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New York State Biomonitoring Program for Trace Elements

Event #1, 2021

Trace Elements in Whole Blood, Urine, and Serum

April, 2021

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #1, 2021:
Trace Elements in Whole Blood, Urine, and Serum

4/21/2021

Dear Laboratory Director,

This report summarizes performance for the first 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 #2, 2021) will be shipped June 16, 2021. Comments about this report may be directed to trel@health.ny.gov. If you have not yet enrolled for next year, please contact PT program staff at trel@health.ny.gov.

Sincerely,

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

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

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Event #1, 2021

Trace Elements in Whole Blood

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Trace Elements Laboratory

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Event #1, 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 for analysis.

Graded Elements

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

Additional Elements

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

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

Amended Report

An amended report was issued on 9/9/21 for event #1, 2021. One participant lab reported a low bias with sample BE21-03 resulting in an unacceptable grade, and was unable to find a root cause. A follow up investigation was conducted by our program that confirmed a low bias for their sample BE21-03. In addition, we note that another participant also reported a low bias for their BE21-03.

A review of the homogeneity data for this study did not indicate a problem for BE21-03. However, we cannot be certain that the pool BE21-03 is free from a sporadic low bias, and so we have decided not to grade sample BE21-03. All other samples appear to meet our criteria for PT grading.

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Results for Event #1, 2021:
Summary Statistics

Whole Blood As (µg/L)					
	BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Target (Arithmetic Mean ($\bar{x}$))	5.2	14.9	7.8	1.95	25.5
Upper Limit	11.2	20.9	13.8	7.95	31.5
Lower Limit	0.0	8.9	1.8	0.00	19.5
Arithmetic SD (s)	0.4	1.5	2.1	0.25	1.6
Arithmetic RSD (%)	7.3	10	27	13	6.3
Number of Sample Measurements (N)	8	8	8	8	8

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

Whole Blood As (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
	Target	**5.2**	**14.9**	**7.8**	**1.95**	**25.5**
103	ICP-MS/MS	5.12	15.2	4.45	1.80	25.5
110	DRC/CC-ICP-MS	4.92	13.5	7.98	1.60	23.8
147	ICP-MS	4.93	14.2	8.31	1.83	24.4
264	ICP-MS	5.65	16.36	8.84	2.06	26.00
293	DRC/CC-ICP-MS	5.56	16.26	9.23	2	28.01
391	ICP-MS	5.73	16.94	9.93	2.38	27.80
597	ICP-MS/MS	4.71	13.5	4.46	1.76	23.9
598	DRC/CC-ICP-MS	5.18	13.2	9.09	2.15	24.8

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

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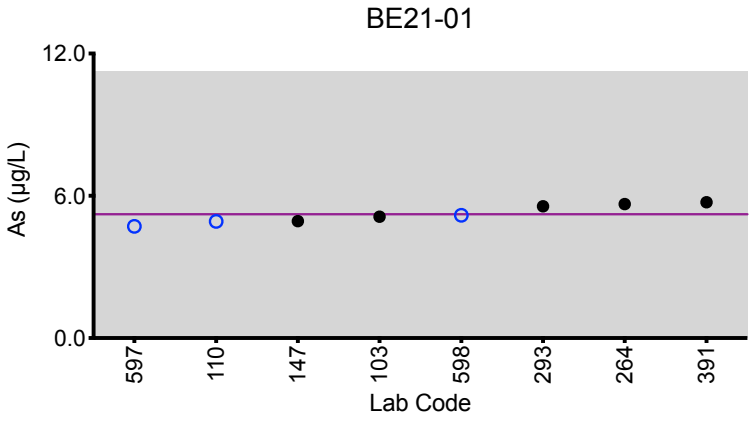
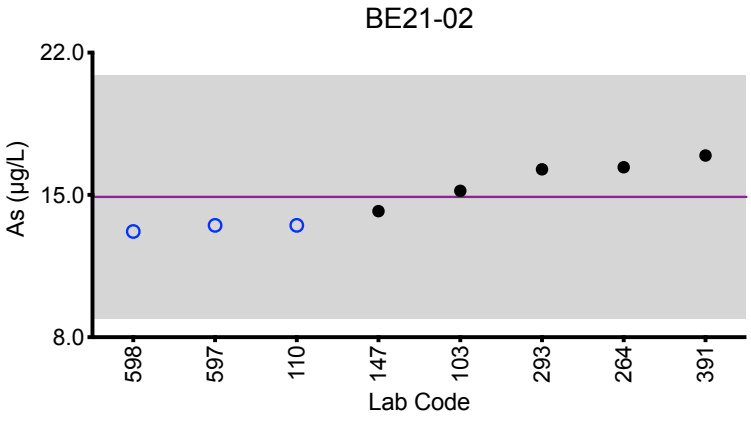
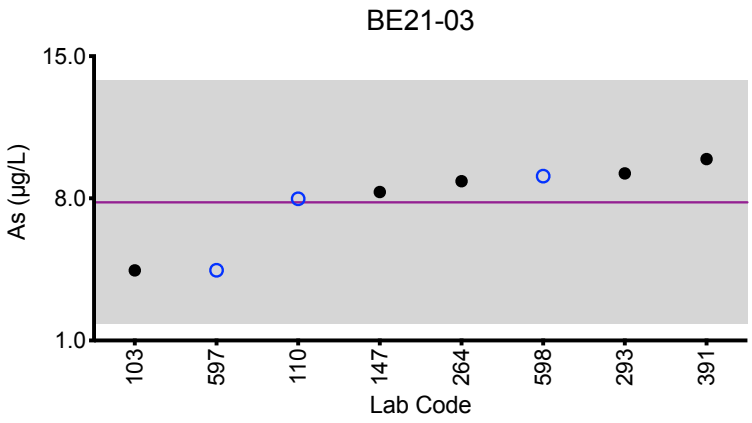
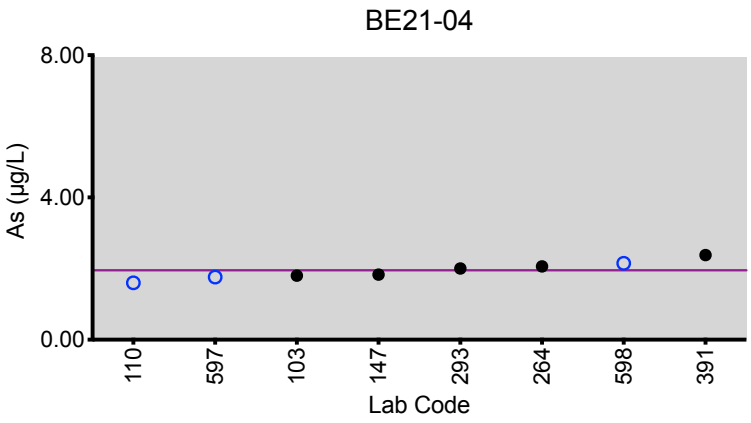
Results for Event #1, 2021: Summary Figures

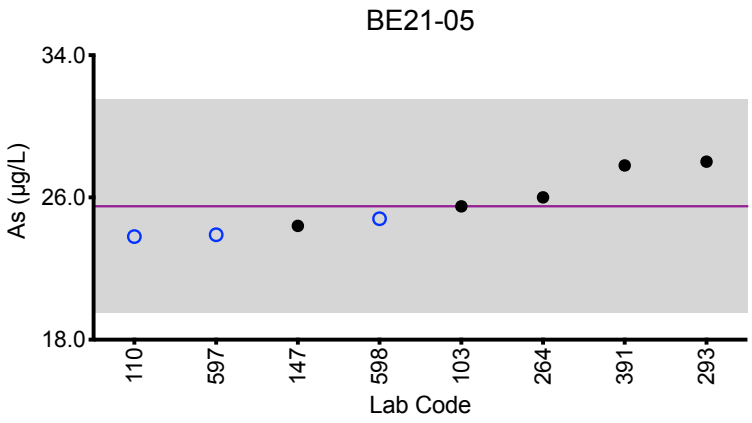
Whole Blood As











Legend:

o C/HHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2021: Summary Statistics

Whole Blood Cd (µg/L)					
	BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Target (Robust Mean (x*))	2.30	8.7	0.93	16.1	3.15
Upper Limit	3.30	10.0	1.93	18.5	4.15
Lower Limit	1.30	7.4	0.00	13.7	2.15
Robust SD (s*)	0.15	0.9	0.10	0.9	0.18
Robust RSD (%)	6.5	10	11	5.6	5.7
Number of Sample Measurements (N)	13	13	12	13	13
Standard Uncertainty (*u*)	0.05	0.3	0.03	0.3	0.06

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
	Target	**2.30**	**8.7**	**0.93**	**16.1**	**3.15**
103	ICP-MS/MS	2.42	9.43	0.561	16.3	3.22
107	ICP-MS/MS	2.235	8.125	0.965	15.525	2.978
110	ICP-MS	2.45	9.46	0.92	16.3	3.13
116	ICP-MS/MS	2.21	8.92	<1.5	16.4	3.53
147	ICP-MS	2.43	9.09	0.950	16.3	3.20
264	ICP-MS	2.43	9.79	1.01	16.44	3.30
293	DRC/CC-ICP-MS	2.17	8.76	0.88	15.03	2.97
391	ICP-MS	2.26	8.82	0.88	15.56	2.96
597	ICP-MS/MS	2.13	8.53	0.513	15.1	2.91
598	DRC/CC-ICP-MS	2.04	8.17	0.87	13.7	2.82
605	ICP-MS	2.35	6.67 ↓	0.975	17.4	3.29
606	ICP-MS/MS	2.32	6.35 ↓	1.08	16.9	3.25
686	ICP-MS	2.44	9.75	1.02	16.6	3.26

Based on the grading criteria for Cd in Whole blood, 97% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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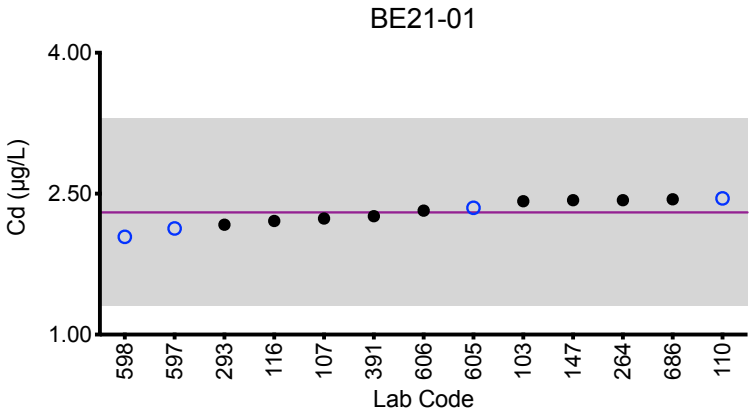
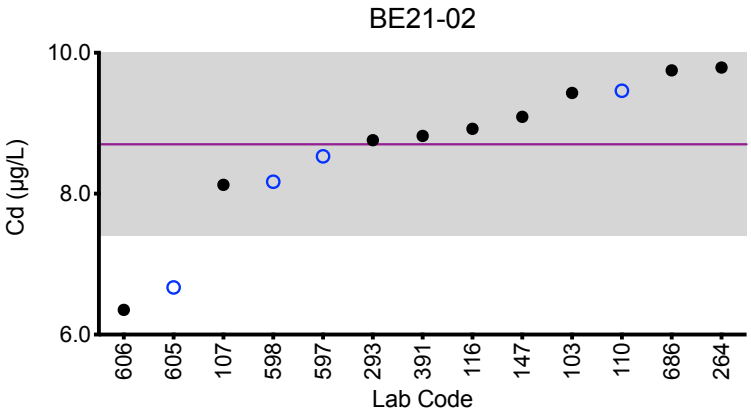
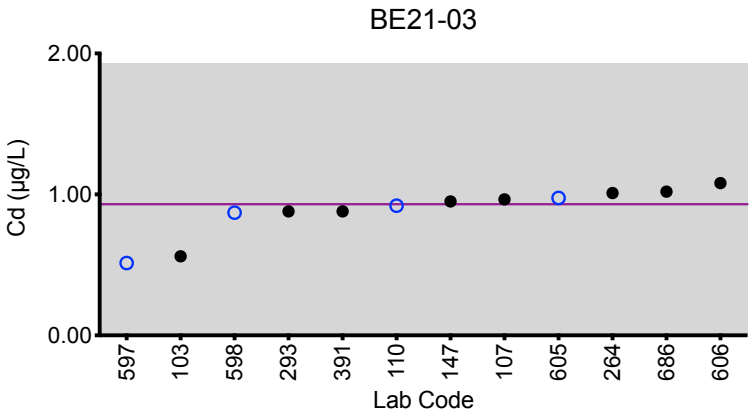
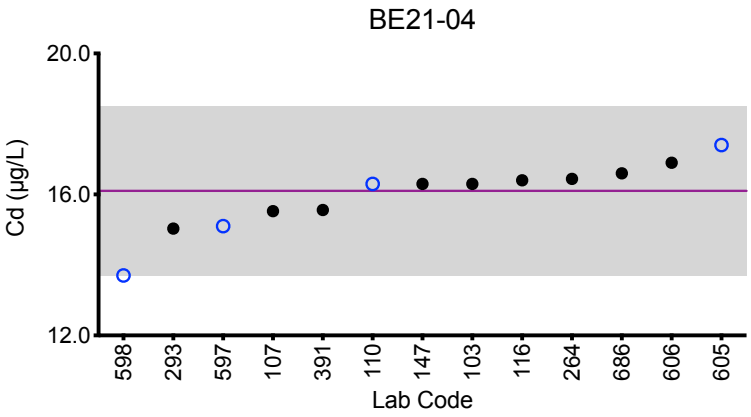
Results for Event #1, 2021: Summary Figures

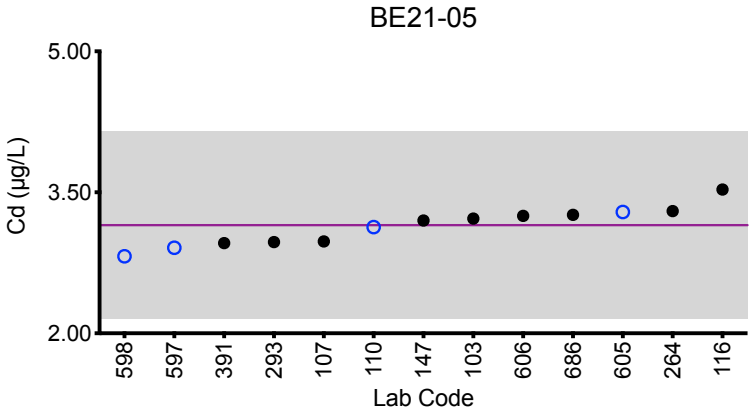
Whole Blood Cd











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 #1, 2021:
Summary Statistics

Whole Blood Co (µg/L)					
	BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Target (Arithmetic Mean ($\bar{x}$))	0.54	1.28	3.8	19.9	15.9
Upper Limit	2.04	2.78	5.3	23.9	19.1
Lower Limit	0.00	0.00	2.3	15.9	12.7
Arithmetic SD (s)	0.05	0.08	0.9	1.3	0.9
Arithmetic RSD (%)	9.3	6.3	24	6.5	5.7
Number of Sample Measurements (N)	9	9	9	9	9

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
	Target	**0.54**	**1.28**	**3.8**	**19.9**	**15.9**
103	ICP-MS/MS	0.515	1.24	2.22	19.8	15.8
110	ICP-MS	0.54	1.42	4.46	21.0	16.1
147	ICP-MS	0.613	1.38	4.40	20.9	16.5
255	ICP-MS	0.57	1.3	4.3	18	15
264	ICP-MS	0.57	1.29	4.64	21.74	17.38
293	DRC/CC-ICP-MS	0.51	1.28	4.19	20.28	16.25
391	ICP-MS	0.43	1.18	4.17	19.78	16.04
597	ICP-MS/MS	0.534	1.25	2.53	19.4	15.7
598	ICP-MS	0.55	1.21	3.68	18.2	14.2

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

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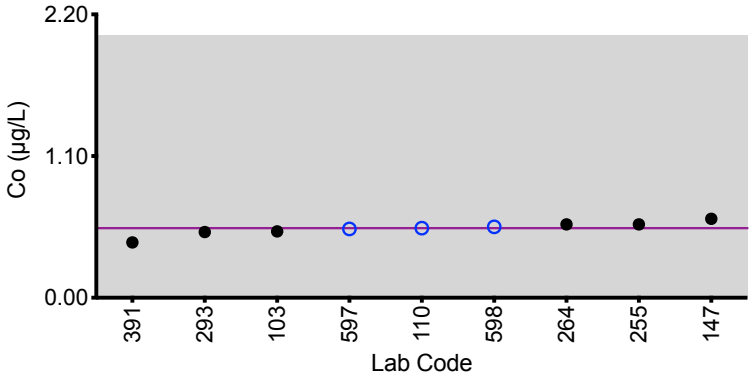
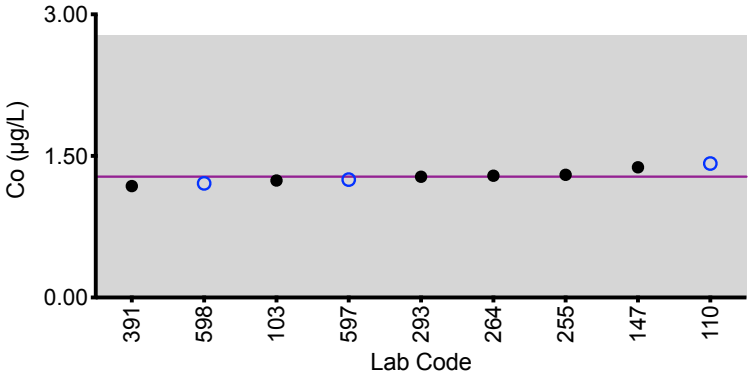
Results for Event #1, 2021: Summary Figures

Whole Blood Co

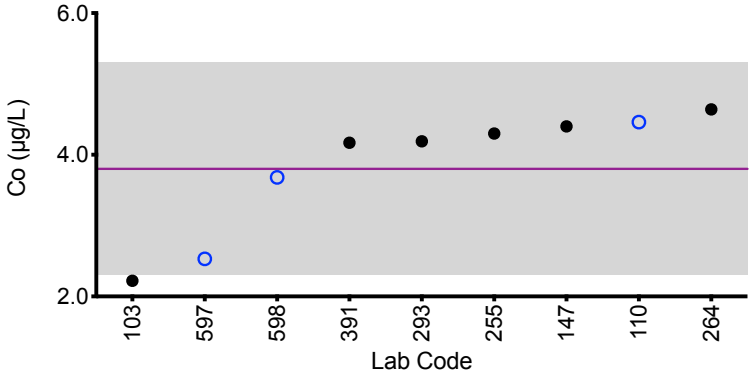
BE21-01



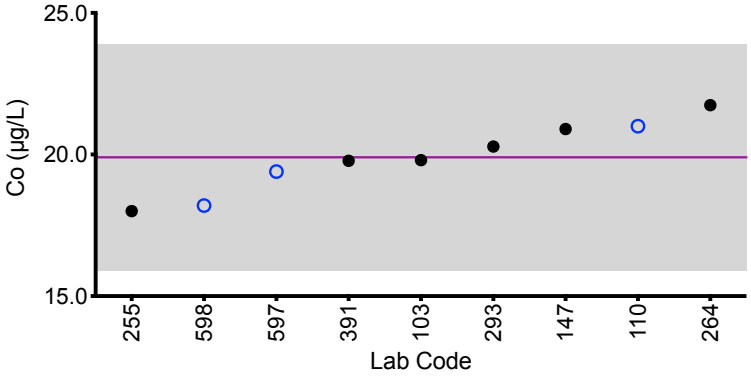
BE21-02



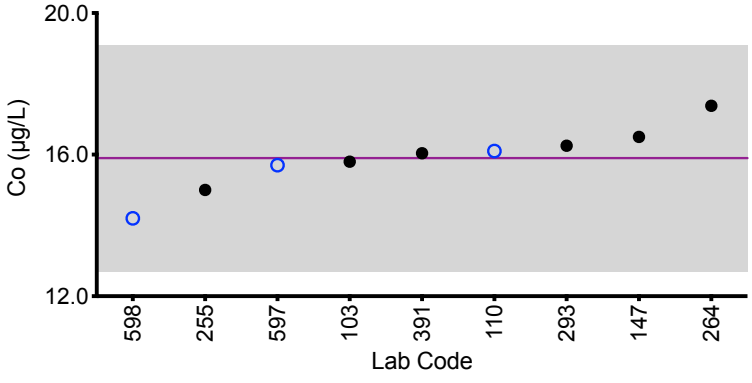
BE21-03



BE21-04



BE21-05



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 #1, 2021: Summary Statistics

Whole Blood Cr (µg/L)					
	BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Target (Arithmetic Mean ($\bar{x}$))	0.97	4.6	1.3	NA	6.8
Upper Limit	2.97	6.6	3.3	NA	8.8
Lower Limit	0.00	2.6	0.0	NA	4.8
Arithmetic SD (s)	0.20	0.5	0.4	NA	0.8
Arithmetic RSD (%)	21	11	28	NA	12
Number of Sample Measurements (N)	7	9	8	NA	9

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

Statistical data was not calculated for BE21-04 based on a lack of consensus among participating labs. Consequently, a target value cannot be assigned with confidence.

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Results for Event #1, 2021:
Performance of Participating Laboratories

Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
	Target	**0.97**	**4.6**	**1.3**	**NA**	**6.8**
103	ICP-MS/MS	<2.50	4.98	<2.50	<2.50	6.84
110	DRC/CC-ICP-MS	1.12	5.67	1.74	0.20	7.44
147	DRC/CC-ICP-MS	0.952	4.78	1.54	0.251	7.28
255	ICP-MS	<1.0	4.5	1.3	<1.0	6.6
264	ICP-MS	0.89	4.56	1.62	0.53	8.25
293	DRC/CC-ICP-MS	0.98	4.83	1.63	0.44	6.78
391	ICP-MS	1.28	4.14	1.03	0.00	6.22
597	ICP-MS/MS	0.905	4.40	0.700	<0.47	6.34
598	DRC/CC-ICP-MS	0.63	3.94	1.05	<0.2	5.31

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

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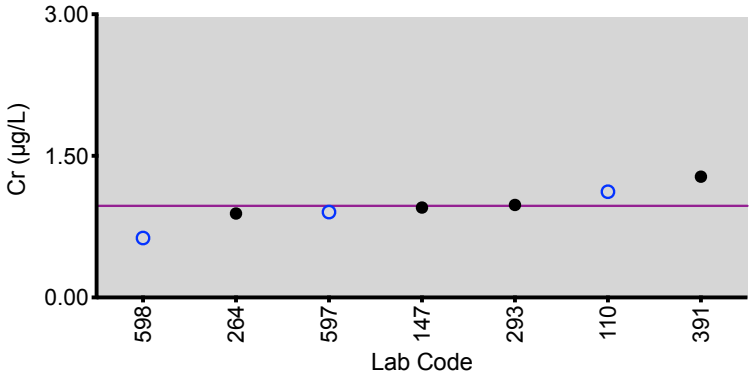
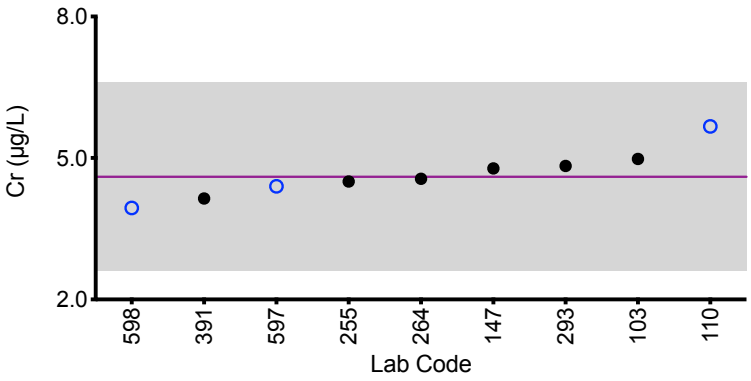
Results for Event #1, 2021: Summary Figures

Whole Blood Cr

BE21-01



BE21-02



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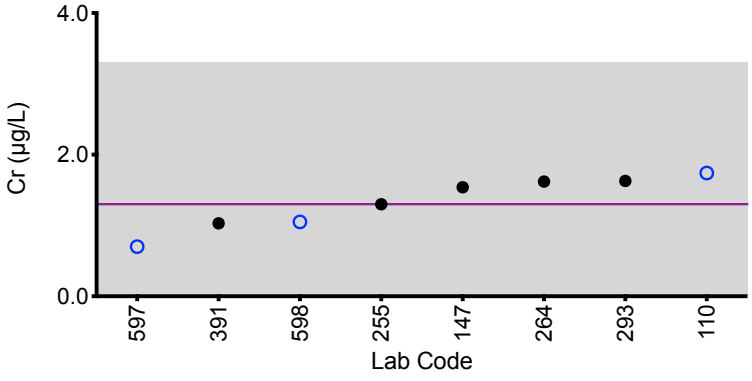
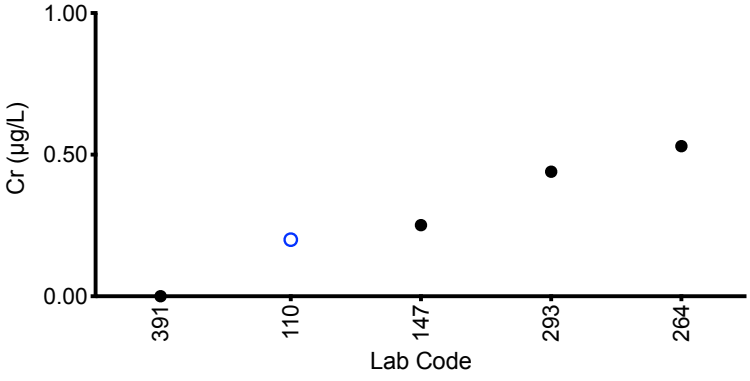
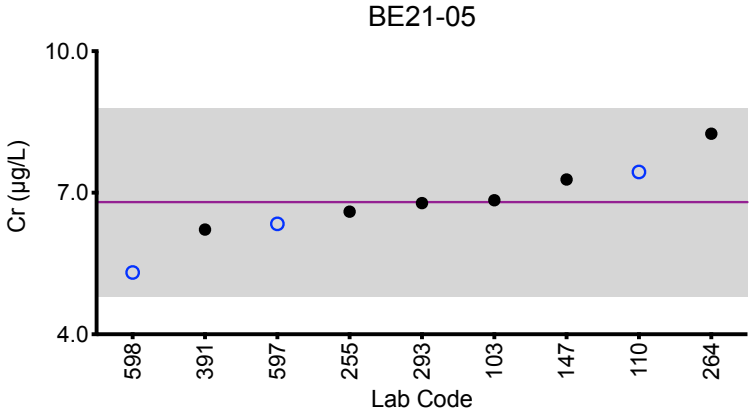


BE21-04



BE21-05



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 #1, 2021: Summary Statistics

Whole Blood Hg (µg/L)					
	BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Target (Robust Mean (x*))	12.2	1.9	25.0	4.76	0.54
Upper Limit	15.9	4.9	32.5	7.76	3.54
Lower Limit	8.5	0.0	17.5	1.76	0.00
Robust SD (s*)	0.5	0.4	3.6	0.20	0.21
Robust RSD (%)	4.1	21	14	4.2	39
Number of Sample Measurements (N)	13	13	13	13	12
Standard Uncertainty (*u*)	0.2	0.1	0.1	0.07	0.08

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

Whole Blood Hg (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
	Target	**12.2**	**1.9**	**25.0**	**4.76**	**0.54**
103	ICP-MS/MS	12.5	2.15	13.2	4.48	0.573
107	ICP-MS/MS	12.34	1.82	26.42	4.78	0.55
110	ICP-MS	11.8	1.74	23.8	4.12	0.42
116	ICP-MS/MS	12.6	2.09	28.2	4.97	<1.5
147	ICP-MS	12.2	1.99	24.7	4.59	0.573
264	ICP-MS	11.11	1.66	25.21	4.32	0.10
293	DRC/CC-ICP-MS	10.74	1.54	19.64	4.03	0.42
391	CV-AAS	12.53	1.66	30.53	4.86	0.00
597	ICP-MS/MS	12.3	2.27	16.0	4.83	0.748
598	ICP-MS	11.4	2.21	23.1	4.83	0.73
605	ICP-MS	12.3	1.39	26.7	4.96	0.558
606	ICP-MS/MS	13.1	1.31	28.2	4.90	0.612
686	ICP-MS	12.7	2.28	27.2	4.96	0.826

Based on the grading criteria for Hg 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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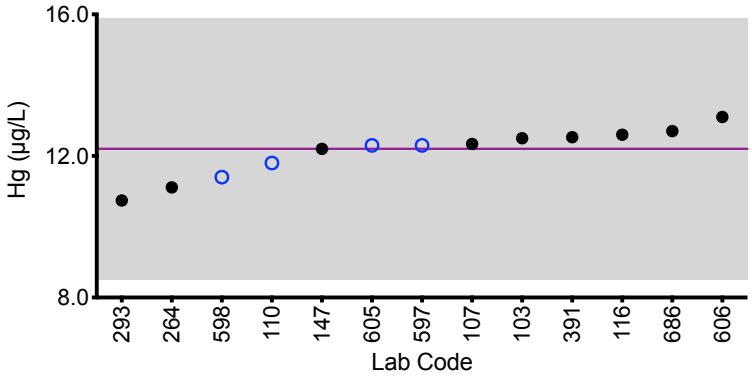
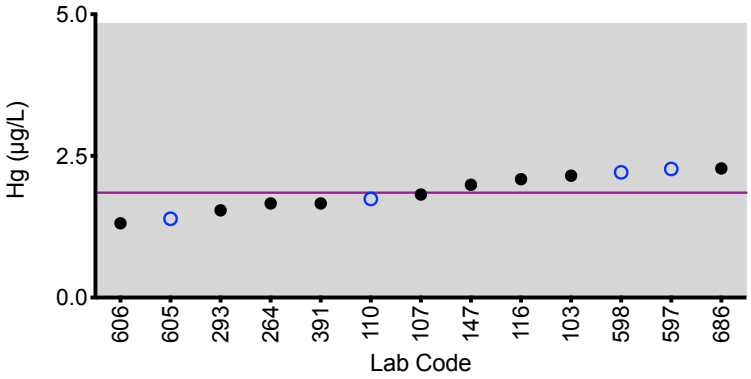
Results for Event #1, 2021: Summary Figures

Whole Blood Hg

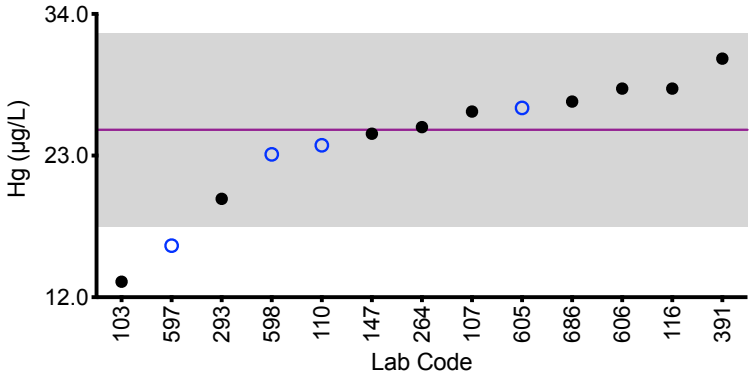
BE21-01



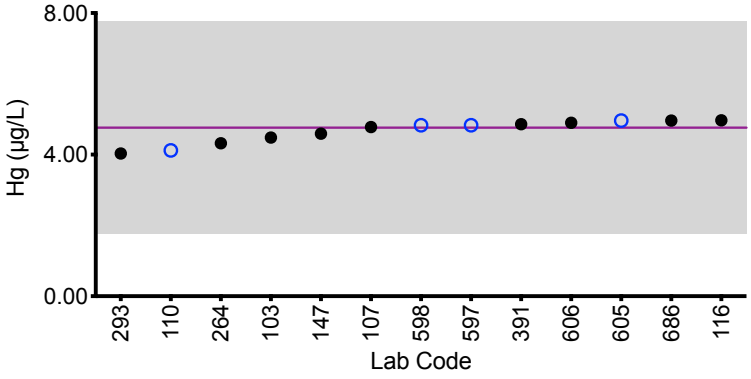
BE21-02



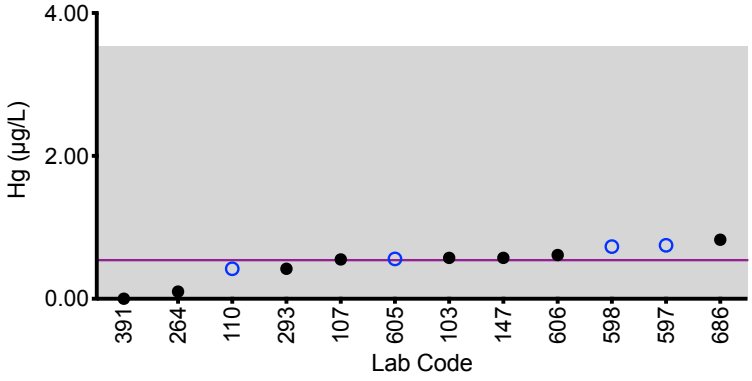
BE21-03



BE21-04



BE21-05



Legend:

o C/HHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2021: Summary Statistics

Whole Blood Mn (µg/L)					
	BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Target (Robust Mean (x*))	26.1	6.4	13.9	16.9	9.1
Upper Limit	30.5	9.4	16.9	19.9	12.1
Lower Limit	21.7	3.4	10.9	13.9	6.1
Robust SD (s*)	1.9	1.6	2.5	1.2	1.4
Robust RSD (%)	7.3	25	18	7.1	15
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.7	0.7	0.1	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 #1, 2021:
Performance of Participating Laboratories

Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
	Target	**26.1**	**6.4**	**13.9**	**16.9**	**9.1**
103	ICP-MS/MS	26.0	6.55	7.33	16.7	8.96
107	ICP-MS/MS	24.47	5.41	13.82	16.18	8.34
110	ICP-MS	26.5	5.9	15.0	16.7	9.1
147	ICP-MS	28.4	8.19	16.5	19.7	11.3
264	ICP-MS	28.75	8.75	16.63	17.70	10.93
293	DRC/CC-ICP-MS	24.71	5.66	13.34	15.93	7.96
391	ICP-MS	26.21	9.04	14.90	18.27	10.78
597	ICP-MS/MS	25.2	6.72	8.73	16.5	8.61
598	ICP-MS	21.7	5.17	11.5	14.7	7.13
606	ICP-MS/MS	26.8	4.06	15.4	17.6	8.91

Based on the grading criteria for Mn in Whole Blood, 100% of results were satisfactory, with 0 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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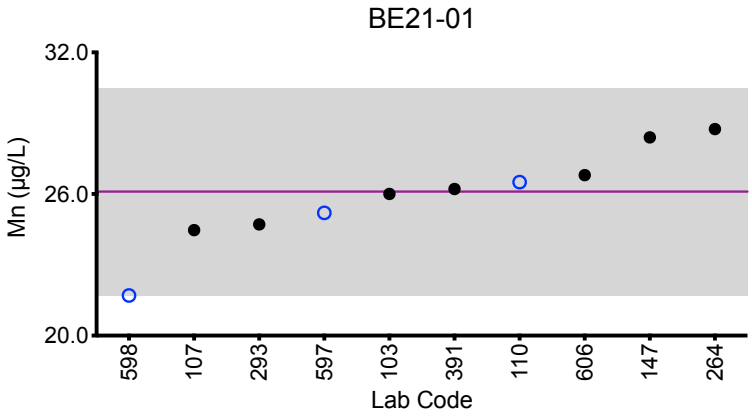
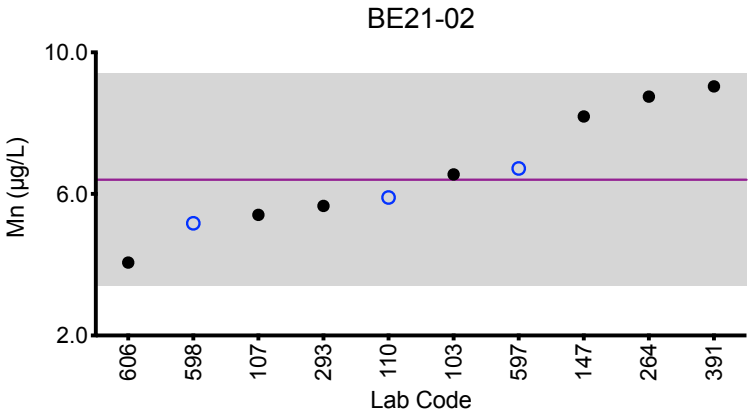
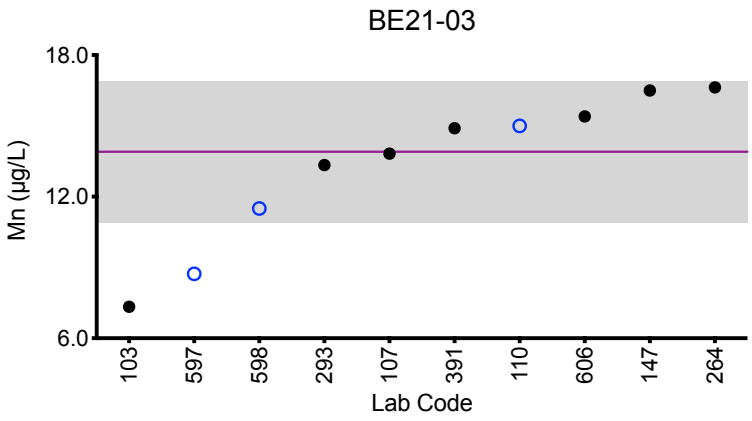
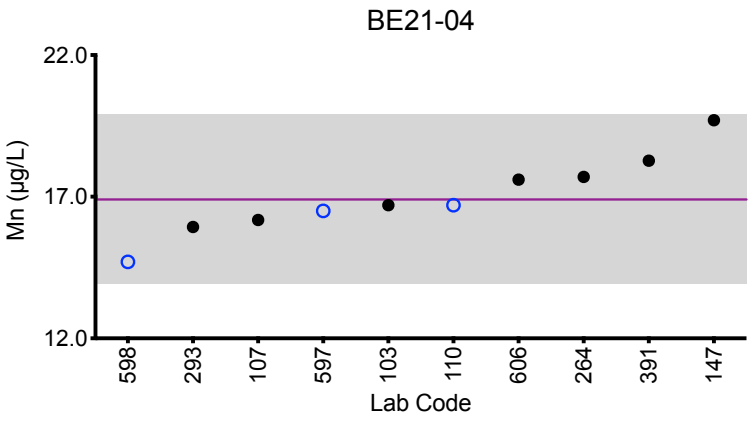
Results for Event #1, 2021: Summary Figures

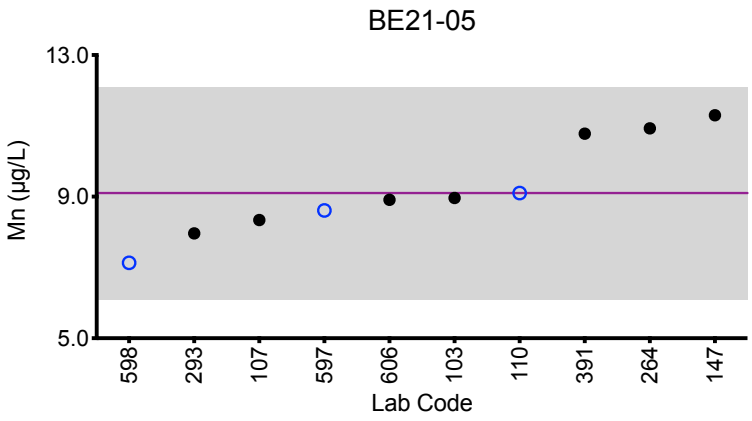
Whole Blood Mn











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 #1, 2021: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Target (Robust Mean (x*))	0.65	2.81	1.06	10.1	4.81
Upper Limit	2.65	4.81	3.06	12.1	6.81
Lower Limit	0.00	0.81	0.00	8.1	2.81
Robust SD (s*)	0.03	0.29	0.11	0.7	0.29
Robust RSD (%)	5.1	10	10	6.9	6.1
Number of Sample Measurements (N)	8	14	12	14	14
Standard Uncertainty (*u*)	NA	0.09	0.04	0.2	0.09

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/)

An arithmetic mean, SD, RSD and n are provided for sample BE21-01.

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Results for Event #1, 2021:
Performance of Participating Laboratories

Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
	Target	**0.65**	**2.81**	**1.06**	**10.1**	**4.81**
103	ICP-MS/MS	0.672	3.08	0.584	10.2	4.97
107	ICP-MS/MS	0.661	2.725	1.111	10.096	4.837
110	ICP-MS	0.70	3.06	1.14	10.2	4.91
116	ICP-MS/MS	<3.0	3.09	<3.0	10.7	5.1
147	ICP-MS	0.671	3.03	1.12	10.3	5.04
264	ICP-MS	0.67	2.60	1.02	8.41	4.20
293	DRC/CC-ICP-MS	0.62	2.89	1.03	9.72	4.76
343	ASV-LeadCare	<1.9	2.7	<1.9	11.2	4.2
391	ETAAS-Z	*0.10	2.61	0.72	9.26	4.16
597	ICP-MS/MS	0.614	2.82	0.63	9.56	4.66
598	ICP-MS	0.61	2.85	1.05	9.52	4.56
605	ICP-MS	<1.00	2.06	1.08	10.7	5.04
606	ICP-MS/MS	<1.00	2.13	1.24	10.9	5.20
686	ICP-MS	<1	3.08	1.17	10.1	4.95

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

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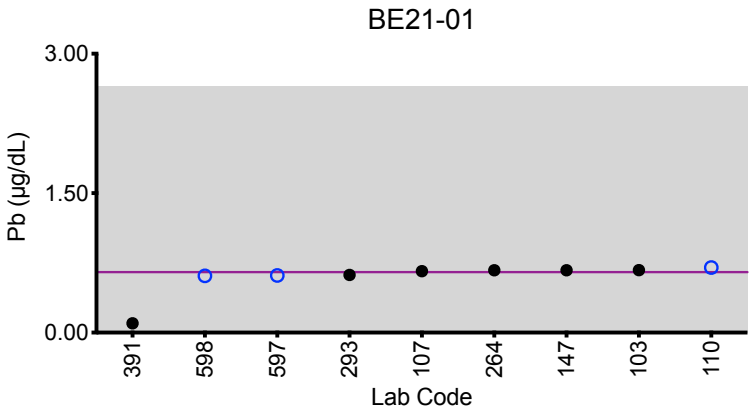
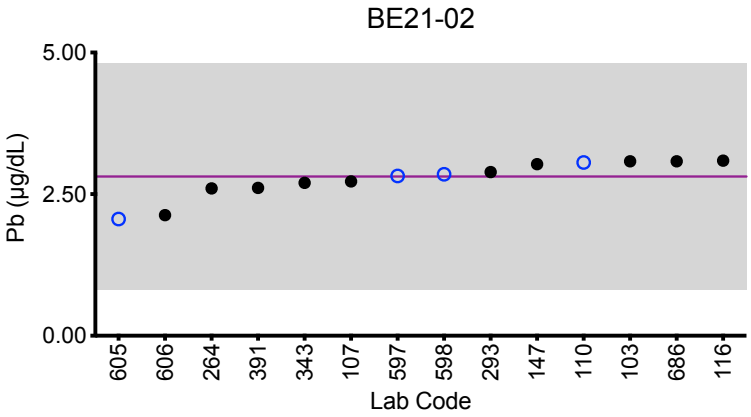
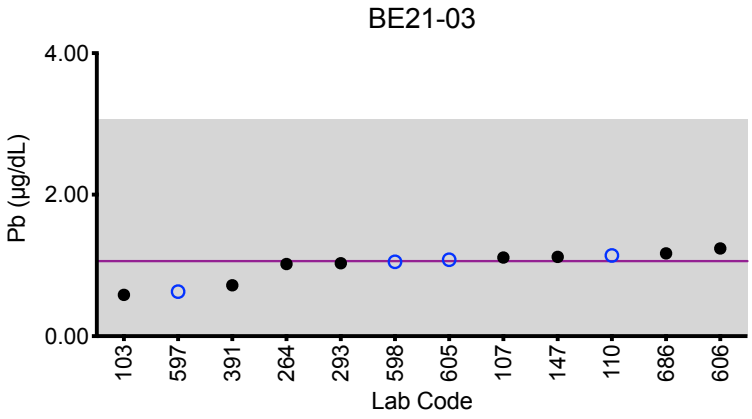
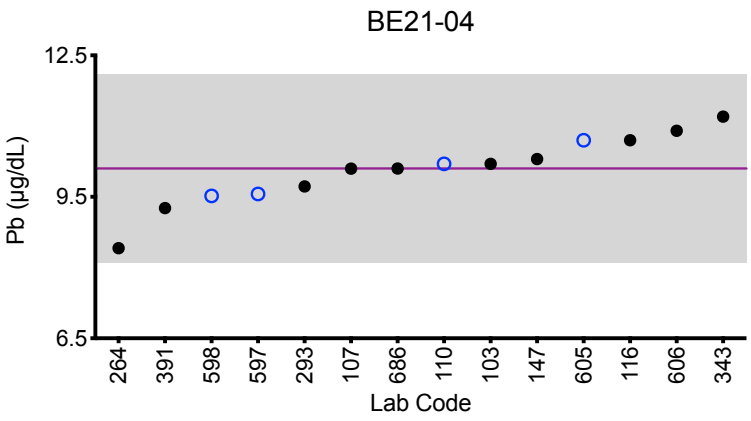
Results for Event #1, 2021: Summary Figures

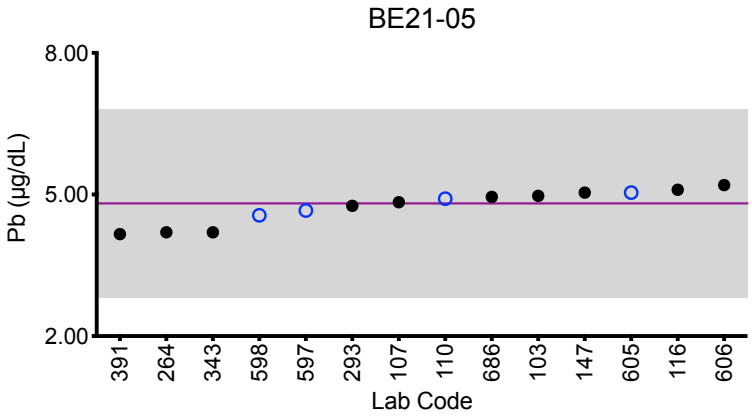
Whole Blood Pb











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 #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)

Lab Code	Method	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
110	ICP-MS	6.8	11.2	1.8	7.0	3.6
147	ICP-MS	6.79	11.0	2.00	7.62	3.43
293	DRC/CC-ICP-MS	6.23	10.05	1.44	6.93	3.14
597	ICP-MS/MS	6.84	9.98	0.992	7.27	3.49
598	ICP-MS	6.49	10.3	1.68	7.53	3.34

Summary Statistics

	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
Arithmetic Mean ($\bar{x}$)	6.6	10.5	1.6	7.3	3.40
Arithmetic SD (s)	0.3	0.6	0.4	0.3	0.17
Arithmetic RSD (%)	3.9	5.7	25	4.3	5.1
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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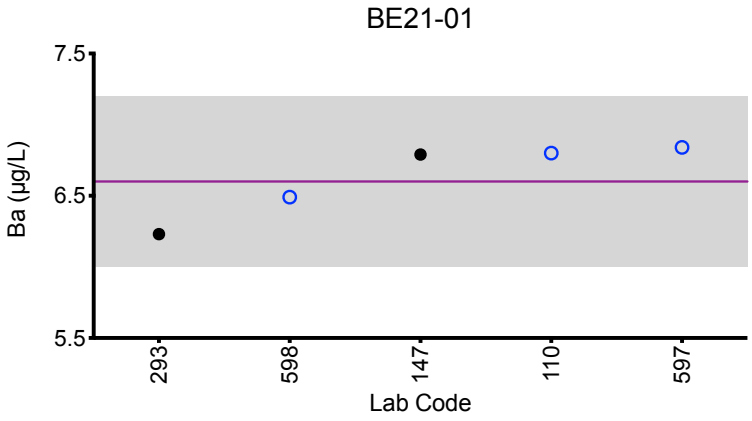
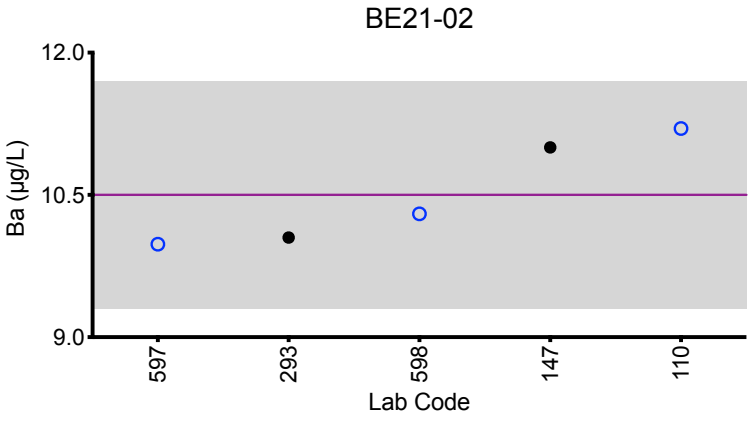
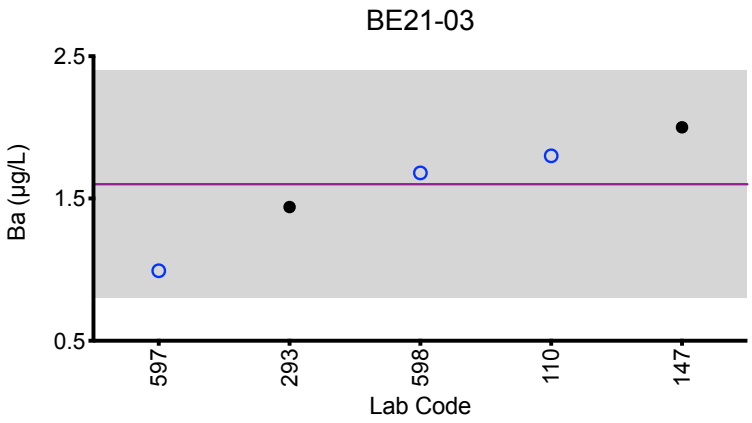
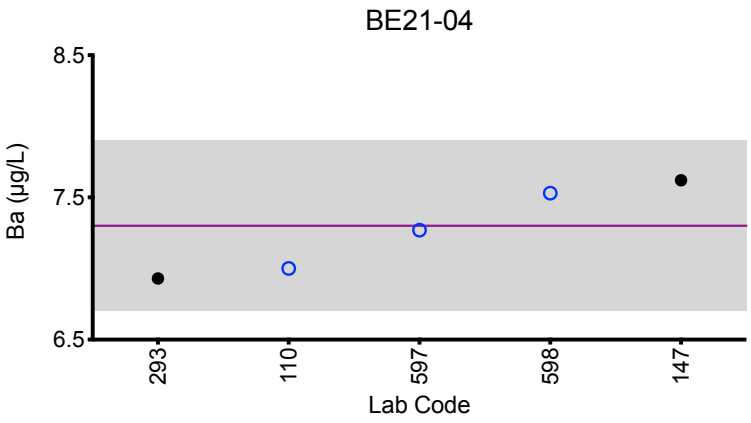
Results for Event #1, 2021: Summary Figures

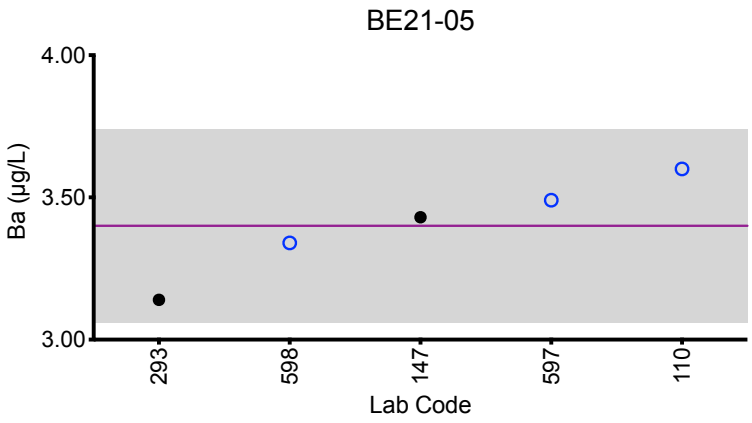
Whole Blood Ba











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 #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)

Lab Code	Method	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
103	ICP-MS/MS	<1.50	4.09	<1.50	11.0	2.77
147	ICP-MS	0.979	3.98	1.01	10.9	2.83
264	ICP-MS	*1.96	4.65	*2.23	13.36	2.95
597	ICP-MS/MS	0.909	3.65	0.62	9.70	2.55
598	DRC/CC-ICP-MS	1.05	3.71	1.18	10.4	2.95

Summary Statistics

	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
Arithmetic Mean ($\bar{x}$)	1.0	4.0	0.9	11.1	2.81
Arithmetic SD (s)	0.1	0.4	0.3	1.4	0.16
Arithmetic RSD (%)	7.2	10	31	13	5.7
Number of Sample Measurements (N)	3	5	3	5	5

*Denotes a statistical Outlier.

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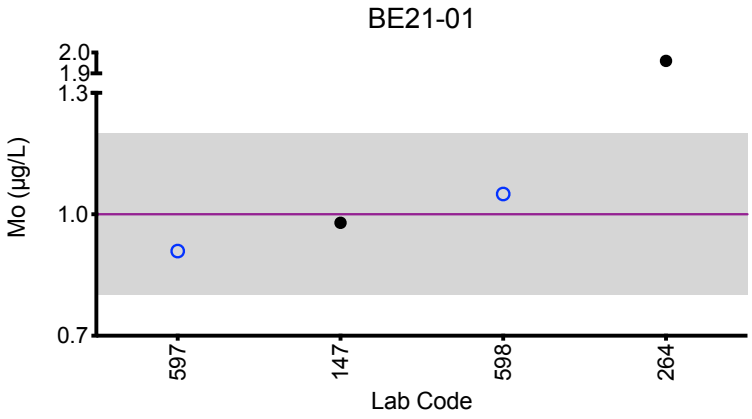
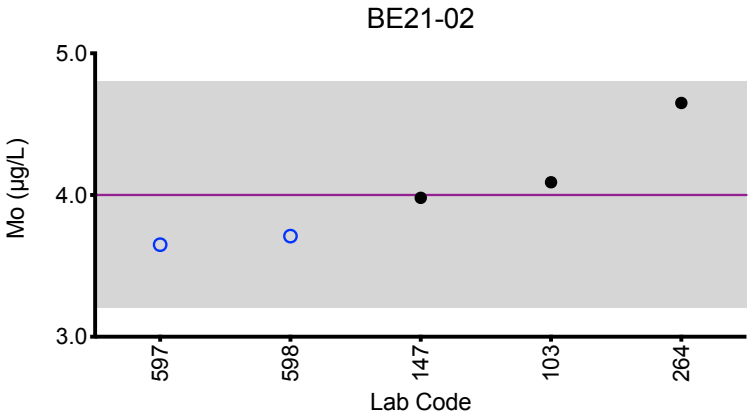
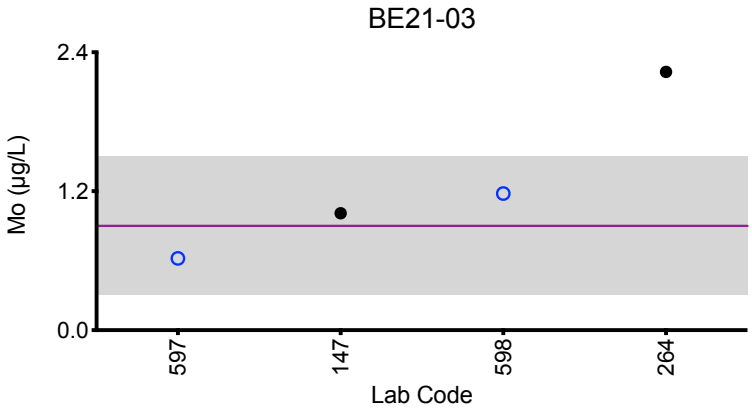
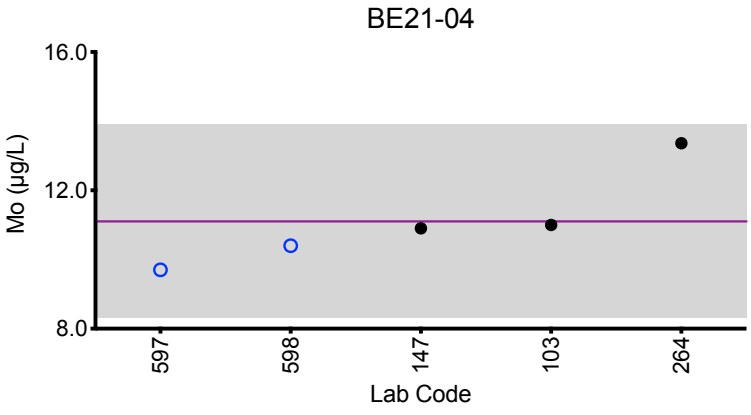
Results for Event #1, 2021: Summary Figures

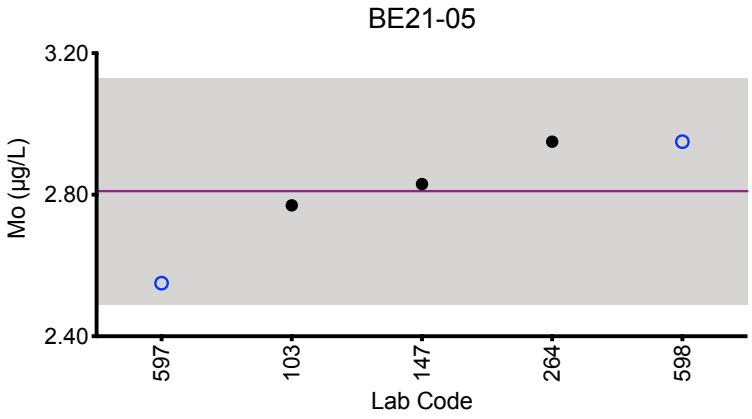
Whole Blood Mo











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 #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)

Lab Code	Method	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
103	ICP-MS/MS	<0.150	1.64	2.59	3.63	2.46
110	ICP-MS	0.009	1.88	5.90	4.35	2.86
147	ICP-MS	<0.329	1.90	5.63	4.20	2.85
264	ICP-MS	0.03	1.50	4.70	3.65	2.37
293	DRC/CC-ICP-MS	0.02	1.97	5.47	4.31	3.06
597	ICP-MS/MS	0.01	1.74	3.16	4.08	2.61
598	ICP-MS	<0.2	1.98	6.16	4.46	2.89

Summary Statistics

	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
Arithmetic Mean ($\bar{x}$)	NA	1.80	4.8	4.1	2.7
Arithmetic SD (s)	NA	0.18	1.4	0.3	0.3
Arithmetic RSD (%)	NA	10	29	8.2	9.2
Number of Sample Measurements (N)	NA	7	7	7	7

*Denotes a statistical Outlier.

Statistical data was not calculated for BE21-01 based on a lack of consensus among participating labs.

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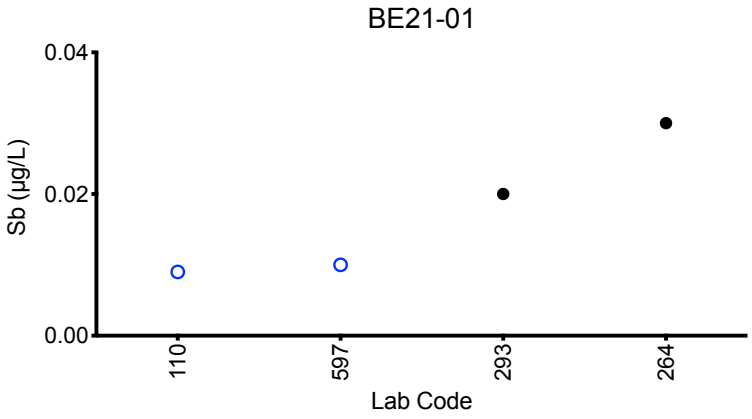
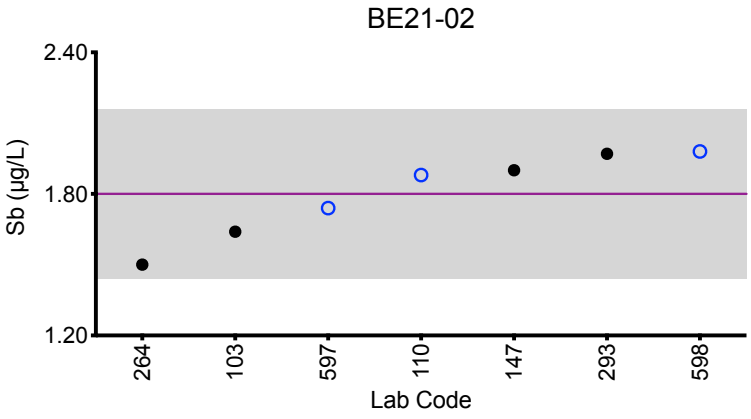
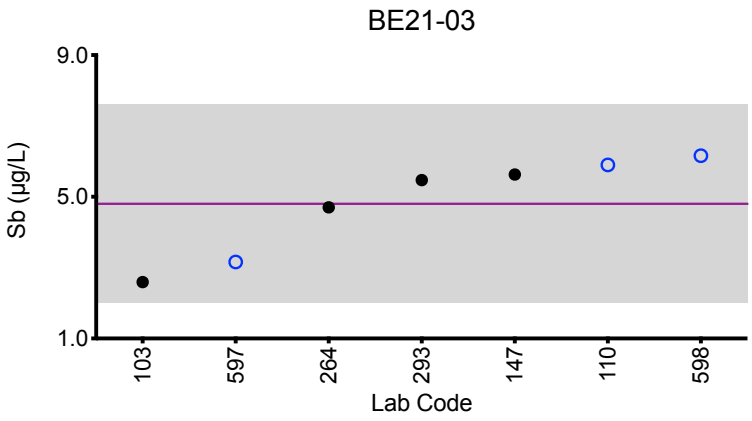
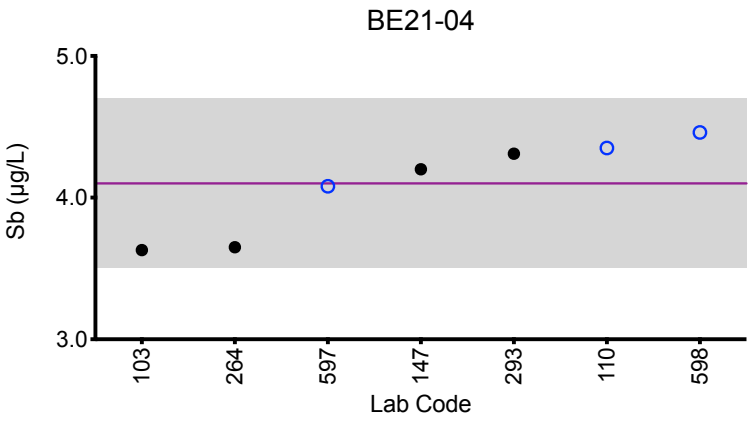
Results for Event #1, 2021: Summary Figures

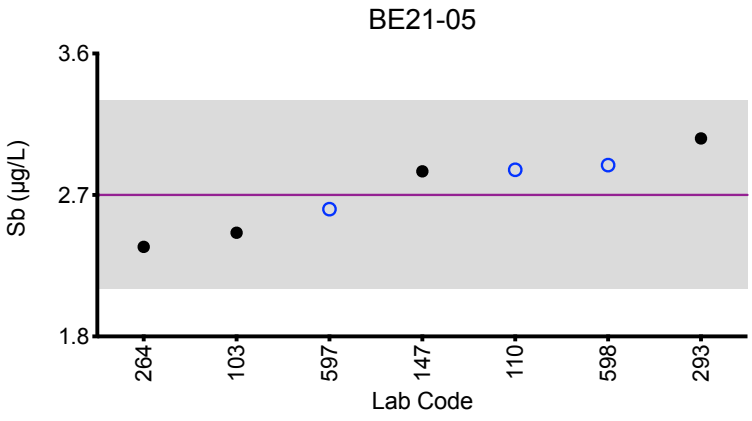
Whole Blood Sb











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 #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
103	ICP-MS/MS	145	318	73.3	186	163
107	ICP-MS/MS	143.4	295.0	149.0	190.1	165.8
110	DRC/CC-ICP-MS	145	319	151	163	176
147	ICP-MS	141	306	142	183	162
264	ICP-MS	149.7	333.6	165.6	198.0	173.9
293	DRC/CC-ICP-MS	149.96	308.6	146.01	192.58	166.54
597	ICP-MS/MS	142	296	83.3	178	161
598	DRC/CC-ICP-MS	156	294	139	188	150

Summary Statistics					
	BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Arithmetic Mean ($\bar{x}$)	147	309	131	185	165
Arithmetic SD (s)	5	14	34	11	8
Arithmetic RSD (%)	3.4	4.5	26	5.9	4.8
Number of Sample Measurements (N)	8	8	8	8	8

*Denotes a statistical Outlier.

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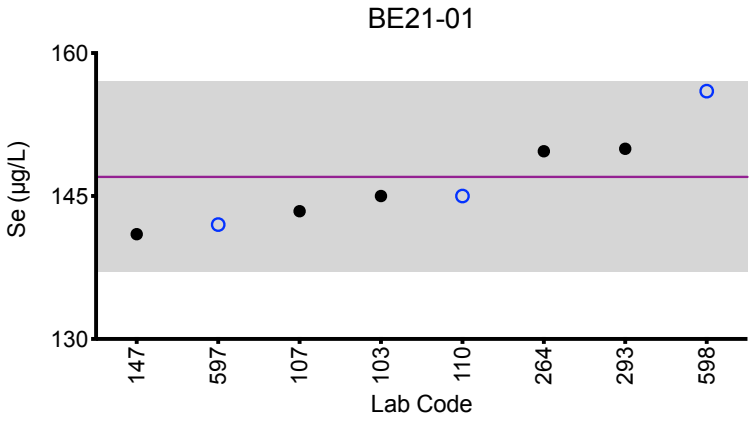
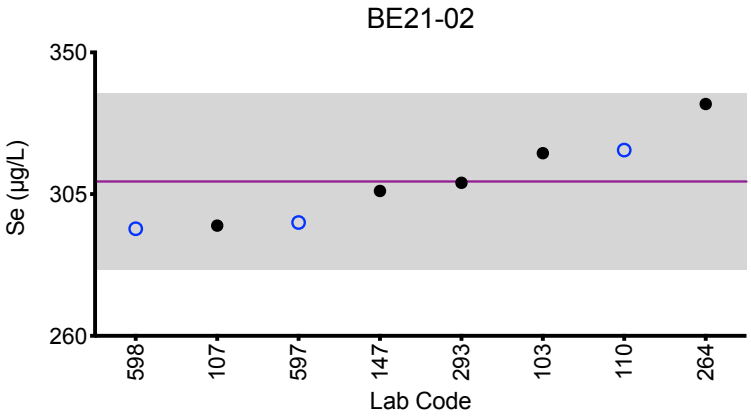
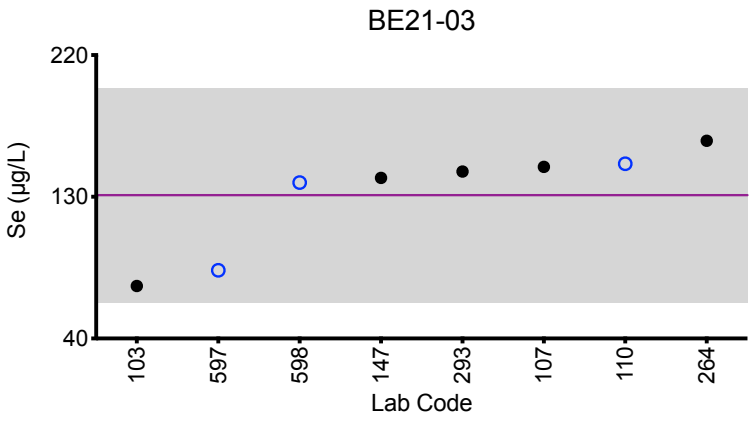
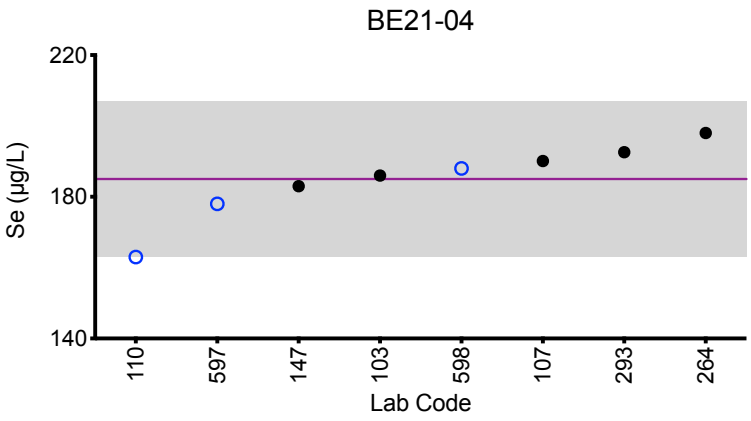
Results for Event #1, 2021: Summary Figures

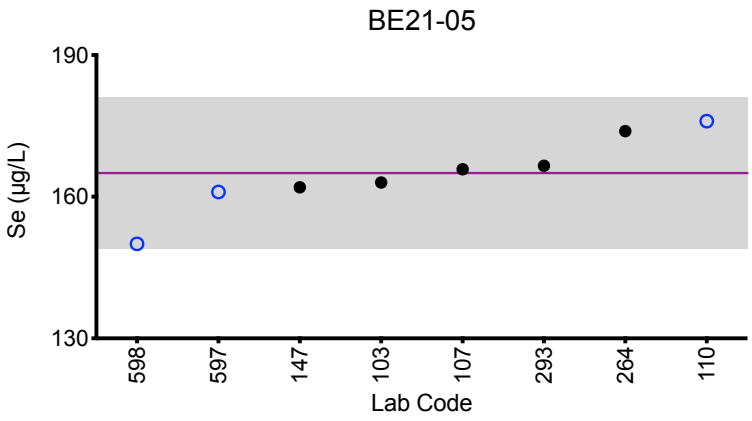
Whole Blood Se











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

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Tl (µg/L)

Lab Code	Method	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
103	ICP-MS/MS	0.877	2.79	0.666	3.44	0.306
110	ICP-MS	0.862	2.80	1.38	3.55	0.303
147	ICP-MS	0.881	2.72	1.29	3.54	0.337
264	ICP-MS	0.88	2.38	1.07	2.81	0.18
293	DRC/CC-ICP-MS	0.75	2.48	1.15	3.14	0.29
597	ICP-MS/MS	0.864	2.63	0.787	3.36	0.36
598	ICP-MS	0.9	2.79	1.31	3.4	0.32

Summary Statistics

	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
Arithmetic Mean ($\bar{x}$)	0.86	2.66	1.1	3.3	0.30
Arithmetic SD (s)	0.05	0.17	0.3	0.3	0.06
Arithmetic RSD (%)	5.8	6.4	25	7.8	20
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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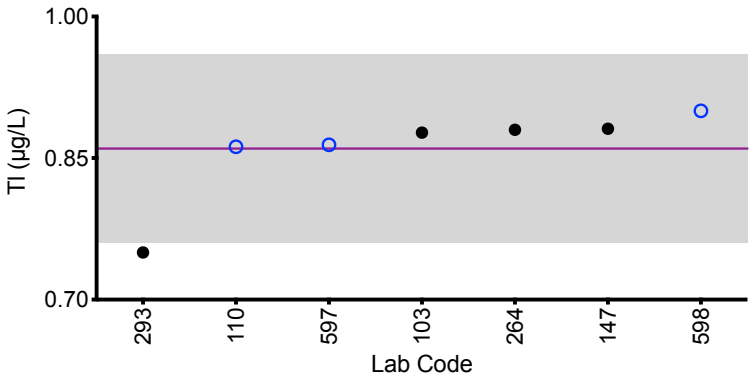
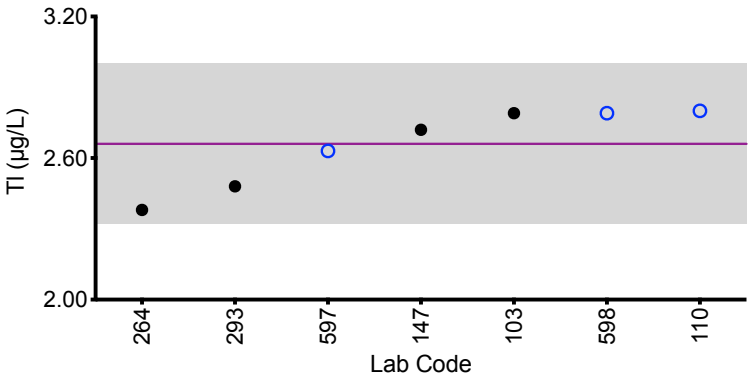
Results for Event #1, 2021: Summary Figures

Whole Blood Tl

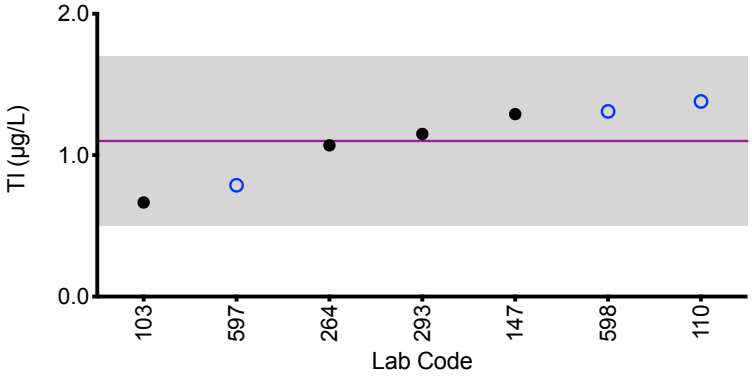
BE21-01



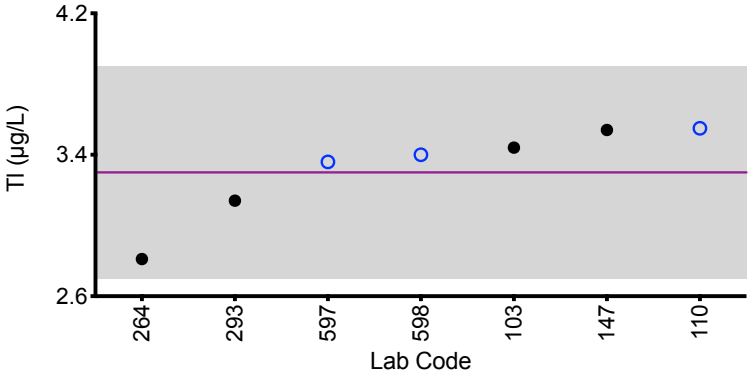
BE21-02



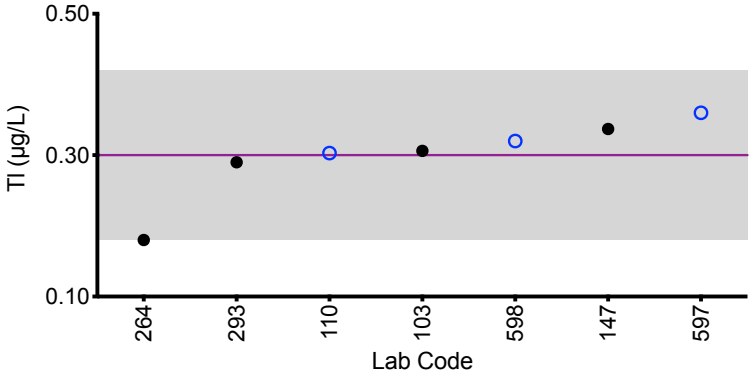
BE21-03



BE21-04



BE21-05



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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)

Lab Code	Method	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
103	ICP-MS/MS	0.221	0.0725	0.0660	0.0552	0.109
110	ICP-MS	0.225	0.092	0.134	0.059	0.129
147	ICP-MS	0.217	0.0721	0.131	0.0574	0.111
597	ICP-MS/MS	0.222	0.076	0.089	0.059	0.115
598	ICP-MS	0.21	0.07	0.14	0.06	0.12

Summary Statistics

	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
Arithmetic Mean ($\bar{x}$)	0.219	0.077	0.11	0.0581	0.117
Arithmetic SD (s)	0.006	0.009	0.03	0.0019	0.008
Arithmetic RSD (%)	2.7	12	29	3.3	6.8
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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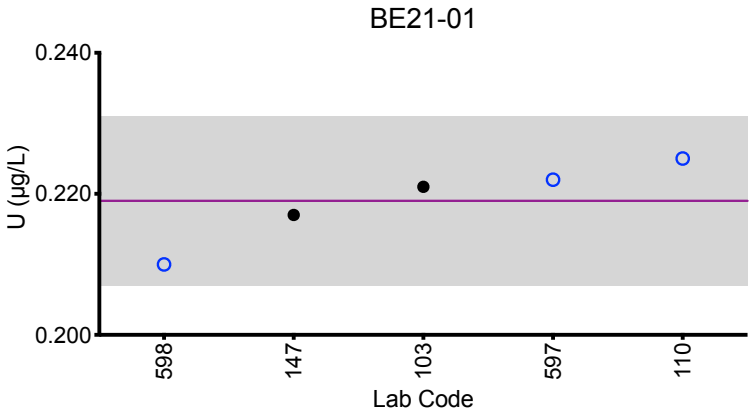
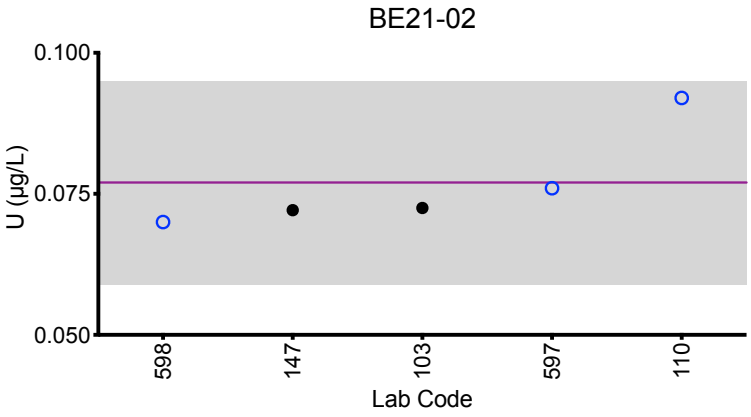
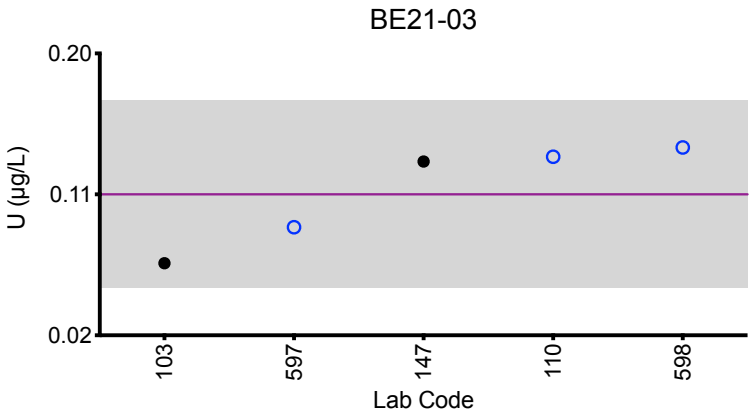
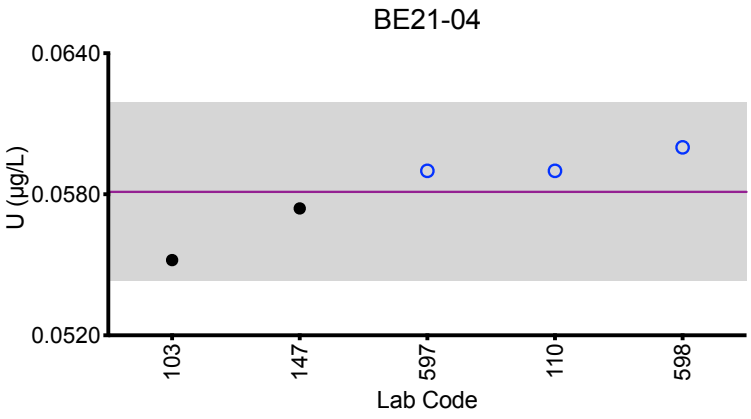
Results for Event #1, 2021: Summary Figures

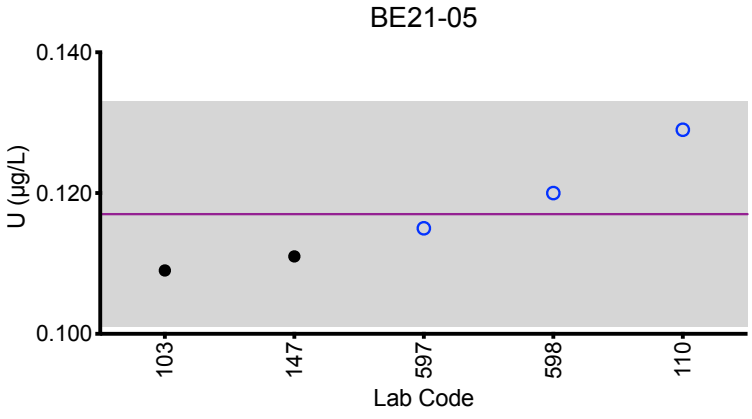
Whole Blood U











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
110	ICP-MS	1.72	3.76	0.520	2.77	5.28
147	ICP-MS	1.62	3.37	<1.17	2.22	4.34
597	ICP-MS/MS	1.62	3.76	0.348	2.80	4.75
598	ICP-MS	1.52	2.97	0.41	2.26	3.26
Summary Statistics						
		BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Arithmetic Mean ($\bar{x}$)		1.62	3.5	0.43	2.5	4.4
Arithmetic SD (s)		0.08	0.4	0.09	0.3	0.9
Arithmetic RSD (%)		4.9	11	21	12	20
Number of Sample Measurements (N)		4	4	3	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)

Lab Code	Method	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
110	ICP-MS	2.97	0.95	0.91	2.68	2.81
597	ICP-MS/MS	2.82	0.989	0.670	2.73	2.63
598	ICP-MS	2.62	0.86	0.9	2.55	2.53

Summary Statistics

	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
Arithmetic Mean ($\bar{x}$)	2.8	0.93	0.83	2.65	2.66
Arithmetic SD (s)	0.2	0.07	0.14	0.09	0.14
Arithmetic RSD (%)	6.4	7.5	17	3.4	5.3
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
110	ICP-MS	1140	2360	2640	1980	873
147	ICP-MS	1093	2300	2522	1944	864
597	ICP-MS/MS	1000	2200	1400	1800	815
598	ICP-MS	855	1860	1990	1560	677
Summary Statistics						
		BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Arithmetic Mean ($\bar{x}$)		1020	2180	2100	1820	810
Arithmetic SD (s)		130	220	600	190	90
Arithmetic RSD (%)		13	10	29	10	11
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)

Lab Code	Method	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
110	DRC/CC-ICP-MS	10.4	*3.05	7.78	6.05	10.2
147	ICP-MS	8.93	1.17	6.34	5.93	8.46
597	ICP-MS/MS	8.43	1.62	3.59	5.82	8.39
598	ICP-MS	7.85	1.29	4.87	5.73	7.26

Summary Statistics

	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
Arithmetic Mean ($\bar{x}$)	8.9	1.4	5.6	5.88	8.6
Arithmetic SD (s)	1.1	0.2	1.8	0.14	1.2
Arithmetic RSD (%)	12	17	32	2.4	14
Number of Sample Measurements (N)	4	3	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Pt (µg/L)

Lab Code	Method	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
110	ICP-MS	0.754	0.236	3.95	2.07	5.50
293	DRC/CC-ICP-MS	0.8	0.33	3.59	1.85	5.52
598	ICP-MS	0.78	0.3	3.94	1.94	5.44

Summary Statistics

	BE21-01	BE21-02	BE21-03	BE21-04	BE21-05
Arithmetic Mean ($\bar{x}$)	0.78	0.29	3.8	1.95	5.49
Arithmetic SD (s)	0.02	0.05	0.2	0.11	0.04
Arithmetic RSD (%)	3.0	17	5.5	5.6	0.73
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
110	ICP-MS	1.31	0.492	5.16	1.70	3.47
147	ICP-MS	1.13	<0.368	4.44	1.67	3.22
597	ICP-MS/MS	1.08	0.219	2.66	1.65	3.14
598	ICP-MS	1.08	<0.2	4.48	1.8	3.3

Summary Statistics					
	BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Arithmetic Mean ($\bar{x}$)	1.15	NA	4.2	1.71	3.28
Arithmetic SD (s)	0.11	NA	1.1	0.07	0.14
Arithmetic RSD (%)	9.6	NA	26	4.1	4.3
Number of Sample Measurements (N)	4	NA	4	4	4

*Denotes a statistical Outlier.

Statistical data was not calculated for BE21-02 based on a lack of consensus among participating labs.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
103	ICP-MS/MS	38.1	20.0	10.9	38.7	38.1
147	ICP-MS	36.6	19.2	21.1	37.6	37.6
597	ICP-MS/MS	34.5	18.2	12.6	34.8	34.0
Summary Statistics						
		BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Arithmetic Mean ($\bar{x}$)		36.4	19.1	15	37.0	36.6
Arithmetic SD (s)		1.8	0.9	5	2.0	2.2
Arithmetic RSD (%)		4.9	4.7	33	5.4	6.1
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
110	DRC/CC-ICP-MS	0.575	1.46	0.074	3.45	0.377
147	DRC/CC-ICP-MS	0.541	1.46	0.0364	3.96	0.311
597	ICP-MS/MS	0.540	1.30	0.037	3.47	0.29
598	DRC/CC-ICP-MS	0.38	1.16	<0.2	3.09	0.22
Summary Statistics						
		BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Arithmetic Mean ($\bar{x}$)		0.51	1.35	0.05	3.5	0.30
Arithmetic SD (s)		0.09	0.14	0.02	0.4	0.06
Arithmetic RSD (%)		18	10	45	11	20
Number of Sample Measurements (N)		4	4	3	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
110	ICP-MS	0.213	0.677	3.03	4.42	1.22
200	ICP-MS	0.2	0.7	2.9	4.2	1.2
597	ICP-MS/MS	0.158	0.593	1.51	3.81	1.05
598	ICP-MS	0.36	0.76	3.12	4.79	1.24
Summary Statistics						
		BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Arithmetic Mean ($\bar{x}$)		0.23	0.68	2.6	4.3	1.18
Arithmetic SD (s)		0.09	0.07	0.8	0.4	0.09
Arithmetic RSD (%)		39	10	31	9.3	7.6
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
110	ICP-MS	5540	5250	5640	6970	7490
147	ICP-MS	5706	5484	5804	7647	8105
597	ICP-MS/MS	5460	5350	3360	7270	7730
598	ICP-MS	4560	4450	4620	6350	6500
Summary Statistics						
		BE21-01	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
Arithmetic Mean ($\bar{x}$)		5300	5100	4900	7100	7500
Arithmetic SD (s)		500	500	1100	500	700
Arithmetic RSD (%)		9.4	9.8	22	7.8	9.3
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Additional Elements in Whole blood

Whole blood Ag (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
147	ICP-MS	<0.302	<0.302	<0.302	<0.302	<0.302
Whole blood Al (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
147	ICP-MS	<5.13	<5.13	<5.13	<5.13	5.86
597	ICP-MS/MS	4.15	3.31	9.06	7.43	1.85
Whole blood Bi (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
147	ICP-MS	<0.0334	<0.0334	<0.0334	<0.0334	<0.0334
597	ICP-MS/MS	<0.05	<0.05	<0.05	<0.05	<0.05
Whole blood I (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
147	ICP-MS	30.8	39.4	35.8	30.3	30.4
Whole blood Li (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
147	ICP-MS	0.902	0.243	0.266	0.902	0.916
Whole blood Mg (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
597	ICP-MS/MS	31000	32000	19000	30000	29800
Whole blood Te (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
147	ICP-MS	<0.117	<0.117	<0.117	<0.117	<0.117
Whole blood Th (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
147	ICP-MS	<0.0278	<0.0278	<0.0278	<0.0278	<0.0278
597	ICP-MS/MS	0.09	<0.03	<0.03	<0.03	<0.03
Whole blood Ti (µg/L)						
Lab Code	**Method**	**BE21-01**	**BE21-02**	**BE21-03**	**BE21-04**	**BE21-05**
597	ICP-MS/MS	4.54	7.65	7.20	5.67	8.40

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Event #1, 2021

Trace Elements in Urine

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NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #1, 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), 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

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

Additional Elements

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

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

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Results for Event #1, 2021: Summary Statistics

	Urine As (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	5.56	21.3	36.2	57.3	1.2
Upper Limit	11.56	27.3	43.4	68.8	7.2
Lower Limit	0.00	15.3	29.0	45.8	0.0
Robust SD (s*)	0.25	1.0	2.0	2.5	0.3
Robust RSD (%)	4.5	4.7	5.5	4.4	29
Number of Sample Measurements (N)	14	16	16	16	9
Standard Uncertainty (*u*)	0.08	0.3	0.6	0.8	NA

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.

An arithmetic mean, SD, RSD and n are provided for sample UE21-05.

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Results for Event #1, 2021:
Performance of Participating Laboratories

Urine As (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**5.56**	**21.3**	**36.2**	**57.3**	**1.2**
103	ICP-MS/MS	5.30	20.9	35.8	55.9	1.01
107	DRC/CC-ICP-MS	5.06	17.99	31.58	49.29	0.87
110	DRC/CC-ICP-MS	5.76	21.3	38.8	59.0	1.29
116	ICP-MS/MS	<5.00	20.5	35.0	54.7	<5.00
147	ICP-MS	5.80	21.7	36.0	57.9	<4.04
220	DRC/CC-ICP-MS	5.84	23.1	38.2	60.7	<2
264	ICP-MS	5.44	21.46	34.91	56.67	1.24
293	DRC/CC-ICP-MS	5.53	21.64	36.35	57.1	1.04
324	ICP-MS	5.656607	22.17313	36.90281	58.70335	1.084243
399	DRC/CC-ICP-MS	5.40	21.0	36.9	58.5	<2.00
597	ICP-MS/MS	5.38	21.1	36.7	57.8	1.29
598	DRC/CC-ICP-MS	5.58	19.9	34.1	54.6	0.84
605	ICP-MS	5.66	24.4	39.0	61.6	<2.00
606	ICP-MS/MS	5.42	21.1	36.4	57.0	<2.00
676	DRC/CC-ICP-MS	5.92	22.5	38.1	58.9	1.98
686	DRC/CC-ICP-MS	<6	19.2	31.7	50.9	<6

Based on the grading criteria for As 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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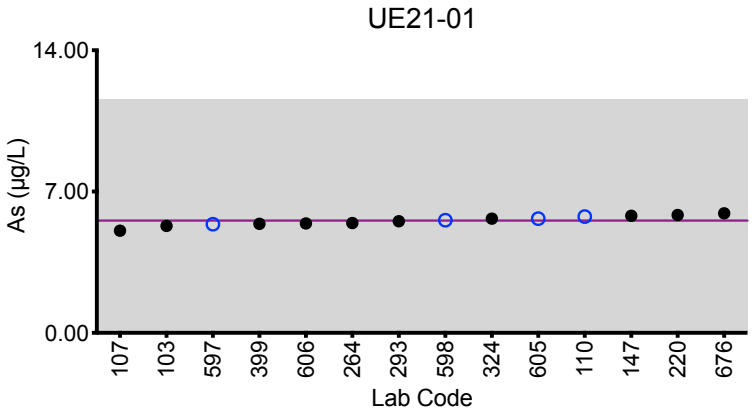
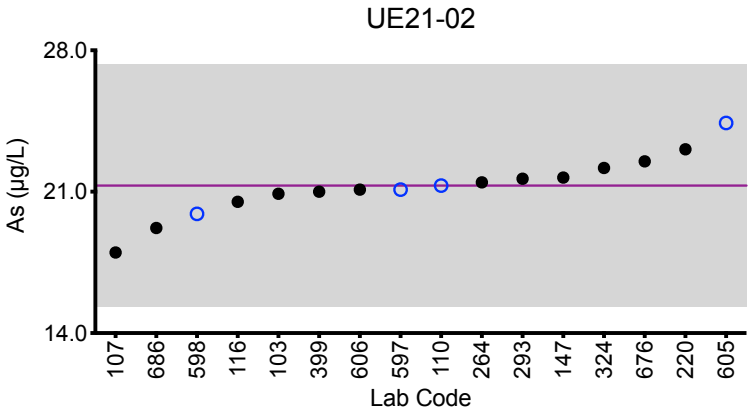
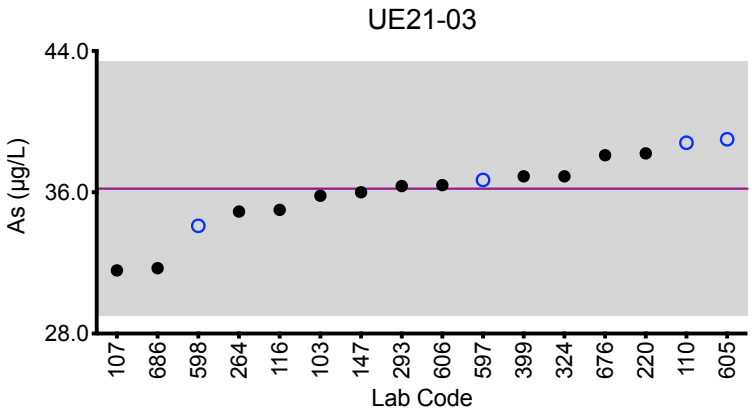
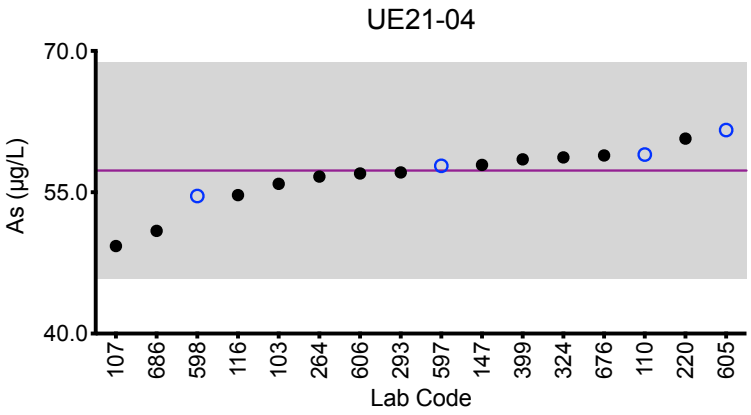
Results for Event #1, 2021: Summary Figures

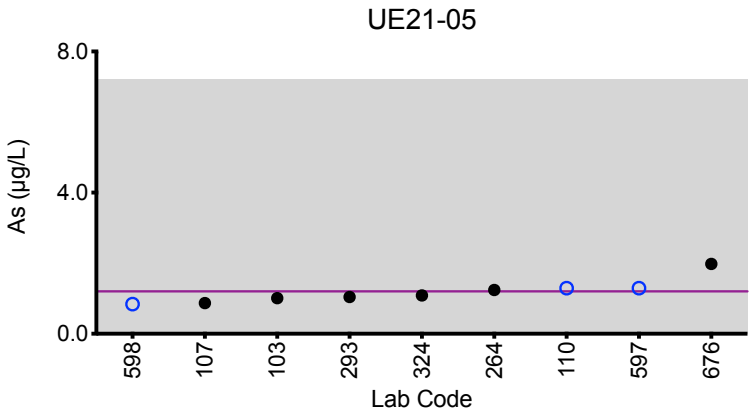
Urine As











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 #1, 2021: Summary Statistics

	Urine Ba (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	1.50	0.72	1.31	5.48	2.44
Upper Limit	2.50	1.72	2.31	6.58	3.44
Lower Limit	0.50	0.00	0.31	4.38	1.44
Robust SD (s*)	0.09	0.06	0.07	0.28	0.17
Robust RSD (%)	5.9	8.3	5.3	5.1	7.1
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (*u*)	0.03	0.02	0.02	0.09	0.06

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

Urine Ba (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**1.50**	**0.72**	**1.31**	**5.48**	**2.44**
107	ICP-MS	1.483	0.713	1.219	4.932	2.389
110	ICP-MS	1.54	0.70	1.32	5.68	2.47
116	ICP-MS/MS	1.66	0.804	1.35	5.65	2.53
147	ICP-MS	1.47	0.694	1.90	5.45	3.05
220	ICP-MS	1.56	0.77	1.35	5.74	2.57
264	ICP-MS	1.41	0.69	1.14	4.68	2.17
293	ICP-MS	1.41	0.64	1.16	5.21	2.22
399	ICP-MS/MS	1.49	0.731	1.31	5.65	2.45
597	ICP-MS/MS	1.46	0.577	1.39	5.36	2.56
598	ICP-MS	1.46	0.66	1.3	5.38	2.26
605	ICP-MS	1.52	0.96	1.29	5.75	2.51
606	ICP-MS/MS	1.33	0.689	1.07	5.50	2.36
607	ICP-MS	1.61	0.842	1.45	5.89	2.66
676	ICP-MS	1.44	0.749	1.34	5.23	2.3
686	ICP-MS	1.91	0.742	1.30	5.54	2.44

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

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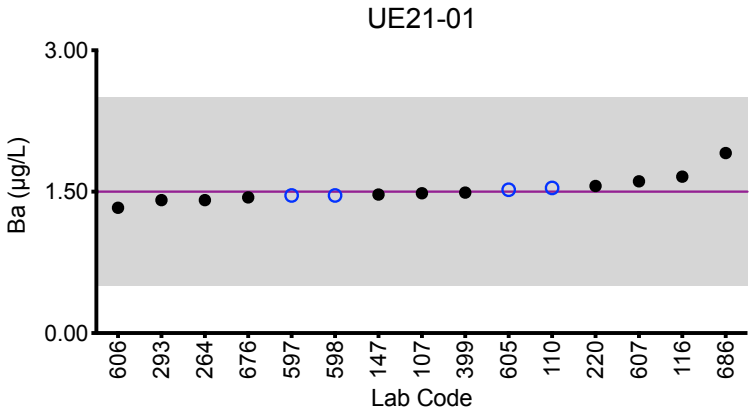
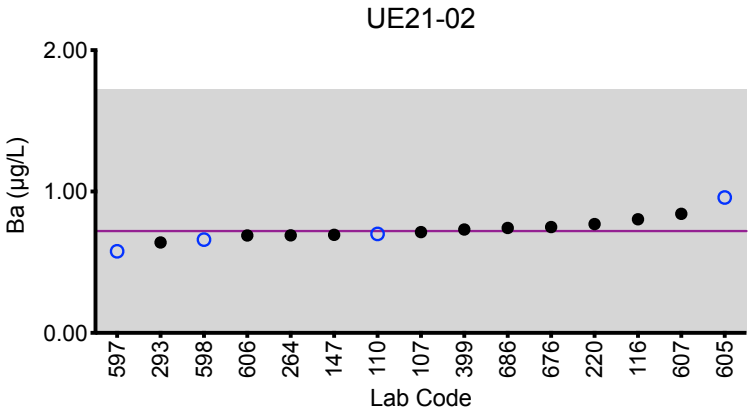
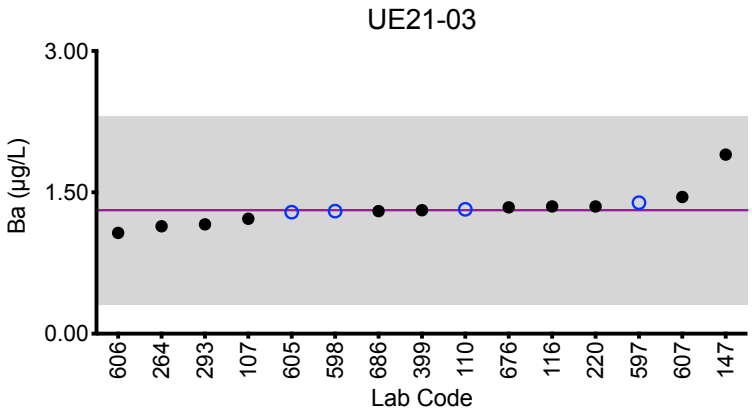
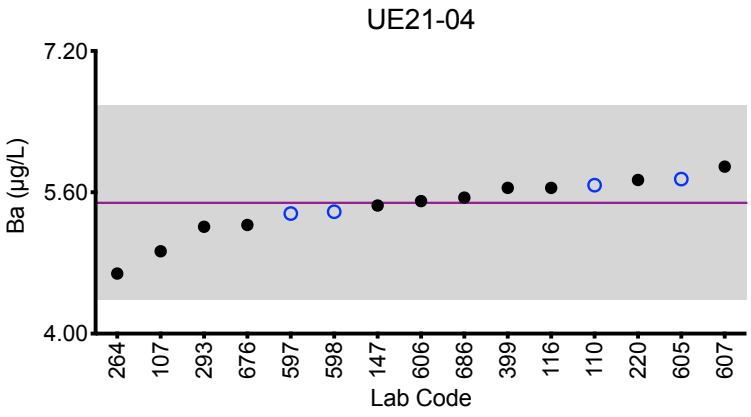
Results for Event #1, 2021: Summary Figures

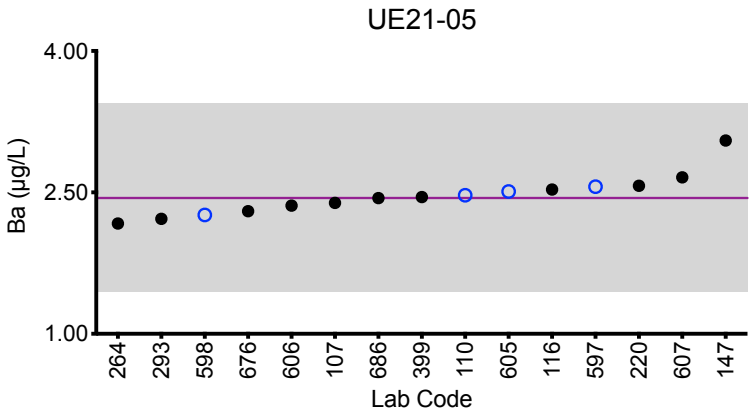
Urine Ba











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 #1, 2021: Summary Statistics

	Urine Be (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	3.55	4.64	0.67	1.85	1.06
Upper Limit	4.55	5.64	1.67	2.85	2.06
Lower Limit	2.55	3.64	0.00	0.85	0.06
Robust SD (s*)	0.09	0.23	0.03	0.09	0.07
Robust RSD (%)	2.5	5.0	4.6	4.9	6.6
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.03	0.08	0.01	0.03	0.02

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**3.55**	**4.64**	**0.67**	**1.85**	**1.06**
107	ICP-MS	3.353	4.560	0.619	1.696	0.964
110	ICP-MS	3.55	4.40	0.694	1.91	1.09
116	ICP-MS/MS	3.32	4.48	0.685	1.68	1.01
147	ICP-MS	3.84	4.86	0.679	2.02	1.17
220	ICP-MS	3.56	4.65	0.67	1.86	1.10
264	ICP-MS	3.50	4.83	0.67	1.89	1.10
293	ICP-MS	3.51	4.62	0.62	1.84	1.02
399	ICP-MS/MS	3.56	4.74	0.666	1.90	1.08
597	ICP-MS/MS	3.61	4.37	0.549	1.73	0.944
598	ICP-MS	3.54	4.04	0.68	1.82	0.99
605	ICP-MS	3.67	4.85	0.673	1.92	1.08
607	ICP-MS	3.55	4.71	0.712	1.83	1.07
676	ICP-MS	3.47	4.6	0.608	1.81	1.04
686	ICP-MS	3.94	4.98	0.704	2.02	1.15

Based on the grading criteria for Be 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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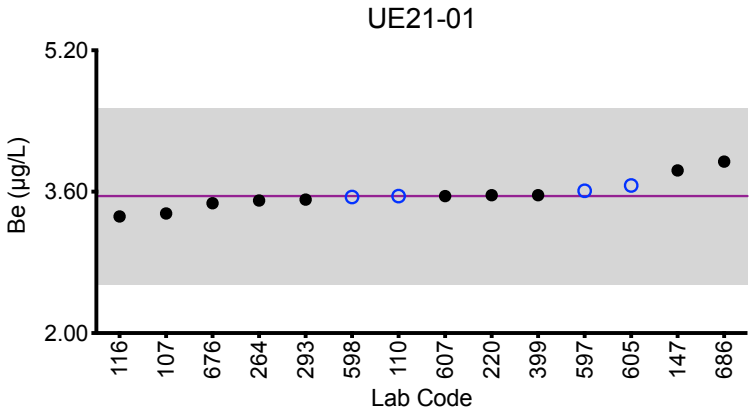
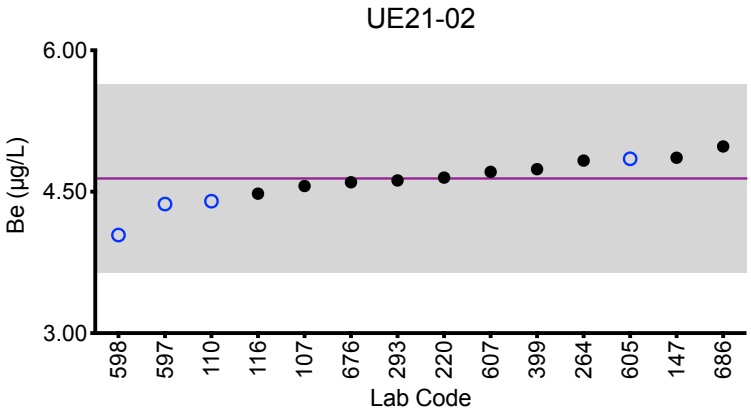
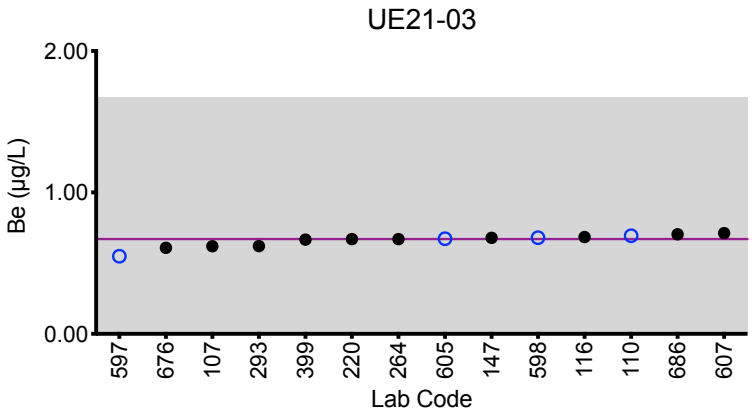
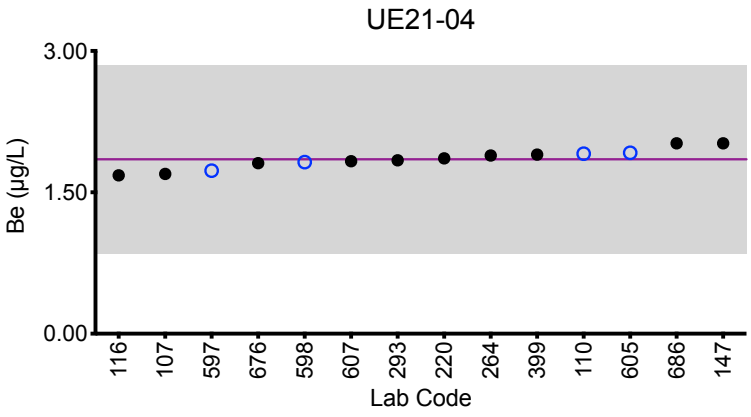
Results for Event #1, 2021: Summary Figures

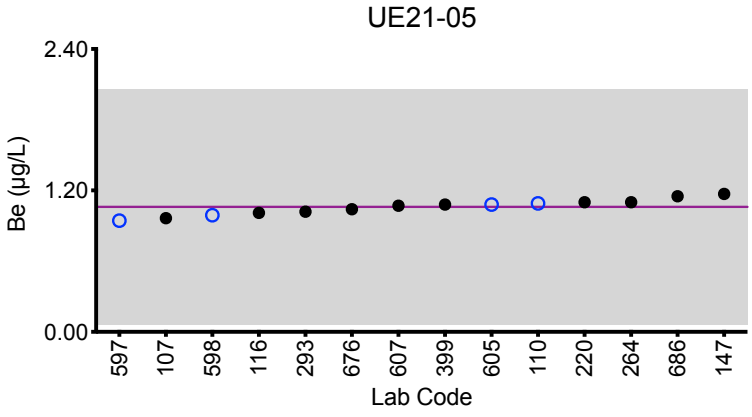
Urine Be











Legend:

o C/HHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #1, 2021: Summary Statistics

	Urine Cd (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	1.98	0.348	1.23	0.81	4.36
Upper Limit	2.98	1.348	2.23	1.81	5.36
Lower Limit	0.98	0.000	0.23	0.00	3.36
Robust SD (s*)	0.11	0.029	0.05	0.06	0.24
Robust RSD (%)	5.6	8.3	4.1	7.4	5.5
Number of Sample Measurements (N)	17	16	17	16	17
Standard Uncertainty (*u*)	0.03	0.009	0.02	0.02	0.07

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**1.98**	**0.348**	**1.23**	**0.81**	**4.36**
103	ICP-MS/MS	2.06	0.370	1.26	0.845	4.69
107	DRC/CC-ICP-MS	2.060	0.369	1.165	0.697	4.080
110	ICP-MS	2.07	0.351	1.27	0.779	4.33
116	ICP-MS/MS	1.83	0.353	1.32	0.784	4.33
147	ICP-MS	2.09	0.359	1.24	0.759	4.54
220	ICP-MS	1.90	0.34	1.20	0.89	4.28
264	ICP-MS	2.10	0.32	1.24	0.80	4.69
293	DRC/CC-ICP-MS	1.87	0.32	1.19	0.77	4.19
324	ICP-MS	1.964428	<1	1.300675	<1	4.32126
399	DRC/CC-ICP-MS	1.95	0.360	1.20	0.781	4.39
597	ICP-MS/MS	1.97	0.298	1.20	0.80	4.44
598	DRC/CC-ICP-MS	1.94	0.41	1.17	0.91	4.11
605	ICP-MS	2.03	0.345	1.26	0.814	4.69
606	ICP-MS/MS	1.91	0.318	1.18	0.762	4.06
607	ICP-MS	1.80	0.459	1.16	0.931	4.16
676	DRC/CC-ICP-MS	2	0.279	1.25	0.834	4.28
686	ICP-MS	2.17	0.353	1.27	0.865	4.53

Based on the grading criteria for Cd in Urine, 100% 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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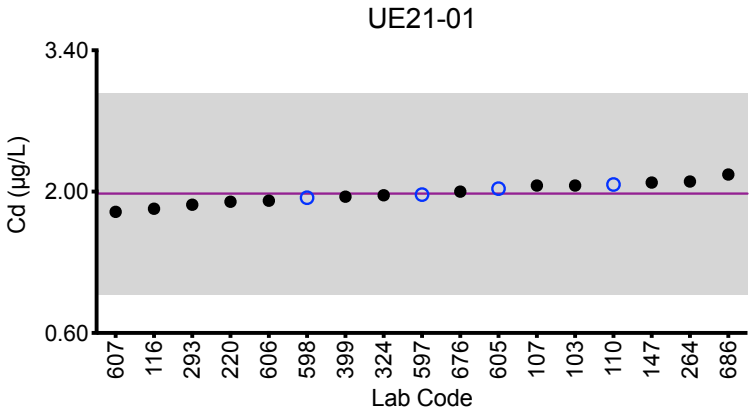
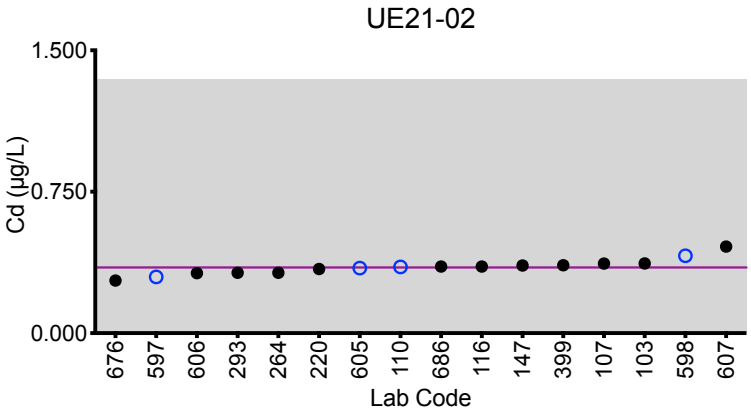
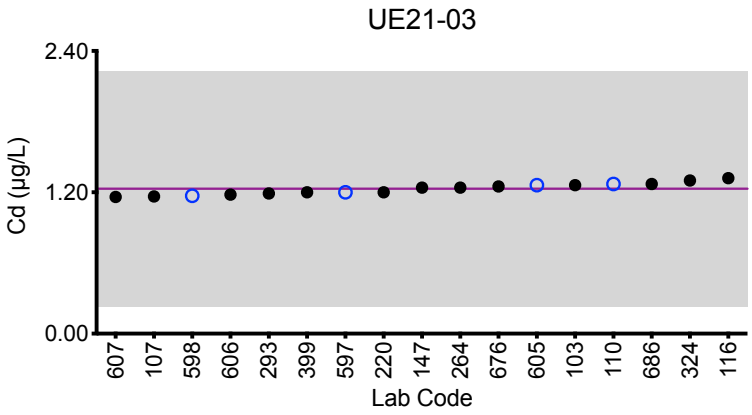
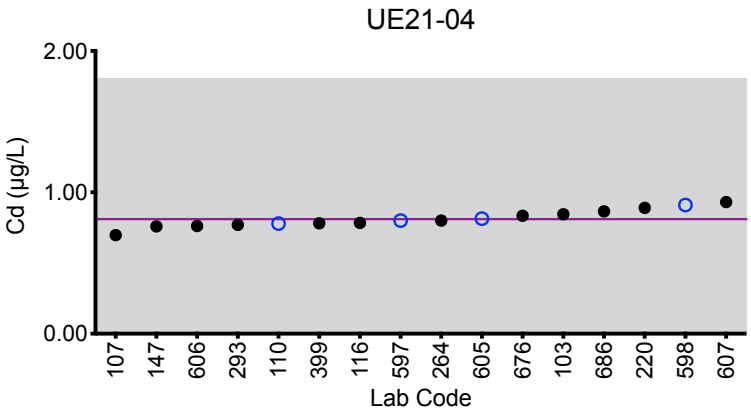
Results for Event #1, 2021: Summary Figures

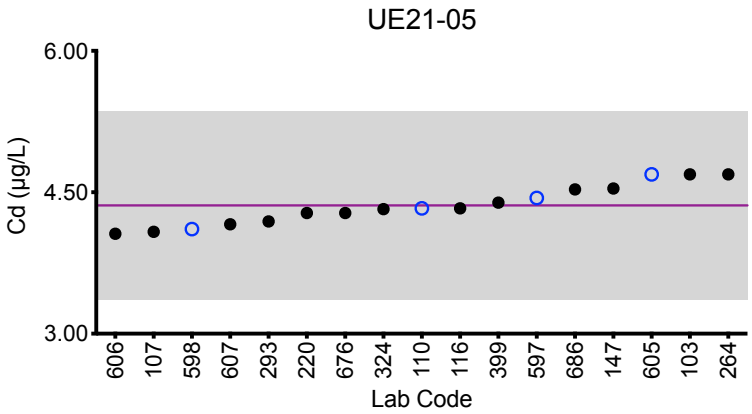
Urine Cd











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 #1, 2021: Summary Statistics

	Urine Co (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	5.98	0.62	2.53	0.84	4.23
Upper Limit	7.48	2.12	4.03	2.34	5.73
Lower Limit	4.48	0.00	1.03	0.00	2.73
Robust SD (s*)	0.23	0.05	0.09	0.06	0.14
Robust RSD (%)	3.8	8.1	3.6	7.1	3.3
Number of Sample Measurements (N)	14	13	14	13	14
Standard Uncertainty (*u*)	0.08	0.02	0.03	0.02	0.05

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

Urine Co (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**5.98**	**0.62**	**2.53**	**0.84**	**4.23**
103	ICP-MS/MS	5.98	0.614	2.54	0.827	4.20
107	ICP-MS	4.966	0.615	2.435	0.778	4.014
110	ICP-MS	6.39	0.648	2.75	0.940	4.51
147	ICP-MS	5.86	0.631	2.45	0.866	4.28
220	ICP-MS	6.20	0.71	2.66	0.90	4.42
264	ICP-MS	5.84	0.57	2.49	0.79	4.17
293	DRC/CC-ICP-MS	6	0.58	2.52	0.81	4.21
324	ICP-MS	6.182333	<1	2.698532	<1	4.491041
399	DRC/CC-ICP-MS	5.89	0.611	2.48	0.820	4.19
597	ICP-MS/MS	6.00	0.565	2.48	0.82	4.18
598	ICP-MS	5.45	0.56	2.39	0.77	3.78
605	ICP-MS	6.30	0.679	2.72	0.906	4.52
606	ICP-MS/MS	6.00	0.652	2.52	0.819	4.12
676	ICP-MS	5.85	0.698	2.56	0.896	4.28

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

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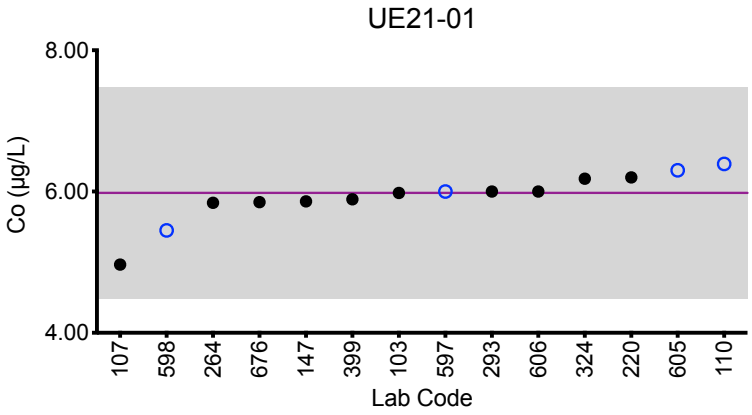
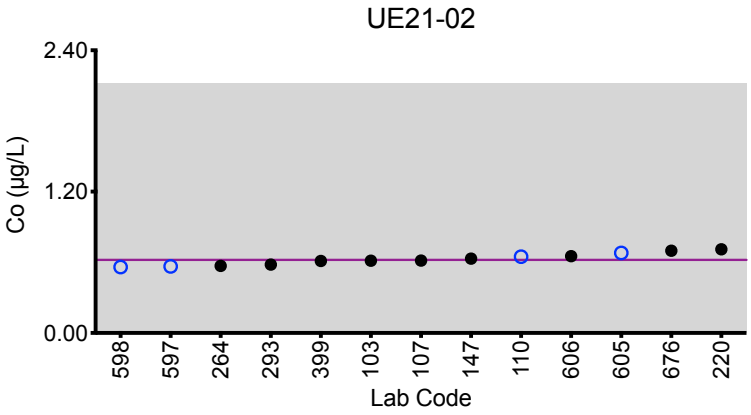
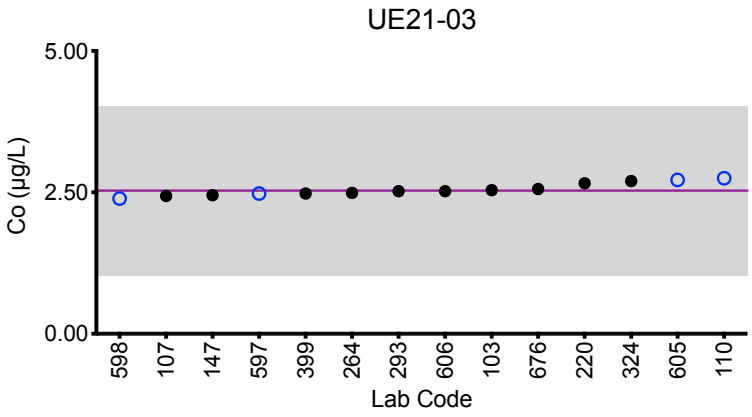
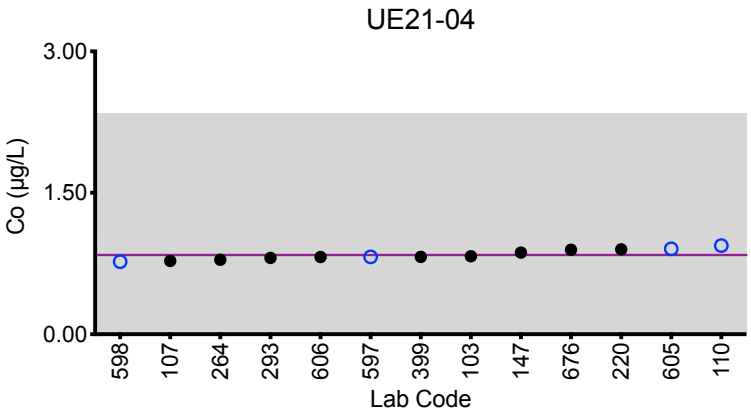
Results for Event #1, 2021: Summary Figures

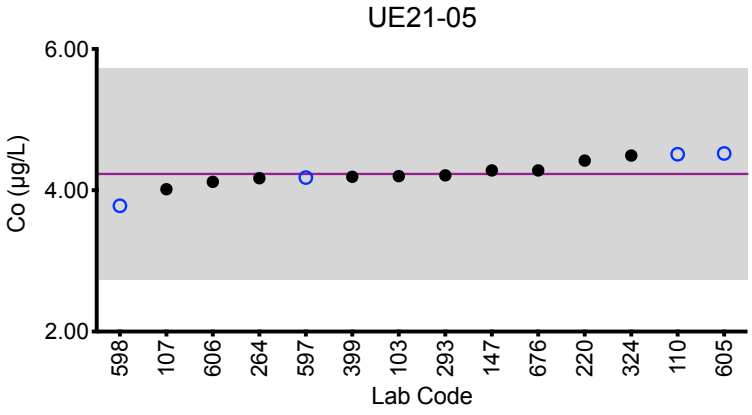
Urine Co











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 #1, 2021: Summary Statistics

	Urine Cr (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	0.69	0.36	1.86	4.3	2.07
Upper Limit	3.69	3.36	4.86	7.3	5.07
Lower Limit	0.00	0.00	0.00	1.3	0.00
Robust SD (s*)	0.10	0.10	0.19	0.4	0.25
Robust RSD (%)	14	28	10	8.1	12
Number of Sample Measurements (N)	9	8	11	11	11
Standard Uncertainty (*u*)	NA	NA	0.07	0.1	0.09

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 UE21-01 and UE21-02.

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Results for Event #1, 2021:
Performance of Participating Laboratories

		Urine Cr (µg/L)				
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**0.69**	**0.36**	**1.86**	**4.3**	**2.07**
103	ICP-MS/MS	<1.00	<1.00	1.85	4.09	1.81
107	DRC/CC-ICP-MS	0.65	0.28	1.64	3.81	1.89
110	DRC/CC-ICP-MS	0.82	0.57	2.11	4.81	2.50
116	ICP-MS/MS	0.631	0.355	1.83	4.35	1.85
147	DRC/CC-ICP-MS	0.650	0.346	1.63	4.07	1.97
264	ICP-MS	0.65	0.38	1.85	4.14	2.23
293	DRC/CC-ICP-MS	0.61	0.32	1.84	4.29	1.97
324	ICP-MS	<1	<1	2.175526	4.846963	3.086187
597	ICP-MS/MS	0.878	*0.756	1.92	4.48	2.48
598	DRC/CC-ICP-MS	0.57	0.23	1.68	4.12	1.83
605	ICP-MS	0.712	0.374	1.98	4.70	2.28

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

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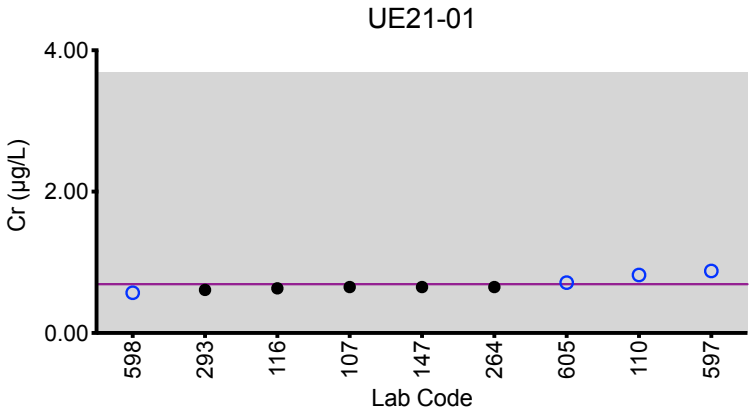
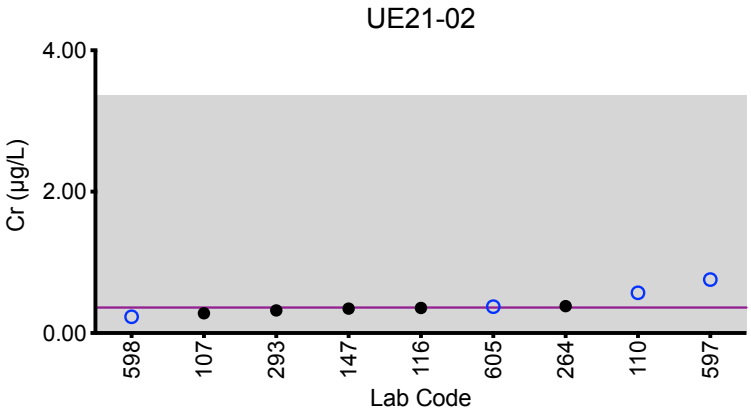
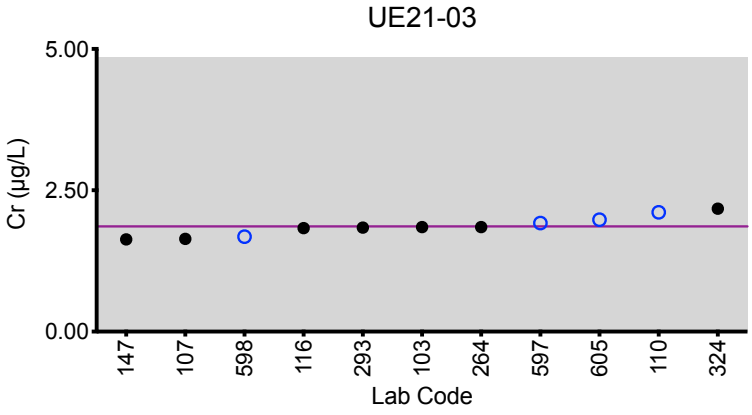
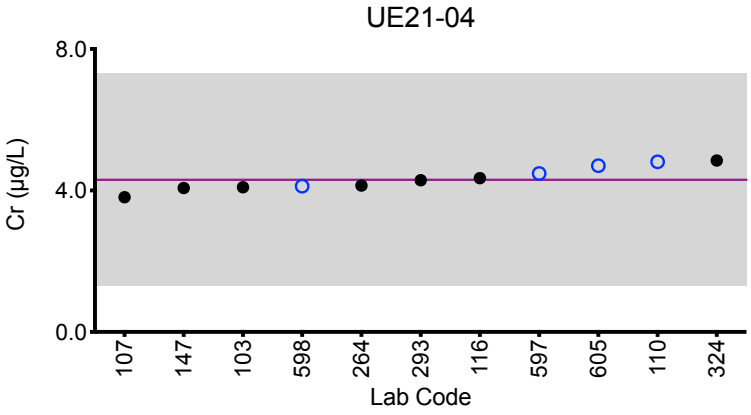
Results for Event #1, 2021: Summary Figures

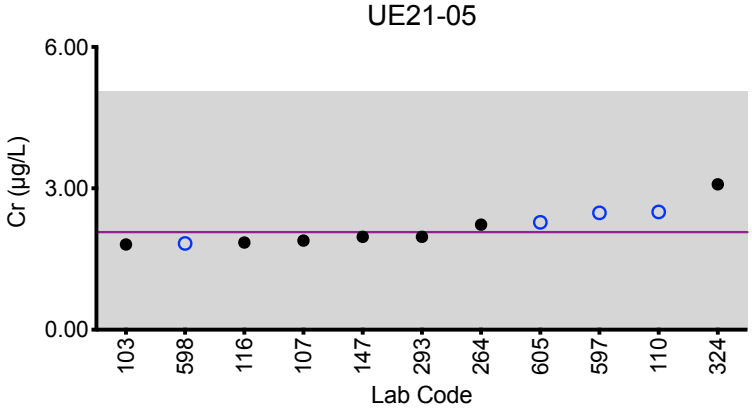
Urine Cr











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 #1, 2021: Summary Statistics

	Urine Hg (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	21.1	NA	3.9	1.08	9.5
Upper Limit	27.4	NA	6.9	4.08	12.5
Lower Limit	14.8	NA	0.9	0.00	6.5
Robust SD (s*)	2.2	NA	0.5	0.26	0.9
Robust RSD (%)	10	NA	13	24	9.5
Number of Sample Measurements (N)	12	NA	12	12	12
Standard Uncertainty (*u*)	0.8	NA	0.2	0.09	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.

Statistical data was not calculated for UE21-02 based on a lack of consensus among participating labs. Consequently, a target value cannot be assigned with confidence.

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Results for Event #1, 2021:
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**21.1**	**NA**	**3.9**	**1.08**	**9.5**
103	ICP-MS/MS	21.9	0.486	4.16	1.20	10.1
107	DRC/CC-ICP-MS	17.61	0.16	3.14	0.89	9.65
110	ICP-MS	21.5	1.03	4.01	1.36	10.0
116	ICP-MS/MS	22.1	<0.50	3.52	0.707	7.31
147	ICP-MS	20.7	0.491	3.79	1.09	8.87
264	ICP-MS	34.65 ↑	1.23	6.09	1.77	15.43 ↑
293	DRC/CC-ICP-MS	20.97	0.37	3.86	1.11	9.61
597	ICP-MS/MS	18.65	0.344	3.53	1.06	8.12
598	ICP-MS	20.1	0.4	3.92	1.04	9.28
605	ICP-MS	22.8	<1.00	4.08	1.01	10.2
606	ICP-MS/MS	23.3	<1.00	4.42	1.36	9.66
676	ICP-MS	18.5	<0.122	2.95	0.513	7.7

Based on the grading criteria for Hg in Urine, 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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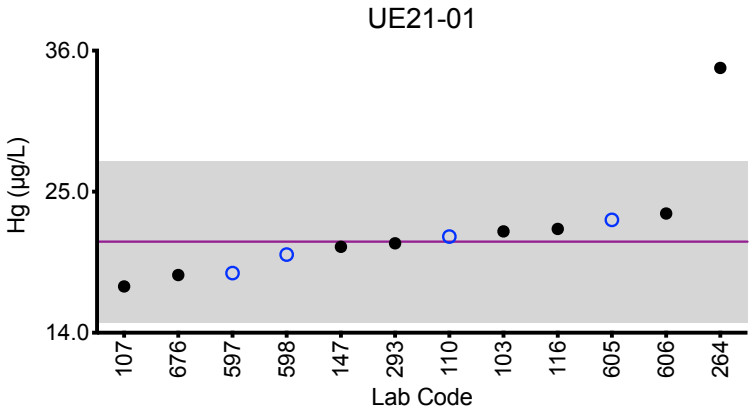
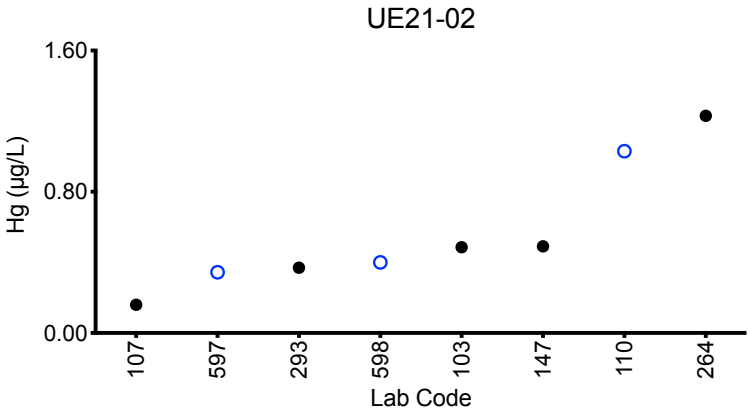
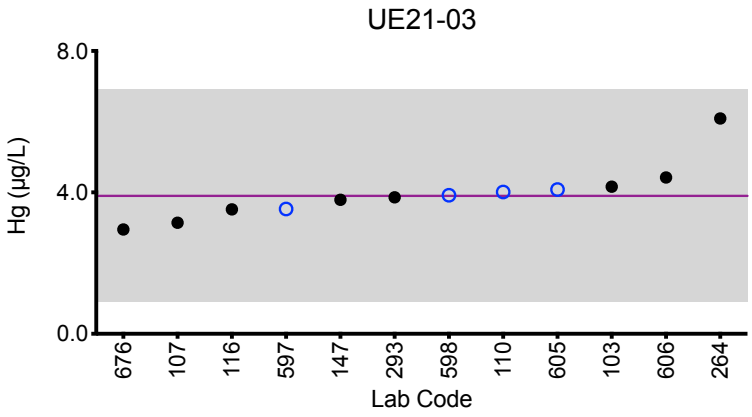
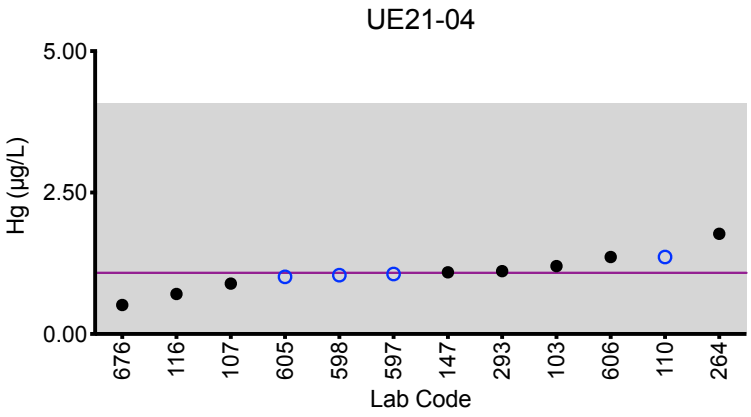
Results for Event #1, 2021: Summary Figures

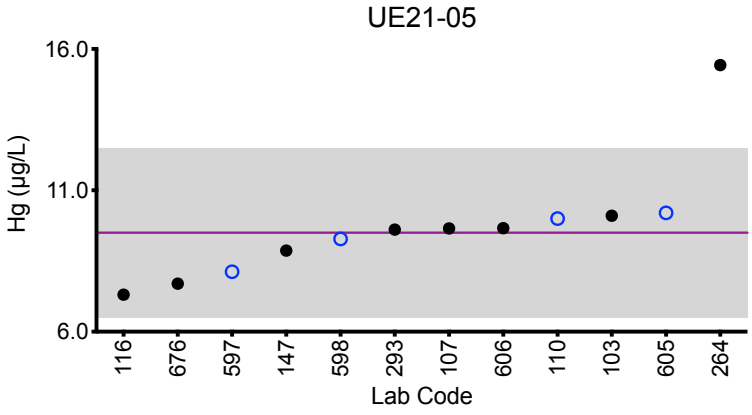
Urine Hg











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 #1, 2021: Summary Statistics

	Urine Mn (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	0.45	1.07	2.11	4.9	6.49
Upper Limit	1.00	1.62	2.66	6.1	8.11
Lower Limit	0.00	0.52	1.56	3.7	4.87
Robust SD (s*)	0.03	0.06	0.11	0.3	0.29
Robust RSD (%)	7.1	5.6	5.2	6.1	4.5
Number of Sample Measurements (N)	14	15	15	15	15
Standard Uncertainty (*u*)	0.01	0.02	0.04	0.1	0.09

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**0.45**	**1.07**	**2.11**	**4.9**	**6.49**
103	ICP-MS/MS	0.408	1.04	2.08	4.94	6.45
107	DRC/CC-ICP-MS	0.447	1.011	1.968	4.573	5.942
110	DRC/CC-ICP-MS	0.457	0.984	2.12	5.08	6.64
116	ICP-MS/MS	0.449	1.03	2.13	4.74	5.87
147	DRC/CC-ICP-MS	0.434	1.02	1.96	4.78	6.32
220	DRC/CC-ICP-MS	0.53	1.03	2.07	5.04	6.66
264	ICP-MS	0.44	1.05	2.00	4.48	6.32
293	DRC/CC-ICP-MS	0.47	1.08	2.17	5.08	6.51
324	ICP-MS	<1	1.225786	2.213037	5.283083	7.129364
399	DRC/CC-ICP-MS	0.410	1.02	2.04	4.89	6.49
597	ICP-MS/MS	0.295	1.11	2.22	4.62	6.54
598	ICP-MS	0.46	1.14	2.11	4.86	6.17
605	ICP-MS	0.441	1.35	2.30	5.57	7.40
606	ICP-MS/MS	0.501	1.13	2.03	4.78	6.42
676	DRC/CC-ICP-MS	0.567	1.3	2.24	5.27	6.94

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

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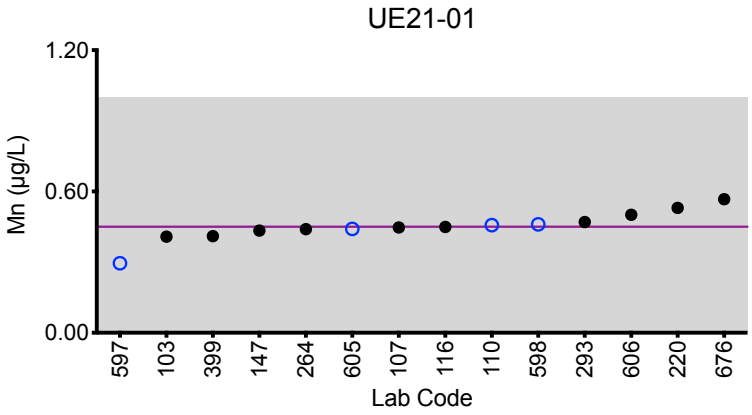
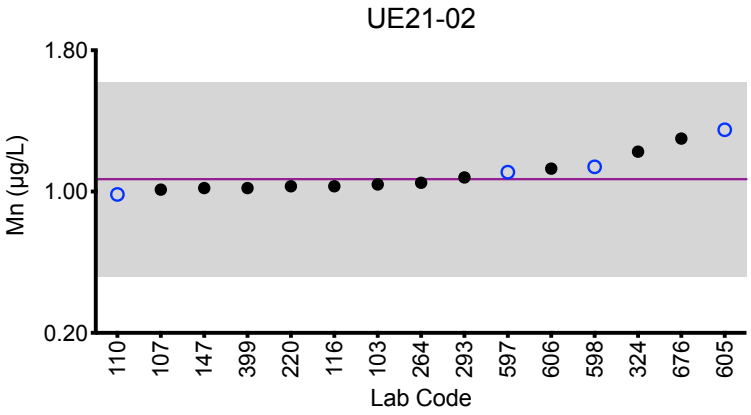
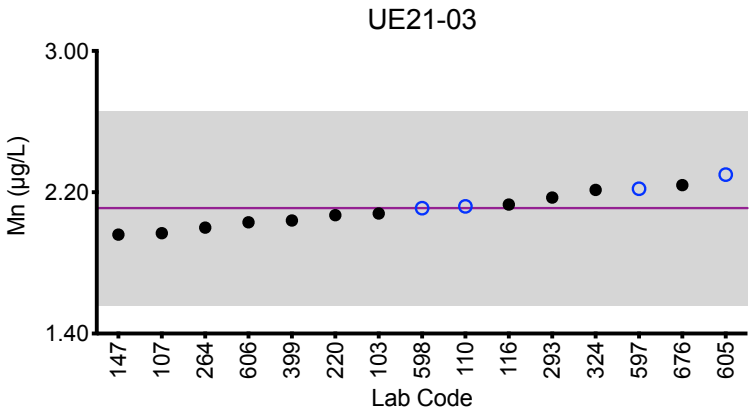
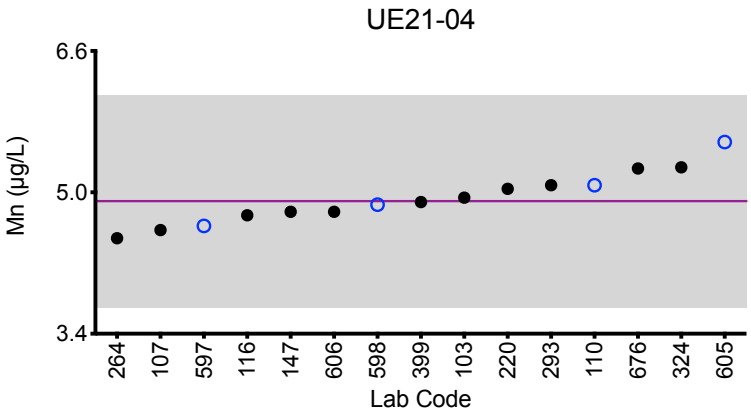
Results for Event #1, 2021: Summary Figures

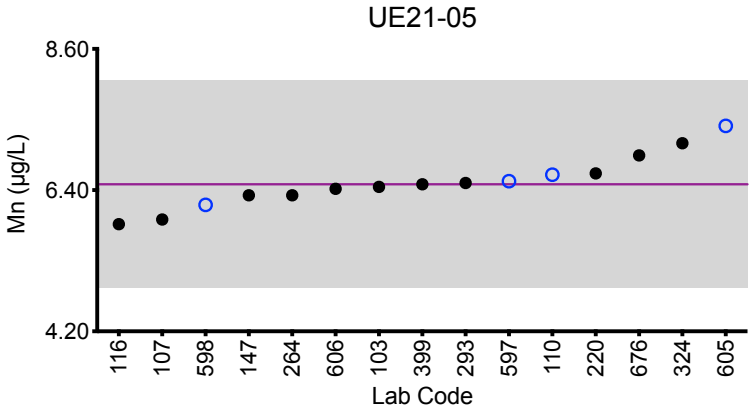
Urine Mn











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 #1, 2021: Summary Statistics

	Urine Pb (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	0.63	2.72	7.70	1.09	3.73
Upper Limit	1.63	3.72	9.24	2.09	4.73
Lower Limit	0.00	1.72	6.16	0.09	2.73
Robust SD (s*)	0.05	0.13	0.21	0.06	0.14
Robust RSD (%)	7.9	4.8	2.7	5.5	3.8
Number of Sample Measurements (N)	16	17	17	17	17
Standard Uncertainty (*u*)	0.02	0.04	0.06	0.02	0.04

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

		Urine Pb (µg/L)				
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**0.63**	**2.72**	**7.70**	**1.09**	**3.73**
103	ICP-MS/MS	0.627	2.77	7.84	1.12	3.81
107	ICP-MS	0.644	2.750	7.579	1.064	3.558
110	ICP-MS	0.63	2.59	7.75	1.12	3.79
116	ICP-MS/MS	0.664	2.85	7.73	1.08	3.73
147	ICP-MS	0.555	2.67	7.69	1.03	3.81
220	ICP-MS	0.58	2.58	7.61	1.05	3.62
264	ICP-MS	0.73	2.86	8.03	1.16	3.96
293	DRC/CC-ICP-MS	0.61	2.78	7.67	1.08	3.68
324	ICP-MS	<1	2.730071	7.587115	1.099425	3.707863
399	ICP-MS/MS	0.641	2.67	7.52	1.07	3.62
597	ICP-MS/MS	0.572	2.59	7.68	0.983	3.81
598	ICP-MS	0.6	2.43	7.18	1.01	3.31
605	ICP-MS	0.656	2.99	8.45	1.19	4.00
606	ICP-MS/MS	0.617	2.70	7.55	1.08	3.67
607	ICP-MS	0.668	2.82	7.97	1.19	3.94
676	ICP-MS	0.569	2.66	7.42	1.08	3.54
686	ICP-MS	0.818	2.82	7.95	1.20	3.80

Based on the grading criteria for Pb in Urine, 100% 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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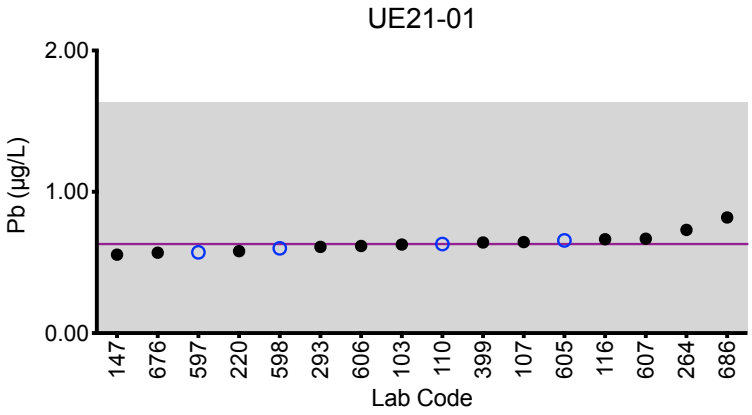
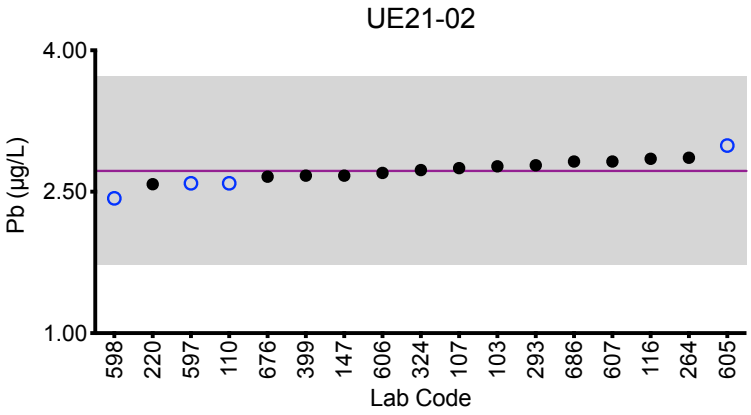
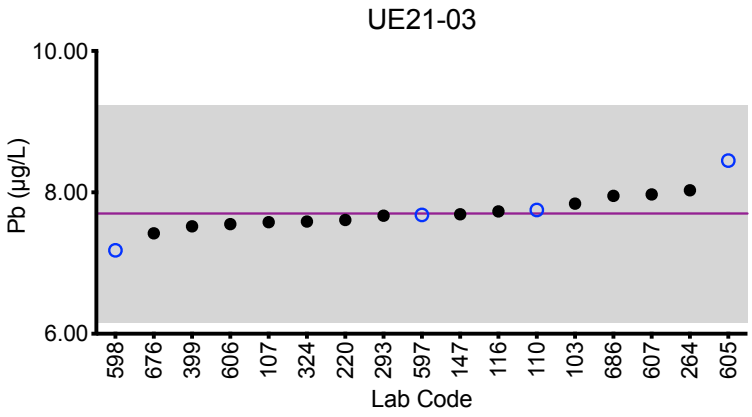
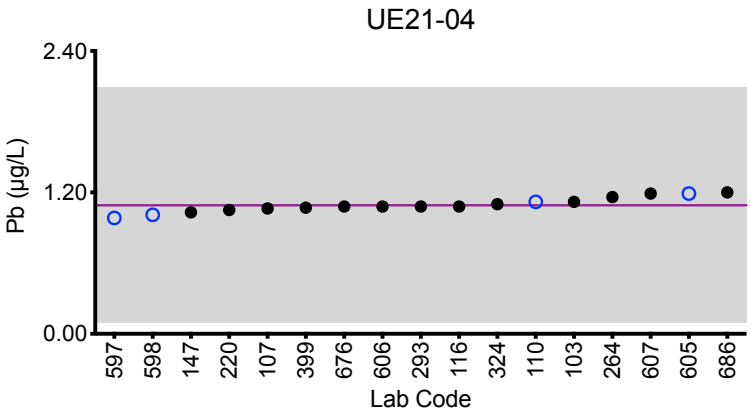
Results for Event #1, 2021: Summary Figures

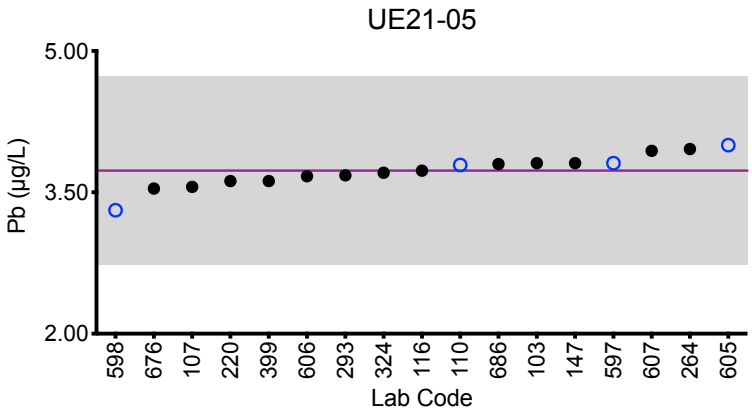
Urine Pb











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 #1, 2021: Summary Statistics

Urine Tl (µg/L)					
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	0.70	2.18	0.279	1.40	4.48
Upper Limit	0.90	2.62	0.479	1.68	5.38
Lower Limit	0.50	1.74	0.079	1.12	3.58
Robust SD (s*)	0.04	0.07	0.010	0.05	0.21
Robust RSD (%)	5.0	3.2	3.6	3.6	4.7
Number of Sample Measurements (N)	16	16	16	16	16
Standard Uncertainty (*u*)	0.01	0.02	0.003	0.02	0.07

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

Urine Tl (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**0.70**	**2.18**	**0.279**	**1.40**	**4.48**
103	ICP-MS/MS	0.689	2.21	0.285	1.45	4.63
107	ICP-MS	0.620	2.171	0.270	1.307	4.212
110	ICP-MS	0.704	2.00	0.280	1.37	4.43
116	ICP-MS/MS	0.683	2.18	0.279	1.38	4.39
147	ICP-MS	0.711	2.19	0.276	1.46	4.64
220	ICP-MS	0.69	2.10	0.27	1.39	4.42
264	ICP-MS	0.73	2.26	0.30	1.47	4.72
293	DRC/CC-ICP-MS	0.71	2.13	0.27	1.37	4.3
399	ICP-MS/MS	0.686	2.14	0.265	1.40	4.79
597	ICP-MS/MS	0.631	2.13	0.27	1.35	4.35
598	ICP-MS	0.87	2.3	0.33	1.36	4.06
605	ICP-MS	0.756	2.31	0.278	1.46	4.67
606	ICP-MS/MS	0.698	2.16	0.273	1.36	4.44
607	ICP-MS	0.736	2.26	0.287	1.44	4.61
676	ICP-MS	0.677	2.17	0.287	1.38	4.37
686	ICP-MS	0.770	2.21	0.280	1.43	4.59

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

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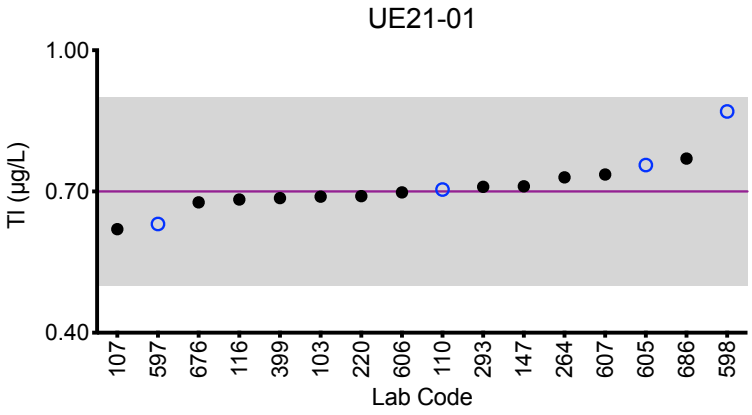
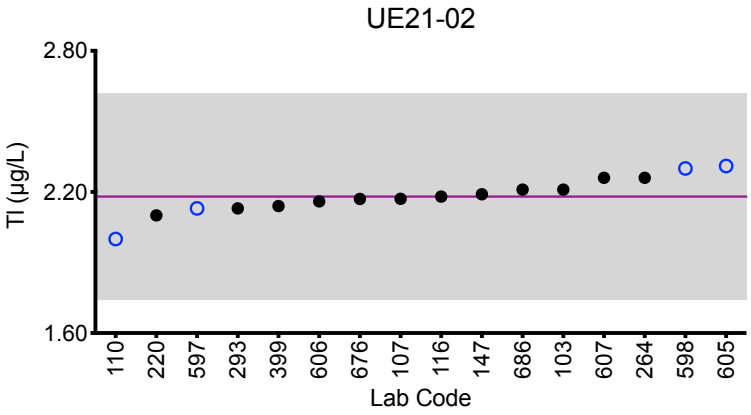
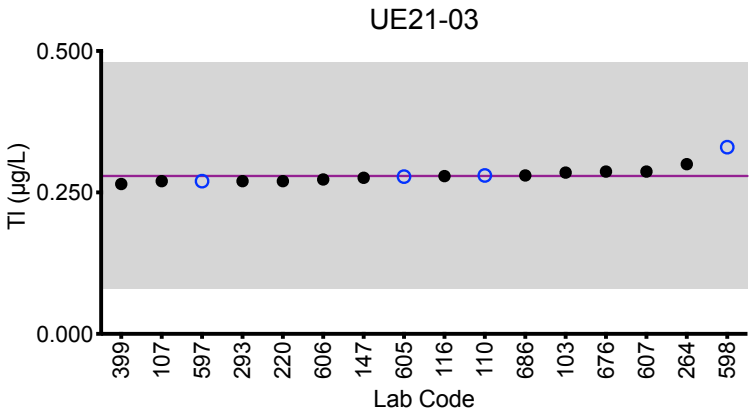
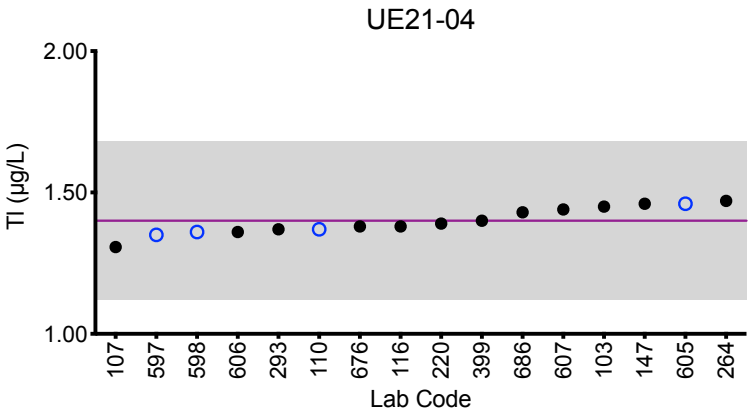
Results for Event #1, 2021: Summary Figures

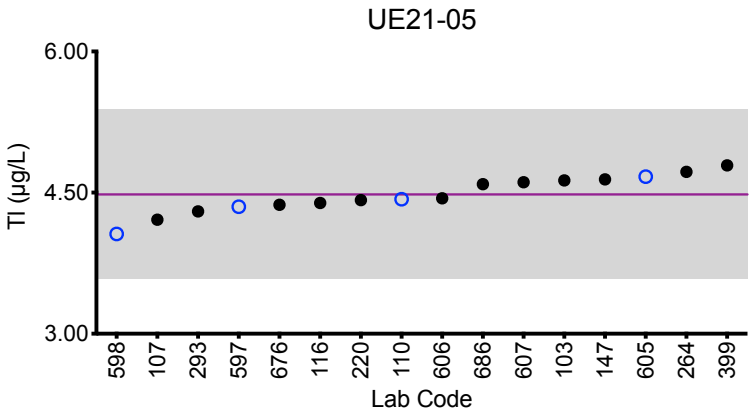
Urine Tl











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 #1, 2021: Summary Statistics

	Urine U (µg/L)				
	UE21-01	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
Target (Robust Mean (x*))	0.0062	0.0105	0.120	0.0254	0.156
Upper Limit	0.0362	0.0405	0.150	0.0554	0.187
Lower Limit	0.0000	0.0000	0.090	0.0000	0.125
Robust SD (s*)	0.0015	0.0015	0.004	0.0014	0.008
Robust RSD (%)	24	14	3.3	5.5	5.1
Number of Sample Measurements (N)	11	13	16	14	16
Standard Uncertainty (*u*)	0.0006	0.0005	0.001	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 #1, 2021:
Performance of Participating Laboratories

Urine U (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
	Target	**0.0062**	**0.0105**	**0.120**	**0.0254**	**0.156**
103	ICP-MS/MS	<0.0200	<0.0200	0.118	<0.0200	0.155
107	ICP-MS	0.0086	0.0115	0.1188	0.0250	0.1439
110	ICP-MS	0.0055	0.0099	0.124	0.0254	0.161
116	ICP-MS/MS	<0.0150	0.0221	0.130	0.0311	0.155
147	ICP-MS	<0.00762	0.00907	0.123	0.0267	0.164
220	ICP-MS	0.005	0.011	0.117	0.026	0.144
264	ICP-MS	0.01	0.01	0.12	0.03	0.16
324	ICP-MS	0.005	0.009	0.112	0.023	0.142
399	ICP-MS/MS	0.006	0.008	0.121	0.025	0.155
597	ICP-MS/MS	<0.03	<0.03	0.111	<0.03	0.168
598	ICP-MS	0.005	0.01	0.12	0.025	0.16
605	ICP-MS	0.006	0.015	0.128	0.028	0.162
606	ICP-MS/MS	0.005	0.010	0.120	0.025	0.155
607	ICP-MS	0.00868	0.0130	0.124	0.0248	0.158
676	ICP-MS	0.006	0.011	0.121	0.024	0.155
686	ICP-MS	<0.015	<0.015	0.118	0.0241	0.153

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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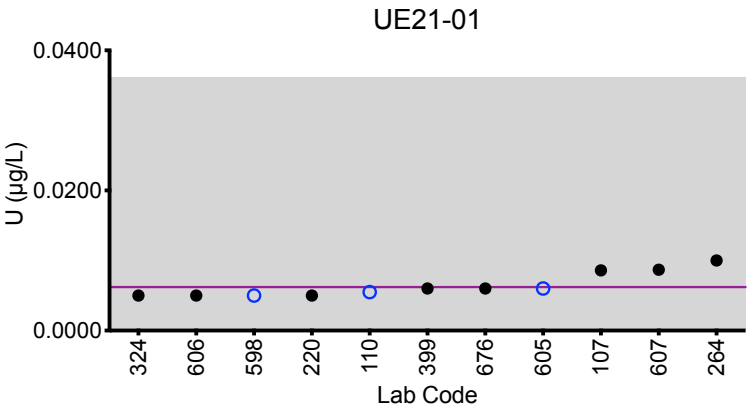
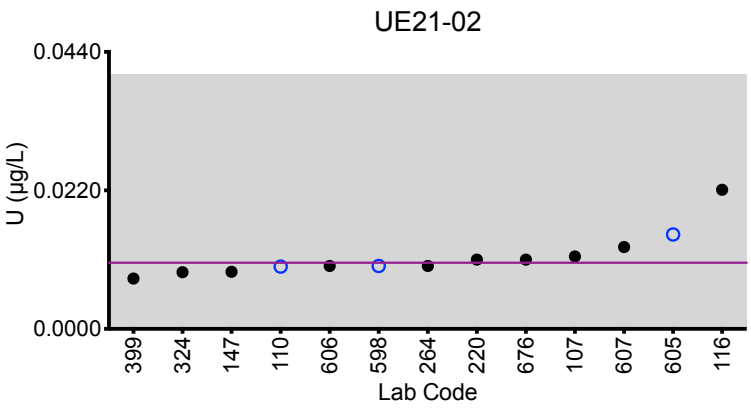
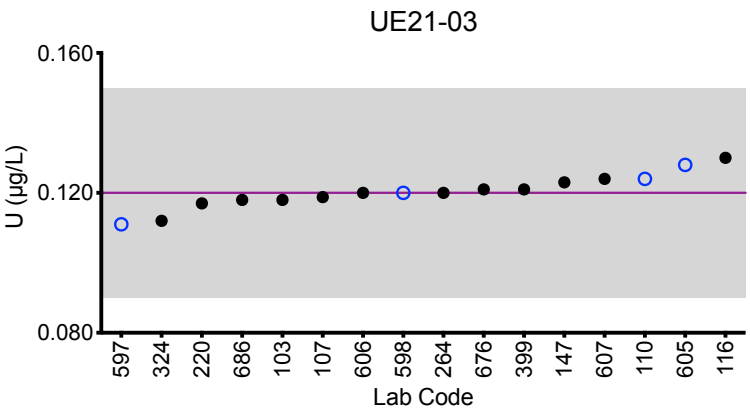
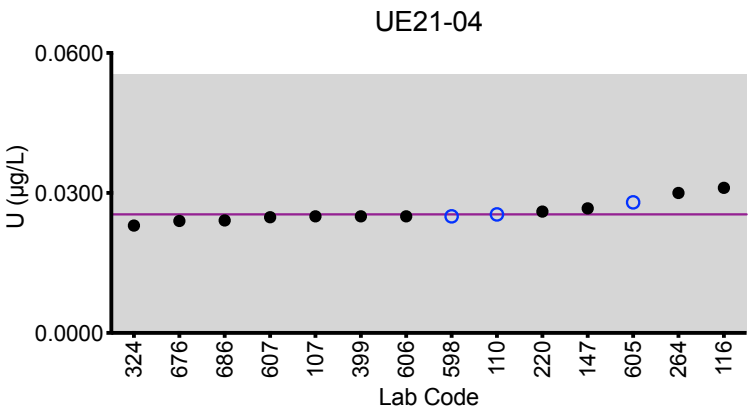
Results for Event #1, 2021: Summary Figures

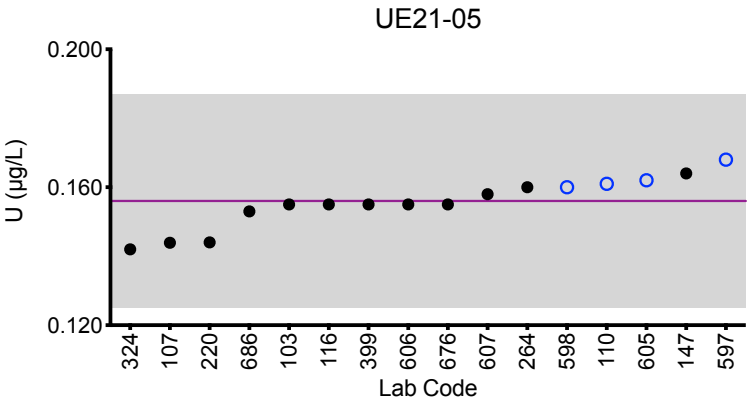
Urine U











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 #1, 2021:
Laboratory Data and Summary Statistics

Urine Al (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
147	ICP-MS	11.5	<9.44	21.8	16.0	<9.44
264	ICP-MS	12.47	8.56	19.57	16.53	8.57
293	DRC/CC-ICP-MS	16.67	10.75	22.04	18.28	6.99
324	ICP-MS	12.18967	13.35864	18.12911	16.22974	9.114767
597	ICP-MS/MS	16.9	14.5	22.1	14.8	8.26

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Arithmetic Mean ($\bar{x}$)	13.9	11.8	20.7	16.4	8.2
Arithmetic SD (s)	2.6	2.7	1.8	1.3	0.9
Arithmetic RSD (%)	19	23	8.7	7.9	11
Number of Sample Measurements (N)	5	4	5	5	4

*Denotes a statistical Outlier.

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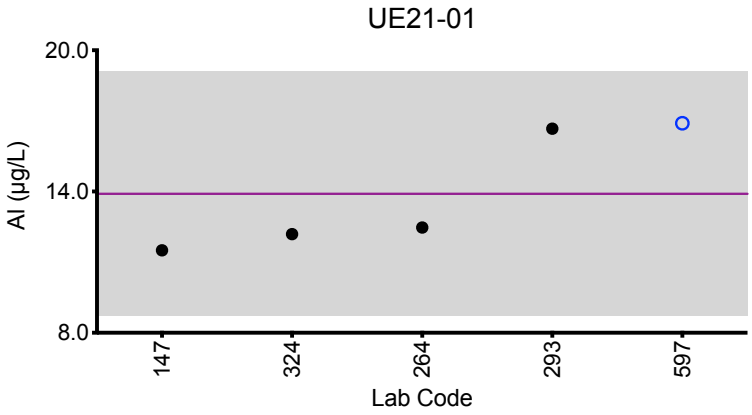
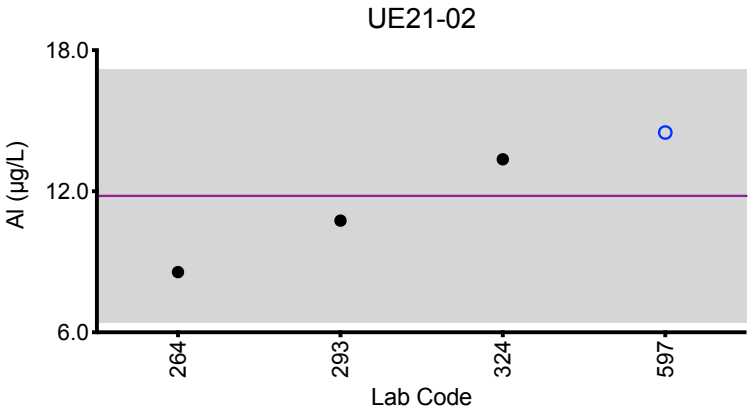
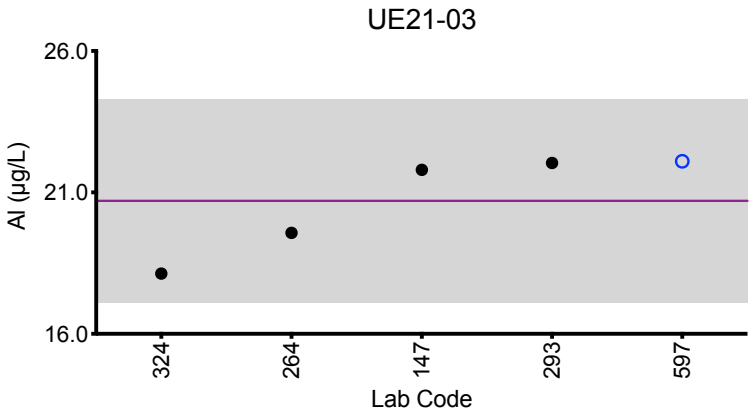
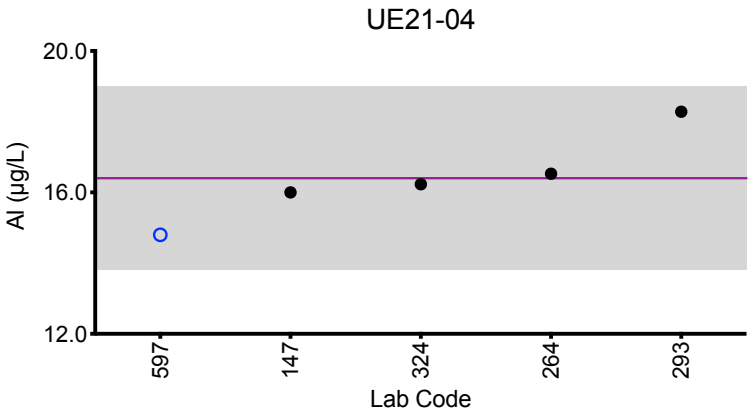
Results for Event #1, 2021: Summary Figures

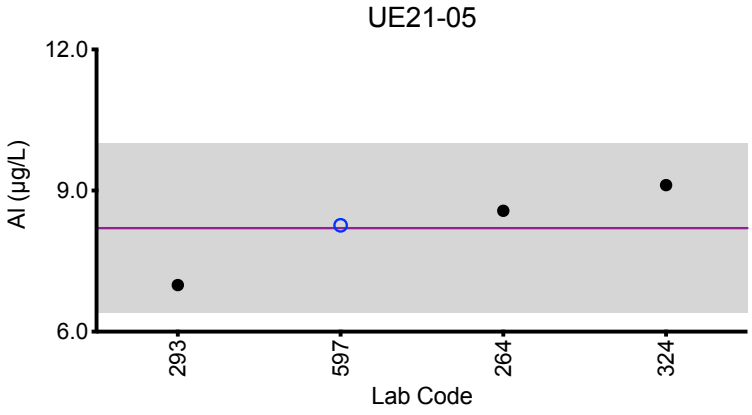
Urine Al











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 #1, 2021:
Laboratory Data and Summary Statistics

Urine Cs (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
107	ICP-MS	12.68	1.41	9.27	1.50	6.71
110	ICP-MS	13.4	1.43	10.2	1.71	7.84
147	ICP-MS	12.5	1.38	9.52	1.65	7.27
220	ICP-MS	13.2	1.46	10.1	1.71	7.72
264	ICP-MS	2.82	1.40	9.30	1.52	7.06
399	ICP-MS/MS	13.0	1.46	10.2	1.71	7.65
597	ICP-MS/MS	12.8	1.67	10.13	1.75	7.50
598	ICP-MS	12.6	1.37	9.56	1.59	7.13
605	ICP-MS	13.6	1.50	10.6	1.64	7.89
606	ICP-MS/MS	12.8	1.39	9.85	1.59	7.40
676	ICP-MS	12.6	1.39	9.64	1.59	7.16

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Robust Mean (x*)	12.8	1.42	9.8	1.63	7.4
Robust SD (s*)	0.4	0.05	0.5	0.09	0.4
Robust RSD (%)	2.7	3.5	5.1	5.5	5.4
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.1	0.02	0.2	0.04	0.1

*Denotes a statistical Outlier.

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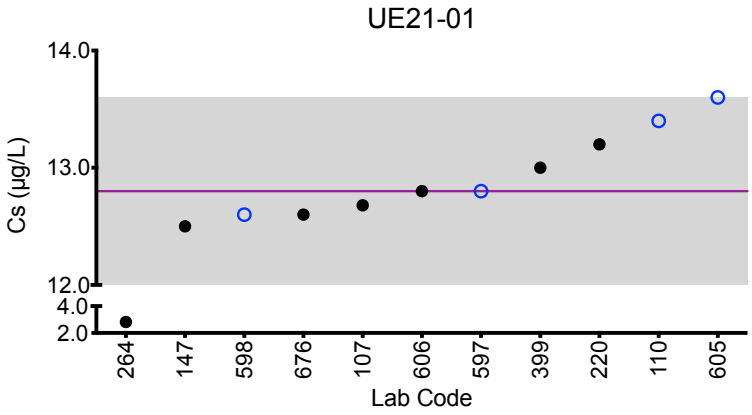
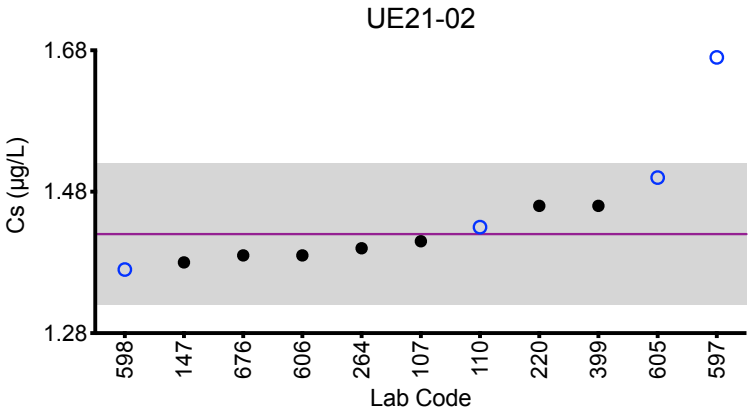
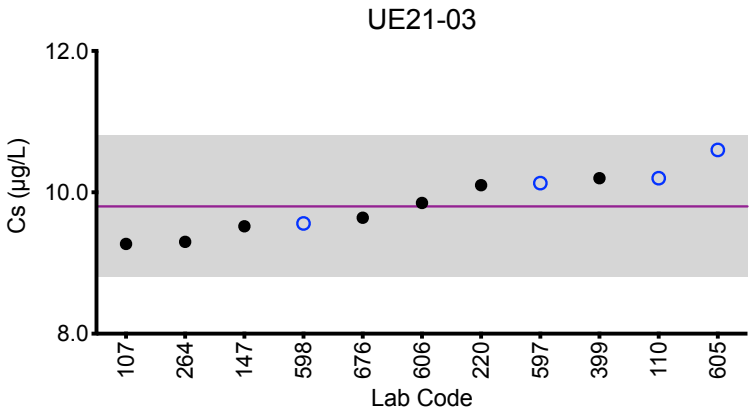
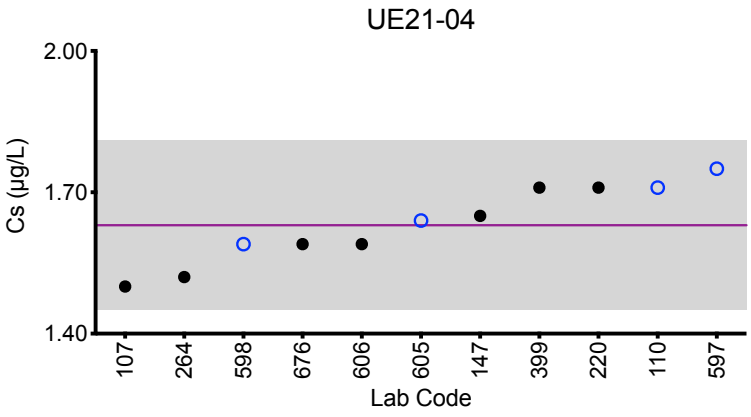
Results for Event #1, 2021: Summary Figures

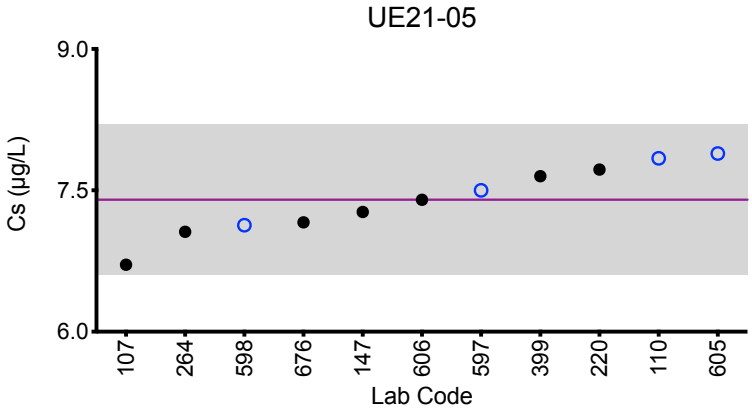
Urine Cs











Legend:
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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
110	ICP-MS	69.6	*6.98	11.1	25.0	*6.60
116	ICP-MS/MS	62.3	<5.00	8.28	19.3	<5.00
147	ICP-MS	70.5	*10.4	11.1	28.4	*10.0
264	ICP-MS	64.02	3.47	8.03	20.56	3.10
293	DRC/CC-ICP-MS	62.94	3.18	8.26	20.98	2.54
324	ICP-MS	61.72058	3.58523	8.255056	21.08232	2.646743
597	ICP-MS/MS	63.4	3.02	8.11	21.6	2.43
598	ICP-MS	55	3.3	7.45	18.8	2.76

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Arithmetic Mean ($\bar{x}$)	64	3.3	8.8	22.0	2.7
Arithmetic SD (s)	5	0.3	1.4	3.2	0.3
Arithmetic RSD (%)	7.8	6.8	16	15	9.5
Number of Sample Measurements (N)	8	5	8	8	5

*Denotes a statistical Outlier.

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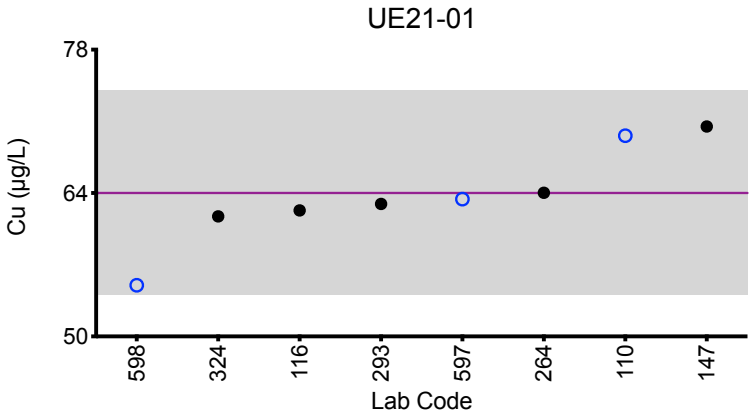
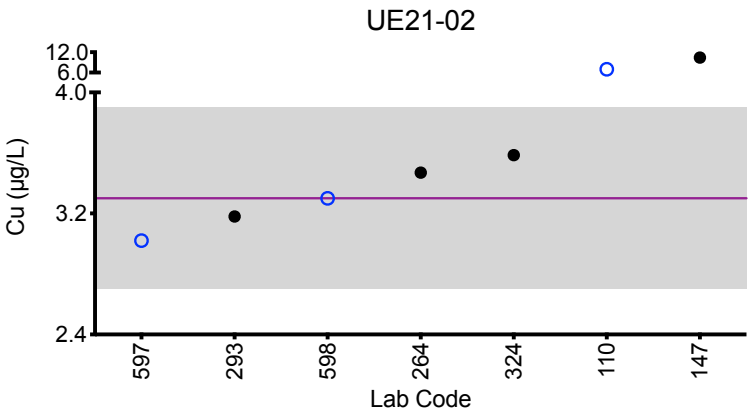
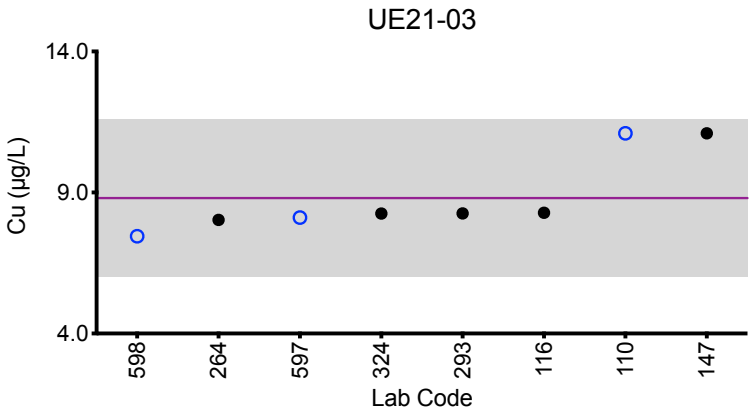
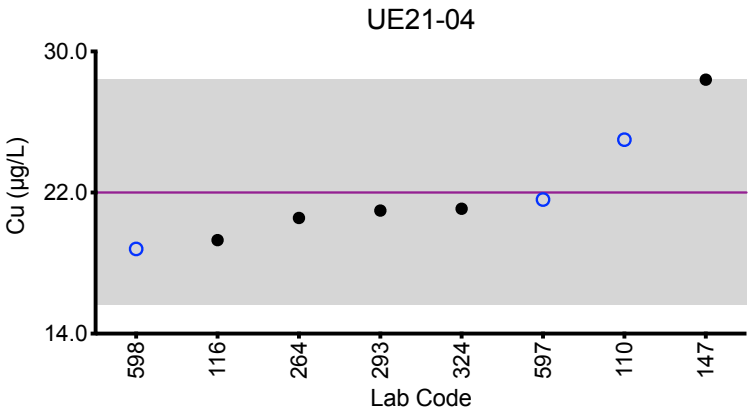
Results for Event #1, 2021: Summary Figures

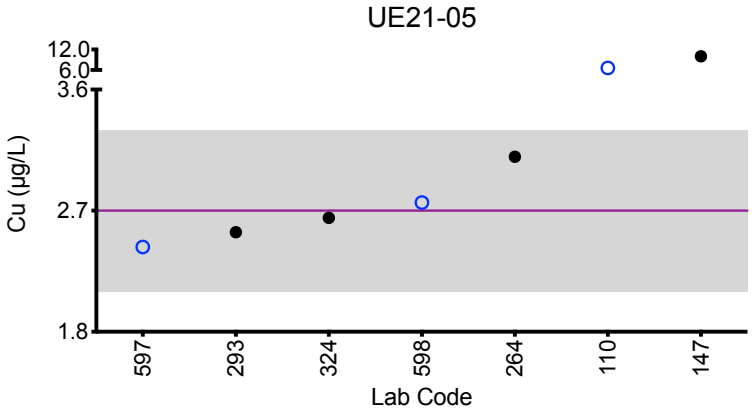
Urine Cu











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
103	ICP-MS/MS	8.47	8.66	42.4	85.4	13.5
107	ICP-MS	8.51	8.61	39.27	77.50	11.38
110	ICP-MS	9.05	9.07	44.5	93.3	14.6
147	ICP-MS	7.84	8.32	37.4	81.7	13.1
220	ICP-MS	5.82	7.09	38.6	84.9	11.4
264	ICP-MS	6.89	7.68	37.48	78.70	12.80
293	DRC/CC-ICP-MS	8.47	9.02	40.63	83.46	13.63
324	ICP-MS	8.311807	8.440102	40.22937	82.26507	12.11075
399	ICP-MS/MS	8.67	9.01	42.7	88.3	12.7
597	ICP-MS/MS	8.20	8.14	41.3	84.4	12.7
598	DRC/CC-ICP-MS	7.8	8.32	39.8	80.6	13.2
605	ICP-MS	<9.00	<9.00	44.3	89.5	12.9
606	ICP-MS/MS	8.27	8.81	41.0	83.3	12.8
676	ICP-MS	8.33	8.71	40.6	83.3	12.7

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Robust Mean (x*)	8.3	8.5	40.7	83.6	12.8
Robust SD (s*)	0.4	0.4	2.4	3.2	0.6
Robust RSD (%)	4.4	4.7	5.9	3.8	4.7
Number of Sample Measurements (N)	13	13	14	14	14
Standard Uncertainty (*u*)	0.1	0.2	0.8	0.1	0.2

*Denotes a statistical Outlier.

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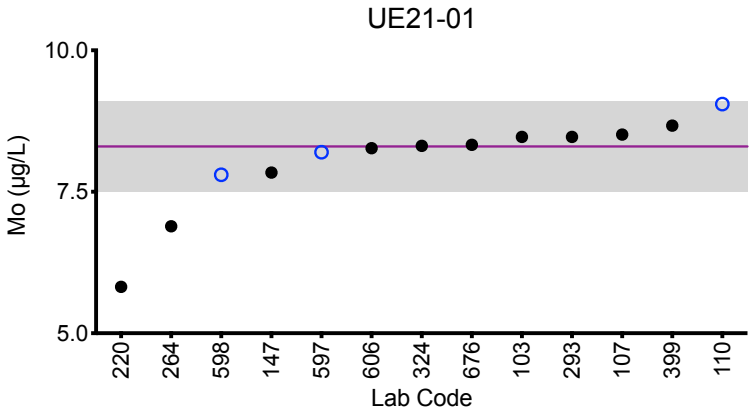
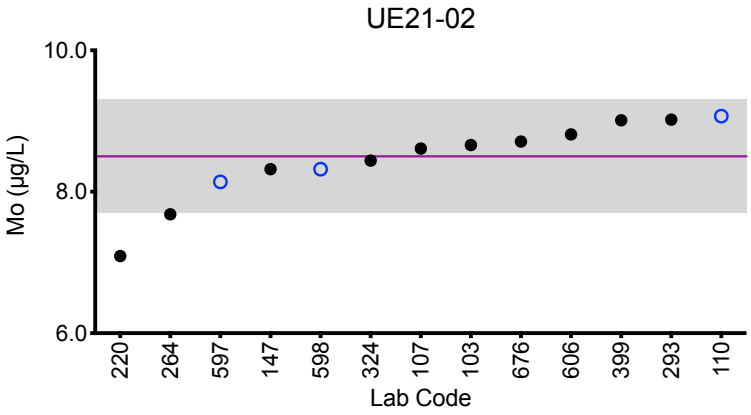
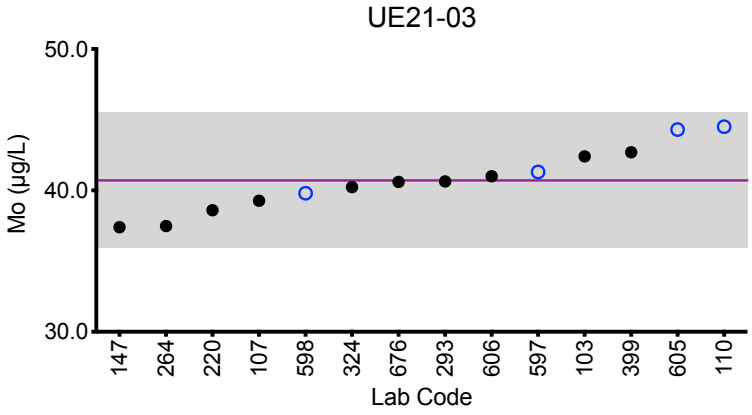
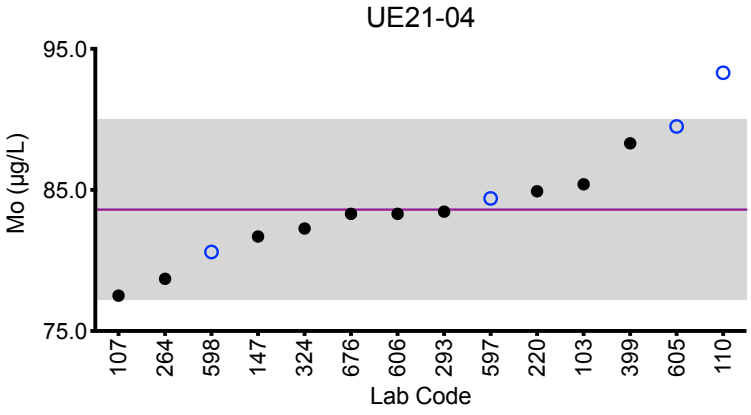
Results for Event #1, 2021: Summary Figures

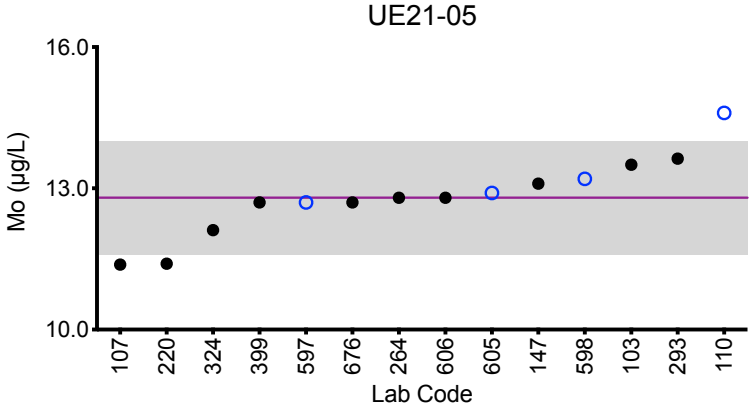
Urine Mo











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
107	DRC/CC-ICP-MS	5.10	0.78	1.07	3.76	5.06
110	ICP-MS	5.64	1.91	1.56	4.21	6.57
147	ICP-MS	5.21	1.36	0.818	3.54	6.22
264	ICP-MS	5.02	1.47	0.95	3.20	6.16
293	DRC/CC-ICP-MS	4.64	1.14	0.79	3.08	5.43
324	ICP-MS	4.733861	1.873369	1.189585	3.360979	5.667273
597	ICP-MS/MS	5.39	*2.83	1.57	3.85	7.05
598	ICP-MS	4.54	1.52	1.04	3.24	5.22
605	ICP-MS	5.30	1.51	0.950	3.39	6.02

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Arithmetic Mean ($\bar{x}$)	5.1	1.4	1.1	3.5	5.9
Arithmetic SD (s)	0.4	0.4	0.3	0.4	0.7
Arithmetic RSD (%)	7.3	26	26	10	12
Number of Sample Measurements (N)	9	8	9	9	9

*Denotes a statistical Outlier.

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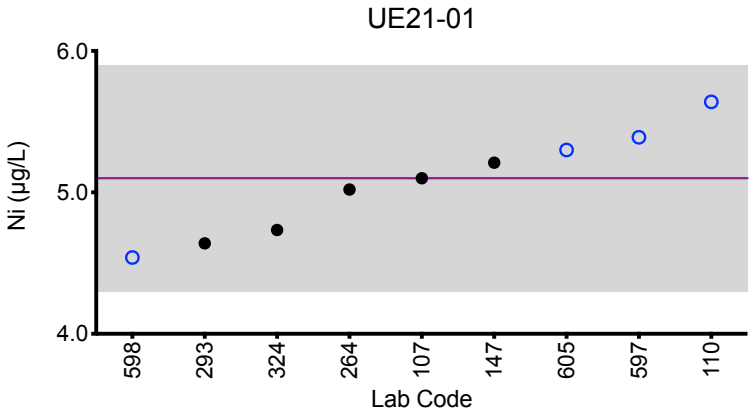
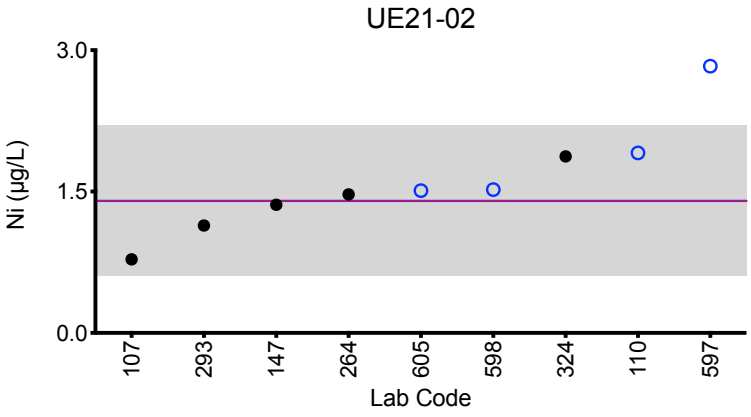
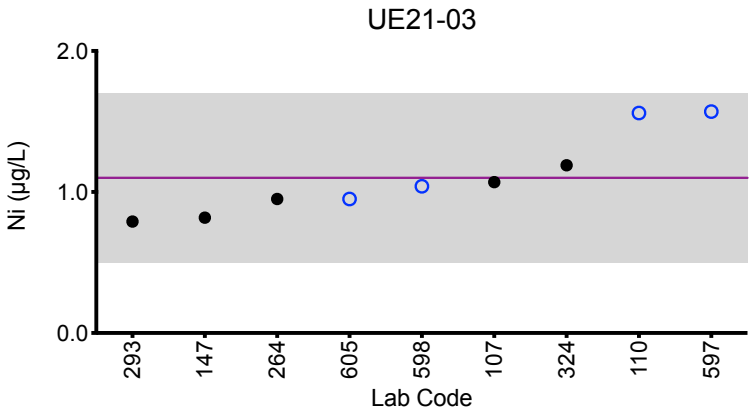
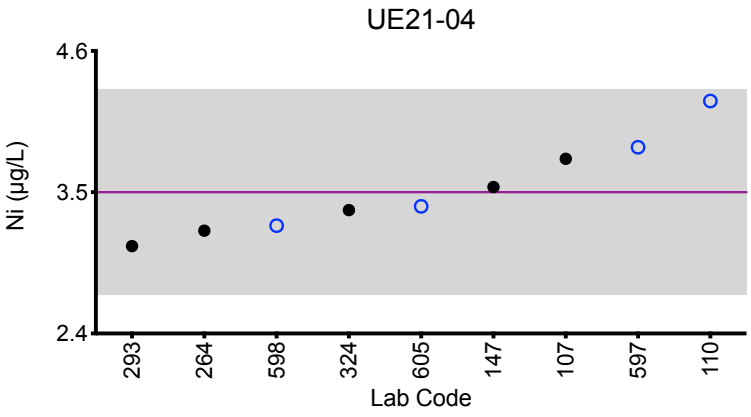
Results for Event #1, 2021: Summary Figures

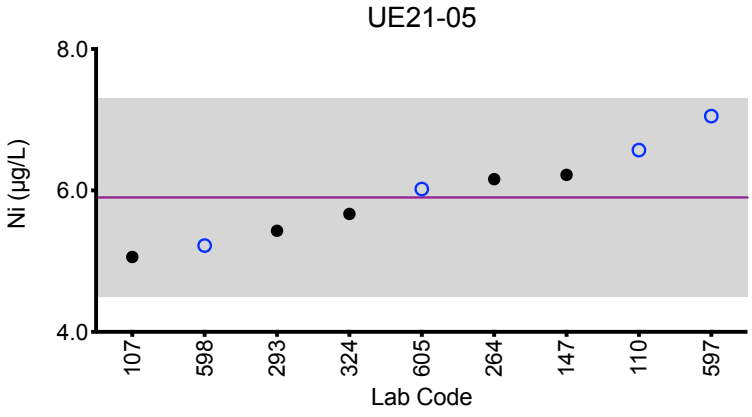
Urine Ni











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
107	ICP-MS	0.1881	0.4499	0.0867	2.4643	0.7196
110	ICP-MS	0.254	0.423	0.101	3.75	1.03
220	ICP-MS	0.18	0.38	0.064	3.42	0.81
264	ICP-MS	0.22	0.43	0.08	3.44	0.90
293	DRC/CC-ICP-MS	0.37	0.6	*0.31	3.98	1.21
399	ICP-MS/MS	0.217	0.394	0.082	3.34	0.819
598	ICP-MS	0.22	0.39	0.077	3.35	0.88
605	ICP-MS	0.233	0.438	0.093	3.50	0.817
676	ICP-MS	0.218	0.389	0.074	3.35	0.803

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Arithmetic Mean ($\bar{x}$)	0.23	0.43	0.08	3.4	0.89
Arithmetic SD (s)	0.06	0.07	0.01	0.4	0.15
Arithmetic RSD (%)	26	16	14	12	17
Number of Sample Measurements (N)	9	9	8	9	9

*Denotes a statistical Outlier.

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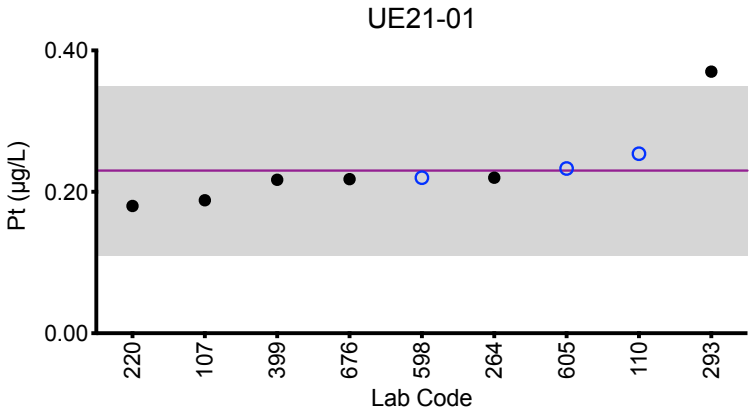
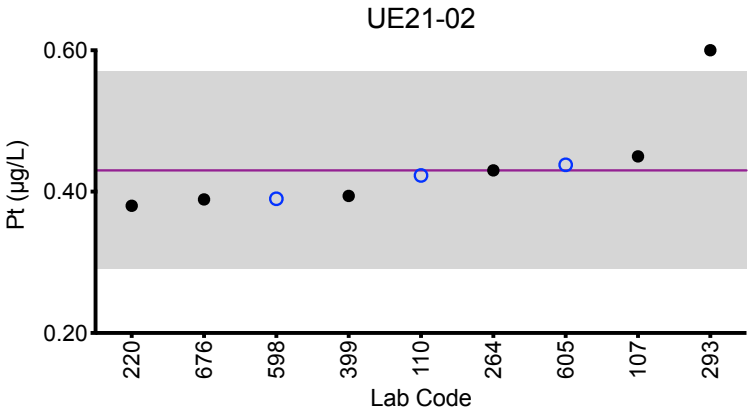
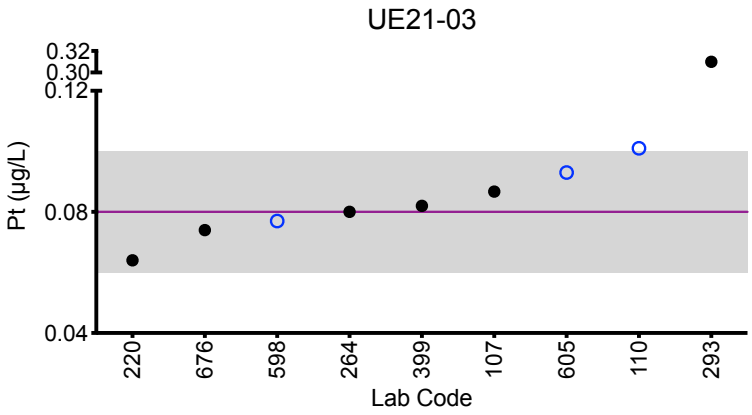
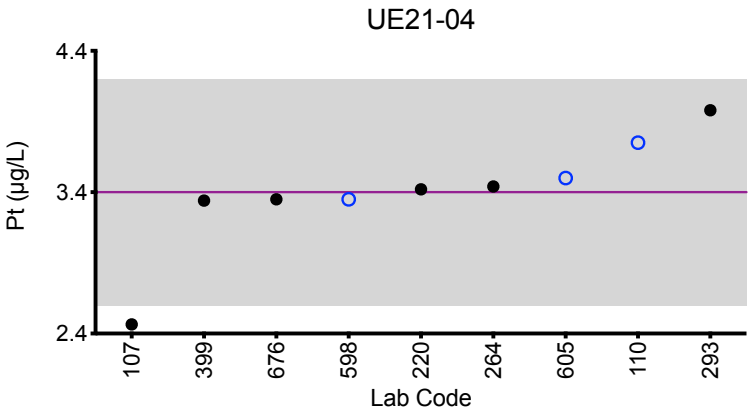
Results for Event #1, 2021: Summary Figures

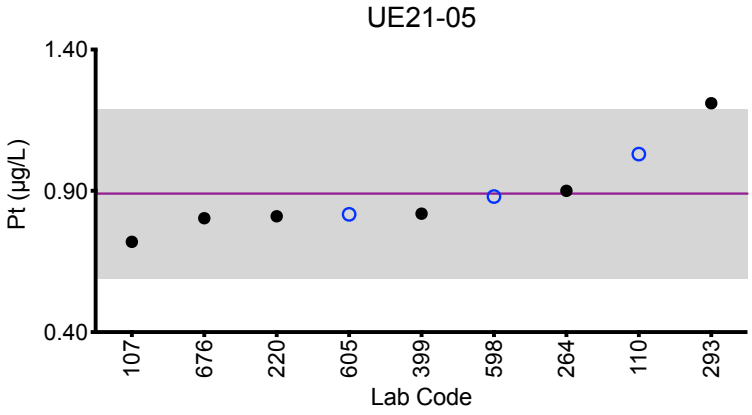
Urine Pt











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
103	ICP-MS/MS	1.13	0.385	1.76	0.695	2.53
107	ICP-MS	0.852	0.419	1.732	0.670	1.883
110	ICP-MS	0.922	0.383	1.84	0.737	2.58
147	ICP-MS	1.11	0.433	2.05	0.810	2.74
220	ICP-MS	0.88	0.40	1.87	0.74	2.54
264	ICP-MS	0.89	0.43	1.83	0.75	2.38
293	DRC/CC-ICP-MS	1.18	0.47	2	0.81	2.95
399	ICP-MS/MS	1.10	0.437	1.94	0.770	2.21
597	ICP-MS/MS	1.02	0.41	1.84	0.71	2.57
598	ICP-MS	0.96	0.41	1.72	0.72	2.51
605	ICP-MS	1.02	<0.800	2.02	0.848	2.48
606	ICP-MS/MS	1.04	0.442	1.93	0.743	2.52
676	ICP-MS	0.901	0.44	1.79	0.706	2.31

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Robust Mean (x*)	1.00	0.422	1.87	0.74	2.51
Robust SD (s*)	0.12	0.024	0.12	0.05	0.11
Robust RSD (%)	12	5.7	6.4	6.8	4.4
Number of Sample Measurements (N)	13	12	13	13	13
Standard Uncertainty (*u*)	0.04	0.009	0.04	0.02	0.04

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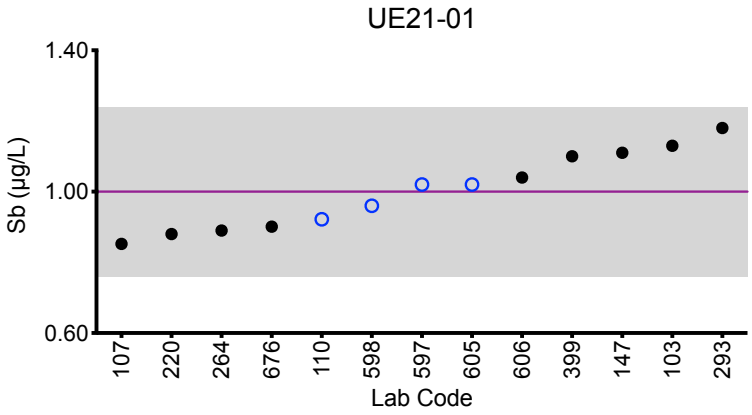
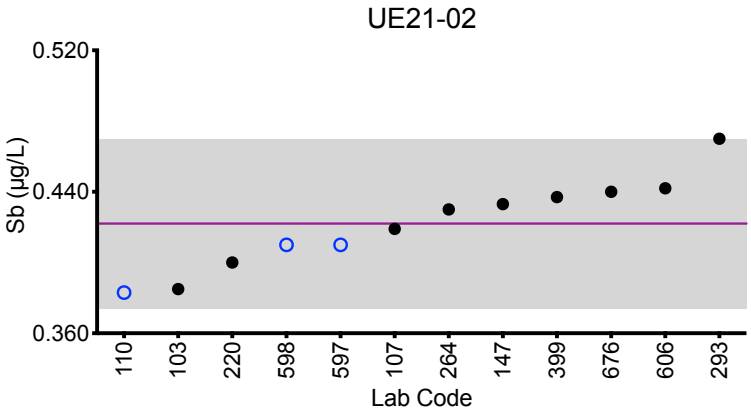
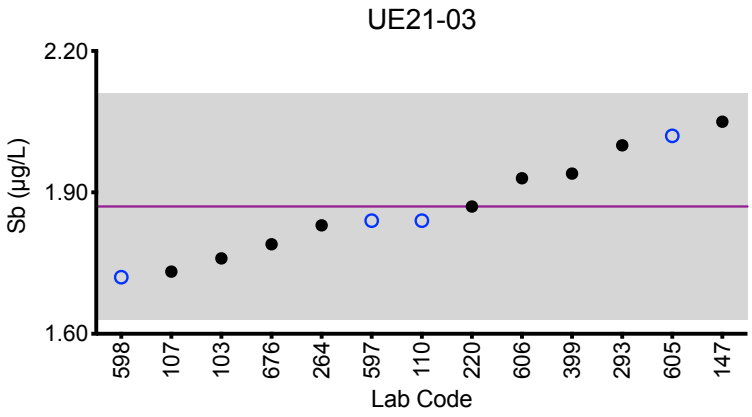
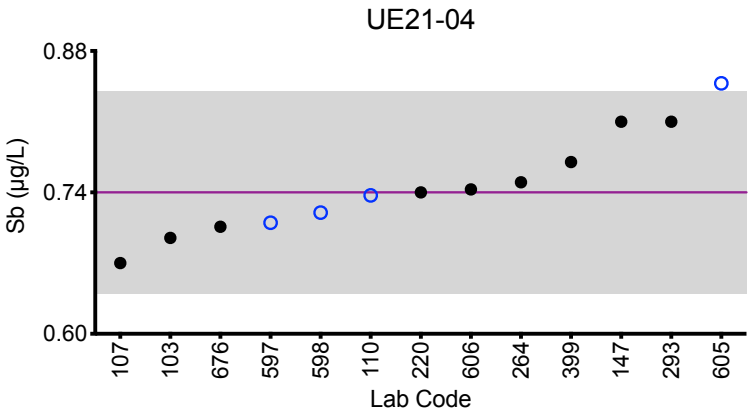
Results for Event #1, 2021: Summary Figures

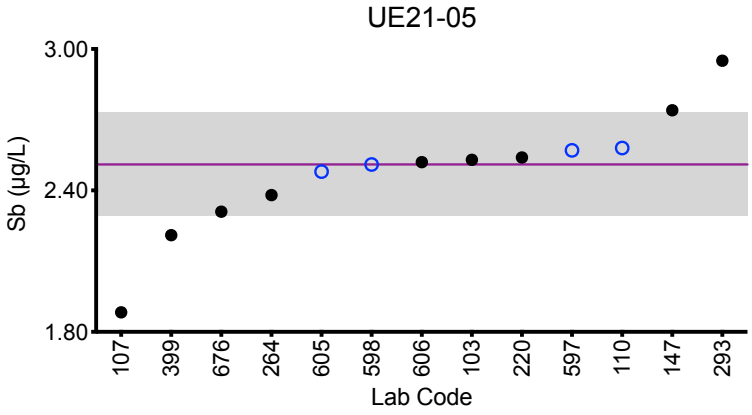
Urine Sb











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine Se (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
103	ICP-MS/MS	5.95	42.6	56.6	180	71.3
110	DRC/CC-ICP-MS	8.01	35.8	54.1	182	71.2
147	ICP-MS	6.16	41.4	61.0	194	76.3
293	DRC/CC-ICP-MS	4.74	36.31	55.25	176.8	71.82
597	ICP-MS/MS	5.62	41.1	58.7	180	72.1
598	DRC/CC-ICP-MS	5.24	34.3	46.5	172	68

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Arithmetic Mean ($\bar{x}$)	6.0	38.6	55	181	71.8
Arithmetic SD (s)	1.1	3.5	5	7	2.7
Arithmetic RSD (%)	18	9.1	9.1	3.9	3.8
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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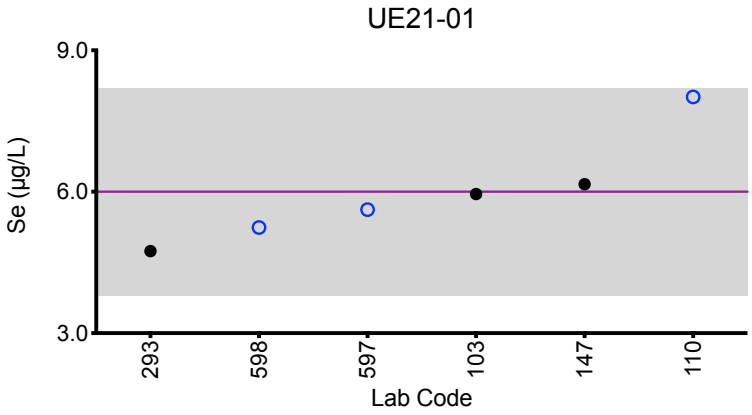
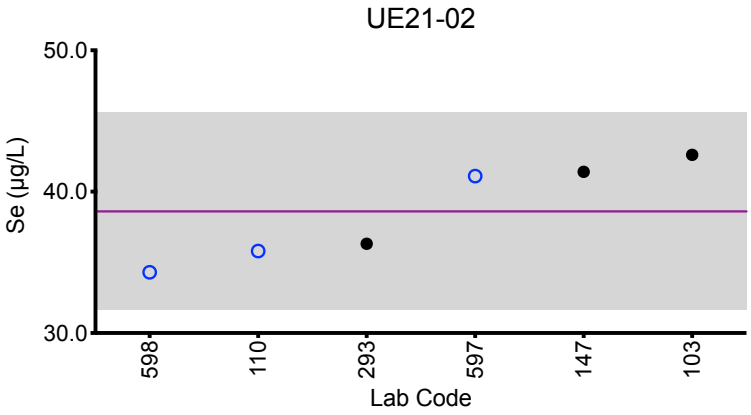
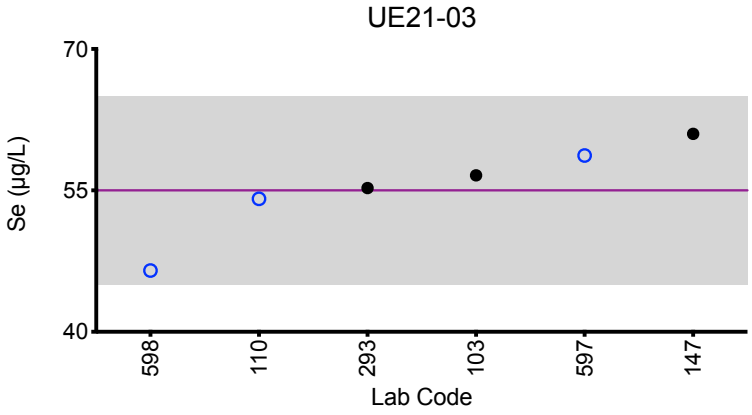
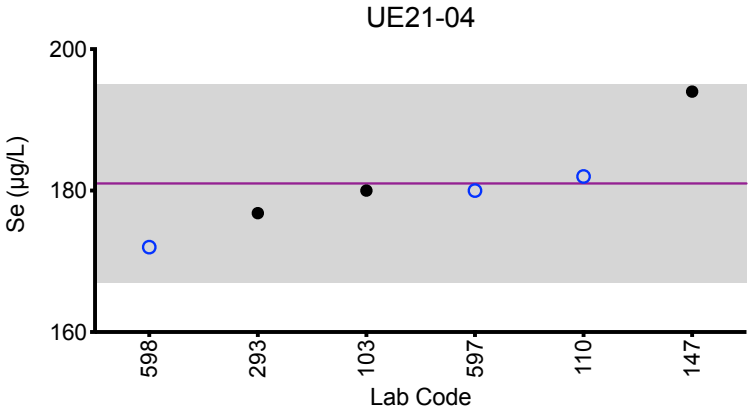
Results for Event #1, 2021: Summary Figures

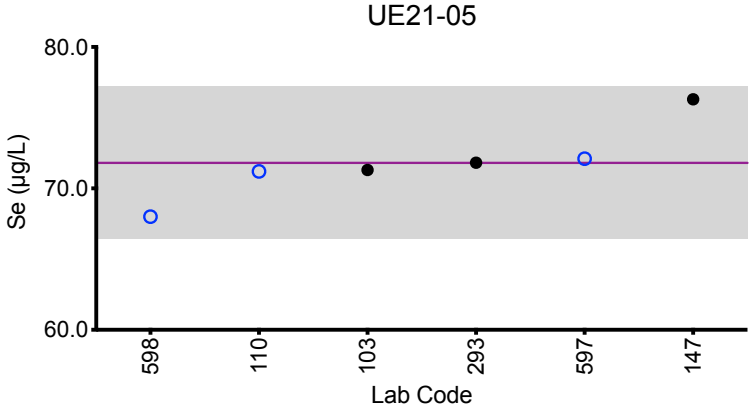
Urine Se











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
107	ICP-MS	0.47	2.70	0.88	3.30	1.42
110	ICP-MS	0.43	3.36	0.59	4.15	1.62
147	ICP-MS	0.299	2.16	0.486	3.16	1.09
220	ICP-MS	<0.4	2.53	0.77	3.14	1.25
264	ICP-MS	0.22	2.00	0.44	2.71	0.98
399	DRC/CC-ICP-MS	0.388	3.41	0.622	4.01	1.52
597	ICP-MS/MS	0.43	2.83	0.59	3.50	1.36
598	ICP-MS	0.23	1.84	0.33	2.73	1
605	ICP-MS	<0.900	3.38	<0.900	4.00	1.51
676	ICP-MS	0.422	3.28	0.568	3.71	1.45

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Robust Mean (x*)	0.36	2.7	0.59	3.4	1.34
Robust SD (s*)	0.10	0.7	0.17	0.6	0.23
Robust RSD (%)	27	26	28	18	17
Number of Sample Measurements (N)	8	10	9	10	10
Standard Uncertainty (*u*)	NA	0.3	NA	0.2	0.09

*Denotes a statistical Outlier.

An arithmetic mean, SD, RSD and n are provided for samples UE21-01 and UE21-03.

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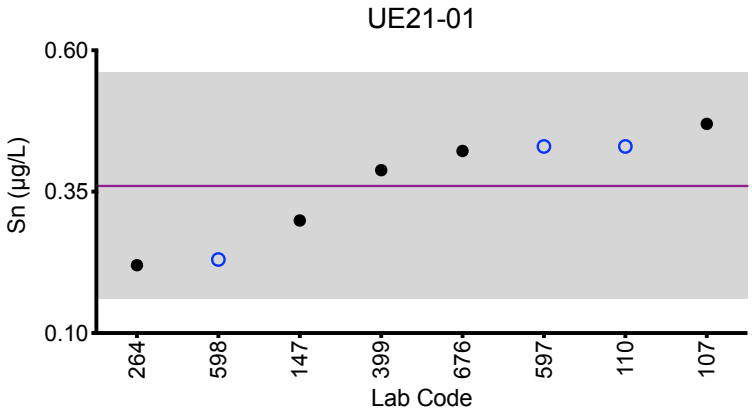
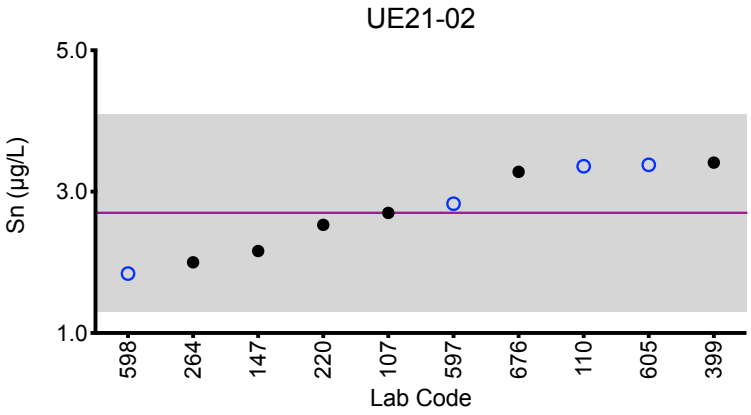
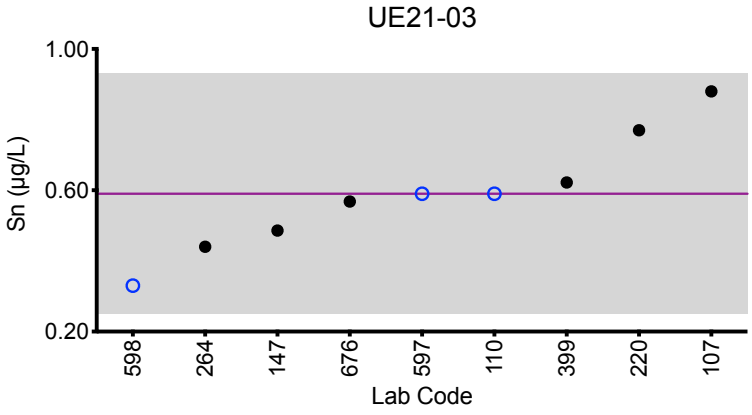
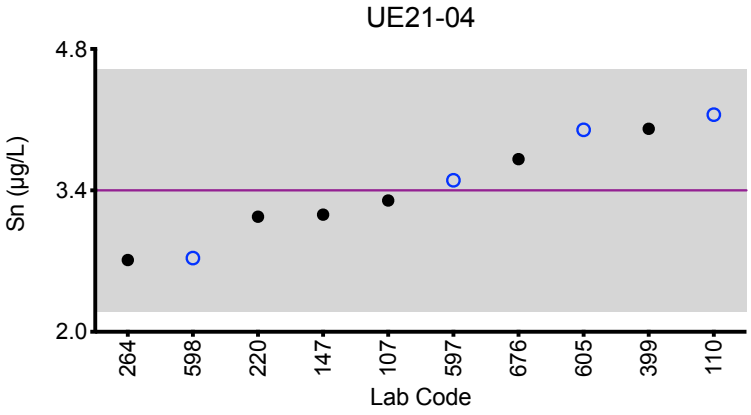
Results for Event #1, 2021: Summary Figures

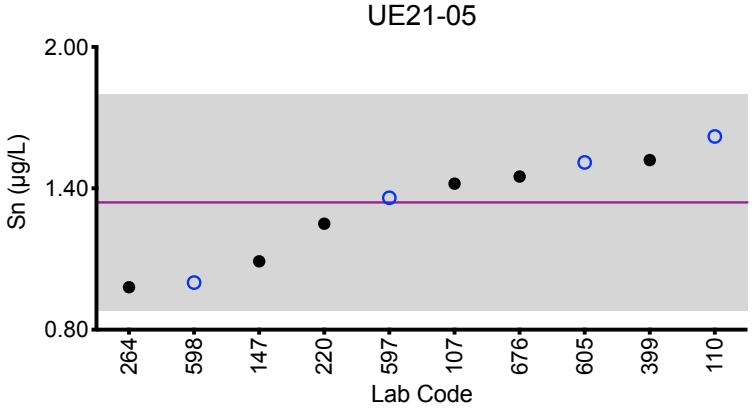
Urine Sn











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine Sr (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
103	ICP-MS/MS	10.6	30.7	38.9	51.9	51.8
107	ICP-MS	11.5	30.9	37.8	47.2	47.1
200	ICP-MS	11.4	31.5	38.5	51.7	49.9
220	ICP-MS	11.7	33.0	41.9	54.4	55.0
264	ICP-MS	10.48	29.95	38.24	48.33	49.85
399	DRC/CC-ICP-MS	11.2	31.9	39.7	51.4	51.9
597	ICP-MS/MS	11.7	32.7	40.4	53.2	52.7
605	ICP-MS	<18.0	33.6	41.6	53.7	54.8
676	ICP-MS	11.5	32.8	41.4	53.2	53.8

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Arithmetic Mean ($\bar{x}$)	11.3	31.9	39.8	51.7	51.9
Arithmetic SD (s)	0.5	1.2	1.6	2.4	2.6
Arithmetic RSD (%)	4.4	3.8	3.9	4.6	5.0
Number of Sample Measurements (N)	8	9	9	9	9

*Denotes a statistical Outlier.

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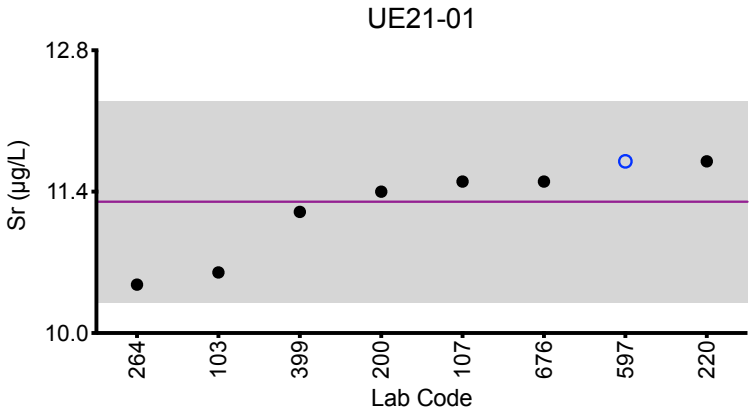
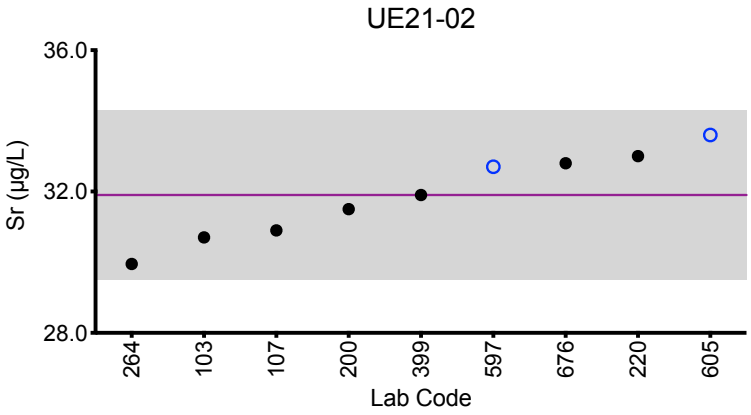
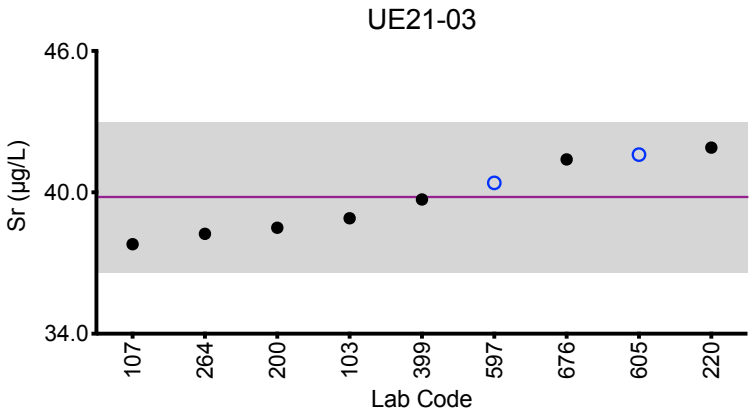
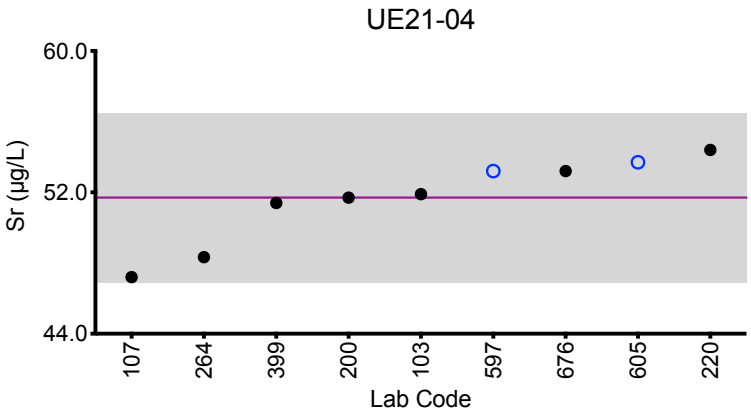
Results for Event #1, 2021: Summary Figures

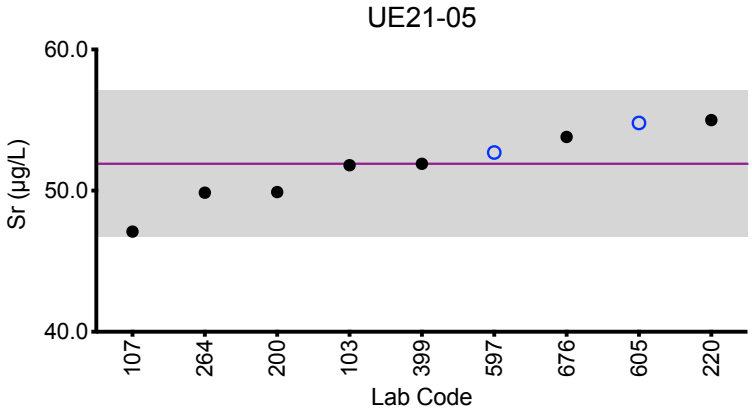
Urine Sr











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
116	ICP-MS/MS	0.852	3.17	0.532	5.11	1.96
147	DRC/CC-ICP-MS	0.867	3.10	0.561	4.98	1.91
293	DRC/CC-ICP-MS	0.95	3.4	0.54	5.27	*0.73
597	ICP-MS/MS	0.93	3.32	0.600	5.36	2.04
598	DRC/CC-ICP-MS	0.97	3.32	0.59	5.03	2.03
605	ICP-MS	0.878	3.76	0.483	5.79	2.18

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Arithmetic Mean ($\bar{x}$)	0.91	3.35	0.55	5.3	2.02
Arithmetic SD (s)	0.05	0.23	0.04	0.3	0.10
Arithmetic RSD (%)	5.5	6.9	7.3	5.7	5.0
Number of Sample Measurements (N)	6	6	6	6	5

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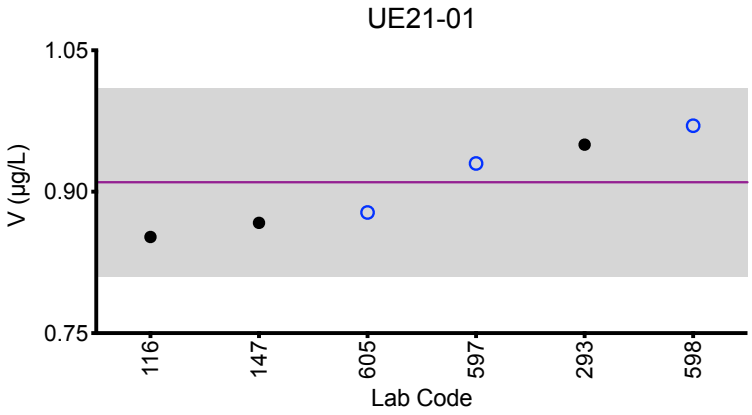
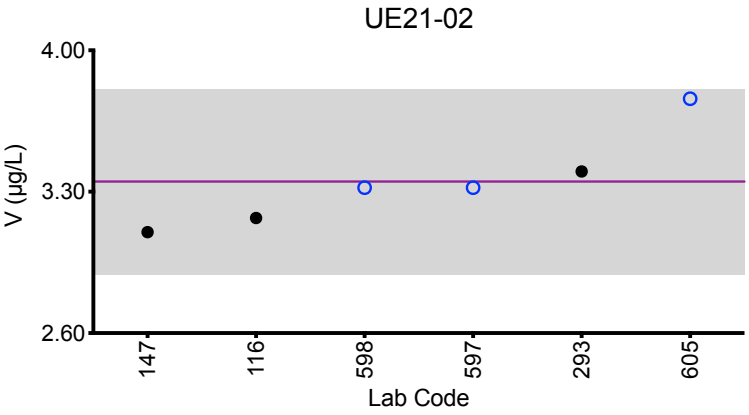
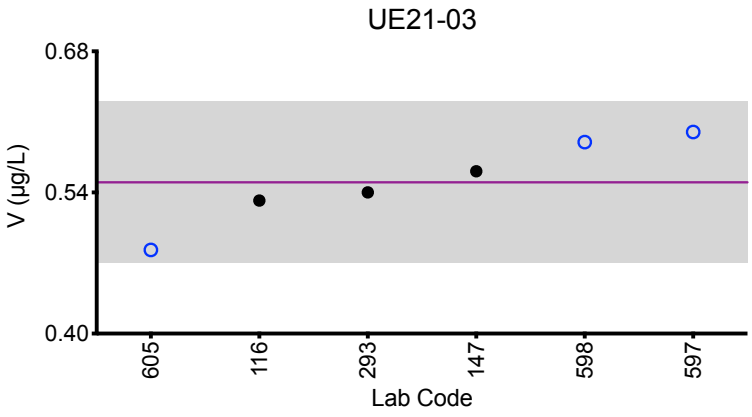
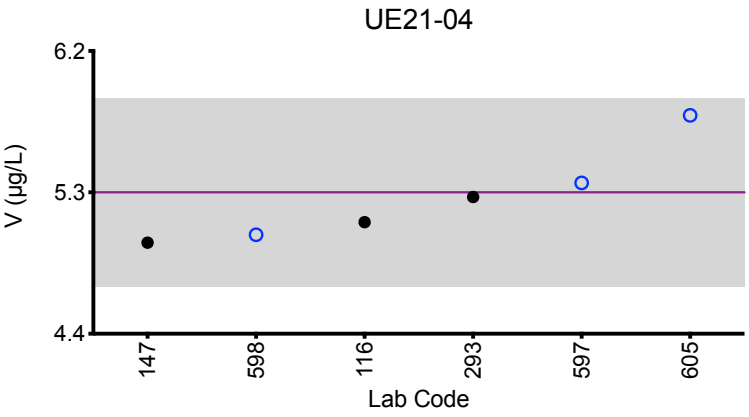
Results for Event #1, 2021: Summary Figures

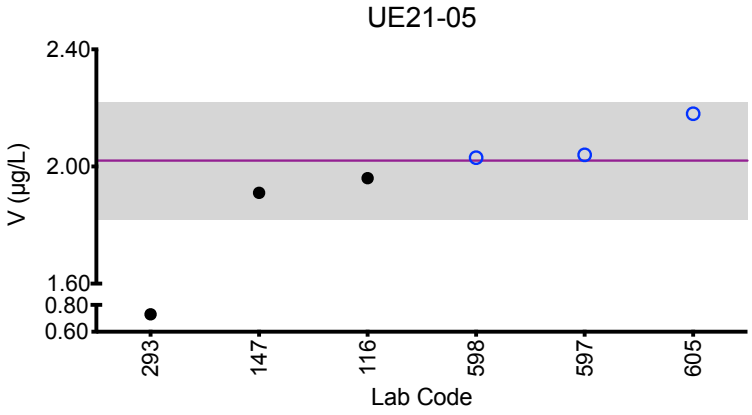
Urine V











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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
107	ICP-MS	0.235	1.566	0.549	0.157	4.274
110	ICP-MS	0.255	1.50	0.590	0.166	4.80
147	ICP-MS	0.213	1.57	0.541	0.184	4.71
200	ICP-MS	0.07	1	0.35	0.13	3.6
220	ICP-MS	0.22	1.63	0.58	0.18	4.74
264	ICP-MS	0.18	1.47	0.51	0.13	4.42
324	ICP-MS	<1	1.550177	<1	<1	4.367959
399	ICP-MS/MS	0.239	1.61	0.576	0.163	4.83
597	ICP-MS/MS	0.25	1.51	0.511	0.142	4.56
598	ICP-MS	0.3	1.85	0.58	0.17	4.59
605	ICP-MS	0.233	1.71	0.598	<0.18	4.96
606	ICP-MS/MS	0.196	1.62	0.554	0.164	4.70
676	ICP-MS	0.259	1.8	0.577	0.153	4.65

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Robust Mean (x*)	0.23	1.58	0.56	0.160	4.61
Robust SD (s*)	0.03	0.10	0.03	0.017	0.23
Robust RSD (%)	15	6.3	5.7	11	5.1
Number of Sample Measurements (N)	12	13	12	11	13
Standard Uncertainty (*u*)	0.01	0.04	0.01	0.006	0.08

*Denotes a statistical Outlier.

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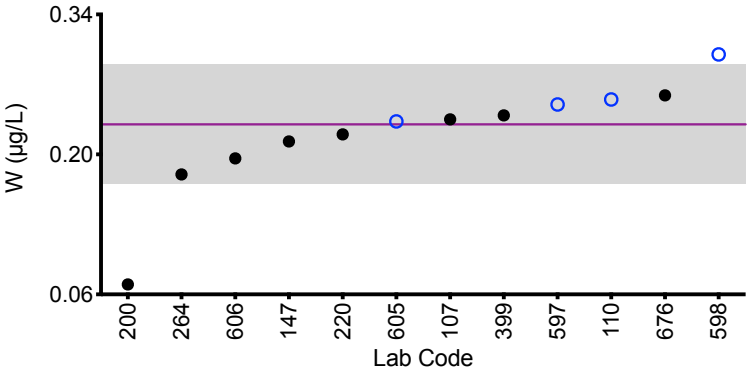
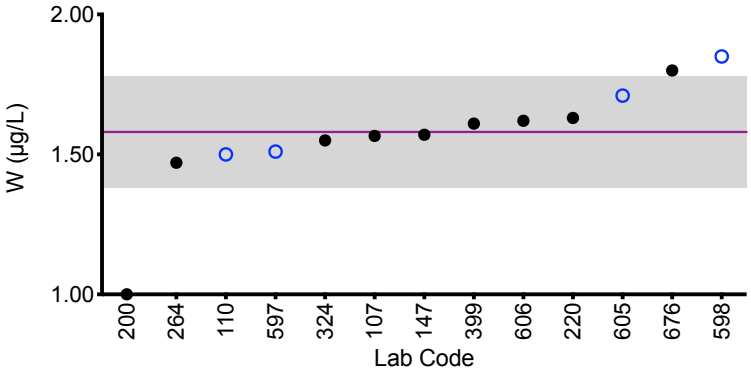
Results for Event #1, 2021: Summary Figures

Urine W

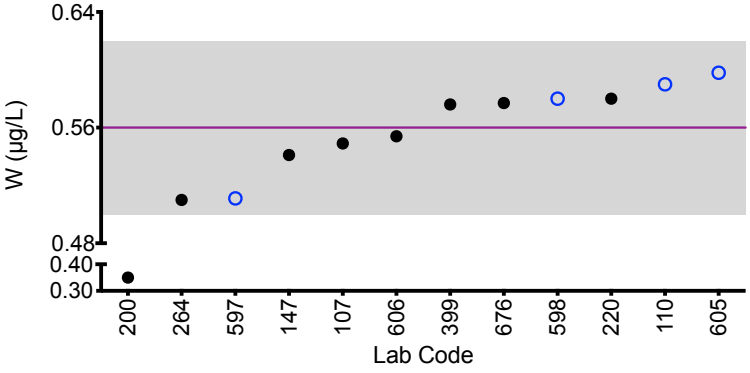
UE21-01



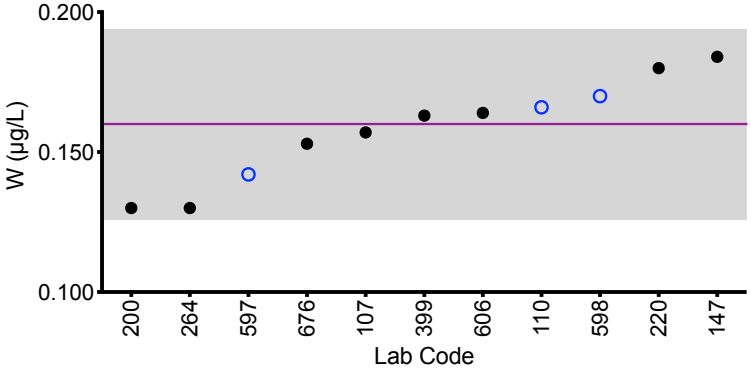
UE21-02



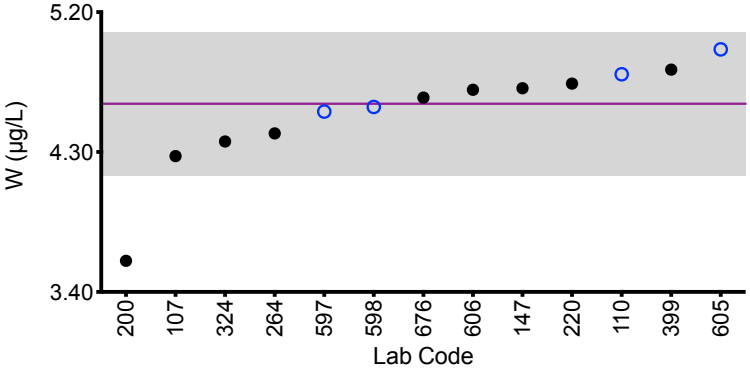
UE21-03



UE21-04



UE21-05



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 #1, 2021:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
110	ICP-MS	173	123	348	863	234
147	ICP-MS	180	133	378	895	243
264	ICP-MS	158.3	133.1	340.7	813.9	235.6
293	DRC/CC-ICP-MS	149.02	135.95	343.14	822.88	233.33
324	ICP-MS	152.2619	136.3832	336.5282	814.6085	236.2491
597	ICP-MS/MS	154	132	338	824	231
598	ICP-MS	146	120	328	786	215

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Arithmetic Mean ($\bar{x}$)	159	130	345	831	233
Arithmetic SD (s)	13	6	16	36	9
Arithmetic RSD (%)	8.2	4.6	4.6	4.3	3.9
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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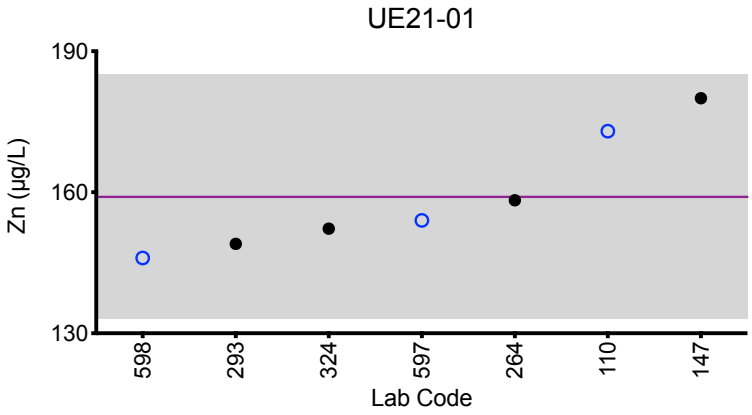
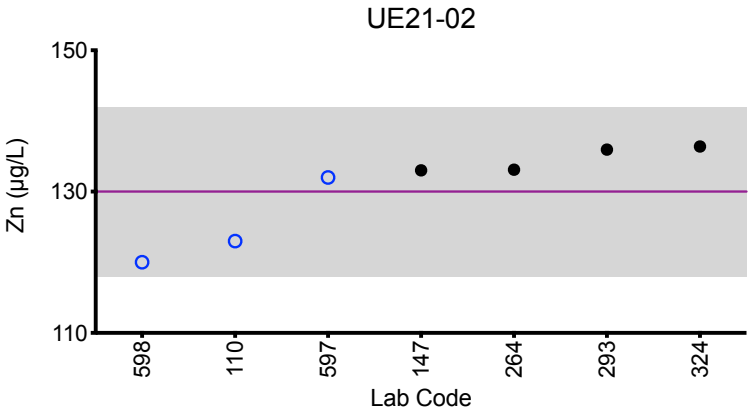
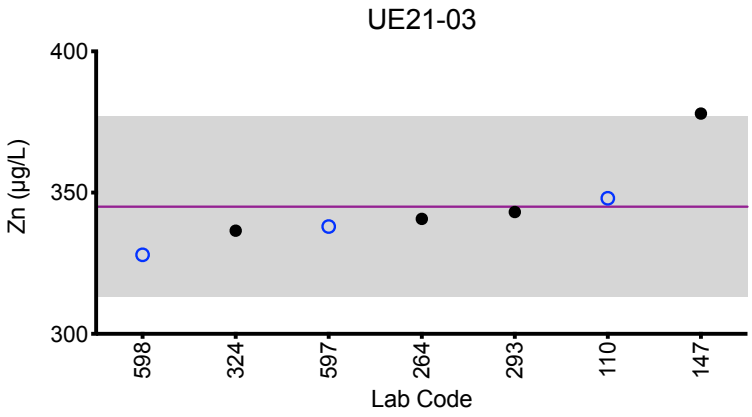
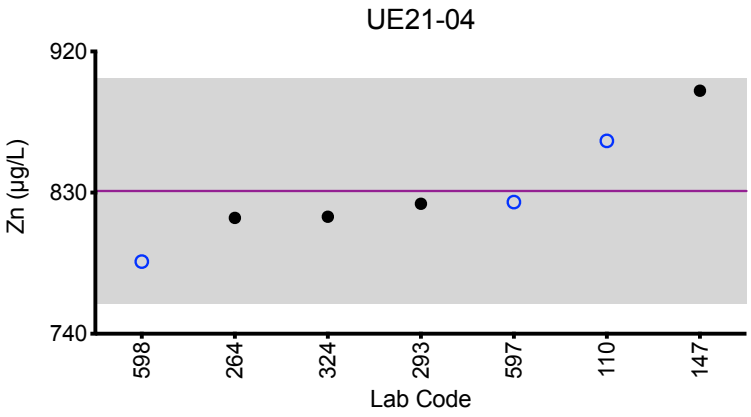
Results for Event #1, 2021: Summary Figures

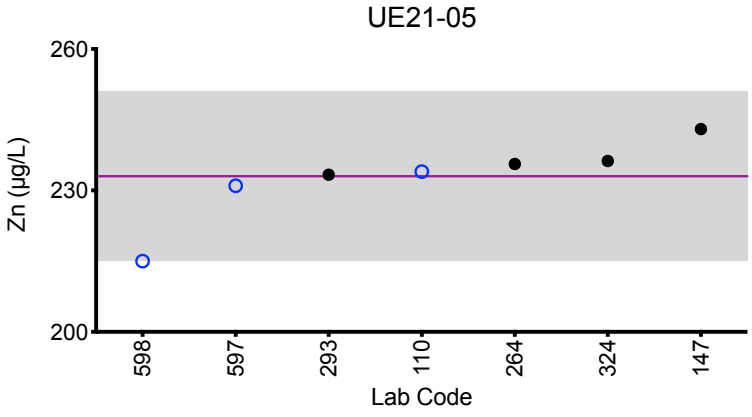
Urine Zn











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 #1, 2021:
Laboratory Data and Summary Statistics

Urine Te (µg/L)

Lab Code	Method	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
110	ICP-MS	0.713	0.410	1.83	1.14	2.86
147	ICP-MS	0.643	0.302	1.57	0.961	2.41

Summary Statistics

	UE21-01	UE21-02	UE21-03	UE21-04	UE21-05
Arithmetic Mean ($\bar{x}$)	0.68	0.36	1.7	1.05	2.6
Arithmetic SD (s)	0.05	0.08	0.2	0.13	0.3
Arithmetic RSD (%)	7.4	22	11	12	12
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2021: Additional Elements in Urine

Urine Ag (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
147	ICP-MS	<0.183	<0.183	<0.183	<0.183	<0.183

Urine B (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
200	ICP-MS	201	562	281	356	421

Urine Bi (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
147	ICP-MS	<0.0815	<0.0815	<0.0815	<0.0815	<0.0815
264	ICP-MS	0.02	0.03	0.02	0.01	0.02
597	ICP-MS/MS	<0.05	<0.05	<0.05	<0.05	<0.05

Urine Fe (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
324	ICP-MS	4.594920	6.190382	4.505734	3.591939	7.697611

Urine I (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
147	ICP-MS	<32.9	<32.9	79.0	95.8	91.9

Urine Li (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
147	ICP-MS	3.40	9.30	6.12	8.05	18.2

Urine Mg (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
597	ICP-MS/MS	9300	26200	14700	18800	28000

Urine Th (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
147	ICP-MS	<0.0673	<0.0673	<0.0673	<0.0673	<0.0673
597	ICP-MS/MS	<0.04	<0.04	<0.04	<0.04	<0.04

Urine Ti (µg/L)						
Lab Code	**Method**	**UE21-01**	**UE21-02**	**UE21-03**	**UE21-04**	**UE21-05**
597	ICP-MS/MS	2.54	3.24	2.61	3.29	2.66

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Event #1, 2021

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

NEW YORK STATE | Department of Health | Wadsworth Center

Event #1, 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 25 were reported by at least one participant: As, B, Ba, Be, Bi, Cd, Cs, Fe, Hg, I, Li, Mg, Mn, Mo, Ni, Pb, Pt, Sb, Sn, Sr, Ti, Tl, U, V, and W. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

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

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Results for Event #1, 2021:
Summary Statistics

	Serum Al (µg/L)				
	SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Target (Arithmetic Mean ($\bar{x}$))	67	45.7	12.2	16.8	27
Upper Limit	80	54.8	17.2	21.8	32
Lower Limit	54	36.6	7.2	11.8	22
Arithmetic SD (s)	4	3.2	2.1	2.2	4
Arithmetic RSD (%)	5.9	7.0	17	13	15
Number of Sample Measurements (N)	4	6	6	6	6

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

		Serum Al (µg/L)				
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
	Target	**67**	**45.7**	**12.2**	**16.8**	**27**
147	ETAAS-Z	64.0	47.2	13.3	16.5	26.4
264	ICP-MS	*6.97 ↓	39.43	9.01	13.98	22.11
293	DRC/CC-ICP-MS	72.58	48.39	13.44	16.13	26.88
391	ETAAS-Z	*32.26 ↓	46.32	14.83	20.62	33.49 ↑
485	HR-ICP-MS	67.3	45.7	11.7	16.0	26.2
597	ICP-MS/MS	64.4	47.4	11.2	17.3	28.7

Based on the grading criteria for Al in Serum, 90% 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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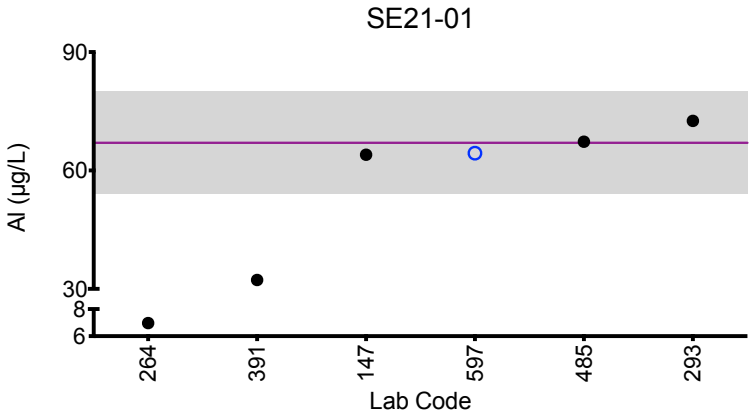
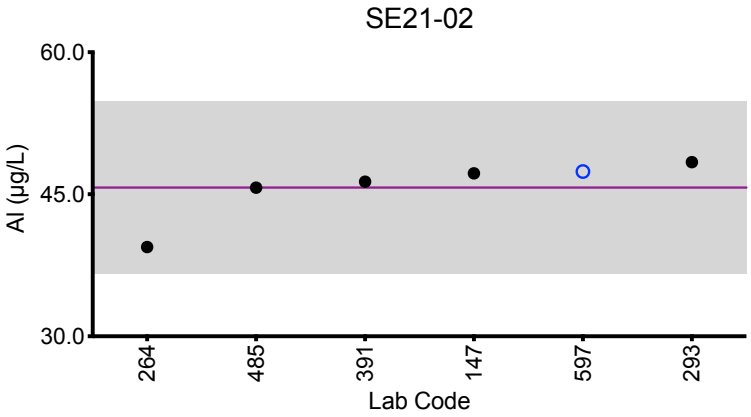
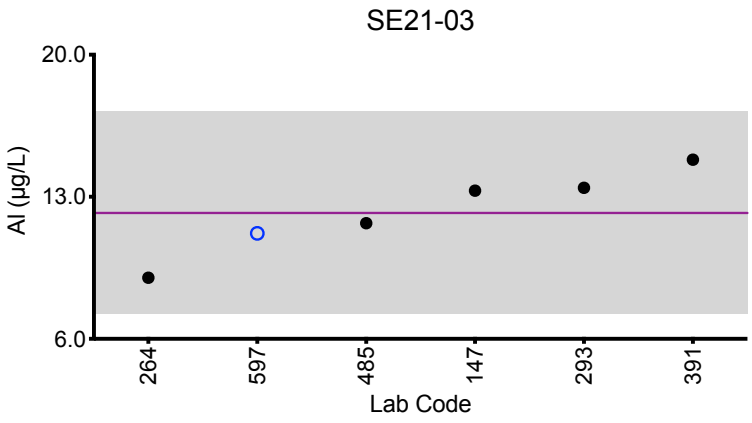
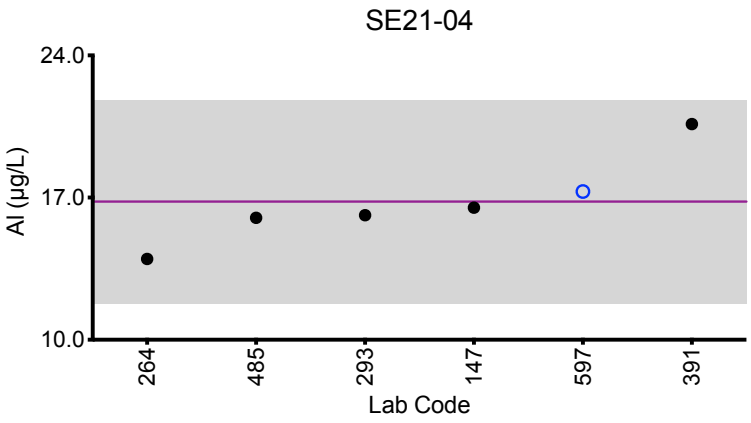
Results for Event #1, 2021: Summary Figures

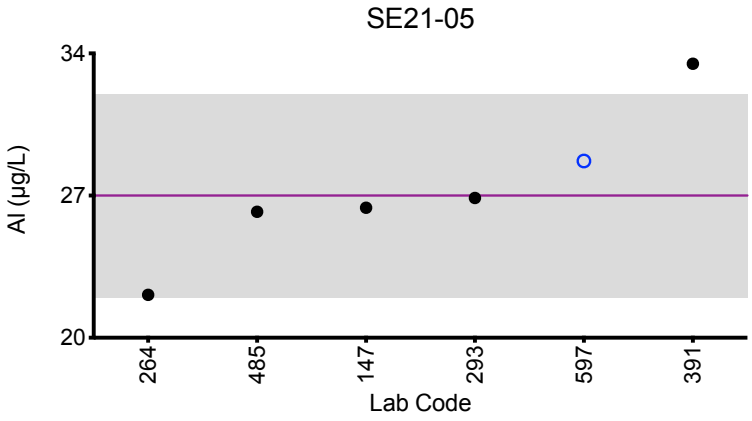
Serum Al











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 #1, 2021:
Summary Statistics

	Serum Co (µg/L)				
	SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Target (Arithmetic Mean ($\bar{x}$))	12.9	1.20	3.77	0.85	1.87
Upper Limit	14.8	2.70	5.27	2.35	3.37
Lower Limit	11.0	0.00	2.27	0.00	0.37
Arithmetic SD (s)	1.0	0.07	0.20	0.05	0.14
Arithmetic RSD (%)	7.8	5.8	5.3	5.9	7.5
Number of Sample Measurements (N)	6	7	7	7	7

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

Serum Co (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
	Target	**12.9**	**1.20**	**3.77**	**0.85**	**1.87**
103	ICP-MS/MS	*6.97 ↓	1.14	3.34	0.827	1.62
110	ICP-MS	13.8	1.36	3.89	0.94	2.08
147	DRC/CC-ICP-MS	11.5	1.16	3.81	0.824	1.86
264	ICP-MS	13.15	1.15	3.70	0.81	1.84
293	DRC/CC-ICP-MS	13	1.19	3.83	0.86	1.88
485	HR-ICP-MS	13.8	1.19	3.90	0.871	1.96
597	ICP-MS/MS	11.9	1.20	3.92	0.813	1.88

Based on the grading criteria for Co 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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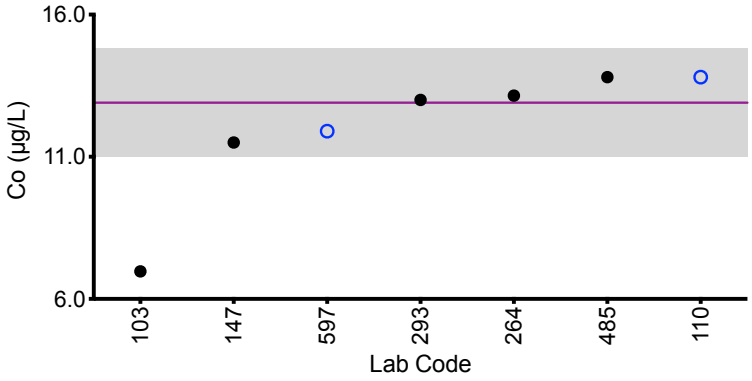
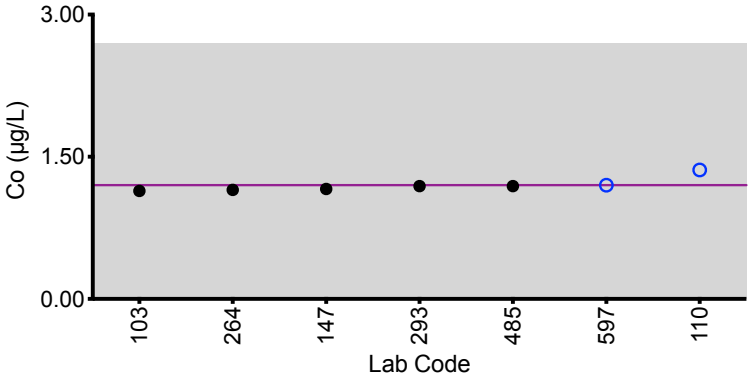
Results for Event #1, 2021: Summary Figures

Serum Co

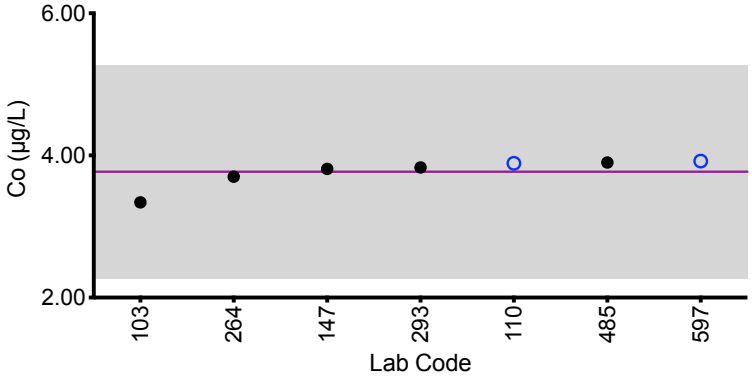
SE21-01



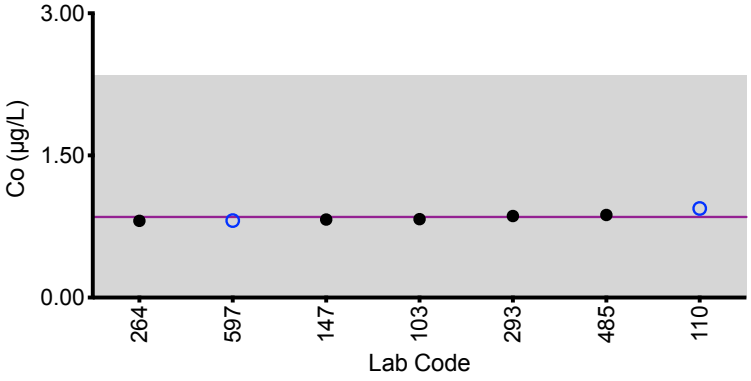
SE21-02



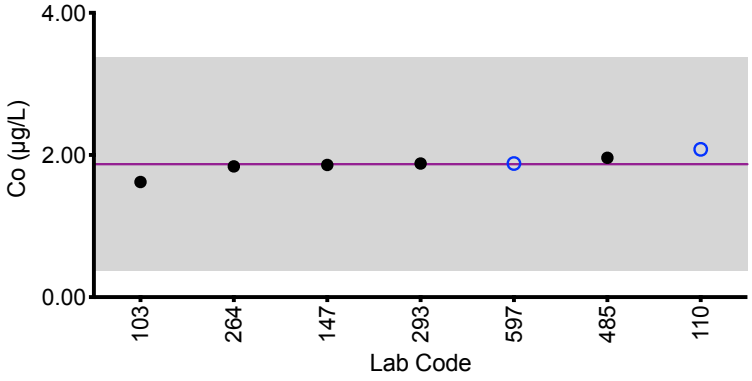
SE21-03



SE21-04



SE21-05



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 #1, 2021:
Summary Statistics

	Serum Cr (µg/L)				
	SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Target (Arithmetic Mean ($\bar{x}$))	0.32	1.27	0.61	3.06	8.1
Upper Limit	2.32	3.27	2.61	5.06	10.1
Lower Limit	0.00	0.00	0.00	1.06	6.1
Arithmetic SD (s)	0.09	0.19	0.20	0.27	0.6
Arithmetic RSD (%)	27	15	33	8.7	7.4
Number of Sample Measurements (N)	5	7	6	7	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 #1, 2021:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
	Target	**0.32**	**1.27**	**0.61**	**3.06**	**8.1**
103	ICP-MS/MS	<0.500	1.15	<0.500	2.95	7.28
110	DRC/CC-ICP-MS	0.37	1.39	0.84	3.23	9.10
147	DRC/CC-ICP-MS	0.220	1.16	0.625	3.03	7.95
264	ICP-MS	*0.06	1.03	0.26	2.54	7.65
293	DRC/CC-ICP-MS	0.35	1.38	0.77	3.35	8.27
485	HR-ICP-MS	0.243	1.20	0.642	3.12	8.29
597	ICP-MS/MS	0.427	1.60	0.528	3.22	7.94

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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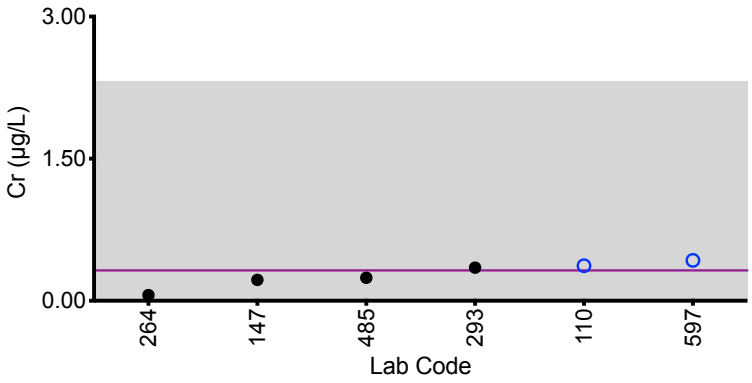
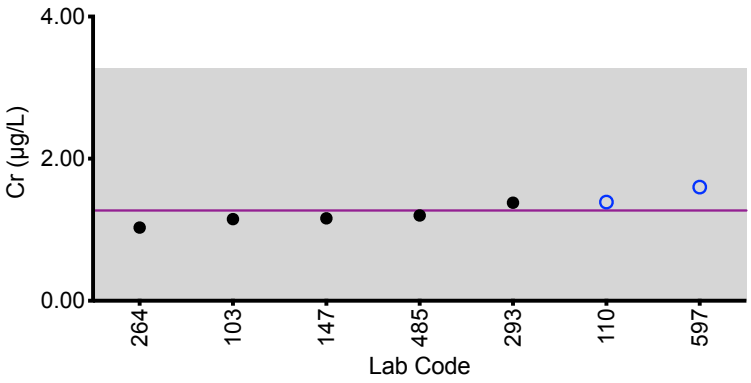
Results for Event #1, 2021: Summary Figures

Serum Cr

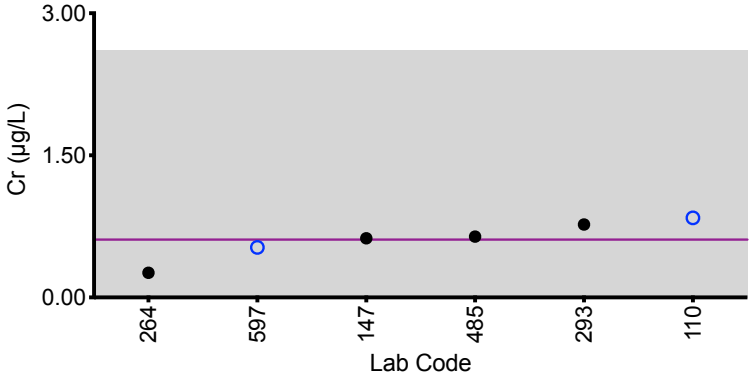
SE21-01



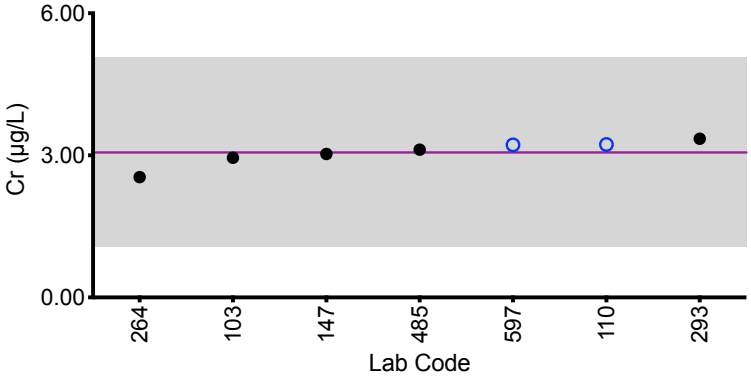
SE21-02



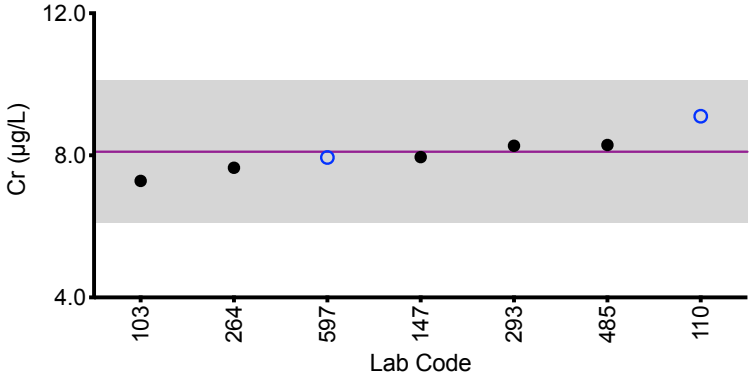
SE21-03



SE21-04



SE21-05



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 #1, 2021: Summary Statistics

Serum Cu (µg/L)					
	SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Target (Arithmetic Mean ($\bar{x}$))	880	840	2330	1179	1010
Upper Limit	1010	970	2680	1356	1160
Lower Limit	750	710	1980	1002	860
Arithmetic SD (s)	50	40	60	29	50
Arithmetic RSD (%)	5.7	4.8	2.6	2.5	5.1
Number of Sample Measurements (N)	6	6	6	6	6

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

		Serum Cu (µg/L)				
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
	Target	**880**	**840**	**2330**	**1179**	**1010**
107	DRC/CC-ICP-MS	919	854	2371	1219	1030
110	ICP-MS	956	909	2410	1200	1110
147	DRC/CC-ICP-MS	858	809	2313	1145	982
264	ICP-MS	860.9	805.6	2249.9	1147.9	1000.6
293	DRC/CC-ICP-MS	858.23	832.8	2275.91	1182.45	998.09
597	ICP-MS/MS	804	854	2350	1182	966

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

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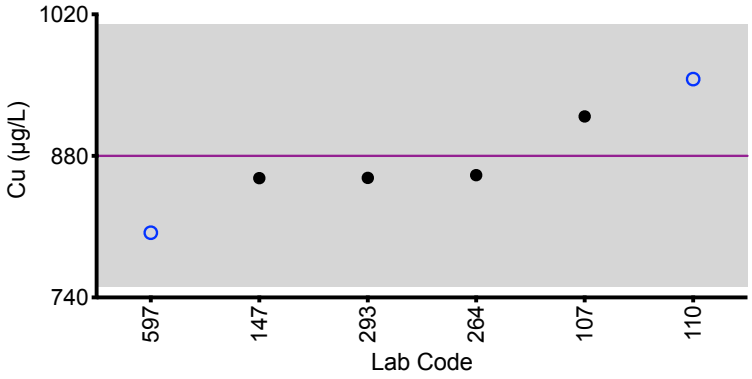
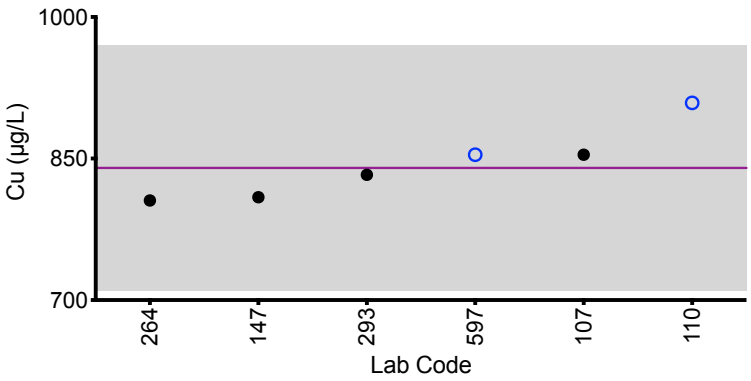
Results for Event #1, 2021: Summary Figures

Serum Cu

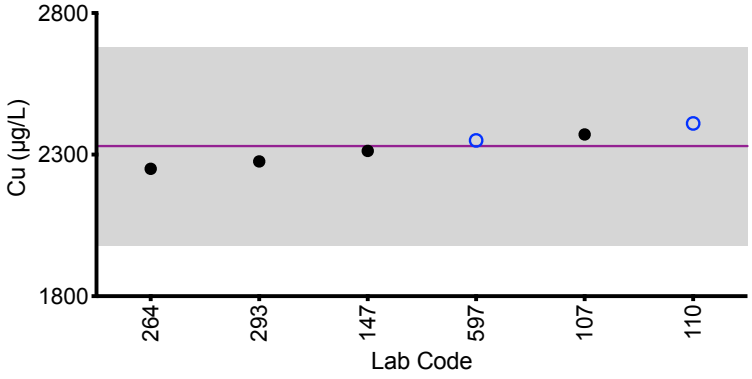
SE21-01



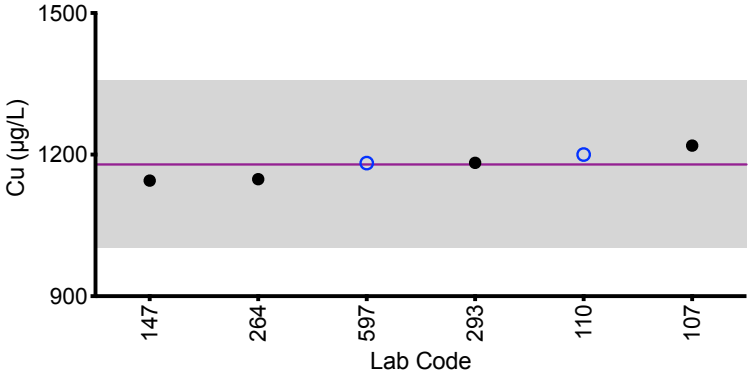
SE21-02



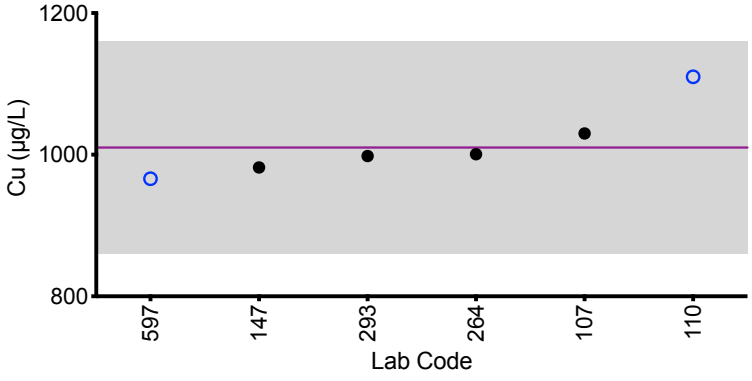
SE21-03



SE21-04



SE21-05



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 #1, 2021:
Summary Statistics

	Serum Se (µg/L)				
	SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Target (Arithmetic Mean ($\bar{x}$))	104	128	86.8	255	174
Upper Limit	125	154	104.2	306	209
Lower Limit	83	102	69.4	204	139
Arithmetic SD (s)	7	5	2.0	10	8
Arithmetic RSD (%)	6.7	3.9	2.3	3.9	4.6
Number of Sample Measurements (N)	6	7	7	7	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 by New York State Department of Health's Wadsworth Center, the PT Program organizer.

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Results for Event #1, 2021:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
	Target	**104**	**128**	**86.8**	**255**	**174**
103	ICP-MS/MS	*60.2 ↓	133	83.4	259	170
107	DRC/CC-ICP-MS	106.1	124.2	87.4	256.6	175.1
110	DRC/CC-ICP-MS	110	130	86.6	242	178
147	DRC/CC-ICP-MS	102	120	86.1	246	164
264	ICP-MS	107.6	130.6	89.98	265.4	183.9
293	DRC/CC-ICP-MS	106.55	132.6	87.61	266.77	180.74
597	ICP-MS/MS	90.8	127	86.4	248	165.4

Based on the grading criteria for Se 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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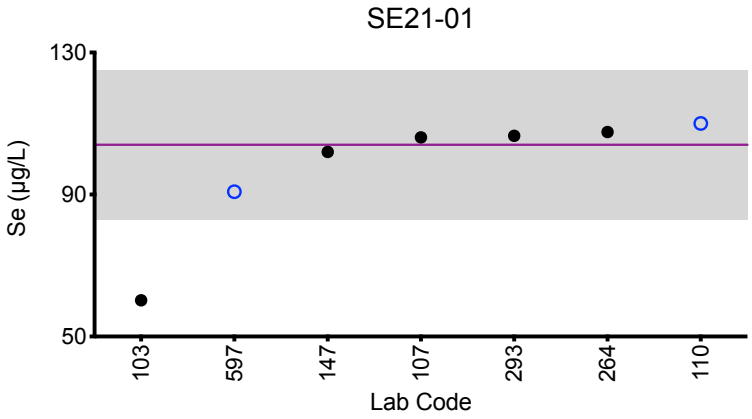
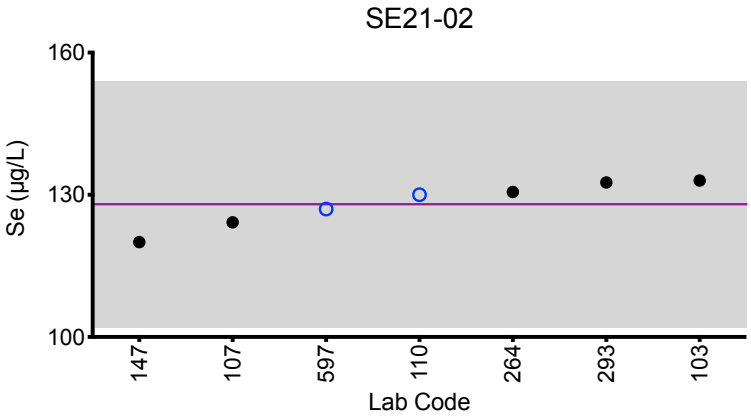
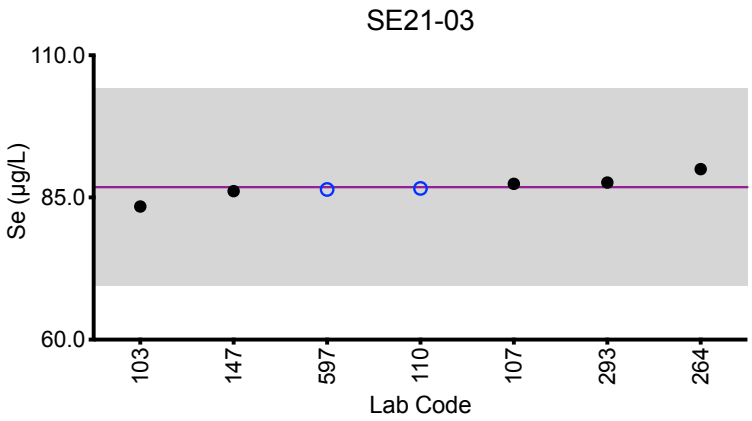
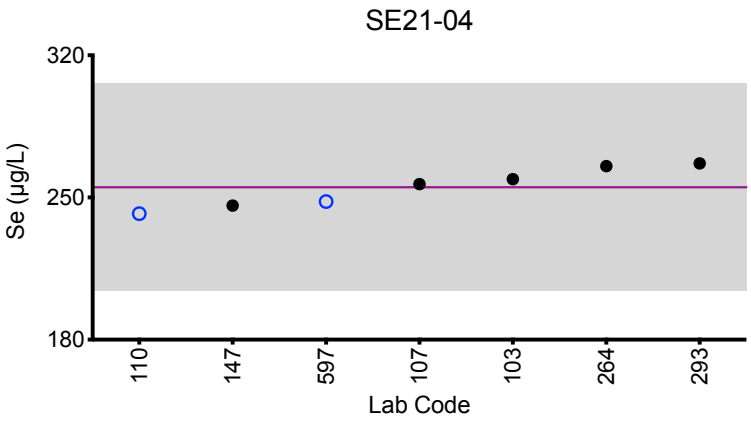
Results for Event #1, 2021: Summary Figures

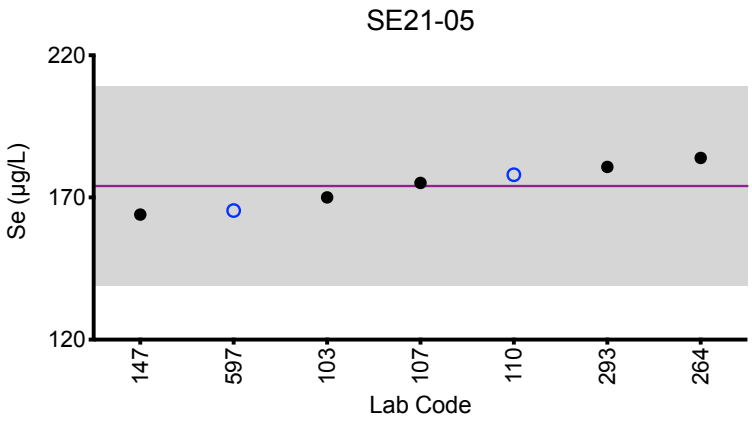
Serum Se











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

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Results for Event #1, 2021:
Summary Statistics

Serum Zn (µg/L)					
	SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Target (Arithmetic Mean ($\bar{x}$))	810	630	930	1180	690
Upper Limit	930	720	1070	1360	790
Lower Limit	690	540	790	1000	590
Arithmetic SD (s)	60	60	40	40	60
Arithmetic RSD (%)	7.4	9.5	4.3	3.4	8.7
Number of Sample Measurements (N)	6	6	6	6	6

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

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Results for Event #1, 2021:
Performance of Participating Laboratories

Serum Zn (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
	Target	**810**	**630**	**930**	**1180**	**690**
107	DRC/CC-ICP-MS	872	626	962	1231	688
110	ICP-MS	875	661	975	1190	805 ↑
147	DRC/CC-ICP-MS	723	548	868	1113	616
264	ICP-MS	794.6	596.8	897.8	1146.1	672.2
293	DRC/CC-ICP-MS	816.99	633.99	934.64	1209.15	692.81
597	ICP-MS/MS	761	723 ↑	961	1210	662

Based on the grading criteria for Zn in Serum, 93% of results were satisfactory, with 0 of the 6 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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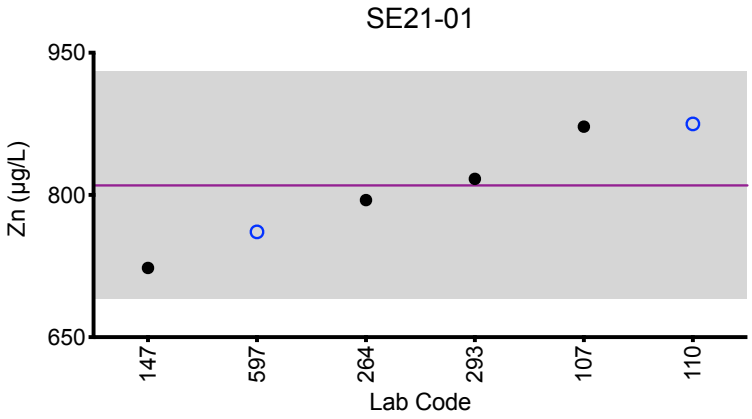
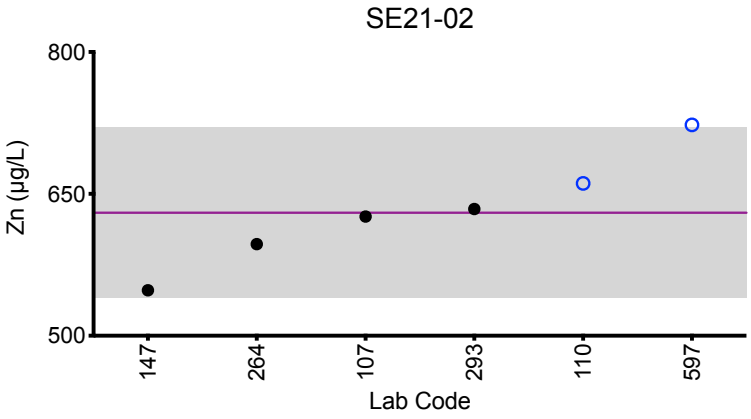
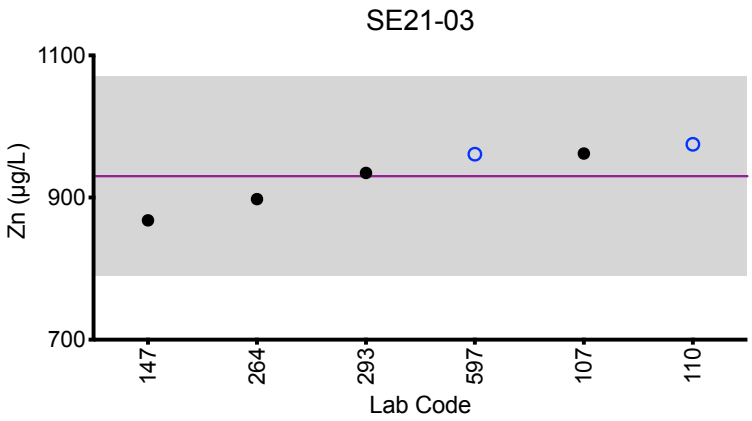
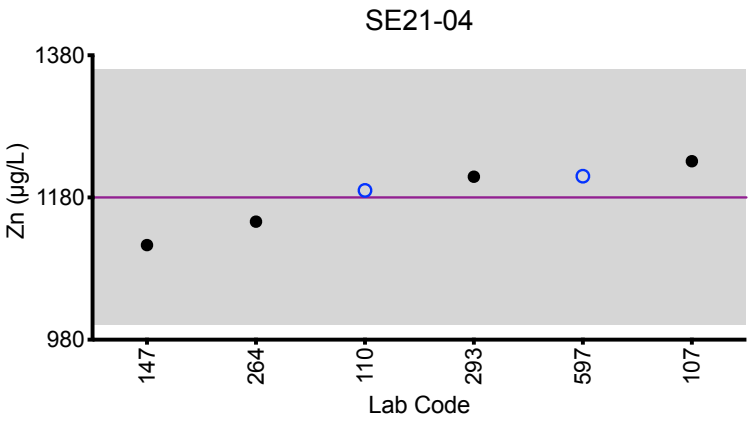
Results for Event #1, 2021: Summary Figures

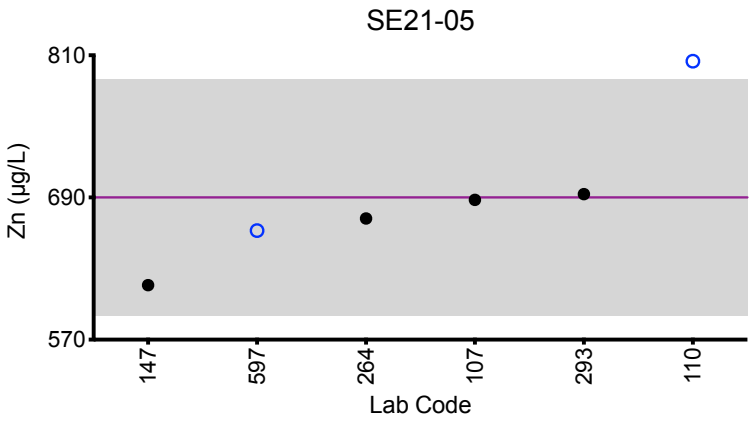
Serum Zn











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 #1, 2021:
Laboratory Data and Summary Statistics

Serum Mn (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
103	ICP-MS/MS	2.34	0.952	6.21	4.28	15.8
110	ICP-MS	4.64	1.25	6.98	4.81	20.4
147	DRC/CC-ICP-MS	4.11	0.941	6.68	4.16	14.8
264	ICP-MS	5.40	1.44	7.81	5.57	20.67
293	DRC/CC-ICP-MS	4.35	1	6.96	4.68	17.34
597	ICP-MS/MS	3.75	1.13	6.92	4.52	16.3

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	4.1	1.12	6.9	4.7	17.6
Arithmetic SD (s)	1.0	0.20	0.5	0.5	2.5
Arithmetic RSD (%)	24	18	7.2	11	14
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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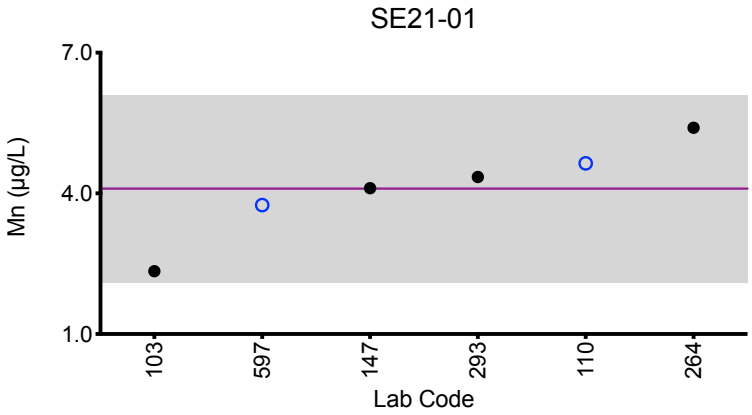
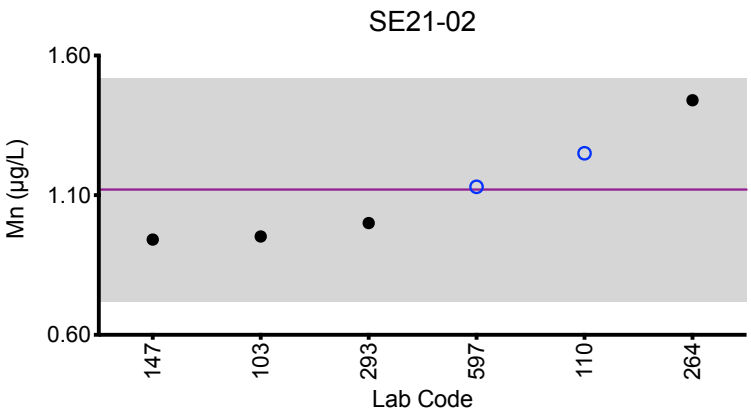
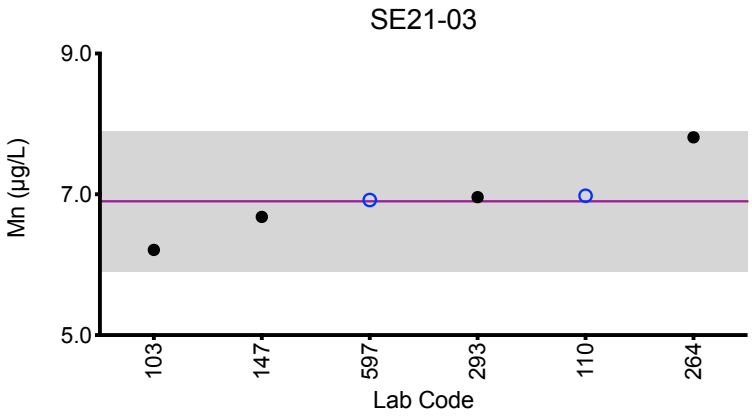
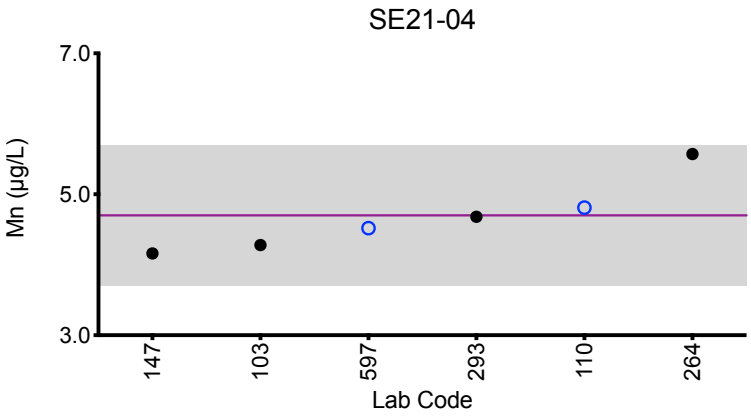
Results for Event #1, 2021: Summary Figures

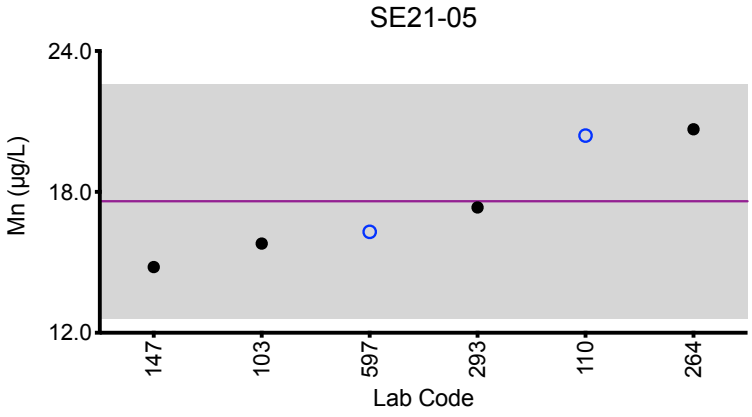
Serum Mn











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 #1, 2021:
Laboratory Data and Summary Statistics

Serum Mo (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
103	ICP-MS/MS	2.43	6.09	0.653	2.05	3.37
110	ICP-MS	4.85	6.04	0.91	2.26	3.94
147	DRC/CC-ICP-MS	4.49	5.90	0.832	1.99	3.60
293	DRC/CC-ICP-MS	4.9	7.39	0.75	1.92	3.5
485	HR-ICP-MS	4.73	6.15	<1.0	2.13	3.76
597	ICP-MS/MS	3.75	5.80	0.606	1.69	3.18

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	4.2	6.2	0.75	2.01	3.6
Arithmetic SD (s)	1.0	0.6	0.12	0.19	0.3
Arithmetic RSD (%)	24	9.7	16	9.5	7.6
Number of Sample Measurements (N)	6	6	5	6	6

*Denotes a statistical Outlier.

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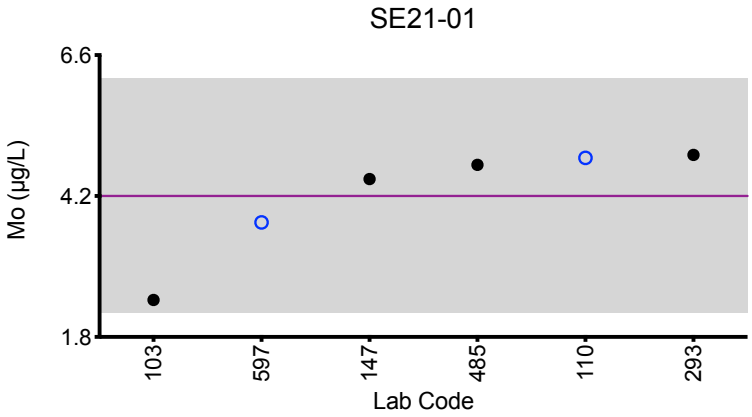
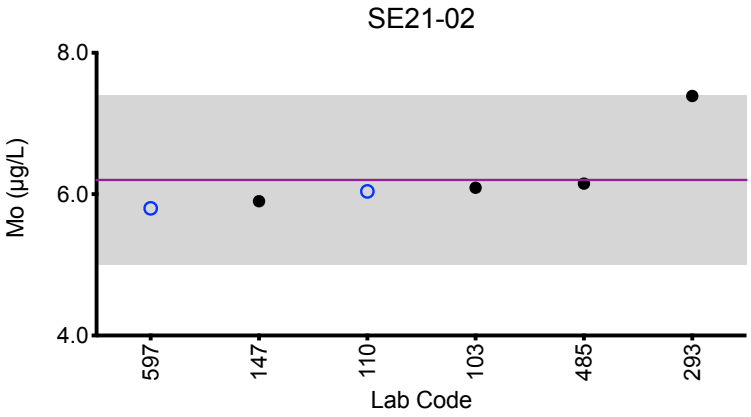
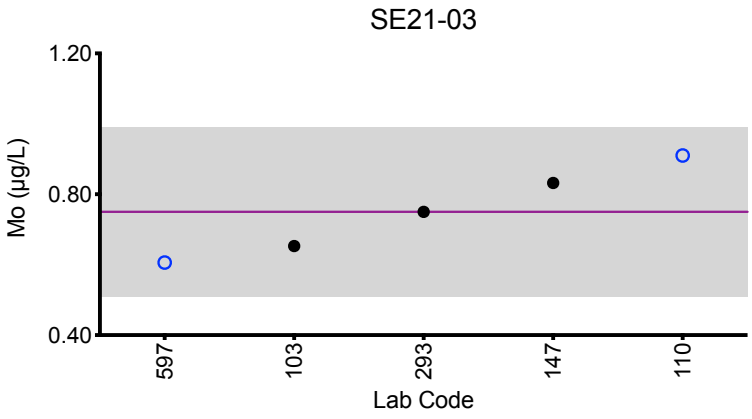
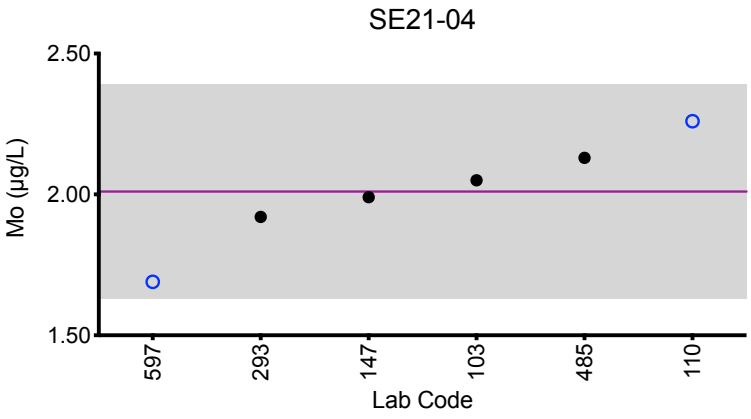
Results for Event #1, 2021: Summary Figures

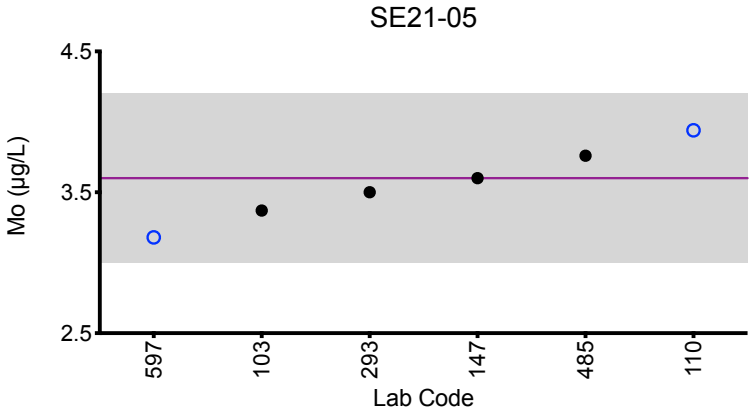
Serum Mo











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

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
110	DRC/CC-ICP-MS	3.23	9.61	1.79	4.49	3.12
147	DRC/CC-ICP-MS	2.44	7.04	0.659	3.11	1.37
293	DRC/CC-ICP-MS	2.38	7.33	1.02	3.21	1.4
485	HR-ICP-MS	2.38	7.40	0.609	3.09	1.44
597	ICP-MS/MS	3.03	8.19	1.62	4.14	2.59

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	2.7	7.9	1.1	3.6	2.0
Arithmetic SD (s)	0.4	1.0	0.5	0.7	0.8
Arithmetic RSD (%)	15	13	45	19	40
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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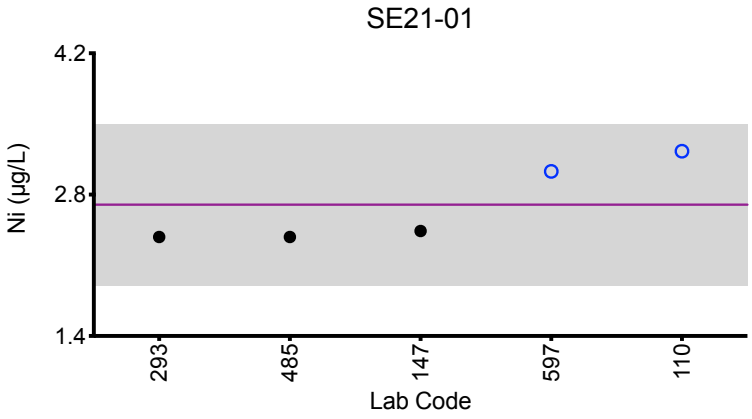
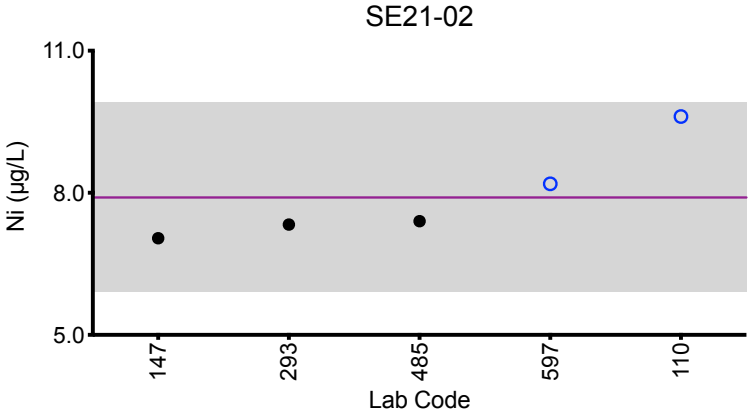
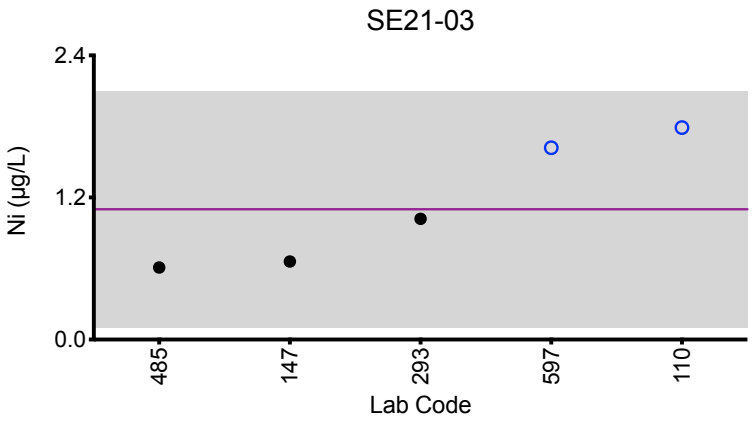
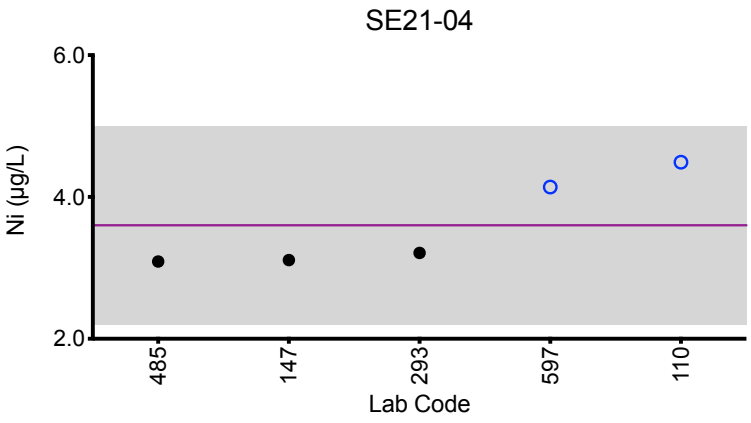
Results for Event #1, 2021: Summary Figures

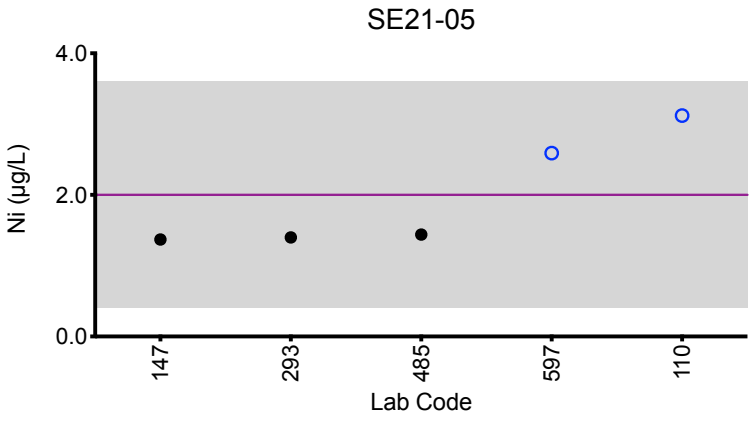
Serum Ni











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

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum V (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
110	DRC/CC-ICP-MS	*0.5	2.0	*1.0	7.3	1.5
147	DRC/CC-ICP-MS	0.132	1.90	0.402	6.75	0.976
293	DRC/CC-ICP-MS	0.23	2.23	0.56	7.43	1.3
485	HR-ICP-MS	0.142	2.08	0.403	7.21	0.991
597	ICP-MS/MS	0.153	1.97	0.417	6.76	1.02

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	0.16	2.04	0.45	7.1	1.16
Arithmetic SD (s)	0.04	0.13	0.08	0.3	0.23
Arithmetic RSD (%)	25	6.4	18	4.5	20
Number of Sample Measurements (N)	4	5	4	5	5

*Denotes a statistical Outlier.

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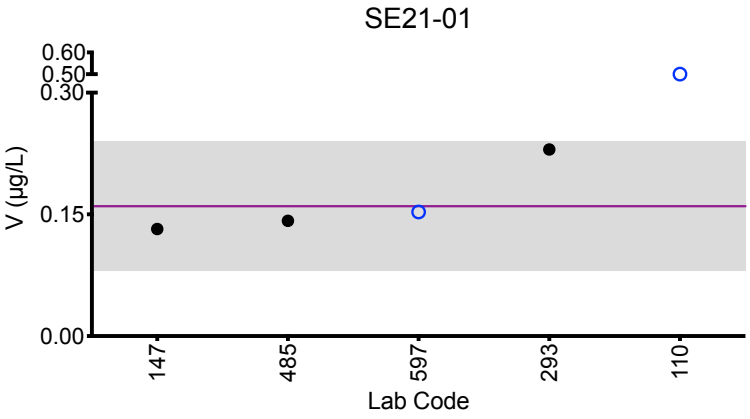
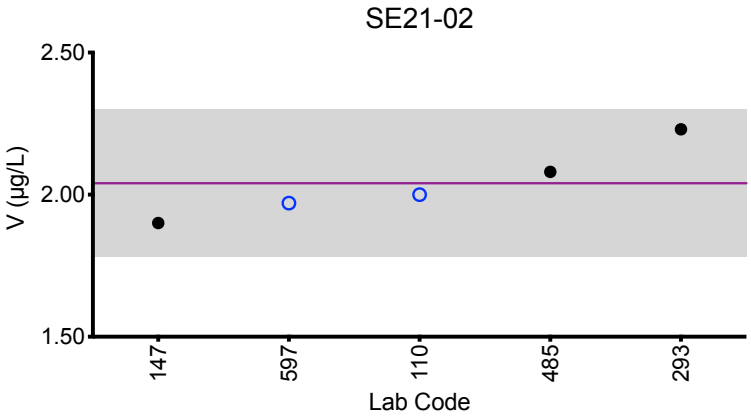
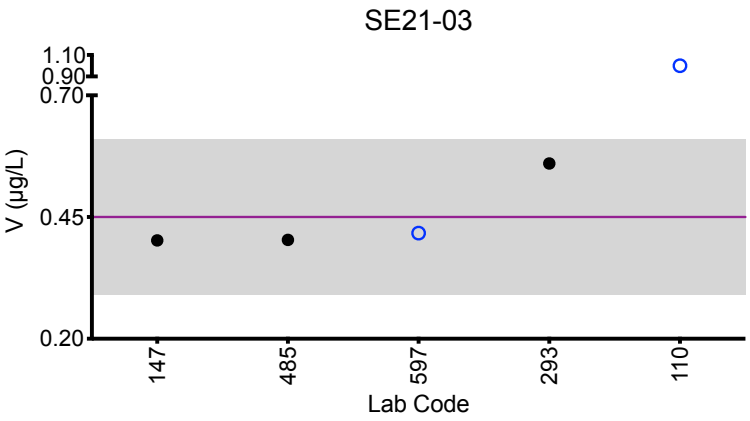
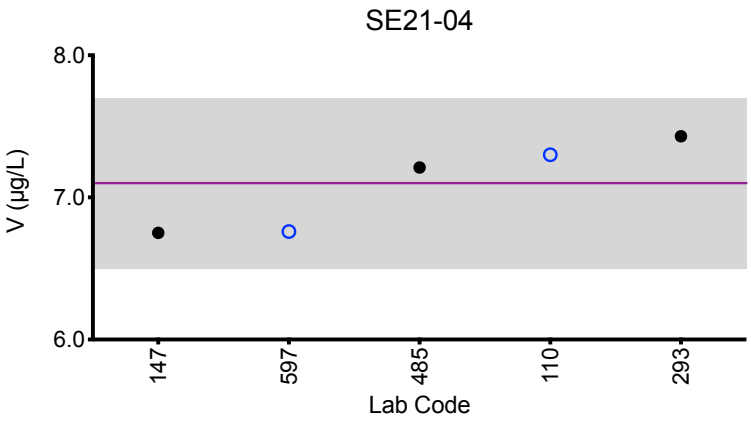
Results for Event #1, 2021: Summary Figures

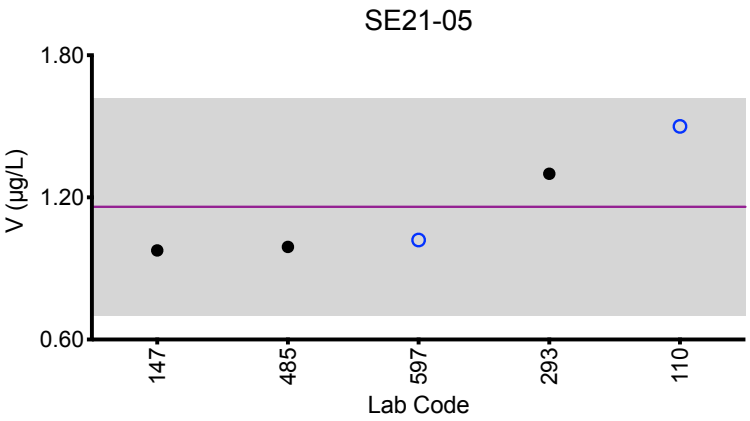
Serum V











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 #1, 2021:
Laboratory Data and Summary Statistics

Serum As (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
103	ICP-MS/MS	10.4	0.634	1.82	1.13	8.65
110	DRC/CC-ICP-MS	18.6	0.82	1.98	1.36	9.46
147	DRC/CC-ICP-MS	19.0	0.684	2.17	1.20	9.33
597	ICP-MS/MS	16.5	0.872	2.26	1.43	9.12

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	16	0.75	2.1	1.28	9.1
Arithmetic SD (s)	4	0.11	0.2	0.14	0.4
Arithmetic RSD (%)	25	15	9.7	11	4.4
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
110	ICP-MS	0.61	1.27	0.71	0.85	*2.09
147	ICP-MS	0.532	1.35	0.821	0.957	0.595
293	DRC/CC-ICP-MS	0.52	1.22	0.67	0.8	0.55
597	ICP-MS/MS	0.548	1.35	0.846	0.874	0.627

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	0.55	1.30	0.76	0.87	0.59
Arithmetic SD (s)	0.04	0.06	0.09	0.07	0.04
Arithmetic RSD (%)	7.3	4.6	12	7.5	6.8
Number of Sample Measurements (N)	4	4	4	4	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Be (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
110	ICP-MS	0.434	1.21	3.68	1.88	0.959
147	ICP-MS	0.429	0.928	3.31	2.00	0.802
293	ICP-MS	0.5	1.15	3.79	2.07	0.8
597	ICP-MS/MS	0.526	1.08	3.21	1.79	0.737

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	0.47	1.09	3.5	1.94	0.82
Arithmetic SD (s)	0.05	0.12	0.3	0.12	0.09
Arithmetic RSD (%)	11	11	8.0	6.2	11
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
103	ICP-MS/MS	0.342	0.879	0.284	7.60	2.32
110	ICP-MS	0.607	0.912	0.310	7.53	2.53
147	ICP-MS	0.582	0.867	0.333	7.60	2.50
597	ICP-MS/MS	0.569	0.844	0.313	7.50	2.26

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	0.53	0.88	0.31	7.56	2.40
Arithmetic SD (s)	0.12	0.03	0.02	0.05	0.13
Arithmetic RSD (%)	23	3.2	6.5	0.66	5.4
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
110	ICP-MS	0.325	0.249	0.301	0.486	0.418
597	ICP-MS/MS	0.224	0.234	0.204	0.448	0.344
Summary Statistics						
		SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Arithmetic Mean ($\bar{x}$)		0.27	0.242	0.25	0.47	0.38
Arithmetic SD (s)		0.07	0.011	0.07	0.03	0.05
Arithmetic RSD (%)		26	4.5	28	6.4	13
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
103	ICP-MS/MS	1.42	0.626	1.04	1.08	6.95
110	ICP-MS	2.80	0.69	1.09	0.96	7.41
597	ICP-MS/MS	2.38	0.687	1.15	1.02	6.78
Summary Statistics						
		SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Arithmetic Mean ($\bar{x}$)		2.2	0.67	1.09	1.02	7.0
Arithmetic SD (s)		0.7	0.04	0.06	0.06	0.3
Arithmetic RSD (%)		32	5.4	5.5	5.9	4.3
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Mg (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
264	ICP-MS	15846	15669	15463	17312	17230
597	ICP-MS/MS	15200	18100	16700	18800	17700

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	15500	16900	16100	18100	17500
Arithmetic SD (s)	500	1700	900	1100	300
Arithmetic RSD (%)	3.2	10	5.6	6.1	1.7
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
103	ICP-MS/MS	1.14	7.78	0.960	16.5	3.89
110	ICP-MS	2.04	7.86	1.06	15.8	4.61
597	ICP-MS/MS	1.62	7.35	0.929	15.3	3.75
Summary Statistics						
		SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Arithmetic Mean ($\bar{x}$)		1.6	7.7	0.98	15.9	4.1
Arithmetic SD (s)		0.5	0.3	0.07	0.6	0.5
Arithmetic RSD (%)		31	3.9	7.1	3.8	12
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
110	ICP-MS	0.83	0.30	1.54	0.70	2.11
264	ICP-MS	0.79	0.24	1.44	0.68	2.09
293	DRC/CC-ICP-MS	0.90	0.4	1.5	0.8	2.2

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	0.84	0.31	1.49	0.73	2.13
Arithmetic SD (s)	0.06	0.08	0.05	0.06	0.06
Arithmetic RSD (%)	7.1	26	3.4	8.2	2.8
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
103	ICP-MS/MS	3.02	0.835	3.33	0.667	1.64
110	ICP-MS	6.51	0.90	4.14	0.76	2.26
147	ICP-MS	6.33	0.871	4.01	0.661	2.01
597	ICP-MS/MS	5.34	0.791	3.77	0.610	1.83

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	5.3	0.85	3.8	0.67	1.9
Arithmetic SD (s)	1.6	0.05	0.4	0.06	0.3
Arithmetic RSD (%)	30	5.9	11	9.3	13
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
110	ICP-MS	2.93	6.21	1.29	4.39	0.90
597	ICP-MS/MS	2.37	6.05	1.19	4.39	0.595
Summary Statistics						
		SE21-01	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
Arithmetic Mean ($\bar{x}$)		2.7	6.13	1.24	4.39	0.7
Arithmetic SD (s)		0.4	0.11	0.07	0.00	0.2
Arithmetic RSD (%)		15	1.8	5.6	0.0	29
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
103	ICP-MS/MS	17.7	30.5	30.2	63.7	24.7
200	ICP-MS	29.8	28	30.7	58.7	23.7
597	ICP-MS/MS	28.7	30.7	32.8	62.1	25.6

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	25	29.7	31.2	61.5	24.7
Arithmetic SD (s)	7	1.5	1.4	2.6	1.0
Arithmetic RSD (%)	26	5.1	4.4	4.2	3.9
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
200	DRC/CC-ICP-MS	1.1	0.7	1	3.7	0.9
485	HR-ICP-MS	2.14	3.87	1.05	9.19	3.43
597	ICP-MS/MS	5.72	8.29	5.59	12.7	7.39

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	NA	NA	NA	NA	NA
Arithmetic SD (s)	NA	NA	NA	NA	NA
Arithmetic RSD (%)	NA	NA	NA	NA	NA
Number of Sample Measurements (N)	NA	NA	NA	NA	NA

*Denotes a statistical Outlier.

Statistical data was not calculated for SE21-01, SE21-02, SE21-03, SE21-04 and SE21-05 based on a lack of consensus among participating labs.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
103	ICP-MS/MS	0.396	0.964	0.322	5.14	2.77
110	ICP-MS	0.746	0.971	0.366	4.91	3.13
147	ICP-MS	0.644	0.901	0.337	4.78	2.81
597	ICP-MS/MS	0.593	0.858	0.292	4.46	2.58

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	0.59	0.92	0.33	4.8	2.8
Arithmetic SD (s)	0.15	0.05	0.03	0.3	0.2
Arithmetic RSD (%)	25	5.4	9.1	5.8	8.2
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum U (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
103	ICP-MS/MS	0.0330	0.0283	0.136	0.131	0.202
110	ICP-MS	0.065	0.027	0.163	0.115	0.223
597	ICP-MS/MS	<0.04	<0.04	0.168	0.129	0.193

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	0.05	0.0277	0.16	0.125	0.206
Arithmetic SD (s)	0.02	0.0009	0.02	0.009	0.015
Arithmetic RSD (%)	40	3.2	11	7.2	7.3
Number of Sample Measurements (N)	2	2	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021:
Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
110	ICP-MS	0.32	2.62	0.70	1.06	4.87
200	ICP-MS	0.4	2.6	0.7	1	4.4
597	ICP-MS/MS	0.266	2.60	0.624	1.05	4.34

Summary Statistics

	SE21-01	SE21-02	SE21-03	SE21-04	SE21-05
Arithmetic Mean ($\bar{x}$)	0.33	2.61	0.67	1.04	4.5
Arithmetic SD (s)	0.07	0.01	0.04	0.03	0.3
Arithmetic RSD (%)	20	0.44	6.5	3.1	6.4
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #1, 2021: Additional Elements in Serum

Serum B (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
200	ICP-MS	23.0	22	14	77	24

Serum Bi (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
147	ICP-MS	<0.040	<0.040	<0.040	0.529	<0.040
597	ICP-MS/MS	0.036	0.073	<0.03	0.536	0.037

Serum Fe (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
264	ICP-MS	774.2	136.6	323.1	2211.1	512.1

Serum I (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
147	ICP-MS	54.7	44.9	54.2	42.3	41.4

Serum Li (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
147	ICP-MS	0.472	0.500	1.13	2.48	0.305

Serum Th (µg/L)						
Lab Code	**Method**	**SE21-01**	**SE21-02**	**SE21-03**	**SE21-04**	**SE21-05**
597	ICP-MS/MS	0.06	1.29	<0.03	<0.03	<0.03

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.