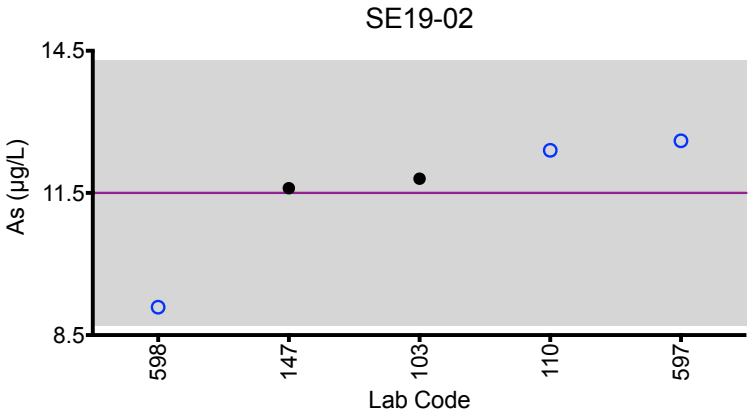
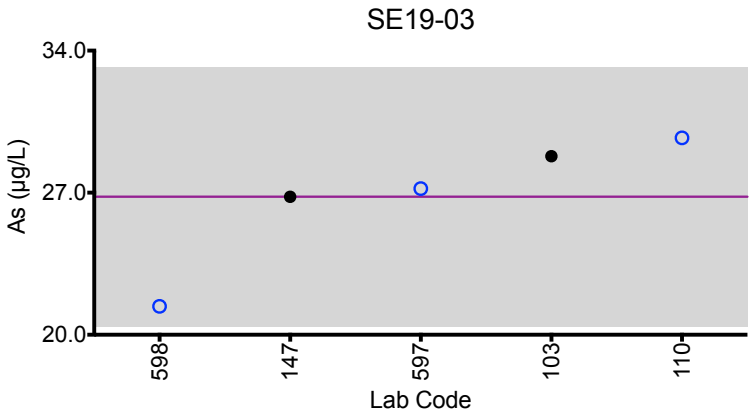
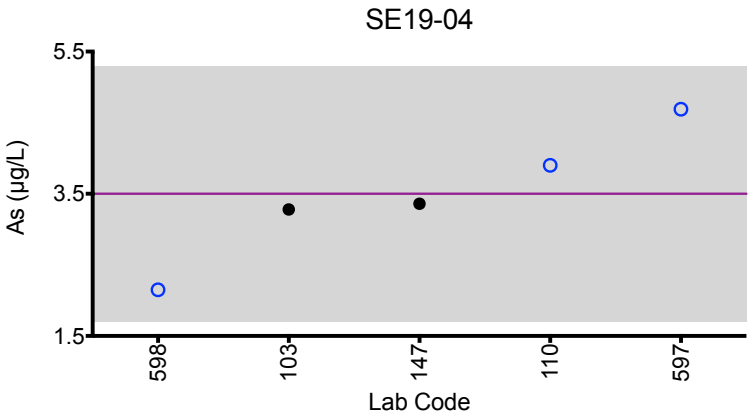
Results for Event #1, 2019: Summary Figures

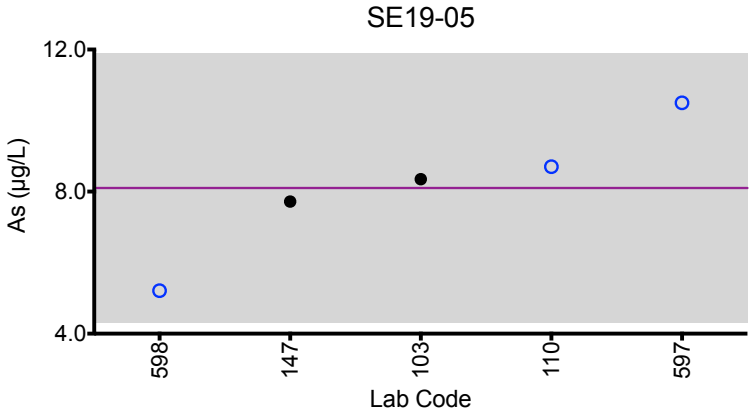
Serum As











Legend:
o 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.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)

Lab Code	Method	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
103	DRC/CC-ICP-MS	5.60	4.12	1.51	0.819	7.00
110	ICP-MS	6.9	5.2	1.9	1.1	8.5
147	ICP-MS	5.02	3.95	1.52	1.11	6.38
597	DMA	5.77	4.83	1.88	1.09	7.49
598	ICP-MS	5.49	4.00	1.33	0.93	5.96

Summary Statistics

	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
Arithmetic Mean ($\bar{x}$)	5.8	4.4	1.6	1.01	7.1
Arithmetic SD (s)	0.7	0.6	0.2	0.13	1.0
Arithmetic RSD (%)	12	14	15	13	14
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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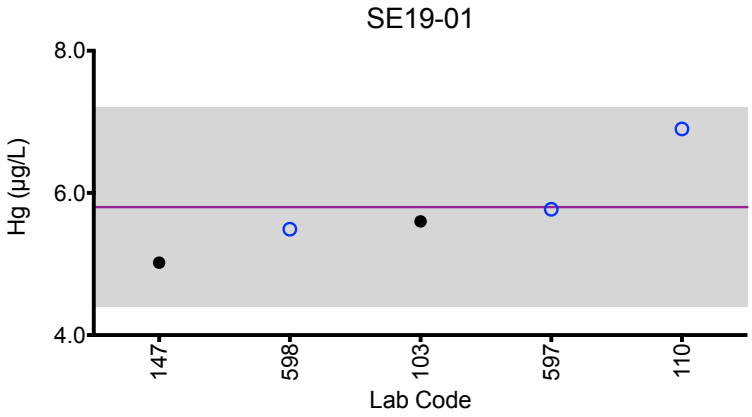
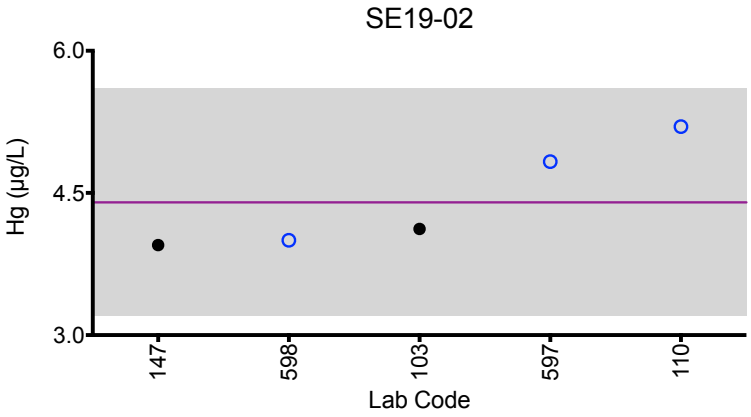
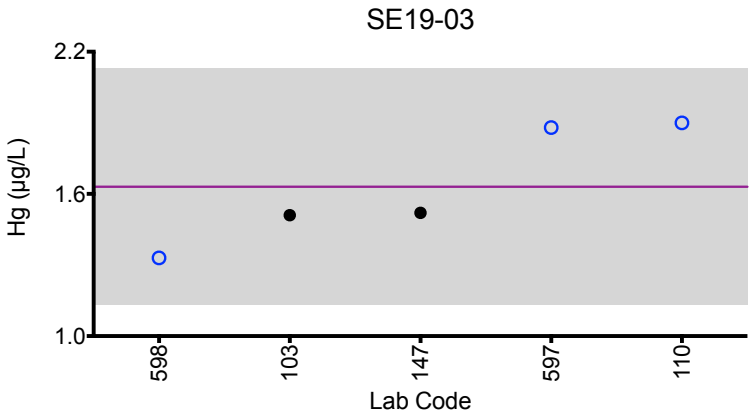
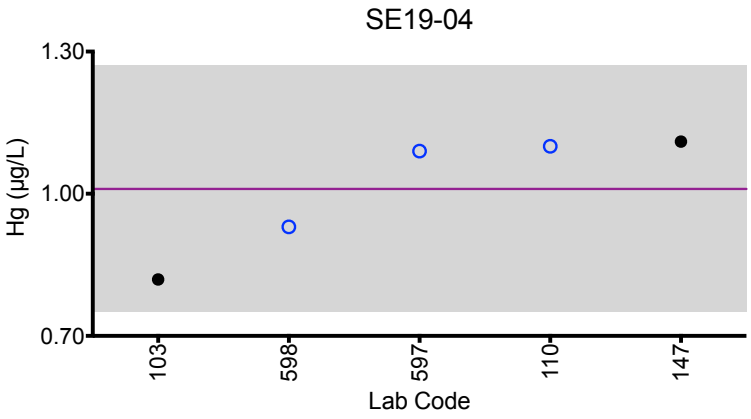
Results for Event #1, 2019: Summary Figures

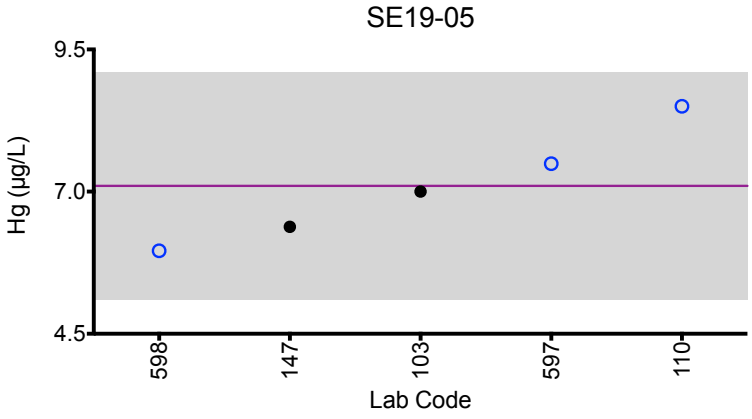
Serum Hg











Legend:
o 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 #1, 2019:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
103	DRC/CC-ICP-MS	2.12	4.83	14.5	11.9	6.67
110	ICP-MS	2.4	5.2	15.4	12.6	7.0
147	ICP-MS	2.24	5.01	14.2	11.8	6.48
293	DRC/CC-ICP-MS	3.07	4.86	16.54	12.28	6.72
597	DRC/CC-ICP-MS	2.92	5.57	14.8	13.2	*8.76
598	ICP-MS	2.00	4.62	13.52	10.93	5.99
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		2.5	5.0	14.8	12.1	6.6
Arithmetic SD (s)		0.4	0.3	1.0	0.8	0.4
Arithmetic RSD (%)		16	6.6	6.8	6.6	6.1
Number of Sample Measurements (N)		6	6	6	6	5

*Denotes a statistical Outlier.

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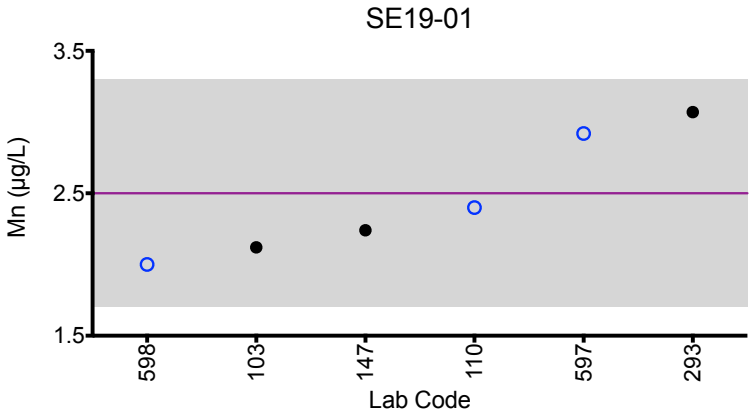
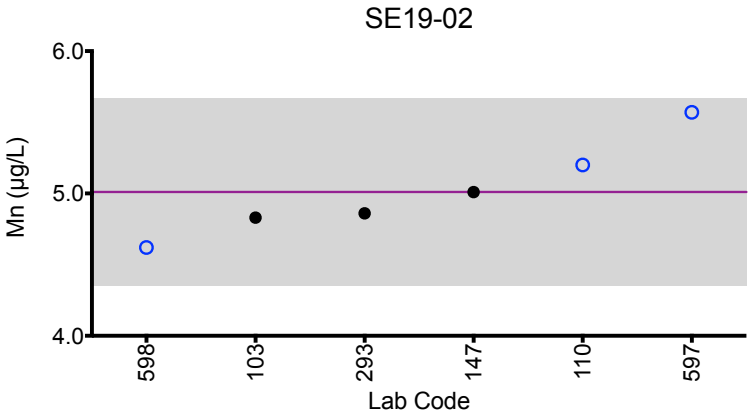
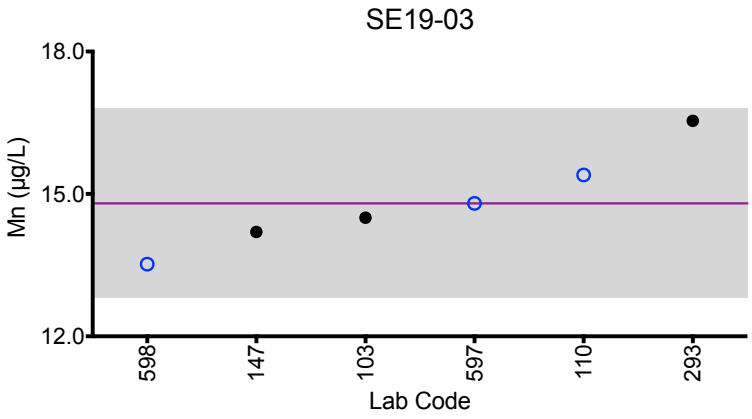
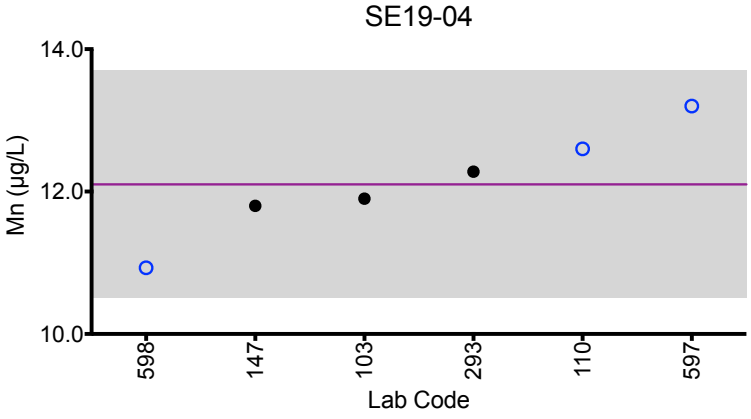
Results for Event #1, 2019: Summary Figures

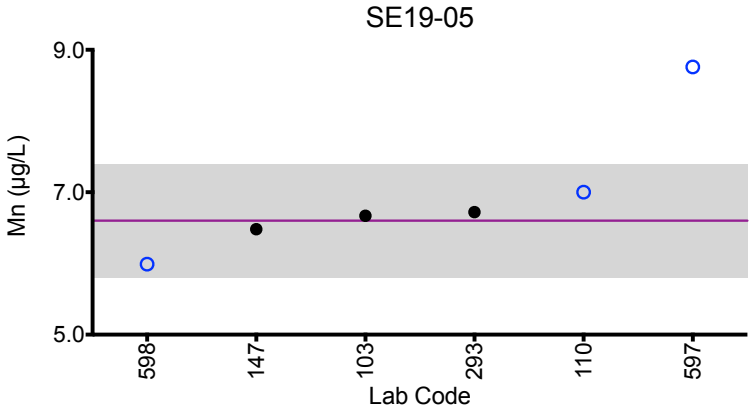
Serum Mn











Legend:
o 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 #1, 2019:
Laboratory Data and Summary Statistics

Serum Mo (µg/L)

Lab Code	Method	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
103	DRC/CC-ICP-MS	7.74	0.726	4.82	2.51	4.14
110	ICP-MS	8.4	1.1	5.4	2.7	4.5
147	ICP-MS	7.46	0.774	4.72	2.58	3.94
293	DRC/CC-ICP-MS	9.25	1.63	5.7	3.03	4.5
485	HR-ICP-MS	7.8	<1	5.14	2.7	4.18
597	DRC/CC-ICP-MS	7.97	0.993	4.60	2.75	4.63
598	DRC/CC-ICP-MS	6.36	0.956	4.49	2.07	3.25

Summary Statistics

	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
Arithmetic Mean ($\bar{x}$)	7.9	1.0	5.0	2.6	4.2
Arithmetic SD (s)	0.9	0.3	0.4	0.3	0.5
Arithmetic RSD (%)	11	32	8.0	11	12
Number of Sample Measurements (N)	7	6	7	7	7

*Denotes a statistical Outlier.

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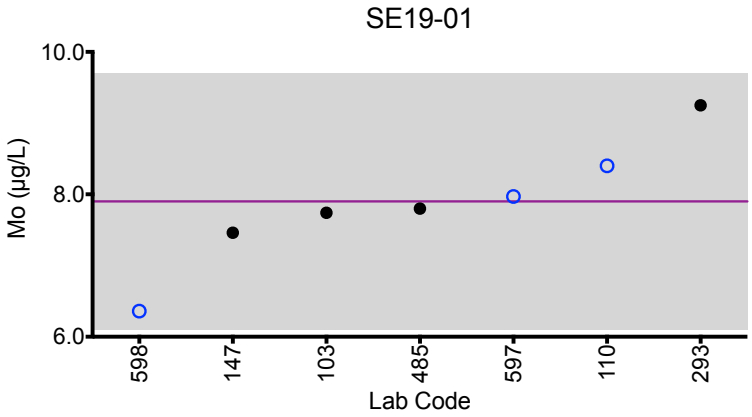
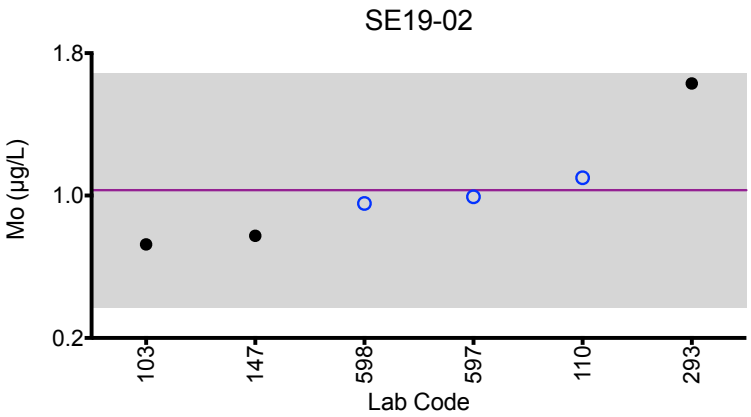
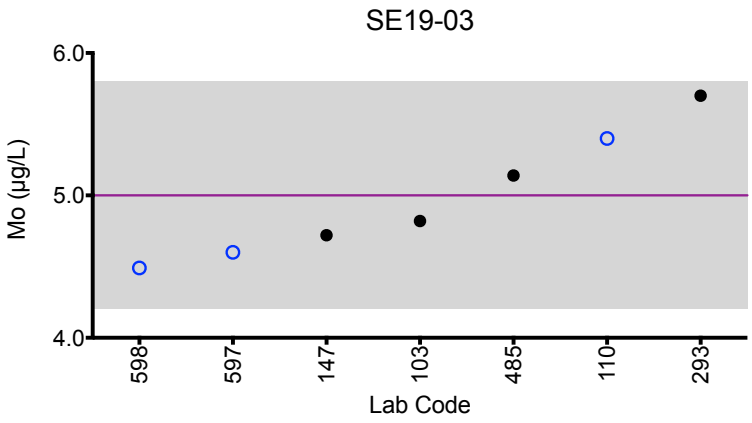
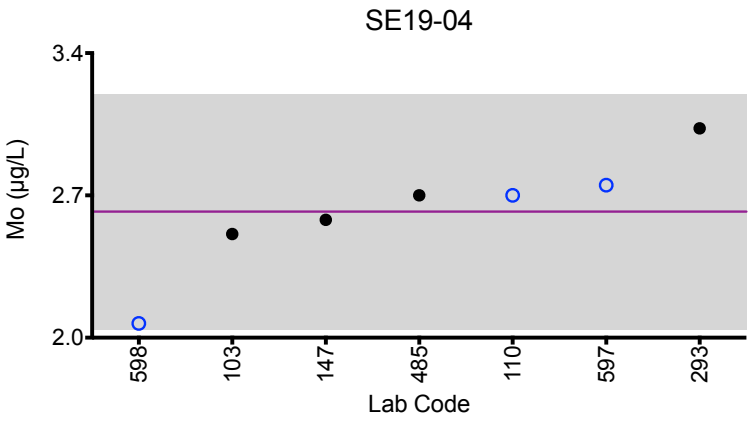
Results for Event #1, 2019: Summary Figures

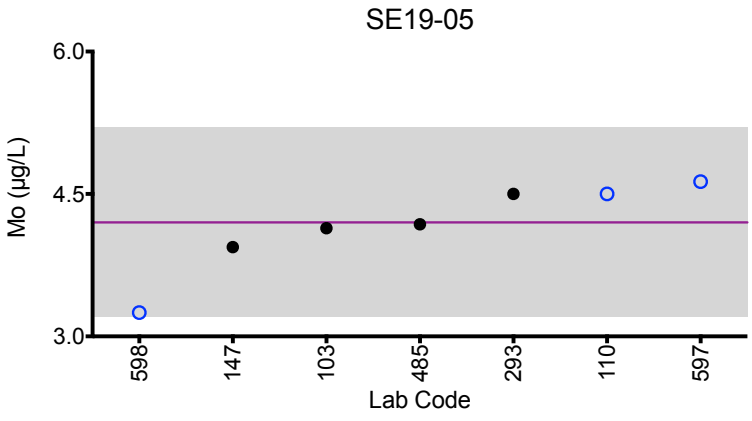
Serum Mo











Legend:
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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
110	DRC/CC-ICP-MS	5.3	10.2	1.7	14.7	7.3
147	ICP-MS	4.06	7.57	1.23	10.9	5.46
293	DRC/CC-ICP-MS	5.52	9.64	*23.08	16.37	6.97
485	HR-ICP-MS	5.45	9.37	1.26	14.4	6.81
598	ICP-MS	4.99	9.06	2.06	12.90	6.46
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		5.1	9.2	1.6	13.9	6.6
Arithmetic SD (s)		0.6	1.0	0.4	2.1	0.7
Arithmetic RSD (%)		12	11	25	15	11
Number of Sample Measurements (N)		5	5	4	5	5

*Denotes a statistical Outlier.

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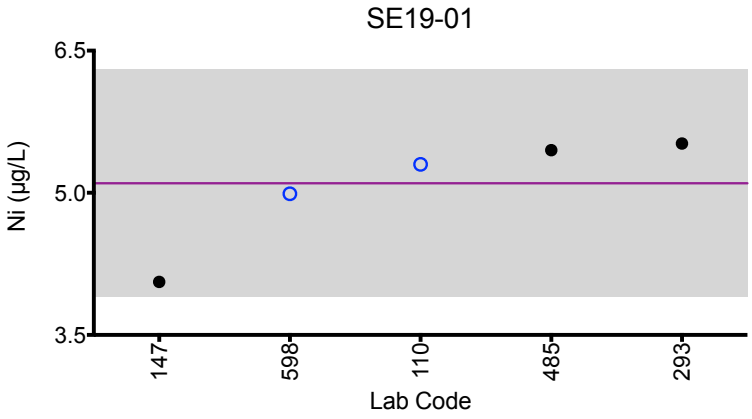
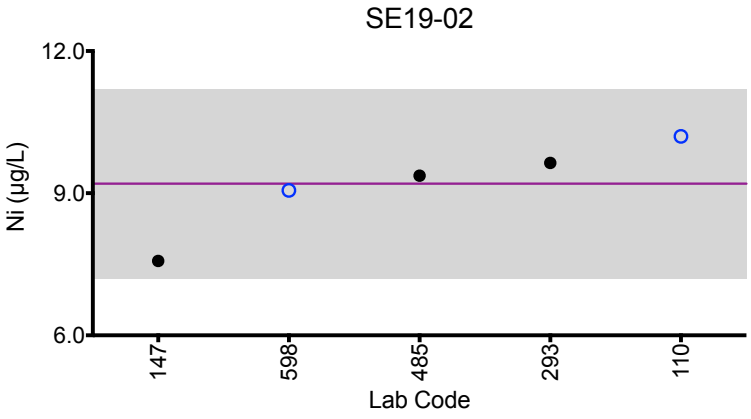
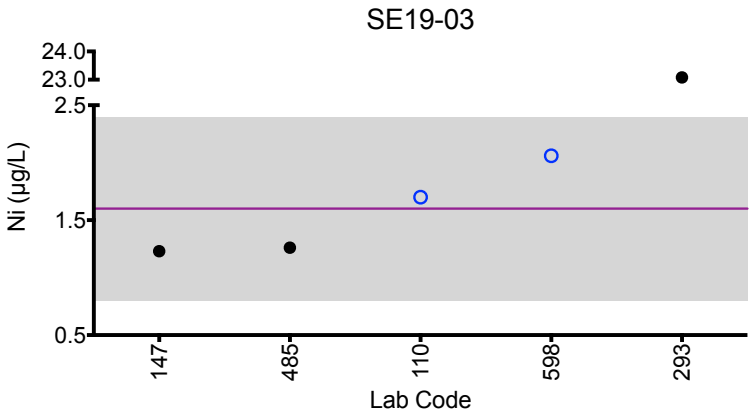
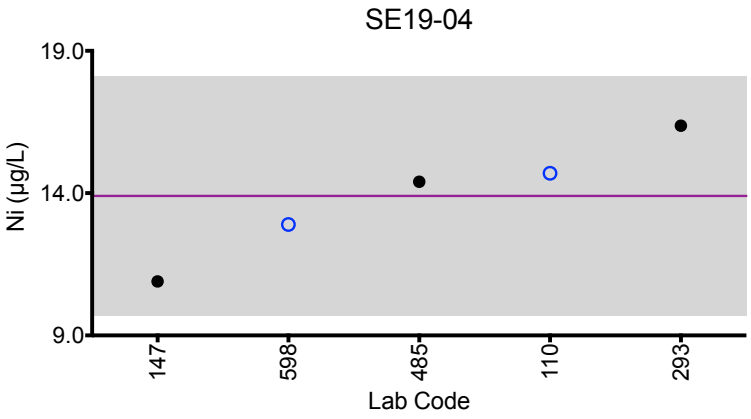
Results for Event #1, 2019: Summary Figures

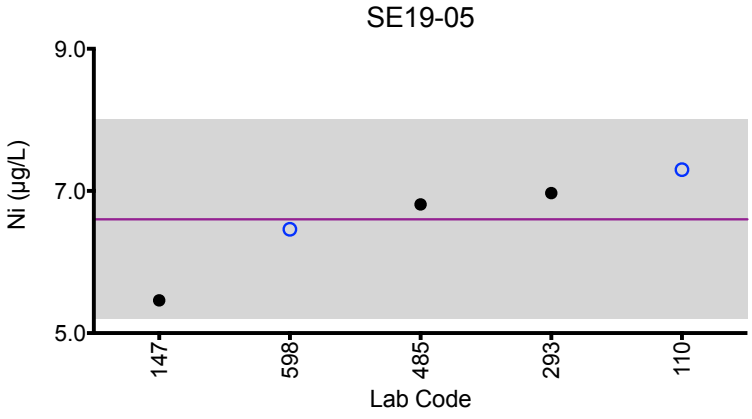
Serum Ni











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
103	DRC/CC-ICP-MS	9.15	3.14	6.53	1.72	5.60
110	ICP-MS	9.7	3.4	7.0	1.7	5.8
147	ICP-MS	9.53	3.32	6.86	1.72	5.84
597	DRC/CC-ICP-MS	8.91	3.16	6.16	1.68	6.45
598	ICP-MS	7.08	2.50	4.88	*1.22	4.03
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		8.9	3.1	6.3	1.71	5.5
Arithmetic SD (s)		1.0	0.4	0.9	0.02	0.9
Arithmetic RSD (%)		11	13	14	1.1	16
Number of Sample Measurements (N)		5	5	5	4	5

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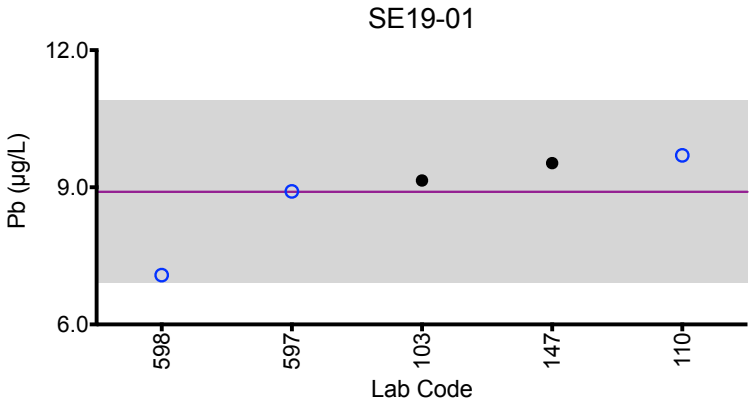
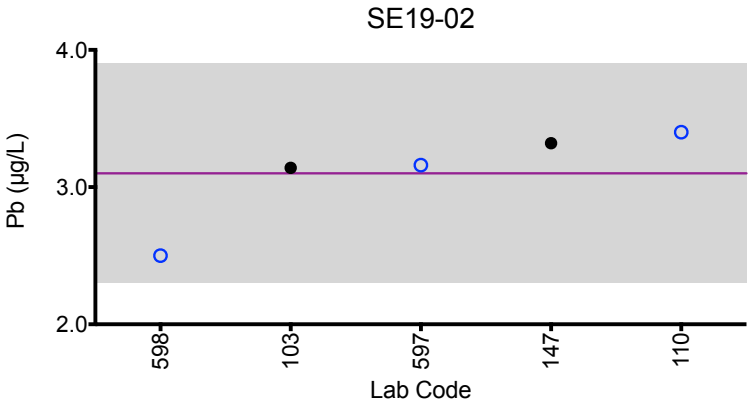
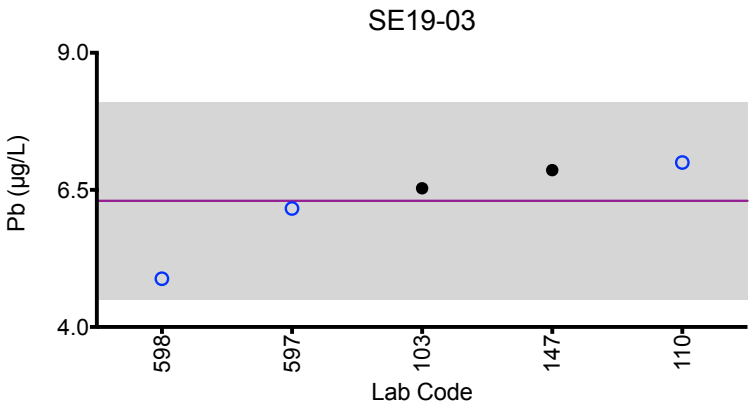
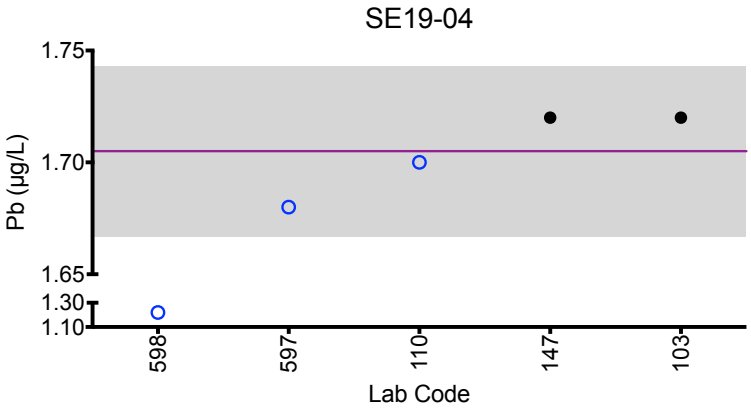
Results for Event #1, 2019: Summary Figures

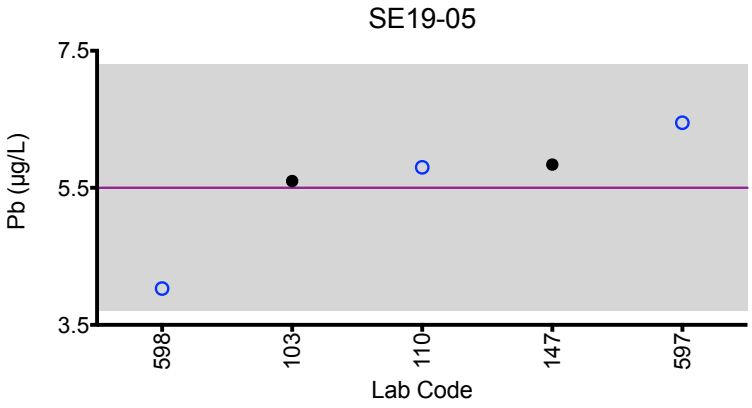
Serum Pb











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)

Lab Code	Method	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
103	DRC/CC-ICP-MS	6.54	0.893	4.83	2.18	3.31
110	ICP-MS	6.90	0.96	5.23	2.21	3.56
147	ICP-MS	6.94	1.02	5.03	2.24	3.63
597	DRC/CC-ICP-MS	6.32	0.963	4.45	2.22	3.95
598	ICP-MS	6.09	0.94	4.28	*1.94	2.85

Summary Statistics

	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
Arithmetic Mean ($\bar{x}$)	6.6	0.96	4.8	2.21	3.5
Arithmetic SD (s)	0.4	0.05	0.4	0.02	0.4
Arithmetic RSD (%)	6.1	5.2	8.3	1.1	11
Number of Sample Measurements (N)	5	5	5	4	5

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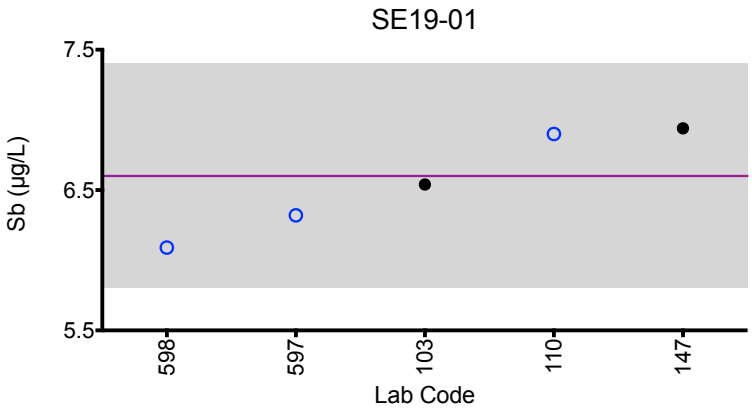
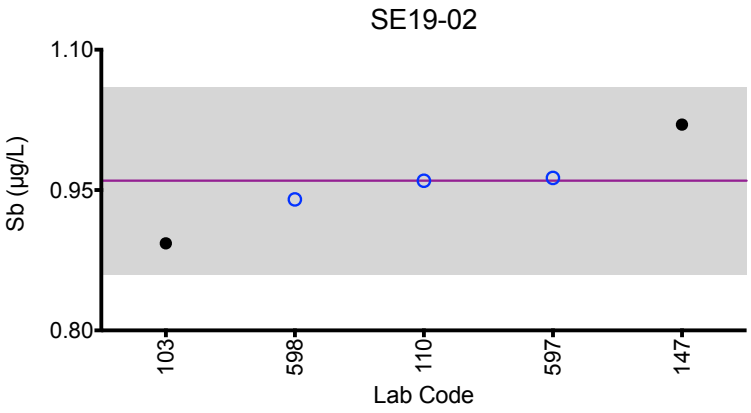
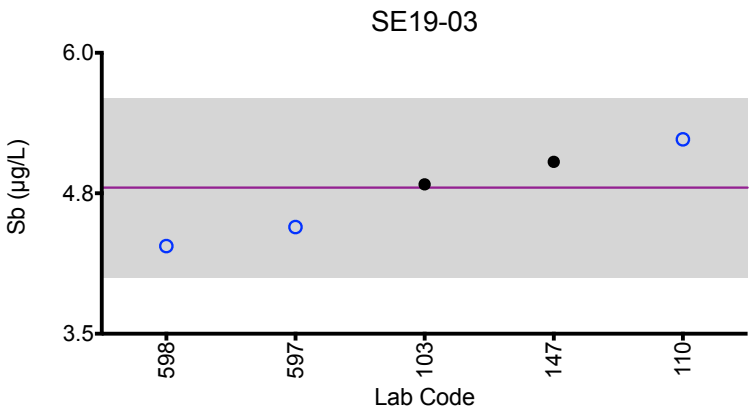
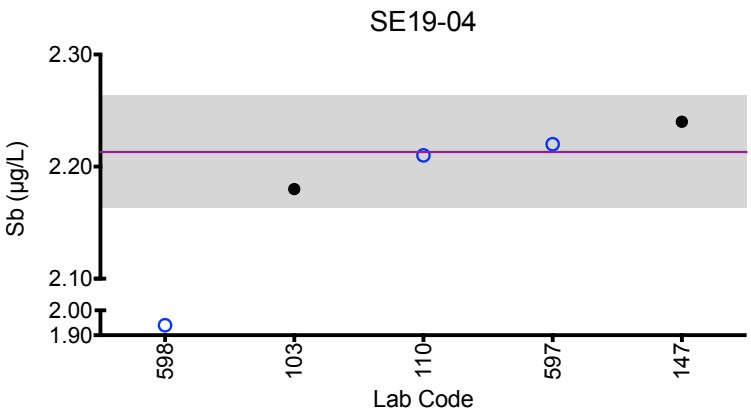
Results for Event #1, 2019: Summary Figures

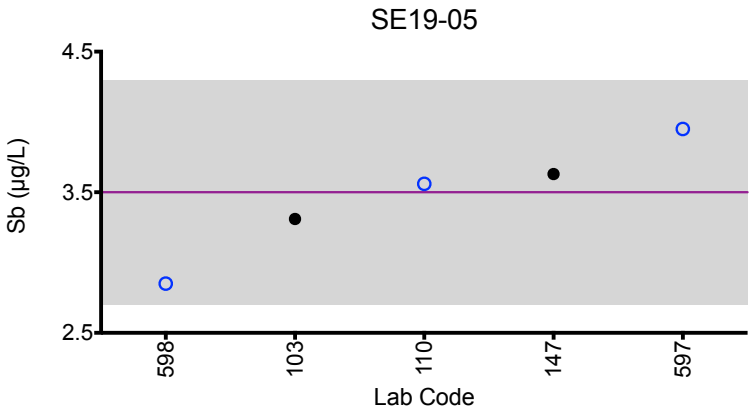
Serum Sb











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum V (µg/L)

Lab Code	Method	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
110	DRC/CC-ICP-MS	2.4	3.4	11.6	1.0	6.4
147	DRC/CC-ICP-MS	1.55	2.70	8.32	0.745	5.01
293	DRC/CC-ICP-MS	2.08	3.25	10.39	1.12	5.9
485	HR-ICP-MS	1.81	2.89	9.93	0.839	5.61
597	DRC/CC-ICP-MS	2.08	3.22	8.43	1.31	6.12
598	DRC/CC-ICP-MS	1.35	2.53	8.23	0.898	4.15

Summary Statistics

	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
Arithmetic Mean ($\bar{x}$)	1.9	3.0	9.5	0.99	5.5
Arithmetic SD (s)	0.4	0.3	1.4	0.21	0.8
Arithmetic RSD (%)	21	11	15	21	15
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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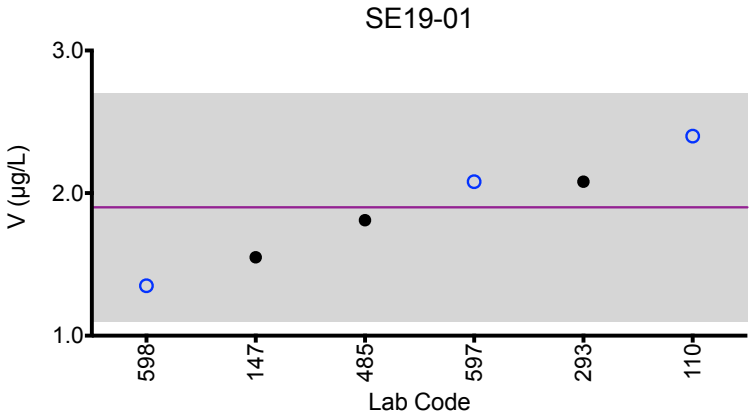
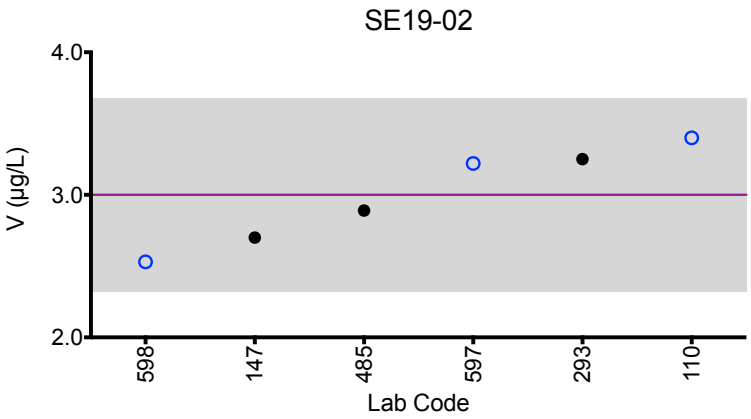
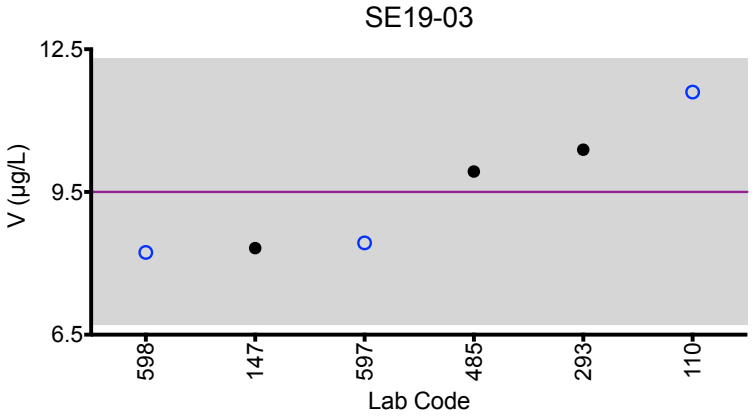
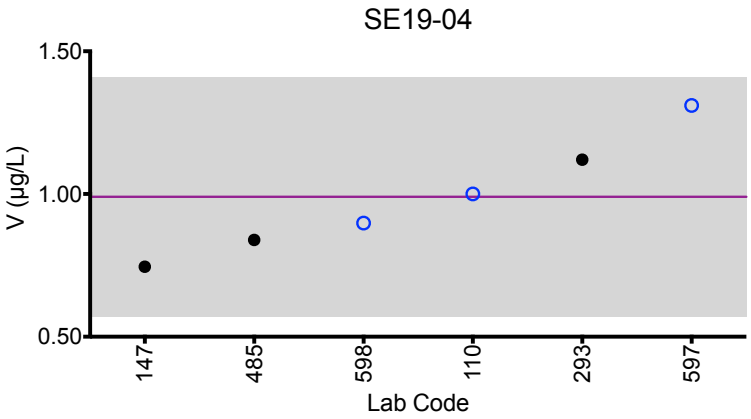
Results for Event #1, 2019: Summary Figures

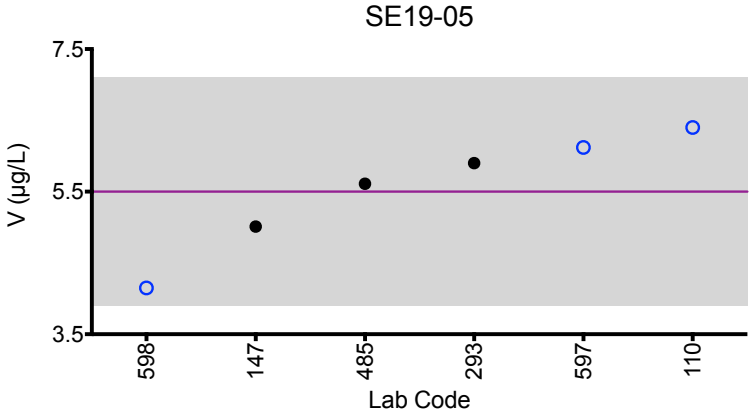
Serum V











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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
110	ICP-MS	1.9	1.9	2.8	4.5	3.0
147	ICP-MS	1.58	1.83	2.34	3.97	2.62
598	ICP-MS	1.51	1.64	2.10	3.70	2.38
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		1.7	1.79	2.4	4.1	2.7
Arithmetic SD (s)		0.2	0.13	0.4	0.4	0.3
Arithmetic RSD (%)		13	7.3	17	9.8	11
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Be (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
110	ICP-MS	1.1	2.5	4.7	0.6	3.9
147	ICP-MS	1.41	2.76	4.76	0.750	3.94
293	ICP-MS	1.4	2.6	4.74	0.84	3.88
598	ICP-MS	1.26	2.59	4.35	0.671	3.67
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		1.29	2.61	4.6	0.72	3.85
Arithmetic SD (s)		0.15	0.11	0.2	0.10	0.12
Arithmetic RSD (%)		12	4.2	4.1	14	3.1
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
103	DRC/CC-ICP-MS	6.62	1.05	3.78	0.289	5.13
110	ICP-MS	7.1	1.1	4.1	0.3	5.4
147	ICP-MS	6.950	1.07	3.88	0.275	5.05
598	DRC/CC-ICP-MS	4.86	0.921	2.90	0.157	3.74
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		6.4	1.04	3.7	0.26	4.8
Arithmetic SD (s)		1.0	0.08	0.5	0.07	0.7
Arithmetic RSD (%)		16	7.7	14	27	15
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
110	ICP-MS	0.38	0.69	0.89	0.40	0.51
597	DRC/CC-ICP-MS	0.425	0.665	0.822	0.448	0.598
598	ICP-MS	0.35	0.62	0.73	0.36	0.43

Summary Statistics					
	SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)	0.39	0.66	0.81	0.40	0.51
Arithmetic SD (s)	0.04	0.04	0.08	0.04	0.08
Arithmetic RSD (%)	10	6.1	9.9	10	16
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Fe (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
457	ICP-AES/OES	308.4	273.6	411.8	266.7	376.9
483	DRC/CC-ICP-MS	236	204	345	192	312
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		270	240	380	230	340
Arithmetic SD (s)		50	50	50	50	50
Arithmetic RSD (%)		19	21	13	22	15
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
110	ICP-MS	1.4	1.9	0.5	0.1	0.6
598	ICP-MS	1.42	1.66	0.39	0.09	0.53
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		1.41	1.8	0.45	0.095	0.56
Arithmetic SD (s)		0.01	0.2	0.08	0.007	0.05
Arithmetic RSD (%)		0.99	9.6	18	7.4	8.9
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
110	ICP-MS	0.9	11.8	2.4	7.6	5.1
147	ICP-MS	0.734	10.4	2.11	7.04	4.54
597	DRC/CC-ICP-MS	1.33	10.73	*4.77	7.57	5.78
598	ICP-MS	0.83	9.61	1.98	6.40	4.27
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		1.0	10.6	2.2	7.2	4.9
Arithmetic SD (s)		0.3	0.9	0.2	0.6	0.7
Arithmetic RSD (%)		27	8.5	9.9	8.3	14
Number of Sample Measurements (N)		4	4	3	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
103	DRC/CC-ICP-MS	35.8	47.8	132	98.0	40.3
200	ICP-MS	32	43	114	84	35
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		34	45	123	91	38
Arithmetic SD (s)		3	3	13	10	4
Arithmetic RSD (%)		8.8	6.7	11	11	11
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)

Lab Code	Method	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
200	DRC/CC-ICP-MS	1.5	4.6	3.2	2.5	4.8
485	HR-ICP-MS	3.54	5.27	7.56	1.89	12.2

Summary Statistics

	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
Arithmetic Mean ($\bar{x}$)	NA	4.9	NA	2.2	NA
Arithmetic SD (s)	NA	0.5	NA	0.4	NA
Arithmetic RSD (%)	NA	10	NA	18	NA
Number of Sample Measurements (N)	NA	2	NA	2	NA

*Denotes a statistical Outlier.

Statistical data were not calculated for SE19-01, SE19-03, or SE19-05 based on a lack of consensus among participating labs.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)

Lab Code	Method	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
103	DRC/CC-ICP-MS	3.87	4.80	1.27	3.18	2.01
110	ICP-MS	4.01	4.98	1.35	3.42	2.08
147	ICP-MS	3.84	4.84	1.26	3.15	1.95

Summary Statistics

	SE19-01	SE19-02	SE19-03	SE19-04	SE19-05
Arithmetic Mean ($\bar{x}$)	3.91	4.87	1.29	3.25	2.01
Arithmetic SD (s)	0.09	0.09	0.05	0.15	0.07
Arithmetic RSD (%)	2.3	1.8	3.9	4.6	3.5
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum U (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
103	DRC/CC-ICP-MS	0.0697	0.158	<0.0100	0.0340	0.204
110	ICP-MS	0.076	0.172	0.013	0.039	0.210
147	ICP-MS	0.0648	0.150	<0.0169	0.0295	0.197
598	ICP-MS	0.072	0.148	0.016	0.033	0.169
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		0.071	0.157	0.015	0.034	0.195
Arithmetic SD (s)		0.005	0.011	0.002	0.004	0.018
Arithmetic RSD (%)		7.0	7.0	13	12	9.2
Number of Sample Measurements (N)		4	4	2	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2019:
Laboratory Data and Summary Statistics

Serum W (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
110	ICP-MS	2.45	3.45	0.52	4.93	1.11
147	ICP-MS	2.28	3.29	0.495	4.62	1.11
200	ICP-MS	2.32	3.29	0.5	4.73	1.1
598	ICP-MS	2.29	3.08	0.44	4.17	1.03
Summary Statistics						
		SE19-01	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
Arithmetic Mean ($\bar{x}$)		2.34	3.28	0.49	4.6	1.09
Arithmetic SD (s)		0.08	0.15	0.03	0.3	0.04
Arithmetic RSD (%)		3.4	4.6	6.1	6.5	3.7
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2019: Additional Elements in Serum

Serum Ag (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
147	ICP-MS	<0.227	<0.227	<0.227	<0.227	<0.227

Serum B (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
200	ICP-MS	145.0	187	177	211	94

Serum Bi (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
147	ICP-MS	<0.230	<0.230	<0.230	<0.230	<0.230

Serum I (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
147	ICP-MS	40.3	63.8	47.2	63.4	68.6

Serum Li (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
147	ICP-MS	1.51	0.798	0.895	2.29	0.854

Serum Te (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
147	ICP-MS	<0.153	< 0.153	<0.153	<0.153	<0.153

Serum Th (µg/L)						
Lab Code	**Method**	**SE19-01**	**SE19-02**	**SE19-03**	**SE19-04**	**SE19-05**
147	ICP-MS	<0.00882	<0.00882	<0.00882	<0.00882	<0.00882

References

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

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