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New York State Biomonitoring Program for Trace Elements

Event #1, 2020

Trace Elements in Whole Blood, Urine, and Serum

July, 2020

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #1, 2020:
Trace Elements in Whole Blood, Urine, and Serum

7/20/2020

Dear Laboratory Director,

This report summarizes performance for the first biomonitoring proficiency test (PT) event of 2020 for Trace Elements in Whole Blood, Urine, and Serum. There was a delay getting this report finalized due to the pandemic and COVID-19. Currently, we are back in the laboratory at Wadsworth and slowly resuming our laboratory programs. We expect the second PT event to be delayed as a result of COVID-19, shipping on 6/30/2020, with results due 7/29/20. Should your laboratory experience any unforseen delays with reporting results, please contact us as soon as possible. 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.

Sincerely,

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

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

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Event #1, 2020

Trace Elements in Whole Blood

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #1, 2020:
Trace Elements in Whole Blood

PT Materials

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

Graded Elements

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

Additional Elements

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

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

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Results for Event #1, 2020: Summary Statistics

Whole Blood As (µg/L)					
	BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Target (Arithmetic Mean ($\bar{x}$))	18.0	2.93	29.1	10.0	41.4
Upper Limit	24.0	8.93	35.1	16.0	49.7
Lower Limit	12.0	0.00	23.1	4.0	33.1
Arithmetic SD (s)	1.4	0.22	2.0	0.6	3.7
Arithmetic RSD (%)	7.8	7.5	6.9	6.3	8.9
Number of Sample Measurements (N)	7	7	8	8	8

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
	Target	**18.0**	**2.93**	**29.1**	**10.0**	**41.4**
103	DRC/CC-ICP-MS	18.7	2.85	31.3	10.5	44.3
110	DRC/CC-ICP-MS	19.0	2.8	30.3	10.0	43.8
147	ICP-MS	17.6	2.77	29.1	9.59	41.4
264	ICP-MS	*27.98 ↑	3.01	28.67	10.01	41.32
293	DRC/CC-ICP-MS	17.89	2.85	29.75	9.96	41.96
391	DRC/CC-ICP-MS	17.457	*5.558	28.005	11.005	36.475
597	ICP-MS/MS	15.5	2.83	25.1	8.86	35.7
598	DRC/CC-ICP-MS	19.8	3.39	30.8	9.88	46.3

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

* Denotes a statistical Outlier

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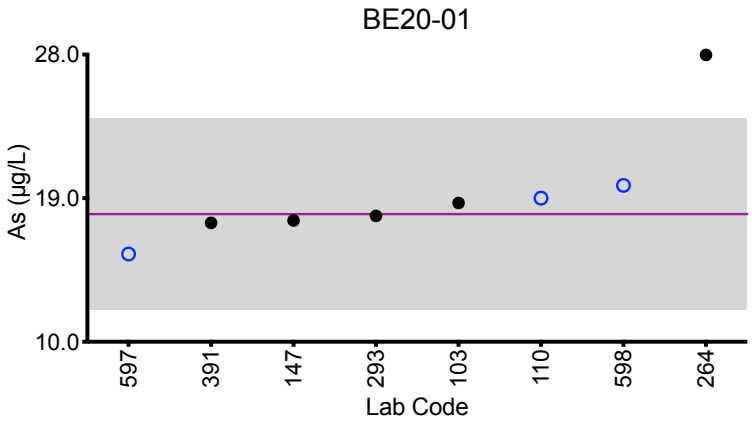
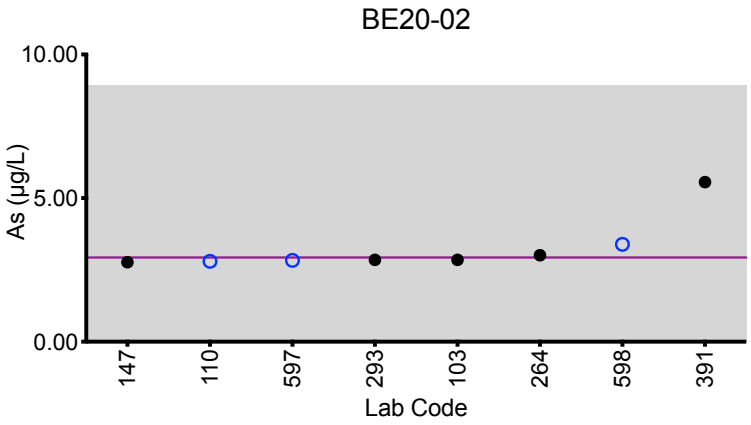
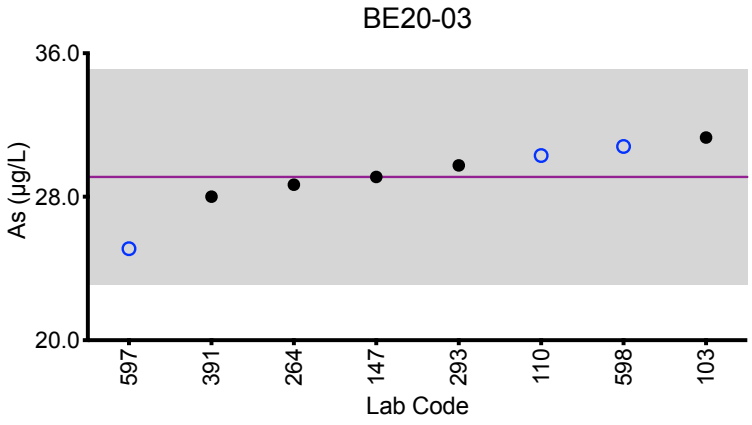
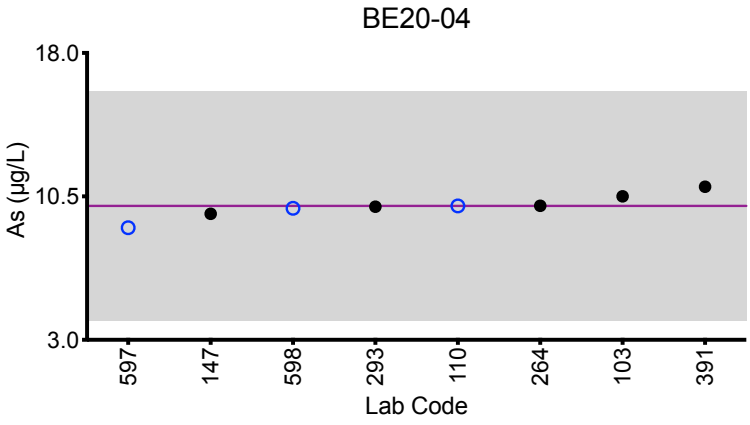
Results for Event #1, 2020: Summary Figures

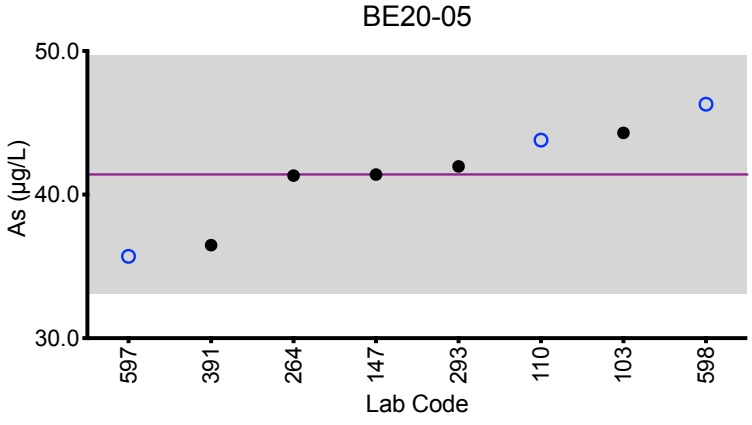
Whole Blood As











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020: Summary Statistics

Whole Blood Cd (µg/L)					
	BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Target (Robust Mean (x*))	3.64	15.0	11.4	0.88	7.1
Upper Limit	4.64	17.3	13.1	1.88	8.1
Lower Limit	2.64	12.8	9.7	0.00	6.0
Robust SD (s*)	0.18	0.8	0.8	0.11	0.3
Robust RSD (%)	4.9	5.3	6.7	13	4.8
Number of Sample Measurements (N)	13	13	13	12	13
Standard Uncertainty (*u*)	0.06	0.3	0.3	0.04	0.1

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
	Target	**3.64**	**15.0**	**11.4**	**0.88**	**7.1**
103	DRC/CC-ICP-MS	3.60	14.9	11.8	0.975	7.22
107	ICP-MS/MS	3.648	15.809	10.675	0.874	7.277
110	ICP-MS	3.64	15.2	11.6	0.88	7.05
116	ICP-MS/MS	3.53	15.7	12.6	<1.5	7.61
147	ICP-MS	3.60	13.9	11.1	0.803	6.73
264	ICP-MS	5.29 ↑	14.44	10.62	0.73	7.08
293	DRC/CC-ICP-MS	3.76	15.76	11.88	0.97	7.45
391	DRC/CC-ICP-MS	3.32	14.171	11.01	0.759	6.477
597	ICP-MS/MS	3.36	14.6	10.6	0.882	6.40
598	DRC/CC-ICP-MS	3.68	14.3	10.7	0.82	6.71
605	ICP-MS	4.13	16.1	12.3	1.01	7.20
606	ICP-MS/MS	3.75	15.2	12.1	1.02	7.26
686	ICP-MS	3.52	14.7	11.2	0.882	6.99

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

* Denotes a statistical Outlier

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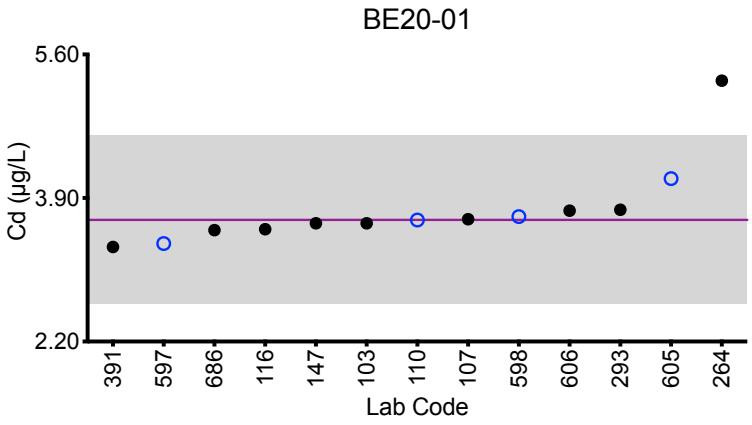
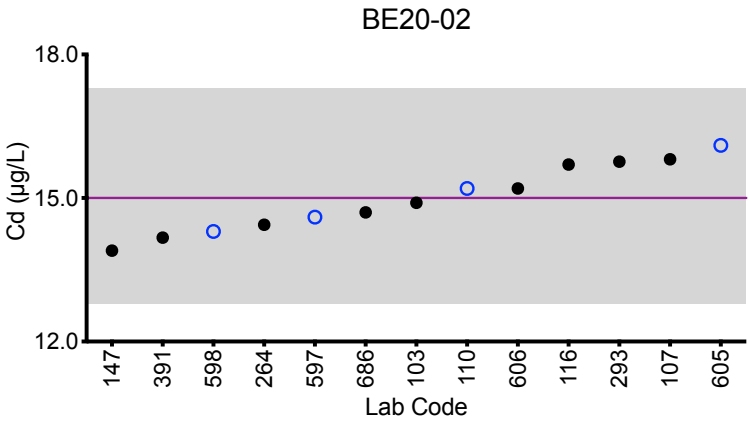
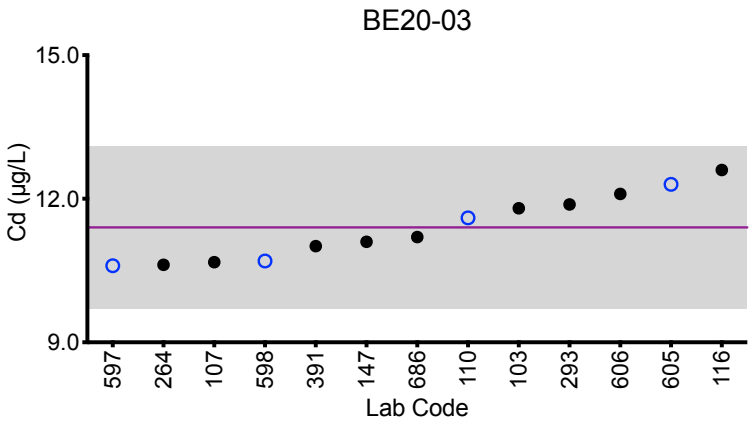
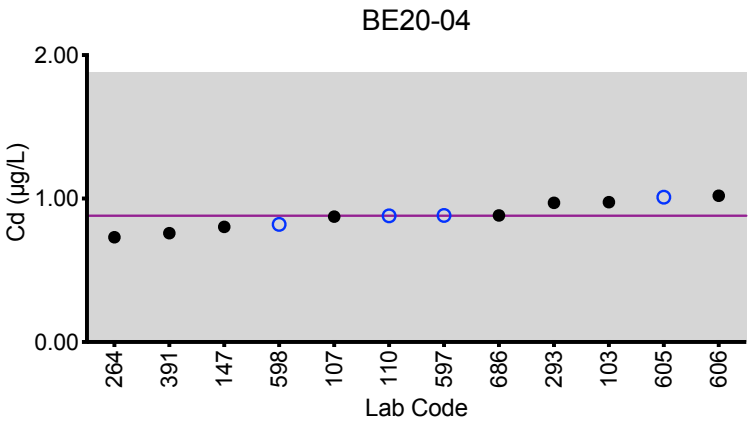
Results for Event #1, 2020: Summary Figures

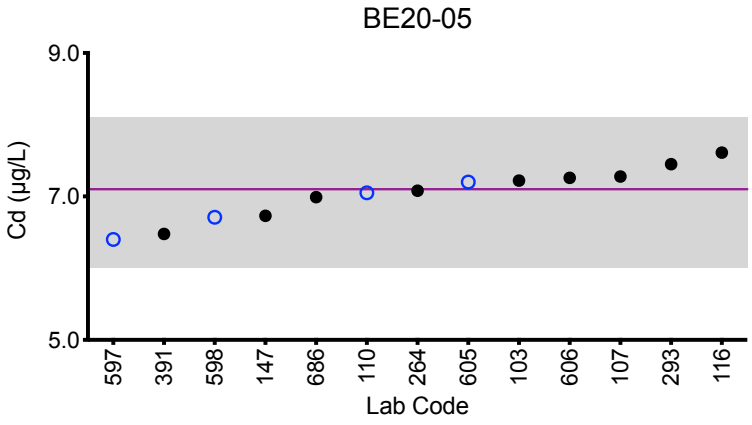
Whole Blood Cd











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 #1, 2020: Summary Statistics

Whole Blood Co (µg/L)					
	BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Target (Arithmetic Mean ($\bar{x}$))	15.2	10.4	4.7	7.7	7.4
Upper Limit	18.2	12.5	6.2	9.2	8.9
Lower Limit	12.2	8.3	3.2	6.2	5.9
Arithmetic SD (s)	0.8	0.5	0.3	0.5	0.5
Arithmetic RSD (%)	5.3	4.8	7.2	6.5	6.8
Number of Sample Measurements (N)	8	9	9	9	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 #1, 2020:
Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
	Target	**15.2**	**10.4**	**4.7**	**7.7**	**7.4**
103	DRC/CC-ICP-MS	15.2	10.2	4.72	7.50	7.20
110	ICP-MS	16.1	10.9	5.1	8.0	8.1
147	ICP-MS	16.0	10.5	4.99	7.72	7.66
255	ICP-MS	15	10	5.2	8.6	7.6
264	ICP-MS	*23.76 ↑	10.73	4.47	7.51	7.39
293	DRC/CC-ICP-MS	15.9	11.13	4.91	7.97	7.97
391	DRC/CC-ICP-MS	15.048	10.429	4.607	7.2	7.359
597	ICP-MS/MS	13.5	9.61	4.19	7.02	6.41
598	ICP-MS	14.8	9.92	4.41	7.50	7.08

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

* Denotes a statistical Outlier

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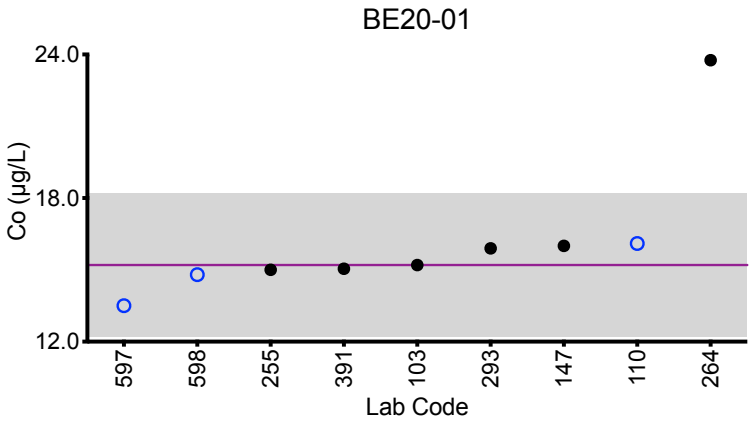
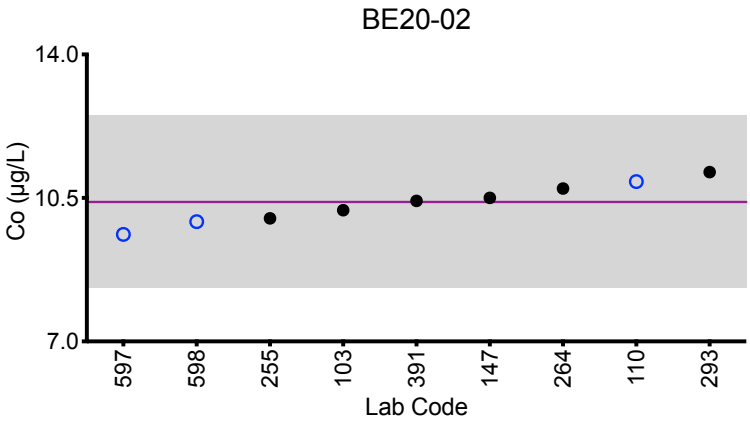
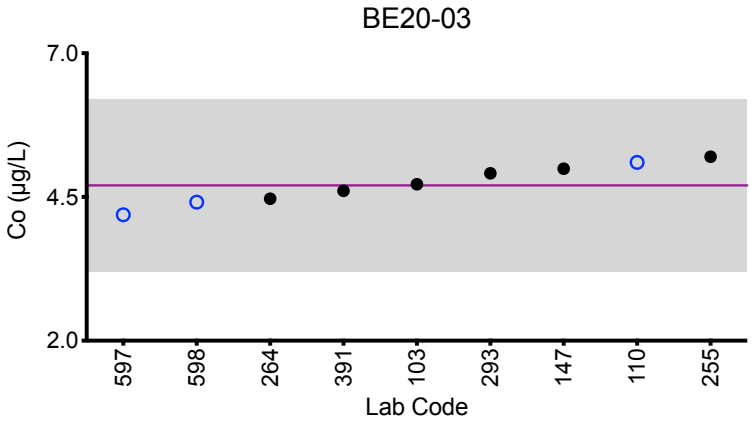
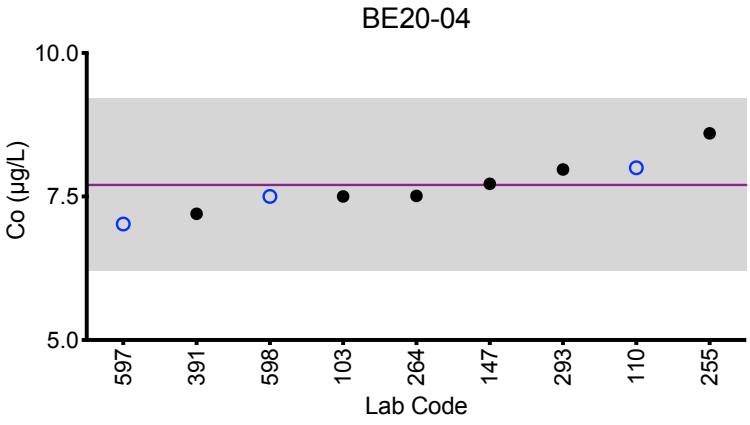
Results for Event #1, 2020: Summary Figures

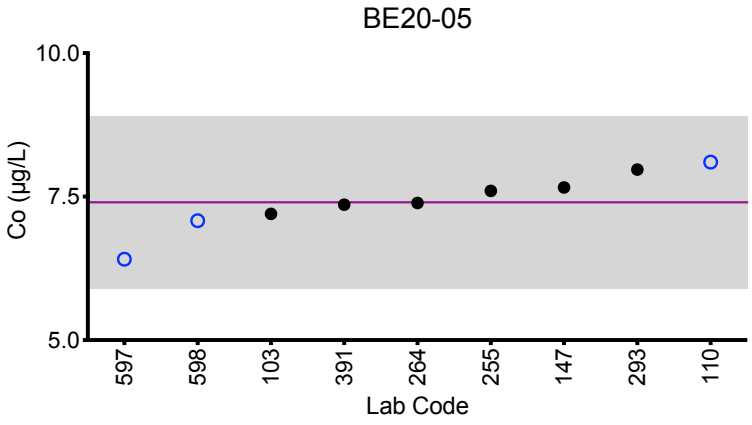
Whole Blood Co











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020: Summary Statistics

Whole Blood Cr (µg/L)					
	BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Target (Arithmetic Mean ($\bar{x}$))	12.5	1.54	15.9	7.7	4.1
Upper Limit	15.0	3.54	19.1	9.7	6.1
Lower Limit	10.0	0.00	12.7	5.7	2.1
Arithmetic SD (s)	1.2	0.12	1.4	0.6	0.5
Arithmetic RSD (%)	9.6	7.8	8.8	7.8	12
Number of Sample Measurements (N)	8	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 #1, 2020:
Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
	Target	**12.5**	**1.54**	**15.9**	**7.7**	**4.1**
110	DRC/CC-ICP-MS	13.5	1.7	17.5	7.8	4.1
147	DRC/CC-ICP-MS	13.1	1.42	16.2	7.28	4.27
255	ICP-MS	13	1.6	17	7.9	4.7
264	ICP-MS	10.87	1.58	15.43	8.32	4.48
293	DRC/CC-ICP-MS	13.88	1.63	17.66	8.46	4.36
391	DRC/CC-ICP-MS	10.735	1.462	14.435	6.58	3.082
597	ICP-MS/MS	13.3	*2.22	14.4	7.51	3.67
598	DRC/CC-ICP-MS	11.8	1.38	14.8	7.45	3.85

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

* Denotes a statistical Outlier

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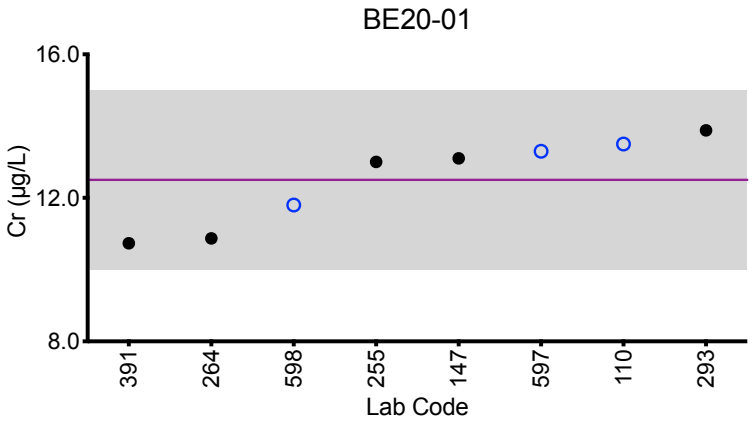
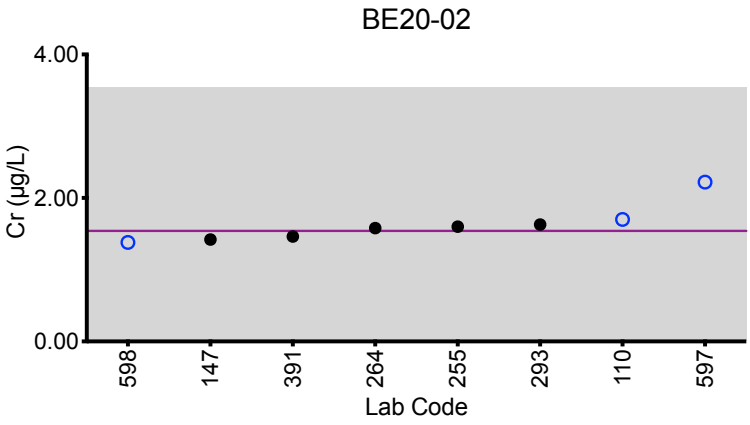
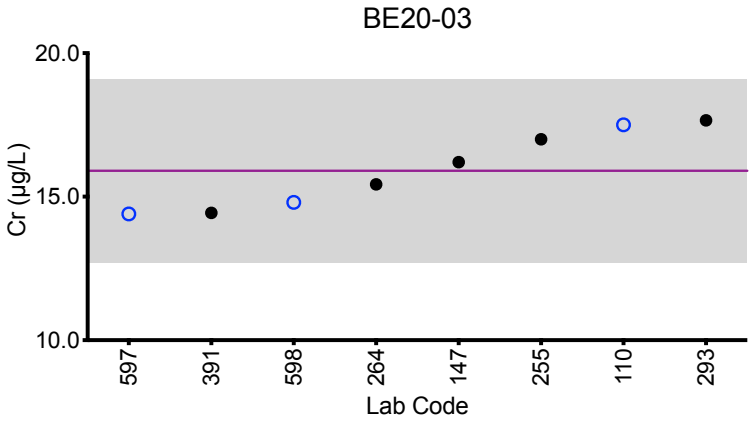
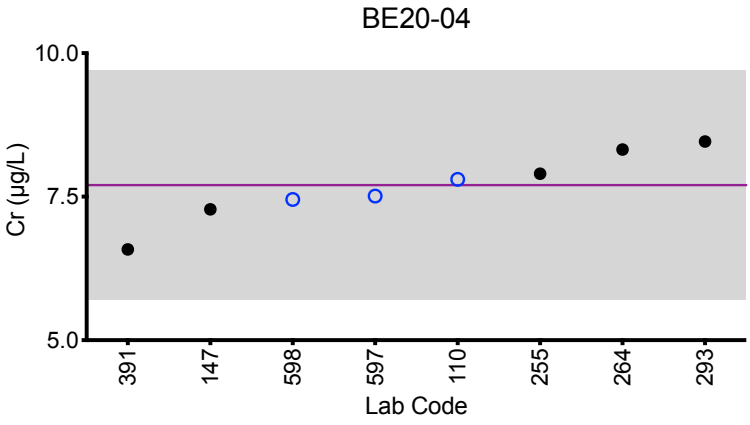
Results for Event #1, 2020: Summary Figures

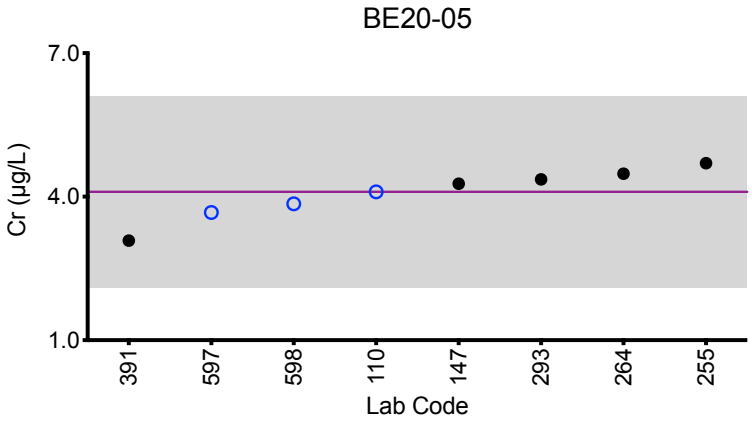
Whole Blood Cr











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 #1, 2020: Summary Statistics

Whole Blood Hg (µg/L)					
	BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Target (Robust Mean (x*))	25.6	1.87	5.3	9.7	13.4
Upper Limit	33.3	4.87	8.3	12.7	17.4
Lower Limit	17.9	0.00	2.3	6.7	9.4
Robust SD (s*)	1.7	0.21	0.3	0.8	1.0
Robust RSD (%)	6.6	11	5.5	8.2	7.5
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (*u*)	0.6	0.07	0.1	0.3	0.3

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
	Target	**25.6**	**1.87**	**5.3**	**9.7**	**13.4**
103	DRC/CC-ICP-MS	26.0	2.10	5.49	9.64	13.5
107	ICP-MS/MS	26.83	2.02	5.05	10.12	13.98
110	ICP-MS	24.0	1.66	5.34	9.20	12.7
116	ICP-MS/MS	26.9	1.94	5.49	10.8	14.4
147	ICP-MS	24.3	1.69	4.97	8.89	12.5
264	ICP-MS	27.21	1.99	6.15	10.55	14.62
293	DRC/CC-ICP-MS	23.81	1.46	4.81	8.92	12.67
391	CV-AAS	35.32 ↑	2.547	8.991 ↑	17.27 ↑	25.2 ↑
597	DMA	25.3	1.80	5.28	9.20	13.2
598	ICP-MS	21.2	1.71	4.51	9.00	11.5
605	ICP-MS	25.3	1.87	5.32	9.29	12.9
606	ICP-MS/MS	26.6	1.93	5.48	9.84	13.5
686	ICP-MS	25.6	1.83	5.33	9.80	13.3

Based on the grading criteria for Hg in Whole Blood, 94% of results were satisfactory, with 1 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier

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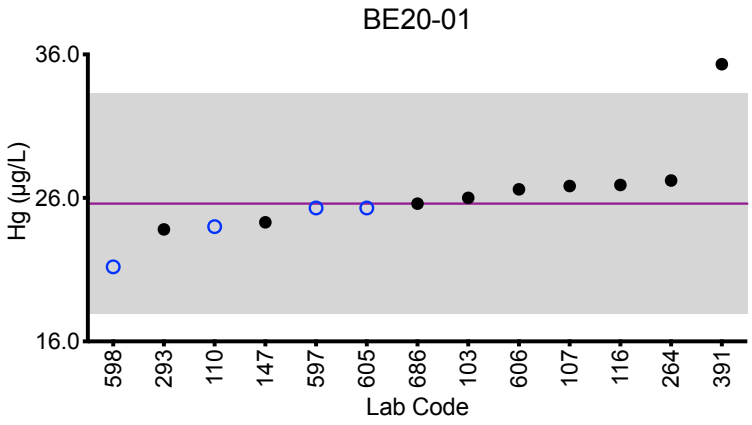
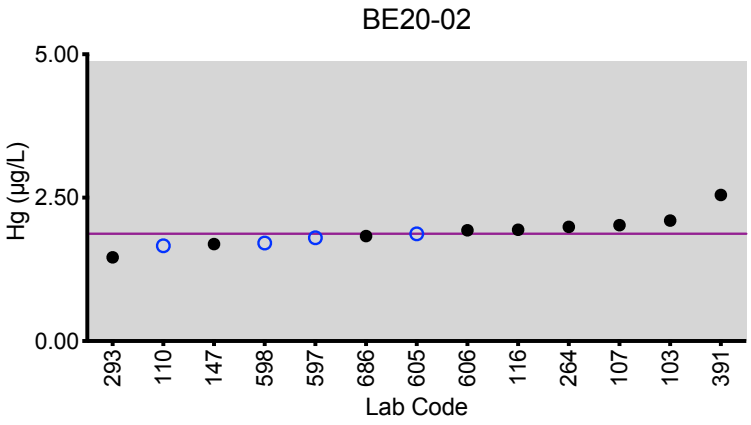
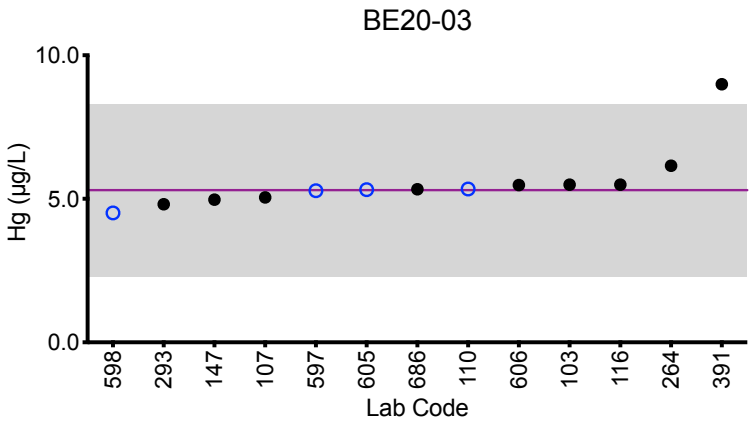
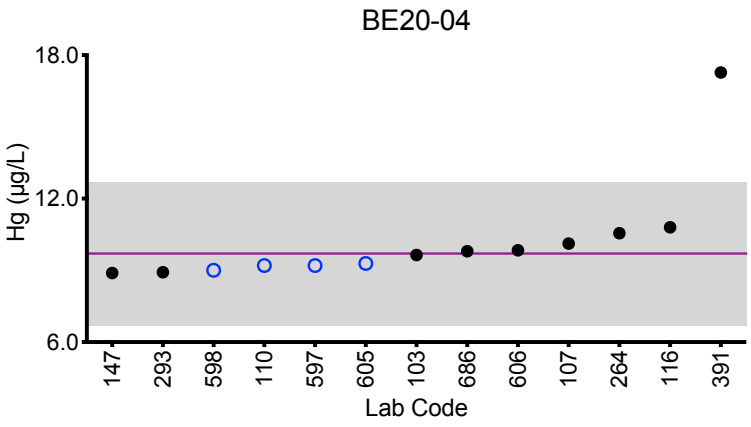
Results for Event #1, 2020: Summary Figures

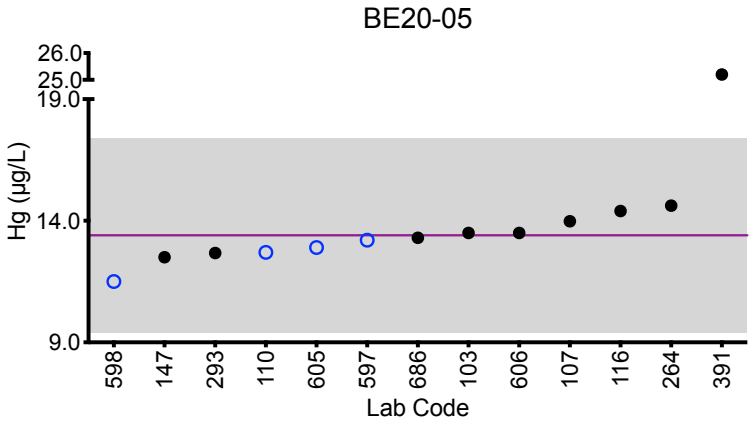
Whole Blood Hg











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 #1, 2020: Summary Statistics

Whole Blood Mn (µg/L)					
	BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Target (Robust Mean (x*))	14.9	27.3	10.4	26.9	23.9
Upper Limit	17.9	31.9	13.4	31.5	28.0
Lower Limit	11.9	22.7	7.4	22.3	19.8
Robust SD (s*)	2.3	2.9	2.1	2.0	2.3
Robust RSD (%)	15	11	20	7.4	9.6
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.9	0.1	0.8	0.8	0.9

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
	Target	**14.9**	**27.3**	**10.4**	**26.9**	**23.9**
103	DRC/CC-ICP-MS	16.7	29.8	12.8	29.5	26.1
107	ICP-MS/MS	14.54	30.44	9.34	27.42	26.35
110	ICP-MS	13.6	28.2	10.9	27.4	25.2
147	ICP-MS	15.3	25.9	12.1	26.3	22.9
264	ICP-MS	17.56	30.17	12.51	29.03	26.14
293	DRC/CC-ICP-MS	9.88 ↓	23.89	7.96	23.01	21.91
391	DRC/CC-ICP-MS	15.918	27.918	11.449	26.602	23.461
597	ICP-MS/MS	17.2	23.5	7.67	23.1	20.0
598	ICP-MS	12.3	25.2	8.61	25.8	22.28
606	ICP-MS/MS	14.6	28.3	10.3	28.2	24.2

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

* Denotes a statistical Outlier

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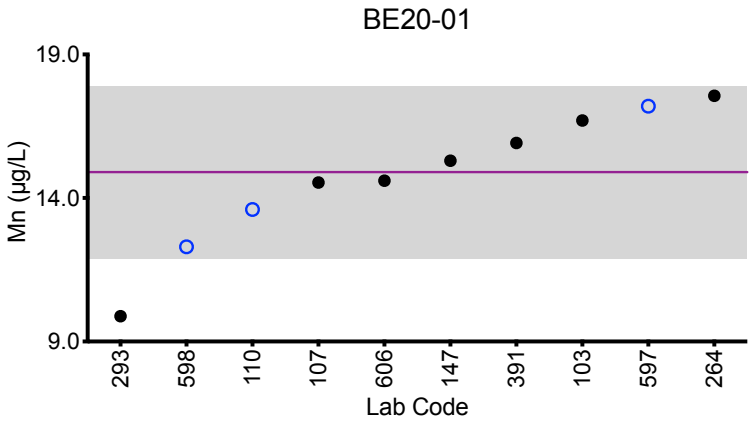
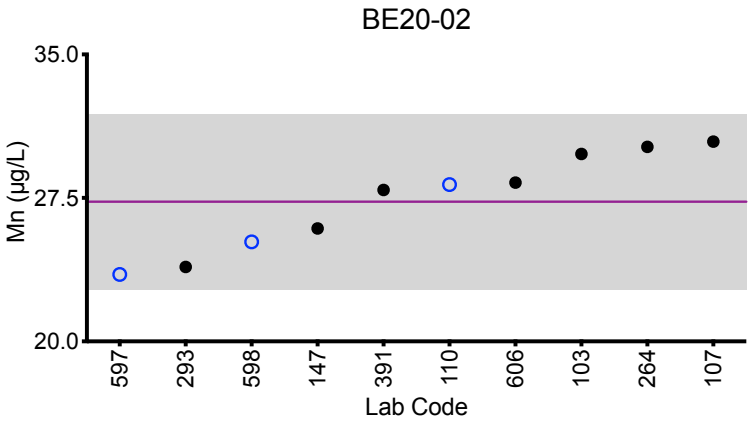
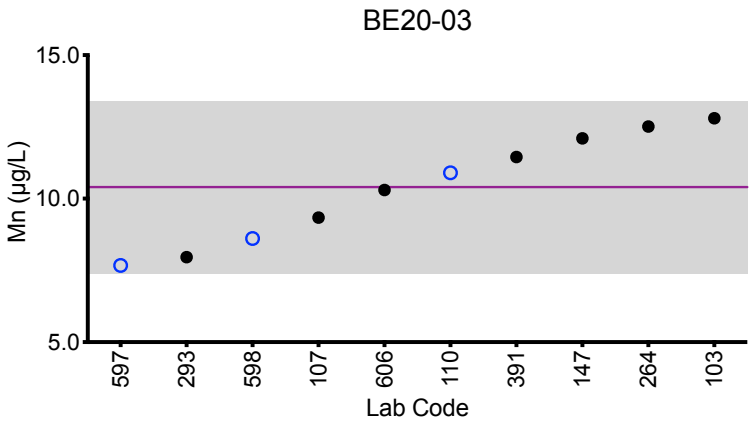
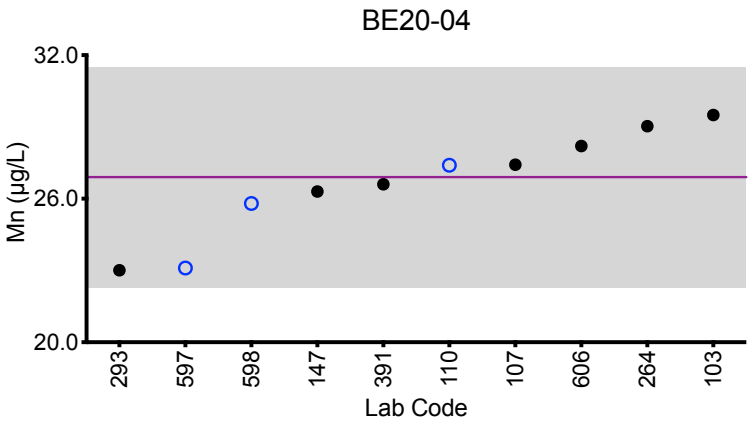
Results for Event #1, 2020: Summary Figures

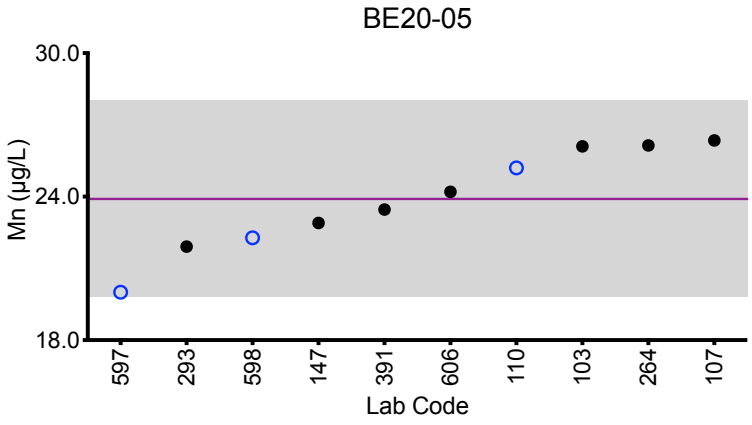
Whole Blood Mn











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 #1, 2020: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Target (Robust Mean (x*))	3.30	1.09	7.8	18.6	44.2
Upper Limit	5.30	3.09	9.8	20.6	48.6
Lower Limit	1.30	0.00	5.8	16.6	39.8
Robust SD (s*)	0.20	0.06	0.7	1.2	2.4
Robust RSD (%)	6.1	5.5	8.7	6.5	5.4
Number of Sample Measurements (N)	12	11	14	14	14
Standard Uncertainty (*u*)	0.07	0.02	0.2	0.4	0.8

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
	Target	**3.30**	**1.09**	**7.8**	**18.6**	**44.2**
103	DRC/CC-ICP-MS	3.32	1.11	8.01	19.3	44.8
107	ICP-MS/MS	3.323	1.146	7.456	18.561	45.762
110	ICP-MS	3.40	1.12	8.14	19.1	45.4
116	ICP-MS/MS	3.49	<3.0	8.46	20.2	47.7
147	ICP-MS	3.48	1.14	8.58	20.0	48.5
264	ICP-MS	3.09	1.00	7.13	16.86	39.55 ↓
293	DRC/CC-ICP-MS	3.1	1.03	7.86	17.99	43.22
343	ASV-LeadCare	<1.9	<1.9	6.5	13.3 ↓	45.2
391	ETAAS-Z	<0.5 ↓	<0.5	3.98 ↓	14.4 ↓	41
597	ICP-MS/MS	3.14	1.08	7.58	18.6	41.9
598	ICP-MS	3.08	1.03	7.44	18.1	41.5
605	ICP-MS	3.69	1.15	8.52	21.3 ↑	45.2
606	ICP-MS/MS	3.37	1.09	8.34	19.2	44.4
686	ICP-MS	3.19	1.06	7.82	18.4	43.3

Based on the grading criteria for Pb in Whole Blood, 91% of results were satisfactory, with 1 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier

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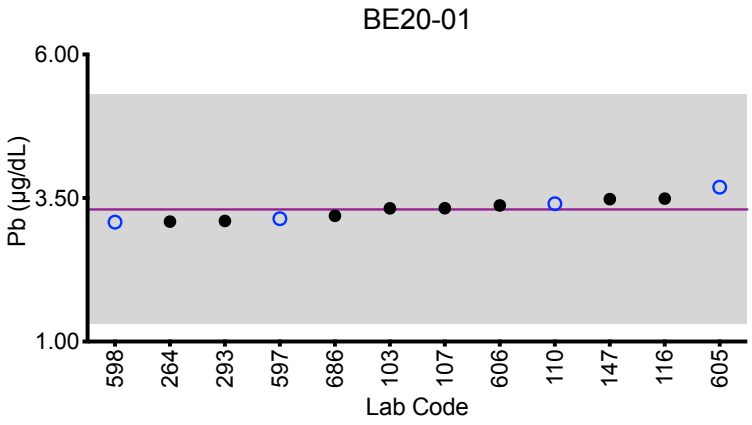
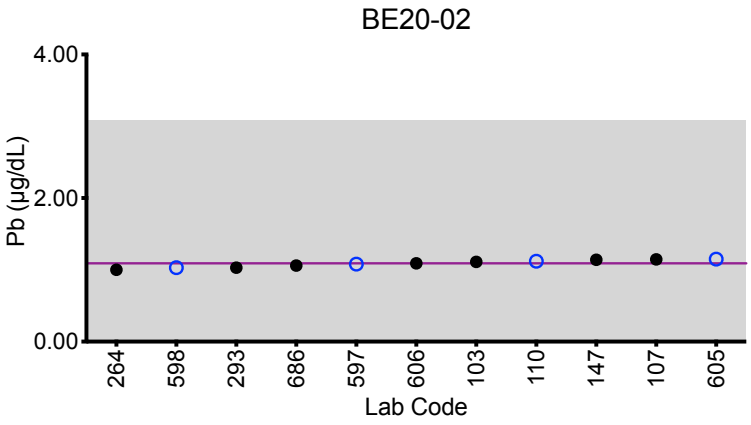
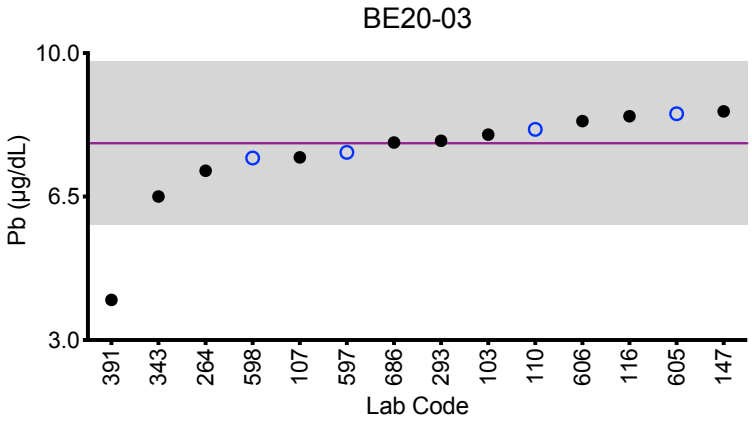
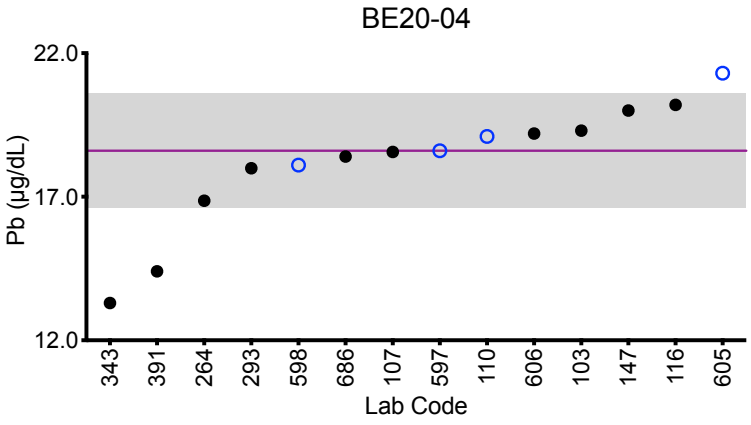
Results for Event #1, 2020: Summary Figures

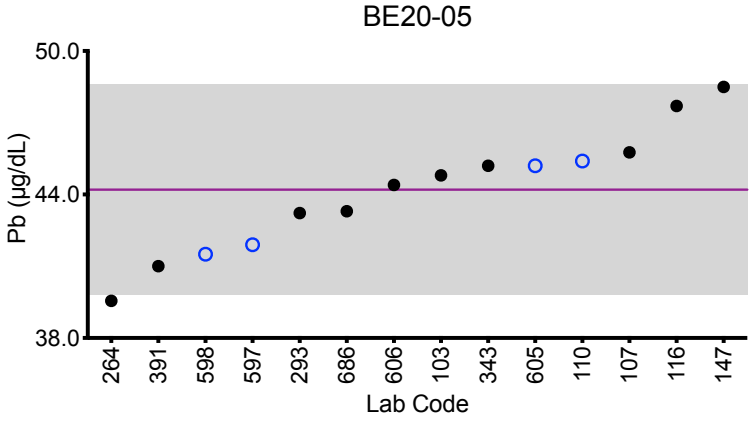
Whole Blood Pb











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 #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
103	DRC/CC-ICP-MS	<1.5	6.51	2.32	2.36	3.42
147	ICP-MS	0.682	6.03	2.36	2.22	3.61
264	ICP-MS	<0.10	6.43	*0.28	*0.27	2.11
597	ICP-MS/MS		5.99	2.17	2.16	3.22
598	DRC/CC-ICP-MS	0.91	7.61	2.86	2.87	4.97
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		NA	6.5	2.4	2.4	3.5
Arithmetic SD (s)		NA	0.7	0.3	0.3	1.0
Arithmetic RSD (%)		NA	11	13	13	29
Number of Sample Measurements (N)		NA	5	4	4	5

*Denotes a statistical Outlier.

Statistical data was not calculated for BE20-01 based on a lack of consensus among participating labs.

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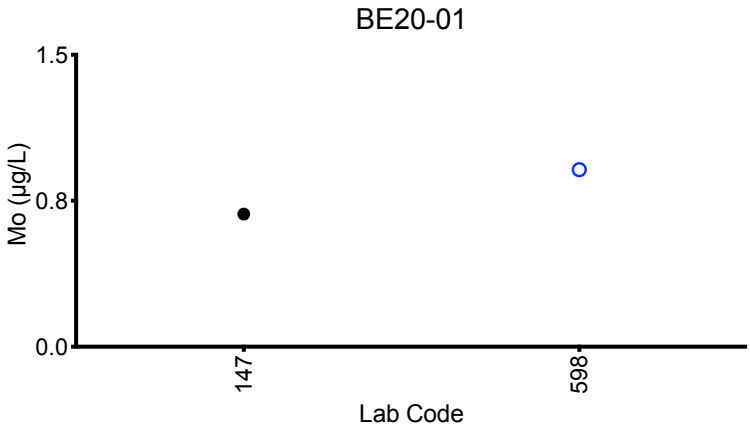
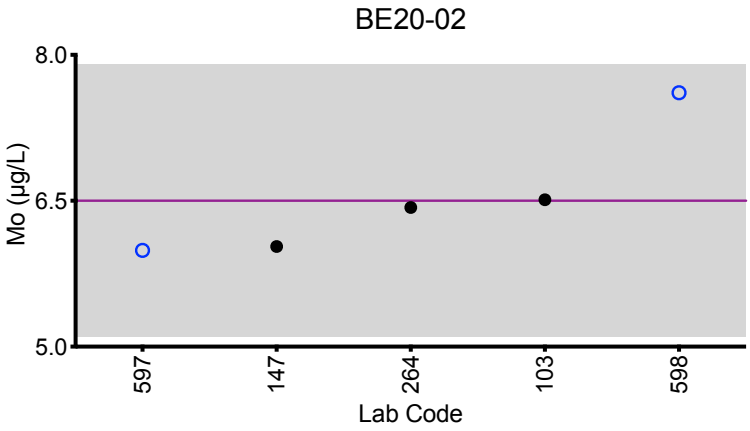
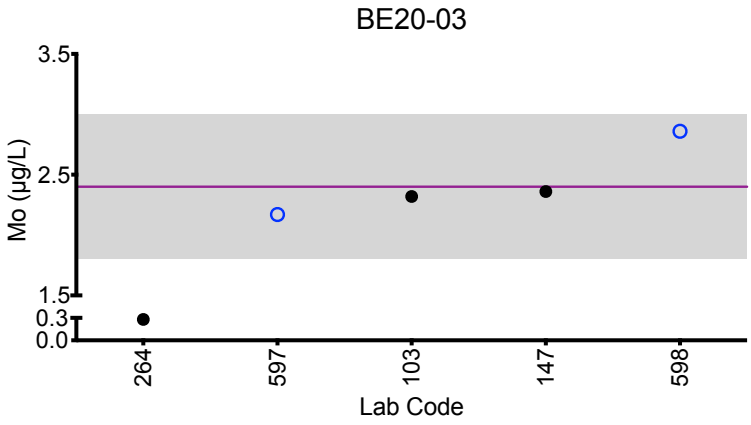
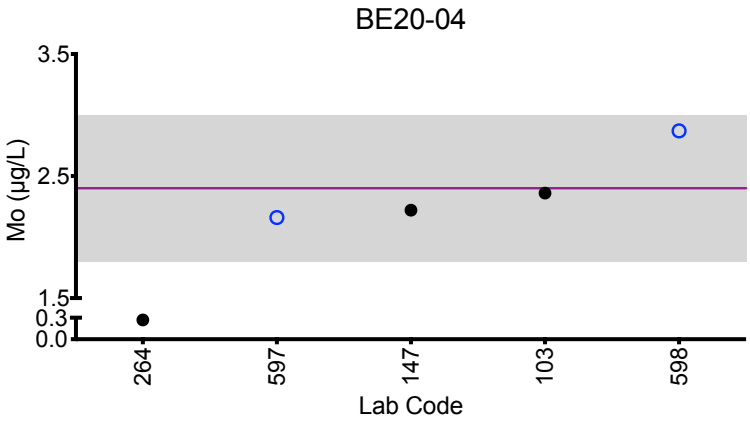
Results for Event #1, 2020: Summary Figures

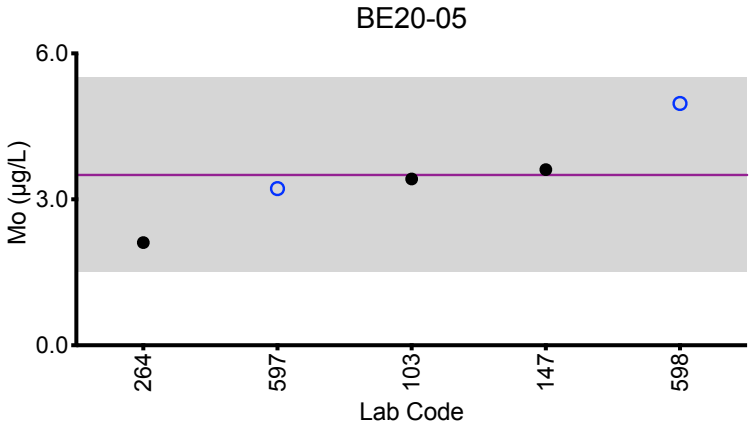
Whole Blood Mo











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

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

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
103	DRC/CC-ICP-MS	<0.15	2.59	0.213	3.96	4.18
110	ICP-MS	<0.04	2.52	0.21	3.63	4.05
147	ICP-MS	<0.0475	2.52	0.230	3.99	4.40
264	ICP-MS	<0.10	2.38	0.18	3.41	3.72
293	DRC/CC-ICP-MS	0.05	2.58	0.21	3.72	4.22
598	ICP-MS	<0.5	2.50	<0.5	4.07	4.14
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		NA	2.52	0.209	3.8	4.12
Arithmetic SD (s)		NA	0.08	0.018	0.3	0.23
Arithmetic RSD (%)		NA	3.2	8.6	6.6	5.6
Number of Sample Measurements (N)		NA	6	5	6	6

*Denotes a statistical Outlier.

Statistical data was not calculated for BE20-01 based on a lack of consensus among participating labs.

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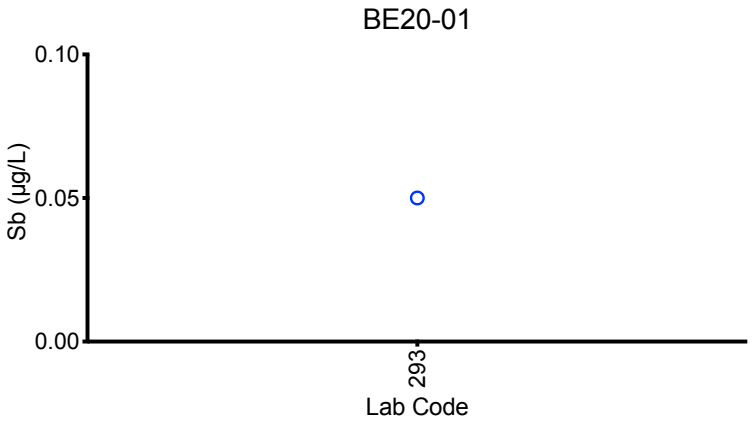
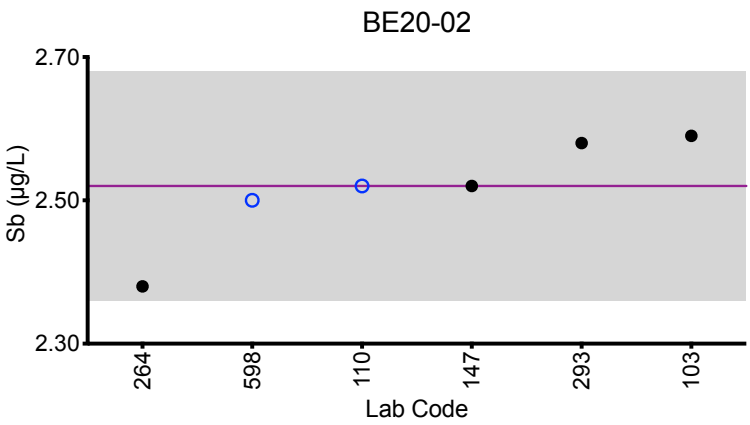
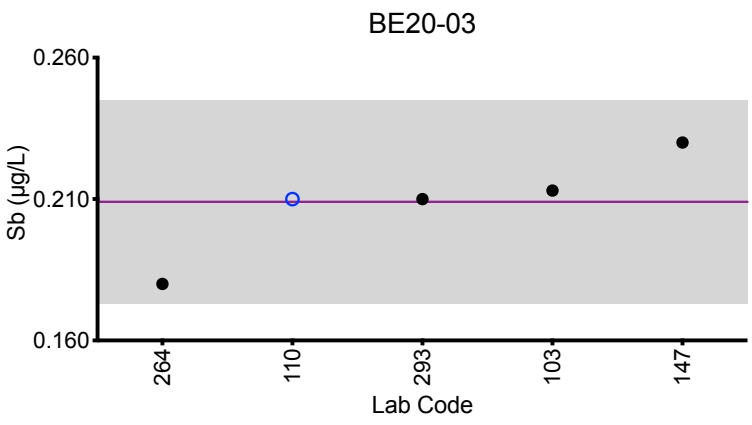
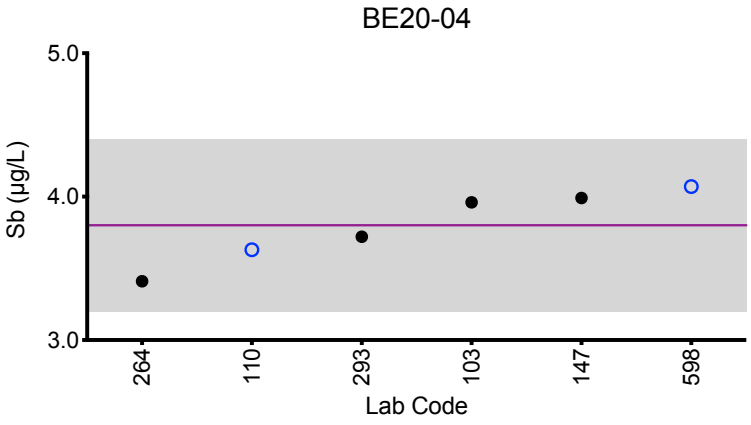
Results for Event #1, 2020: Summary Figures

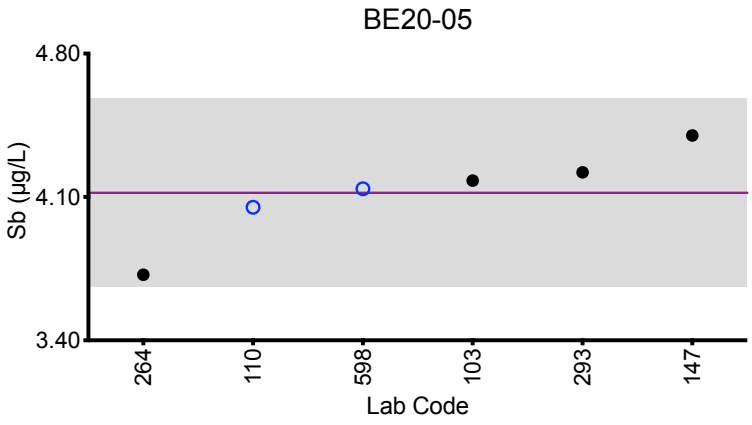
Whole Blood Sb











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 intended to be quality specifications and are included for informational purposes only.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)

Lab Code	Method	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
103	DRC/CC-ICP-MS	142	130	147	138	142
107	ICP-MS/MS	140.9	136.7	135.8	133.9	131.7
110	DRC/CC-ICP-MS	141	132	150	132	143
147	ICP-MS	140	126	149	136	141
264	ICP-MS	*202.73	121.87	139.45	134.24	133.41
597	ICP-MS/MS	122.0	120	130	126	123
598	DRC/CC-ICP-MS	143	123	137	123	130

Summary Statistics

	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
Arithmetic Mean ($\bar{x}$)	138	127	141	132	135
Arithmetic SD (s)	8	6	8	5	7
Arithmetic RSD (%)	5.8	4.7	5.7	3.8	5.2
Number of Sample Measurements (N)	6	7	7	7	7

*Denotes a statistical Outlier.

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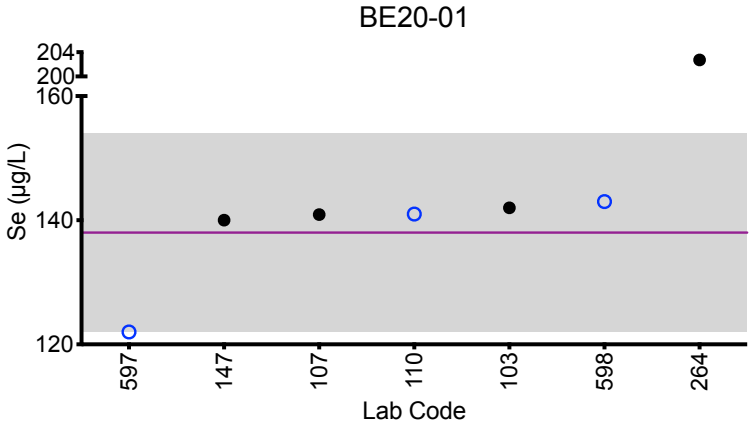
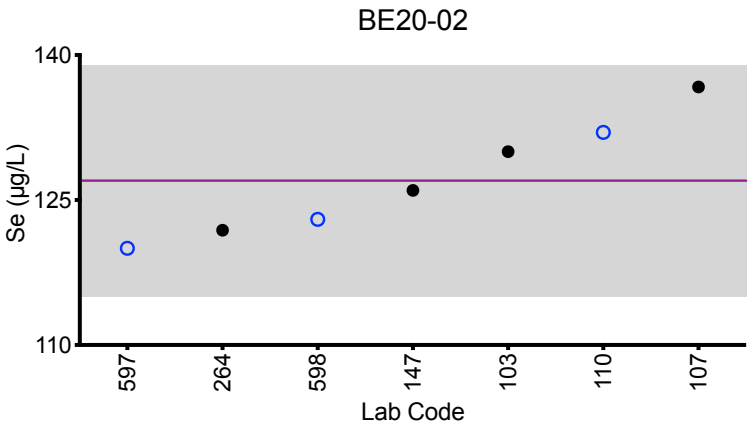
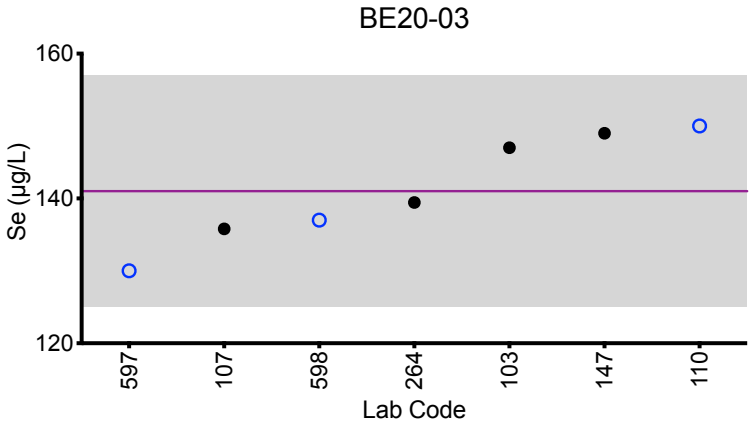
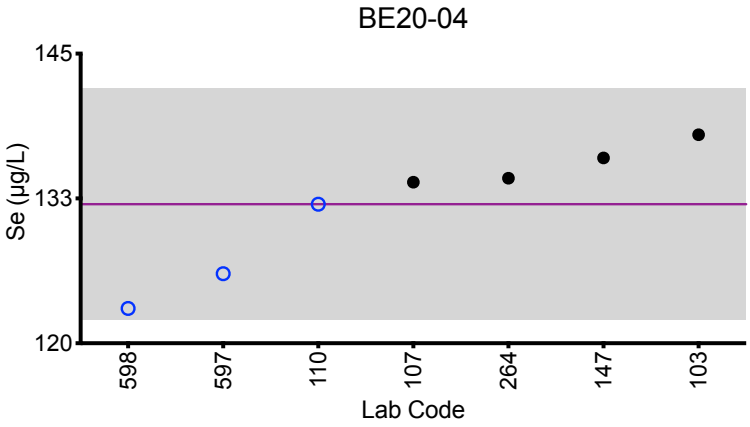
Results for Event #1, 2020: Summary Figures

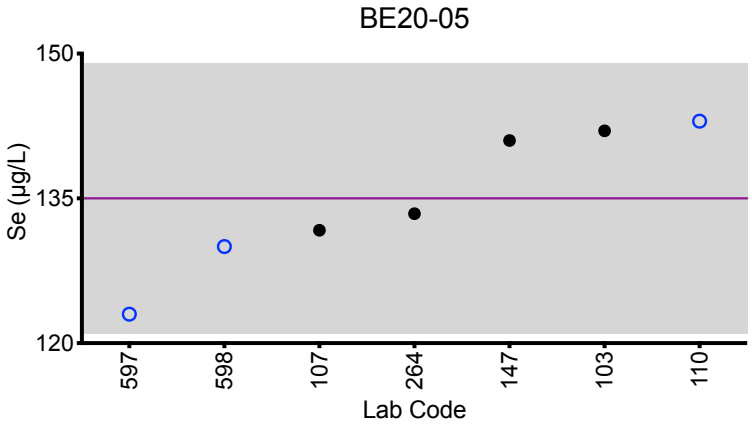
Whole Blood Se











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

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

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Results for Event #1, 2020: Laboratory Data and Summary Statistics

Whole Blood Tl (µg/L)

Lab Code	Method	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
103	DRC/CC-ICP-MS	0.639	1.60	3.08	2.27	0.231
110	ICP-MS	0.63	1.63	3.14	2.26	0.22
147	ICP-MS	0.662	1.65	3.21	2.33	0.241
264	ICP-MS	0.50	1.39	2.48	1.78	0.15
293	DRC/CC-ICP-MS	0.63	1.57	2.95	2.12	0.21
597	ICP-MS/MS	0.649	1.64	2.91	2.25	0.242

Summary Statistics

	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
Arithmetic Mean ($\bar{x}$)	0.62	1.58	3.0	2.17	0.22
Arithmetic SD (s)	0.06	0.10	0.3	0.20	0.03
Arithmetic RSD (%)	9.7	6.3	8.8	9.2	16
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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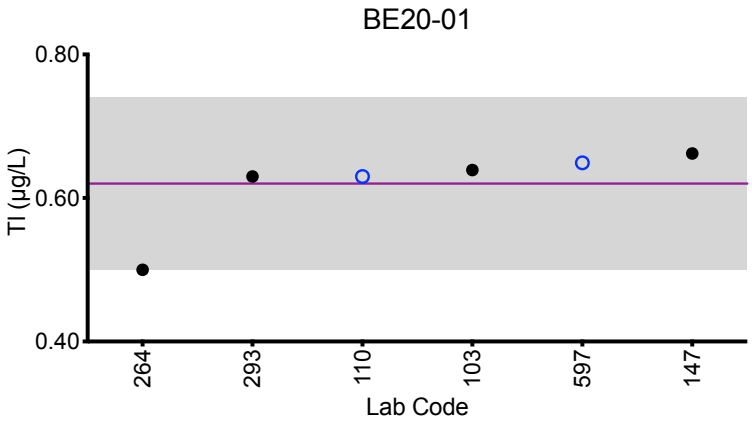
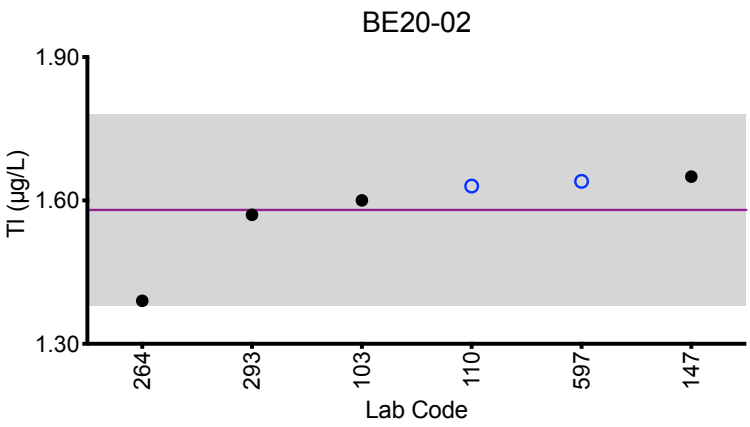
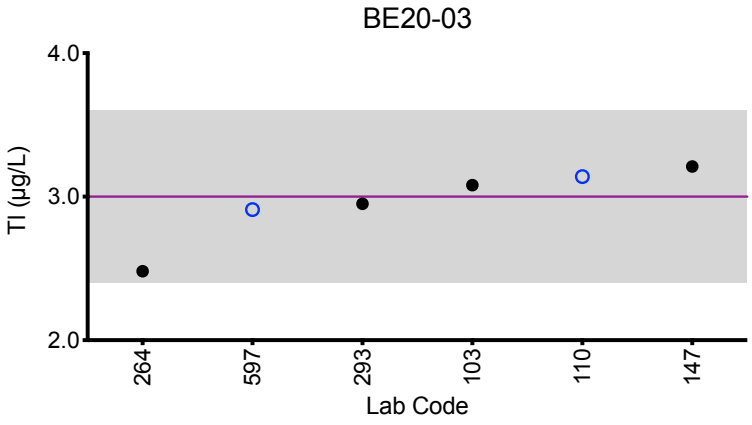
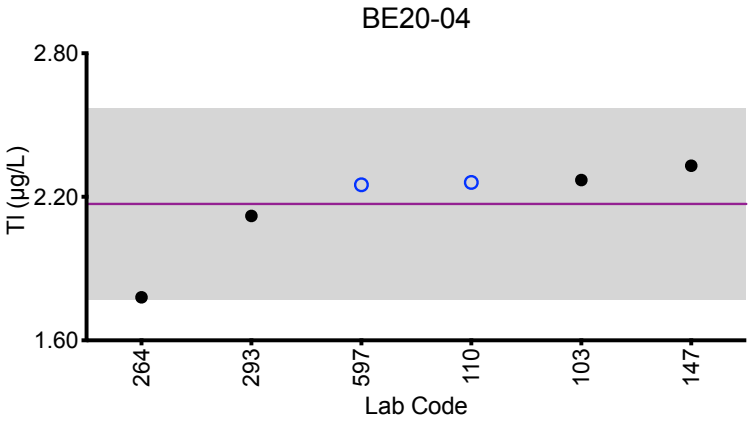
Results for Event #1, 2020: Summary Figures

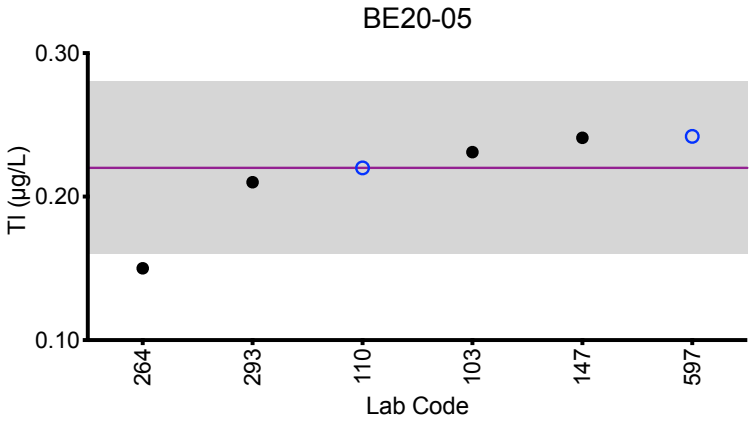
Whole Blood Tl











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

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

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
110	ICP-MS	9.7	12.7	2.5	6.4	8.1
147	ICP-MS	8.90	11.3	2.24	5.73	7.65
597	ICP-MS/MS	9.00	11.3	2.65	5.56	7.11
598	ICP-MS	9.01	11.1	1.91	6.16	7.87
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		9.2	11.6	2.3	6.0	7.7
Arithmetic SD (s)		0.4	0.7	0.3	0.4	0.4
Arithmetic RSD (%)		4.3	6.4	13	6.7	5.2
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
110	ICP-MS	1.20	0.85	2.74	4.04	5.76
147	ICP-MS	1.32	0.937	3.06	4.13	5.39
598	ICP-MS	1.27	0.74	3.09	4.18	5.25
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		1.26	0.84	3.0	4.12	5.5
Arithmetic SD (s)		0.06	0.10	0.2	0.07	0.3
Arithmetic RSD (%)		4.8	12	6.4	1.7	5.5
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
110	ICP-MS	3.54	3.43	1.19	3.45	1.06
597	ICP-MS/MS	3.25	3.16	1.22	3.25	1.03
598	ICP-MS	3.38	3.18	1.05	3.42	1.04
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		3.39	3.26	1.15	3.37	1.043
Arithmetic SD (s)		0.15	0.15	0.09	0.11	0.015
Arithmetic RSD (%)		4.4	4.6	7.8	3.3	1.4
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
110	ICP-MS	884	990	885	1052	1119
147	ICP-MS	883	934	851	1010	1048
597	ICP-MS/MS	790	881	764	951	923
598	ICP-MS	725	782	673	873	864
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		820	900	790	970	990
Arithmetic SD (s)		80	90	90	80	120
Arithmetic RSD (%)		9.8	10	11	8.2	12
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
110	DRC/CC-ICP-MS	2.1	4.8	4.3	11.2	9.6
147	ICP-MS	1.61	3.90	3.69	10.0	8.57
598	ICP-MS	1.04	3.26	2.56	9.16	7.19
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		1.6	4.0	3.5	10.1	8.5
Arithmetic SD (s)		0.5	0.8	0.9	1.0	1.2
Arithmetic RSD (%)		31	20	26	9.9	14
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Pt (µg/L)

Lab Code	Method	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
110	ICP-MS	0.81	0.26	5.79	1.89	7.96
598	ICP-MS	0.97	0.38	5.58	1.92	7.68

Summary Statistics

	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
Arithmetic Mean ($\bar{x}$)	0.89	0.32	5.7	1.91	7.8
Arithmetic SD (s)	0.11	0.08	0.1	0.02	0.2
Arithmetic RSD (%)	12	25	2.6	1.1	2.6
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
110	ICP-MS	0.17	4.27	1.09	8.52	2.85
147	ICP-MS	<0.356	3.98	1.03	8.23	2.91
597	ICP-MS/MS		4.10	1.18	8.22	2.79
598	ICP-MS	<0.5	4.42	1.01	8.89	2.94
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		NA	4.2	1.08	8.5	2.87
Arithmetic SD (s)		NA	0.2	0.08	0.3	0.07
Arithmetic RSD (%)		NA	4.5	7.4	3.5	2.4
Number of Sample Measurements (N)		NA	4	4	4	4

*Denotes a statistical Outlier.

Statistical data was not calculated for BE20-01 based on a lack of consensus among participating labs.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)

Lab Code	Method	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
103	DRC/CC-ICP-MS	0.201	0.105	0.284	0.112	0.246
110	ICP-MS	0.202	0.091	0.314	0.120	0.245
147	ICP-MS	0.114	0.0548	0.165	0.0643	0.132
598	ICP-MS	0.23	0.11	0.3	0.14	0.24

Summary Statistics

	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
Arithmetic Mean ($\bar{x}$)	0.19	0.09	0.27	0.11	0.22
Arithmetic SD (s)	0.05	0.02	0.07	0.03	0.06
Arithmetic RSD (%)	26	28	26	27	27
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
110	DRC/CC-ICP-MS	0.8	5.2	0.7	1.2	7.0
147	DRC/CC-ICP-MS	0.801	5.05	0.566	1.30	6.63
598	DRC/CC-ICP-MS	0.57	5.25	0.34	1.22	6.29
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		0.72	5.17	NA	1.24	6.6
Arithmetic SD (s)		0.13	0.10	NA	0.05	0.4
Arithmetic RSD (%)		18	1.9	NA	4.3	6.1
Number of Sample Measurements (N)		3	3	NA	3	3

*Denotes a statistical Outlier.

Statistical data was not calculated for BE20-03 based on a lack of consensus among participating labs.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)

Lab Code	Method	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
110	ICP-MS	0.44	1.82	0.11	0.85	1.14
200	ICP-MS	0.5	1.8	0.2	0.9	1.3
598	ICP-MS	0.71	1.99	0.27	0.99	1.45

Summary Statistics

	BE20-01	BE20-02	BE20-03	BE20-04	BE20-05
Arithmetic Mean ($\bar{x}$)	0.55	1.87	NA	0.91	1.30
Arithmetic SD (s)	0.14	0.10	NA	0.07	0.16
Arithmetic RSD (%)	25	5.3	NA	7.7	12
Number of Sample Measurements (N)	3	3	NA	3	3

*Denotes a statistical Outlier.

Statistical data was not calculated for BE20-03 based on a lack of consensus among participating labs.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
110	ICP-MS	5971	6494	7502	6366	5556
147	ICP-MS	5170	5320	6261	5314	4614
597	ICP-MS/MS	5460	5950	6730	5940	4820
598	ICP-MS	4650	4860	5890	4950	4120
Summary Statistics						
		BE20-01	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
Arithmetic Mean ($\bar{x}$)		5300	5700	6600	5600	4800
Arithmetic SD (s)		600	700	600	600	600
Arithmetic RSD (%)		11	12	11	11	13
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
147	ICP-MS	<0.183	<0.183	<0.183	<0.183	<0.183

Whole Blood Al (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
147	ICP-MS	<6.75	<6.75	<6.75	<6.75	<6.75
597	ICP-MS/MS	18.5	5.90	11.7	9.65	13.5

Whole Blood Bi (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
147	ICP-MS	<0.272	<0.272	1.00	<0.272	0.963

Whole Blood I (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
147	ICP-MS	38.5	39.4	27.8	37.7	30.4

Whole Blood Li (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
147	ICP-MS	0.412	0.379	0.548	0.411	0.582

Whole Blood Mg (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
597	ICP-MS/MS	30300	29800	26300	30500	24100

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
103	DRC/CC-ICP-MS	25.4	27.8	19.1	25.4	22.0

Whole Blood Te (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
147	ICP-MS	<0.0817	<0.0817	<0.0817	<0.0817	<0.0817

Whole Blood Th (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
147	ICP-MS	<0.123	<0.123	<0.123	<0.123	<0.123

Whole Blood Ti (µg/L)						
Lab Code	**Method**	**BE20-01**	**BE20-02**	**BE20-03**	**BE20-04**	**BE20-05**
598	ICP-MS	0.60	1.56	2.81	2.26	0.21

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Event #1, 2020

Trace Elements in Urine

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Trace Elements Laboratory

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Event #1, 2020:
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). Urine samples were homogenized overnight prior to aliquoting 10-mL into polypropylene vials. PT samples were stored at -80°C until the week of the PT event, when they were thawed at 4°C prior to circulation to laboratories for analysis.

Graded Elements

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

Additional Elements

An additional 22 elements were reported by at least one participant: Ag, Al, B, Bi, Cs, Cu, Fe, I, Li, Mg, Mo, Ni, Pt, Sb, Se, Sn, Sr, Te, Th, V, W, and Zn. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

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

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Results for Event #1, 2020: Summary Statistics

	Urine As (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	73.5	39.1	9.6	12.8	253
Upper Limit	88.2	46.9	15.6	18.8	304
Lower Limit	58.8	31.3	3.6	6.8	202
Robust SD (s*)	2.2	2.1	0.8	1.0	18
Robust RSD (%)	3.0	5.4	8.3	7.8	7.1
Number of Sample Measurements (N)	17	17	17	17	17
Standard Uncertainty (*u*)	0.7	0.7	0.3	0.3	6

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Urine As (µg/L)				
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**73.5**	**39.1**	**9.6**	**12.8**	**253**
103	DRC/CC-ICP-MS	72.9	38.0	9.11	12.5	239
107	DRC/CC-ICP-MS	73.10	37.78	9.06	12.22	242.36
110	DRC/CC-ICP-MS	79.0	41.4	10.2	13.8	265
116	ICP-MS/MS	70.3	37.6	9.25	12.6	251
147	ICP-MS	74.7	39.3	10.8	13.4	249
220	ICP-MS	80.8	43.4	14.2	16.3	289
264	ICP-MS	75.71	39.92	9.62	14.02	258.46
293	DRC/CC-ICP-MS	69.48	36.32	9.03	12.06	231.82
324	ICP-MS	74.020	38.889	9.178	12.379	236.82
391	DRC/CC-ICP-MS	67.83	30.75 ↓	9.061	11.823	224.82
399	DRC/CC-ICP-MS	74.1	39.8	9.59	13.2	242
597	ICP-MS/MS	61.7	33.5	8.26	10.7	250
598	DRC/CC-ICP-MS	83.6	43.2	10.7	13.6	278
605	ICP-MS	73.5	38.0	8.74	11.7	254
606	ICP-MS/MS	74.3	40.2	9.84	13.1	269
676	DRC/CC-ICP-MS	73.4	39.9	10.6	13.4	342 ↑
686	DRC/CC-ICP-MS	72.6	40.4	9.76	12.9	251

Based on the grading criteria for As in Urine, 98% of results were satisfactory, with 0 of the 17 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier

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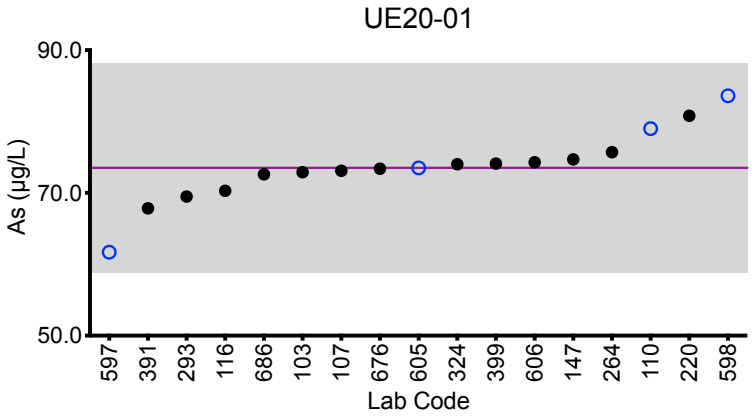
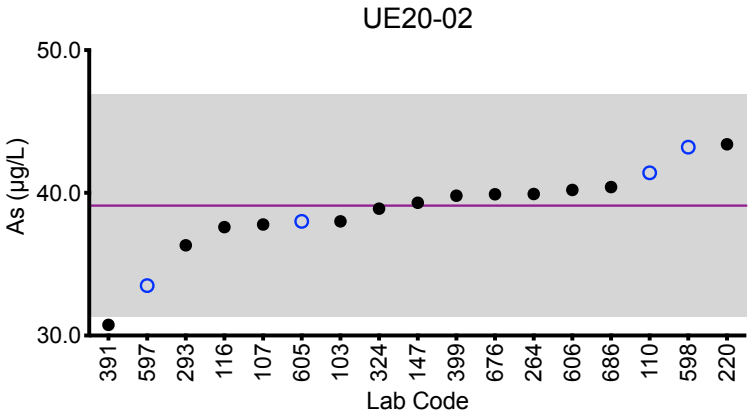
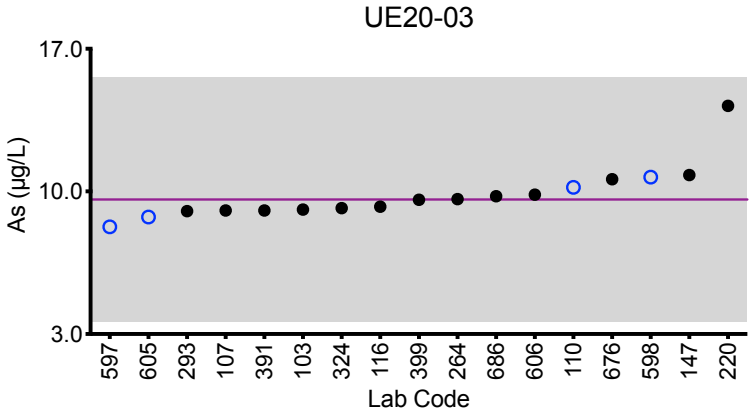
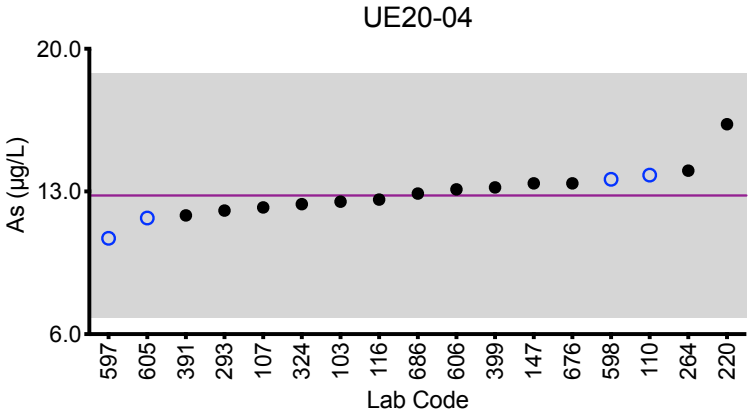
Results for Event #1, 2020: Summary Figures

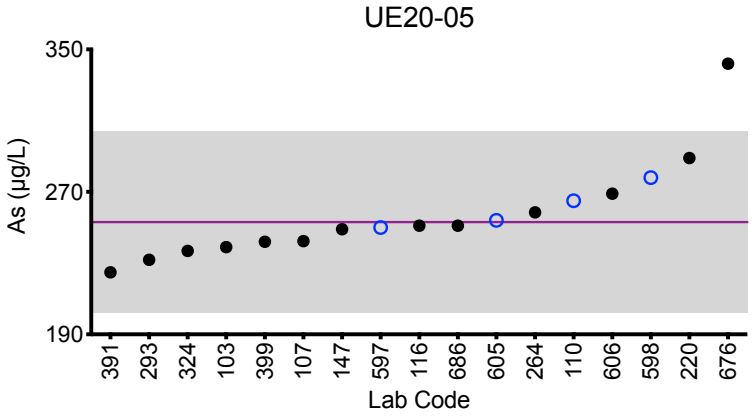
Urine As











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 #1, 2020: Summary Statistics

	Urine Ba (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	2.37	6.73	1.89	3.44	11.8
Upper Limit	3.37	8.08	2.89	4.44	14.1
Lower Limit	1.37	5.38	0.89	2.44	9.4
Robust SD (s*)	0.12	0.26	0.07	0.15	0.4
Robust RSD (%)	5.1	3.9	3.7	4.4	3.5
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.04	0.09	0.02	0.05	0.1

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Urine Ba (µg/L)				
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**2.37**	**6.73**	**1.89**	**3.44**	**11.8**
107	ICP-MS	2.362	6.669	1.893	3.468	11.843
110	ICP-MS	2.56	7.65	2.11	3.91	13.1
116	ICP-MS/MS	2.27	6.58	1.87	3.26	11.3
147	ICP-MS	2.38	6.98	1.84	3.46	11.8
220	ICP-MS	2.35	6.69	1.88	3.41	12.3
264	ICP-MS	2.45	6.84	1.94	3.57	11.72
399	ICP-MS	2.38	6.79	1.93	3.49	11.8
597	ICP-MS/MS	2.26	6.37	1.94	3.24	13.2
598	ICP-MS	2.05	6.55	1.39	3.01	11.4
605	ICP-MS	2.29	6.41	1.76	3.38	11.6
606	ICP-MS/MS	2.41	6.55	1.86	3.39	11.5
607	ICP-MS	2.56	7.37	1.93	3.80	11.7
676	ICP-MS	2.32	6.74	1.85	3.42	10.8
686	ICP-MS	2.46	6.88	1.93	3.56	12.0

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.

* Denotes a statistical Outlier

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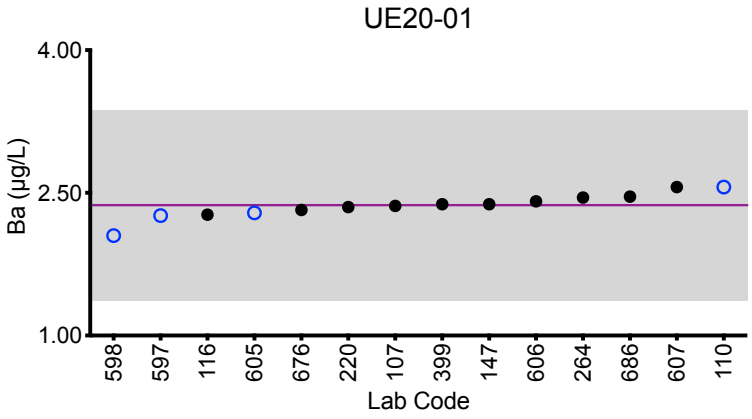
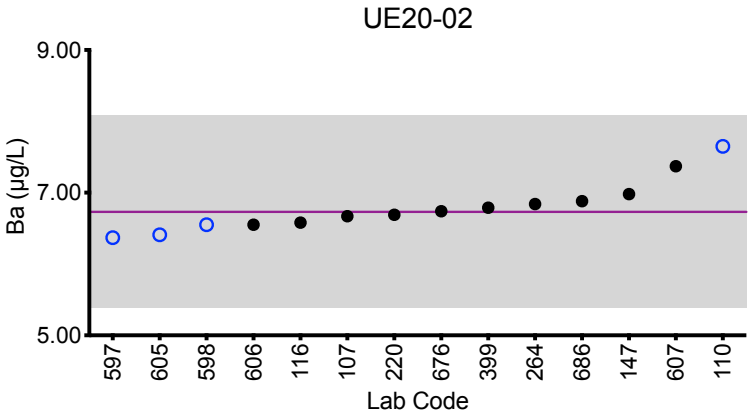
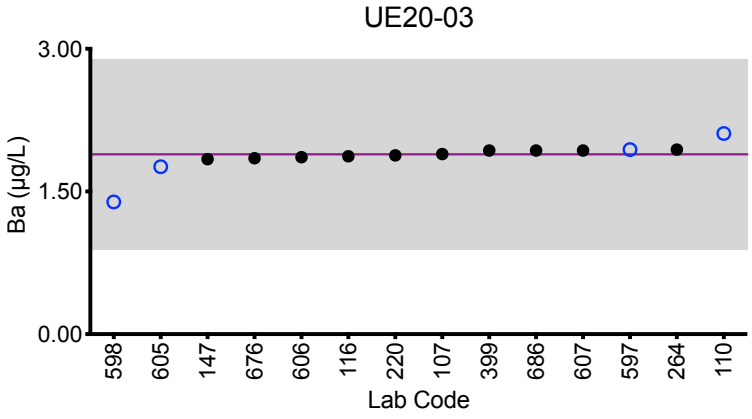
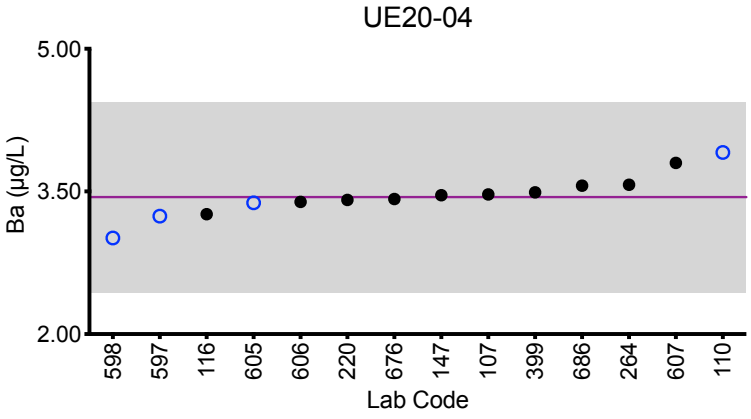
Results for Event #1, 2020: Summary Figures

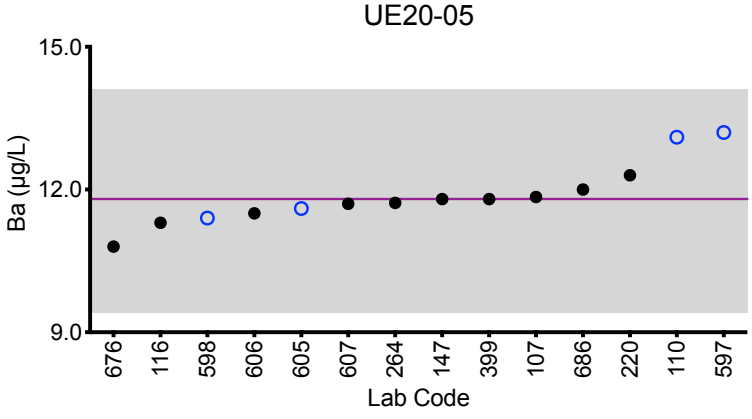
Urine Ba











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020: Summary Statistics

	Urine Be (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	4.47	1.14	2.95	6.28	0.481
Upper Limit	5.47	2.14	3.95	7.54	1.481
Lower Limit	3.47	0.14	1.95	5.02	0.000
Robust SD (s*)	0.21	0.06	0.15	0.25	0.026
Robust RSD (%)	4.7	5.3	5.1	4.0	5.4
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (*u*)	0.07	0.02	0.05	0.09	0.009

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**4.47**	**1.14**	**2.95**	**6.28**	**0.481**
107	ICP-MS	4.185	1.054	2.946	6.033	0.492
110	ICP-MS	4.51	1.13	3.00	6.46	0.493
116	ICP-MS/MS	4.24	1.09	2.88	6.02	0.50
147	ICP-MS	4.65	1.19	2.92	6.32	0.477
220	ICP-MS	4.60	1.15	3.14	6.34	0.52
264	ICP-MS	4.83	1.20	3.05	6.89	0.48
293	DRC/CC-ICP-MS	4.28	1.06	2.78	6.16	0.46
399	ICP-MS	4.36	1.12	3.07	6.21	0.484
598	ICP-MS	4.49	1.15	2.81	5.98	0.37
605	ICP-MS	4.31	1.05	2.74	6.13	0.456
607	ICP-MS	4.60	1.24	3.15	6.76	0.510
676	ICP-MS	4.65	1.16	2.90	6.29	0.415
686	ICP-MS	4.49	1.17	3.00	6.40	0.487

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

* Denotes a statistical Outlier

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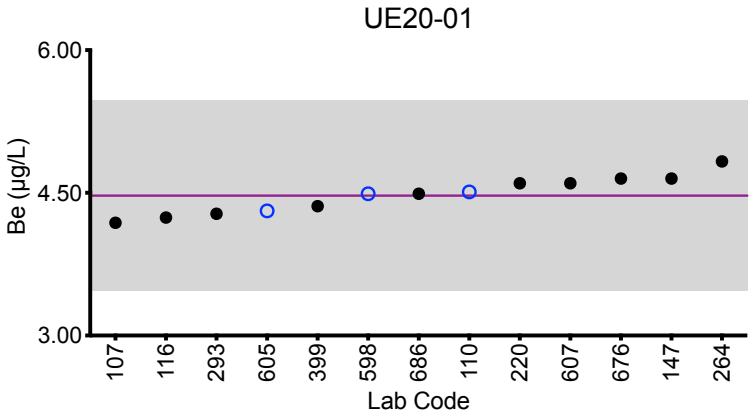
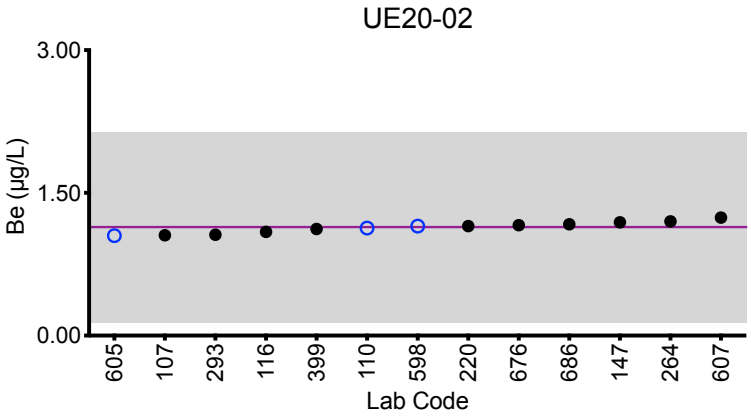
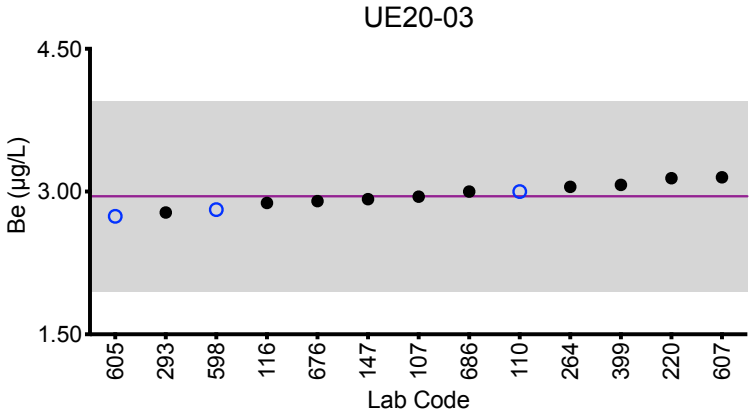
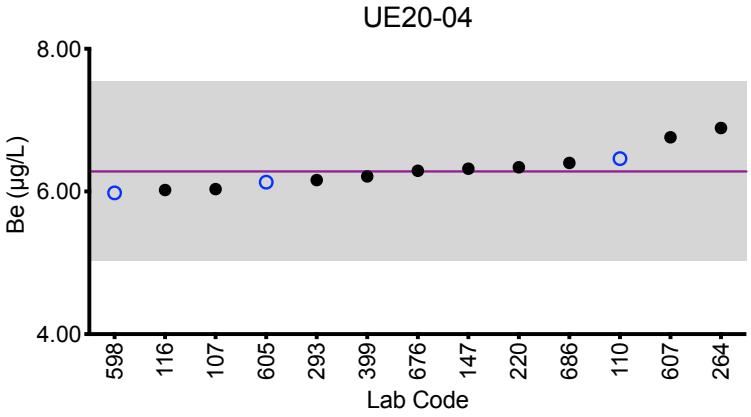
Results for Event #1, 2020: Summary Figures

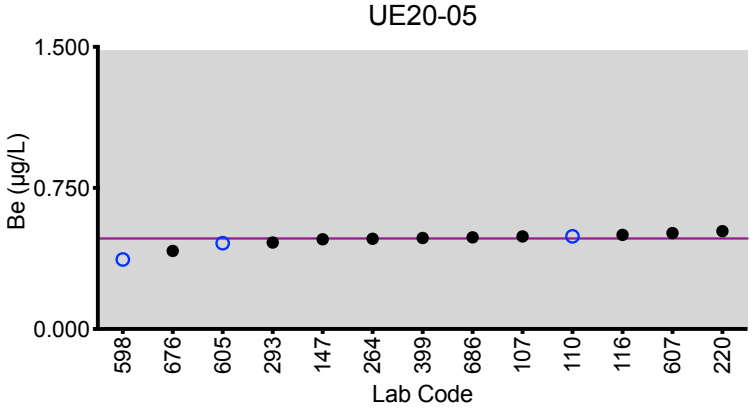
Urine Be











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020: Summary Statistics

	Urine Cd (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	0.229	1.011	0.57	4.60	2.80
Upper Limit	1.229	2.011	1.57	5.60	3.80
Lower Limit	0.000	0.011	0.00	3.60	1.80
Robust SD (s*)	0.020	0.028	0.04	0.29	0.19
Robust RSD (%)	8.7	2.8	6.9	6.3	6.8
Number of Sample Measurements (N)	15	18	17	18	18
Standard Uncertainty (*u*)	0.006	0.008	0.01	0.09	0.06

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Urine Cd (µg/L)						
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**0.229**	**1.011**	**0.57**	**4.60**	**2.80**
103	DRC/CC-ICP-MS	0.239	1.07	0.632	4.74	2.87
107	DRC/CC-ICP-MS	0.225	1.009	0.555	4.966	2.718
110	ICP-MS	0.231	0.996	0.541	4.60	2.69
116	ICP-MS/MS	<0.2	1.04	0.527	4.53	2.67
147	ICP-MS	0.229	1.00	0.590	4.79	2.69
220	DRC/CC-ICP-MS	0.46	0.40	1.03	2.77 ↓	2.74
264	ICP-MS	0.22	1.03	0.59	4.82	2.98
293	DRC/CC-ICP-MS	0.24	1.1	0.58	4.99	2.98
324	ICP-MS	<1	1.003	<1	4.595	2.659
391	DRC/CC-ICP-MS	0.152	0.913	0.505	4.028	2.446
399	DRC/CC-ICP-MS	0.217	1.02	0.555	4.68	2.87
597	ICP-MS/MS	0.22	0.99	0.57	4.20	3.10
598	DRC/CC-ICP-MS	0.24	1.00	0.59	4.65	2.83
605	ICP-MS	0.152	0.987	0.497	4.56	2.6
606	ICP-MS/MS	0.205	1.02	0.594	4.75	2.96
607	ICP-MS	0.303	1.07	0.529	4.32	2.54
676	DRC/CC-ICP-MS	0.265	1.00	0.555	4.26	3.41
686	ICP-MS	<0.240	1.03	0.597	4.90	2.89

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

* Denotes a statistical Outlier

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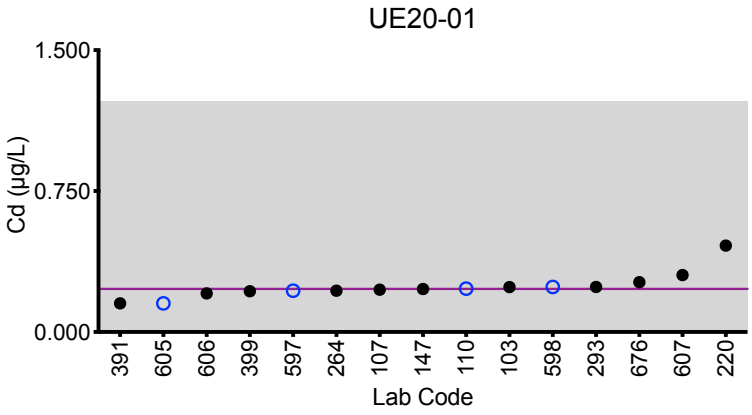
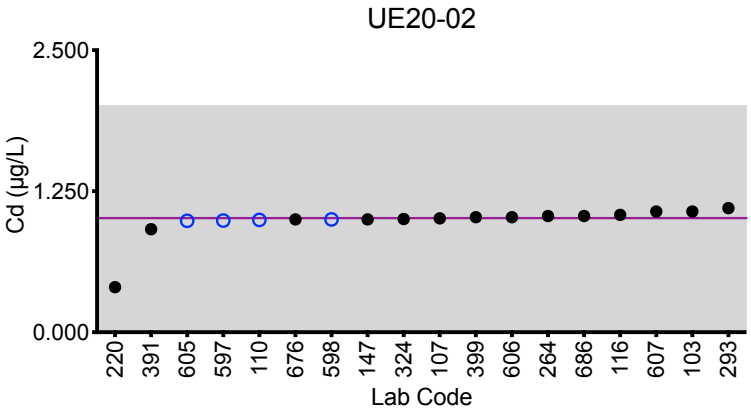
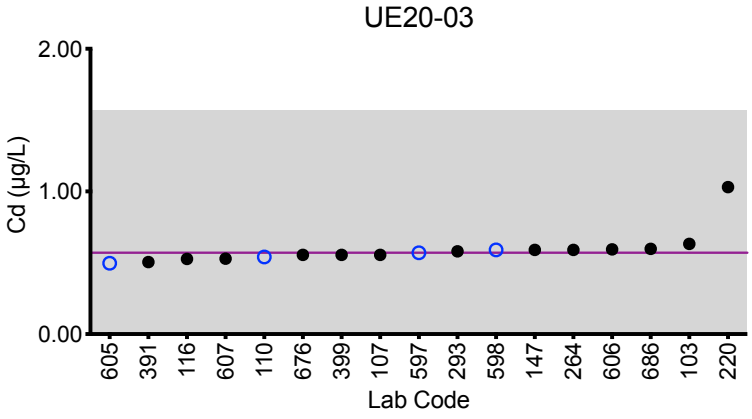
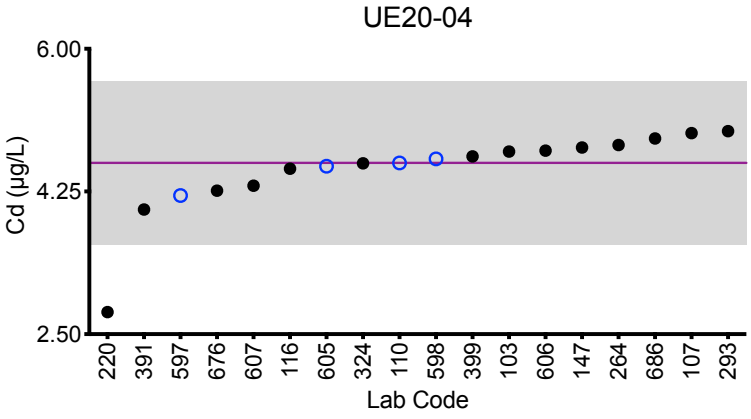
Results for Event #1, 2020: Summary Figures

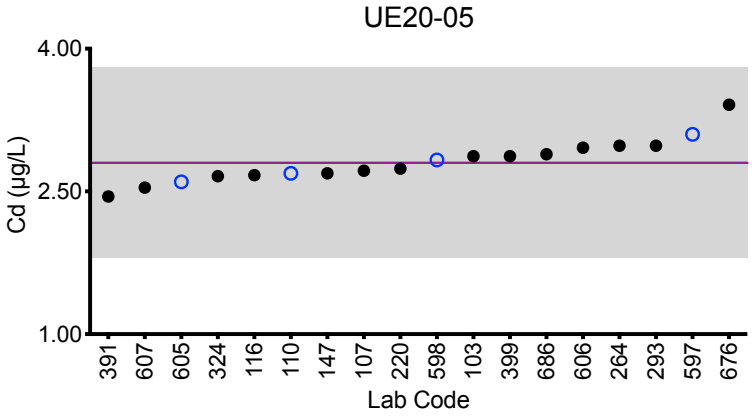
Urine Cd











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020: Summary Statistics

	Urine Co (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	3.89	6.11	0.79	262	38.6
Upper Limit	5.39	7.61	2.29	301	44.4
Lower Limit	2.39	4.61	0.00	223	32.8
Robust SD (s*)	0.09	0.16	0.06	17	1.5
Robust RSD (%)	2.3	2.6	7.6	6.5	3.9
Number of Sample Measurements (N)	14	14	13	12	14
Standard Uncertainty (*u*)	0.03	0.05	0.02	6	0.5

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Urine Co (µg/L)						
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**3.89**	**6.11**	**0.79**	**262**	**38.6**
103	DRC/CC-ICP-MS	4.06	6.19	0.734	272	39.8
107	ICP-MS	3.925	6.140	0.816	>150	37.244
110	ICP-MS	3.83	6.15	0.884	262	38.0
147	ICP-MS	3.87	6.08	0.748	241	38.8
220	ICP-MS	4.25	6.62	1.00	286	43.6
264	ICP-MS	3.83	6.00	0.75	264.12	40.27
324	ICP-MS	3.888	6.103	<1	265.823	37.692
391	DRC/CC-ICP-MS	3.532	5.544	0.72	250.94	36.369
399	DRC/CC-ICP-MS	3.94	6.26	0.774	270	39.2
597	ICP-MS/MS	3.51	5.57	0.75	235	37.6
598	ICP-MS	3.83	5.76	0.80	246	34.7
605	ICP-MS	3.93	6.07	0.842	265	39.7
606	ICP-MS/MS	3.85	6.19	0.731	>225	38.9
676	ICP-MS	4.42	6.76	1.00	283	39.0

Based on the grading criteria for Co 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.

* Denotes a statistical Outlier

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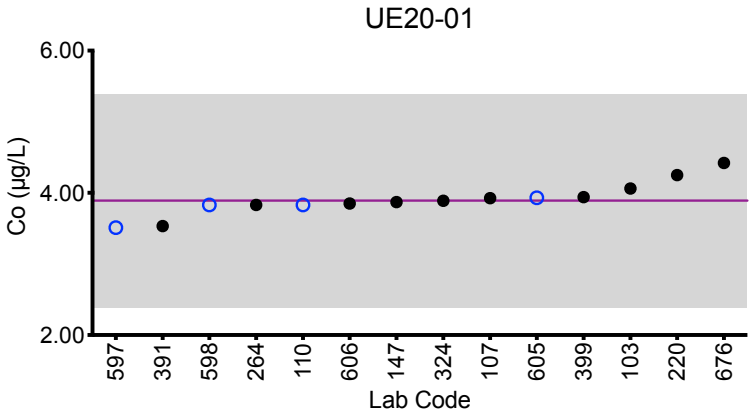
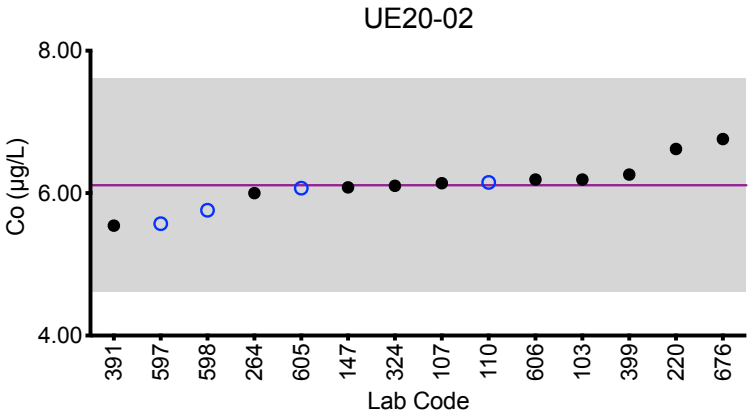
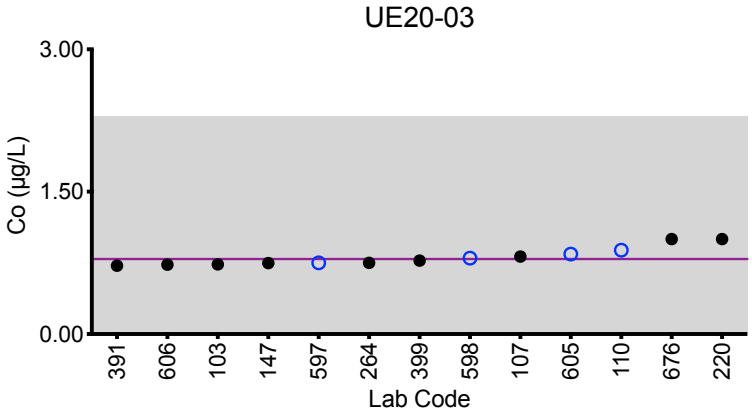
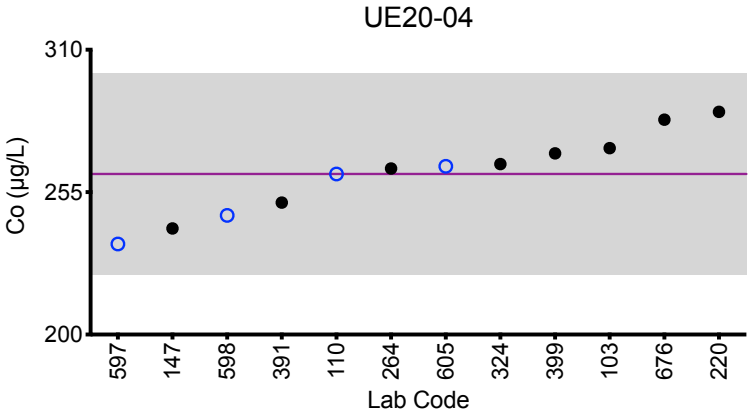
Results for Event #1, 2020: Summary Figures

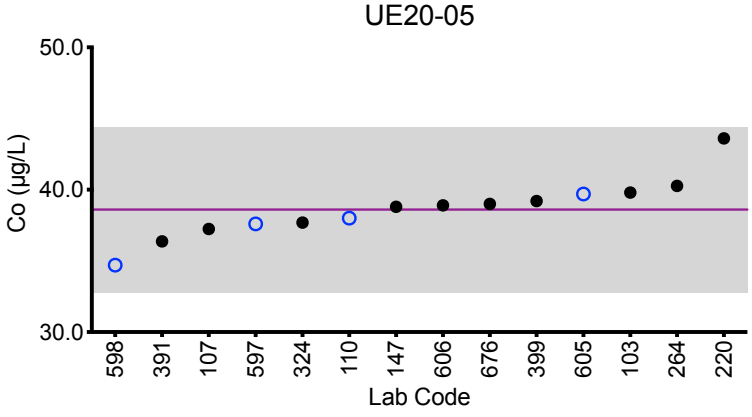
Urine Co











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 #1, 2020: Summary Statistics

	Urine Cr (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	7.5	0.34	3.9	0.68	17.4
Upper Limit	10.5	3.34	6.9	3.68	20.9
Lower Limit	4.5	0.00	0.9	0.00	13.9
Robust SD (s*)	0.7	0.08	0.5	0.12	1.8
Robust RSD (%)	9.3	24	13	18	10
Number of Sample Measurements (N)	10	6	10	8	10
Standard Uncertainty (*u*)	0.3	0.04	0.2	0.06	0.7

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

An arithmetic mean, SD, RSD and n are provided for samples UE20-02 and UE20-04.

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**7.5**	**0.34**	**3.9**	**0.68**	**17.4**
107	DRC/CC-ICP-MS	7.69	0.25	3.82	0.70	18.16
110	DRC/CC-ICP-MS	7.86	0.30	4.22	0.72	18.5
116	ICP-MS/MS	7.04	0.338	3.52	0.629	16.2
147	DRC/CC-ICP-MS	6.86	0.279	3.37	0.551	16.2
264	ICP-MS	7.51	0.42	4.03	0.79	17.92
324	ICP-MS	7.568	<1	3.523	<1	12.088 ↓
391	DRC/CC-ICP-MS	6.544	*0.003	3.285	0.519	15.481
597	ICP-MS/MS	9.36	*3.27	5.08	*2.52	18.6
598	DRC/CC-ICP-MS	8.62	0.45	4.97	0.87	22.6 ↑
605	ICP-MS	7.33	<0.300	3.73	0.626	17.5

Based on the grading criteria for Cr in Urine, 96% of results were satisfactory, with 0 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier

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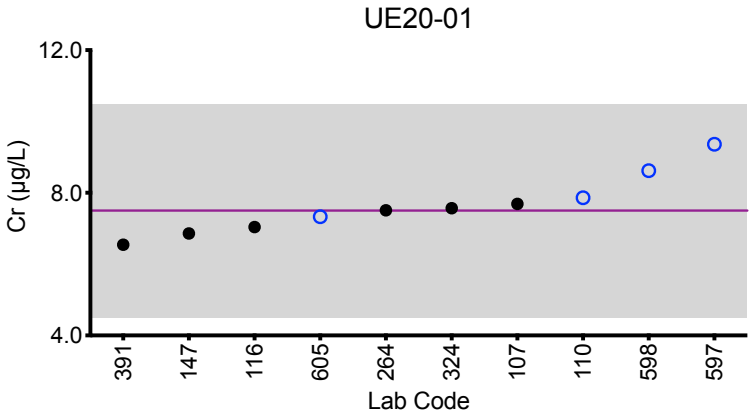
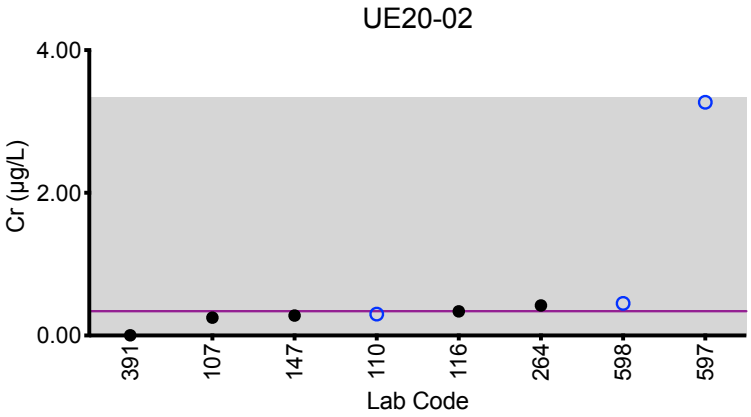
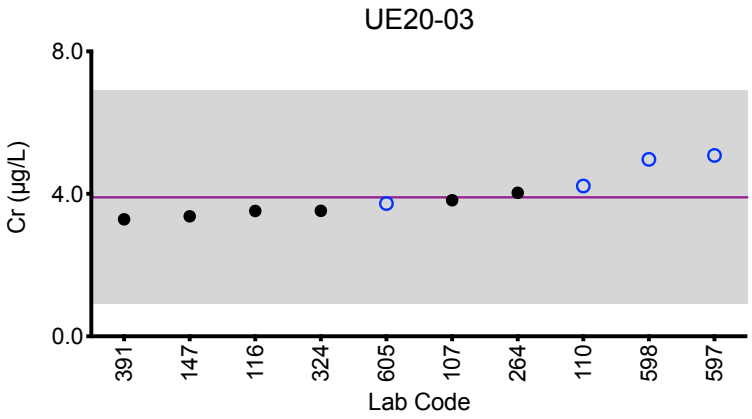
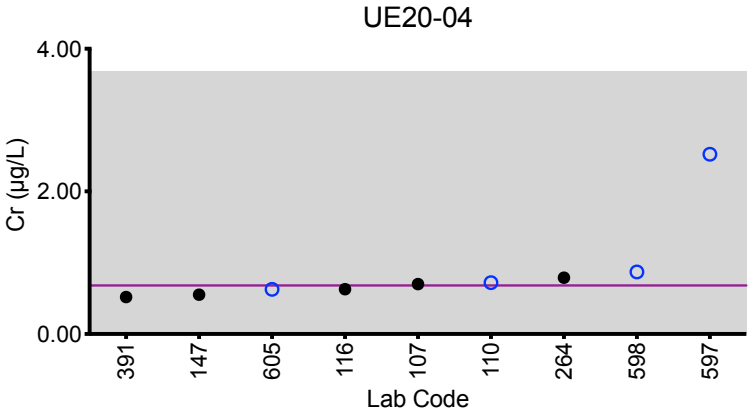
Results for Event #1, 2020: Summary Figures

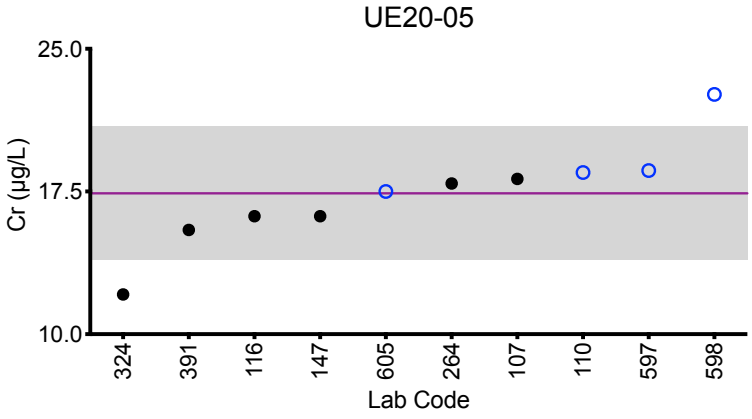
Urine Cr











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020: Summary Statistics

	Urine Hg (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	6.4	0.52	16.9	3.0	46
Upper Limit	9.4	3.52	22.0	6.0	60
Lower Limit	3.4	0.00	11.8	0.0	32
Robust SD (s*)	0.7	0.15	1.4	0.5	5
Robust RSD (%)	11	29	8.3	17	11
Number of Sample Measurements (N)	13	10	13	13	13
Standard Uncertainty (*u*)	0.2	0.06	0.5	0.2	2

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**6.4**	**0.52**	**16.9**	**3.0**	**46**
103	DRC/CC-ICP-MS	7.23	0.574	16.3	3.45	48.1
107	DRC/CC-ICP-MS	5.51	0.31	15.00	2.17	39.75
110	ICP-MS	6.46	0.560	17.1	3.05	47.7
147	ICP-MS	6.56	0.570	17.4	2.81	46.0
264	ICP-MS	11.50 ↑	1.38	21.43	3.29	58.44
293	DRC/CC-ICP-MS	6.07	0.3	16.27	2.8	43.86
391	DRC/CC-ICP-MS	5.992	0.616	17.649	5.35	47.154
597	DMA	6.29	0.430	17.1	2.85	48.7
598	ICP-MS	5.75	0.61	13.8	2.42	34.9
605	ICP-MS	6.68	<1.00	17.1	3.29	43.4
606	ICP-MS/MS	6.58	<1.00	14.4	2.86	43.0
676	ICP-MS	5.58	0.267	16.8	2.81	41.1
686	ICP-MS	6.96	<1.00	19.7	3.70	56.7

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

* Denotes a statistical Outlier

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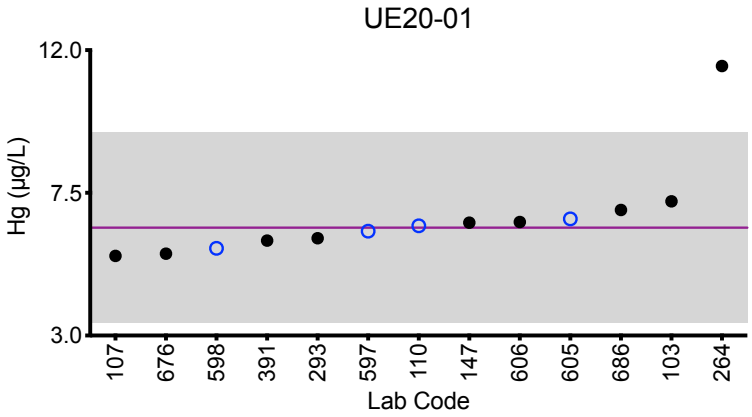
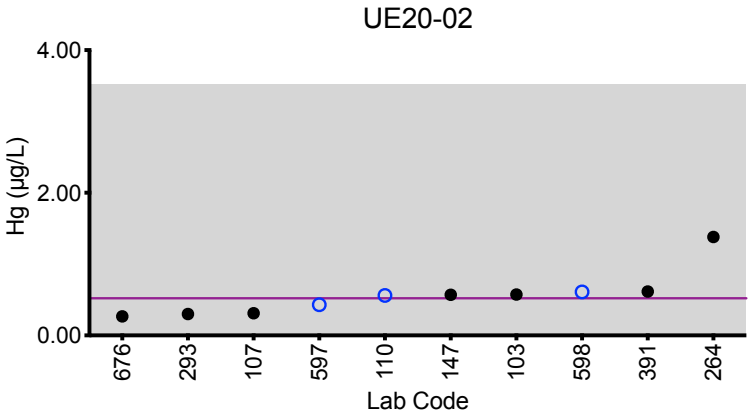
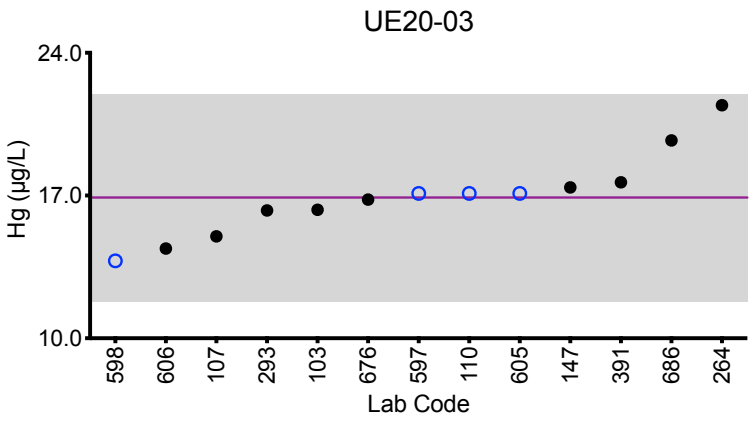
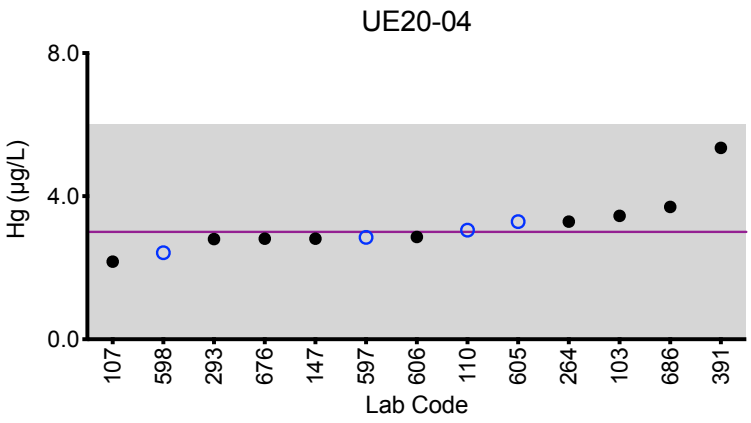
Results for Event #1, 2020: Summary Figures

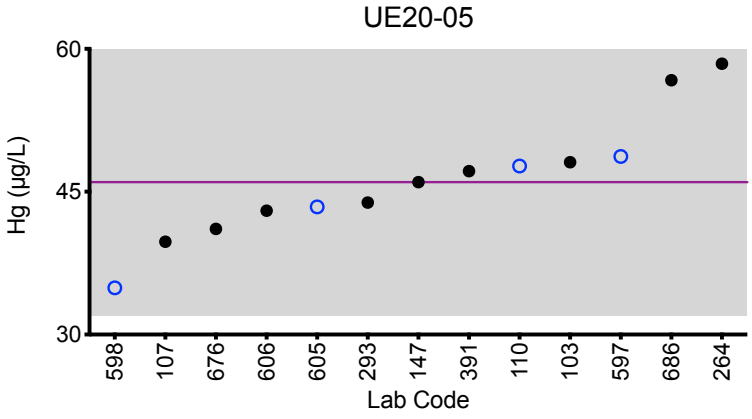
Urine Hg











Legend:
o CHEAR Labs ● Other Labs
Horizontal purple line = assigned target value based on the robust mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±3 µg/L or ±30% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 10 µg/L.

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Results for Event #1, 2020: Summary Statistics

	Urine Mn (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	5.44	1.44	7.75	3.90	1.11
Upper Limit	6.80	1.99	9.69	4.88	1.66
Lower Limit	4.08	0.89	5.81	2.93	0.56
Robust SD (s*)	0.27	0.11	0.28	0.22	0.17
Robust RSD (%)	4.9	7.6	3.6	5.6	15
Number of Sample Measurements (N)	15	15	15	15	14
Standard Uncertainty (*u*)	0.09	0.03	0.09	0.07	0.06

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**5.44**	**1.44**	**7.75**	**3.90**	**1.11**
103	DRC/CC-ICP-MS	5.71	1.48	7.89	4.03	0.954
107	DRC/CC-ICP-MS	5.572	1.479	8.129	4.144	1.081
110	DRC/CC-ICP-MS	5.65	1.52	7.92	4.05	1.08
116	ICP-MS/MS	5.04	1.33	7.35	3.55	0.915
147	DRC/CC-ICP-MS	5.64	1.71	7.61	3.71	1.33
220	DRC/CC-ICP-MS	5.68	1.52	8.05	4.12	1.12
264	ICP-MS	5.46	1.54	8.06	4.04	1.12
324	ICP-MS	5.663	1.463	7.801	4.023	<1
391	DRC/CC-ICP-MS	4.629	1.347	7.142	3.541	0.908
399	DRC/CC-ICP-MS	5.45	1.39	7.83	3.94	1.00
597	ICP-MS/MS	4.74	1.34	6.57	3.46	1.59
598	ICP-MS	5.58	1.56	7.58	3.79	1.45
605	ICP-MS	5.33	1.41	7.74	4.09	1.10
606	ICP-MS/MS	5.41	1.39	7.62	3.80	0.985
676	DRC/CC-ICP-MS	5.30	1.27	7.85	3.96	1.21

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

* Denotes a statistical Outlier

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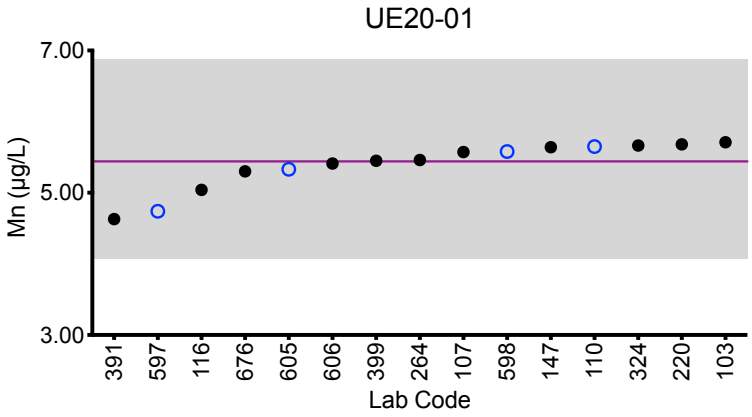
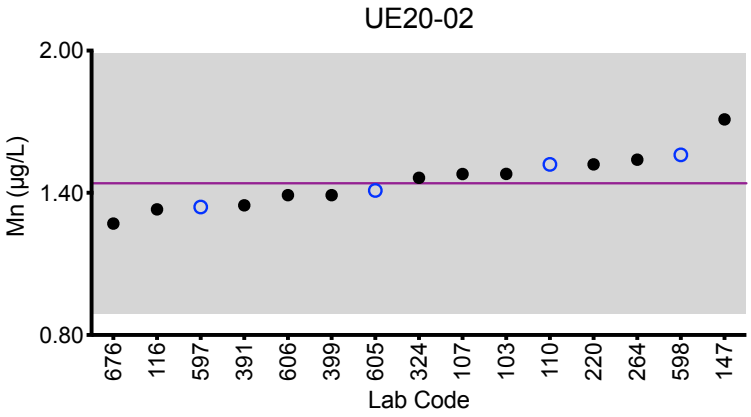
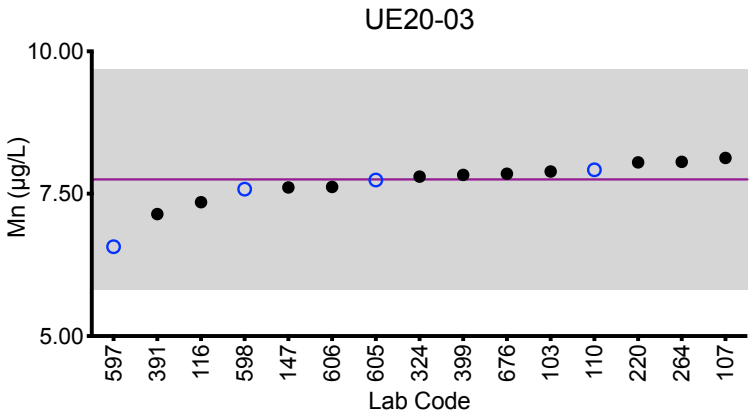
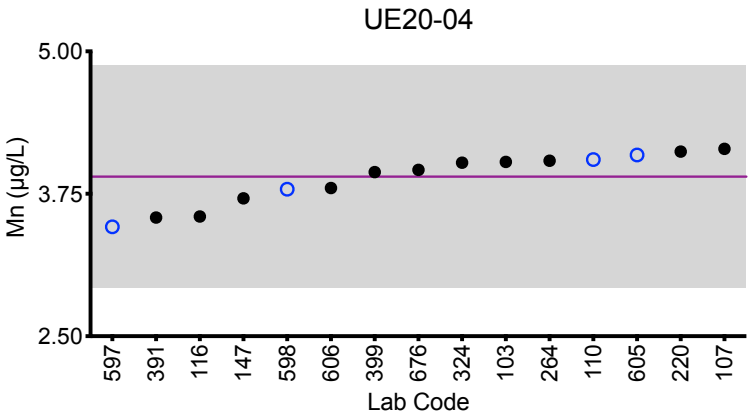
Results for Event #1, 2020: Summary Figures

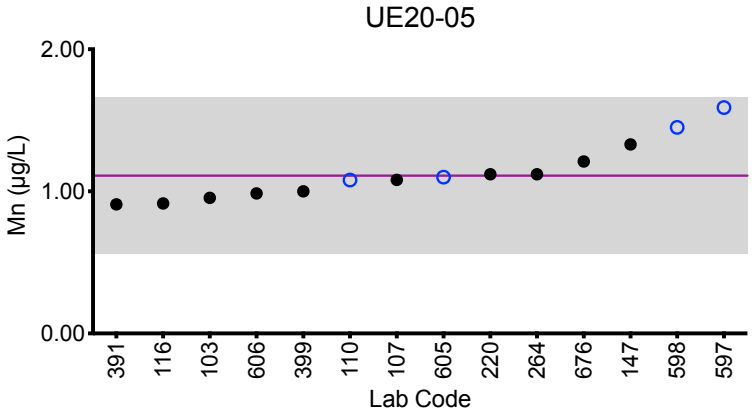
Urine Mn











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 #1, 2020: Summary Statistics

	Urine Pb (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	3.47	1.82	10.6	6.14	0.76
Upper Limit	4.47	2.82	12.8	7.37	1.76
Lower Limit	2.47	0.82	8.5	4.91	0.00
Robust SD (s*)	0.21	0.08	0.5	0.26	0.07
Robust RSD (%)	6.1	4.4	4.4	4.2	9.2
Number of Sample Measurements (N)	18	18	18	18	16
Standard Uncertainty (*u*)	0.06	0.02	0.1	0.08	0.02

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Urine Pb (µg/L)						
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**3.47**	**1.82**	**10.6**	**6.14**	**0.76**
103	DRC/CC-ICP-MS	3.48	1.85	11.0	6.31	0.769
107	ICP-MS	3.428	1.823	11.000	6.203	0.742
110	ICP-MS	3.38	1.81	10.6	6.07	0.71
116	ICP-MS/MS	3.31	1.76	10.3	5.94	0.746
147	ICP-MS	3.65	2.00	11.0	6.38	0.767
220	ICP-MS	3.3	1.72	10.2	6.03	0.68
264	ICP-MS	3.60	1.80	11.02	6.30	0.71
293	DRC/CC-ICP-MS	4.05	2.02	11.69	7.7 ↑	0.93
324	ICP-MS	3.506	1.846	10.731	6.082	<1
391	DRC/CC-ICP-MS	2.402 ↓	0.949	8.918	4.873 ↓	<0.000
399	ICP-MS	3.40	1.79	10.6	6.07	0.771
597	ICP-MS/MS	3.11	1.72	10.3	5.89	0.95
598	ICP-MS	3.36	1.75	9.80	5.71	0.60
605	ICP-MS	3.41	1.76	10.3	6.09	0.734
606	ICP-MS/MS	3.51	1.80	10.6	6.07	0.792
607	ICP-MS	3.687	1.96	10.8	6.60	0.941
676	ICP-MS	3.75	1.89	10.6	6.16	0.709
686	ICP-MS	3.68	1.91	11.2	6.46	0.824

Based on the grading criteria for Pb in Urine, 97% of results were satisfactory, with 1 of the 18 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier

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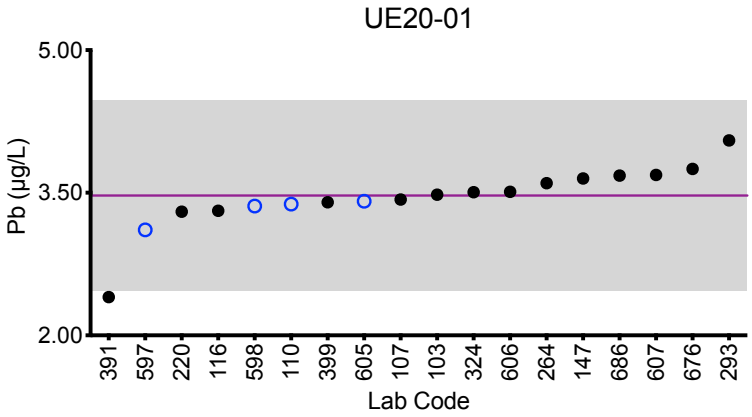
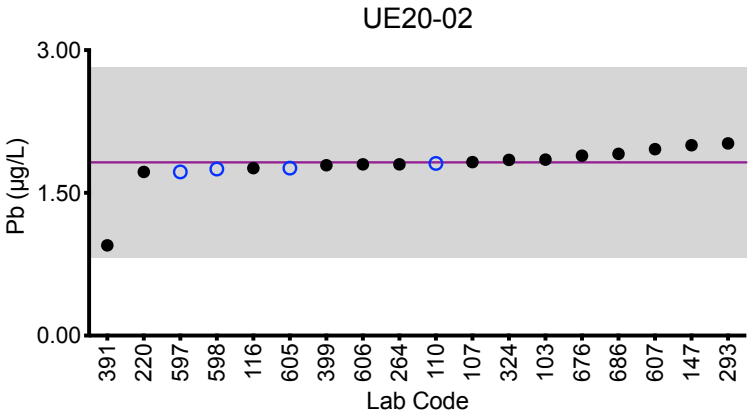
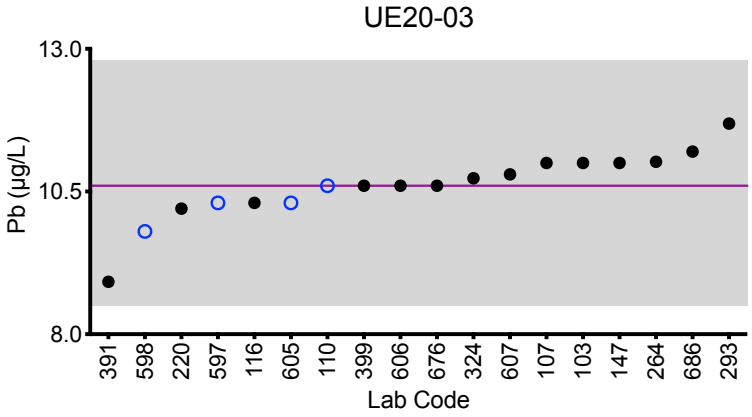
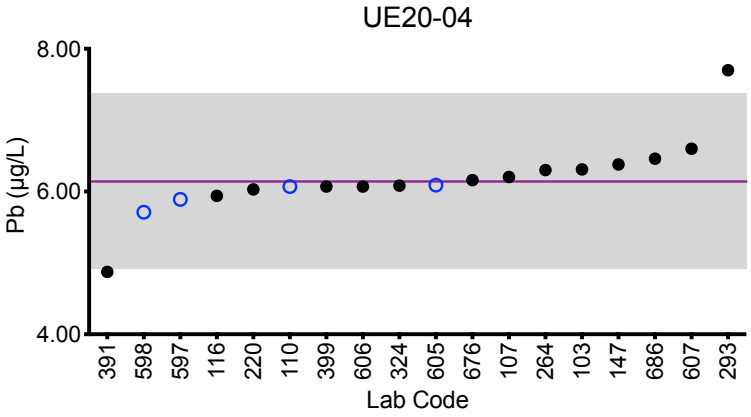
Results for Event #1, 2020: Summary Figures

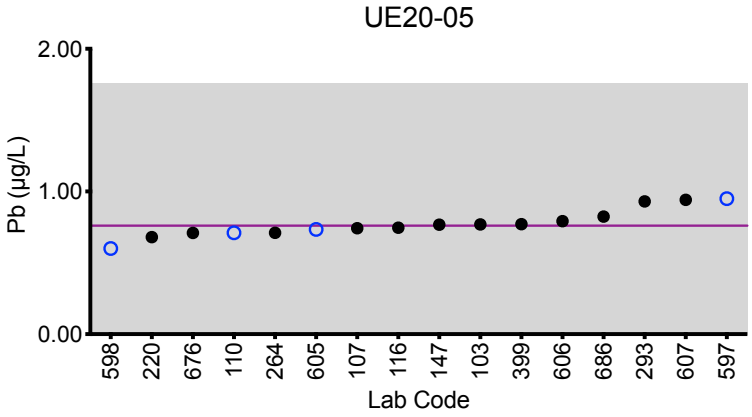
Urine Pb











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 #1, 2020: Summary Statistics

Urine Tl (µg/L)					
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	0.80	0.496	2.00	3.46	0.334
Upper Limit	1.00	0.696	2.40	4.15	0.534
Lower Limit	0.60	0.296	1.60	2.77	0.134
Robust SD (s*)	0.04	0.026	0.09	0.15	0.025
Robust RSD (%)	4.9	5.2	4.5	4.3	7.5
Number of Sample Measurements (N)	16	16	16	16	16
Standard Uncertainty (*u*)	0.01	0.008	0.03	0.05	0.008

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Urine Tl (µg/L)						
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**0.80**	**0.496**	**2.00**	**3.46**	**0.334**
103	DRC/CC-ICP-MS	0.823	0.500	2.15	3.57	0.351
107	ICP-MS	0.791	0.485	2.046	3.529	0.325
110	ICP-MS	0.869	0.485	1.99	3.48	0.344
116	ICP-MS/MS	0.759	0.478	1.94	3.35	0.327
147	ICP-MS	0.818	0.515	2.00	3.50	0.337
220	ICP-MS	0.76	0.46	1.95	3.34	0.31
264	ICP-MS	0.83	0.51	2.01	3.60	0.33
293	DRC/CC-ICP-MS	0.78	0.5	2.03	3.51	0.32
399	ICP-MS	0.77	0.485	2.03	3.44	0.333
597	ICP-MS/MS	0.79	0.52	1.93	3.32	0.40
598	ICP-MS	0.84	0.58	1.88	3.29	0.29
605	ICP-MS	0.755	0.451	1.90	3.36	0.301
606	ICP-MS/MS	0.762	0.475	1.92	3.26	0.321
607	ICP-MS	0.843	0.514	2.15	3.66	0.359
676	ICP-MS	0.786	0.491	2.06	3.60	0.397
686	ICP-MS	0.822	0.524	2.06	3.61	0.354

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

* Denotes a statistical Outlier

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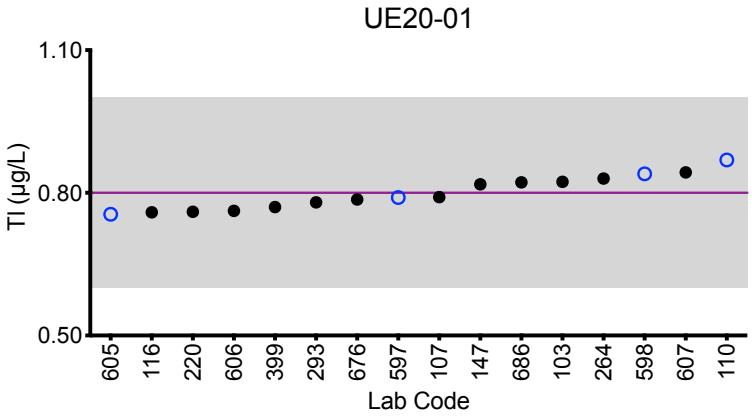
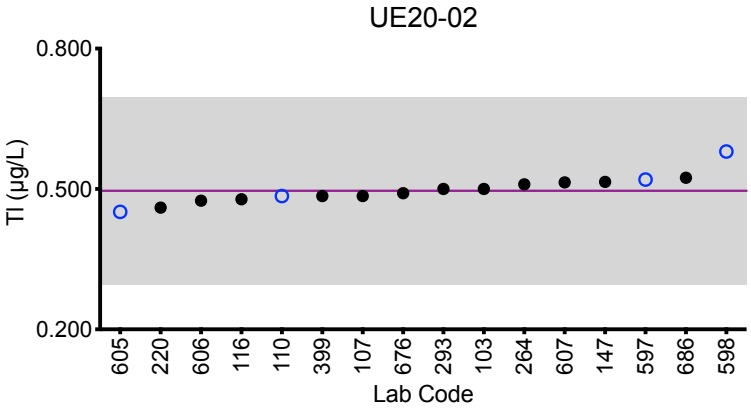
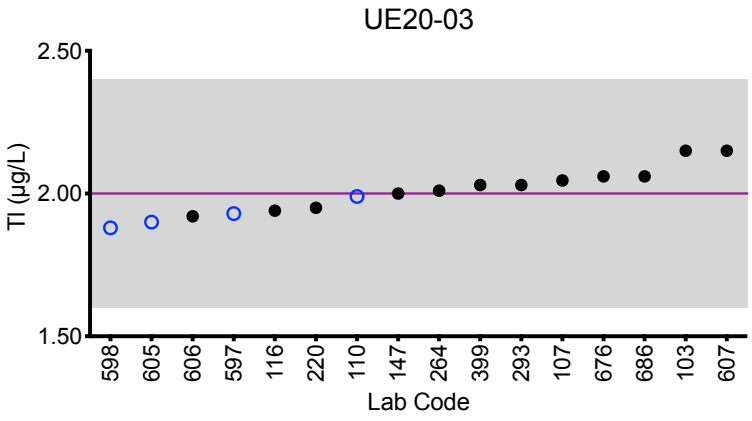
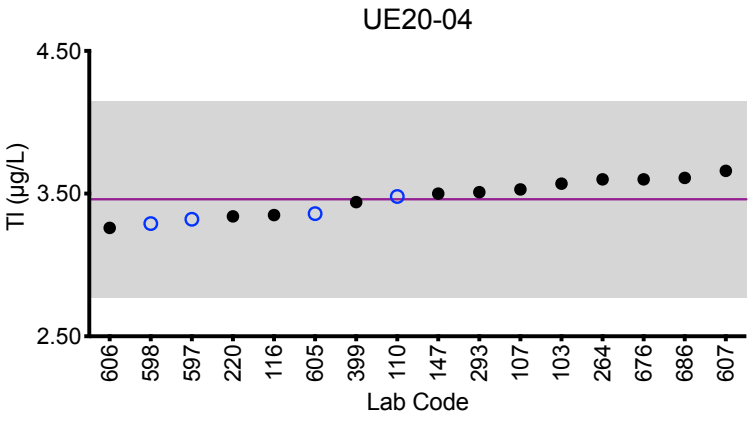
Results for Event #1, 2020: Summary Figures

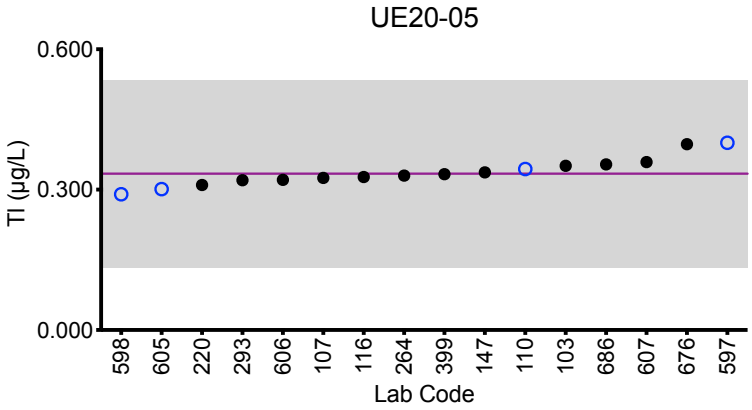
Urine Tl











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 #1, 2020: Summary Statistics

	Urine U (µg/L)				
	UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Target (Robust Mean (x*))	0.0093	0.074	0.249	0.0345	0.194
Upper Limit	0.0393	0.104	0.299	0.0645	0.233
Lower Limit	0.0000	0.044	0.199	0.0045	0.155
Robust SD (s*)	0.0016	0.005	0.017	0.0029	0.007
Robust RSD (%)	17	6.8	6.8	8.4	3.6
Number of Sample Measurements (N)	10	15	15	15	15
Standard Uncertainty (*u*)	0.0006	0.002	0.006	0.0009	0.002

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Urine U (µg/L)				
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
	Target	**0.0093**	**0.074**	**0.249**	**0.0345**	**0.194**
103	DRC/CC-ICP-MS	<0.02	0.0694	0.252	0.0275	0.196
107	ICP-MS	0.0096	0.0763	0.2588	0.0368	0.1959
110	ICP-MS	0.0087	0.0751	0.247	0.0349	0.194
116	ICP-MS/MS	<0.015	0.0732	0.259	0.0350	0.197
147	ICP-MS	<0.0210	0.0817	0.269	0.0338	0.205
220	ICP-MS	0.008	0.076	0.258	0.034	0.202
264	ICP-MS	0.01	0.071	0.24	0.04	0.19
324	ICP-MS	0.009	0.072	0.218	0.032	0.164
399	ICP-MS	0.007	0.064	0.237	0.032	0.178
598	ICP-MS	<0.01	0.06	0.22	0.03	0.17
605	ICP-MS	0.008	0.072	0.237	0.033	0.190
606	ICP-MS/MS	0.011	0.071	0.238	0.035	0.192
607	ICP-MS	0.0114	0.0853	0.274	0.0382	0.226
676	ICP-MS	0.01	0.079	0.256	0.037	0.190
686	ICP-MS	<0.0150	0.0795	0.263	0.0355	0.208

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

* Denotes a statistical Outlier

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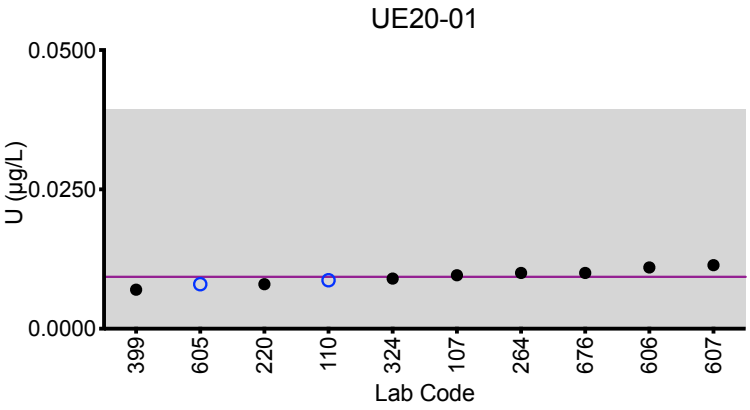
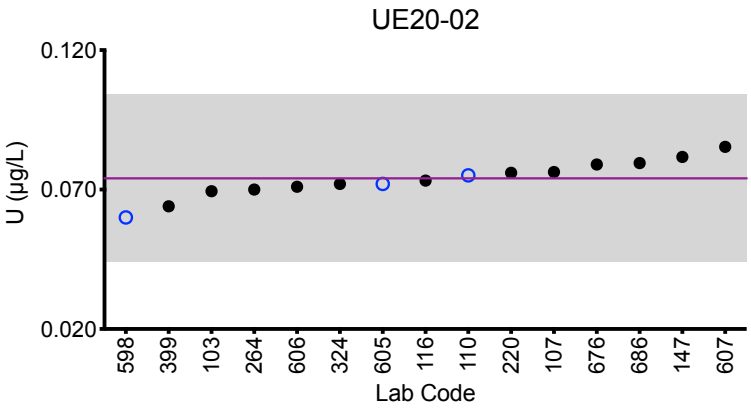
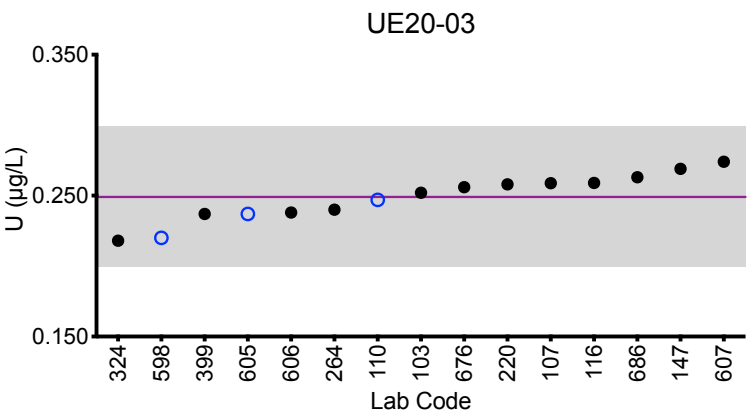
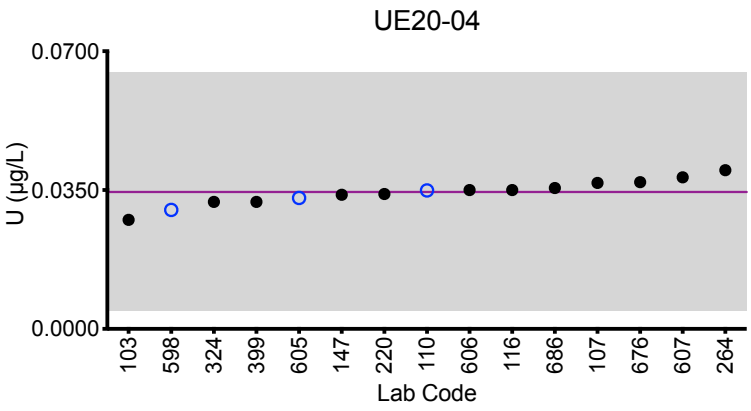
Results for Event #1, 2020: Summary Figures

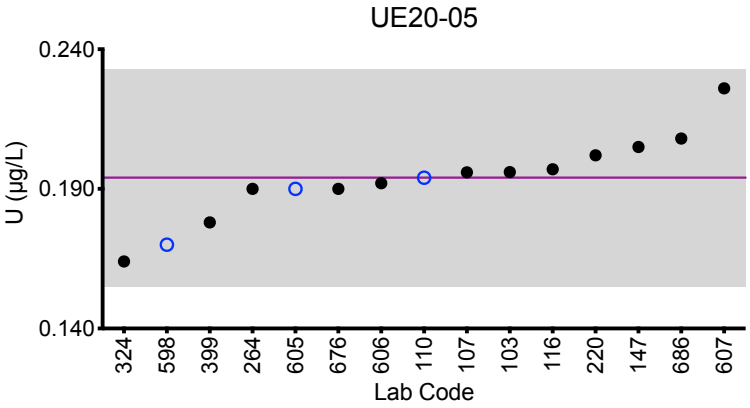
Urine U











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
107	ICP-MS	2.42	8.23	6.70	12.06	4.97
110	ICP-MS	2.56	9.15	7.10	13.0	5.36
147	ICP-MS	2.41	8.31	6.46	11.8	4.89
220	ICP-MS	2.42	8.09	6.61	11.9	5.15
264	ICP-MS	2.58	8.71	6.85	12.71	5.12
399	ICP-MS	2.46	8.39	6.63	12.1	5.00
597	ICP-MS/MS	2.45	8.3	6.39	11.63	5.3
598	ICP-MS	2.52	8.48	6.49	12.4	5.08
605	ICP-MS	2.23	7.85	6.30	11.9	4.60
606	ICP-MS/MS	2.34	8.10	6.35	11.4	4.80
676	ICP-MS	2.53	8.53	6.65	12.1	4.71

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Robust Mean (x*)	2.45	8.3	6.58	12.1	5.00
Robust SD (s*)	0.10	0.3	0.23	0.4	0.25
Robust RSD (%)	4.1	3.7	3.5	3.3	5.0
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.04	0.1	0.09	0.2	0.09

*Denotes a statistical Outlier.

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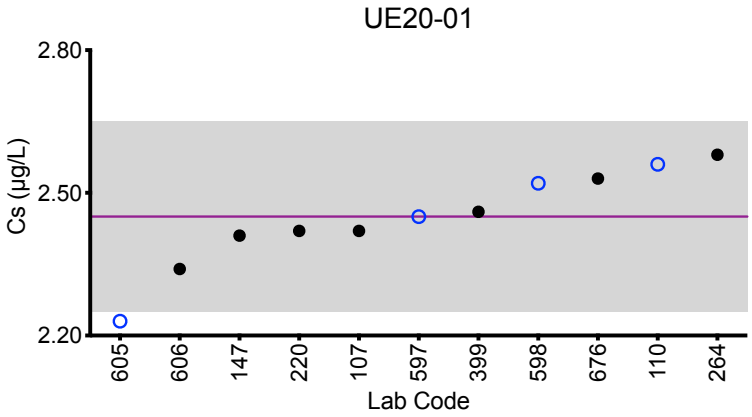
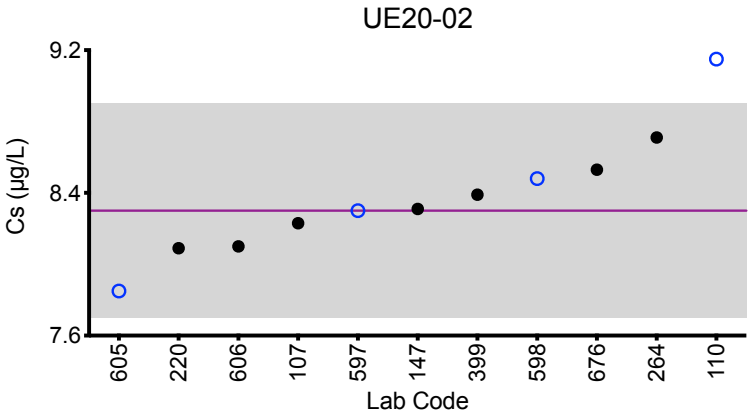
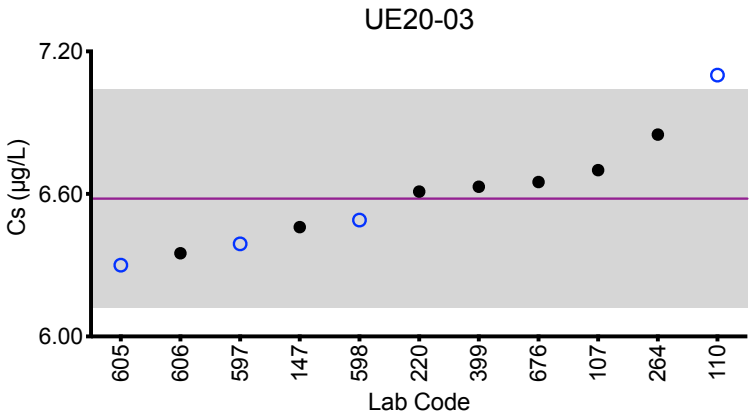
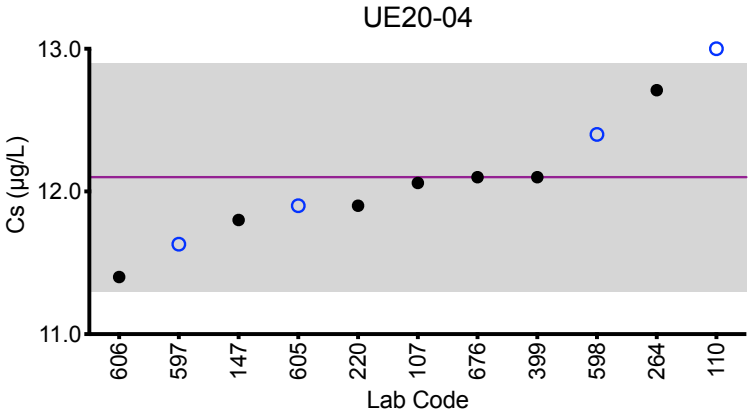
Results for Event #1, 2020: Summary Figures

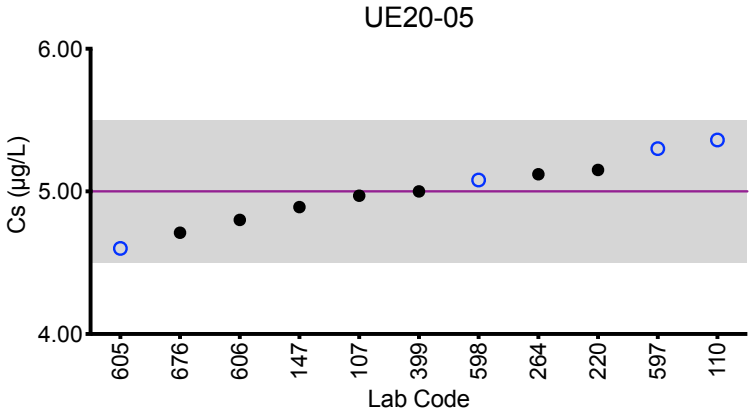
Urine Cs











Legend:
o CHEAR Labs ● Other Labs
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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
110	ICP-MS	15.8	5.1	10.7	12.2	12.3
116	ICP-MS/MS	11.1	<5.0	7.61	10.2	7.28
147	ICP-MS	16.6	*10.9	15.1	14.9	*18.6
264	ICP-MS	12.60	3.63	8.57	9.92	7.80
293	DRC/CC-ICP-MS	12.08	3.81	7.63	10.17	7.63
324	ICP-MS	12.991	4.372	8.533	*22.497	8.135
391	DRC/CC-ICP-MS	9.163	1.878	5.981	7.693	5.935
597	ICP-MS/MS	11.7	4.14	7.71	9.84	*22.3
598	ICP-MS	11.9	4.39	8.50	9.86	8.66

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Arithmetic Mean ($\bar{x}$)	12.7	3.9	8.9	10.6	8.2
Arithmetic SD (s)	2.3	1.0	2.6	2.1	2.0
Arithmetic RSD (%)	18	26	29	20	24
Number of Sample Measurements (N)	9	7	9	8	7

*Denotes a statistical Outlier.

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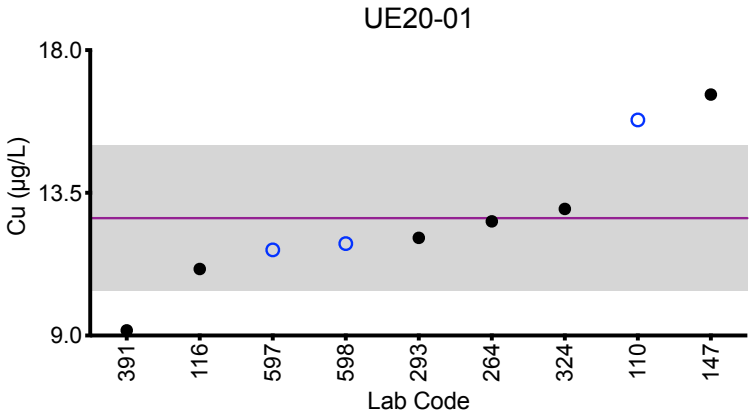
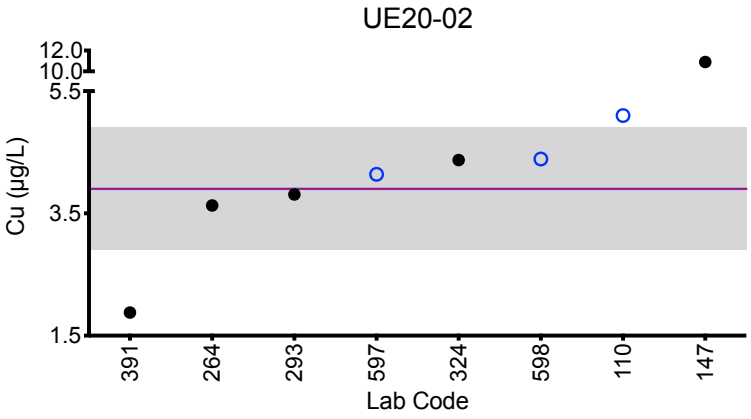
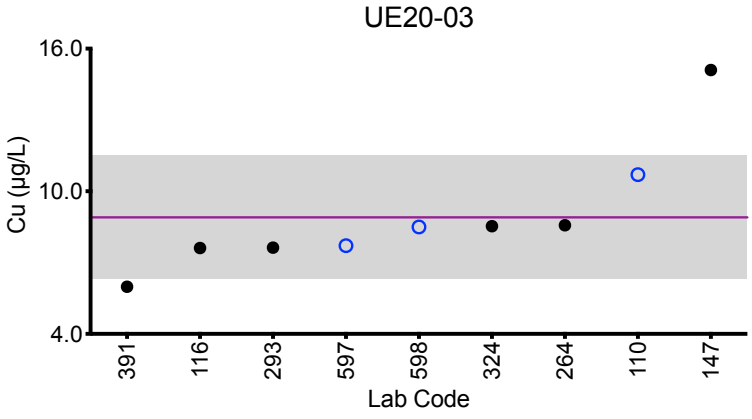
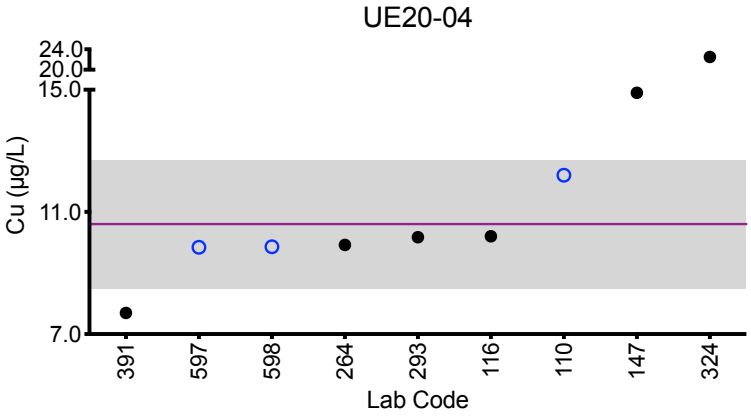
Results for Event #1, 2020: Summary Figures

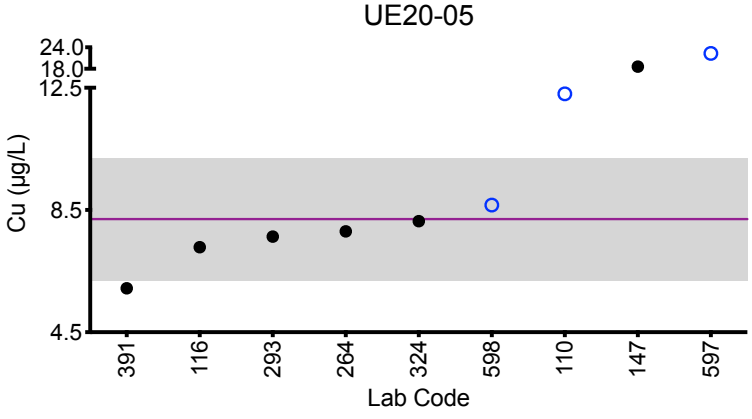
Urine Cu











Legend:

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
103	DRC/CC-ICP-MS	16.5	12.1	41.3	95.0	104
107	ICP-MS	15.65	11.25	40.36999	91.91	99.45
110	ICP-MS	16.8	12.0	42.8	97.6	105
147	ICP-MS	16.4	11.6	40.8	90.7	102
220	ICP-MS	18.9	12.8	43.8	100	111
264	ICP-MS	13.89	10.00	36.81	80.86	94.46
293	DRC/CC-ICP-MS	16.29	12.18	44.96	99.08	107.24
324	ICP-MS	16.580	11.990	41.572	93.966	102.421
399	ICP-MS	16.3	11.9	40.5	93.9	101
597	ICP-MS/MS	14.5	10.6	36.8	83.8	105
598	DRC/CC-ICP-MS	17.5	12.3	43.1	98.8	107
605	ICP-MS	14.6	9.75	38.3	90.5	97.9
606	ICP-MS/MS	15.8	11.6	39.0	92.6	97.3
676	ICP-MS	17.1	12.2	41.6	96.0	98.9

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Robust Mean (x*)	16.3	11.8	40.8	94	102
Robust SD (s*)	1.0	0.5	2.8	5	5
Robust RSD (%)	6.1	4.2	6.9	5.3	4.9
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.3	0.2	0.9	2	2

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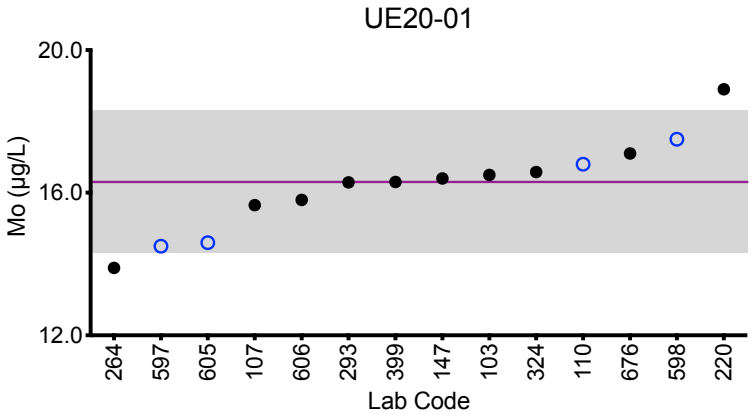
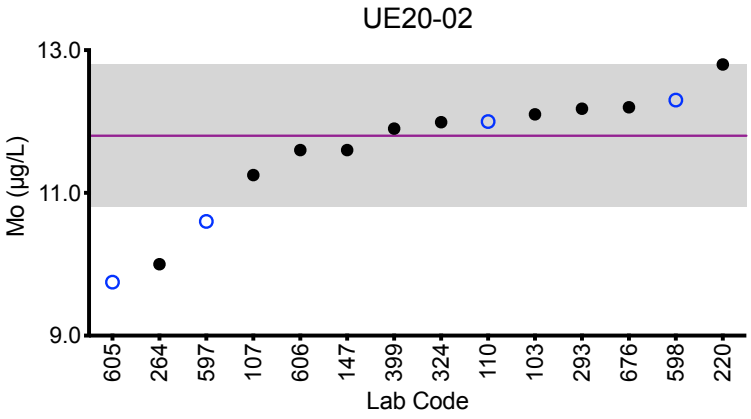
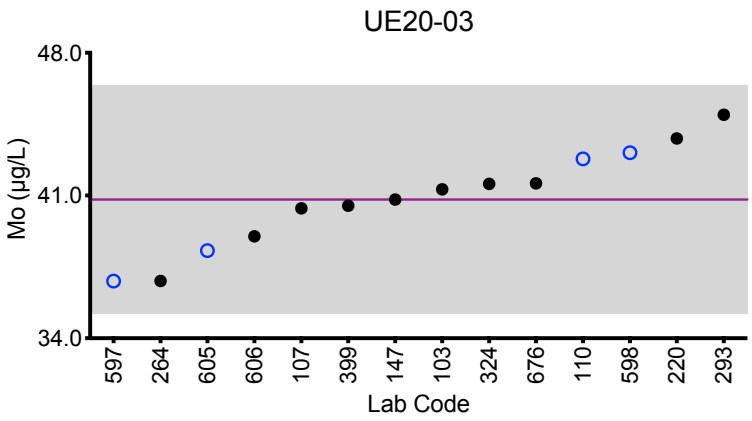
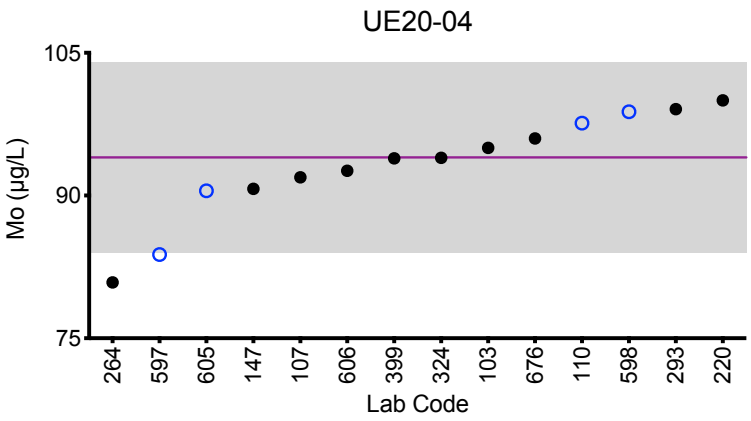
Results for Event #1, 2020: Summary Figures

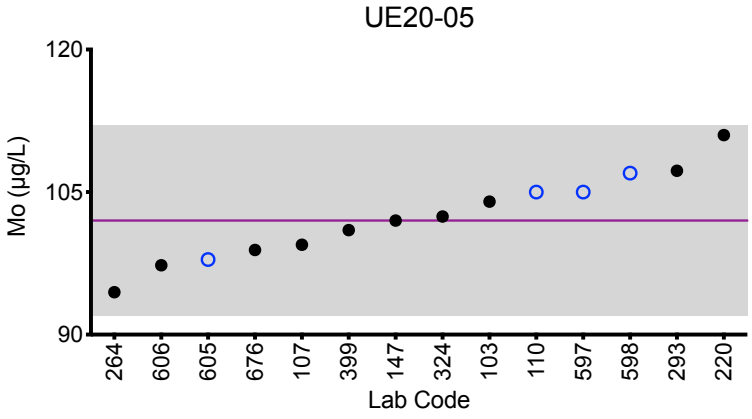
Urine Mo











Legend:
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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
107	DRC/CC-ICP-MS	6.81	1.93	3.43	77.07	13.01
110	ICP-MS	6.59	2.35	3.84	76.0	12.2
147	ICP-MS	6.20	1.16	2.28	74.0	11.0
264	ICP-MS	6.52	1.45	2.80	77.02	12.12
293	DRC/CC-ICP-MS	6.46	1.5	*7.37	83.4	13.7
324	ICP-MS	6.272	1.755	3.304	84.163	11.935
391	DRC/CC-ICP-MS	5.35	1.122	2.419	69.927	10.173
598	ICP-MS	6.16	1.99	3.30	70.5	11.5
605	ICP-MS	6.05	1.22	2.58	74.3	11.5

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Arithmetic Mean ($\bar{x}$)	6.3	1.6	3.0	76	11.9
Arithmetic SD (s)	0.4	0.4	0.6	5	1.0
Arithmetic RSD (%)	6.7	27	20	6.6	8.4
Number of Sample Measurements (N)	9	9	8	9	9

*Denotes a statistical Outlier.

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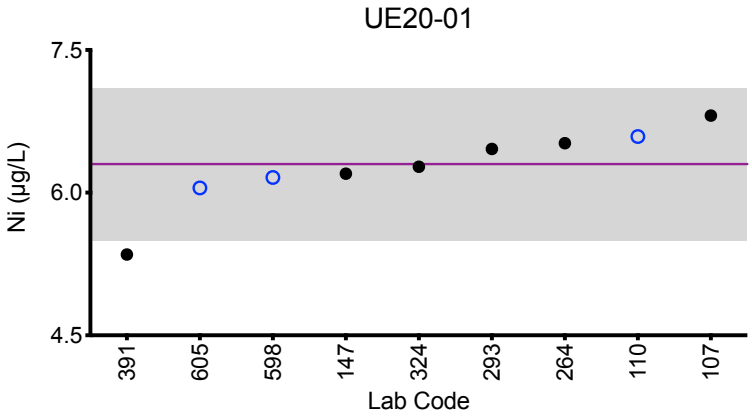
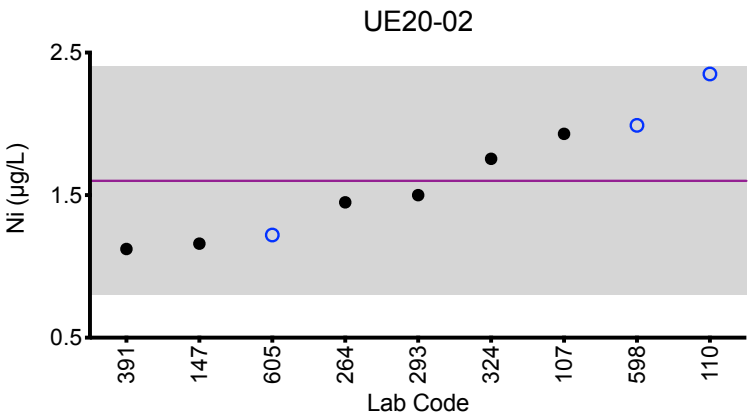
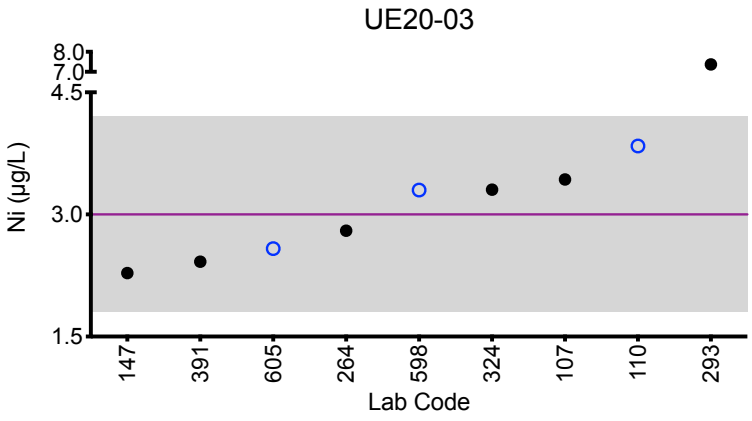
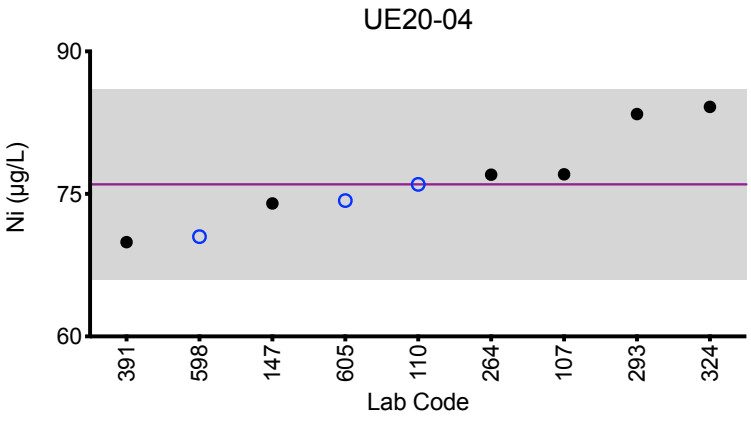
Results for Event #1, 2020: Summary Figures

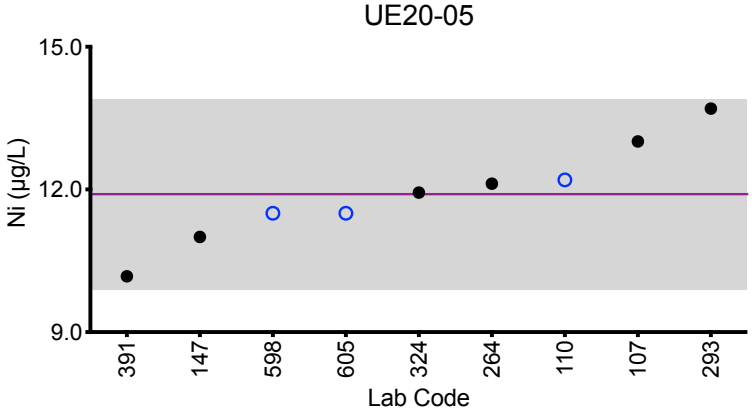
Urine Ni











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
107	ICP-MS	0.1322	3.7950	0.3428	0.7516	4.5811
110	ICP-MS	0.128	3.63	0.337	0.748	4.56
220	ICP-MS	0.15	3.38	0.28	0.72	4.17
264	ICP-MS	0.13	3.39	0.36	0.72	4.24
399	ICP-MS	0.118	3.50	0.357	0.711	4.33
598	ICP-MS	0.16	3.26	0.32	0.68	*6.89
605	ICP-MS	0.117	3.27	0.296	0.713	4.19
676	ICP-MS	0.137	3.46	0.337	0.702	4.22

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Arithmetic Mean ($\bar{x}$)	0.134	3.46	0.33	0.718	4.33
Arithmetic SD (s)	0.015	0.18	0.03	0.023	0.17
Arithmetic RSD (%)	11	5.2	8.5	3.2	3.9
Number of Sample Measurements (N)	8	8	8	8	7

*Denotes a statistical Outlier.

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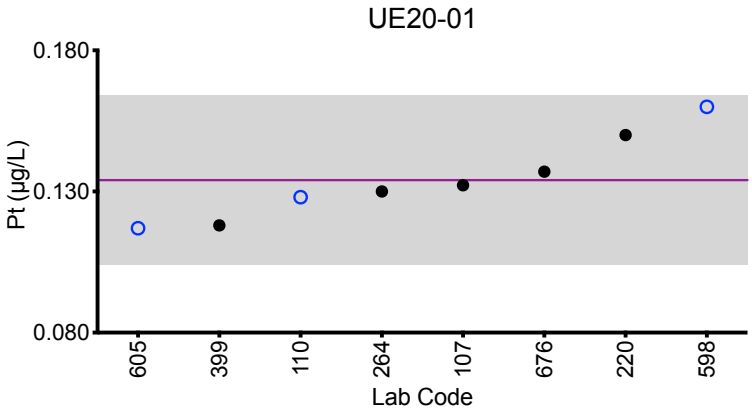
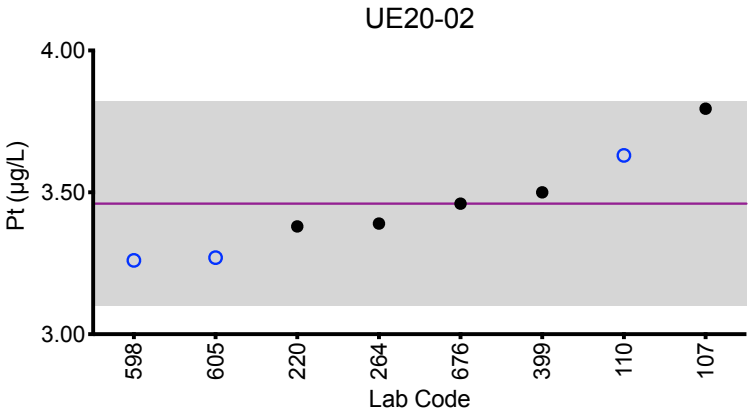
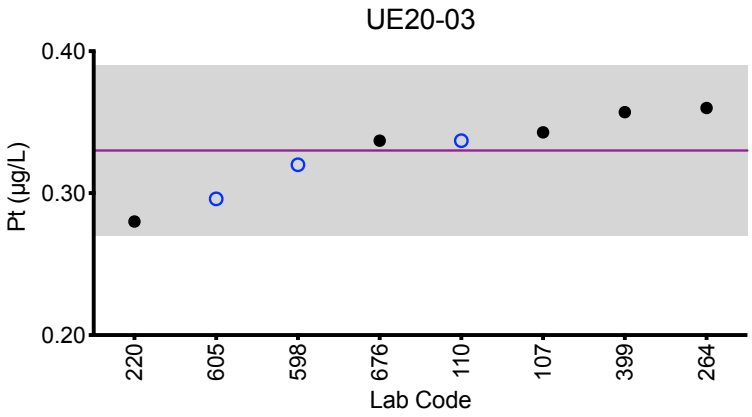
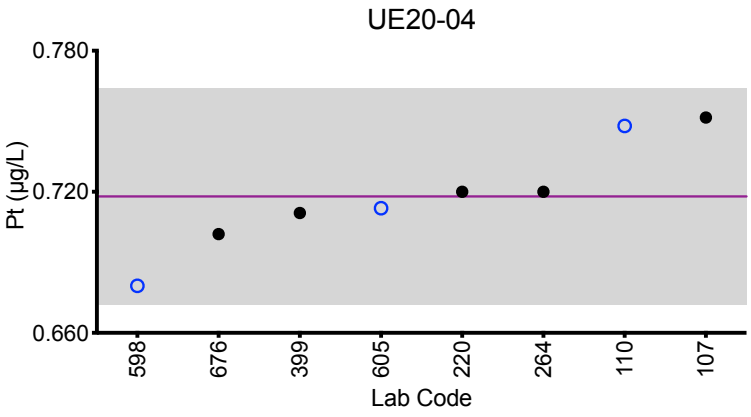
Results for Event #1, 2020: Summary Figures

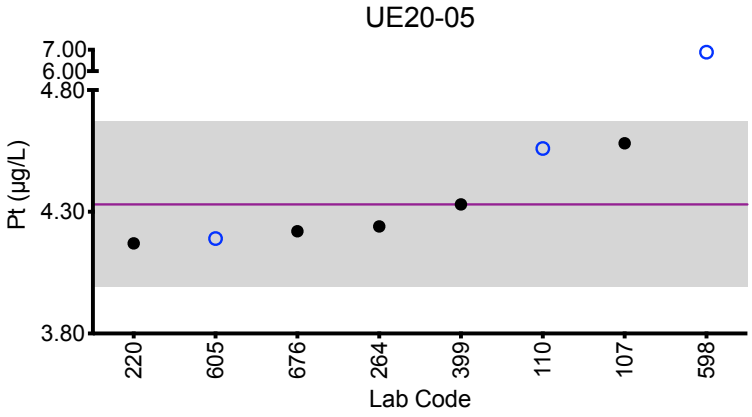
Urine Pt











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
103	DRC/CC-ICP-MS	2.65	0.292	1.48	0.911	0.739
107	ICP-MS	2.391	0.297	1.388	0.880	0.705
110	ICP-MS	2.29	0.287	1.36	0.906	0.746
147	ICP-MS	2.68	0.302	1.53	0.963	0.728
220	ICP-MS	2.42	0.29	1.39	0.91	0.76
264	ICP-MS	2.56	0.32	1.49	0.95	0.78
293	DRC/CC-ICP-MS	2.76	0.25	1.52	0.99	0.81
399	ICP-MS	2.53	0.294	1.55	0.935	0.773
598	ICP-MS	2.45	0.31	1.37	0.89	0.72
605	ICP-MS	2.24	<0.800	1.20	0.835	<0.800
606	ICP-MS/MS	2.56	0.303	1.39	0.858	0.728
676	ICP-MS	2.40	0.266	1.40	0.916	0.652

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Robust Mean (x*)	2.49	0.294	1.43	0.91	0.74
Robust SD (s*)	0.16	0.014	0.09	0.04	0.03
Robust RSD (%)	6.4	4.8	6.3	4.4	4.7
Number of Sample Measurements (N)	12	11	12	12	11
Standard Uncertainty (*u*)	0.06	0.005	0.03	0.02	0.01

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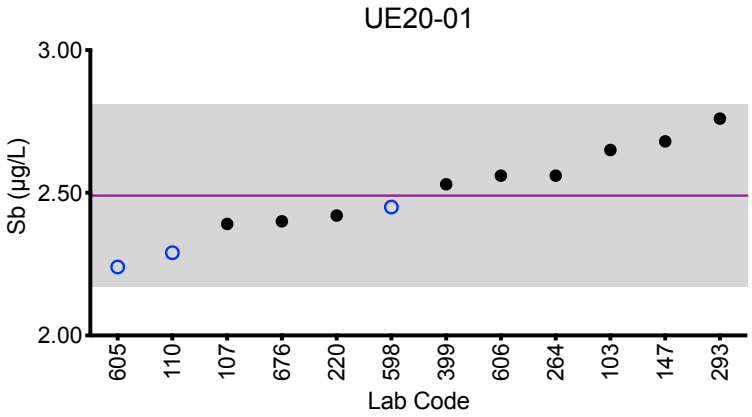
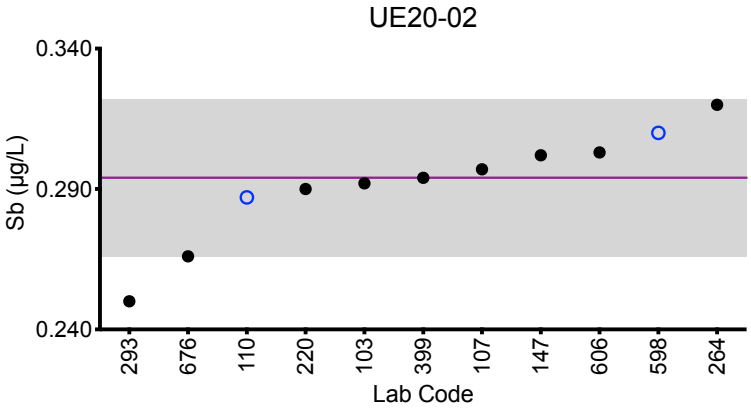
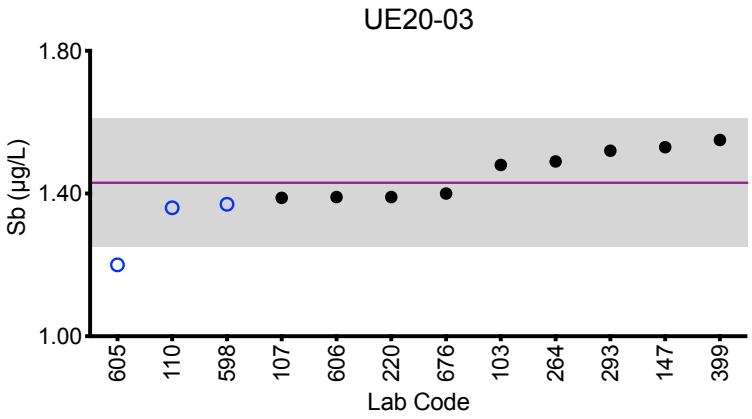
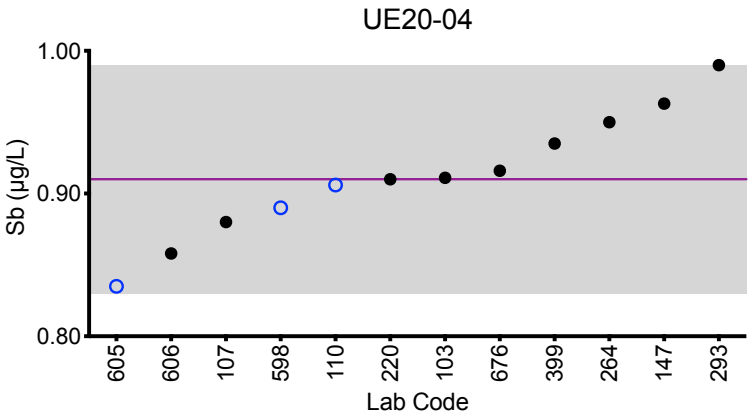
Results for Event #1, 2020: Summary Figures

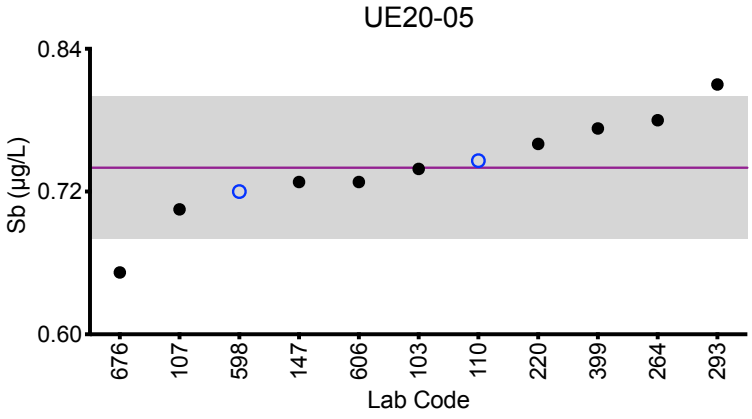
Urine Sb











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Se (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
103	DRC/CC-ICP-MS	25.1	30.4	39.7	29.2	77.1
110	DRC/CC-ICP-MS	24.2	27.3	36.9	23.3	78.4
147	ICP-MS	22.4	26.9	38.2	25.0	71.8
597	ICP-MS/MS	21.8	26.7	38.1	23.9	78.8
598	DRC/CC-ICP-MS	22.9	28.2	37.9	24.6	78.5

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Arithmetic Mean ($\bar{x}$)	23.3	27.9	38.2	25	77
Arithmetic SD (s)	1.3	1.5	1.0	2	3
Arithmetic RSD (%)	5.6	5.4	2.6	9.1	3.8
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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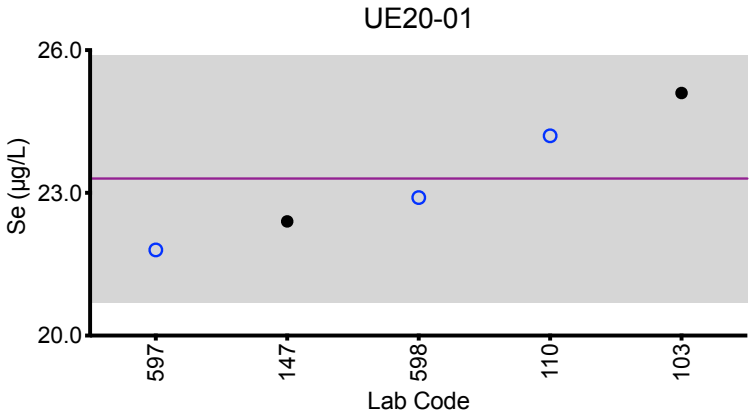
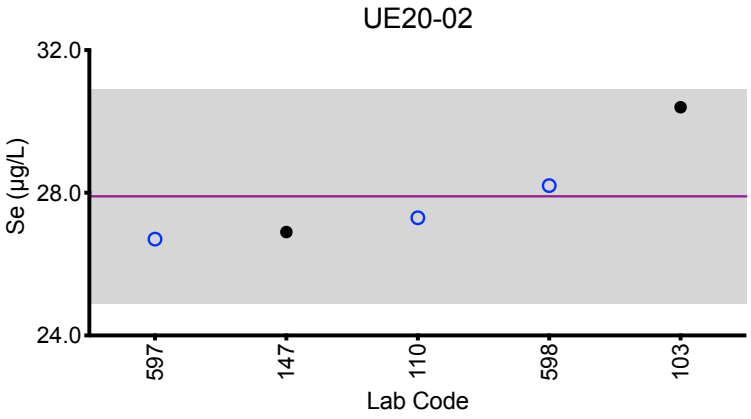
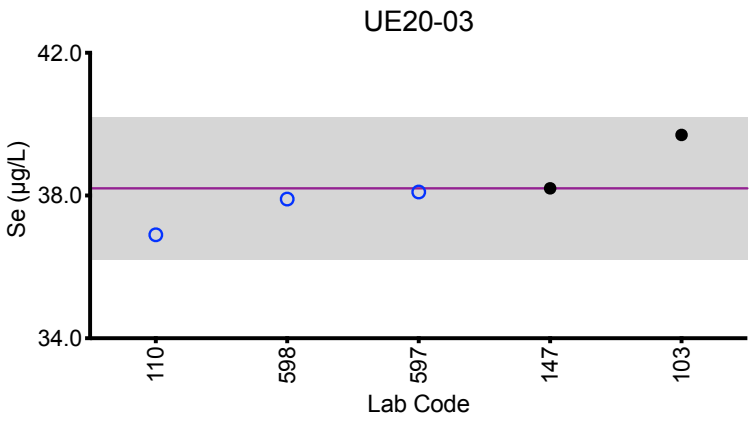
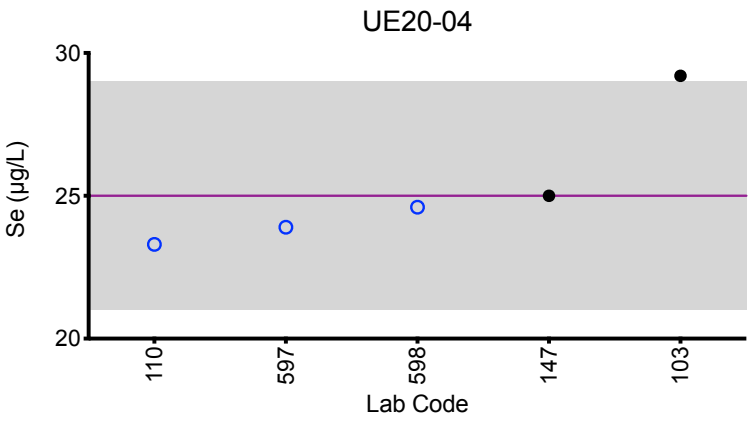
Results for Event #1, 2020: Summary Figures

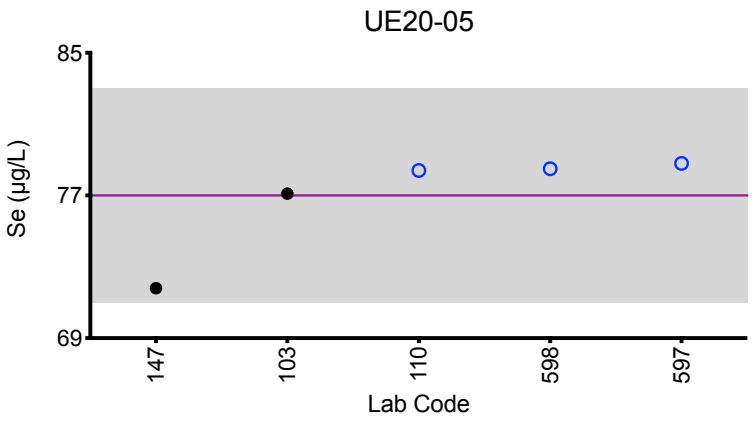
Urine Se











Legend:
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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
107	ICP-MS	1.55	5.16	0.52	1.24	4.58
110	ICP-MS	2.01	5.02	0.60	1.23	6.31
147	ICP-MS	1.57	5.52	0.583	1.26	4.98
220	ICP-MS	1.96	5.25	0.69	1.28	6.14
264	ICP-MS	1.25	4.79	0.51	1.04	4.73
399	ICP-MS	2.40	4.78	0.712	1.29	6.82
597	ICP-MS/MS	1.79	4.36	0.71	1.31	6.26
598	ICP-MS	0.95	4.87	0.37	0.96	3.48
605	ICP-MS	1.77	4.15	<0.900	0.923	4.79
676	ICP-MS	2.38	4.63	0.664	1.20	6.68

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Robust Mean (x*)	1.8	4.9	0.60	1.22	5.5
Robust SD (s*)	0.4	0.4	0.11	0.08	1.2
Robust RSD (%)	22	8.2	19	6.6	22
Number of Sample Measurements (N)	10	10	9	10	10
Standard Uncertainty (*u*)	0.2	0.2	0.05	0.03	0.5

*Denotes a statistical Outlier.
An arithmetic mean, SD, RSD and n are provided for sample UE20-03.

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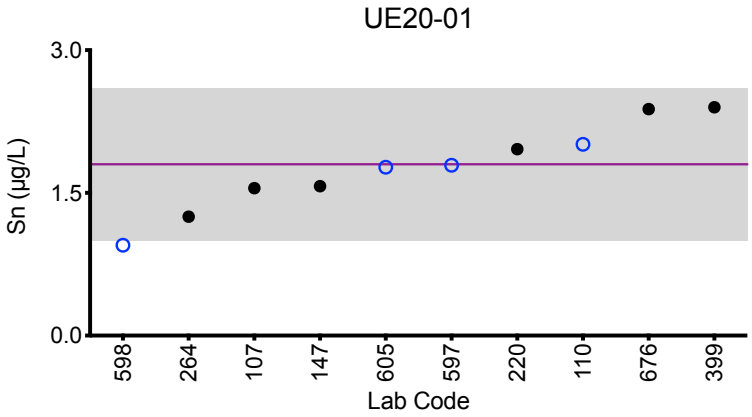
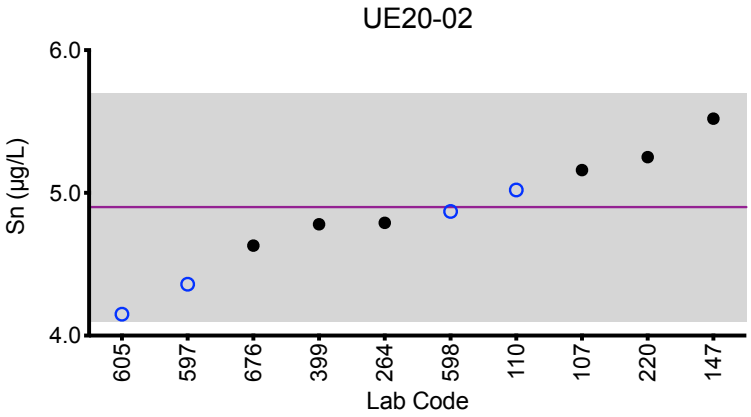
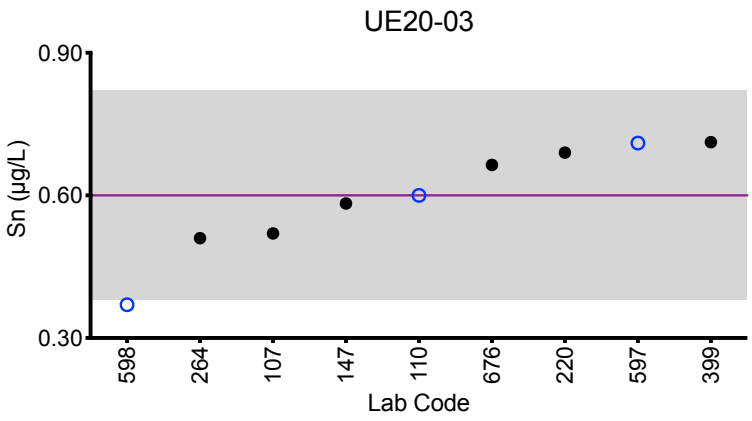
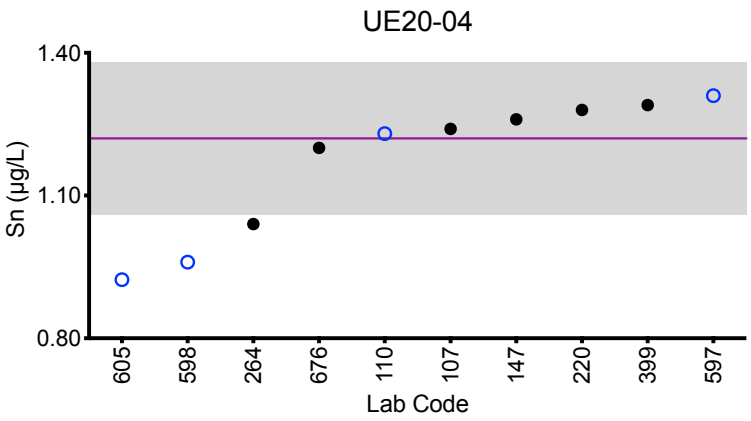
Results for Event #1, 2020: Summary Figures

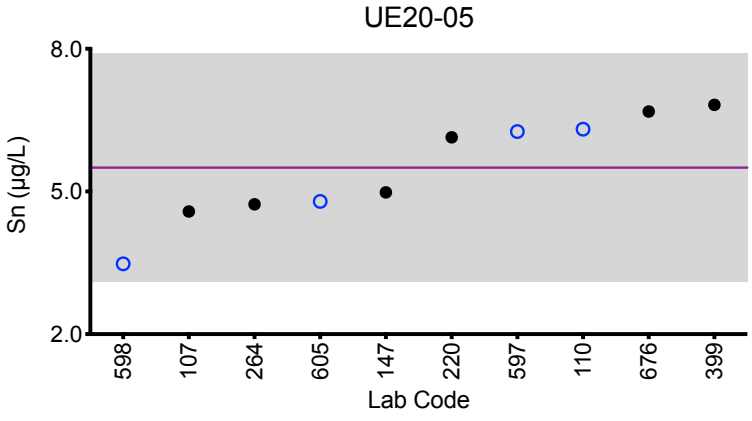
Urine Sn











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Sr (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
103	DRC/CC-ICP-MS	119	513	127	203	264
107	ICP-MS	111.9	483.1	127.2	197.3	265.6
200	ICP-MS	96	433	107	175	251
220	ICP-MS	124	537	139	218	296
264	ICP-MS	83.35	492.93	90.45	143.89	*187.44
399	DRC/CC-ICP-MS	115	515	126	199	262
605	ICP-MS	111	481	122	192	260
676	ICP-MS	123	527	133	207	267

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Arithmetic Mean ($\bar{x}$)	110	498	121	192	267
Arithmetic SD (s)	14	33	16	23	14
Arithmetic RSD (%)	13	6.6	13	12	5.2
Number of Sample Measurements (N)	8	8	8	8	7

*Denotes a statistical Outlier.

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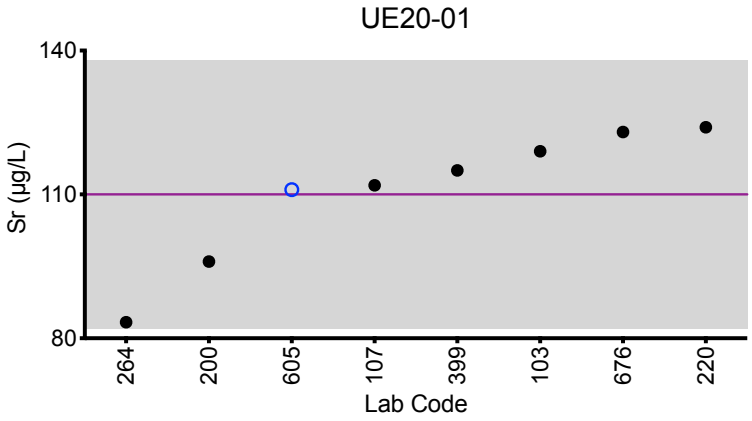
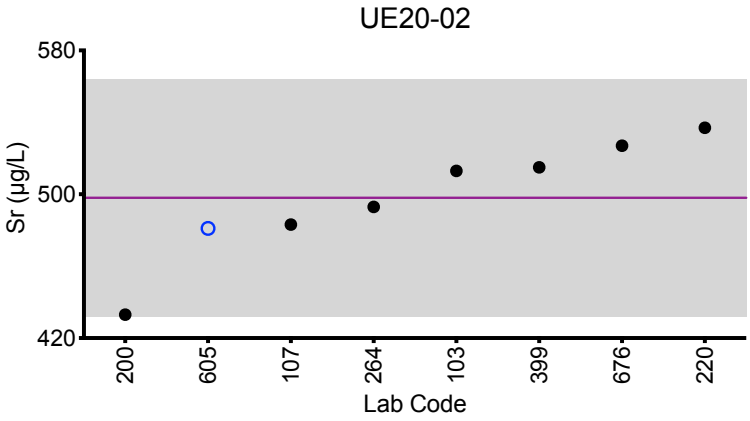
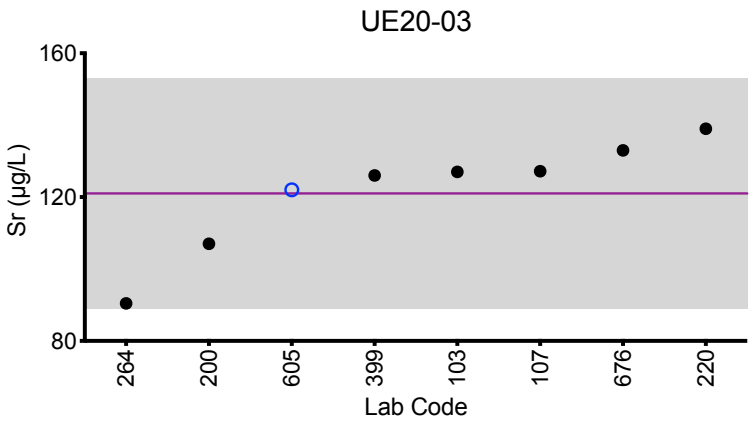
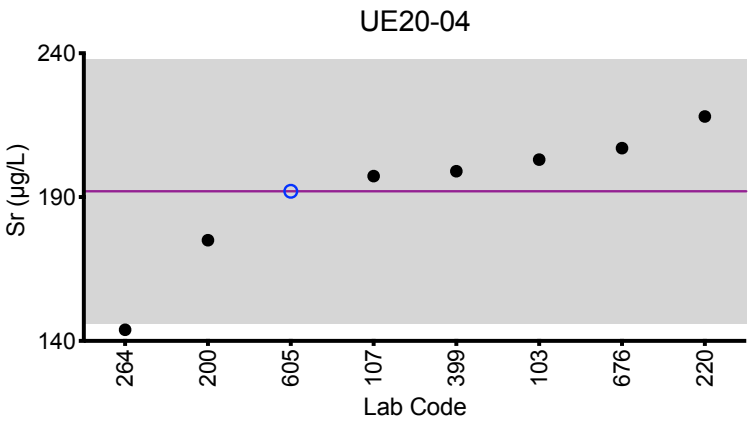
Results for Event #1, 2020: Summary Figures

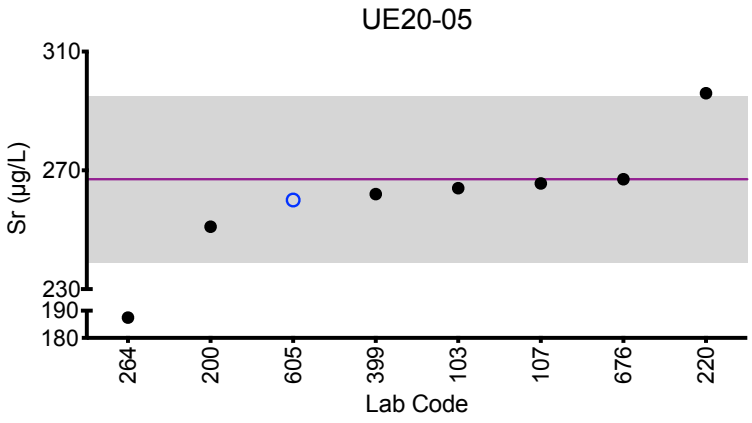
Urine Sr











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
116	ICP-MS/MS	0.690	1.64	0.401	2.54	4.68
147	DRC/CC-ICP-MS	0.643	1.52	0.431	2.26	4.40
293	DRC/CC-ICP-MS	0.9	2.02	0.58	3.11	5.79
597	ICP-MS/MS	0.670	1.53	0.45	2.26	4.57
598	DRC/CC-ICP-MS	0.86	1.96	0.56	3.06	6.52
605	ICP-MS	0.565	1.48	0.350	2.25	4.60

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Arithmetic Mean ($\bar{x}$)	0.72	1.7	0.46	2.6	5.1
Arithmetic SD (s)	0.13	0.2	0.09	0.4	0.9
Arithmetic RSD (%)	18	14	20	15	18
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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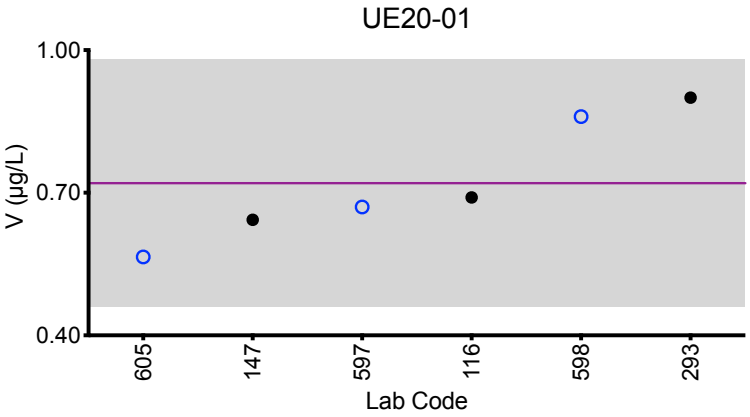
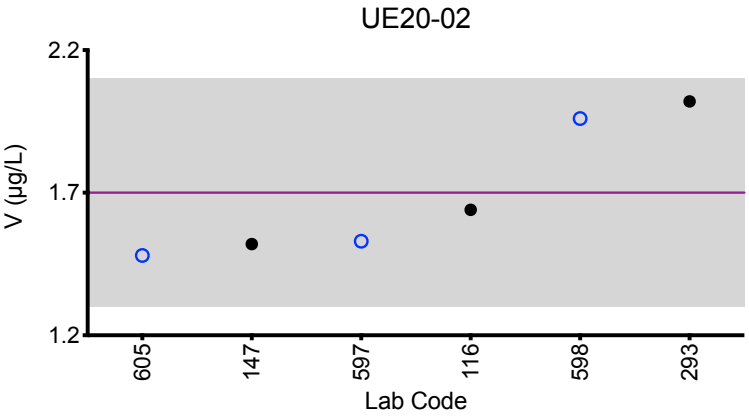
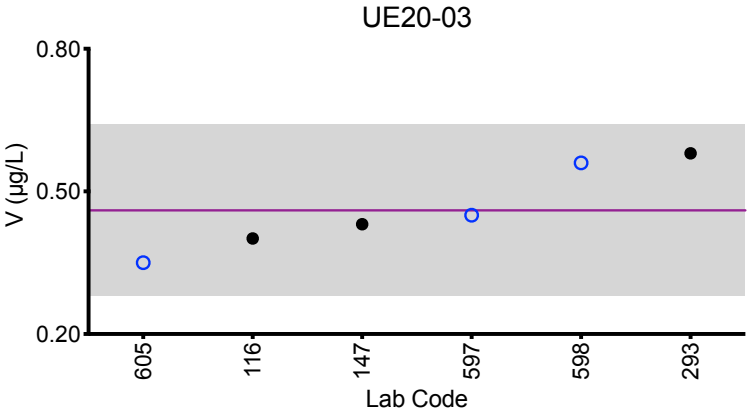
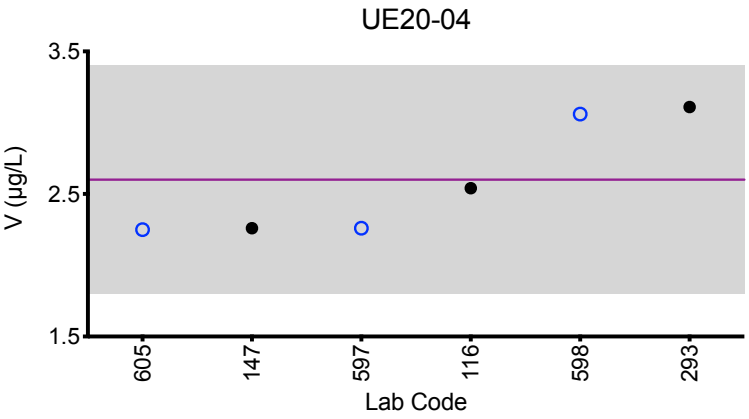
Results for Event #1, 2020: Summary Figures

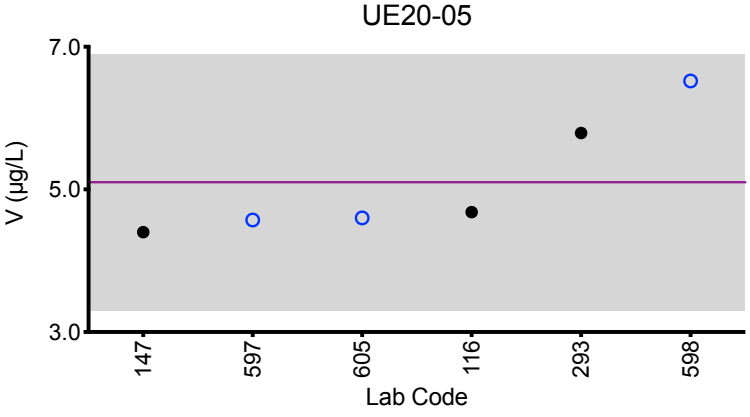
Urine V











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
107	ICP-MS	1.321	0.519	0.749	0.228	1.066
110	ICP-MS	1.38	0.525	0.758	0.246	1.14
147	ICP-MS	1.44	0.544	0.796	0.248	1.21
200	ICP-MS	1.2	0.5	0.8	0.2	1.2
220	ICP-MS	1.41	0.56	0.75	0.23	1.10
264	ICP-MS	1.29	0.51	0.70	0.22	1.08
324	ICP-MS	1.373	<1	<1	<1	1.001
399	ICP-MS	1.35	0.538	0.735	0.228	1.09
598	ICP-MS	1.50	0.62	0.82	0.28	1.12
605	ICP-MS	1.31	0.502	0.677	0.205	1.03
606	ICP-MS/MS	1.36	0.515	0.690	0.225	1.10
676	ICP-MS	1.34	0.529	0.712	0.257	1.05

Summary Statistics

	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
Robust Mean (x*)	1.36	0.527	0.74	0.232	1.10
Robust SD (s*)	0.06	0.023	0.05	0.024	0.06
Robust RSD (%)	4.4	4.4	6.8	10	5.5
Number of Sample Measurements (N)	12	11	11	11	12
Standard Uncertainty (*u*)	0.02	0.009	0.02	0.009	0.02

*Denotes a statistical Outlier.

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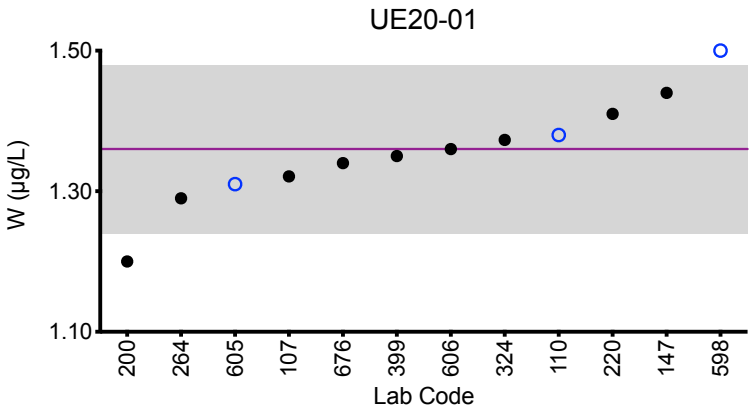
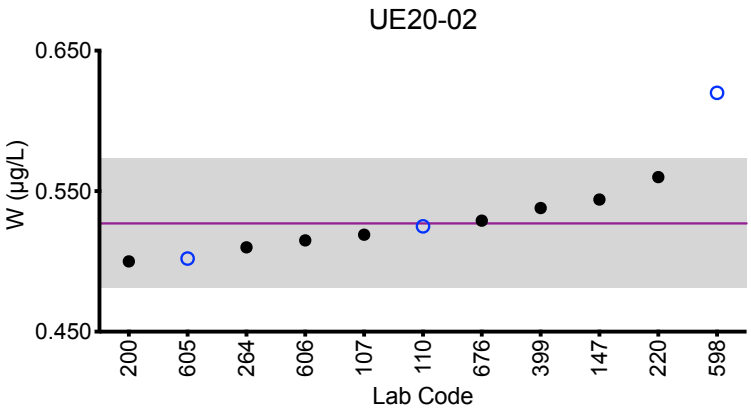
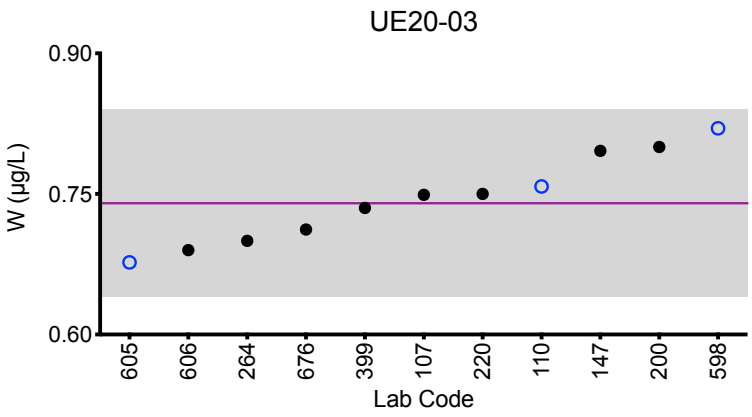
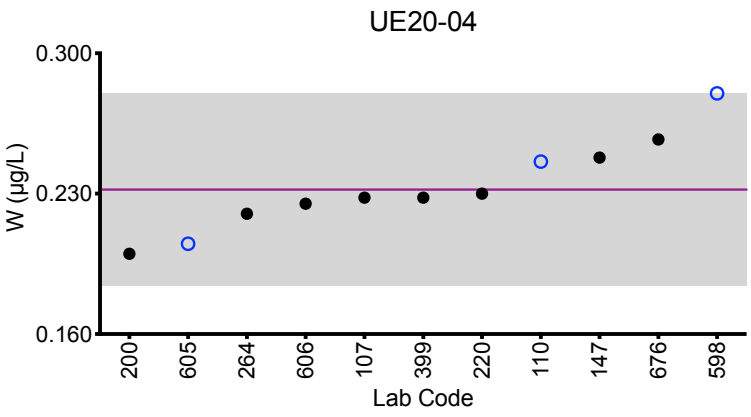
Results for Event #1, 2020: Summary Figures

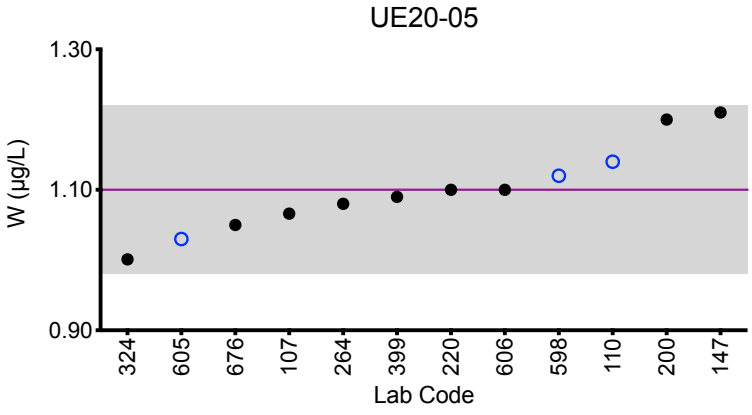
Urine W











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)						
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
110	ICP-MS	201	928	286	186	565
147	ICP-MS	190	974	295	185	558
264	ICP-MS	200.32	995.08	310.90	196.83	621.04
324	ICP-MS	184.675	936.326	291.226	178.814	588.160
597	ICP-MS/MS	*94.2	836	198	138	785
598	ICP-MS	170	861	256	165	497
Summary Statistics						
		UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Arithmetic Mean ($\bar{x}$)		189	920	270	175	600
Arithmetic SD (s)		13	60	40	21	100
Arithmetic RSD (%)		6.9	6.5	15	12	17
Number of Sample Measurements (N)		5	6	6	6	6

*Denotes a statistical Outlier.

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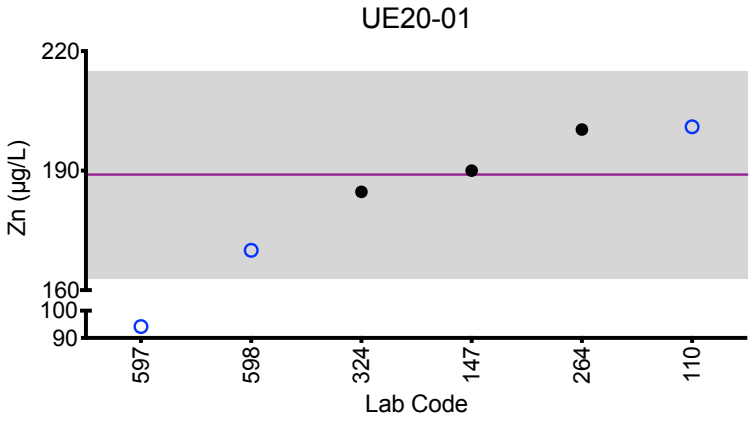
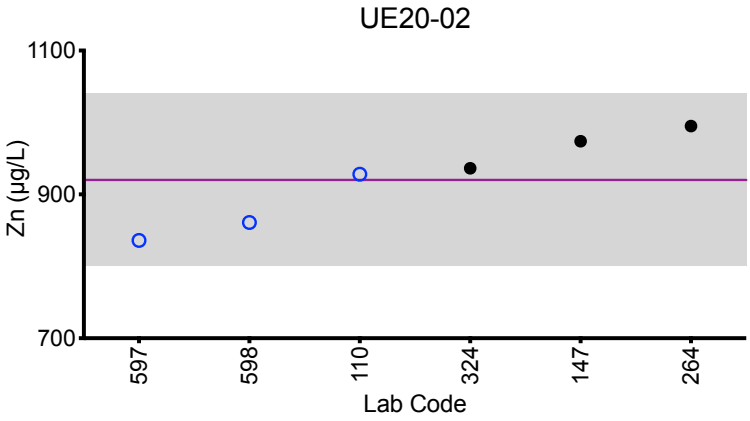
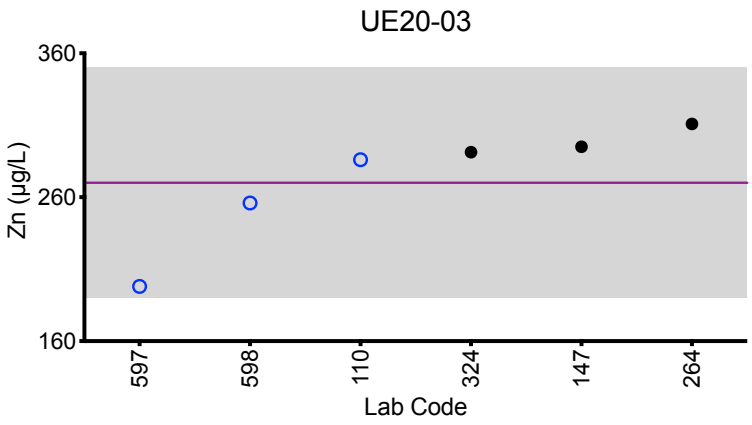
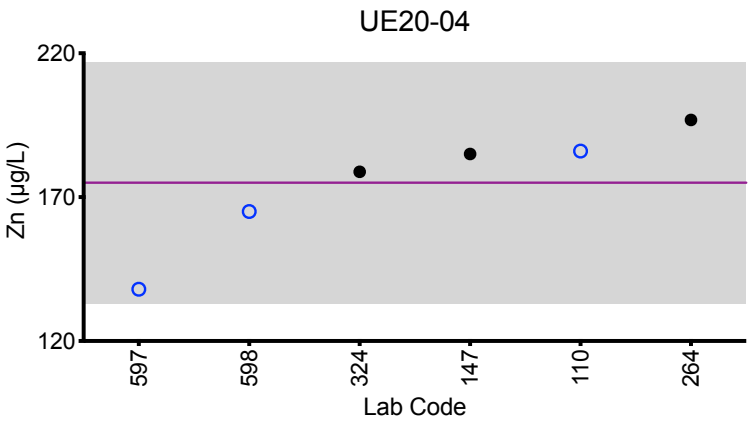
Results for Event #1, 2020: Summary Figures

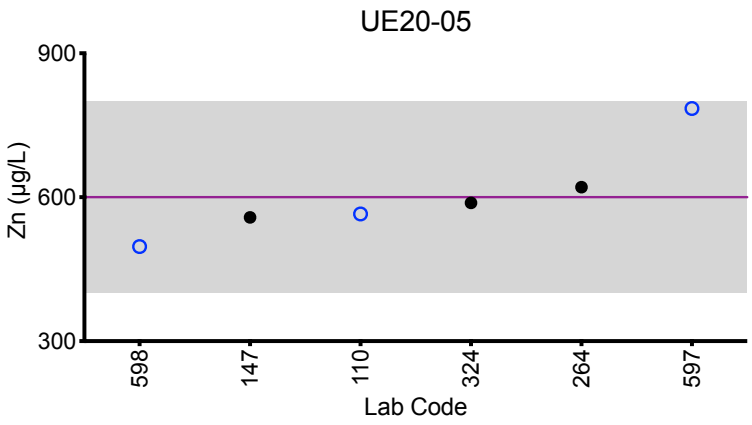
Urine Zn











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Urine Al (µg/L)						
Lab Code	**Method**	**UE20-01**	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
147	ICP-MS	15.9	20.2	<11.6	14.9	24.4
264	ICP-MS	10.00	16.98	8.62	13.78	24.62
324	ICP-MS	10.213	16.274	10.756	12.376	29.106
597	ICP-MS/MS	11.8	21.0	13.2	14.7	28.8
Summary Statistics						
		UE20-01	**UE20-02**	**UE20-03**	**UE20-04**	**UE20-05**
Arithmetic Mean ($\bar{x}$)		12.0	18.6	10.9	13.9	26.7
Arithmetic SD (s)		2.7	2.3	2.3	1.2	2.6
Arithmetic RSD (%)		23	12	21	8.6	9.7
Number of Sample Measurements (N)		4	4	3	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2020: Additional Elements in Urine

Urine Ag (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
147	ICP-MS	<0.216	<0.216	<0.216	<0.216	<0.216

Urine B (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
200	ICP-MS	292	151	702	216	1188

Urine Bi (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
147	ICP-MS	<0.0669	<0.0669	<0.0669	<0.0669	<0.0669
264	ICP-MS	<0.01	0.01	0.02	<0.01	<0.01

Urine Fe (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
324	ICP-MS	2.733	3.769	5.091	29.324	9.394

Urine I (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
147	ICP-MS	53.2	94.8	113	55.8	177

Urine Li (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
147	ICP-MS	7.08	8.54	15.1	6.10	24.8

Urine Mg (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
597	ICP-MS/MS	22100	23000	47000	27800	82500

Urine Te (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
147	ICP-MS	<0.0931	0.185	0.318	0.601	1.74

Urine Th (µg/L)

Lab Code	Method	UE20-01	UE20-02	UE20-03	UE20-04	UE20-05
147	ICP-MS	<0.169	<0.169	<0.169	<0.169	<0.169

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Event #1, 2020

Trace Elements in Serum

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Trace Elements Laboratory

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Event #1, 2020:
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 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

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

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

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Results for Event #1, 2020: Summary Statistics

	Serum Al (µg/L)				
	SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Target (Arithmetic Mean ($\bar{x}$))	NA	124	173	150	78
Upper Limit	NA	149	208	180	94
Lower Limit	NA	99	138	120	62
Arithmetic SD (s)	NA	24	14	21	5
Arithmetic RSD (%)	NA	19	8.1	14	6.4
Number of Sample Measurements (N)	NA	7	6	7	6

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

Statistical data was not calculated for SE20-01 based on a lack of consensus among participating labs.

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Serum Al (µg/L)				
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
	Target	**NA**	**124**	**173**	**150**	**78**
147	ETAAS-Z	30.7	103	152	123	73.5
264	ICP-MS	28.58	100.15	164.74	136.01	71.19
293	DRC/CC-ICP-MS	37.63	115.59	188.17	150.54	80.65
391	ETAAS-Z	48.85	155.6 ↑	*239.55 ↑	190.6 ↑	*108.77 ↑
485	HR-ICP-MS	34.0	116	173	155	76.7
597	ICP-MS/MS	46.9	159 ↑	177	150	86.4
598	ICP-MS	46.70	120	186	148	78.5

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

* Denotes a statistical Outlier

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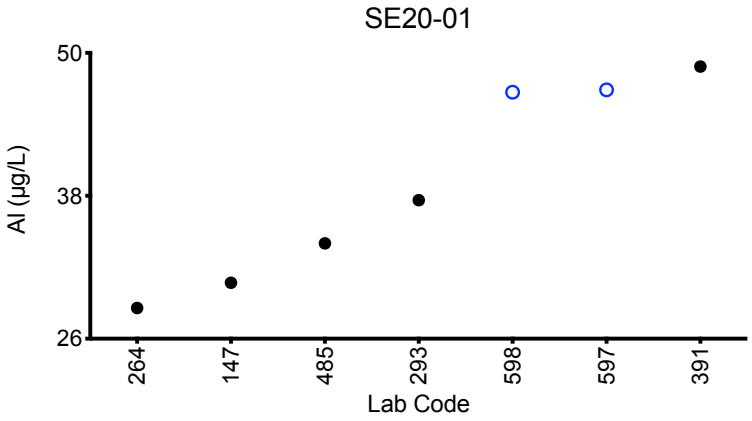
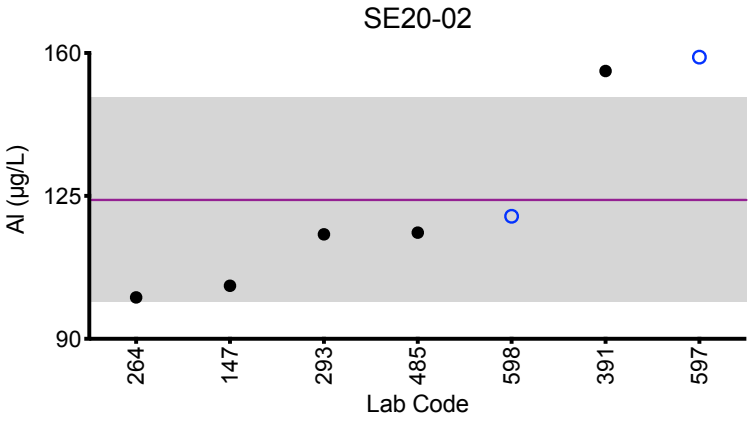
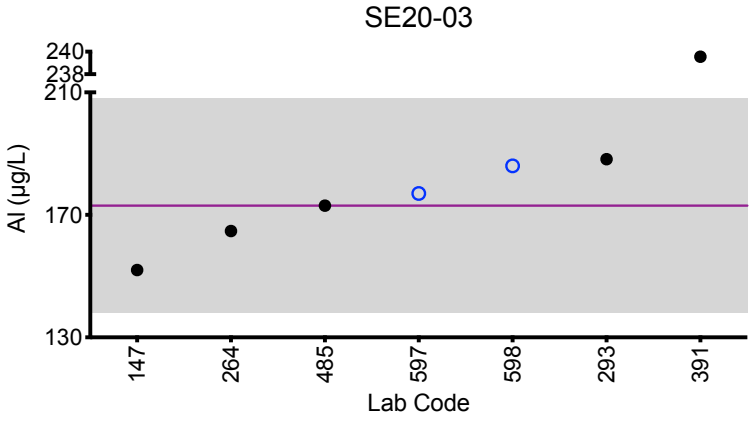
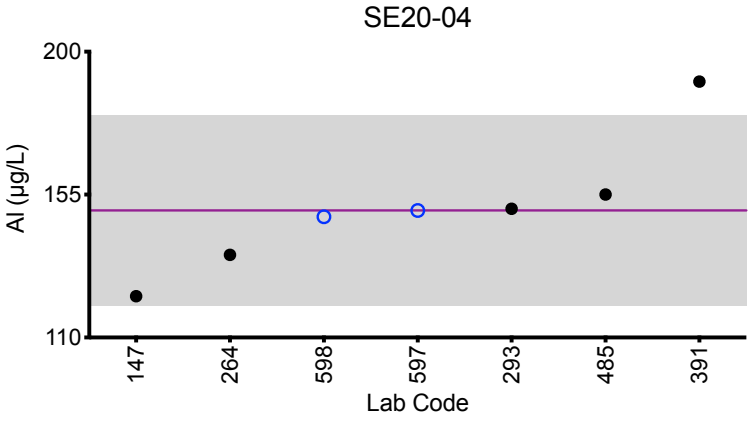
Results for Event #1, 2020: Summary Figures

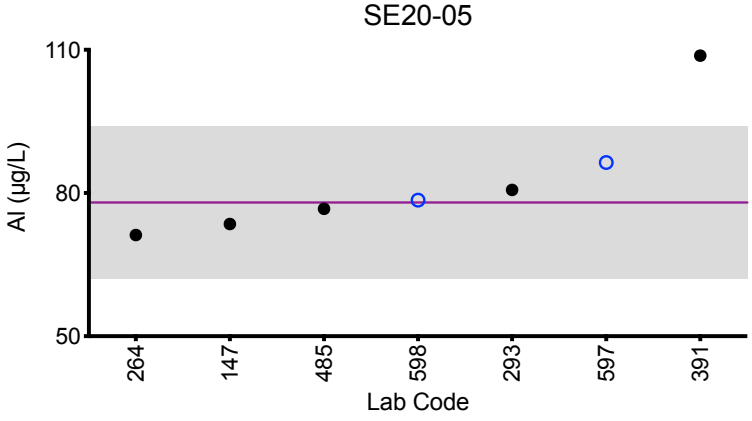
Serum AI











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020: Summary Statistics

	Serum Co (µg/L)				
	SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Target (Arithmetic Mean ($\bar{x}$))	38.1	14.2	3.02	9.1	4.8
Upper Limit	43.8	16.3	4.52	10.6	6.3
Lower Limit	32.4	12.1	1.52	7.6	3.3
Arithmetic SD (s)	1.3	0.9	0.11	0.6	0.3
Arithmetic RSD (%)	3.4	6.3	3.6	6.6	6.1
Number of Sample Measurements (N)	8	8	8	8	8

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Serum Co (µg/L)				
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
	Target	**38.1**	**14.2**	**3.02**	**9.1**	**4.8**
103	DRC/CC-ICP-MS	37.3	13.6	2.89	8.77	4.75
110	ICP-MS	38.9	14.7	3.20	9.38	4.87
147	ICP-MS	39.4	15.4	3.07	9.92	4.97
264	ICP-MS	37.75	14.00	2.94	9.07	4.72
293	DRC/CC-ICP-MS	38.92	14.79	3.12	9.22	4.97
485	HR-ICP-MS	39.4	15.0	3.03	9.68	4.98
597	ICP-MS/MS	35.8	13.6	2.96	8.51	4.8
598	ICP-MS	37.0	12.7	2.91	7.97	4.11

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

* Denotes a statistical Outlier

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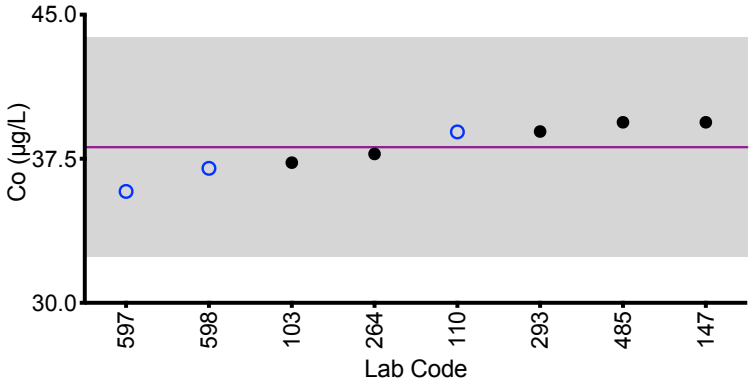
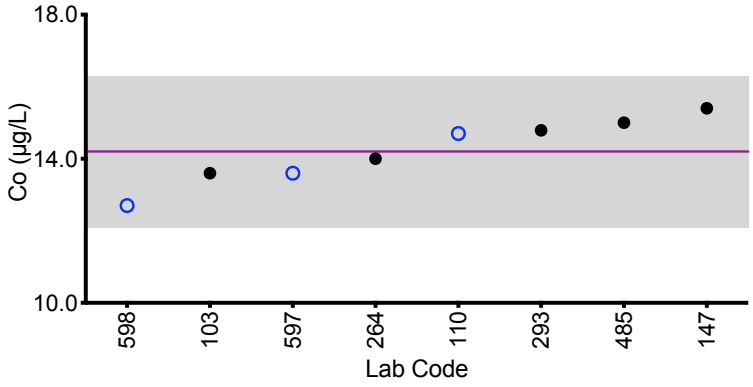
Results for Event #1, 2020: Summary Figures

Serum Co

SE20-01



SE20-02



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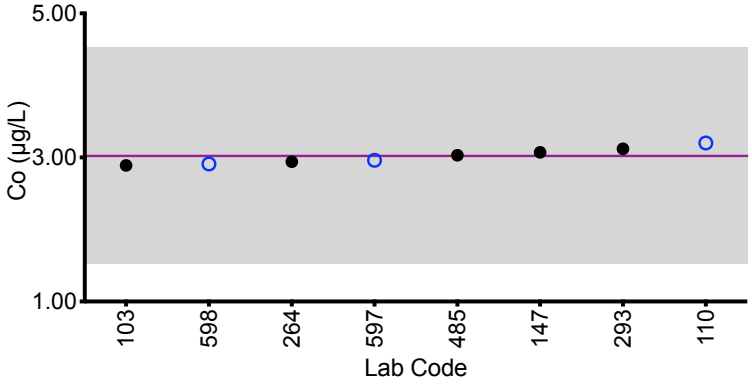
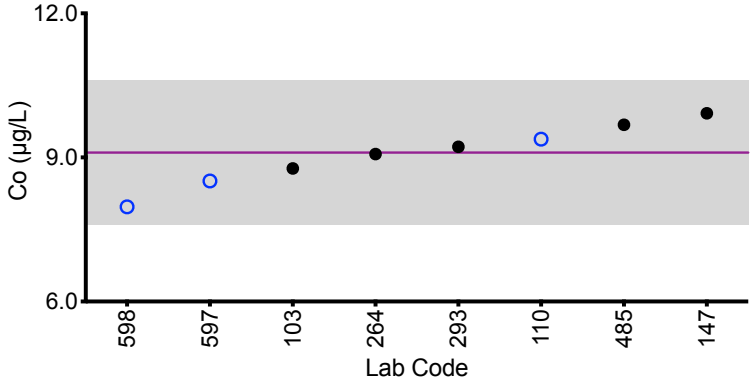
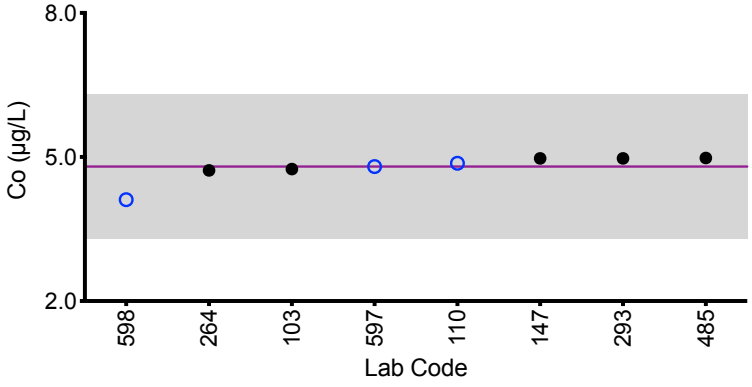


SE20-04



SE20-05



Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020: Summary Statistics

	Serum Cr (µg/L)				
	SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Target (Arithmetic Mean ($\bar{x}$))	1.92	3.5	12.1	0.91	7.2
Upper Limit	3.92	5.5	14.5	2.91	9.2
Lower Limit	0.00	1.5	9.7	0.00	5.2
Arithmetic SD (s)	0.14	0.4	0.1	0.08	0.9
Arithmetic RSD (%)	7.3	11	8.3	8.8	13
Number of Sample Measurements (N)	6	6	6	6	6

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
	Target	**1.92**	**3.5**	**12.1**	**0.91**	**7.2**
110	DRC/CC-ICP-MS	1.9	3.8	12.6	1.0	7.6
147	DRC/CC-ICP-MS	2.03	3.94	12.8	0.972	7.55
264	ICP-MS	2.12	3.01	12.05	0.94	7.47
293	DRC/CC-ICP-MS	1.93	3.77	13.33	0.9	7.96
485	HR-ICP-MS	1.77	3.39	11.4	0.854	7.09
598	DRC/CC-ICP-MS	1.79	2.87	10.5	0.78	5.47

Based on the grading criteria for Cr in Serum, 100% of results were satisfactory, with 0 of the 6 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier

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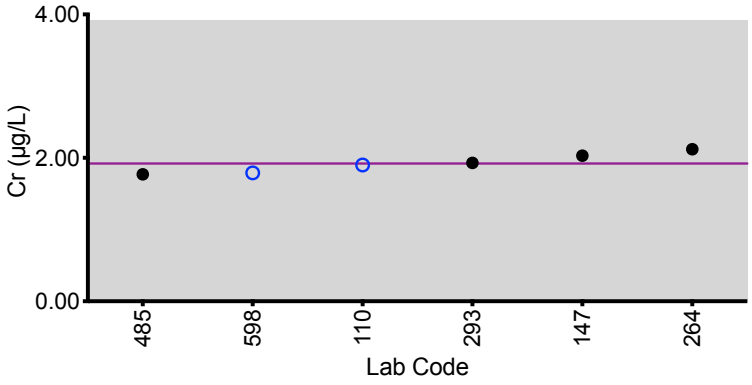
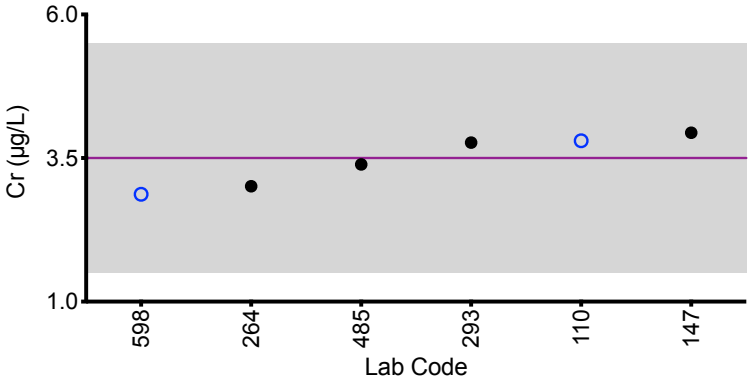
Results for Event #1, 2020: Summary Figures

Serum Cr

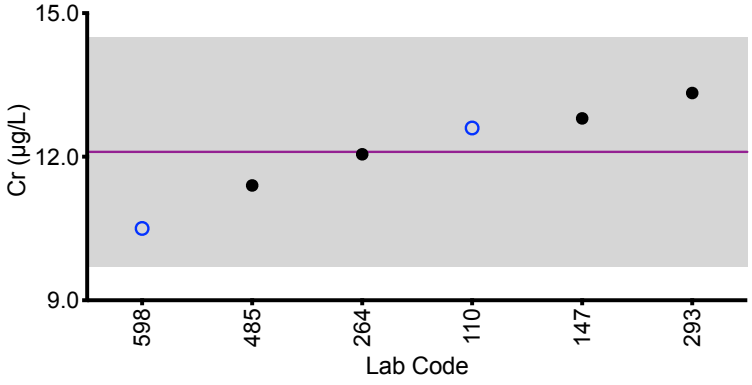
SE20-01



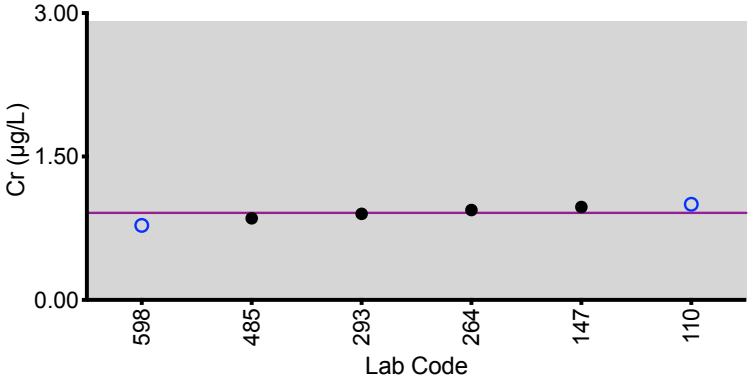
SE20-02



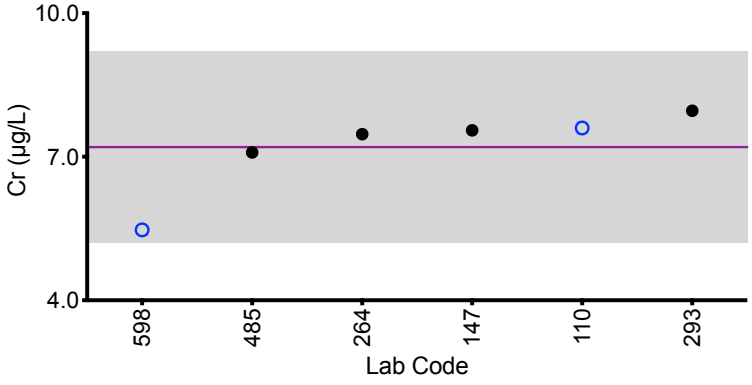
SE20-03



SE20-04



SE20-05



Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020: Summary Statistics

	Serum Cu (µg/L)				
	SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Target (Arithmetic Mean ($\bar{x}$))	920	1200	1060	900	1200
Upper Limit	1060	1380	1220	1040	1380
Lower Limit	780	1020	900	770	1020
Arithmetic SD (s)	60	110	70	90	180
Arithmetic RSD (%)	6.5	9.2	6.6	10	15
Number of Sample Measurements (N)	8	8	8	8	8

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Serum Cu (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
	Target	**920**	**1200**	**1060**	**900**	**1200**
107	DRC/CC-ICP-MS	897	1176	1032	900	915 ↓
110	ICP-MS	958	1235	1100	932	1283
147	ICP-MS	991	1360	1131	1061 ↑	1334
264	ICP-MS	880	1162	1037	896	1206
293	DRC/CC-ICP-MS	959.95	1265.1	1125.24	966.31	1347.74
483	DRC/CC-ICP-MS	960	1280	1120	849	1350
597	ICP-MS/MS	879	1160	1011	850	1226
598	ICP-MS	824	974 ↓	920	742 ↓	941 ↓

Based on the grading criteria for Cu in Serum, 88% of results were satisfactory, with 1 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier

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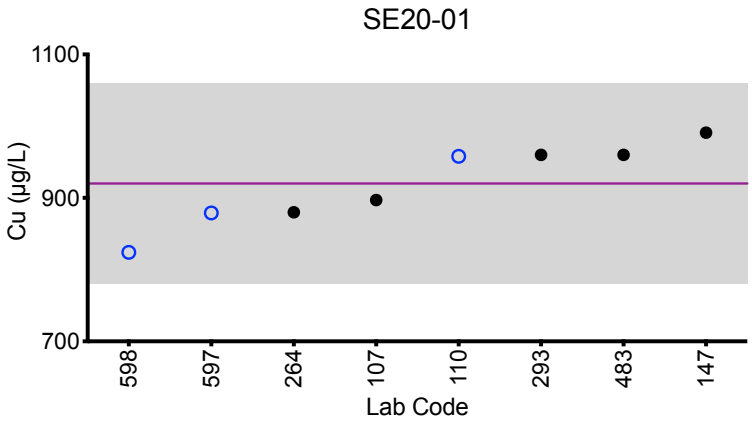
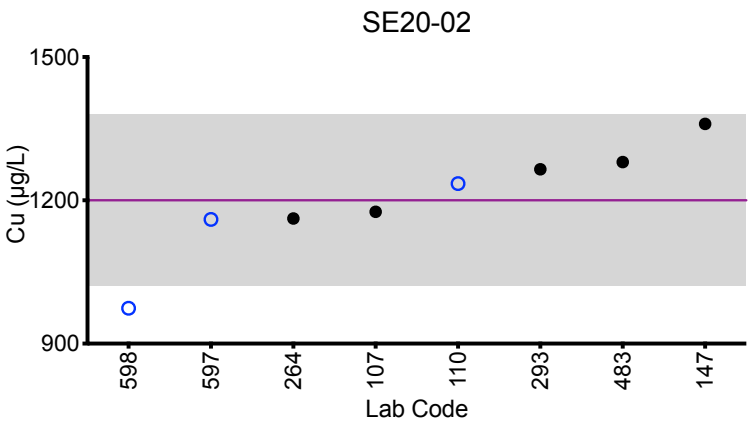
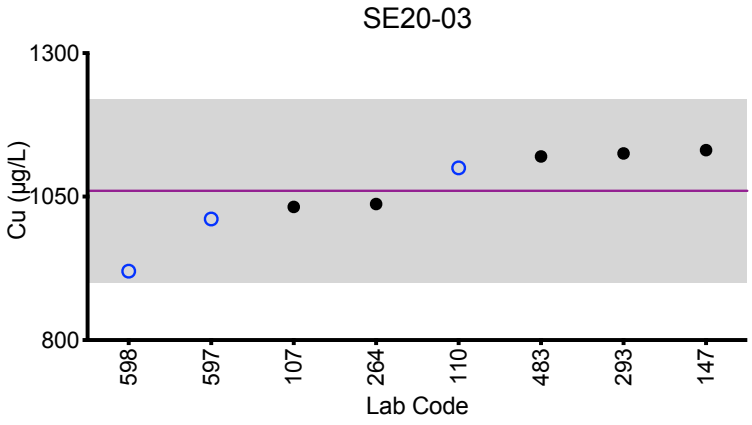
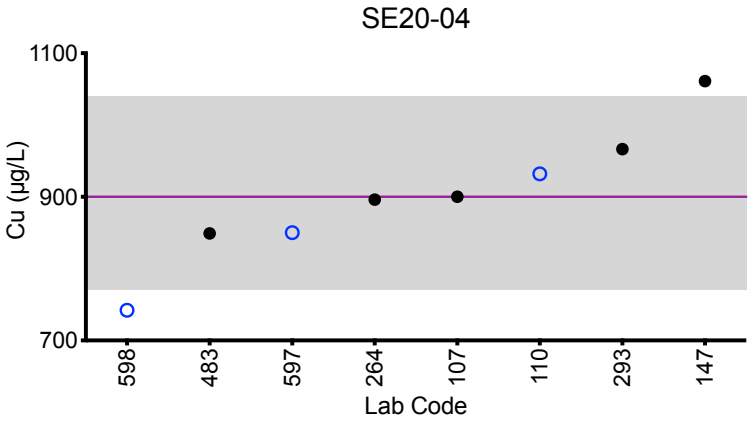
Results for Event #1, 2020: Summary Figures

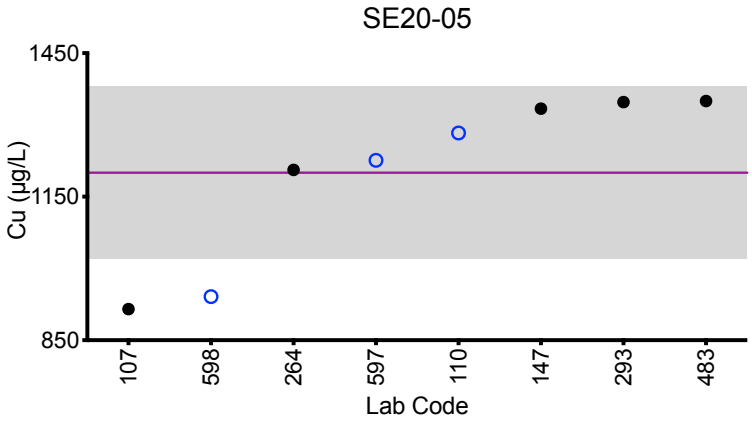
Serum Cu











Legend:
o CHEAR Labs ● Other Labs
Horizontal purple line = assigned target value based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±95 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±95 µg/L at concentrations less than or equal to 635 µg/L.

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Results for Event #1, 2020: Summary Statistics

	Serum Se (µg/L)				
	SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Target (Arithmetic Mean ($\bar{x}$))	100	113	115	102	121
Upper Limit	120	136	138	122	145
Lower Limit	80	90	92	82	97
Arithmetic SD (s)	6	11	7	11	17
Arithmetic RSD (%)	6.4	9.7	6.1	11	14
Number of Sample Measurements (N)	9	9	9	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 by New York State Department of Health's Wadsworth Center, the PT Program organizer.

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Results for Event #1, 2020:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
	Target	**100**	**113**	**115**	**102**	**121**
103	DRC/CC-ICP-MS	103	116	118	108	131
107	DRC/CC-ICP-MS	94.3	110.1	110.2	97.7	90.1 ↓
110	DRC/CC-ICP-MS	101	106	114	96.5	116
147	ICP-MS	111	133	125	124 ↑	135
264	ICP-MS	97.35	110.79	116.57	103.70	124.60
293	DRC/CC-ICP-MS	99.45	116.02	121.55	105.76	134.18
483	DRC/CC-ICP-MS	106	120	122	95.4	137
597	ICP-MS/MS	97.2	110	109	97.4	126
598	DRC/CC-ICP-MS	89.5	92.0	102	85.5	94.8 ↓

Based on the grading criteria for Se in Serum, 93% of results were satisfactory, with 0 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier

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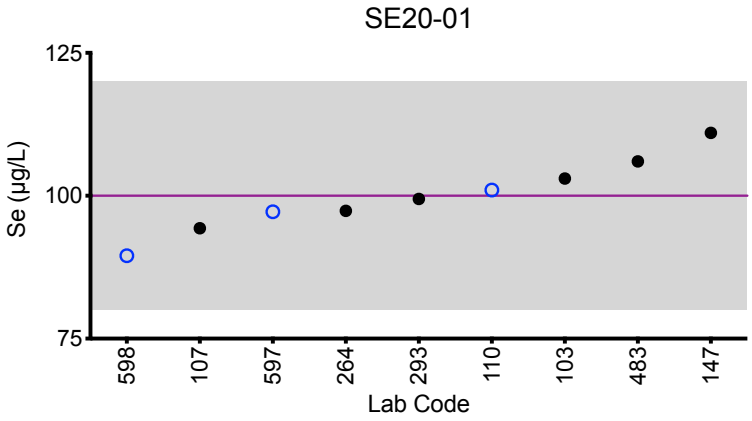
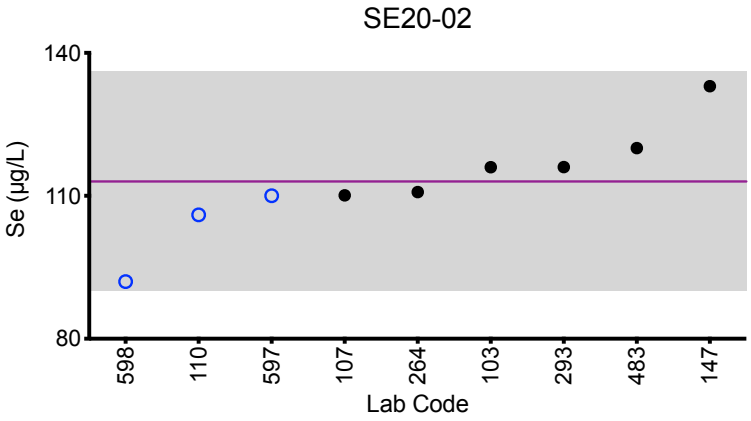
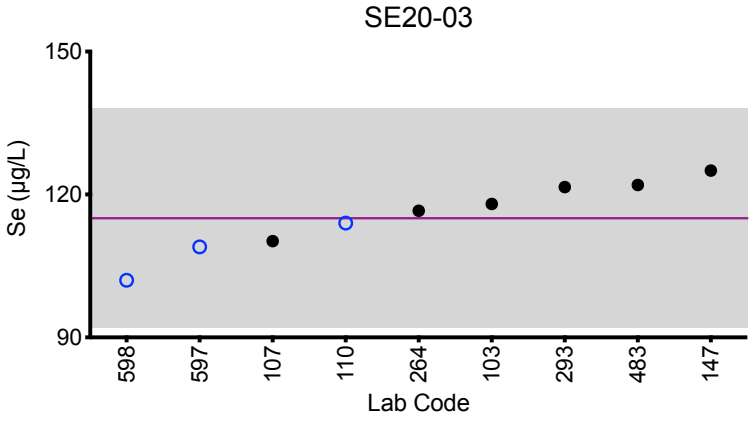
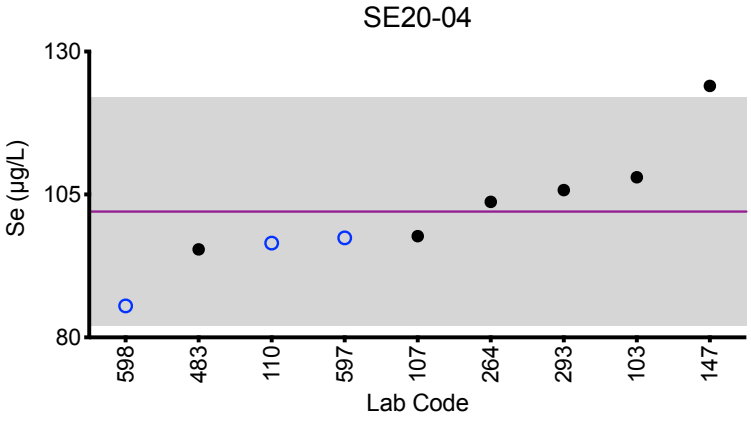
Results for Event #1, 2020: Summary Figures

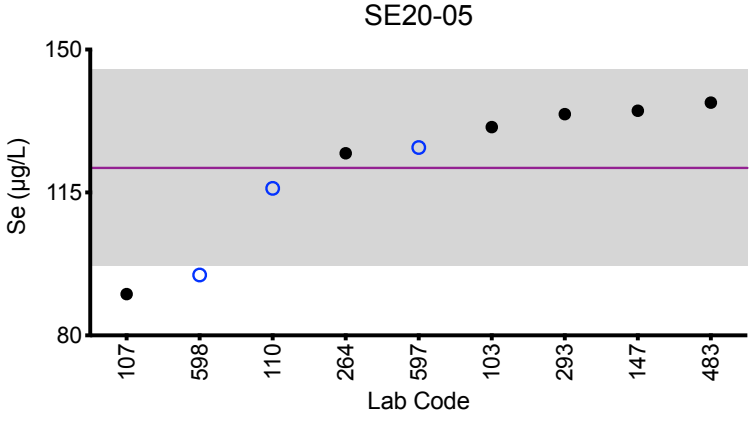
Serum Se











Legend:
o CHEAR Labs ● Other Labs
Horizontal purple line = assigned target value based on the arithmetic mean of all laboratories.
Gray area = acceptable range based on quality specifications:
±2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±2 µg/L at concentrations less than or equal to 10 µg/L.

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Results for Event #1, 2020: Summary Statistics

Serum Zn (µg/L)					
	SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Target (Arithmetic Mean ($\bar{x}$))	980	2540	1960	1360	1360
Upper Limit	1130	2920	2250	1560	1560
Lower Limit	830	2160	1670	1160	1160
Arithmetic SD (s)	70	100	50	160	210
Arithmetic RSD (%)	7.1	3.9	2.6	12	15
Number of Sample Measurements (N)	8	7	7	8	8

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

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Results for Event #1, 2020:
Performance of Participating Laboratories

Serum Zn (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
	Target	**980**	**2540**	**1960**	**1360**	**1360**
107	DRC/CC-ICP-MS	986	2531	1923	1402	1074 ↓
110	ICP-MS	990	2517	1936	1402	1422
147	ICP-MS	1039	2739	2026	1575 ↑	1503
264	ICP-MS	964	2433	1912	1376	1404
293	DRC/CC-ICP-MS	986.93	2509.8	1993.46	1418.3	1496.73
483	DRC/CC-ICP-MS	968	2490	1930	1190	1440
597	ICP-MS/MS	1071	2589	2030	1465	1561 ↑
598	ICP-MS	829 ↓	*1860 ↓	*1540 ↓	1050 ↓	1007 ↓

Based on the grading criteria for Zn in Serum, 80% of results were satisfactory, with 1 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

* Denotes a statistical Outlier

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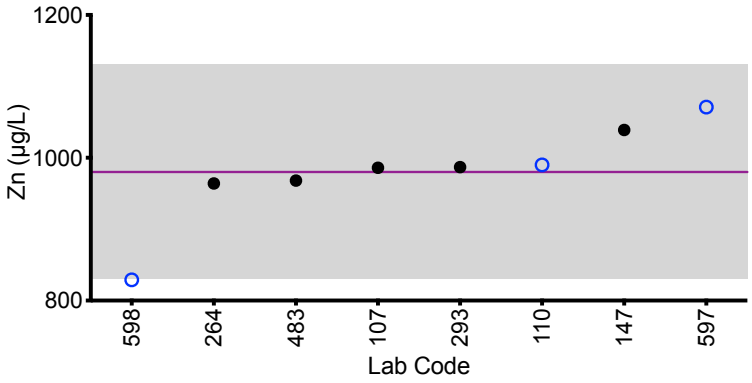
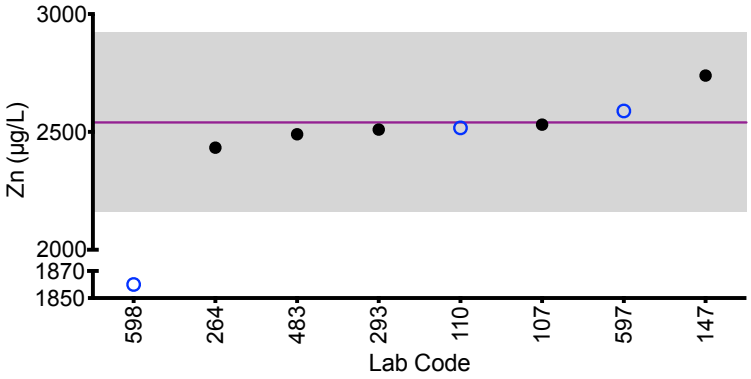
Results for Event #1, 2020: Summary Figures

Serum Zn

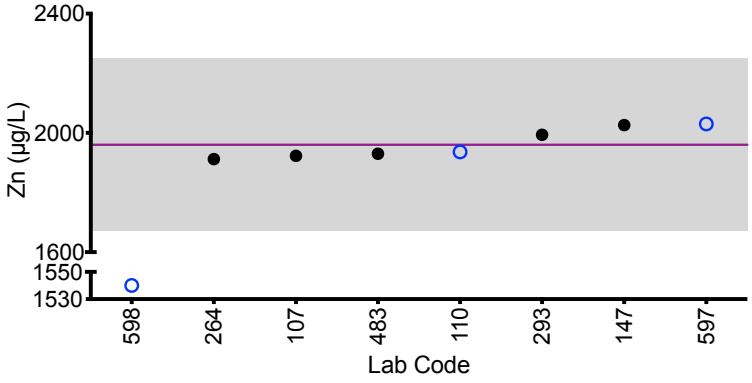
SE20-01



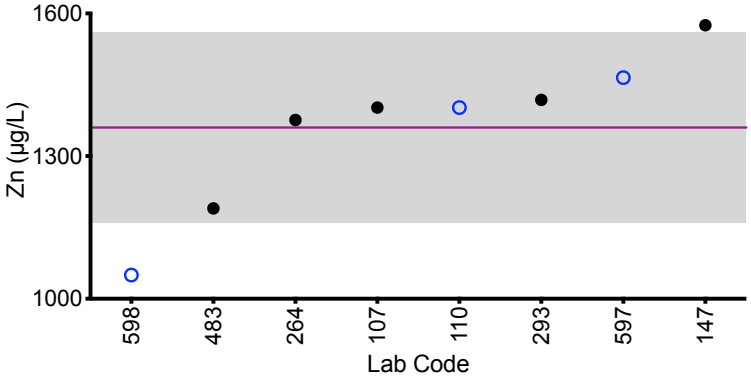
SE20-02



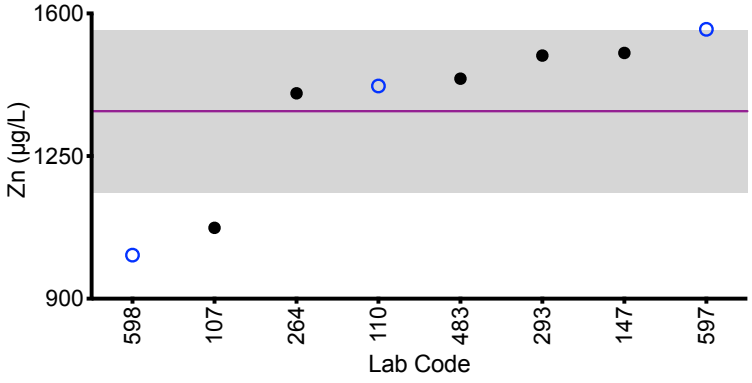
SE20-03



SE20-04



SE20-05



Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum As (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
103	DRC/CC-ICP-MS	12.5	5.12	27.3	1.12	21.0
110	DRC/CC-ICP-MS	11.6	5.30	27.6	1.45	21.2
147	ICP-MS	12.3	5.17	26.4	0.884	20.4
597	ICP-MS/MS	11.2	4.74	24.5	1.06	19.1
598	DRC/CC-ICP-MS	11.5	4.72	24.1	1.05	16.3
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		11.8	5.0	26.0	1.11	19.6
Arithmetic SD (s)		0.6	0.3	1.6	0.21	2.0
Arithmetic RSD (%)		5.1	5.2	6.2	19	10
Number of Sample Measurements (N)		5	5	5	5	5

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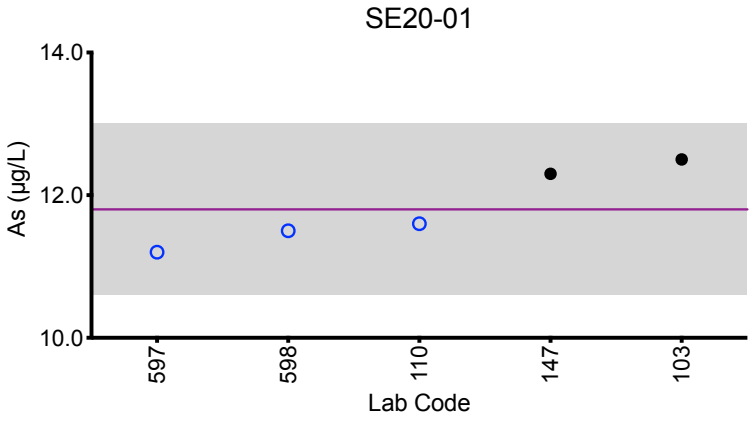
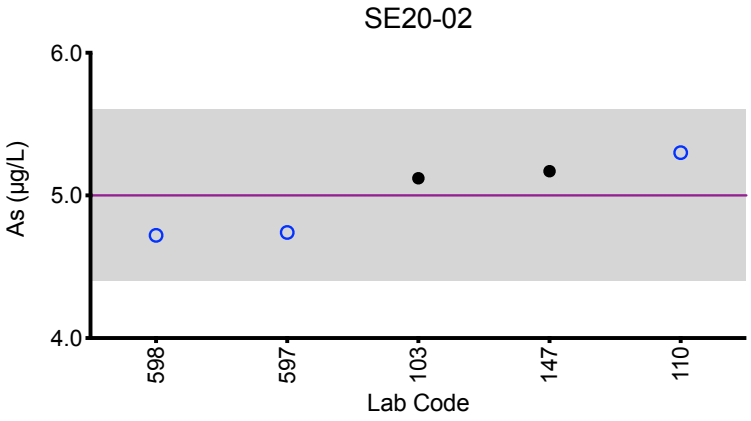
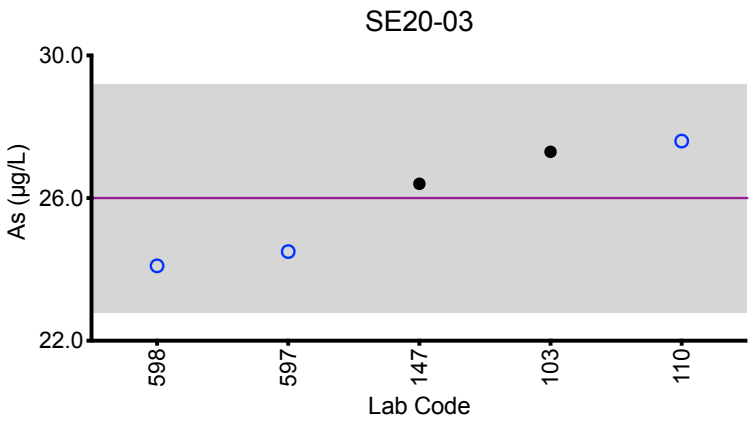
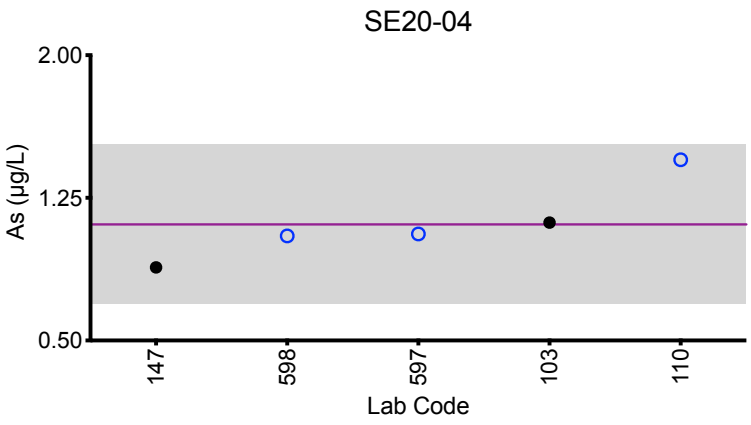
Results for Event #1, 2020: Summary Figures

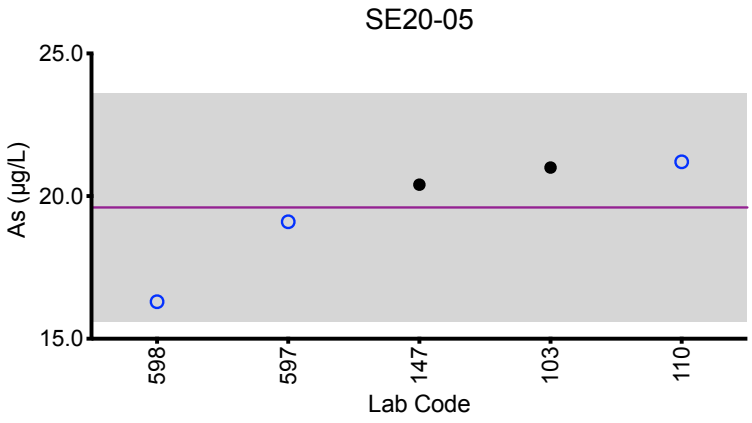
Serum As











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o CHEAR Labs ● Other Labs
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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
103	DRC/CC-ICP-MS	1.24	0.803	3.10	0.335	6.51
110	ICP-MS	1.24	0.83	3.40	0.23	6.64
147	ICP-MS	1.44	0.8992	3.45	0.362	7.31
597	ICP-MS/MS	1.26	0.84	3.10	0.35	6.79
598	DRC/CC-ICP-MS	0.98	0.69	2.81	0.23	4.45
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		1.23	0.81	3.2	0.30	6.3
Arithmetic SD (s)		0.16	0.08	0.3	0.07	1.1
Arithmetic RSD (%)		13	9.9	8.2	23	17
Number of Sample Measurements (N)		5	5	5	5	5

*Denotes a statistical Outlier.

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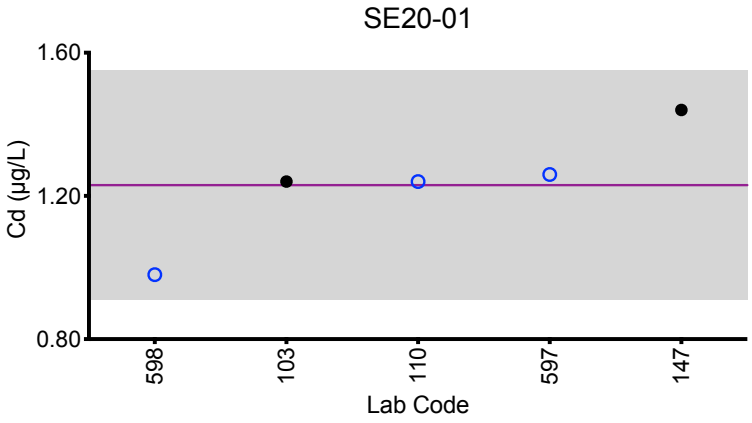
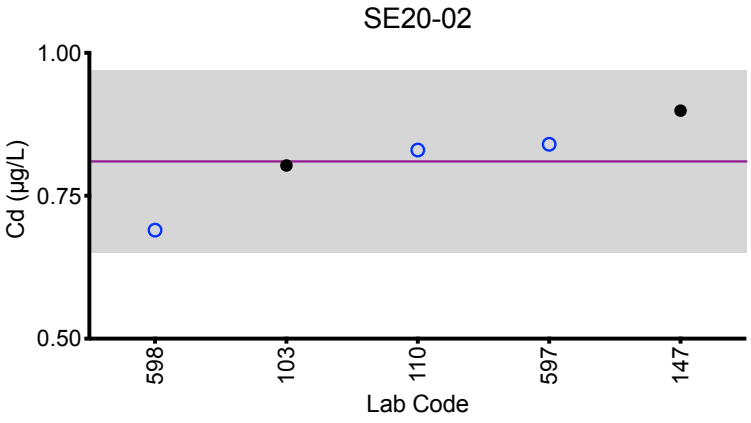
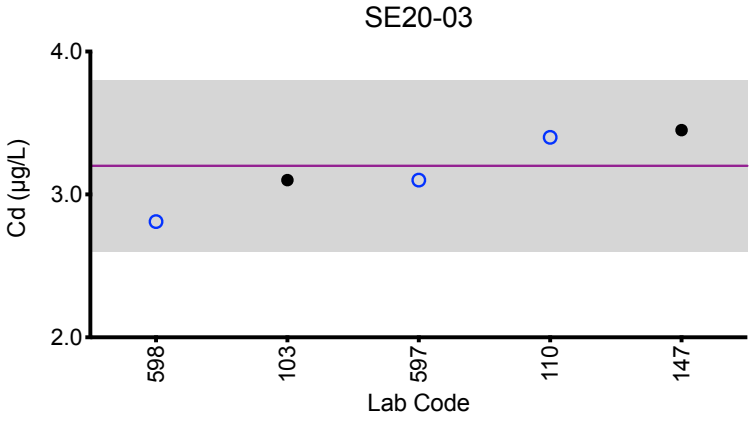
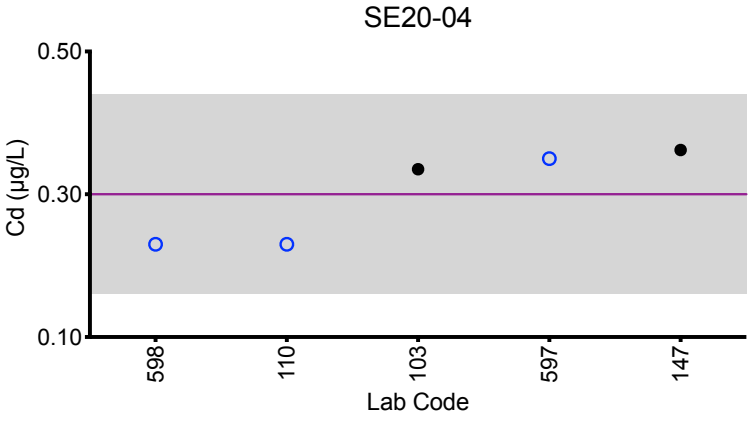
Results for Event #1, 2020: Summary Figures

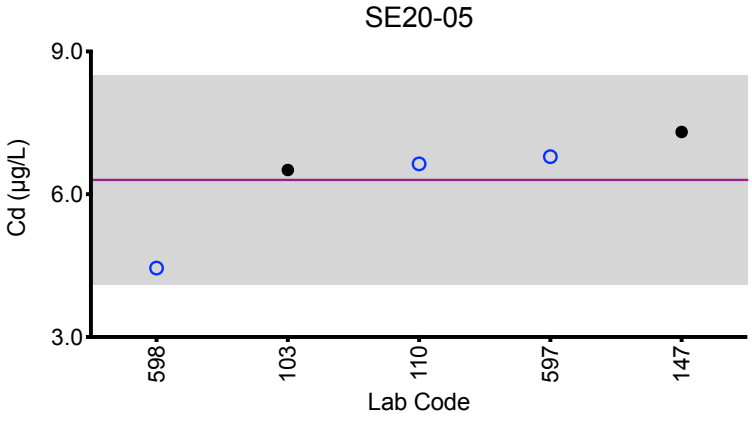
Serum Cd











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
103	DRC/CC-ICP-MS	0.967	5.95	2.12	3.19	6.00
110	ICP-MS	1.09	6.16	2.55	3.66	6.82
147	ICP-MS	1.04	6.08	2.19	3.29	5.98
597	DMA	1.13	6.18	2.62	3.82	7.27
598	ICP-MS	0.99	5.24	2.52	3.25	5.52

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	1.04	5.9	2.4	3.4	6.3
Arithmetic SD (s)	0.07	0.4	0.2	0.3	0.7
Arithmetic RSD (%)	6.7	6.8	9.6	8.1	11
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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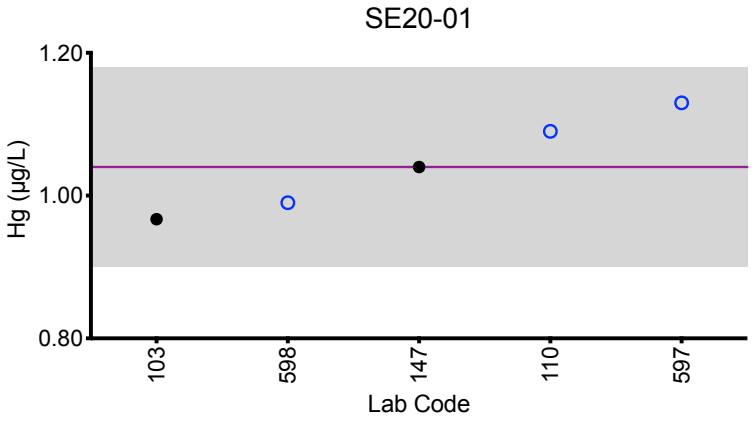
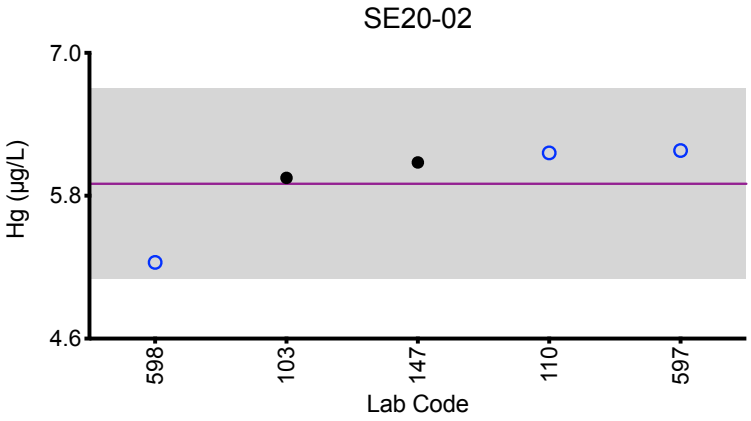
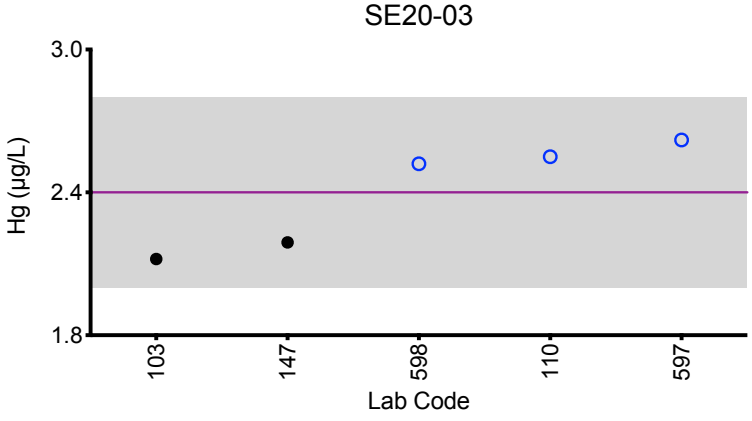
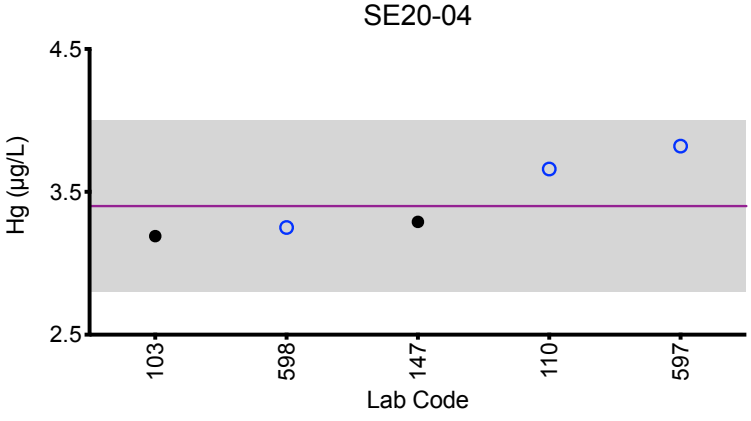
Results for Event #1, 2020: Summary Figures

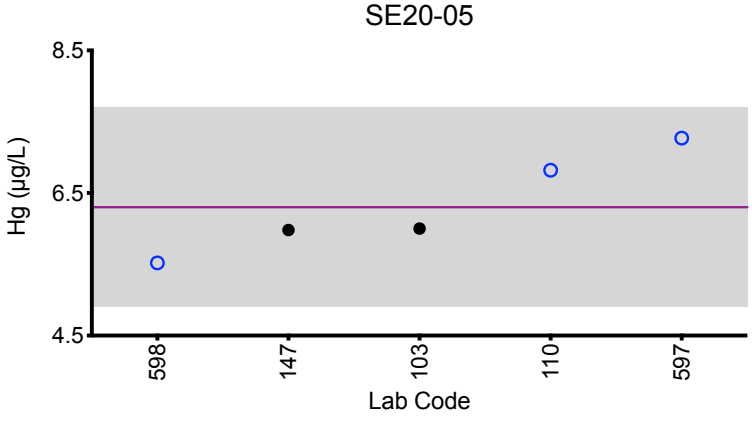
Serum Hg











Legend:
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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
103	DRC/CC-ICP-MS	1.80	8.26	5.13	12.0	17.8
110	ICP-MS	2.09	8.78	5.44	12.4	19.1
147	ICP-MS	1.86	9.01	5.12	12.7	17.9
264	ICP-MS	1.90	7.88	4.92	11.07	16.70
293	DRC/CC-ICP-MS	1.96	8.15	5.00	11.22	17.2
597	ICP-MS/MS	*4.76	*53.1	*7.87	14.1	20.1
598	ICP-MS	1.98	7.79	5.06	10.8	15.2

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	1.93	8.3	5.11	12.0	17.7
Arithmetic SD (s)	0.10	0.5	0.18	1.2	1.6
Arithmetic RSD (%)	5.2	6.0	3.5	10	9.0
Number of Sample Measurements (N)	6	6	6	7	7

*Denotes a statistical Outlier.

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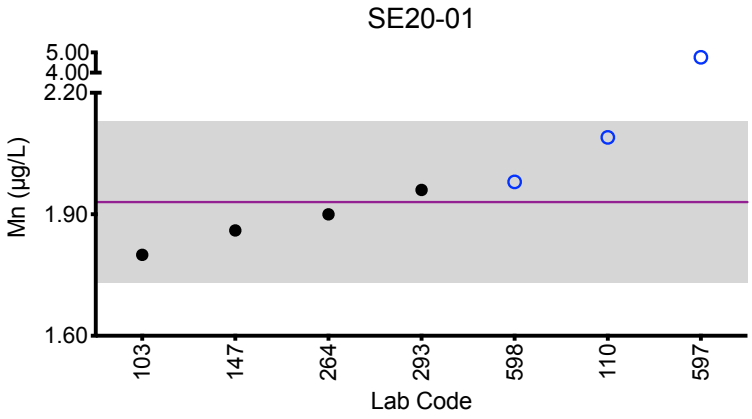
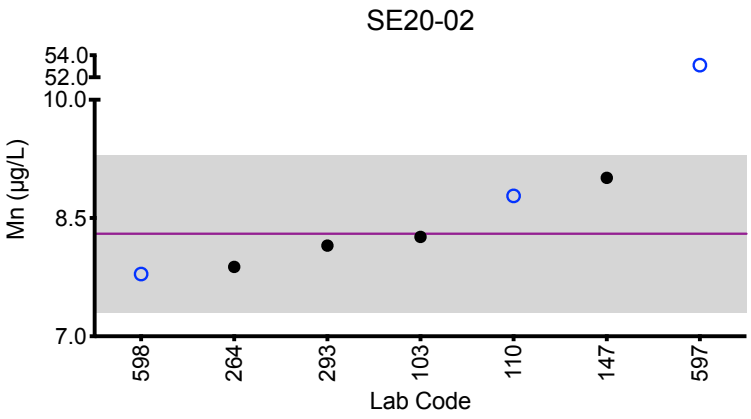
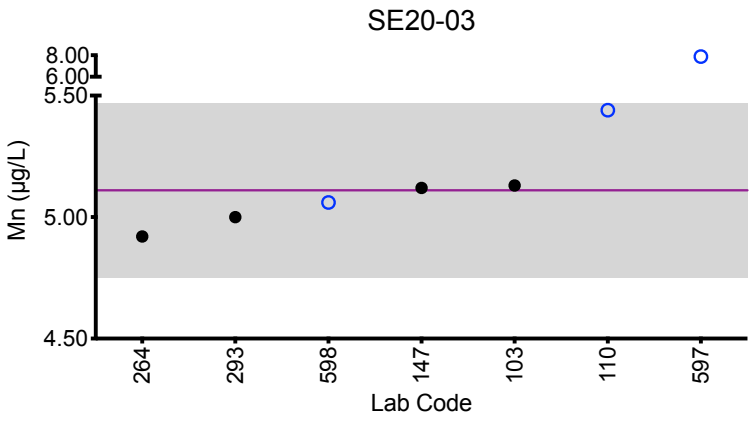
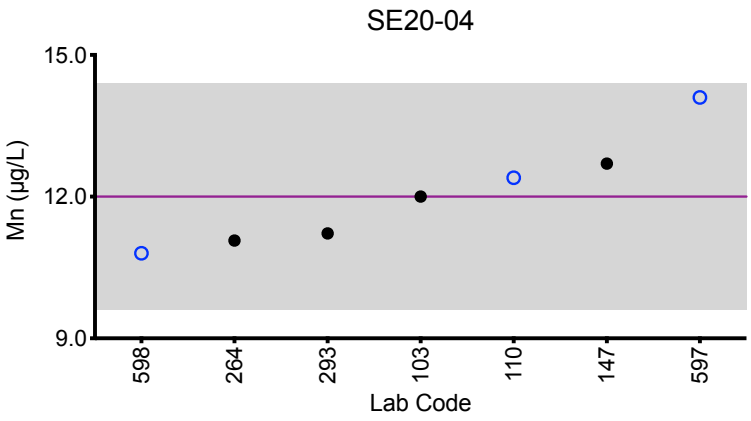
Results for Event #1, 2020: Summary Figures

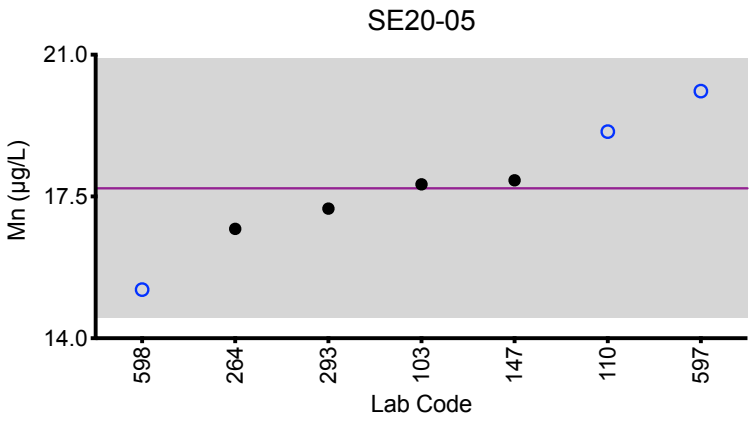
Serum Mn











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Mo (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
103	DRC/CC-ICP-MS	2.88	5.34	1.60	6.61	4.36
110	ICP-MS	3.13	5.83	1.66	6.99	4.60
147	ICP-MS	3.00	5.84	1.64	7.01	4.45
293	DRC/CC-ICP-MS	3.21	5.54	1.88	6.74	4.55
485	HR-ICP-MS	2.87	5.72	1.71	6.78	4.58
597	ICP-MS/MS	2.70	4.90	1.48	6.09	4.28
598	DRC/CC-ICP-MS	2.66	5.16	1.5	6.17	3.70

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	2.92	5.5	1.64	6.6	4.4
Arithmetic SD (s)	0.21	0.4	0.14	0.4	0.3
Arithmetic RSD (%)	7.2	6.6	8.5	5.6	7.1
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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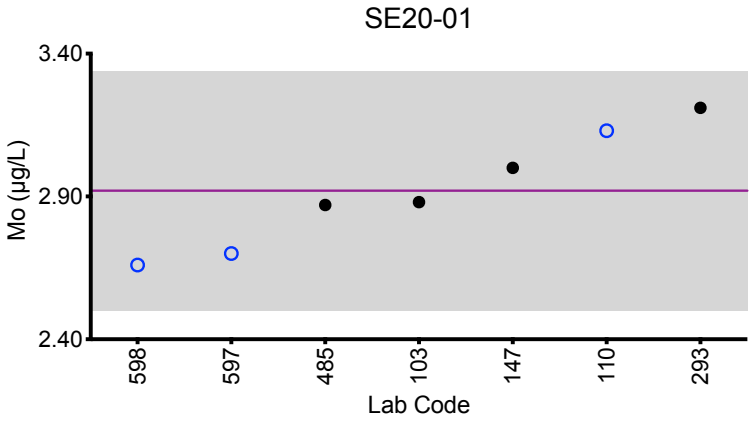
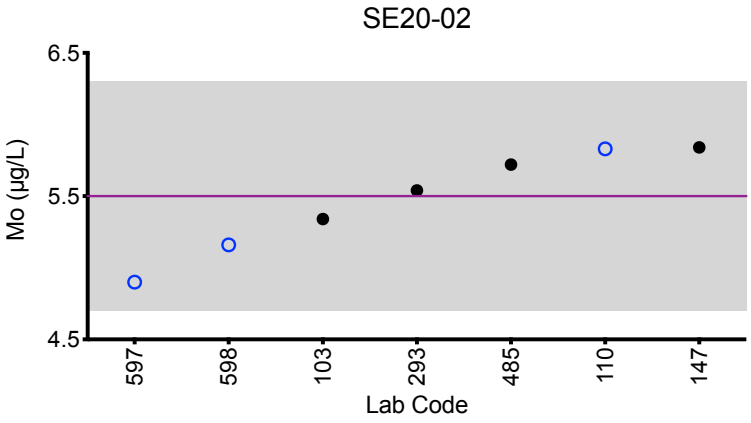
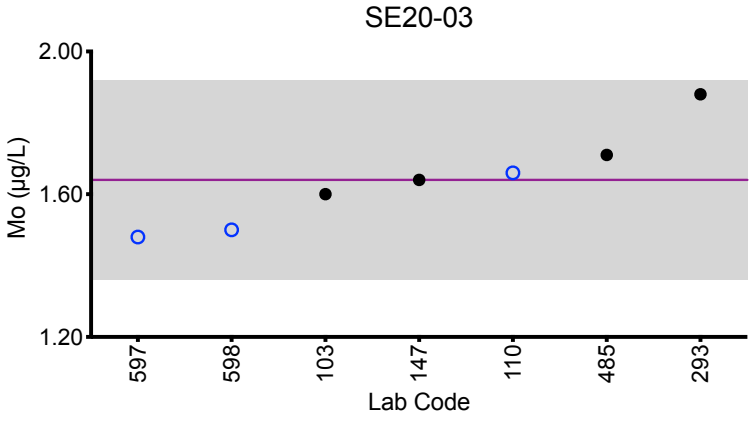
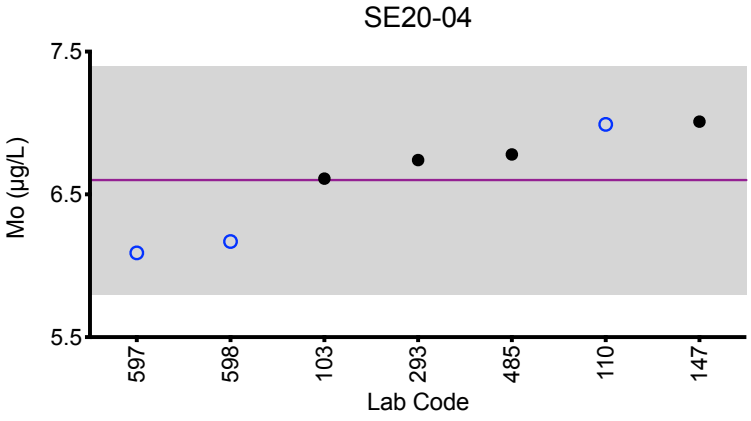
Results for Event #1, 2020: Summary Figures

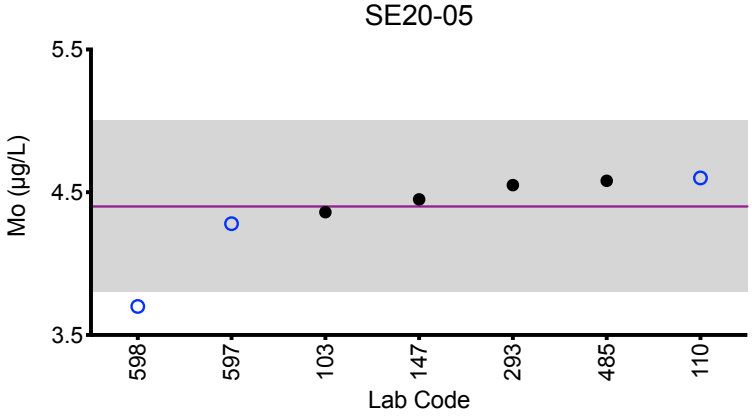
Serum Mo











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
110	DRC/CC-ICP-MS	23.3	10.1	10.5	1.87	3.25
147	ICP-MS	22.7	10.5	10.0	1.61	3.20
293	DRC/CC-ICP-MS	22.48	9.99	10.46	1.48	3.22
485	HR-ICP-MS	22.3	9.68	9.64	1.41	3.05
597	ICP-MS/MS	26.7	15.7	15.1	*7.65	*9.14
598	ICP-MS	21.3	8.9	9.83	2.07	3.05

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	23.1	10.8	10.9	1.7	3.15
Arithmetic SD (s)	1.9	2.5	2.1	0.3	0.10
Arithmetic RSD (%)	8.2	23	19	17	3.2
Number of Sample Measurements (N)	6	6	6	5	5

*Denotes a statistical Outlier.

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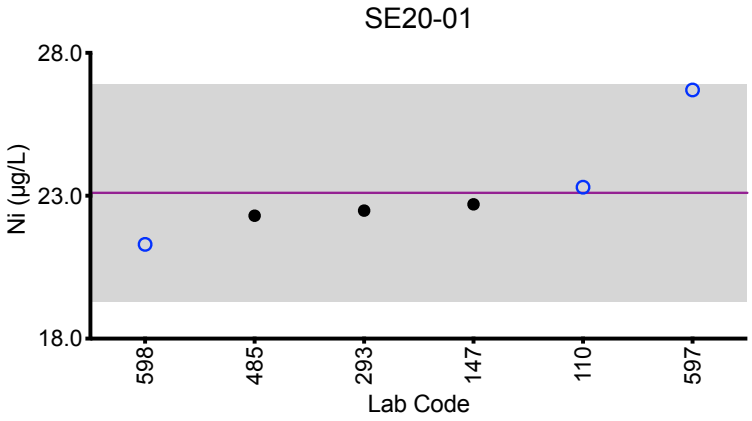
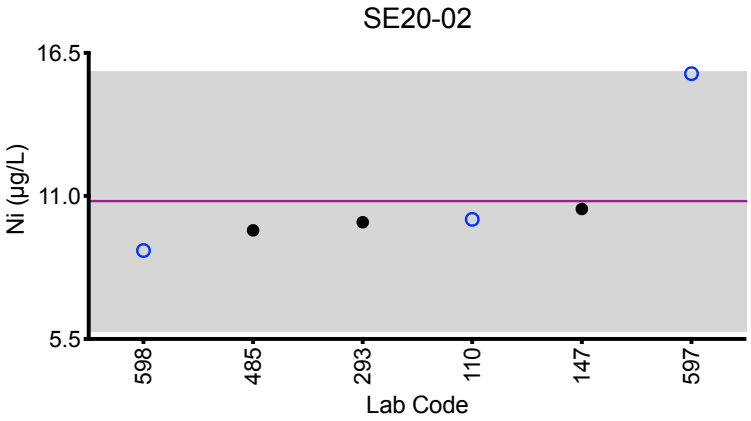
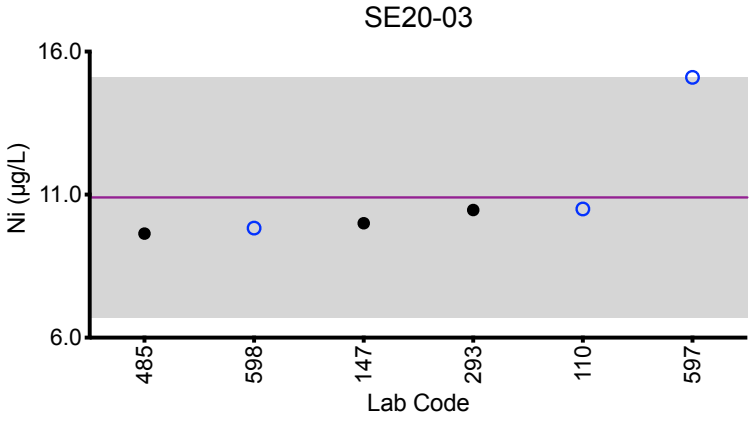
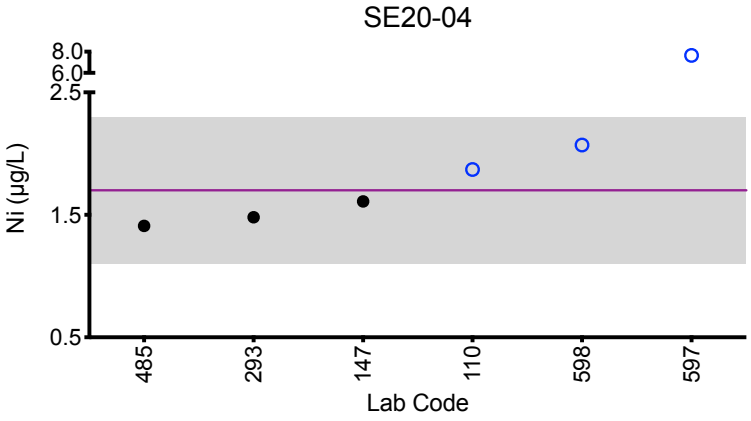
Results for Event #1, 2020: Summary Figures

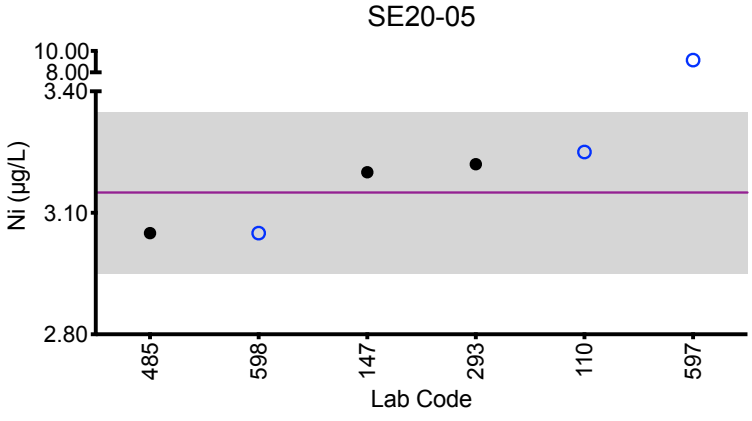
Serum Ni











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
103	DRC/CC-ICP-MS	1.86	8.43	6.80	1.01	5.07
110	ICP-MS	2.00	8.61	7.06	1.08	5.24
147	ICP-MS	2.20	9.74	7.42	1.10	5.62
597	ICP-MS/MS	2.07	8.28	6.78	1.13	5.03
598	ICP-MS	1.81	6.94	6.12	0.85	3.73
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		1.99	8.4	6.8	1.03	4.9
Arithmetic SD (s)		0.16	1.0	0.5	0.11	0.7
Arithmetic RSD (%)		7.9	12	7.4	11	14
Number of Sample Measurements (N)		5	5	5	5	5

*Denotes a statistical Outlier.

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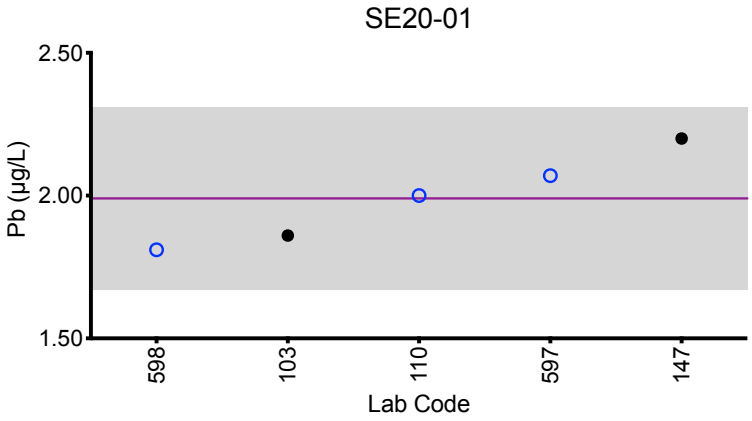
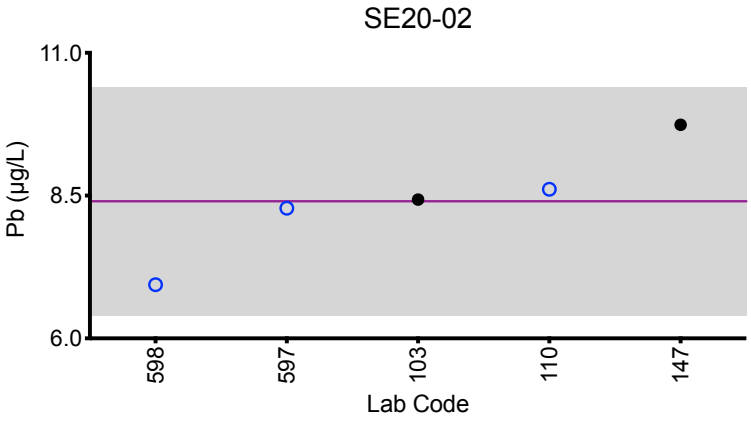
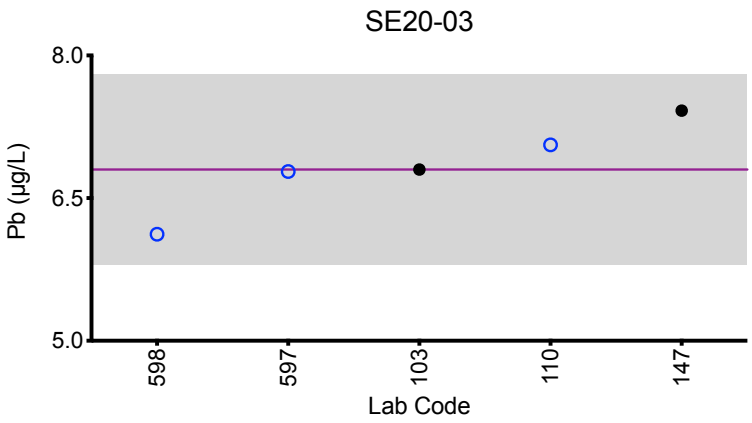
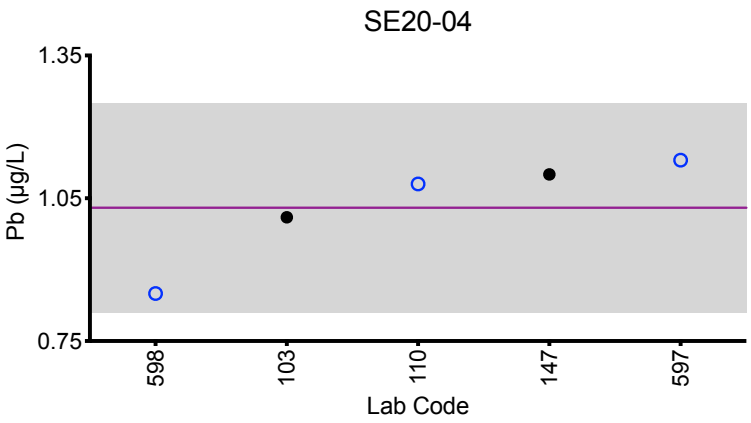
Results for Event #1, 2020: Summary Figures

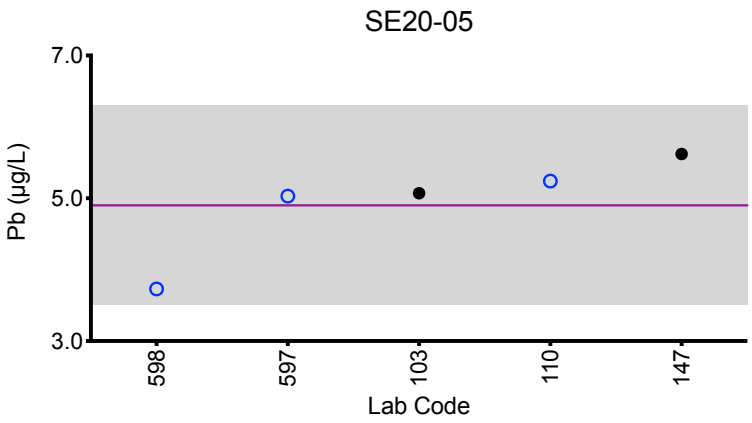
Serum Pb











Legend:
o CHEAR Labs ● Other Labs
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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
103	DRC/CC-ICP-MS	1.25	0.198	4.15	3.26	4.77
110	ICP-MS	1.30	0.23	4.27	3.38	4.85
147	ICP-MS	1.33	<0.235	4.31	3.60	5.09
597	ICP-MS/MS	1.24	0.20	3.93	2.97	4.54
598	ICP-MS	1.17	0.14	3.78	2.62	3.64

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	1.26	0.19	4.1	3.2	4.6
Arithmetic SD (s)	0.06	0.04	0.2	0.4	0.6
Arithmetic RSD (%)	4.8	21	5.6	13	13
Number of Sample Measurements (N)	5	4	5	5	5

*Denotes a statistical Outlier.

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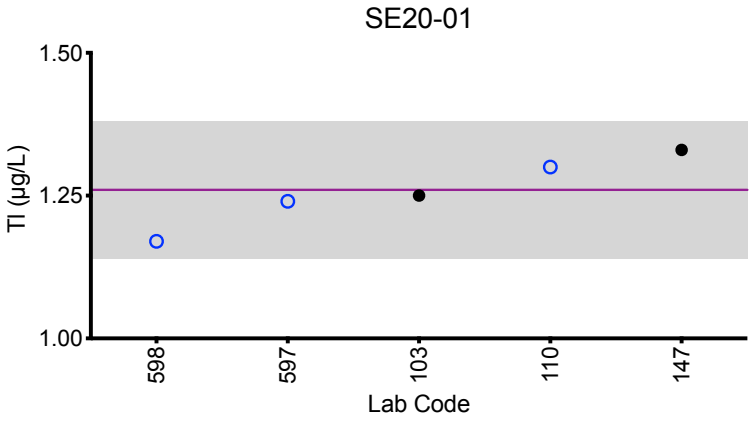
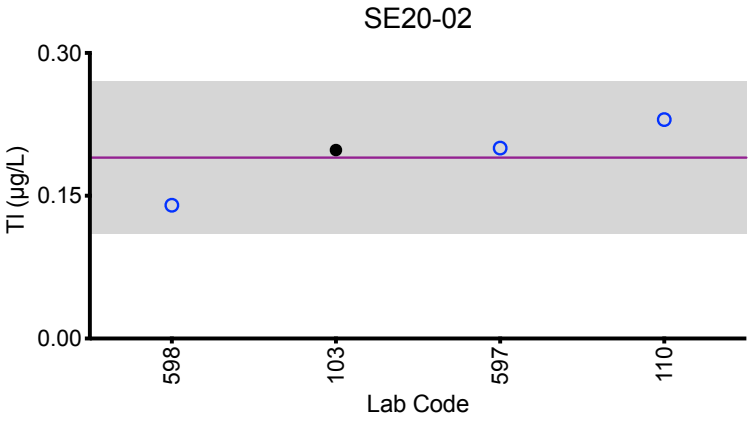
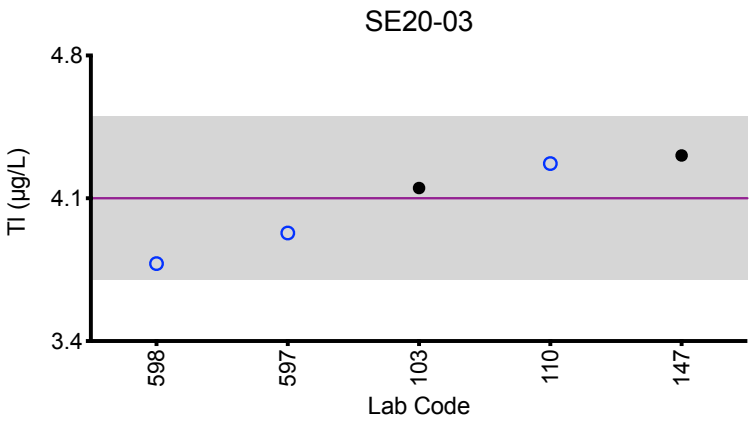
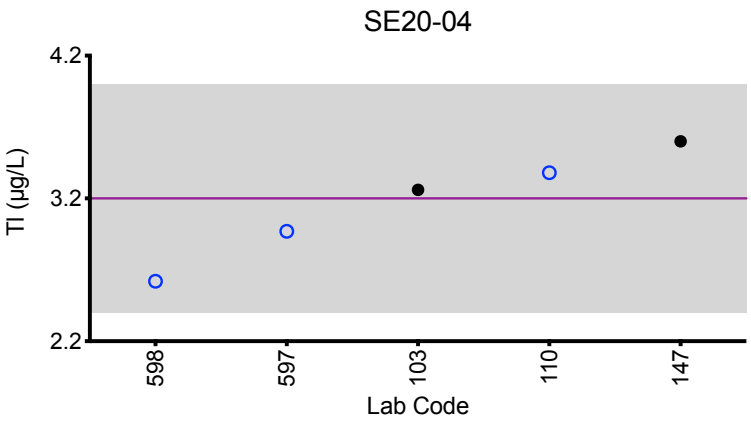
Results for Event #1, 2020: Summary Figures

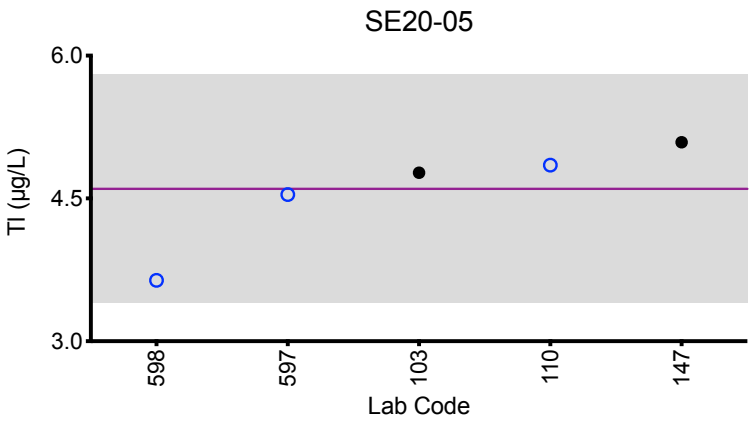
Serum Tl











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum V (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
110	DRC/CC-ICP-MS	1.36	3.74	*1.27	6.66	5.19
147	DRC/CC-ICP-MS	0.913	4.68	0.602	9.18	6.98
293	DRC/CC-ICP-MS	1.13	4.69	0.81	8.84	7.15
485	ICP-AES/OES	0.814	3.93	0.536	7.35	5.82
597	ICP-MS/MS	0.897	3.72	0.65	7.00	5.81
598	DRC/CC-ICP-MS	0.82	3.34	0.63	6.42	4.73
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		0.99	4.0	0.65	7.6	5.9
Arithmetic SD (s)		0.21	0.6	0.10	1.2	1.0
Arithmetic RSD (%)		21	15	15	16	17
Number of Sample Measurements (N)		6	6	5	6	6

*Denotes a statistical Outlier.

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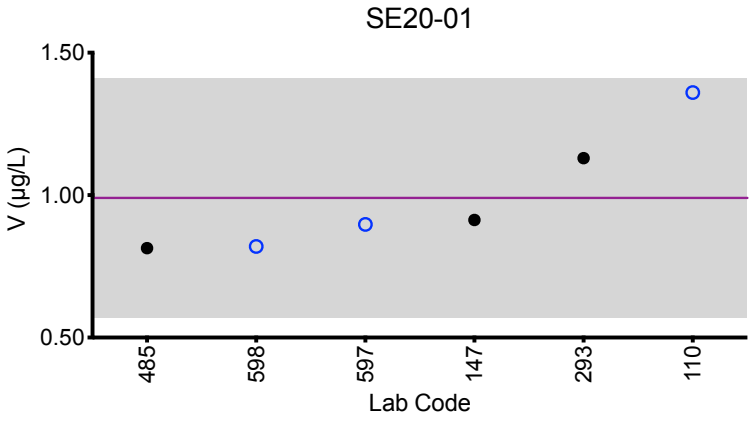
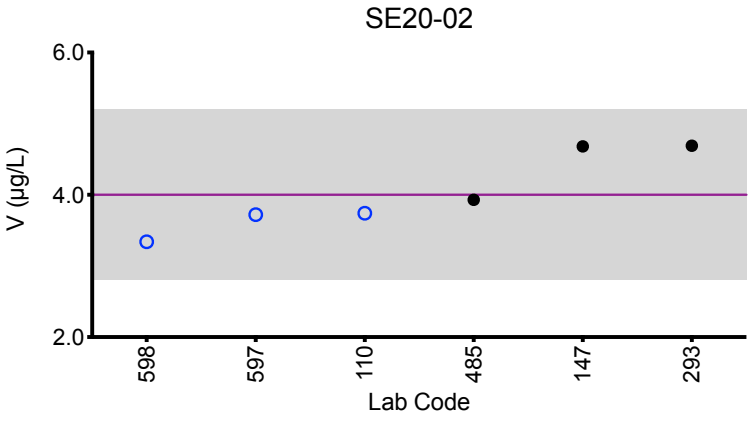
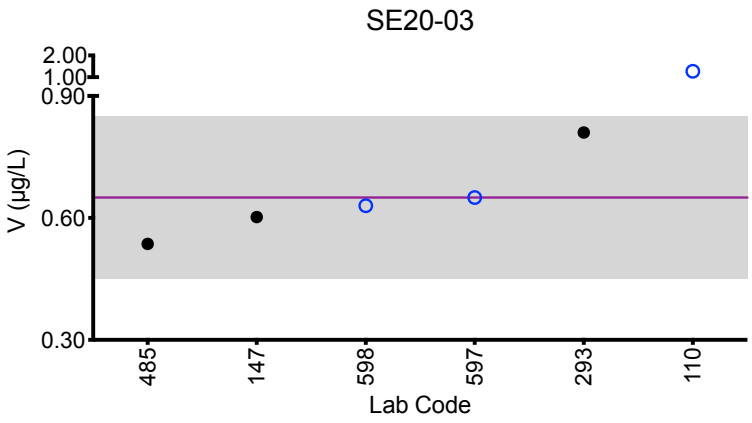
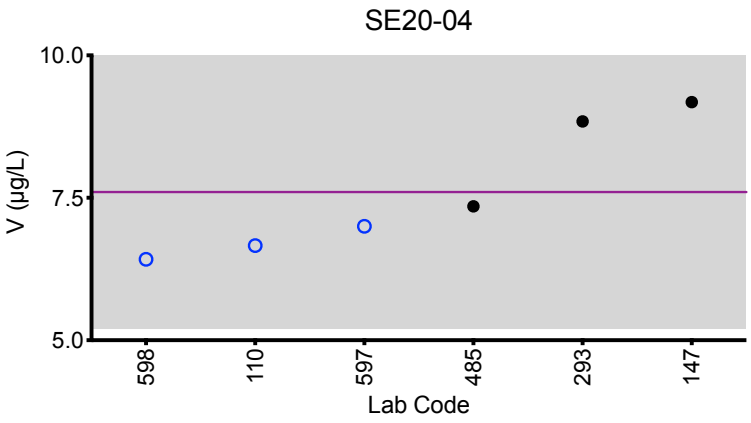
Results for Event #1, 2020: Summary Figures

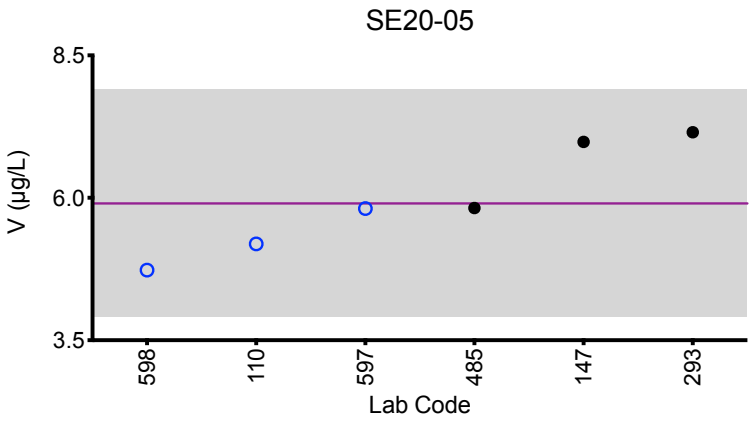
Serum V











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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
110	ICP-MS	0.59	0.93	1.16	0.83	0.88
147	ICP-MS	0.541	0.876	1.24	0.952	0.758
597	ICP-MS/MS	0.70	*4.16	1.53	1.01	0.83
598	ICP-MS	0.76	1.22	1.43	1.07	0.75
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		0.65	1.0	1.34	0.97	0.80
Arithmetic SD (s)		0.10	0.2	0.17	0.10	0.06
Arithmetic RSD (%)		15	19	13	10	7.5
Number of Sample Measurements (N)		4	3	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Be (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
110	ICP-MS	0.22	1.88	3.71	1.02	6.73
147	ICP-MS	<0.523	1.81	2.89	1.04	6.45
293	ICP-MS	0.25	1.66	3.10	0.86	6.35
598	ICP-MS	*0.5	1.62	3.21	0.85	5.22

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	0.24	1.74	3.2	0.94	6.2
Arithmetic SD (s)	0.02	0.12	0.3	0.10	0.7
Arithmetic RSD (%)	9.0	6.9	9.4	11	11
Number of Sample Measurements (N)	2	4	4	4	4

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
110	ICP-MS	0.39	0.86	0.48	0.38	0.85
597	ICP-MS/MS	0.45	0.90	0.57	0.42	0.84
598	ICP-MS	0.40	0.80	0.47	0.34	0.73

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	0.41	0.85	0.51	0.38	0.81
Arithmetic SD (s)	0.03	0.05	0.06	0.04	0.07
Arithmetic RSD (%)	7.3	5.9	12	11	8.6
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Mg (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
264	ICP-MS	16770	20453	18212	16929	20106
597	ICP-MS/MS	17174	20635	18195	16659	21244

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	17000	20540	18204	16790	20700
Arithmetic SD (s)	300	130	12	190	800
Arithmetic RSD (%)	1.8	0.63	0.070	1.1	3.9
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
110	ICP-MS	0.494	0.280	1.89	0.817	1.39
264	ICP-MS	0.50	0.24	2.01	0.81	1.42
598	ICP-MS	0.53	0.29	1.79	0.73	1.11
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		0.51	0.27	1.90	0.79	1.3
Arithmetic SD (s)		0.02	0.03	0.11	0.05	0.2
Arithmetic RSD (%)		3.7	11	5.8	6.3	13
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
103	DRC/CC-ICP-MS	6.34	0.701	4.31	1.33	5.43
110	ICP-MS	6.65	0.71	4.36	1.37	5.32
147	ICP-MS	6.54	0.856	4.51	1.53	5.69
598	ICP-MS	6.49	0.69	4.12	1.19	4.38
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		6.51	0.74	4.33	1.36	5.2
Arithmetic SD (s)		0.13	0.08	0.16	0.14	0.6
Arithmetic RSD (%)		2.0	11	3.7	10	12
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
110	ICP-MS	1.18	5.04	*4.76	8.76	5.02
147	ICP-MS	0.960	5.38	2.33	9.64	4.82
597	ICP-MS/MS	1.10	4.75	2.27	8.17	4.72
598	ICP-MS	1.20	4.83	2.39	8.08	4.14
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		1.11	5.0	2.3	8.7	4.7
Arithmetic SD (s)		0.11	0.3	0.1	0.7	0.4
Arithmetic RSD (%)		9.9	5.6	2.6	8.3	8.5
Number of Sample Measurements (N)		4	4	3	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
103	DRC/CC-ICP-MS	49.1	101	82.1	107	133
200	ICP-MS	47	86	72	93	110
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		48.1	94	77	100	122
Arithmetic SD (s)		1.5	11	7	10	16
Arithmetic RSD (%)		3.1	12	9.1	10	13
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
200	DRC/CC-ICP-MS	3.2	5.9	6.5	6.9	5.0
485	HR-ICP-MS	1.57	3.95	8.51	6.42	2.55

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	NA	NA	7.5	6.7	NA
Arithmetic SD (s)	NA	NA	1.4	0.3	NA
Arithmetic RSD (%)	NA	NA	19	4.5	NA
Number of Sample Measurements (N)	NA	NA	2	2	NA

*Denotes a statistical Outlier.

Statistical data were not calculated for SE20-01, SE20-02 or SE20-05 based on a lack of consensus among participating labs.

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum U (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
103	DRC/CC-ICP-MS	0.0580	0.0595	0.195	0.162	0.103
110	ICP-MS	0.061	0.060	0.210	0.159	0.108
147	ICP-MS	0.0557	0.0552	0.192	0.154	0.0974
598	ICP-MS	0.07	0.07	0.20	0.14	0.09
Summary Statistics						
		SE20-01	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
Arithmetic Mean ($\bar{x}$)		0.061	0.061	0.199	0.154	0.100
Arithmetic SD (s)		0.006	0.006	0.008	0.010	0.008
Arithmetic RSD (%)		9.8	9.8	4.0	6.5	8.0
Number of Sample Measurements (N)		4	4	4	4	4

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Results for Event #1, 2020:
Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
110	ICP-MS	0.44	0.86	3.62	4.23	2.27
147	ICP-MS	0.443	0.872	3.64	4.36	2.21
200	ICP-MS	0.5	0.8	3.6	4.2	2.2
598	ICP-MS	0.70	0.94	3.88	4.20	1.95

Summary Statistics

	SE20-01	SE20-02	SE20-03	SE20-04	SE20-05
Arithmetic Mean ($\bar{x}$)	0.52	0.87	3.69	4.25	2.16
Arithmetic SD (s)	0.12	0.06	0.13	0.08	0.14
Arithmetic RSD (%)	23	6.9	3.5	1.9	6.5
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2020: Additional Elements in Serum

Serum Ag (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
147	ICP-MS	0.252	<0.227	<0.227	<0.227	<0.227

Serum B (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
200	ICP-MS	37	39	30	31	37

Serum Bi (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
147	ICP-MS	<0.230	<0.230	<0.230	<0.230	<0.230

Serum Fe (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
264	ICP-MS	652	599	668	649	590.0

Serum I (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
147	ICP-MS	53.5	44.6	52.3	54.3	42.5

Serum Li (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
147	ICP-MS	0.471	0.616	0.543	0.507	0.609

Serum Te (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
147	ICP-MS	<0.153	<0.153	<0.153	<0.153	<0.153

Serum Th (µg/L)						
Lab Code	**Method**	**SE20-01**	**SE20-02**	**SE20-03**	**SE20-04**	**SE20-05**
147	ICP-MS	<0.00882	<0.00882	<0.00882	<0.00882	<0.00882

References

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

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