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New York State Biomonitoring Program for Trace Elements

Event #3, 2020

Trace Elements in Whole Blood, Urine, and Serum

December, 2020

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #3, 2020:
Trace Elements in Whole Blood, Urine, and Serum

12/1/2020

Dear Laboratory Director,

This report summarizes performance for the third biomonitoring proficiency test (PT) event of 2020 for Trace Elements in Whole Blood, Urine, and Serum. One of the key goals of this PT program is to achieve harmonization of biomonitoring data for trace elements.

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

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

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

Samples for the next PT event (Event #1, 2021) will be shipped February 17, 2021. Comments about this report may be directed to trel@health.ny.gov. If you have not yet enrolled for next year, please contact PT program staff at trel@health.ny.gov.

Sincerely,

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

Kayla Mehigan
Coordinator, Biomonitoring PT Program,
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Wadsworth Center

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Event #3, 2020

Trace Elements in Whole Blood

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Trace Elements Laboratory

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Event #3, 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 24 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, 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 #3, 2020: Summary Statistics

Whole Blood As (µg/L)					
	BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Target (Arithmetic Mean ($\bar{x}$))	37.6	21.3	4.16	12.4	7.6
Upper Limit	45.1	27.3	10.16	18.4	13.6
Lower Limit	30.1	15.3	0.00	6.4	1.6
Arithmetic SD (s)	1.8	2.2	0.19	1.0	0.5
Arithmetic RSD (%)	4.8	10	4.6	8.1	6.6
Number of Sample Measurements (N)	6	7	6	7	7

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

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Results for Event #3, 2020:
Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
	Target	**37.6**	**21.3**	**4.16**	**12.4**	**7.6**
103	ICP-MS/MS	39.5	22.0	4.28	12.7	7.81
110	DRC/CC-ICP-MS	36.9	19.8	3.94	12.1	7.70
147	ICP-MS	37.0	20.8	4.05	11.8	7.45
264	ICP-MS	35.22	19.60	4.10	11.05	7.10
293	DRC/CC-ICP-MS	39.92	21.96	4.46	12.57	7.90
597	ICP-MS	37.2	19.3	4.10	12.3	6.84
598	DRC/CC-ICP-MS	*48.3 ↑	25.7	*5.30	14.4	8.15

Based on the grading criteria for As in Whole Blood, 97% of results were satisfactory, with 0 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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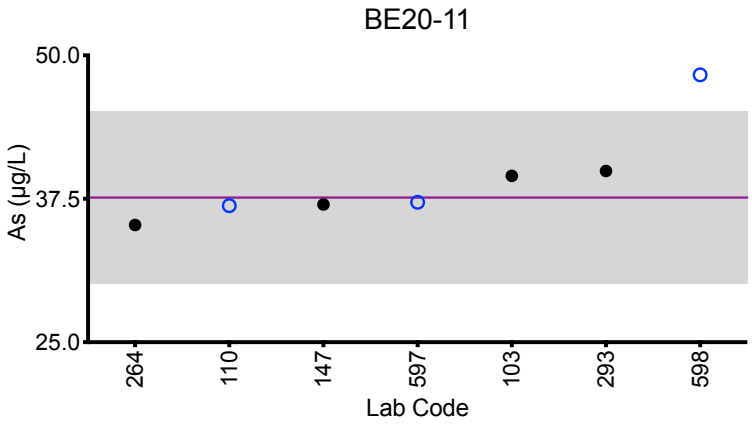
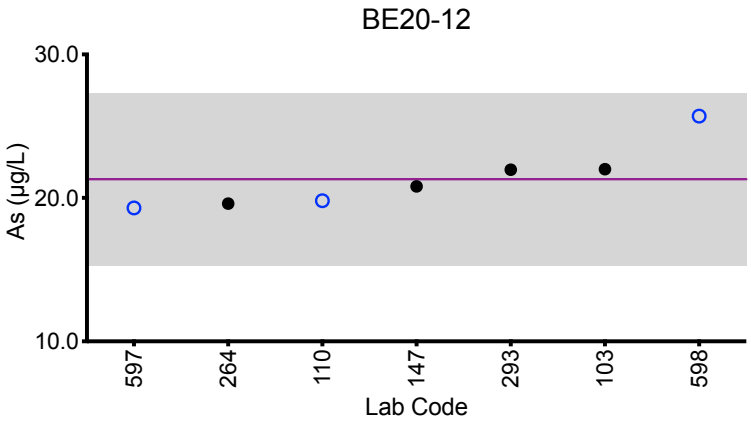
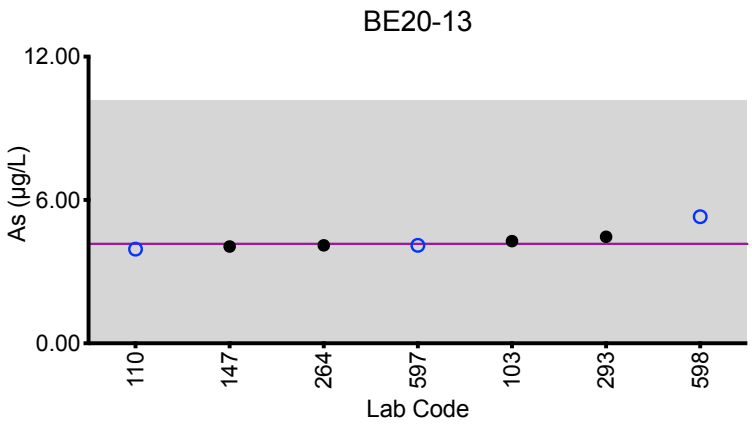
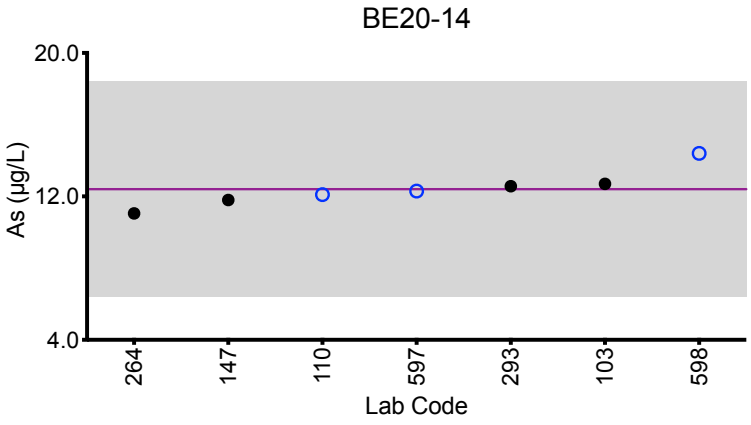
Results for Event #3, 2020: Summary Figures

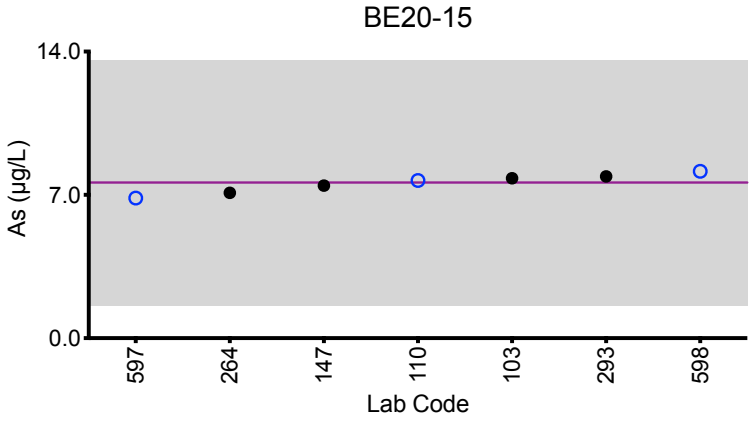
Whole Blood As











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

Whole Blood Cd (µg/L)					
	BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Target (Robust Mean (x*))	0.92	3.99	1.65	10.5	13.9
Upper Limit	1.92	4.99	2.65	12.1	16.0
Lower Limit	0.00	2.99	0.65	8.9	11.8
Robust SD (s*)	0.07	0.18	0.06	0.4	0.8
Robust RSD (%)	7.6	4.5	3.6	3.3	5.8
Number of Sample Measurements (N)	11	12	12	12	12
Standard Uncertainty (*u*)	0.03	0.07	0.02	0.1	0.3

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 #3, 2020:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
	Target	**0.92**	**3.99**	**1.65**	**10.5**	**13.9**
103	ICP-MS/MS	0.977	4.11	1.69	10.9	14.7
107	ICP-MS/MS	0.907	4.119	1.631	10.541	13.440
110	ICP-MS	0.87	3.98	1.61	10.4	13.8
116	ICP-MS/MS	<1.50	4.21	1.61	11.3	14.6
147	ICP-MS	0.936	4.15	1.69	10.7	13.9
264	ICP-MS	0.84	3.65	1.50	10.01	12.82
293	DRC/CC-ICP-MS	0.97	3.99	1.66	10.40	14.03
391	ICP-MS	0.958	3.398	1.685	8.972	14.568
597	ICP-MS	0.857	3.82	1.64	10.5	13.1
598	DRC/CC-ICP-MS	0.855	3.60	1.45	9.54	12.3
605	ICP-MS	0.879	4.10	1.68	10.7	14.3
606	ICP-MS/MS	1.05	4.06	1.77	10.5	14.5

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

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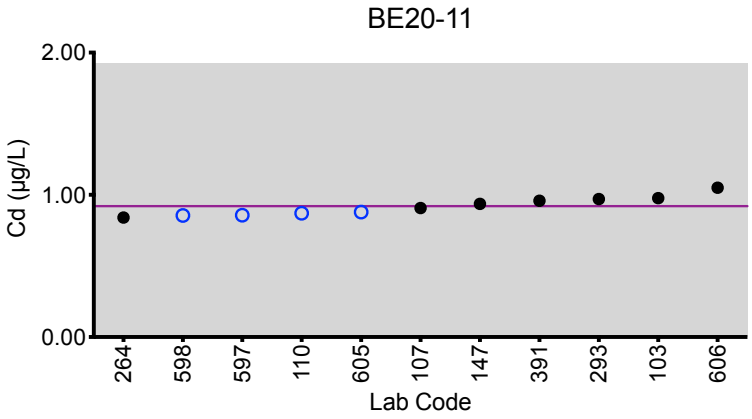
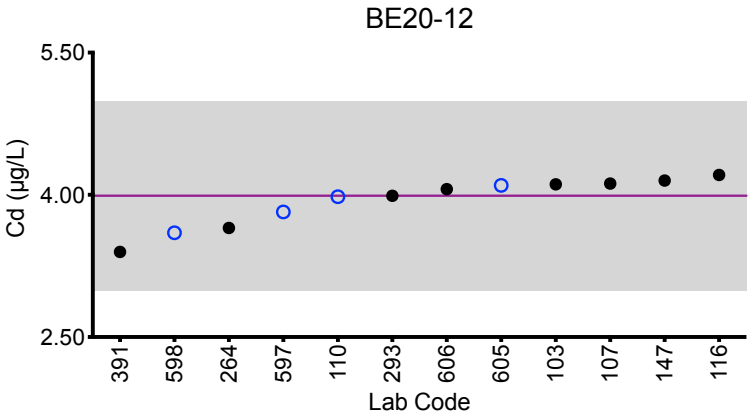
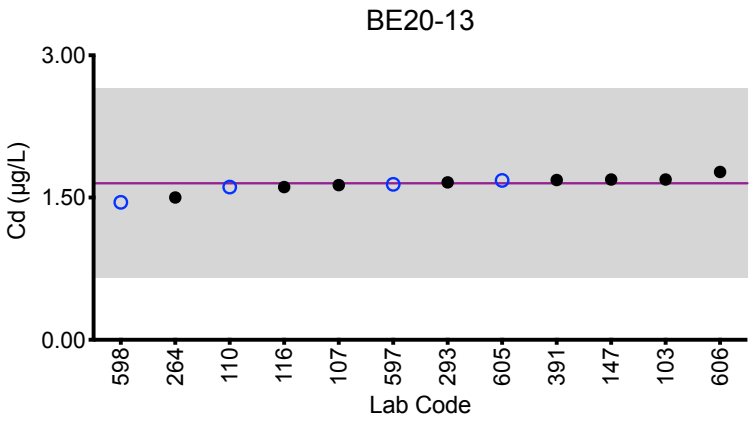
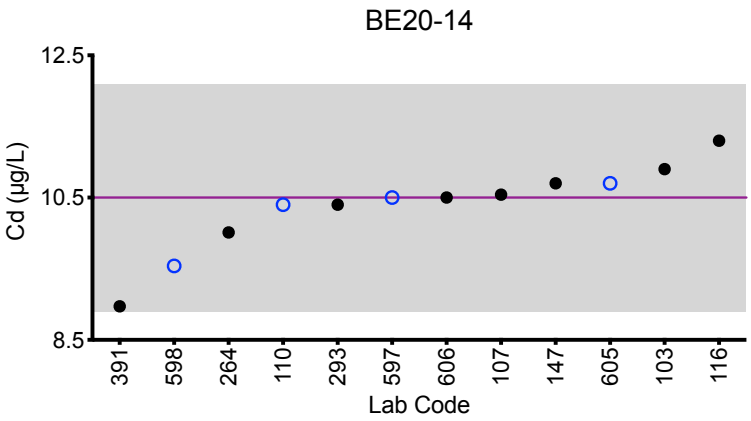
Results for Event #3, 2020: Summary Figures

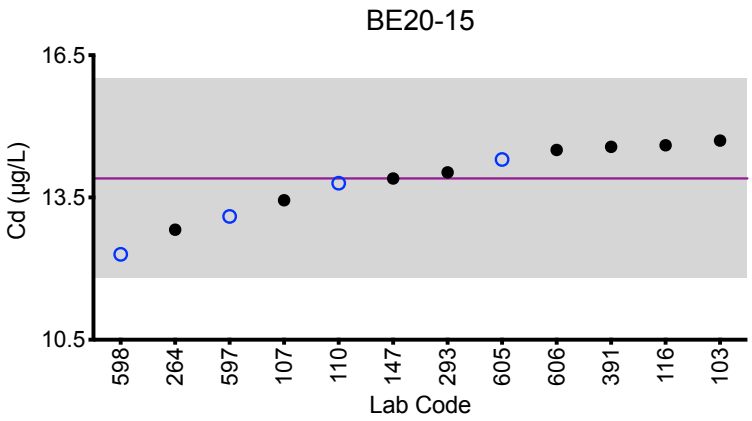
Whole Blood Cd











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

Whole Blood Co (µg/L)					
	BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Target (Arithmetic Mean ($\bar{x}$))	7.2	1.60	3.0	9.80	13.9
Upper Limit	8.7	3.10	4.5	11.76	16.7
Lower Limit	5.7	0.10	1.5	7.84	11.1
Arithmetic SD (s)	0.4	0.14	0.6	0.25	0.7
Arithmetic RSD (%)	5.3	8.8	20	2.6	5.3
Number of Sample Measurements (N)	8	8	9	8	9

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

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Results for Event #3, 2020:
Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
	Target	**7.2**	**1.60**	**3.0**	**9.80**	**13.9**
103	ICP-MS/MS	7.17	1.58	3.22	9.69	14.0
110	ICP-MS	7.26	1.65	3.10	9.91	14.2
147	ICP-MS	7.45	1.79	3.40	10.1	14.4
255	ICP-MS	6.8	1.4	1.8	9.8	13
264	ICP-MS	6.44	1.45	3.06	9.28	12.86
293	DRC/CC-ICP-MS	7.12	1.55	3.32	9.82	13.88
391	ICP-MS	*4.985 ↓	*0.825	2.104	*8.568	15.105
597	ICP-MS	7.37	1.58	3.21	9.99	13.2
598	ICP-MS	7.64	1.80	3.56	9.83	14.2

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.

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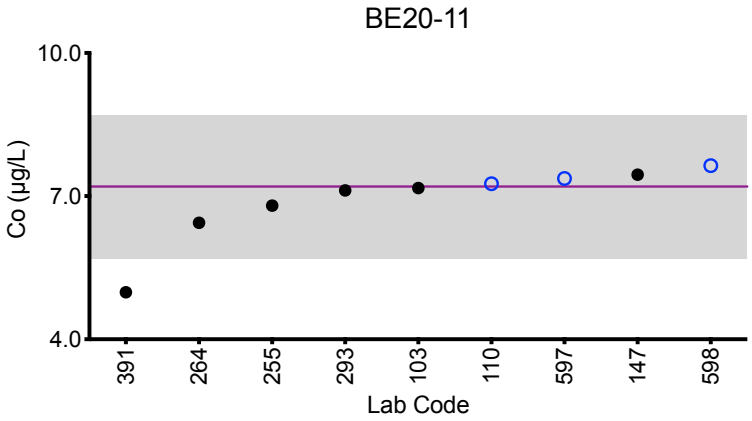
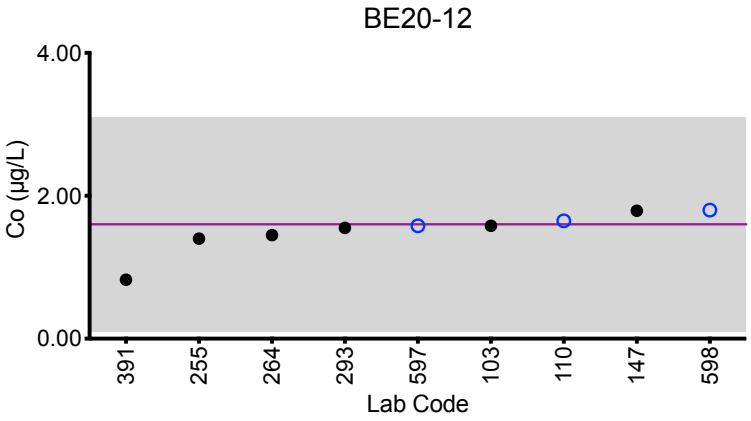
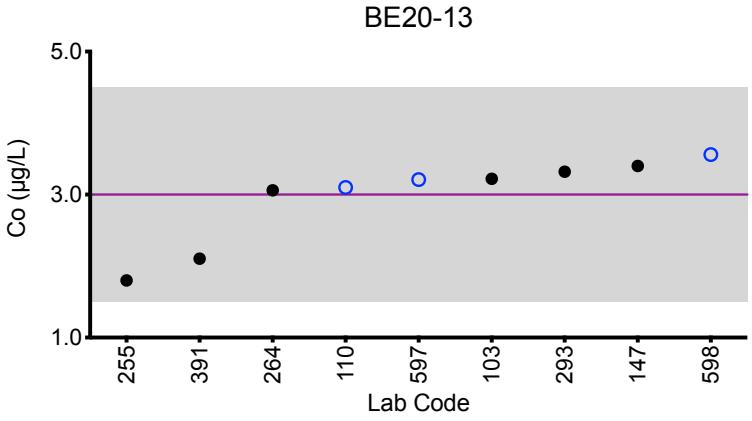
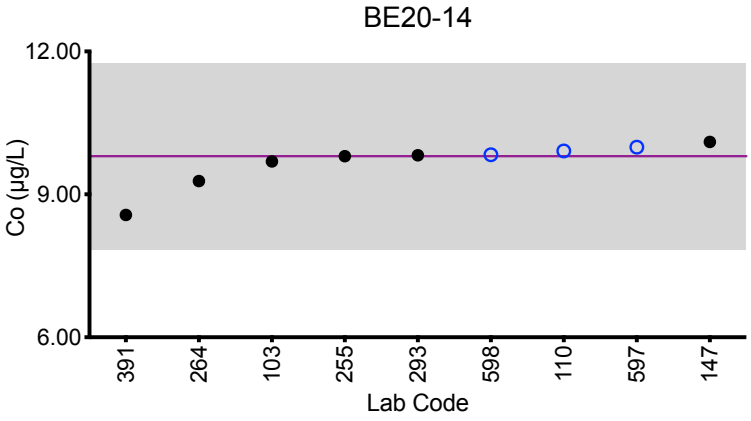
Results for Event #3, 2020: Summary Figures

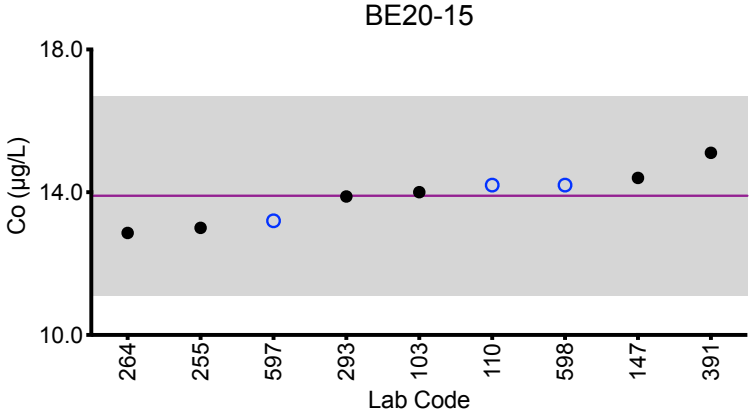
Whole Blood Co











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

Whole Blood Cr (µg/L)					
	BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Target (Arithmetic Mean ($\bar{x}$))	4.6	1.7	14.0	NA	8.5
Upper Limit	6.6	3.7	16.8	NA	10.5
Lower Limit	2.6	0.0	11.2	NA	6.5
Arithmetic SD (s)	0.6	0.6	1.8	NA	0.8
Arithmetic RSD (%)	13	35	13	NA	9.4
Number of Sample Measurements (N)	8	8	8	NA	9

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

Statistical data was not calculated for BE20-14 based on a lack of consensus among participating labs. Consequently, a target value cannot be assigned with confidence.

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Results for Event #3, 2020:
Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
	Target	**4.6**	**1.7**	**14.0**	**NA**	**8.5**
103	ICP-MS/MS	4.59	<2.50	13.5	<2.50	8.18
110	DRC/CC-ICP-MS	5.23	1.41	13.6	0.33	8.64
147	DRC/CC-ICP-MS	5.33	1.93	16.5	0.250	9.41
255	ICP-MS	4.7	1.4	*8.6 ↓	<1	7.8
264	ICP-MS	3.80	0.89	11.29	0.11	7.90
293	DRC/CC-ICP-MS	4.86	1.62	14.74	0.36	8.47
391	ICP-MS	3.742	2.601	12.375	1.295	9.912
597	ICP-MS	4.56	1.34	13.7	<0.75	7.22
598	DRC/CC-ICP-MS	*7.24 ↑	2.67	16.3	0.94	8.68

Based on the grading criteria for Cr in Whole Blood, 96% of results were satisfactory, with 0 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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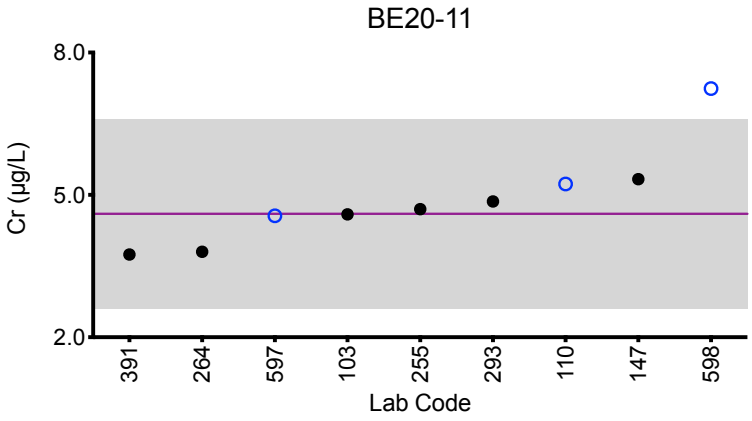
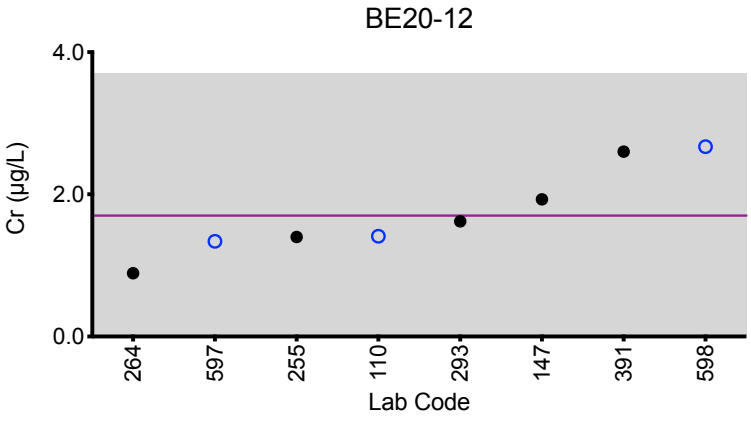
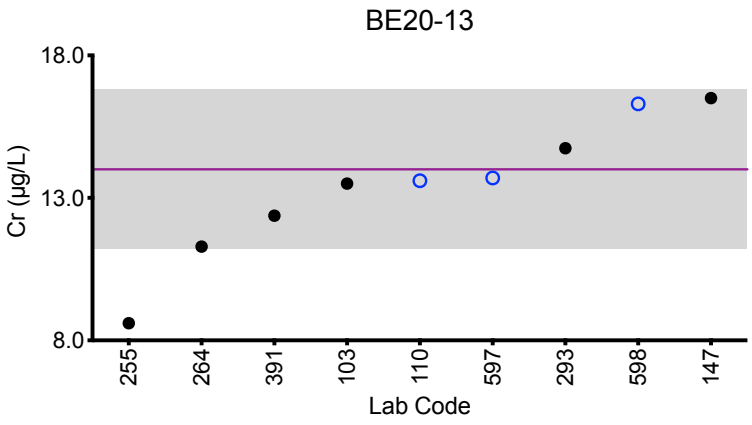
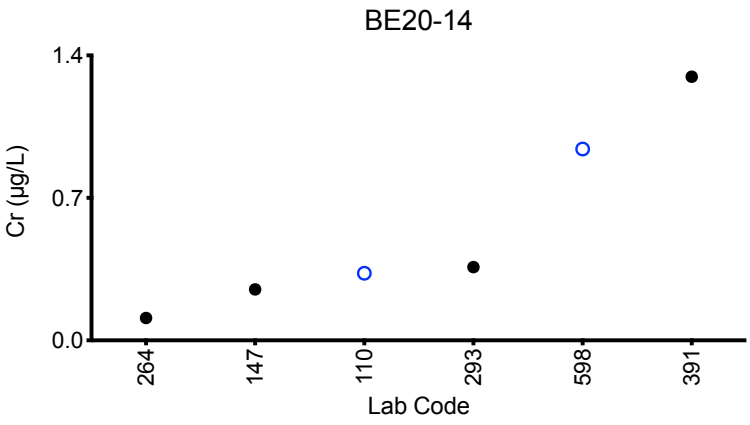
Results for Event #3, 2020: Summary Figures

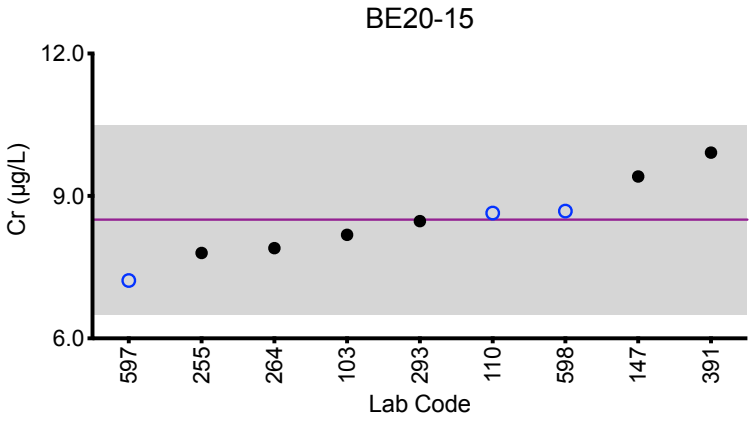
Whole Blood Cr











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Target (Robust Mean (x*))	28.1	1.94	8.4	1.19	14.0
Upper Limit	30.9	3.94	10.4	3.19	16.0
Lower Limit	25.3	0.00	6.4	0.00	12.0
Robust SD (s*)	1.2	0.14	0.6	0.07	0.8
Robust RSD (%)	4.3	7.2	7.1	5.9	5.7
Number of Sample Measurements (N)	13	11	13	11	13
Standard Uncertainty (*u*)	0.4	0.05	0.2	0.03	0.3

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 #3, 2020:
Performance of Participating Laboratories

Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
	Target	**28.1**	**1.94**	**8.4**	**1.19**	**14.0**
103	ICP-MS/MS	28.8	2.00	8.75	1.22	14.4
107	ICP-MS/MS	27.988	2.013	8.356	1.161	13.560
110	ICP-MS	28.0	1.93	8.42	1.13	14.4
116	ICP-MS/MS	30.6	<3.00	9.09	<3.00	15.3
147	ICP-MS	29.2	2.07	8.56	1.22	14.3
264	ICP-MS	22.55 ↓	1.52	6.80	0.93	11.54 ↓
293	ICP-AES/OES	28.74	1.86	8.68	1.24	14.06
343	ASV-LeadCare	28.2	<1.9	6.6	<1.9	13.5
391	ETAAS-Z	22.75 ↓	4.79 ↑	7.315	1.48	13.85
597	ICP-MS	27.3	1.87	8.47	1.22	13.1
598	ICP-MS	24.8 ↓	1.76	7.39	1.08	11.5 ↓
605	ICP-MS	28.9	1.96	8.81	1.15	14.5
606	ICP-MS/MS	28.5	1.98	8.83	1.21	15.1

Based on the grading criteria for Pb in Whole Blood, 91% of results were satisfactory, with 3 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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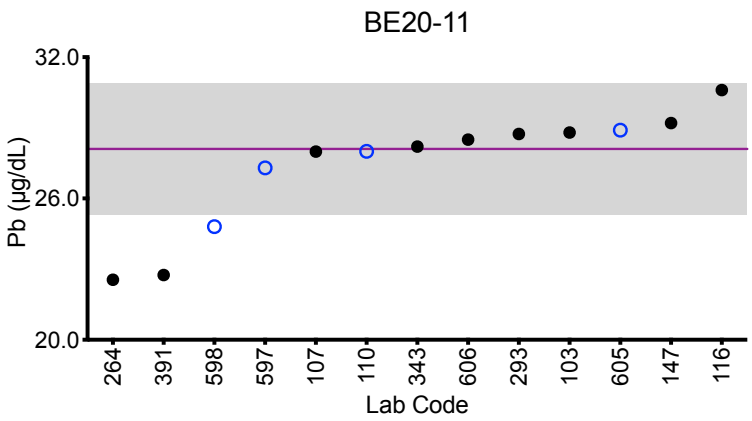
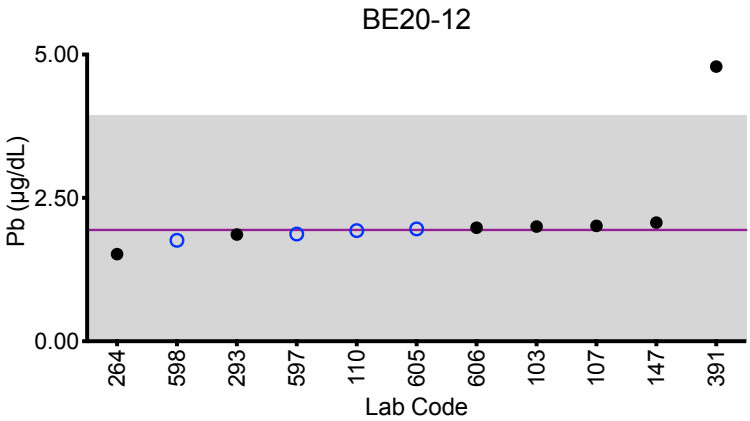
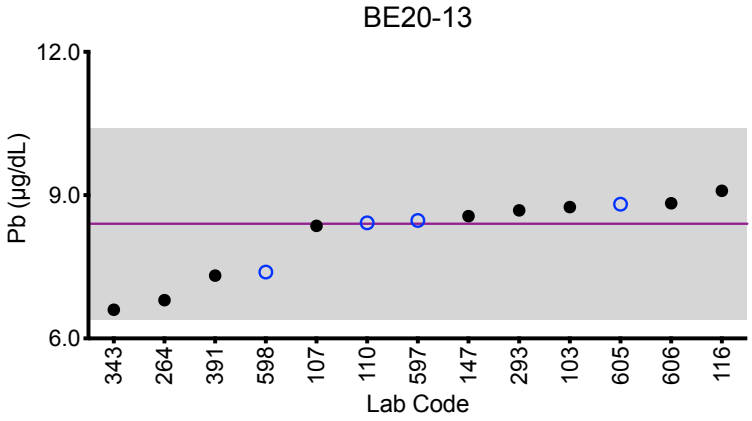
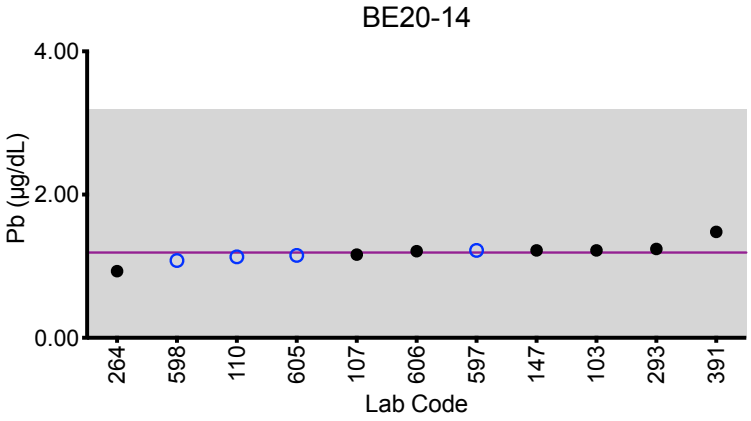
Results for Event #3, 2020: Summary Figures

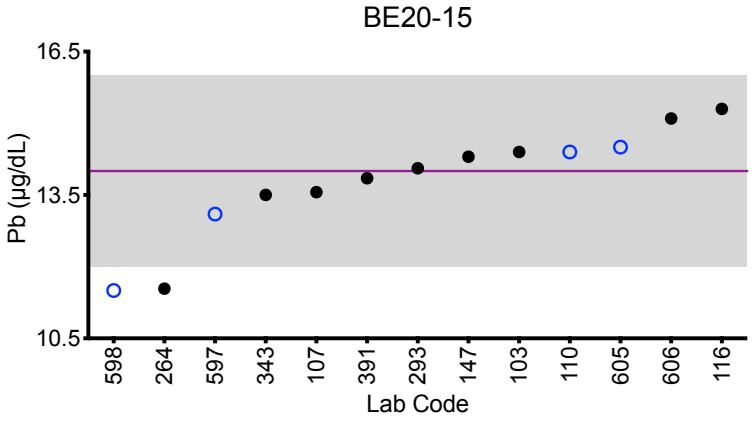
Whole Blood Pb











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

Whole Blood Hg (µg/L)					
	BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Target (Robust Mean (x*))	1.56	9.0	14.3	0.79	3.9
Upper Limit	4.56	12.0	18.6	3.79	6.9
Lower Limit	0.00	6.0	10.0	0.00	0.9
Robust SD (s*)	0.12	0.6	1.4	0.10	0.5
Robust RSD (%)	7.7	6.7	9.8	13	13
Number of Sample Measurements (N)	12	12	12	10	12
Standard Uncertainty (*u*)	0.04	0.2	0.5	0.04	0.2

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

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Results for Event #3, 2020:
Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
	Target	**1.56**	**9.0**	**14.3**	**0.79**	**3.9**
103	ICP-MS/MS	1.63	9.37	15.5	0.926	4.32
107	ICP-MS/MS	1.59	9.98	15.00	0.74	3.97
110	ICP-MS	1.47	8.62	12.9	0.71	3.65
116	ICP-MS/MS	1.73	9.77	16.1	<1.5	4.41
147	ICP-MS	1.51	8.73	13.7	0.806	3.89
264	ICP-MS	2.22	9.37	15.21	0.91	4.36
293	DRC/CC-ICP-MS	1.34	8.74	14.37	0.66	3.71
391	ICP-MS	0.428	9.085	12.146	<0.364	2.397
597	ICP-MS	1.59	8.43	14.4	0.75	3.62
598	ICP-MS	1.49	8.4	12.8	1.17	3.45
605	ICP-MS	1.57	8.49	14.0	0.809	3.93
606	ICP-MS/MS	1.56	9.19	15.6	0.737	4.59

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

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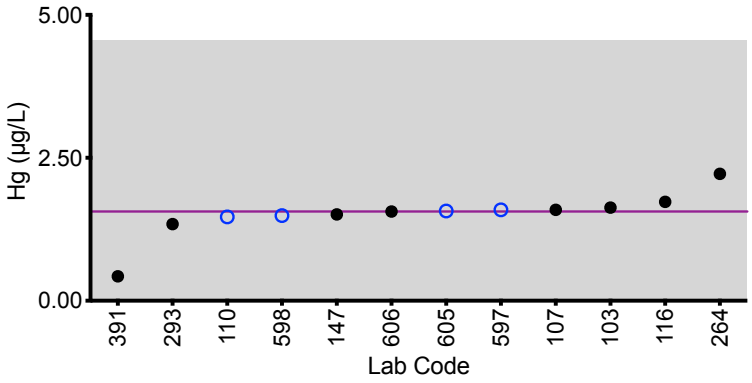
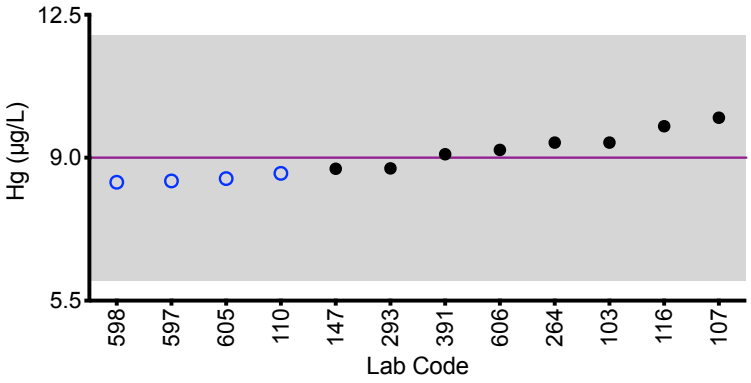
Results for Event #3, 2020: Summary Figures

Whole Blood Hg

BE20-11



BE20-12



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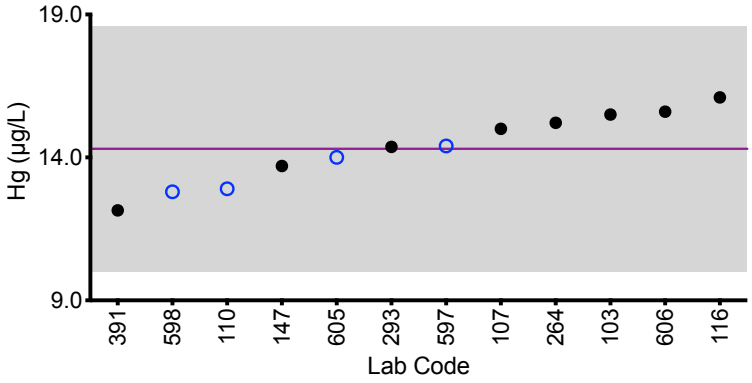
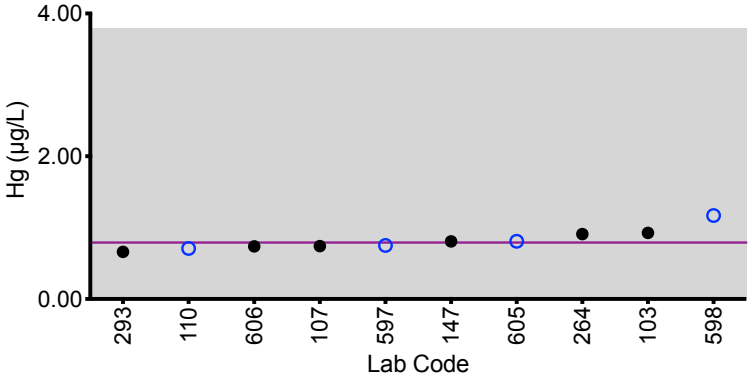
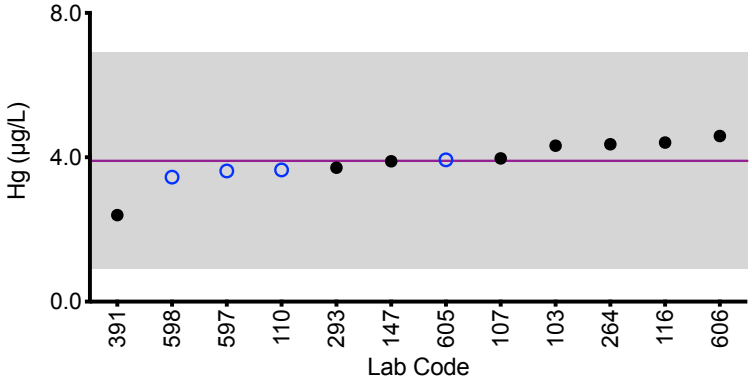


BE20-14



BE20-15



Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

Whole Blood Mn (µg/L)					
	BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Target (Robust Mean (x*))	24.5	19.4	15.0	32.7	21.3
Upper Limit	28.7	22.7	18.0	38.3	24.9
Lower Limit	20.3	16.1	12.0	27.1	17.7
Robust SD (s*)	1.6	1.3	0.8	1.8	1.1
Robust RSD (%)	6.5	6.7	5.3	5.5	5.2
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.6	0.5	0.3	0.7	0.5

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 #3, 2020:
Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
	Target	**24.5**	**19.4**	**15.0**	**32.7**	**21.3**
103	ICP-MS/MS	25.9	19.4	15.9	33.1	21.2
107	ICP-MS/MS	25.34	20.66	15.02	33.69	20.64
110	ICP-MS	24.7	18.8	14.5	32.9	21.9
147	ICP-MS	27.8	26.1 ↑	17.4	35.4	23.4
264	ICP-MS	23.92	19.08	14.78	30.06	21.06
293	DRC/CC-ICP-MS	23.01	17.35	14.22	31.91	20.65
391	ICP-MS	22.273	20.005	15.63	31.604	27.439 ↑
597	ICP-MS	24.3	19.1	14.1	32.7	19.7
598	ICP-MS	23.3	17.9	15.0	29.6	20.6
606	ICP-MS/MS	25.0	20.1	15.1	34.6	22.9

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

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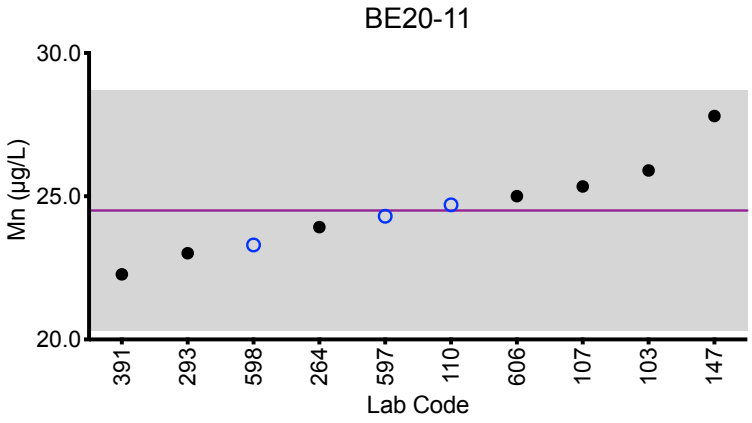
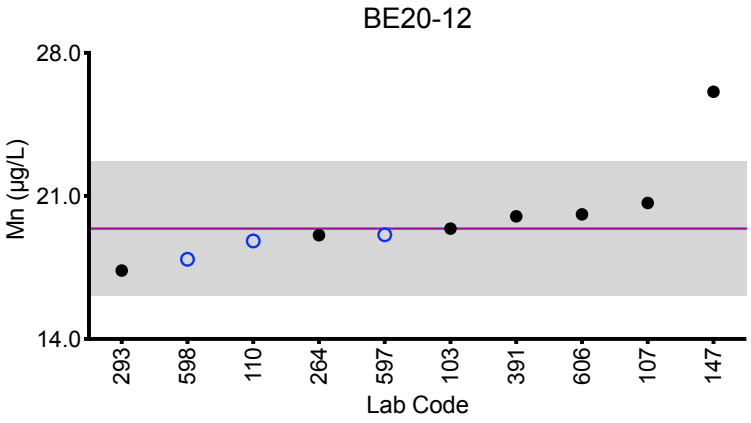
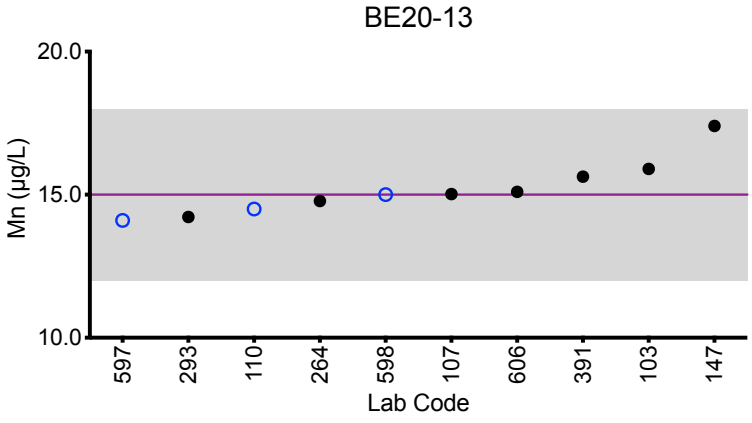
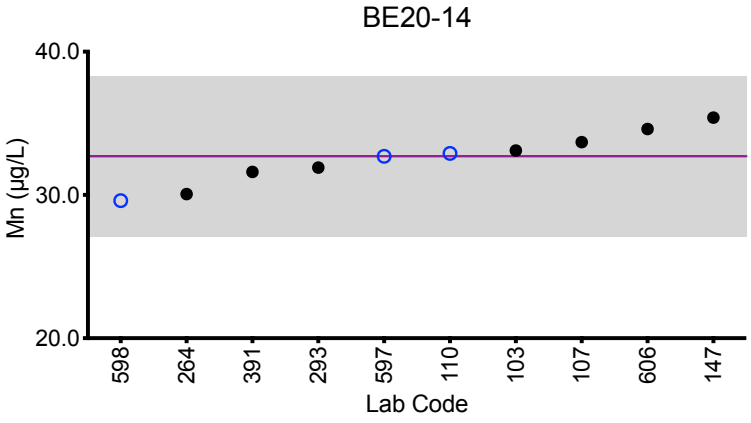
Results for Event #3, 2020: Summary Figures

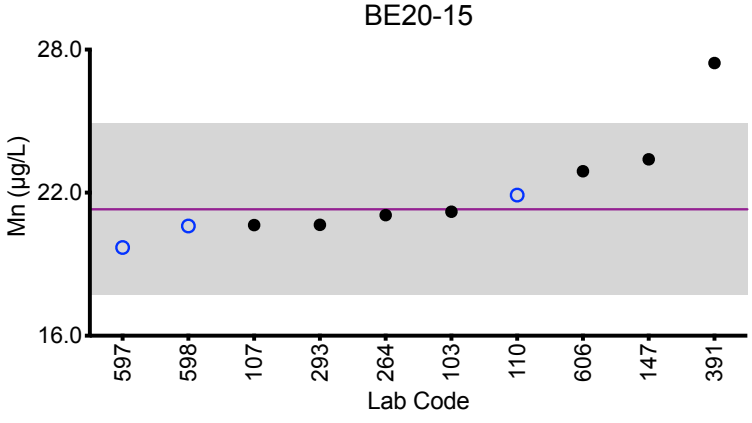
Whole Blood Mn











Legend:
○ C/HHEAR 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 #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
103	ICP-MS/MS	<1.50	<1.50	3.42	5.52	2.28
147	ICP-MS	1.12	0.462	3.34	5.22	2.26
264	ICP-MS	<0.10	<0.10	1.48	*3.35	*0.40
597	ICP-MS	1.03	0.675	3.31	5.35	2.19
598	DRC/CC-ICP-MS	1.23	0.58	4.34	5.81	2.34
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		1.13	0.57	3.2	5.5	2.27
Arithmetic SD (s)		0.10	0.11	1.0	0.2	0.06
Arithmetic RSD (%)		8.8	19	31	4.6	2.6
Number of Sample Measurements (N)		3	3	5	4	4

*Denotes a statistical Outlier.

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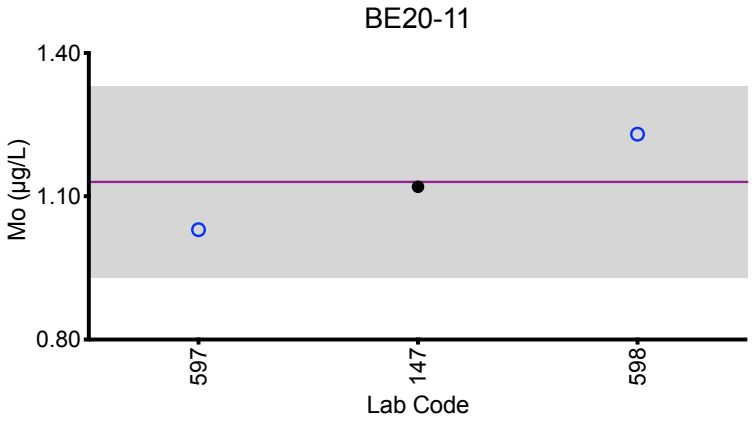
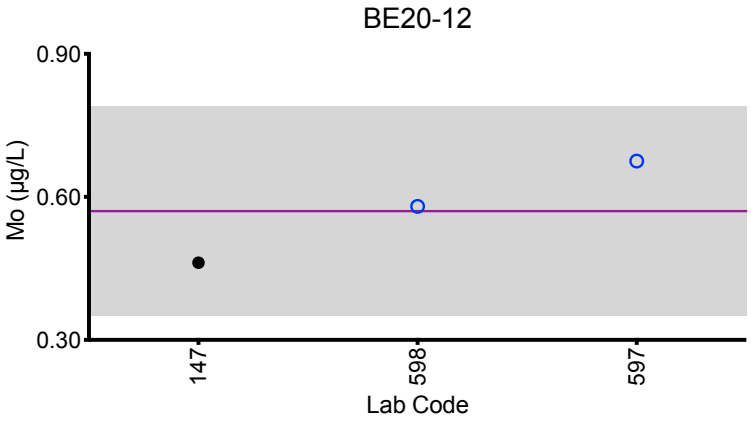
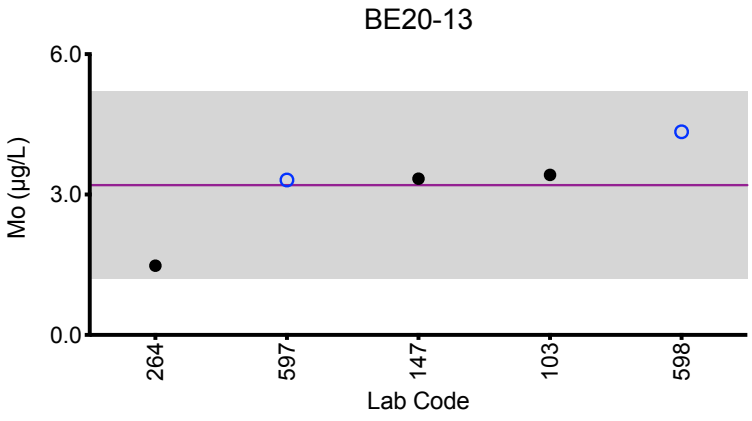
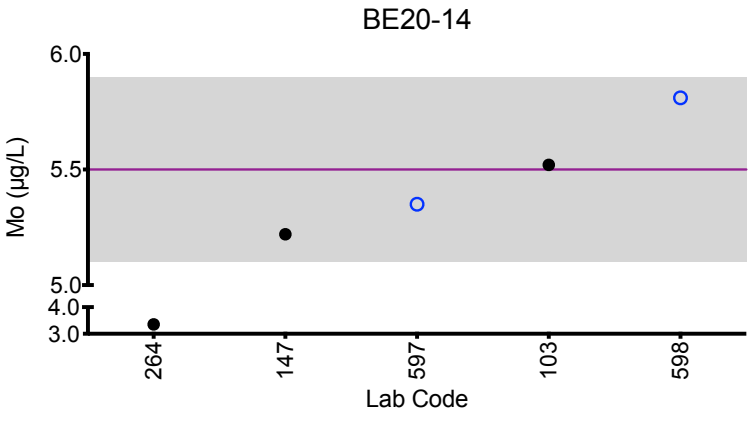
Results for Event #3, 2020: Summary Figures

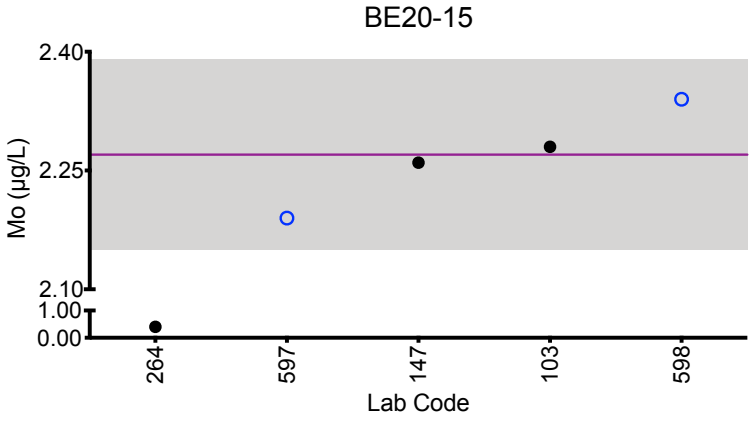
Whole Blood Mo











Legend:
o C/HHEAR 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 #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)

Lab Code	Method	BE20-11	BE20-12	BE20-13	BE20-14	BE20-15
103	ICP-MS/MS	<0.150	5.52	1.37	2.66	4.06
110	ICP-MS	0.018	5.74	1.32	2.82	4.29
147	ICP-MS	<0.329	6.20	1.47	3.00	4.53
264	ICP-MS	<0.10	4.96	1.30	*3.51	3.83
293	DRC/CC-ICP-MS	0.05	5.32	1.4	2.69	4.86
597	ICP-MS	0.028	5.67	1.45	2.97	4.09
598	ICP-MS	<0.2	5.72	1.51	2.76	4.29

Summary Statistics

	BE20-11	BE20-12	BE20-13	BE20-14	BE20-15
Arithmetic Mean ($\bar{x}$)	NA	5.6	1.40	2.82	4.3
Arithmetic SD (s)	NA	0.4	0.08	0.14	0.3
Arithmetic RSD (%)	NA	6.9	5.7	5.0	7.9
Number of Sample Measurements (N)	NA	7	7	6	7

*Denotes a statistical Outlier.

Statistical data was not calculated for BE20-11 based on a lack of consensus among participating labs.

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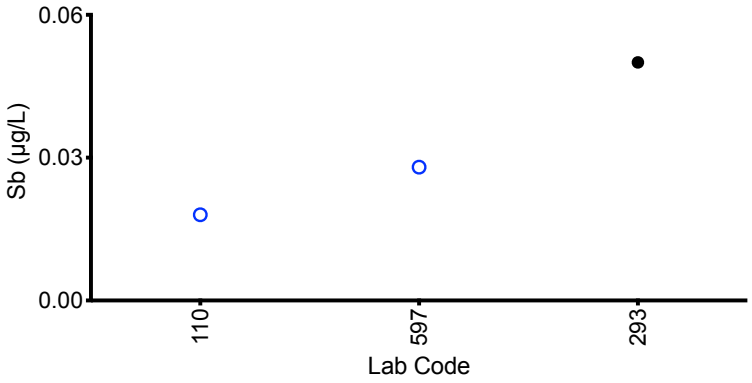
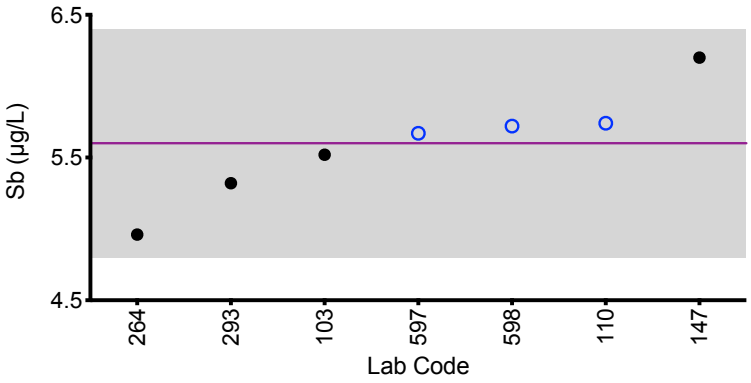
Results for Event #3, 2020: Summary Figures

Whole Blood Sb

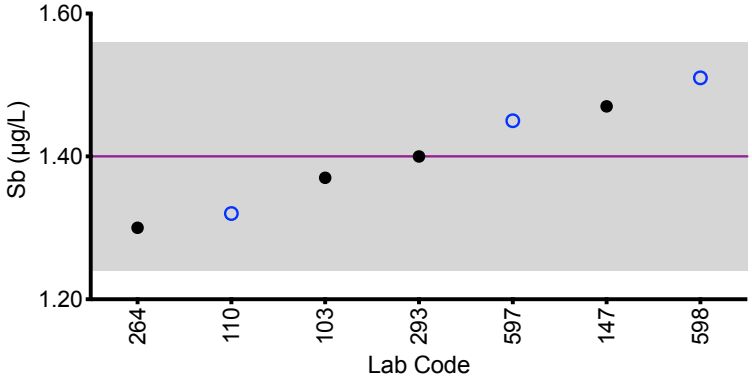
BE20-11



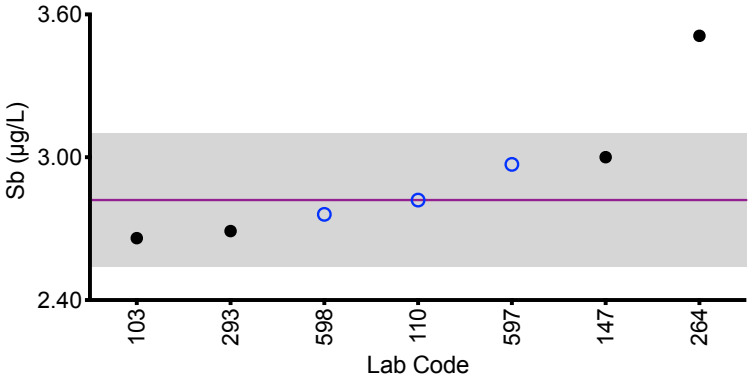
BE20-12



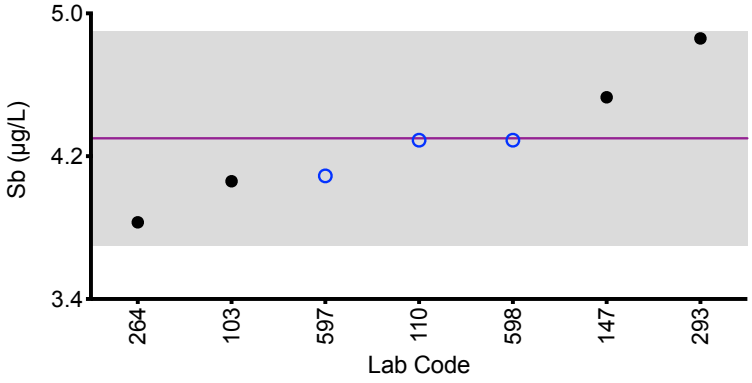
BE20-13



BE20-14



BE20-15



Legend:

o C/HHEAR 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 #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)

Lab Code	Method	BE20-11	BE20-12	BE20-13	BE20-14	BE20-15
103	ICP-MS/MS	135	132	178	152	175
107	ICP-MS/MS	133.6	136.6	169.1	153.9	169.6
110	DRC/CC-ICP-MS	120	110	146	131	151
147	ICP-MS	134	130	168	149	178
264	ICP-MS	129.5	123.1	164.4	136.7	167.6
293	DRC/CC-ICP-MS	143.65	138.91	177.58	161.01	193.37
597	ICP-MS	126	118	164	145	156
598	DRC/CC-ICP-MS	140	130	179	151	170

Summary Statistics

	BE20-11	BE20-12	BE20-13	BE20-14	BE20-15
Arithmetic Mean ($\bar{x}$)	133	127	168	147	170
Arithmetic SD (s)	8	10	11	10	13
Arithmetic RSD (%)	5.7	7.9	6.5	6.8	7.6
Number of Sample Measurements (N)	8	8	8	8	8

*Denotes a statistical Outlier.

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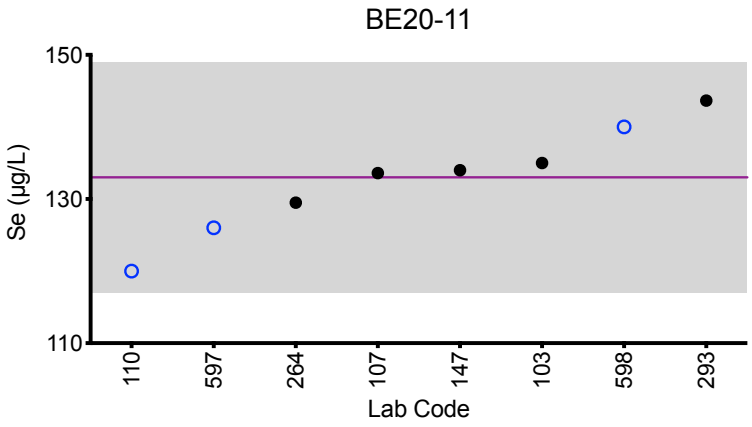
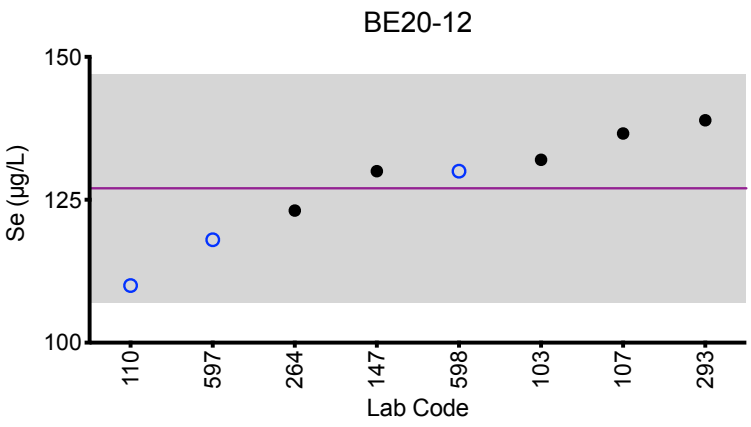
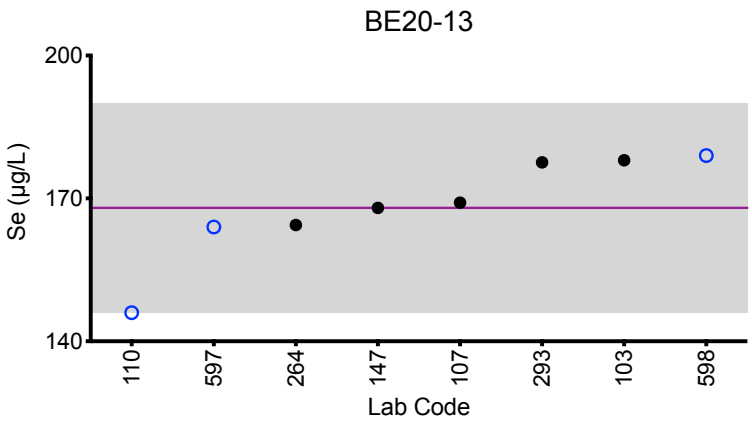
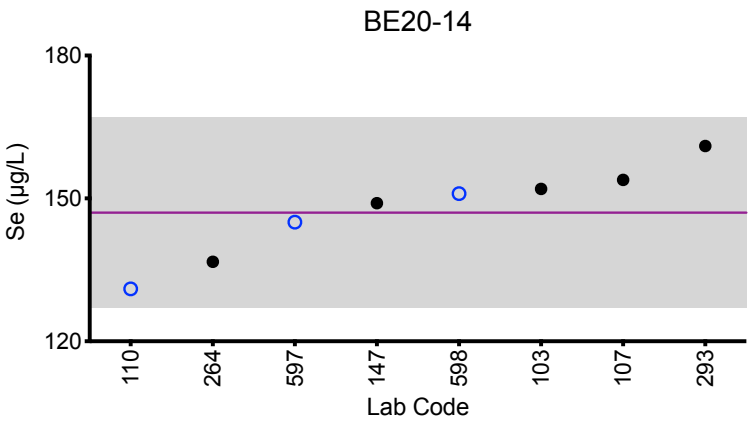
Results for Event #3, 2020: Summary Figures

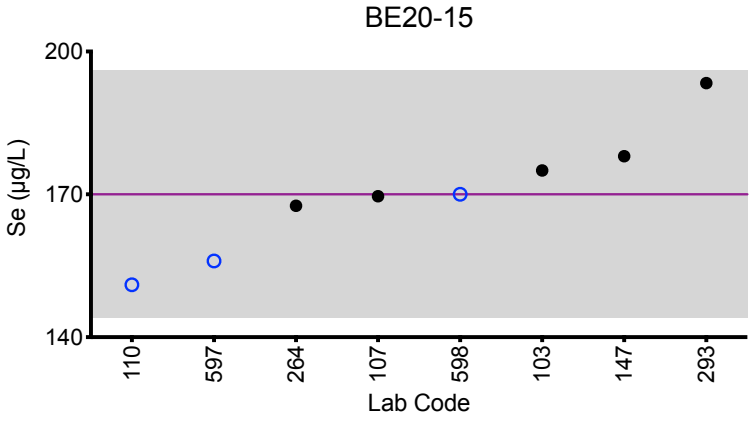
Whole Blood Se











Legend:
o C/HHEAR 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 #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Tl (µg/L)

Lab Code	Method	BE20-11	BE20-12	BE20-13	BE20-14	BE20-15
103	ICP-MS/MS	3.01	0.577	1.44	1.08	0.723
110	ICP-MS	2.98	0.54	1.51	1.07	0.72
147	ICP-MS	2.98	0.583	1.38	1.07	0.715
264	ICP-MS	*2.21	0.41	1.08	*0.75	0.57
293	DRC/CC-ICP-MS	2.79	0.51	1.29	1.01	0.66
597	ICP-MS	2.81	0.559	1.37	1.08	0.70
598	ICP-MS	2.75	0.46	1.32	0.96	0.66

Summary Statistics

	BE20-11	BE20-12	BE20-13	BE20-14	BE20-15
Arithmetic Mean ($\bar{x}$)	2.89	0.52	1.34	1.04	0.68
Arithmetic SD (s)	0.12	0.06	0.14	0.05	0.05
Arithmetic RSD (%)	4.2	12	10	4.8	7.4
Number of Sample Measurements (N)	6	7	7	6	7

*Denotes a statistical Outlier.

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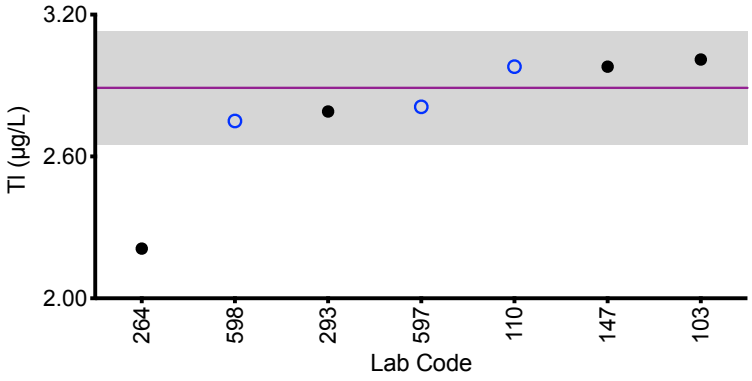
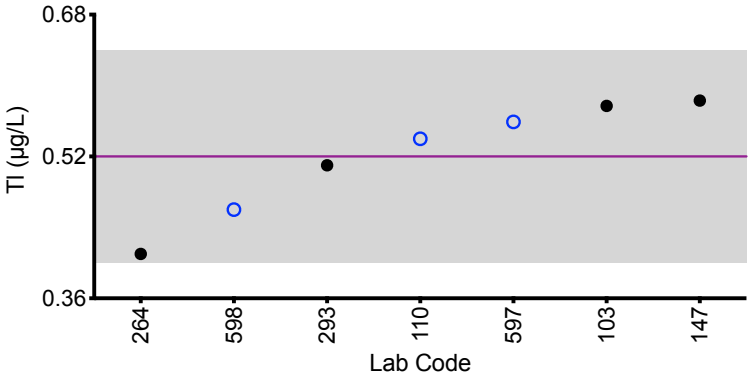
Results for Event #3, 2020: Summary Figures

Whole Blood Tl

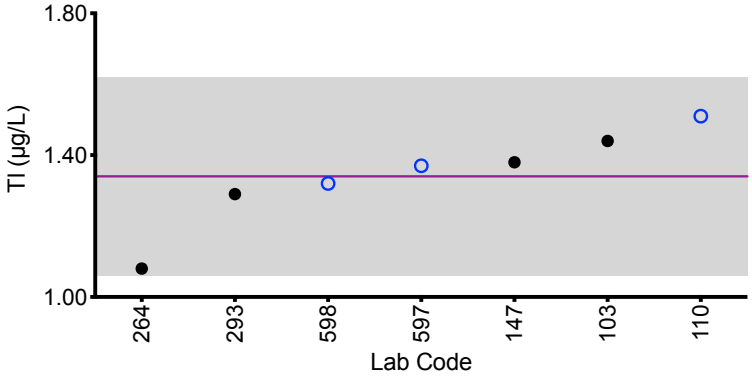
BE20-11



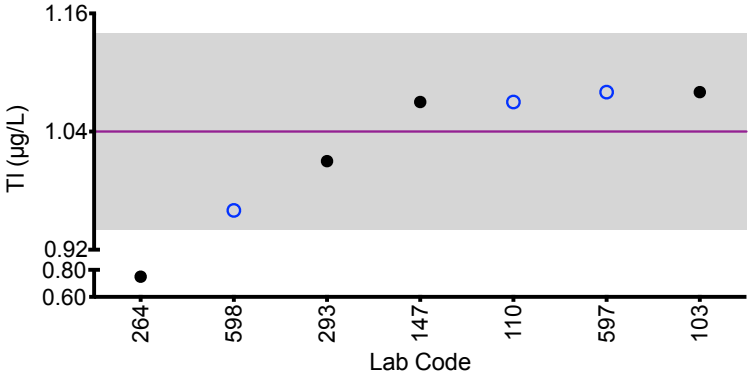
BE20-12



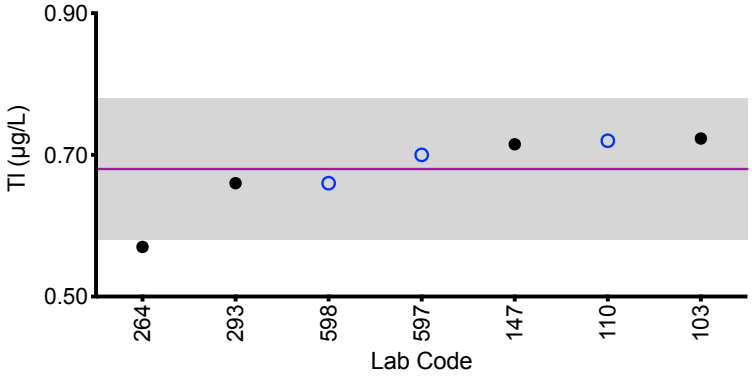
BE20-13



BE20-14



BE20-15



Legend:
o C/HHEAR 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 #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
110	ICP-MS	6.7	10.7	2.8	7.3	4.8
147	ICP-MS	7.13	11.4	3.30	8.67	4.97
597	ICP-MS	6.94	12.8	3.39	8.38	4.56
598	ICP-MS	7.05	11.5	3.47	6.94	4.84
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		6.96	11.6	3.2	7.8	4.79
Arithmetic SD (s)		0.19	0.9	0.3	0.8	0.17
Arithmetic RSD (%)		2.7	7.8	9.4	10	3.5
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
110	ICP-MS	3.24	4.24	0.499	1.98	1.48
147	ICP-MS	2.95	4.37	<1.17	2.02	1.48
597	ICP-MS	2.86	3.93	0.650	1.98	1.31
598	ICP-MS	2.96	4.53	0.56	1.84	1.41
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		3.00	4.3	0.57	1.96	1.42
Arithmetic SD (s)		0.16	0.2	0.08	0.08	0.08
Arithmetic RSD (%)		5.3	5.9	14	4.1	5.6
Number of Sample Measurements (N)		4	4	3	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
110	ICP-MS	0.92	0.88	1.60	0.89	1.69
597	ICP-MS	0.974	0.977	1.80	1.08	1.69
598	ICP-MS	0.91	0.89	1.76	0.87	1.69
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		0.93	0.92	1.72	0.95	1.69
Arithmetic SD (s)		0.03	0.05	0.11	0.12	0.00
Arithmetic RSD (%)		3.2	5.4	6.4	13	0.0
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
110	ICP-MS	1220	2170	2440	1810	1380
147	ICP-MS	1175	2319	2465	1792	1366
597	ICP-MS	1140	2040	2400	1780	1250
598	ICP-MS	1100	2020	2200	1600	1200
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		1160	2140	2380	1750	1300
Arithmetic SD (s)		50	140	120	100	90
Arithmetic RSD (%)		4.3	6.5	5.1	5.7	6.9
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
110	DRC/CC-ICP-MS	12.8	3.12	8.12	1.26	6.09
147	ICP-MS	12.9	2.81	7.93	1.05	4.90
597	ICP-MS	13.1	2.24	7.81	0.801	4.30
598	ICP-MS	16.2	4.29	9.10	*2.44	5.67
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		13.8	3.1	8.2	1.0	5.2
Arithmetic SD (s)		1.6	0.9	0.6	0.2	0.8
Arithmetic RSD (%)		12	29	7.3	22	15
Number of Sample Measurements (N)		4	4	4	3	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Pt (µg/L)

Lab Code	Method	BE20-11	BE20-12	BE20-13	BE20-14	BE20-15
110	ICP-MS	3.29	7.75	0.590	5.96	1.26
293	DRC/CC-ICP-MS	3.12	7.15	0.51	5.53	1.14
598	ICP-MS	3.15	6.93	0.55	5.09	1.09

Summary Statistics

	BE20-11	BE20-12	BE20-13	BE20-14	BE20-15
Arithmetic Mean ($\bar{x}$)	3.19	7.3	0.55	5.5	1.16
Arithmetic SD (s)	0.09	0.4	0.04	0.4	0.09
Arithmetic RSD (%)	2.8	5.5	7.3	7.3	7.8
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
110	ICP-MS	8.94	0.801	5.51	3.67	1.24
147	ICP-MS	8.85	1.05	5.63	3.68	1.16
597	ICP-MS	8.77	0.77	5.84	3.90	1.19
598	ICP-MS	9.26	0.89	6.11	3.59	1.31
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		9.0	0.88	5.8	3.71	1.23
Arithmetic SD (s)		0.2	0.13	0.3	0.13	0.07
Arithmetic RSD (%)		2.3	15	4.5	3.5	5.7
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
103	ICP-MS/MS	39.4	39.1	34.8	39.0	35.8
147	ICP-MS	37.9	38.7	33.4	38.2	35.0
597	ICP-MS	35.5	36.5	34.1	39.0	33.1
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		38	38.1	34.1	38.7	34.6
Arithmetic SD (s)		2	1.4	0.7	0.5	1.4
Arithmetic RSD (%)		5.3	3.7	2.1	1.3	4.0
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
103	ICP-MS/MS	0.177	0.156	0.118	0.141	0.373
110	ICP-MS	0.182	0.171	0.125	0.133	0.374
147	ICP-MS	0.176	0.157	0.121	0.128	0.367
598	ICP-MS	0.15	0.13	0.12	0.12	0.32
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		0.171	0.154	0.121	0.131	0.36
Arithmetic SD (s)		0.014	0.017	0.003	0.009	0.03
Arithmetic RSD (%)		8.2	11	2.4	6.9	7.3
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
110	DRC/CC-ICP-MS	8.04	6.19	0.981	4.05	1.62
147	DRC/CC-ICP-MS	7.91	6.74	0.801	4.62	1.35
597	ICP-MS	6.95	5.72	0.712	4.12	1.20
598	DRC/CC-ICP-MS	8.28	6.77	0.86	4.55	1.48
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		7.8	6.4	0.84	4.3	1.41
Arithmetic SD (s)		0.6	0.5	0.11	0.3	0.18
Arithmetic RSD (%)		7.7	7.8	13	6.7	13
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
110	ICP-MS	0.860	1.72	0.628	2.83	0.349
200	ICP-MS	1	1.8	0.7	3.1	0.35
598	ICP-MS	0.84	1.61	0.57	2.87	0.31
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		0.90	1.71	0.63	2.93	0.34
Arithmetic SD (s)		0.09	0.10	0.07	0.15	0.02
Arithmetic RSD (%)		10	5.8	11	5.1	6.8
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
110	ICP-MS	4980	4000	6340	4430	7050
147	ICP-MS	4830	4085	6732	4386	7320
597	ICP-MS	5100	4150	6870	4700	6950
598	ICP-MS	4000	3300	5300	3400	5400
Summary Statistics						
		BE20-11	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
Arithmetic Mean ($\bar{x}$)		4700	3900	6300	4200	6700
Arithmetic SD (s)		500	400	700	600	900
Arithmetic RSD (%)		11	10	11	14	13
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
147	ICP-MS	<0.302	<0.302	<0.302	<0.302	<0.302

Whole Blood Al (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
147	ICP-MS	<5.13	<5.13	<5.13	<5.13	<5.13
597	ICP-MS	<20	23.5	<20	31.3	<20

Whole Blood Bi (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
147	ICP-MS	<0.0334	<0.0334	<0.0334	<0.0334	<0.0334

Whole Blood I (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
147	ICP-MS	37.7	37.3	38.2	36.1	38.7

Whole Blood Li (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
147	ICP-MS	0.749	0.763	0.493	0.750	0.507

Whole Blood Mg (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
597	ICP-MS	26000	25000	26400	26600	25800

Whole Blood Te (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
147	ICP-MS	<0.117	<0.117	<0.117	<0.117	<0.117

Whole Blood Th (µg/L)						
Lab Code	**Method**	**BE20-11**	**BE20-12**	**BE20-13**	**BE20-14**	**BE20-15**
147	ICP-MS	<0.0278	<0.0278	<0.0278	<0.0278	<0.0278

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Event #3, 2020

Trace Elements in Urine

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Trace Elements Laboratory

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Event #3, 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 21 elements were reported by at least one participant: Ag, Al, B, Bi, Cs, Cu, 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 #3, 2020: Summary Statistics

	Urine As (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	33.9	118	49	5.4	185
Upper Limit	40.7	142	59	11.4	222
Lower Limit	27.1	94	39	0.0	148
Robust SD (s*)	2.9	9	5	0.4	15
Robust RSD (%)	8.6	7.6	10	8.2	8.1
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (*u*)	0.9	3	2	0.1	5

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 #3, 2020:
Performance of Participating Laboratories

Urine As (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**33.9**	**118**	**49**	**5.4**	**185**
103	ICP-MS/MS	34.2	119	51.0	5.15	188
107	DRC/CC-ICP-MS	29.67	102.07	34.91 ↓	4.10	160.77
110	DRC/CC-ICP-MS	36.5	124	53.4	5.66	197
116	ICP-MS/MS	33.5	115	49.7	5.55	178
147	ICP-MS	35.4	120	52.0	5.71	193
220	DRC/CC-ICP-MS	38.2	126	54.9	5.90	204
264	ICP-MS	35.45	122.83	50.24	5.42	185.87
293	DRC/CC-ICP-MS	32.43	112.48	47.08	5.21	173.39
391	ICP-MS	31.57	144.18 ↑	43.75	9.1	294.49 ↑
399	DRC/CC-ICP-MS	30.1	106	44.2	4.83	168
597	ICP-MS	30.7	112	46.4	4.82	171
598	DRC/CC-ICP-MS	37.7	129	56.3	5.67	199
605	ICP-MS	35.2	121	52.1	5.11	189
606	ICP-MS/MS	32.7	112	48.6	5.23	183
676	DRC/CC-ICP-MS	34.9	113	46.3	5.59	178

Based on the grading criteria for As in Urine, 96% of results were satisfactory, with 1 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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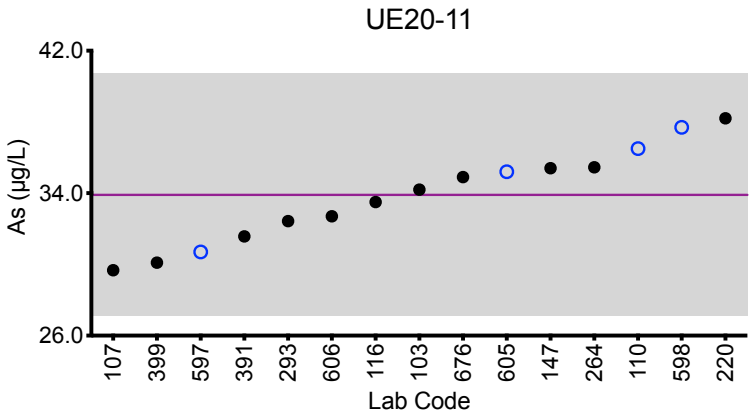
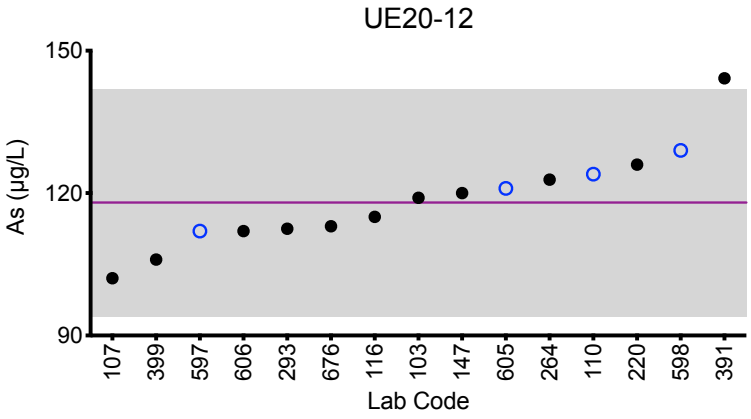
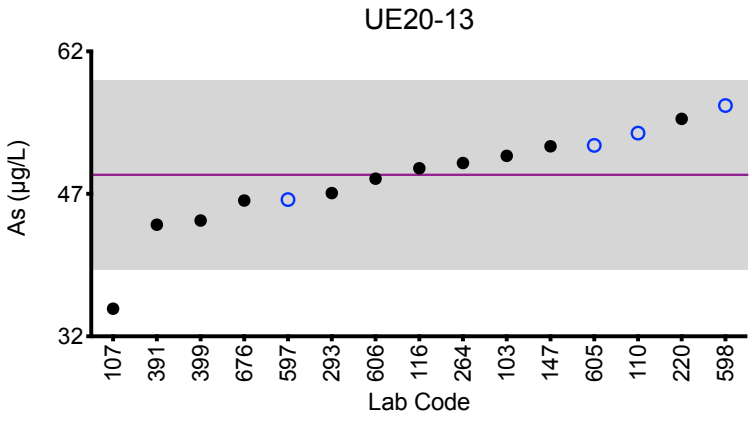
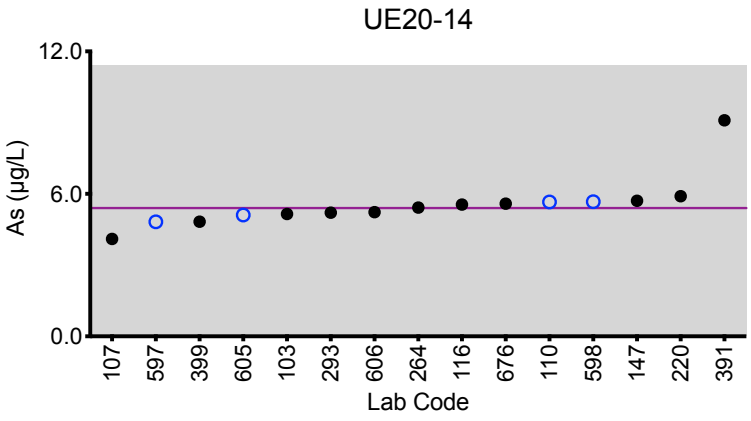
Results for Event #3, 2020: Summary Figures

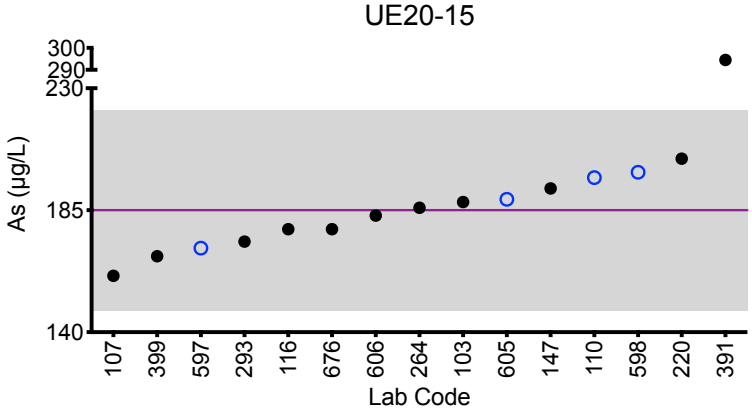
Urine As











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Urine Ba (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	4.9	11.3	0.50	2.64	8.1
Upper Limit	5.9	13.6	1.50	3.64	9.7
Lower Limit	3.9	9.0	0.00	1.64	6.5
Robust SD (s*)	0.3	0.5	0.03	0.18	0.7
Robust RSD (%)	6.3	4.4	6.2	6.8	8.6
Number of Sample Measurements (N)	13	13	11	13	13
Standard Uncertainty (*u*)	0.1	0.2	0.01	0.06	0.3

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 #3, 2020:
Performance of Participating Laboratories

		Urine Ba (µg/L)				
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**4.9**	**11.3**	**0.50**	**2.64**	**8.1**
107	ICP-MS	4.873	11.045	0.536	2.423	7.560
110	ICP-MS	5.28	12.1	0.53	2.88	8.63
116	ICP-MS/MS	4.11	9.34	0.504	2.05	6.57
147	ICP-MS	5.03	11.1	<0.673	2.72	9.38
220	ICP-MS	5.12	11.5	0.51	2.76	8.35
264	ICP-MS	4.58	10.56	0.46	2.45	7.38
399	ICP-MS/MS	5.08	11.6	0.517	2.71	8.28
597	ICP-MS	4.61	11.7	0.516	2.74	8.16
598	ICP-MS	5.03	11.3	0.49	2.54	7.83
605	ICP-MS	5.05	11.3	<0.600	2.61	8.07
606	ICP-MS/MS	4.82	11.3	0.285	2.71	8.48
607	ICP-MS	5.36	12.0	0.531	2.83	8.77
676	ICP-MS	4.31	9.43	0.423	2.36	6.81

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

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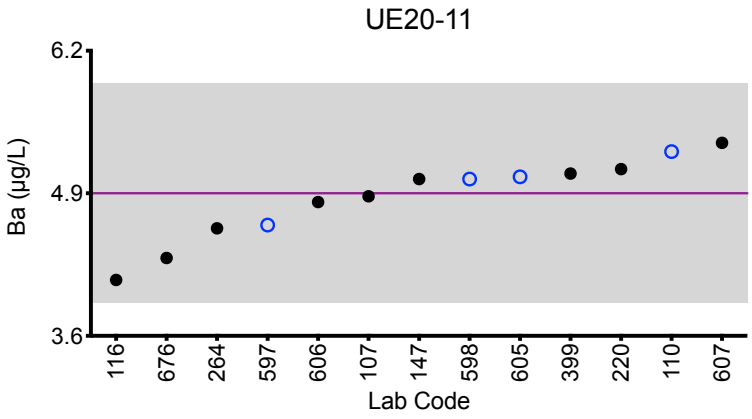
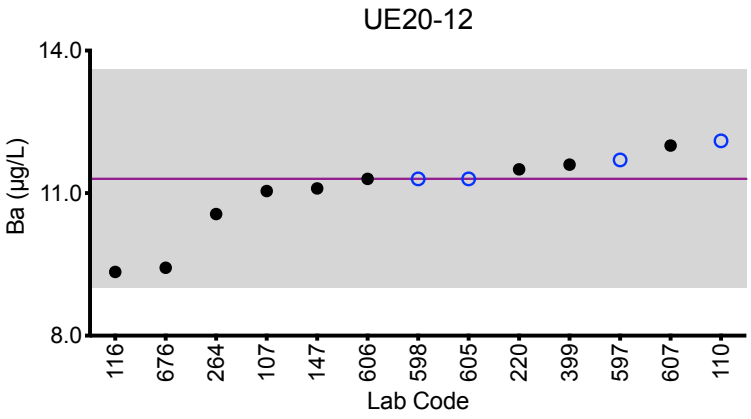
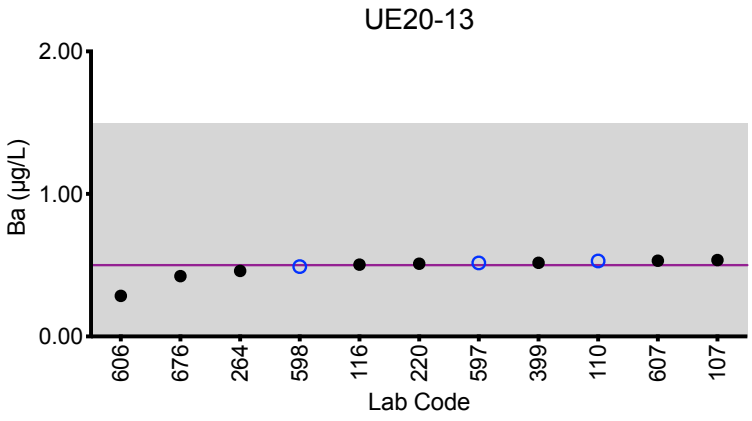
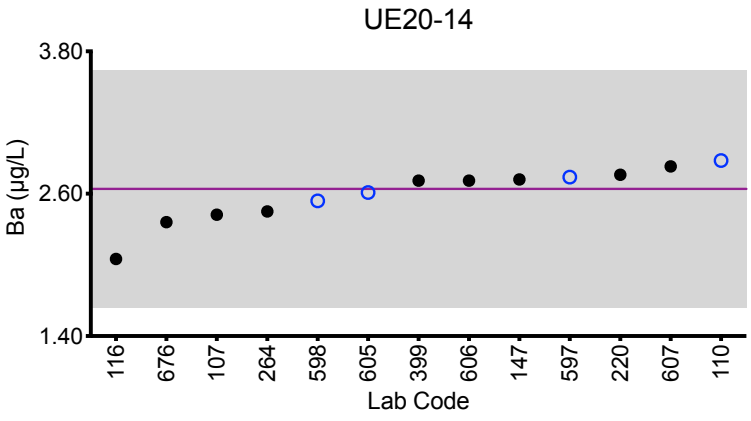
Results for Event #3, 2020: Summary Figures

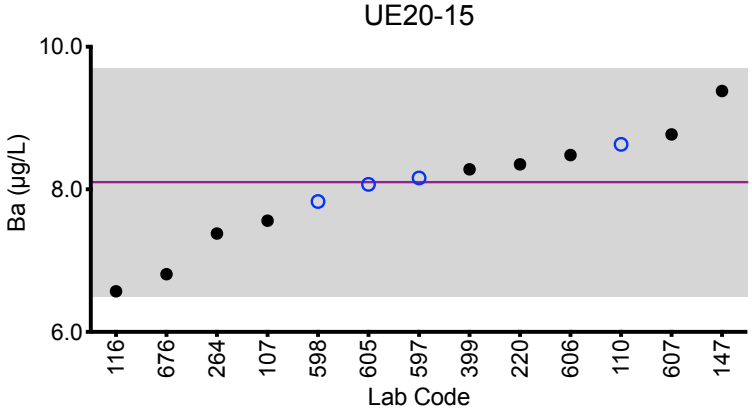
Urine Ba











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Urine Be (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	6.6	1.93	5.5	0.83	4.2
Upper Limit	7.9	2.93	6.6	1.83	5.2
Lower Limit	5.3	0.93	4.4	0.00	3.2
Robust SD (s*)	0.4	0.08	0.3	0.06	0.3
Robust RSD (%)	6.2	4.1	5.6	7.2	7.5
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (*u*)	0.1	0.03	0.1	0.02	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 #3, 2020:
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**6.6**	**1.93**	**5.5**	**0.83**	**4.2**
107	ICP-MS	6.371	1.858	5.333	0.786	3.814
110	ICP-MS	6.58	1.98	5.86	0.857	4.35
116	ICP-MS/MS	6.59	1.89	5.38	0.803	4.14
147	ICP-MS	7.44	2.11	6.18	0.916	4.61
220	ICP-MS	6.63	1.86	5.48	0.80	4.14
264	ICP-MS	6.37	1.86	5.31	0.80	3.96
293	ICP-MS	6.83	1.93	5.5	0.84	4.5
399	ICP-MS/MS	6.90	1.99	5.57	0.880	4.19
597	ICP-MS	5.84	1.93	4.95	0.71	3.75
598	ICP-MS	6.44	1.91	5.38	0.82	4.18
605	ICP-MS	7.11	2.00	5.93	0.869	4.37
607	ICP-MS	6.98	1.98	5.82	0.904	4.28
676	ICP-MS	5.79	1.61	4.75	0.746	3.45

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

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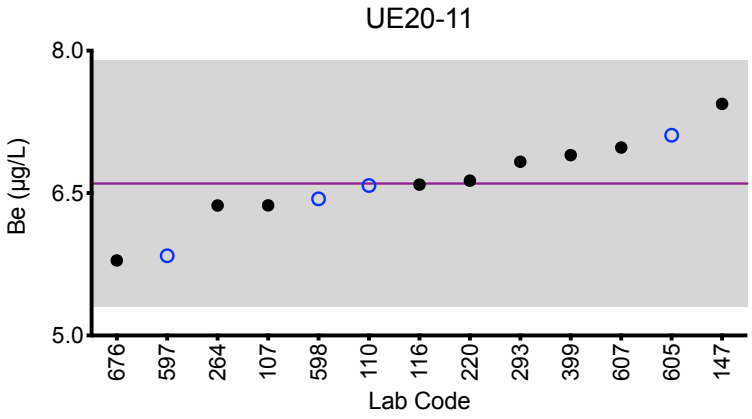
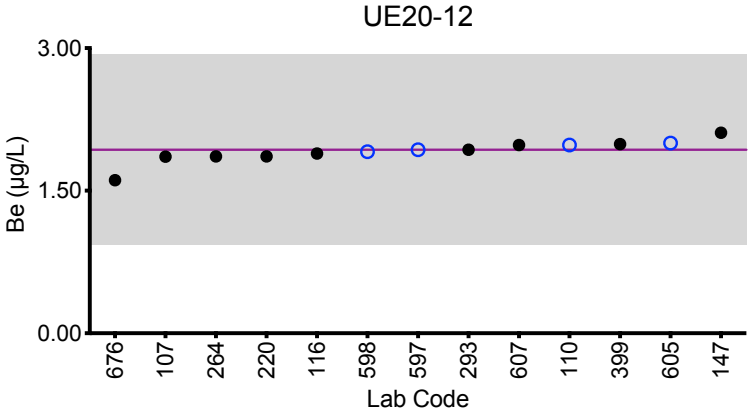
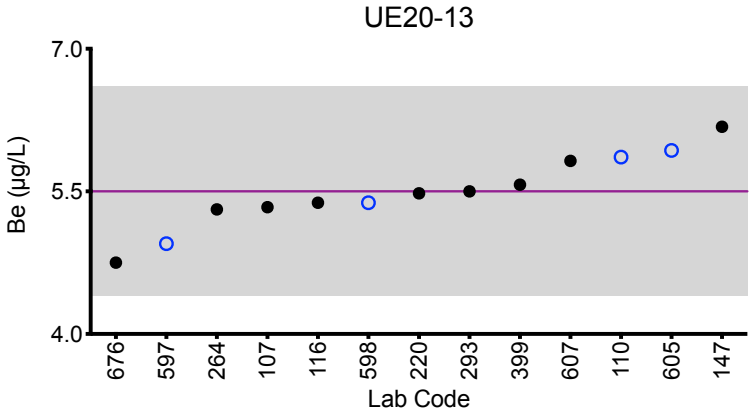
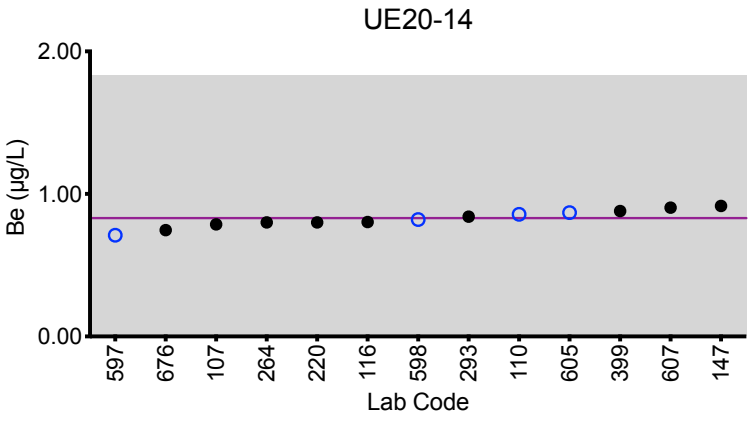
Results for Event #3, 2020: Summary Figures

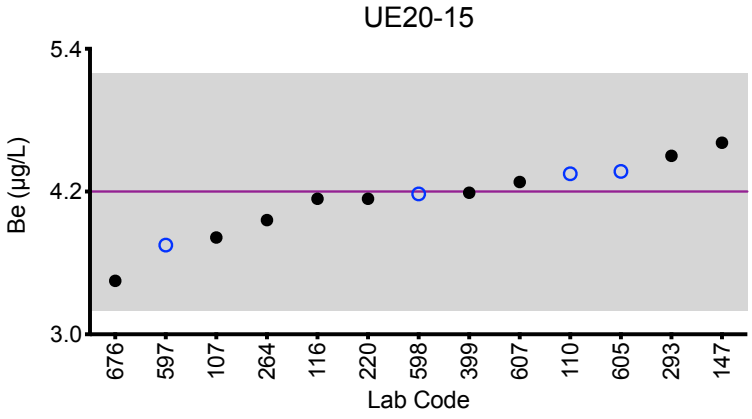
Urine Be











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Urine Cd (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	0.87	3.43	2.12	0.460	5.51
Upper Limit	1.87	4.43	3.12	1.460	6.51
Lower Limit	0.00	2.43	1.12	0.000	4.51
Robust SD (s*)	0.05	0.14	0.12	0.027	0.30
Robust RSD (%)	5.3	4.1	5.7	5.9	5.4
Number of Sample Measurements (N)	16	16	16	16	16
Standard Uncertainty (*u*)	0.01	0.04	0.04	0.009	0.09

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 #3, 2020:
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**0.87**	**3.43**	**2.12**	**0.460**	**5.51**
103	ICP-MS/MS	0.928	3.54	2.24	0.475	5.86
107	DRC/CC-ICP-MS	0.860	3.466	2.192	0.434	5.346
110	ICP-MS	0.850	3.47	2.16	0.487	5.54
116	ICP-MS/MS	0.821	3.26	2.24	0.435	5.51
147	ICP-MS	0.891	3.52	2.28	0.471	5.90
220	ICP-MS	0.92	3.25	2.12	0.48	5.45
264	ICP-MS	0.91	3.83	2.27	0.48	6.14
293	DRC/CC-ICP-MS	0.91	3.58	2.12	0.48	5.78
391	ICP-MS	0.76	3.13	1.87	0.33	5.21
399	DRC/CC-ICP-MS	0.881	3.52	2.14	0.407	5.68
597	ICP-MS	0.81	3.45	2.02	0.473	5.39
598	DRC/CC-ICP-MS	0.85	3.48	2.11	0.47	5.22
605	ICP-MS	0.882	3.44	2.16	0.447	5.56
606	ICP-MS/MS	0.828	3.22	2.03	0.441	5.49
607	ICP-MS	0.881	3.37	2.03	0.635	5.25
676	DRC/CC-ICP-MS	0.924	3.10	1.94	0.441	5.07

Based on the grading criteria for Cd 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.

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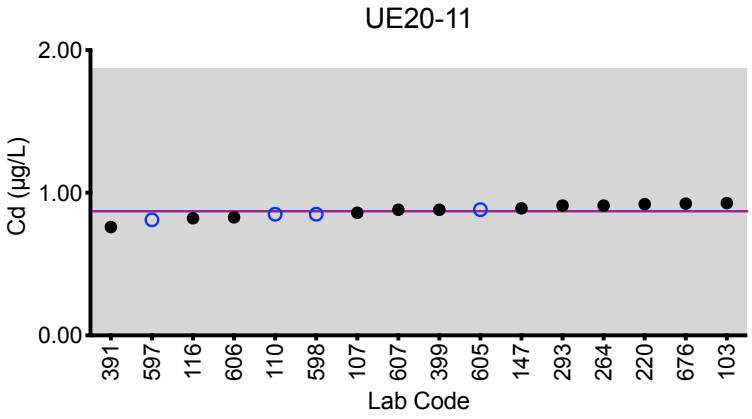
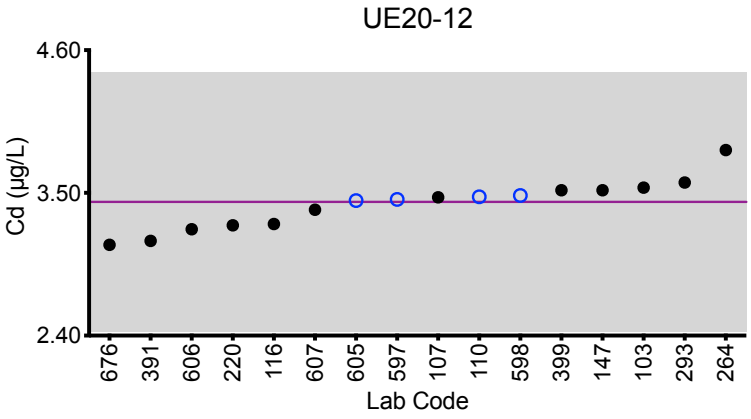
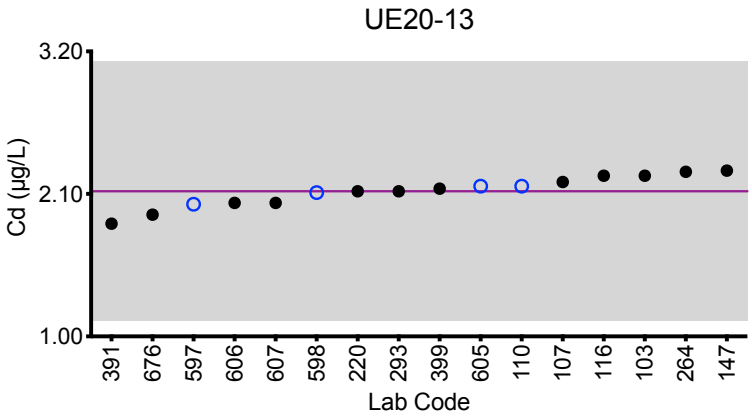
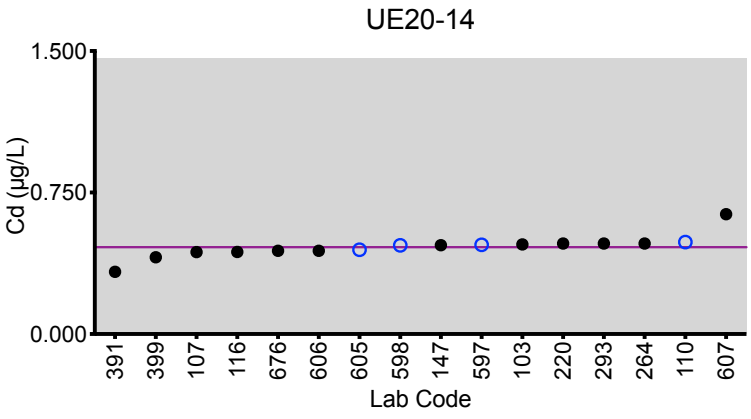
Results for Event #3, 2020: Summary Figures

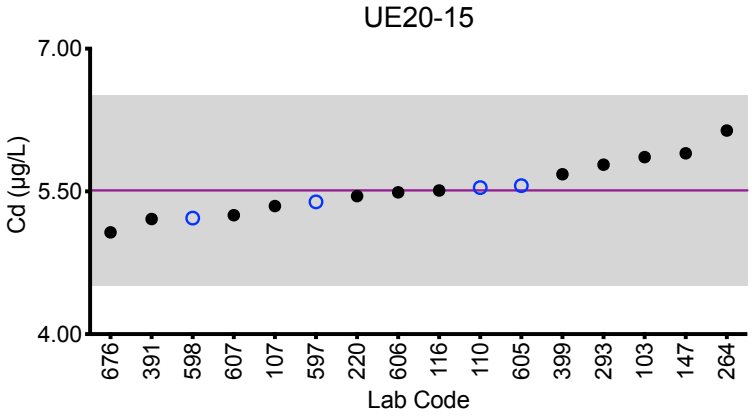
Urine Cd











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Urine Co (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	6.6	1.53	5.12	0.65	3.13
Upper Limit	8.1	3.03	6.62	2.15	4.63
Lower Limit	5.1	0.03	3.62	0.00	1.63
Robust SD (s*)	0.4	0.05	0.27	0.05	0.17
Robust RSD (%)	6.3	3.3	5.3	7.7	5.4
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.1	0.02	0.09	0.02	0.06

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 #3, 2020:
Performance of Participating Laboratories

		Urine Co (µg/L)				
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**6.6**	**1.53**	**5.12**	**0.65**	**3.13**
103	ICP-MS/MS	6.94	1.58	5.31	0.636	3.18
107	ICP-MS	6.751	1.542	5.236	0.620	3.062
110	ICP-MS	7.22	1.72	5.75	0.769	3.52
147	ICP-MS	6.55	1.51	5.15	0.648	3.18
220	ICP-MS	6.89	1.57	5.37	0.71	3.32
264	ICP-MS	6.45	1.48	5.12	0.64	3.10
293	DRC/CC-ICP-MS	6.59	1.55	4.92	0.61	3.12
391	ICP-MS	5.63	1.1	4.41	0.56	2.25
399	DRC/CC-ICP-MS	6.84	1.53	5.23	0.658	3.31
597	ICP-MS	6.03	1.56	4.85	0.68	2.95
598	ICP-MS	6.63	1.55	5.33	0.72	3.16
605	ICP-MS	6.67	1.52	5.18	0.645	3.22
606	ICP-MS/MS	6.22	1.35	4.95	0.380	3.02
676	ICP-MS	5.88	1.34	4.54	0.615	2.78

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.

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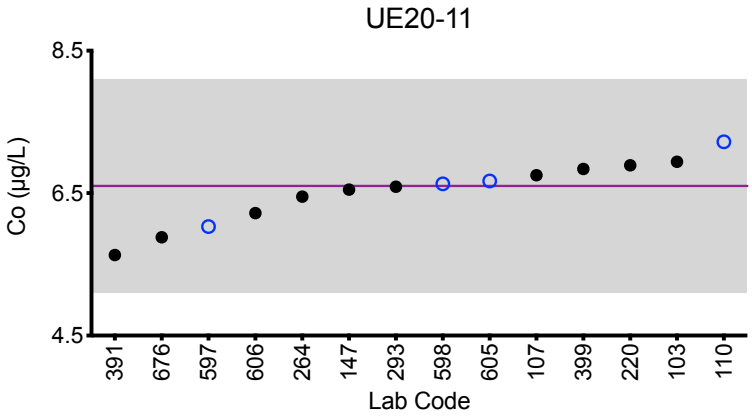
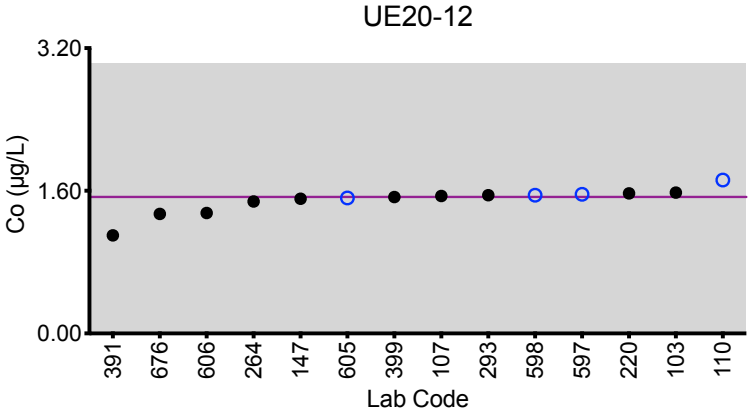
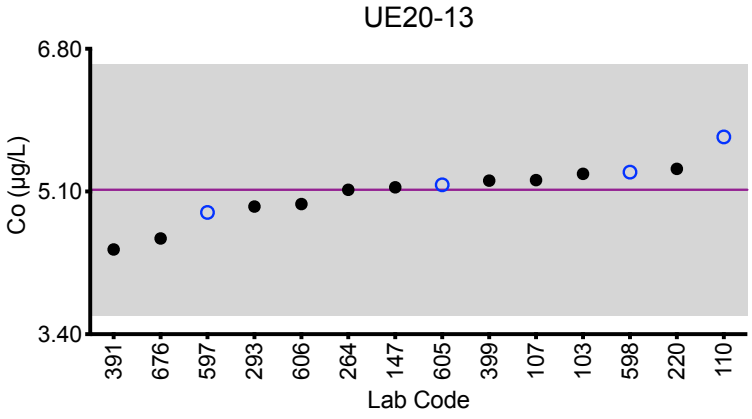
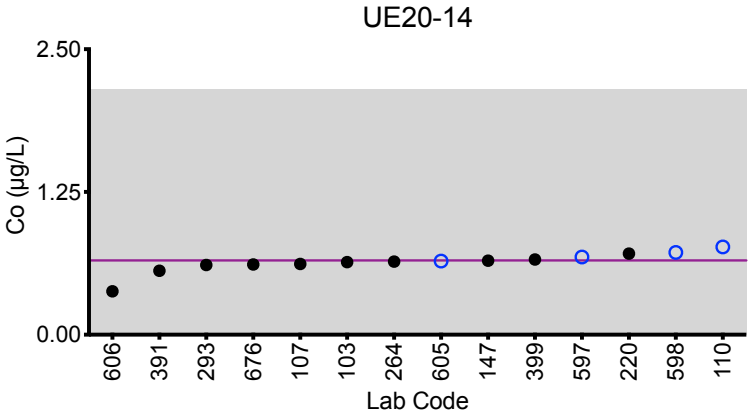
Results for Event #3, 2020: Summary Figures

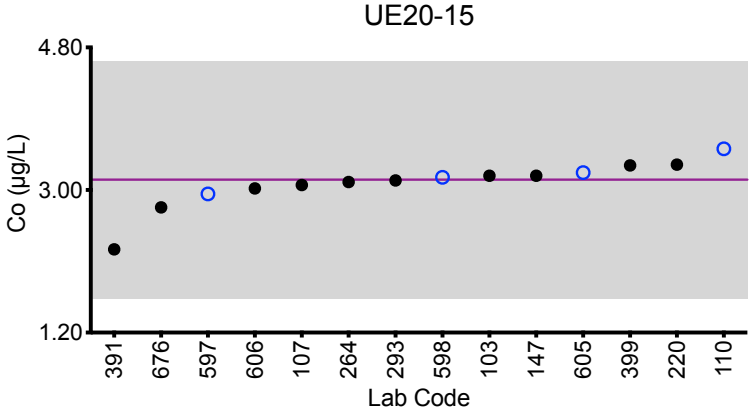
Urine Co











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Urine Cr (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	17.5	2.69	13.0	0.73	5.7
Upper Limit	21.0	5.69	16.0	3.73	8.7
Lower Limit	14.0	0.00	10.0	0.00	2.7
Robust SD (s*)	1.1	0.14	1.0	0.10	0.4
Robust RSD (%)	6.3	5.2	7.7	13	7.2
Number of Sample Measurements (N)	11	11	11	9	11
Standard Uncertainty (*u*)	0.4	0.05	0.4	NA	0.2

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

An arithmetic mean, SD, RSD and n are provided for sample UE20-14.

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Results for Event #3, 2020:
Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**17.5**	**2.69**	**13.0**	**0.73**	**5.7**
103	ICP-MS/MS	17.4	2.64	12.9	<1.00	5.92
107	DRC/CC-ICP-MS	14.77	2.48	11.63	0.65	5.12
110	DRC/CC-ICP-MS	18.2	2.83	13.7	0.92	6.00
116	ICP-MS/MS	17.4	2.71	13.2	0.622	5.63
147	DRC/CC-ICP-MS	18.7	2.79	13.9	0.755	6.03
264	ICP-MS	16.54	2.65	12.41	0.79	5.52
293	DRC/CC-ICP-MS	17.26	2.67	12.36	0.66	5.57
391	ICP-MS	18.28	2.84	14.32	0.83	5.8
597	ICP-MS	16.7	2.23	12.2	<0.75	5.15
598	DRC/CC-ICP-MS	19.1	2.78	14.2	0.68	6.51
605	ICP-MS	17.4	2.69	12.7	0.684	5.54

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

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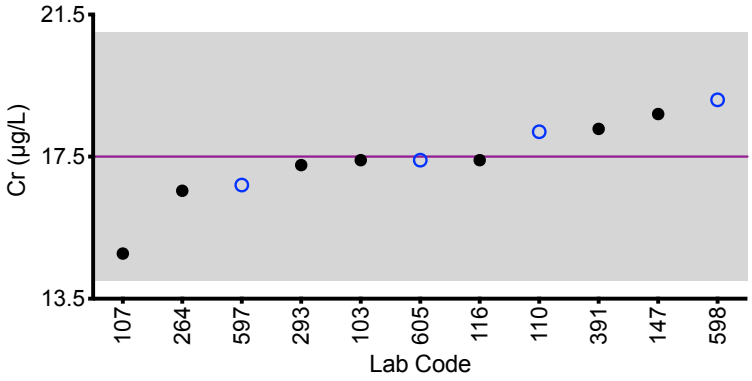
Results for Event #3, 2020: Summary Figures

Urine Cr

UE20-11



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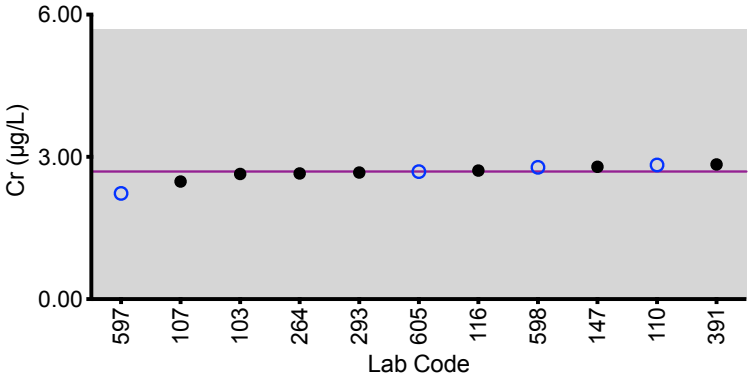

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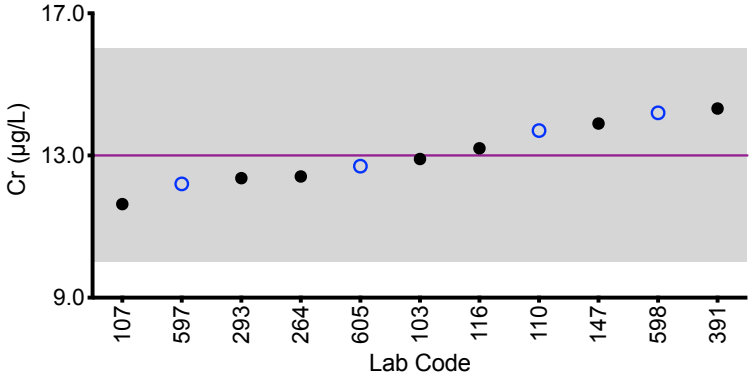
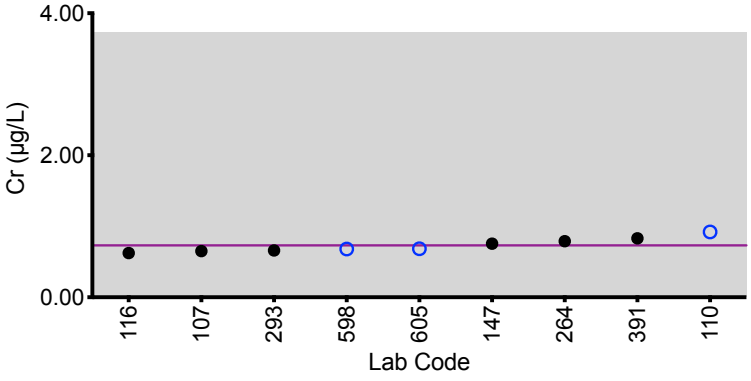
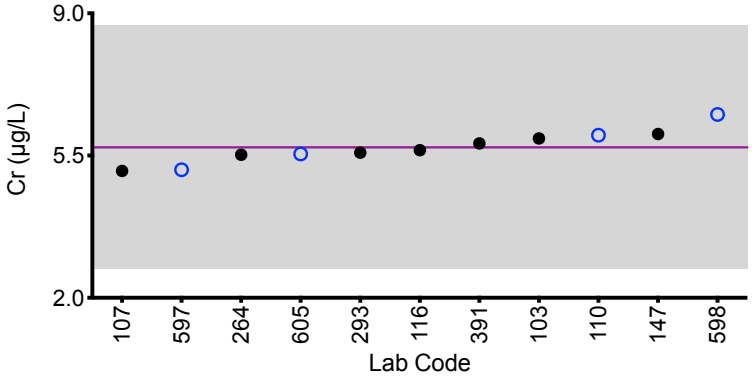


UE20-14



UE20-15



Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Urine Hg (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	4.2	26	9.2	1.65	0.7
Upper Limit	7.2	34	12.2	4.65	3.7
Lower Limit	1.2	18	6.2	0.00	0.0
Robust SD (s*)	0.6	5	1.0	0.27	0.2
Robust RSD (%)	14	19	11	16	35
Number of Sample Measurements (N)	12	12	13	13	10
Standard Uncertainty (*u*)	0.2	2	0.3	0.09	0.1

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

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Results for Event #3, 2020:
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**4.2**	**26**	**9.2**	**1.65**	**0.7**
103	ICP-MS/MS	4.21	26.1	9.57	1.73	0.667
107	DRC/CC-ICP-MS	4.21	19.06	9.17	1.53	0.54
110	ICP-MS	4.94	27.7	9.37	2.03	0.820
116	ICP-MS/MS	3.38	21.1	7.47	1.41	<1.00
147	ICP-MS	4.04	25.3	9.28	1.44	0.376
264	ICP-MS	16.35 ↑	38.88 ↑	15.77 ↑	2.79	1.08
293	DRC/CC-ICP-MS	4.13	27.44	9.86	1.61	0.55
391	ICP-MS	3.47	45.21 ↑	7.19	5.2 ↑	1.77
597	ICP-MS	4.29	26.3	9.18	1.61	0.709
598	ICP-MS	3.88	22.7	8.32	1.48	0.76
605	ICP-MS	4.59	29.1	10.2	1.79	<1.00
606	ICP-MS/MS	<1.00 ↓	<1.00 ↓	9.78	1.59	<1.00
676	ICP-MS	3.74	21.3	7.74	1.24	0.456

Based on the grading criteria for Hg in Urine, 89% of results were satisfactory, with 3 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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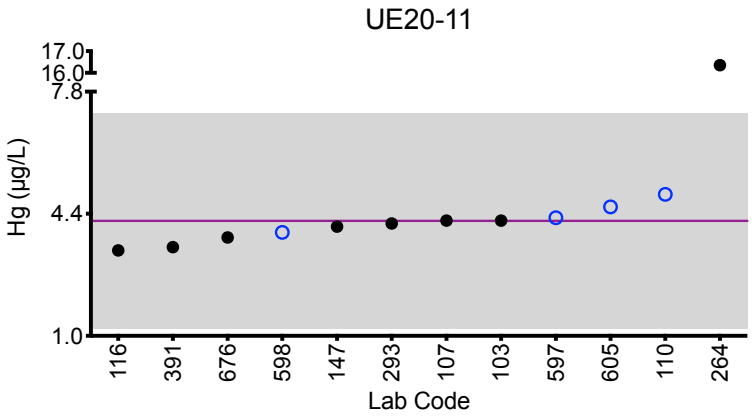
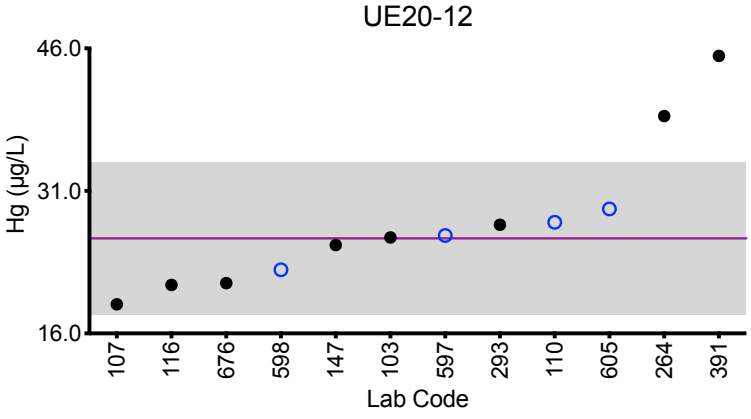
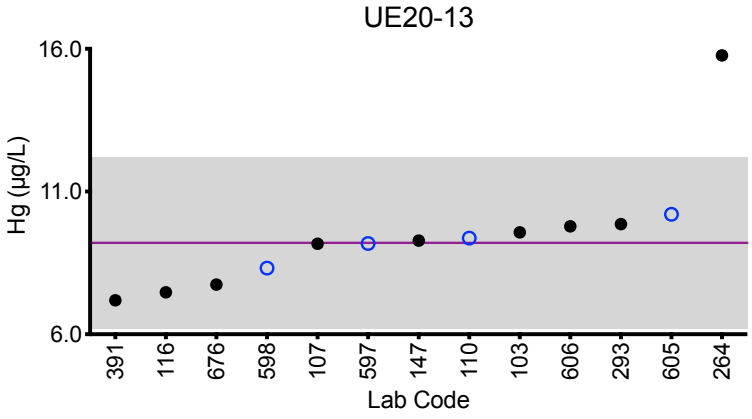
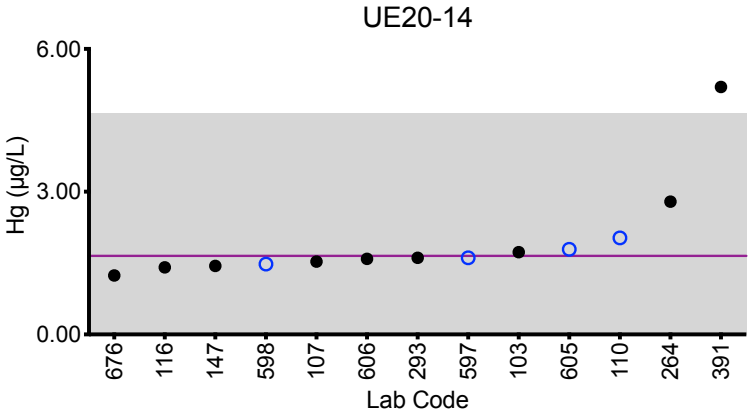
Results for Event #3, 2020: Summary Figures

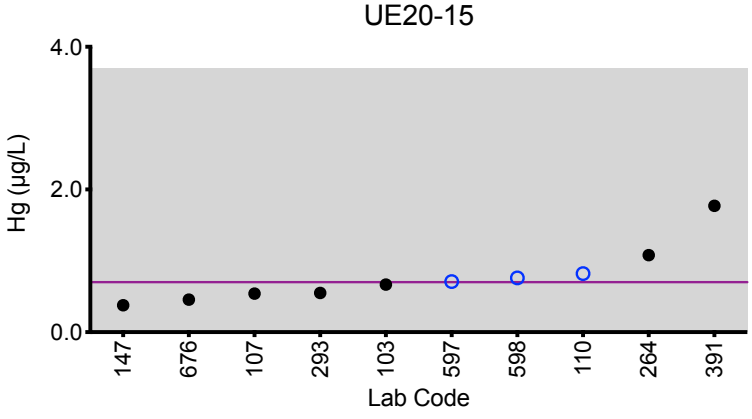
Urine Hg











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Urine Mn (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	4.84	9.4	6.27	1.21	2.92
Upper Limit	6.05	11.8	7.84	1.76	3.65
Lower Limit	3.63	7.0	4.70	0.66	2.19
Robust SD (s*)	0.18	0.4	0.24	0.08	0.17
Robust RSD (%)	3.7	4.2	3.8	6.6	5.8
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (*u*)	0.06	0.1	0.08	0.03	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 #3, 2020:
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**4.84**	**9.4**	**6.27**	**1.21**	**2.92**
103	ICP-MS/MS	4.89	9.62	6.27	1.30	3.02
107	DRC/CC-ICP-MS	4.858	9.539	6.315	1.167	2.756
110	DRC/CC-ICP-MS	5.19	9.91	6.63	1.29	3.05
116	ICP-MS/MS	4.68	9.08	6.31	1.06	2.80
147	DRC/CC-ICP-MS	4.86	9.21	6.09	1.39	3.10
220	DRC/CC-ICP-MS	4.94	9.40	6.43	1.21	3.05
264	ICP-MS	4.74	9.24	6.15	1.25	2.93
293	DRC/CC-ICP-MS	5.74	10.06	6.28	1.18	2.93
391	ICP-MS	3.72	7.43	5.14	0.64 ↓	1.82 ↓
399	DRC/CC-ICP-MS	4.99	9.86	6.40	1.19	3.10
597	ICP-MS	4.33	8.95	5.75	1.25	2.74
598	ICP-MS	4.77	9.32	6.43	1.27	2.84
605	ICP-MS	4.93	9.52	6.22	1.18	2.91
606	ICP-MS/MS	4.74	9.28	6.03	1.20	3.16
676	DRC/CC-ICP-MS	4.79	8.93	6.65	1.12	2.81

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

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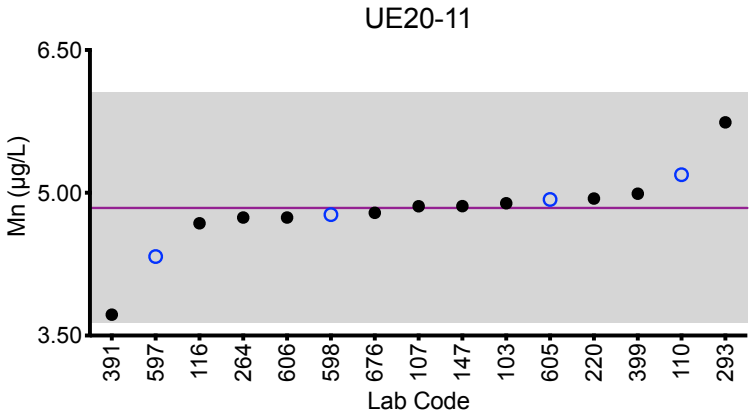
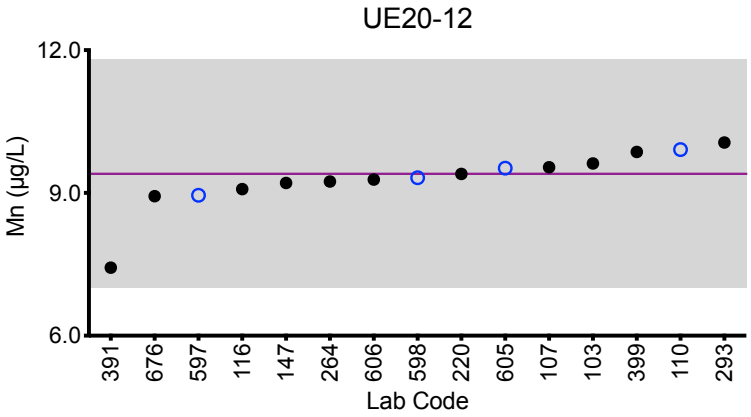
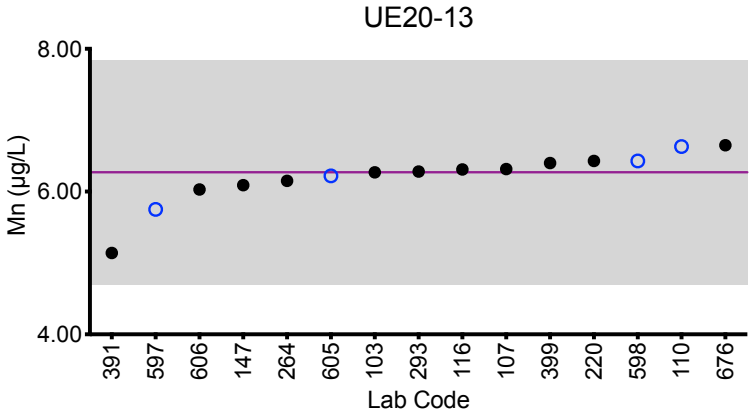
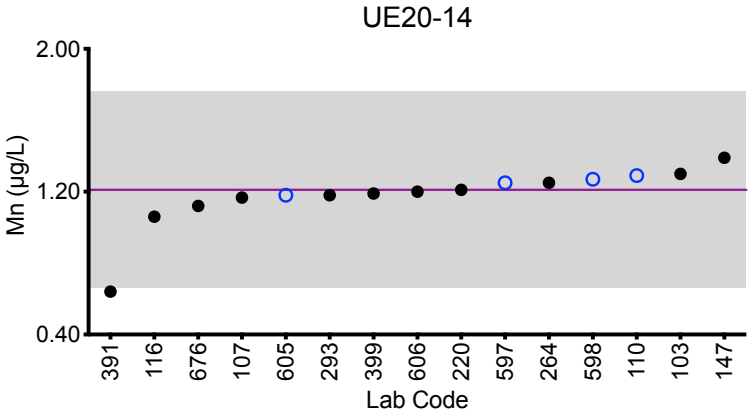
Results for Event #3, 2020: Summary Figures

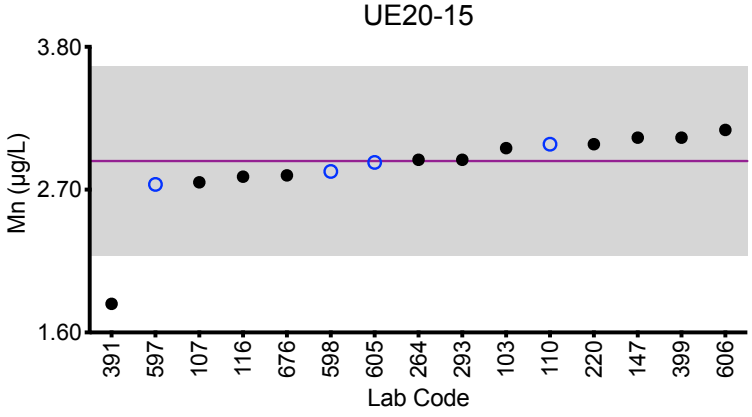
Urine Mn











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Urine Pb (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	4.61	2.86	13.9	0.34	1.19
Upper Limit	5.61	3.86	16.7	1.34	2.19
Lower Limit	3.61	1.86	11.1	0.00	0.19
Robust SD (s*)	0.19	0.20	0.8	0.03	0.08
Robust RSD (%)	4.1	7.0	5.8	9.5	6.7
Number of Sample Measurements (N)	16	16	16	15	16
Standard Uncertainty (*u*)	0.06	0.06	0.2	0.01	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 #3, 2020:
Performance of Participating Laboratories

		Urine Pb (µg/L)				
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**4.61**	**2.86**	**13.9**	**0.34**	**1.19**
103	ICP-MS/MS	4.78	2.94	14.1	0.341	1.20
107	ICP-MS	4.717	2.899	14.781	0.342	1.151
110	ICP-MS	4.69	2.89	14.6	0.33	1.20
116	ICP-MS/MS	4.71	3.78	14.5	0.368	1.30
147	ICP-MS	4.79	3.01	14.6	0.380	1.28
220	ICP-MS	4.66	2.76	13.9	0.29	1.13
264	ICP-MS	4.70	3.06	14.28	0.33	1.20
293	ICP-MS	4.61	3.03	13.52	0.36	1.25
391	ICP-MS	3.92	2.34	12.41	0	0.82
399	ICP-MS/MS	4.60	2.76	13.6	0.317	1.16
597	ICP-MS	4.34	2.81	13.7	0.314	1.17
598	ICP-MS	4.06	2.58	12.0	0.46	1.45
605	ICP-MS	4.56	2.84	14.1	<0.300	1.13
606	ICP-MS/MS	4.48	2.77	13.6	0.322	1.16
607	ICP-MS	4.94	3.02	15.0	0.342	1.23
676	ICP-MS	4.20	2.40	12.5	0.339	1.11

Based on the grading criteria for Pb 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.

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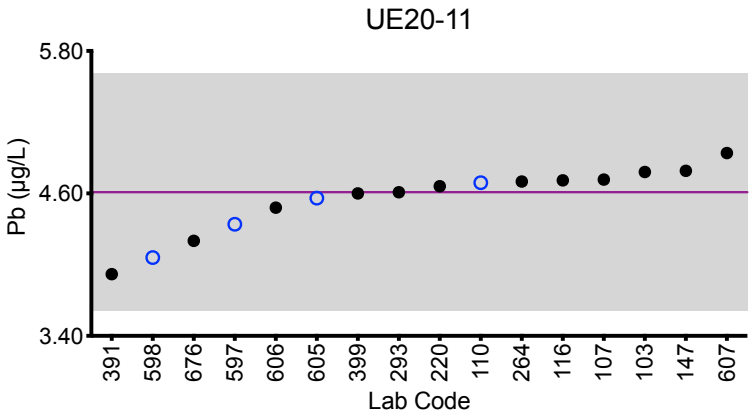
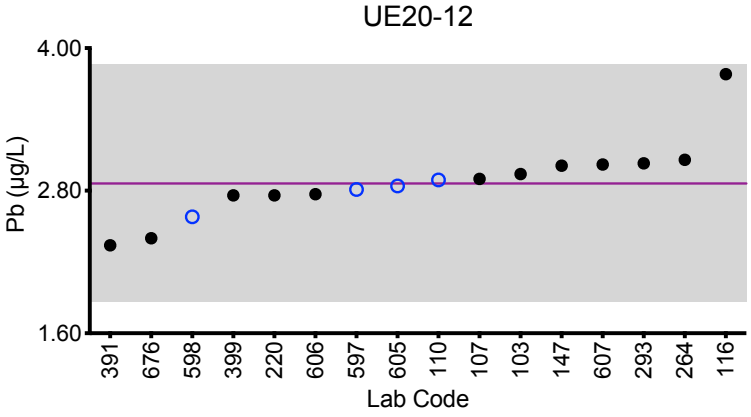
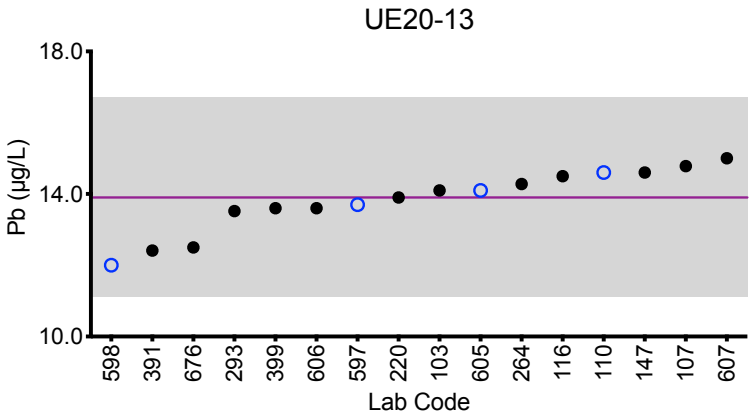
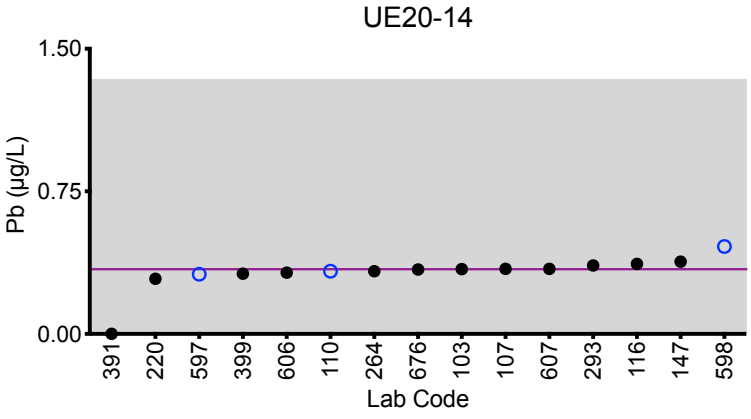
Results for Event #3, 2020: Summary Figures

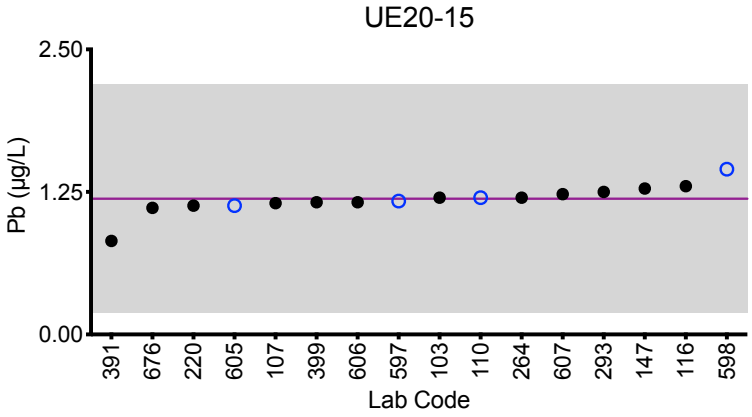
Urine Pb











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

Urine Tl (µg/L)					
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	0.69	4.12	2.58	0.264	1.30
Upper Limit	0.89	4.94	3.10	0.464	1.56
Lower Limit	0.49	3.30	2.06	0.064	1.04
Robust SD (s*)	0.04	0.17	0.09	0.007	0.04
Robust RSD (%)	6.0	4.1	3.5	2.7	3.2
Number of Sample Measurements (N)	16	16	16	16	16
Standard Uncertainty (*u*)	0.01	0.05	0.03	0.002	0.01

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

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Results for Event #3, 2020:
Performance of Participating Laboratories

Urine Tl (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**0.69**	**4.12**	**2.58**	**0.264**	**1.30**
103	ICP-MS/MS	0.687	4.17	2.57	0.278	1.32
107	ICP-MS	0.694	4.211	2.640	0.259	1.283
110	ICP-MS	0.725	4.06	2.60	0.263	1.28
116	ICP-MS/MS	0.687	4.11	2.60	0.265	1.31
147	ICP-MS	0.784	4.59	2.95	0.302	1.48
220	ICP-MS	0.67	3.96	2.56	0.26	1.27
264	ICP-MS	0.70	4.09	2.60	0.26	1.28
293	DRC/CC-ICP-MS	0.77	4.21	2.59	0.3	1.32
391	ICP-MS	0.58	7.39 ↑	2.15	0.59 ↑	2.39 ↑
399	ICP-MS/MS	0.692	4.11	2.59	0.256	1.31
597	ICP-MS	0.664	4.07	2.53	0.280	1.26
598	ICP-MS	0.66	3.60	2.35	0.26	1.13
605	ICP-MS	0.684	4.18	2.66	0.261	1.30
606	ICP-MS/MS	0.650	3.92	2.48	0.261	1.27
607	ICP-MS	0.734	4.33	2.71	0.268	1.35
676	ICP-MS	0.580	3.49	2.31	0.185	1.08

Based on the grading criteria for Tl in Urine, 96% of results were satisfactory, with 1 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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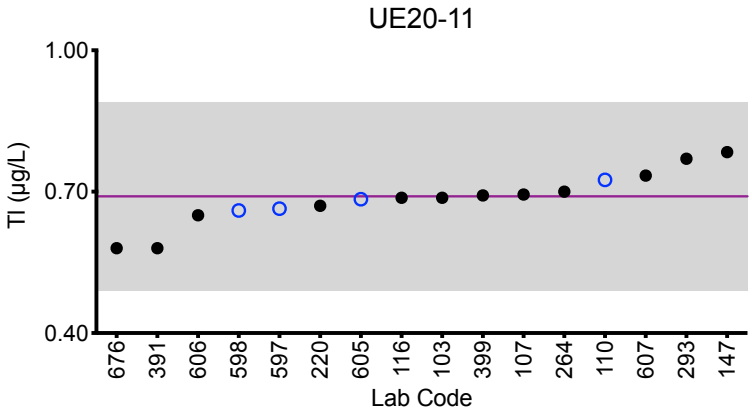
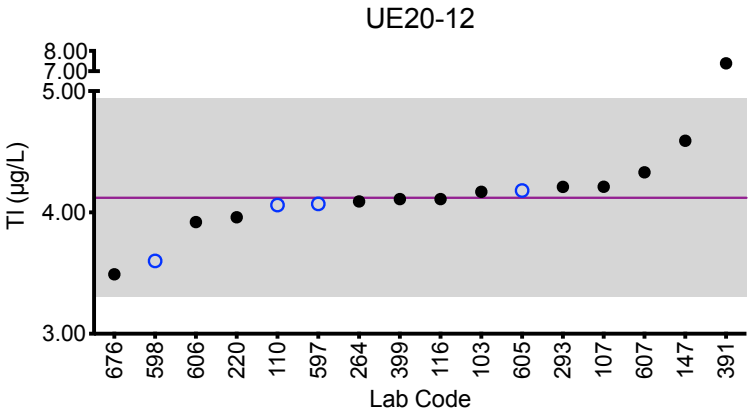
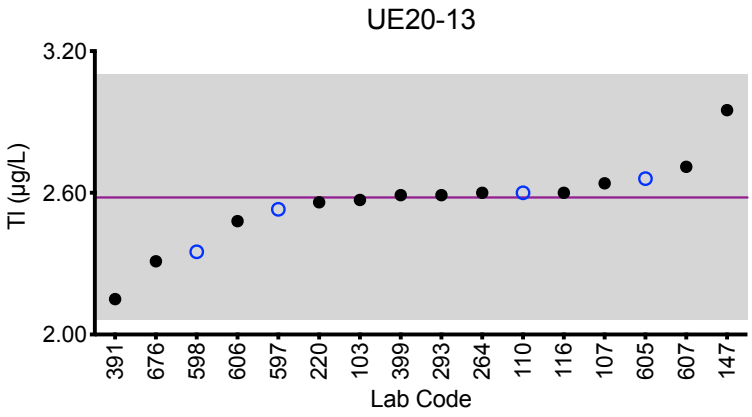
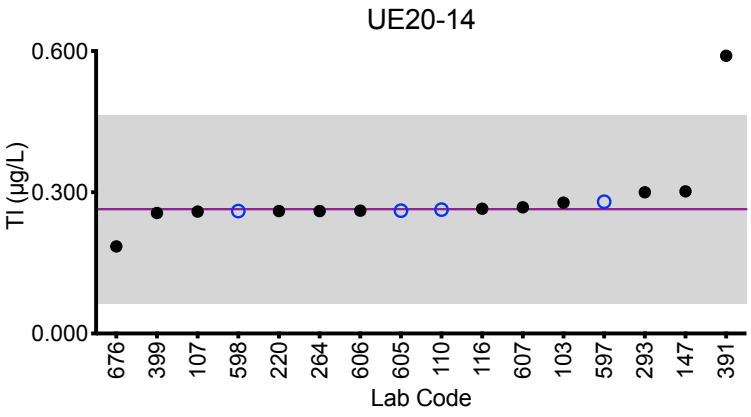
Results for Event #3, 2020: Summary Figures

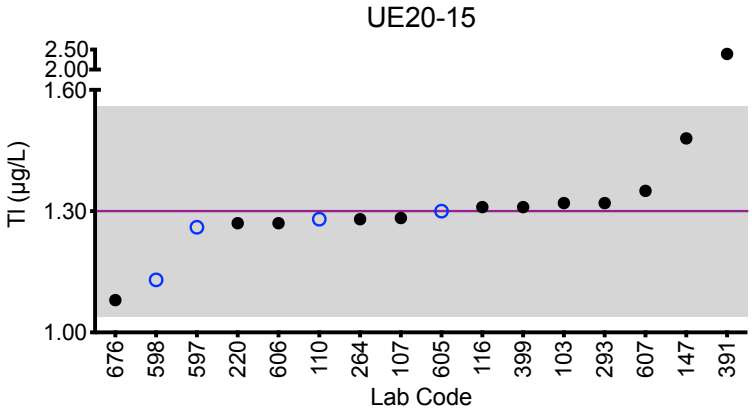
Urine Tl











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Urine U (µg/L)				
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Target (Robust Mean (x*))	0.184	0.128	0.0154	0.077	0.051
Upper Limit	0.221	0.158	0.0454	0.107	0.081
Lower Limit	0.147	0.098	0.0000	0.047	0.021
Robust SD (s*)	0.012	0.007	0.0020	0.005	0.005
Robust RSD (%)	6.5	5.5	13	6.5	9.8
Number of Sample Measurements (N)	13	13	12	13	13
Standard Uncertainty (*u*)	0.004	0.002	0.0007	0.002	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 #3, 2020:
Performance of Participating Laboratories

		Urine U (µg/L)				
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
	Target	**0.184**	**0.128**	**0.0154**	**0.077**	**0.051**
103	ICP-MS/MS	0.188	0.125	<0.0200	0.0816	0.0518
107	ICP-MS	0.1965	0.1363	0.0169	0.0760	0.0507
110	ICP-MS	0.193	0.137	0.0158	0.0822	0.0524
116	ICP-MS/MS	0.176	0.125	0.0159	0.0733	0.0505
147	ICP-MS	0.196	0.134	0.0167	0.0847	0.0563
220	ICP-MS	0.186	0.126	0.018	0.078	0.051
264	ICP-MS	0.17	0.13	0.014	0.073	0.044
399	ICP-MS/MS	0.191	0.129	0.018	0.078	0.054
598	ICP-MS	0.18	0.12	0.014	0.068	0.066
605	ICP-MS	0.179	0.126	0.014	0.074	0.047
606	ICP-MS/MS	0.168	0.123	0.012	0.076	0.047
607	ICP-MS	0.199	0.135	0.0155	0.0793	0.0502
676	ICP-MS	0.169	0.112	0.014	0.072	0.044

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

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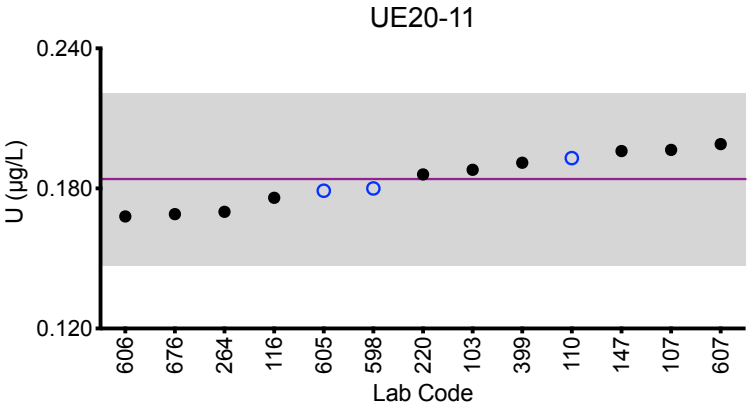
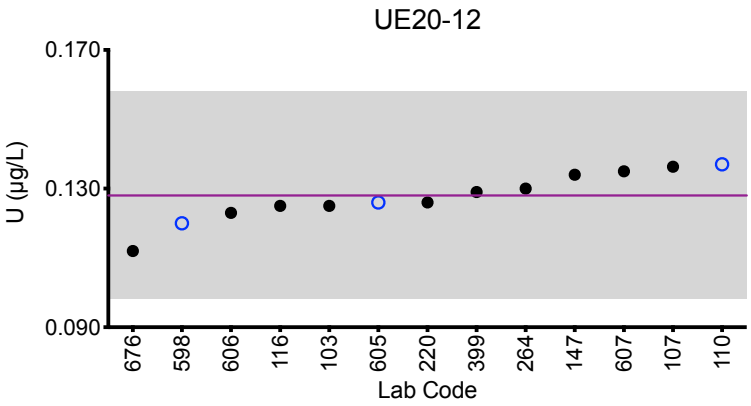
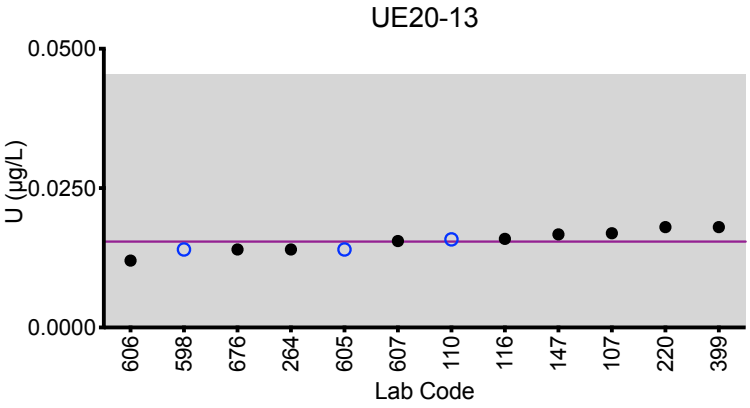
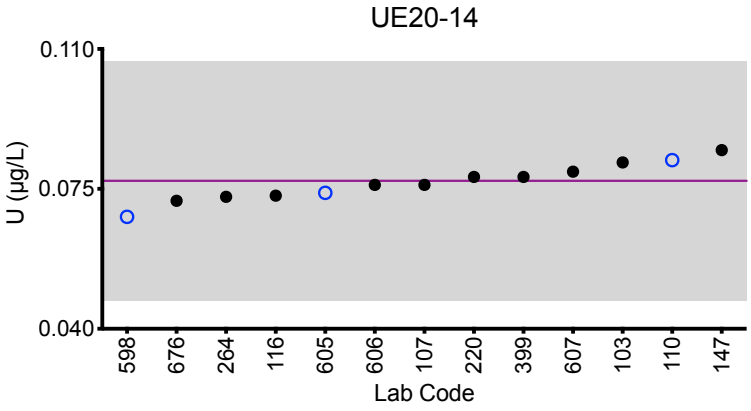
Results for Event #3, 2020: Summary Figures

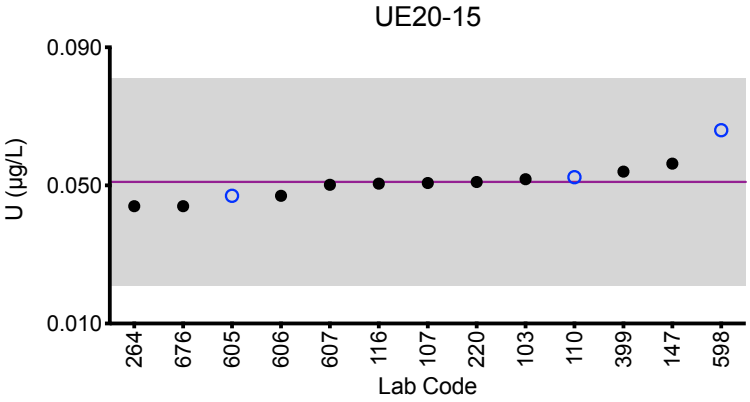
Urine U











Legend:

o C/HHEAR 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 #3, 2020:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
107	ICP-MS	0.84	8.40	4.39	12.47	1.32
110	ICP-MS	0.91	8.93	4.59	14.4	1.47
147	ICP-MS	0.892	8.6	4.45	13.60	1.42
220	ICP-MS	0.88	8.56	4.48	13.8	1.43
264	ICP-MS	0.83	8.19	4.15	12.88	1.31
399	ICP-MS/MS	0.908	8.84	4.45	13.8	1.46
597	ICP-MS	0.901	8.74	4.59	13.7	1.54
598	ICP-MS	0.93	8.69	4.39	13.6	1.36
605	ICP-MS	0.896	8.76	4.62	13.7	1.43
606	ICP-MS/MS	0.830	8.07	4.20	13.0	1.35
676	ICP-MS	0.733	7.21	3.75	11.8	1.15

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Robust Mean (x*)	0.88	8.6	4.40	13.5	1.40
Robust SD (s*)	0.03	0.3	0.20	0.4	0.09
Robust RSD (%)	3.6	3.7	4.5	2.7	6.4
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.01	0.1	0.07	0.1	0.03

*Denotes a statistical Outlier.

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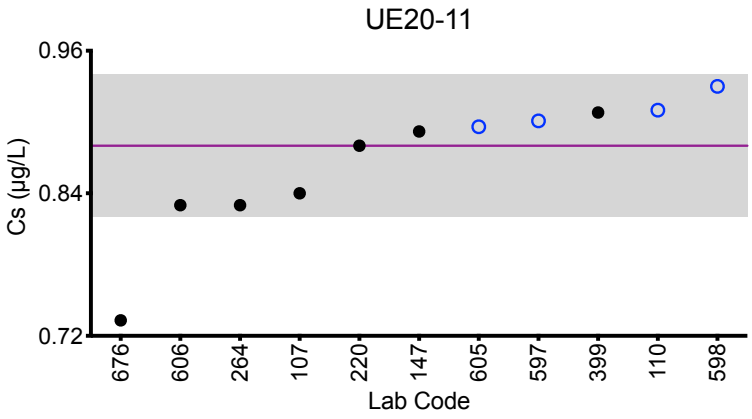
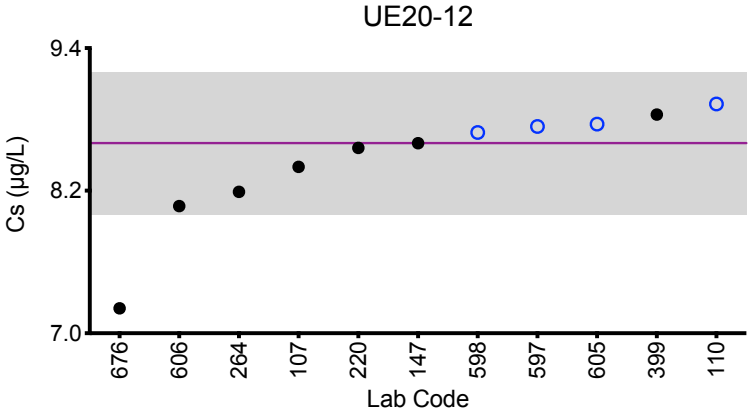
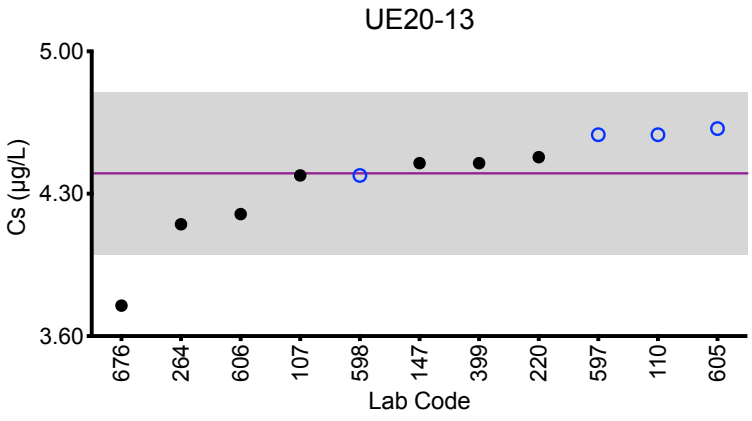
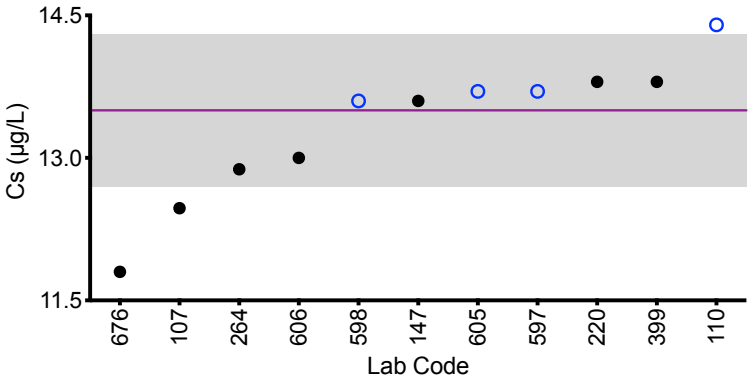
Results for Event #3, 2020: Summary Figures

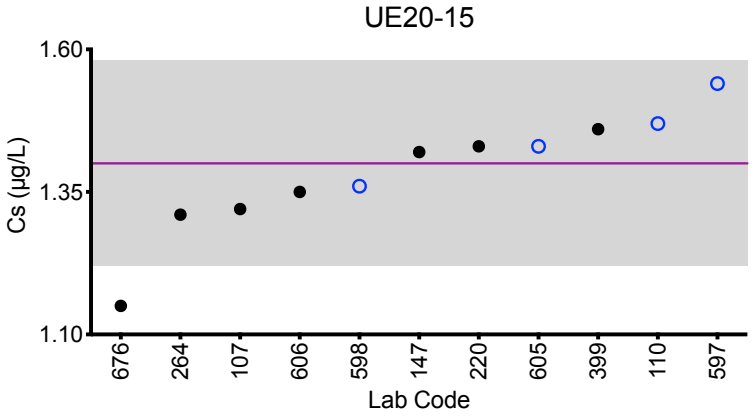
Urine Cs











Legend:
o C/HHEAR Labs ● Other Labs
Horizontal purple line = robust mean of all laboratories.
Gray area = ±2SD of the mean.

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

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
110	ICP-MS	*33.9	118	10.9	94.9	30.8
116	ICP-MS/MS	23.2	104	6.87	86.7	24.1
147	ICP-MS	26.8	109	8.86	94.1	26.4
264	ICP-MS	24.66	110.72	7.60	92.04	24.88
293	DRC/CC-ICP-MS	23.52	105.53	6.99	86.46	24.16
391	ICP-MS	22.23	99.39	4	95.42	14.9
597	ICP-MS	22.7	105	7.04	85.5	23.3
598	ICP-MS	23.2	100	7.77	82.8	23.8

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Arithmetic Mean ($\bar{x}$)	23.8	106	7.5	90	24
Arithmetic SD (s)	1.5	6	1.9	5	4
Arithmetic RSD (%)	6.3	5.7	25	5.6	17
Number of Sample Measurements (N)	7	8	8	8	8

*Denotes a statistical Outlier.

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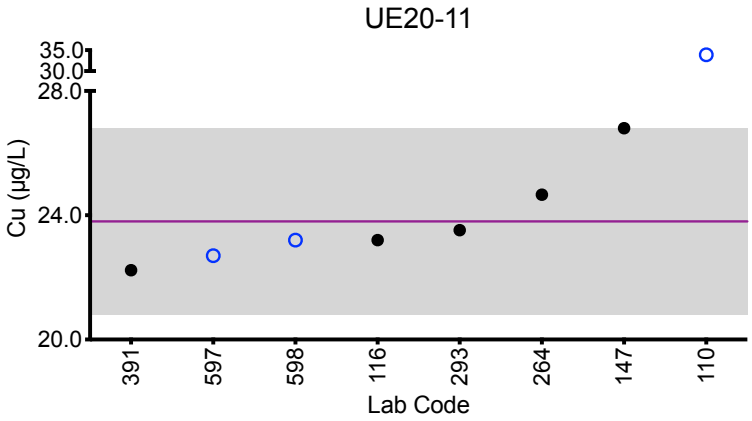
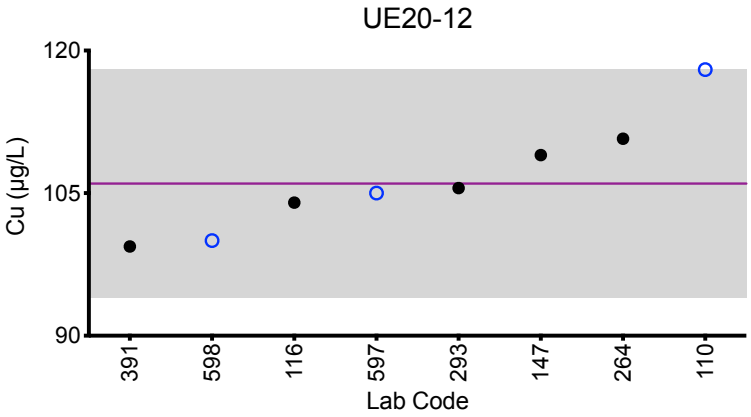
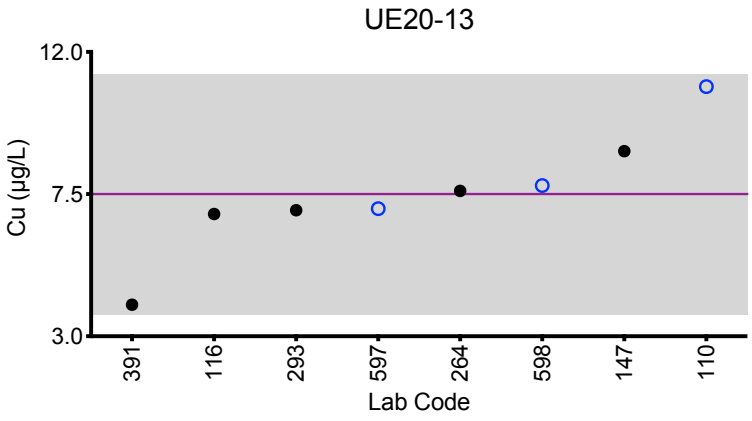
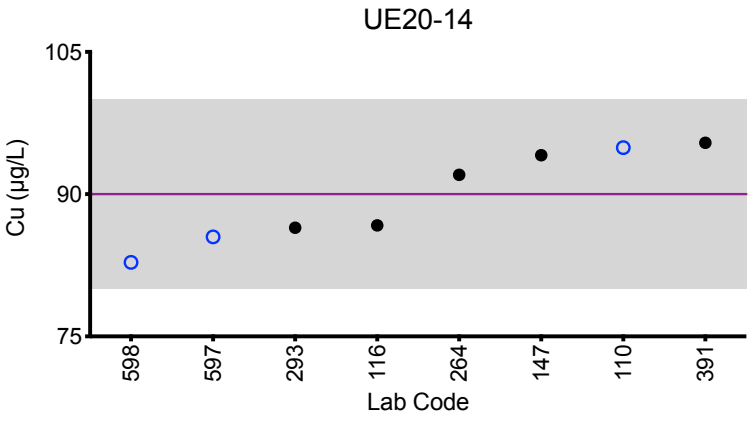
Results for Event #3, 2020: Summary Figures

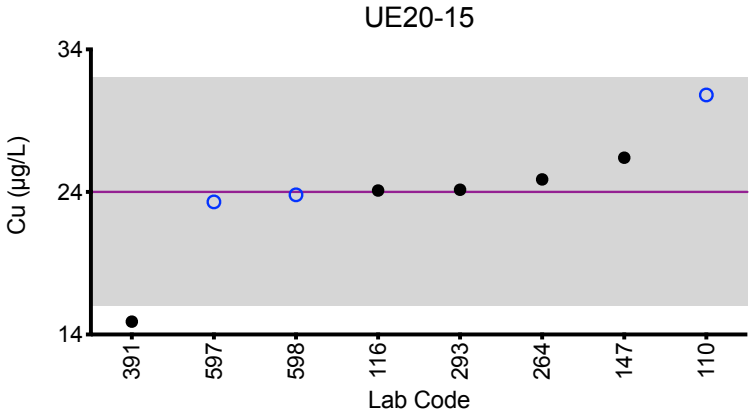
Urine Cu











Legend:
o C/HHEAR Labs ● Other Labs
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Gray area = ±2SD of the mean.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
103	ICP-MS/MS	60.4	12.3	27.5	5.97	44.8
107	ICP-MS	57.00	9.07	25.48	3.83	39.52
110	ICP-MS	61.6	13.2	28.3	6.46	47.0
147	ICP-MS	61.0	12.5	27.5	6.01	45.6
220	ICP-MS	58.0	10.2	26.5	*13.4	43.1
264	ICP-MS	51.07	10.15	21.85	4.13	36.44
293	DRC/CC-ICP-MS	58.57	11.77	25.28	4.91	44.46
399	ICP-MS/MS	61.1	11.3	26.7	5.30	45.0
597	ICP-MS	51.8	11.7	24.7	4.65	39.9
598	DRC/CC-ICP-MS	61.7	13.4	28.5	5.88	45.0
605	ICP-MS	57.0	10.4	25.2	<9.00	41.4
606	ICP-MS/MS	56.0	11.0	24.8	5.38	42.5
676	ICP-MS	51.4	10.2	23.1	4.16	37.0

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Robust Mean (x*)	57	11.3	25.8	5.3	43
Robust SD (s*)	4	1.5	2.0	1.1	3
Robust RSD (%)	7.6	13	7.8	21	7.5
Number of Sample Measurements (N)	13	13	13	11	13
Standard Uncertainty (*u*)	2	0.5	0.7	0.4	1

*Denotes a statistical Outlier.

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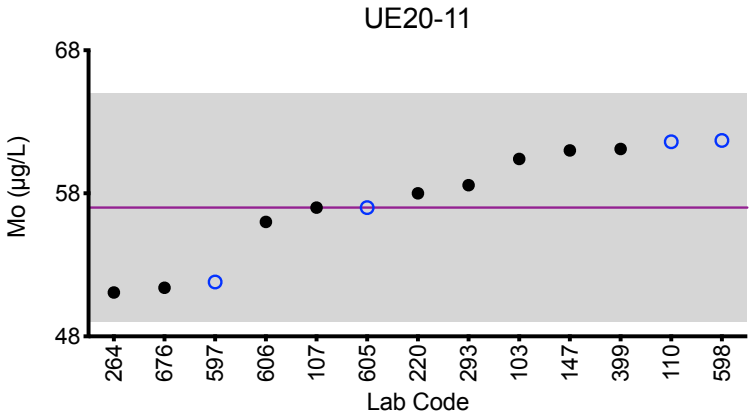
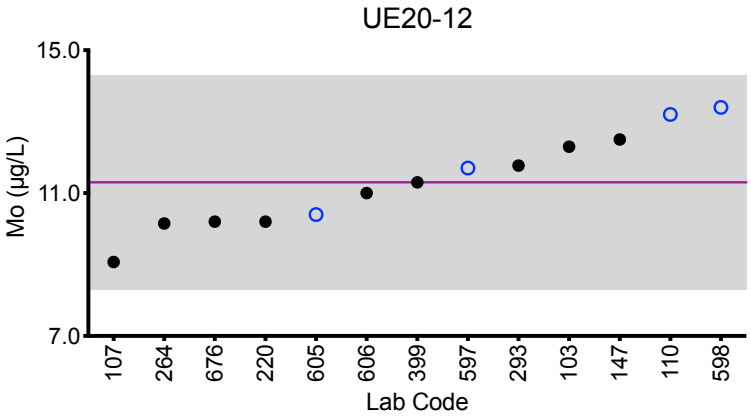
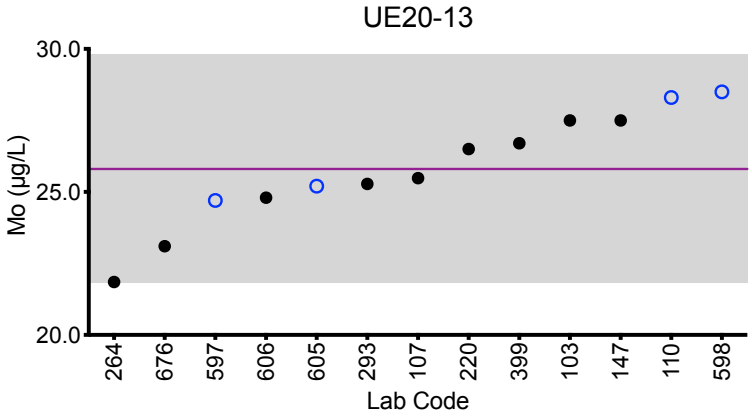
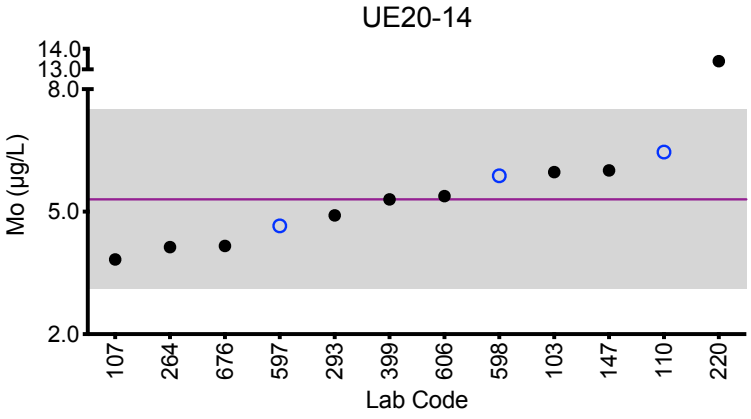
Results for Event #3, 2020: Summary Figures

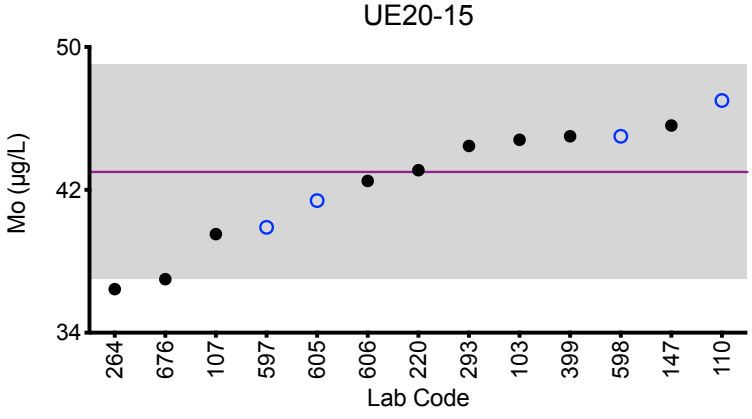
Urine Mo











Legend:
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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
107	DRC/CC-ICP-MS	*2.61	6.41	<0.31	*4.52	2.57
110	ICP-MS	4.24	8.96	1.09	7.16	4.09
147	ICP-MS	3.68	7.55	<0.558	6.29	3.45
264	ICP-MS	3.95	7.99	0.80	6.77	3.98
293	DRC/CC-ICP-MS	3.74	7.68	0.5	6.51	3.85
391	ICP-MS	4.03	8.62	*19.96	7.48	4.37
598	ICP-MS	4.05	7.91	0.93	7.10	3.84
605	ICP-MS	3.68	7.66	0.550	6.66	3.57
Summary Statistics						
		UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Arithmetic Mean ($\bar{x}$)		3.91	7.8	0.8	6.9	3.7
Arithmetic SD (s)		0.22	0.8	0.2	0.4	0.5
Arithmetic RSD (%)		5.6	10	32	5.8	14
Number of Sample Measurements (N)		7	8	5	7	8

*Denotes a statistical Outlier.

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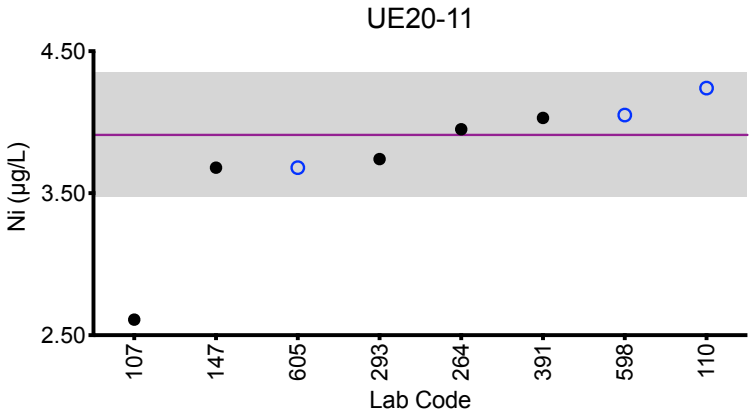
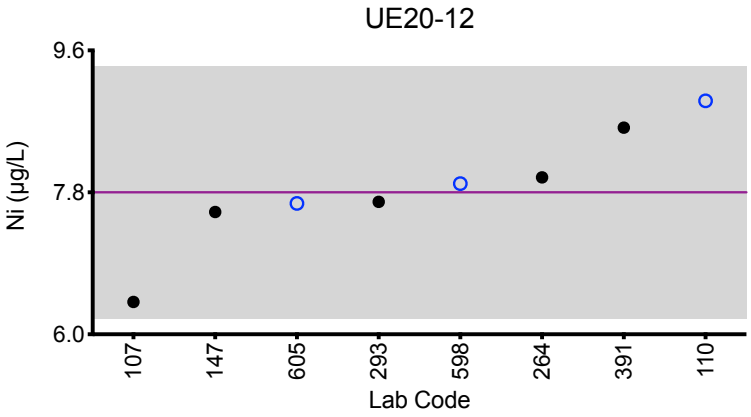
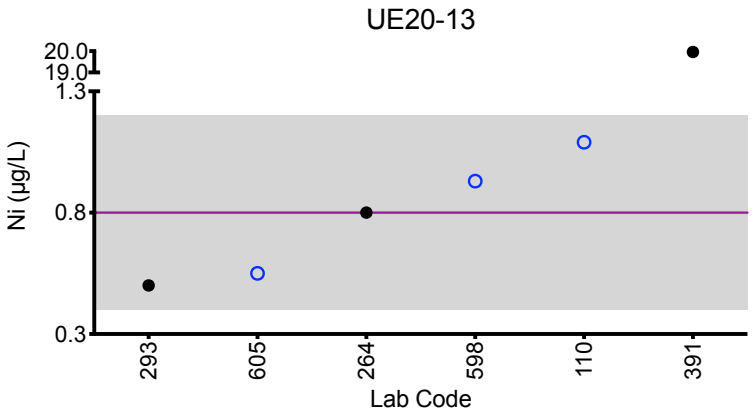
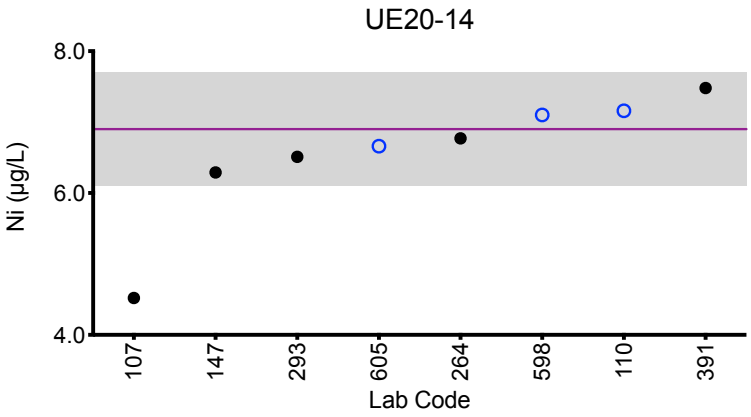
Results for Event #3, 2020: Summary Figures

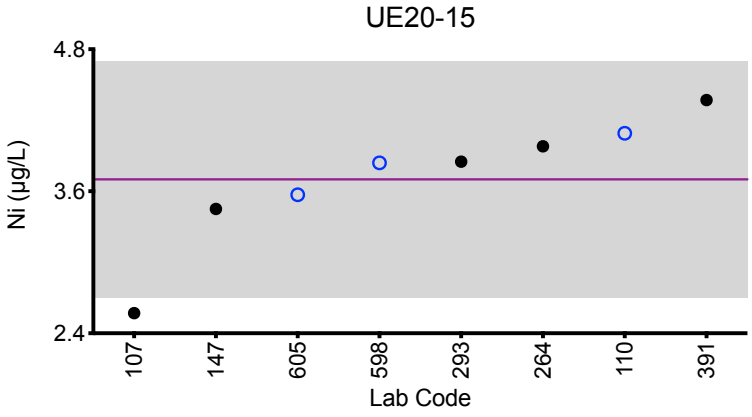
Urine Ni











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
107	ICP-MS	0.4090	3.0226	1.5177	0.1714	0.4667
110	ICP-MS	0.425	3.84	1.78	0.192	0.563
220	ICP-MS	0.43	3.44	1.69	0.19	0.54
264	ICP-MS	0.38	3.32	1.58	0.18	0.48
293	DRC/CC-ICP-MS	0.39	3.61	1.68	0.19	0.57
399	ICP-MS/MS	0.390	3.34	1.66	0.189	0.471
598	ICP-MS	0.40	3.39	1.65	0.18	0.51
605	ICP-MS	0.362	3.43	1.55	0.171	0.494
676	ICP-MS	0.366	3.11	1.48	0.157	0.473

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Arithmetic Mean ($\bar{x}$)	0.395	3.39	1.62	0.180	0.51
Arithmetic SD (s)	0.024	0.24	0.10	0.012	0.04
Arithmetic RSD (%)	6.1	7.1	6.2	6.7	8.1
Number of Sample Measurements (N)	9	9	9	9	9

*Denotes a statistical Outlier.

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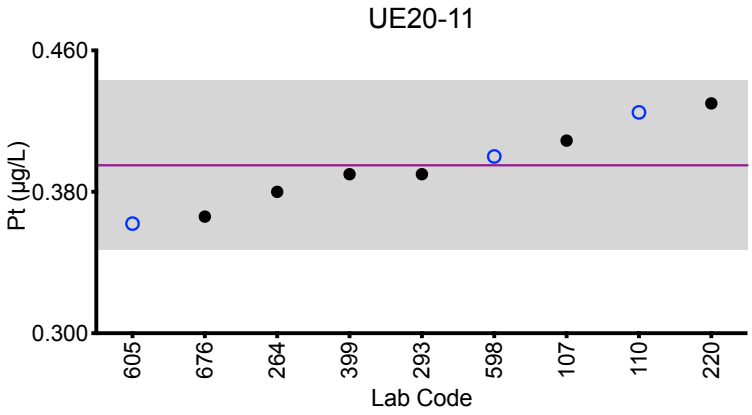
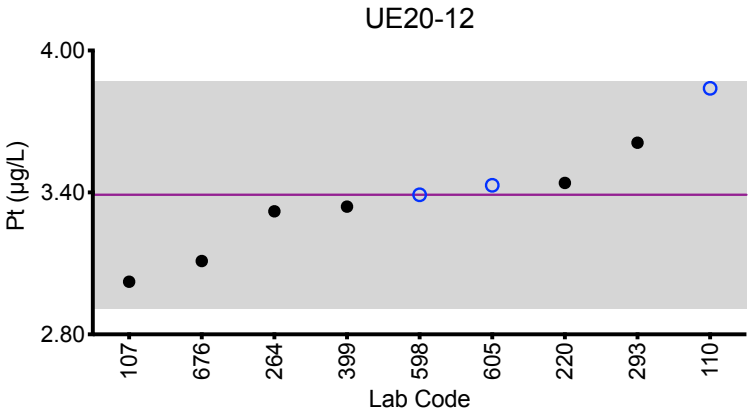
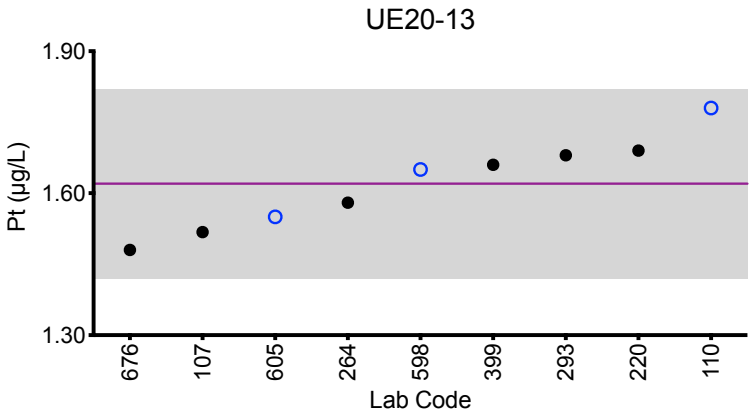
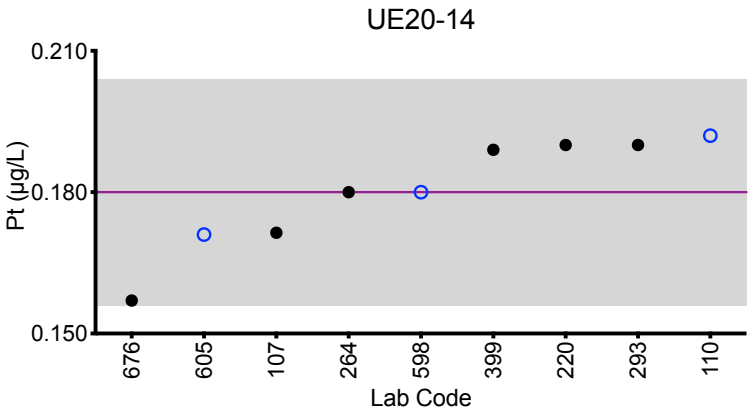
Results for Event #3, 2020: Summary Figures

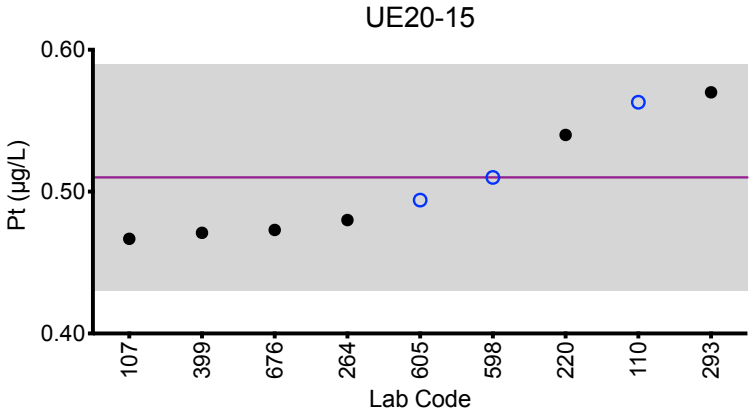
Urine Pt











Legend:
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Gray area = ±2SD of the mean.

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Results for Event #3, 2020: Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
103	ICP-MS/MS	0.199	1.93	2.67	1.64	0.548
107	ICP-MS	0.215	1.183	2.289	1.283	0.418
110	ICP-MS	0.224	2.05	2.63	1.73	0.569
147	ICP-MS	0.251	2.03	2.93	1.71	0.604
220	ICP-MS	0.24	1.88	2.77	1.65	0.56
264	ICP-MS	0.20	1.89	2.56	1.64	0.52
293	DRC/CC-ICP-MS	0.28	2.03	2.95	1.53	0.67
399	ICP-MS/MS	0.232	1.76	2.41	1.53	0.505
597	ICP-MS	0.227	1.82	2.39	1.43	0.508
598	ICP-MS	0.22	1.98	2.78	1.48	0.58
605	ICP-MS	<0.800	1.86	2.67	1.53	<0.800
606	ICP-MS/MS	0.166	1.84	2.61	1.62	0.550
676	ICP-MS	0.181	1.68	2.39	1.38	0.481

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Robust Mean (x*)	0.22	1.88	2.62	1.56	0.54
Robust SD (s*)	0.03	0.14	0.24	0.14	0.05
Robust RSD (%)	14	7.4	9.2	9.0	9.3
Number of Sample Measurements (N)	12	13	13	13	12
Standard Uncertainty (*u*)	0.01	0.05	0.08	0.05	0.02

*Denotes a statistical Outlier.

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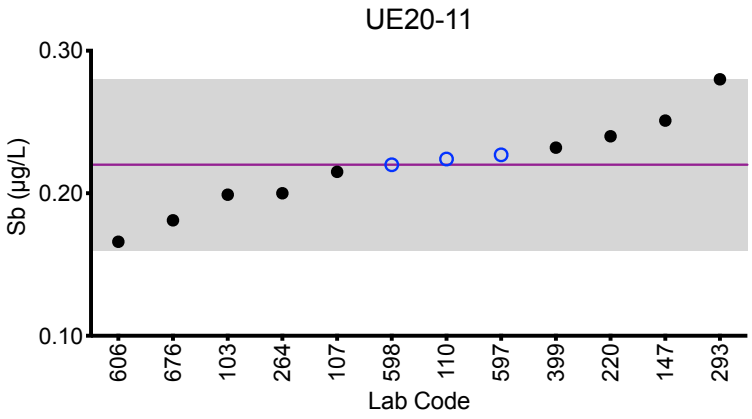
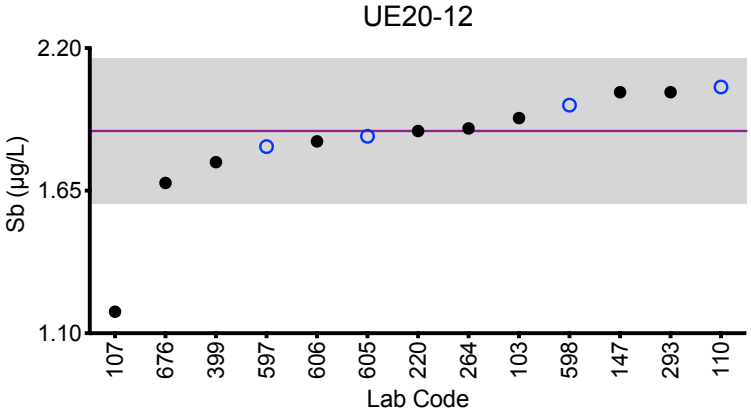
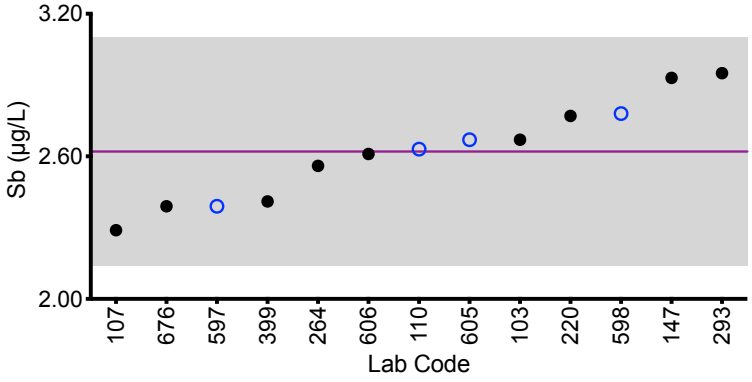
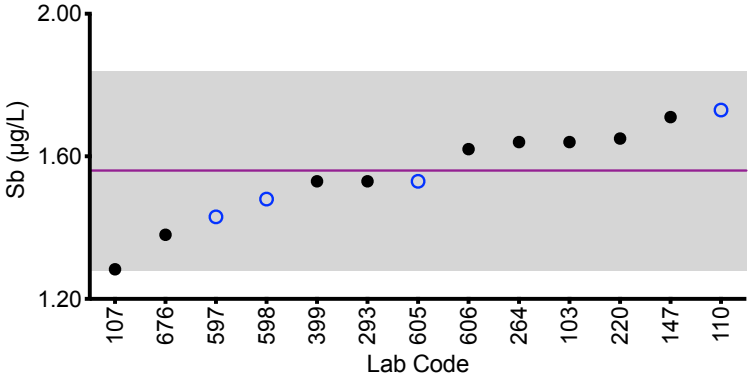
Results for Event #3, 2020: Summary Figures

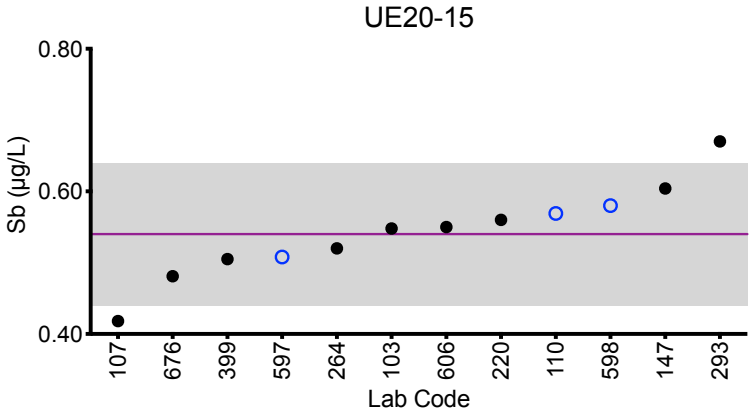
Urine Sb











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Se (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
103	ICP-MS/MS	34.4	67.8	172	21.0	102
110	DRC/CC-ICP-MS	34.5	63.4	149	19.8	92.8
147	ICP-MS	33.3	65.9	167	21.1	103
293	DRC/CC-ICP-MS	30.78	68.67	157.06	22.1	97.87
597	ICP-MS	27.9	60.8	140	17.6	86.3
598	DRC/CC-ICP-MS	34.1	60.6	166	18.5	84.6
Summary Statistics						
		UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Arithmetic Mean ($\bar{x}$)		32	64	159	20.0	94
Arithmetic SD (s)		3	4	12	1.7	8
Arithmetic RSD (%)		8.1	5.4	7.5	8.5	8.5
Number of Sample Measurements (N)		6	6	6	6	6

*Denotes a statistical Outlier.

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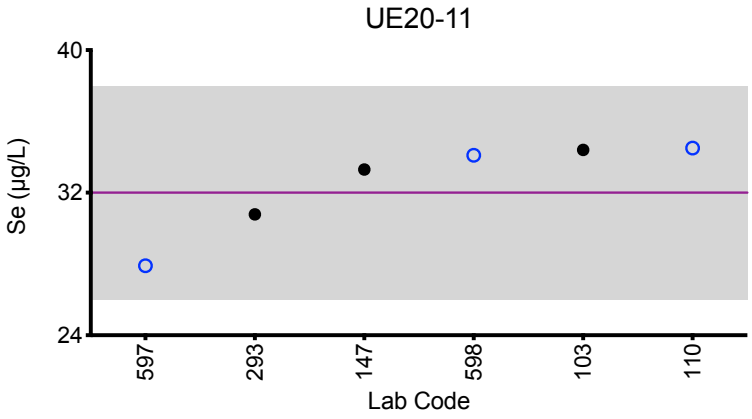
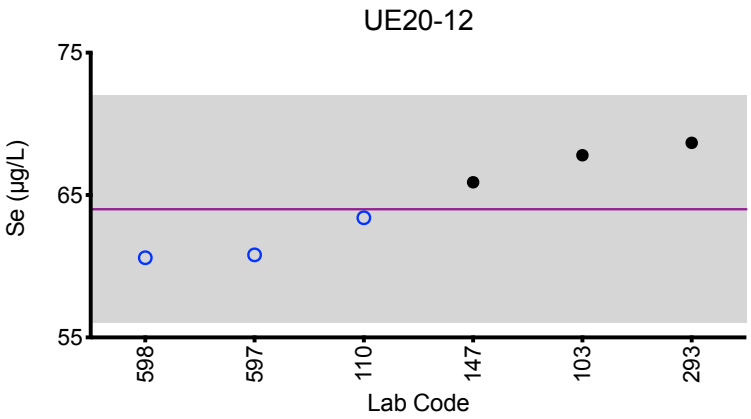
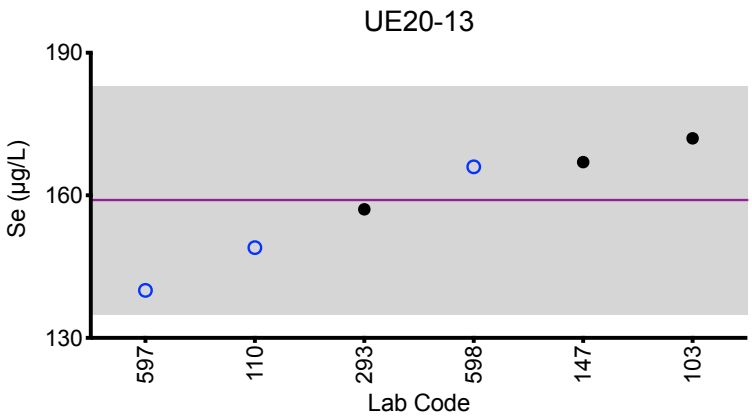
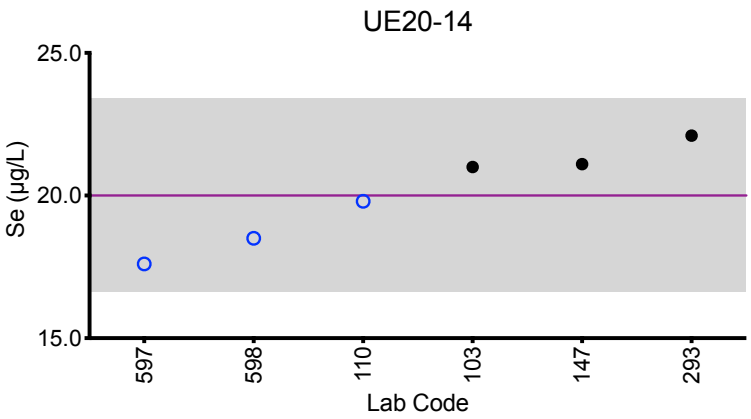
Results for Event #3, 2020: Summary Figures

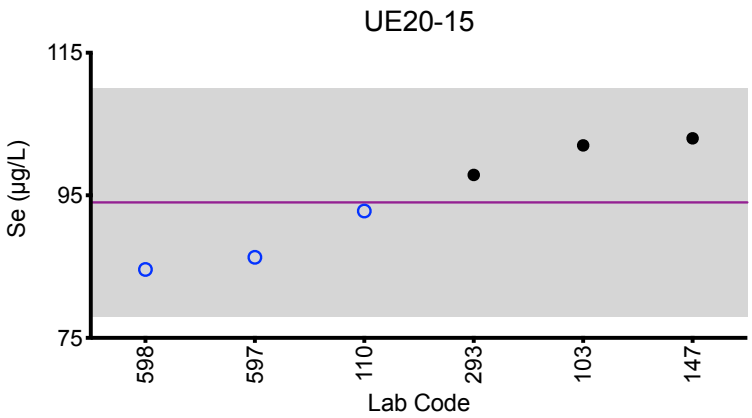
Urine Se











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
107	ICP-MS	0.58	5.29	1.60	5.60	2.76
110	ICP-MS	0.41	6.13	1.43	7.41	3.30
147	ICP-MS	<0.238	4.79	1.07	5.42	2.50
220	ICP-MS	0.57	4.98	0.65	6.38	2.94
264	ICP-MS	0.35	4.43	0.97	4.98	2.07
399	ICP-MS/MS	0.362	5.82	1.32	6.98	3.11
598	ICP-MS	*0.17	4.63	0.86	4.63	2.39
605	ICP-MS	<0.9	4.36	1.00	5.92	2.23
676	ICP-MS	0.306	4.93	1.12	5.90	2.63

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Arithmetic Mean ($\bar{x}$)	0.43	5.0	1.1	5.9	2.7
Arithmetic SD (s)	0.12	0.6	0.3	0.9	0.4
Arithmetic RSD (%)	27	12	26	15	15
Number of Sample Measurements (N)	6	9	9	9	9

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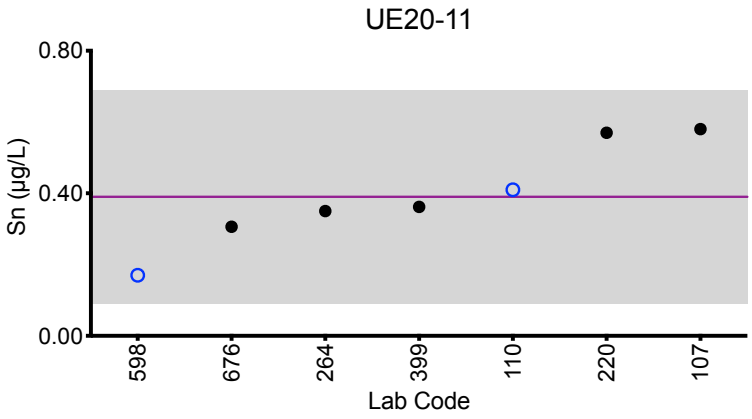
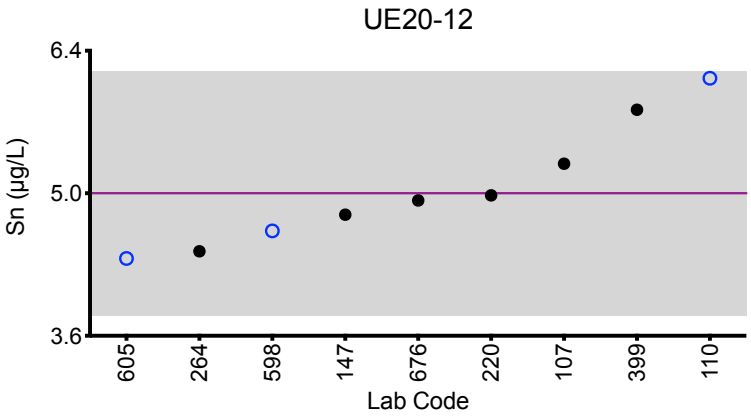
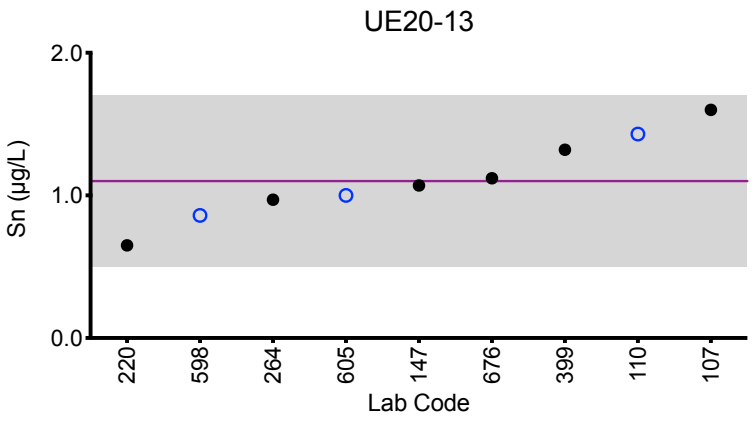
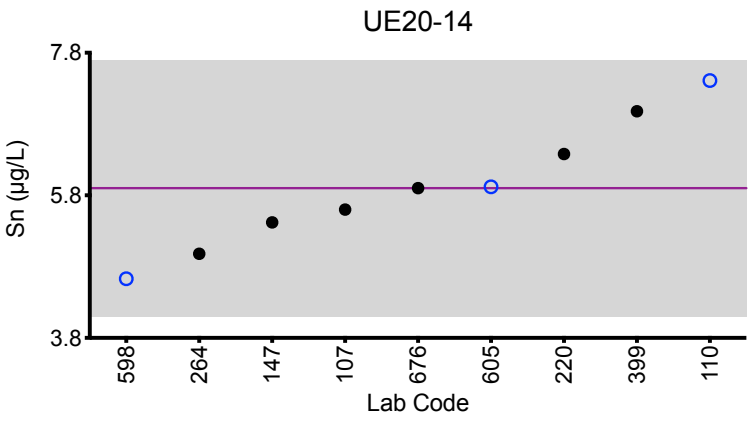
Results for Event #3, 2020: Summary Figures

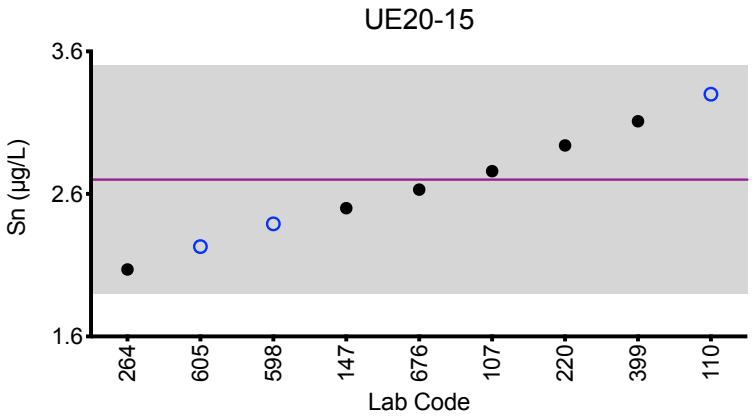
Urine Sn











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Sr (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
103	ICP-MS/MS	378	142	262	188	115
107	ICP-MS	388.9	139.5	269.0	177.6	109.0
200	ICP-MS	385	141	248	187	116
220	ICP-MS	382	141	264	193	117
264	ICP-MS	330.21	128.19	230.92	170.75	103.57
399	DRC/CC-ICP-MS	366	138	248	183	113
597	ICP-MS	348	142	251	191	112
605	ICP-MS	376	140	264	190	115
676	ICP-MS	330	120	225	167	96.4

Summary Statistics					
	UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Arithmetic Mean ($\bar{x}$)	365	137	251	183	111
Arithmetic SD (s)	23	8	15	9	7
Arithmetic RSD (%)	6.3	5.8	6.0	5.1	6.3
Number of Sample Measurements (N)	9	9	9	9	9

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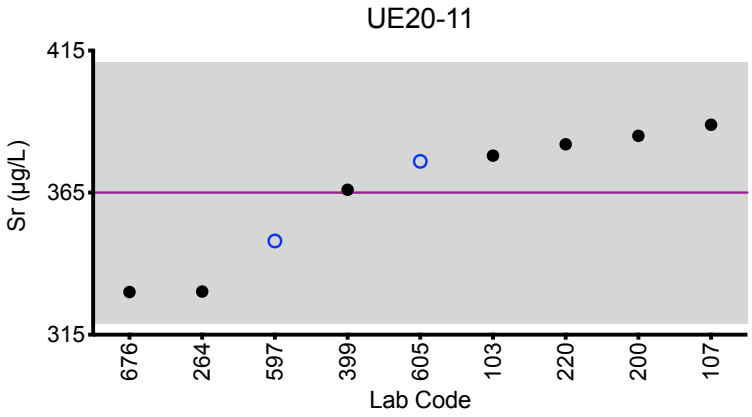
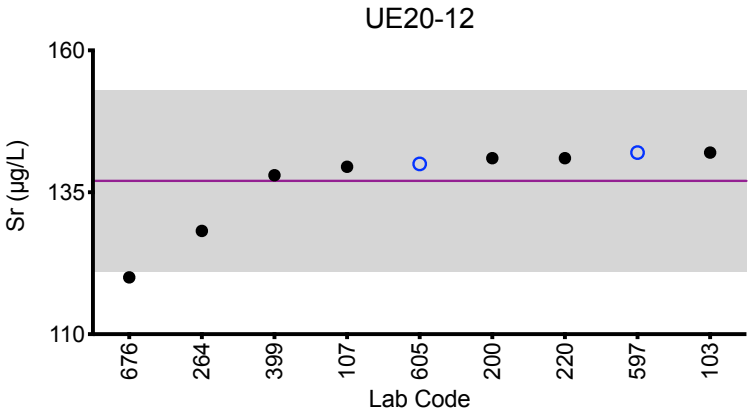
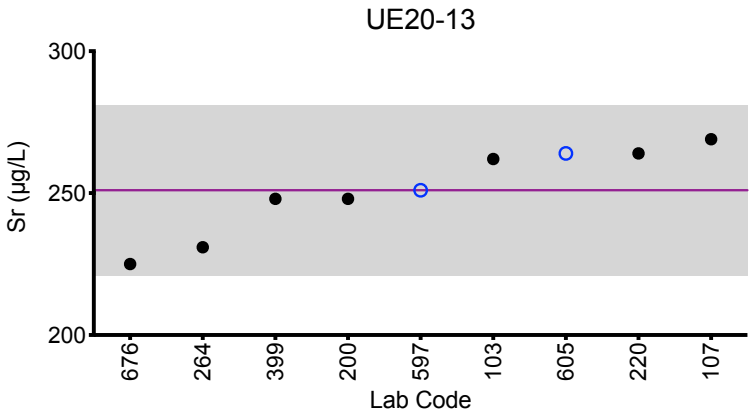
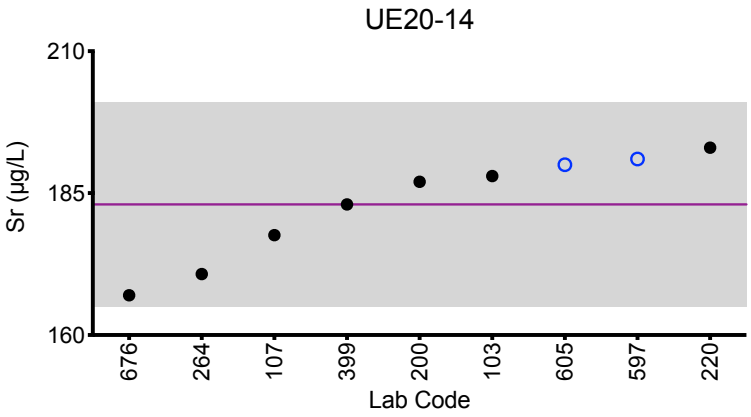
Results for Event #3, 2020: Summary Figures

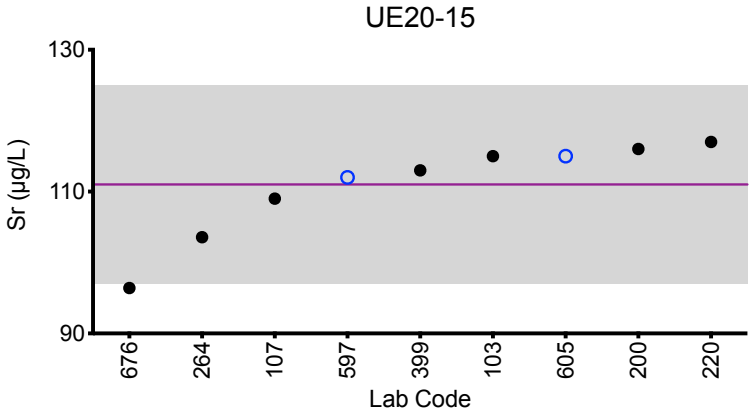
Urine Sr











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
116	ICP-MS/MS	2.96	5.70	0.268	1.33	0.586
147	DRC/CC-ICP-MS	3.02	5.62	0.269	1.36	0.617
293	DRC/CC-ICP-MS	3.11	5.88	0.27	1.51	0.73
597	ICP-MS	2.79	5.69	0.267	1.38	0.600
598	DRC/CC-ICP-MS	3.53	*6.77	0.30	1.75	0.71
605	ICP-MS	3.28	5.95	*0.134	1.13	0.7

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Arithmetic Mean ($\bar{x}$)	3.1	5.77	0.275	1.41	0.66
Arithmetic SD (s)	0.3	0.14	0.014	0.21	0.06
Arithmetic RSD (%)	8.3	2.4	5.1	15	9.1
Number of Sample Measurements (N)	6	5	5	6	6

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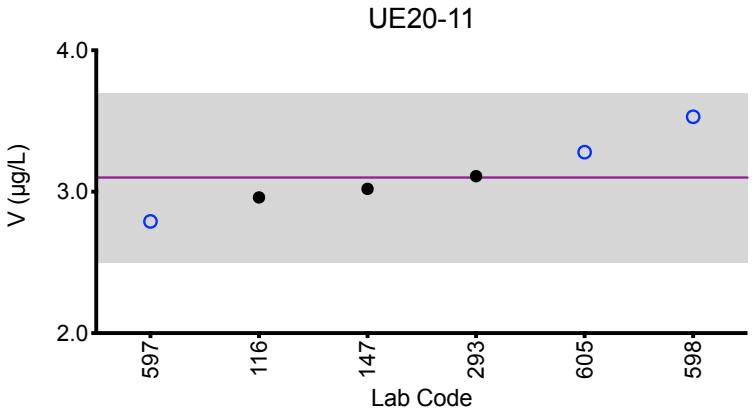
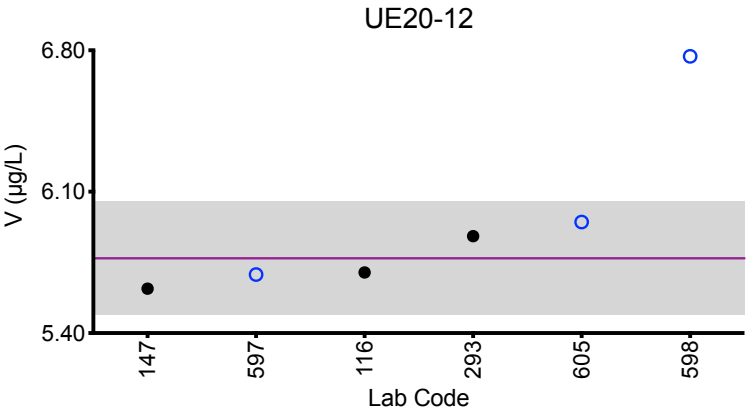
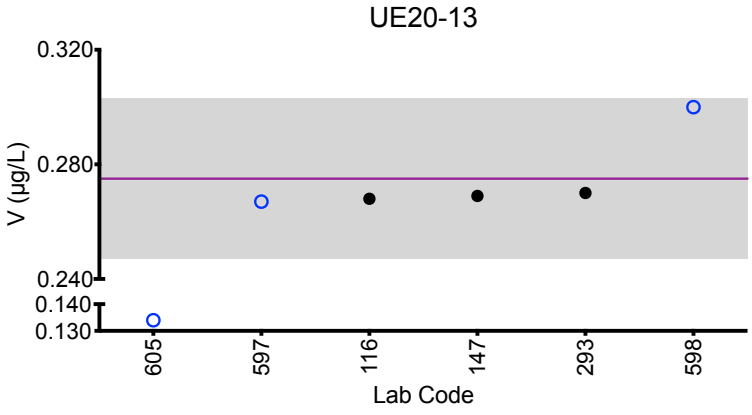
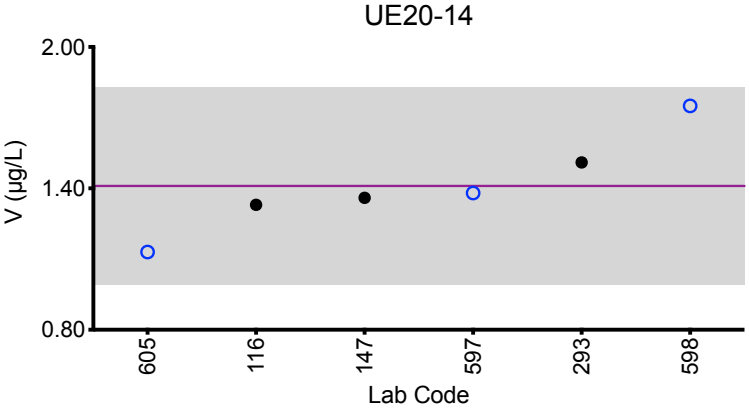
Results for Event #3, 2020: Summary Figures

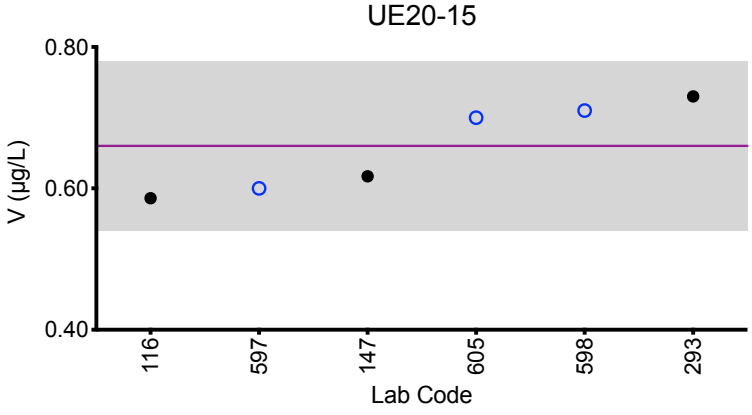
Urine V











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
107	ICP-MS	0.985	0.721	0.390	1.575	0.487
110	ICP-MS	1.06	0.760	0.403	1.75	0.543
147	ICP-MS	0.953	0.676	0.371	1.63	0.482
200	ICP-MS	0.9	0.7	0.4	1.8	0.5
220	ICP-MS	1.02	0.72	0.39	1.70	0.50
264	ICP-MS	0.89	0.64	0.33	1.53	0.47
399	ICP-MS/MS	1.01	0.713	0.376	1.64	0.510
598	ICP-MS	1.03	0.72	0.38	1.62	0.53
605	ICP-MS	0.994	0.727	0.385	1.69	0.498
606	ICP-MS/MS	0.947	0.740	0.361	1.66	0.504
676	ICP-MS	0.913	0.614	0.341	1.49	0.424

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Robust Mean (x*)	0.97	0.71	0.379	1.64	0.498
Robust SD (s*)	0.06	0.03	0.018	0.10	0.022
Robust RSD (%)	6.2	4.4	4.7	6.1	4.4
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.02	0.01	0.007	0.04	0.008

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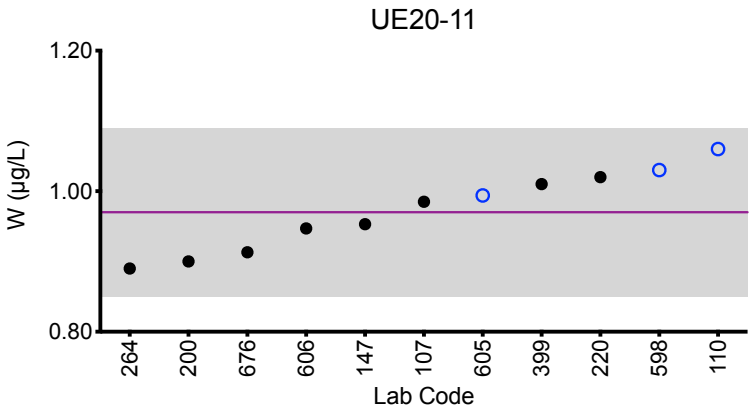
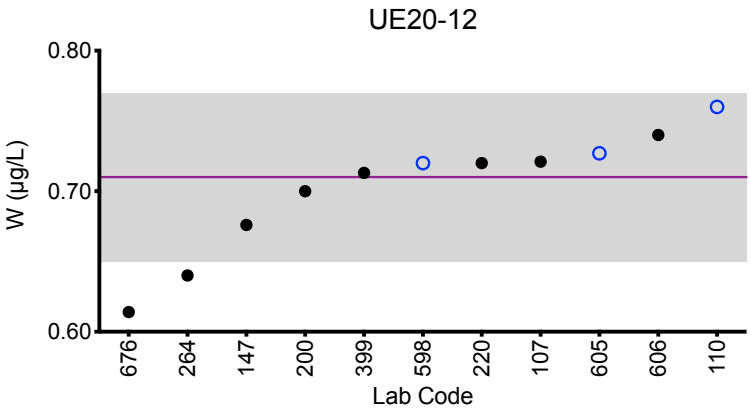
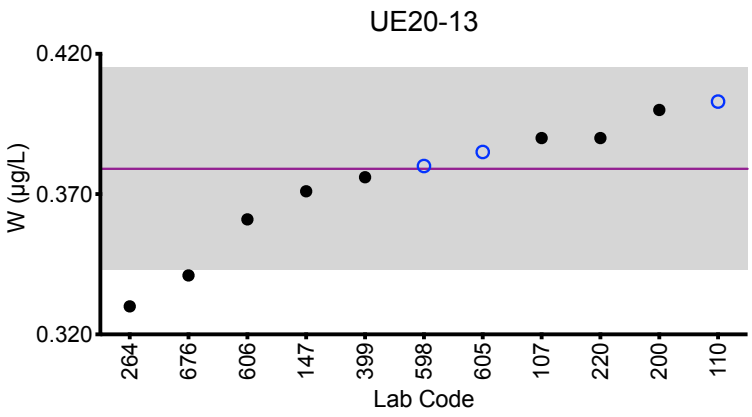
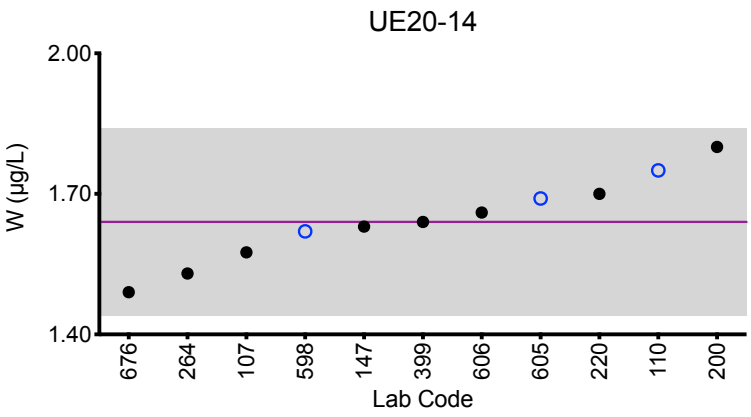
Results for Event #3, 2020: Summary Figures

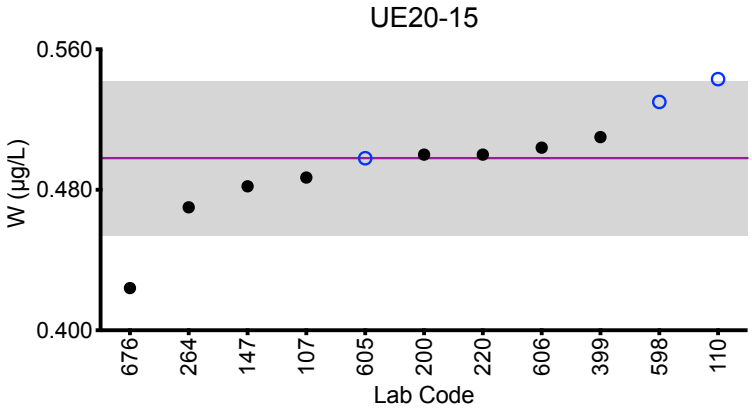
Urine W











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
110	ICP-MS	426	972	127	284	650
147	ICP-MS	380	947	118	284.6	665
264	ICP-MS	402.56	1035.98	127.21	299.96	684.08
293	DRC/CC-ICP-MS	375.16	968.63	110.46	278.43	647.71
391	ICP-MS	363.071	968.843	105.072	261.438	621.846
597	ICP-MS	433	1060	*191	*377	700
598	ICP-MS	372	887	118	272	629

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Arithmetic Mean ($\bar{x}$)	393	980	118	280	657
Arithmetic SD (s)	28	60	9	13	28
Arithmetic RSD (%)	7.1	6.1	7.6	4.6	4.3
Number of Sample Measurements (N)	7	7	6	6	7

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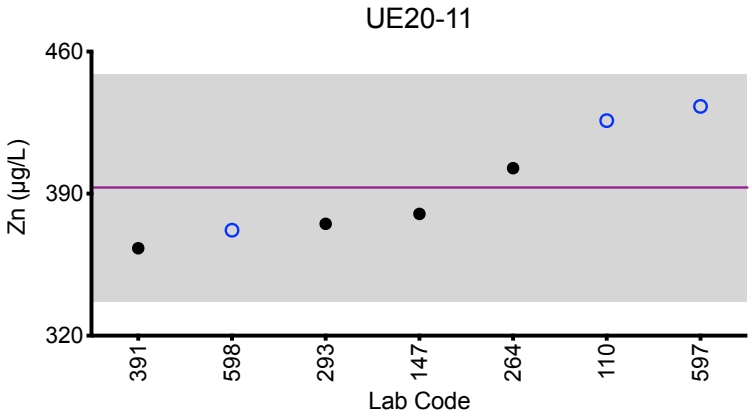
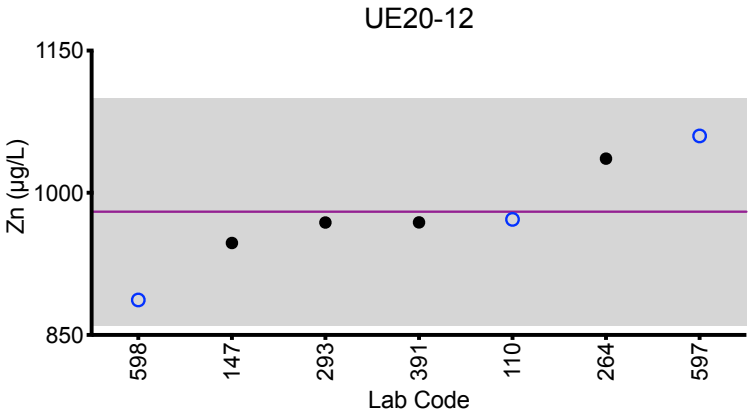
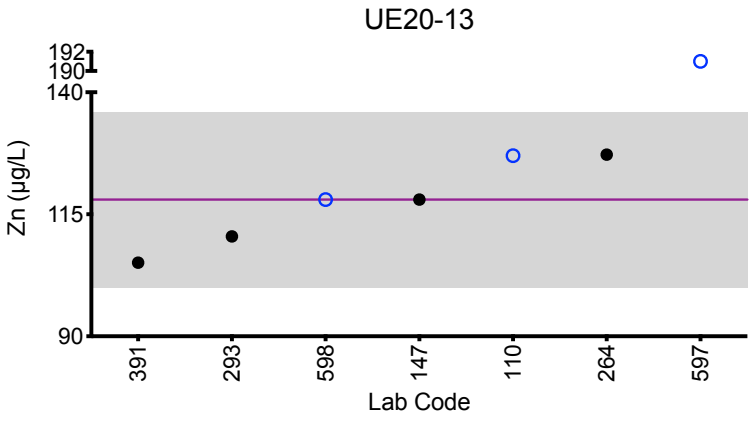
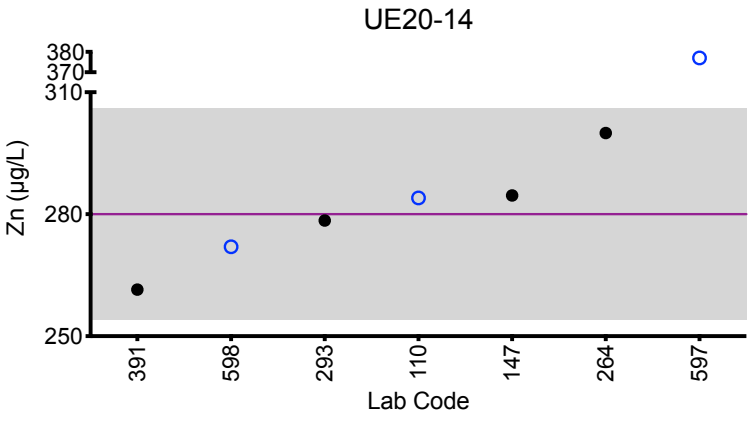
Results for Event #3, 2020: Summary Figures

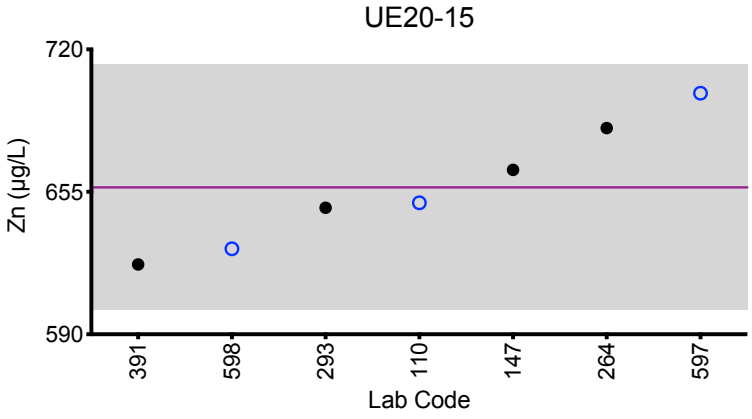
Urine Zn











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Al (µg/L)

Lab Code	Method	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
147	ICP-MS	<9.44	14.3	25.2	23.5	<9.44
264	ICP-MS	5.23	11.30	21.67	16.92	8.05
293	DRC/CC-ICP-MS	4.3	11.02	21.24	16.13	7.26

Summary Statistics

	UE20-11	UE20-12	UE20-13	UE20-14	UE20-15
Arithmetic Mean ($\bar{x}$)	4.8	12	23	19	7.7
Arithmetic SD (s)	0.7	2	2	4	0.6
Arithmetic RSD (%)	15	15	9.7	21	7.8
Number of Sample Measurements (N)	2	3	3	3	2

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Urine Te (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
110	ICP-MS	0.350	2.69	0.642	1.74	0.836
147	ICP-MS	0.382	2.62	0.629	1.54	0.799
Summary Statistics						
		UE20-11	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
Arithmetic Mean ($\bar{x}$)		0.37	2.65	0.636	1.6	0.82
Arithmetic SD (s)		0.02	0.05	0.009	0.1	0.03
Arithmetic RSD (%)		5.4	1.9	1.4	8.5	3.7
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2020: Additional Elements in Urine

Urine Ag (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
147	ICP-MS	<0.183	<0.183	<0.183	<0.183	<0.183

Urine B (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
200	ICP-MS	160	272	102	268	157

Urine Bi (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
147	ICP-MS	<0.0815	<0.0815	<0.0815	<0.0815	<0.0815
264	ICP-MS	<0.10	<0.10	<0.10	<0.10	<0.10

Urine I (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
147	ICP-MS	82.9	97.4	219	123	283

Urine Li (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
147	ICP-MS	4.85	5.49	8.04	7.25	10.6

Urine Mg (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
597	ICP-MS	12600	12700	10400	17280	13300

Urine Th (µg/L)						
Lab Code	**Method**	**UE20-11**	**UE20-12**	**UE20-13**	**UE20-14**	**UE20-15**
147	ICP-MS	<0.0673	<0.0673	<0.0673	<0.0673	<0.0673

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Event #3, 2020

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

NEW YORK STATE | Department of Health | Wadsworth Center

Event #3, 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 25 were reported by at least one participant: As, B, Ba, Be, Bi, Cd, Cs, Fe, Hg, I, Li, Mg, Mn, Mo, Ni, Pb, Pt, Sb, Sn, Sr, 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 #3, 2020: Summary Statistics

	Serum Al (µg/L)				
	SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Target (Arithmetic Mean ($\bar{x}$))	197	130	56.2	157	96
Upper Limit	236	156	67.4	188	115
Lower Limit	158	104	45.0	126	77
Arithmetic SD (s)	11	10	2.0	9	10
Arithmetic RSD (%)	5.6	7.7	3.6	5.7	10
Number of Sample Measurements (N)	6	7	7	7	7

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

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Results for Event #3, 2020:
Performance of Participating Laboratories

		Serum Al (µg/L)				
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
	Target	**197**	**130**	**56.2**	**157**	**96**
147	ETAAS-Z	*142 ↓	111	53.2	142	90.3
264	ICP-MS	200.64	137.34	59.52	164.57	101.78
293	DRC/CC-ICP-MS	201.61	137.1	56.45	161.29	99.46
391	ETAAS-Z	176.25	124.41	57.84	148.98	78.15
485	HR-ICP-MS	206.00	138	55.6	168	104
597	ICP-MS	203	128	55	160	95
598	ICP-MS	194	131	55.8	153	106

Based on the grading criteria for Al in Serum, 97% of results were satisfactory, with 0 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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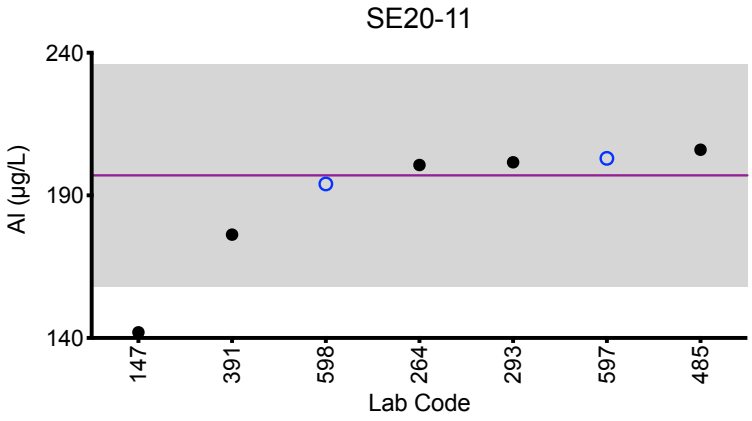
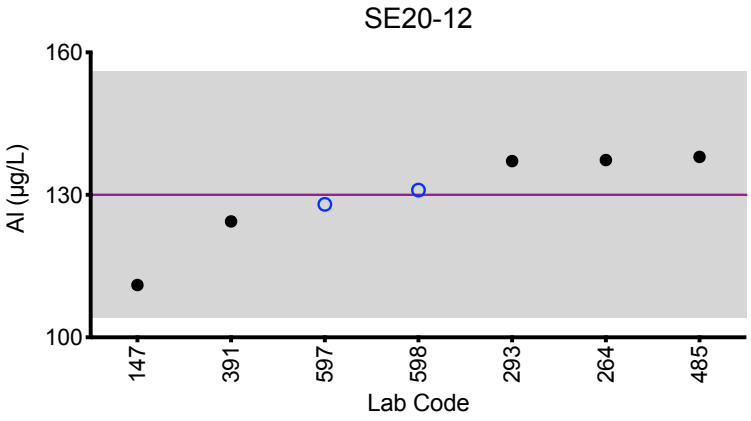
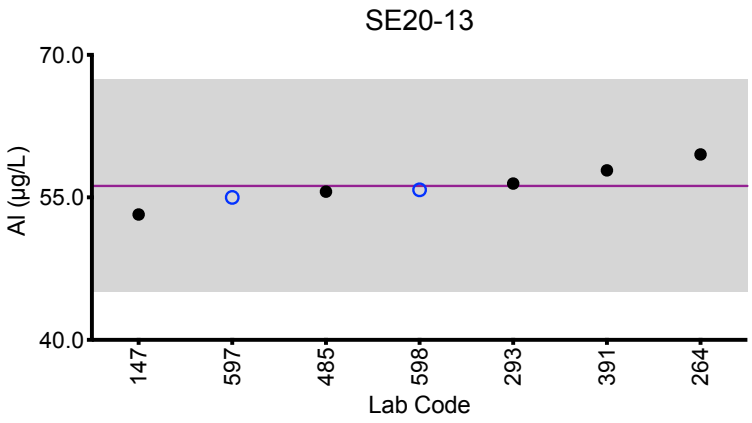
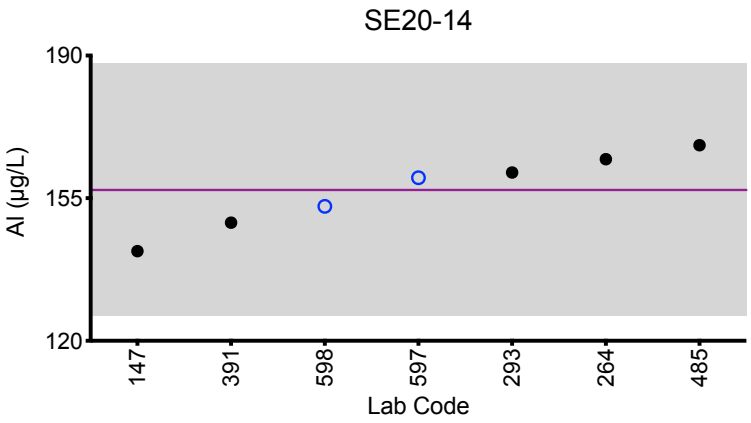
Results for Event #3, 2020: Summary Figures

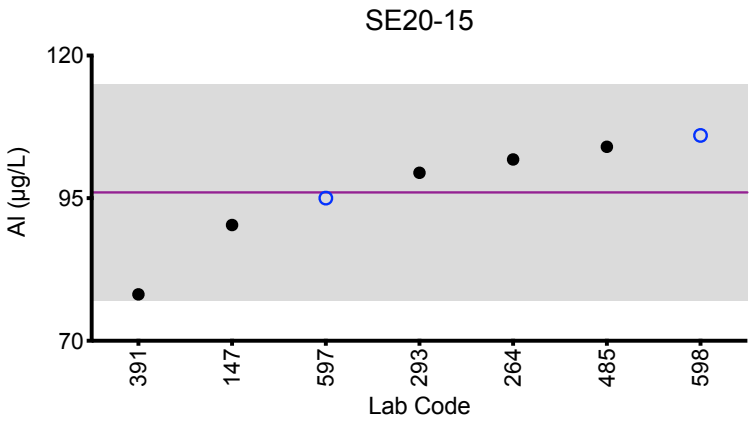
Serum Al











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Serum Co (µg/L)				
	SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Target (Arithmetic Mean ($\bar{x}$))	2.27	26.9	2.07	12.2	8.3
Upper Limit	3.77	30.9	3.57	14.0	9.8
Lower Limit	0.77	22.9	0.57	10.4	6.8
Arithmetic SD (s)	0.10	0.9	0.15	0.7	0.3
Arithmetic RSD (%)	4.4	3.3	7.2	5.7	4.1
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 #3, 2020:
Performance of Participating Laboratories

		Serum Co (µg/L)				
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
	Target	**2.27**	**26.9**	**2.07**	**12.2**	**8.3**
103	ICP-MS/MS	2.22	27.3	2.07	12.6	8.29
110	ICP-MS	2.46	28.2	2.26	10.8	8.86
147	DRC/CC-ICP-MS	2.15	26.4	1.81	12.3	7.79
264	ICP-MS	2.32	25.64	1.92	12.02	8.01
293	DRC/CC-ICP-MS	2.18	26.9	2.02	12.49	8.33
485	HR-ICP-MS	2.29	27.9	2.12	12.9	8.64
597	ICP-MS	2.30	27.1	2.20	12.6	8.42
598	ICP-MS	2.28	25.9	2.15	11.7	8.137

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

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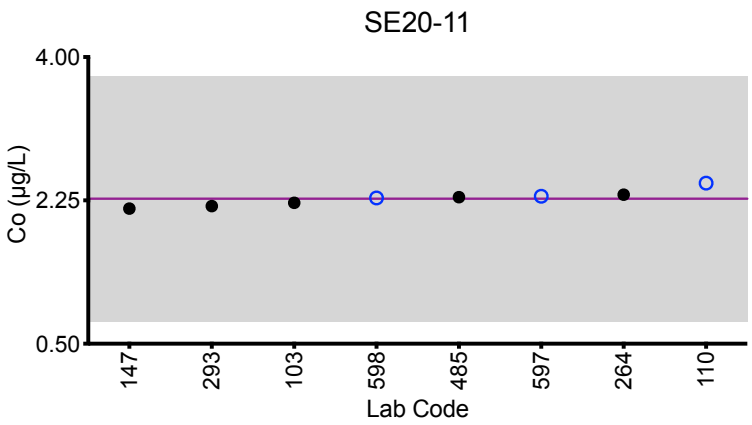
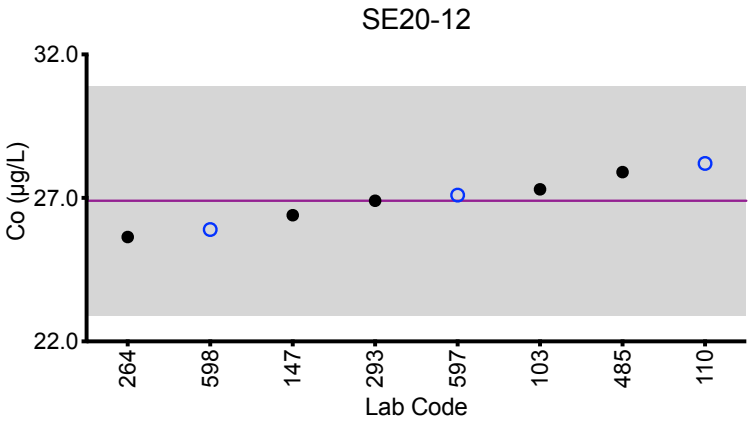
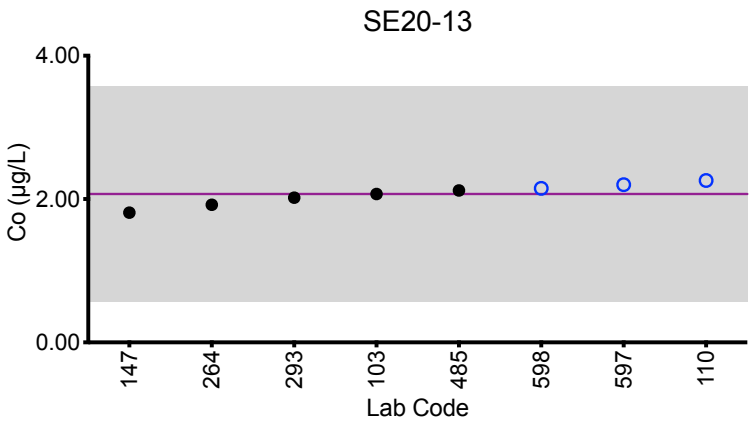
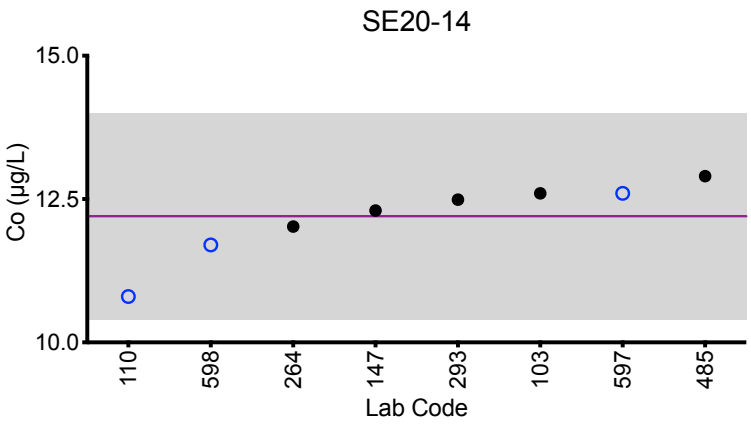
Results for Event #3, 2020: Summary Figures

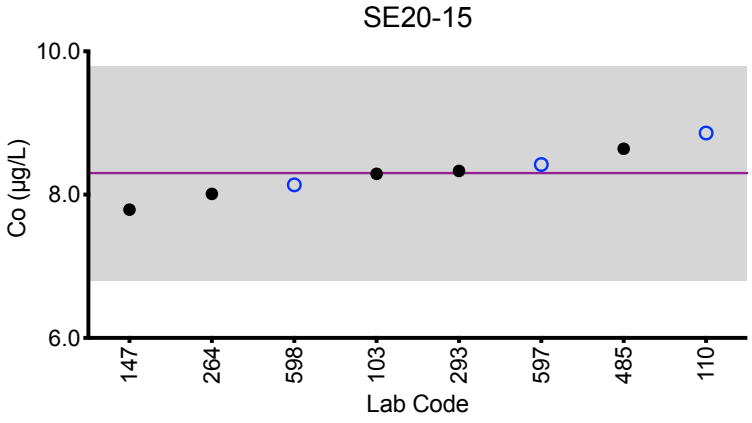
Serum Co











Legend:
o C/HHEAR 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 #3, 2020: Summary Statistics

	Serum Cr (µg/L)				
	SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Target (Arithmetic Mean ($\bar{x}$))	1.06	4.3	8.1	0.34	2.98
Upper Limit	3.06	6.3	10.1	2.34	4.98
Lower Limit	0.00	2.3	6.1	0.00	0.98
Arithmetic SD (s)	0.08	0.3	0.3	0.05	0.26
Arithmetic RSD (%)	7.5	7.4	3.4	15	8.7
Number of Sample Measurements (N)	7	8	7	5	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 #3, 2020:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
	Target	**1.06**	**4.3**	**8.1**	**0.34**	**2.98**
103	ICP-MS/MS	0.957	4.42	8.08	<0.500	2.86
110	DRC/CC-ICP-MS	1.20	4.89	8.63	0.36	3.53
147	DRC/CC-ICP-MS	0.983	4.44	7.86	0.31	2.83
264	ICP-MS	1.08	3.85	7.77	0.31	2.99
293	DRC/CC-ICP-MS	1.12	4.53	8.11	0.43	3.05
485	HR-ICP-MS	1.01	4.38	8.15	0.307	2.95
597	ICP-MS	1.06	4.05	8.24	<0.75	3.01
598	DRC/CC-ICP-MS	*1.74	4.1	*4.2 ↓	<0.2	2.6

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

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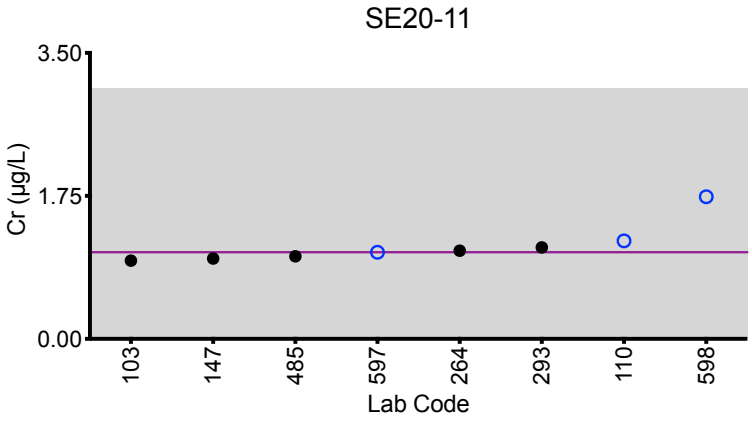
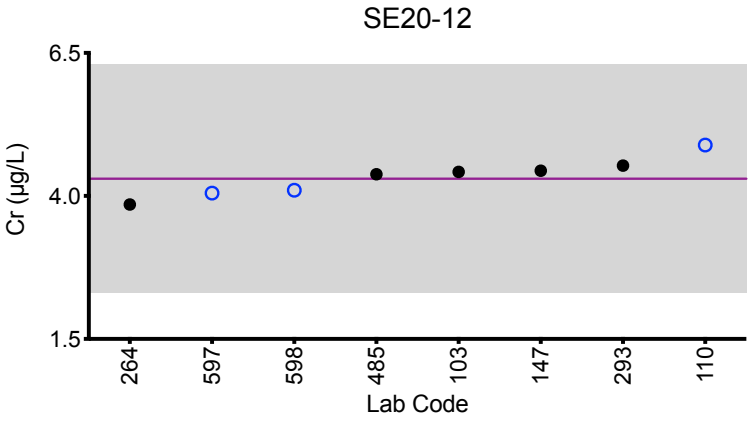
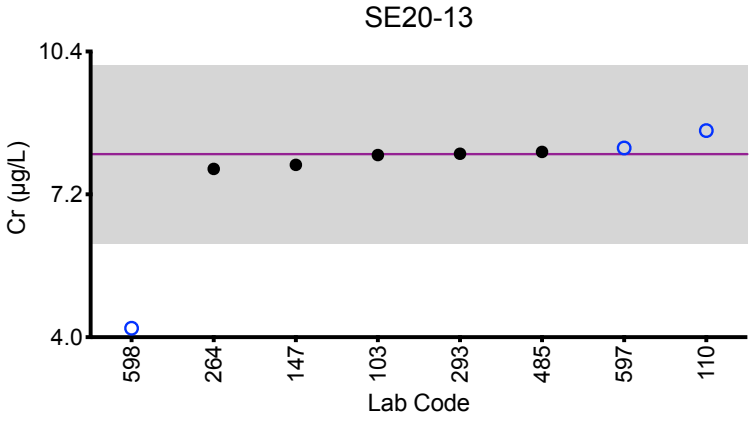
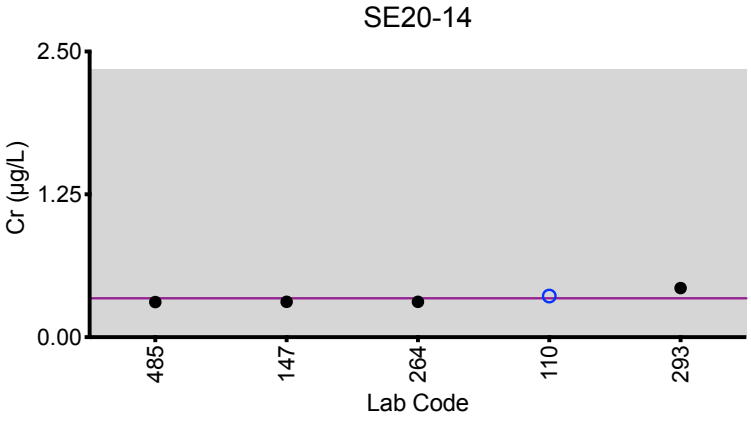
Results for Event #3, 2020: Summary Figures

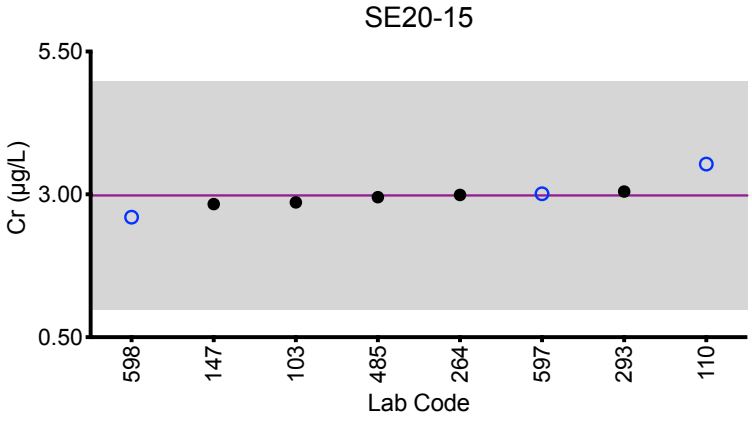
Serum Cr











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Serum Cu (µg/L)				
	SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Target (Arithmetic Mean ($\bar{x}$))	880	1600	1190	1960	2640
Upper Limit	1012	1840	1370	2250	3040
Lower Limit	748	1360	1010	1670	2240
Arithmetic SD (s)	40	80	60	130	160
Arithmetic RSD (%)	4.5	5.1	4.7	6.6	6.1
Number of Sample Measurements (N)	9	9	9	9	9

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

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Results for Event #3, 2020:
Performance of Participating Laboratories

		Serum Cu (µg/L)				
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
	Target	**880**	**1600**	**1190**	**1960**	**2640**
107	DRC/CC-ICP-MS	914	1682	1229	2058	2677
110	ICP-MS	931	1670	1240	1750	2760
147	DRC/CC-ICP-MS	835	1563	1119	1893	2503
264	ICP-MS	843	1543	1142	1938	2563
293	DRC/CC-ICP-MS	864.59	1608.39	1182.45	2008.9	2663.7
457	ICP-AES/OES	944	1711	1267	2183	2969
483	DRC/CC-ICP-MS	865	1530	1180	1960	2520
597	ICP-MS	882	1617	1228	2011	2668
598	ICP-MS	844	1458	1109	1805	2433

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

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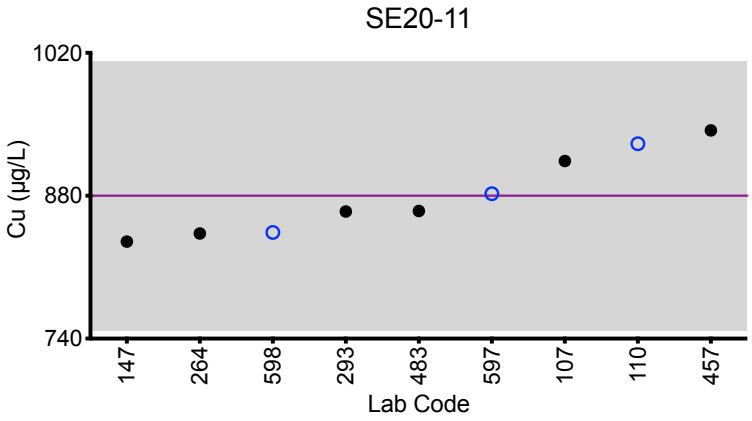
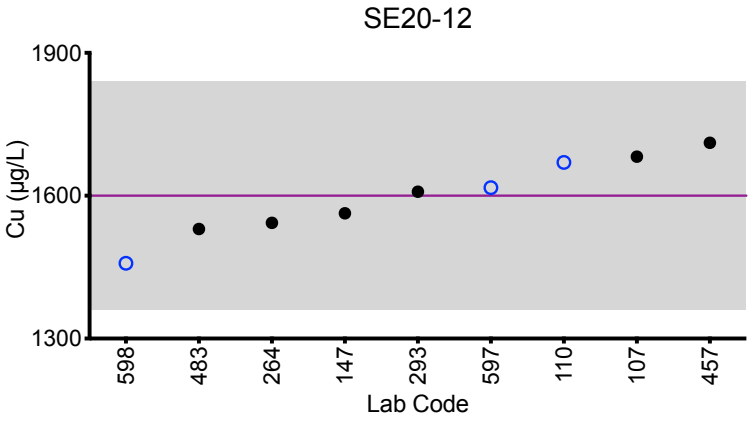
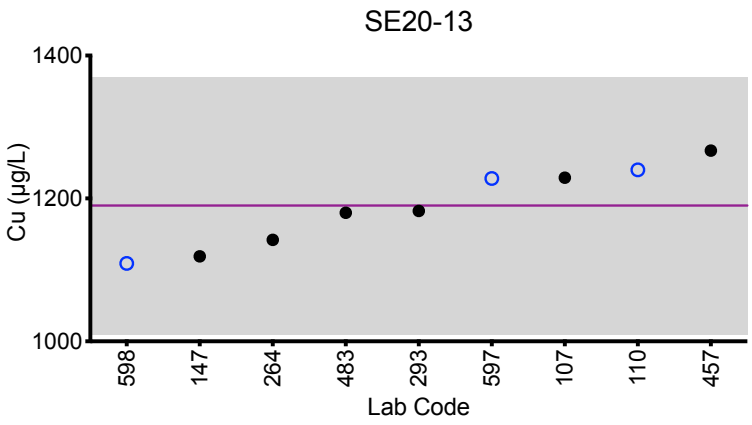
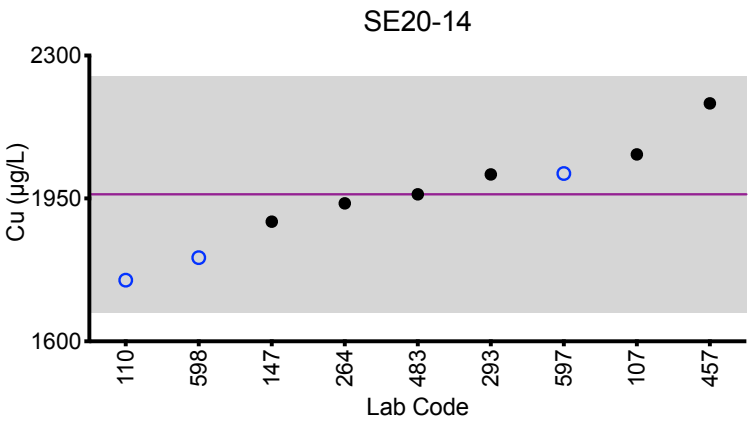
Results for Event #3, 2020: Summary Figures

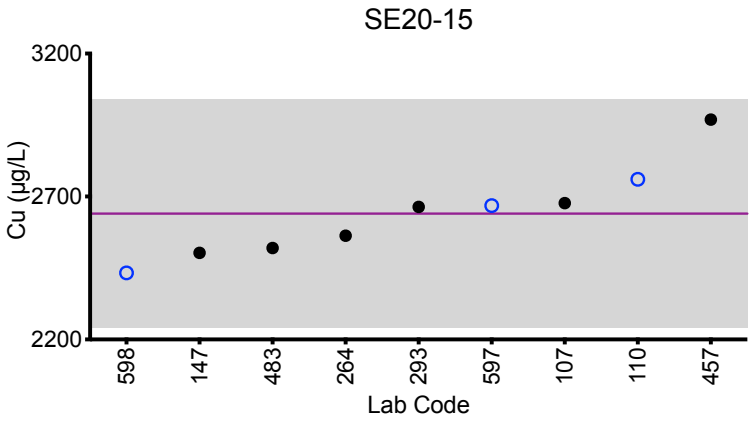
Serum Cu











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

	Serum Se (µg/L)				
	SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Target (Arithmetic Mean ($\bar{x}$))	141	216	109	179	285
Upper Limit	169	259	131	215	342
Lower Limit	113	173	87	143	228
Arithmetic SD (s)	5	9	3	11	14
Arithmetic RSD (%)	3.5	4.2	2.8	6.1	4.9
Number of Sample Measurements (N)	9	9	8	9	9

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

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Results for Event #3, 2020:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
	Target	**141**	**216**	**109**	**179**	**285**
103	ICP-MS/MS	148	229	113	195	306
107	DRC/CC-ICP-MS	142.9	217.5	109.7	185.4	285.5
110	DRC/CC-ICP-MS	147	219	112	159	290
147	DRC/CC-ICP-MS	137	215	*91.6	172	272
264	ICP-MS	136.40	204.40	107.26	172.58	273.13
293	DRC/CC-ICP-MS	147.59	227.31	111.29	193.37	307.02
483	DRC/CC-ICP-MS	134	201	106	176	268
597	ICP-MS	141	218	109	179	282
598	DRC/CC-ICP-MS	138	213	104	183	284

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

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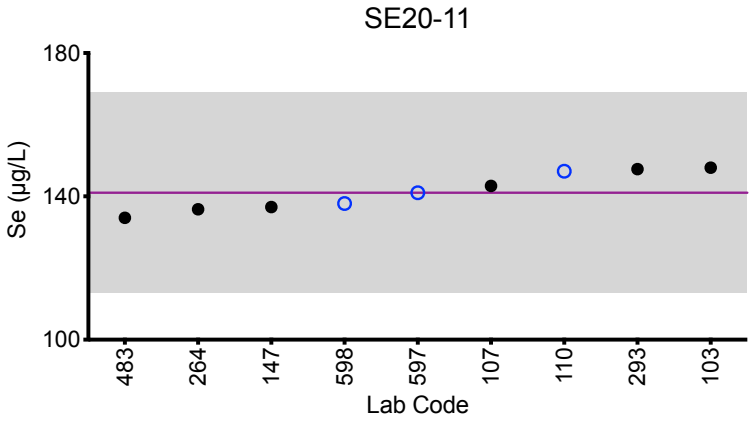
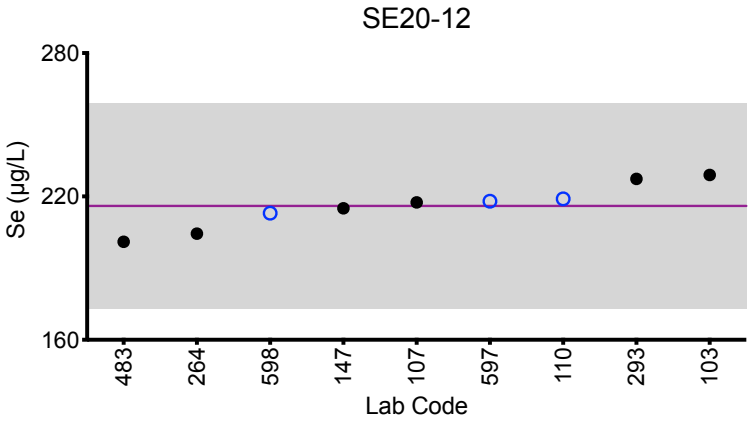
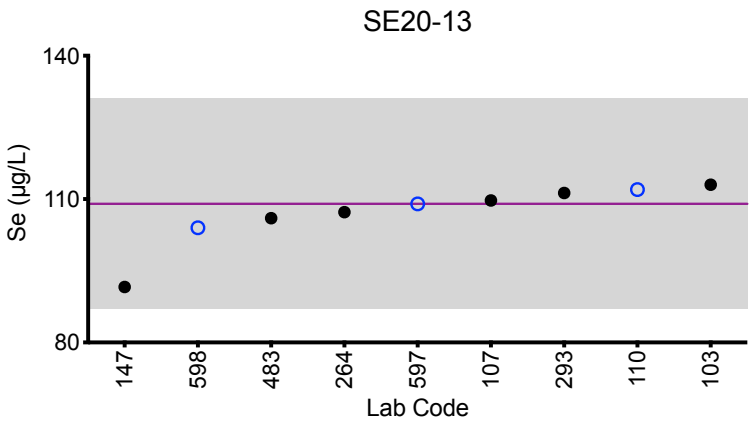
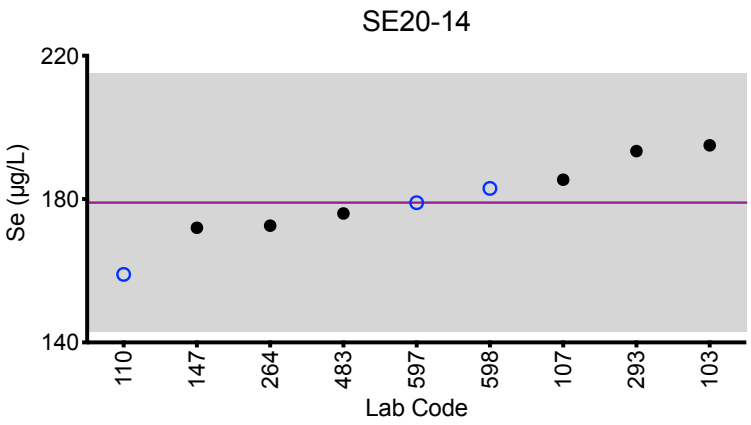
Results for Event #3, 2020: Summary Figures

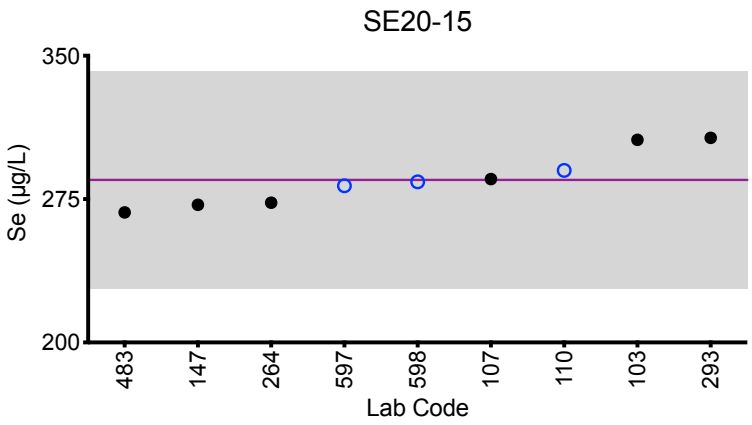
Serum Se











Legend:

o C/HHEAR 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 #3, 2020: Summary Statistics

Serum Zn (µg/L)					
	SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Target (Arithmetic Mean ($\bar{x}$))	1140	866	1880	800	2590
Upper Limit	1310	996	2160	920	2980
Lower Limit	970	736	1600	680	2200
Arithmetic SD (s)	60	40	100	60	120
Arithmetic RSD (%)	5.3	4.6	5.3	7.5	4.6
Number of Sample Measurements (N)	9	9	9	9	9

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

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Results for Event #3, 2020:
Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
	Target	**1140**	**866**	**1880**	**800**	**2590**
107	DRC/CC-ICP-MS	1191	929	1985	854	2729
110	ICP-MS	1240	888	2040	701	2710
147	DRC/CC-ICP-MS	1046	796	1752	732	2376
264	ICP-MS	1083	832	1796	781	2482
293	DRC/CC-ICP-MS	1111.11	862.75	1856.21	797.39	2594.77
457	ICP-AES/OES	1160	905	1802	880	2628
483	DRC/CC-ICP-MS	1120	845	1890	819	2500
597	ICP-MS	1169	864	1972	807	2673
598	ICP-MS	1145	868	1837	798	2659

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

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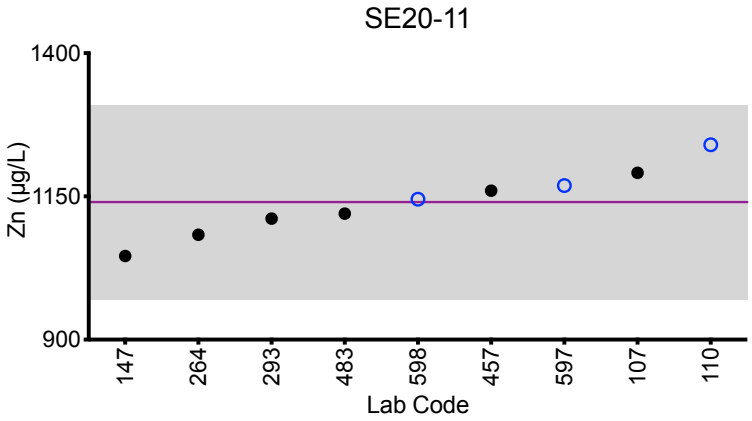
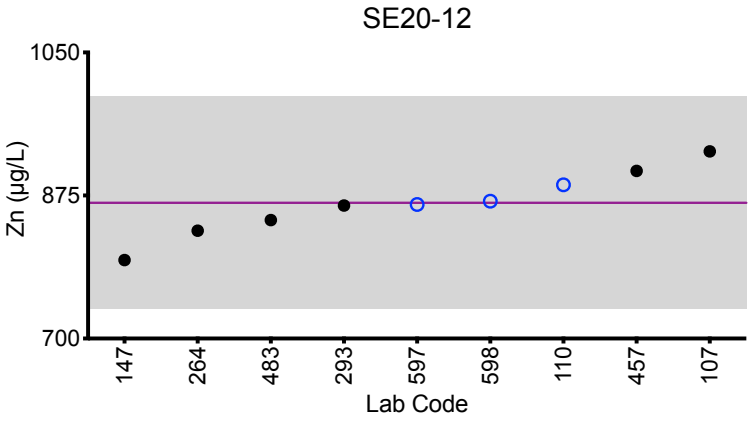
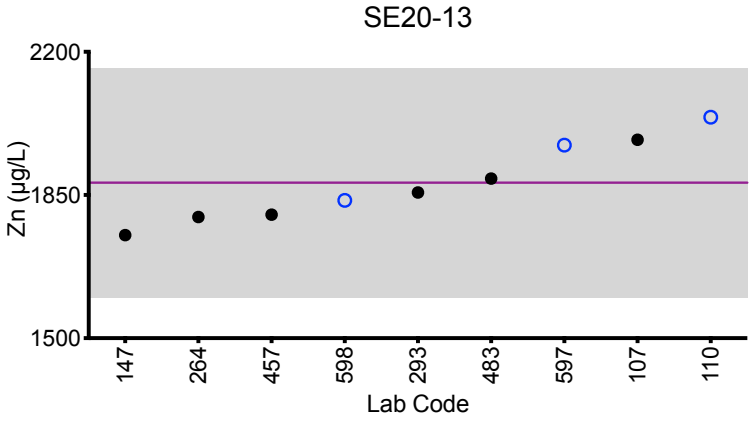
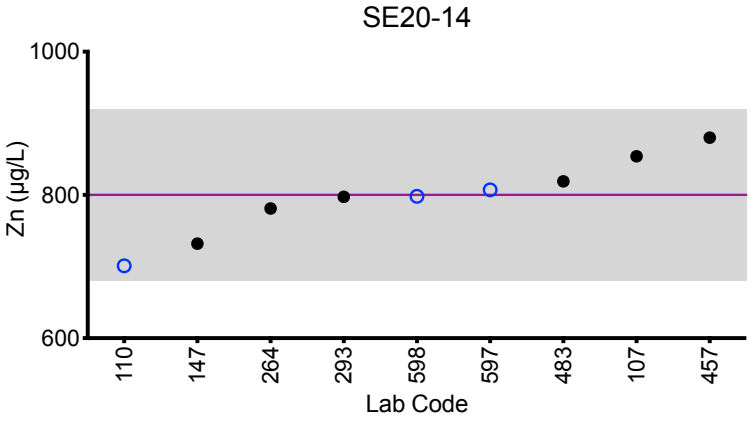
Results for Event #3, 2020: Summary Figures

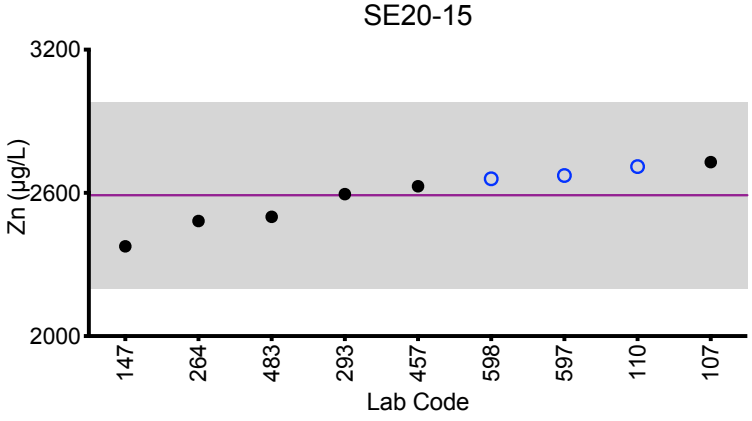
Serum Zn











Legend:

o C/HHEAR 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 #3, 2020:
Laboratory Data and Summary Statistics

Serum As (µg/L)

Lab Code	Method	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
103	ICP-MS/MS	27.6	4.07	8.14	1.53	15.1
110	DRC/CC-ICP-MS	28.3	4.42	8.11	1.64	15.9
147	DRC/CC-ICP-MS	27.0	4.10	7.14	1.50	14.0
597	ICP-MS	25.6	3.94	7.16	1.50	13.7
598	DRC/CC-ICP-MS	25.3	3.8	7.4	1.4	14.2

Summary Statistics

	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
Arithmetic Mean ($\bar{x}$)	26.8	4.1	7.6	1.51	14.6
Arithmetic SD (s)	1.3	0.2	0.5	0.09	0.9
Arithmetic RSD (%)	4.9	5.7	6.6	5.9	6.2
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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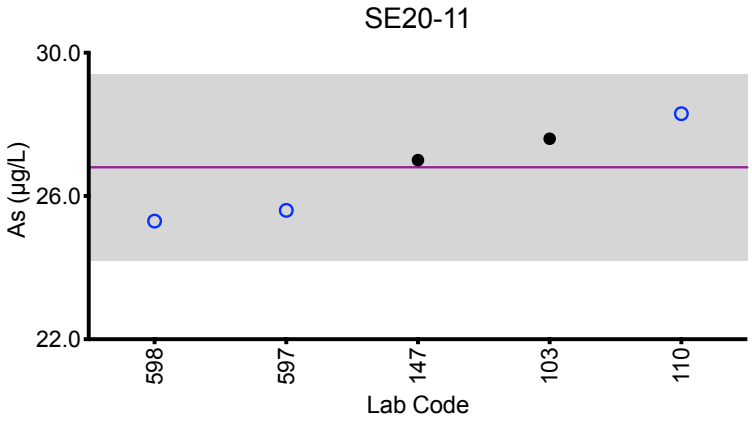
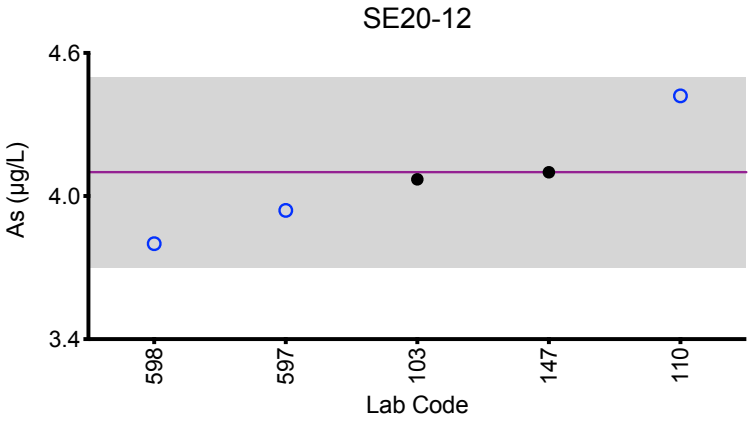
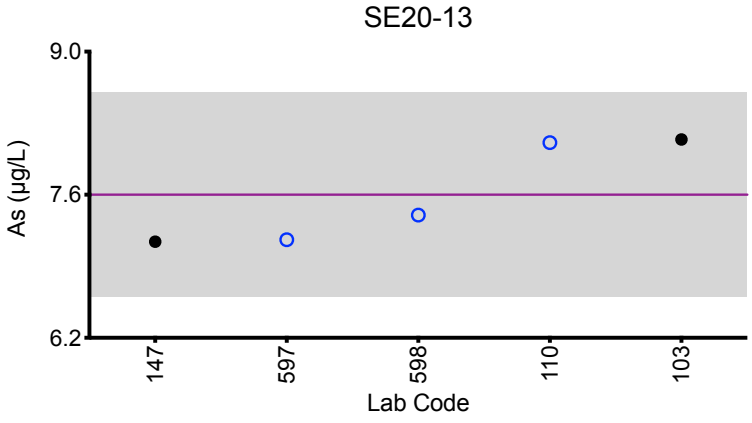
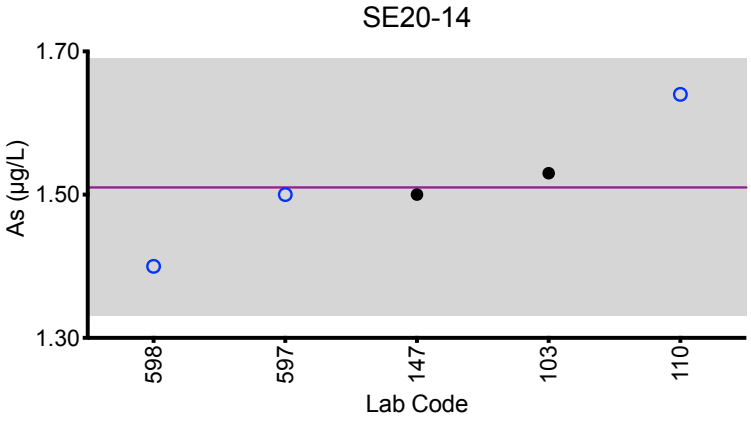
Results for Event #3, 2020: Summary Figures

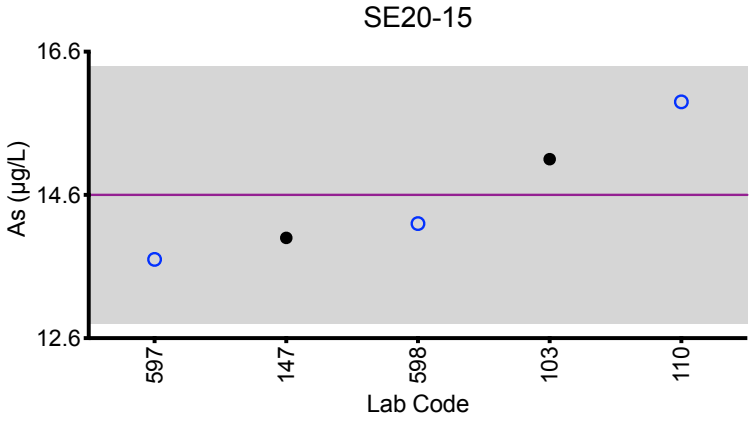
Serum As











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

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Be (µg/L)

Lab Code	Method	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
110	ICP-MS	5.34	4.48	0.231	2.09	0.636
147	ICP-MS	4.89	4.32	*2.41	2.32	0.667
293	ICP-MS	5.73	4.76	0.25	2.74	0.62
597	ICP-MS	5.76	4.62	0.259	2.17	0.515
598	ICP-MS	5.8	4.51	0.21	2.49	0.64

Summary Statistics

	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
Arithmetic Mean ($\bar{x}$)	5.5	4.54	0.24	2.4	0.62
Arithmetic SD (s)	0.4	0.16	0.02	0.3	0.06
Arithmetic RSD (%)	7.3	3.5	9.2	11	9.7
Number of Sample Measurements (N)	5	5	4	5	5

*Denotes a statistical Outlier.

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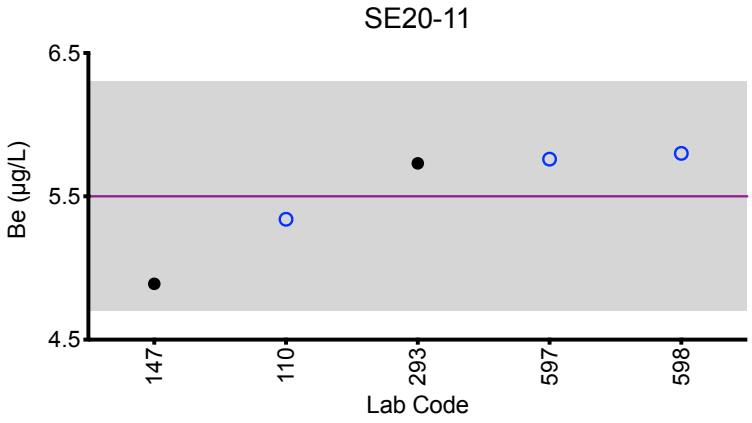
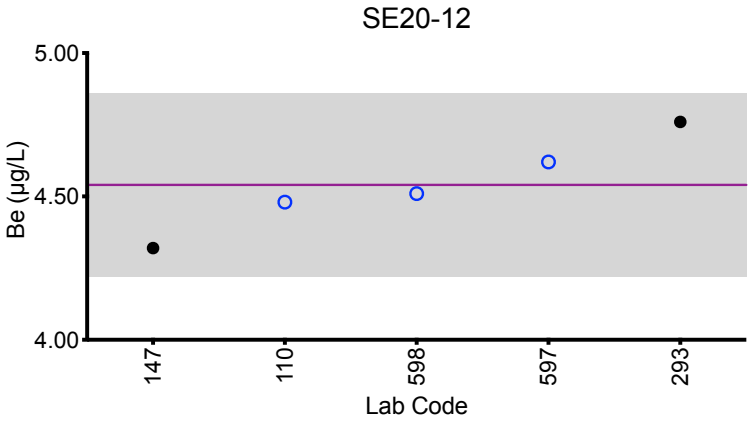
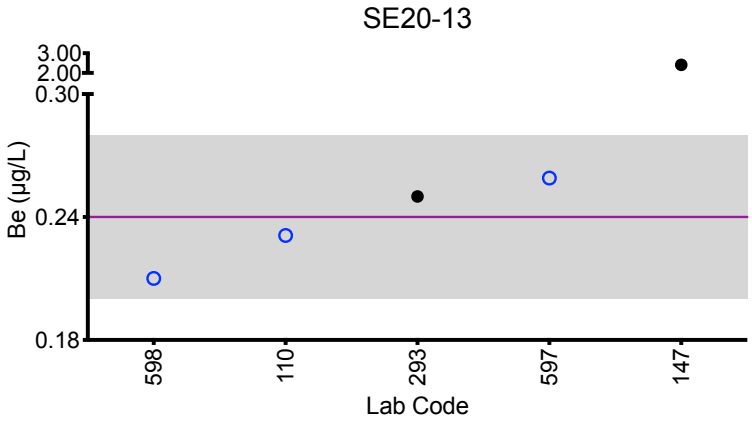
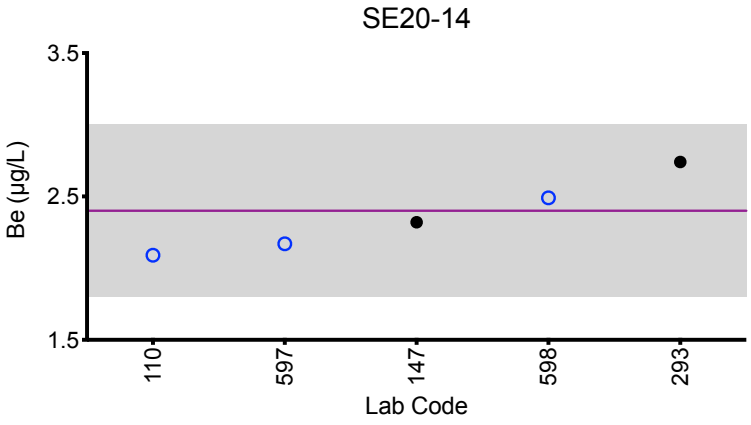
Results for Event #3, 2020: Summary Figures

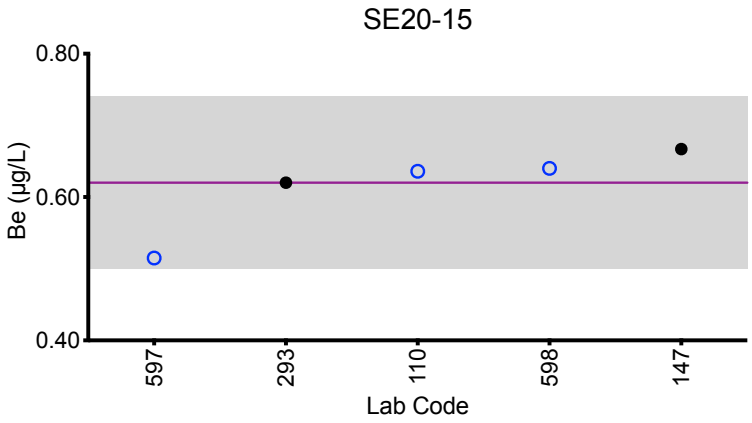
Serum Be











Legend:
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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
103	ICP-MS/MS	1.09	5.32	2.70	0.514	7.01
110	ICP-MS	1.07	5.33	2.63	0.415	7.13
147	ICP-MS	1.16	5.650	2.73	0.534	7.070
597	ICP-MS	1.00	5.18	2.55	0.472	6.71
598	DRC/CC-ICP-MS	0.82	4.7	2.5	0.34	6.34

Summary Statistics					
	SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)	1.03	5.2	2.62	0.46	6.8
Arithmetic SD (s)	0.13	0.3	0.10	0.08	0.3
Arithmetic RSD (%)	13	5.8	3.8	17	4.8
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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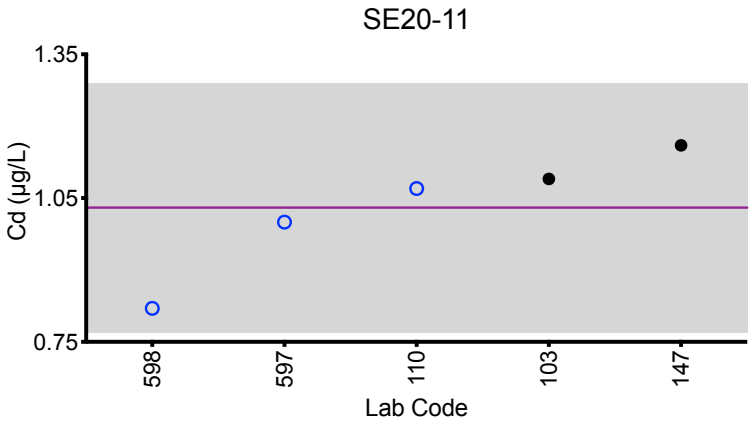
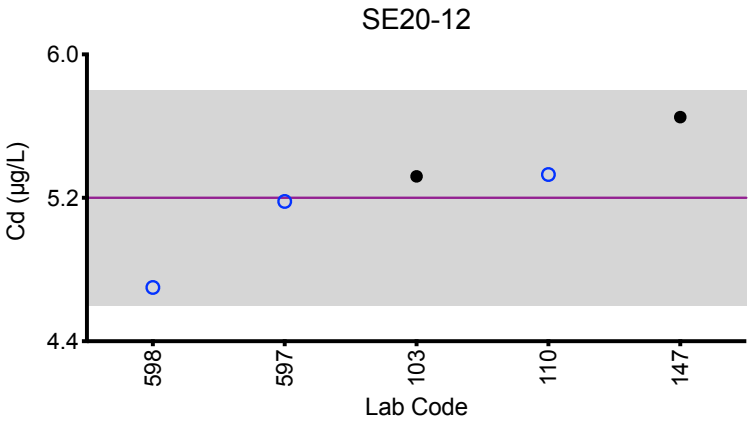
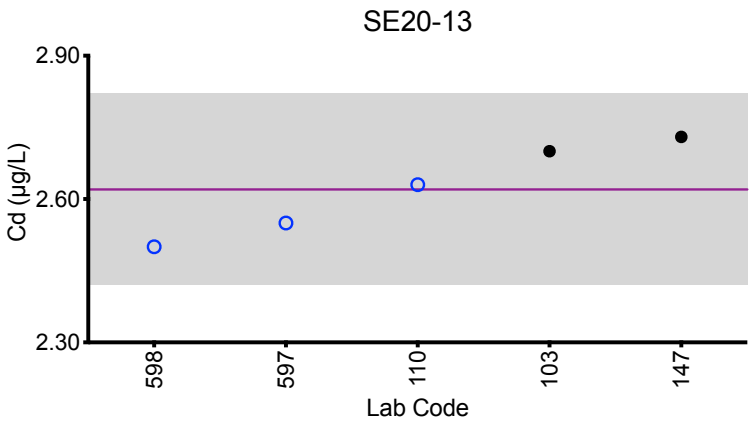
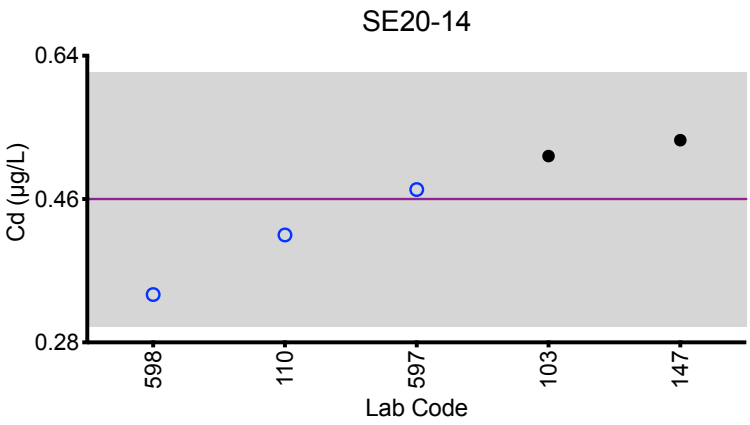
Results for Event #3, 2020: Summary Figures

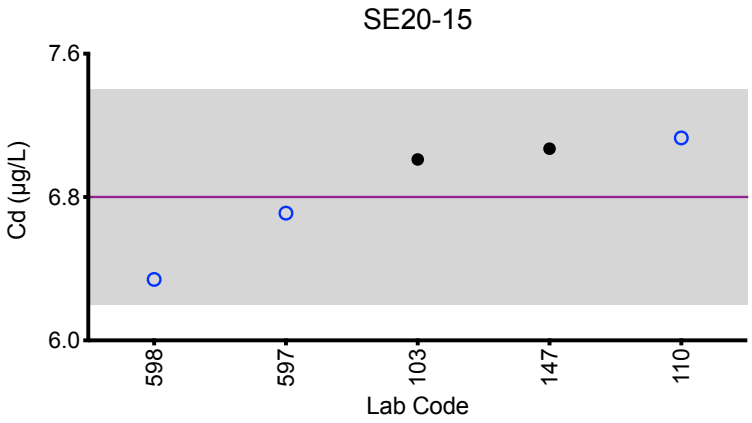
Serum Cd











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
103	ICP-MS/MS	5.91	3.47	8.75	15.5	2.40
110	ICP-MS	6.12	3.54	8.79	12.8	2.30
147	DRC/CC-ICP-MS	5.53	3.30	8.15	13.8	2.26
264	ICP-MS	6.63	3.97	9.37	16.62	4.08
293	DRC/CC-ICP-MS	5.74	3.33	8.53	15.34	2.40
457	ICP-AES/OES	7	4.5	8.8	16.5	3.8
597	ICP-MS	5.94	3.31	8.77	14.9	2.20
598	ICP-MS	5.61	3.23	7.95	13.9	2.11
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		6.1	3.6	8.6	14.9	2.7
Arithmetic SD (s)		0.5	0.4	0.4	1.3	0.8
Arithmetic RSD (%)		8.2	11	4.7	8.7	30
Number of Sample Measurements (N)		8	8	8	8	8

*Denotes a statistical Outlier.

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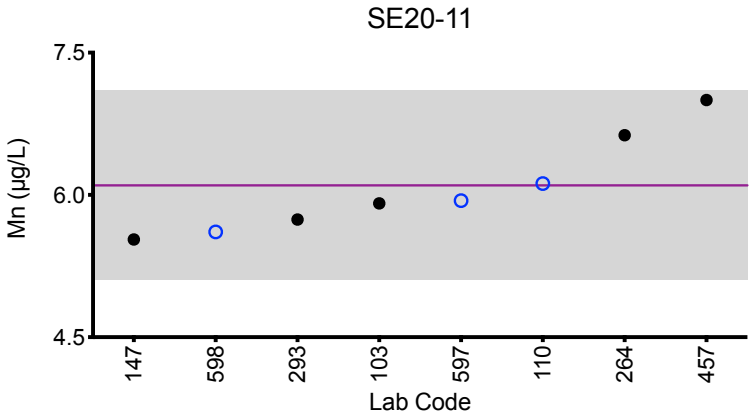
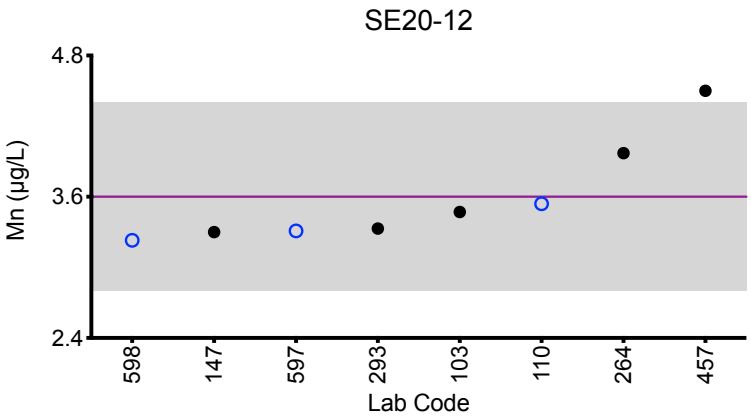
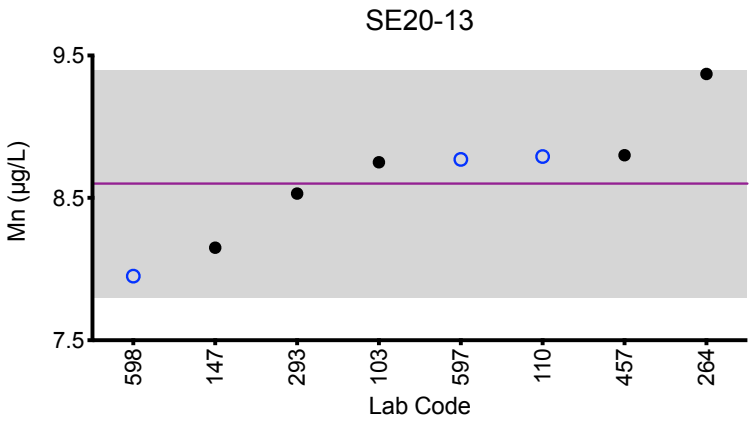
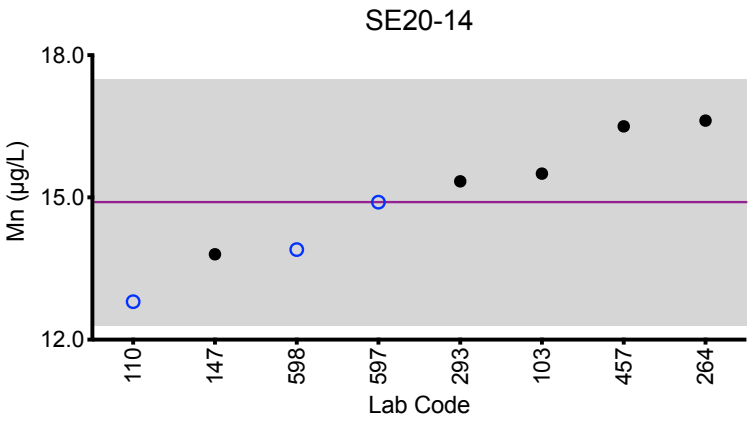
Results for Event #3, 2020: Summary Figures

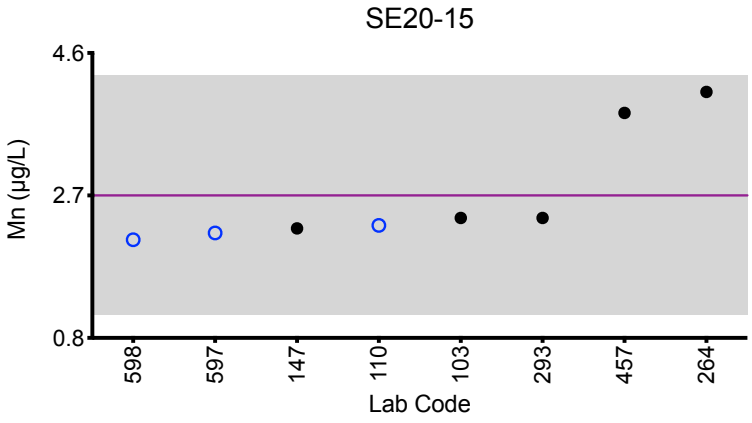
Serum Mn











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Mo (µg/L)

Lab Code	Method	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
103	ICP-MS/MS	4.85	2.75	6.85	1.37	7.53
110	ICP-MS	5.08	2.87	6.73	1.27	7.72
147	DRC/CC-ICP-MS	4.73	2.74	6.42	1.32	7.06
293	DRC/CC-ICP-MS	4.71	2.63	6.29	1.49	7.10
485	HR-ICP-MS	4.81	2.79	6.58	1.38	7.33
597	ICP-MS	4.56	2.60	6.34	1.39	6.82
598	DRC/CC-ICP-MS	5.0	2.5	6.9	1.4	7.8

Summary Statistics

	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
Arithmetic Mean ($\bar{x}$)	4.82	2.70	6.59	1.37	7.3
Arithmetic SD (s)	0.18	0.13	0.25	0.07	0.4
Arithmetic RSD (%)	3.7	4.8	3.8	5.1	4.9
Number of Sample Measurements (N)	7	7	7	7	7

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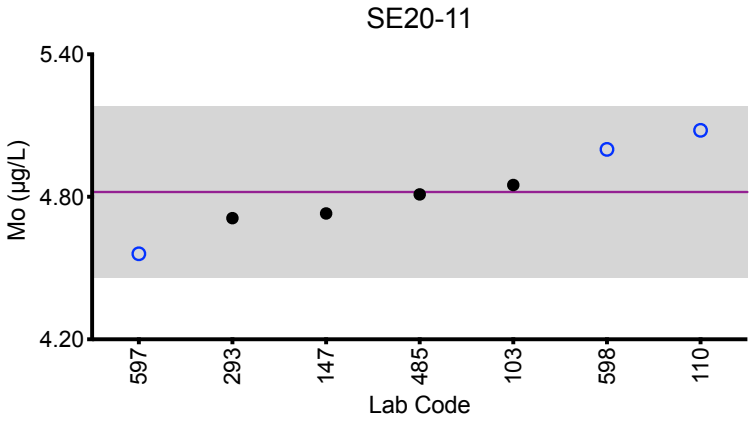
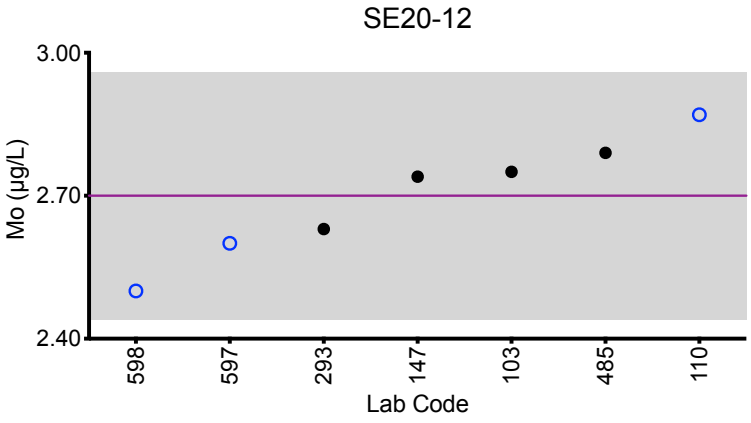
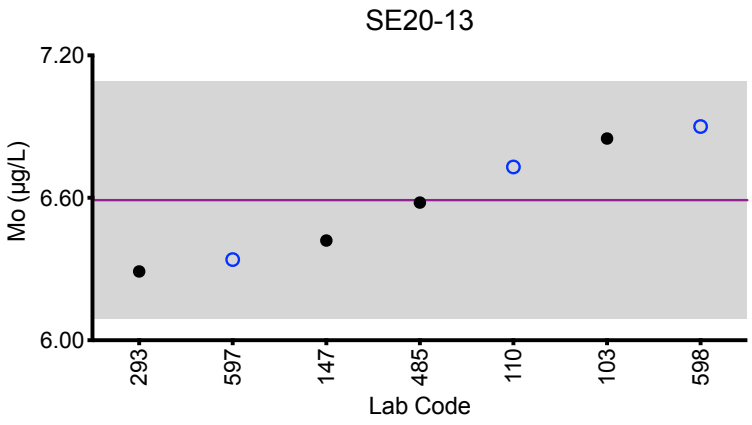
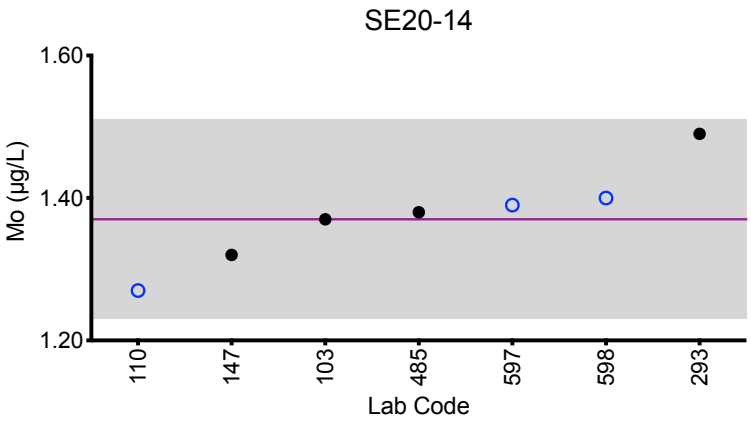
Results for Event #3, 2020: Summary Figures

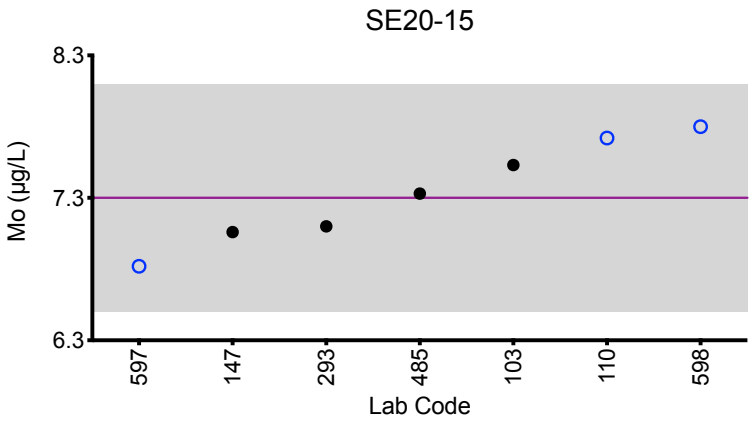
Serum Mo











Legend:
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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
110	DRC/CC-ICP-MS	2.36	5.20	5.52	16.8	*40.5
147	DRC/CC-ICP-MS	1.53	4.85	4.83	12.70	13.6
293	DRC/CC-ICP-MS	1.62	4.76	4.84	14.47	13.79
485	HR-ICP-MS	1.52	4.78	4.62	12.4	14.6
598	ICP-MS	*6.25	*6.44	*8.2	15.2	*30.6
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		1.8	4.9	5.0	14.3	14
Arithmetic SD (s)		0.4	0.2	0.4	1.8	1
Arithmetic RSD (%)		22	4.3	8.0	13	3.8
Number of Sample Measurements (N)		4	4	4	5	3

*Denotes a statistical Outlier.

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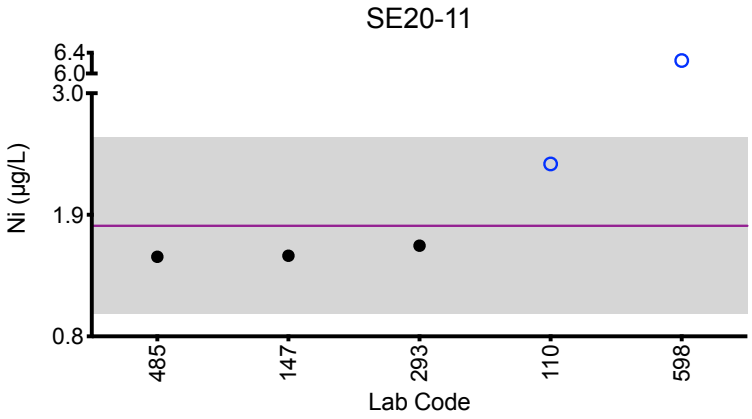
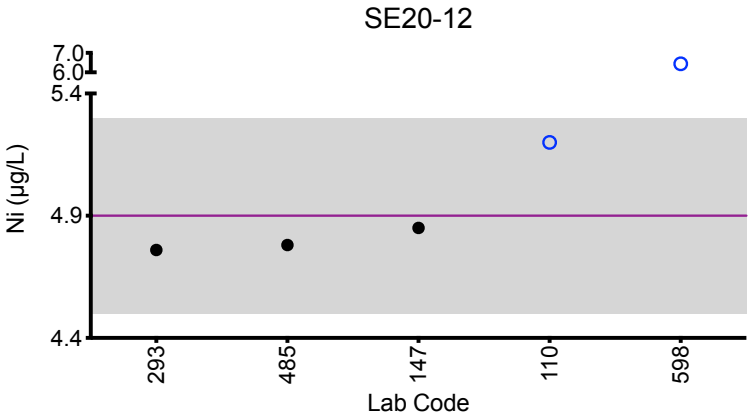
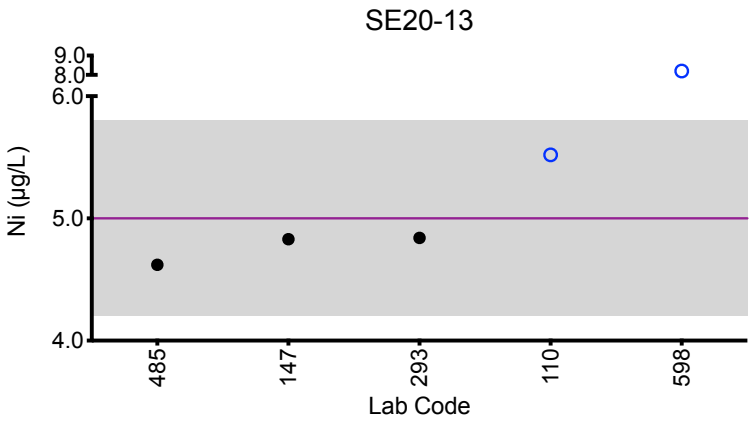
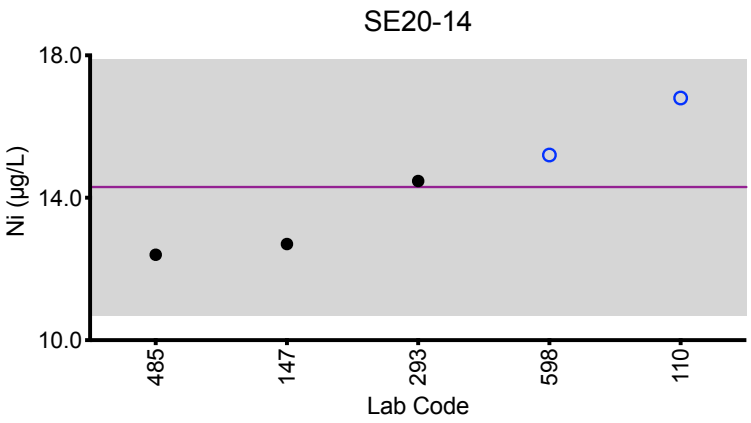
Results for Event #3, 2020: Summary Figures

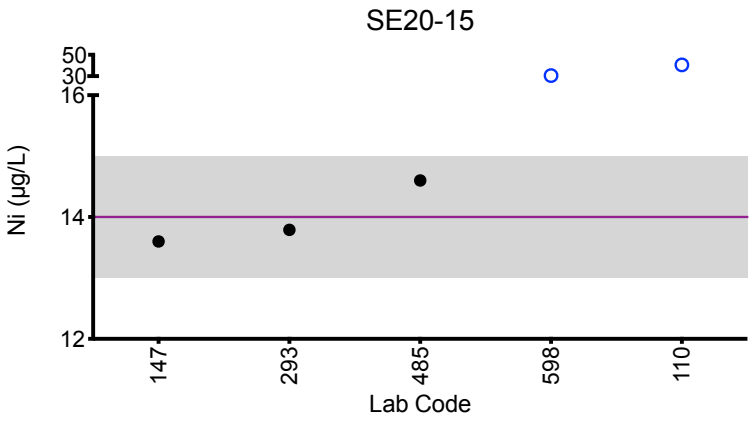
Serum Ni











Legend:
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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
103	ICP-MS/MS	3.53	4.99	2.11	6.06	0.985
110	ICP-MS	3.96	5.41	2.40	5.13	1.05
147	ICP-MS	3.66	5.19	2.14	5.69	0.936
597	ICP-MS	3.40	4.85	2.17	5.50	0.952
598	ICP-MS	3.67	5.16	2.23	5.80	1.0
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		3.64	5.12	2.21	5.6	0.98
Arithmetic SD (s)		0.21	0.21	0.12	0.3	0.04
Arithmetic RSD (%)		5.8	4.1	5.4	5.4	4.1
Number of Sample Measurements (N)		5	5	5	5	5

*Denotes a statistical Outlier.

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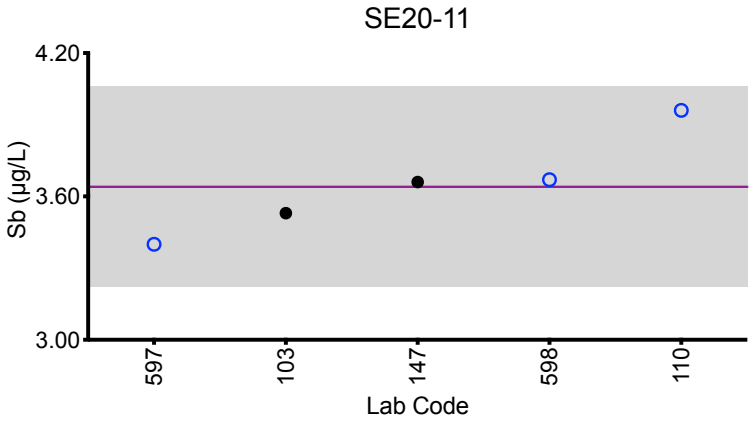
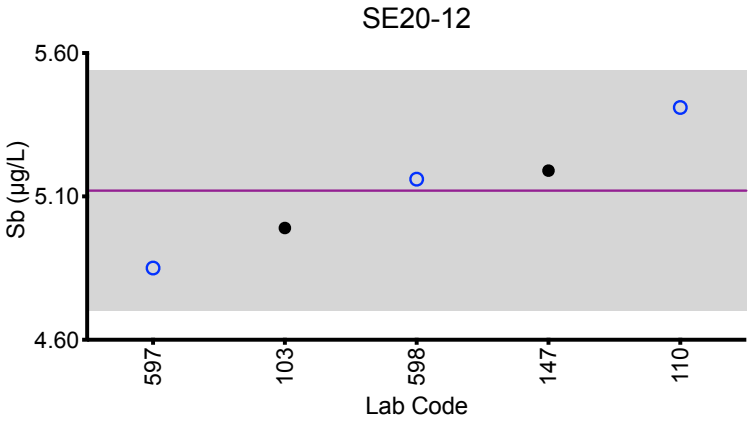
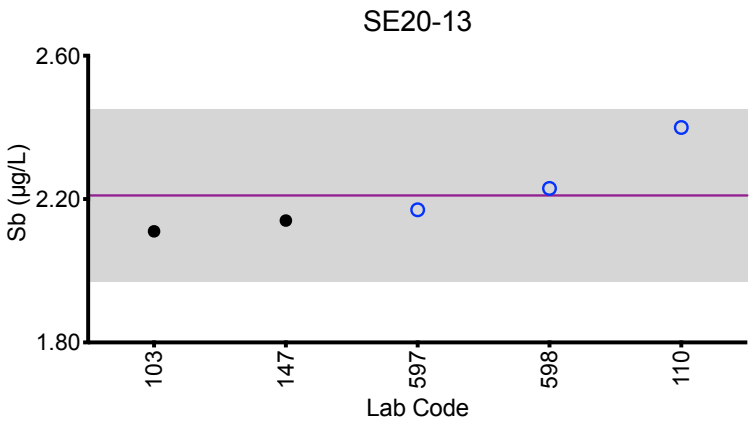
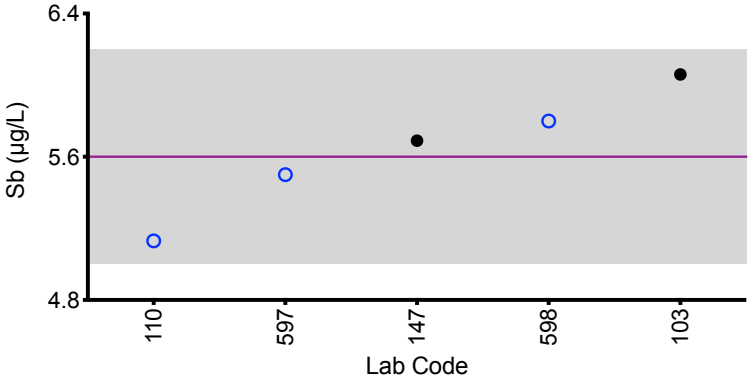
Results for Event #3, 2020: Summary Figures

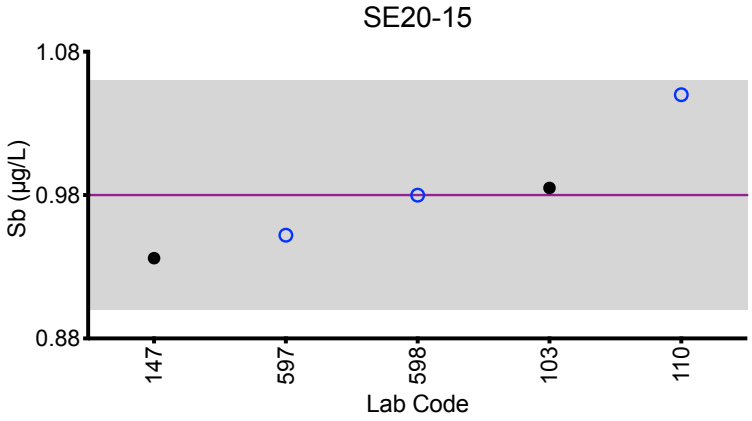
Serum Sb











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)

Lab Code	Method	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
103	ICP-MS/MS	4.83	2.78	0.831	1.95	1.43
110	ICP-MS	4.78	2.81	0.823	1.63	1.45
147	ICP-MS	4.50	2.68	0.783	1.89	1.37
597	ICP-MS	4.82	2.70	0.82	1.92	1.36
598	ICP-MS	4.22	*1.26	0.7	1.68	1.24

Summary Statistics

	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
Arithmetic Mean ($\bar{x}$)	4.6	2.74	0.79	1.81	1.37
Arithmetic SD (s)	0.3	0.06	0.05	0.15	0.08
Arithmetic RSD (%)	5.8	2.2	6.3	8.3	5.8
Number of Sample Measurements (N)	5	4	5	5	5

*Denotes a statistical Outlier.

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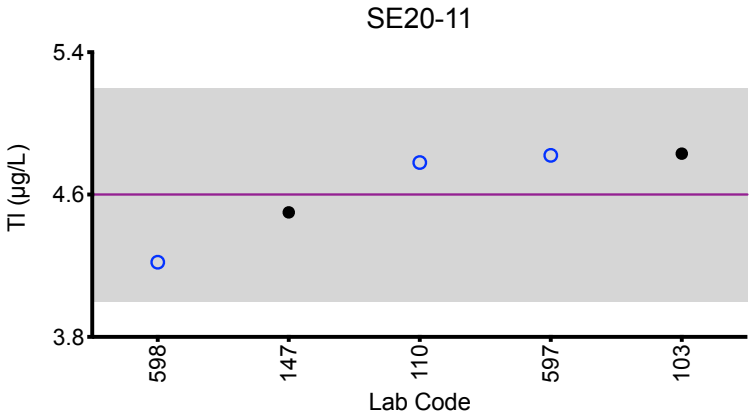
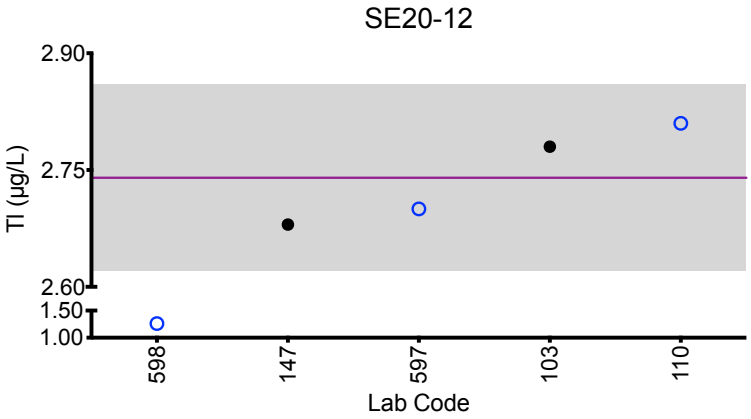
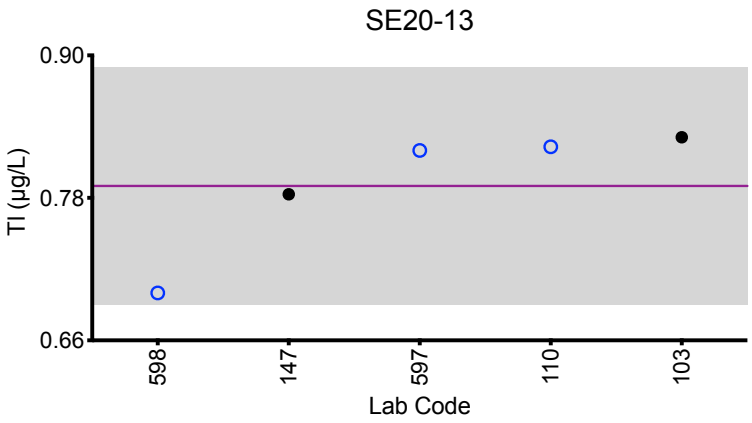
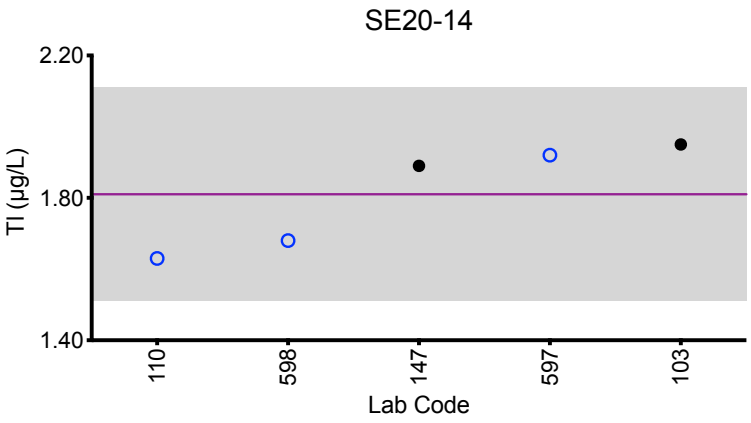
Results for Event #3, 2020: Summary Figures

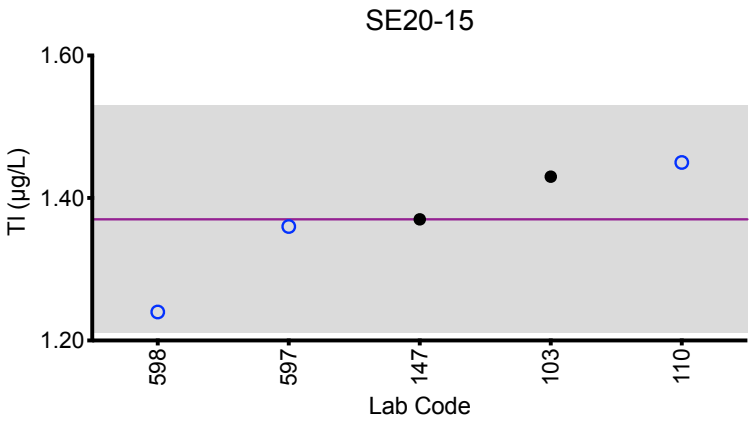
Serum Tl











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum V (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
110	DRC/CC-ICP-MS	*0.9	*7.8	6.4	2.2	10.1
147	DRC/CC-ICP-MS	0.255	6.58	4.90	1.75	7.83
293	DRC/CC-ICP-MS	0.37	6.79	5.55	2.09	8.70
485	HR-ICP-MS	0.271	6.69	5.27	1.92	8.57
597	ICP-MS	0.294	6.59	5.18	1.88	8.07
598	DRC/CC-ICP-MS	0.37	6.6	5.1	2	8.7
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		0.31	6.65	5.4	1.97	8.7
Arithmetic SD (s)		0.05	0.09	0.5	0.16	0.8
Arithmetic RSD (%)		16	1.4	9.3	8.1	9.2
Number of Sample Measurements (N)		5	5	6	6	6

*Denotes a statistical Outlier.

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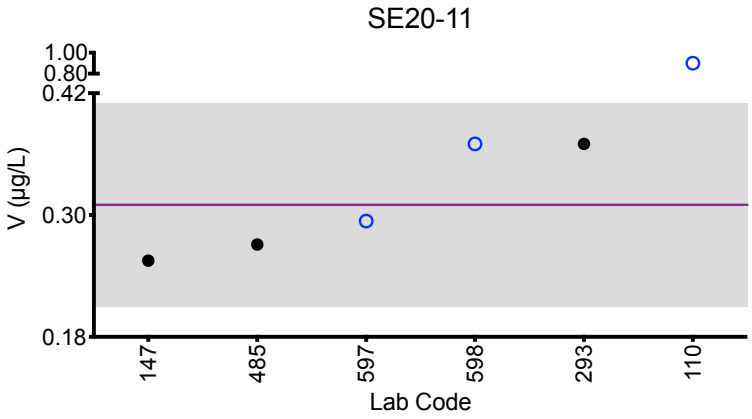
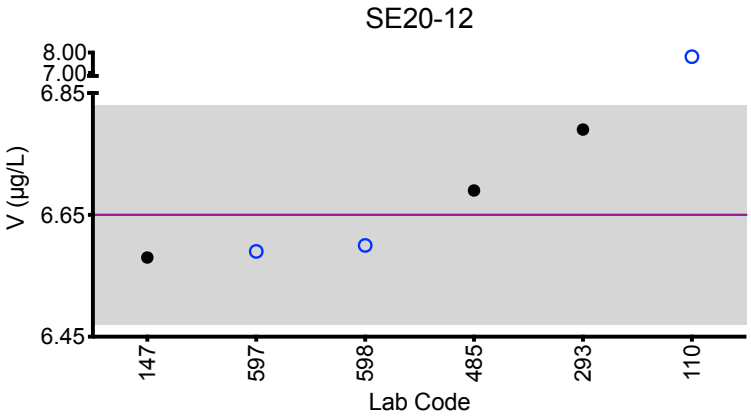
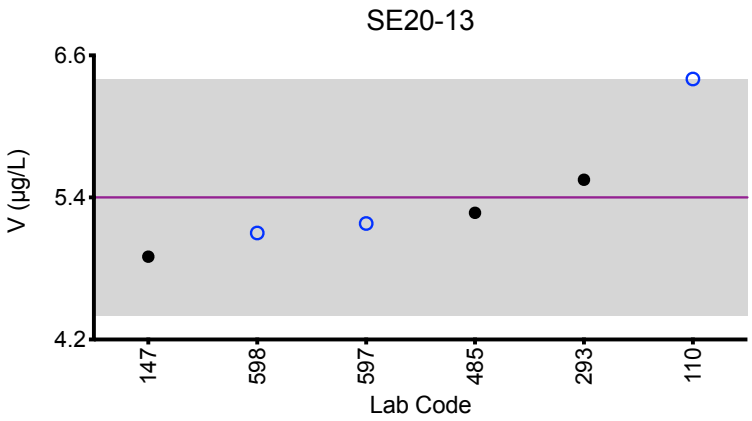
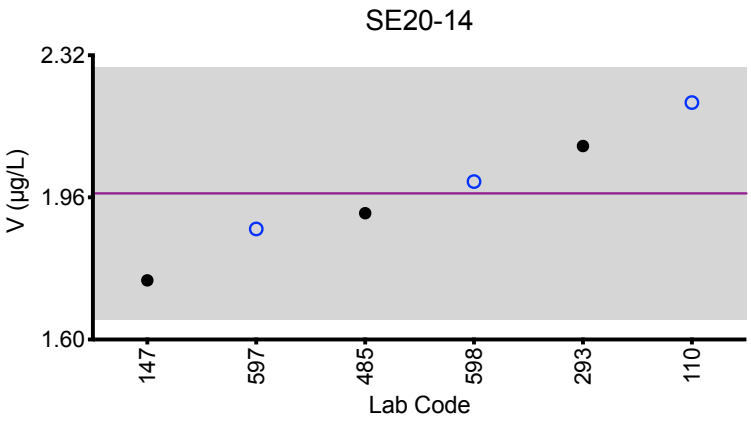
Results for Event #3, 2020: Summary Figures

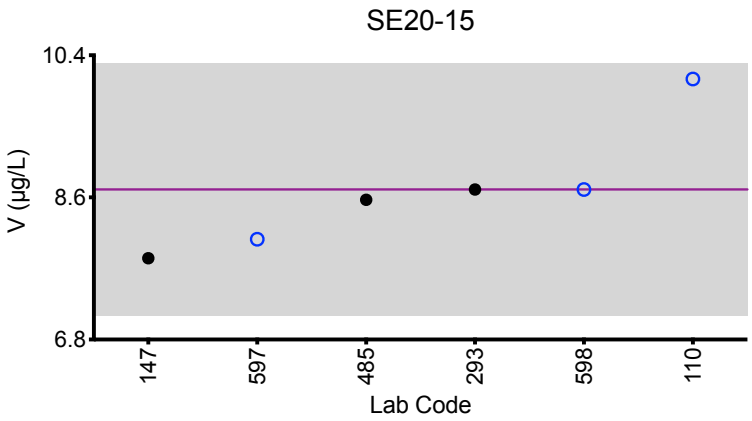
Serum V











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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
110	ICP-MS	1.11	1.25	0.88	0.66	1.86
147	ICP-MS	1.14	1.31	0.801	0.816	1.72
598	ICP-MS	0.86	1.14	0.79	0.71	1.8
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		1.04	1.23	0.82	0.73	1.79
Arithmetic SD (s)		0.15	0.09	0.05	0.08	0.07
Arithmetic RSD (%)		14	7.3	6.1	11	3.9
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
110	ICP-MS	0.370	1.16	0.663	0.678	0.448
597	ICP-MS	0.456	1.22	0.775	0.844	0.513
598	ICP-MS	0.33	1.0	0.60	0.69	0.40
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		0.39	1.14	0.68	0.74	0.45
Arithmetic SD (s)		0.06	0.09	0.09	0.09	0.06
Arithmetic RSD (%)		15	7.9	13	12	13
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Fe (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
264	ICP-MS	914.0	944	1351	603	589
457	ICP-AES/OES	911.0	921	1327	624	606

Summary Statistics					
	SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)	912	933	1339	614	598
Arithmetic SD (s)	2	16	17	15	12
Arithmetic RSD (%)	0.23	1.7	1.3	2.4	2.0
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)

Lab Code	Method	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
103	ICP-MS/MS	5.69	1.39	3.36	4.70	0.685
110	ICP-MS	5.85	1.51	3.39	4.08	0.73
597	ICP-MS	5.33	1.27	3.16	4.26	0.630
598	ICP-MS	5.47	1.26	3.21	4.39	0.59

Summary Statistics

	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
Arithmetic Mean ($\bar{x}$)	5.6	1.36	3.28	4.4	0.66
Arithmetic SD (s)	0.2	0.12	0.11	0.3	0.06
Arithmetic RSD (%)	4.1	8.8	3.4	6.0	9.1
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Mg (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
264	ICP-MS	17808	19096	18359	21306	17756
457	ICP-AES/OES	15591	16437	15987	19029	16173
597	ICP-MS	17500	18400	17600	20400	16600
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		17000	18000	17300	20200	16800
Arithmetic SD (s)		1200	1400	1200	1100	800
Arithmetic RSD (%)		7.1	7.8	6.9	5.4	4.8
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
103	ICP-MS/MS	9.57	6.89	1.61	3.95	2.61
110	ICP-MS	9.66	6.99	1.61	3.19	2.53
597	ICP-MS	9.43	6.73	1.56	3.71	2.45
598	ICP-MS	7.85	5.47	1.21	2.98	1.973
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		9.1	6.5	1.5	3.5	2.4
Arithmetic SD (s)		0.9	0.7	0.2	0.4	0.3
Arithmetic RSD (%)		9.9	11	13	11	12
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
110	ICP-MS	0.61	1.50	1.11	0.66	0.23
264	ICP-MS	0.66	1.54	1.25	0.93	0.25
293	DRC/CC-ICP-MS	0.61	1.41	1.17	0.86	0.25
598	ICP-MS	0.57	1.35	1.16	0.80	0.23
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		0.61	1.45	1.17	0.81	0.240
Arithmetic SD (s)		0.04	0.09	0.06	0.11	0.012
Arithmetic RSD (%)		6.6	6.2	5.1	14	4.8
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
110	ICP-MS	0.91	10.3	2.14	4.77	3.45
597	ICP-MS	0.817	9.45	2.04	5.07	3.11
598	ICP-MS	0.85	9.40	2.0	4.99	3.1
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		0.86	9.7	2.06	4.94	3.2
Arithmetic SD (s)		0.05	0.5	0.07	0.16	0.2
Arithmetic RSD (%)		5.8	5.2	3.4	3.2	6.2
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
103	ICP-MS/MS	112	78.3	153	64.5	115
200	ICP-MS	116	79	155	69	119
597	ICP-MS	115	78.1	151	62.6	111
Summary Statistics						
		SE20-11	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
Arithmetic Mean ($\bar{x}$)		114	78.5	153	65	115
Arithmetic SD (s)		2	0.5	2	3	4
Arithmetic RSD (%)		1.8	0.64	1.3	4.6	3.5
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)

Lab Code	Method	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
200	DRC/CC-ICP-MS	2.7	4.9	5.7	3.6	7.2
485	HR-ICP-MS	2.41	6.51	4.11	9.41	1.23

Summary Statistics

	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
Arithmetic Mean ($\bar{x}$)	2.6	5.7	4.9	NA	NA
Arithmetic SD (s)	0.2	1.1	1.1	NA	NA
Arithmetic RSD (%)	8.2	19	22	NA	NA
Number of Sample Measurements (N)	2	2	2	NA	NA

*Denotes a statistical Outlier.

Statistical data was not calculated for SE20-14 and SE20-15 based on a lack of consensus among participating labs.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum U (µg/L)

Lab Code	Method	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
103	ICP-MS/MS	0.130	0.0865	0.0363	0.196	0.0689
110	ICP-MS	0.128	0.086	0.035	0.170	0.069
598	ICP-MS	0.125	0.08	0.04	0.18	0.06

Summary Statistics

	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
Arithmetic Mean ($\bar{x}$)	0.128	0.084	0.037	0.182	0.066
Arithmetic SD (s)	0.002	0.004	0.003	0.013	0.005
Arithmetic RSD (%)	2.0	4.8	7.0	7.1	7.6
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020:
Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
110	ICP-MS	2.40	0.96	3.32	3.87	0.32
200	ICP-MS	2.8	1.1	3.7	5.4	0.35
598	ICP-MS	2.4	0.93	3.17	4.42	0.28

Summary Statistics

	SE20-11	SE20-12	SE20-13	SE20-14	SE20-15
Arithmetic Mean ($\bar{x}$)	2.5	1.00	3.4	4.6	0.32
Arithmetic SD (s)	0.2	0.09	0.3	0.8	0.04
Arithmetic RSD (%)	9.1	9.1	8.8	17	13
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2020: Additional Elements in Serum

Serum B (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
200	ICP-MS	238.0	194	173	194	205

Serum Bi (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
147	ICP-MS	<0.040	<0.040	<0.040	<0.040	<0.040

Serum I (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
147	ICP-MS	44.9	63.3	62.5	65.2	56.8

Serum Li (µg/L)						
Lab Code	**Method**	**SE20-11**	**SE20-12**	**SE20-13**	**SE20-14**	**SE20-15**
147	ICP-MS	0.777	1.55	0.736	0.701	0.514

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.