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New York State Biomonitoring Program for Trace Elements

Event #2, 2021

Trace Elements in Whole Blood, Urine, and Serum

September, 2021

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #2, 2021:
Trace Elements in Whole Blood, Urine, and Serum

9/17/2021

Dear Laboratory Director,

This report summarizes performance for the second biomonitoring proficiency test (PT) event of 2021 for Trace Elements in Whole Blood, Urine, and Serum. One of the key goals of this PT program is to achieve harmonization of biomonitoring data for trace elements.

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

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

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

Samples for the next PT event (Event #3, 2021) will be shipped September 8, 2021. Comments about this report may be directed to trel@health.ny.gov.

Sincerely,

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

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

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Event #2, 2021

Trace Elements in Whole Blood

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Event #2, 2021:
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

Graded Elements

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

Additional Elements

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

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

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Results for Event #2, 2021:
Summary Statistics

Whole Blood As (µg/L)					
	BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Target (Arithmetic Mean ($\bar{x}$))	7.9	4.1	11.9	33.1	2.33
Upper Limit	13.9	10.1	17.9	39.7	8.33
Lower Limit	1.9	0.0	5.9	26.5	0.00
Arithmetic SD (s)	1.1	0.3	1.0	2.6	0.16
Arithmetic RSD (%)	14	7.3	8.4	7.9	6.9
Number of Sample Measurements (N)	8	7	8	8	7

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

Whole Blood As (µg/L)							
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**	
	Target	**7.9**	**4.1**	**11.9**	**33.1**	**2.33**	
103	ICP-MS/MS	7.59	4.09	11.9	33.0	2.35	
110	DRC/CC-ICP-MS	7.64	4.34	11.4	31.3	2.23	
147	ICP-MS	7.21	3.99	11.2	30.6	2.39	
264	ICP-MS	6.24	3.86	11.59	31.79	2.03	
293	DRC/CC-ICP-MS	8.79	4.65	13.19	36.48	2.4	
391	DRC/CC-ICP-MS	10.04	*8.6	13.68	37.65	*9.0	↑
597	ICP-MS/MS	7.64	4.00	11.5	32.7	2.51	
598	DRC/CC-ICP-MS	7.69	3.8	11.1	31.4	2.4	

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

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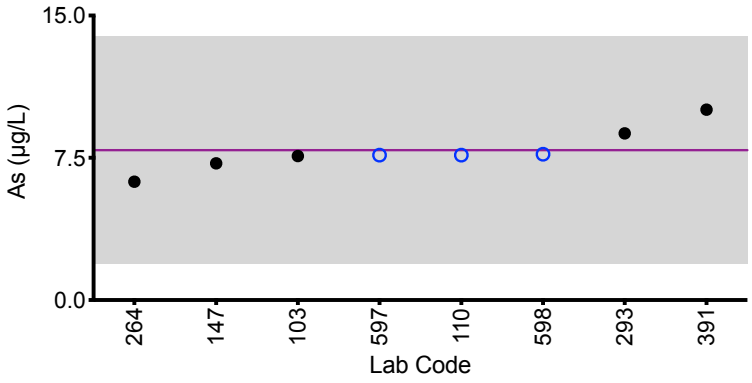
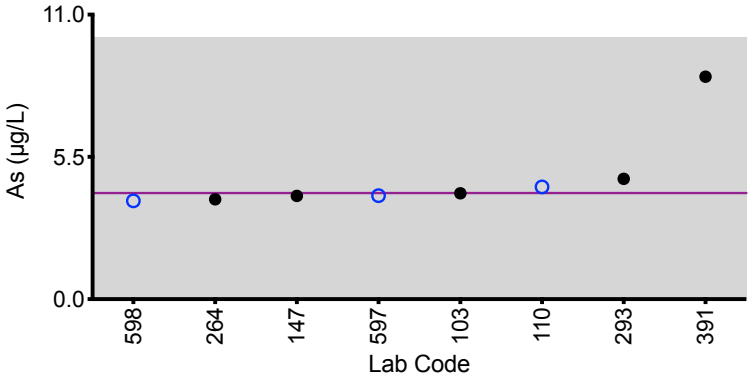
Results for Event #2, 2021: Summary Figures

Whole Blood As

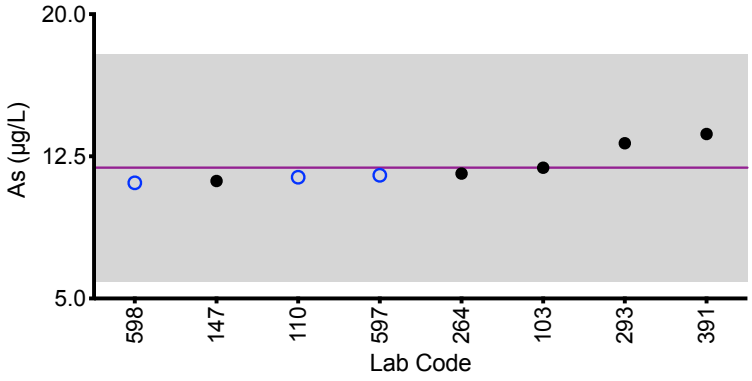
BE21-06



BE21-07



BE21-08



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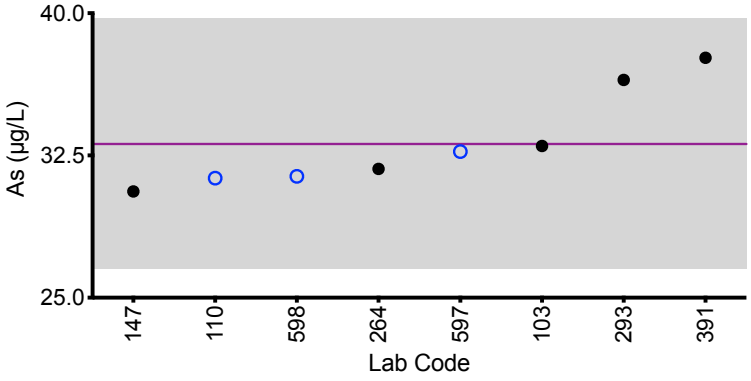

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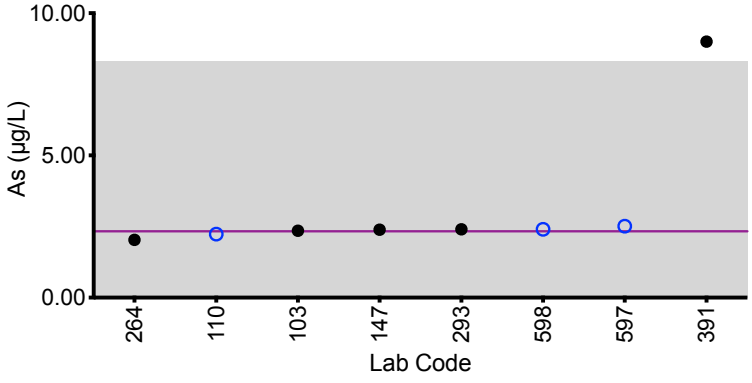

Legend:

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 #2, 2021: Summary Statistics

Whole Blood Cd (µg/L)					
	BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Target (Robust Mean (x*))	5.52	2.00	3.9	0.84	1.37
Upper Limit	6.52	3.00	4.9	1.84	2.37
Lower Limit	4.52	1.00	2.9	0.00	0.37
Robust SD (s*)	0.24	0.17	0.3	0.06	0.08
Robust RSD (%)	4.3	8.5	8.7	7.1	5.8
Number of Sample Measurements (N)	13	13	13	12	12
Standard Uncertainty (*u*)	0.08	0.06	0.1	0.02	0.03

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
	Target	**5.52**	**2.00**	**3.9**	**0.84**	**1.37**
103	ICP-MS/MS	5.66	2.12	3.94	0.819	1.36
107	ICP-MS/MS	5.590	2.046	4.246	0.848	1.398
110	ICP-MS	5.61	2.22	4.09	0.88	1.48
116	ICP-MS/MS	6.04	2.09	4.01	<1.50	<1.50
147	ICP-MS	5.43	2.16	4.20	0.814	1.34
264	ICP-MS	5.02	1.81	3.56	0.86	1.27
293	DRC/CC-ICP-MS	5.17	1.87	3.720	0.78	1.20
391	DRC/CC-ICP-MS	4.53	1.40	3.381	0.9	1.35
597	ICP-MS/MS	5.58	1.88	3.84	0.887	1.41
598	DRC/CC-ICP-MS	4.72	1.72	3.10	0.6	1.19
605	ICP-MS	5.74	2.05	4.34	0.811	1.39
606	ICP-MS/MS	5.61	2.08	4.05	0.941	1.44
686	ICP-MS	5.67	2.11	3.96	0.796	1.44

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

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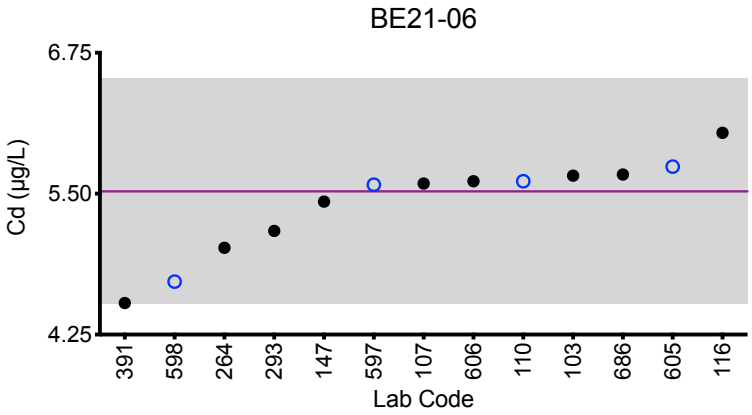
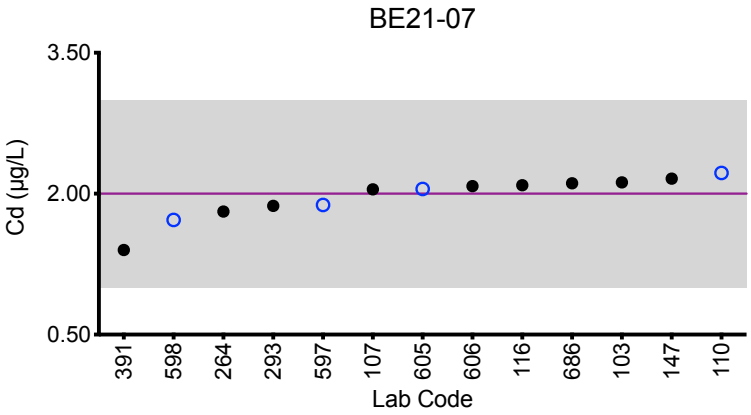
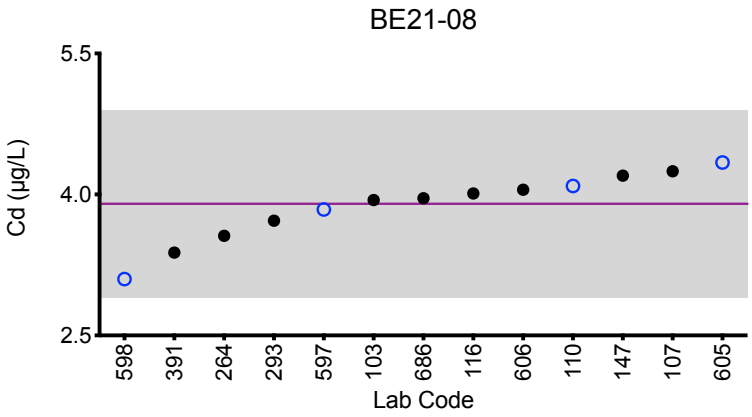
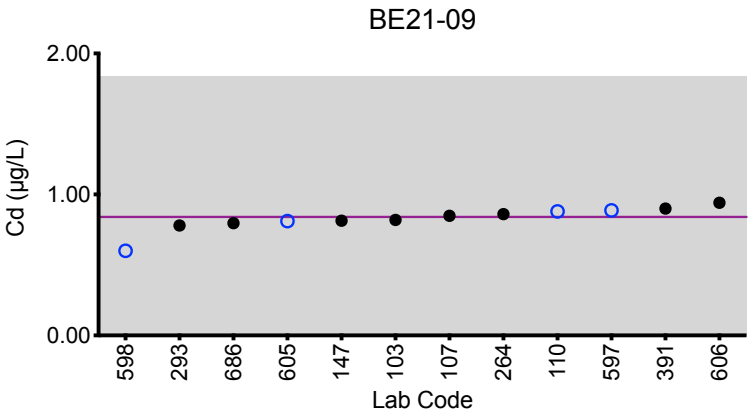
Results for Event #2, 2021: Summary Figures

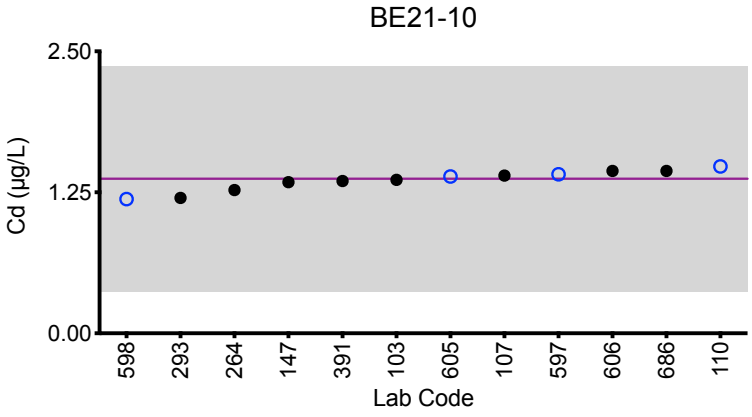
Whole Blood Cd











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 #2, 2021:
Summary Statistics

Whole Blood Co (µg/L)					
	BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Target (Arithmetic Mean ($\bar{x}$))	0.42	13.2	3.5	10.7	1.85
Upper Limit	1.92	15.8	5.0	12.8	3.35
Lower Limit	0.00	10.6	2.0	8.6	0.35
Arithmetic SD (s)	0.08	1.2	0.3	0.9	0.16
Arithmetic RSD (%)	19	9.1	9.8	8.4	8.6
Number of Sample Measurements (N)	8	9	9	9	9

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
	Target	**0.42**	**13.2**	**3.5**	**10.7**	**1.85**
103	ICP-MS/MS	0.352	13.2	3.42	10.7	1.73
110	ICP-MS	0.46	14.4	3.75	11.6	2.02
147	ICP-MS	0.510	14.8	4.01	11.8	2.08
255	ICP-MS	<0.5	13	3.5	10	1.8
264	ICP-MS	0.33	12.45	3.50	10.63	1.68
293	DRC/CC-ICP-MS	0.38	13.93	3.59	10.95	1.83
391	DRC/CC-ICP-MS	0.32	12.40	3.14	11.06	1.61
597	ICP-MS/MS	0.454	13.8	3.61	11.0	1.98
598	ICP-MS	0.53	11.0	2.84	8.90	1.94

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

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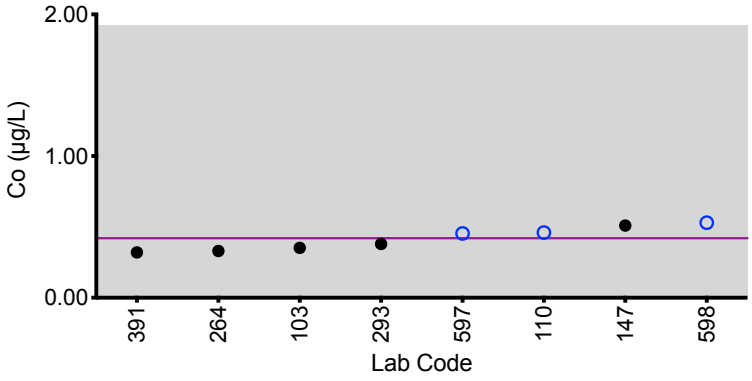
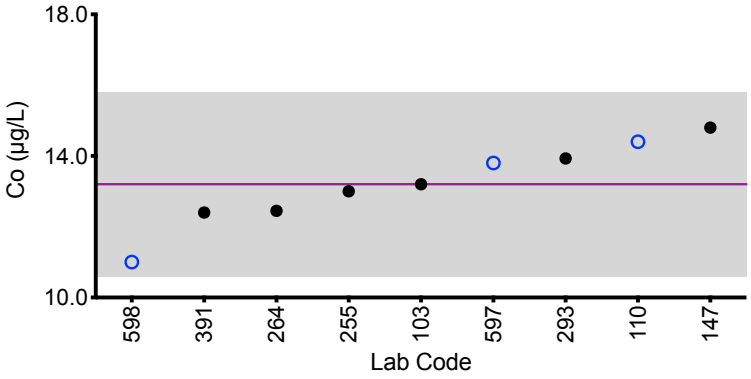
Results for Event #2, 2021: Summary Figures

Whole Blood Co

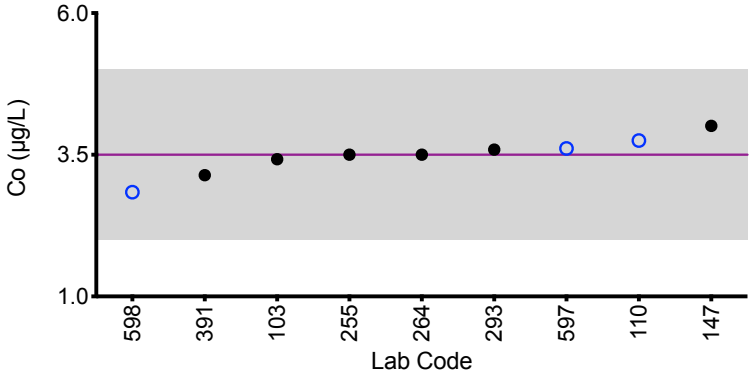
BE21-06



BE21-07



BE21-08



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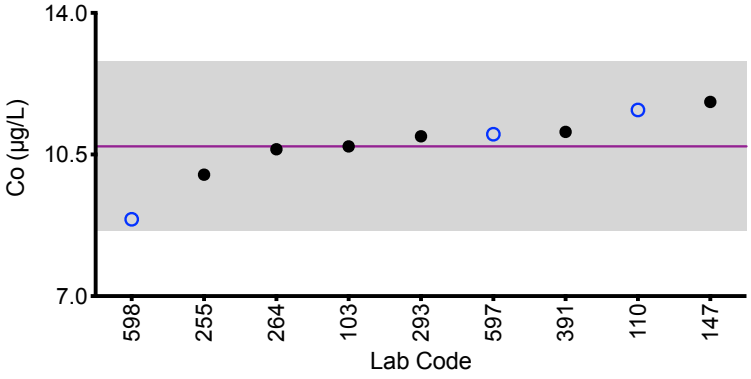
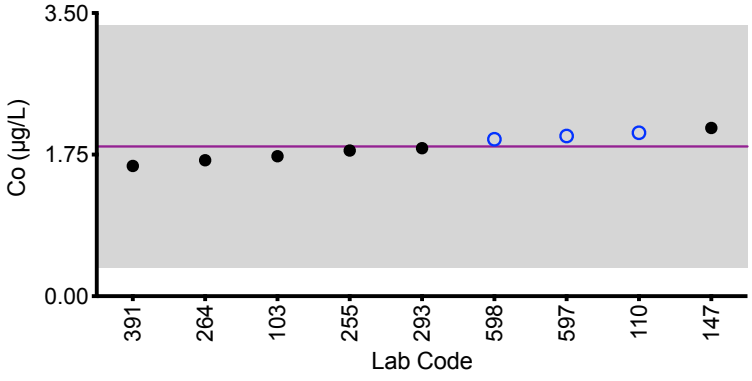


BE21-10



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 #2, 2021: Summary Statistics

Whole Blood Cr (µg/L)					
	BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Target (Arithmetic Mean ($\bar{x}$))	7.2	1.2	2.4	3.9	NA
Upper Limit	9.2	3.2	4.4	5.9	NA
Lower Limit	5.2	0.0	0.4	1.9	NA
Arithmetic SD (s)	1.0	0.3	0.3	0.6	NA
Arithmetic RSD (%)	14	21	11	15	NA
Number of Sample Measurements (N)	8	7	8	8	NA

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 BE21-10 based on a lack of consensus among participating labs.

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Results for Event #2, 2021:
Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
	Target	**7.2**	**1.2**	**2.4**	**3.9**	**NA**
103	ICP-MS/MS	7.65	<2.50	2.68	4.27	<2.50
110	DRC/CC-ICP-MS	7.39	1.31	2.35	3.86	0.28
147	DRC/CC-ICP-MS	8.94	1.63	2.71	5.12	0.107
255	ICP-MS	7.4	1.2	2.4	4	<1.0
264	ICP-MS	5.57	0.84	2.05	3.01	0.02
293	DRC/CC-ICP-MS	7.49	1.44	2.55	4.07	0.31
391	DRC/CC-ICP-MS	*11.65 ↑	*9.72 ↑	*10.08 ↑	*10.69 ↑	8.08
597	ICP-MS/MS	6.97	1.03	2.23	3.87	<0.84
598	DRC/CC-ICP-MS	6.42	1.14	1.98	3.35	0.24

Based on the grading criteria for Cr in Whole Blood, 89% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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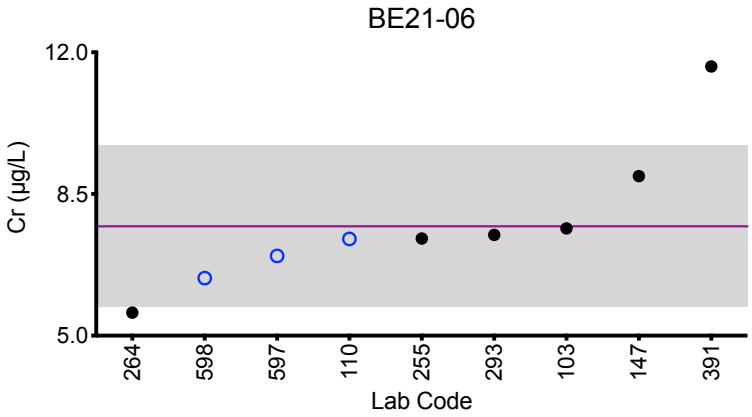
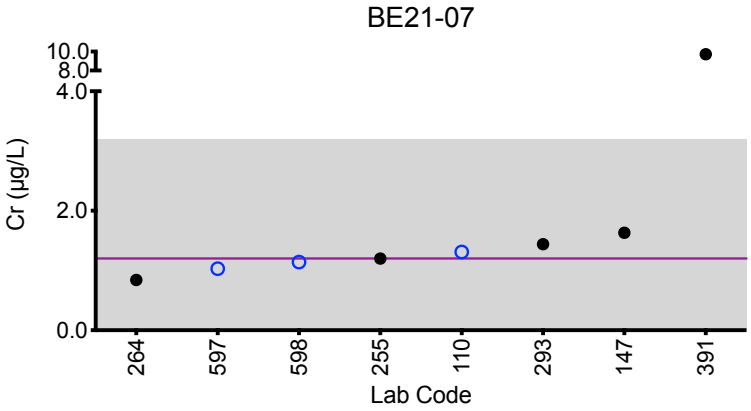
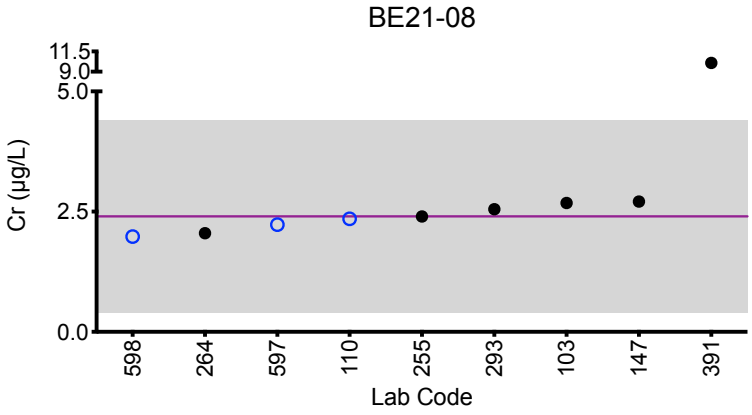
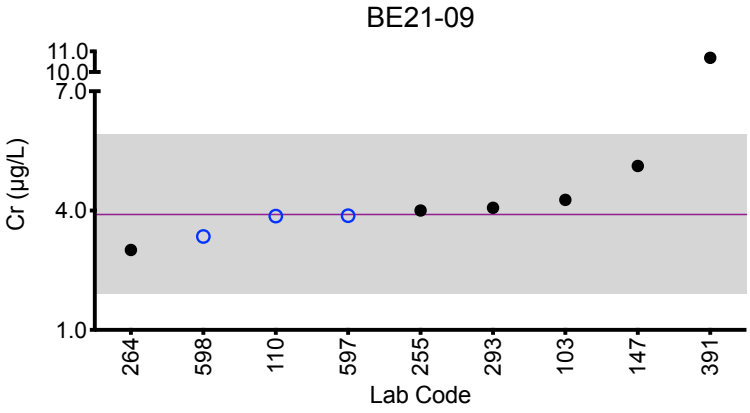
Results for Event #2, 2021: Summary Figures

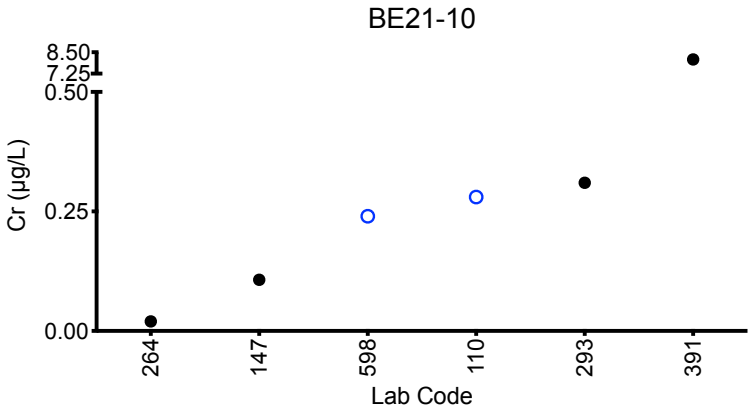
Whole Blood Cr











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 #2, 2021: Summary Statistics

Whole Blood Hg (µg/L)					
	BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Target (Robust Mean (x*))	3.1	8.1	1.14	14.5	6.1
Upper Limit	6.1	11.1	4.14	18.9	9.1
Lower Limit	0.1	5.1	0.00	10.2	3.1
Robust SD (s*)	0.3	1.2	0.19	2.1	0.9
Robust RSD (%)	10	15	17	14	15
Number of Sample Measurements (N)	12	12	11	12	12
Standard Uncertainty (*u*)	0.1	0.4	0.07	0.7	0.3

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Whole Blood Hg (µg/L)				
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
	Target	**3.1**	**8.1**	**1.14**	**14.5**	**6.1**
103	ICP-MS/MS	3.21	8.03	1.27	14.4	6.39
107	ICP-MS/MS	3.23	8.30	1.31	14.58	6.09
110	ICP-MS	2.92	7.72	1.16	14.2	5.97
116	ICP-MS/MS	3.27	9.19	<1.50	17.0	6.79
147	ICP-MS	2.91	7.78	1.19	13.9	5.60
293	DRC/CC-ICP-MS	2.55	6.41	0.96	11.78	4.75
391	CV-AAS	3.9	11.84 ↑	1.0	22.46 ↑	8.59
597	ICP-MS/MS	2.86	6.90	1.15	12.6	5.38
598	ICP-MS	2.5	5.72	0.85	10.6	5.1
605	ICP-MS	3.05	8.25	1.01	14.7	6.18
606	ICP-MS/MS	3.15	8.39	1.20	14.9	6.27
686	ICP-MS	3.90	9.33	1.73	16.4	6.97

Based on the grading criteria for Hg in Whole Blood, 97% of results were satisfactory, with 1 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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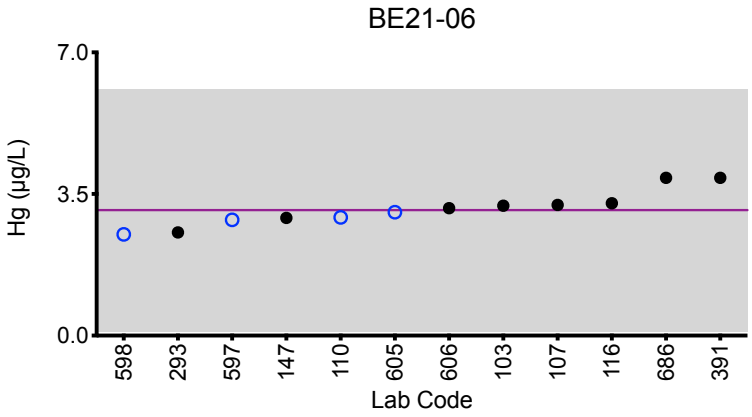
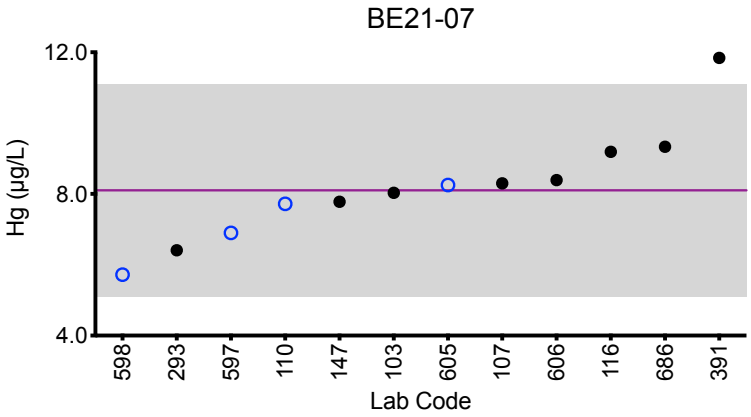
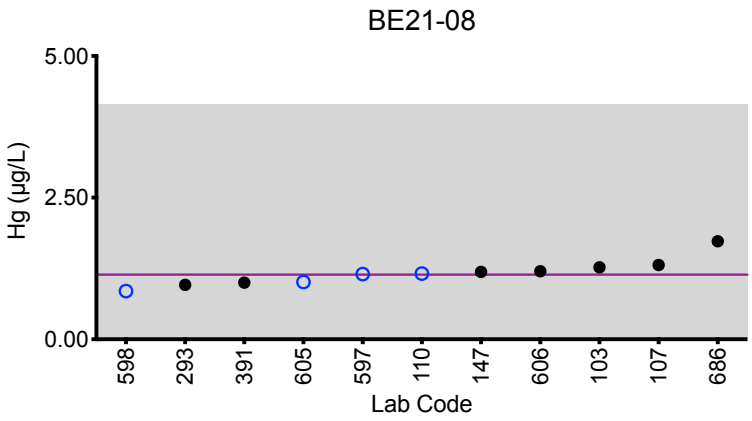
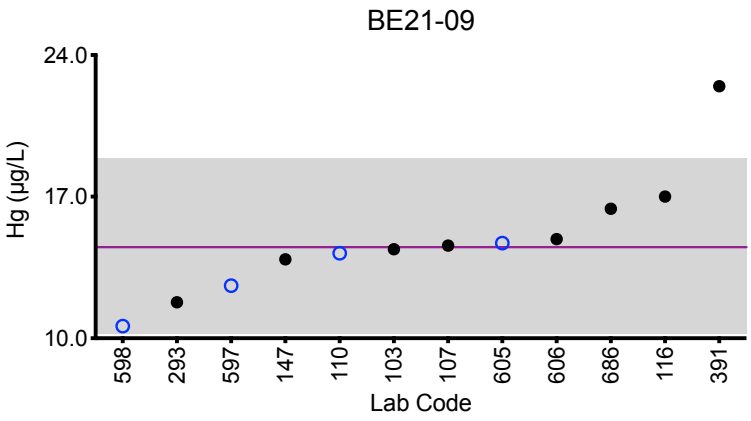
Results for Event #2, 2021: Summary Figures

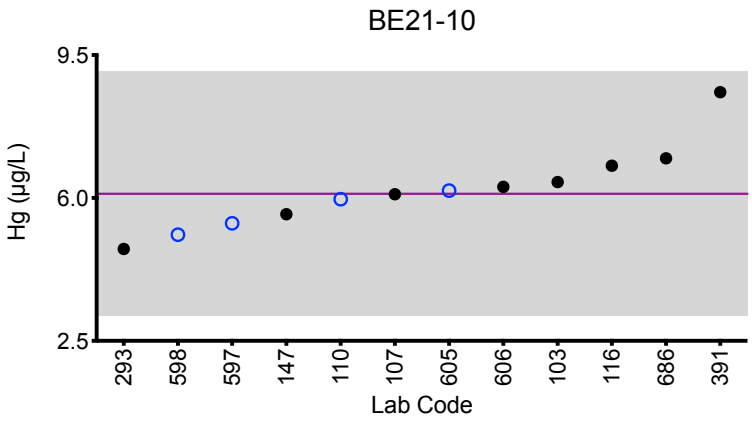
Whole Blood Hg











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 ±30% around the target value, whichever is greater; thus, it is fixed at ±3 µg/L at concentrations less than or equal to 10 µg/L.

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Results for Event #2, 2021: Summary Statistics

Whole Blood Mn (µg/L)					
	BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Target (Robust Mean (x*))	29.6	21.9	18.8	12.3	14.1
Upper Limit	34.6	25.6	22.0	15.3	17.1
Lower Limit	24.6	18.2	15.6	9.3	11.1
Robust SD (s*)	2.2	1.9	2.2	1.2	1.3
Robust RSD (%)	7.4	8.7	12	9.8	9.2
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.9	0.7	0.9	0.5	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 #2, 2021:
Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
	Target	**29.6**	**21.9**	**18.8**	**12.3**	**14.1**
103	ICP-MS/MS	30.3	21.9	19.4	12.1	14.4
107	ICP-MS/MS	31.80	23.50	20.76	12.66	14.50
110	ICP-MS	30.8	23.4	20.2	12.8	15.4
147	ICP-MS	28.4	22.0	19.3	12.7	14.3
264	ICP-MS	36.16 ↑	26.32 ↑	24.04 ↑	16.18 ↑	17.62 ↑
293	DRC/CC-ICP-MS	27.90	19.44	16.58	10.21	12.08
391	DRC/CC-ICP-MS	27.1	21.12	16.5	14.2	13.24
597	ICP-MS/MS	29.4	21.7	18.4	11.5	14.5
598	ICP-MS	27.3	17.0 ↓	14.2 ↓	9.6	12.5
606	ICP-MS/MS	30.1	22.1	19.0	12.1	13.7

Based on the grading criteria for Mn in Whole Blood, 86% of results were satisfactory, with 2 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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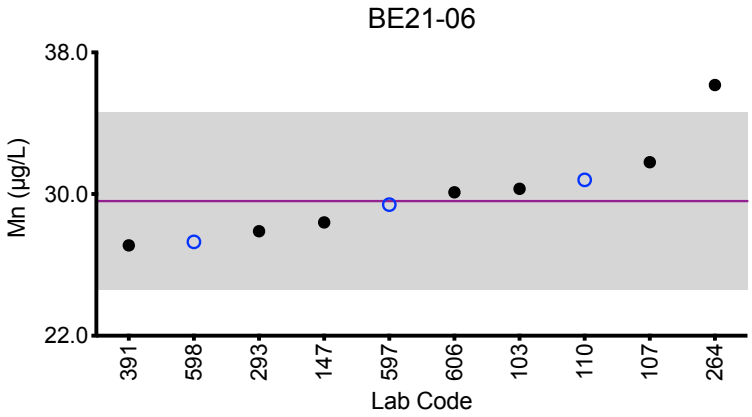
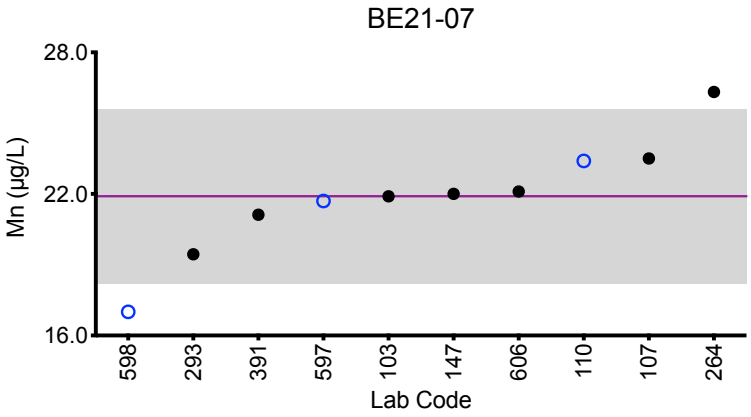
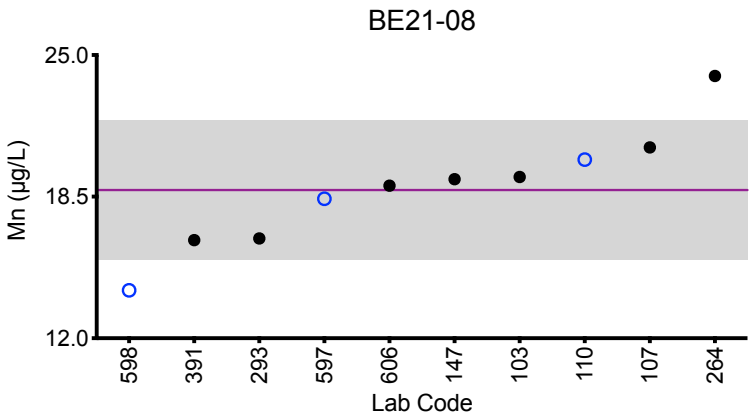
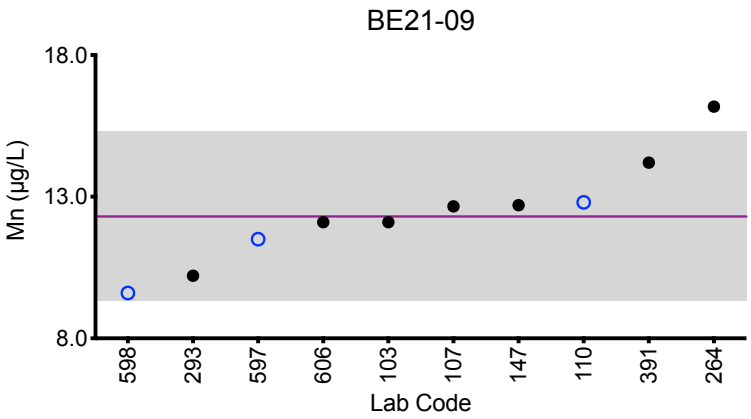
Results for Event #2, 2021: Summary Figures

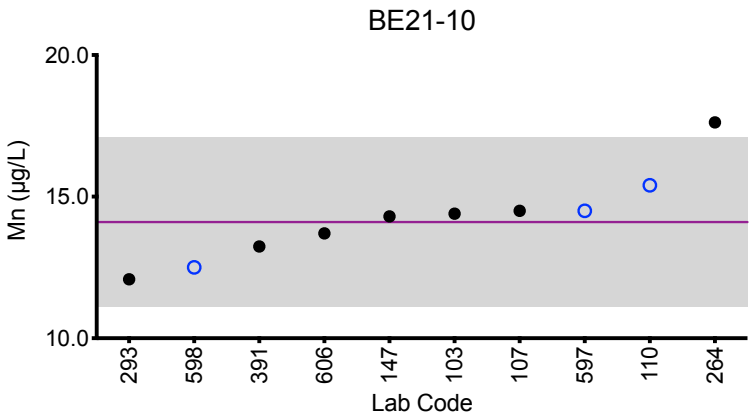
Whole Blood Mn











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:

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

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Results for Event #2, 2021: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Target (Robust Mean (x*))	4.02	7.3	42.4	1.03	13.3
Upper Limit	6.02	9.3	46.6	3.03	15.3
Lower Limit	2.02	5.3	38.2	0.00	11.3
Robust SD (s*)	0.14	0.3	2.6	0.04	0.8
Robust RSD (%)	3.5	4.1	6.1	3.7	6.0
Number of Sample Measurements (N)	13	14	14	11	14
Standard Uncertainty (*u*)	0.05	0.1	0.9	0.01	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 #2, 2021:
Performance of Participating Laboratories

Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
	Target	**4.02**	**7.3**	**42.4**	**1.03**	**13.3**
103	ICP-MS/MS	3.97	7.18	41.4	1.05	13.4
107	ICP-MS/MS	4.051	7.251	43.724	1.021	13.489
110	ICP-MS	4.00	7.35	42.1	1.05	13.6
116	ICP-MS/MS	4.31	7.67	44.3	<3.00	14.3
147	ICP-MS	4.00	7.25	42.3	1.04	13.5
264	ICP-MS	3.81	6.46	38.48	0.91	12.17
293	DRC/CC-ICP-MS	3.93	7.44	43.22	1.03	12.61
343	ASV-LeadCare	<1.9 ↓	5.3	47.5 ↑	<1.9	12.5
391	ETAAS-Z	4.91	7.44	39.93	1.6	13.59
597	ICP-MS/MS	3.92	6.90	40.0	0.978	12.8
598	ICP-MS	3.19	4.59 ↓	26.5 ↓	0.7	10.1 ↓
605	ICP-MS	4.10	7.45	46.4	<1.00	14.2
606	ICP-MS/MS	4.08	7.31	42.6	1.02	13.6
686	ICP-MS	4.21	7.68	43.7	1.08	14.2

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

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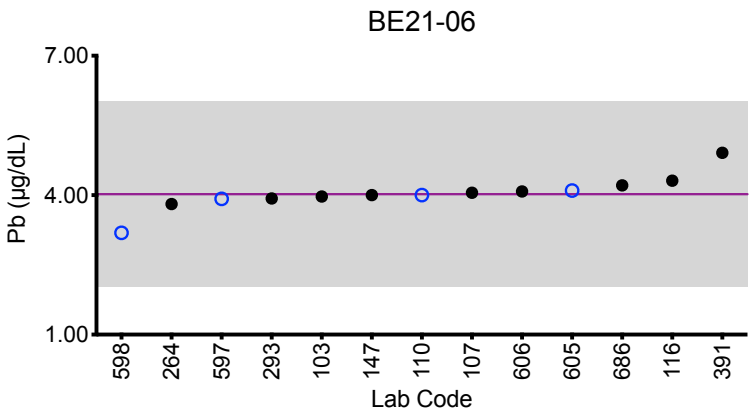
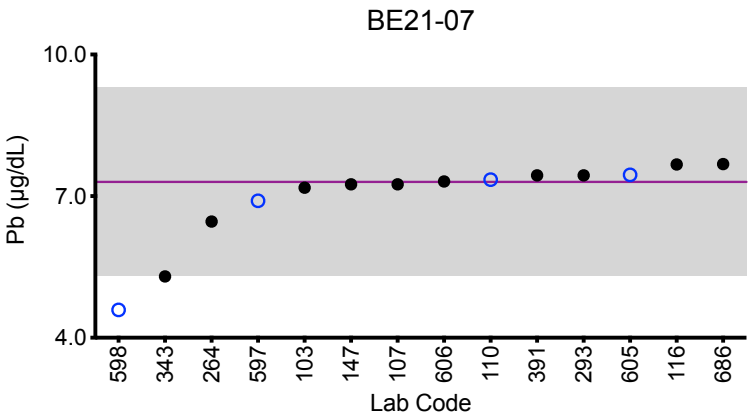
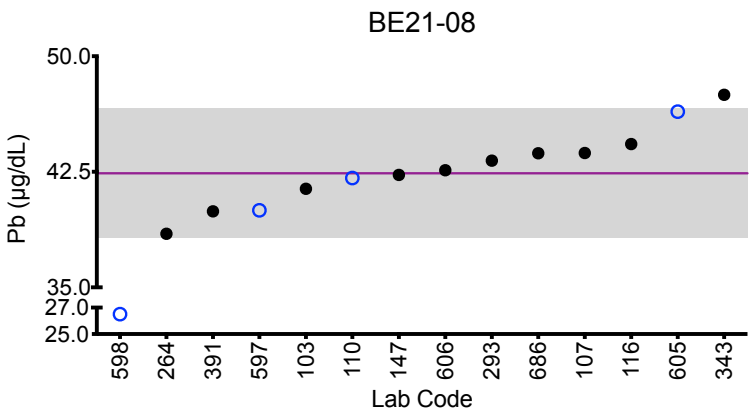
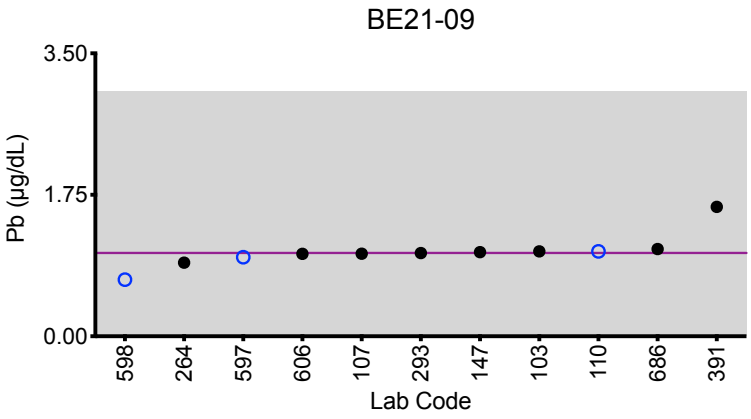
Results for Event #2, 2021: Summary Figures

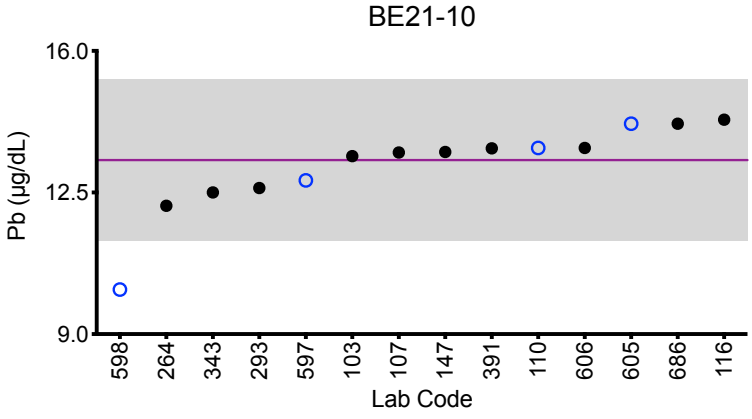
Whole Blood Pb











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 #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)

Lab Code	Method	BE21-06	BE21-07	BE21-08	BE21-09	BE21-10
103	ICP-MS/MS	<1.50	6.90	5.03	<1.50	2.08
147	ICP-MS	1.40	6.90	4.71	0.438	1.82
264	ICP-MS	<0.01	*2.21	*0.06	<0.01	<0.01
442	DRC/CC-ICP-MS	1.35	6.6	4.78	0.463	1.92
597	ICP-MS/MS	1.42	6.66	4.79	0.392	1.94
598	DRC/CC-ICP-MS	1.47	6.58	5.41	0.42	1.99

Summary Statistics

	BE21-06	BE21-07	BE21-08	BE21-09	BE21-10
Arithmetic Mean ($\bar{x}$)	1.41	6.73	4.9	0.43	1.95
Arithmetic SD (s)	0.05	0.16	0.3	0.03	0.10
Arithmetic RSD (%)	3.5	2.4	5.9	7.0	5.1
Number of Sample Measurements (N)	4	5	5	4	5

*Denotes a statistical Outlier.

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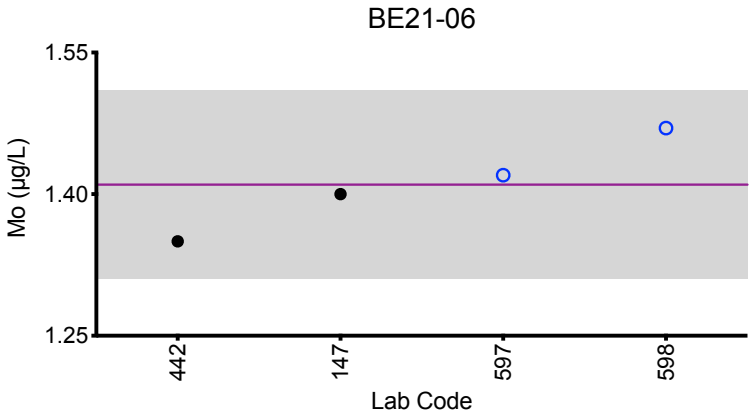
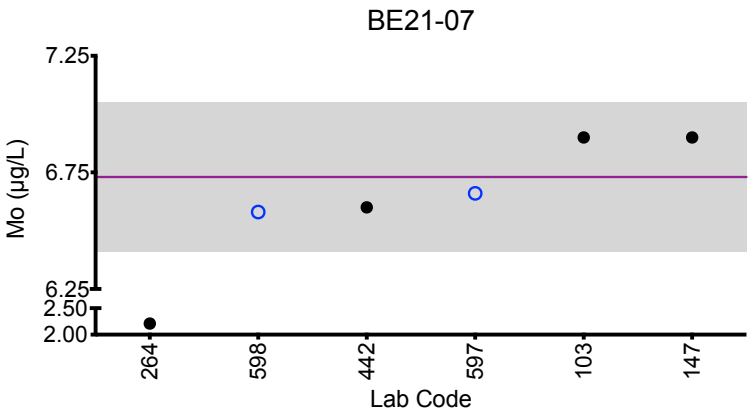
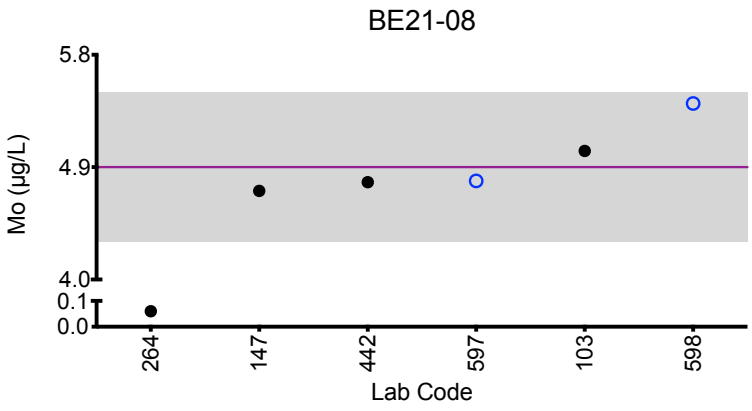
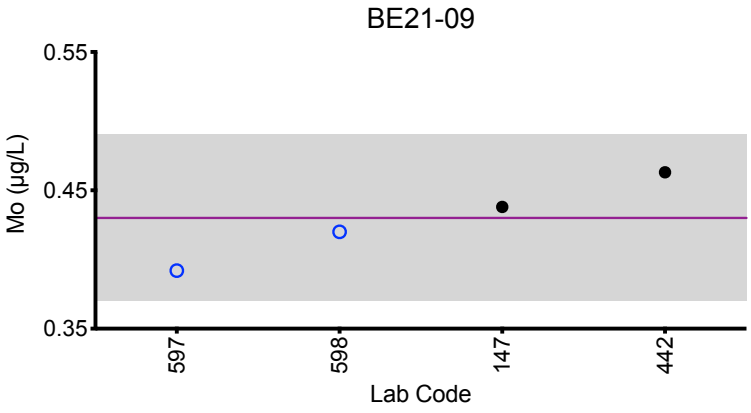
Results for Event #2, 2021: Summary Figures

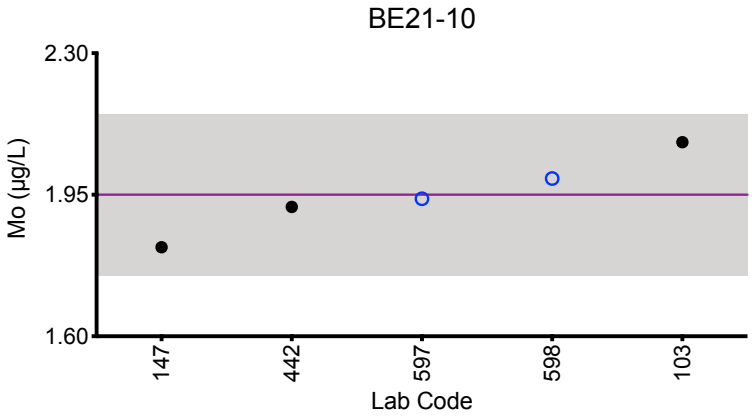
Whole Blood Mo











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 #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
103	ICP-MS/MS	3.58	1.52	0.531	2.07	4.96
110	ICP-MS	4.30	1.79	0.620	2.40	6.07
147	ICP-MS	4.690	1.90	0.654	2.67	6.34
264	ICP-MS	4.21	1.52	0.58	2.29	5.15
293	DRC/CC-ICP-MS	4.340	1.79	0.65	2.27	5.97
442	DRC/CC-ICP-MS	4.360	1.64	0.48	2.28	5.80
597	ICP-MS/MS	4.42	1.79	*1.09	2.45	5.91
598	ICP-MS	4.68	1.58	0.51	2.20	5.40
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		4.3	1.69	0.57	2.33	5.7
Arithmetic SD (s)		0.4	0.14	0.07	0.18	0.5
Arithmetic RSD (%)		8.1	8.3	12	7.7	8.8
Number of Sample Measurements (N)		8	8	7	8	8

*Denotes a statistical Outlier.

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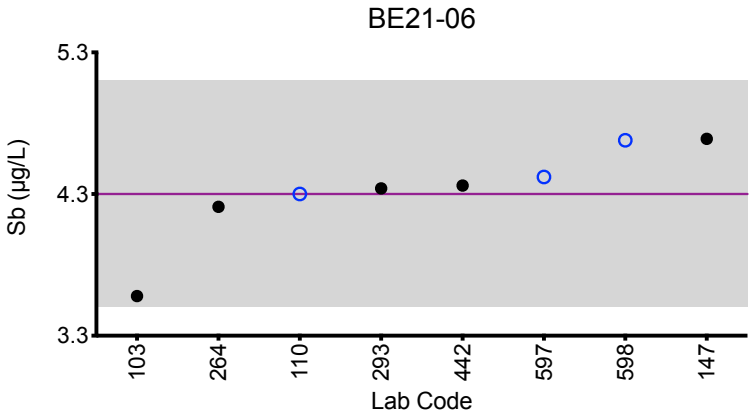
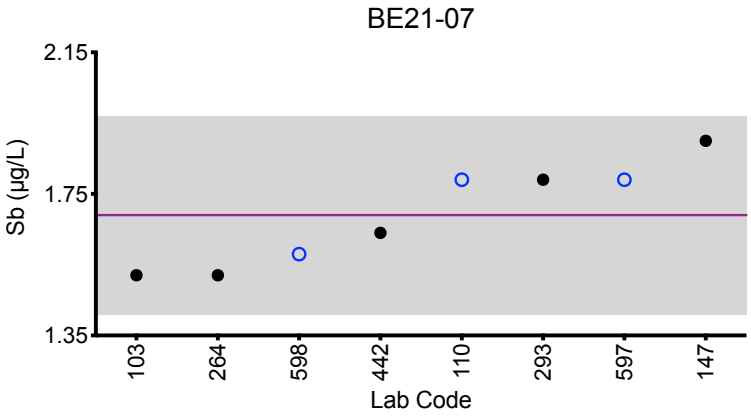
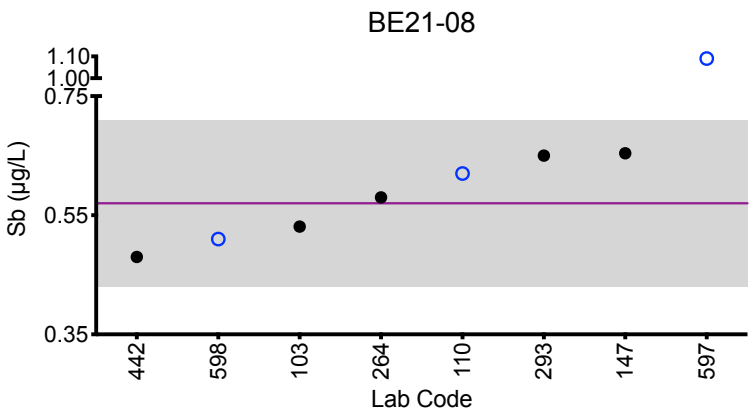
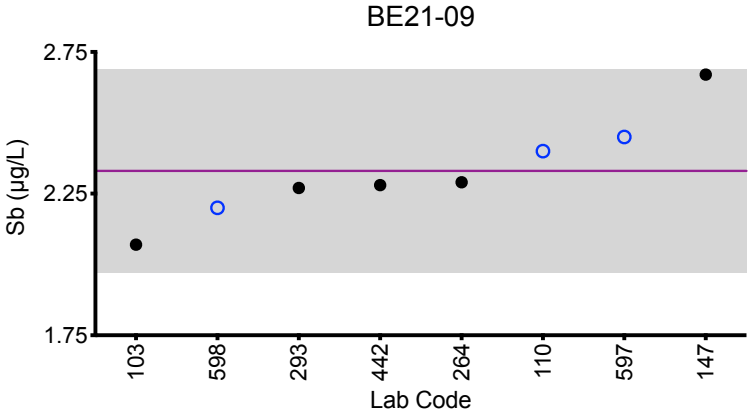
Results for Event #2, 2021: Summary Figures

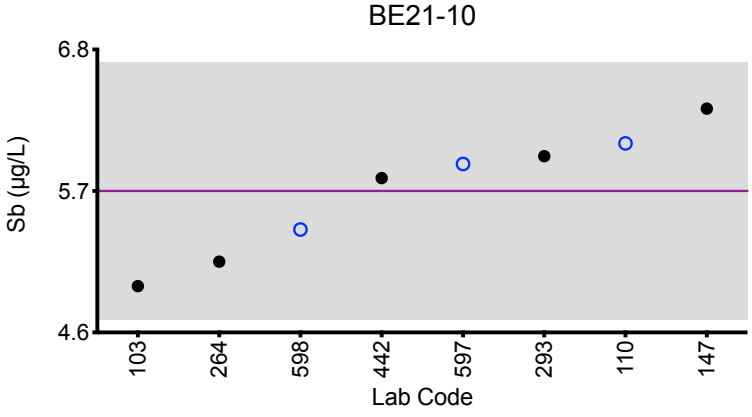
Whole Blood Sb











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 #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
103	ICP-MS/MS	333	134	183	174	260
107	ICP-MS/MS	334.8	134.1	198.2	178.1	272.9
110	DRC/CC-ICP-MS	313	133	182	175	264
147	ICP-MS	300	124	173	163	239
264	ICP-MS	238.2	107.3	147.2	140.2	181.4
293	DRC/CC-ICP-MS	295	121	171	163	238
597	ICP-MS/MS	318	129	179	173	260
598	DRC/CC-ICP-MS	323	126	172	168	268
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		307	126	176	167	248
Arithmetic SD (s)		31	9	14	12	30
Arithmetic RSD (%)		10	7.1	8.0	7.2	12
Number of Sample Measurements (N)		8	8	8	8	8

*Denotes a statistical Outlier.

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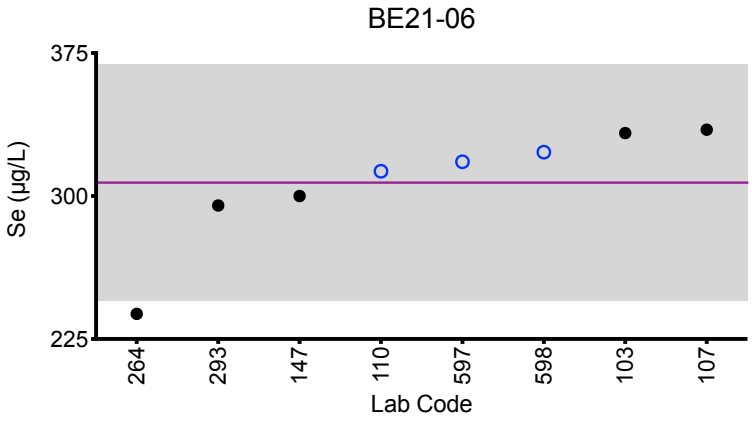
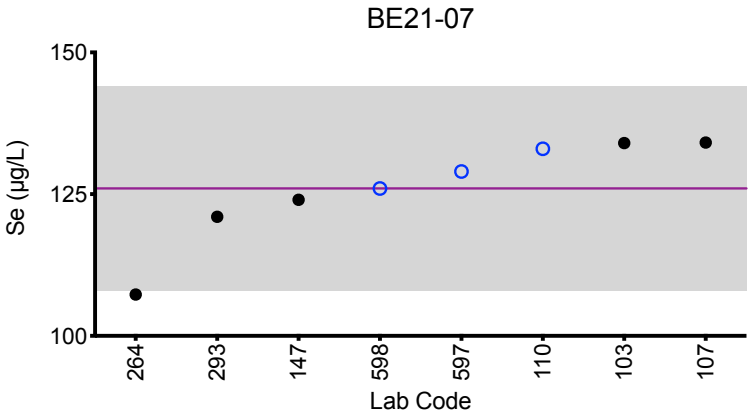
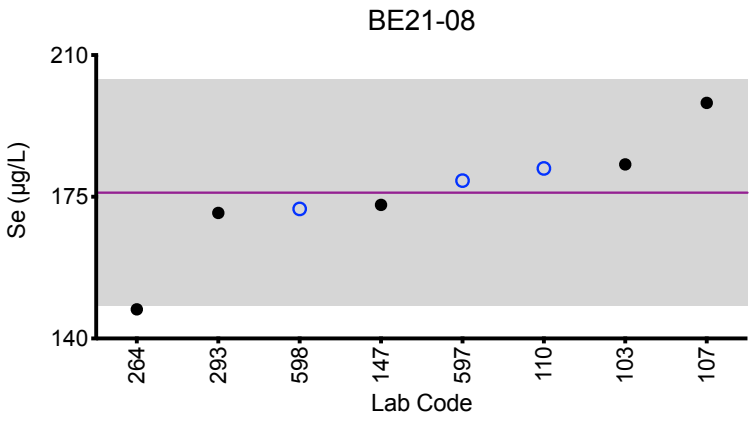
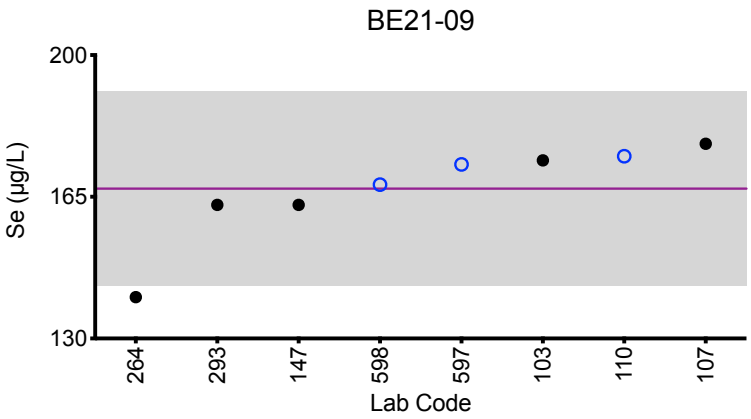
Results for Event #2, 2021: Summary Figures

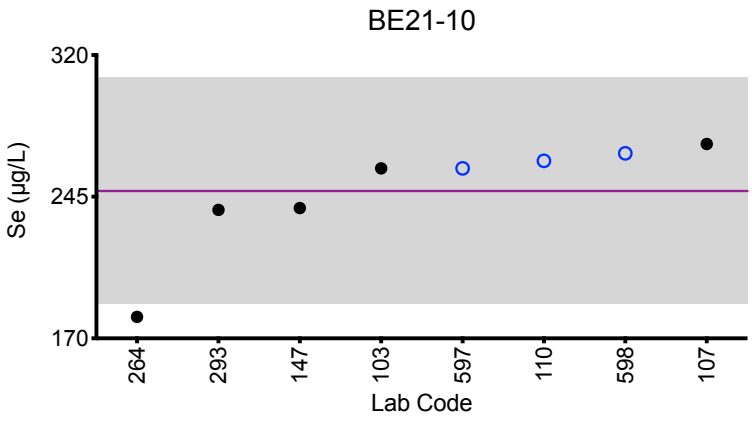
Whole Blood Se











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 #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Tl (µg/L)

Lab Code	Method	BE21-06	BE21-07	BE21-08	BE21-09	BE21-10
103	ICP-MS/MS	0.711	1.60	2.74	0.479	1.05
110	ICP-MS	0.739	1.67	2.75	0.460	1.07
147	ICP-MS	0.74	1.65	2.74	0.476	1.04
264	ICP-MS	0.71	1.48	2.41	0.41	0.91
293	DRC/CC-ICP-MS	0.67	1.71	2.76	0.47	1.00
597	ICP-MS/MS	0.752	1.64	2.69	0.469	1.07
598	ICP-MS	0.71	1.20	2.00	0.37	0.90

Summary Statistics

	BE21-06	BE21-07	BE21-08	BE21-09	BE21-10
Arithmetic Mean ($\bar{x}$)	0.72	1.56	2.6	0.45	1.01
Arithmetic SD (s)	0.03	0.18	0.3	0.04	0.07
Arithmetic RSD (%)	3.9	12	11	8.9	6.9
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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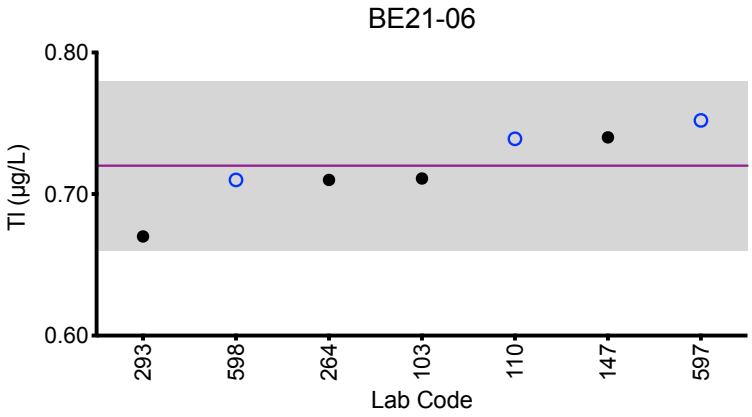
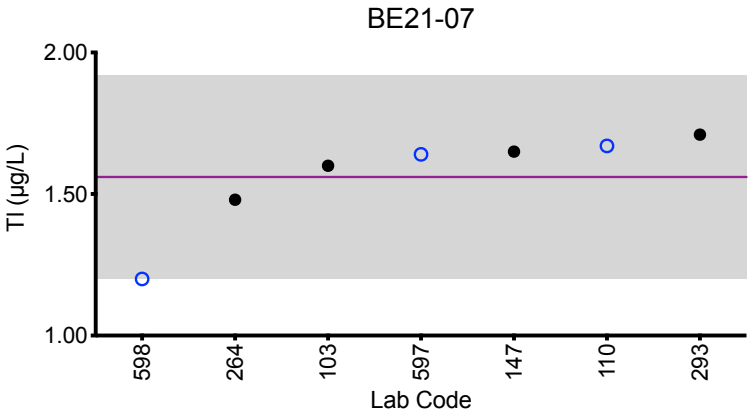
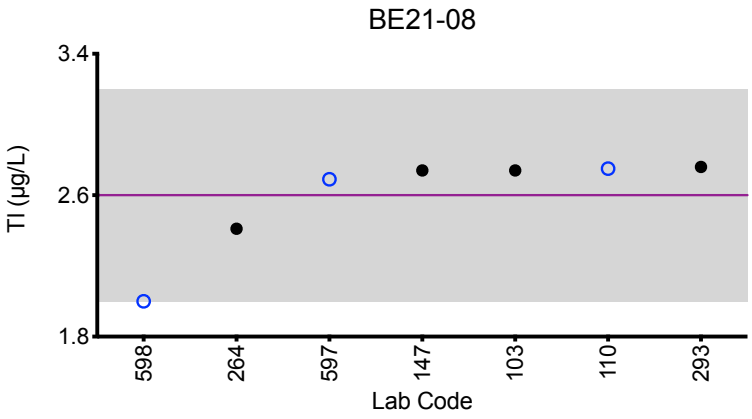
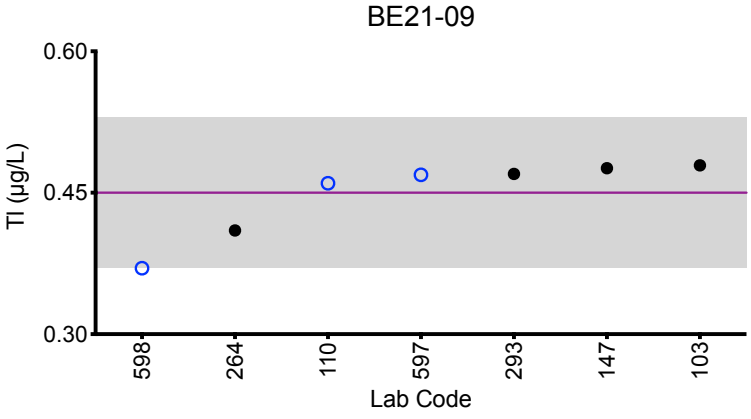
Results for Event #2, 2021: Summary Figures

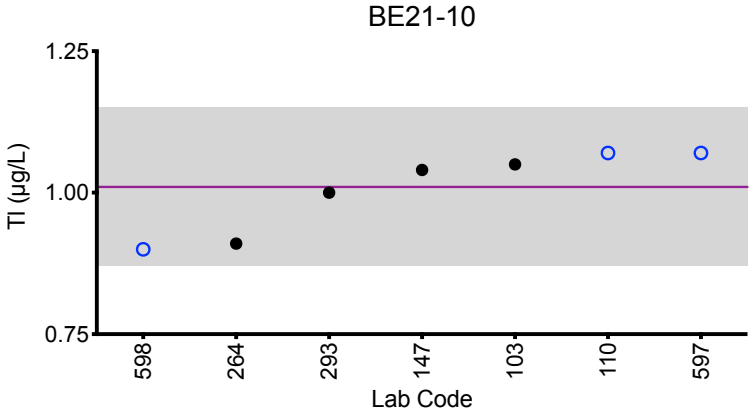
Whole Blood Tl











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 #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
103	ICP-MS/MS	0.0862	0.0533	0.0713	0.195	0.146
110	ICP-MS	0.089	0.058	0.071	0.188	0.144
147	ICP-MS	0.084	0.047	0.062	0.184	0.131
597	ICP-MS/MS	0.0785	0.0548	0.0680	0.175	0.127
598	ICP-MS	0.089	0.041	0.062	0.140	0.130
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		0.085	0.051	0.067	0.18	0.136
Arithmetic SD (s)		0.004	0.007	0.005	0.02	0.009
Arithmetic RSD (%)		4.7	14	7.5	13	6.6
Number of Sample Measurements (N)		5	5	5	5	5

*Denotes a statistical Outlier.

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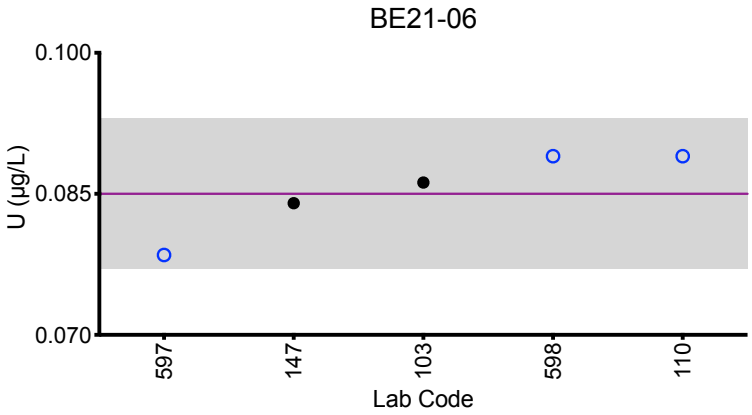
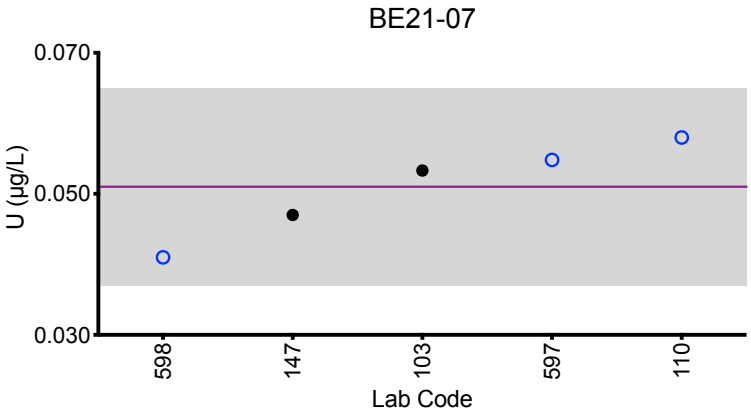
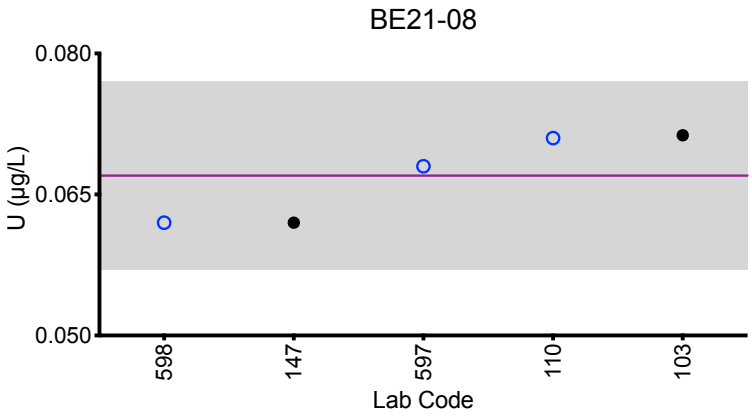
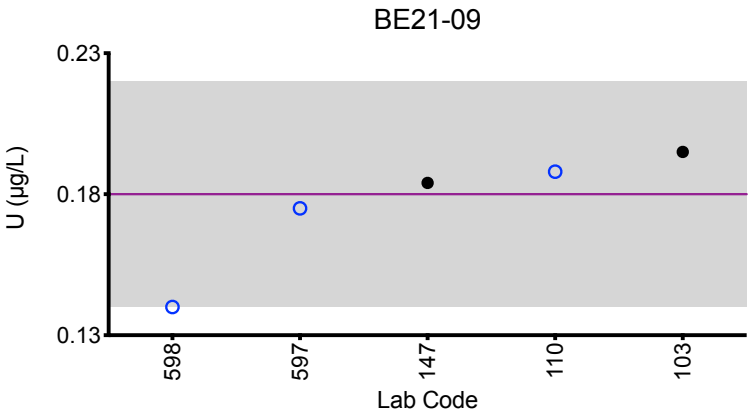
Results for Event #2, 2021: Summary Figures

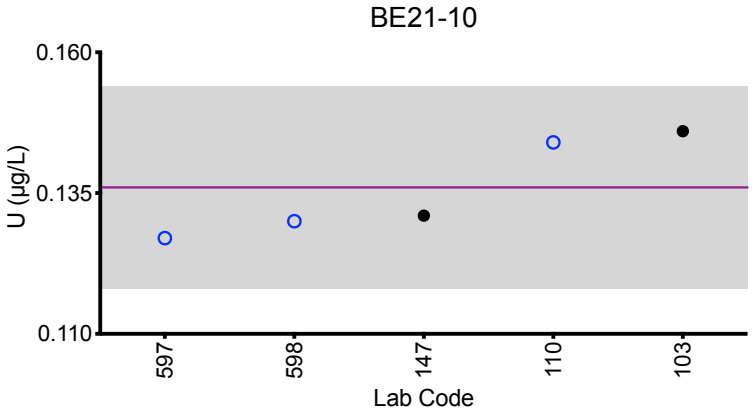
Whole Blood U











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 #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
110	ICP-MS	9.2	12.4	3.1	5.6	7.9
147	ICP-MS	8.87	12.00	3.17	5.52	7.32
597	ICP-MS/MS	8.79	11.6	3.17	6.07	7.58
598	ICP-MS	8.8	9.4	2.3	5.0	6.5
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		8.9	11.4	2.9	5.5	7.3
Arithmetic SD (s)		0.2	1.3	0.4	0.4	0.6
Arithmetic RSD (%)		2.1	11	14	7.3	8.2
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
110	ICP-MS	3.05	4.68	0.701	2.01	1.61
147	ICP-MS	2.91	4.11	<1.17	1.92	1.45
597	ICP-MS/MS	3.03	4.76	0.591	2.00	1.49
598	ICP-MS	3.03	3.81	0.420	1.56	1.26
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		3.00	4.3	0.57	1.9	1.45
Arithmetic SD (s)		0.06	0.5	0.14	0.2	0.15
Arithmetic RSD (%)		2.0	12	25	11	10
Number of Sample Measurements (N)		4	4	3	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
110	ICP-MS	1.83	1.89	1.90	1.51	1.46
147	ICP-MS	1.93	1.95	2.01	1.58	1.46
597	ICP-MS/MS	1.98	1.86	1.86	1.60	1.54
598	ICP-MS	1.92	1.41	1.49	1.23	1.31

Summary Statistics					
	BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)	1.92	1.8	1.8	1.48	1.4
Arithmetic SD (s)	0.06	0.3	0.2	0.17	0.1
Arithmetic RSD (%)	3.1	14	13	11	6.9
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
110	ICP-MS	730	1797	722	1951	2836
147	ICP-MS	724	1766	743	1950	2789
597	ICP-MS/MS	686	1670	674	1800	2690
598	ICP-MS	569	1160	467	1250	2100
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		680	1600	650	1700	2600
Arithmetic SD (s)		70	300	130	300	300
Arithmetic RSD (%)		10	19	20	18	12
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
110	DRC/CC-ICP-MS	3.66	4.81	1.71	10.1	4.99
147	ICP-MS	3.71	4.93	1.23	9.57	4.67
597	ICP-MS/MS	3.92	5.25	1.42	9.49	4.89
598	ICP-MS	4.5	4.34	1.72	7.80	5.0
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		3.9	4.8	1.5	9.2	4.89
Arithmetic SD (s)		0.4	0.4	0.2	1.0	0.15
Arithmetic RSD (%)		10	8.3	16	11	3.1
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Pt (µg/L)

Lab Code	Method	BE21-06	BE21-07	BE21-08	BE21-09	BE21-10
110	ICP-MS	4.62	0.608	1.94	1.30	5.84
293	DRC/CC-ICP-MS	4.470	0.690	1.97	1.42	5.75
598	ICP-MS	4.09	0.370	1.47	1.09	5.13

Summary Statistics

	BE21-06	BE21-07	BE21-08	BE21-09	BE21-10
Arithmetic Mean ($\bar{x}$)	4.4	0.6	1.8	1.3	5.6
Arithmetic SD (s)	0.3	0.2	0.3	0.2	0.4
Arithmetic RSD (%)	6.8	30	17	13	7.1
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
110	ICP-MS	1.16	0.505	3.31	2.62	6.66
147	ICP-MS	0.947	0.411	3.21	2.47	6.70
597	ICP-MS/MS	1.09	0.456	3.04	2.37	6.52
598	ICP-MS	1.02	0.410	2.56	2.06	6.08
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		1.05	0.45	3.0	2.4	6.5
Arithmetic SD (s)		0.09	0.05	0.3	0.2	0.3
Arithmetic RSD (%)		8.6	11	10	10	4.3
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
103	ICP-MS/MS	21.5	21.5	23.2	23.7	22.8
147	ICP-MS	22.8	22.5	23.8	24.6	23.1
597	ICP-MS/MS	22.8	21.4	23.6	24.5	24.1

Summary Statistics					
	BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)	22.4	21.8	23.5	24.3	23.3
Arithmetic SD (s)	0.8	0.6	0.3	0.5	0.7
Arithmetic RSD (%)	3.6	2.8	1.3	2.1	3.0
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Ti (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
200	DRC/CC-ICP-MS	3.2	9.3	5.1	6.4	10.9
442	ICP-MS/MS	2.22	8.77	3.96	6	10.6
597	ICP-MS/MS	*6.32	11.4	6.90	9.45	12.8
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		2.7	9.8	5.3	7	11.4
Arithmetic SD (s)		0.7	1.4	1.5	2	1.2
Arithmetic RSD (%)		26	14	28	26	11
Number of Sample Measurements (N)		2	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
110	DRC/CC-ICP-MS	0.109	3.03	0.571	0.217	1.03
147	DRC/CC-ICP-MS	*0.028	2.67	0.404	0.161	0.913
597	ICP-MS/MS	0.0882	2.96	0.479	0.227	1.05
598	DRC/CC-ICP-MS	<0.2	2.67	0.490	<0.2	1.14
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		0.10	2.83	0.49	0.20	1.03
Arithmetic SD (s)		0.01	0.19	0.07	0.04	0.09
Arithmetic RSD (%)		15	6.7	14	20	8.7
Number of Sample Measurements (N)		2	4	4	3	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
110	ICP-MS	0.264	0.970	0.139	0.423	1.52
200	ICP-MS	0.3	1.1	*0.3	0.5	1.7
597	ICP-MS/MS	0.221	0.817	0.119	0.407	1.30
598	ICP-MS	0.36	0.81	<0.2	0.46	1.39
Summary Statistics						
		BE21-06	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
Arithmetic Mean ($\bar{x}$)		0.29	0.92	0.13	0.45	1.48
Arithmetic SD (s)		0.06	0.14	0.01	0.04	0.17
Arithmetic RSD (%)		21	15	11	8.9	11
Number of Sample Measurements (N)		4	4	2	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)

Lab Code	Method	BE21-06	BE21-07	BE21-08	BE21-09	BE21-10
110	ICP-MS	6792	7157	6450	6495	5309
147	ICP-MS	6157	6667	6105	6039	4856
597	ICP-MS/MS	6550	6890	6280	6280	5140
598	ICP-MS	5460	4660	4190	4270	3970

Summary Statistics

	BE21-06	BE21-07	BE21-08	BE21-09	BE21-10
Arithmetic Mean ($\bar{x}$)	6200	6300	5800	5800	4800
Arithmetic SD (s)	600	1100	1100	1000	600
Arithmetic RSD (%)	9.7	17	19	17	13
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
147	ICP-MS	<0.302	<0.302	<0.302	<0.302	<0.302

Whole Blood Al (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
147	ICP-MS	<5.13	<5.13	<5.13	<5.13	<5.13
597	ICP-MS/MS	13.7	9.59	8.37	5.64	13.7

Whole Blood Bi (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
147	ICP-MS	<0.033	<0.033	<0.033	<0.033	<0.033
597	ICP-MS/MS	<0.04	<0.04	<0.04	<0.04	<0.04

Whole Blood I (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
147	ICP-MS	149	152	153	27.5	27.5

Whole Blood Li (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
147	ICP-MS	0.493	0.493	0.548	0.402	0.368

Whole Blood Mg (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
597	ICP-MS/MS	30600	30300	30700	32000	30800

Whole Blood Te (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
147	ICP-MS	<0.117	<0.117	<0.117	<0.117	<0.117

Whole Blood Th (µg/L)						
Lab Code	**Method**	**BE21-06**	**BE21-07**	**BE21-08**	**BE21-09**	**BE21-10**
147	ICP-MS	<0.028	<0.028	<0.028	<0.028	<0.028
597	ICP-MS/MS	0.0632	0.0587	0.0502	0.0353	0.0398

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Event #2, 2021

Trace Elements in Urine

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Trace Elements Laboratory

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Event #2, 2021:
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), titanium (Ti), vanadium (V), tungsten (W), and zinc (Zn). 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

Ten elements in urine are formally graded: As, Ba, Be, Cd, Co, Cr, 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.

Urine Hg

The statistical data for urine Hg show the %RSD varies from ~17-22% for Hg concentrations well above most lab-reported LOQs. Typically we expect to see %RSD for these urine Hg pools to be in the range 8-11%. The inflated %RSD for this event suggests the PT samples for urine Hg may be unreliable. Consequently, we have suspended grading for urine Hg pending further investigation.

Additional Elements

An additional 23 elements were reported by at least one participant: Ag, Al, B, Bi, Cs, Cu, Fe, I, Li, Mg, Mo, Ni, Pt, Sb, Se, Sn, Sr, Te, Th, Ti, V, W, and Zn. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

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

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Results for Event #2, 2021:
Summary Statistics

	Urine As (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	42.1	15.0	23.9	11.0	70
Upper Limit	50.5	21.0	29.9	17.0	84
Lower Limit	33.7	9.0	17.9	5.0	56
Robust SD (s*)	3.1	0.8	1.8	1.0	4
Robust RSD (%)	7.4	5.3	7.5	9.1	6.0
Number of Sample Measurements (N)	18	18	18	18	18
Standard Uncertainty (*u*)	0.9	0.2	0.5	0.3	1

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Urine As (µg/L)				
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**42.1**	**15.0**	**23.9**	**11.0**	**70**
103	ICP-MS/MS	43.0	14.8	23.5	10.1	69.6
107	DRC/CC-ICP-MS	38.35	14.41	22.72	9.65	65.49
110	DRC/CC-ICP-MS	44.8	15.6	25.2	11.3	70.6
116	ICP-MS/MS	40.3	14.9	22.9	11.5	66.8
147	ICP-MS	44.8	15.3	24.5	11.3	72.2
220	DRC/CC-ICP-MS	46.5	16.3	25.5	11.3	73.8
264	ICP-MS	43.68	15.07	24.77	12.24	71.68
293	DRC/CC-ICP-MS	39.74	15.89	23.73	11.19	69.39
324	ICP-MS	39.831	14.931	23.492	10.508	68.691
391	DRC/CC-ICP-MS	160.151↑	145.502↑	164.424↑	157.355↑	246.981↑
399	DRC/CC-ICP-MS	38.4	14.0	22.3	10.3	61.3
442	DRC/CC-ICP-MS	43.8	14.9	24.4	10.4	71.6
597	ICP-MS/MS	39.4	14.1	21.8	10.2	66.1
598	DRC/CC-ICP-MS	41.9	15.1	21.7	8.92	66.8
605	ICP-MS	43.00	15.7	25.3	11.8	74.0
606	ICP-MS/MS	43.1	15.1	24.1	11.0	69.9
676	DRC/CC-ICP-MS	38.8	13.5	21.7	10.8	64.1
686	DRC/CC-ICP-MS	40.9	14.4	26.9	13.1	74.9

Based on the grading criteria for As in Urine, 94% of results were satisfactory, with 1 of the 18 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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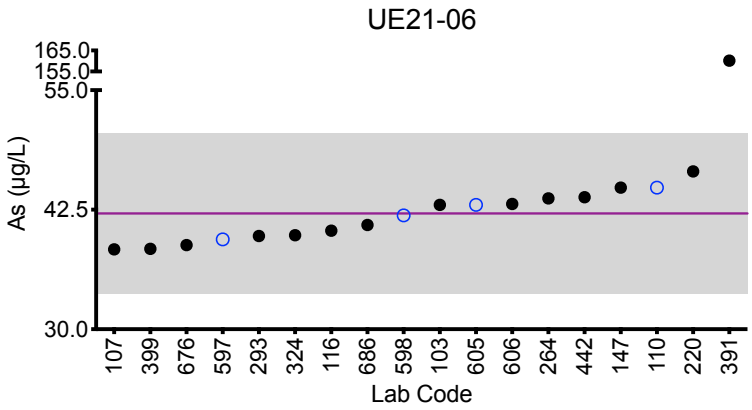
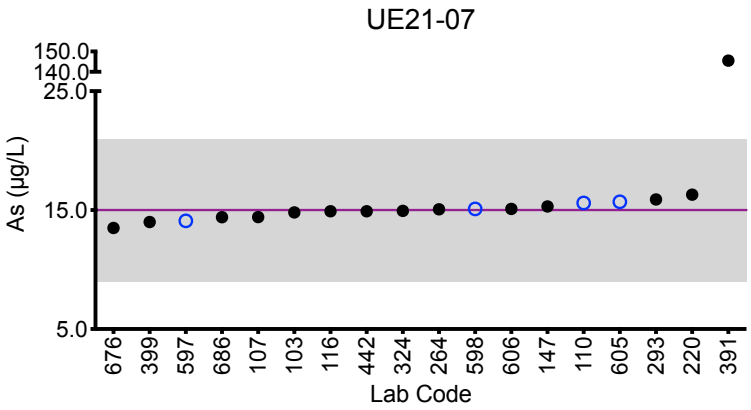
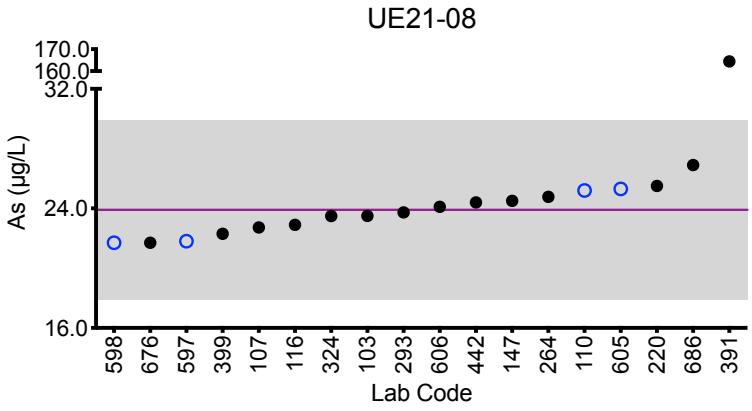
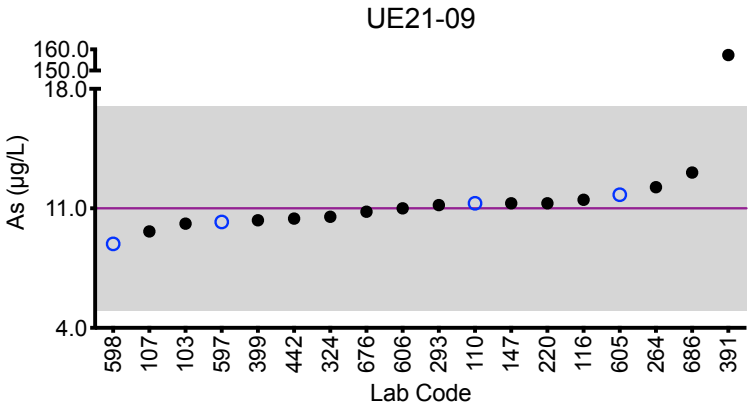
Results for Event #2, 2021: Summary Figures

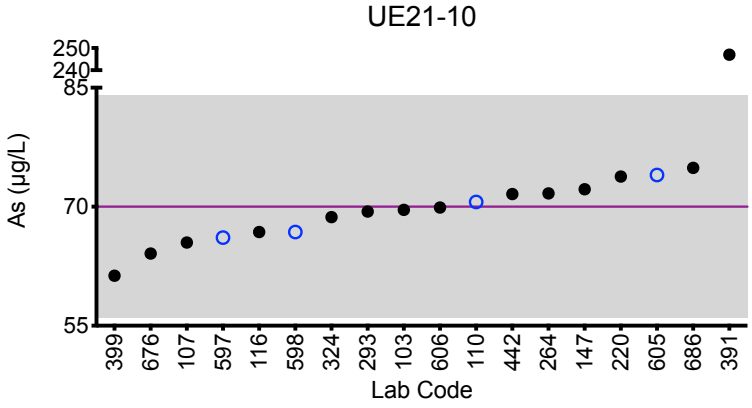
Urine As











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 #2, 2021:
Summary Statistics

	Urine Ba (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	4.01	8.0	1.37	3.64	1.39
Upper Limit	5.01	9.6	2.37	4.64	2.39
Lower Limit	3.01	6.4	0.37	2.64	0.39
Robust SD (s*)	0.17	0.4	0.10	0.22	0.09
Robust RSD (%)	4.2	4.5	7.3	6.0	6.5
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.06	0.1	0.03	0.07	0.03

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Urine Ba (µg/L)				
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**4.01**	**8.0**	**1.37**	**3.64**	**1.39**
107	ICP-MS	3.936	7.920	1.377	3.567	1.396
110	ICP-MS	4.08	8.28	1.52	4.08	1.45
116	ICP-MS/MS	3.61	7.53	1.14	3.33	1.31
147	ICP-MS	4.15	7.95	1.39	3.60	1.47
220	ICP-MS	4.06	8.02	1.34	3.85	1.32
264	ICP-MS	3.61	7.14	1.20	3.32	1.22
399	ICP-MS/MS	3.99	7.9	1.35	3.66	1.40
597	ICP-MS/MS	4.41	8.27	1.43	3.51	1.46
598	ICP-MS	3.86	7.74	1.34	3.48	1.38
605	ICP-MS	4.13	8.55	1.64	3.75	1.46
606	ICP-MS/MS	3.73	8.38	1.30	3.85	1.19
607	ICP-MS	4.18	8.36	1.46	3.67	1.43
676	ICP-MS	4.01	8.03	1.43	3.87	1.48
686	ICP-MS	4.07	7.87	1.35	3.54	1.37

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

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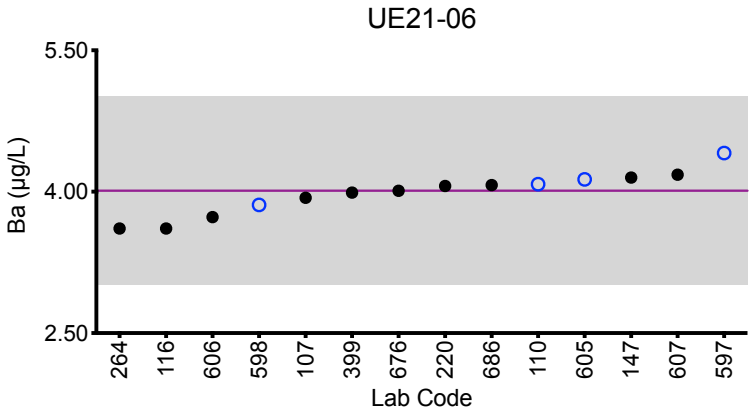
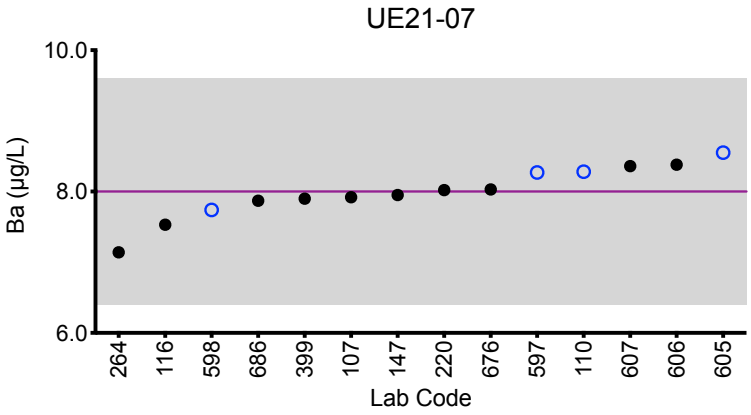
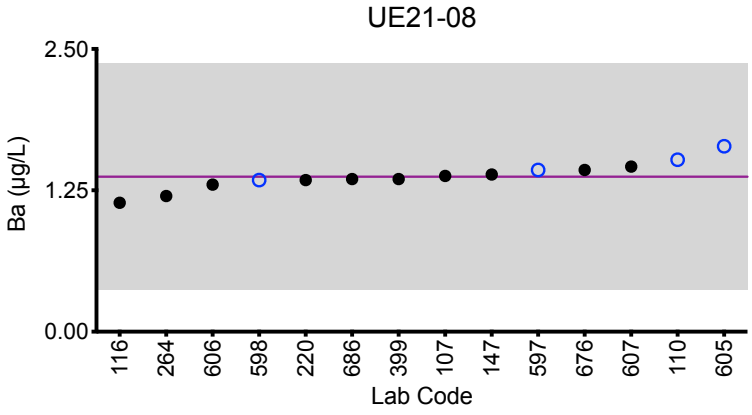
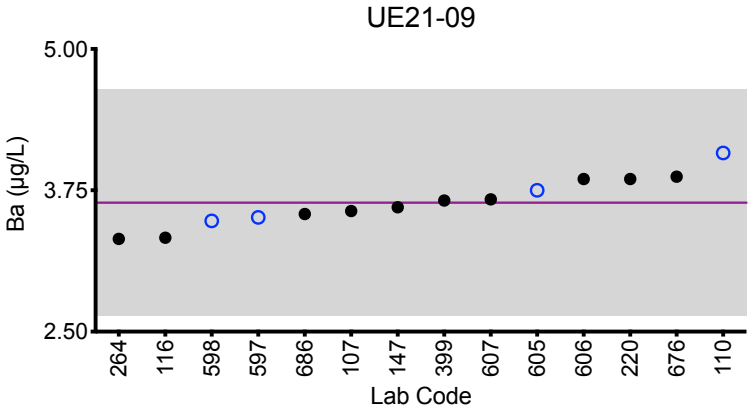
Results for Event #2, 2021: Summary Figures

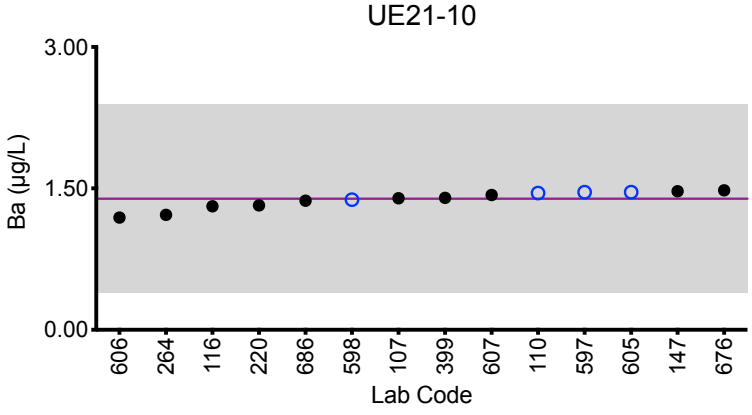
Urine Ba











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 #2, 2021: Summary Statistics

	Urine Be (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	3.85	2.21	2.66	0.93	0.61
Upper Limit	4.85	3.21	3.66	1.93	1.61
Lower Limit	2.85	1.21	1.66	0.00	0.00
Robust SD (s*)	0.21	0.17	0.17	0.04	0.03
Robust RSD (%)	5.5	7.7	6.4	4.1	5.0
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.07	0.06	0.06	0.01	0.01

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**3.85**	**2.21**	**2.66**	**0.93**	**0.61**
107	ICP-MS	3.890	2.324	2.758	0.951	0.630
110	ICP-MS	3.76	2.25	2.83	0.930	0.627
116	ICP-MS/MS	3.81	2.09	2.47	0.913	0.615
147	ICP-MS	4.05	2.29	2.71	0.964	0.608
220	ICP-MS	3.87	2.24	2.7	0.93	0.61
264	ICP-MS	3.39	2.00	2.39	0.88	0.55
293	DRC/CC-ICP-MS	1.96 ↓	1.15 ↓	1.41 ↓	0.49	0.31
399	ICP-MS/MS	3.74	2.19	2.63	0.967	0.597
597	ICP-MS/MS	4.24	2.65	2.71	0.970	0.577
598	ICP-MS	3.93	2.32	2.88	0.93	0.67
605	ICP-MS	4.12	2.46	2.86	0.951	0.640
607	ICP-MS	3.90	2.14	2.66	0.892	0.581
676	ICP-MS	3.51	2.1	2.49	0.981	0.598
686	ICP-MS	3.92	2.16	2.64	0.932	0.617

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

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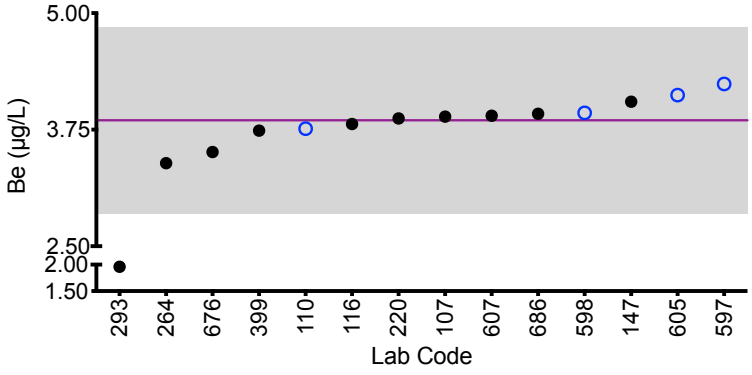
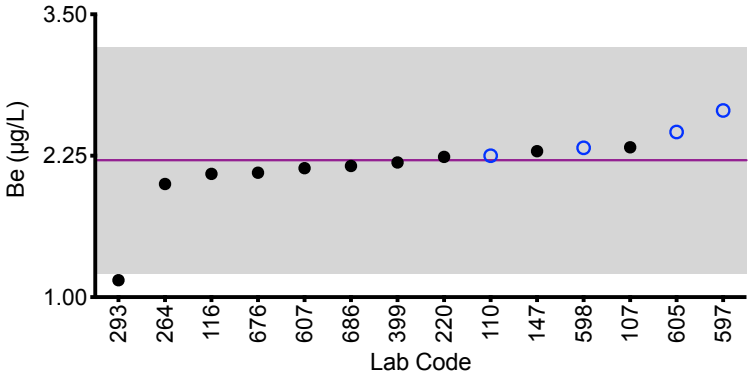
Results for Event #2, 2021: Summary Figures

Urine Be

UE21-06



UE21-07



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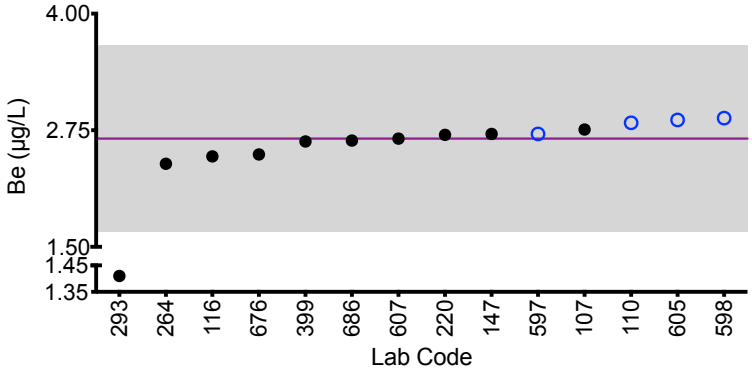
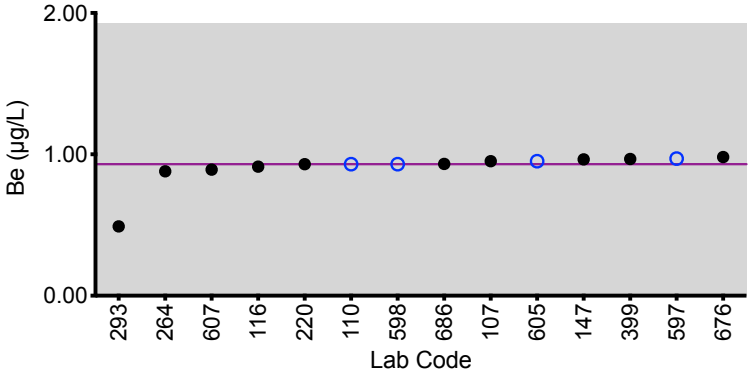
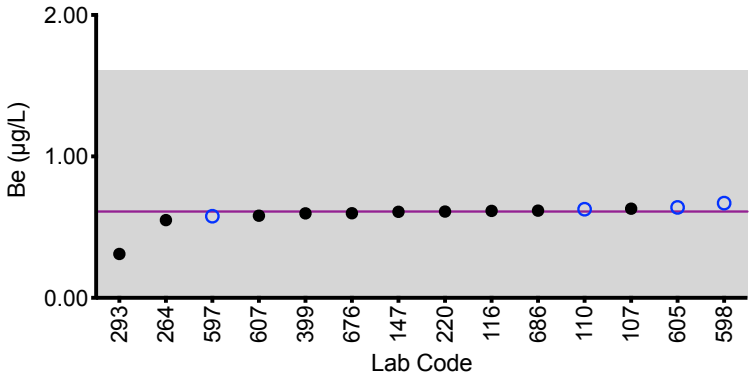


UE21-09



UE21-10



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 #2, 2021:
Summary Statistics

	Urine Cd (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	2.22	0.63	5.60	1.45	0.171
Upper Limit	3.22	1.63	6.60	2.45	1.171
Lower Limit	1.22	0.00	4.60	0.45	0.000
Robust SD (s*)	0.11	0.05	0.30	0.07	0.017
Robust RSD (%)	5.0	7.9	5.4	4.8	9.9
Number of Sample Measurements (N)	19	19	19	19	17
Standard Uncertainty (*u*)	0.03	0.02	0.09	0.02	0.005

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**2.22**	**0.63**	**5.60**	**1.45**	**0.171**
103	ICP-MS/MS	2.22	0.584	5.52	1.45	0.162
107	DRC/CC-ICP-MS	2.325	0.676	5.929	1.514	0.177
110	ICP-MS	2.18	0.591	5.52	1.40	0.153
116	ICP-MS/MS	2.23	0.678	5.76	1.52	<0.200
147	ICP-MS	2.25	0.608	5.77	1.45	0.161
220	ICP-MS	2.21	0.66	5.52	1.41	0.18
264	ICP-MS	2.31	0.70	5.89	1.53	0.17
293	DRC/CC-ICP-MS	2.06	0.59	5.35	1.4	0.17
324	ICP-MS	2.125	0.700	5.503	1.419	0.234
391	DRC/CC-ICP-MS	1.773	0.645	3.123 ↓	1.218	0.102
399	DRC/CC-ICP-MS	2.17	0.617	5.44	1.45	0.165
442	DRC/CC-ICP-MS	2.38	0.55	6.19	1.55	0.101
597	ICP-MS/MS	2.29	0.653	5.65	1.49	0.190
598	DRC/CC-ICP-MS	1.95	0.58	5.3	1.19	0.26
605	ICP-MS	2.37	0.672	6.04	1.47	0.176
606	ICP-MS/MS	2.29	0.617	5.54	1.51	0.169
607	ICP-MS	2.19	0.579	5.19	1.21	0.220
676	DRC/CC-ICP-MS	2.19	0.641	5.53	1.42	0.16
686	ICP-MS	2.28	0.709	5.79	1.49	<0.240

Based on the grading criteria for Cd in Urine, 99% of results were satisfactory, with 0 of the 19 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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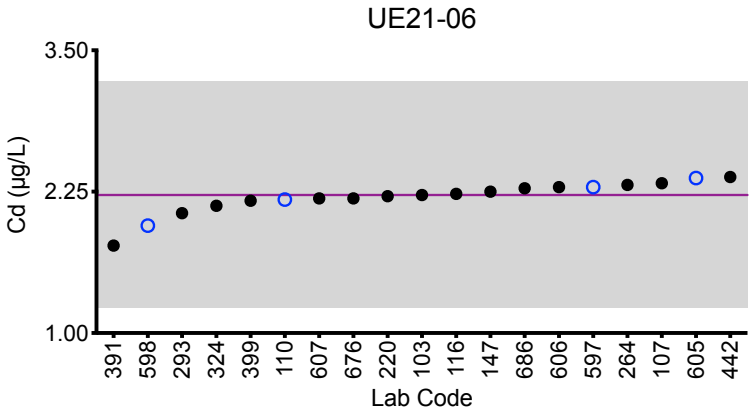
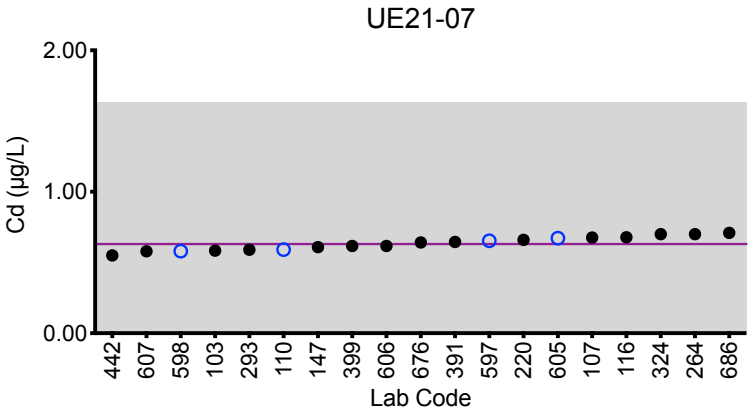
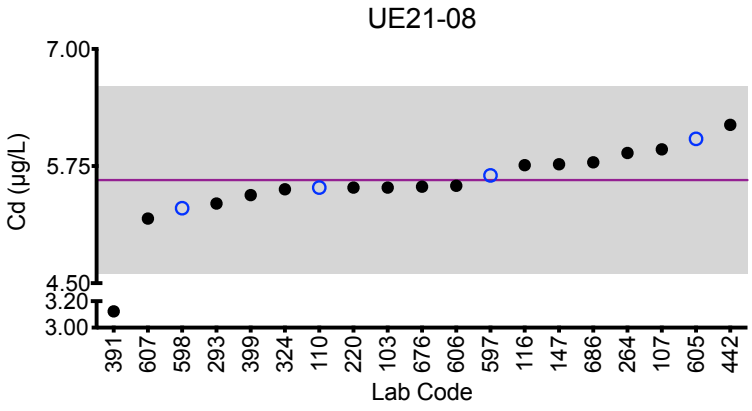
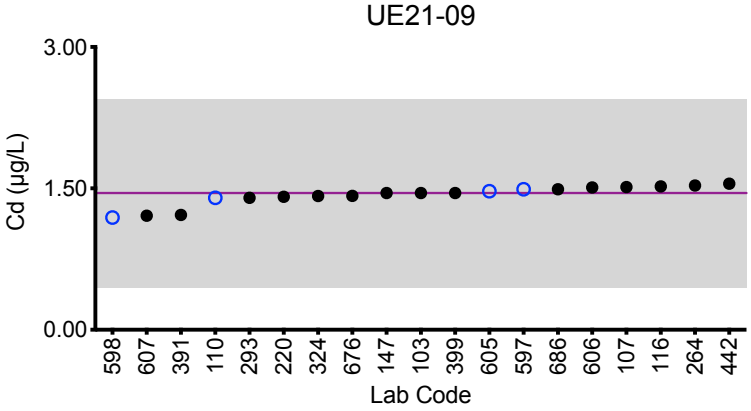
Results for Event #2, 2021: Summary Figures

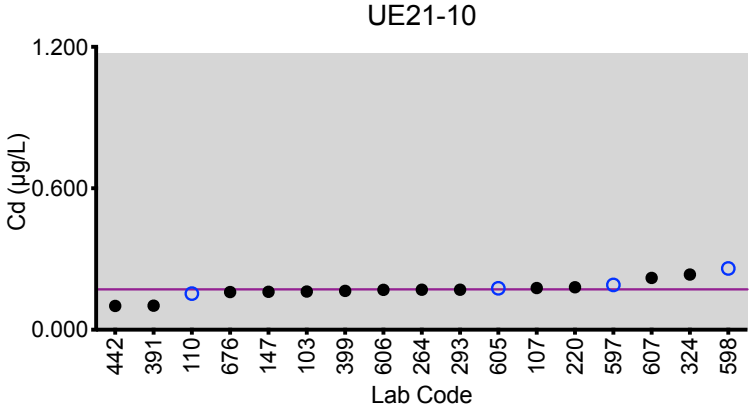
Urine Cd











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 #2, 2021: Summary Statistics

	Urine Co (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	2.74	0.11	9.8	0.98	1.63
Upper Limit	4.24	1.61	11.3	2.48	3.13
Lower Limit	1.24	0.00	8.3	0.00	0.13
Robust SD (s*)	0.13	0.03	0.5	0.17	0.08
Robust RSD (%)	4.7	30	5.1	17	4.9
Number of Sample Measurements (N)	14	13	14	14	14
Standard Uncertainty (*u*)	0.05	0.01	0.2	0.06	0.03

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Urine Co (µg/L)				
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**2.74**	**0.11**	**9.8**	**0.98**	**1.63**
103	ICP-MS/MS	2.77	0.0779	10.0	0.809	1.61
107	ICP-MS	2.706	0.082	9.722	0.856	1.564
110	ICP-MS	2.86	0.141	10.4	1.17	1.71
147	ICP-MS	2.73	0.101	9.72	0.837	1.59
220	ICP-MS	2.89	0.13	10.2	1.23	1.71
264	ICP-MS	2.67	0.09	9.68	0.85	1.60
324	ICP-MS	2.602	0.224	9.607	1.570	1.784
391	DRC/CC-ICP-MS	2.544	0.112	5.928 ↓	0.904	1.539
399	DRC/CC-ICP-MS	2.67	0.0780	9.24	0.859	1.56
597	ICP-MS/MS	2.92	<0.05	9.83	0.807	1.57
598	ICP-MS	2.62	0.14	9.38	1.13	1.69
605	ICP-MS	2.81	0.088	10.4	0.940	1.69
606	ICP-MS/MS	2.90	0.079	10.2	1.04	1.65
676	ICP-MS	2.72	0.144	9.71	1.17	1.64

Based on the grading criteria for Co in Urine, 99% of results were satisfactory, with 0 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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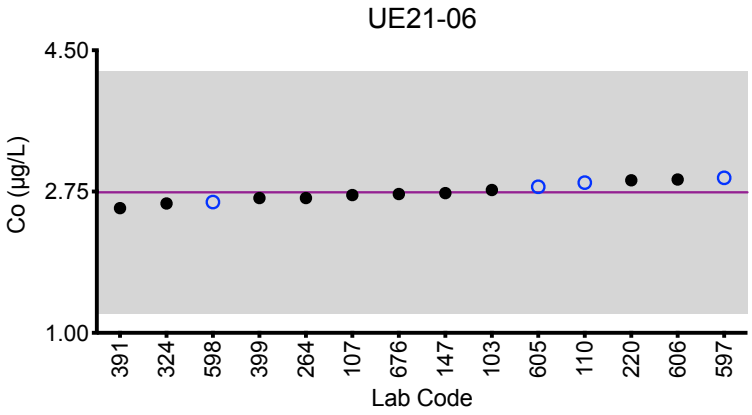
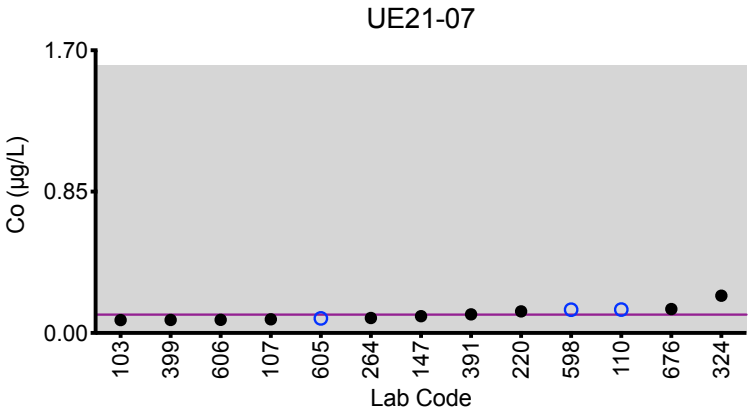
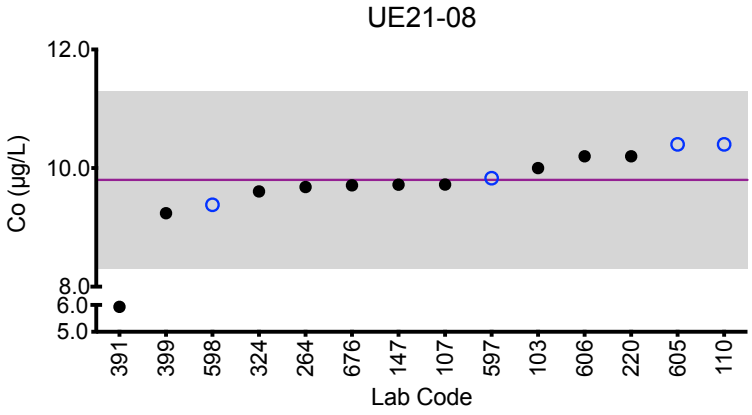
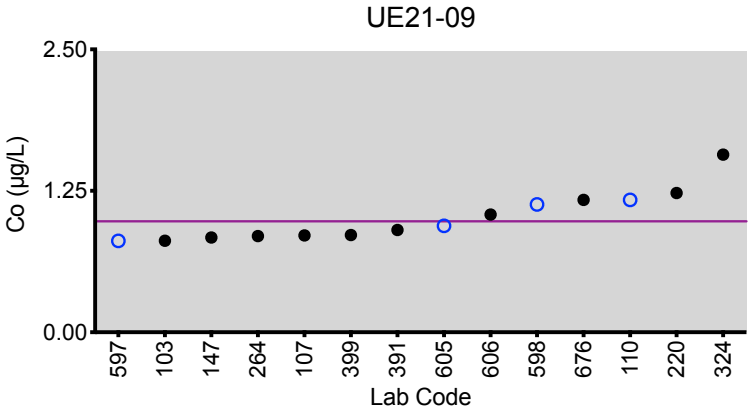
Results for Event #2, 2021: Summary Figures

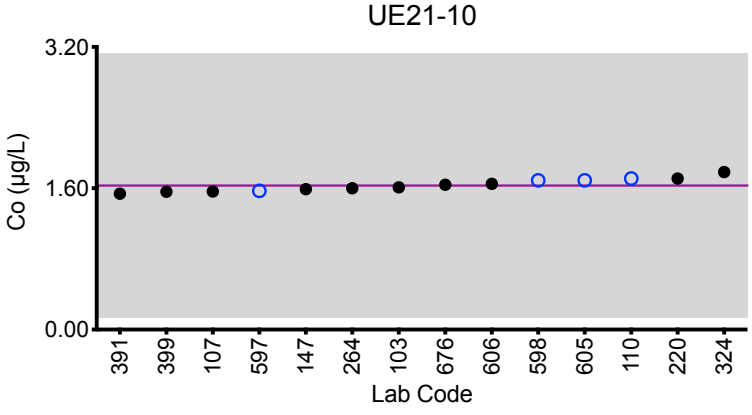
Urine Co











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 #2, 2021:
Summary Statistics

	Urine Cr (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	1.39	0.67	8.6	0.67	9.9
Upper Limit	4.39	3.67	11.6	3.67	12.9
Lower Limit	0.00	0.00	5.6	0.00	6.9
Robust SD (s*)	0.19	0.08	0.5	0.21	0.3
Robust RSD (%)	14	12	5.8	31	3.3
Number of Sample Measurements (N)	11	8	11	8	11
Standard Uncertainty (*u*)	0.07	NA	0.2	NA	0.1

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

An arithmetic mean, SD, RSD and n are provided for samples UE21-07 and UE21-09.

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**1.39**	**0.67**	**8.6**	**0.67**	**9.9**
103	ICP-MS/MS	1.21	<1.00	7.99	<1.00	9.41
107	DRC/CC-ICP-MS	1.33	0.64	8.63	0.53	9.80
110	DRC/CC-ICP-MS	1.66	0.81	9.19	0.99	10.7
116	ICP-MS/MS	1.54	0.608	8.12	0.427	9.58
147	DRC/CC-ICP-MS	1.47	0.712	8.63	0.572	9.93
264	ICP-MS	1.42	0.69	8.78	0.91	9.73
324	ICP-MS	1.342	0.717	8.615	0.815	9.927
391	DRC/CC-ICP-MS	8.078 ↑	*8.175 ↑	16.914 ↑	*19.29 ↑	19.8 ↑
597	ICP-MS/MS	1.08	<0.82	8.44	<0.82	9.98
598	DRC/CC-ICP-MS	1.33	0.6	8.06	0.67	10.1
605	ICP-MS	1.28	0.561	8.88	0.483	10.2

Based on the grading criteria for Cr in Urine, 91% of results were satisfactory, with 1 of the 11 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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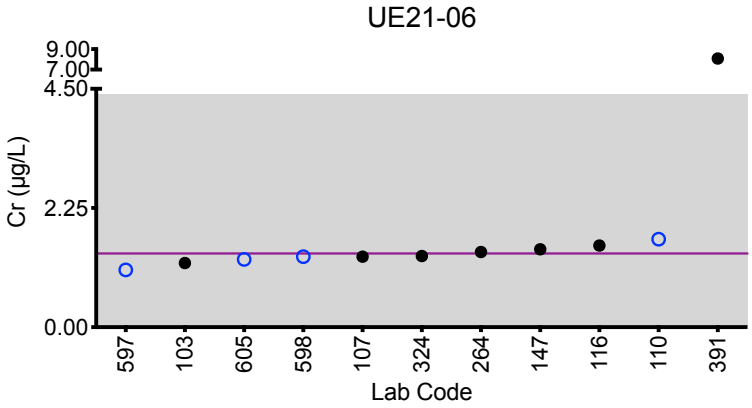
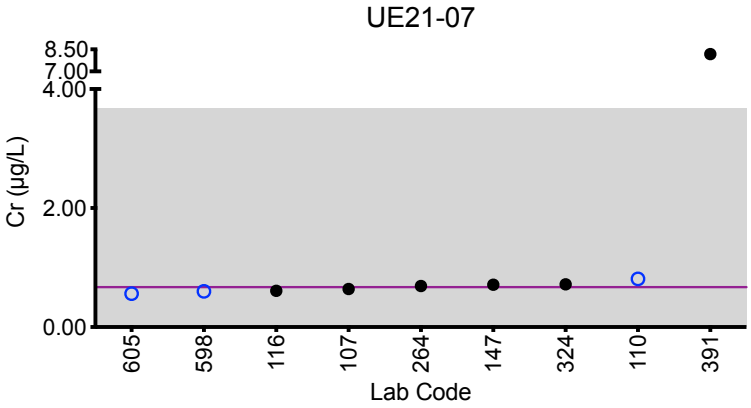
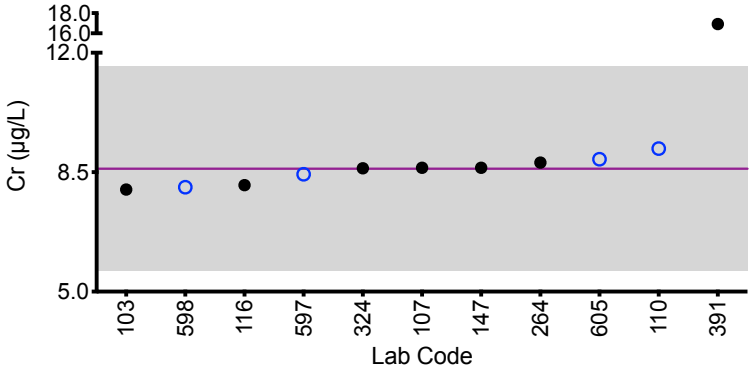
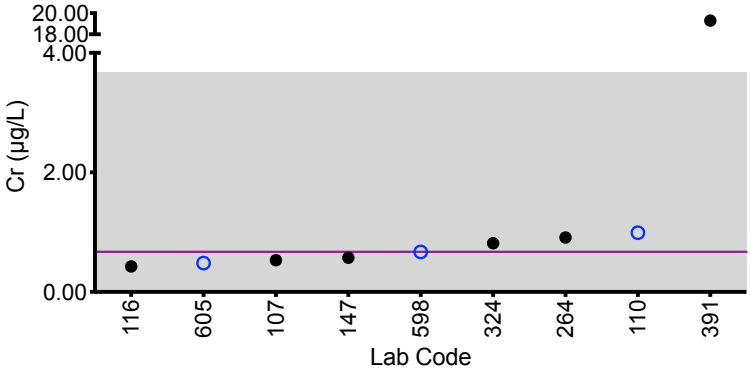
Results for Event #2, 2021: Summary Figures

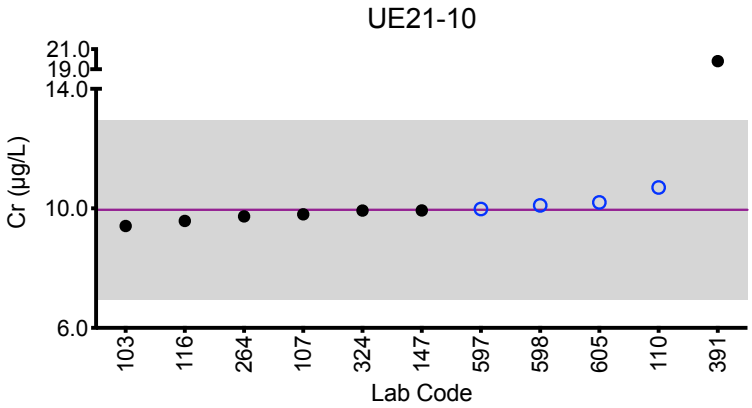
Urine Cr











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 #2, 2021: Summary Statistics

	Urine Hg (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	1.9	30	0.84	14	2.9
Upper Limit	NA	NA	NA	NA	NA
Lower Limit	NA	NA	NA	NA	NA
Robust SD (s*)	0.6	5	0.15	3	0.7
Robust RSD (%)	32	17	18	22	24
Number of Sample Measurements (N)	14	14	11	14	14
Standard Uncertainty (*u*)	0.02	2	0.06	1	0.2

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**1.9**	**30**	**0.84**	**14**	**2.9**
103	ICP-MS/MS	2.26	29.9	0.974	15.4	3.29
107	DRC/CC-ICP-MS	2.55	12.29	0.14	6.62	2.66
110	ICP-MS	1.42	26.0	0.801	6.88	2.39
116	ICP-MS/MS	1.74	25.6	<0.500	12.1	2.45
147	ICP-MS	1.53	29.1	0.867	12.9	2.29
264	ICP-MS	4.74	40.86	1.75	20.33	3.94
293	DRC/CC-ICP-MS	1.73	32.06	1	15.13	3.26
391	DRC/CC-ICP-MS	3.391	56.362	2.22	32.018	7.327
442	DRC/CC-ICP-MS	2.01	28.4	0.748	15.2	3.31
597	ICP-MS/MS	2.04	30.3	0.780	14.95	3.44
598	ICP-MS	1.32	24.7	0.76	11.3	2
605	ICP-MS	1.03	31.5	<1.00	14.5	2.55
606	ICP-MS/MS	1.61	26.8	<1.00	13.1	3.06
676	ICP-MS	2.2	33.9	0.714	16.8	2.61

The %RSD values for urine Hg appear to be unusually inflated for this event. Consequently, laboratory performance for urine Hg has been suspended pending further investigation.

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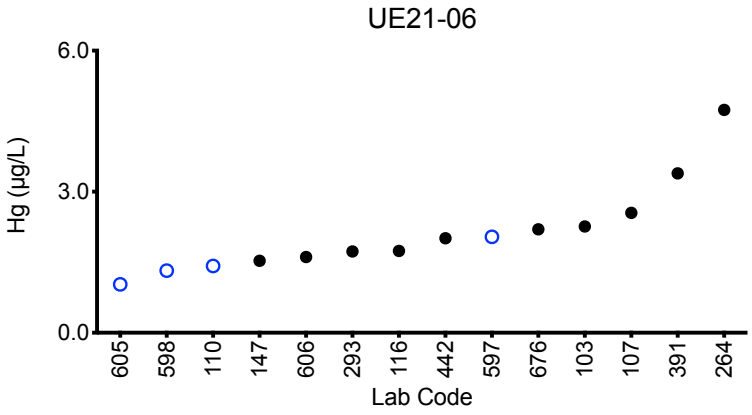
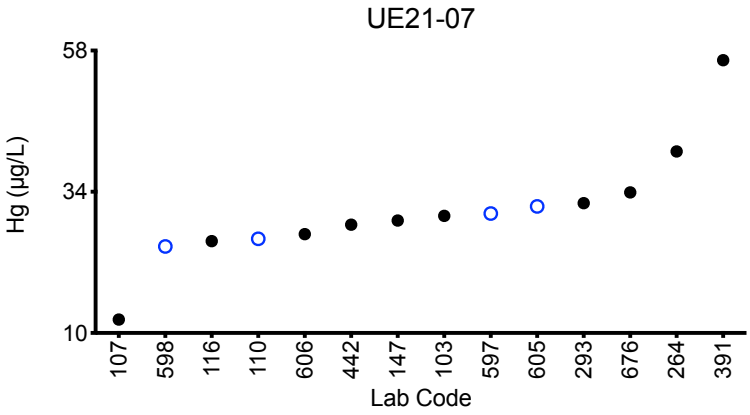
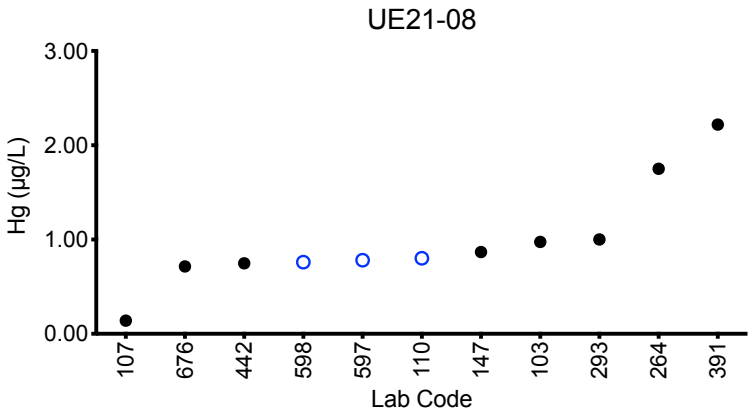
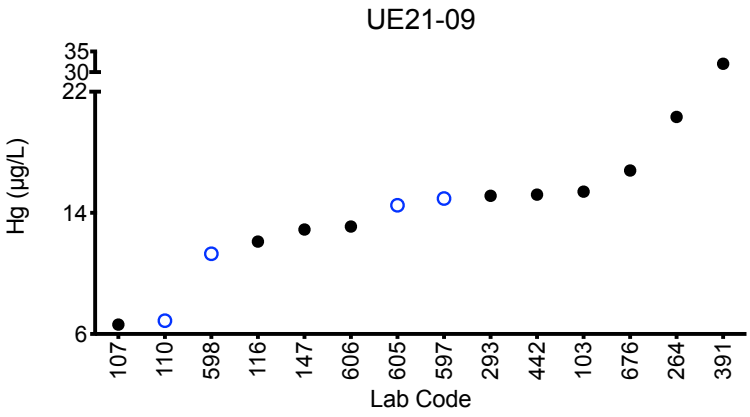
Results for Event #2, 2021: Summary Figures

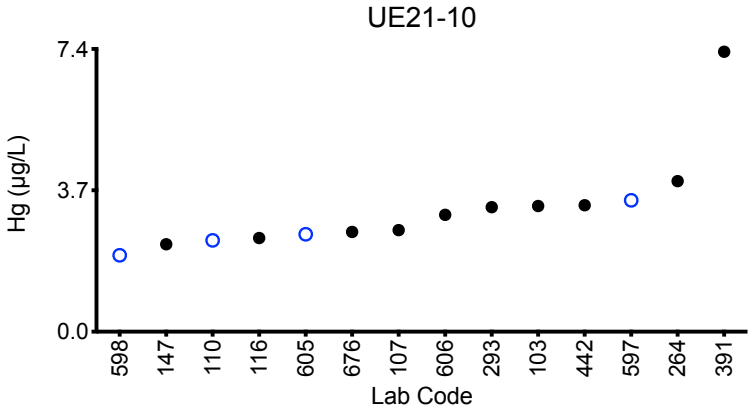
Urine Hg











Legend:
○ C/HHEAR Labs ● Other Labs

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Results for Event #2, 2021: Summary Statistics

	Urine Mn (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	0.42	5.9	1.60	3.19	2.09
Upper Limit	0.97	7.3	2.15	3.99	2.64
Lower Limit	0.00	4.4	1.05	2.39	1.54
Robust SD (s*)	0.06	0.4	0.14	0.24	0.14
Robust RSD (%)	14	6.0	8.8	7.5	6.7
Number of Sample Measurements (N)	13	15	15	15	15
Standard Uncertainty (*u*)	0.02	0.1	0.04	0.08	0.04

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 #2, 2021:
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**0.42**	**5.9**	**1.60**	**3.19**	**2.09**
103	ICP-MS/MS	0.391	5.84	1.61	2.98	1.99
107	DRC/CC-ICP-MS	<0.068	5.241	1.192	2.947	1.559
110	DRC/CC-ICP-MS	0.431	6.10	1.65	3.17	2.19
116	ICP-MS/MS	0.455	5.44	1.52	2.89	1.91
147	DRC/CC-ICP-MS	0.473	5.82	1.63	3.29	2.32
220	DRC/CC-ICP-MS	0.33	5.78	1.53	3.15	2.02
264	ICP-MS	0.40	5.94	1.56	3.20	2.06
324	ICP-MS	0.453	5.885	1.614	3.484	2.126
391	DRC/CC-ICP-MS	1.628 ↑	6.57	1.986	3.746	2.83 ↑
399	DRC/CC-ICP-MS	0.387	5.76	1.53	3.11	2.02
597	ICP-MS/MS	<0.39	6.26	1.41	2.99	2.35
598	ICP-MS	0.34	5.41	1.48	3.13	2.04
605	ICP-MS	0.390	6.06	1.63	3.45	2.14
606	ICP-MS/MS	0.513	6.23	1.82	3.93	2.29
676	DRC/CC-ICP-MS	0.412	5.64	2.21 ↑	3.07	2.01

Based on the grading criteria for Mn 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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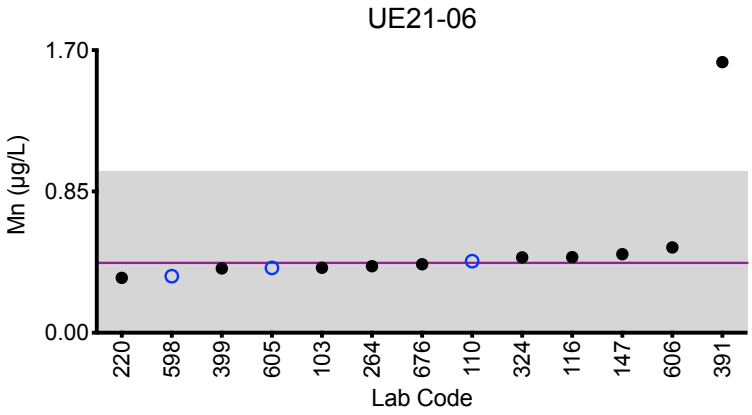
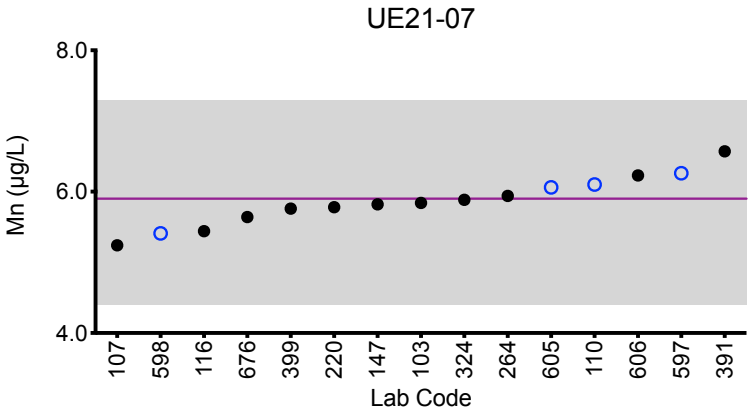
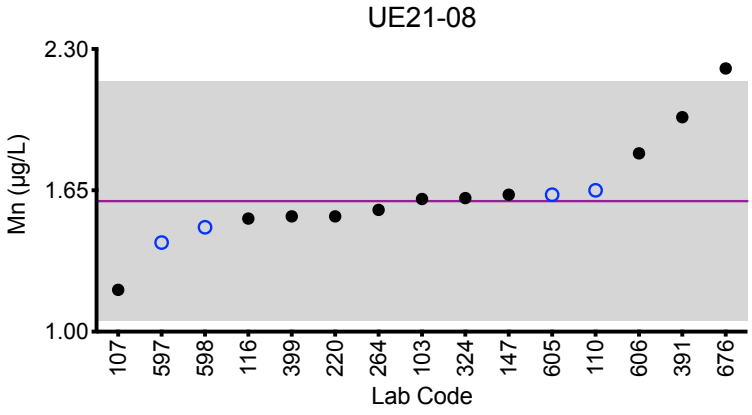
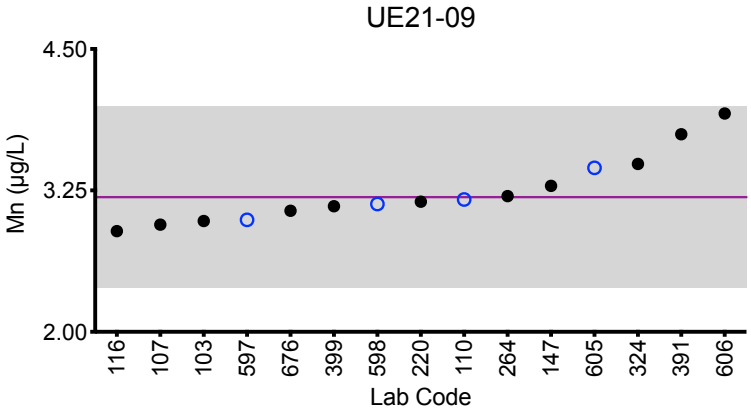
Results for Event #2, 2021: Summary Figures

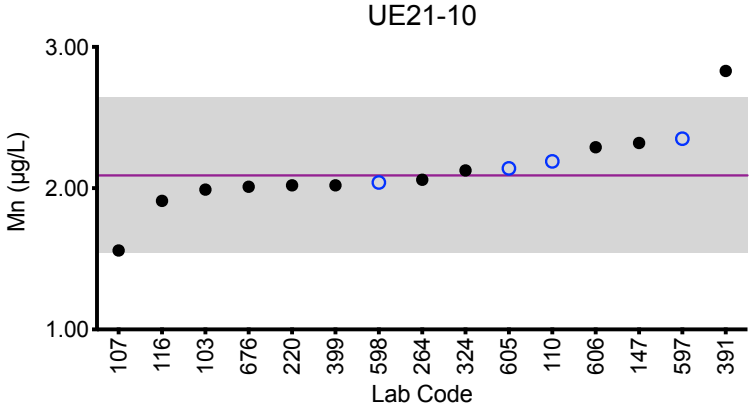
Urine Mn











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 #2, 2021: Summary Statistics

	Urine Pb (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	0.48	6.11	1.69	3.28	2.27
Upper Limit	1.48	7.33	2.69	4.28	3.27
Lower Limit	0.00	4.89	0.69	2.28	1.27
Robust SD (s*)	0.05	0.22	0.08	0.11	0.10
Robust RSD (%)	10	3.6	4.7	3.4	4.4
Number of Sample Measurements (N)	19	19	19	19	19
Standard Uncertainty (*u*)	0.01	0.06	0.02	0.03	0.03

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Urine Pb (µg/L)				
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**0.48**	**6.11**	**1.69**	**3.28**	**2.27**
103	ICP-MS/MS	0.473	6.22	1.65	3.34	2.25
107	ICP-MS	0.481	6.087	1.684	3.227	2.262
110	ICP-MS	0.47	6.28	1.68	3.11	2.27
116	ICP-MS/MS	0.549	5.98	1.54	3.07	2.09
147	ICP-MS	0.414	6.01	1.86	3.32	2.28
220	ICP-MS	0.64	6.11	1.74	3.36	2.32
264	ICP-MS	0.51	6.40	1.76	3.38	2.36
293	DRC/CC-ICP-MS	0.55	6.04	1.69	3.14	2.39
324	ICP-MS	0.454	5.895	1.681	3.246	2.178
391	DRC/CC-ICP-MS	0.167	5.033	0.331 ↓	2.211 ↓	1.357
399	ICP-MS/MS	0.418	5.83	1.57	3.13	2.10
442	DRC/CC-ICP-MS	0.439	5.98	1.7	3.42	2.32
597	ICP-MS/MS	0.516	6.53	1.79	3.38	2.44
598	ICP-MS	0.43	5.19	1.42	2.44	1.83
605	ICP-MS	0.507	6.98	1.79	3.62	2.47
606	ICP-MS/MS	0.484	6.28	1.73	3.32	2.32
607	ICP-MS	0.457	6.19	1.69	3.33	2.21
676	ICP-MS	0.494	6.18	1.71	3.31	2.27
686	ICP-MS	0.480	6.20	1.74	3.29	2.27

Based on the grading criteria for Pb in Urine, 98% of results were satisfactory, with 1 of the 19 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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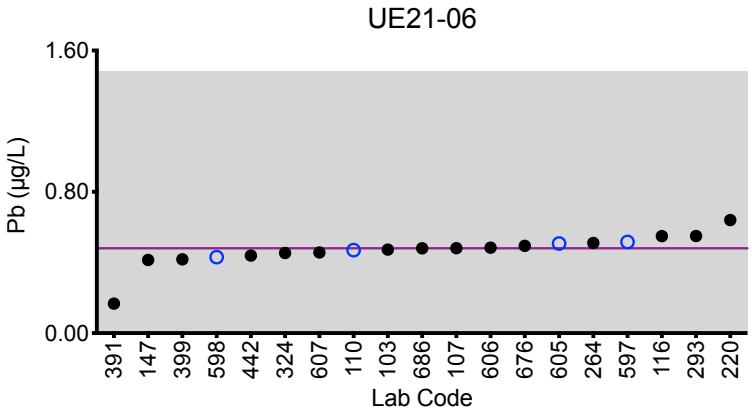
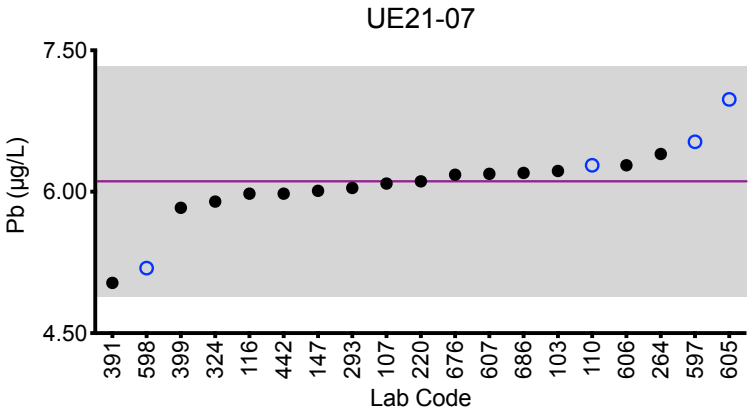
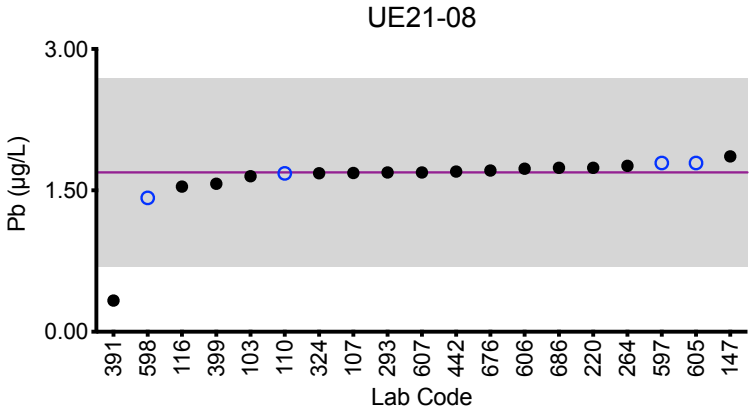
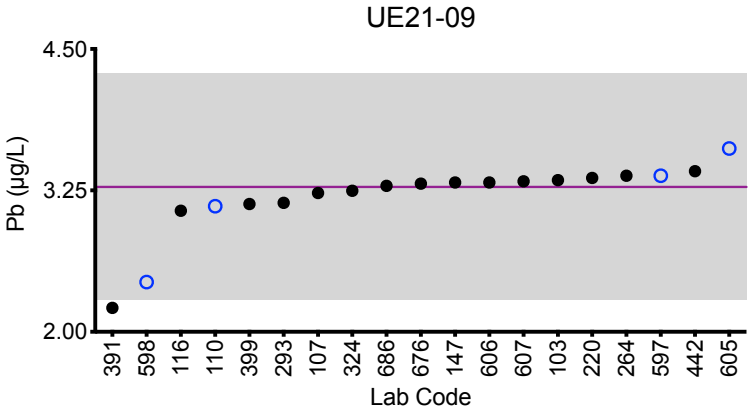
Results for Event #2, 2021: Summary Figures

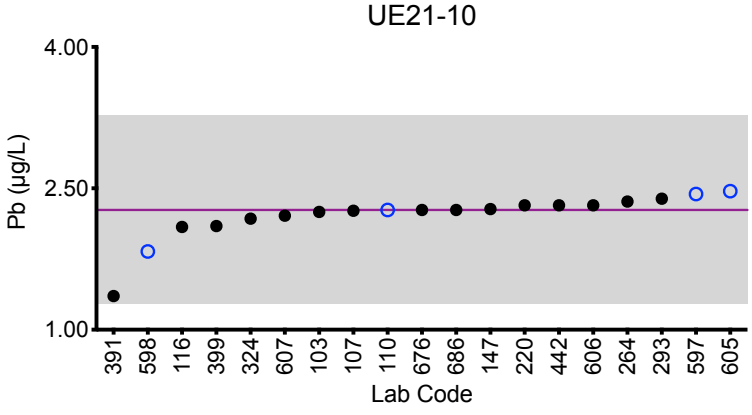
Urine Pb











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 #2, 2021: Summary Statistics

	Urine Tl (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	2.35	0.817	3.83	0.692	1.27
Upper Limit	2.82	1.017	4.60	0.892	1.52
Lower Limit	1.88	0.617	3.06	0.492	1.01
Robust SD (s*)	0.09	0.028	0.10	0.031	0.04
Robust RSD (%)	3.8	3.4	2.6	4.5	2.8
Number of Sample Measurements (N)	17	17	17	17	17
Standard Uncertainty (*u*)	0.03	0.009	0.03	0.009	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 #2, 2021:
Performance of Participating Laboratories

Urine Tl (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**2.35**	**0.817**	**3.83**	**0.692**	**1.27**
103	ICP-MS/MS	2.32	0.818	3.83	0.701	1.26
107	ICP-MS	2.270	0.819	3.860	0.699	1.276
110	ICP-MS	2.36	0.831	3.89	0.682	1.28
116	ICP-MS/MS	2.32	0.802	3.78	0.670	1.23
147	ICP-MS	2.43	0.832	3.82	0.679	1.29
220	ICP-MS	2.24	0.78	3.69	0.67	1.25
264	ICP-MS	2.39	0.84	3.91	0.72	1.30
293	DRC/CC-ICP-MS	2.63	0.79	3.78	0.69	1.22
391	DRC/CC-ICP-MS	2.309	0.969	2.046 ↓	0.662	1.277
399	ICP-MS/MS	2.26	0.799	3.66	0.677	1.21
597	ICP-MS/MS	2.43	0.806	3.88	0.654	1.24
598	ICP-MS	2.05	0.7	3.2	0.55	1.09
605	ICP-MS	2.48	0.923	4.11	0.778	1.38
606	ICP-MS/MS	2.37	0.794	3.88	0.715	1.30
607	ICP-MS	2.42	0.823	3.99	0.735	1.30
676	ICP-MS	2.34	0.837	3.88	0.718	1.28
686	ICP-MS	2.35	0.818	3.84	0.708	1.27

Based on the grading criteria for Tl in Urine, 99% of results were satisfactory, with 0 of the 17 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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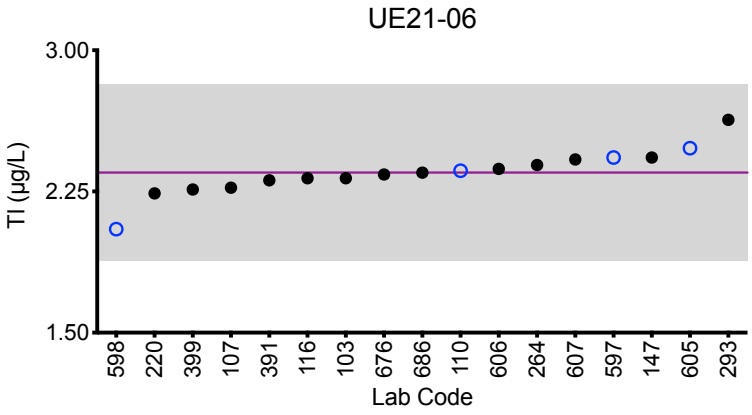
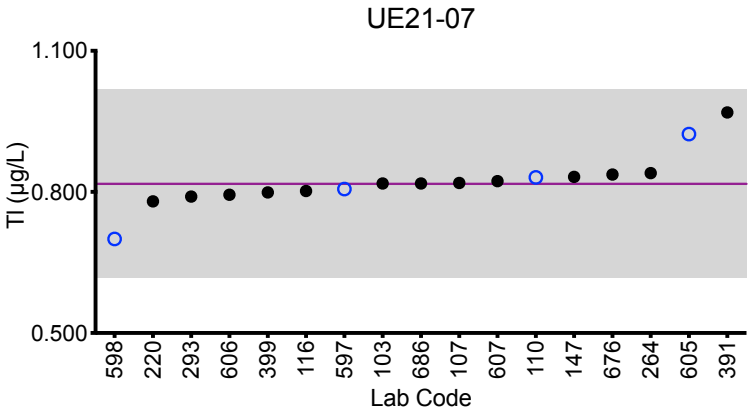
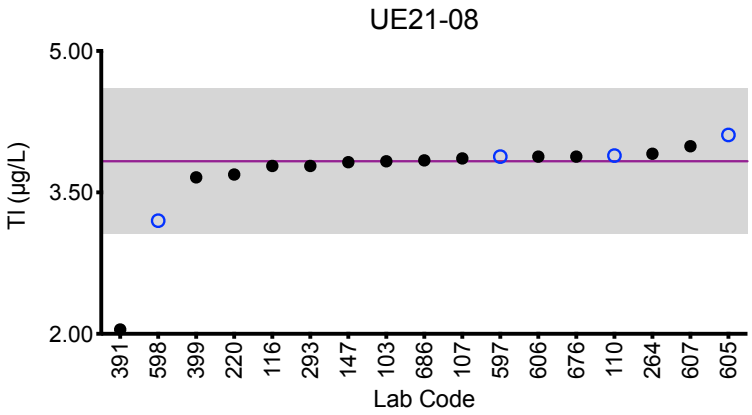
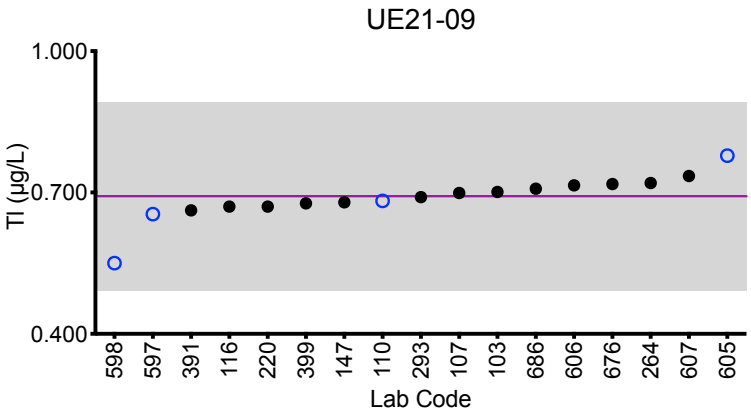
Results for Event #2, 2021: Summary Figures

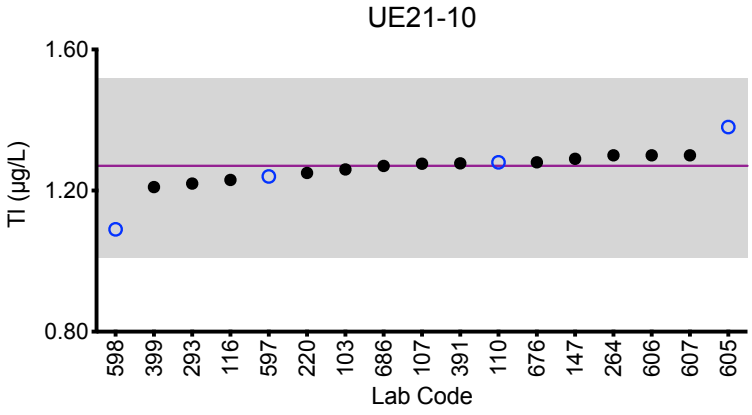
Urine Tl











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 #2, 2021: Summary Statistics

	Urine U (µg/L)				
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Target (Robust Mean (x*))	0.152	0.0390	0.0212	0.0108	0.097
Upper Limit	0.182	0.0690	0.0512	0.0408	0.127
Lower Limit	0.121	0.0090	0.0000	0.0000	0.067
Robust SD (s*)	0.004	0.0016	0.0017	0.0014	0.007
Robust RSD (%)	2.3	4.1	8.0	13	7.2
Number of Sample Measurements (N)	16	16	15	13	16
Standard Uncertainty (*u*)	0.001	0.0005	0.0005	0.0005	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 #2, 2021:
Performance of Participating Laboratories

Urine U (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
	Target	**0.152**	**0.0390**	**0.0212**	**0.0108**	**0.097**
103	ICP-MS/MS	0.150	0.0356	<0.0200	<0.0200	0.0868
107	ICP-MS	0.1639	0.0404	0.0237	0.0123	0.1033
110	ICP-MS	0.159	0.0396	0.0222	0.0105	0.0998
116	ICP-MS/MS	0.154	0.0361	0.0197	<0.0150	0.0948
147	ICP-MS	0.151	0.04	0.024	0.011	0.097
220	ICP-MS	0.15	0.036	0.019	0.008	0.093
264	ICP-MS	0.15	0.04	0.02	0.01	0.10
324	ICP-MS	0.127	0.03	0.018	0.009	0.087
399	ICP-MS/MS	0.151	0.039	0.021	0.010	0.089
597	ICP-MS/MS	0.163	0.0400	0.0251	0.0120	0.115
598	ICP-MS	0.15	0.04	0.021	0.01	0.088
605	ICP-MS	0.159	0.043	0.022	0.012	0.103
606	ICP-MS/MS	0.159	0.040	0.020	0.012	0.100
607	ICP-MS	0.151	0.0388	0.0216	0.0105	0.102
676	ICP-MS	0.145	0.035	0.021	0.012	0.093
686	ICP-MS	0.152	0.0380	0.0214	<0.0150	0.100

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

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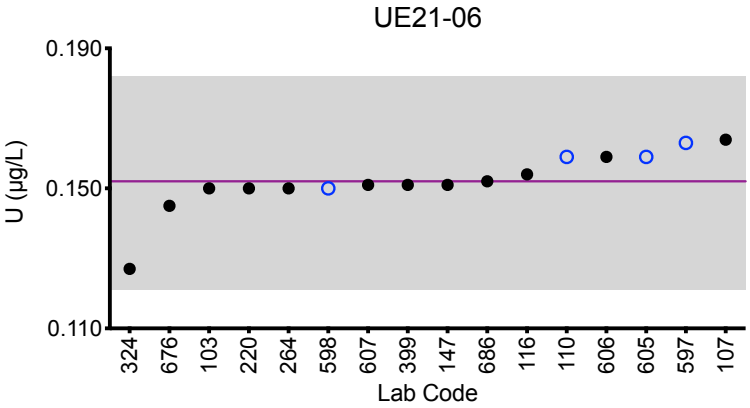
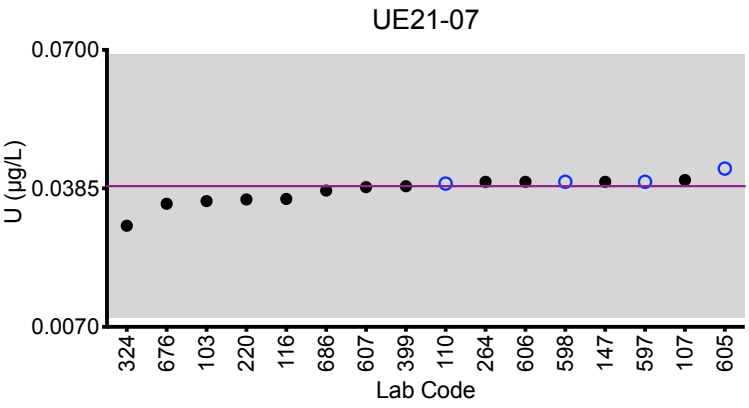
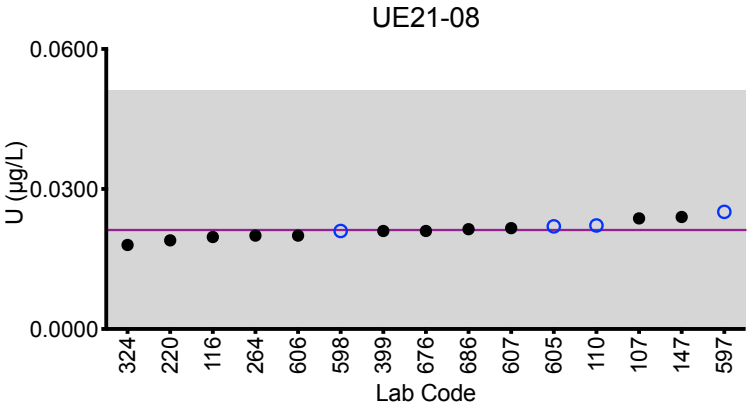
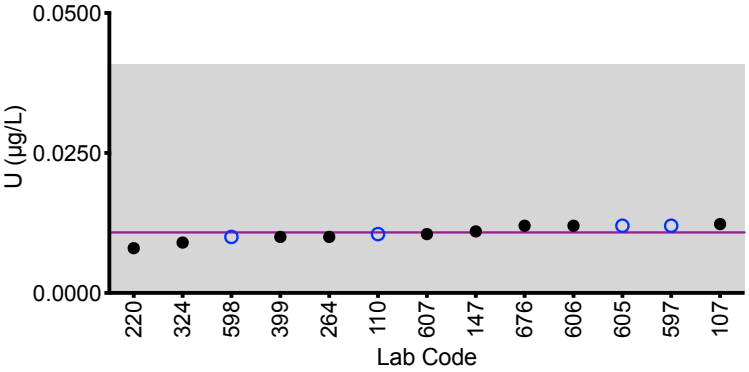
Results for Event #2, 2021: Summary Figures

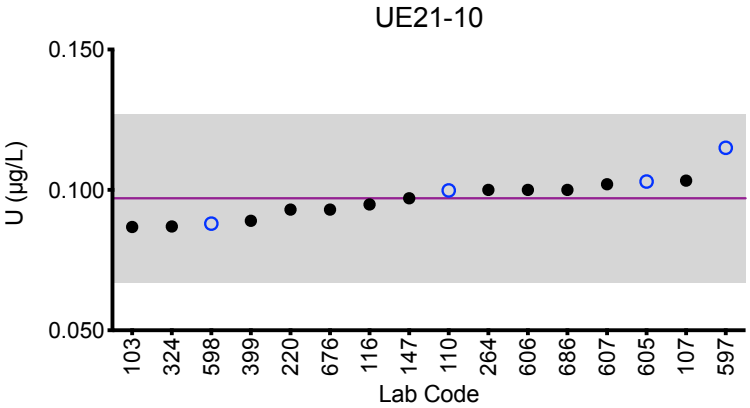
Urine U











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 #2, 2021:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
107	ICP-MS	2.22	4.57	1.84	11.61	1.42
110	ICP-MS	2.39	4.77	2.02	13.3	1.52
147	ICP-MS	2.35	4.57	1.83	11.9	1.48
220	ICP-MS	2.41	4.78	1.96	12.8	1.51
264	ICP-MS	2.08	4.22	1.72	11.32	1.32
399	ICP-MS/MS	2.29	4.59	1.86	11.9	1.44
597	ICP-MS/MS	2.51	4.81	1.96	11.9	1.61
598	ICP-MS	2.33	4.36	1.78	11.2	1.37
605	ICP-MS	2.46	5.13	2.05	12.6	1.57
606	ICP-MS/MS	2.42	4.85	1.98	12.8	1.57
676	ICP-MS	2.29	4.63	1.91	12.7	1.48

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Robust Mean (x*)	2.35	4.65	1.90	12.2	1.48
Robust SD (s*)	0.10	0.23	0.11	0.8	0.10
Robust RSD (%)	4.3	4.9	5.8	6.6	6.8
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.04	0.09	0.04	0.3	0.04

*Denotes a statistical Outlier.

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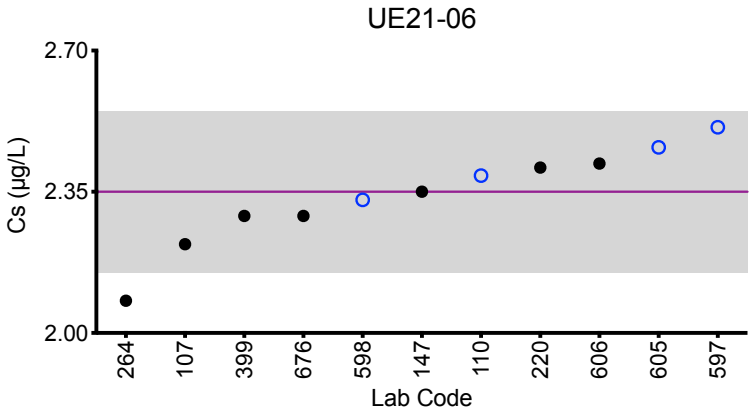
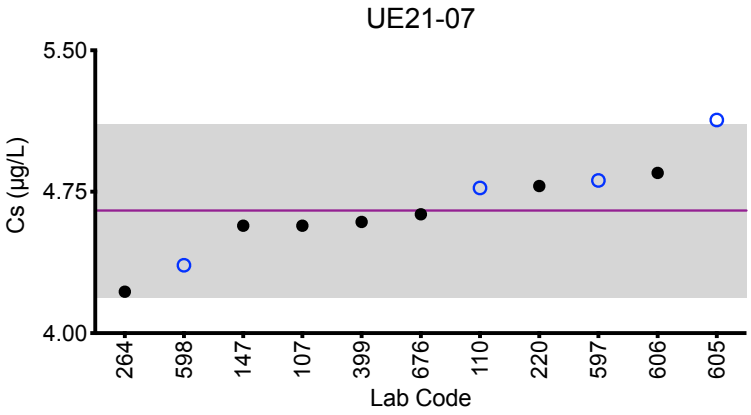
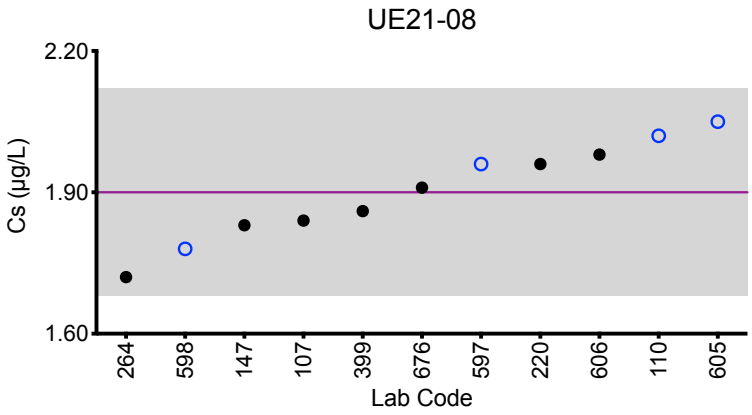
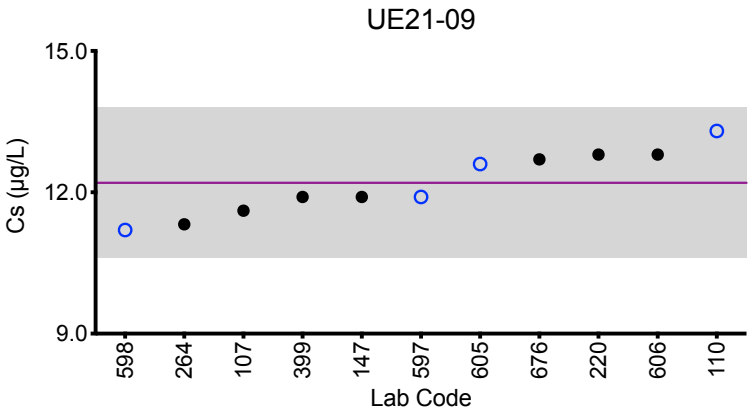
Results for Event #2, 2021: Summary Figures

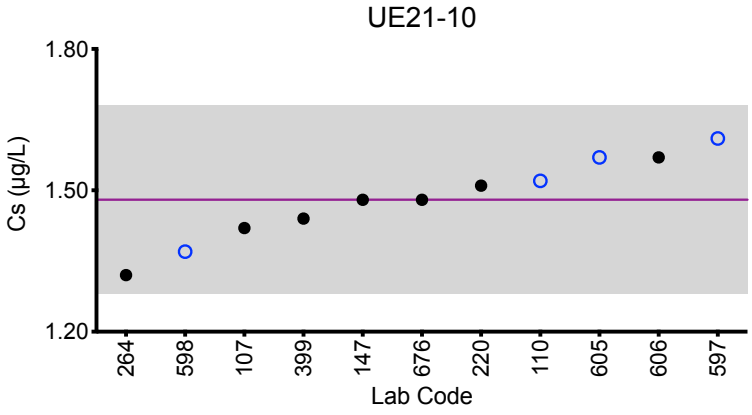
Urine Cs











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 #2, 2021:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
110	ICP-MS	69.1	16.3	30.5	3.8	106
116	ICP-MS/MS	57.9	12.6	26.5	<5.00	95.2
147	ICP-MS	61.3	18.6	33.9	15.0	105
264	ICP-MS	61.25	14.74	29.17	1.59	104.73
293	DRC/CC-ICP-MS	54.04	13.35	26.7	<0.05	92.18
324	ICP-MS	57.994	13.671	36.439	1.818	97.887
391	DRC/CC-ICP-MS	*116.3	*71.021	*78.738	61.658	*145.299
597	ICP-MS/MS	65.3	15.3	28.9	1.08	99.8
598	ICP-MS	51.1	12.8	25.1	2.24	89.5

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Arithmetic Mean ($\bar{x}$)	60	14.7	30	NA	99
Arithmetic SD (s)	6	2.0	4	NA	6
Arithmetic RSD (%)	10	14	13	NA	6.1
Number of Sample Measurements (N)	8	8	8	NA	8

*Denotes a statistical Outlier.

Statistical data was not calculated for UE21-09 based on a lack of consensus among participating labs.

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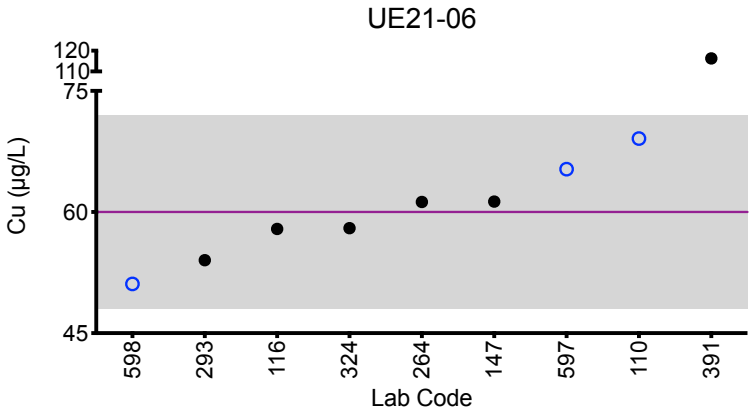
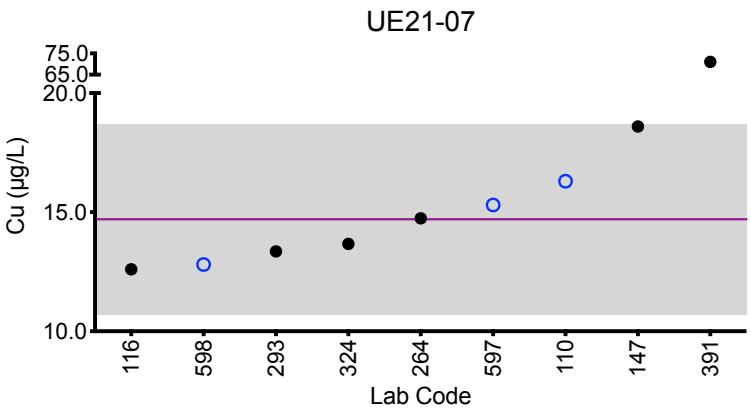
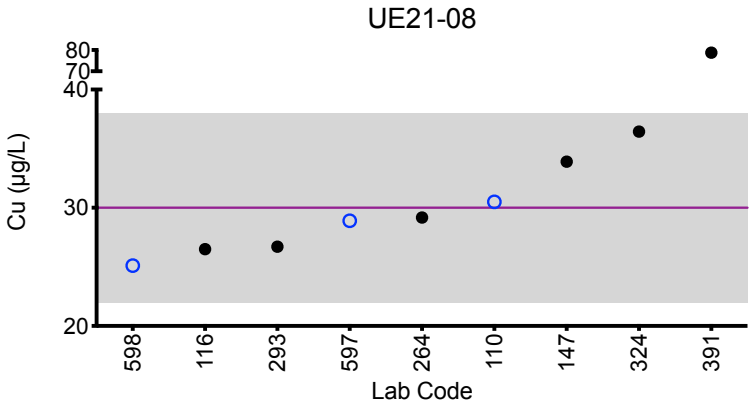
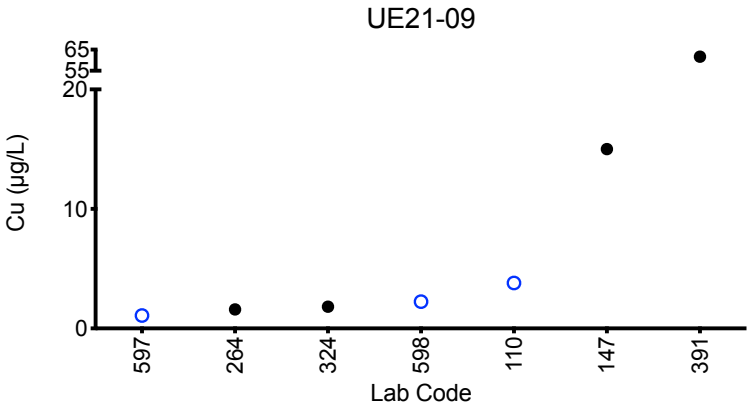
Results for Event #2, 2021: Summary Figures

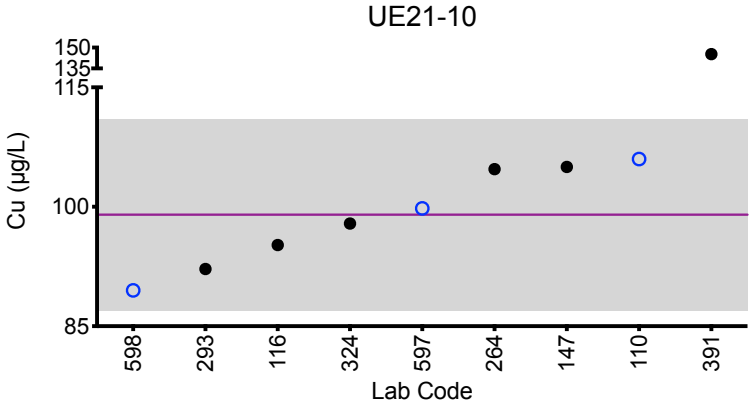
Urine Cu











Legend:
○ C/HHEAR Labs ● Other Labs
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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
103	ICP-MS/MS	75.9	43.7	128	20.6	17.3
107	ICP-MS	72.12	44.08	127.19	20.91	16.46
110	ICP-MS	79.9	47.1	140	23.1	18.4
147	ICP-MS	68.3	42.5	122	21.4	15.6
264	ICP-MS	61.31	38.54	113.27	18.16	12.67
293	DRC/CC-ICP-MS	87.92	51.07	149.45	25.71	18.83
324	ICP-MS	67.478	43.572	125.155	20.167	15.893
399	ICP-MS/MS	72.1	43.7	126	21.1	16.6
597	ICP-MS/MS	70.9	42.0	124	20.1	16.2
598	DRC/CC-ICP-MS	72.5	45.6	129	18.3	15.7
605	ICP-MS	78.5	47.6	138	22.9	17.3
606	ICP-MS/MS	77.3	45.7	135	22.2	17.2
676	ICP-MS	69.5	42.5	124	20.7	15.2

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Robust Mean (x*)	73	44.3	128	21.0	16.5
Robust SD (s*)	6	2.5	6	1.4	1.3
Robust RSD (%)	8.2	5.6	4.7	6.7	7.9
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (*u*)	2	0.9	2	0.5	0.4

*Denotes a statistical Outlier.

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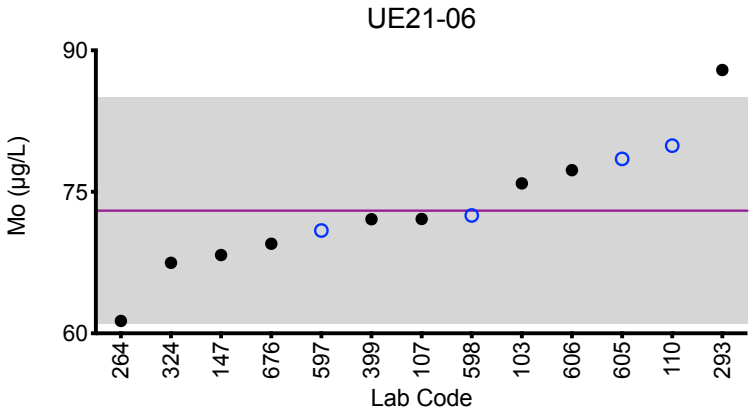
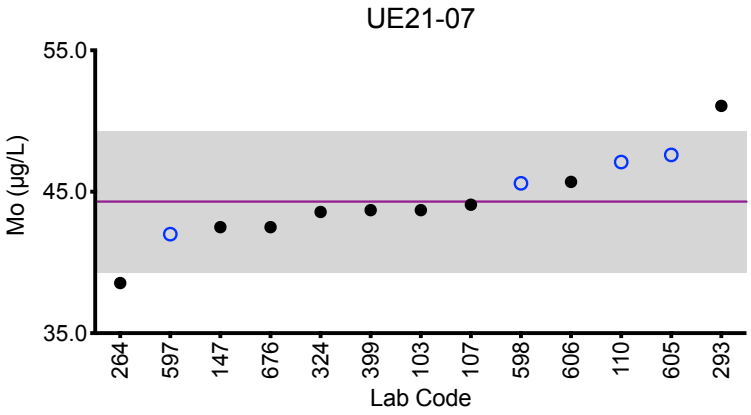
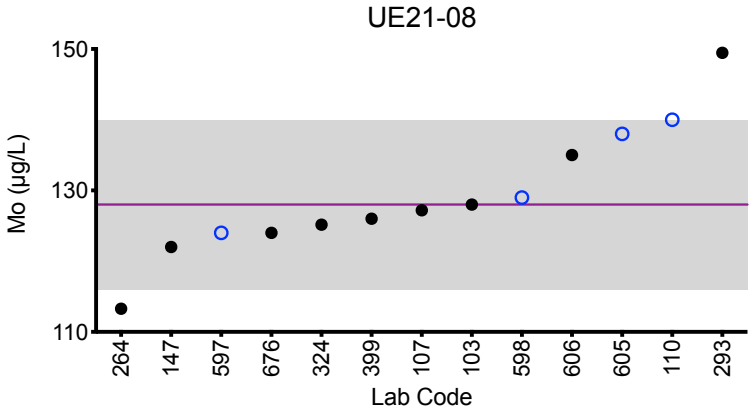
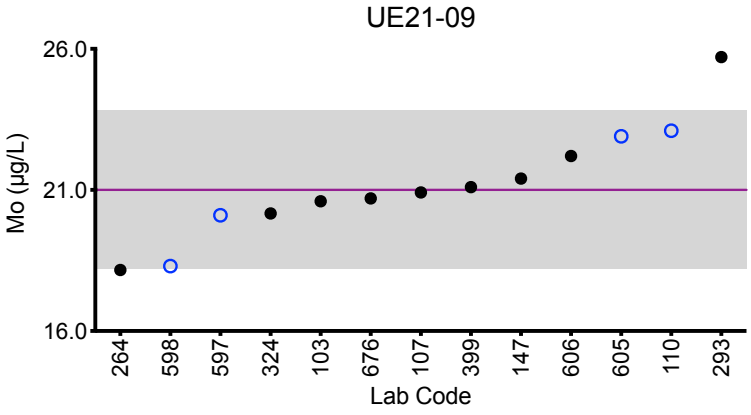
Results for Event #2, 2021: Summary Figures

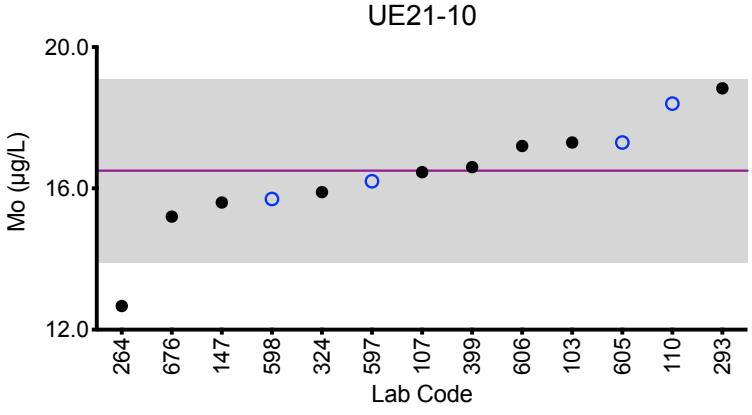
Urine Mo











Legend:
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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
107	DRC/CC-ICP-MS	1.97	0.87	4.60	2.37	1.51
110	ICP-MS	3.83	1.33	5.88	4.91	2.51
147	ICP-MS	2.2	0.746	4.91	2.09	1.46
264	ICP-MS	2.38	0.99	5.3	2.85	1.84
293	DRC/CC-ICP-MS	2.62	0.82	5.19	2.55	1.59
324	ICP-MS	2.178	1.192	12.928	3.328	1.903
391	DRC/CC-ICP-MS	3.661	2.163	4.235	4.441	3.269
442	DRC/CC-ICP-MS	2.1	0.8	5.1	2.4	1.6
597	ICP-MS/MS	2.05	0.65	4.93	2.49	1.56
598	ICP-MS	2.37	1.12	5.14	4.83	2.42
605	ICP-MS	2.26	0.836	5.46	2.51	1.61

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Robust Mean (x*)	2.3	0.93	5.1	2.7	1.72
Robust SD (s*)	0.3	0.21	0.4	0.5	0.22
Robust RSD (%)	12	23	7.8	19	13
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.1	0.08	0.2	0.2	0.08

*Denotes a statistical Outlier.

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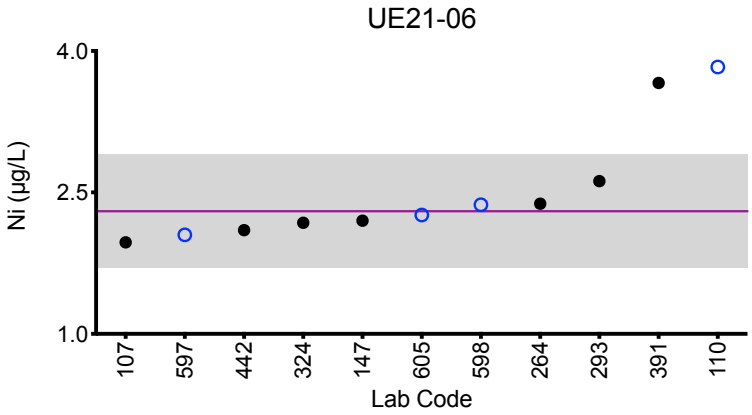
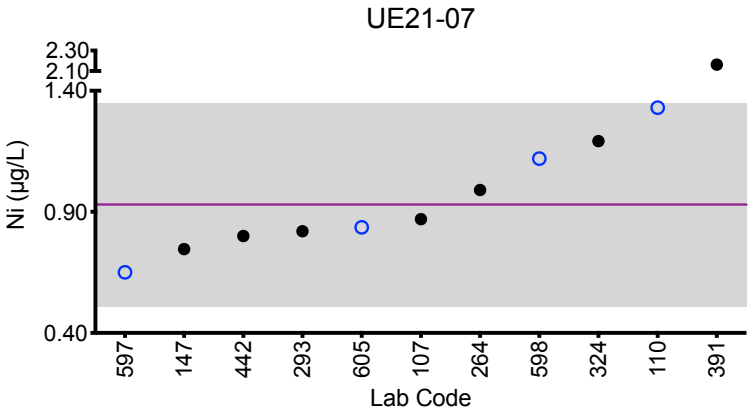
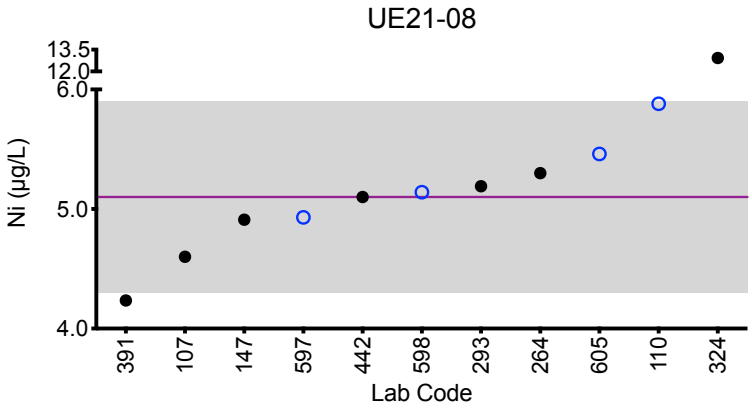
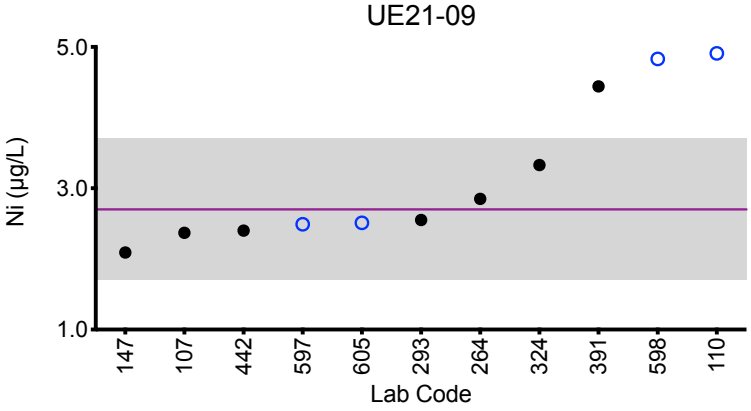
Results for Event #2, 2021: Summary Figures

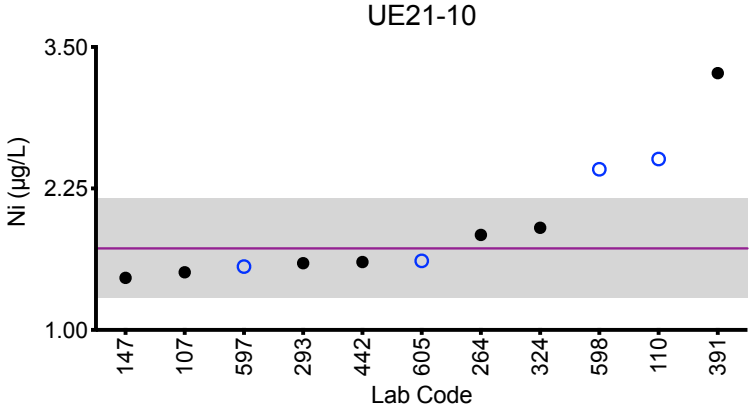
Urine Ni











Legend:
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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
107	ICP-MS	0.1040	0.7928	0.3010	4.0889	1.5492
110	ICP-MS	0.085	0.716	0.291	3.96	1.21
220	ICP-MS	0.07	0.78	0.27	3.81	1.28
264	ICP-MS	0.09	0.78	0.31	3.85	1.27
399	ICP-MS/MS	0.084	0.745	0.278	4.09	1.38
598	ICP-MS	0.1	0.71	0.26	3.32	1.22
605	ICP-MS	0.061	0.813	0.268	4.41	1.52
676	ICP-MS	0.128	0.782	0.331	4.14	1.43

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Arithmetic Mean ($\bar{x}$)	0.090	0.76	0.289	3.96	1.36
Arithmetic SD (s)	0.021	0.04	0.024	0.32	0.13
Arithmetic RSD (%)	23	4.8	8.3	8.1	9.6
Number of Sample Measurements (N)	8	8	8	8	8

*Denotes a statistical Outlier.

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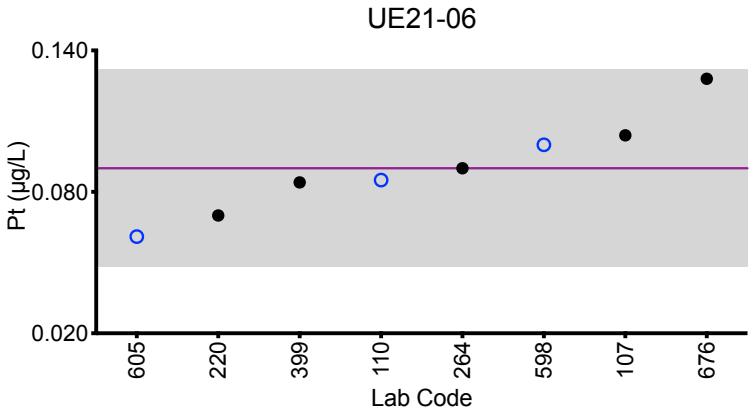
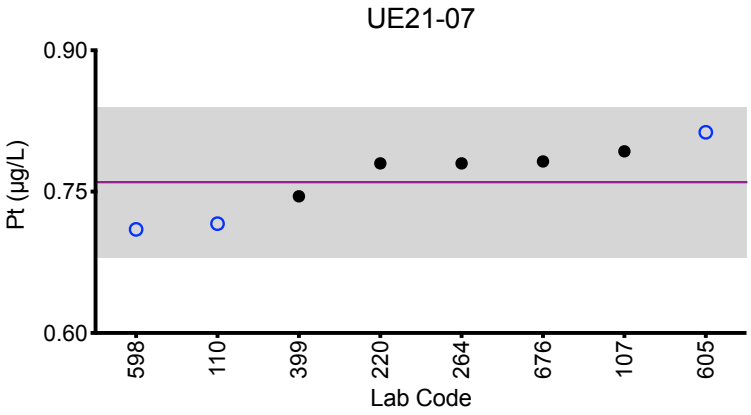
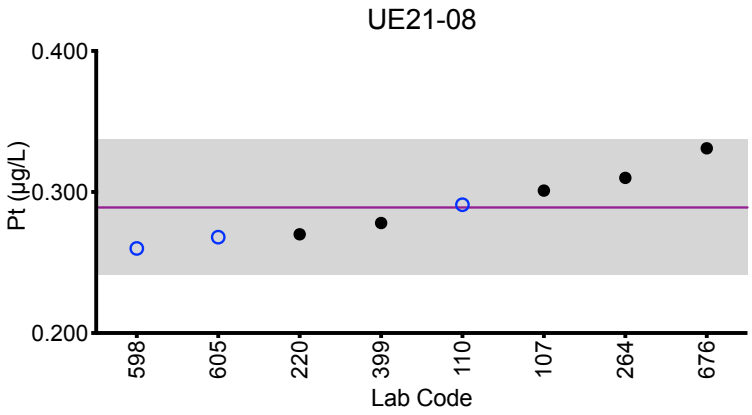
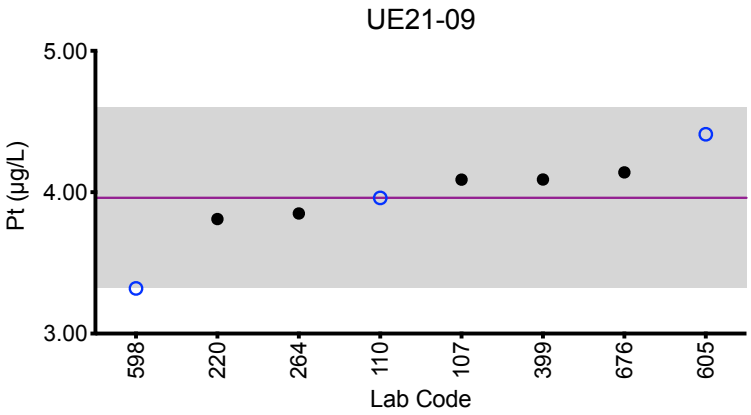
Results for Event #2, 2021: Summary Figures

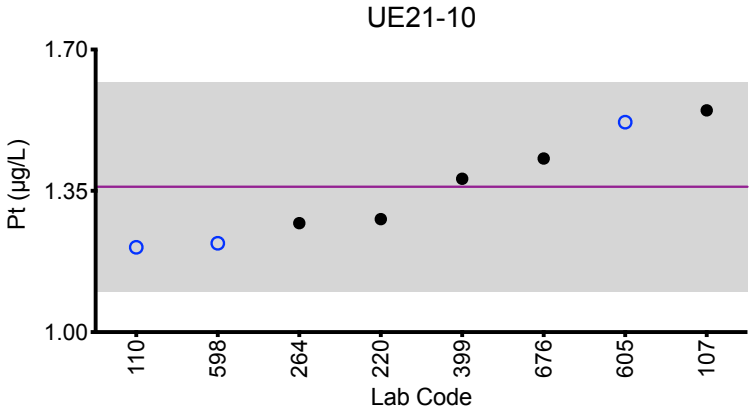
Urine Pt











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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
103	ICP-MS/MS	0.592	0.220	2.65	1.36	0.432
107	ICP-MS	0.548	0.304	2.820	1.269	0.450
110	ICP-MS	0.673	0.299	2.96	1.24	0.453
147	ICP-MS	0.678	0.323	3.29	1.52	0.499
220	ICP-MS	0.59	0.32	2.87	1.16	0.44
264	ICP-MS	0.52	0.26	2.71	1.28	0.39
293	DRC/CC-ICP-MS	0.64	0.32	3.26	1.5	0.46
399	ICP-MS/MS	0.537	0.281	2.66	1.28	0.384
597	ICP-MS/MS	0.862	0.380	2.90	1.51	0.678
598	ICP-MS	0.5	0.27	2.65	1.26	0.36
605	ICP-MS	<0.800	<0.800	3.13	1.38	<0.800
606	ICP-MS/MS	0.629	0.329	2.93	1.45	0.439
676	ICP-MS	0.6	0.302	2.78	1.36	0.404

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Robust Mean (x*)	0.60	0.30	2.89	1.35	0.44
Robust SD (s*)	0.08	0.03	0.23	0.13	0.05
Robust RSD (%)	13	11	8.0	9.6	11
Number of Sample Measurements (N)	12	12	13	13	12
Standard Uncertainty (*u*)	0.03	0.01	0.08	0.05	0.02

*Denotes a statistical Outlier.

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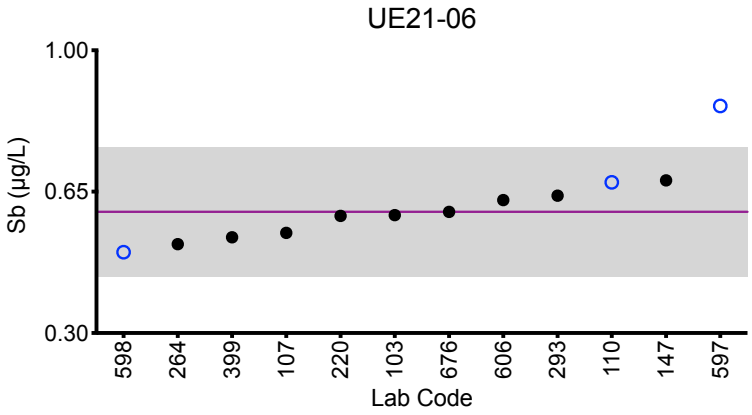
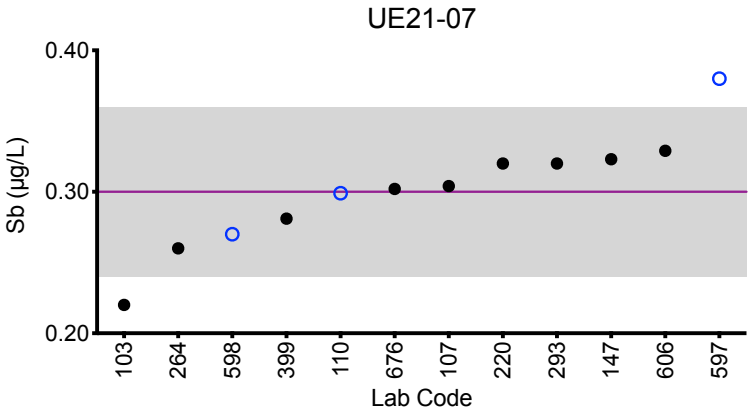
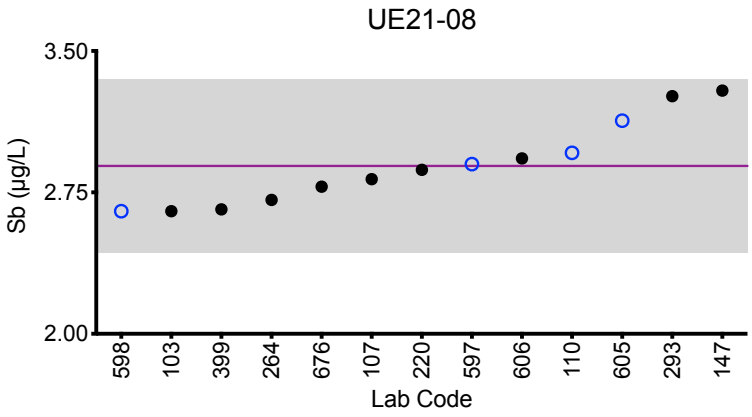
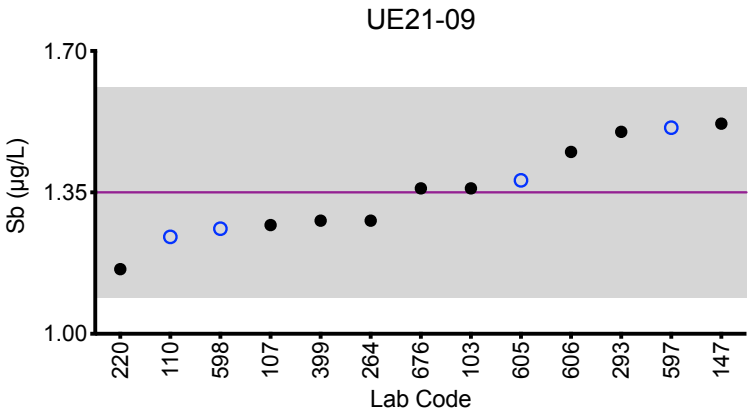
Results for Event #2, 2021: Summary Figures

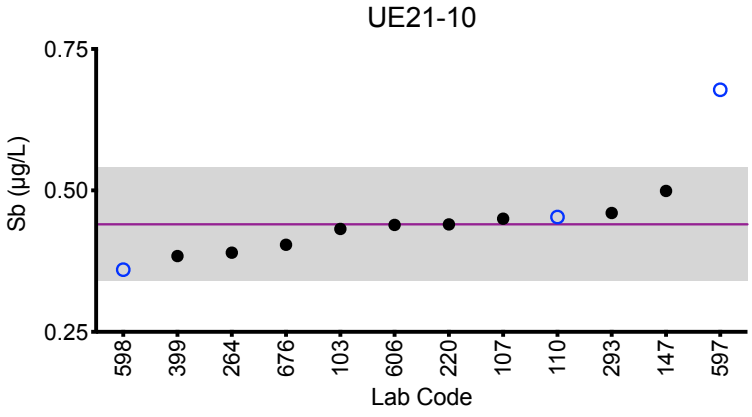
Urine Sb











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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Se (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
103	ICP-MS/MS	188	28.0	61.9	65.4	99.9
110	DRC/CC-ICP-MS	184	26.4	65.4	70.7	108
147	ICP-MS	184	28.1	63.9	67.4	103
597	ICP-MS/MS	185	30.1	65.1	68.2	102
598	DRC/CC-ICP-MS	172	25.6	57	58.5	92.4

Summary Statistics					
	UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Arithmetic Mean ($\bar{x}$)	183	27.6	63	66	101
Arithmetic SD (s)	6	1.7	3	5	6
Arithmetic RSD (%)	3.3	6.2	4.8	7.6	5.9
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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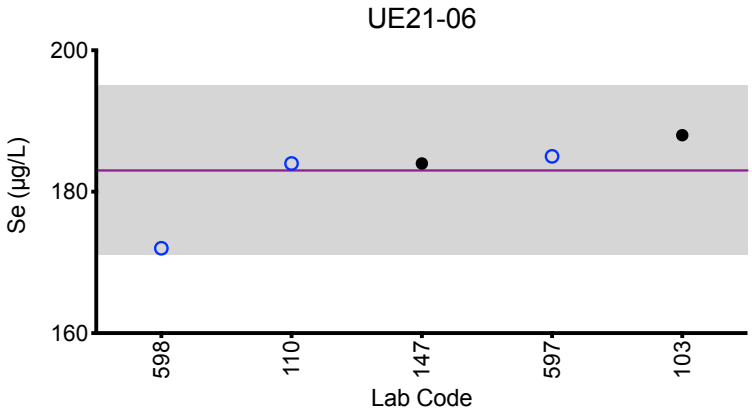
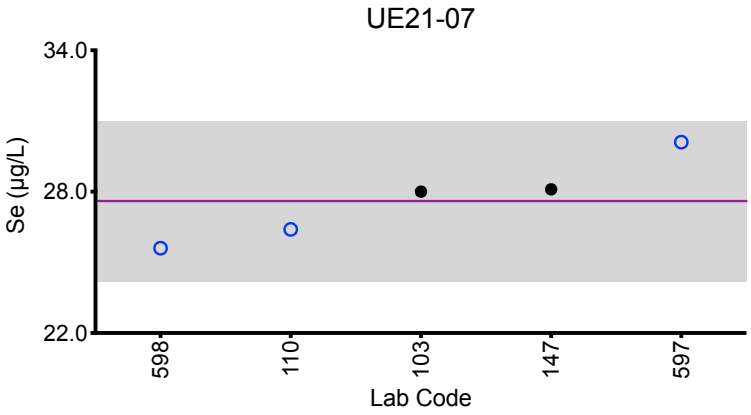
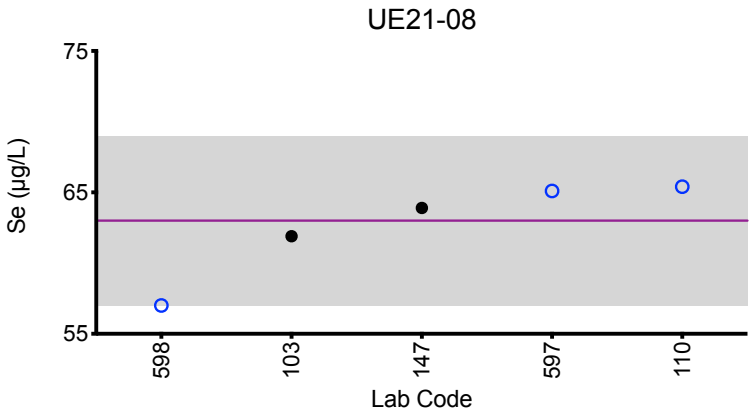
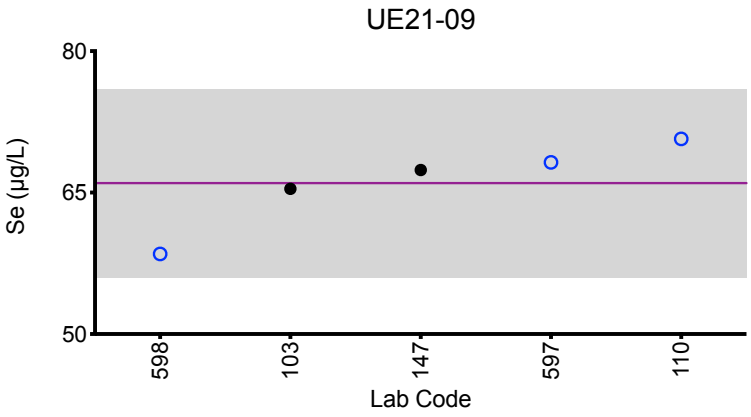
Results for Event #2, 2021: Summary Figures

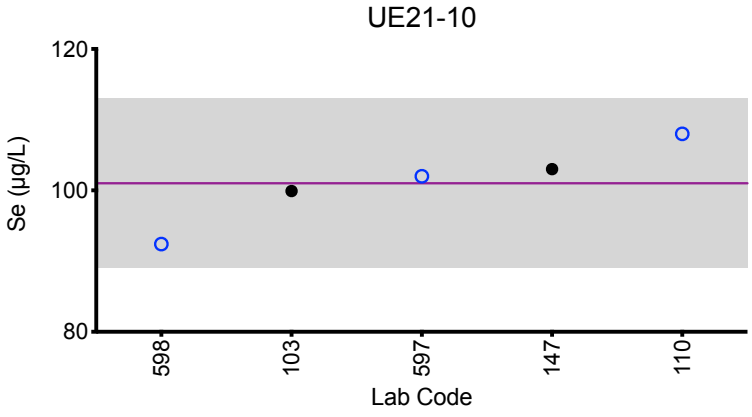
Urine Se











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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
107	ICP-MS	6.20	0.89	2.96	1.03	3.26
110	ICP-MS	5.52	0.81	2.64	0.97	2.79
147	ICP-MS	6.25	0.941	2.90	1.24	3.24
220	ICP-MS	5.76	0.94	2.63	1.25	2.72
264	ICP-MS	4.25	0.61	1.94	0.80	2.08
399	ICP-MS/MS	5.34	0.770	2.55	0.990	2.81
597	ICP-MS/MS	5.19	0.88	2.50	1.02	2.75
598	ICP-MS	4.98	0.64	2.04	0.87	2.46
605	ICP-MS	5.25	<0.900	2.56	<0.900	2.52
676	ICP-MS	5.43	0.789	2.64	0.959	2.74

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Robust Mean (x*)	5.4	0.81	2.59	1.01	2.7
Robust SD (s*)	0.5	0.12	0.13	0.15	0.3
Robust RSD (%)	9.3	15	5.0	15	9.2
Number of Sample Measurements (N)	10	9	10	9	10
Standard Uncertainty (*u*)	0.2	NA	0.05	NA	0.1

*Denotes a statistical Outlier.

An arithmetic mean, SD, RSD and n are provided for samples UE21-07 and UE21-09.

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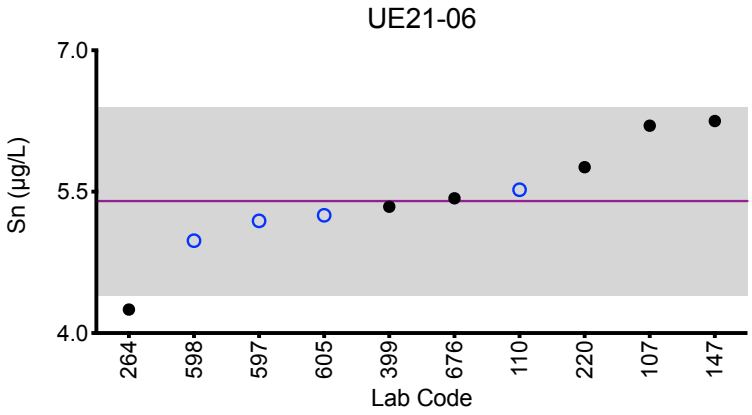
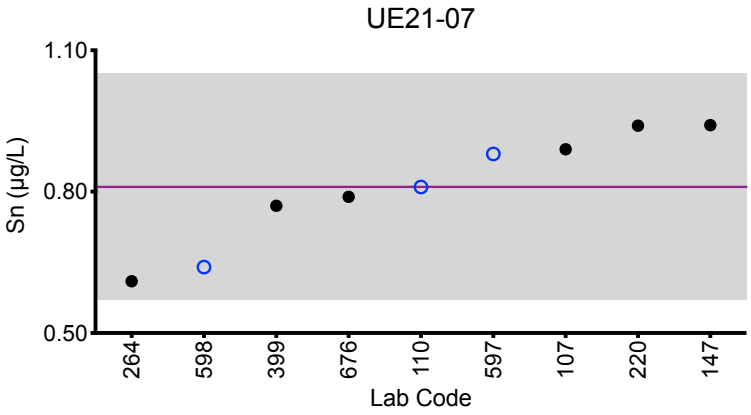
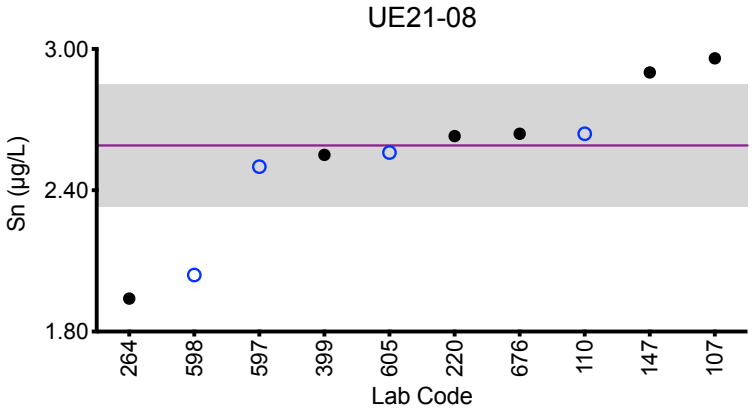
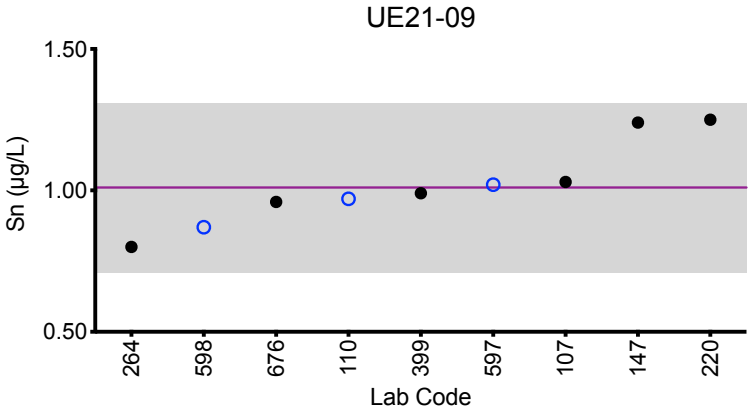
Results for Event #2, 2021: Summary Figures

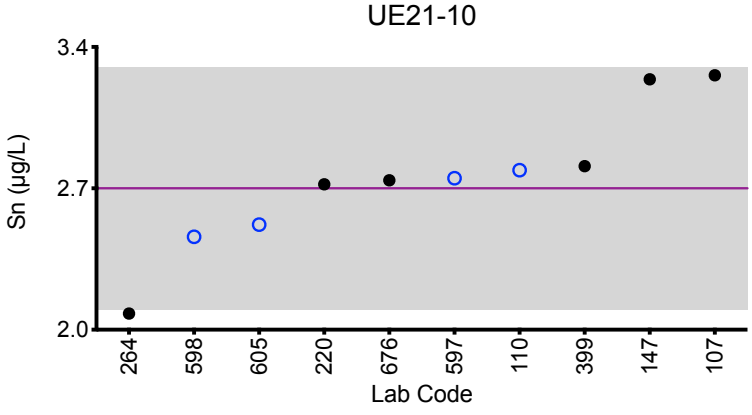
Urine Sn











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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Sr (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
103	ICP-MS/MS	82.9	121	162	176	88.3
107	ICP-MS	81.5	120.9	162.2	176.3	87.9
200	ICP-MS	80.6	119.1	169.1	172.6	88.5
220	ICP-MS	84.8	123	168	193	91.2
264	ICP-MS	74.70	110.26	148.00	165.42	80.58
399	DRC/CC-ICP-MS	81.7	118	158	176	87.4
597	ICP-MS/MS	83.5	121	164	168	86.5
605	ICP-MS	87.1	131	177	194	95.4
676	ICP-MS	80.4	121	162	185	87.3

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Arithmetic Mean ($\bar{x}$)	82	121	163	178	88
Arithmetic SD (s)	3	5	8	10	4
Arithmetic RSD (%)	4.2	4.1	4.9	5.6	4.4
Number of Sample Measurements (N)	9	9	9	9	9

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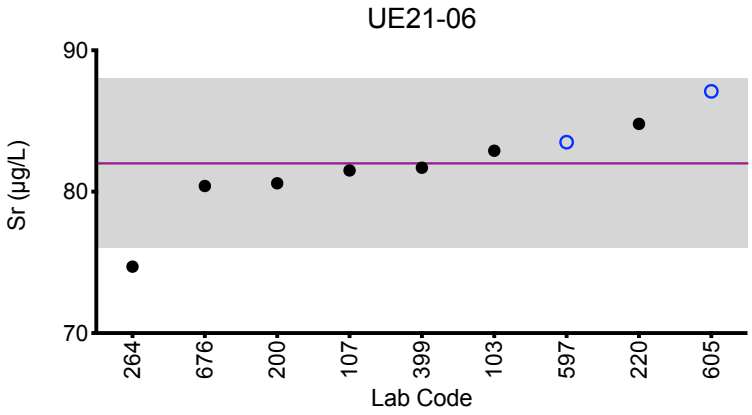
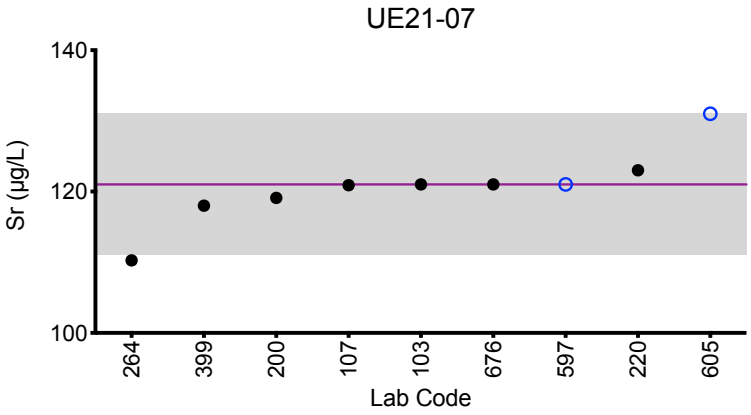
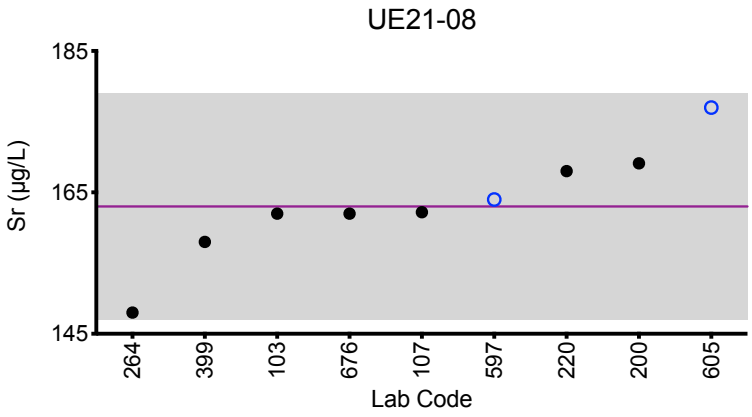
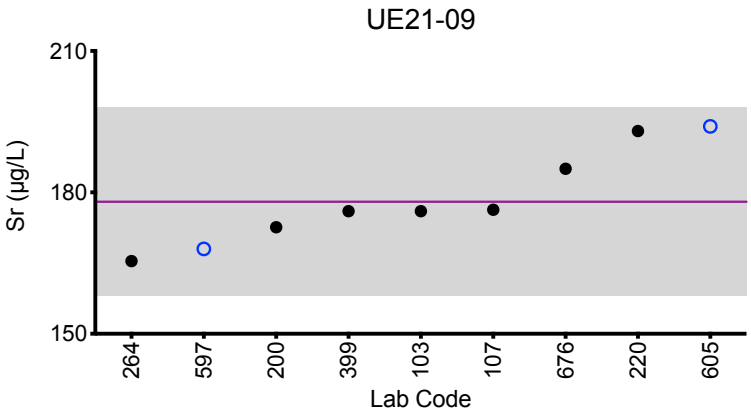
Results for Event #2, 2021: Summary Figures

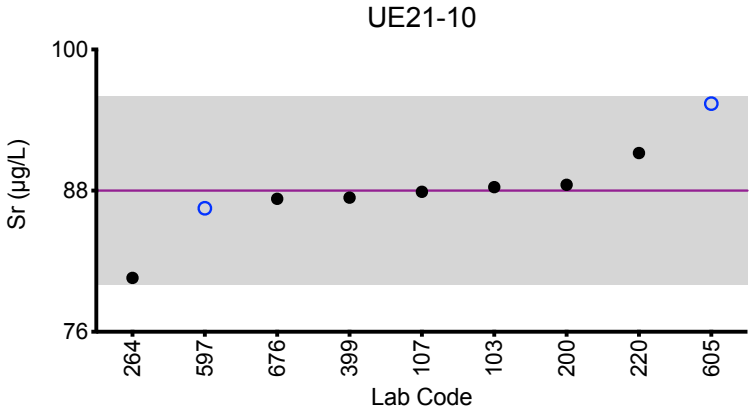
Urine Sr











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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
116	ICP-MS/MS	0.291	4.66	1.30	0.693	2.63
147	DRC/CC-ICP-MS	0.355	4.76	1.34	0.765	2.83
293	DRC/CC-ICP-MS	0.32	4.87	1.33	0.81	2.68
597	ICP-MS/MS	0.334	5.07	1.35	0.687	2.86
598	DRC/CC-ICP-MS	0.39	5.14	1.48	0.75	2.99
605	ICP-MS	<1.00	5.02	1.29	<1.00	2.83

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Arithmetic Mean ($\bar{x}$)	0.34	4.92	1.35	0.74	2.80
Arithmetic SD (s)	0.04	0.19	0.07	0.05	0.13
Arithmetic RSD (%)	12	3.9	5.2	6.8	4.6
Number of Sample Measurements (N)	5	6	6	5	6

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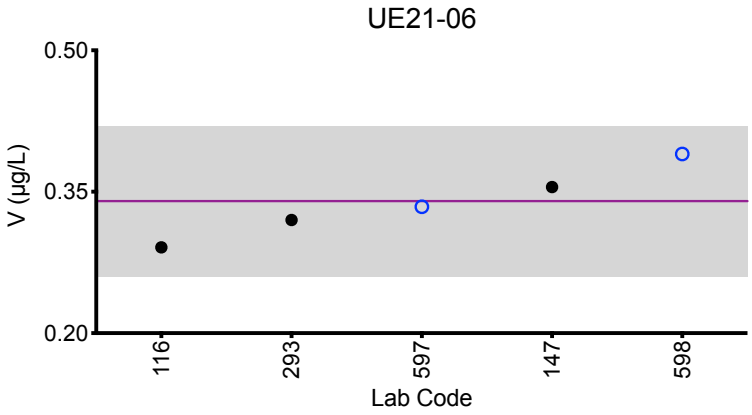
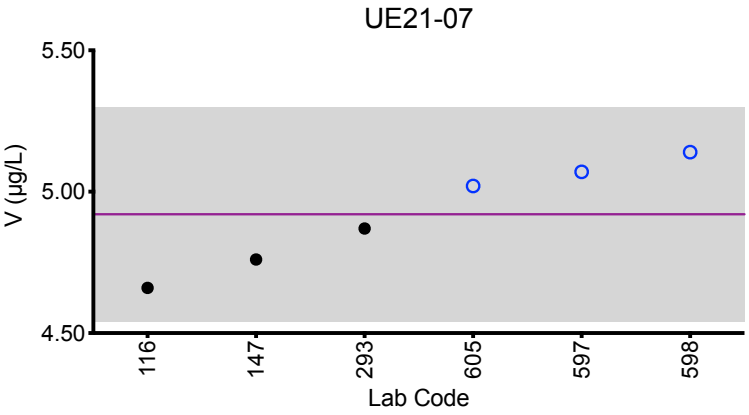
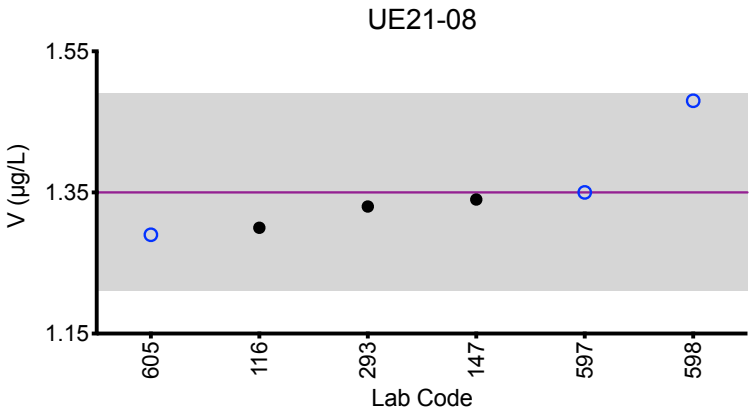
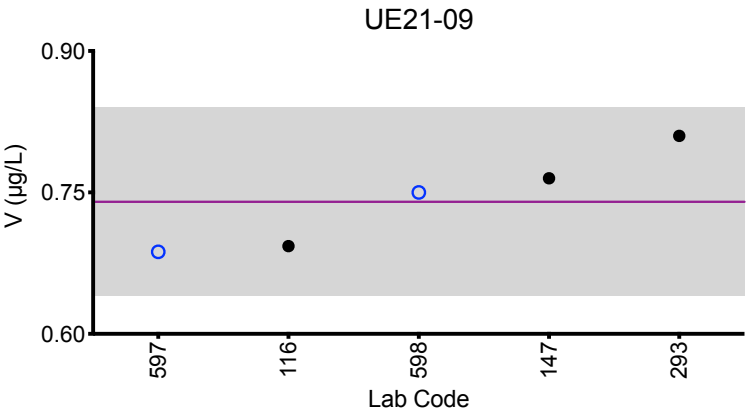
Results for Event #2, 2021: Summary Figures

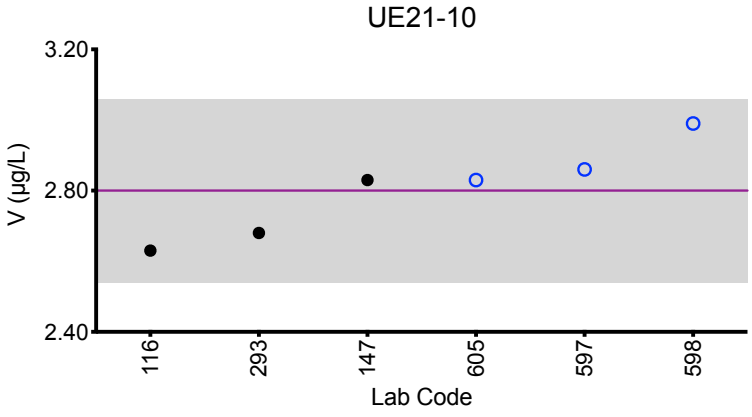
Urine V











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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
107	ICP-MS	0.126	0.336	0.071	3.024	1.223
110	ICP-MS	0.137	0.347	0.079	3.19	1.30
147	ICP-MS	<0.184	0.305	<0.184	3.00	1.20
200	ICP-MS	0.2	0.3	0.1	3.2	1.2
220	ICP-MS	0.13	0.32	0.08	3.15	1.25
264	ICP-MS	0.10	0.28	0.04	3.00	1.20
324	ICP-MS	0.152	0.335	0.109	2.770	1.144
399	ICP-MS/MS	0.142	0.331	0.075	3.12	1.28
597	ICP-MS/MS	0.0991	0.318	0.0624	2.90	1.16
598	ICP-MS	0.16	0.35	<0.2	2.86	1.21
605	ICP-MS	0.190	0.349	<0.180	3.34	1.30
606	ICP-MS/MS	0.146	0.324	0.083	3.19	1.29
676	ICP-MS	0.157	0.33	0.087	3.16	1.25

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Robust Mean (x*)	0.144	0.327	0.079	3.08	1.23
Robust SD (s*)	0.025	0.019	0.014	0.15	0.05
Robust RSD (%)	17	5.8	18	4.9	4.1
Number of Sample Measurements (N)	12	13	10	13	13
Standard Uncertainty (*u*)	0.009	0.007	0.006	0.05	0.02

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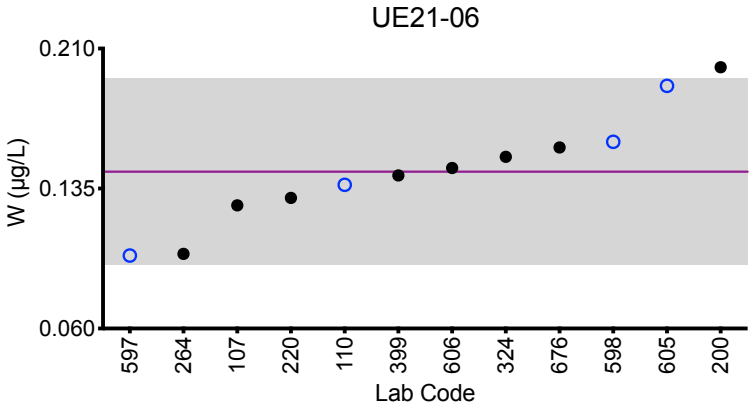
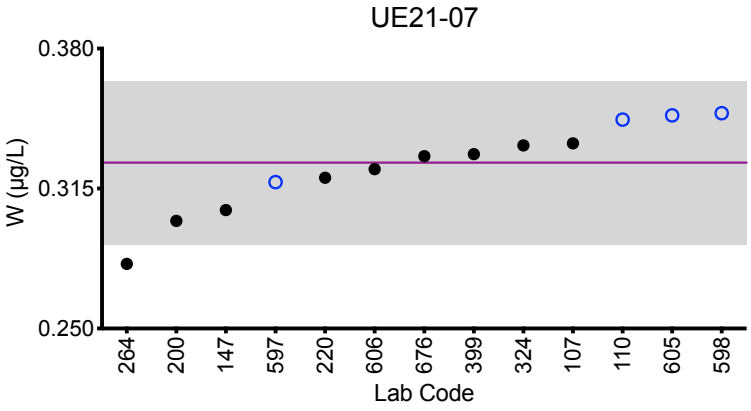
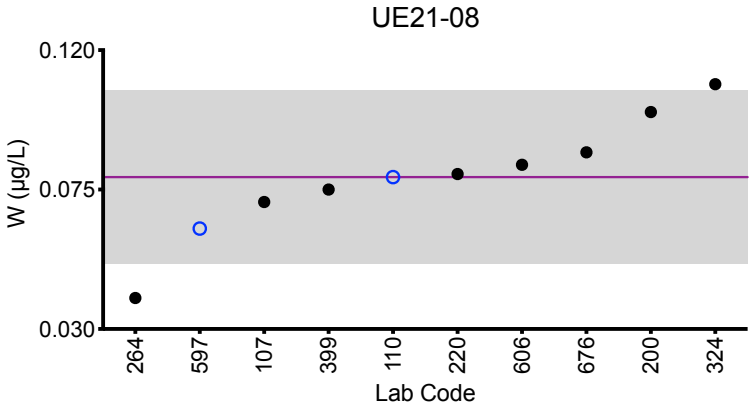
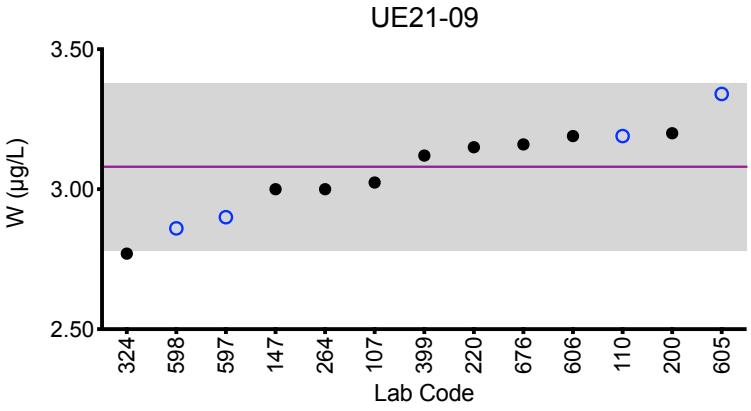
Results for Event #2, 2021: Summary Figures

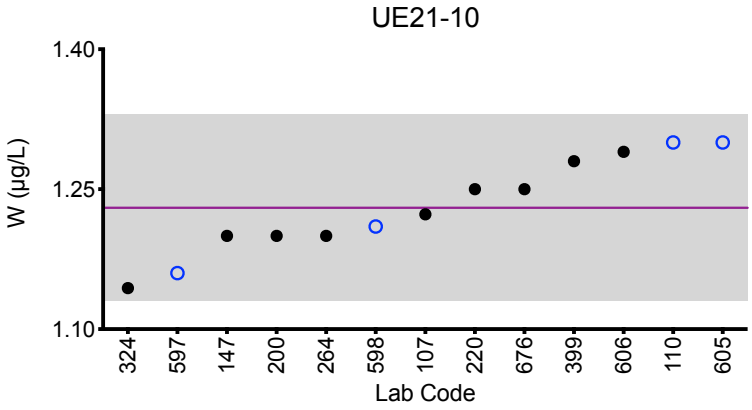
Urine W











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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
110	ICP-MS	506	277	234	459	215
147	ICP-MS	534	288	251	490	222
264	ICP-MS	527.07	291.43	242.26	488.30	224.90
293	DRC/CC-ICP-MS	538.56	297.39	249.67	498.04	236.6
324	ICP-MS	480.859	275.708	233.252	488.563	217.884
391	DRC/CC-ICP-MS	459.586	253.706	197.334	603.371	192.083
597	ICP-MS/MS	563	302	253	521	248
598	ICP-MS	467	253	211	414	201

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Arithmetic Mean ($\bar{x}$)	510	280	234	500	220
Arithmetic SD (s)	37	19	20	50	18
Arithmetic RSD (%)	7.3	6.8	8.5	10	8.2
Number of Sample Measurements (N)	8	8	8	8	8

*Denotes a statistical Outlier.

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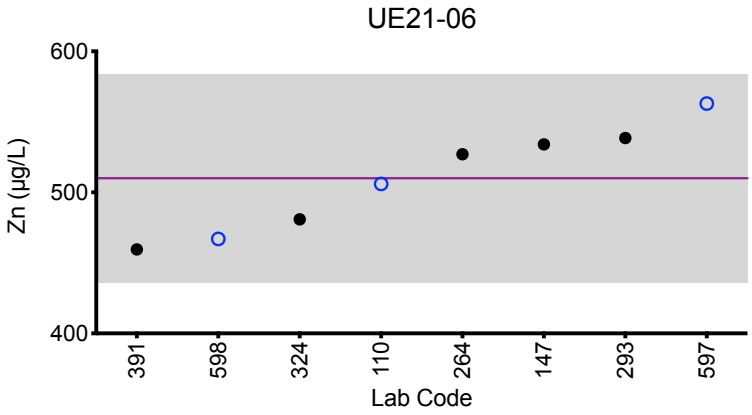
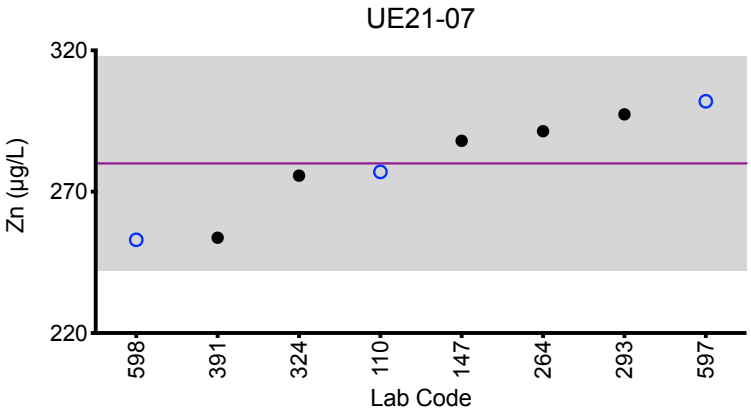
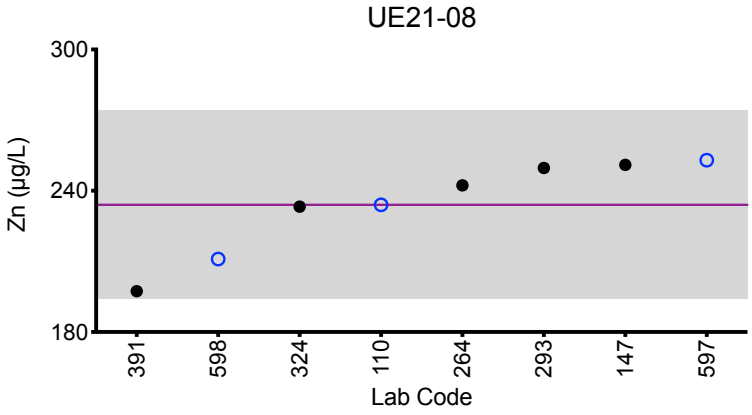
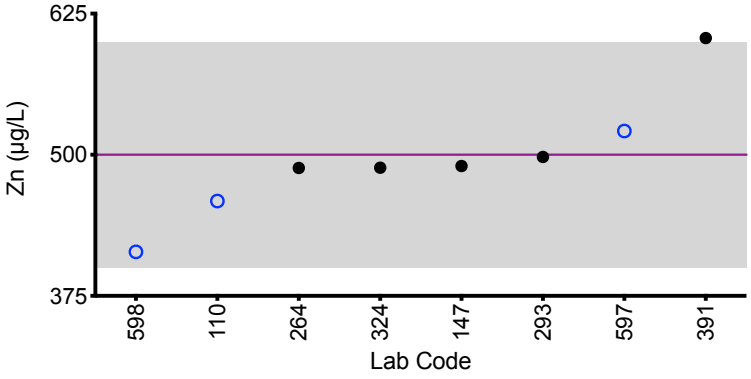
Results for Event #2, 2021: Summary Figures

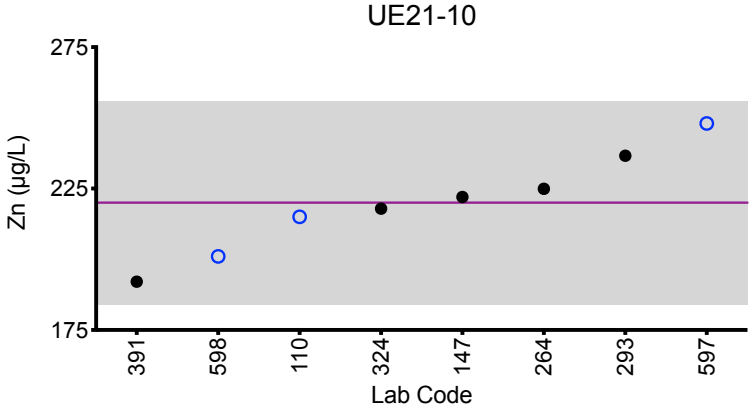
Urine Zn











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 #2, 2021:
Laboratory Data and Summary Statistics

Urine Al (µg/L)

Lab Code	Method	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
147	ICP-MS	17.7	<9.44	<9.44	12.2	25.4
264	ICP-MS	14.70	1.27	15.64	12.66	21.25
324	ICP-MS	15.164	6.233	14.776	17.067	21.075
597	ICP-MS/MS	20.8	<7.58	13.0	10.7	32.1

Summary Statistics

	UE21-06	UE21-07	UE21-08	UE21-09	UE21-10
Arithmetic Mean ($\bar{x}$)	17	NA	14.5	13	25
Arithmetic SD (s)	3	NA	1.3	3	5
Arithmetic RSD (%)	16	NA	9.0	20	20
Number of Sample Measurements (N)	4	NA	3	4	4

*Denotes a statistical Outlier.

Statistical data was not calculated for UE21-07 based on a lack of consensus among participating labs.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Te (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
110	ICP-MS	1.27	0.484	0.587	1.36	0.661
147	ICP-MS	1.18	0.489	0.615	1.49	0.648
Summary Statistics						
		UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Arithmetic Mean ($\bar{x}$)		1.23	0.486	0.60	1.43	0.655
Arithmetic SD (s)		0.06	0.004	0.02	0.09	0.009
Arithmetic RSD (%)		4.9	0.82	3.3	6.3	1.4
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Urine Ti (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
442	ICP-MS/MS	1.43	10.2	7.09	4.33	9.16
597	ICP-MS/MS	4.35	13.9	10.5	9.94	13.6
Summary Statistics						
		UE21-06	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
Arithmetic Mean ($\bar{x}$)		NA	12	9	NA	11
Arithmetic SD (s)		NA	3	2	NA	3
Arithmetic RSD (%)		NA	25	22	NA	27
Number of Sample Measurements (N)		NA	2	2	NA	2

*Denotes a statistical Outlier.

Statistical data was not calculated for UE21-06 and UE21-09 based on a lack of consensus among participating labs.

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Results for Event #2, 2021: Additional Elements in Urine

Urine Ag (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
147	ICP-MS	<0.183	<0.183	<0.183	<0.183	<0.183

Urine B (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
200	ICP-MS	324	281	389	1393	497

Urine Bi (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
147	ICP-MS	<0.082	<0.082	<0.082	<0.082	<0.082
264	ICP-MS	0.02	0.02	0.01	<0.01	0.01
597	ICP-MS/MS	<0.04	0.0461	<0.04	0.0425	<0.04

Urine Fe (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
324	ICP-MS	3.372	6.507	10.495	7.827	3.275

Urine I (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
147	ICP-MS	53.5	134	176	168	73.8

Urine Li (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
147	ICP-MS	9.02	6.68	9.09	39.2	13.9

Urine Mg (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
597	ICP-MS/MS	17500	21500	29100	73100	26000

Urine Th (µg/L)						
Lab Code	**Method**	**UE21-06**	**UE21-07**	**UE21-08**	**UE21-09**	**UE21-10**
147	ICP-MS	<0.067	<0.067	<0.067	<0.067	<0.067
597	ICP-MS/MS	0.0478	<0.04	<0.04	0.184	0.0489

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Event #2, 2021

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #2, 2021:
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). 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 26 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, Th, Ti, Tl, U, V, and W. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

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

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Results for Event #2, 2021:
Summary Statistics

	Serum Al (µg/L)				
	SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Target (Arithmetic Mean ($\bar{x}$))	37	9	56	22	16.8
Upper Limit	44	14	68	27	21.8
Lower Limit	30	4	45	17	11.8
Arithmetic SD (s)	4	3.6	3	3	1.5
Arithmetic RSD (%)	11	41	5.3	16	8.9
Number of Sample Measurements (N)	6	6	6	6	5

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 #2, 2021:
Performance of Participating Laboratories

		Serum Al (µg/L)				
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
	Target	**37**	**9**	**56**	**22**	**16.8**
147	ETAAS-Z	34.8	7.99	54.0	20.4	15.4
264	ICP-MS	33.53	6.11	53.86	18.24	16.55
293	DRC/CC-ICP-MS	34.95	5.38	61.83	18.82	16.13
391	ETAAS-Z	42.23	12.81	55.06	23.01	19.41
485	HR-ICP-MS	34.4	6.68	56.2	21.0	16.4
597	ICP-MS/MS	43.4	13.7	57.2	27.5 ↑	*31.3 ↑

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

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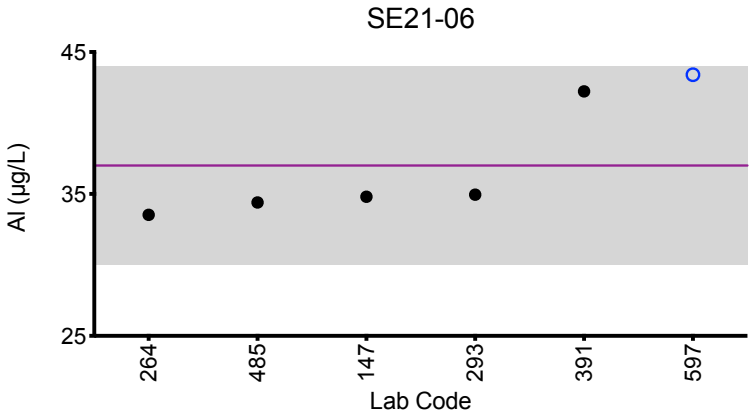
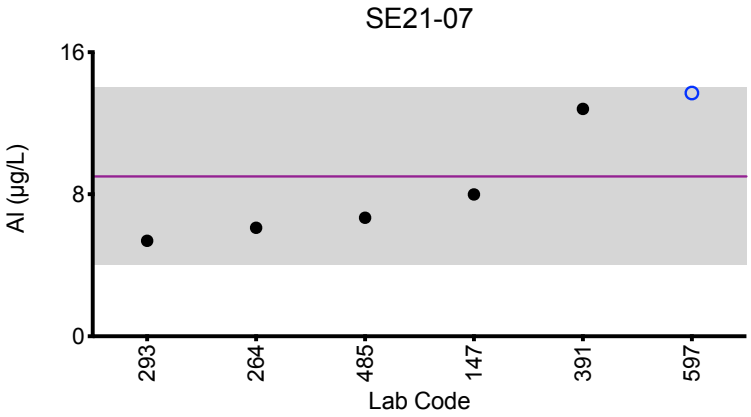
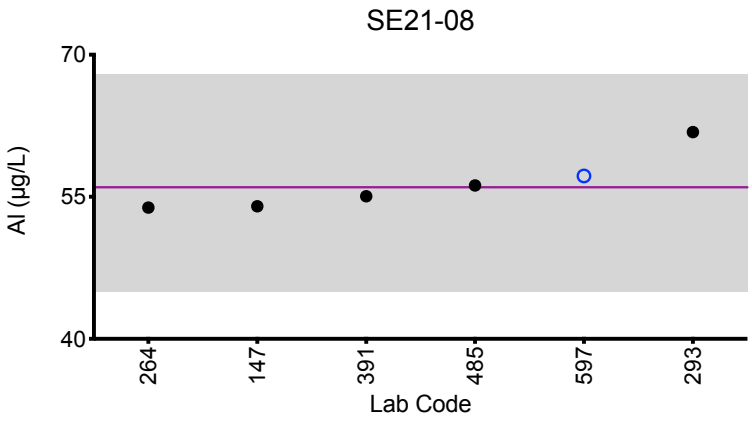
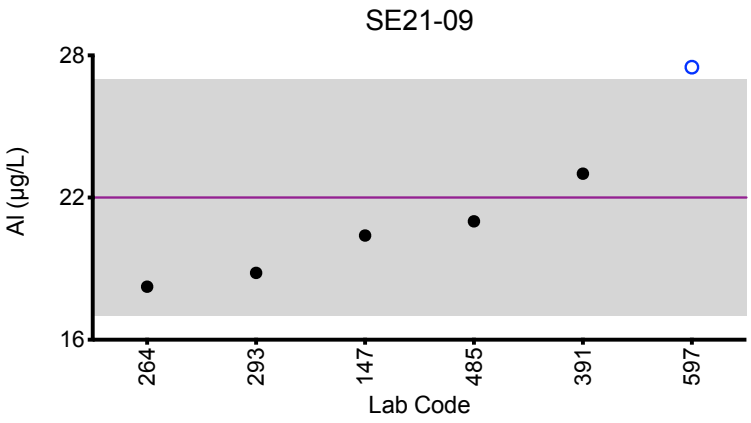
Results for Event #2, 2021: Summary Figures

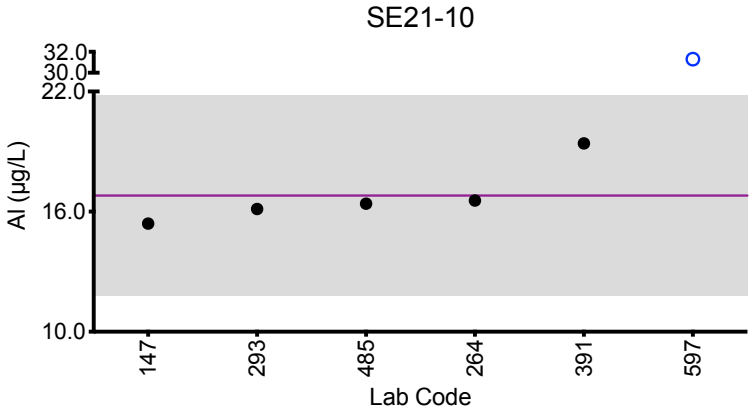
Serum Al











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 #2, 2021:
Summary Statistics

Serum Co (µg/L)					
	SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Target (Arithmetic Mean ($\bar{x}$))	0.90	7.83	0.57	7.88	2.80
Upper Limit	2.40	9.33	2.07	9.38	4.30
Lower Limit	0.00	6.33	0.00	6.38	1.30
Arithmetic SD (s)	0.05	0.22	0.03	0.30	0.10
Arithmetic RSD (%)	5.6	2.8	5.2	3.8	3.6
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 #2, 2021:
Performance of Participating Laboratories

		Serum Co (µg/L)				
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
	Target	**0.90**	**7.83**	**0.57**	**7.88**	**2.80**
103	ICP-MS/MS	0.870	7.68	0.568	7.68	2.74
110	ICP-MS	1.02	8.08	0.62	8.13	2.93
147	DRC/CC-ICP-MS	0.878	7.90	0.560	8.13	2.8
264	ICP-MS	0.85	7.37	0.54	7.32	2.81
293	DRC/CC-ICP-MS	0.88	7.86	0.55	7.69	2.84
442	DRC/CC-ICP-MS	0.942	7.98	0.59	8.20	2.79
485	HR-ICP-MS	0.879	7.77	0.547	7.81	2.60
597	ICP-MS/MS	0.907	7.98	0.612	8.04	2.91

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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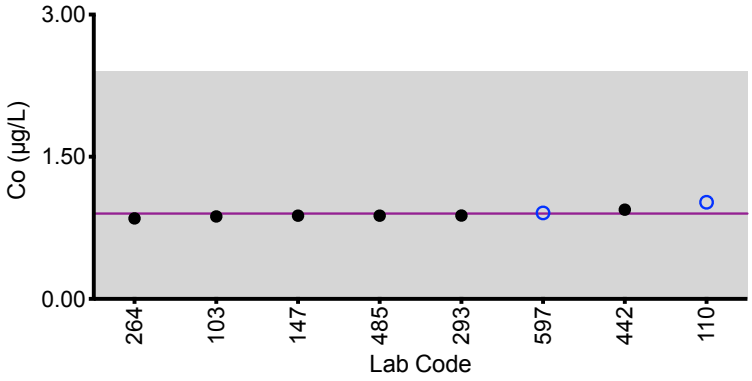
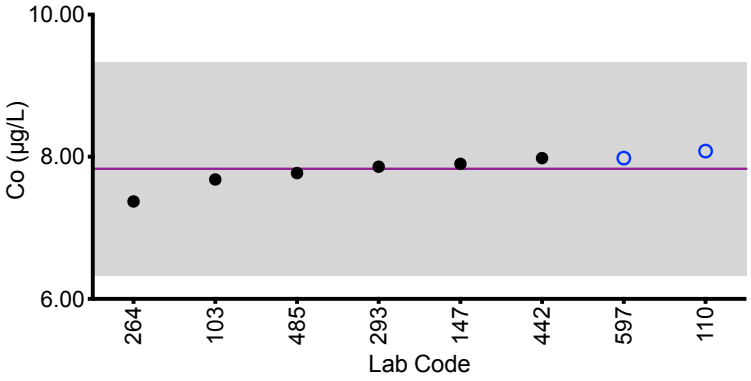
Results for Event #2, 2021: Summary Figures

Serum Co

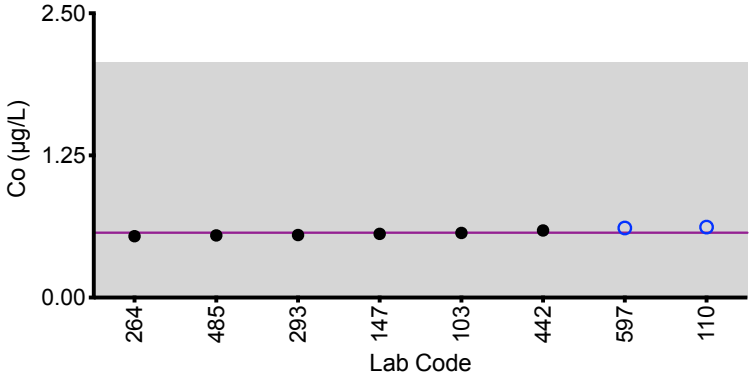
SE21-06



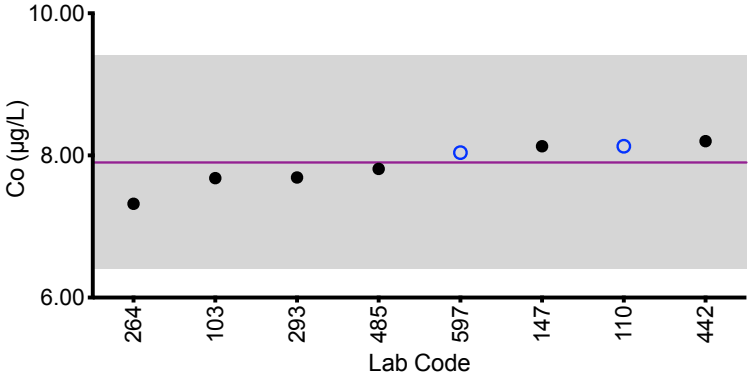
SE21-07



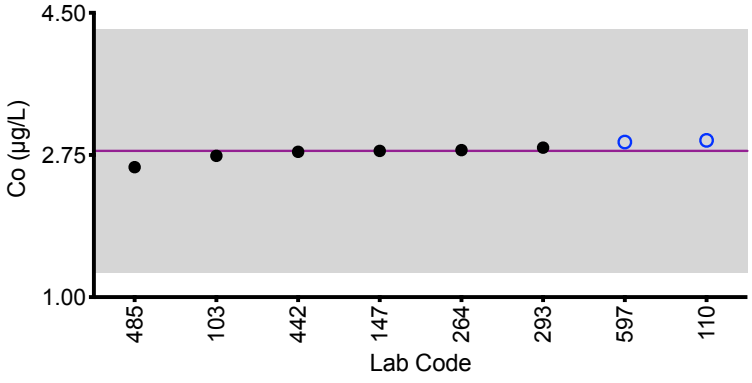
SE21-08



SE21-09



SE21-10



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 #2, 2021:
Summary Statistics

	Serum Cr (µg/L)				
	SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Target (Arithmetic Mean ($\bar{x}$))	1.45	0.77	4.90	0.25	2.34
Upper Limit	3.45	2.77	6.90	2.25	4.34
Lower Limit	0.00	0.00	2.90	0.00	0.34
Arithmetic SD (s)	0.10	0.19	0.14	0.04	0.28
Arithmetic RSD (%)	6.9	25	2.9	16	12
Number of Sample Measurements (N)	6	7	7	5	7

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
	Target	**1.45**	**0.77**	**4.90**	**0.25**	**2.34**
103	ICP-MS/MS	1.44	0.620	4.99	<0.500	2.11
110	DRC/CC-ICP-MS	1.34	0.69	4.80	0.25	2.54
147	DRC/CC-ICP-MS	1.58	0.671	5.02	0.222	2.27
264	ICP-MS	1.32	0.97	4.91	0.30	2.68
293	DRC/CC-ICP-MS	1.53	0.72	4.82	0.27	2.23
485	HR-ICP-MS	1.46	0.619	4.67	0.213	1.92
597	ICP-MS/MS	*3.06	1.10	5.08	<0.74	2.61

Based on the grading criteria for Cr in Serum, 100% 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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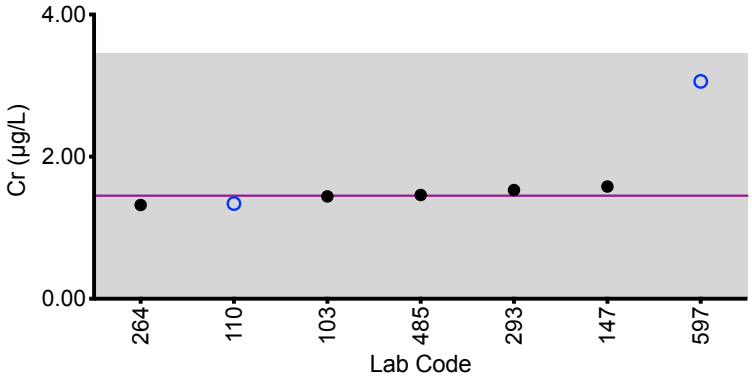
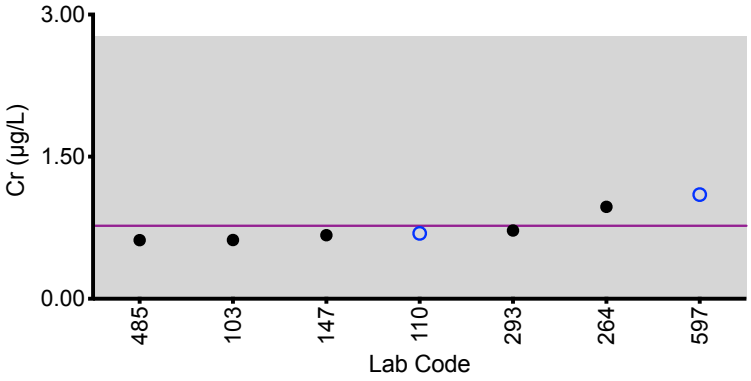
Results for Event #2, 2021: Summary Figures

Serum Cr

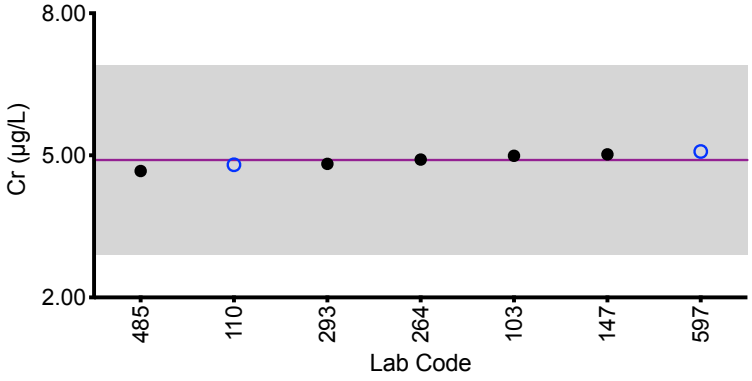
SE21-06



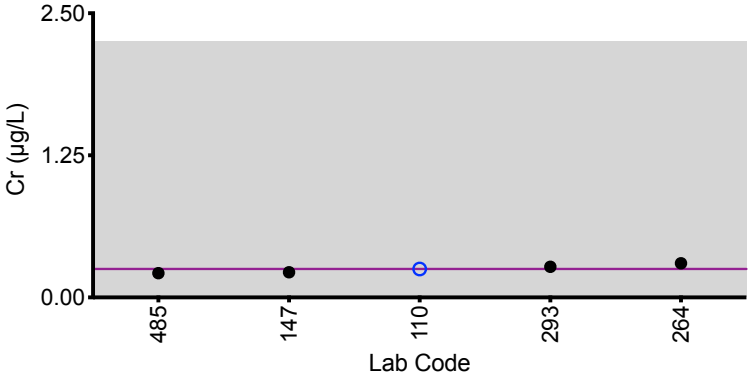
SE21-07



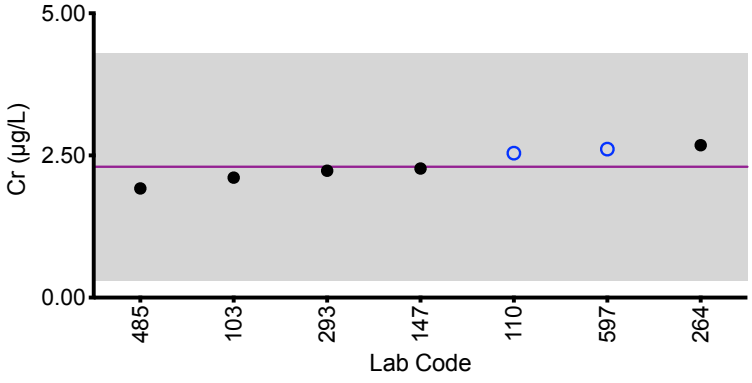
SE21-08



SE21-09



SE21-10



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 #2, 2021:
Summary Statistics

	Serum Cu (µg/L)				
	SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Target (Arithmetic Mean ($\bar{x}$))	1110	1980	1840	2360	1330
Upper Limit	1280	2280	2120	2710	1530
Lower Limit	940	1680	1560	2010	1130
Arithmetic SD (s)	100	90	130	230	50
Arithmetic RSD (%)	9.0	4.5	7.1	9.7	3.8
Number of Sample Measurements (N)	8	7	8	8	8

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Serum Cu (µg/L)				
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
	Target	**1110**	**1980**	**1840**	**2360**	**1330**
107	DRC/CC-ICP-MS	1164	1980	1871	2436	1348
110	ICP-MS	1155	1977	1864	2390	1345
147	DRC/CC-ICP-MS	1233	2122	1950	2598	1410
264	ICP-MS	1076.3	1818.6	1670.0	2128.5	1261.5
293	DRC/CC-ICP-MS	1151	1996	2034	2511	1341
436	FAAS	953.19	*1398.012	1652.196	1906.381	1270.92
483	ICP-MS	960	1950	1810	2560	1320
597	ICP-MS/MS	1180	1990	1870	2390	1320

Based on the grading criteria for Cu in Serum, 95% of results were satisfactory, with 1 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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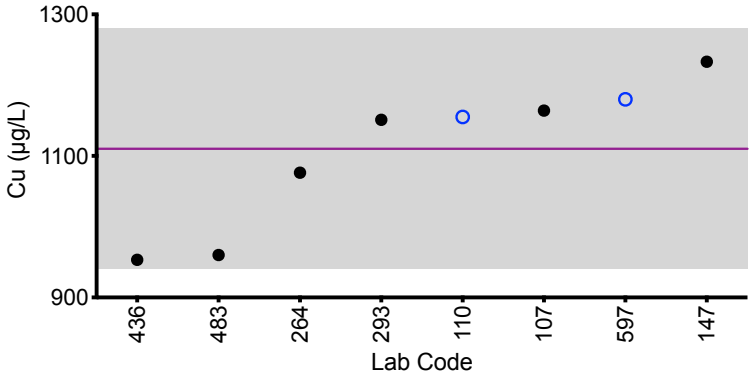
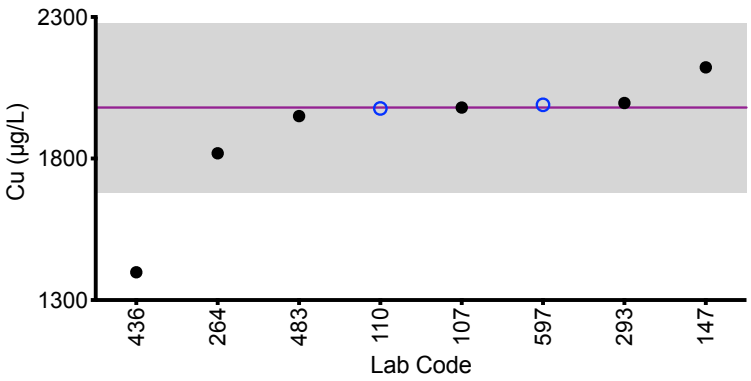
Results for Event #2, 2021: Summary Figures

Serum Cu

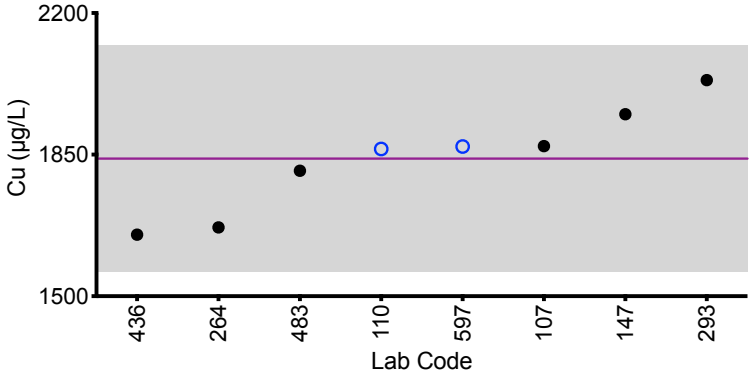
SE21-06



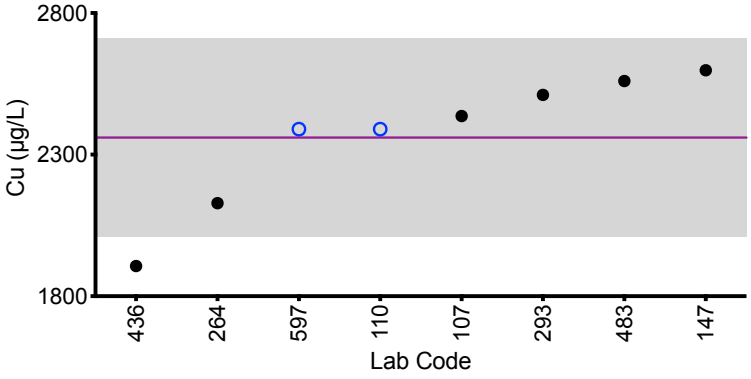
SE21-07



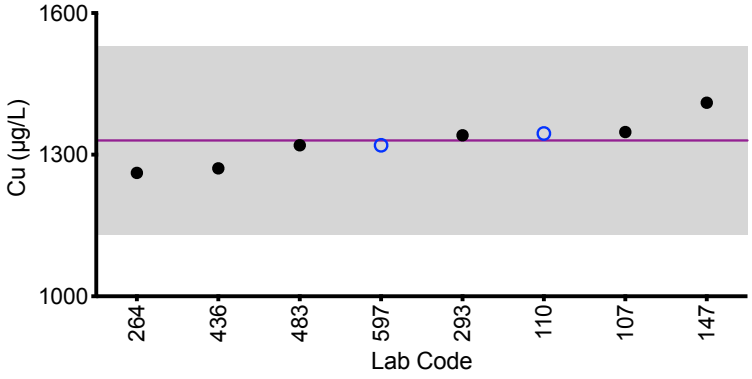
SE21-08



SE21-09



SE21-10



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 #2, 2021: Summary Statistics

Serum Se (µg/L)					
	SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Target (Arithmetic Mean ($\bar{x}$))	140	220	122	110	273
Upper Limit	168	264	146	132	328
Lower Limit	112	176	98	88	218
Arithmetic SD (s)	9	7	8	5	11
Arithmetic RSD (%)	6.4	3.2	6.6	4.5	4.0
Number of Sample Measurements (N)	8	8	8	8	8

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
	Target	**140**	**220**	**122**	**110**	**273**
103	ICP-MS/MS	144	224	131	118	284
107	DRC/CC-ICP-MS	143.6	218.7	118.4	107.5	271.9
110	DRC/CC-ICP-MS	148	226	129	112	286
147	DRC/CC-ICP-MS	137	210	112	105	254
264	ICP-MS	136.25	211.36	112.17	102.24	265.95
293	DRC/CC-ICP-MS	144	228	133	114	283
483	ICP-MS	119	219	118	108	270
597	ICP-MS/MS	147	225	124	112	273

Based on the grading criteria for Se 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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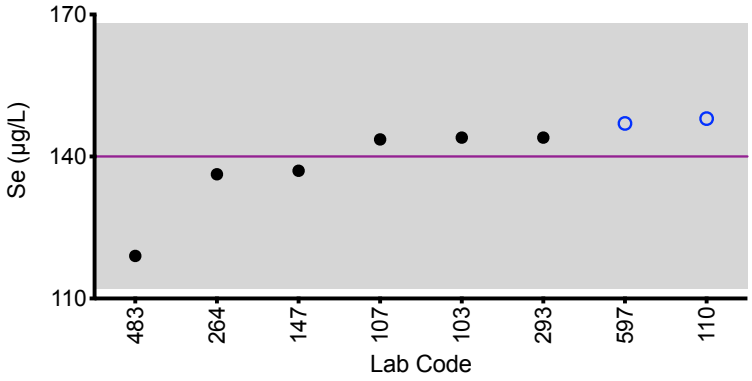
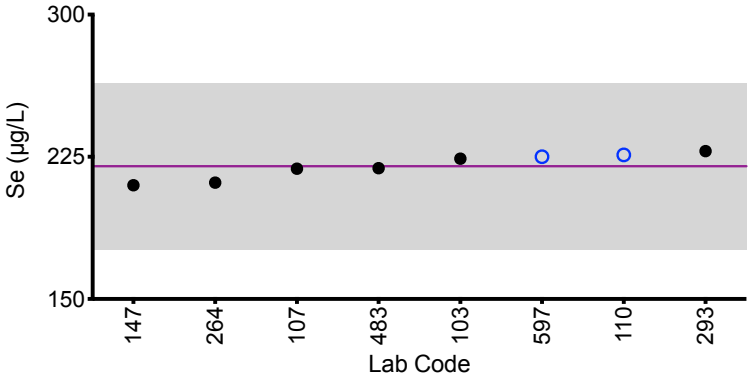
Results for Event #2, 2021: Summary Figures

Serum Se

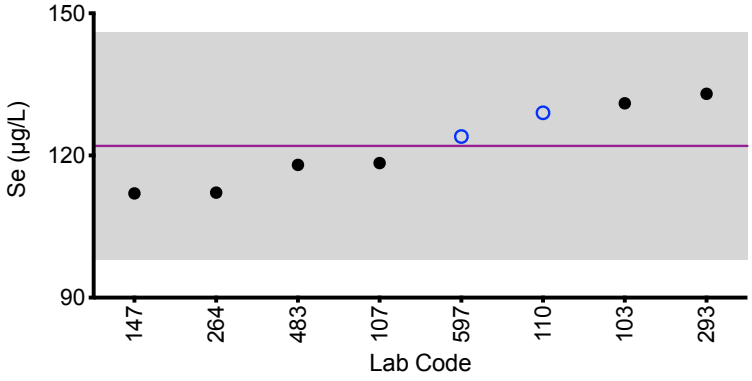
SE21-06



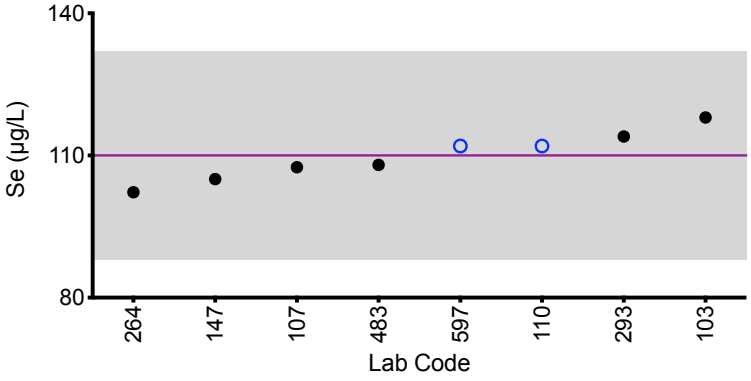
SE21-07



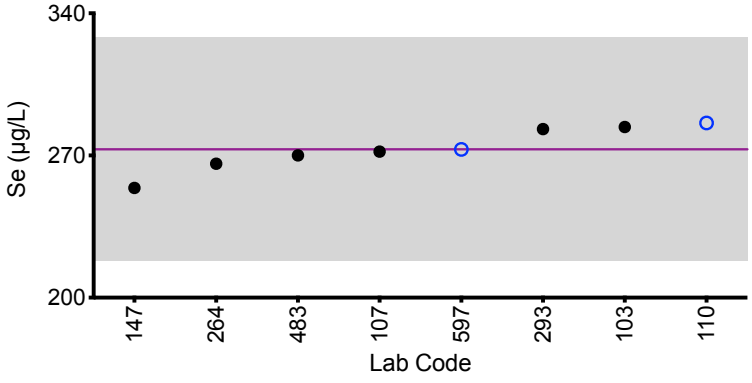
SE21-08



SE21-09



SE21-10



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 #2, 2021:
Summary Statistics

Serum Zn (µg/L)					
	SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Target (Arithmetic Mean ($\bar{x}$))	750	987	820	1170	684
Upper Limit	860	1135	940	1350	787
Lower Limit	640	839	700	990	581
Arithmetic SD (s)	60	24	40	50	30
Arithmetic RSD (%)	8.0	2.4	4.9	4.3	4.4
Number of Sample Measurements (N)	7	7	7	7	7

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

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Results for Event #2, 2021:
Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
	Target	**750**	**987**	**820**	**1170**	**684**
107	DRC/CC-ICP-MS	825	989	868	1218	736
110	ICP-MS	786	997	815	1157	675
147	DRC/CC-ICP-MS	752	967	778	1150	652
264	ICP-MS	732.9	954.2	758.7	1075.6	664.5
293	DRC/CC-ICP-MS	745	993	863	1190	673
483	ICP-MS	627 ↓	982	787	1200	671
597	ICP-MS/MS	801	1030	844	1200	713

Based on the grading criteria for Zn 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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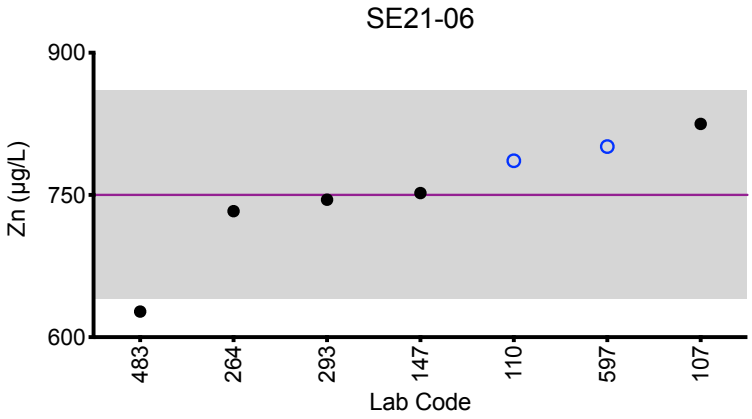
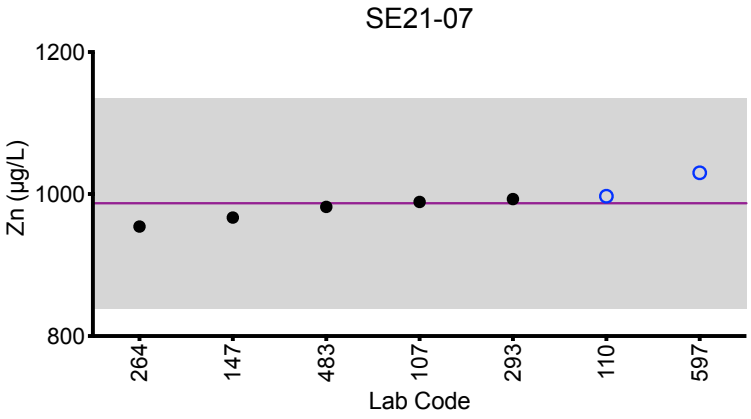
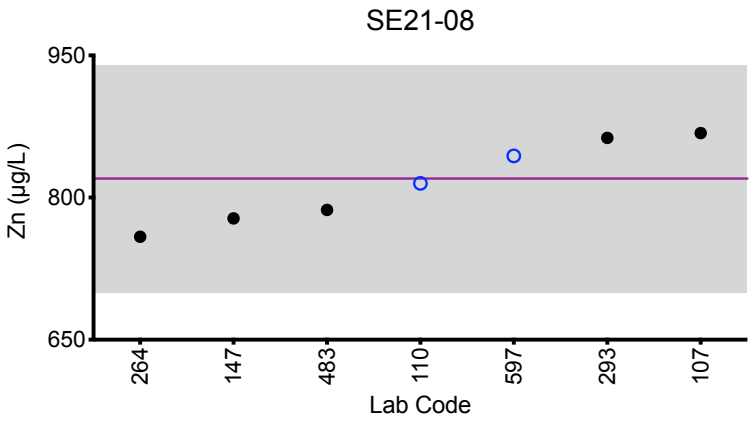
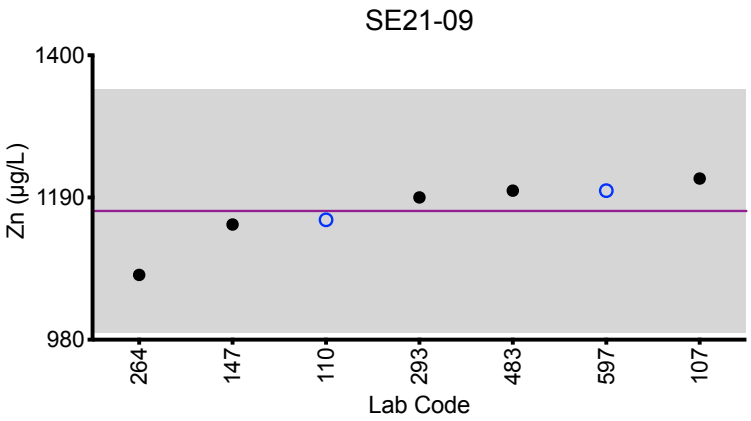
Results for Event #2, 2021: Summary Figures

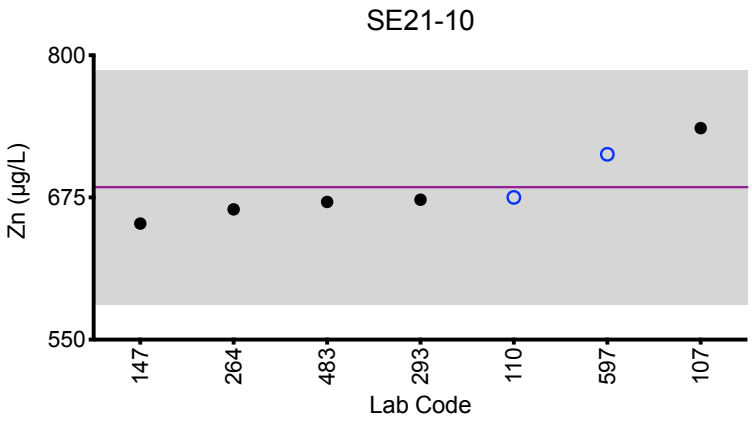
Serum Zn











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 #2, 2021:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
103	ICP-MS/MS	0.917	5.63	2.45	19.6	7.77
110	ICP-MS	0.97	6.41	3.03	20.6	8.67
147	DRC/CC-ICP-MS	0.819	5.88	2.54	18.4	8.08
264	ICP-MS	1.46	6.86	3.18	22.41	9.54
293	DRC/CC-ICP-MS	0.80	5.80	2.61	19.73	8.2
597	ICP-MS/MS	1.70	6.09	3.14	20.5	7.93
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		1.1	6.1	2.8	20.2	8.4
Arithmetic SD (s)		0.4	0.5	0.3	1.3	0.7
Arithmetic RSD (%)		36	8.2	12	6.4	8.3
Number of Sample Measurements (N)		6	6	6	6	6

*Denotes a statistical Outlier.

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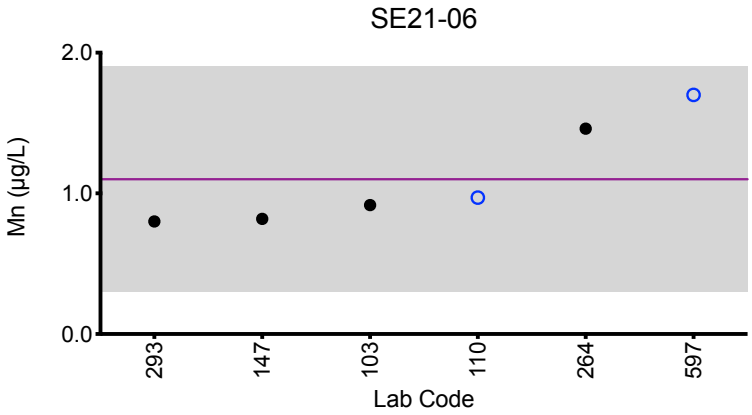
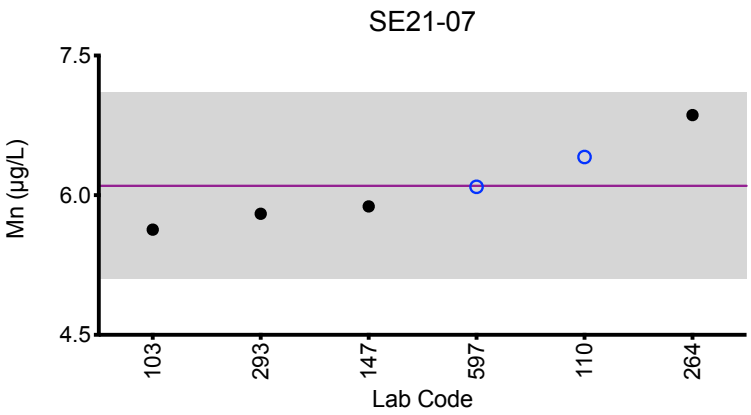
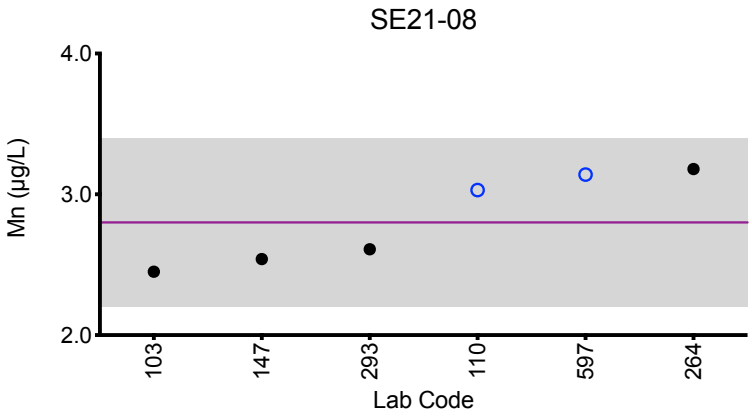
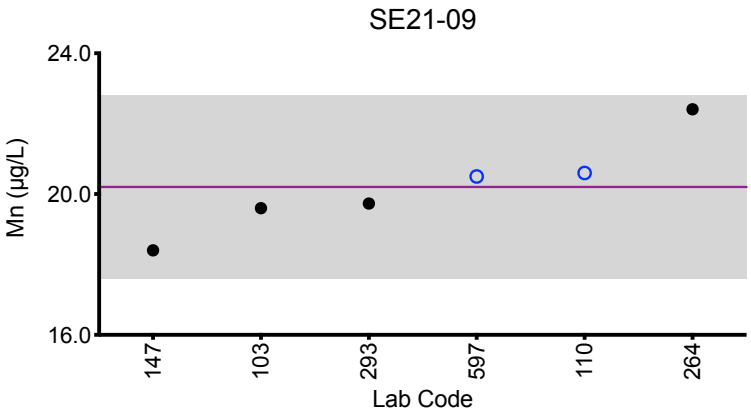
Results for Event #2, 2021: Summary Figures

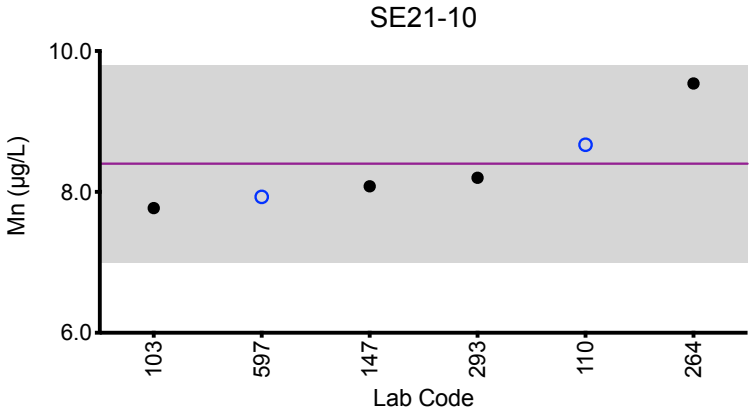
Serum Mn











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 #2, 2021:
Laboratory Data and Summary Statistics

Serum Mo (µg/L)

Lab Code	Method	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
103	ICP-MS/MS	2.76	5.63	0.734	7.53	1.61
110	ICP-MS	2.67	5.50	0.80	7.55	1.66
147	DRC/CC-ICP-MS	2.74	5.58	0.735	7.49	1.57
293	DRC/CC-ICP-MS	*3.34	*6.35	1.00	8.41	1.89
442	DRC/CC-ICP-MS	2.63	5.62	0.91	7.28	1.85
485	HR-ICP-MS	2.85	5.59	<1	7.84	1.59
597	ICP-MS/MS	2.71	5.43	0.767	7.10	1.56

Summary Statistics

	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
Arithmetic Mean ($\bar{x}$)	2.73	5.56	0.82	7.6	1.68
Arithmetic SD (s)	0.08	0.08	0.11	0.4	0.14
Arithmetic RSD (%)	2.9	1.4	13	5.3	8.3
Number of Sample Measurements (N)	6	6	6	7	7

*Denotes a statistical Outlier.

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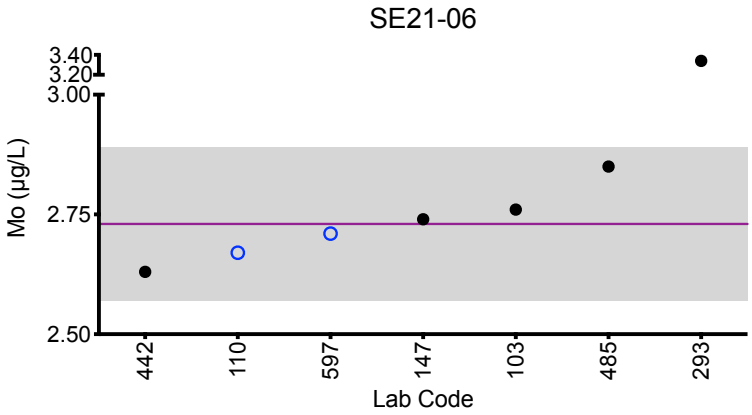
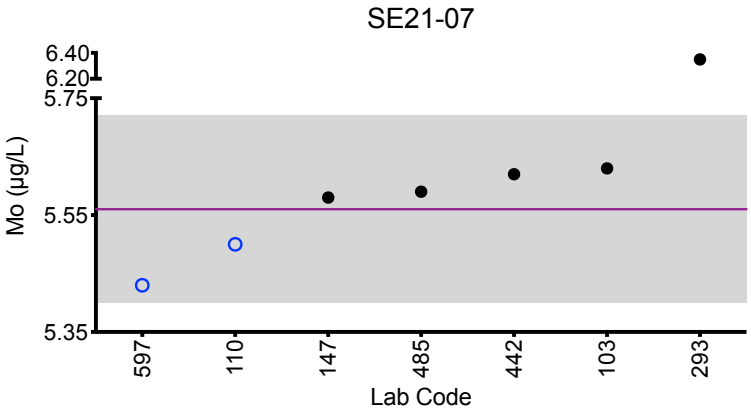
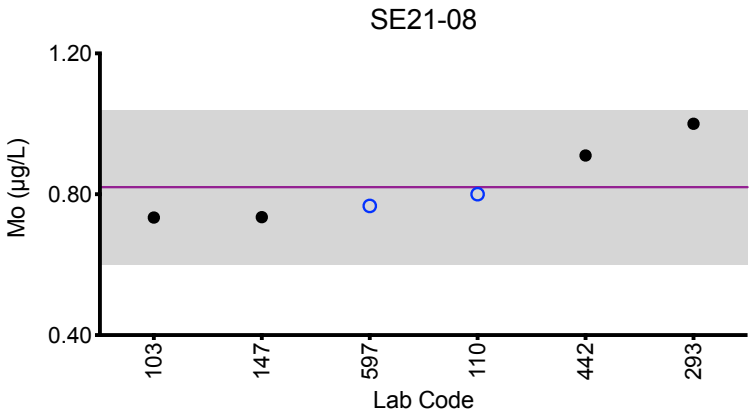
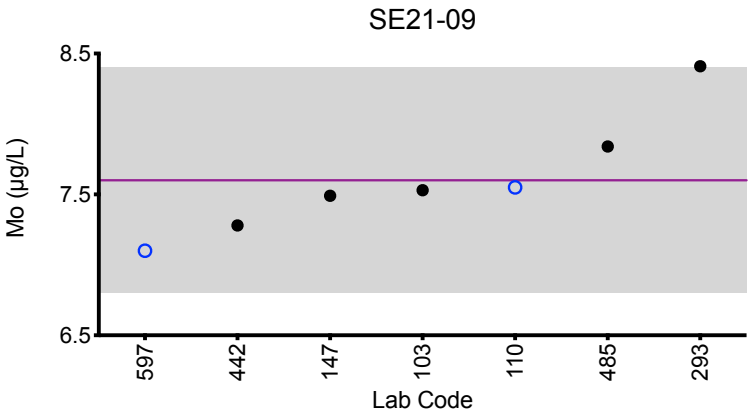
Results for Event #2, 2021: Summary Figures

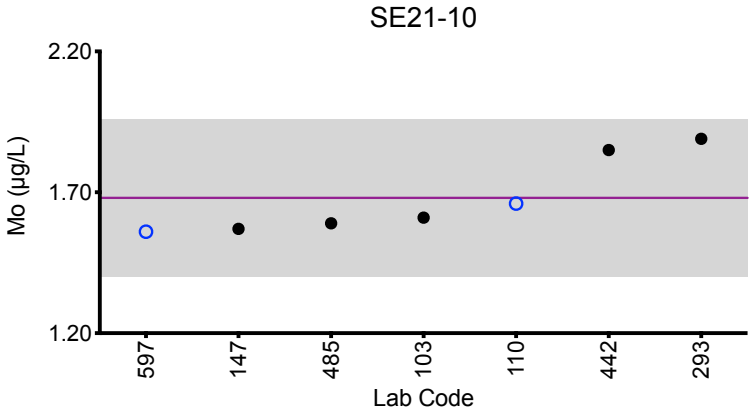
Serum Mo











Legend:
○ 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 #2, 2021:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
110	DRC/CC-ICP-MS	1.18	6.95	4.05	2.12	7.62
147	DRC/CC-ICP-MS	0.564	7.81	3.12	2.45	7.05
293	DRC/CC-ICP-MS	1.13	6.63	3.30	1.96	7.92
485	HR-ICP-MS	1.05	6.50	3.11	1.85	6.72
597	ICP-MS/MS	1.73	7.17	2.92	2.53	8.19
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		1.1	7.0	3.3	2.2	7.5
Arithmetic SD (s)		0.4	0.5	0.4	0.3	0.6
Arithmetic RSD (%)		36	7.1	12	14	8.0
Number of Sample Measurements (N)		5	5	5	5	5

*Denotes a statistical Outlier.

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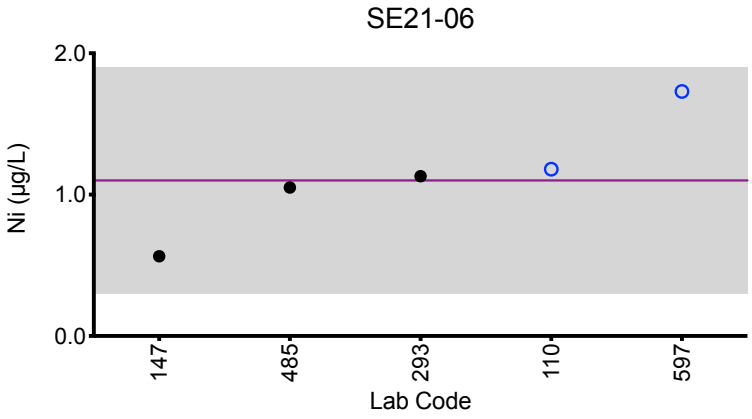
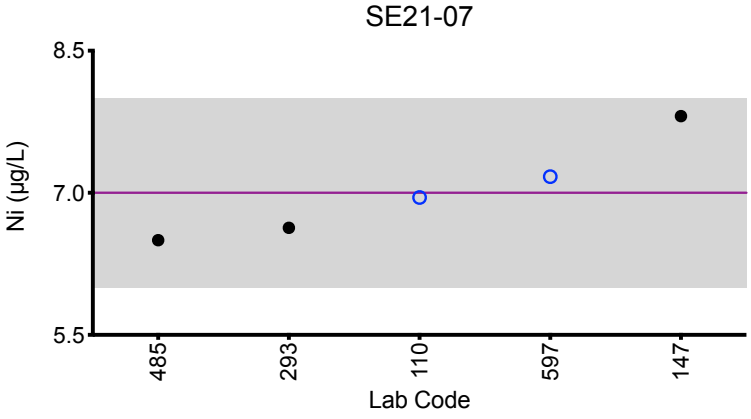
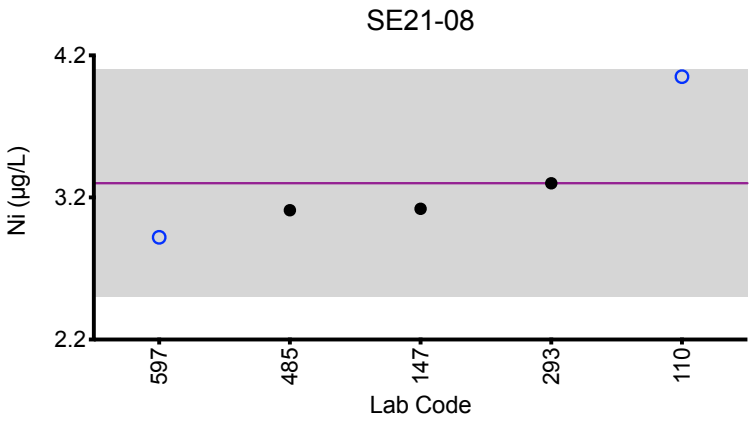
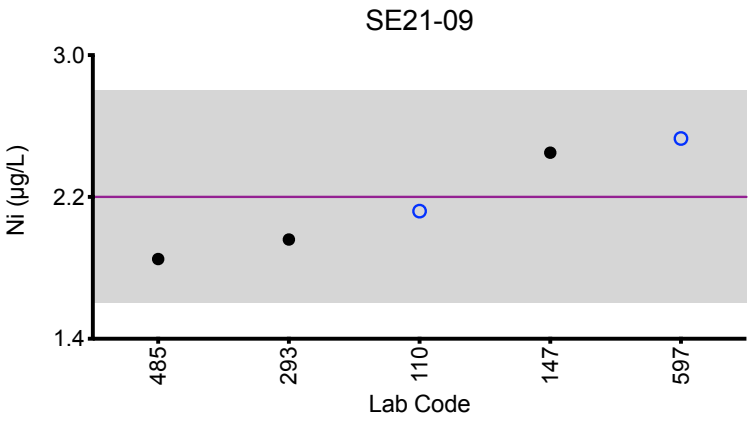
Results for Event #2, 2021: Summary Figures

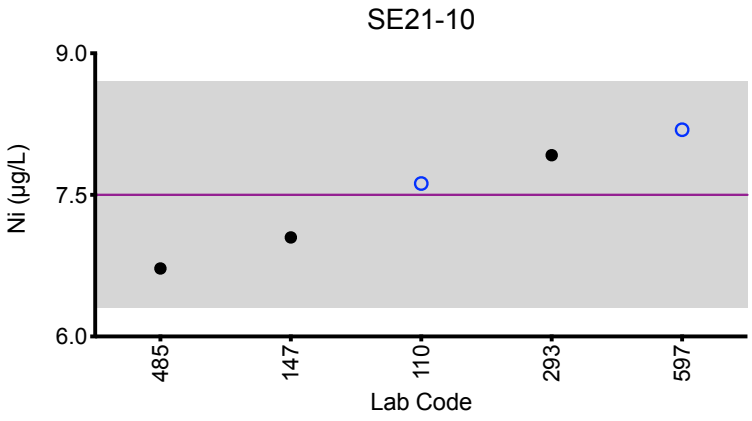
Serum Ni











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 #2, 2021:
Laboratory Data and Summary Statistics

Serum V (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
110	DRC/CC-ICP-MS	3.0	8.3	0.2	0.6	0.8
147	DRC/CC-ICP-MS	2.42	7.81	0.045	0.244	0.714
293	DRC/CC-ICP-MS	2.61	7.76	0.21	0.43	0.88
485	HR-ICP-MS	2.39	7.38	0.034	0.226	0.615
597	ICP-MS/MS	2.56	7.48	0.207	0.439	0.827
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		2.6	7.7	NA	0.39	0.77
Arithmetic SD (s)		0.2	0.4	NA	0.16	0.10
Arithmetic RSD (%)		9.2	5.2	NA	41	13
Number of Sample Measurements (N)		5	5	NA	5	5

*Denotes a statistical Outlier.

Statistical data was not calculated for SE21-08 based on a lack of consensus among participating labs.

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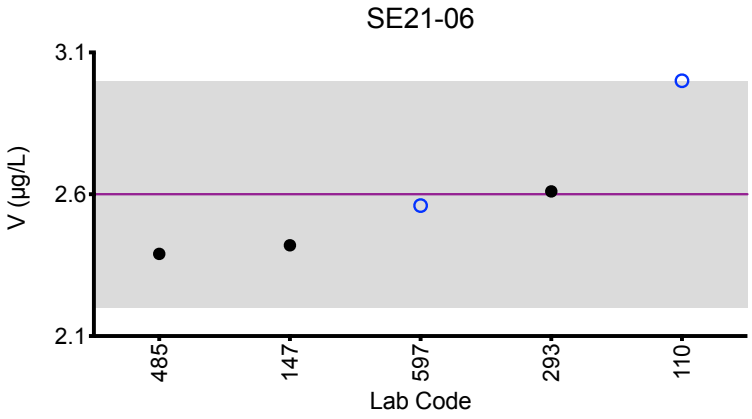
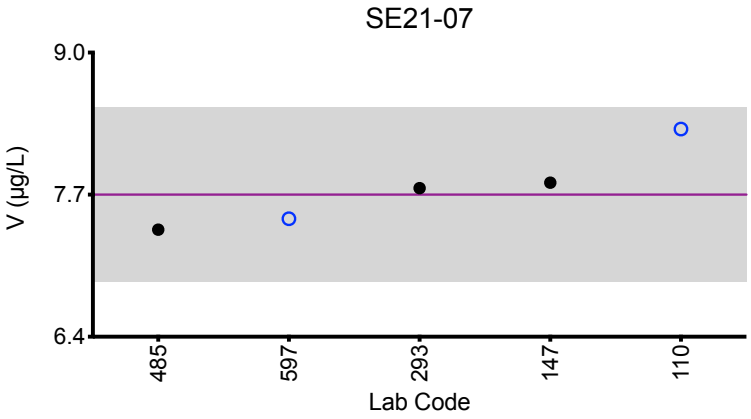
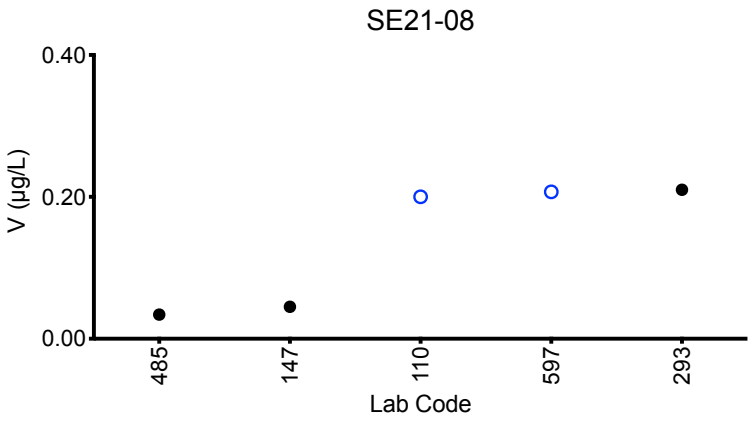
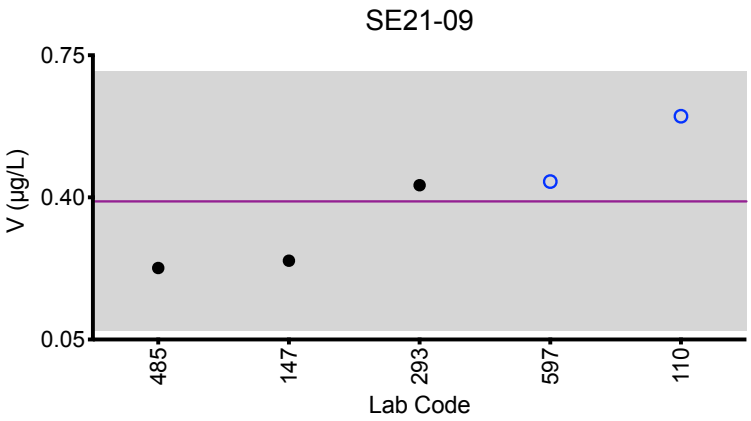
Results for Event #2, 2021: Summary Figures

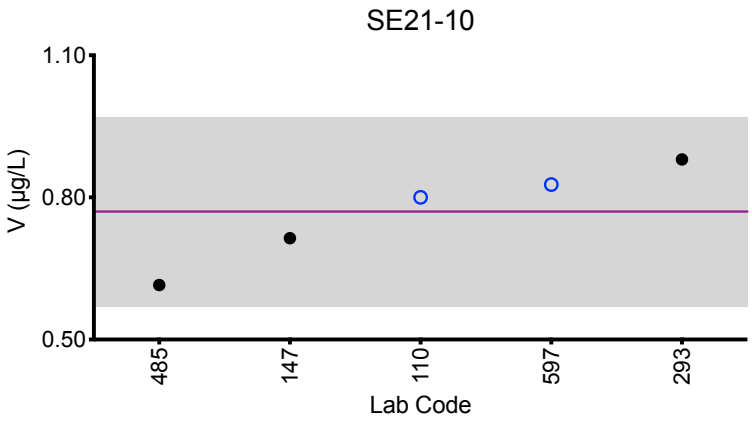
Serum V











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 #2, 2021:
Laboratory Data and Summary Statistics

Serum As (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
103	ICP-MS/MS	2.52	24.5	0.906	5.30	11.8
110	DRC/CC-ICP-MS	2.78	24.6	1.09	5.44	11.7
147	DRC/CC-ICP-MS	2.51	24.4	0.959	5.41	11.5
597	ICP-MS/MS	2.45	23.4	1.06	5.15	11.6

Summary Statistics					
	SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)	2.56	24.2	1.00	5.33	11.65
Arithmetic SD (s)	0.15	0.6	0.09	0.13	0.13
Arithmetic RSD (%)	5.9	2.5	9.0	2.4	1.1
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
110	ICP-MS	0.92	0.68	0.59	0.67	1.69
147	ICP-MS	0.710	0.788	0.592	0.703	1.61
597	ICP-MS/MS	0.844	1.02	0.574	0.597	1.79
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		0.82	0.8	0.585	0.66	1.70
Arithmetic SD (s)		0.11	0.2	0.010	0.05	0.09
Arithmetic RSD (%)		13	20	1.7	7.6	5.3
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Be (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
110	ICP-MS	1.09	4.82	0.693	1.68	2.34
147	ICP-MS	1.05	4.71	0.703	1.650	2.28
293	DRC/CC-ICP-MS	0.510	2.46	0.34	0.84	1.290
597	ICP-MS/MS	1.23	5.48	0.621	1.87	2.52
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		1.0	4.4	0.59	1.5	2.1
Arithmetic SD (s)		0.3	1.3	0.17	0.5	0.6
Arithmetic RSD (%)		30	30	29	33	29
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
103	ICP-MS/MS	2.71	0.437	6.25	0.795	3.79
110	ICP-MS	2.75	0.453	6.32	0.894	4.07
147	ICP-MS	2.63	0.424	6.10	0.804	3.71
597	ICP-MS/MS	2.71	0.445	6.15	0.705	3.77
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		2.70	0.440	6.21	0.8	3.84
Arithmetic SD (s)		0.05	0.012	0.10	0.1	0.16
Arithmetic RSD (%)		1.9	2.7	1.6	10	4.2
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
110	ICP-MS	0.748	0.757	0.351	0.381	0.839
597	ICP-MS/MS	0.647	0.696	0.236	0.269	0.679
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		0.70	0.73	0.29	0.33	0.76
Arithmetic SD (s)		0.07	0.04	0.08	0.08	0.11
Arithmetic RSD (%)		10	5.5	28	24	14
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)

Lab Code	Method	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
103	ICP-MS/MS	0.671	5.62	0.529	2.01	1.31
110	ICP-MS	0.70	5.97	0.59	2.13	1.37
597	ICP-MS/MS	0.746	5.48	0.539	1.98	1.26

Summary Statistics

	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
Arithmetic Mean ($\bar{x}$)	0.71	5.7	0.55	2.04	1.31
Arithmetic SD (s)	0.04	0.3	0.03	0.08	0.06
Arithmetic RSD (%)	5.6	4.4	5.5	3.9	4.6
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Mg (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
264	ICP-MS	17080	16617	17262	17185	20698
597	ICP-MS/MS	18200	18000	18900	19000	20900
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		17600	17300	18100	18100	20800
Arithmetic SD (s)		800	1000	1200	1300	140
Arithmetic RSD (%)		4.5	5.8	6.6	7.2	0.67
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
103	ICP-MS/MS	15.3	1.23	6.64	1.97	3.72
110	ICP-MS	14.5	1.19	6.47	1.88	3.57
597	ICP-MS/MS	15.6	1.27	6.71	2.00	3.77
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		15.1	1.23	6.61	1.95	3.69
Arithmetic SD (s)		0.6	0.04	0.12	0.06	0.10
Arithmetic RSD (%)		4.0	3.3	1.8	3.1	2.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)

Lab Code	Method	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
110	ICP-MS	0.21	1.17	0.42	1.78	0.81
264	ICP-MS	0.14	1.10	0.37	1.72	0.76

Summary Statistics

	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
Arithmetic Mean ($\bar{x}$)	0.18	1.14	0.40	1.75	0.79
Arithmetic SD (s)	0.05	0.05	0.04	0.04	0.04
Arithmetic RSD (%)	28	4.4	10	2.3	5.1
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
103	ICP-MS/MS	1.41	4.65	2.81	1.78	5.82
110	ICP-MS	1.58	5.11	2.98	1.86	6.84
147	ICP-MS	1.44	4.75	2.80	1.70	6.19
597	ICP-MS/MS	1.41	4.58	2.74	1.84	6.09
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		1.46	4.8	2.83	1.79	6.2
Arithmetic SD (s)		0.08	0.2	0.10	0.07	0.4
Arithmetic RSD (%)		5.5	5.0	3.5	3.9	6.5
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
110	ICP-MS	8.11	0.87	4.87	3.83	1.67
597	ICP-MS/MS	7.64	0.834	4.53	3.68	1.46
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		7.9	0.85	4.7	3.75	1.6
Arithmetic SD (s)		0.3	0.03	0.2	0.11	0.2
Arithmetic RSD (%)		3.8	3.5	4.3	2.9	9.6
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
103	ICP-MS/MS	42.7	77.9	58.2	99.0	40.9
200	ICP-MS	40.3	74.5	56.9	97.2	39.4
597	ICP-MS/MS	41.2	75.5	57.2	94.2	38.3
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		41.4	76	57.4	97	39.5
Arithmetic SD (s)		1.2	2	0.7	2	1.3
Arithmetic RSD (%)		2.9	2.2	1.2	2.5	3.3
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
200	DRC/CC-ICP-MS	8.1	9.7	4.0	11.2	4.4
442	ICP-MS/MS	4.02	4.93	1.82	6.210	2.83
485	HR-ICP-MS	3.86	4.95	1.74	6.17	2.89
597	ICP-MS/MS	7.47	9.37	5.91	9.86	7.07

Summary Statistics					
	SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)	NA	NA	NA	8.4	NA
Arithmetic SD (s)	NA	NA	NA	2.5	NA
Arithmetic RSD (%)	NA	NA	NA	31	NA
Number of Sample Measurements (N)	NA	NA	NA	4	NA

*Denotes a statistical Outlier.

Statistical data was not calculated for SE21-06, SE21-07, SE21-08 and SE21-10 based on a lack of consensus among participating labs.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
103	ICP-MS/MS	0.877	2.41	0.488	4.78	1.67
110	ICP-MS	0.884	2.50	0.508	4.87	1.74
147	ICP-MS	0.908	2.39	0.484	4.93	1.69
597	ICP-MS/MS	0.872	2.35	0.490	4.64	1.60
Summary Statistics						
		SE21-06	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
Arithmetic Mean ($\bar{x}$)		0.885	2.41	0.492	4.80	1.68
Arithmetic SD (s)		0.016	0.06	0.011	0.13	0.06
Arithmetic RSD (%)		1.8	2.5	2.2	2.7	3.6
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum U (µg/L)

Lab Code	Method	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
103	ICP-MS/MS	0.0606	0.138	0.0281	0.197	0.0814
110	ICP-MS	0.067	0.137	0.030	0.205	0.093
597	ICP-MS/MS	0.0630	0.143	0.0246	0.199	0.0786

Summary Statistics

	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
Arithmetic Mean ($\bar{x}$)	0.064	0.139	0.028	0.200	0.084
Arithmetic SD (s)	0.003	0.003	0.003	0.004	0.008
Arithmetic RSD (%)	4.7	2.2	11	2.0	9.5
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2021:
Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
110	ICP-MS	0.23	1.55	0.81	0.37	1.98
200	ICP-MS	0.3	1.6	0.9	0.5	2.3
597	ICP-MS/MS	0.209	1.35	0.733	0.38	1.88

Summary Statistics

	SE21-06	SE21-07	SE21-08	SE21-09	SE21-10
Arithmetic Mean ($\bar{x}$)	0.25	1.50	0.81	0.42	2.1
Arithmetic SD (s)	0.05	0.13	0.08	0.07	0.2
Arithmetic RSD (%)	20	8.7	9.9	17	11
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2021: Additional Elements in Serum

Serum B (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
200	ICP-MS	43	48	22	26	35

Serum Bi (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
147	ICP-MS	<0.040	<0.040	<0.040	<0.040	<0.040
597	ICP-MS/MS	<0.04	<0.04	<0.04	<0.04	<0.04

Serum Fe (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
264	ICP-MS	762.5	744.0	150.5	147.7	1045.6

Serum I (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
147	ICP-MS	58.1	57.6	44.6	46.3	39.9

Serum Li (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
147	ICP-MS	0.632	0.666	1.33	1.38	0.881

Serum Th (µg/L)						
Lab Code	**Method**	**SE21-06**	**SE21-07**	**SE21-08**	**SE21-09**	**SE21-10**
597	ICP-MS/MS	<0.01	<0.01	<0.01	<0.01	<0.01

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.