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New York State Biomonitoring Program for Trace Elements

Event #2, 2018

Trace Elements in Whole Blood, Urine, and Serum

September, 2018

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #2, 2018:
Trace Elements in Whole Blood, Urine, and Serum

9/10/2018

Dear Laboratory Director,

This report summarizes performance for the second biomonitoring proficiency test (PT) event of 2018 for Trace Elements in Whole Blood, Urine, and Serum. One of the key goals of this PT program is to achieve harmonization of biomonitoring data for trace elements.

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

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

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

Samples for the next PT event (Event #3, 2018) will be shipped October 10, 2018. 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

Aubrey L. Galusha, PhD
Coordinator, Biomonitoring PT Program,
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Event #2, 2018

Trace Elements in Whole Blood

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

Event #2, 2018:
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 #2, 2018: Summary Statistics

Whole Blood As (µg/L)					
	BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Target (Arithmetic Mean ($\bar{x}$))	19.5	40.3	6.5	29.3	13.1
Upper Limit	25.5	48.4	12.5	35.3	19.1
Lower Limit	13.5	32.2	0.5	23.3	7.1
Arithmetic SD (s)	1.0	2.4	0.8	2.0	0.5
Arithmetic RSD (%)	5.1	6.0	12.3	6.8	3.8
Number of Sample Measurements (N)	7	8	8	8	7

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 #2, 2018:
Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
	Target	**19.5**	**40.3**	**6.5**	**29.3**	**13.1**
103	DRC/CC-ICP-MS	19.5	42.1	6.45	30.5	13.3
110	DRC/CC-ICP-MS	18.4	39.5	6.8	27.8	12.5
147	ICP-MS	18.9	40.5	6.07	29.0	12.6
293	DRC/CC-ICP-MS	20.31	42.32	6.38	31.51	13.63
391	DRC/CC-ICP-MS	21.106	42.43	7.577	31.703	13.125
597	DRC/CC-ICP-MS	19.8	42.0	7.13	30.4	13.5
598	DRC/CC-ICP-MS	*14.67	37.35	4.96	26.22	*10.55
599	DRC/CC-ICP-MS	18.2	36.4	6.50	27.5	12.7

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

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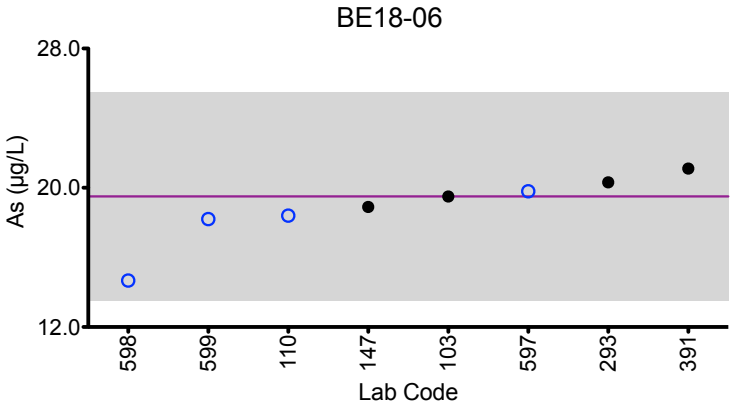
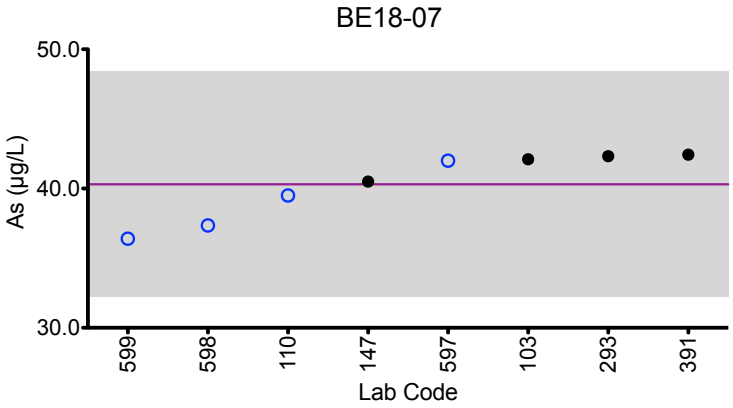
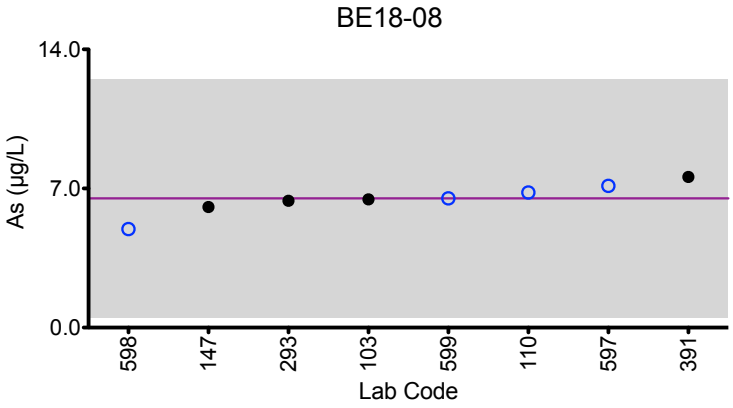
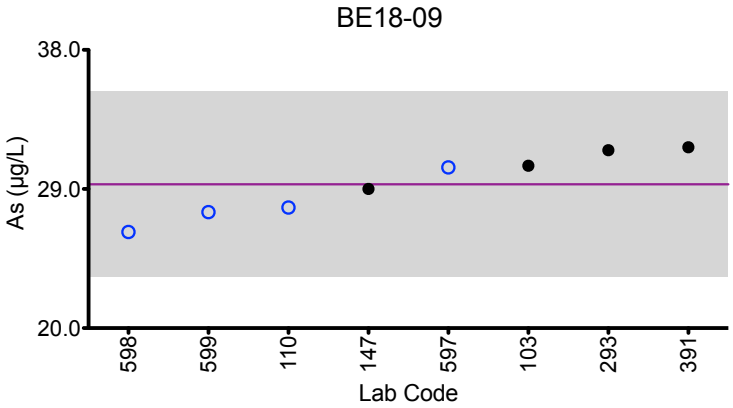
Results for Event #2, 2018: Summary Figures

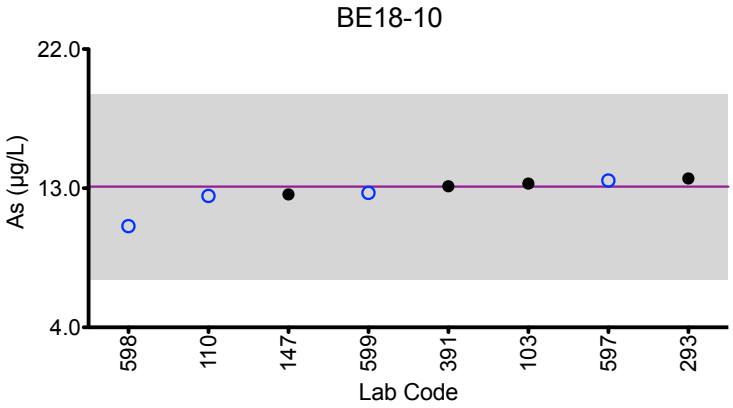
Whole Blood As











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 #2, 2018: Summary Statistics

Whole Blood Cd (µg/L)					
	BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Target (Robust Mean (x*))	7.0	1.4	5.8	13.9	3.5
Upper Limit	8.1	2.4	6.8	16.0	4.5
Lower Limit	5.9	0.4	4.8	11.8	2.5
Robust SD (s*)	0.3	0.1	0.2	0.4	0.3
Robust RSD (%)	4.3	7.1	3.4	2.9	8.6
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (*u*)	0.106	0.045	0.070	0.118	0.087

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 #2, 2018:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
	Target	**7.0**	**1.4**	**5.8**	**13.9**	**3.5**
103	DRC/CC-ICP-MS	7.43	1.61	6.17	14.9	3.75
107	ICP-MS	7.1	1.6	6.1	14	3.8
110	ICP-MS	7.08	1.48	5.76	13.9	3.65
116	ICP-MS/MS	7.43	1.34	5.74	14.7	3.99
147	ICP-MS	7.36	1.42	5.65	14.1	3.44
293	DRC/CC-ICP-MS	6.83	1.44	5.5	13.41	3.41
391	DRC/CC-ICP-MS	6.796	1.43	5.96	13.861	3.394
399	DRC/CC-ICP-MS	6.83	1.40	5.68	13.8	3.46
401	DRC/CC-ICP-MS	6.6	1.3	5.8	13.7	3.6
597	DRC/CC-ICP-MS	7.69	1.67	6.44	14.4	3.82
598	DRC/CC-ICP-MS	4.83 ↓	1.29	3.67 ↓	10.25 ↓	2.58
599	DRC/CC-ICP-MS	6.23	1.36	5.22	12.6	3.10
605	ICP-MS	6.97	1.54	5.82	14.0	3.62
606	DRC/CC-ICP-MS	6.85	1.03	5.64	13.8	3.29
686	ICP-MS	7.13	1.46	5.84	14.3	3.70

Based on the grading criteria for Cd in Whole Blood, 96% 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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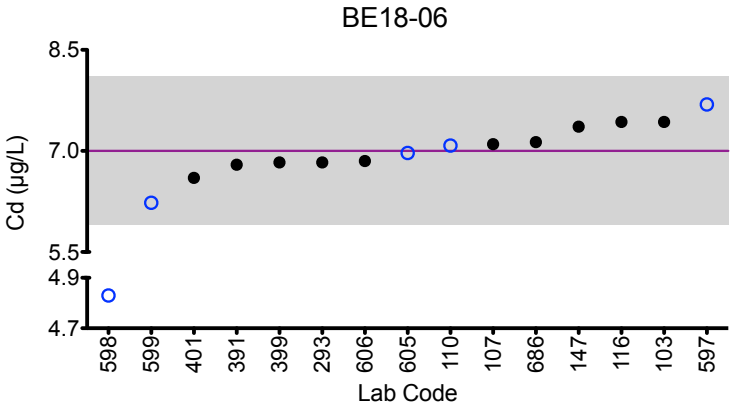
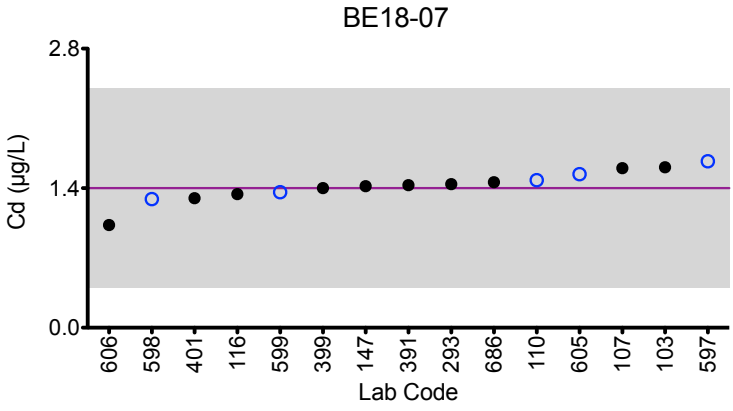
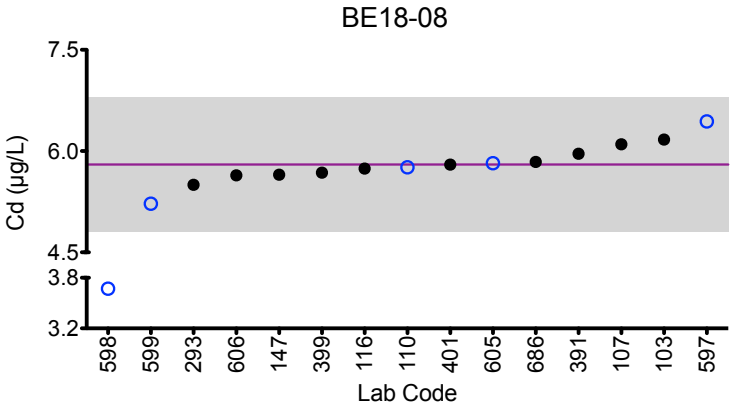
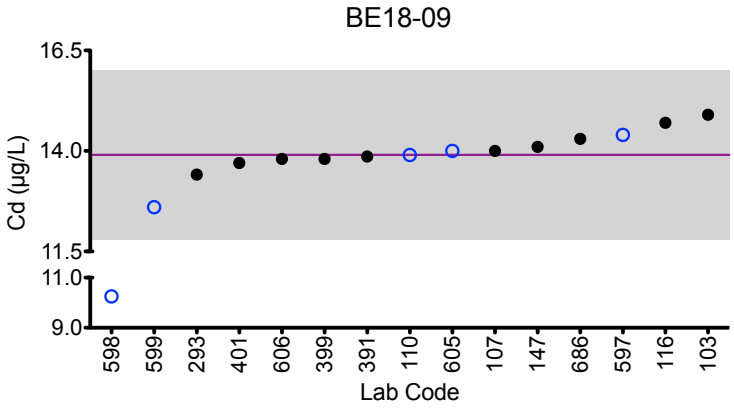
Results for Event #2, 2018: Summary Figures

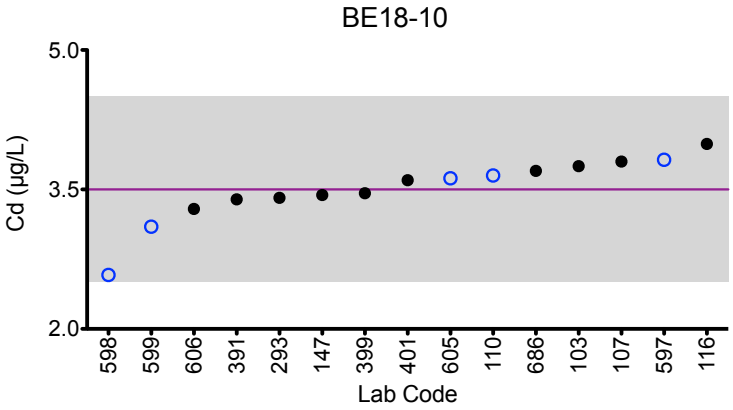
Whole Blood Cd











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 6.7 µg/L.

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Results for Event #2, 2018: Summary Statistics

Whole Blood Co (µg/L)					
	BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Target (Arithmetic Mean ($\bar{x}$))	2.2	4.7	6.8	14.0	10.9
Upper Limit	3.7	6.2	8.3	16.8	13.1
Lower Limit	0.7	3.2	5.3	11.2	8.7
Arithmetic SD (s)	0.2	0.3	0.4	0.3	0.6
Arithmetic RSD (%)	9.1	6.4	5.9	2.1	5.5
Number of Sample Measurements (N)	9	9	9	8	9

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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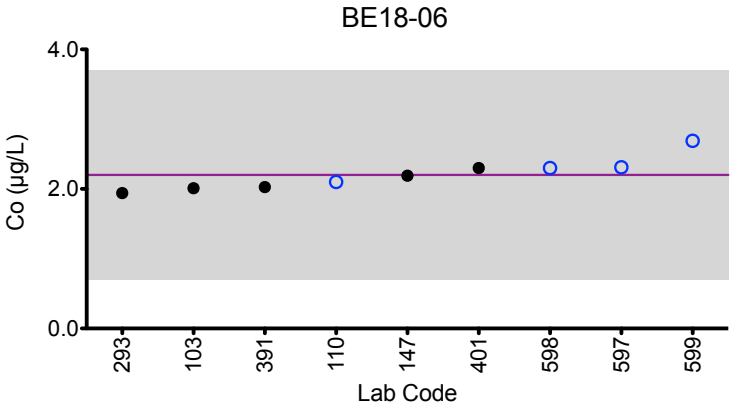
Results for Event #2, 2018:
Performance of Participating Laboratories

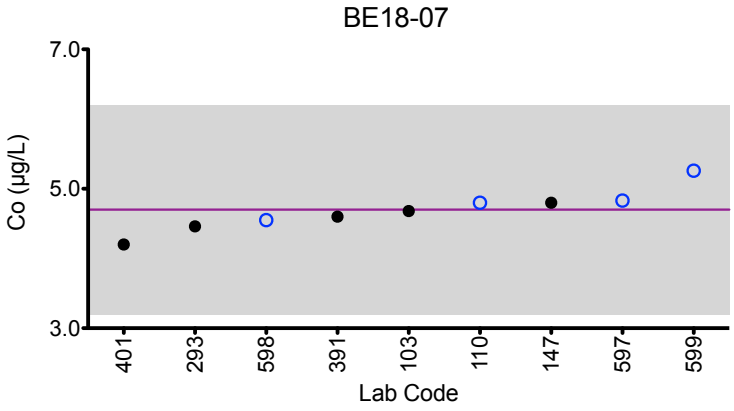
Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
	Target	**2.2**	**4.7**	**6.8**	**14.0**	**10.9**
103	DRC/CC-ICP-MS	2.01	4.68	6.70	14.3	11.1
110	ICP-MS	2.1	4.8	6.7	13.5	10.9
147	ICP-MS	2.19	4.8	6.79	14.1	10.9
293	DRC/CC-ICP-MS	1.94	4.46	6.36	13.84	10.87
391	DRC/CC-ICP-MS	2.026	4.6	6.931	14.227	9.902
401	DRC/CC-ICP-MS	2.3	4.2	6.3	14.0	10.6
597	DRC/CC-ICP-MS	2.31	4.83	7.4	14.3	11.4
598	ICP-MS	2.30	4.55	6.55	13.92	10.40
599	DRC/CC-ICP-MS	2.69	5.26	7.56	*16.1	11.9

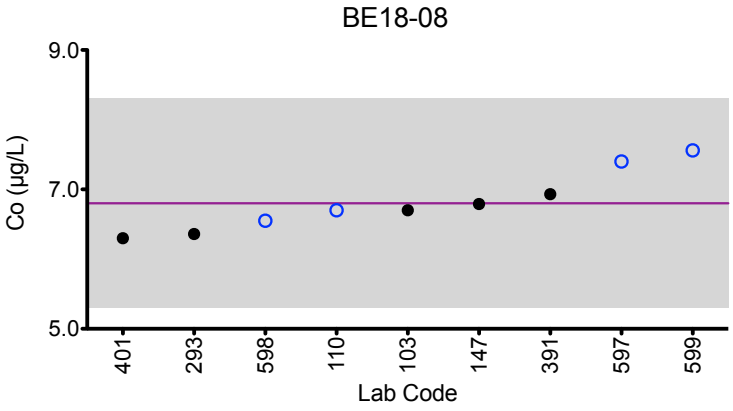
Based on the grading criteria for Co in Whole Blood, 100% of results were satisfactory, with 0 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

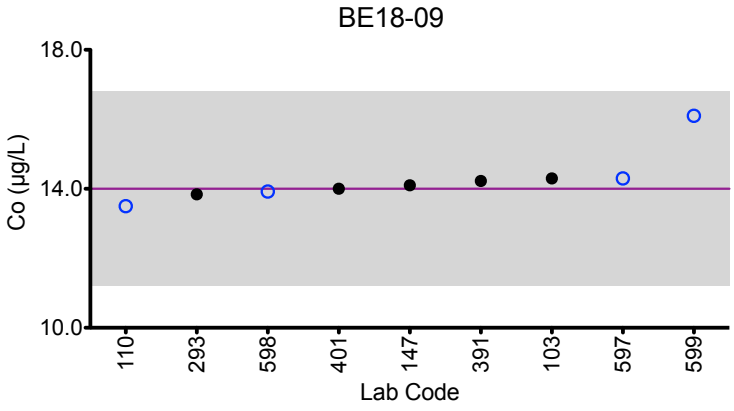
Results for Event #2, 2018: Summary Figures

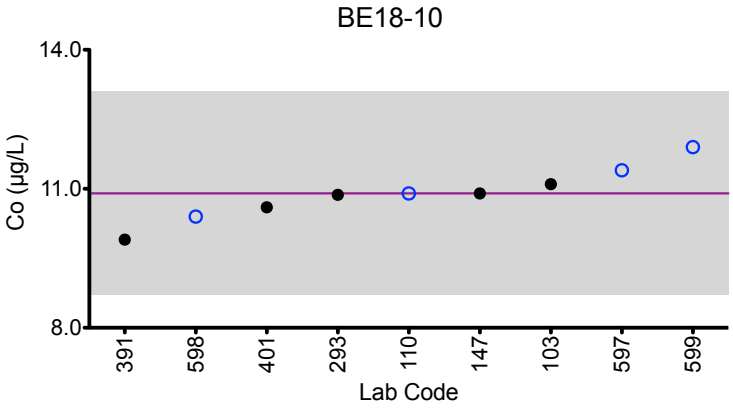
Whole Blood Co











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 #2, 2018: Summary Statistics

Whole Blood Cr (µg/L)					
	BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Target (Arithmetic Mean ($\bar{x}$))	15.8	11.4	15.1	6.6	2.3
Upper Limit	19.0	13.7	18.1	8.6	4.3
Lower Limit	12.6	9.1	12.1	4.6	0.3
Arithmetic SD (s)	0.7	0.5	0.8	0.9	0.4
Arithmetic RSD (%)	4.4	4.4	5.3	13.6	17.4
Number of Sample Measurements (N)	8	8	8	9	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 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 #2, 2018:
Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
	Target	**15.8**	**11.4**	**15.1**	**6.6**	**2.3**
103	DRC/CC-ICP-MS	15.1	11.1	14.5	6.61	2.18
110	DRC/CC-ICP-MS	15.3	11.3	14.4	6.0	2.2
147	DRC/CC-ICP-MS	16.0	11.3	15.1	6.89	2.33
293	DRC/CC-ICP-MS	15.14	11.3	14.79	6.83	2.81
391	DRC/CC-ICP-MS	15.379	11.374	14.717	6.245	2.052
401	DRC/CC-ICP-MS	15.5	11.6	15.0	6.8	2.8
597	DRC/CC-ICP-MS	16.8	12.5	16.7	7.22	2.83
598	DRC/CC-ICP-MS	*10.65 ↓	*8.41 ↓	*9.36 ↓	4.93	1.78
599	DRC/CC-ICP-MS	16.9	11.0	15.7	8.13	1.91

Based on the grading criteria for Cr in Whole Blood, 93% 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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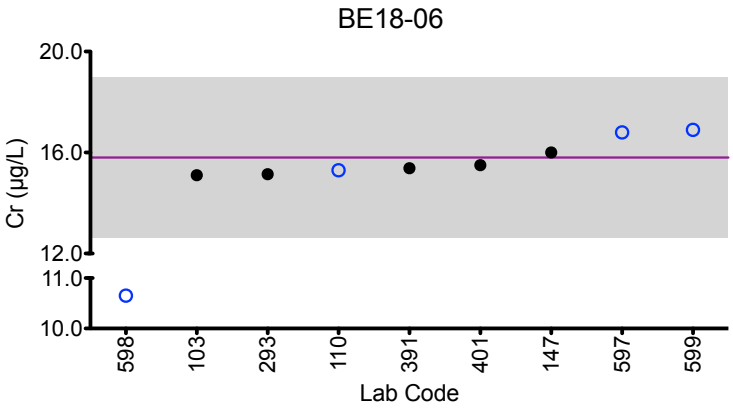
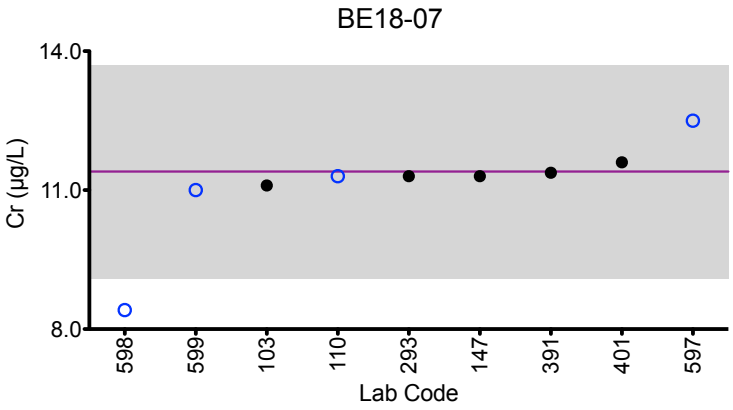
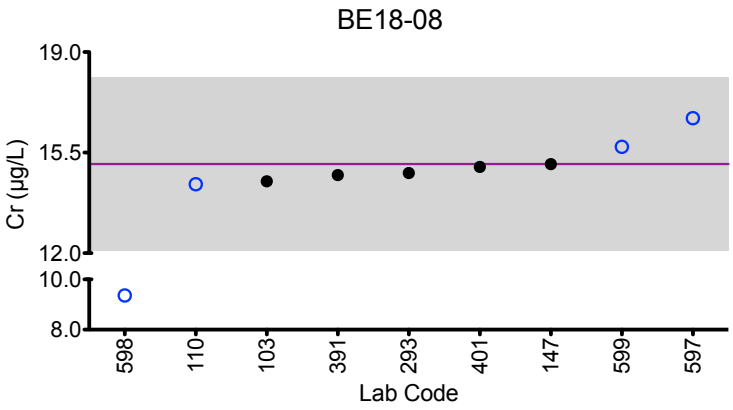
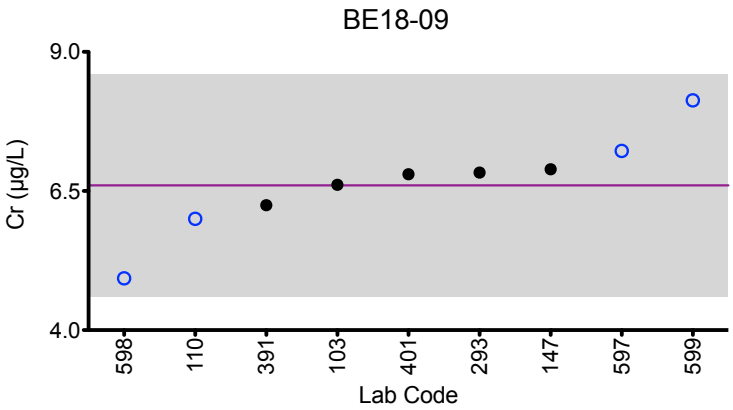
Results for Event #2, 2018: Summary Figures

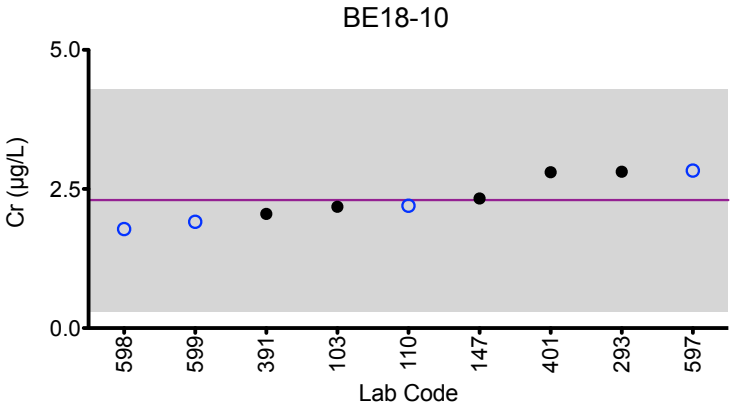
Whole Blood Cr











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 #2, 2018: Summary Statistics

Whole Blood Hg (µg/L)					
	BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Target (Robust Mean (x*))	16.6	25.1	3.5	9.8	39.6
Upper Limit	21.6	32.6	6.5	12.8	51.5
Lower Limit	11.6	17.6	0.5	6.8	27.7
Robust SD (s*)	0.8	1.4	0.2	0.5	2.8
Robust RSD (%)	4.8	5.6	5.7	5.1	7.1
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (*u*)	0.274	0.443	0.080	0.172	0.889

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 #2, 2018:
Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
	Target	**16.6**	**25.1**	**3.5**	**9.8**	**39.6**
103	DRC/CC-ICP-MS	16.9	25.2	3.42	9.60	39.3
107	DRC/CC-ICP-MS	17	26	3.9	10	44
110	ICP-MS	16.1	24.0	3.22	9.26	36.4
116	ICP-MS/MS	17.8	25.5	3.31	10.0	40.7
147	ICP-MS	15.8	24.4	3.77	9.63	37.8
293	DRC/CC-ICP-MS	16.4	24.23	3.73	9.77	38.4
391	CV-AAS	16.04	32.26	6.471	34.57 ↑	42.65
399	DRC/CC-ICP-MS	16.3	24.6	3.40	9.54	38.6
401	DRC/CC-ICP-MS	14.8	23.3	3.4	9.2	36.3
597	DMA	16.73	24.78	3.3	10.3	40.6
598	ICP-MS	14.51	22.48	3.25	8.05	32.43
599	DRC/CC-ICP-MS	18.1	26.6	4.59	10.9	41.6
605	ICP-MS	16.5	26.3	3.36	9.43	39.8
606	DRC/CC-ICP-MS	17.1	24.9	3.12	9.84	40.8
686	ICP-MS	18.2	26.6	3.54	10.2	42.2

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

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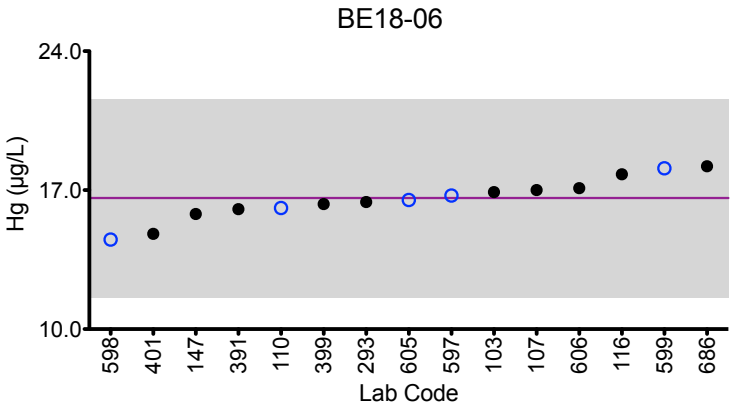
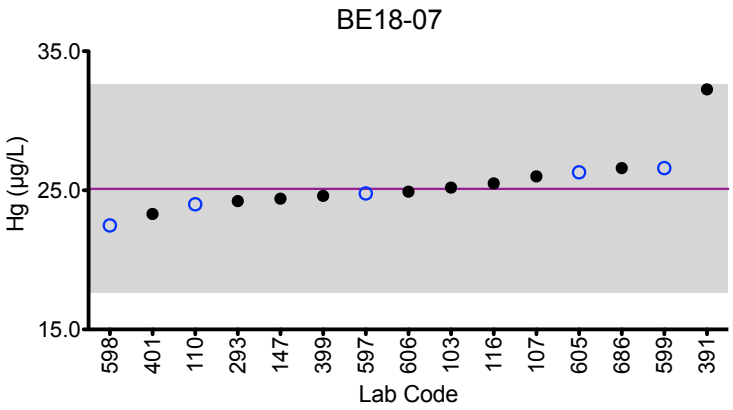
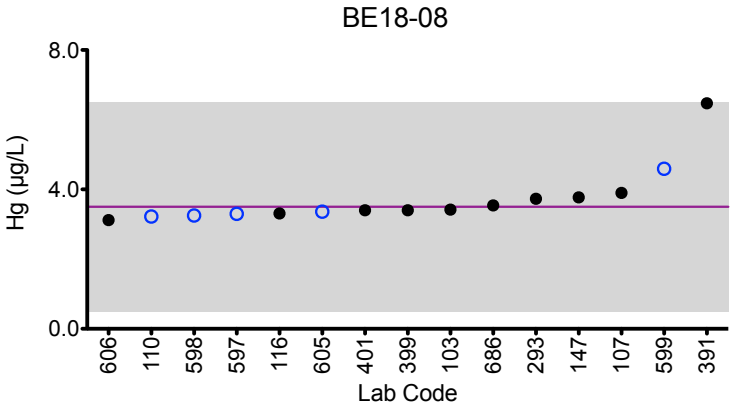
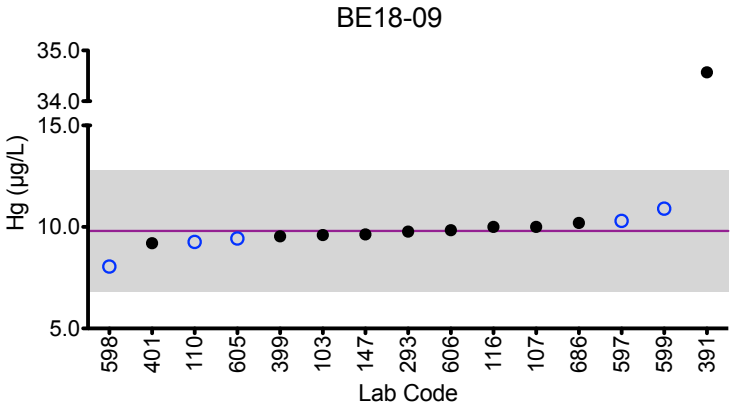
Results for Event #2, 2018: Summary Figures

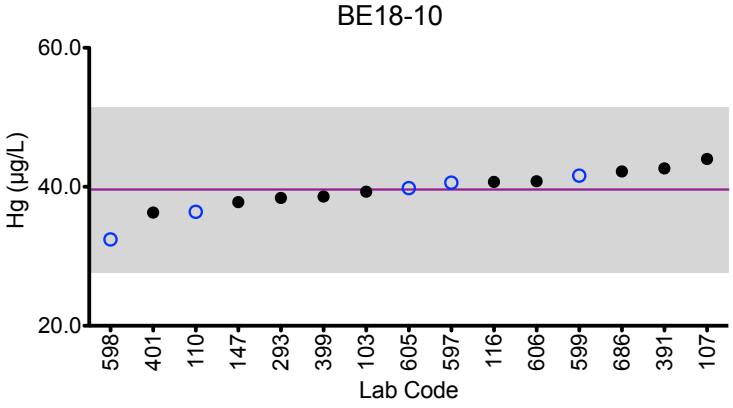
Whole Blood Hg











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 #2, 2018: Summary Statistics

Whole Blood Mn (µg/L)					
	BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Target (Robust Mean (x*))	24.4	18.3	30.6	19.4	9.3
Upper Limit	28.5	21.4	35.8	22.7	12.3
Lower Limit	20.3	15.2	25.4	16.1	6.3
Robust SD (s*)	1.3	1.1	1.8	0.9	0.5
Robust RSD (%)	5.3	6.0	5.9	4.6	5.4
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.486	0.428	0.680	0.326	0.204

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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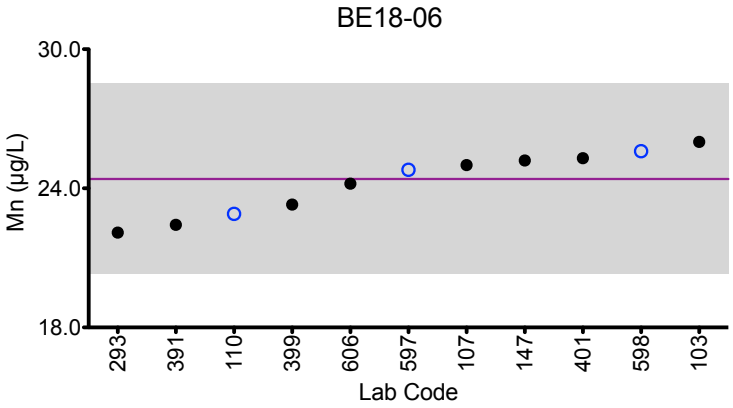
Results for Event #2, 2018:
Performance of Participating Laboratories

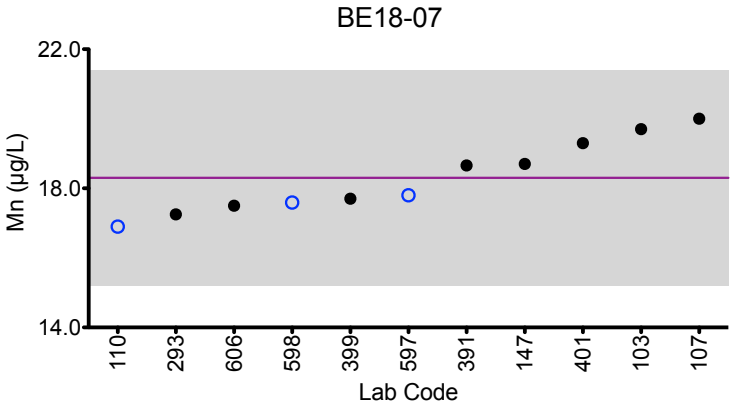
Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
	Target	**24.4**	**18.3**	**30.6**	**19.4**	**9.3**
103	DRC/CC-ICP-MS	26.0	19.7	32.4	21.0	10.4
107	DRC/CC-ICP-MS	25	20	33	21	10
110	ICP-MS	22.9	16.9	28.4	17.7	8.9
147	ICP-MS	25.2	18.7	31.1	19.4	9.40
293	DRC/CC-ICP-MS	22.09	17.25	28.98	18.51	9.46
391	DRC/CC-ICP-MS	22.425	18.658	30.365	19.102	9.107
399	DRC/CC-ICP-MS	23.3	17.7	29.6	18.8	8.74
401	DRC/CC-ICP-MS	25.3	19.3	31.6	20.9	10.3
597	DRC/CC-ICP-MS	24.8	17.8	32.1	19.2	8.91
598	ICP-MS	25.60	17.59	28.53	19.45	8.83
606	DRC/CC-ICP-MS	24.2	17.5	30.6	19.3	8.73

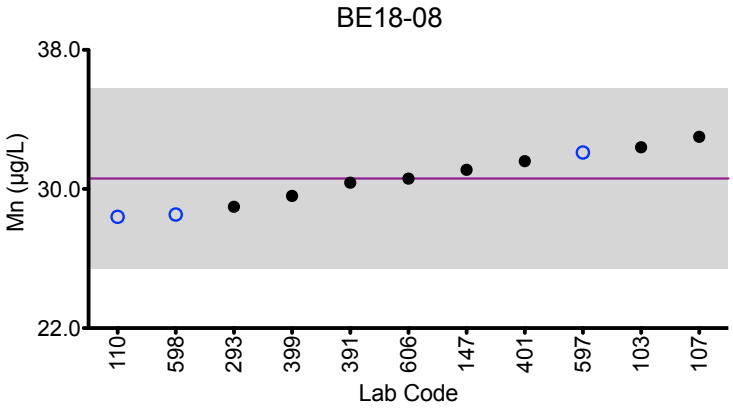
Based on the grading criteria for Mn in Whole Blood, 100% of results were satisfactory, with 0 of the 11 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

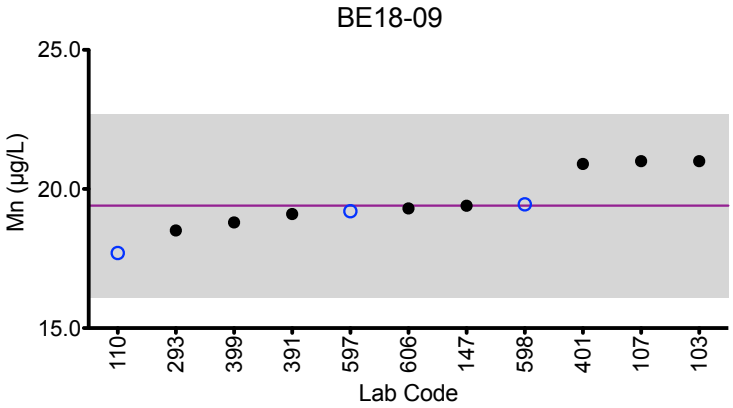
Results for Event #2, 2018: Summary Figures

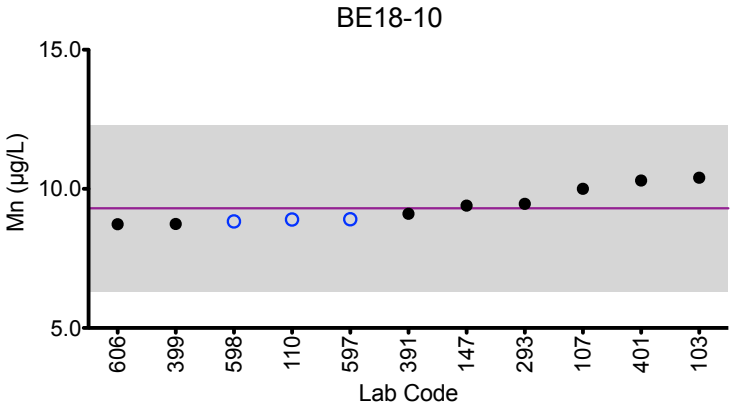
Whole Blood Mn











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 #2, 2018: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Target (Robust Mean (x*))	16.4	3.39	5.06	22.9	10.8
Upper Limit	18.4	5.39	7.06	25.2	12.8
Lower Limit	14.4	1.39	3.06	20.6	8.8
Robust SD (s*)	0.8	0.13	0.22	0.7	0.3
Robust RSD (%)	4.9	3.8	4.3	3.1	2.8
Number of Sample Measurements (N)	16	16	16	16	16
Standard Uncertainty (*u*)	0.248	0.041	0.069	0.229	0.082

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/L 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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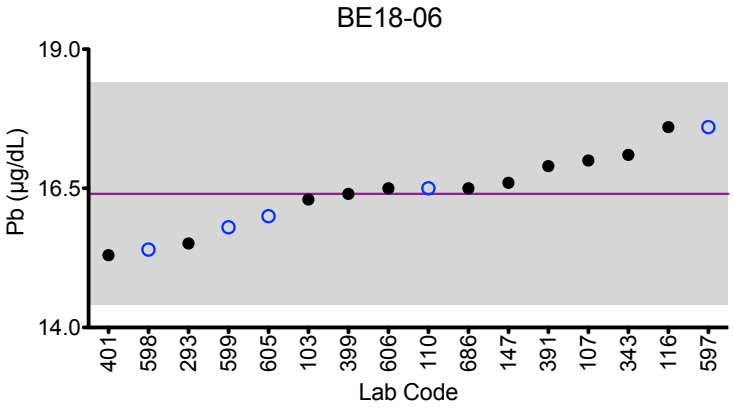
Results for Event #2, 2018:
Performance of Participating Laboratories

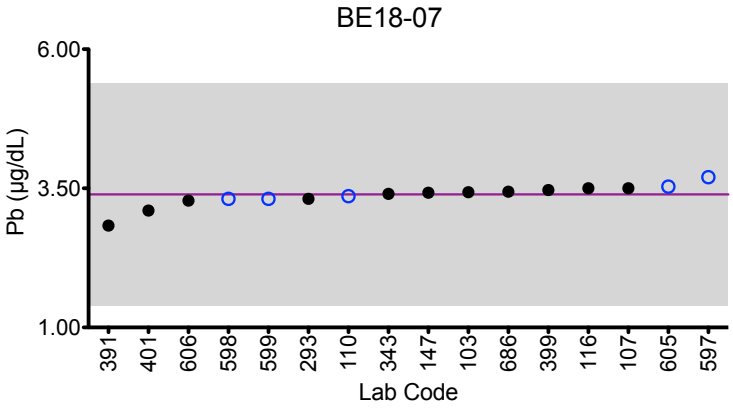
Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
	Target	**16.4**	**3.39**	**5.06**	**22.9**	**10.8**
103	DRC/CC-ICP-MS	16.3	3.43	5.11	22.5	10.7
107	ICP-MS	17	3.5	5.5	23	12
110	ICP-MS	16.5	3.36	5.09	23.1	10.8
116	ICP-MS/MS	17.6	3.50	5.47	24.0	11.3
147	ICP-MS	16.6	3.42	5.16	22.8	10.6
293	DRC/CC-ICP-MS	15.51	3.31	4.96	22.54	10.55
343	ASV-LeadCare	17.1	3.4	4.9	24.9	10.8
391	ETAAS-Z	16.9	2.83	4.84	23.8	10.7
399	DRC/CC-ICP-MS	16.4	3.47	5.16	23.1	10.8
401	DRC/CC-ICP-MS	15.3	3.1	4.8	20.3 ↓	10.2
597	DRC/CC-ICP-MS	17.6	3.7	5.57	23.2	11.4
598	ICP-MS	15.4	3.31	4.82	20.8	0.81 ↓
599	DRC/CC-ICP-MS	15.8	3.31	4.85	22.2	9.99
605	ICP-MS	16.0	3.53	5.00	21.9	10.8
606	DRC/CC-ICP-MS	16.5	3.28	5.04	23.0	10.9
686	ICP-MS	16.5	3.44	5.12	22.9	10.9

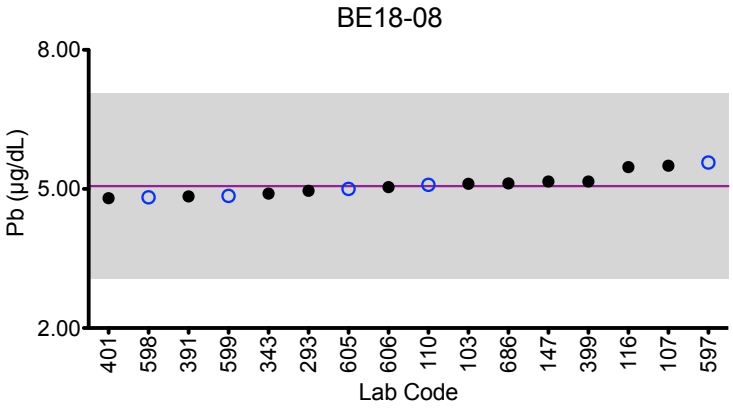
Based on the grading criteria for Pb in Whole Blood, 98% of results were satisfactory, with 0 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

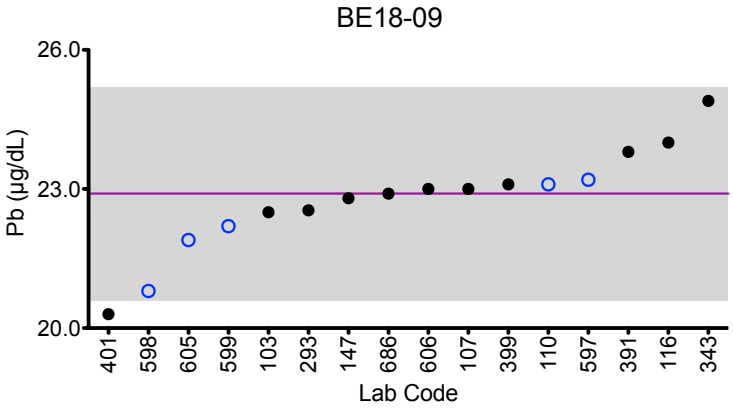
Results for Event #2, 2018: Summary Figures

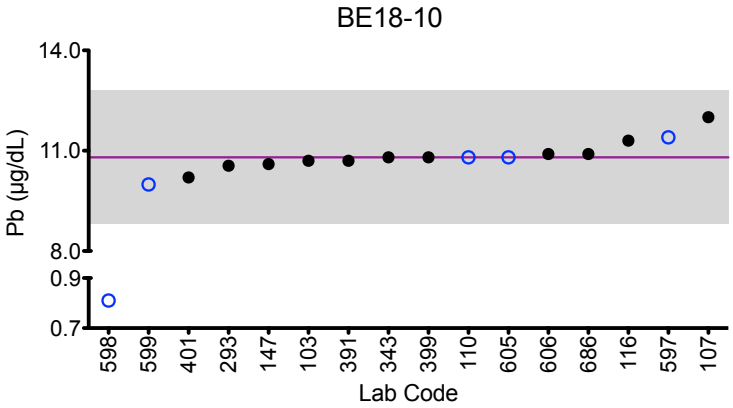
Whole Blood Pb











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 #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	ICP-MS	3.90	1.76	0.97	1.21	2.50
147	ICP-MS	3.87	1.77	<1.53	1.11	2.32
293	ICP-MS	3.77	1.89	0.9	1.24	2.44
598	ICP-MS	4.11	2.22	0.94	1.64	2.81
599	DRC/CC-ICP-MS	3.71	2.10	0.83	1.04	2.08
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		3.9	1.9	0.9	1.2	2.4
Arithmetic SD (s)		0.2	0.2	0.1	0.2	0.3
Arithmetic RSD (%)		5.1	10.5	11.1	16.7	12.5
Number of Sample Measurements (N)		5	5	4	5	5

*Denotes a statistical Outlier.

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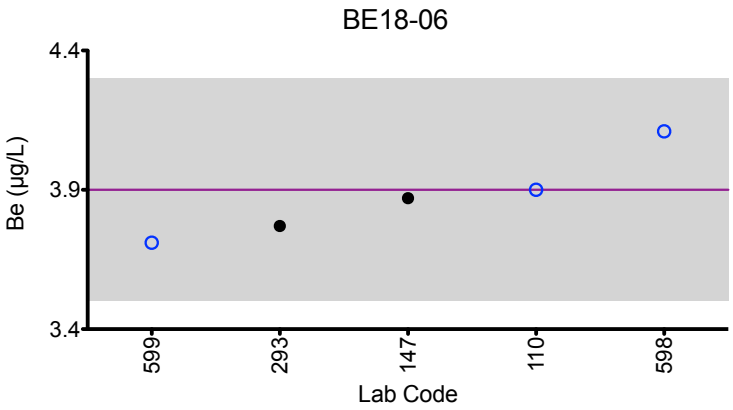
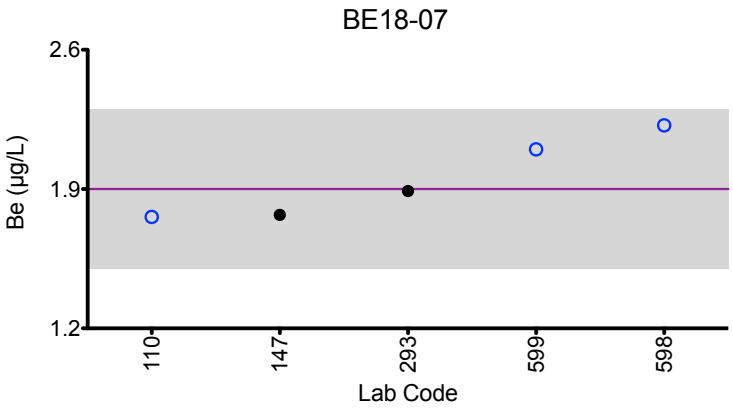
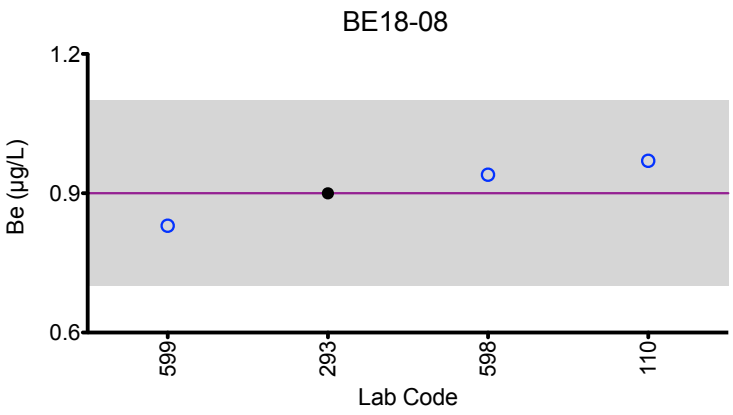
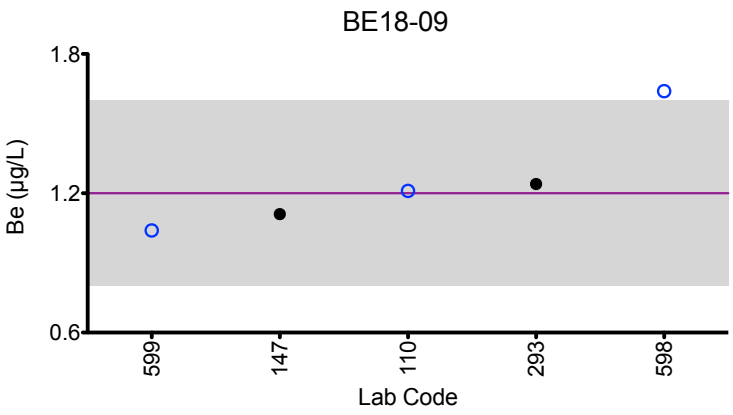
Results for Event #2, 2018: Summary Figures

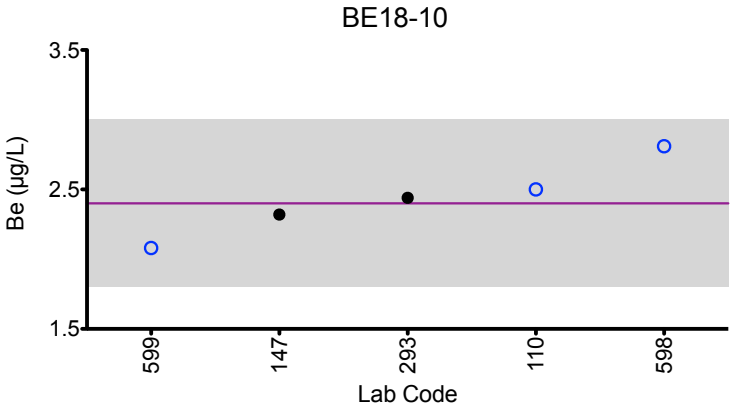
Whole Blood Be











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 not intended to be quality specifications and are included for informational purposes only.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	ICP-MS	1970	1240	1380	1660	2600
147	ICP-MS	2071	1309	1436	1798	2700
597	DRC/CC-ICP-MS	2050	1290	1450	1740	2780
598	ICP-MS	1857	1074	1189	1543	2254
599	DRC/CC-ICP-MS	1917	1196	1318	1710	2332

Summary Statistics					
	BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)	1973	1222	1355	1690	2533
Arithmetic SD (s)	90	94	106	96	230
Arithmetic RSD (%)	4.6	7.7	7.8	5.7	9.1
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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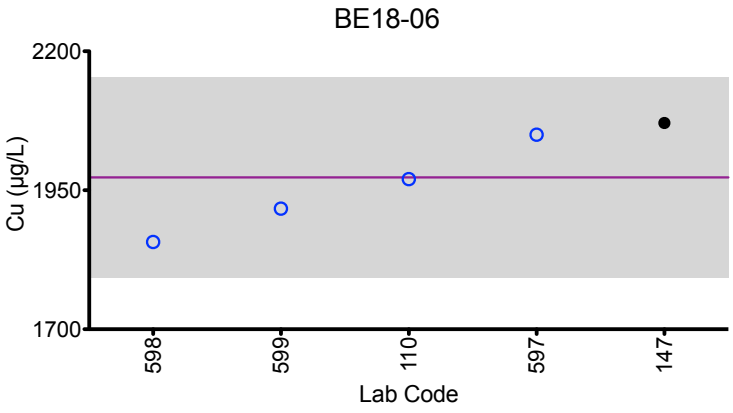
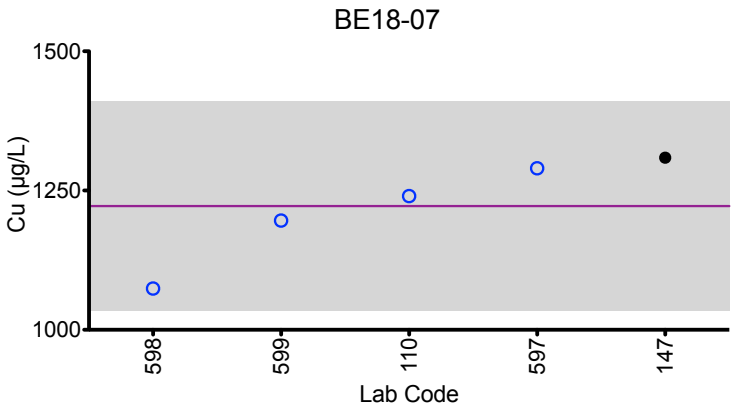
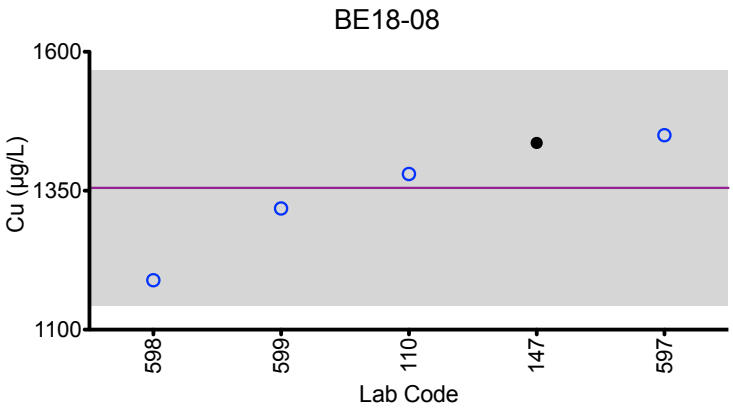
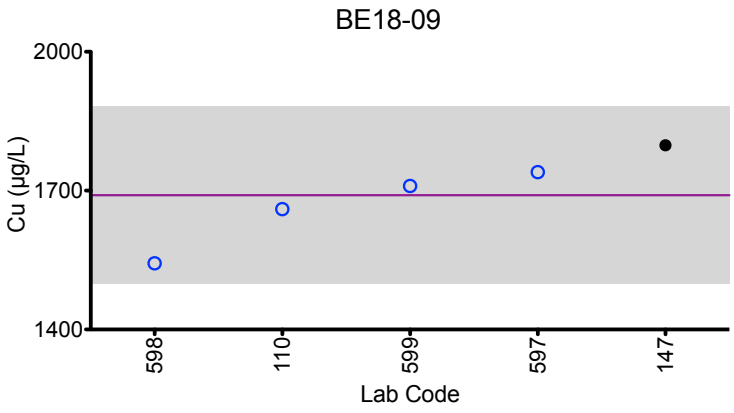
Results for Event #2, 2018: Summary Figures

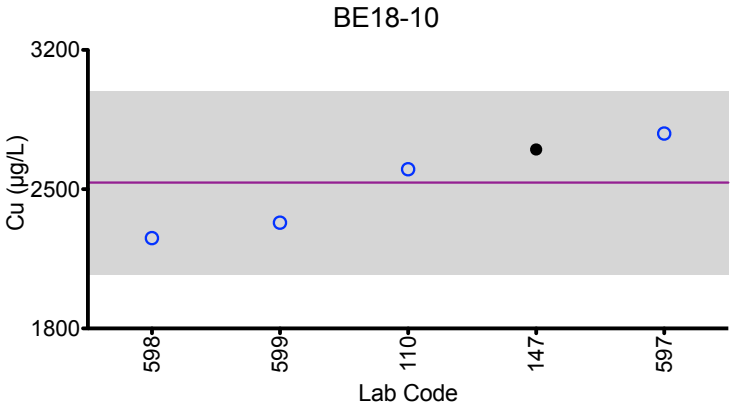
Whole Blood Cu











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 not intended to be quality specifications and are included for informational purposes only.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
103	DRC/CC-ICP-MS	2.95	9.20	4.06	1.98	<0.123
110	ICP-MS	2.65	8.35	*3.8	1.71	0.03
147	ICP-MS	2.78	8.89	4.10	1.89	<0.0548
293	DRC/CC-ICP-MS	2.75	9.11	4.03	2.02	0.04
597	DRC/CC-ICP-MS	2.90	8.68	4.17	2.00	0.09
598	ICP-MS	2.79	9.09	4.09	1.93	<0.5
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		2.80	8.89	4.09	1.92	NA
Arithmetic SD (s)		0.11	0.32	0.05	0.11	NA
Arithmetic RSD (%)		3.9	3.6	1.2	5.7	NA
Number of Sample Measurements (N)		6	6	5	6	NA

*Denotes a statistical Outlier.

Statistical data were not calculated for BE18-10 based on a lack of consensus among participating labs.

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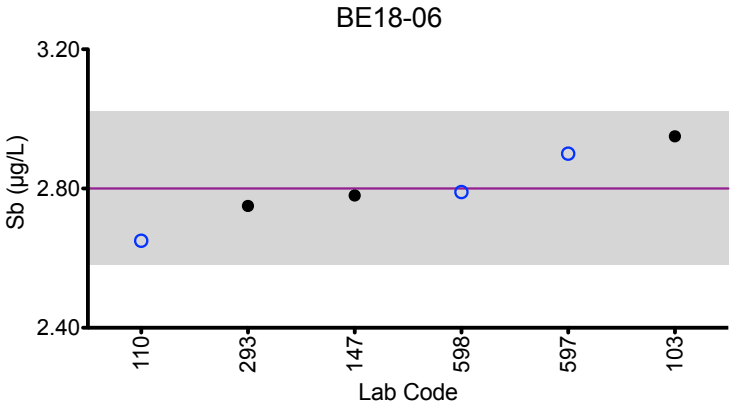
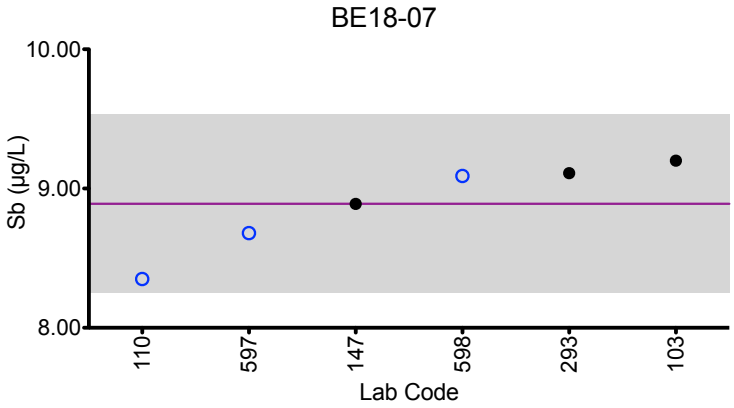
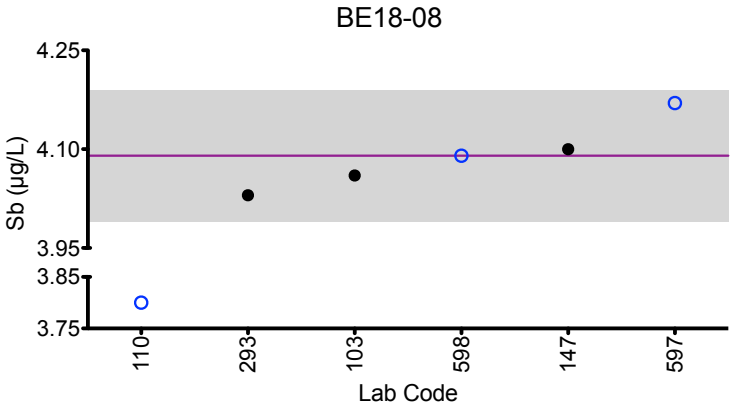
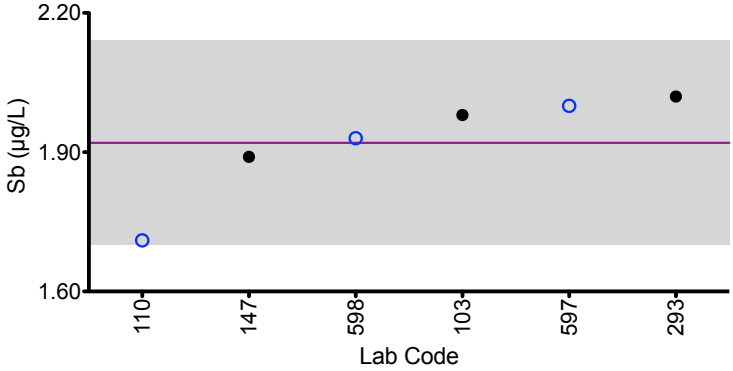
Results for Event #2, 2018: Summary Figures

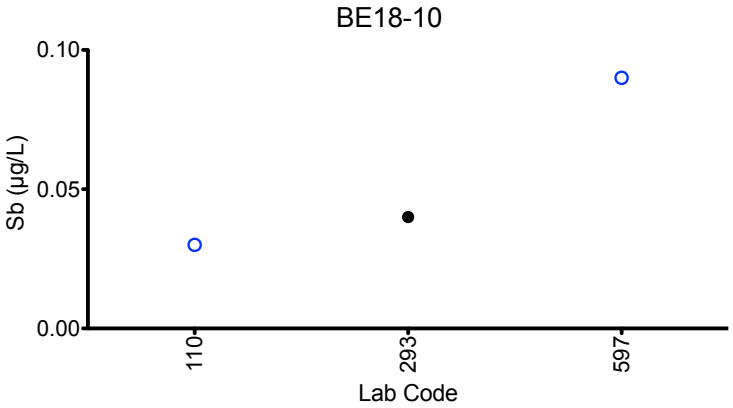
Whole Blood Sb











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

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

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)

Lab Code	Method	BE18-06	BE18-07	BE18-08	BE18-09	BE18-10
103	DRC/CC-ICP-MS	138	313	183	193	394
107	DRC/CC-ICP-MS	160	330	210	220	430
110	DRC/CC-ICP-MS	123	297	162	168	354
147	ICP-MS	133	323	188	194	389
399	DRC/CC-ICP-MS	133	313	176	195	389
401	DRC/CC-ICP-MS	143	345	196	202	420
597	DRC/CC-ICP-MS	135	320	184	187	394
598	DRC/CC-ICP-MS	118	283	134	172	395

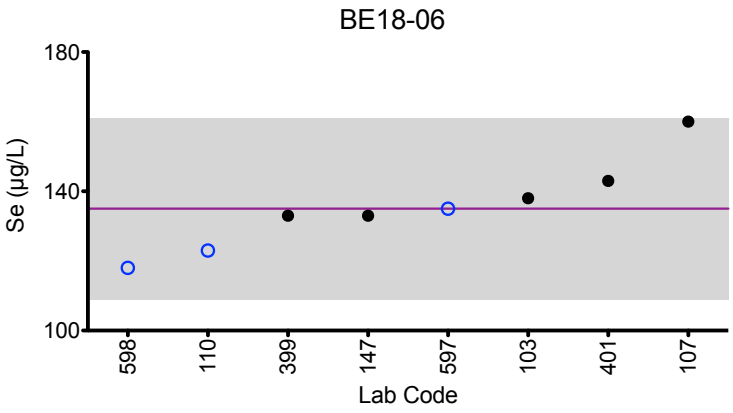
Summary Statistics

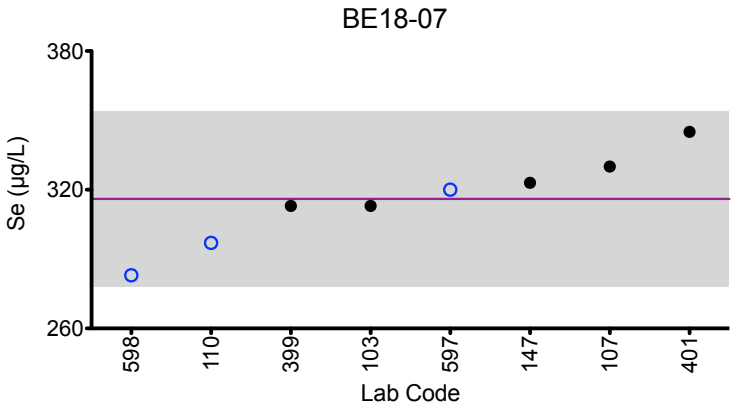
	BE18-06	BE18-07	BE18-08	BE18-09	BE18-10
Arithmetic Mean ($\bar{x}$)	135	316	179	191	396
Arithmetic SD (s)	13	19	23	16	23
Arithmetic RSD (%)	9.6	6.0	12.8	8.4	5.8
Number of Sample Measurements (N)	8	8	8	8	8

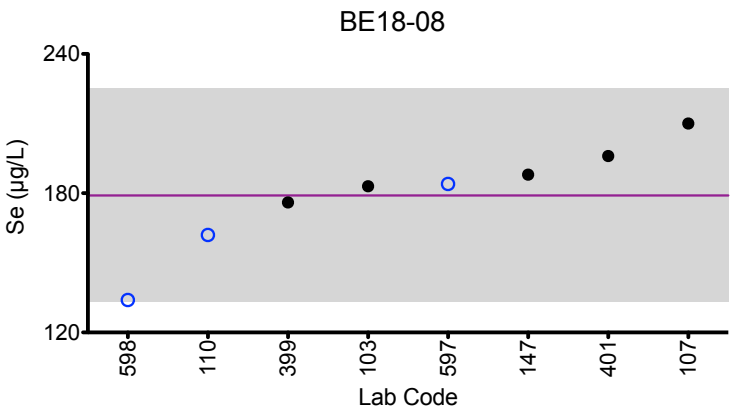
*Denotes a statistical Outlier.

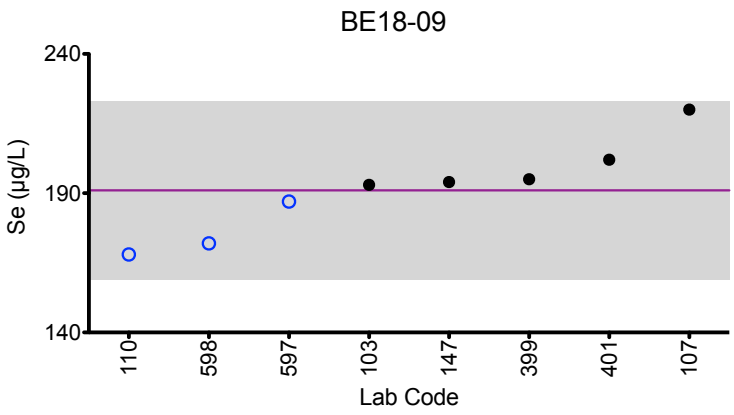
Results for Event #2, 2018: Summary Figures

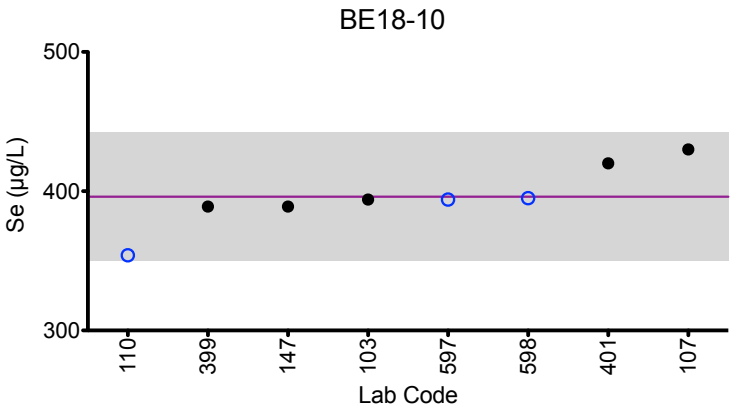
Whole Blood Se











Legend:
○ CHEAR Labs ● Other Labs
Horizontal purple line = arithmetic mean of all laboratories.
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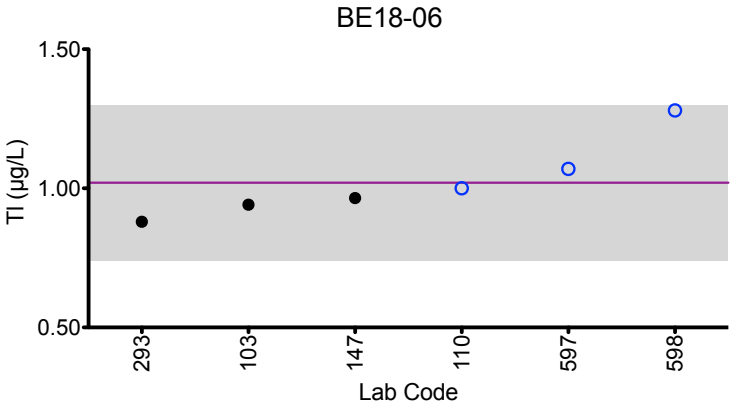
Results for Event #2, 2018: Laboratory Data and Summary Statistics

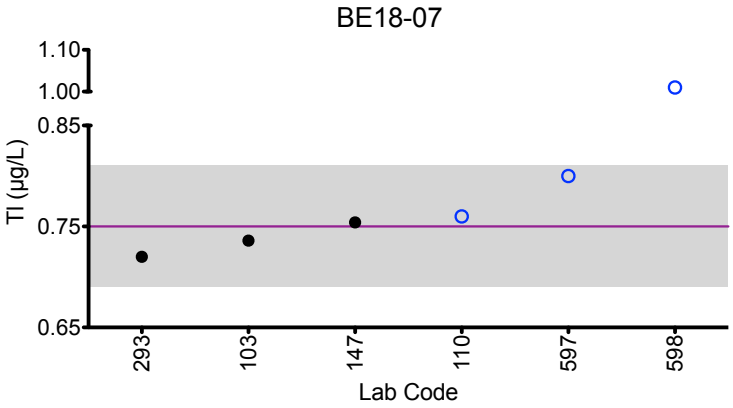
Whole Blood Tl (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
103	DRC/CC-ICP-MS	0.941	0.736	0.337	1.75	0.0252
110	ICP-MS	1.00	0.76	0.35	1.65	0.02
147	ICP-MS	0.965	0.754	0.331	1.70	< 0.0388
293	DRC/CC-ICP-MS	0.88	0.72	0.33	1.68	0.02
597	DRC/CC-ICP-MS	1.07	0.80	0.38	1.73	0.05
598	ICP-MS	1.28	*1.01	0.43	1.89	*0.31
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		1.02	0.75	0.36	1.73	0.03
Arithmetic SD (s)		0.14	0.03	0.04	0.08	0.01
Arithmetic RSD (%)		13.7	4.0	11.1	4.6	33
Number of Sample Measurements (N)		6	5	6	6	4

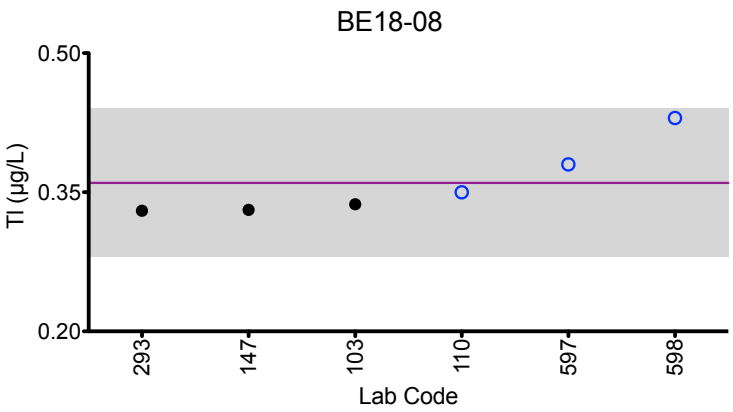
*Denotes a statistical Outlier.

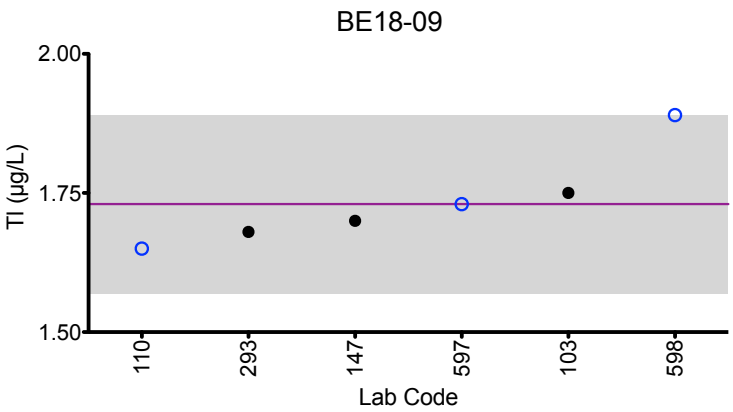
Results for Event #2, 2018: Summary Figures

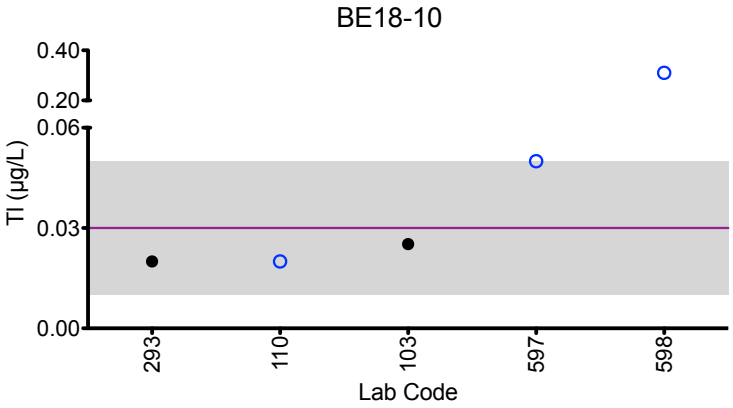
Whole Blood Tl











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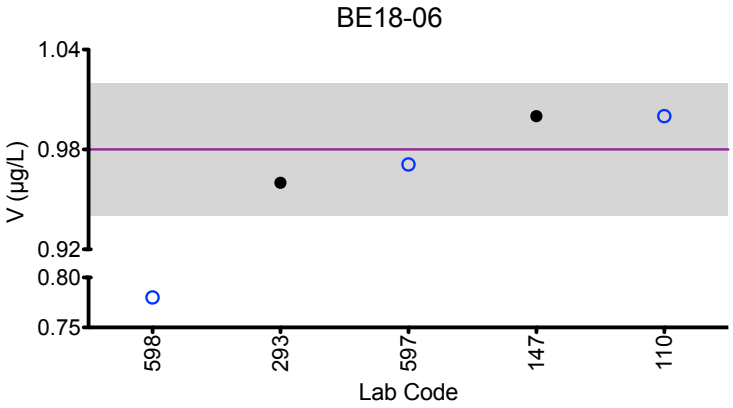
Results for Event #2, 2018:
Laboratory Data and Summary Statistics

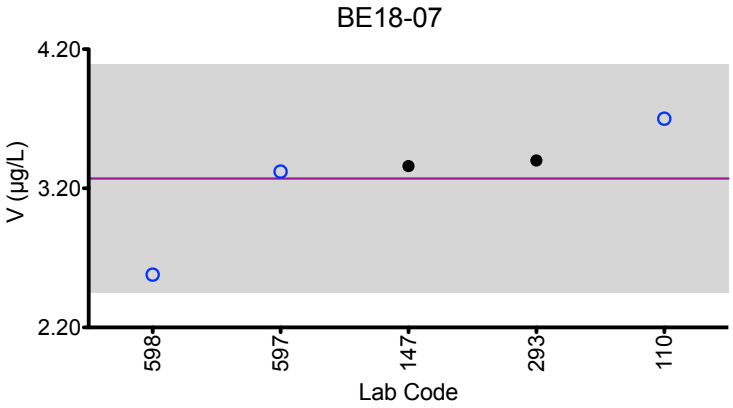
Whole Blood V (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	DRC/CC-ICP-MS	1.0	3.7	1.6	0.5	2.2
147	DRC/CC-ICP-MS	1.00	3.36	1.61	0.458	2.43
293	DRC/CC-ICP-MS	0.96	3.4	1.73	*0.82	2.33
597	DRC/CC-ICP-MS	0.971	3.32	1.65	0.435	2.18
598	DRC/CC-ICP-MS	*0.78	2.58	*1.09	0.38	1.74
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		0.98	3.27	1.65	0.44	2.18
Arithmetic SD (s)		0.02	0.41	0.06	0.05	0.26
Arithmetic RSD (%)		2.0	12.5	3.6	11.4	11.9
Number of Sample Measurements (N)		4	5	4	4	5

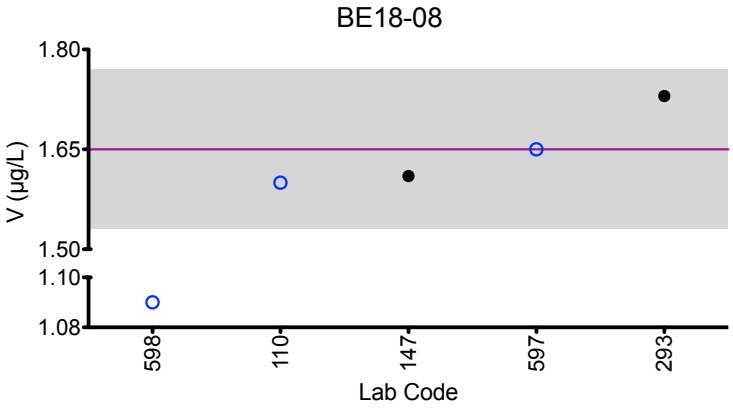
*Denotes a statistical Outlier.

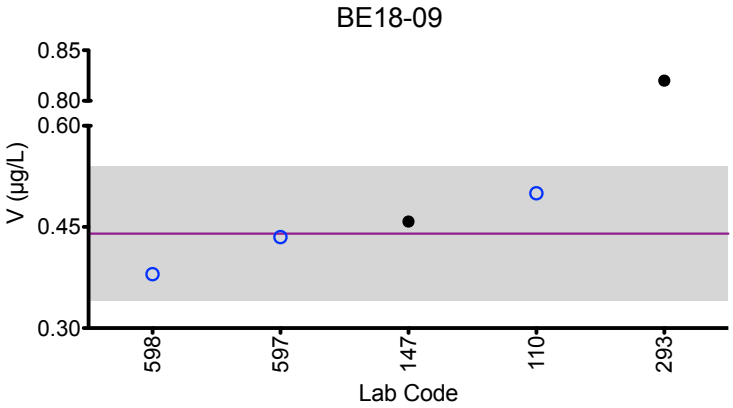
Results for Event #2, 2018: Summary Figures

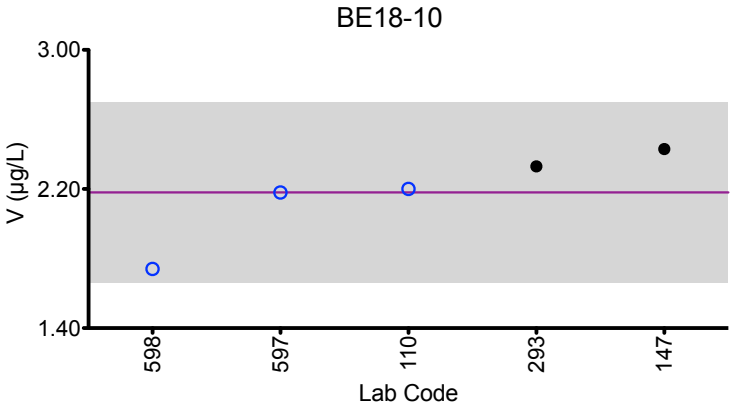
Whole Blood V











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	ICP-MS	4800	5840	6820	7390	6180
147	ICP-MS	4634	5608	6601	7516	6190
597	DRC/CC-ICP-MS	4940	5890	7250	7520	6450
598	ICP-MS	4433	5032	5767	6817	5370
599	DRC/CC-ICP-MS	5120	6070	7040	8320	6430
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		4785	5688	6696	7513	6124
Arithmetic SD (s)		266	402	573	536	440
Arithmetic RSD (%)		5.6	7.1	8.6	7.1	7.2
Number of Sample Measurements (N)		5	5	5	5	5

*Denotes a statistical Outlier.

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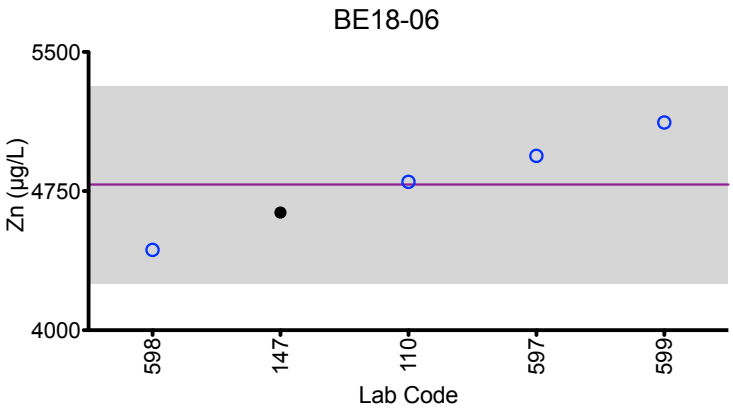
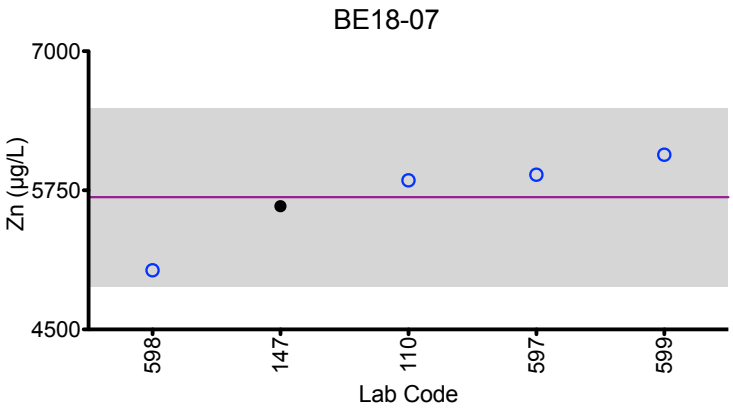
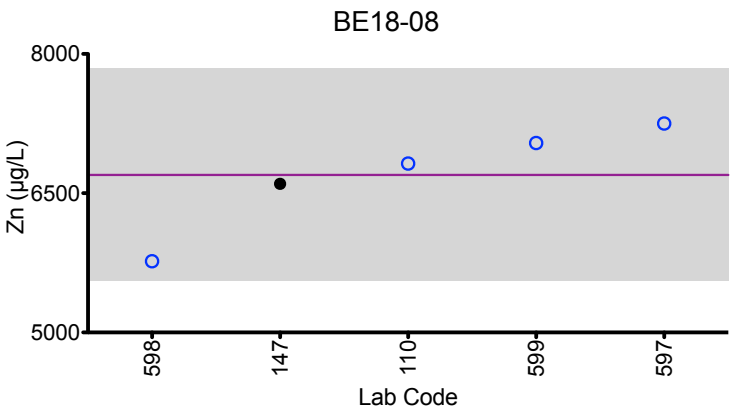
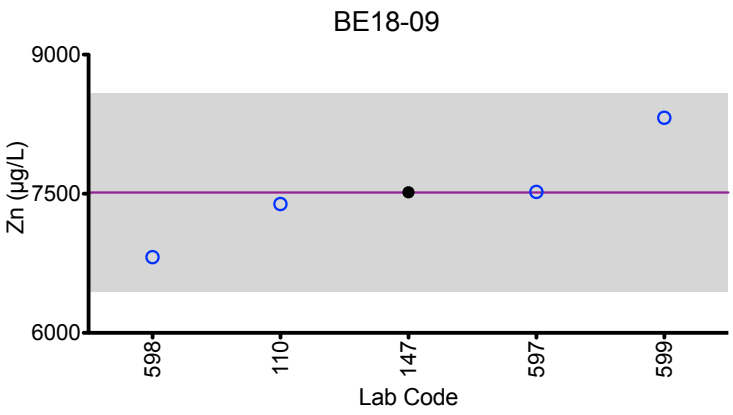
Results for Event #2, 2018: Summary Figures

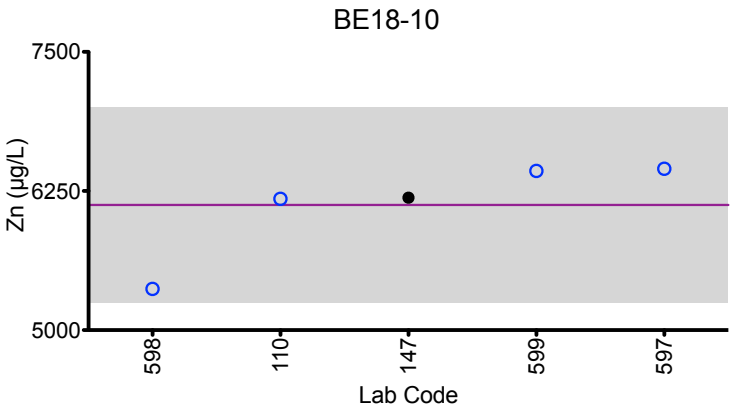
Whole Blood Zn











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	ICP-MS	10.9	4.3	8.4	1.6	14.4
147	ICP-MS	11.5	4.35	8.17	1.99	14.1
597	DRC/CC-ICP-MS	12.3	4.43	9.06	2.00	15.7
598	ICP-MS	10.93	4.32	7.95	1.93	14.54
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		11.4	4.3	8.4	1.9	14.7
Arithmetic SD (s)		0.7	0.1	0.5	0.2	0.7
Arithmetic RSD (%)		6.1	2.3	6.0	10.5	4.8
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	ICP-MS	1.3	1.4	1.4	1.2	1.3
597	DRC/CC-ICP-MS	1.39	1.60	1.56	1.33	1.52
598	ICP-MS	1.83	1.51	1.46	1.28	1.36
599	DRC/CC-ICP-MS	1.23	1.31	1.35	1.15	1.30
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		1.4	1.5	1.4	1.2	1.4
Arithmetic SD (s)		0.3	0.1	0.1	0.1	0.1
Arithmetic RSD (%)		21	6.7	7.1	8.3	7.1
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
103	DRC/CC-ICP-MS	12.1	0.345	5.44	4.27	9.94
147	ICP-MS	12.3	0.587	5.22	4.45	9.58
597	DRC/CC-ICP-MS	12.1	0.605	5.19	3.98	9.53
598	DRC/CC-ICP-MS	9.38	0.64	3.77	3.52	7.89
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		11.5	0.544	4.91	4.05	9.23
Arithmetic SD (s)		1.4	0.135	0.76	0.41	0.92
Arithmetic RSD (%)		12.2	25	15.5	10.1	10.0
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	DRC/CC-ICP-MS	9.20	2.5	3.3	7.2	5.5
147	ICP-MS	9.40	2.64	3.55	8.20	5.46
597	DRC/CC-ICP-MS	10.4	2.62	3.86	8.26	5.66
598	ICP-MS	10.15	2.87	3.62	8.21	5.56
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		9.8	2.7	3.6	8.0	5.5
Arithmetic SD (s)		0.6	0.2	0.2	0.5	0.1
Arithmetic RSD (%)		6.1	7.4	5.6	6.3	1.8
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Pt (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	ICP-MS	7.6	0.6	4.6	0.9	2.6
598	ICP-MS	7.08	0.56	4.37	0.89	1.93
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		7.3	0.58	4.5	0.90	2.3
Arithmetic SD (s)		0.4	0.03	0.2	0.01	0.5
Arithmetic RSD (%)		5.5	5.2	4.4	1.1	22
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	ICP-MS	1.0	3.9	4.9	1.6	2.9
147	ICP-MS	1.02	3.72	4.82	1.69	2.83
597	DRC/CC-ICP-MS	1.07	4.19	5.25	1.71	3.20
598	ICP-MS	0.97	3.95	5.08	1.45	2.83
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		1.02	3.9	5.0	1.6	2.9
Arithmetic SD (s)		0.04	0.2	0.2	0.1	0.2
Arithmetic RSD (%)		3.9	5.1	4.0	6.3	6.9
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
103	DRC/CC-ICP-MS	< 0.0250	0.0556	0.325	0.0710	0.0698
110	ICP-MS	0.023	0.059	0.320	0.076	0.078
147	ICP-MS	< 0.0200	0.0464	0.326	0.0707	0.0733
598	ICP-MS	0.1	*0.13	0.34	*0.12	*0.1
Summary Statistics						
		BE18-06	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
Arithmetic Mean ($\bar{x}$)		NA	0.054	0.328	0.073	0.074
Arithmetic SD (s)		NA	0.007	0.009	0.003	0.004
Arithmetic RSD (%)		NA	12.1	2.6	4.1	5.6
Number of Sample Measurements (N)		NA	3	4	3	3

*Denotes a statistical Outlier.

Statistical data were not calculated for BE18-06 based on a lack of consensus among participating labs.

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Results for Event #2, 2018: Additional Elements in Whole Blood

Whole Blood Ag (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
147	ICP-MS	< 0.173	< 0.173	< 0.173	< 0.173	< 0.173
Whole Blood Al (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
147	ICP-MS	NR	6.53	6.85	<5.40	<5.40
597	DRC/CC-ICP-MS	18.7	18.1	22.4	22.0	99.0
Whole Blood Bi (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
147	ICP-MS	< 0.0251	< 0.0251	< 0.0251	< 0.0251	< 0.0251
Whole Blood I (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
147	ICP-MS	31.6	29.2	27.7	33.8	28.7
Whole Blood Li (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
147	ICP-MS	0.520	0.497	0.441	0.491	0.541
Whole Blood Mg (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
597	DRC/CC-ICP-MS	27900	29800	33700	25900	29600
Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
103	DRC/CC-ICP-MS	24.5	20.5	22.8	25.1	17.7
Whole Blood Te (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
147	ICP-MS	< 0.0791	< 0.0791	< 0.0791	< 0.0791	< 0.0791
Whole Blood Th (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
147	ICP-MS	< 0.0169	< 0.0169	< 0.0169	< 0.0169	< 0.0169
Whole Blood Ti (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
200	DRC/CC-ICP-MS	5.7	1.5	4.6	8.8	8.1
Whole Blood W (µg/L)						
Lab Code	**Method**	**BE18-06**	**BE18-07**	**BE18-08**	**BE18-09**	**BE18-10**
110	ICP-MS	0.21	0.41	0.13	0.59	0.29
200	ICP-MS	2.4	2.5	3.1	2.3	2
598	ICP-MS	0.53	0.69	0.32	0.83	0.46

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Event #2, 2018

Trace Elements in Urine

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

Event #2, 2018:
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, I, Li, Mg, Mo, Ni, Pt, Sb, Se, Sn, Sr, 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 #2, 2018: Summary Statistics

	Urine As (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	34.4	10.2	175	61.4	81.7
Upper Limit	41.3	16.2	210	73.7	98.0
Lower Limit	27.5	4.2	140	49.1	65.4
Robust SD (s*)	1.6	0.7	8	3.8	4.7
Robust RSD (%)	4.7	6.9	4.6	6.2	5.8
Number of Sample Measurements (N)	21	21	21	21	21
Standard Uncertainty (*u*)	0.433	0.190	2.21	1.03	1.29

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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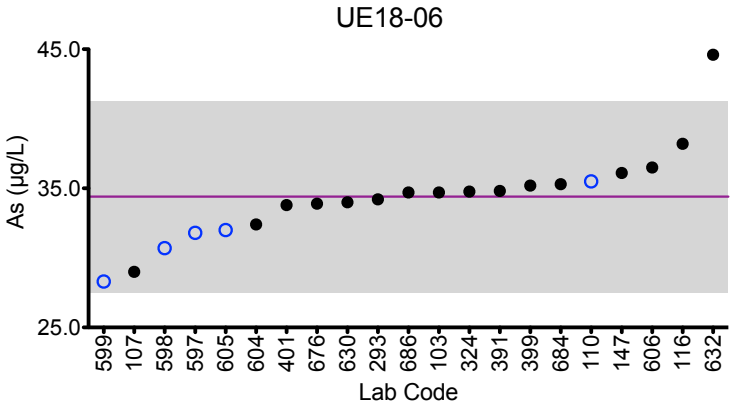
Results for Event #2, 2018:
Performance of Participating Laboratories

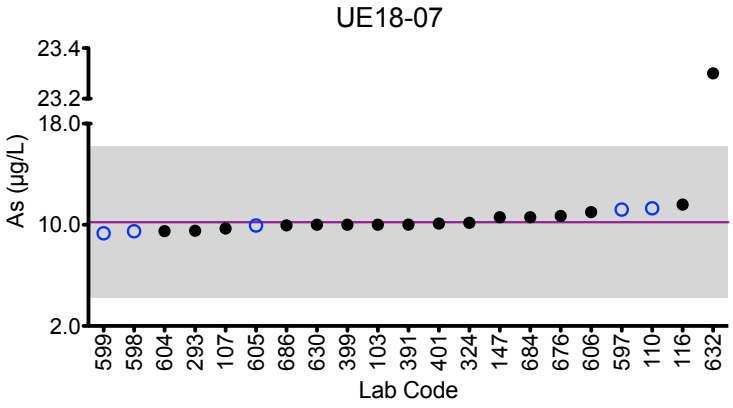
		Urine As (µg/L)				
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**34.4**	**10.2**	**175**	**61.4**	**81.7**
103	DRC/CC-ICP-MS	34.7	10.0	180	61.7	82.7
107	DRC/CC-ICP-MS	29	9.7	150	54	73
110	DRC/CC-ICP-MS	35.5	11.3	183	63.9	85.8
116	ICP-MS/MS	38.2	11.6	193	67.1	88.8
147	ICP-MS	36.1	10.6	175	61.6	81.6
293	DRC/CC-ICP-MS	34.21	9.53	170.69	59.56	77.7
324	ICP-MS	34.768	10.161	175.308	61.055	79.243
391	DRC/CC-ICP-MS	34.815	10.013	175.28	65.168	81.892
399	DRC/CC-ICP-MS	35.2	10.0	178	61.0	82.4
401	DRC/CC-ICP-MS	33.8	10.1	174	58.3	79.8
597	DRC/CC-ICP-MS	31.8	11.2	171.4	62.5	83.4
598	DRC/CC-ICP-MS	30.70	9.49	158	53.20	70.28
599	DRC/CC-ICP-MS	28.3	9.33	158	54.3	72.3
604	DRC/CC-ICP-MS	32.4	9.50	166	57.8	77.4
605	ICP-MS	32.0	9.94	165	57.9	78.4
606	DRC/CC-ICP-MS	36.5	11.0	193	67.6	91.1
630	DRC/CC-ICP-MS	34	10	171	61.5	83
632	DRC/CC-ICP-MS	44.6 ↑	23.3 ↑	190	79.7 ↑	95.0
676	DRC/CC-ICP-MS	33.9	10.7	176	62	82.2
684	DRC/CC-ICP-MS	35.3	10.6	178	63.6	82.9
686	DRC/CC-ICP-MS	34.7	9.95	180	61.8	84.2

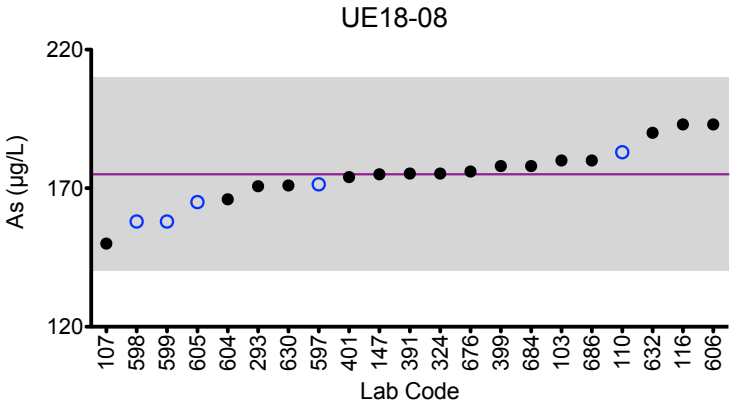
Based on the grading criteria for As in Urine, 97% of results were satisfactory, with 1 of the 21 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

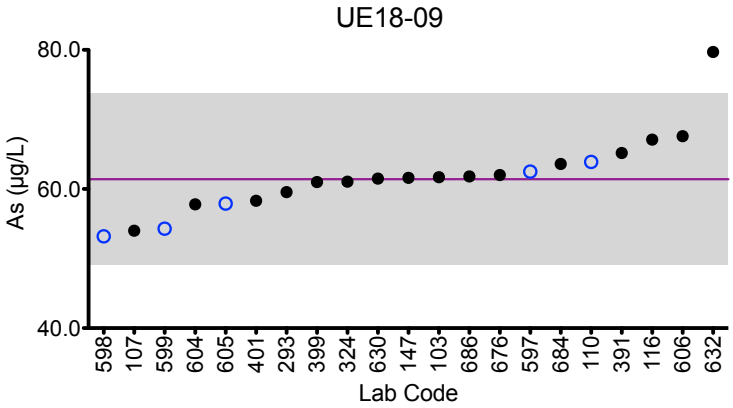
Results for Event #2, 2018: Summary Figures

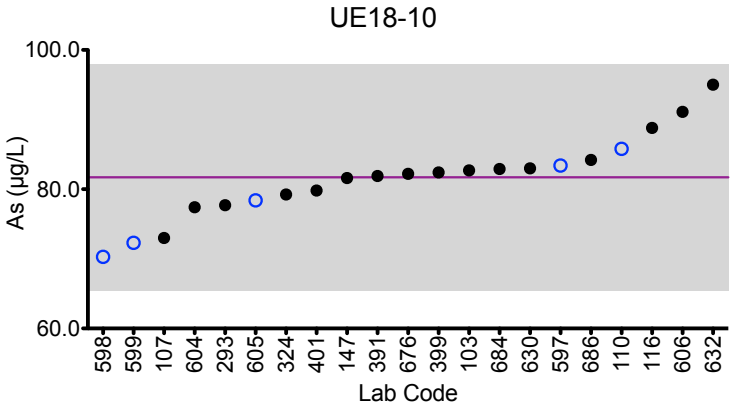
Urine As











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 #2, 2018: Summary Statistics

	Urine Ba (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	8.9	4.9	4.2	3.2	0.9
Upper Limit	10.7	5.9	5.2	4.2	1.9
Lower Limit	7.1	3.9	3.2	2.2	0.0
Robust SD (s*)	0.4	0.2	0.1	0.1	0.1
Robust RSD (%)	4.5	4.1	2.4	3.1	11.1
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.118	0.064	0.021	0.028	0.024

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.

Results for Event #2, 2018:
Performance of Participating Laboratories

		Urine Ba (µg/L)				
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**8.9**	**4.9**	**4.2**	**3.2**	**0.9**
107	ICP-MS	8	4.6	3.7	3.1	0.86
110	ICP-MS	9.12	5.00	4.22	3.31	0.96
116	ICP-MS/MS	9.40	5.13	4.28	3.35	1.05
147	ICP-MS	8.08	4.48	3.57	2.79	0.757
399	ICP-MS	8.88	4.93	4.21	3.23	0.944
597	DRC/CC-ICP-MS	8.21	5.64	4.17	3.66	0.95
598	ICP-MS	8.99	4.83	4.17	3.23	0.93
599	DRC/CC-ICP-MS	8.25	4.80	4.28	3.28	1.08
605	ICP-MS	9.15	4.89	4.20	3.14	0.915
606	DRC/CC-ICP-MS	8.92	4.73	3.93	3.24	0.857
607	ICP-MS	9.13	4.99	4.29	3.27	0.988
632	ICP-MS	8.94	4.98	4.24	3.24	0.991
676	ICP-MS	8.75	4.95	4.19	3.18	0.883
686	ICP-MS	9.16	5.11	4.23	3.28	0.960

Based on the grading criteria for Ba in Urine, 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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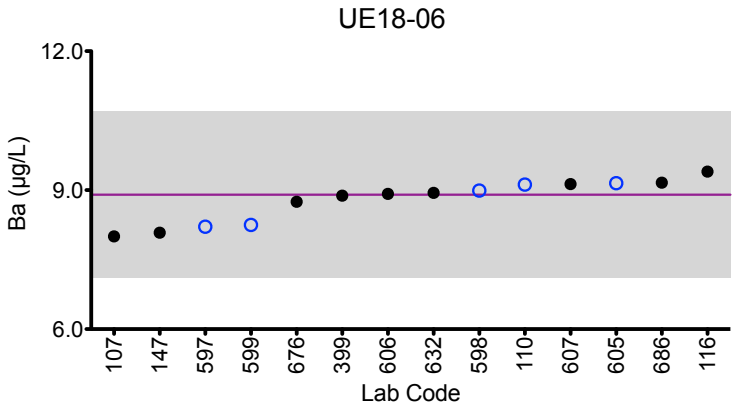
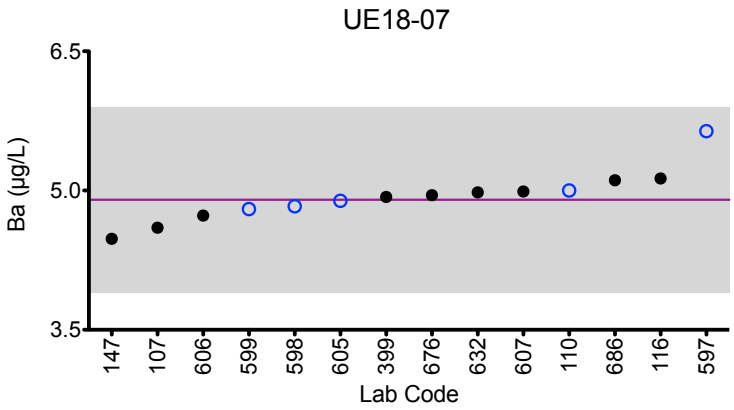
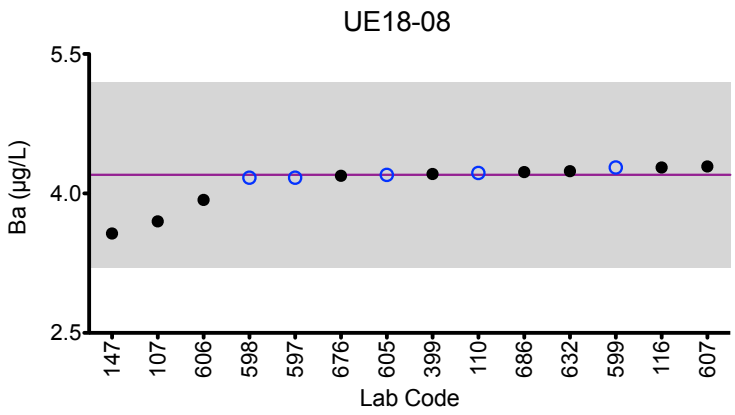
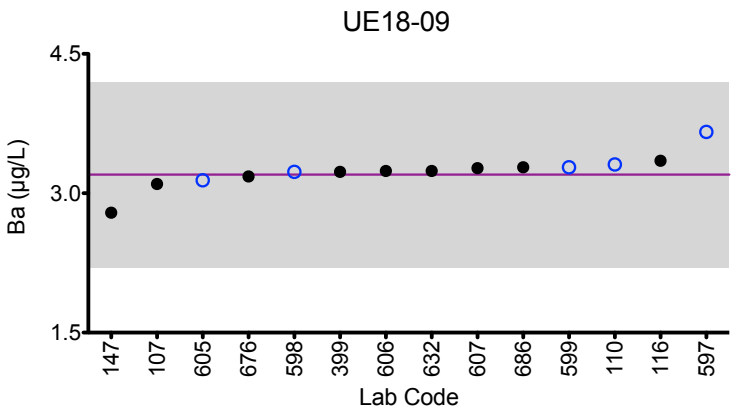
Results for Event #2, 2018: Summary Figures

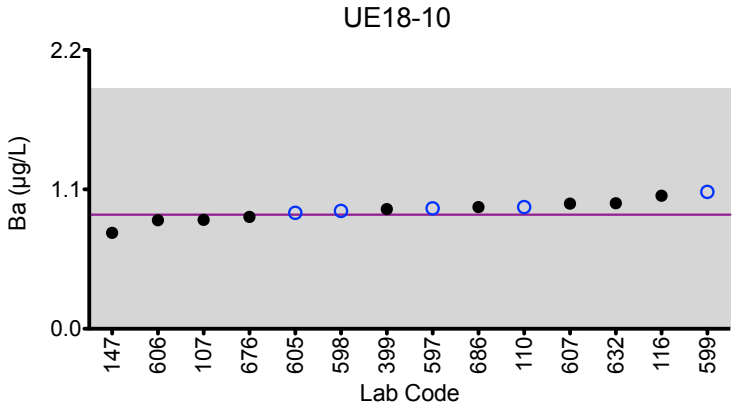
Urine Ba











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 #2, 2018: Summary Statistics

	Urine Be (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	2.9	0.86	5.1	2.4	0.76
Upper Limit	3.9	1.86	6.1	3.4	1.76
Lower Limit	1.9	0.00	4.1	1.4	0.00
Robust SD (s*)	0.3	0.05	0.4	0.2	0.08
Robust RSD (%)	10.3	5.8	7.8	8.3	10.5
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (*u*)	0.104	0.019	0.137	0.059	0.028

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 #2, 2018:
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**2.9**	**0.86**	**5.1**	**2.4**	**0.76**
107	ICP-MS	2.6	0.86	4.5	2.4	0.7
110	ICP-MS	2.67	0.847	4.65	2.27	0.718
116	ICP-MS/MS	2.57	0.797	4.45	2.19	0.608
147	ICP-MS	3.15	0.889	5.43	2.34	0.857
293	ICP-MS	2.8	0.87	4.98	2.32	0.77
399	ICP-MS	2.92	0.861	5.07	2.47	0.772
598	ICP-MS	3.10	0.85	5.36	2.58	0.86
599	DRC/CC-ICP-MS	2.30	0.73	4.31	2.13	0.64
605	ICP-MS	3.14	0.893	5.33	2.51	0.775
607	ICP-MS	2.94	0.792	5.13	2.30	0.726
632	ICP-MS	3.10	0.930	5.29	2.53	0.797
676	ICP-MS	3.34	1.01	5.65	2.63	0.855
686	ICP-MS	3.06	0.903	5.14	2.48	0.784

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

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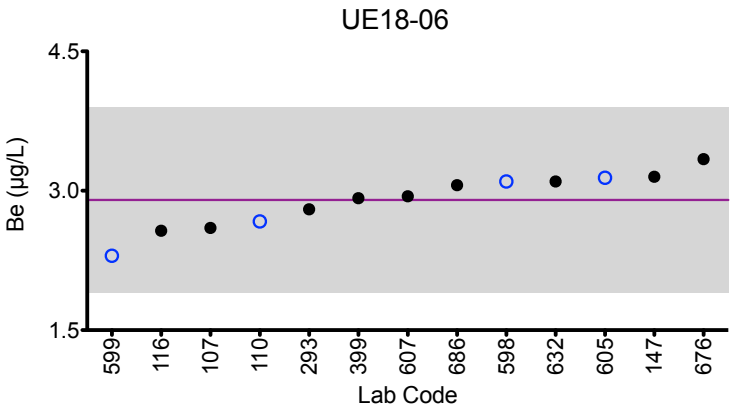
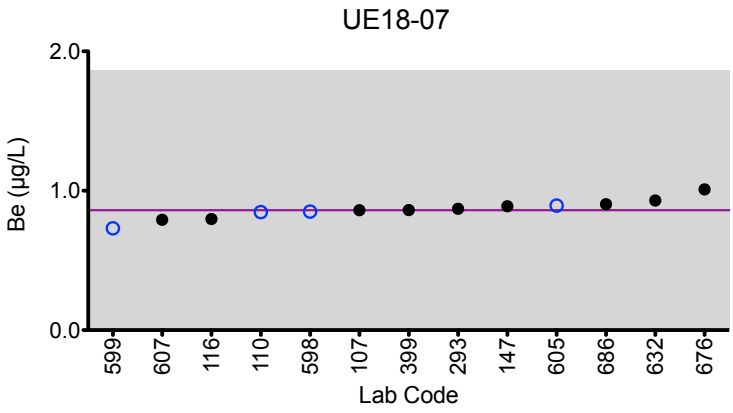
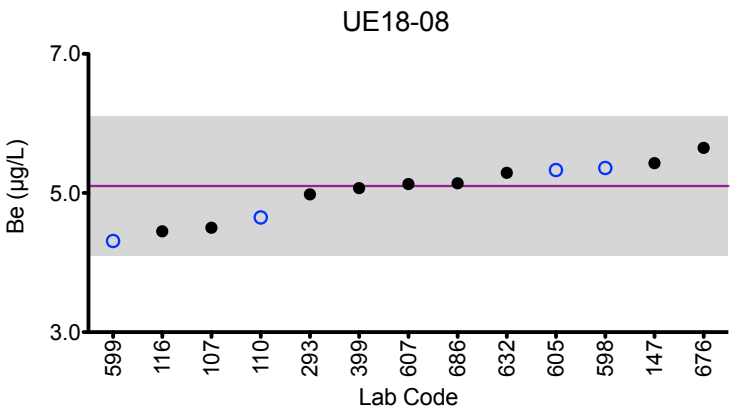
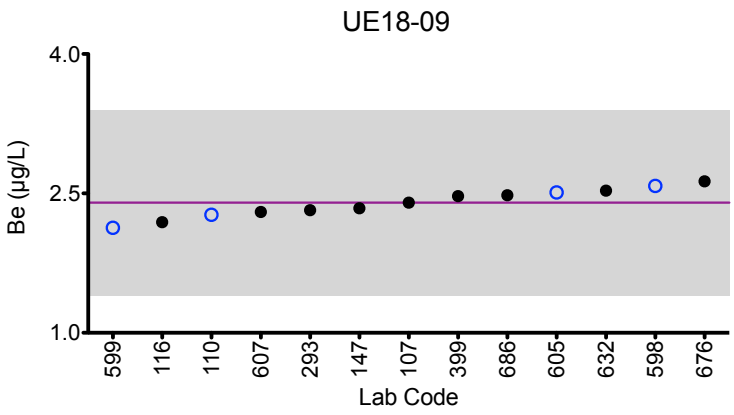
Results for Event #2, 2018: Summary Figures

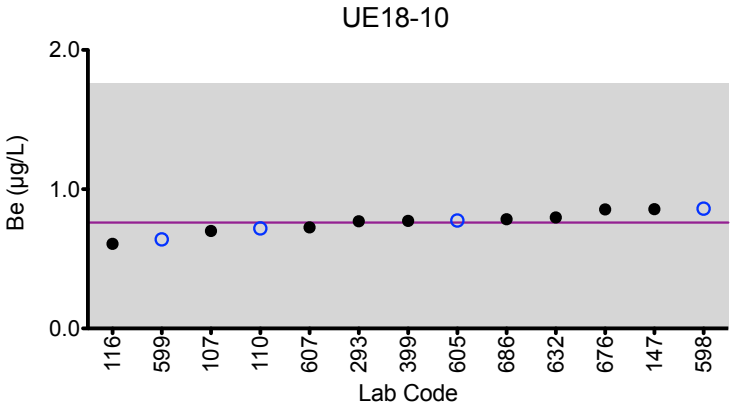
Urine Be











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 #2, 2018: Summary Statistics

	Urine Cd (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	2.85	0.70	0.45	5.23	3.63
Upper Limit	3.85	1.70	1.45	6.23	4.63
Lower Limit	1.85	0.00	0.00	4.23	2.63
Robust SD (s*)	0.14	0.09	0.03	0.23	0.12
Robust RSD (%)	4.9	12.9	6.7	4.4	3.3
Number of Sample Measurements (N)	21	20	20	21	21
Standard Uncertainty (*u*)	0.037	0.026	0.0077	0.063	0.034

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 #2, 2018:
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**2.85**	**0.70**	**0.45**	**5.23**	**3.63**
103	DRC/CC-ICP-MS	3.03	0.667	0.472	5.61	3.75
107	DRC/CC-ICP-MS	2.6	0.58	0.41	5.2	3.7
110	ICP-MS	2.84	0.584	0.444	5.30	3.54
116	ICP-MS/MS	3.25	0.704	0.477	5.80	3.90
147	ICP-MS	3.12	0.626	0.425	5.34	3.82
293	DRC/CC-ICP-MS	2.94	0.74	0.48	5.25	3.68
324	ICP-MS	2.904	<1	<1	5.046	3.636
391	DRC/CC-ICP-MS	2.71	0.829	0.423	4.899	3.463
399	DRC/CC-ICP-MS	2.90	0.677	0.460	5.24	3.68
401	DRC/CC-ICP-MS	2.92	0.67	0.45	5.40	3.60
597	DRC/CC-ICP-MS	2.63	0.72	0.40	5.50	3.56
598	DRC/CC-ICP-MS	2.45	0.63	0.39	4.45	3.10
599	DRC/CC-ICP-MS	2.59	0.72	0.44	4.91	3.42
604	DRC/CC-ICP-MS	2.90	0.606	0.472	5.26	3.52
605	ICP-MS	2.90	0.734	0.458	5.38	3.72
606	DRC/CC-ICP-MS	2.80	0.633	0.422	5.22	3.64
607	ICP-MS	2.83	1.20	0.472	5.02	3.70
630	ICP-MS	2.83	1.11	0.452	5.09	3.6
632	DRC/CC-ICP-MS	2.82	0.680	0.453	5.29	3.64
676	ICP-MS	2.78	0.92	0.467	4.99	3.58
686	ICP-MS	2.97	0.793	0.472	5.31	3.75

Based on the grading criteria for Cd in Urine, 100% of results were satisfactory, with 0 of the 21 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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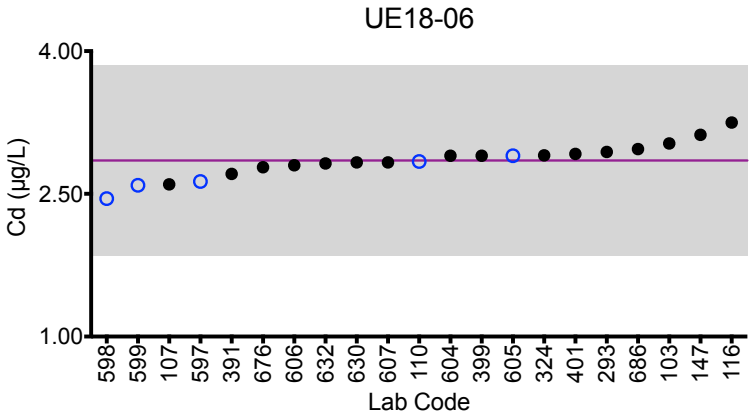
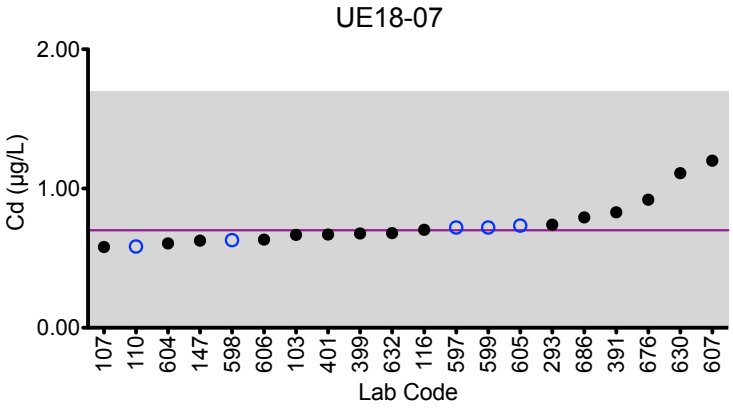
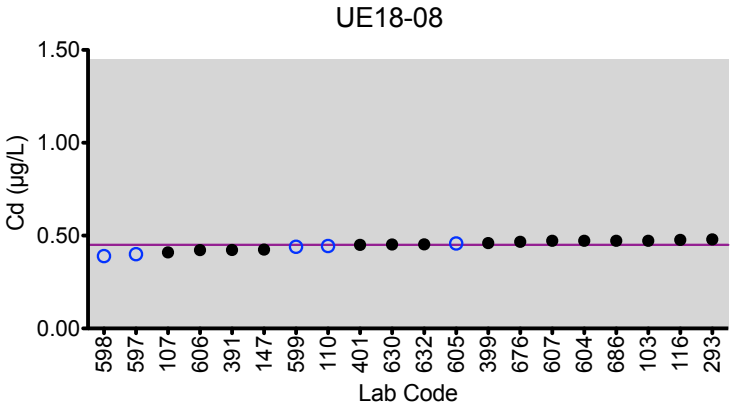
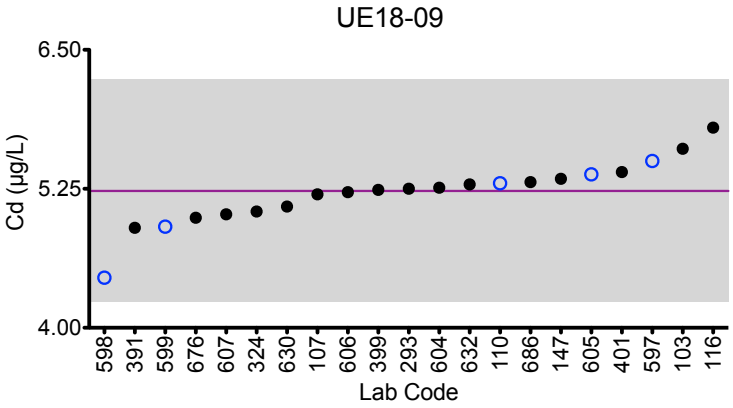
Results for Event #2, 2018: Summary Figures

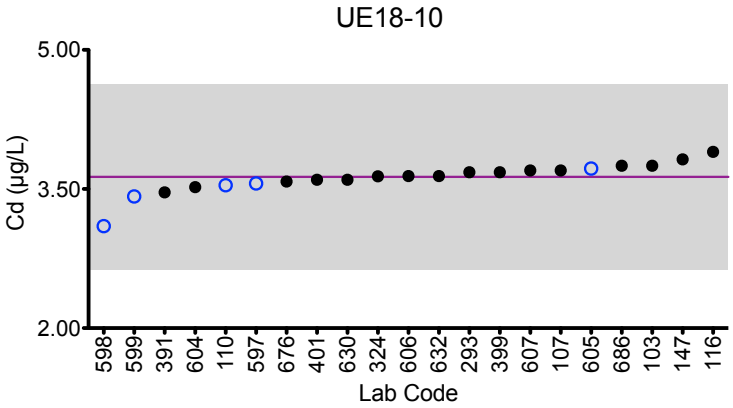
Urine Cd











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 #2, 2018: Summary Statistics

	Urine Co (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	4.3	1.1	3.2	2.5	0.73
Upper Limit	5.8	2.6	4.7	4.0	2.23
Lower Limit	2.8	0.0	1.7	1.0	0.00
Robust SD (s*)	0.2	0.1	0.2	0.1	0.06
Robust RSD (%)	4.7	9.1	6.3	4.0	8.2
Number of Sample Measurements (N)	16	16	16	16	15
Standard Uncertainty (*u*)	0.072	0.026	0.052	0.044	0.019

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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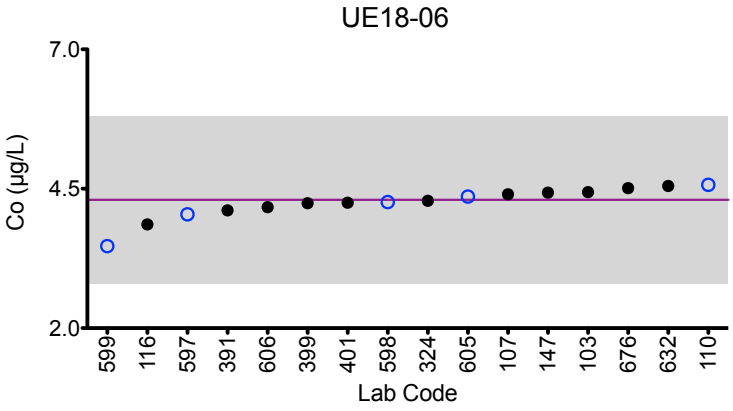
Results for Event #2, 2018:
Performance of Participating Laboratories

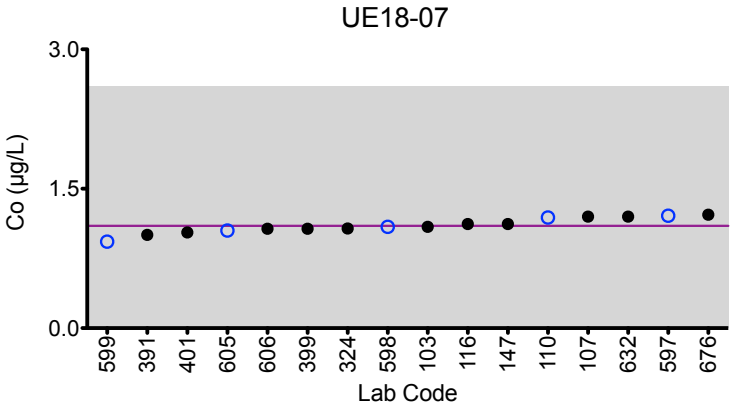
Urine Co (µg/L)						
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**4.3**	**1.1**	**3.2**	**2.5**	**0.73**
103	DRC/CC-ICP-MS	4.44	1.09	3.37	2.56	0.745
107	ICP-MS	4.4	1.2	3.4	2.7	0.75
110	ICP-MS	4.57	1.19	3.31	2.70	0.775
116	ICP-MS/MS	3.86	1.12	2.72	2.25	0.816
147	ICP-MS	4.43	1.12	3.28	2.47	0.742
324	ICP-MS	4.284	1.072	3.144	2.414	<1
391	DRC/CC-ICP-MS	4.112	1.004	2.998	2.4	0.658
399	DRC/CC-ICP-MS	4.24	1.07	3.23	2.49	0.723
401	DRC/CC-ICP-MS	4.25	1.03	3.13	2.35	0.68
597	DRC/CC-ICP-MS	4.04	1.21	3.17	2.44	0.73
598	ICP-MS	4.26	1.09	3.31	2.51	0.74
599	DRC/CC-ICP-MS	3.47	0.93	2.90	2.11	0.63
605	ICP-MS	4.36	1.05	3.24	2.46	0.701
606	DRC/CC-ICP-MS	4.17	1.07	3.20	2.52	0.669
632	ICP-MS	4.55	1.20	3.53	2.77	0.809
676	ICP-MS	4.51	1.22	3.56	2.69	0.789

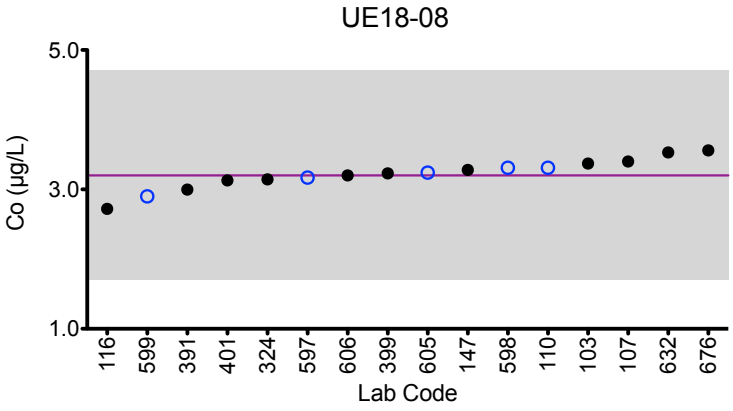
Based on the grading criteria for Co in Urine, 100% of results were satisfactory, with 0 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

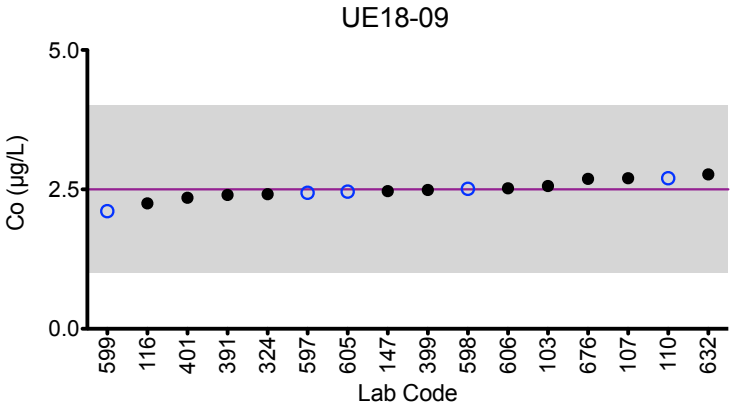
Results for Event #2, 2018: Summary Figures

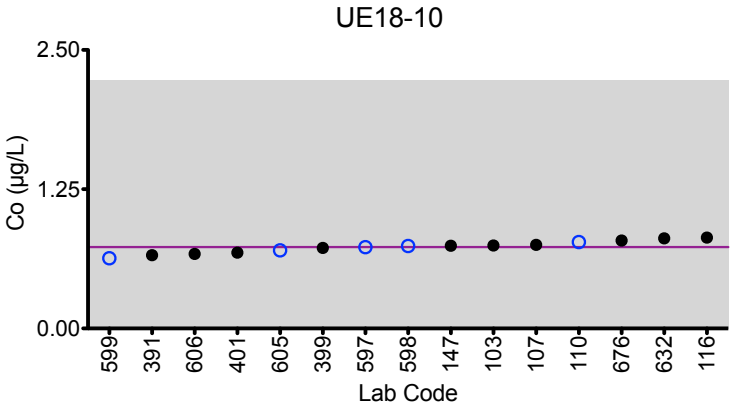
Urine Co











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 #2, 2018: Summary Statistics

	Urine Cr (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	0.49	11.1	1.8	3.2	6.6
Upper Limit	3.49	14.1	4.8	6.2	9.6
Lower Limit	0.00	8.1	0.0	0.2	3.6
Robust SD (s*)	0.09	0.7	0.2	0.2	0.3
Robust RSD (%)	18.4	6.3	11.1	6.3	4.5
Number of Sample Measurements (N)	10	12	12	12	12
Standard Uncertainty (*u*)	0.035	0.257	0.079	0.054	0.093

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

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Results for Event #2, 2018:
Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**0.49**	**11.1**	**1.8**	**3.2**	**6.6**
103	DRC/CC-ICP-MS	<1.00	11.5	1.83	3.40	6.67
107	DRC/CC-ICP-MS	0.49	11	1.6	3.2	5.8
110	DRC/CC-ICP-MS	0.52	11.6	1.92	3.47	6.82
116	ICP-MS/MS	0.47	10.94	1.60	3.06	6.22
147	DRC/CC-ICP-MS	0.490	11.1	1.64	3.09	6.45
324	ICP-MS	<1	11.699	1.935	3.347	6.764
391	DRC/CC-ICP-MS	0.322	10.033	1.544	3.223	6.862
401	DRC/CC-ICP-MS	0.45	11.1	1.97	3.18	6.72
597	DRC/CC-ICP-MS	0.58	12.1	1.869	3.23	6.78
598	DRC/CC-ICP-MS	0.32	9.76	1.48	2.54	5.50
599	DRC/CC-ICP-MS	0.71	10.5	2.01	3.24	6.41
632	DRC/CC-ICP-MS	0.555	11.5	2.00	3.30	6.87

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

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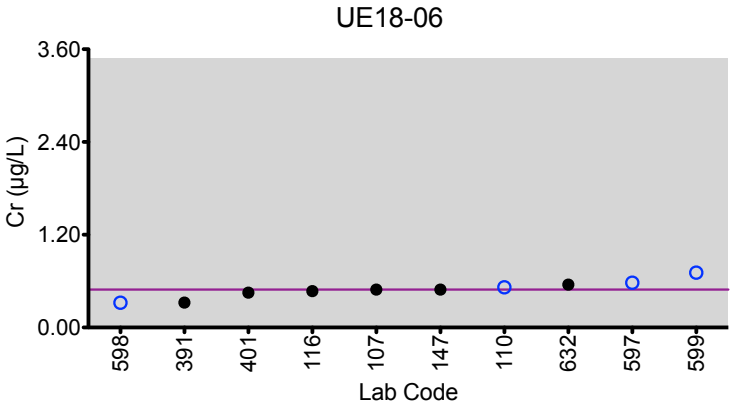
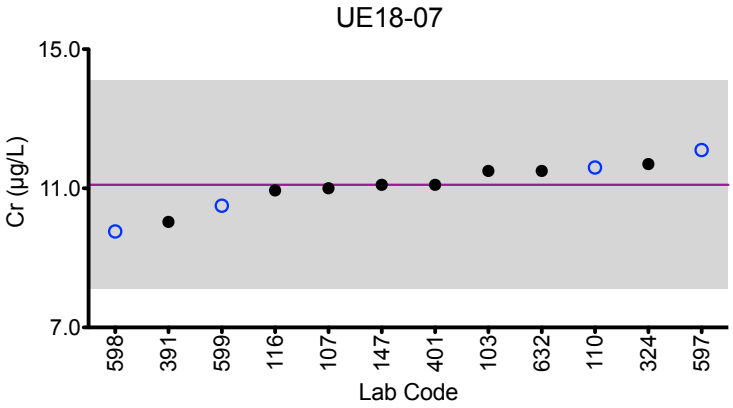
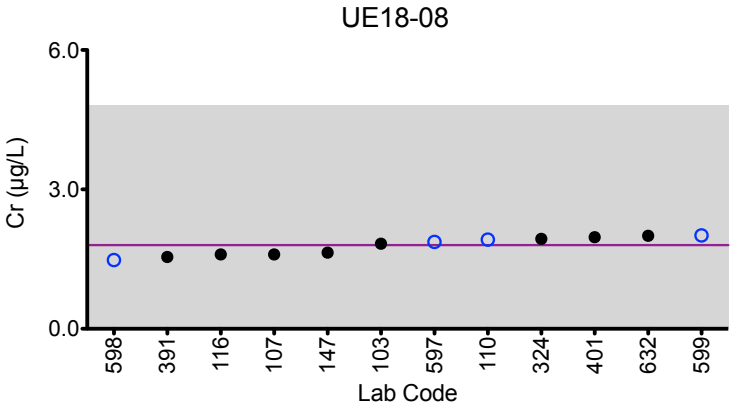
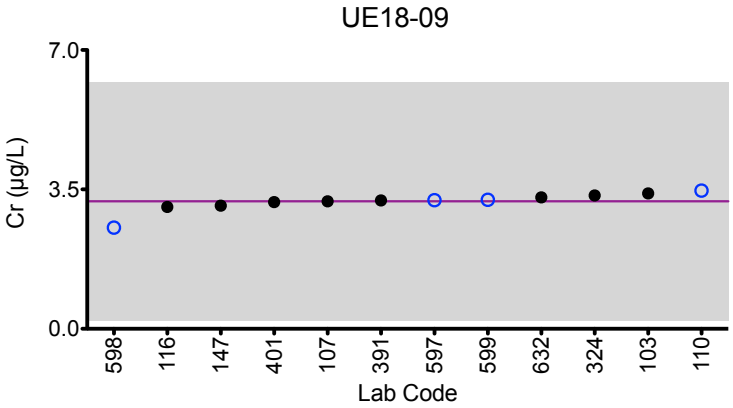
Results for Event #2, 2018: Summary Figures

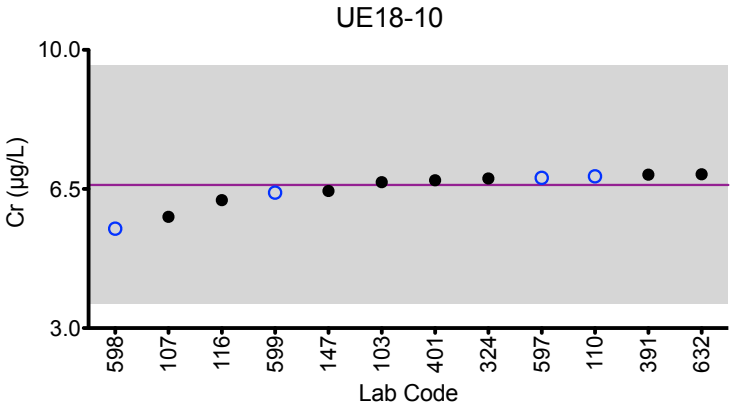
Urine Cr











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 #2, 2018: Summary Statistics

	Urine Hg (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	10.4	23.1	7.9	60.9	3.5
Upper Limit	13.5	30.0	10.9	79.2	6.5
Lower Limit	7.3	16.2	4.9	42.6	0.5
Robust SD (s*)	1.9	1.7	0.7	5.2	0.4
Robust RSD (%)	18.3	7.4	8.9	8.5	11.4
Number of Sample Measurements (N)	17	17	17	16	17
Standard Uncertainty (*u*)	0.563	0.527	0.224	1.61	0.108

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 #2, 2018:
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**10.4**	**23.1**	**7.9**	**60.9**	**3.5**
103	DRC/CC-ICP-MS	9.76	23.7	7.84	64.5	3.57
107	DRC/CC-ICP-MS	13	18	8.9	65	3
110	ICP-MS	11.6	23.2	8.55	61.2	3.49
147	CV-AAS	11.3	23.9	8.16	62.3	3.55
293	DRC/CC-ICP-MS	11.84	23.72	8.75	60.84	3.91
391	DRC/CC-ICP-MS	8.977	23.706	6.475	56.984	3.318
401	DRC/CC-ICP-MS	8.48	27.1	7.58	64.0	3.85
589	CV-AAS	7.055 ↓	9.85 ↓	6.0175	20.905 ↓	5.05
597	DMA	10.86	23.50	8.13	60.49	3.43
598	ICP-MS	9.14	20.14	7.09	52.82	3.30
599	DRC/CC-ICP-MS	6.83 ↓	20.3	7.05	52.9	3.12
604	DRC/CC-ICP-MS	12.3	21.2	8.27	60.5	3.09
605	ICP-MS	12.1	24.1	8.28	67.6	3.70
606	DRC/CC-ICP-MS	11.5	24.5	8.75	>50	3.93
632	DRC/CC-ICP-MS	9.52	21.6	7.97	59.4	3.51
676	ICP-MS	9.11	27.8	7.64	69.1	3.6
684	DRC/CC-ICP-MS	11.4	23.3	7.51	62.6	2.83

Based on the grading criteria for Hg in Urine, 95% 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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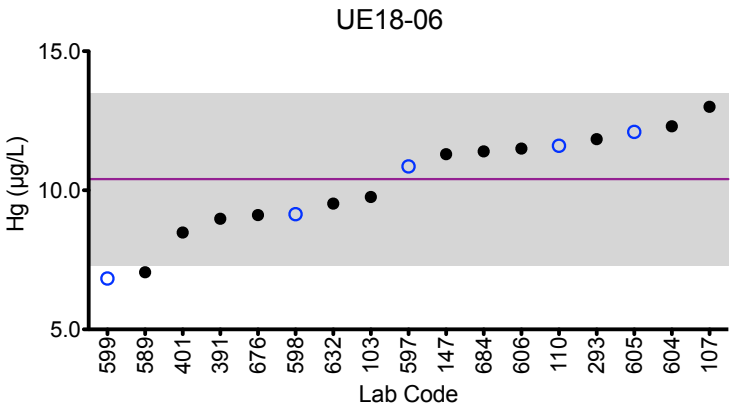
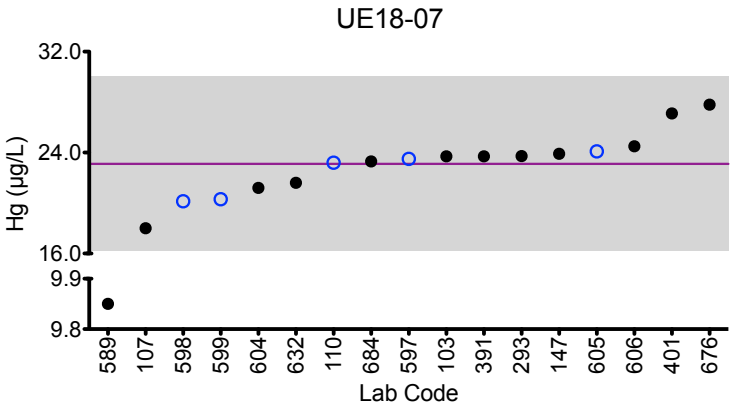
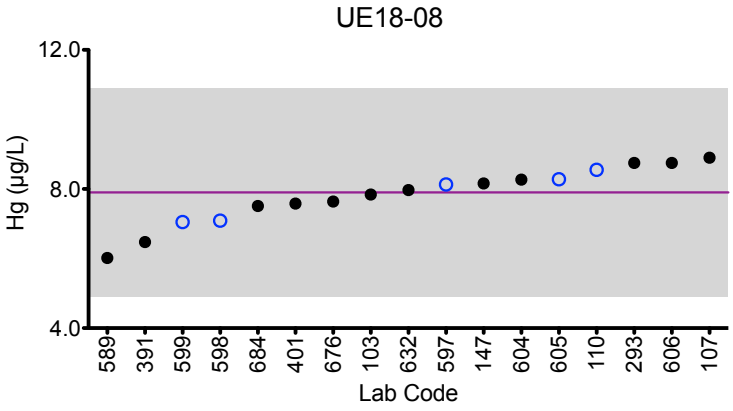
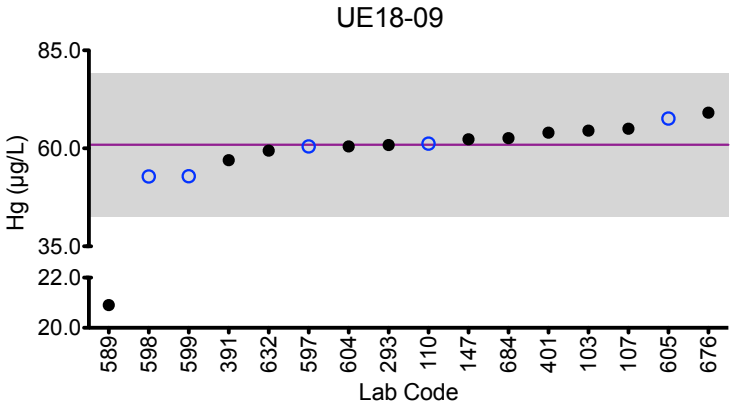
Results for Event #2, 2018: Summary Figures

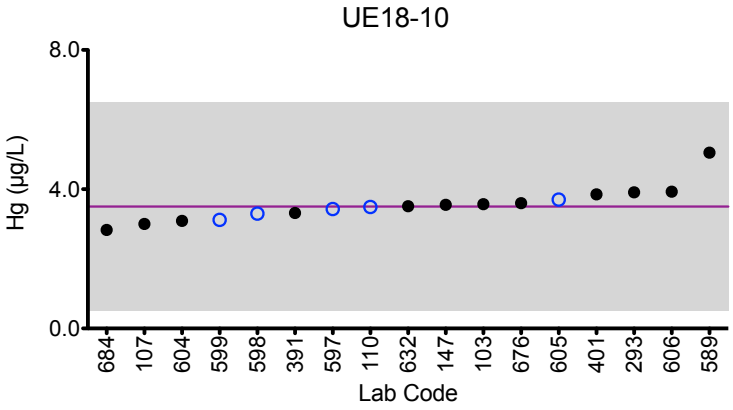
Urine Hg











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 #2, 2018: Summary Statistics

	Urine Mn (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	3.4	5.4	7.5	2.4	0.80
Upper Limit	4.3	6.8	9.4	3.0	1.35
Lower Limit	2.5	4.0	5.6	1.8	0.25
Robust SD (s*)	0.2	0.3	0.4	0.2	0.17
Robust RSD (%)	5.9	5.6	5.3	8.3	21.3
Number of Sample Measurements (N)	16	16	16	16	15
Standard Uncertainty (*u*)	0.052	0.085	0.127	0.057	0.055

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 #2, 2018:
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**3.4**	**5.4**	**7.5**	**2.4**	**0.80**
103	DRC/CC-ICP-MS	3.54	5.55	7.88	2.51	0.795
107	DRC/CC-ICP-MS	3.3	5.1	6.8	2.4	0.73
110	DRC/CC-ICP-MS	3.39	5.37	7.51	2.31	0.589
116	ICP-MS/MS	3.00	4.81	6.71	2.13	0.662
147	DRC/CC-ICP-MS	3.39	5.42	7.31	2.31	0.665
324	ICP-MS	3.535	5.431	7.512	2.517	<1
391	DRC/CC-ICP-MS	3.506	5.336	7.116	3.477 ↑	1
399	DRC/CC-ICP-MS	3.37	5.35	7.53	2.39	0.751
597	DRC/CC-ICP-MS	3.28	6.54	7.64	2.67	0.97
598	ICP-MS	3.43	5.32	7.77	2.59	0.94
604	DRC/CC-ICP-MS	3.24	5.01	7.03	2.25	0.699
605	ICP-MS	3.35	5.18	7.27	2.32	0.701
606	DRC/CC-ICP-MS	3.16	5.20	7.51	2.34	0.581
630	DRC/CC-ICP-MS	3.41	5.41	7.45	2.44	0.907
632	DRC/CC-ICP-MS	3.60	5.81	8.48	2.74	0.944
676	DRC/CC-ICP-MS	3.99	6.07	8.75	2.63	1.01

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

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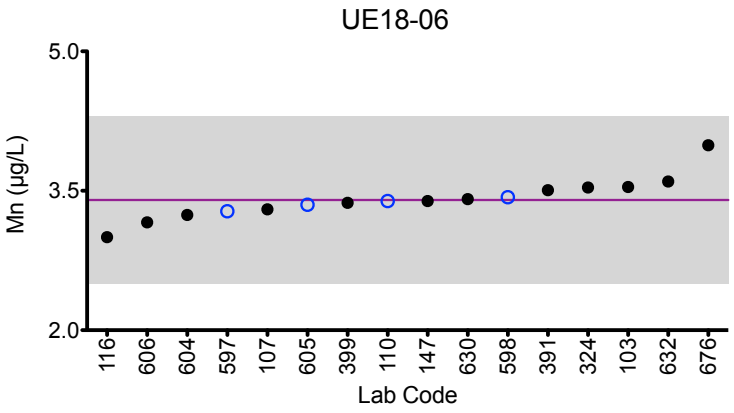
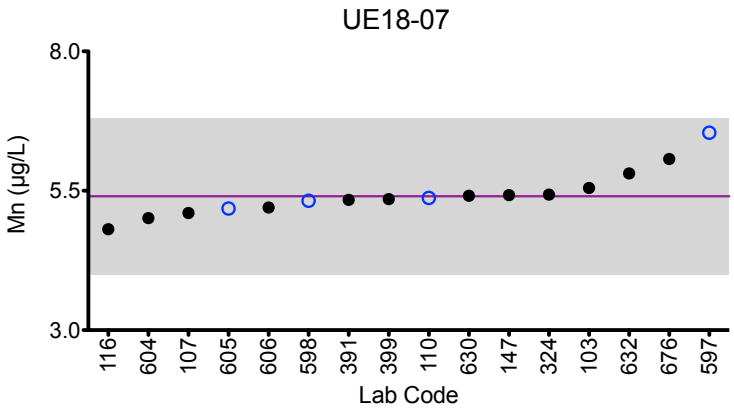
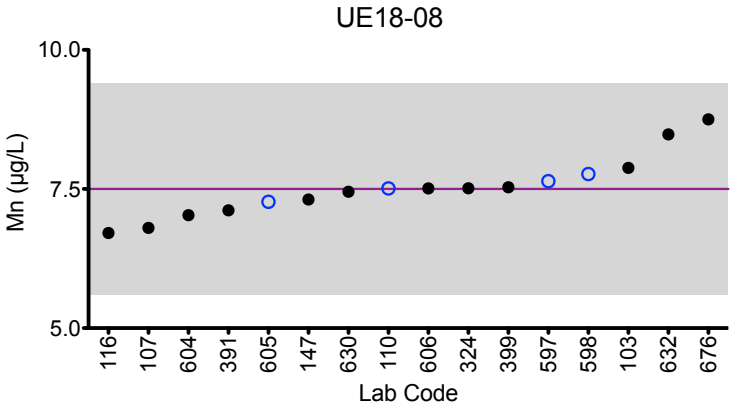
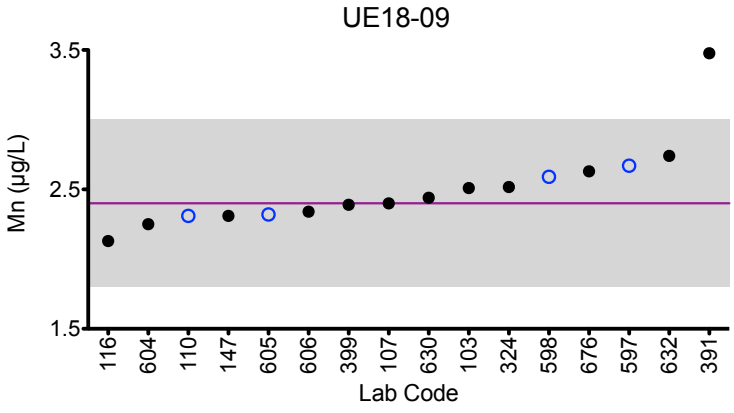
Results for Event #2, 2018: Summary Figures

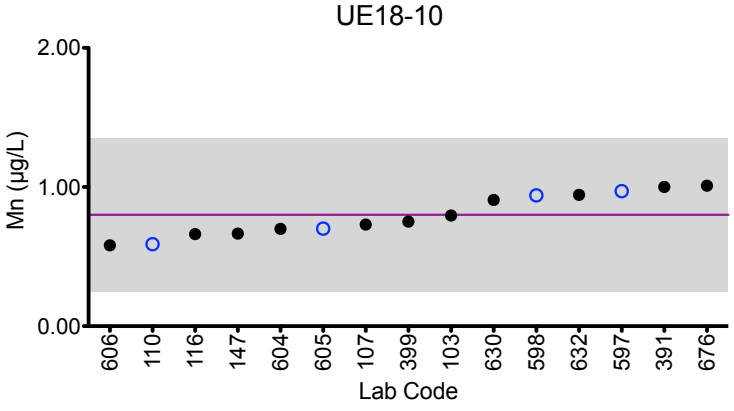
Urine Mn











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 #2, 2018: Summary Statistics

	Urine Pb (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	10.7	1.5	2.2	7.9	13.5
Upper Limit	12.8	2.5	3.2	9.5	16.2
Lower Limit	8.6	0.5	1.2	6.3	10.8
Robust SD (s*)	0.5	0.1	0.1	0.3	0.7
Robust RSD (%)	4.7	6.7	4.5	3.8	5.2
Number of Sample Measurements (N)	18	18	18	18	18
Standard Uncertainty (*u*)	0.136	0.018	0.029	0.090	0.192

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 #2, 2018:
Performance of Participating Laboratories

		Urine Pb (µg/L)				
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**10.7**	**1.5**	**2.2**	**7.9**	**13.5**
103	DRC/CC-ICP-MS	11.2	1.50	2.36	8.25	14.4
107	ICP-MS	11	1.5	2.1	8	14
110	ICP-MS	10.9	1.48	2.27	8.11	13.6
116	ICP-MS/MS	10.97	1.45	2.24	8.03	13.37
147	ICP-MS	10.8	1.34	2.07	7.65	13.6
293	DRC/CC-ICP-MS	10.5	1.47	2.19	7.73	13.17
324	ICP-MS	10.846	1.559	2.307	8.138	13.376
391	DRC/CC-ICP-MS	9.78	1.34	1.991	7.236	12.213
399	ICP-MS	11.1	1.46	2.28	8.03	13.9
597	DRC/CC-ICP-MS	9.38	1.6	2.14	7.55	12.77
598	ICP-MS	10.2	1.36	2.14	7.43	12.5
599	DRC/CC-ICP-MS	9.34	1.44	2.19	7.48	12.6
605	ICP-MS	11.2	1.48	2.28	8.16	13.9
606	ICP-MS	10.4	1.37	2.08	7.71	13.2
607	ICP-MS	11.3	1.56	2.30	8.34	14.2
632	ICP-MS	10.4	1.44	2.25	7.82	13.3
676	ICP-MS	10.99	1.45	2.34	8.09	14.1
686	ICP-MS	11.0	1.50	2.30	8.06	13.7

Based on the grading criteria for Pb in Urine, 100% of results were satisfactory, with 0 of the 18 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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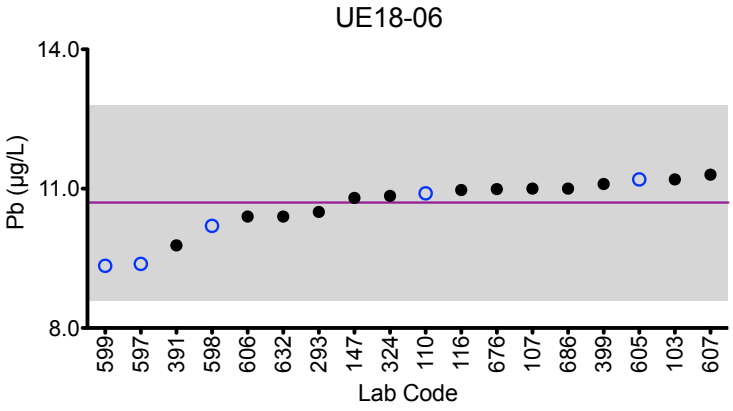
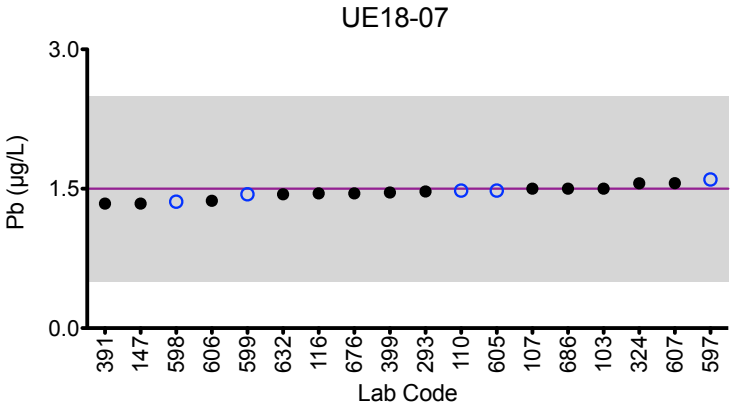
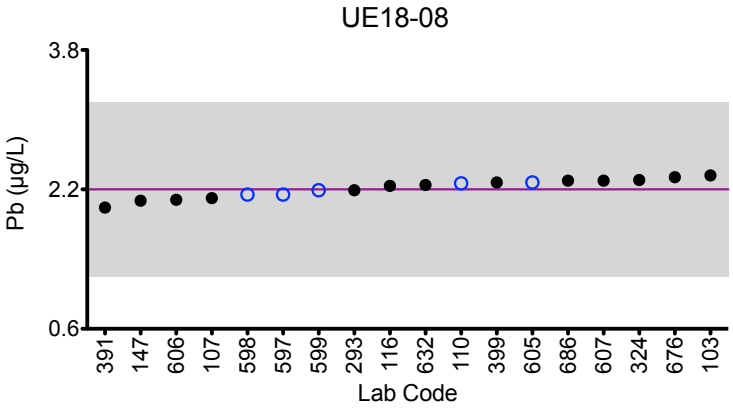
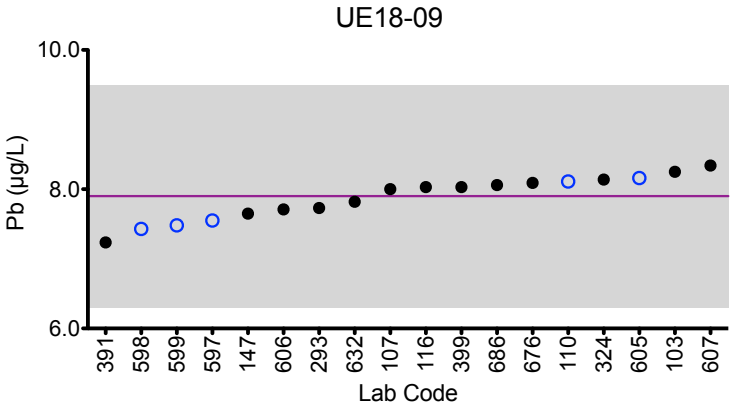
Results for Event #2, 2018: Summary Figures

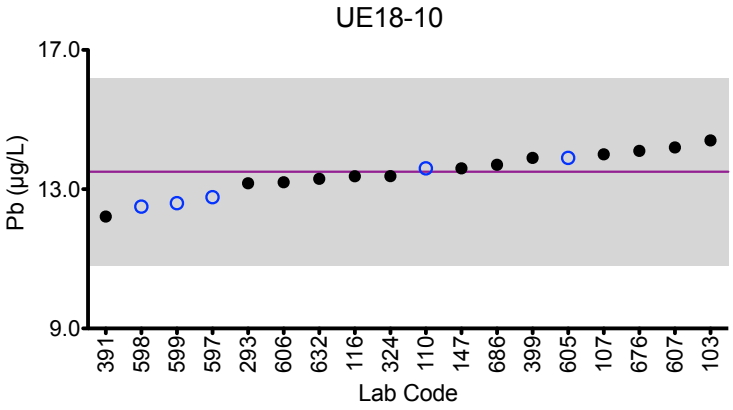
Urine Pb











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 #2, 2018: Summary Statistics

	Urine Tl (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	2.12	0.89	4.02	0.47	1.07
Upper Limit	2.54	1.09	4.82	0.67	1.28
Lower Limit	1.70	0.69	3.22	0.27	0.86
Robust SD (s*)	0.07	0.01	0.14	0.02	0.05
Robust RSD (%)	3.3	1.1	3.5	4.3	4.7
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (*u*)	0.023	0.0046	0.044	0.0059	0.016

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

Results for Event #2, 2018:
Performance of Participating Laboratories

Urine Tl (µg/L)						
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**2.12**	**0.89**	**4.02**	**0.47**	**1.07**
103	DRC/CC-ICP-MS	2.17	0.891	4.15	0.487	1.12
107	ICP-MS	2	0.89	4.1	0.48	1
110	ICP-MS	2.12	0.887	4.03	0.462	1.07
116	ICP-MS/MS	2.11	0.86	3.96	0.45	1.05
147	ICP-MS	2.13	0.887	3.92	0.446	1.08
293	DRC/CC-ICP-MS	2.15	0.9	4.11	0.47	1.1
399	DRC/CC-ICP-MS	2.10	0.903	4.03	0.471	1.08
597	DRC/CC-ICP-MS	1.83	0.92	3.586	0.48	1.03
598	ICP-MS	1.98	0.82	3.77	0.44	0.97
605	ICP-MS	2.20	0.896	4.03	0.465	1.08
606	ICP-MS	2.04	0.818	3.84	0.425	1.02
607	ICP-MS	2.13	0.895	4.00	0.481	1.09
632	ICP-MS	2.28	0.966	4.45	0.524	1.19
676	ICP-MS	2.2	0.958	4.27	0.509	1.26
686	ICP-MS	2.16	0.902	4.04	0.478	1.08

Based on the grading criteria for Tl 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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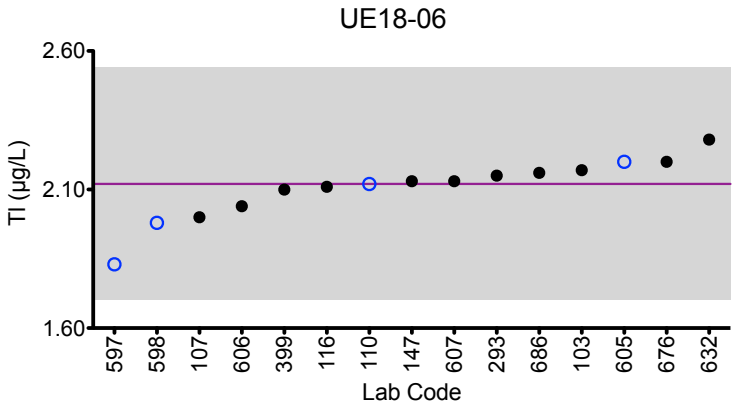
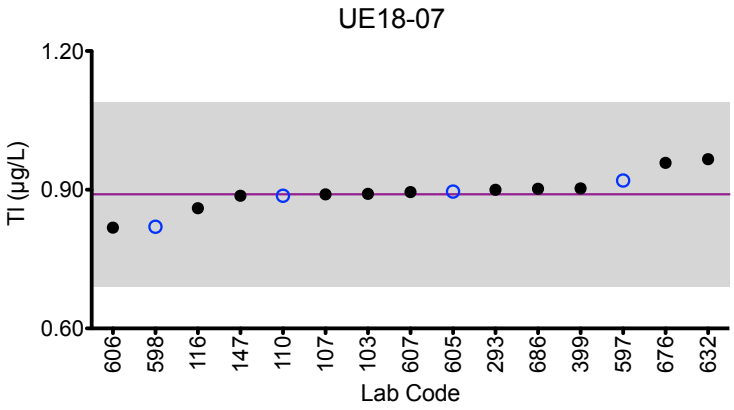
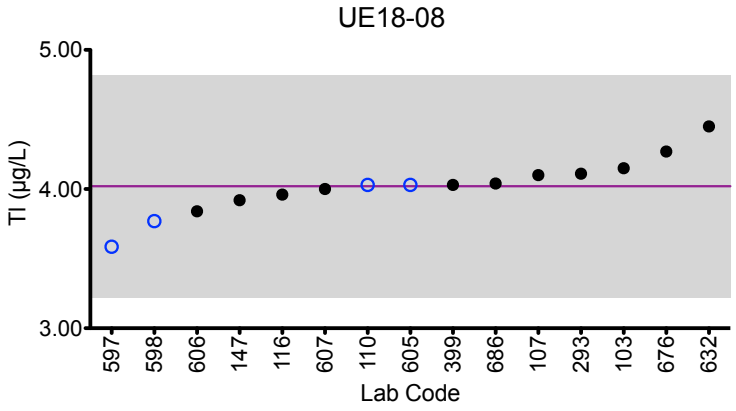
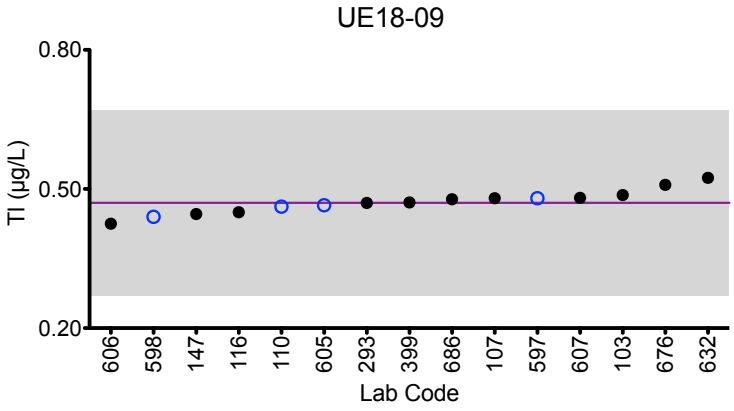
Results for Event #2, 2018: Summary Figures

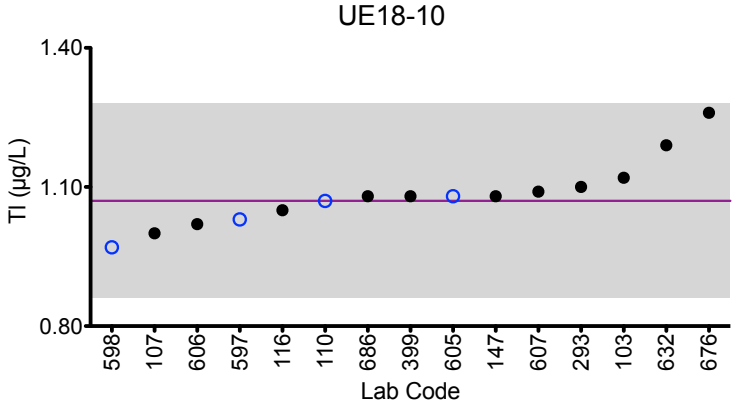
Urine Tl











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 #2, 2018: Summary Statistics

	Urine U (µg/L)				
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Target (Robust Mean (x*))	0.010	0.055	0.138	0.025	0.042
Upper Limit	0.040	0.085	0.168	0.055	0.072
Lower Limit	0.000	0.025	0.108	0.000	0.012
Robust SD (s*)	0.001	0.004	0.003	0.003	0.002
Robust RSD (%)	10.0	7.3	2.2	12.0	4.8
Number of Sample Measurements (N)	12	18	18	18	18
Standard Uncertainty (*u*)	0.00050	0.0013	0.0010	0.00082	0.00067

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 #2, 2018:
Performance of Participating Laboratories

Urine U (µg/L)						
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
	Target	**0.010**	**0.055**	**0.138**	**0.025**	**0.042**
103	DRC/CC-ICP-MS	< 0.0200	0.0548	0.138	0.0216	0.0408
107	ICP-MS	0.0097	0.06	0.16	0.028	0.045
110	ICP-MS	0.0102	0.0543	0.139	0.0264	0.0434
116	ICP-MS/MS	<0.015	0.0543	0.141	0.0262	0.0426
147	ICP-MS	< 0.0164	0.0488	0.116	0.0193	0.0329
324	ICP-MS	0.009	0.053	0.140	0.024	0.042
399	ICP-MS	0.009	0.058	0.140	0.020	0.045
598	ICP-MS	0.02	0.07	0.13	0.03	0.04
599	DRC/CC-ICP-MS	0.02	0.06	0.13	0.03	0.04
604	ICP-MS	< 0.009	0.050	0.127	0.021	0.037
605	ICP-MS	0.009	0.055	0.141	0.025	0.042
606	ICP-MS	0.006	0.048	0.136	0.023	0.040
607	ICP-MS	0.010	0.058	0.140	0.025	0.043
630	ICP-MS	0.0101	0.0524	0.137	0.0250	0.0401
632	ICP-MS	<0.015	0.0557	0.140	0.0254	0.0432
676	ICP-MS	0.008	0.05	0.133	0.023	0.042
684	ICP-MS	0.0100	0.0564	0.145	0.0256	0.0439
686	ICP-MS	< 0.015	0.0547	0.139	0.0246	0.0419

Based on the grading criteria for U in Urine, 100% of results were satisfactory, with 0 of the 18 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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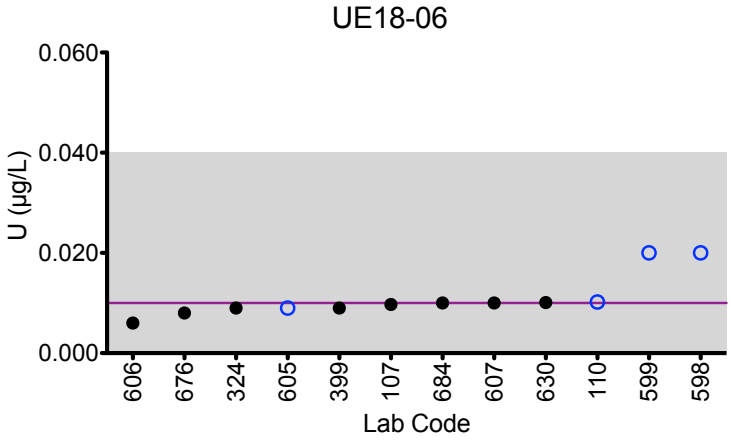
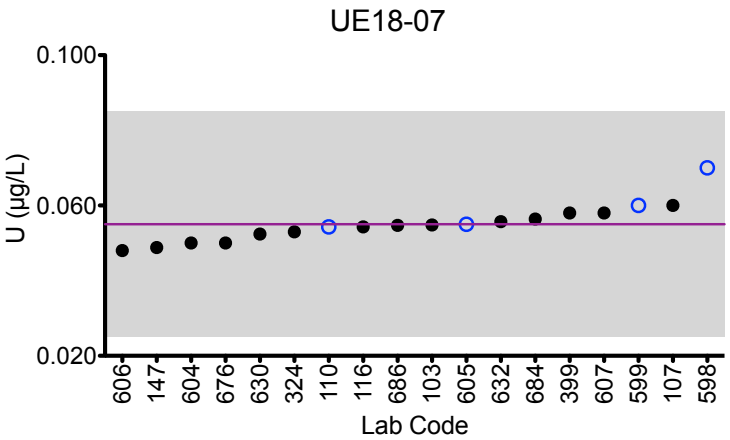
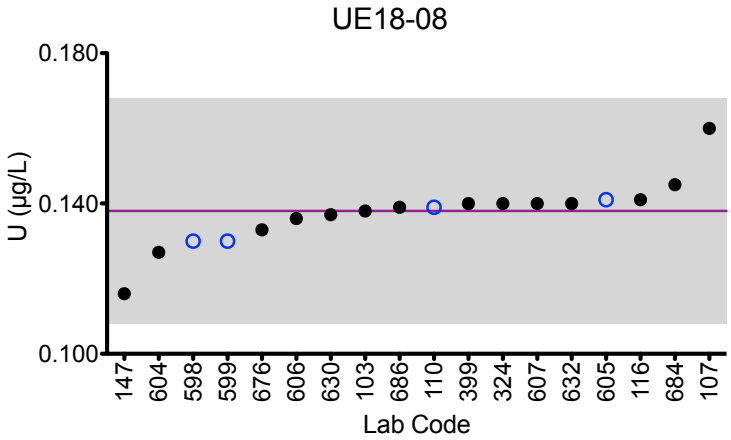
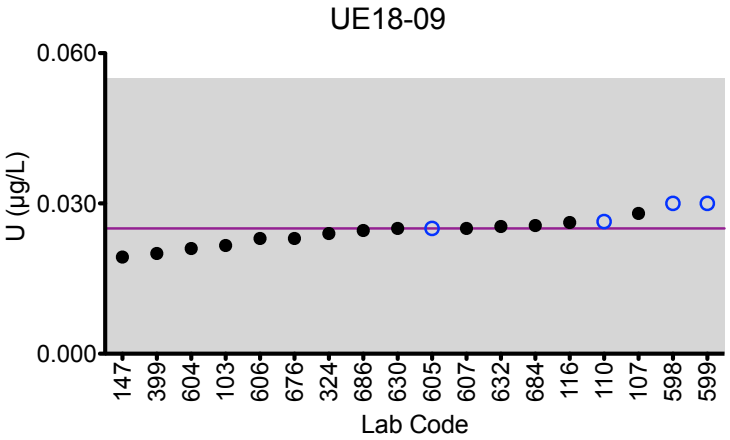
Results for Event #2, 2018: Summary Figures

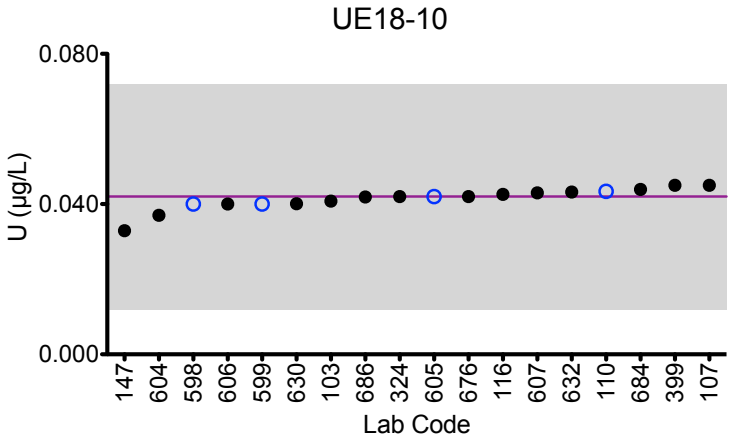
Urine U











Legend:
o CHEAR Labs ● Other Labs
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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
107	ICP-MS	5	7.8	2.7	4.8	8.9
110	ICP-MS	5.61	8.26	3.07	5.12	9.95
147	ICP-MS	4.97	7.58	2.71	4.51	8.85
399	ICP-MS	5.41	7.93	2.99	4.83	9.54
597	DRC/CC-ICP-MS	5.24	8.50	2.94	4.91	9.60
598	ICP-MS	5.86	7.95	3.19	4.95	9.67
599	DRC/CC-ICP-MS	5.13	7.89	3.01	4.76	9.28
605	ICP-MS	5.68	7.96	3.06	4.95	9.66
606	DRC/CC-ICP-MS	5.27	7.76	2.95	4.62	9.53
632	ICP-MS	5.63	8.16	3.20	5.16	10.0
676	ICP-MS	5.52	8.39	3.09	5.05	9.76

Summary Statistics

	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
Robust Mean (x*)	5.4	8.0	3.0	4.9	9.6
Robust SD (s*)	0.3	0.3	0.1	0.2	0.3
Robust RSD (%)	5.6	3.8	3.3	4.1	3.1
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.125	0.110	0.046	0.079	0.109

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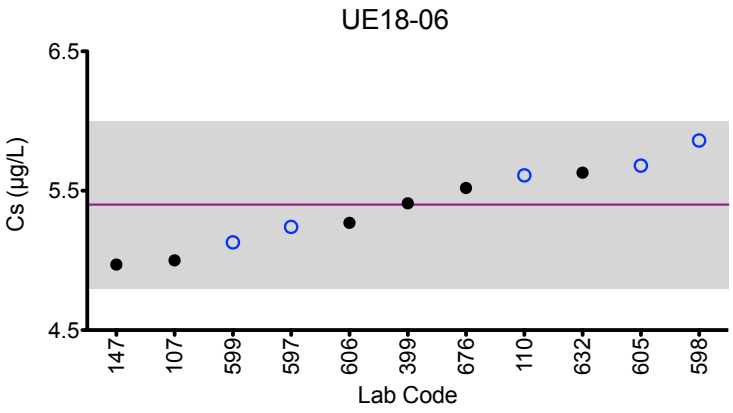
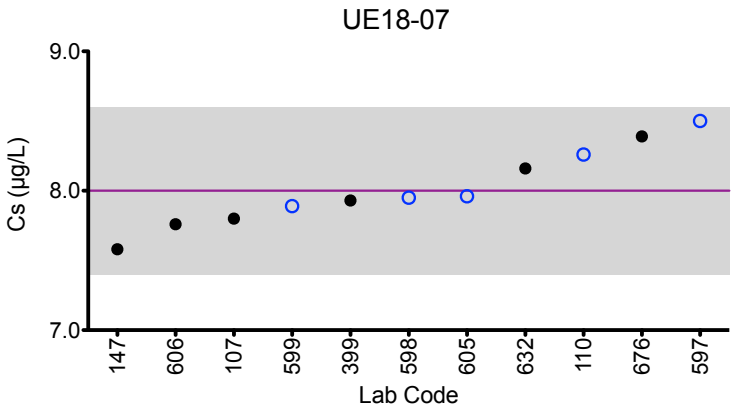
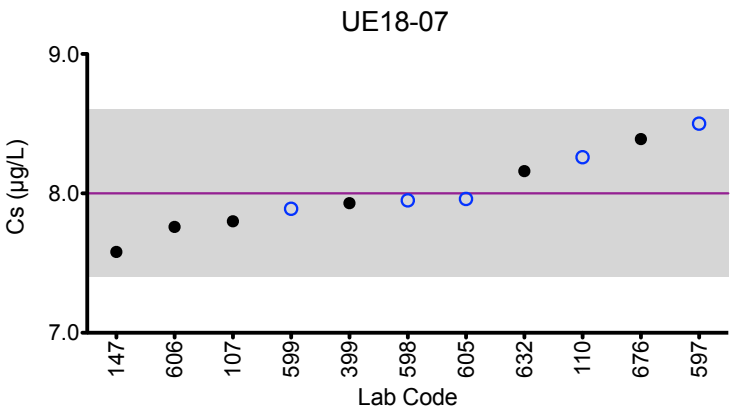
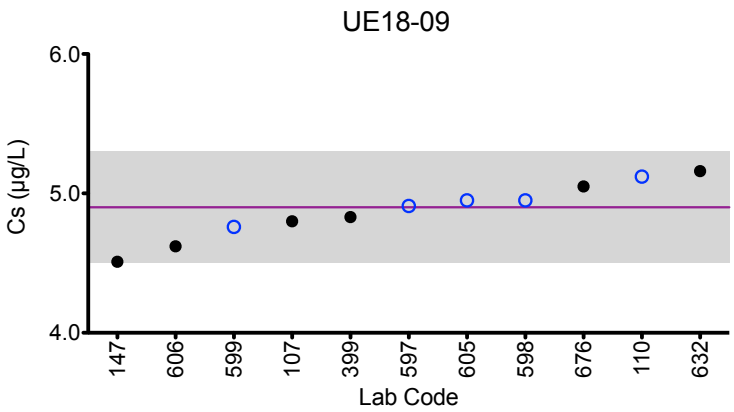
Results for Event #2, 2018: Summary Figures

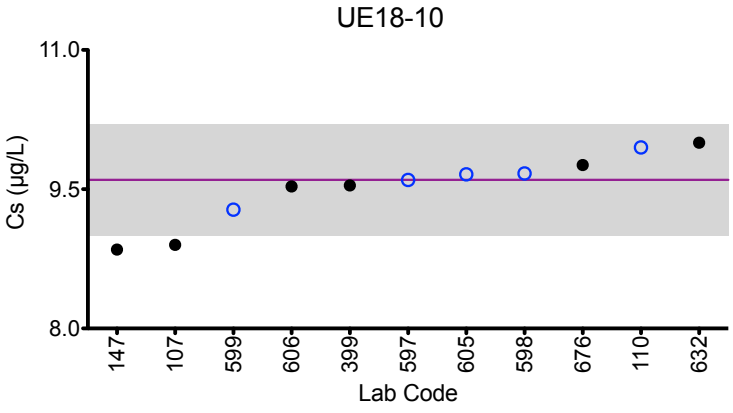
Urine Cs











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)						
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
110	ICP-MS	106	39.3	89.8	67.8	26.9
116	ICP-MS/MS	98.1	35.5	83.8	63.8	24.0
147	ICP-MS	111	40.8	91.5	69.3	29.7
293	DRC/CC-ICP-MS	111.25	36.24	87.09	66.12	24.79
324	ICP-MS	102.719	37.740	88.902	66.862	26.521
391	DRC/CC-ICP-MS	111.1	36.171	97.382	100.388	26.297
401	DRC/CC-ICP-MS	101	35.0	84.5	61.6	23.5
597	DRC/CC-ICP-MS	97.4	41.8	86.2	67.5	26.5
598	ICP-MS	95.3	34.2	83.0	62.7	24.9
599	DRC/CC-ICP-MS	86.7	36.3	81.3	61.2	26.6

Summary Statistics					
	UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Robust Mean (x*)	102	36.9	86.9	65.9	25.9
Robust SD (s*)	8	2.1	4.4	3.9	1.5
Robust RSD (%)	7.8	5.7	5.1	5.9	5.8
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	3.33	0.850	1.75	1.56	0.591

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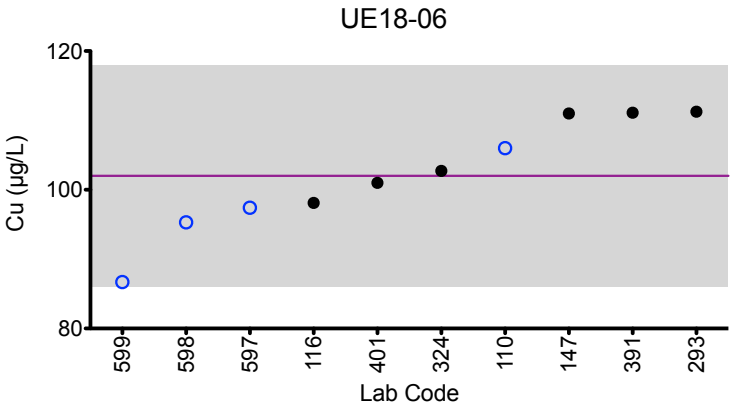
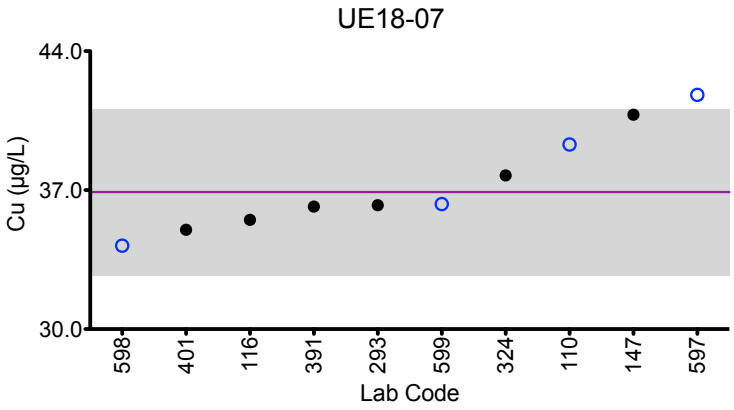
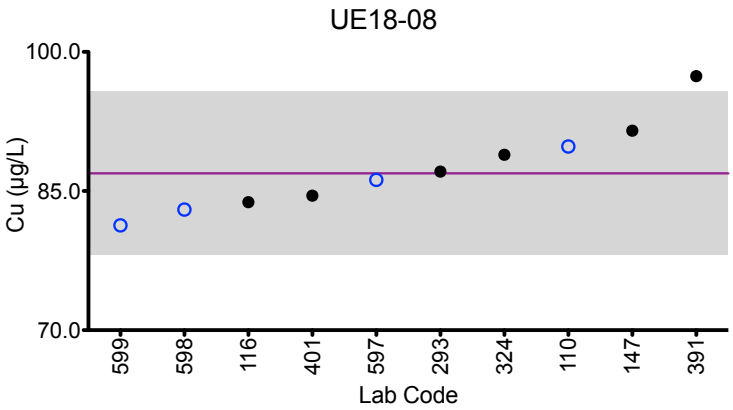
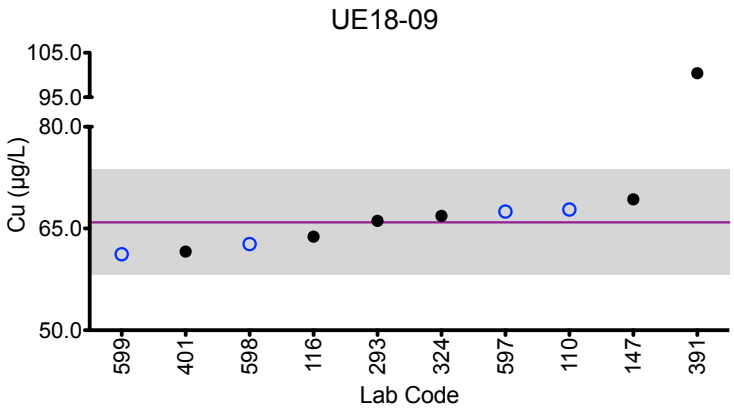
Results for Event #2, 2018: Summary Figures

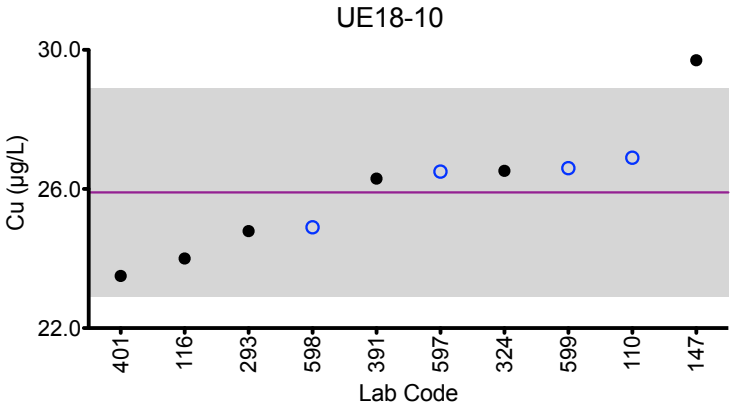
Urine Cu











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

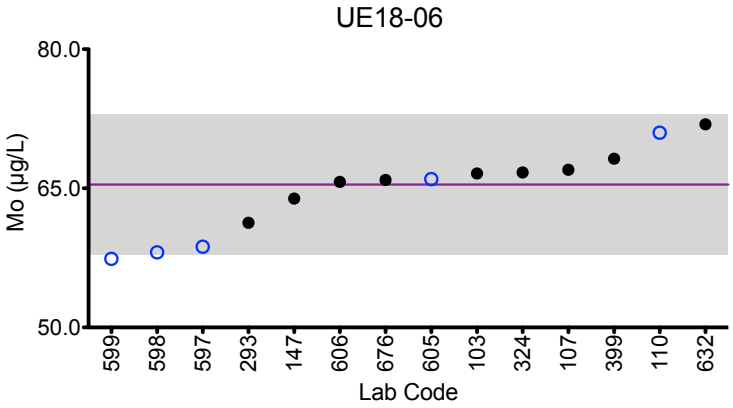
Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
103	DRC/CC-ICP-MS	66.6	257	17.1	85.5	173
107	ICP-MS	67	260	17	87	180
110	ICP-MS	71.0	277	18.3	91.8	183
147	ICP-MS	63.9	253	16.4	82.5	165
293	DRC/CC-ICP-MS	61.29	248.96	18.07	81.87	169.22
324	ICP-MS	66.709	260.840	17.453	86.806	173.046
399	ICP-MS	68.2	265	17.3	87.9	177
597	DRC/CC-ICP-MS	58.7	270	15.6	84.0	167
598	DRC/CC-ICP-MS	58.1	241.9	15.4	76.5	157.3
599	DRC/CC-ICP-MS	57.4	235	16.1	78.8	161
605	ICP-MS	66.0	255	16.3	83.9	168
606	DRC/CC-ICP-MS	65.7	259	15.5	85.0	173
632	DRC/CC-ICP-MS	71.9	279	18.6	92.5	187
676	ICP-MS	65.9	258	17.4	86.4	175

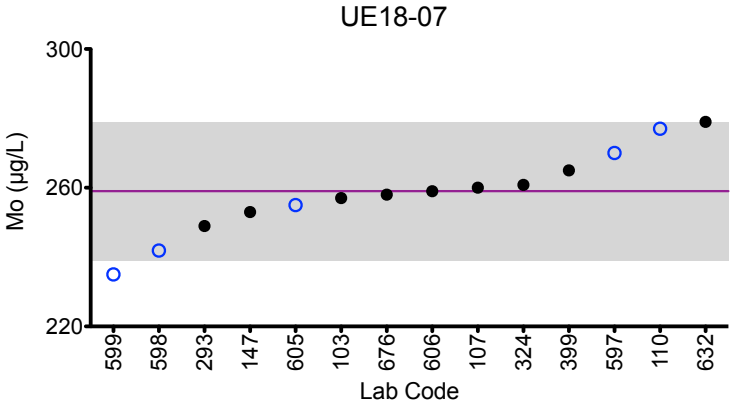
Summary Statistics

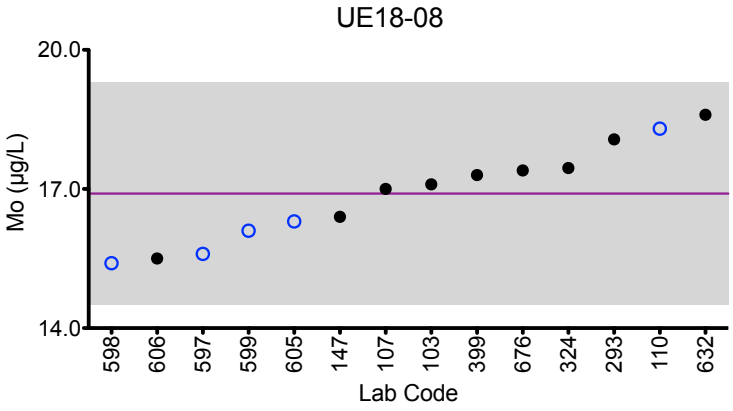
	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
Robust Mean (x*)	65.4	259	16.9	85.1	172
Robust SD (s*)	3.8	10	1.2	3.6	9
Robust RSD (%)	5.8	3.9	7.1	4.2	5.2
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	1.26	3.37	0.395	1.21	2.85

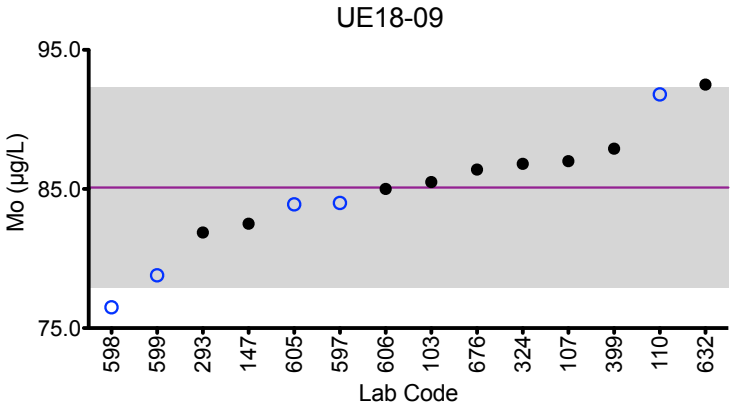
Results for Event #2, 2018: Summary Figures

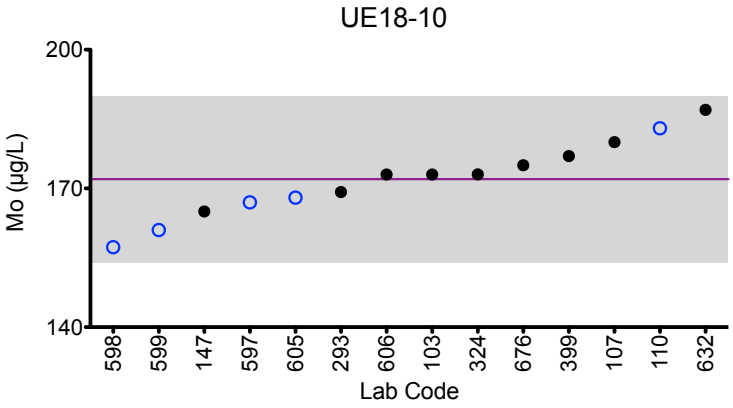
Urine Mo











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
107	DRC/CC-ICP-MS	2.2	5.8	7.8	3.2	6.5
110	ICP-MS	2.30	5.80	8.15	3.25	6.97
293	DRC/CC-ICP-MS	2.3	5.45	8.13	2.97	6.91
324	ICP-MS	2.305	5.788	8.093	3.191	6.898
401	DRC/CC-ICP-MS	2.00	5.22	7.92	2.52	6.57
597	DRC/CC-ICP-MS	2.10	6.13	7.85	3.06	6.89
598	ICP-MS	1.89	4.90	7.71	2.85	6.1
599	DRC/CC-ICP-MS	1.88	5.18	7.80	2.74	6.38
605	ICP-MS	2.14	5.68	8.67	3.04	7.19

Summary Statistics

	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
Arithmetic Mean ($\bar{x}$)	2.1	5.5	8.0	3.0	6.7
Arithmetic SD (s)	0.2	0.4	0.3	0.2	0.3
Arithmetic RSD (%)	9.5	7.3	3.8	6.7	4.5
Number of Sample Measurements (N)	9	9	9	9	9

*Denotes a statistical Outlier.

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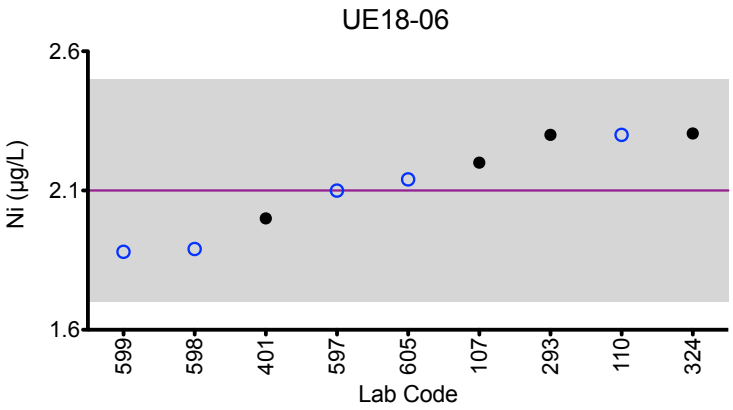
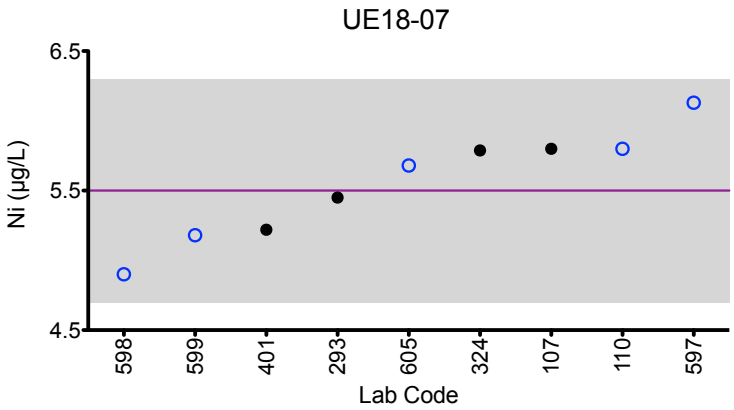
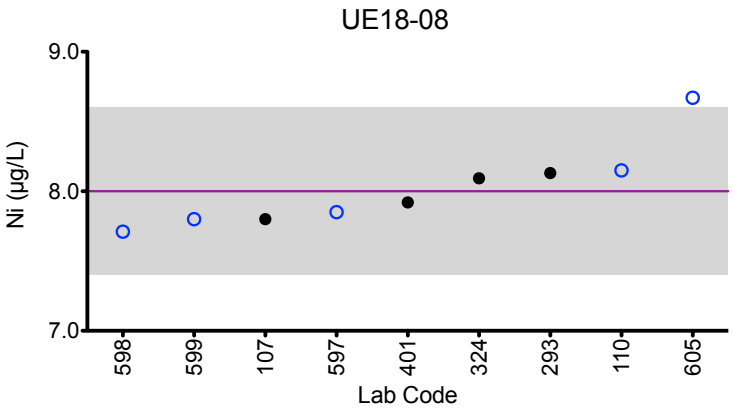
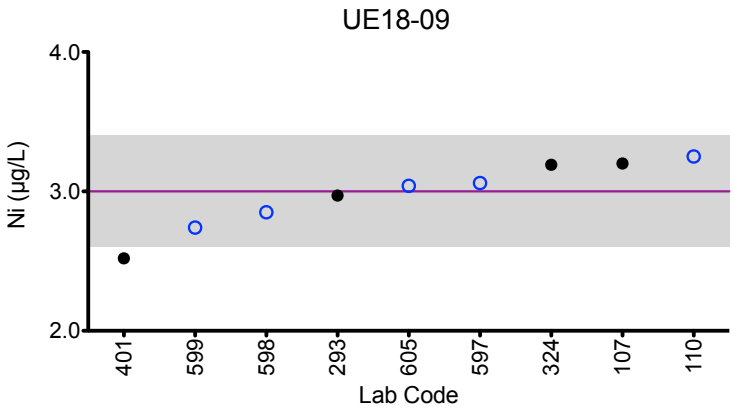
Results for Event #2, 2018: Summary Figures

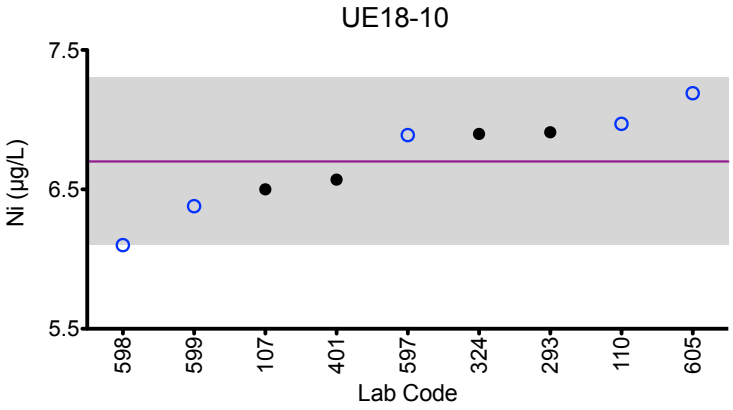
Urine Ni











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
107	ICP-MS	2.3	0.77	4	1.1	0.23
110	ICP-MS	2.53	0.758	3.97	1.03	0.198
147	ICP-MS	2.4	0.712	3.84	1.02	0.167
399	ICP-MS	2.48	0.744	3.94	1.02	0.196
598	ICP-MS	2.57	0.81	4.12	1.07	0.26
605	ICP-MS	2.59	0.769	3.97	1.10	0.196
632	ICP-MS	2.37	0.713	3.80	0.998	0.195
676	ICP-MS	2.5	0.842	4.08	1.11	0.255

Summary Statistics

	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
Arithmetic Mean ($\bar{x}$)	2.47	0.76	3.96	1.06	0.21
Arithmetic SD (s)	0.10	0.04	0.11	0.04	0.03
Arithmetic RSD (%)	4.0	5.3	2.8	3.8	14.3
Number of Sample Measurements (N)	8	8	8	8	8

*Denotes a statistical Outlier.

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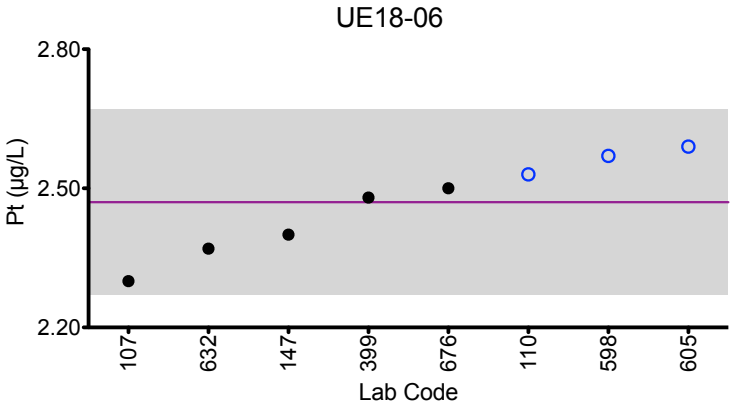
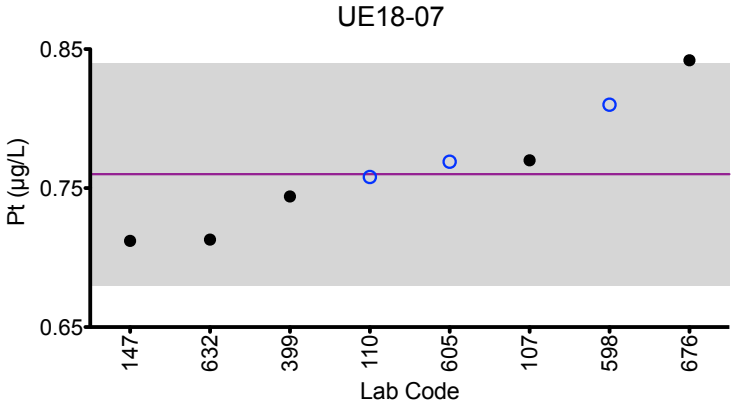
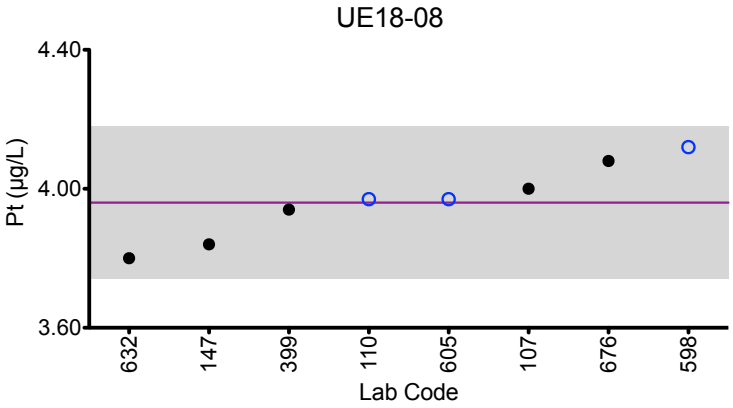
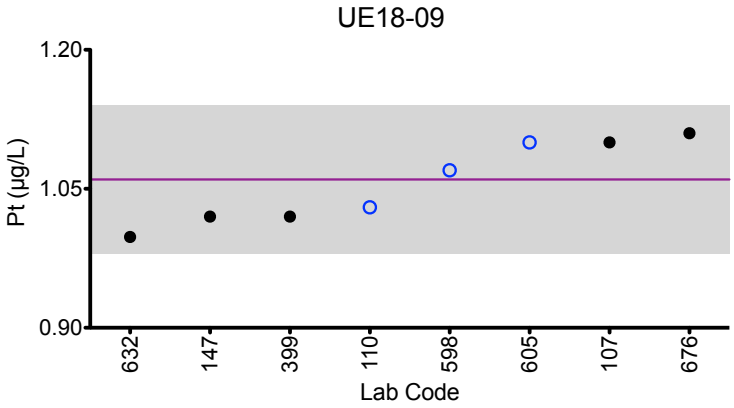
Results for Event #2, 2018: Summary Figures

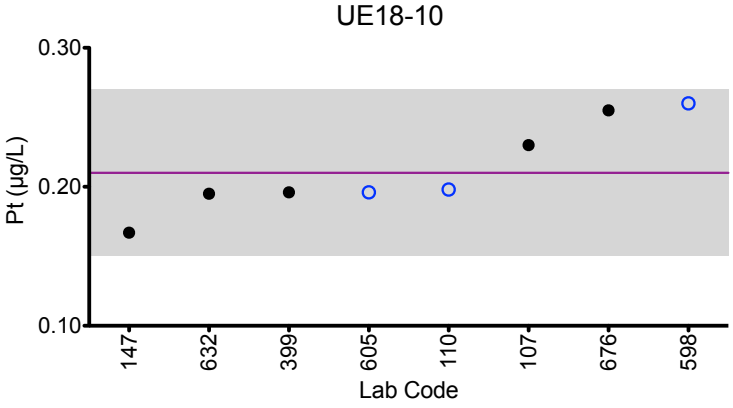
Urine Pt











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

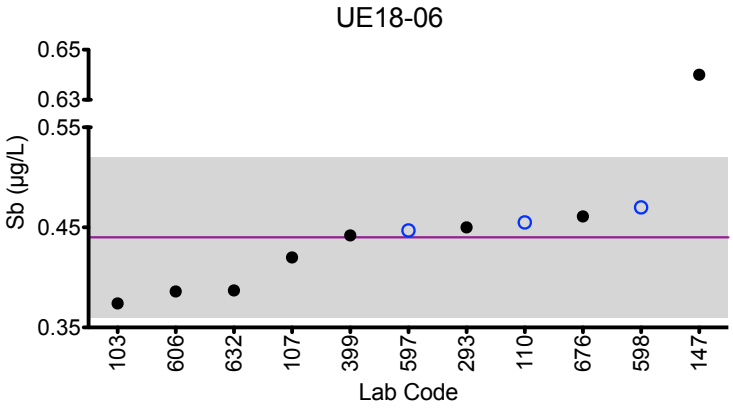
Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
103	DRC/CC-ICP-MS	0.374	0.694	1.34	2.20	0.181
107	ICP-MS	0.42	0.74	1.2	2.2	0.21
110	ICP-MS	0.455	0.795	1.39	2.27	0.221
147	ICP-MS	0.64	0.821	1.42	2.37	0.269
293	DRC/CC-ICP-MS	0.45	0.85	1.43	2.33	0.29
399	ICP-MS	0.442	0.764	1.37	2.27	0.240
597	DRC/CC-ICP-MS	0.447	0.833	1.38	2.36	0.367
598	ICP-MS	0.47	0.83	1.45	2.34	0.23
606	DRC/CC-ICP-MS	0.386	0.723	1.31	2.25	0.170
632	ICP-MS	0.387	0.828	1.46	2.31	<0.24
676	ICP-MS	0.461	0.809	1.47	2.4	0.224

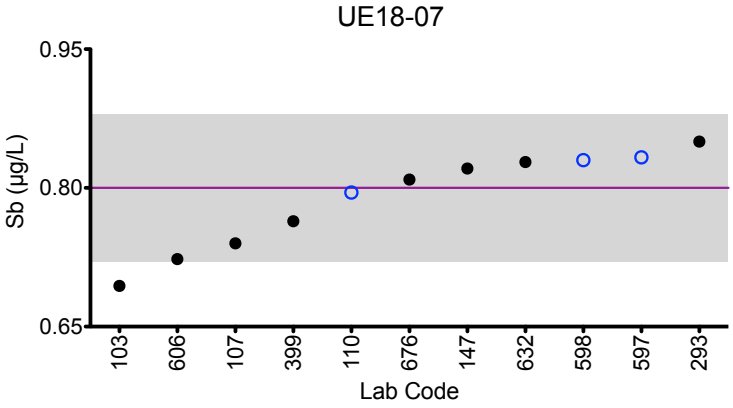
Summary Statistics

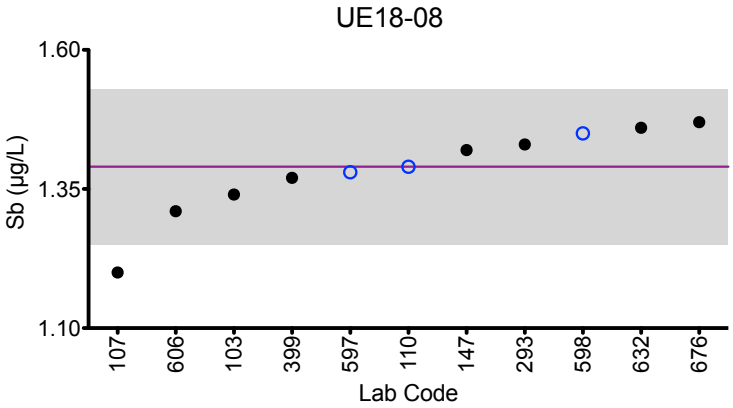
	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
Robust Mean (x*)	0.44	0.80	1.39	2.30	0.23
Robust SD (s*)	0.04	0.04	0.07	0.08	0.05
Robust RSD (%)	9.1	5.0	5.0	3.5	21.7
Number of Sample Measurements (N)	11	11	11	11	10
Standard Uncertainty (*u*)	0.014	0.015	0.026	0.029	0.019

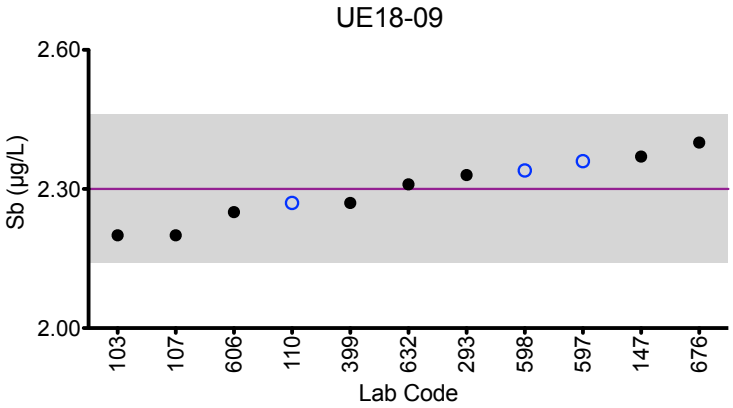
Results for Event #2, 2018: Summary Figures

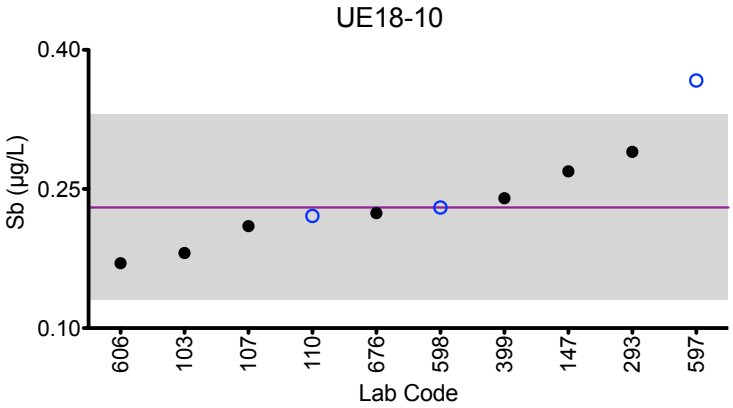
Urine Sb











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine Se (µg/L)						
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
103	DRC/CC-ICP-MS	163	37.2	244	26.4	65.0
110	DRC/CC-ICP-MS	174	50.7	252	39.7	72.8
147	ICP-MS	174	37.1	238	25.6	64.9
597	DRC/CC-ICP-MS	149	38.1	227	25.2	64.0
598	DRC/CC-ICP-MS	132.2	32.0	204.4	19.7	47.9
599	DRC/CC-ICP-MS	130	37.3	205	27.5	60.4
630	ICP-MS	184	46.2	255	36.1	82.4
632	DRC/CC-ICP-MS	158	34.1	225	22.4	56.5
684	DRC/CC-ICP-MS	166	33.8	234	24.5	63.3
Summary Statistics						
		UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Arithmetic Mean ($\bar{x}$)		159	38.5	232	27.5	64.1
Arithmetic SD (s)		19	6.1	18	6.4	9.7
Arithmetic RSD (%)		11.9	15.8	7.8	23	15.1
Number of Sample Measurements (N)		9	9	9	9	9

*Denotes a statistical Outlier.

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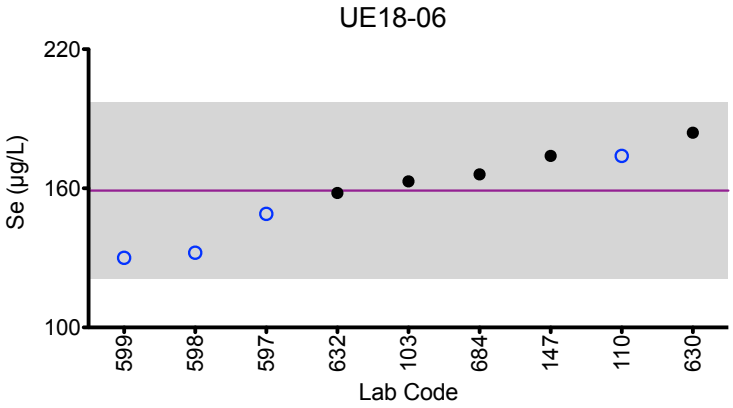
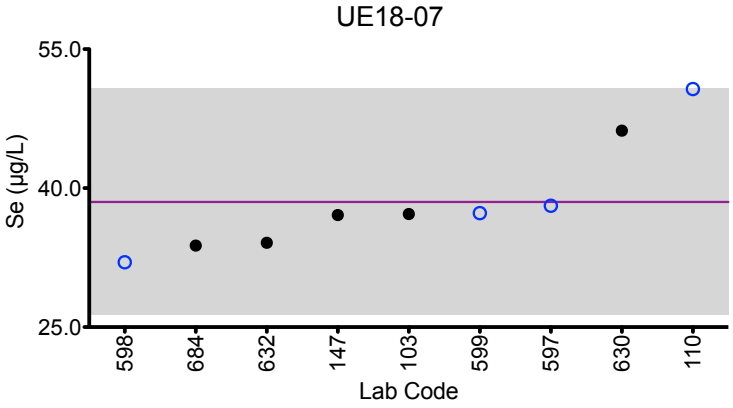
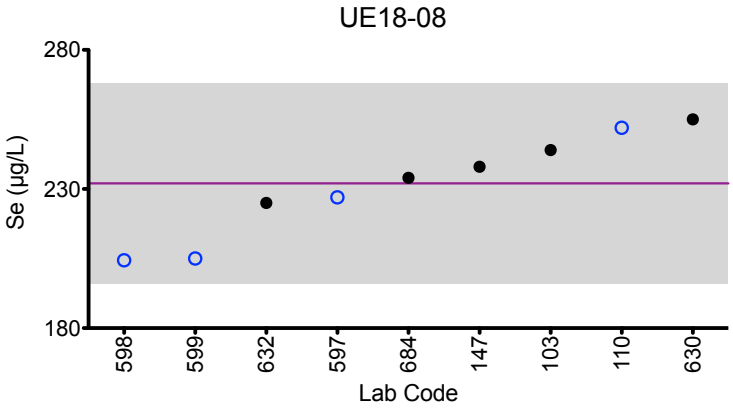
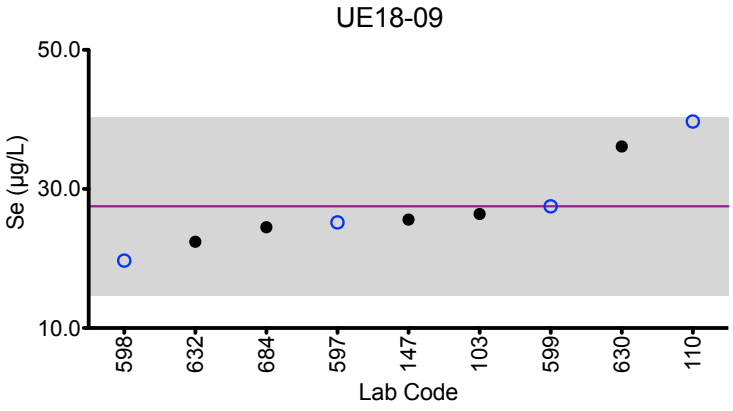
Results for Event #2, 2018: Summary Figures

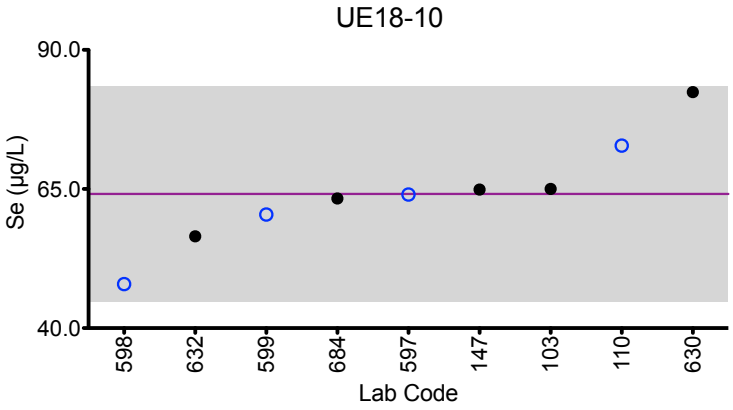
Urine Se











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
107	ICP-MS	0.96	6.4	1.4	3.3	0.95
110	ICP-MS	1.08	6.19	1.33	3.07	0.93
147	ICP-MS	0.789	6.05	1.29	3.04	*1.17
399	ICP-MS	0.724	6.01	1.27	3.00	0.913
597	DRC/CC-ICP-MS	0.654	6.49	1.30	2.95	0.952
598	ICP-MS	0.71	5.75	1.25	2.77	0.91
676	ICP-MS	0.791	6.51	1.36	3.14	0.952

Summary Statistics

	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
Arithmetic Mean ($\bar{x}$)	0.82	6.20	1.31	3.04	0.93
Arithmetic SD (s)	0.15	0.28	0.05	0.16	0.02
Arithmetic RSD (%)	18.3	4.5	3.8	5.3	2.2
Number of Sample Measurements (N)	7	7	7	7	6

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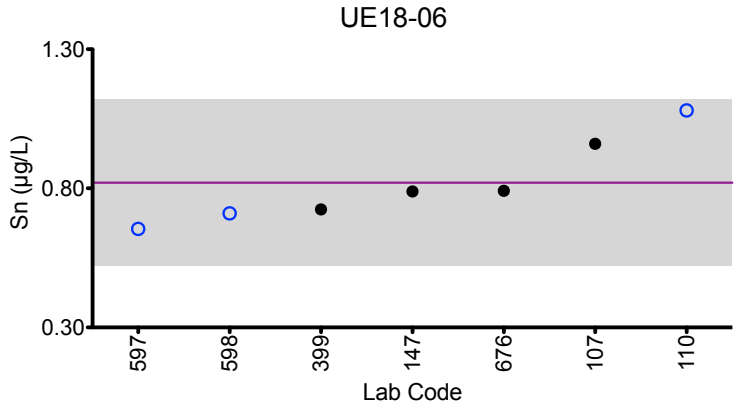
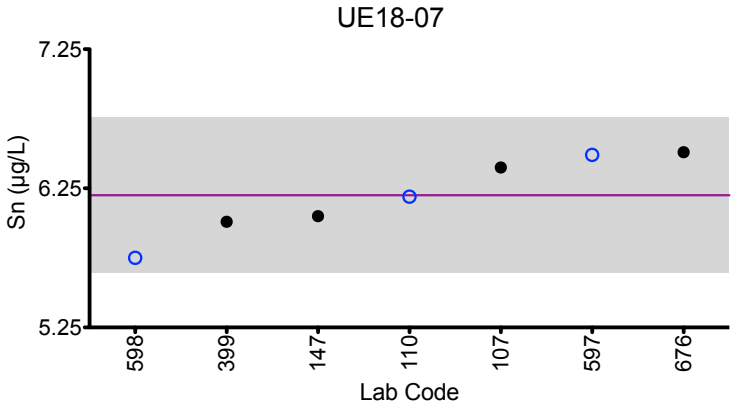
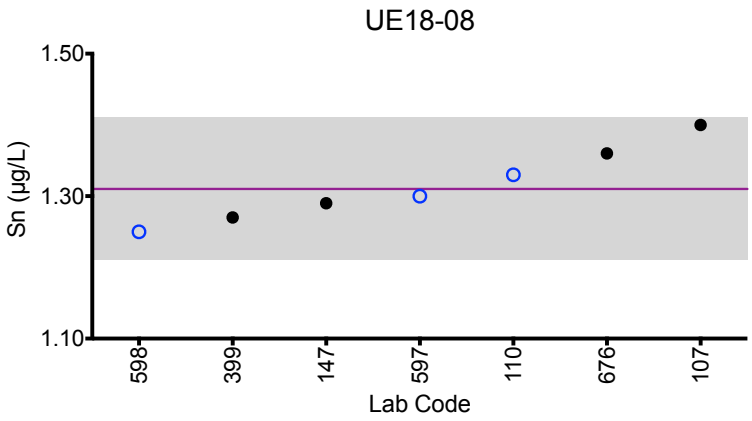
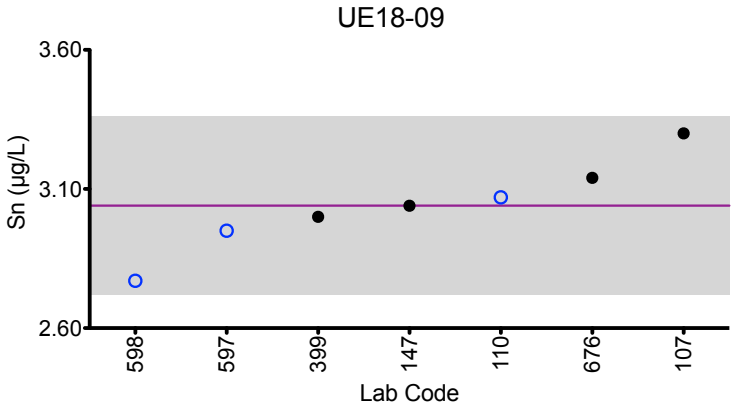
Results for Event #2, 2018: Summary Figures

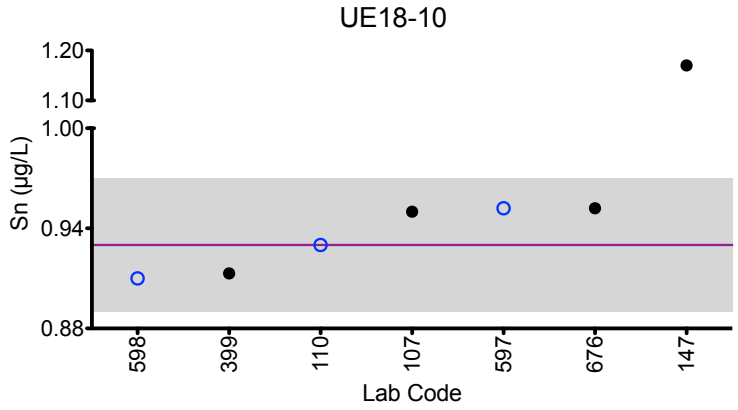
Urine Sn











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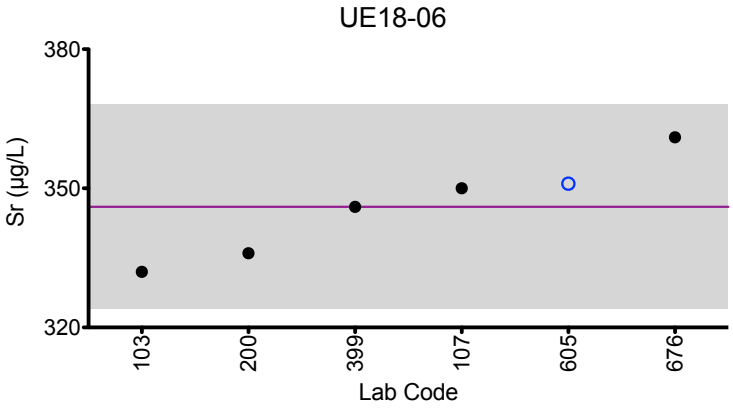
Results for Event #2, 2018:
Laboratory Data and Summary Statistics

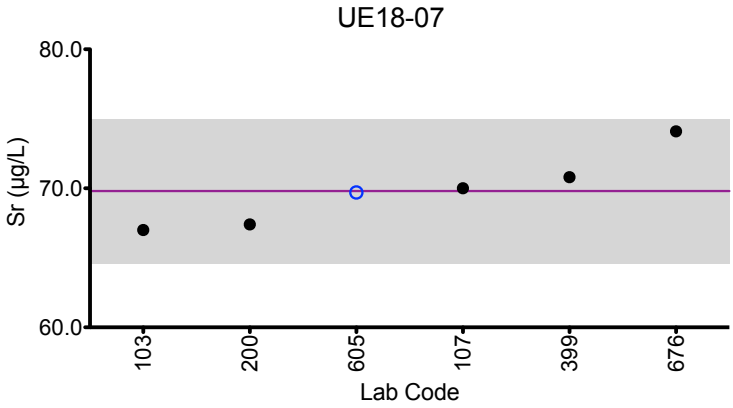
Urine Sr (µg/L)						
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
103	DRC/CC-ICP-MS	332	67.0	19.2	162	414
107	ICP-MS	350	70	21	170	420
200	ICP-MS	336	67.4	19.3	171	407
399	DRC/CC-ICP-MS	346	70.8	20.5	170	433
605	ICP-MS	351	69.7	19.7	166	420
676	ICP-MS	361	74.1	20.9	181	455
Summary Statistics						
		UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Arithmetic Mean ($\bar{x}$)		346	69.8	20.1	170	425
Arithmetic SD (s)		11	2.6	0.8	6	17
Arithmetic RSD (%)		3.2	3.7	4.0	3.5	4.0
Number of Sample Measurements (N)		6	6	6	6	6

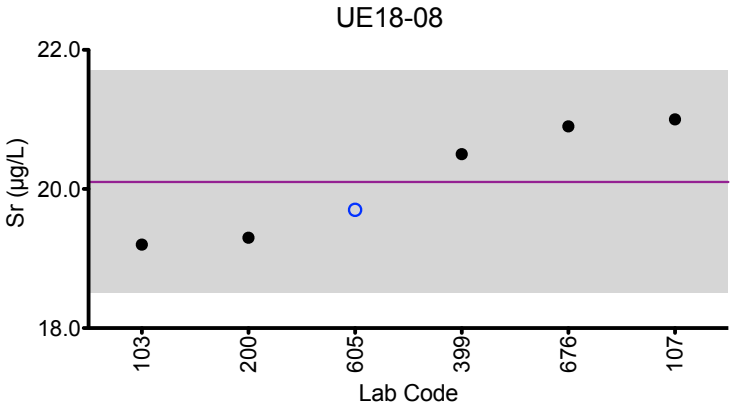
*Denotes a statistical Outlier.

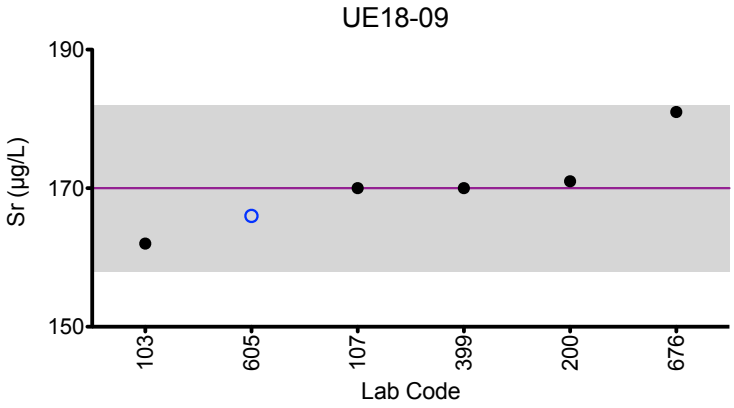
Results for Event #2, 2018: Summary Figures

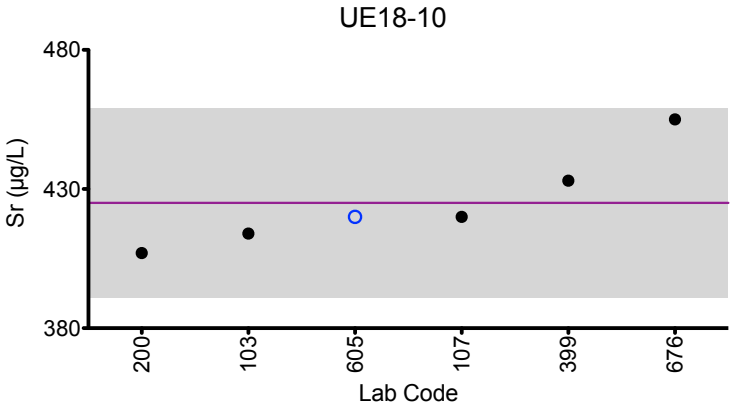
Urine Sr











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
116	ICP-MS/MS	0.646	6.02	3.26	1.66	0.189
147	DRC/CC-ICP-MS	0.561	5.05	2.62	1.41	0.178
293	DRC/CC-ICP-MS	0.67	5.56	3.04	1.66	0.26
597	DRC/CC-ICP-MS	0.555	5.65	2.77	1.54	0.263
598	DRC/CC-ICP-MS	0.56	5.31	2.72	1.48	0.17
605	ICP-MS	0.808	5.73	3.26	1.77	0.237

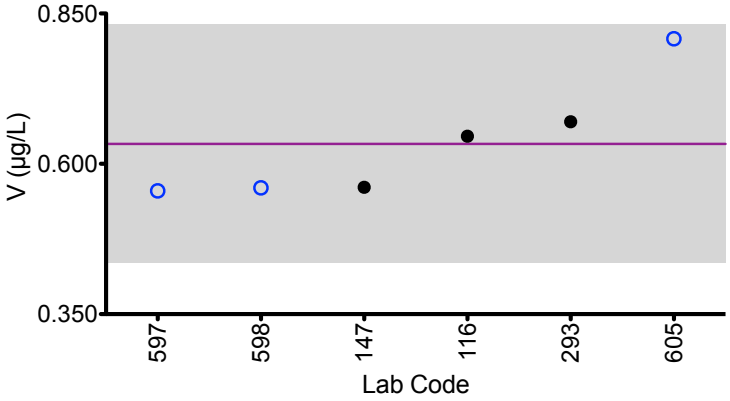
Summary Statistics

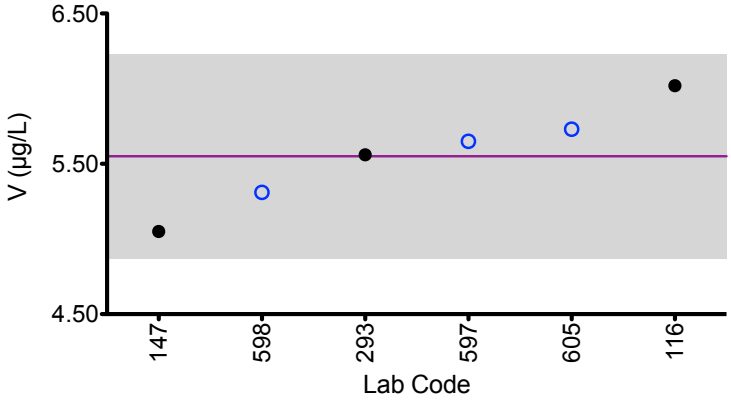
	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
Arithmetic Mean ($\bar{x}$)	0.633	5.55	2.94	1.59	0.216
Arithmetic SD (s)	0.099	0.34	0.28	0.13	0.042
Arithmetic RSD (%)	15.6	6.1	9.5	8.2	19.4
Number of Sample Measurements (N)	6	6	6	6	6

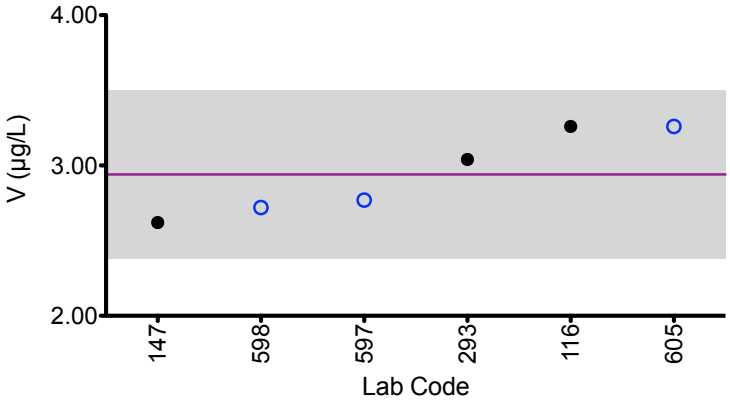
*Denotes a statistical Outlier.

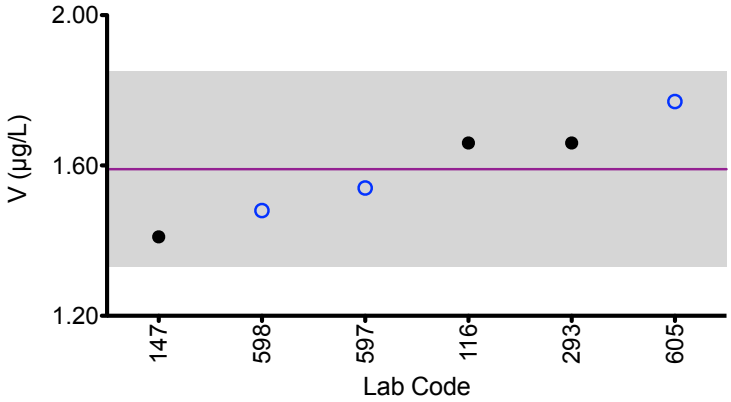
Results for Event #2, 2018: Summary Figures

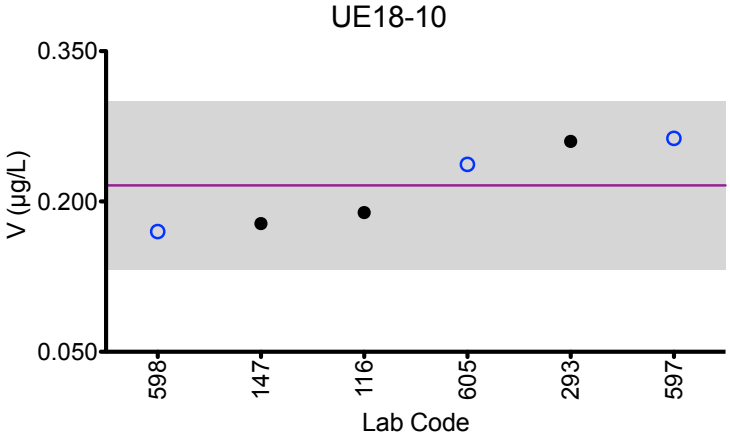
Urine V











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Results for Event #2, 2018: Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
107	ICP-MS	0.27	0.27	0.14	0.14	0.46
110	ICP-MS	0.292	0.261	0.154	0.131	0.450
147	ICP-MS	0.281	0.291	0.142	0.145	0.410
200	ICP-MS	0.2	0.3	0.1	0.1	0.5
324	ICP-MS	<1	<1	<1	<1	<1
399	ICP-MS	0.279	0.251	0.149	0.154	0.463
598	ICP-MS	0.34	0.33	0.18	0.15	0.54
605	ICP-MS	0.273	0.264	<0.180	<0.180	0.427
606	DRC/CC-ICP-MS	0.284	1.06	0.097	0.113	0.411
632	ICP-MS	0.362	0.262	<0.18	<0.18	0.440
676	ICP-MS	0.276	0.282	0.143	0.129	0.41

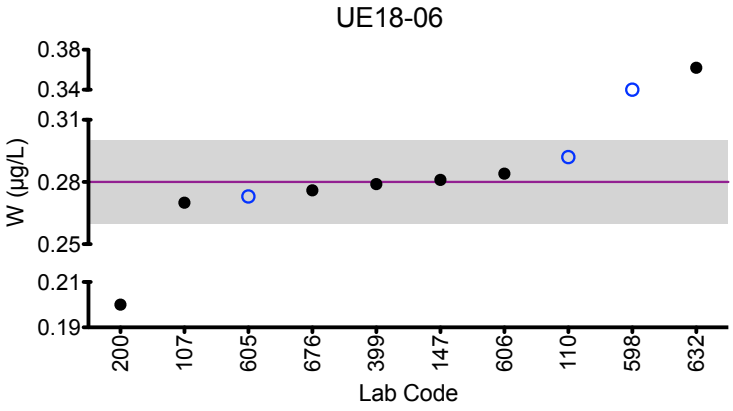
Summary Statistics

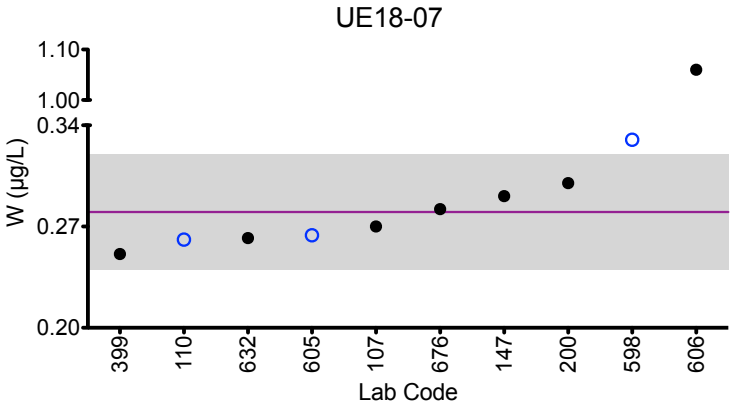
	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
Robust Mean (x*)	0.28	0.28	0.14	0.13	0.45
Robust SD (s*)	0.01	0.02	0.03	0.02	0.04
Robust RSD (%)	3.6	7.1	21	15.4	8.9
Number of Sample Measurements (N)	10	10	8	8	10
Standard Uncertainty (*u*)	0.0056	0.0096	NA	NA	0.016

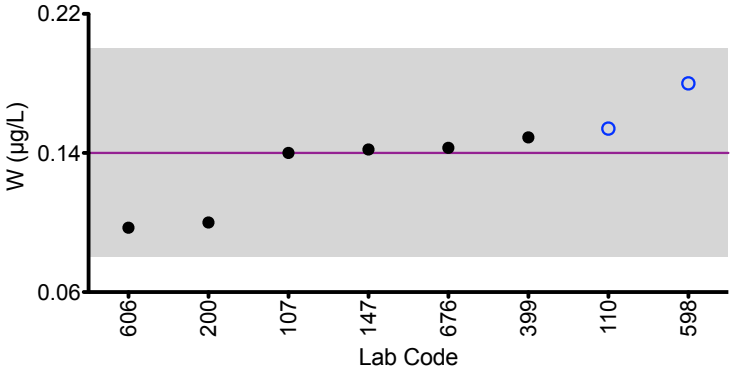
An arithmetic mean, SD, RSD, and n are provided for sample UE18-08 and UE18-09.

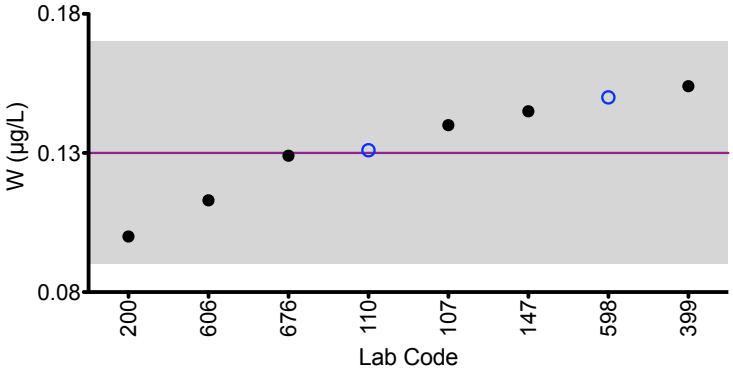
Results for Event #2, 2018: Summary Figures

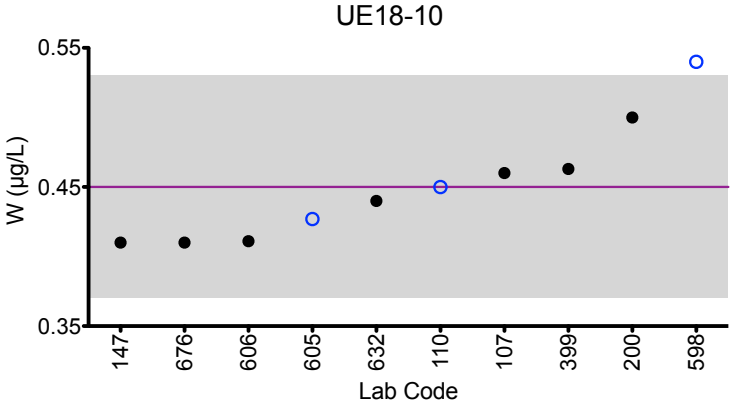
Urine W











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 not intended to be quality specifications and are included for informational purposes only.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)						
Lab Code	**Method**	**UE18-06**	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
110	ICP-MS	77.2	244	532	433	703
147	ICP-MS	92.8	272	600	486	804
293	DRC/CC-ICP-MS	*133.99	237.91	547.06	431.37	686.27
324	ICP-MS	77.705	235.167	531.167	423.309	674.891
401	DRC/CC-ICP-MS	72	242	549	438	719
597	DRC/CC-ICP-MS	85.5	*109	393	434	579
598	ICP-MS	65.8	197	471	373	589
599	DRC/CC-ICP-MS	85.8	227	453	376	569
Summary Statistics						
		UE18-06	**UE18-07**	**UE18-08**	**UE18-09**	**UE18-10**
Arithmetic Mean ($\bar{x}$)		80	236	510	424	666
Arithmetic SD (s)		9	22	66	36	82
Arithmetic RSD (%)		11.3	9.3	12.9	8.5	12.3
Number of Sample Measurements (N)		7	7	8	8	8

*Denotes a statistical Outlier.

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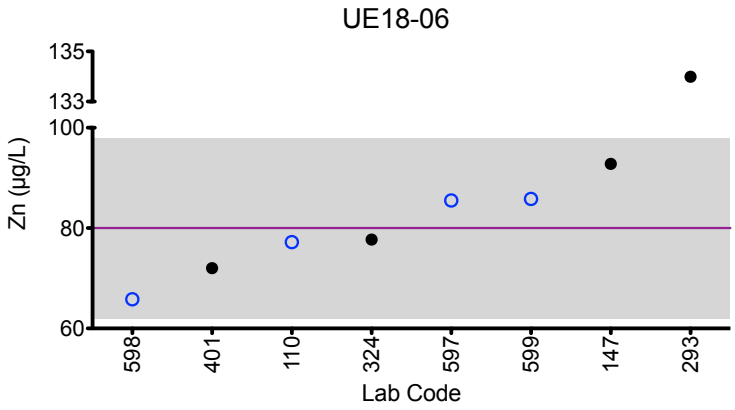
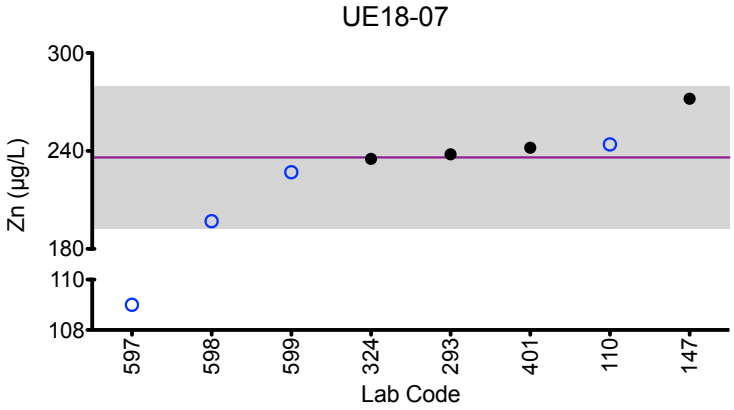
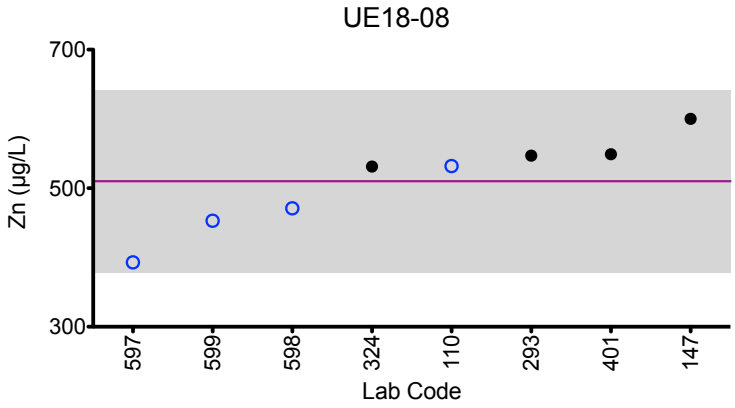
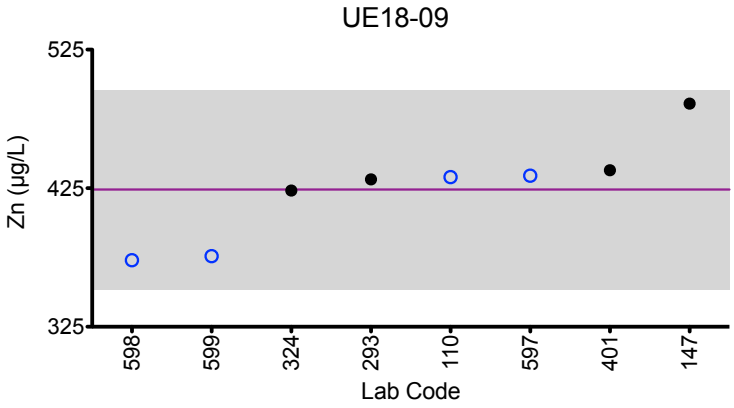
Results for Event #2, 2018: Summary Figures

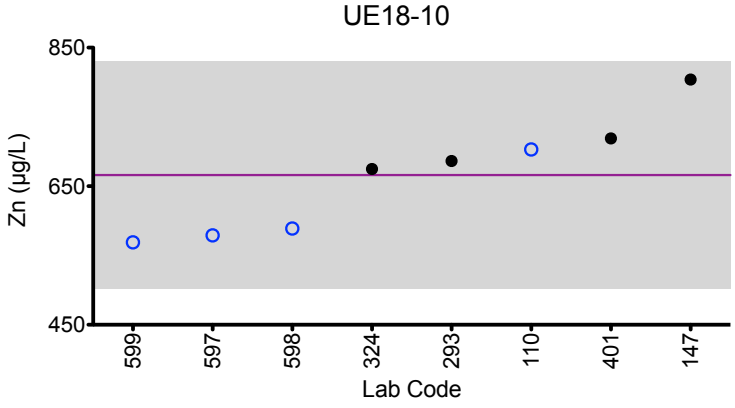
Urine Zn











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 not intended to be quality specifications and are included for informational purposes only.

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Results for Event #2, 2018: Additional Elements in Urine

Urine Ag (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
147	ICP-MS	< 0.507	< 0.507	< 0.507	< 0.507	< 0.507

Urine Al (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
147	DRC/CC-ICP-MS	<18.1	<18.1	<18.1	<18.1	<18.1
324	ICP-MS	9.223	15.448	18.495	12.032	15.448
597	DRC/CC-ICP-MS	17.0	27.3	30.1	20.3	24.6

Urine B (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
200	ICP-MS	335	833	470	599	688

Urine Bi (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
147	ICP-MS	< 0.293	< 0.293	< 0.293	< 0.293	< 0.293

Urine Fe (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
324	ICP-MS	2.921	6.328	4.203	4.821	7.648

Urine I (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
107	ICP-MS	48	94	75	59	28

Urine Li (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
147	ICP-MS	5.84	10.7	14.8	7.43	6.12

Urine Mg (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
597	DRC/CC-ICP-MS	4081	42768	12502	29588	23209

Urine Th (µg/L)

Lab Code	Method	UE18-06	UE18-07	UE18-08	UE18-09	UE18-10
147	ICP-MS	< 0.00719	< 0.00719	< 0.00719	< 0.00719	< 0.00719

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Event #2, 2018

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

Event #2, 2018:
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.

Results for Event #2, 2018: Summary Statistics

	Serum Al (µg/L)				
	SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Target (Arithmetic Mean ($\bar{x}$))	104	57.9	129	170	NA
Upper Limit	125	69.5	155	204	NA
Lower Limit	83	46.3	103	136	NA
Arithmetic SD (s)	18	11.5	13	21	NA
Arithmetic RSD (%)	17.3	19.9	10.1	12.4	NA
Number of Sample Measurements (N)	6	6	6	6	NA

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.

Sample SE18-10 was not graded for Event #2, 2018 due to lack of a consensus value among participating labs.

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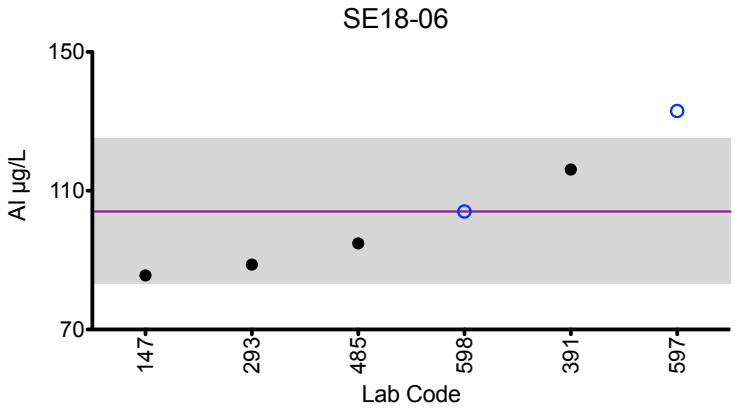
Results for Event #2, 2018:
Performance of Participating Laboratories

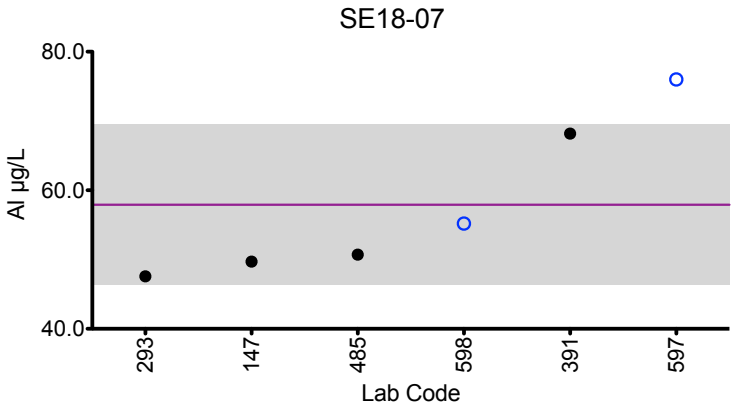
		Serum Al (µg/L)				
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
	Target	**104**	**57.9**	**129**	**170**	**NA**
147	ETAAS-Z	85.6	49.7	118	150	27.7
293	DRC/CC-ICP-MS	88.71	47.58	117.74	149.73	23.12
391	ETAAS-Z	116.10	68.17	146.9	198	38.64
485	HR-ICP-MS	94.8	50.7	120	160	22.5
597	DRC/CC-ICP-MS	133 ↑	76 ↑	141	192	41
598	ICP-MS	104	55.2	133	169	34.8

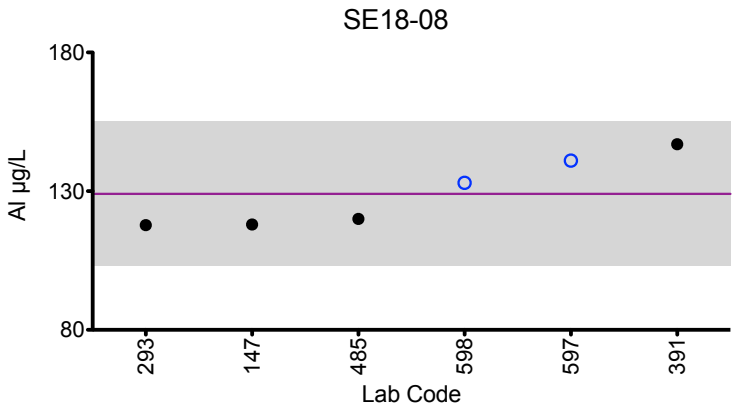
Based on the grading criteria for Al in Serum, 93% of results were satisfactory, with 1 of the 6 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

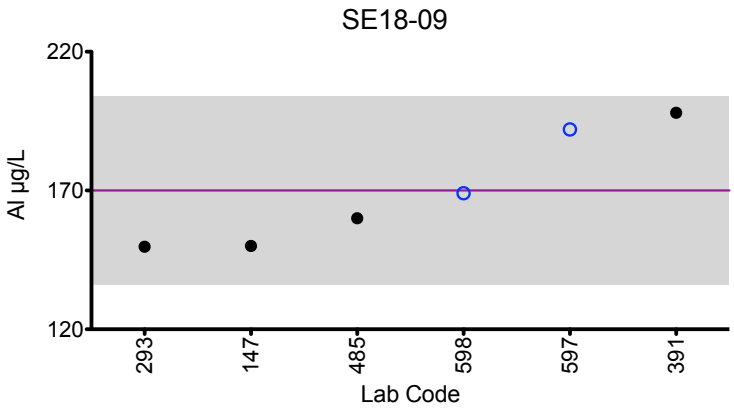
Results for Event #2, 2018: Summary Figures

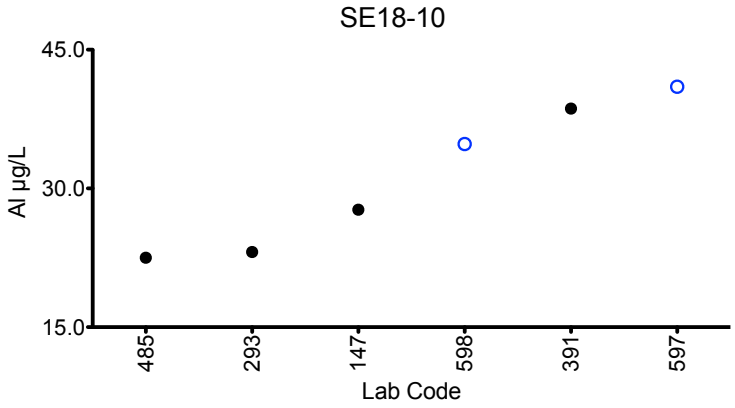
Serum Al











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 #2, 2018: Summary Statistics

	Serum Co (µg/L)				
	SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Target (Arithmetic Mean ($\bar{x}$))	5.4	1.5	3.8	10.1	2.8
Upper Limit	6.9	3.0	5.3	11.6	4.3
Lower Limit	3.9	0.0	2.3	8.6	1.3
Arithmetic SD (s)	0.3	0.3	0.3	1.0	0.2
Arithmetic RSD (%)	5.6	20.0	7.9	9.9	7.1
Number of Sample Measurements (N)	7	7	7	7	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 #2, 2018:
Performance of Participating Laboratories

Serum Co (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
	Target	**5.4**	**1.5**	**3.8**	**10.1**	**2.8**
103	DRC/CC-ICP-MS	5.40	1.34	3.79	9.77	2.69
110	ICP-MS	5.36	1.42	3.79	9.98	2.72
147	ICP-MS	5.04	1.31	3.32	9.13	2.56
293	DRC/CC-ICP-MS	5.29	1.28	3.67	9.51	2.61
485	HR-ICP-MS	5.35	1.39	3.83	9.76	2.69
597	DRC/CC-ICP-MS	*8 ↑	2	4	12 ↑	3
598	ICP-MS	6.11	1.57	4.30	10.73	3.03
599	DRC/CC-ICP-MS	5.32	*3.74 ↑	*10.14 ↑	*1.36 ↓	2.78

Based on the grading criteria for Co in Serum, 88% of results were satisfactory, with 2 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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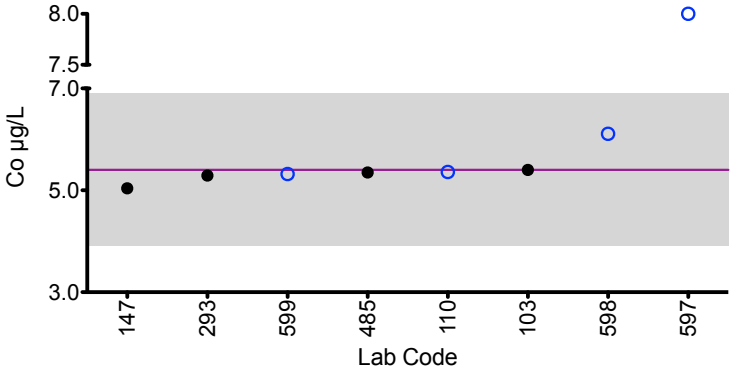
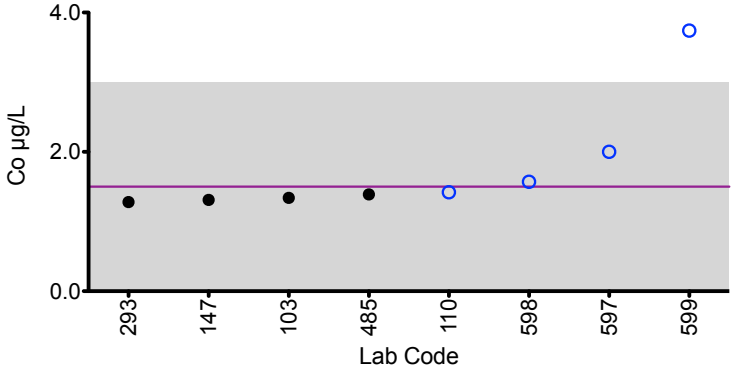
Results for Event #2, 2018: Summary Figures

Serum Co

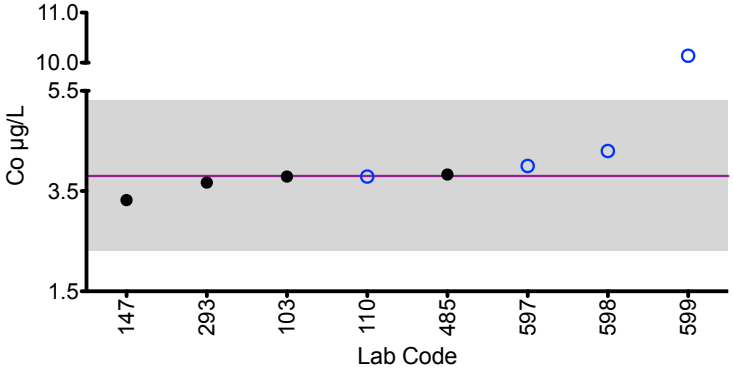
SE18-06



SE18-07



SE18-08



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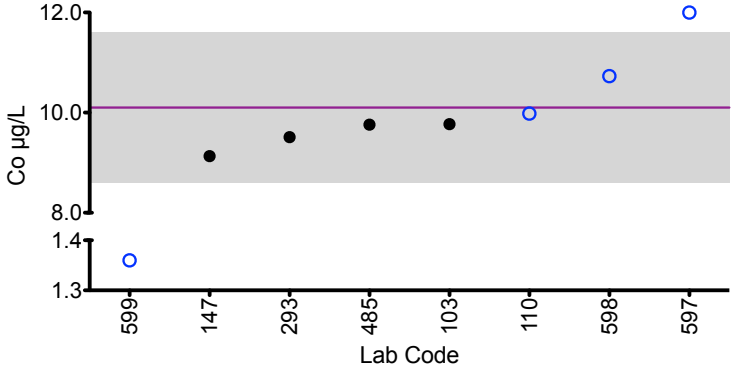
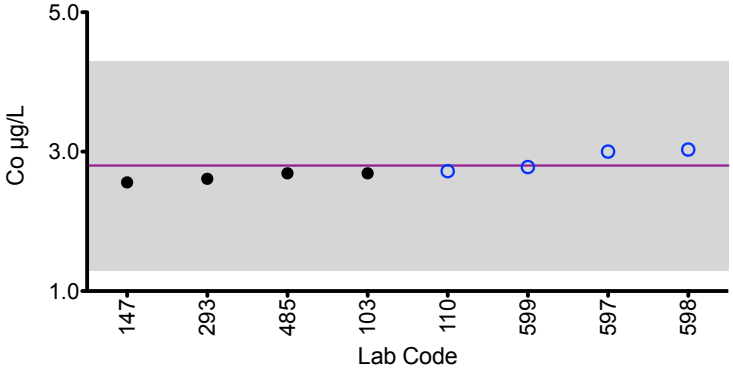


SE18-10



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 #2, 2018: Summary Statistics

	Serum Cr (µg/L)				
	SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Target (Arithmetic Mean ($\bar{x}$))	1.2	3.0	7.9	4.3	6.2
Upper Limit	3.2	5.0	9.9	6.3	8.2
Lower Limit	0.0	1.0	5.9	2.3	4.2
Arithmetic SD (s)	0.5	0.6	1.9	1.2	0.8
Arithmetic RSD (%)	42	20	24	28	12.9
Number of Sample Measurements (N)	7	7	8	8	8

The acceptable range is based on quality specifications:
±2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±2 µg/L at concentrations less than or equal to 10 µg/L. These quality specifications were established 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 #2, 2018:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
	Target	**1.2**	**3.0**	**7.9**	**4.3**	**6.2**
103	DRC/CC-ICP-MS	1.72	3.56	9.12	5.15	6.56
110	DRC/CC-ICP-MS	0.9	2.5	8.0	4.2	5.7
147	DRC/CC-ICP-MS	1.07	2.64	8.06	4.71	5.56
293	DRC/CC-ICP-MS	1.18	3.17	8.33	4.3	6.04
485	HR-ICP-MS	0.857	2.65	8.17	4.25	5.58
597	DRC/CC-ICP-MS	2	4	10 ↑	6	7
598	DRC/CC-ICP-MS	0.84	2.65	8.10	4.21	5.63
599	DRC/CC-ICP-MS	<0.10	*7.16 ↑	3.66 ↓	1.78 ↓	7.55

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

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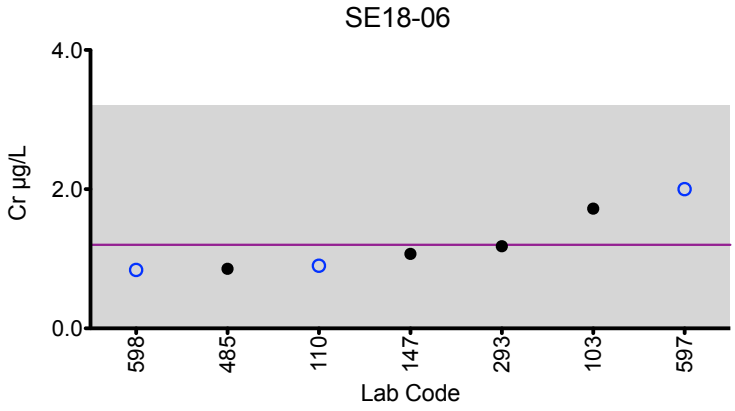
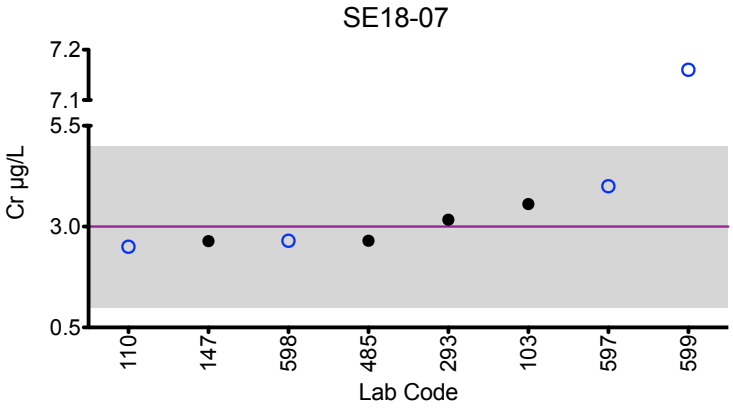
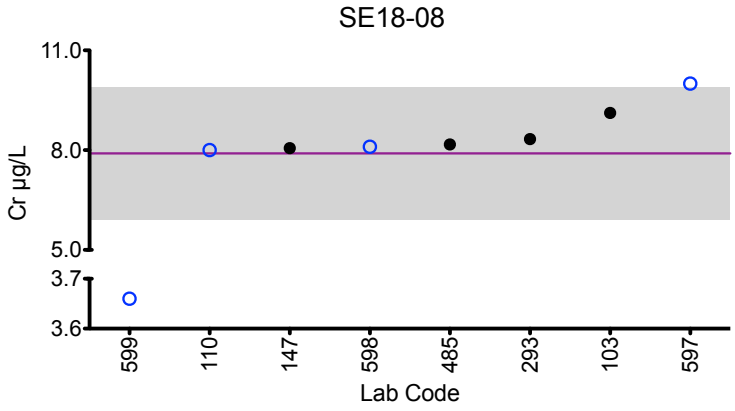
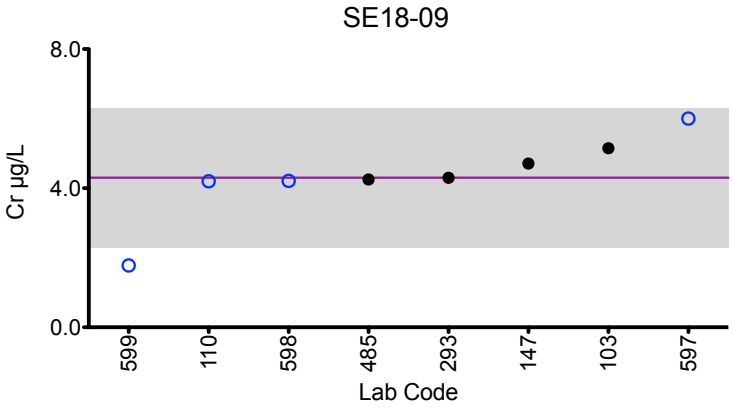
Results for Event #2, 2018: Summary Figures

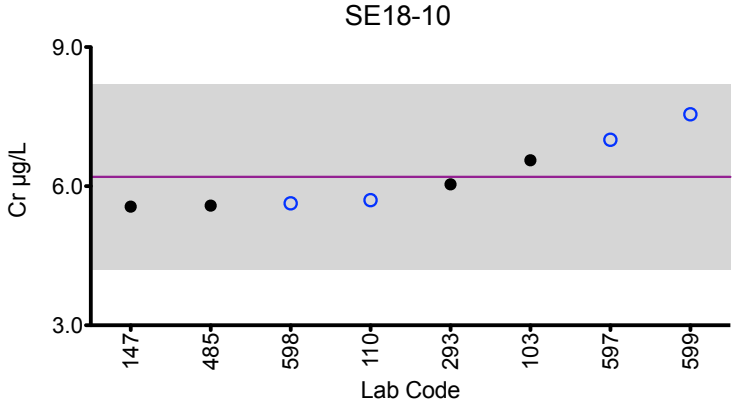
Serum Cr











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 #2, 2018: Summary Statistics

Serum Cu (µg/L)					
	SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Target (Arithmetic Mean ($\bar{x}$))	1421	1750	1459	2528	1099
Upper Limit	1634	2013	1678	2907	1264
Lower Limit	1208	1488	1240	2149	934
Arithmetic SD (s)	68	203	80	339	81
Arithmetic RSD (%)	4.8	11.6	5.5	13.4	7.4
Number of Sample Measurements (N)	8	9	8	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 #2, 2018:
Performance of Participating Laboratories

Serum Cu (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
	Target	**1421**	**1750**	**1459**	**2528**	**1099**
107	DRC/CC-ICP-MS	1400	1700	1400	2500	1100
110	ICP-MS	1420	1740	1440	2600	1100
147	ICP-MS	1442	1798	1499	2541	1099
293	DRC/CC-ICP-MS	1325.49	1621.74	1396.69	2370.63	987.29
457	ICP-AES/OES	1448	1793	1478	2584	1134
483	DRC/CC-ICP-MS	1520	1920	1550	2800	1160
597	DRC/CC-ICP-MS	*1924 ↑	2150 ↑	1567	3069 ↑	1234
598	ICP-MS	1330	1556	1338	2477	971
599	DRC/CC-ICP-MS	1480	1470 ↓	*2630 ↑	1810 ↓	1110

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

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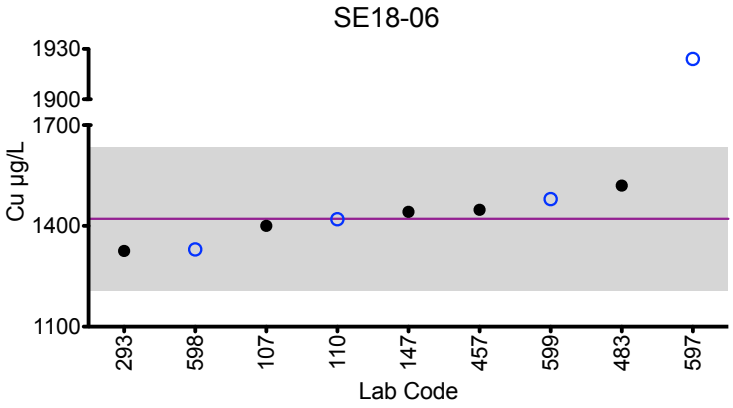
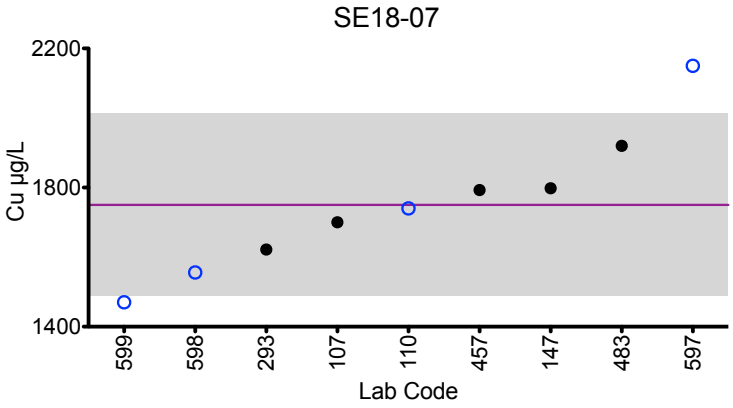
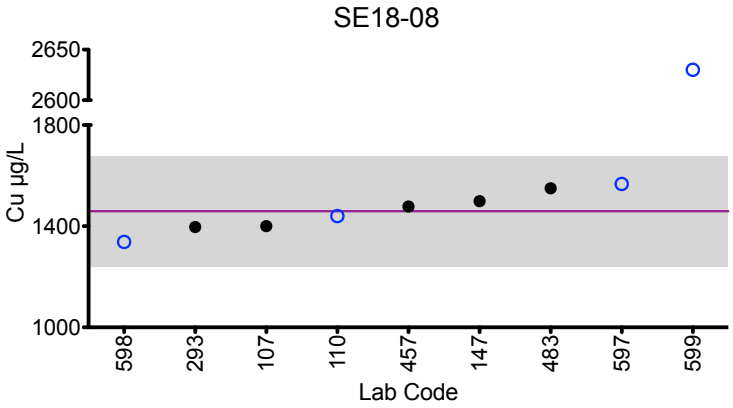
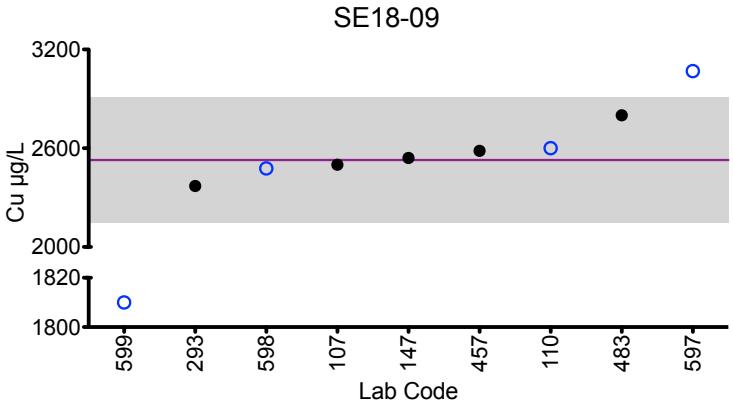
Results for Event #2, 2018: Summary Figures

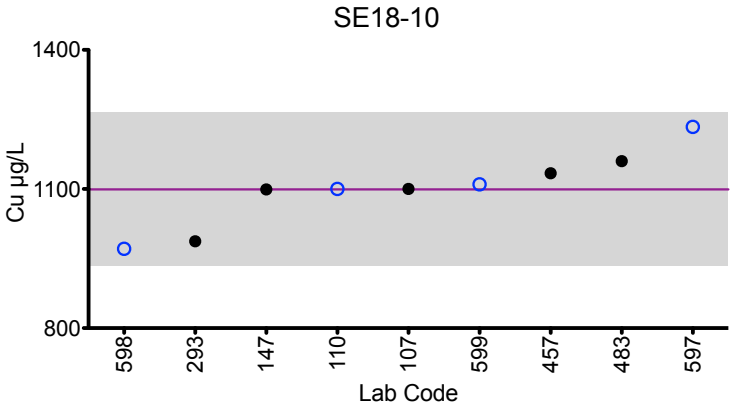
Serum Cu











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 #2, 2018: Summary Statistics

	Serum Se (µg/L)				
	SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Target (Arithmetic Mean ($\bar{x}$))	130	287	197	95	170
Upper Limit	156	344	236	114	204
Lower Limit	104	230	158	76	136
Arithmetic SD (s)	16	38	14	8.3	13
Arithmetic RSD (%)	12.3	13.2	7.1	8.7	7.6
Number of Sample Measurements (N)	9	9	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 #2, 2018:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
	Target	**130**	**287**	**197**	**95**	**170**
103	DRC/CC-ICP-MS	128	303	205	95.2	172
107	DRC/CC-ICP-MS	120	290	190	92	160
110	DRC/CC-ICP-MS	116	277	191	87	160
147	ICP-MS	112	259	167	84.5	154
293	DRC/CC-ICP-MS	122.34	284.93	198.11	91.55	164.96
483	DRC/CC-ICP-MS	140	313	210	106	186
597	DRC/CC-ICP-MS	165 ↑	334	204	108	185
598	DRC/CC-ICP-MS	138	319	207	95.9	160
599	DRC/CC-ICP-MS	130	205 ↓	*106 ↓	*305 ↑	184

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

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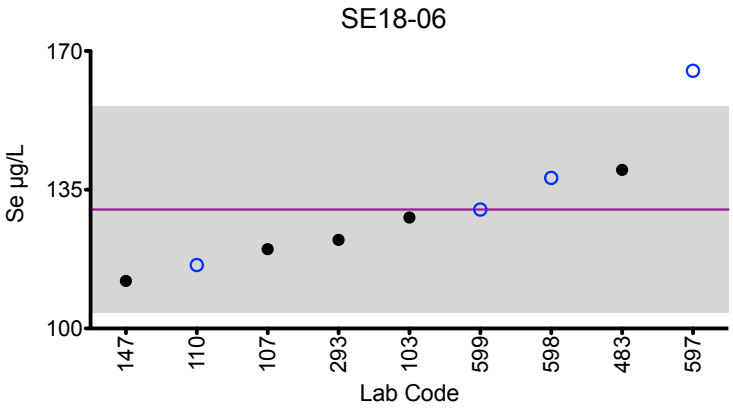
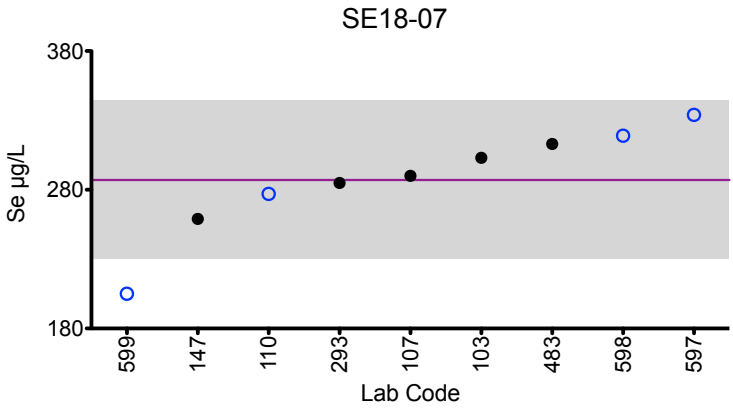
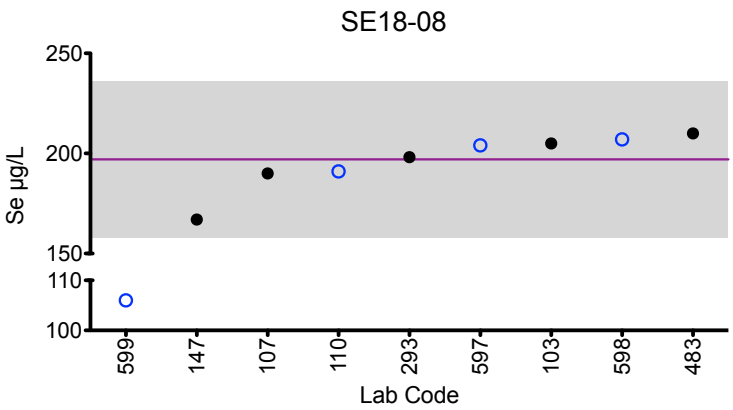
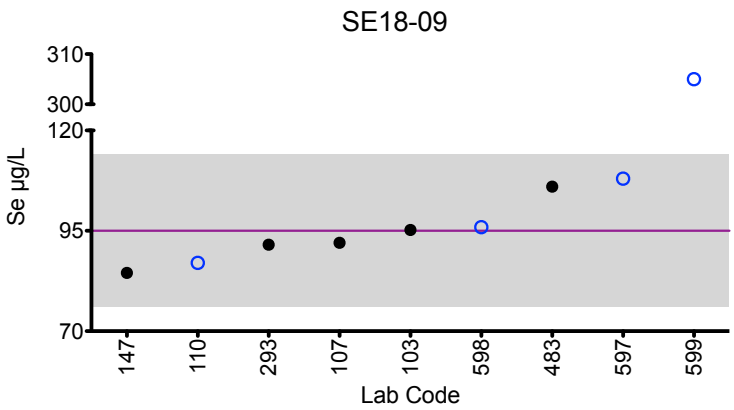
Results for Event #2, 2018: Summary Figures

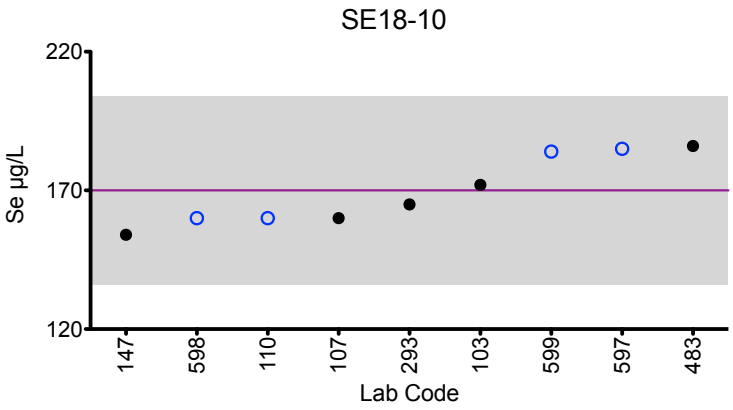
Serum Se











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 #2, 2018: Summary Statistics

Serum Zn (µg/L)					
	SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Target (Arithmetic Mean ($\bar{x}$))	845	659	1174	2113	1828
Upper Limit	972	758	1350	2430	2102
Lower Limit	718	560	998	1796	1554
Arithmetic SD (s)	121	69	86	218	183
Arithmetic RSD (%)	14.3	10.5	7.3	10.3	10.0
Number of Sample Measurements (N)	9	8	8	8	9

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 #2, 2018:
Performance of Participating Laboratories

Serum Zn (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
	Target	**845**	**659**	**1174**	**2113**	**1828**
107	DRC/CC-ICP-MS	810	670	1200	2200	1800
110	ICP-MS	802	631	1180	2120	1820
147	ICP-MS	758	624	1033	1922	1667
293	DRC/CC-ICP-MS	733.99	584.97	1128.76	1931.37	1629.41
457	ICP-AES/OES	769	649	1116	1938	1718
483	DRC/CC-ICP-MS	857	708	1270	2290	1970
597	DRC/CC-ICP-MS	1104 ↑	802 ↑	1301	2529 ↑	2043
598	ICP-MS	791	605	1163	1973	1664
599	DRC/CC-ICP-MS	978 ↑	*1420 ↑	*2510 ↑	*800 ↓	2140 ↑

Based on the grading criteria for Zn in Serum, 82% of results were satisfactory, with 2 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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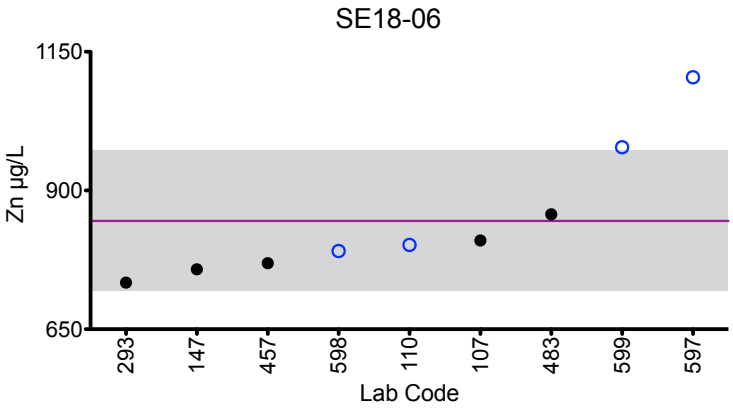
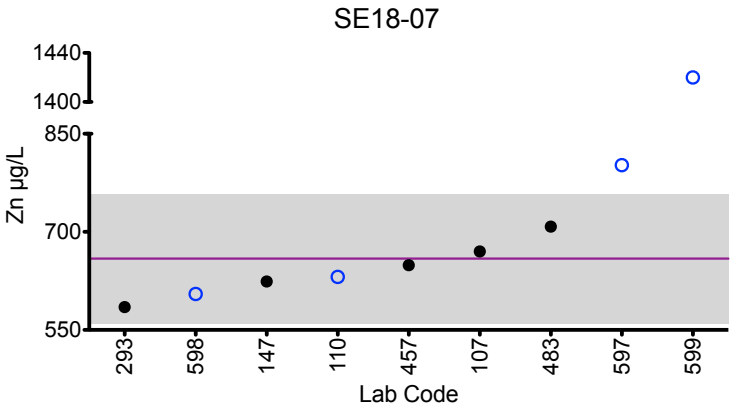
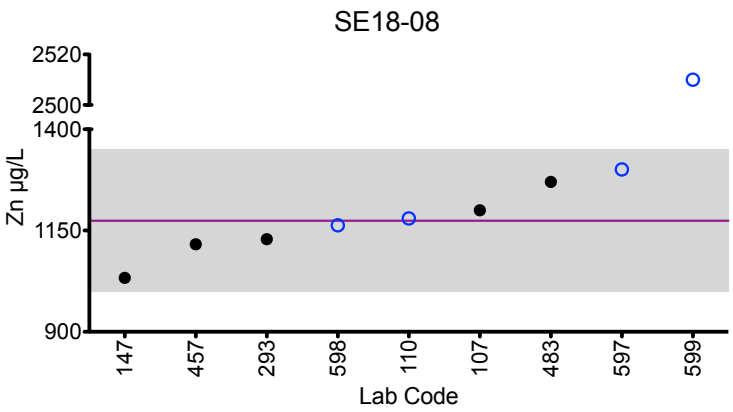
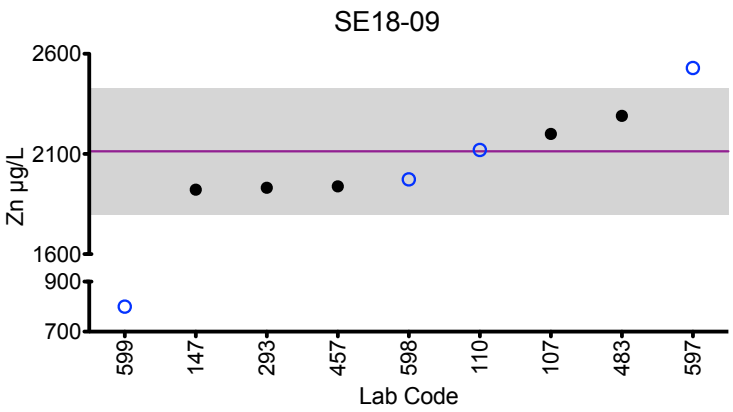
Results for Event #2, 2018: Summary Figures

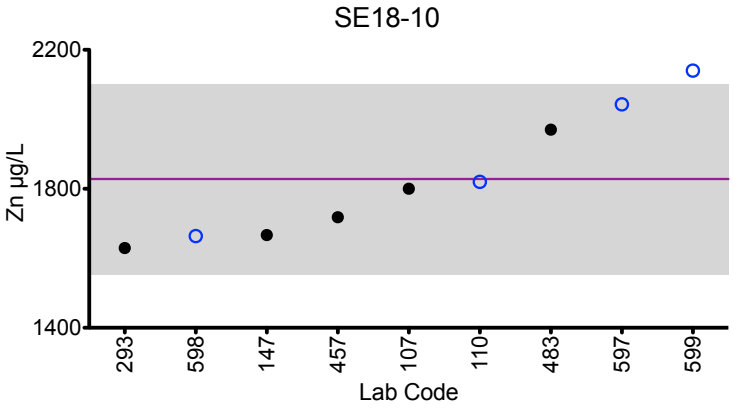
Serum Zn











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 #2, 2018:
Laboratory Data and Summary Statistics

Serum As (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
103	DRC/CC-ICP-MS	6.31	17.1	11.2	9.56	2.87
110	DRC/CC-ICP-MS	6.1	15.9	10.6	9.3	3.2
147	ICP-MS	4.91	14.3	8.61	7.57	2.12
597	DRC/CC-ICP-MS	7.74	18.4	10.7	10.1	3.20
598	DRC/CC-ICP-MS	6.74	17.10	11.87	9.51	2.70
599	DRC/CC-ICP-MS	6.53	10.71	10.08	*16.31	3.58
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		6.4	15.6	10.5	9.2	2.9
Arithmetic SD (s)		0.9	2.8	1.1	1.0	0.5
Arithmetic RSD (%)		14.1	17.9	10.5	10.9	17.2
Number of Sample Measurements (N)		6	6	6	5	6

*Denotes a statistical Outlier.

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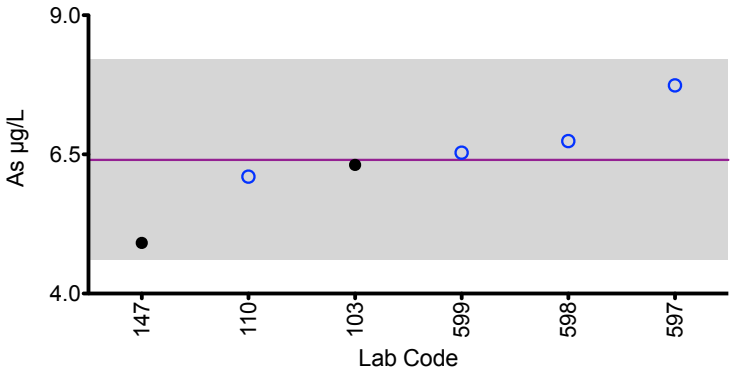
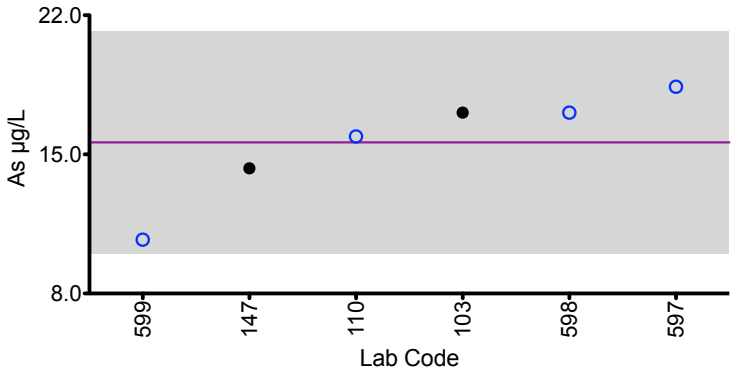
Results for Event #2, 2018: Summary Figures

Serum As

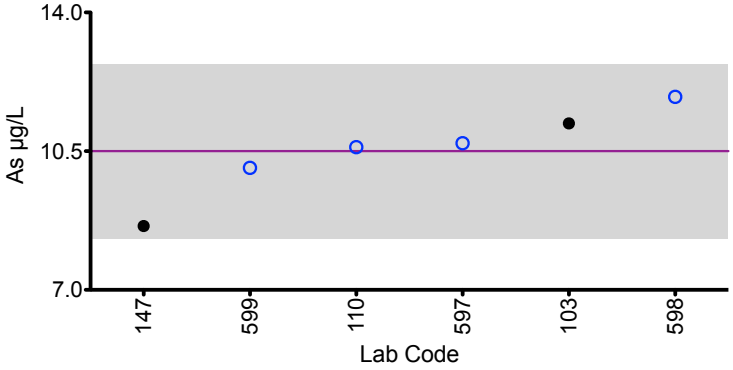
SE18-06



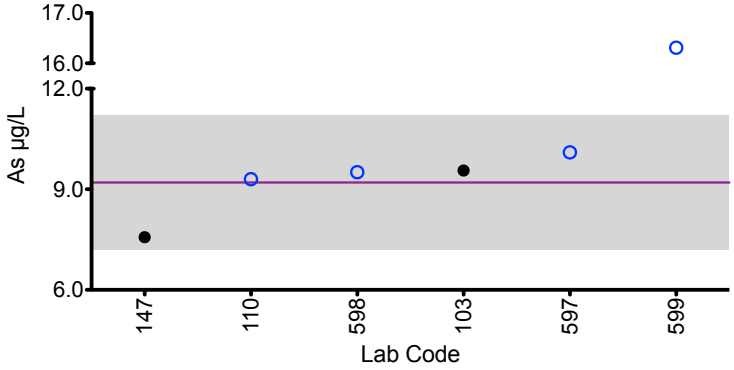
SE18-07



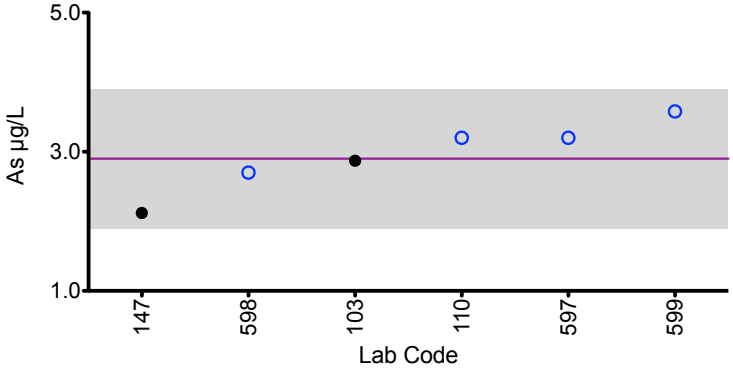
SE18-08



SE18-09



SE18-10



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 not intended to be quality specifications and are included for informational purposes only.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Be (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
110	ICP-MS	5.95	3.72	0.19	1.38	2.01
147	ICP-MS	5.47	3.77	< 0.523	1.36	1.94
293	DRC/CC-ICP-MS	5.71	3.74	0.24	1.25	2.14
598	ICP-MS	*7.04	4.43	0.31	1.47	2.67
599	DRC/CC-ICP-MS	5.73	*0.05	*1.1	*3.44	1.83
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		5.7	3.9	0.25	1.4	2.1
Arithmetic SD (s)		0.2	0.3	0.06	0.1	0.3
Arithmetic RSD (%)		3.5	7.7	24	7.1	14.3
Number of Sample Measurements (N)		4	4	3	4	5

*Denotes a statistical Outlier.

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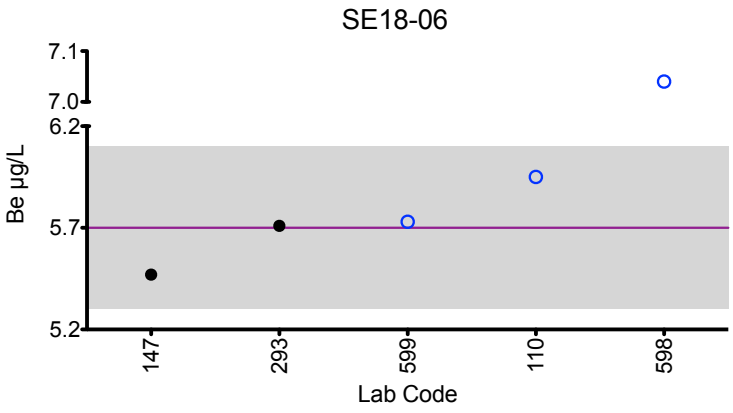
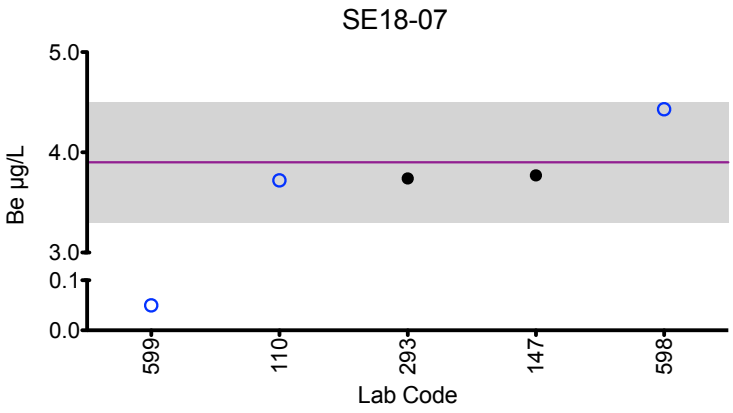
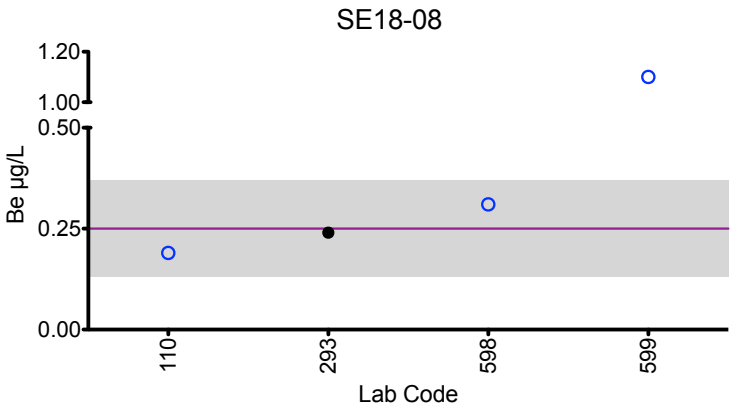
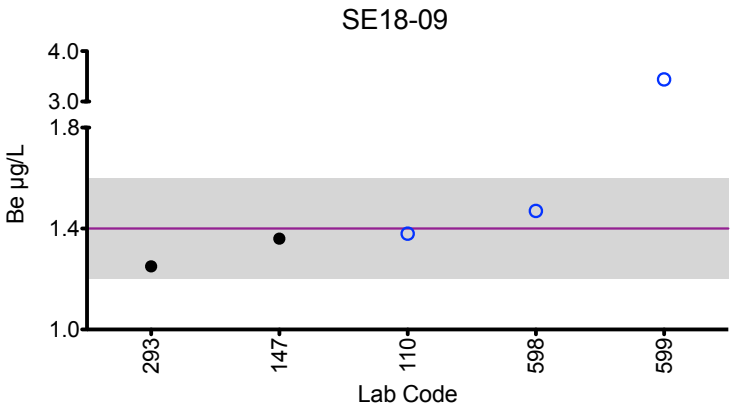
Results for Event #2, 2018: Summary Figures

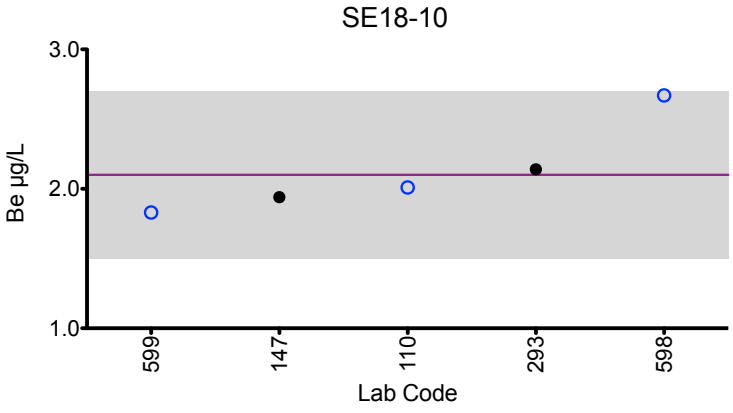
Serum Be











Legend:
o CHEAR Labs ● Other Labs
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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
103	DRC/CC-ICP-MS	1.36	4.63	0.648	1.93	2.79
110	ICP-MS	1.3	4.7	0.6	1.9	2.7
147	ICP-MS	1.34	4.65	0.923	2.01	2.36
598	DRC/CC-ICP-MS	1.36	4.32	0.59	1.83	2.60
599	DRC/CC-ICP-MS	1.33	*0.71	*1.88	*4.21	2.66
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		1.34	4.6	0.69	1.9	2.6
Arithmetic SD (s)		0.02	0.2	0.16	0.1	0.2
Arithmetic RSD (%)		1.5	4.3	23	5.3	7.7
Number of Sample Measurements (N)		5	4	4	4	5

*Denotes a statistical Outlier.

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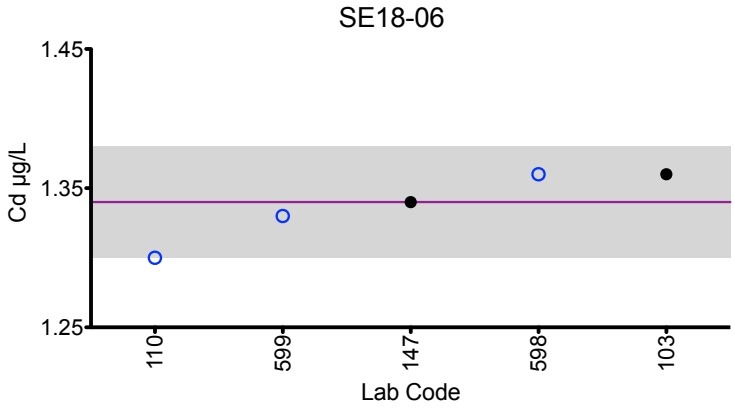
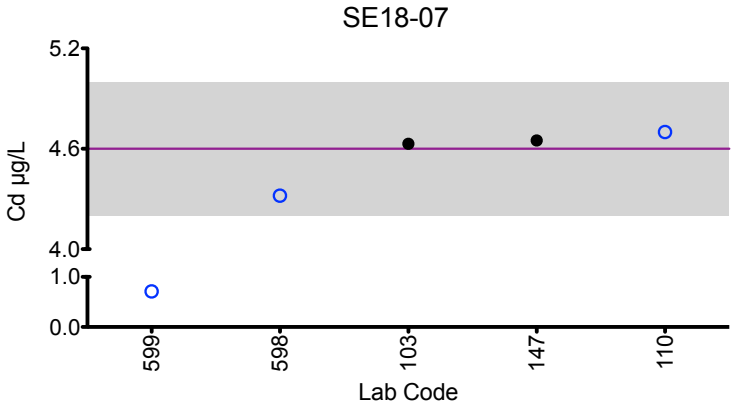
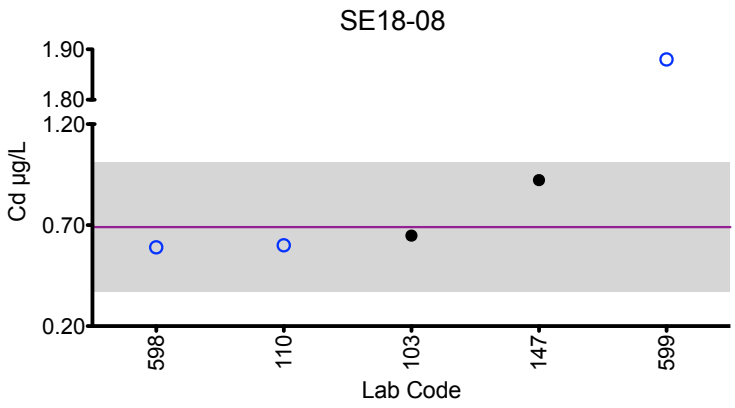
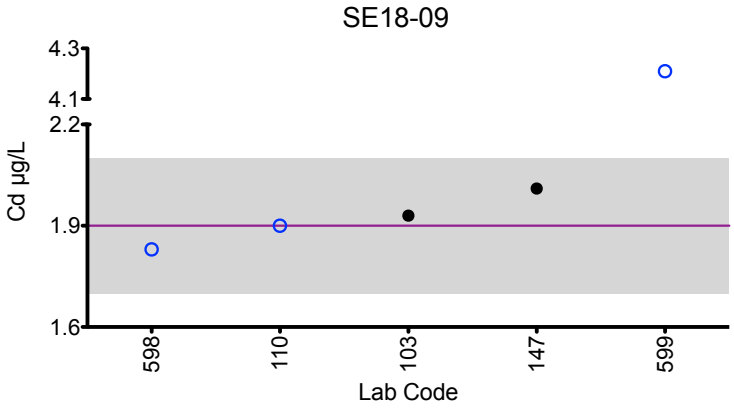
Results for Event #2, 2018: Summary Figures

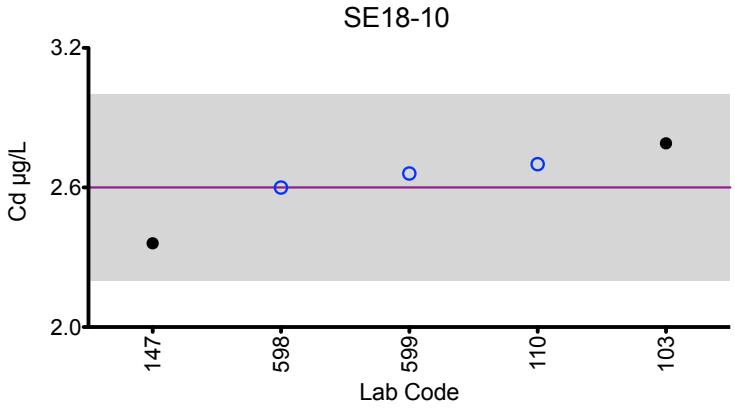
Serum Cd











Legend:
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Gray area = ±2SD of the mean.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
103	DRC/CC-ICP-MS	4.63	6.33	0.526	2.76	0.921
110	ICP-MS	4.5	5.7	0.5	2.7	0.9
147	ICP-MS	5.38	8.3	0.885	3.89	0.881
597	DMA	4.8	6.48	0.37	2.74	0.87
598	ICP-MS	4.58	6.31	0.59	2.86	1.01
599	DRC/CC-ICP-MS	4.29	*0.62	*2.75	*5.95	1.04
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		4.7	6.6	0.6	3.0	0.9
Arithmetic SD (s)		0.4	1.0	0.2	0.5	0.1
Arithmetic RSD (%)		8.5	15.2	33	16.7	11.1
Number of Sample Measurements (N)		6	5	5	5	6

*Denotes a statistical Outlier.

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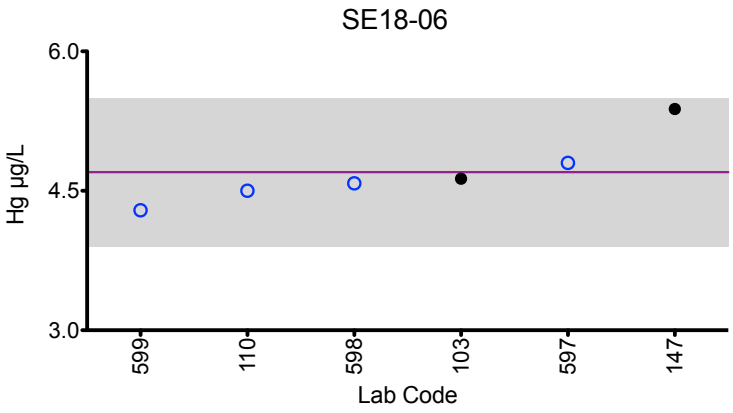
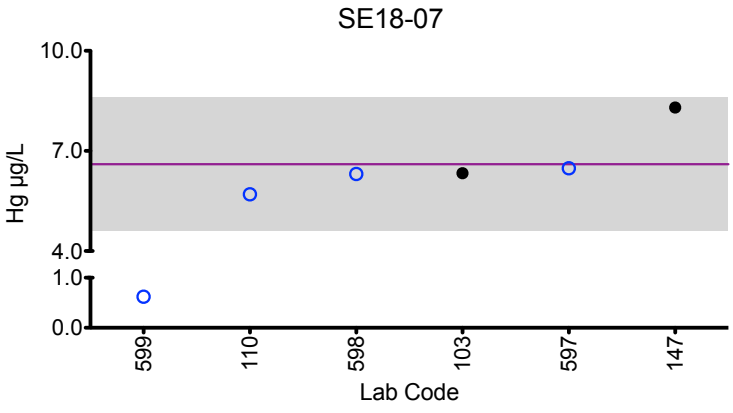
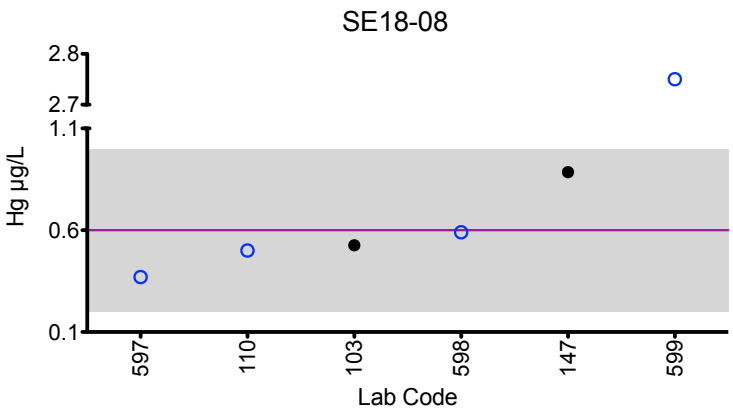
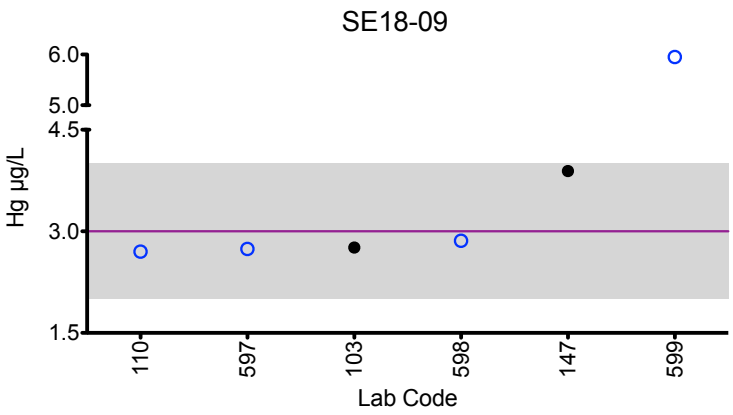
Results for Event #2, 2018: Summary Figures

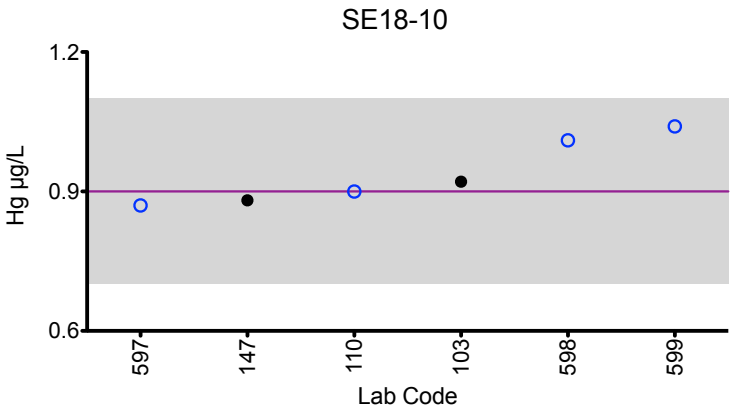
Serum Hg











Legend:
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Gray area = ±2SD of the mean.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
103	DRC/CC-ICP-MS	7.26	4.12	12.6	5.99	2.82
110	ICP-MS	7.4	4.2	12.8	6.1	3.0
147	ICP-MS	6.70	3.85	10.9	5.47	2.73
293	DRC/CC-ICP-MS	7.29	4.09	11.7	5.45	2.77
597	DRC/CC-ICP-MS	9.70	5.31	13.1	7.72	3.77
598	ICP-MS	8.46	4.48	13.94	6.81	3.35
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		7.8	4.3	12.5	6.3	3.1
Arithmetic SD (s)		1.1	0.5	1.1	0.9	0.4
Arithmetic RSD (%)		14.1	11.6	8.8	14.3	12.9
Number of Sample Measurements (N)		6	6	6	6	6

*Denotes a statistical Outlier.

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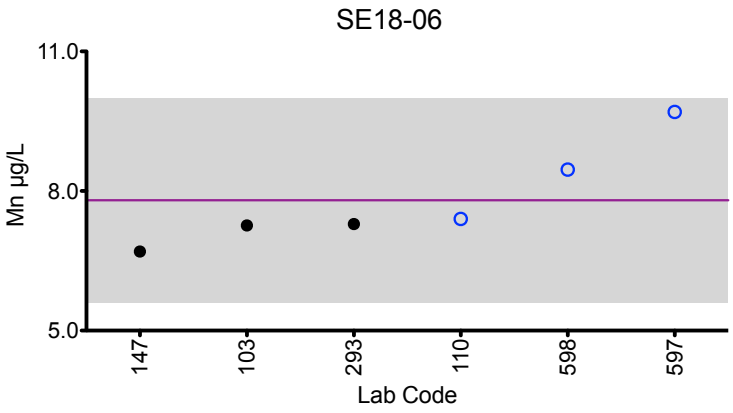
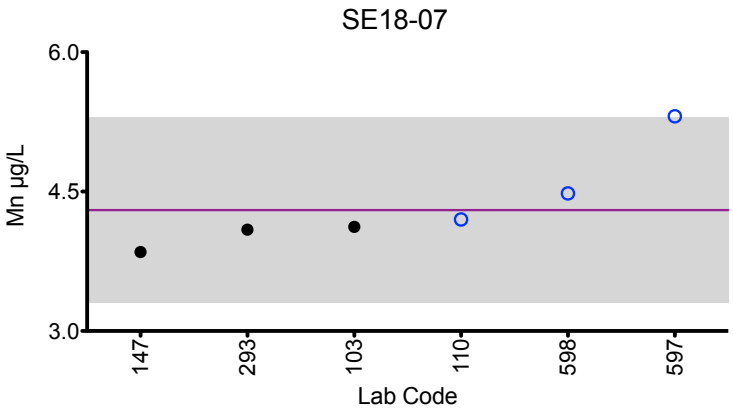
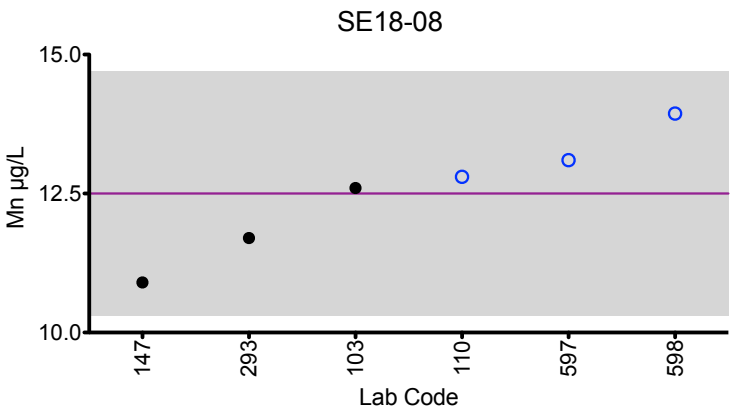
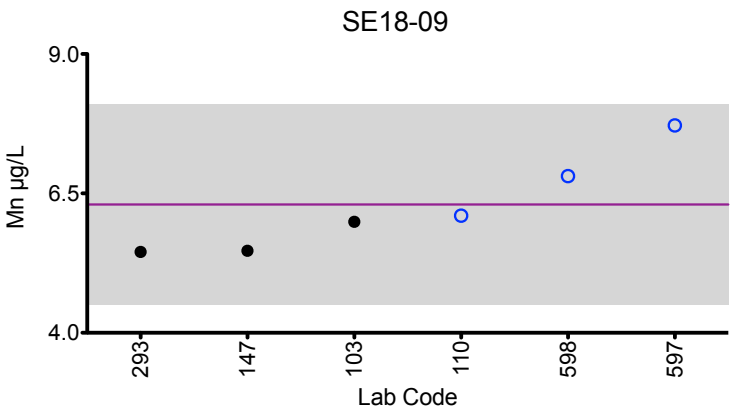
Results for Event #2, 2018: Summary Figures

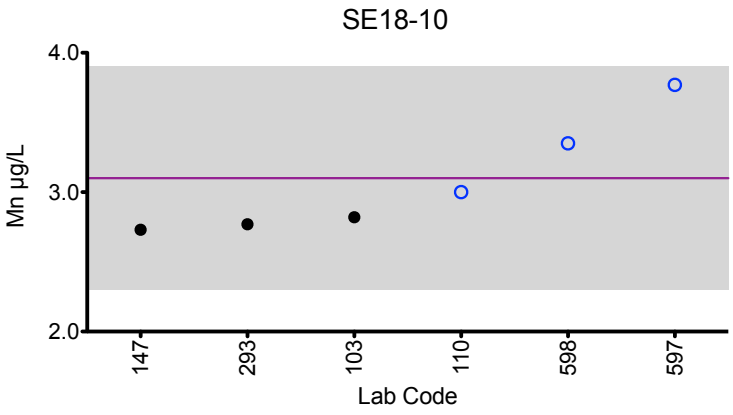
Serum Mn











Legend:
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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Mo (µg/L)

Lab Code	Method	SE18-06	SE18-07	SE18-08	SE18-09	SE18-10
103	DRC/CC-ICP-MS	2.76	7.21	1.08	4.46	5.60
110	ICP-MS	3.2	7.9	1.3	4.9	6.2
147	ICP-MS	2.76	6.13	0.998	4.19	5.27
293	DRC/CC-ICP-MS	2.74	7.32	1.17	4.24	5.54
485	HR-ICP-MS	2.75	6.87	2.35	4.32	5.47
597	DRC/CC-ICP-MS	*3.89	8.38	1.54	5.19	6.18
598	DRC/CC-ICP-MS	3.02	7.54	1.30	4.66	6.02
599	DRC/CC-ICP-MS	2.97	*1.43	*4.94	*7.2	*7.43

Summary Statistics

	SE18-06	SE18-07	SE18-08	SE18-09	SE18-10
Arithmetic Mean ($\bar{x}$)	2.89	7.3	1.39	4.57	5.75
Arithmetic SD (s)	0.18	0.7	0.46	0.37	0.37
Arithmetic RSD (%)	6.2	9.6	33	8.1	6.4
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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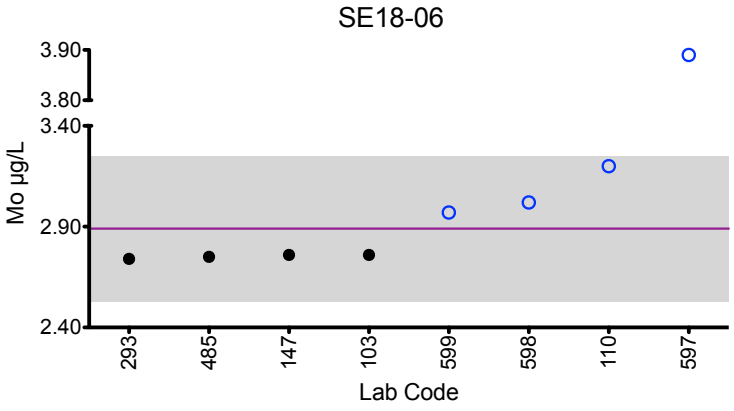
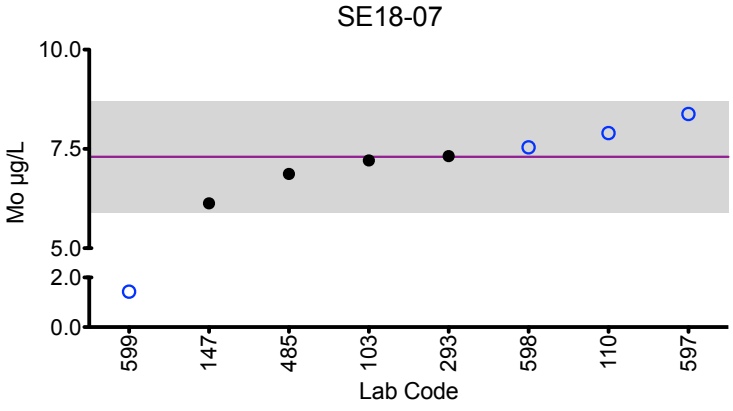
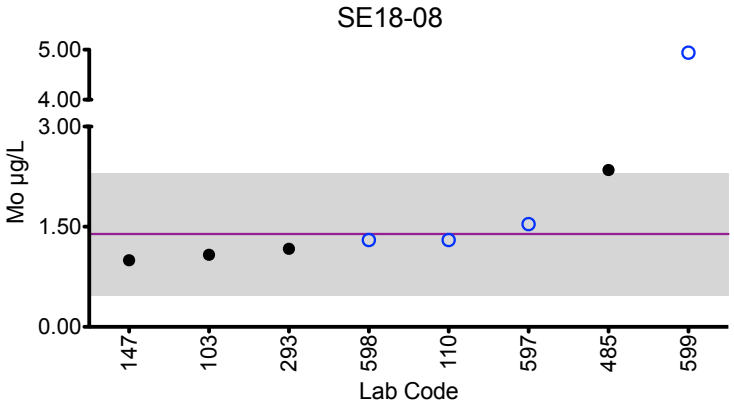
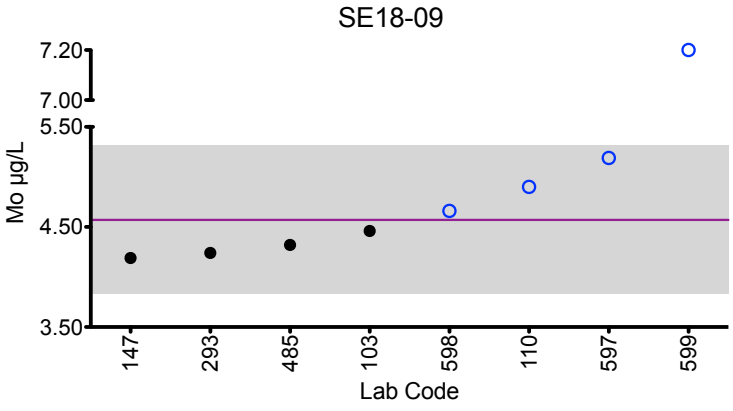
Results for Event #2, 2018: Summary Figures

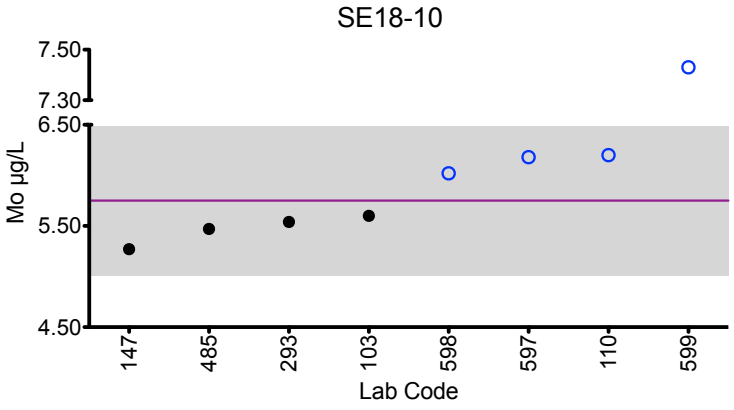
Serum Mo











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
110	DRC/CC-ICP-MS	14.0	3.6	9.0	5.5	2.7
147	ICP-MS	15.4	4.89	10.3	7.40	2.82
293	DRC/CC-ICP-MS	14.54	3.93	9.03	5.38	2.69
485	HR-ICP-MS	13.5	3.73	9.38	5.15	2.40
598	ICP-MS	15.60	4.31	10.21	6.36	3.49
599	DRC/CC-ICP-MS	13.97	*9.4	*6.18	4.53	4.75
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		14.5	4.1	9.6	5.7	3.1
Arithmetic SD (s)		0.8	0.5	0.6	1.0	0.9
Arithmetic RSD (%)		5.5	12.2	6.3	17.5	29
Number of Sample Measurements (N)		6	5	5	6	6

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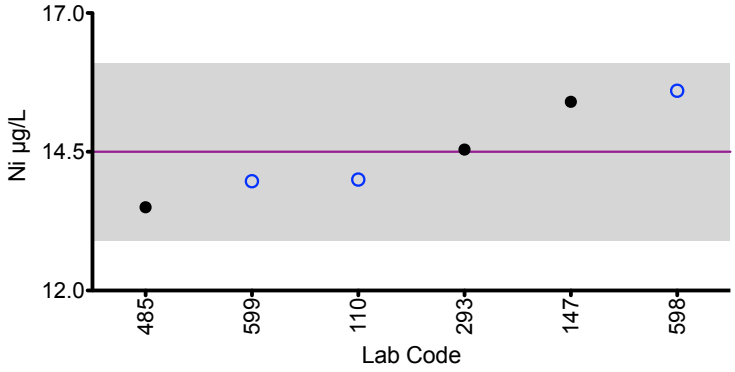
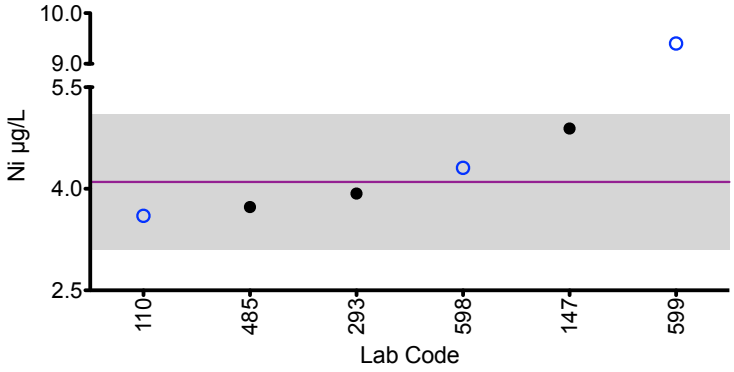
Results for Event #2, 2018: Summary Figures

Serum Ni

SE18-06



SE18-07



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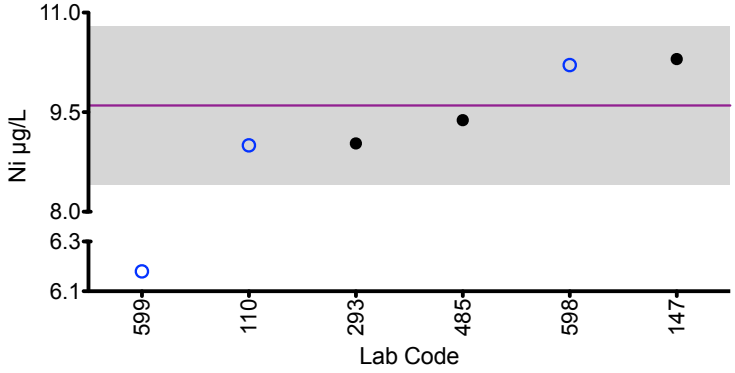

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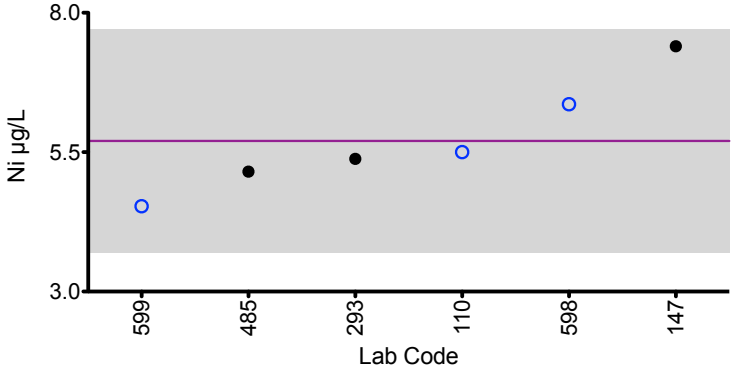
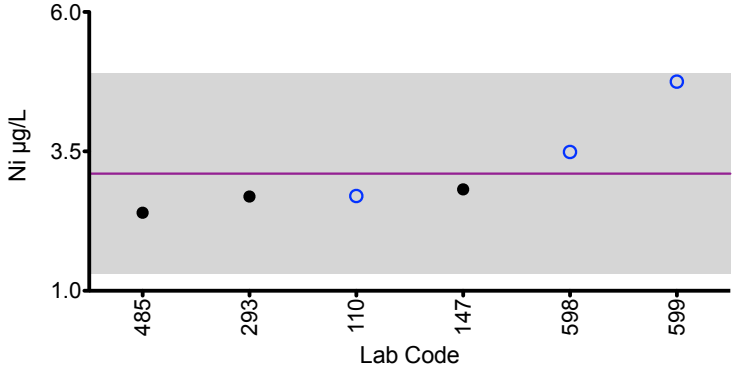


SE18-10



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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
103	DRC/CC-ICP-MS	11.4	3.16	5.83	7.60	8.97
110	ICP-MS	10.8	3.1	5.6	7.6	8.9
147	ICP-MS	10.8	2.84	4.83	6.84	8.50
597	DRC/CC-ICP-MS	*15.2	4.02	6.34	9.33	10.4
598	ICP-MS	10.28	2.89	5.19	6.97	8.05
599	DRC/CC-ICP-MS	10.61	5.43	7.27	3.11	8.63
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		10.8	3.6	5.8	6.9	8.9
Arithmetic SD (s)		0.4	1.0	0.9	2.1	0.8
Arithmetic RSD (%)		3.7	28	15.5	30	9.0
Number of Sample Measurements (N)		5	6	6	6	6

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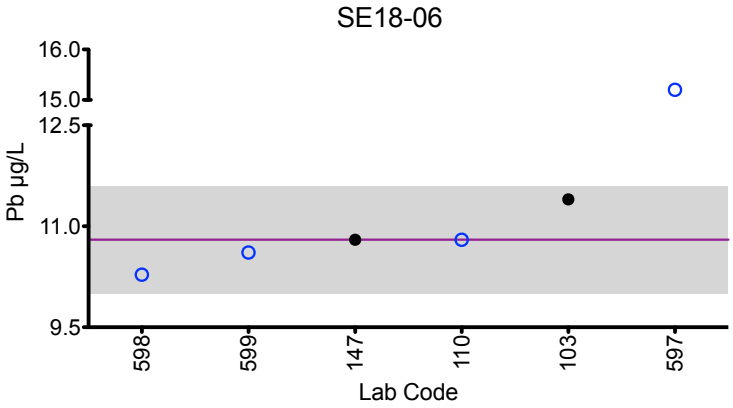
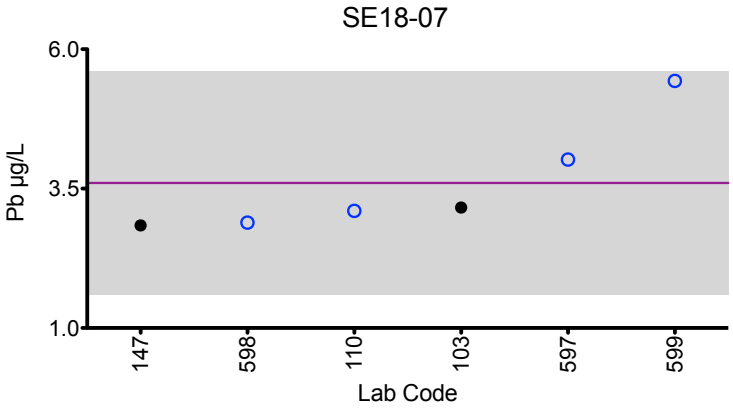
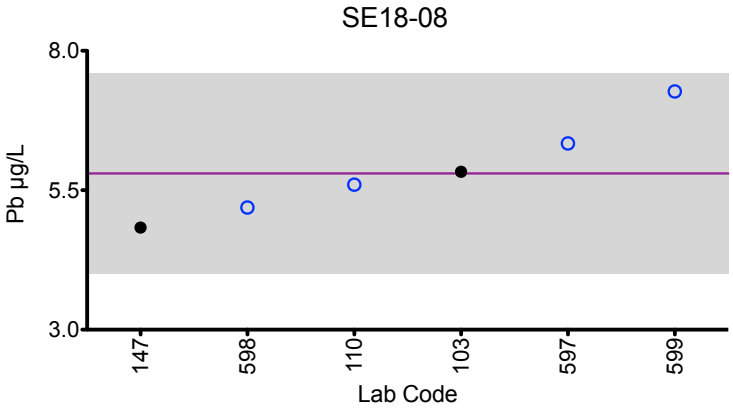
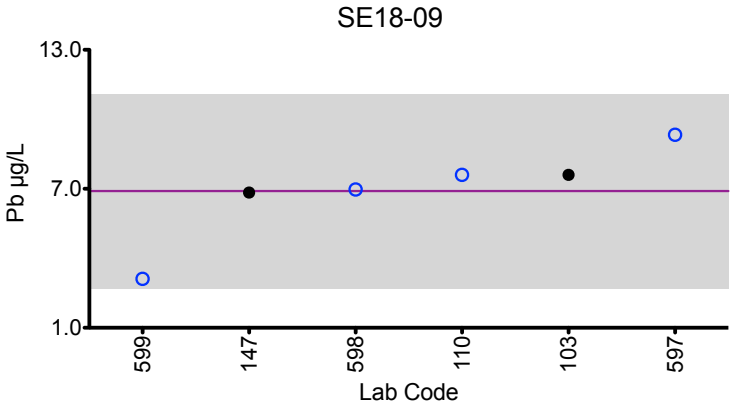
Results for Event #2, 2018: Summary Figures

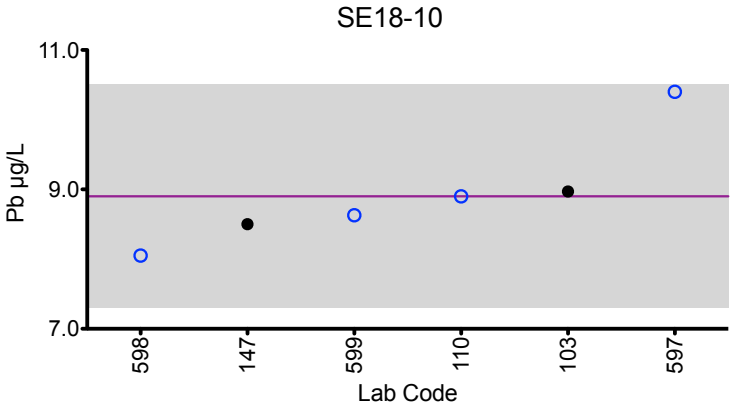
Serum Pb











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)

Lab Code	Method	SE18-06	SE18-07	SE18-08	SE18-09	SE18-10
103	DRC/CC-ICP-MS	1.71	0.358	4.68	1.28	2.96
110	ICP-MS	1.60	0.37	4.30	1.22	2.81
147	ICP-MS	1.74	0.323	3.45	1.36	3.01
597	DRC/CC-ICP-MS	2.41	0.652	4.90	1.67	3.28
598	ICP-MS	1.85	0.46	4.93	1.40	2.95
599	DRC/CC-ICP-MS	1.92	*4.74	1.60	0.53	3.36

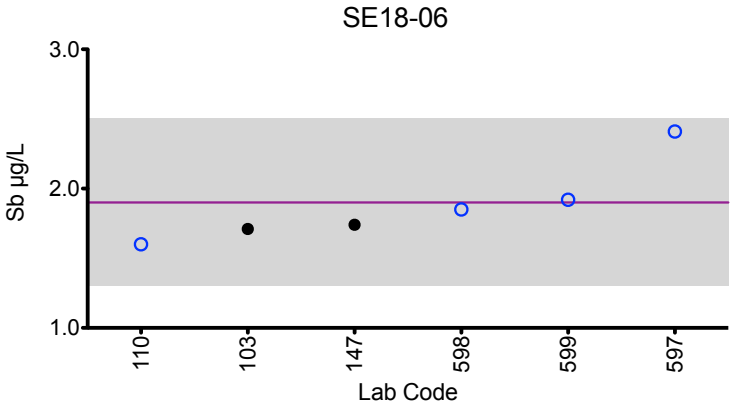
Summary Statistics

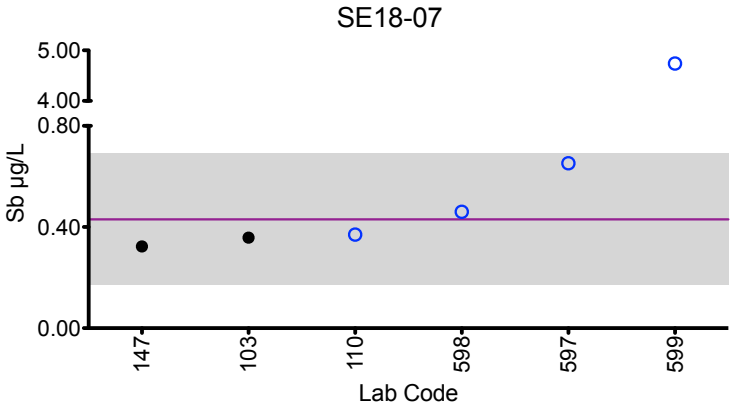
	SE18-06	SE18-07	SE18-08	SE18-09	SE18-10
Arithmetic Mean ($\bar{x}$)	1.9	0.43	4.0	1.2	3.1
Arithmetic SD (s)	0.3	0.13	1.3	0.4	0.2
Arithmetic RSD (%)	15.8	30	33	33	6.5
Number of Sample Measurements (N)	6	5	6	6	6

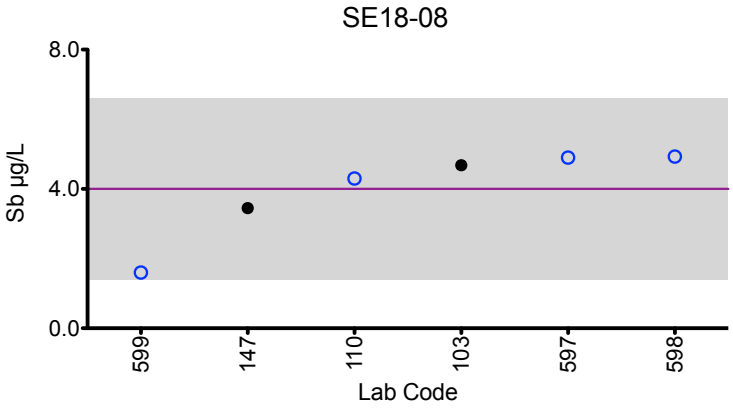
*Denotes a statistical Outlier.

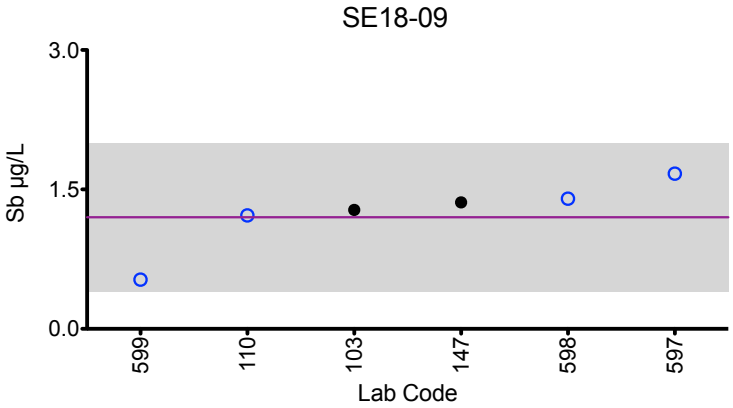
Results for Event #2, 2018: Summary Figures

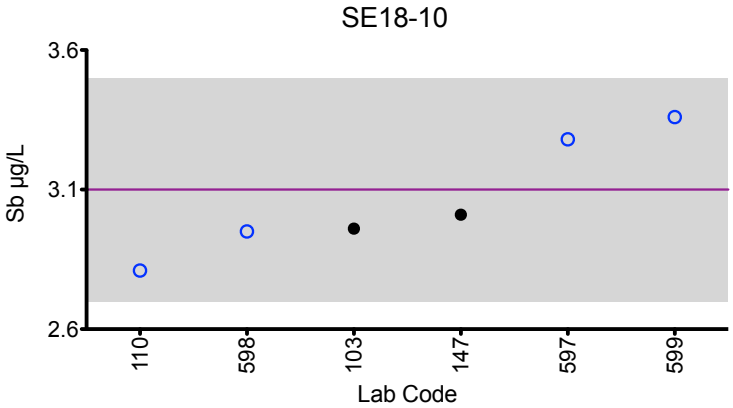
Serum Sb











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum V (µg/L)

Lab Code	Method	SE18-06	SE18-07	SE18-08	SE18-09	SE18-10
110	DRC/CC-ICP-MS	8.6	1.0	2.1	5.6	1.4
147	DRC/CC-ICP-MS	7.70	0.980	1.82	5.41	0.959
293	DRC/CC-ICP-MS	8.57	1.03	2.23	5.97	1.07
485	HR-ICP-MS	8.74	0.986	2.13	5.89	1.00
597	DRC/CC-ICP-MS	10.4	1.25	2.21	6.50	1.23
598	DRC/CC-ICP-MS	9.51	1.11	2.34	6.44	1.16
599	DRC/CC-ICP-MS	9.85	*2.6	*7.3	*2.01	*1.99

Summary Statistics

	SE18-06	SE18-07	SE18-08	SE18-09	SE18-10
Arithmetic Mean ($\bar{x}$)	9.1	1.1	2.1	6.0	1.1
Arithmetic SD (s)	0.9	0.1	0.2	0.4	0.2
Arithmetic RSD (%)	9.9	9.1	9.5	6.7	18.2
Number of Sample Measurements (N)	7	6	6	6	6

*Denotes a statistical Outlier.

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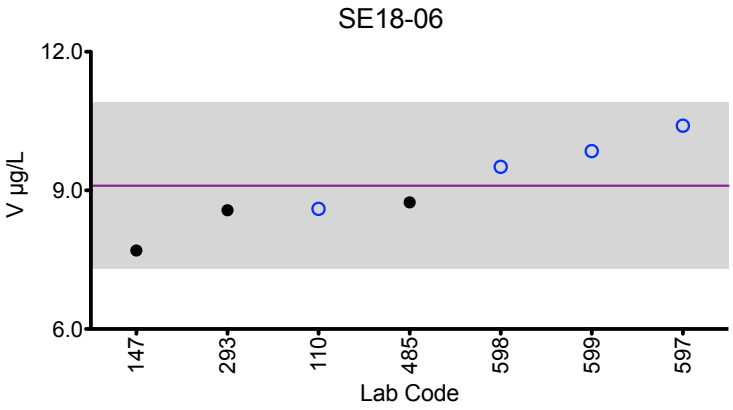
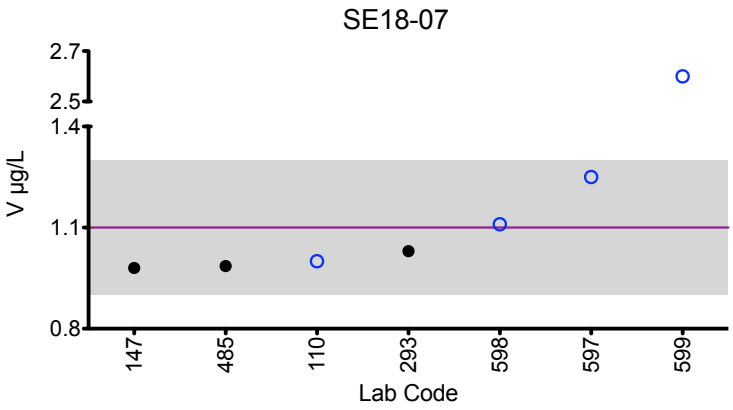
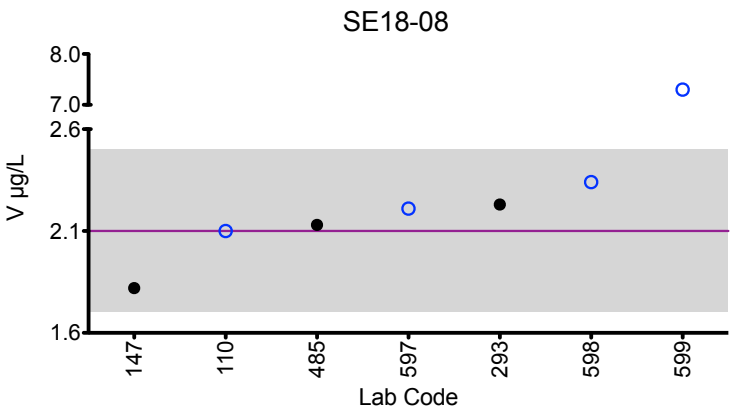
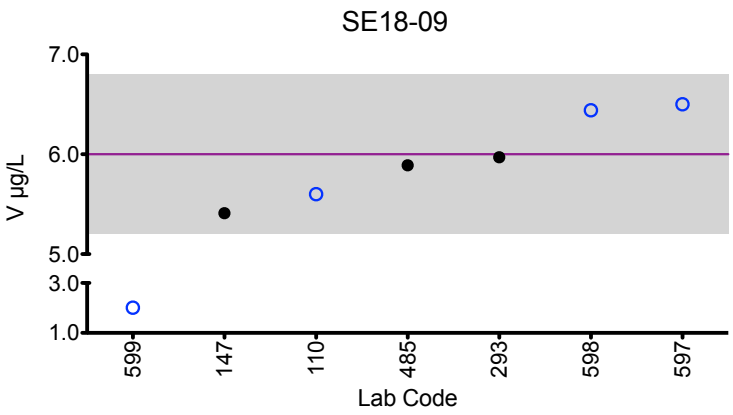
Results for Event #2, 2018: Summary Figures

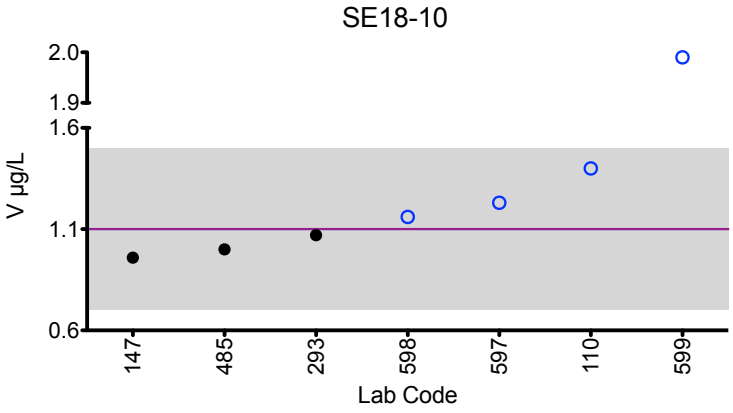
Serum V











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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
110	ICP-MS	1.7	1.7	1.3	1.6	1.3
147	ICP-MS	1.26	1.62	1.04	1.39	1.20
598	ICP-MS	1.47	1.80	1.32	1.78	1.32
599	DRC/CC-ICP-MS	1.06	0.93	1.37	1.24	1.11
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		1.4	1.5	1.3	1.5	1.2
Arithmetic SD (s)		0.3	0.4	0.1	0.2	0.1
Arithmetic RSD (%)		21	27	7.7	13.3	8.3
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
110	ICP-MS	0.35	0.34	0.62	0.35	0.62
597	DRC/CC-ICP-MS	0.491	0.526	0.757	0.504	0.829
598	ICP-MS	0.422	0.384	0.621	0.352	0.604
599	DRC/CC-ICP-MS	0.36	0.64	0.36	0.36	0.64
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		0.4	0.5	0.6	0.4	0.7
Arithmetic SD (s)		0.1	0.1	0.2	0.1	0.1
Arithmetic RSD (%)		25	20	33	25	14.3
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
110	ICP-MS	1.3	0.1	0.2	0.9	0.5
598	ICP-MS	1.57	0.06	0.21	0.98	0.47
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		1.4	0.08	0.20	0.94	0.48
Arithmetic SD (s)		0.2	0.03	0.01	0.06	0.02
Arithmetic RSD (%)		14.3	38	5.0	6.4	4.2
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
110	ICP-MS	9.8	2.4	4.9	1.1	7.5
597	DRC/CC-ICP-MS	13.1	2.99	5.50	1.43	8.44
598	ICP-MS	10.80	2.50	5.16	1.19	7.47
599	DRC/CC-ICP-MS	8.94	*5.22	*1.9	*2.9	8.14
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		10.7	2.6	5.2	1.2	7.9
Arithmetic SD (s)		1.8	0.3	0.3	0.2	0.5
Arithmetic RSD (%)		16.8	11.5	5.8	16.7	6.3
Number of Sample Measurements (N)		4	3	3	3	4

*Denotes a statistical Outlier.

Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
103	DRC/CC-ICP-MS	35.2	107	73.6	82.1	48.9
200	ICP-MS	35.9	111.3	78	86.7	54.3
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		35.6	109	75.8	84.4	51.6
Arithmetic SD (s)		0.5	3	3.1	3.3	3.8
Arithmetic RSD (%)		1.4	2.8	4.1	3.9	7.4
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
200	DRC/CC-ICP-MS	1.9	3.1	4.9	5.2	2.6
485	HR-ICP-MS	2.47	4.10	9.78	6.00	1.57
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		2.2	3.6	NA	5.6	2.1
Arithmetic SD (s)		0.4	0.7	NA	0.6	0.7
Arithmetic RSD (%)		18.2	19.4	NA	10.7	33
Number of Sample Measurements (N)		2	2	NA	2	2

*Denotes a statistical Outlier.

Statistical data were not calculated for SE18-08 based on a lack of consensus among participating labs.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
103	DRC/CC-ICP-MS	4.68	1.07	2.24	3.89	3.28
110	ICP-MS	4.57	1.06	2.17	3.93	3.32
147	ICP-MS	4.35	0.991	1.88	3.52	3.05
598	ICP-MS	4.31	0.96	1.99	3.56	2.93
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		4.5	1.0	2.1	3.7	3.1
Arithmetic SD (s)		0.2	0.1	0.2	0.2	0.2
Arithmetic RSD (%)		4.4	10.0	9.5	5.4	6.5
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum U (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
103	DRC/CC-ICP-MS	0.201	0.0790	0.0587	0.126	0.0215
110	ICP-MS	0.191	0.089	0.056	0.122	0.014
147	ICP-MS	0.195	0.0781	0.0414	0.118	0.0176
598	ICP-MS	0.23	0.09	0.07	0.13	0.03
Summary Statistics						
		SE18-06	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
Arithmetic Mean ($\bar{x}$)		0.204	0.084	0.057	0.124	0.021
Arithmetic SD (s)		0.018	0.006	0.012	0.005	0.007
Arithmetic RSD (%)		8.8	7.1	21	4.0	33
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

Results for Event #2, 2018:
Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE18-06	SE18-07	SE18-08	SE18-09	SE18-10
110	ICP-MS	0.18	0.97	0.38	1.16	0.54
147	ICP-MS	0.134	0.826	0.263	1.06	0.480
200	ICP-MS	0.5	1.4	*0.9	1.7	*1.4
598	ICP-MS	0.35	1.07	0.47	1.24	0.61

Summary Statistics

	SE18-06	SE18-07	SE18-08	SE18-09	SE18-10
Arithmetic Mean ($\bar{x}$)	NA	1.1	0.4	1.3	0.5
Arithmetic SD (s)	NA	0.2	0.1	0.3	0.1
Arithmetic RSD (%)	NA	18.2	25	23	20
Number of Sample Measurements (N)	NA	4	3	4	3

*Denotes a statistical Outlier.

Statistical data were not calculated for SE18-06 based on a lack of consensus among participating labs.

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Results for Event #2, 2018: Additional Elements in Serum

Serum Ag (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
147	ICP-MS	< 0.227	< 0.227	0.228	< 0.227	0.263

Serum B (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
200	ICP-MS	48	46	62	30	43.0

Serum Bi (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
147	ICP-MS	< 0.230	< 0.230	< 0.230	< 0.230	< 0.230

Serum Fe (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
457	ICP-AES/OES	794	244	853	236	883

Serum I (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
147	ICP-MS	50.8	46.3	57.6	46.3	56.1

Serum Li (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
147	ICP-MS	0.708	0.593	0.999	0.461	1.01

Serum Te (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
147	ICP-MS	< 0.153	< 0.153	< 0.153	< 0.153	< 0.153

Serum Th (µg/L)						
Lab Code	**Method**	**SE18-06**	**SE18-07**	**SE18-08**	**SE18-09**	**SE18-10**
147	ICP-MS	< 0.00882	< 0.00882	< 0.00882	< 0.00882	< 0.00882

References

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

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.