NEW YORK STATE | Department of Health | Wadsworth Center

New York State Biomonitoring Program for Trace Elements

Event #3, 2023

Trace Elements in Whole Blood, Urine, and Serum

December, 2023

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

NEW YORK STATE | Department of Health | Wadsworth Center

Event #3, 2023:
Trace Elements in Whole Blood, Urine, and Serum

12/7/2023

Dear Laboratory Director,

This report summarizes performance for the third biomonitoring proficiency test (PT) event of 2023 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. In this report, we summarize the responses to our recent survey request. Please refer to the attachement at the end of the report for more details.

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

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

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

Samples for the next PT event (Event #1, 2024) will be shipped February 7, 2024. 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

NEW YORK STATE | Department of Health | Wadsworth Center

Event #3, 2023

Trace Elements in Whole Blood

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

NEW YORK STATE | Department of Health | Wadsworth Center

Event #3, 2023:
Trace Elements in Whole Blood

PT Materials

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

Graded Elements

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

Additional Elements

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

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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

Whole Blood As (µg/L)					
	BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Target (Arithmetic Mean ($\bar{x}$))	1.89	12.3	36.5	6.7	3.75
Upper Limit	7.89	18.3	43.8	12.7	9.75
Lower Limit	0.00	6.3	29.2	0.7	0.00
Arithmetic SD (s)	0.09	0.5	1.4	0.3	0.23
Arithmetic RSD (%)	4.8	4.1	3.8	3.8	6.1
Number of Sample Measurements (N)	7	7	7	7	7

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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

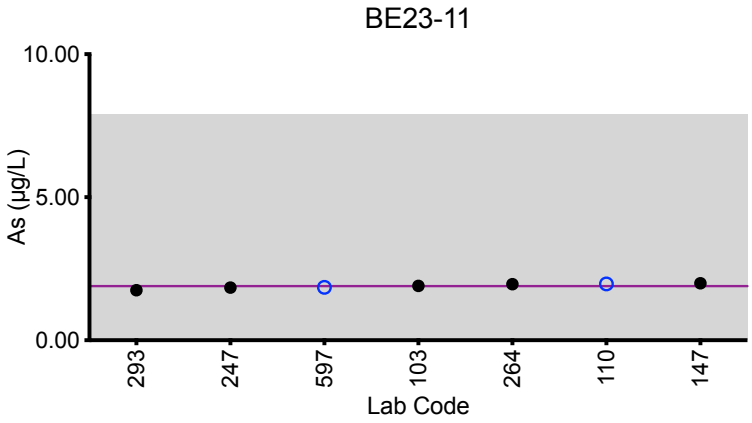
Whole Blood As (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
	Target	**1.89**	**12.3**	**36.5**	**6.7**	**3.75**
103	ICP-MS/MS	1.90	13.1	38.0	6.95	3.94
110	ICP-MS/MS	1.97	12.6	38.0	6.99	4.15
147	ICP-MS	1.99	12.1	37.1	6.53	3.65
247	ICP-MS/MS	1.84	11.5	34.2	6.42	3.48
264	ICP-MS	1.96	11.87	35.98	6.36	3.66
293	DRC/CC-ICP-MS	1.75	12.1	35.65	6.58	3.6
597	ICP-MS/MS	1.85	12.5	36.5	6.82	3.77

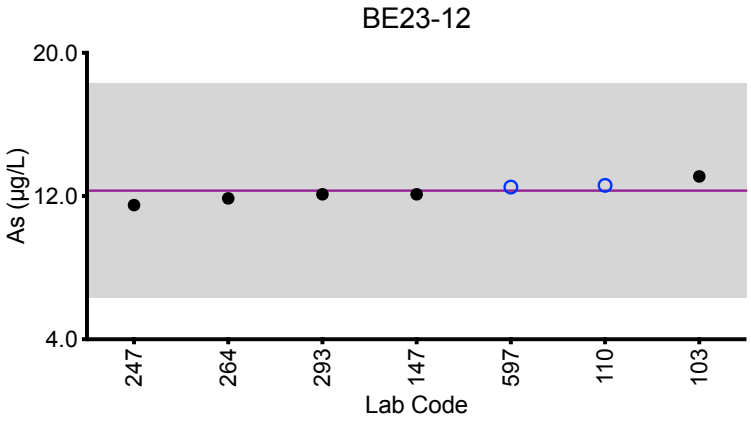
Based on the grading criteria for As in Whole Blood, 100% of results were satisfactory, with 0 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

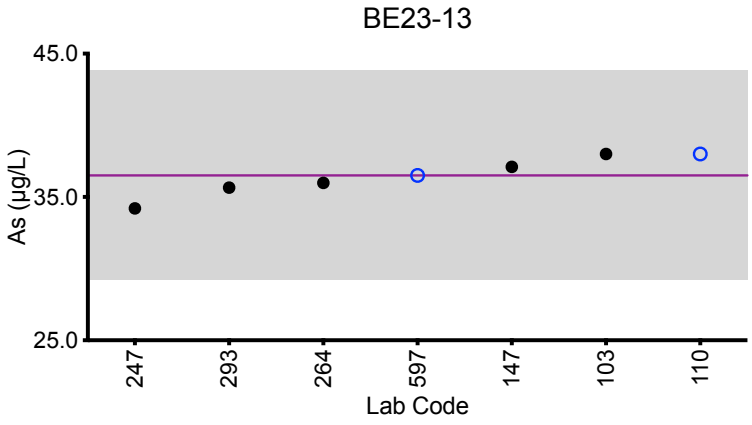
NEW YORK STATE | Department of Health | Wadsworth Center

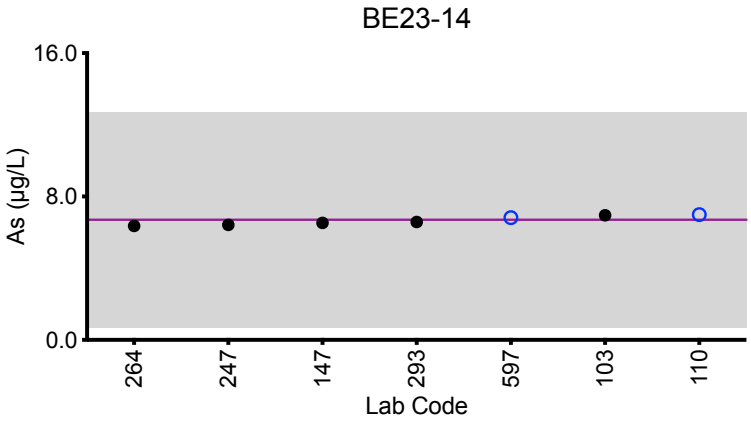
Results for Event #3, 2023: Summary Figures

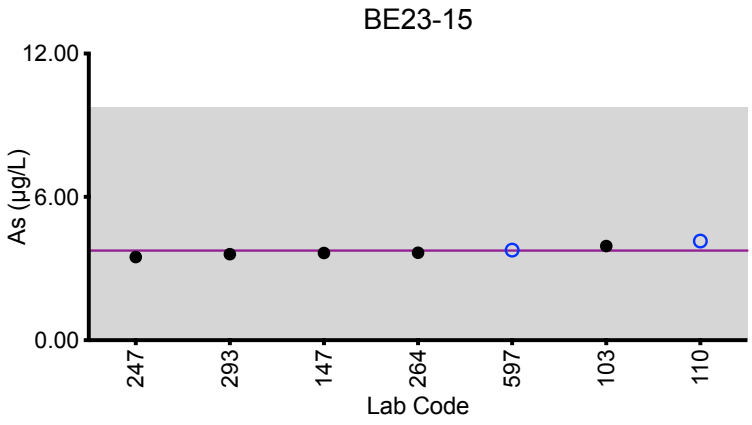
Whole Blood As











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

Whole Blood Cd (µg/L)					
	BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Target (Robust Mean (x*))	1.24	2.81	4.95	12.0	0.569
Upper Limit	2.24	3.81	5.95	13.8	1.569
Lower Limit	0.24	1.81	3.95	10.2	0.000
Robust SD (s*)	0.08	0.14	0.26	0.6	0.020
Robust RSD (%)	6.5	4.9	5.3	4.7	3.5
Number of Sample Measurements (N)	11	12	12	12	11
Standard Uncertainty (*u*)	0.03	0.05	0.09	0.2	0.007

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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

Whole Blood Cd (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
	Target	**1.24**	**2.81**	**4.95**	**12.0**	**0.569**
103	ICP-MS/MS	1.26	2.87	5.15	12.2	0.578
107	ICP-MS/MS	1.22	2.73	4.96	11.70	0.55
110	ICP-MS	1.21	2.93	5.26	12.3	0.43
116	ICP-MS/MS	<1.50	2.83	4.60	11.7	<1.50
147	ICP-MS	1.18	2.76	4.95	11.6	0.570
247	ICP-MS/MS	1.14	2.59	4.47	11.4	0.565
264	ICP-MS	1.14	2.50	4.56	10.72	0.42
293	DRC/CC-ICP-MS	1.21	2.78	5.010	12.1	0.57
597	ICP-MS/MS	1.30	2.94	5.09	12.3	0.581
605	ICP-MS	1.33	2.90	5.06	12.5	0.578
606	ICP-MS/MS	1.32	2.73	4.83	12.5	0.600
686	ICP-MS	1.31	2.98	5.23	12.9	0.589

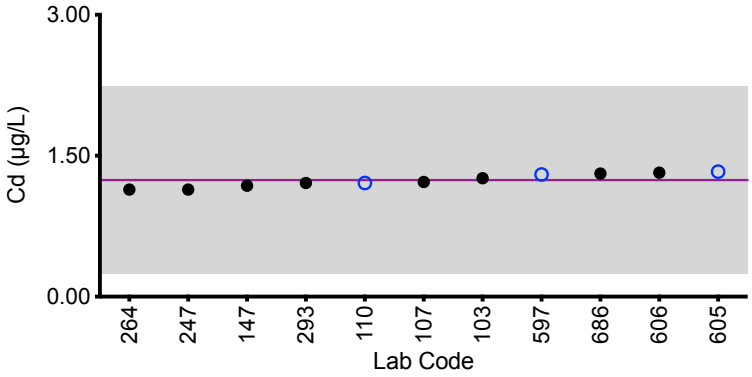
Based on the grading criteria for Cd in Whole Blood, 100% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

NEW YORK STATE | Department of Health | Wadsworth Center

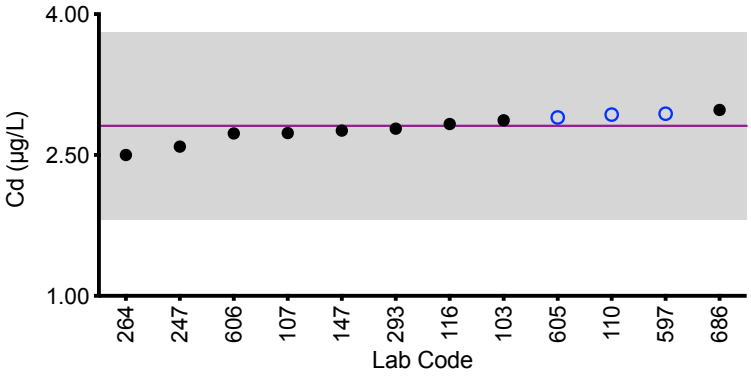
Results for Event #3, 2023: Summary Figures

Whole Blood Cd

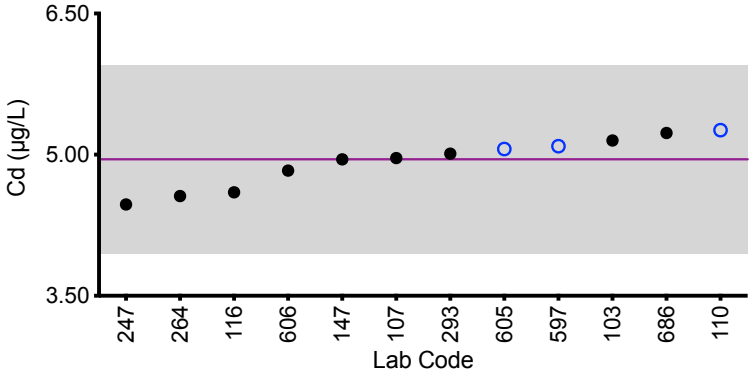
BE23-11



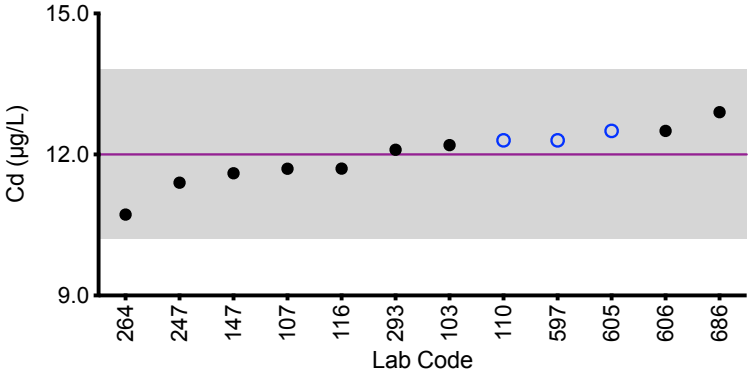
BE23-12



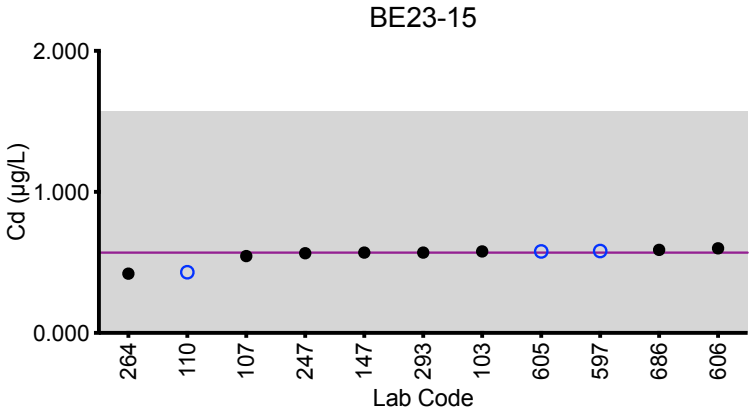
BE23-13



BE23-14



BE23-15



Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

Whole Blood Co (µg/L)					
	BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Target (Arithmetic Mean ($\bar{x}$))	1.99	0.50	11.7	6.3	29.3
Upper Limit	3.49	2.00	14.0	7.8	35.2
Lower Limit	0.49	0.00	9.4	4.8	23.4
Arithmetic SD (s)	0.11	0.05	0.5	0.3	1.1
Arithmetic RSD (%)	5.5	10	4.3	4.3	3.8
Number of Sample Measurements (N)	8	7	8	8	8

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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

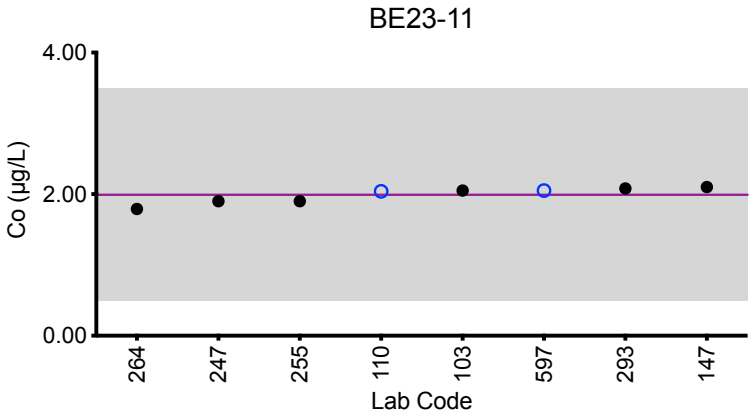
Whole Blood Co (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
	Target	**1.99**	**0.50**	**11.7**	**6.3**	**29.3**
103	ICP-MS/MS	2.05	0.460	11.7	6.23	29.3
110	ICP-MS/MS	2.04	0.51	12.1	6.54	30.5
147	ICP-MS	2.10	0.575	11.8	6.42	29.0
247	ICP-MS/MS	1.90	0.476	11.1	6.01	27.7
255	ICP-MS	1.9	<0.5	11	6.2	29
264	ICP-MS	1.79	0.44	11.09	5.83	28.12
293	DRC/CC-ICP-MS	2.08	0.54	12.43	6.50	30.28
597	ICP-MS/MS	2.05	0.511	12.1	6.61	30.6

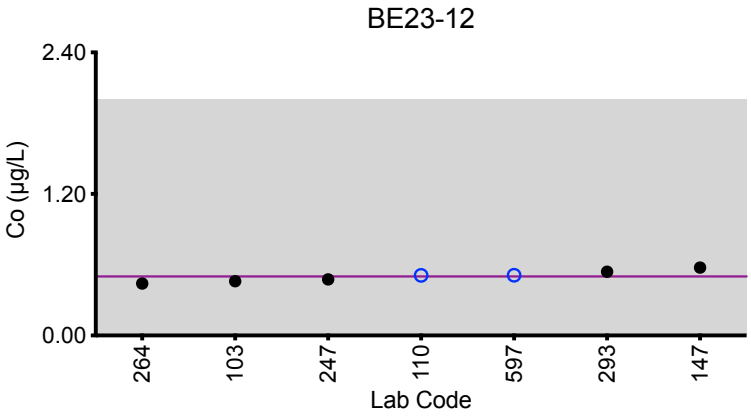
Based on the grading criteria for Co in Whole Blood, 100% of results were satisfactory, with 0 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

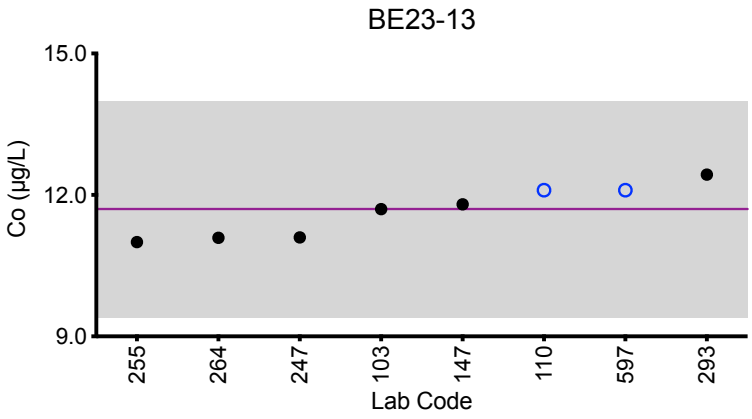
NEW YORK STATE | Department of Health | Wadsworth Center

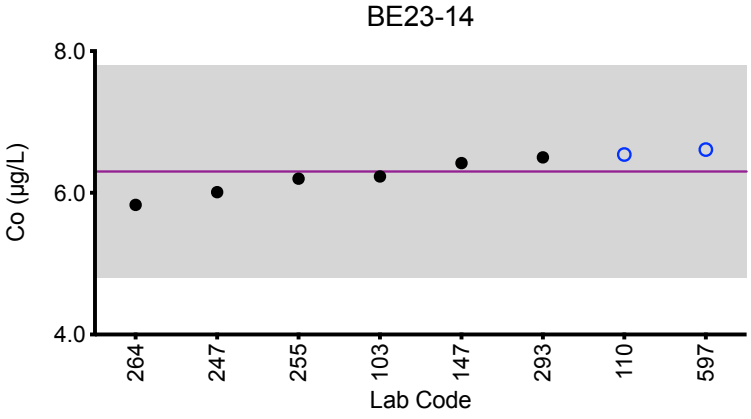
Results for Event #3, 2023: Summary Figures

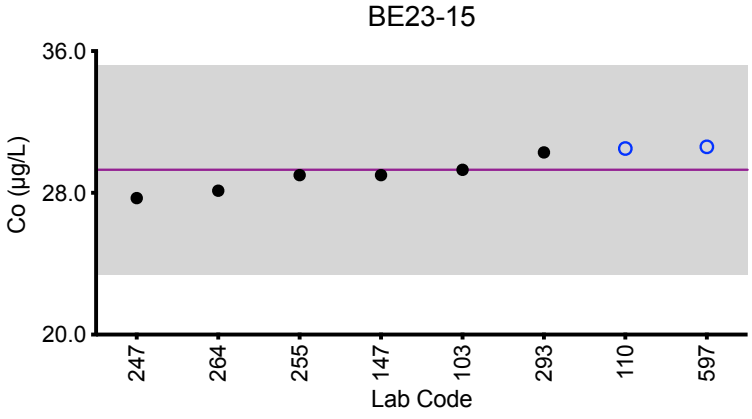
Whole Blood Co











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

Whole Blood Cr (µg/L)					
	BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Target (Arithmetic Mean ($\bar{x}$))	4.14	1.19	10.2	0.49	3.04
Upper Limit	6.14	3.19	12.2	2.49	5.04
Lower Limit	2.14	0.00	8.2	0.00	1.04
Arithmetic SD (s)	0.24	0.19	0.8	0.05	0.11
Arithmetic RSD (%)	5.8	16	7.8	10	3.6
Number of Sample Measurements (N)	7	6	8	6	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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

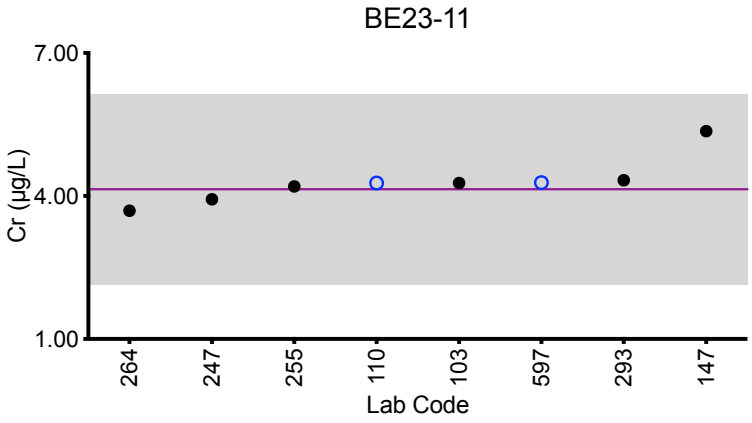
Whole Blood Cr (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
	Target	**4.14**	**1.19**	**10.2**	**0.49**	**3.04**
103	ICP-MS/MS	4.27	<1.50	10.9	<1.50	2.95
110	ICP-MS/MS	4.27	1.04	10.4	0.44	3.22
147	DRC/CC-ICP-MS	*5.36	1.27	11.7	0.551	*3.53
247	ICP-MS/MS	3.93	1.05	9.36	0.495	2.89
255	ICP-MS	4.2	<1.0	10	<1.0	3.1
264	ICP-MS	3.69	1.53	9.06	0.43	3.06
293	DRC/CC-ICP-MS	4.33	1.13	10.34	0.53	3.04
597	ICP-MS/MS	4.28	1.10	10.0	0.510	3.01

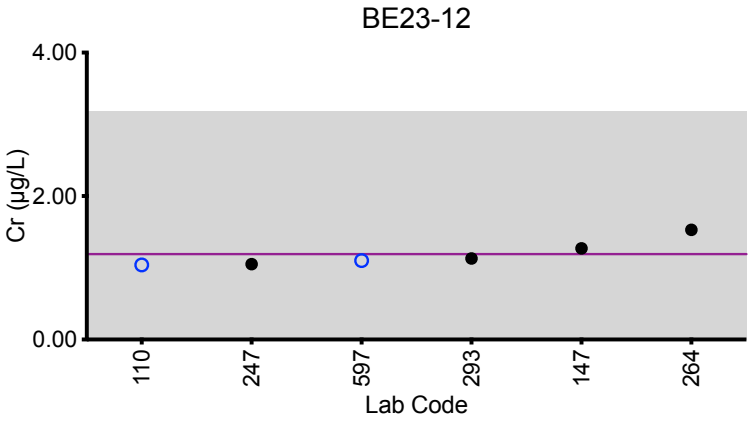
Based on the grading criteria for Cr in Whole Blood, 100% of results were satisfactory, with 0 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

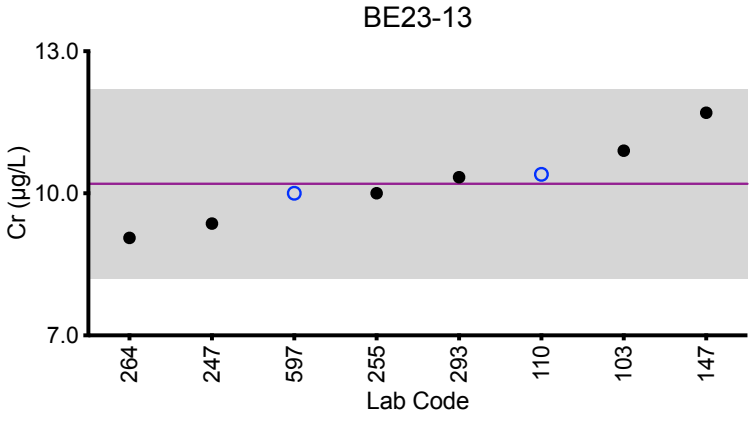
NEW YORK STATE | Department of Health | Wadsworth Center

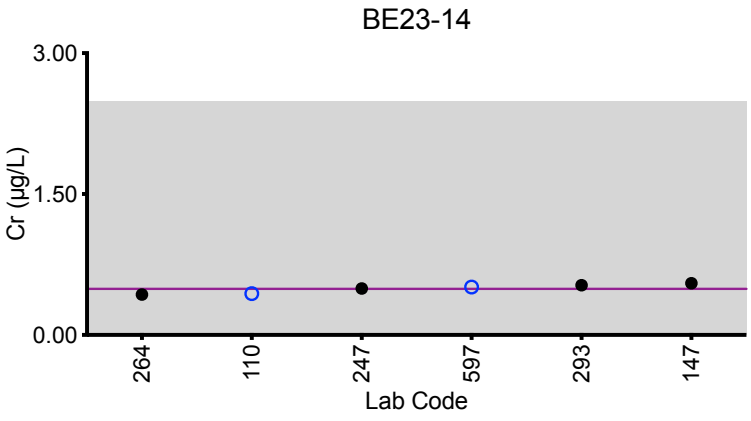
Results for Event #3, 2023: Summary Figures

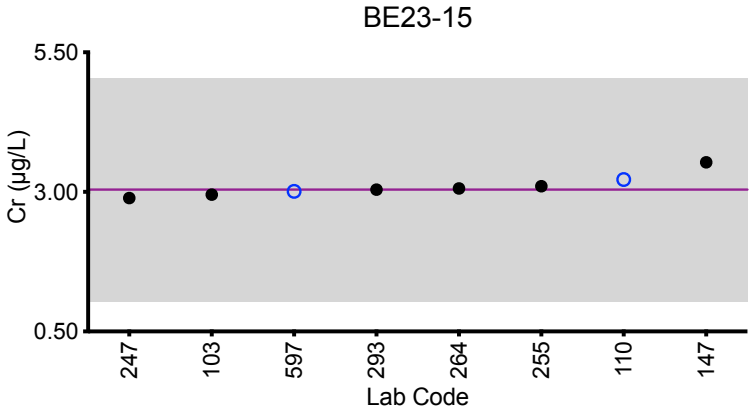
Whole Blood Cr











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

Whole Blood Hg (µg/L)					
	BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Target (Robust Mean (x*))	5.1	0.77	7.7	6.5	17.3
Upper Limit	8.1	3.77	10.7	9.5	22.5
Lower Limit	2.1	0.00	4.7	3.5	12.1
Robust SD (s*)	0.4	0.09	0.8	2.0	1.8
Robust RSD (%)	7.8	12	10	31	10
Number of Sample Measurements (N)	13	11	13	13	13
Standard Uncertainty (*u*)	0.1	0.03	0.3	0.7	0.6

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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

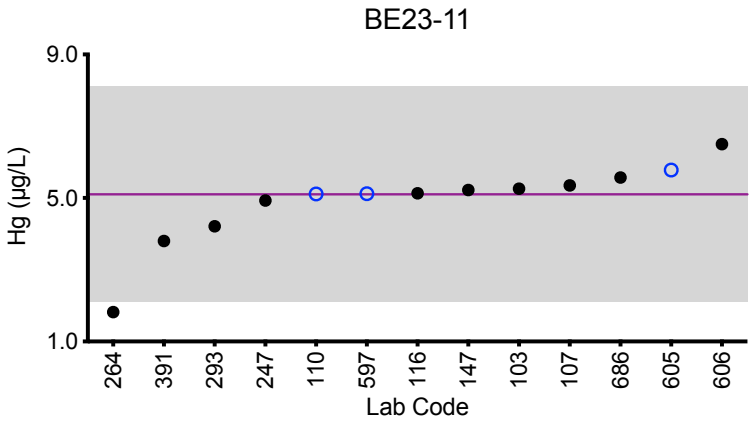
Whole Blood Hg (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
	Target	**5.1**	**0.77**	**7.7**	**6.5**	**17.3**
103	ICP-MS/MS	5.26	0.828	7.78	6.52	17.9
107	ICP-MS/MS	5.35	0.71	8.12	7.37	17.68
110	ICP-MS	5.11	0.81	7.29	4.89	16.4
116	ICP-MS/MS	5.13	<1.50	7.99	7.40	17.5
147	ICP-MS	5.22	0.658	7.66	7.54	18.1
247	ICP-MS/MS	4.93	0.804	7.54	6.54	17.1
264	ICP-MS	1.82 ↓	<0.50	3.06 ↓	2.36 ↓	8.21 ↓
293	DRC/CC-ICP-MS	4.2	0.72	5.8	4.19	13.87
391	CV-AAS	3.8	0.48	6.8	4.69	14.76
597	ICP-MS/MS	5.12	0.749	7.37	5.94	17.2
605	ICP-MS	5.78	0.885	8.93	8.41	19.3
606	ICP-MS/MS	6.50	0.880	10.4	9.26	22.5
686	ICP-MS	5.57	0.774	8.63	7.87	18.7

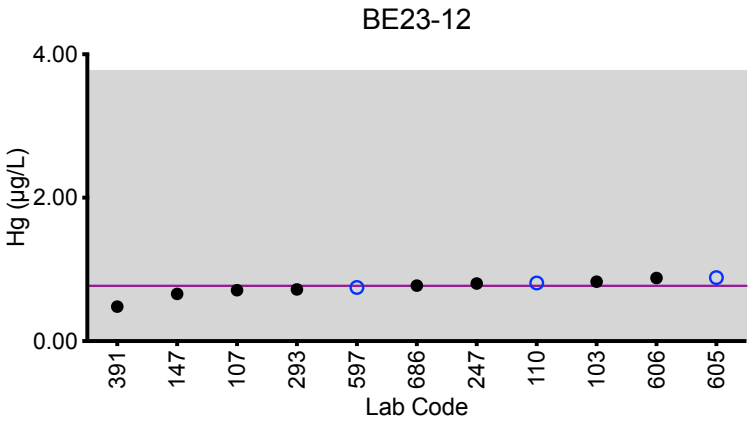
Based on the grading criteria for Hg in Whole Blood, 94% of results were satisfactory, with 1 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

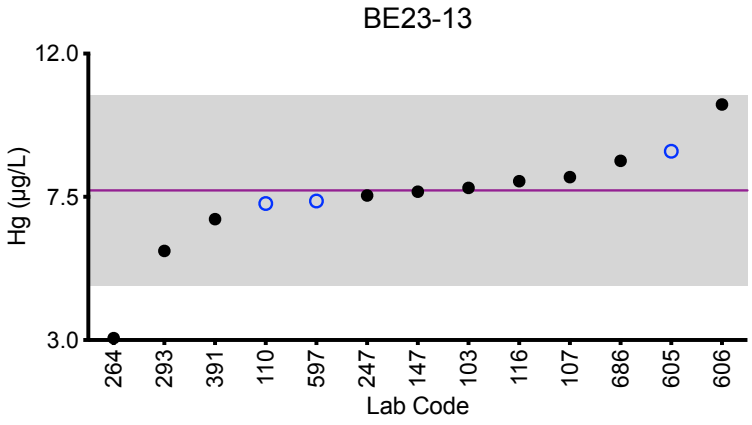
NEW YORK STATE | Department of Health | Wadsworth Center

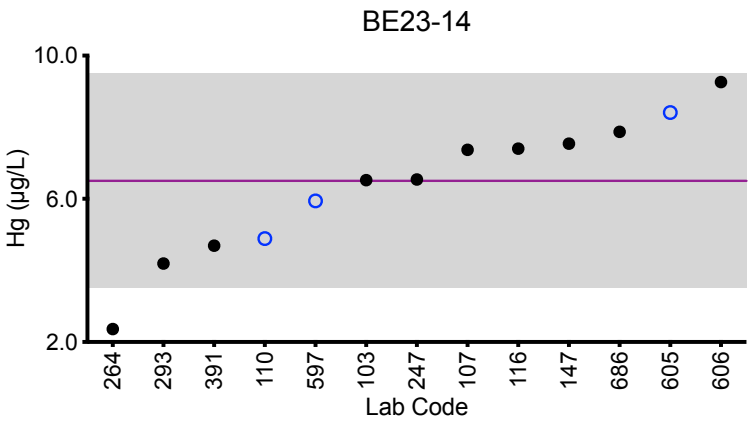
Results for Event #3, 2023: Summary Figures

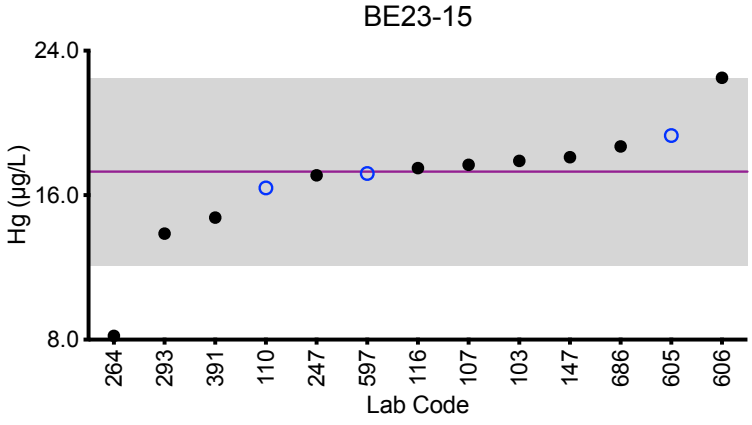
Whole Blood Hg











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

Whole Blood Mn (µg/L)					
	BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Target (Arithmetic Mean ($\bar{x}$))	7.7	26.0	9.6	20.3	27.6
Upper Limit	10.7	30.4	12.6	23.8	32.3
Lower Limit	4.7	21.6	6.6	16.8	22.9
Arithmetic SD (s)	1.3	2.2	1.2	1.6	1.7
Arithmetic RSD (%)	17	8.5	13	7.6	6.2
Number of Sample Measurements (N)	8	9	8	8	8

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).

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

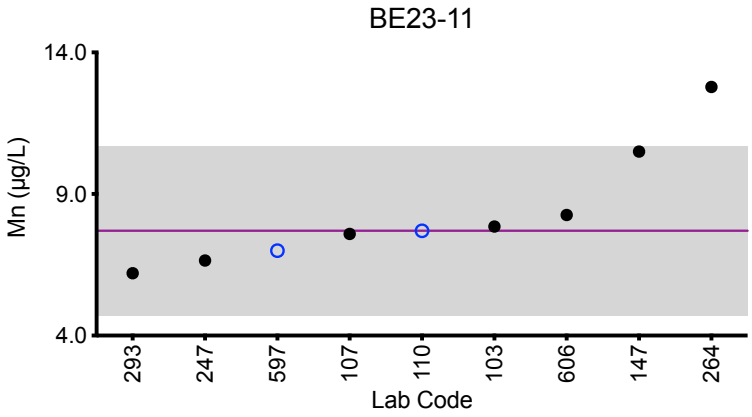
Whole Blood Mn (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
	Target	**7.7**	**26.0**	**9.6**	**20.3**	**27.6**
103	ICP-MS/MS	7.85	26.1	9.92	19.6	27.3
107	ICP-MS/MS	7.59	26.36	9.38	20.67	28.06
110	ICP-MS	7.7	25.6	9.7	19.7	28.3
147	ICP-MS	10.50	27.5	12.2	22.9	30.3
247	ICP-MS/MS	6.65	24.0	8.41	19.0	26.1
264	ICP-MS	*12.78 ↑	30.59 ↑	*14.72 ↑	*26.52 ↑	*34.66 ↑
293	DRC/CC-ICP-MS	6.2	22.95	8.6	18.1	24.66
597	ICP-MS/MS	7.00	25.0	9.10	20.4	27.1
606	ICP-MS/MS	8.26	26.3	9.47	21.9	28.8

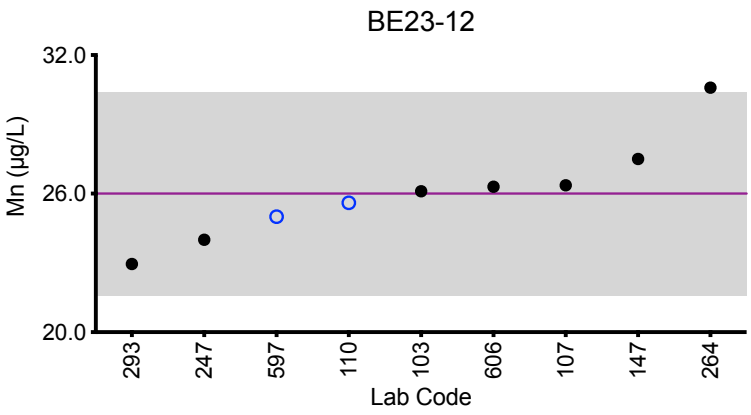
Based on the grading criteria for Mn in Whole Blood, 89% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

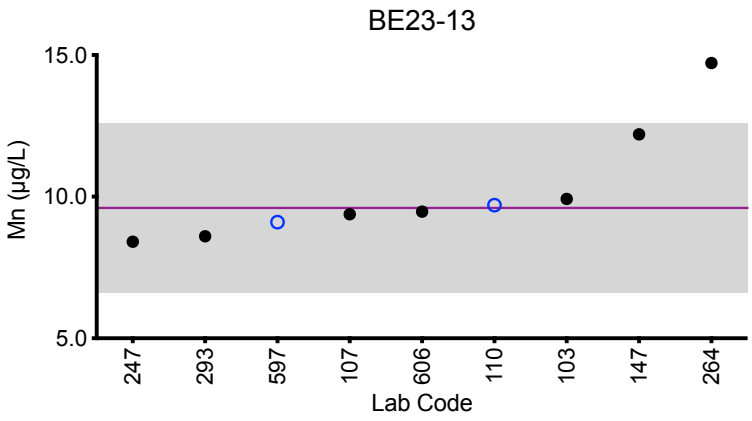
NEW YORK STATE | Department of Health | Wadsworth Center

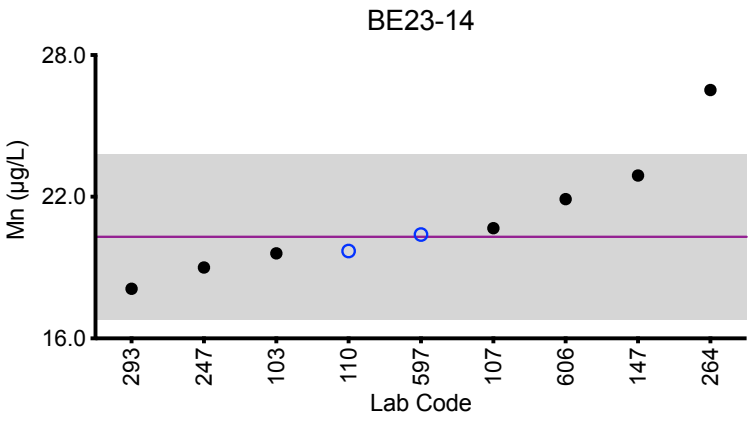
Results for Event #3, 2023: Summary Figures

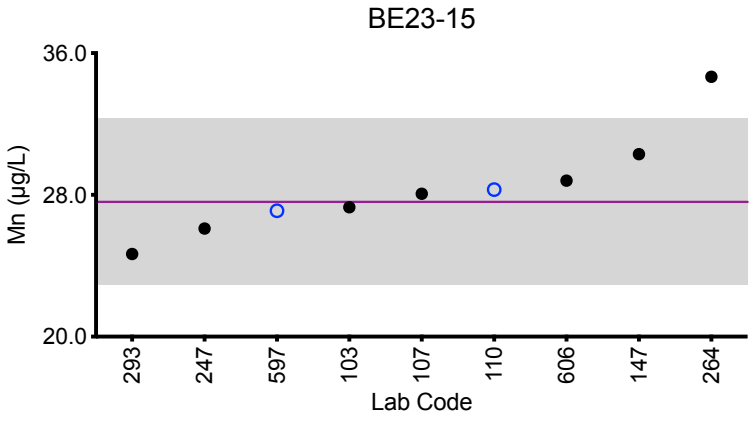
Whole Blood Mn











Legend:

o 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:

±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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

Whole Blood Pb (µg/dL)					
	BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Target (Robust Mean (x*))	0.92	24.5	0.57	1.12	6.0
Upper Limit	2.92	27.0	2.57	3.12	8.0
Lower Limit	0.00	22.1	0.00	0.00	4.0
Robust SD (s*)	0.10	0.6	0.10	0.10	0.3
Robust RSD (%)	11	2.4	18	8.9	5.8
Number of Sample Measurements (N)	10	14	9	12	14
Standard Uncertainty (*u*)	0.04	0.2	NA	0.04	0.1

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 BE23-13.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

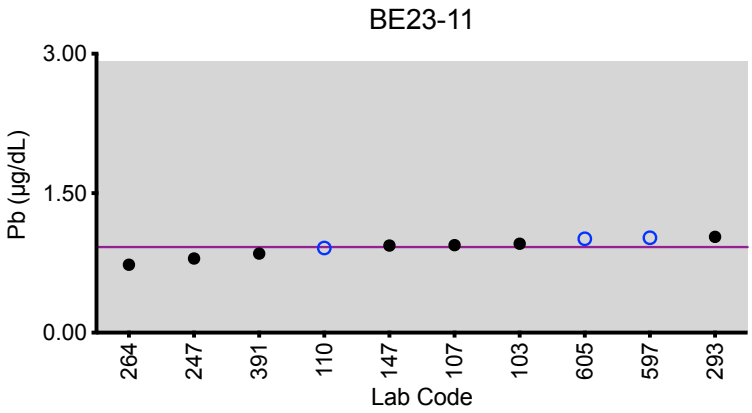
Whole Blood Pb (µg/dL)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
	Target	**0.92**	**24.5**	**0.57**	**1.12**	**6.0**
103	ICP-MS/MS	0.957	24.8	0.670	1.23	6.17
107	ICP-MS/MS	0.941	24.795	0.565	1.147	6.114
110	ICP-MS	0.91	24.3	0.47	0.95	6.20
116	ICP-MS/MS	<3.00	22.9	<3.00	<3.00	5.72
147	ICP-MS	0.937	25.3	0.562	1.20	6.30
247	ICP-MS/MS	0.798	22.8	0.485	1.02	5.66
264	ICP-MS	0.73	21.17 ↓	0.41	0.93	5.37
293	DRC/CC-ICP-MS	1.03	24.61	0.62	1.0	6.00
343	ASV-LeadCare	<3.3	22.4	<3.3	<3.3	4.1
391	ETAAS-Z	0.85	24.59	0.61	1.10	5.83
597	ICP-MS/MS	1.02	24.9	0.728	1.18	6.36
605	ICP-MS	1.01	26.3	<1.00	1.24	6.54
606	ICP-MS/MS	<1.00	24.2	<1.00	1.15	6.06
686	ICP-MS	<1.00	24.7	<1.00	1.16	6.15

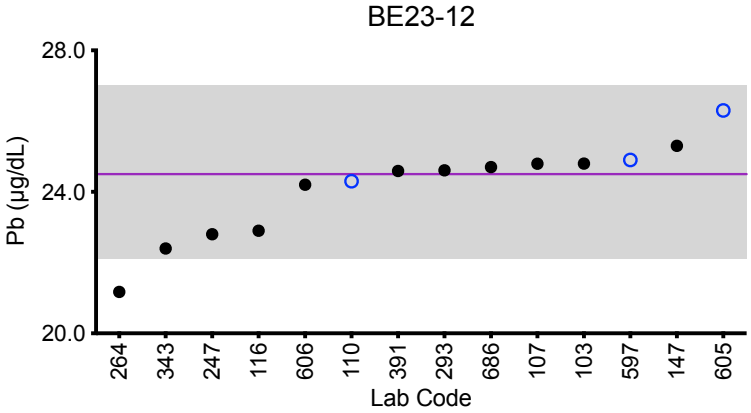
Based on the grading criteria for Pb in Whole Blood, 99% of results were satisfactory, with 0 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

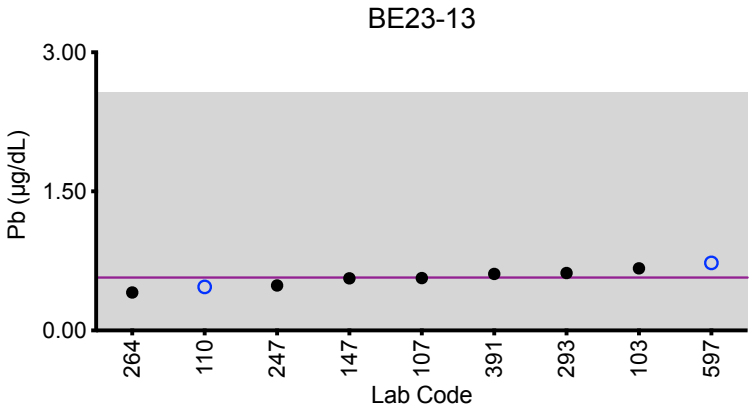
NEW YORK STATE | Department of Health | Wadsworth Center

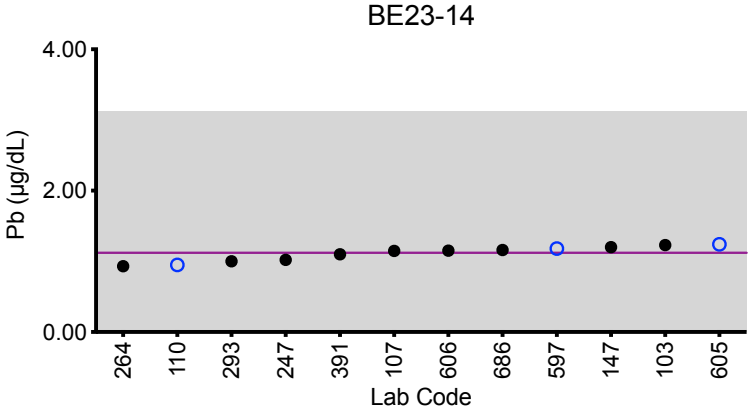
Results for Event #3, 2023: Summary Figures

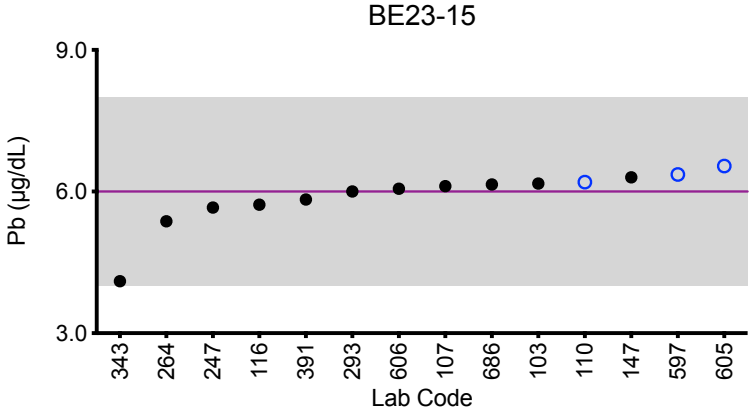
Whole Blood Pb











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Mo (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
103	ICP-MS/MS	6.13	<1.50	3.41	<1.50	<1.50
110	ICP-MS/MS	6.40	0.62	3.44	1.30	0.52
147	ICP-MS	6.37	0.605	3.35	1.24	0.545
442	DRC/CC-ICP-MS	6.22	0.488	3.31	1.19	0.443
597	ICP-MS/MS	6.39	0.603	3.47	1.36	0.519

Summary Statistics

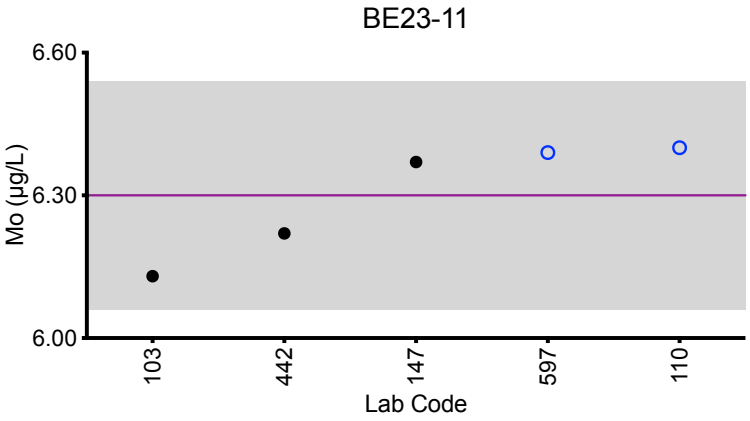
	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
Arithmetic Mean ($\bar{x}$)	6.30	0.58	3.40	1.27	0.51
Arithmetic SD (s)	0.12	0.06	0.07	0.07	0.04
Arithmetic RSD (%)	1.9	10	2.1	5.5	7.8
Number of Sample Measurements (N)	5	4	5	4	4

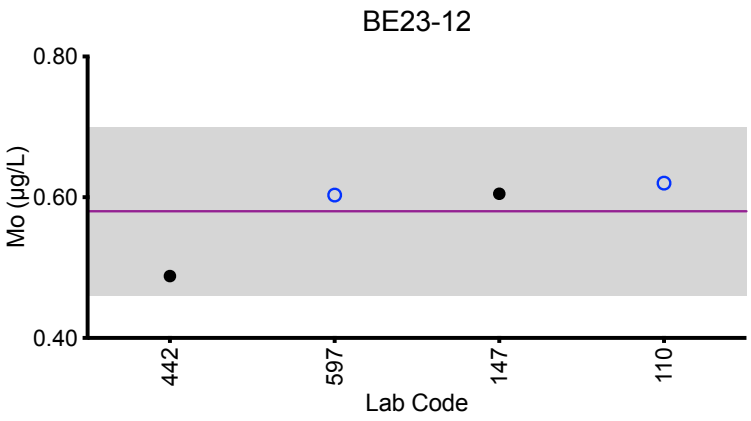
*Denotes a statistical Outlier.

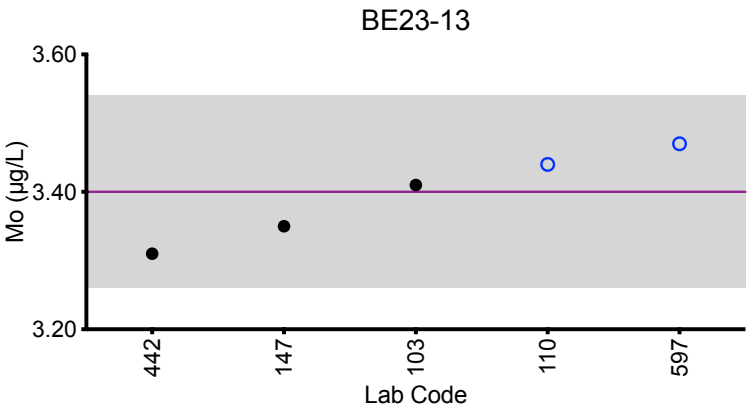
NEW YORK STATE | Department of Health | Wadsworth Center

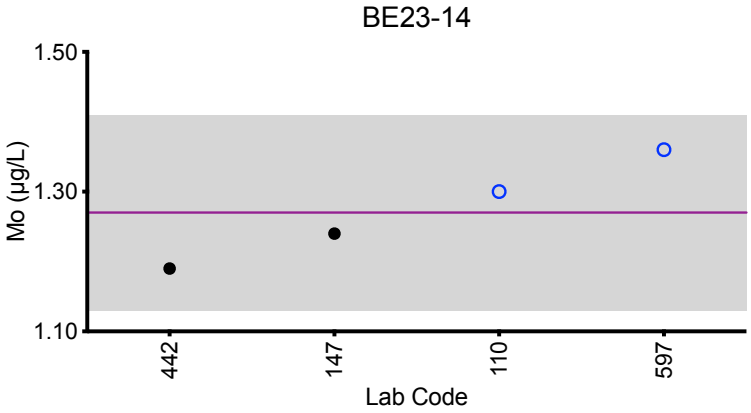
Results for Event #3, 2023: Summary Figures

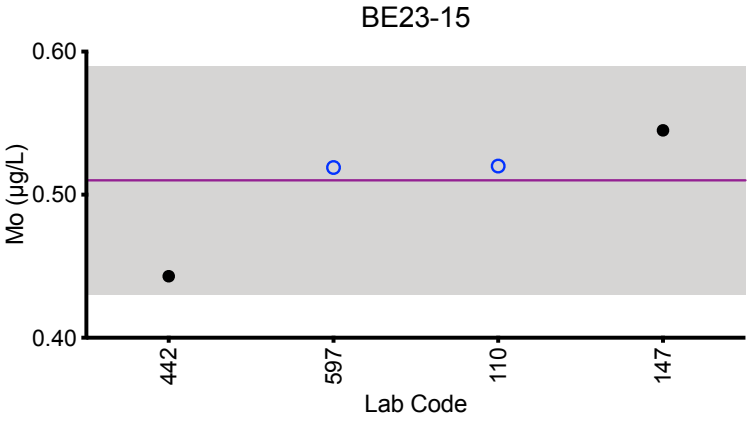
Whole Blood Mo











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Sb (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
103	ICP-MS/MS	4.18	2.00	3.07	1.03	0.506
110	ICP-MS/MS	5.51	2.69	3.55	1.31	0.65
147	ICP-MS	5.25	2.56	3.35	1.27	0.628
264	ICP-MS	4.20	2.15	2.87	0.98	0.45
293	DRC/CC-ICP-MS	5.12	2.43	2.800	1.30	0.61
442	DRC/CC-ICP-MS	6.11	2.97	3.85	1.48	0.605
597	ICP-MS/MS	4.93	2.62	3.28	1.34	0.634

Summary Statistics

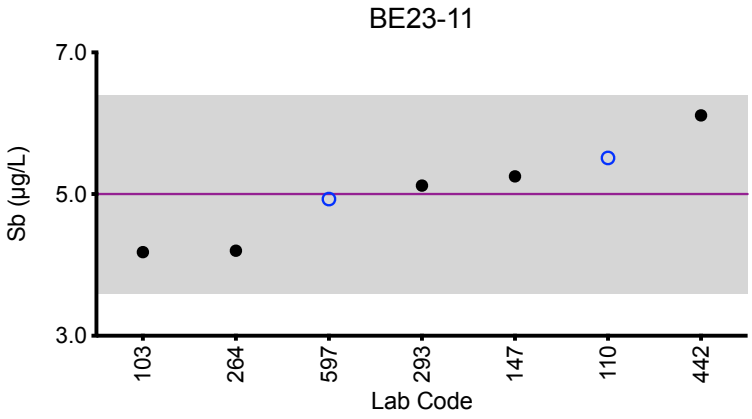
	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
Arithmetic Mean ($\bar{x}$)	5.0	2.5	3.3	1.24	0.58
Arithmetic SD (s)	0.7	0.3	0.4	0.18	0.08
Arithmetic RSD (%)	14	13	11	15	14
Number of Sample Measurements (N)	7	7	7	7	7

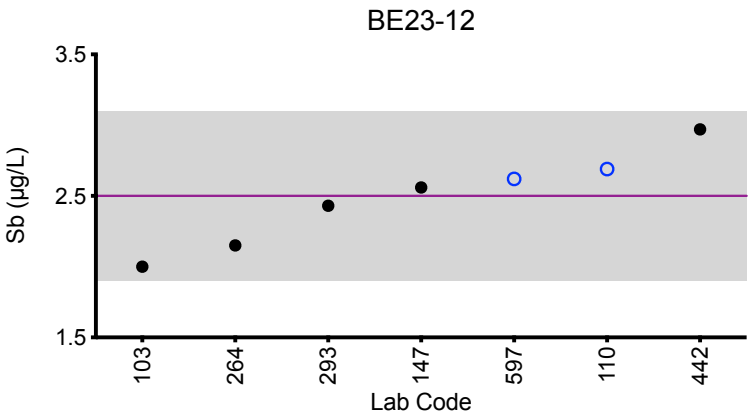
*Denotes a statistical Outlier.

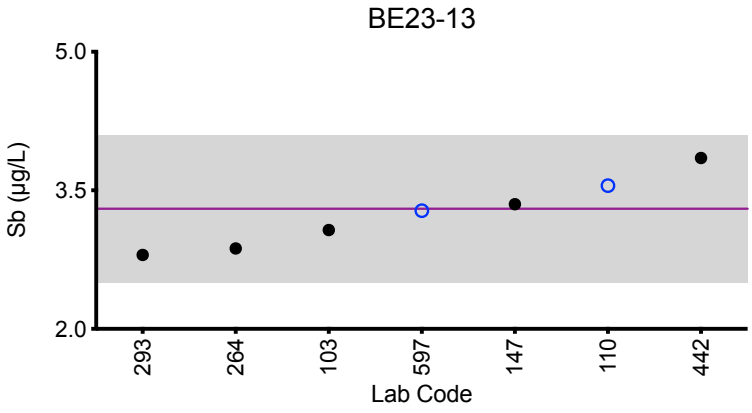
NEW YORK STATE | Department of Health | Wadsworth Center

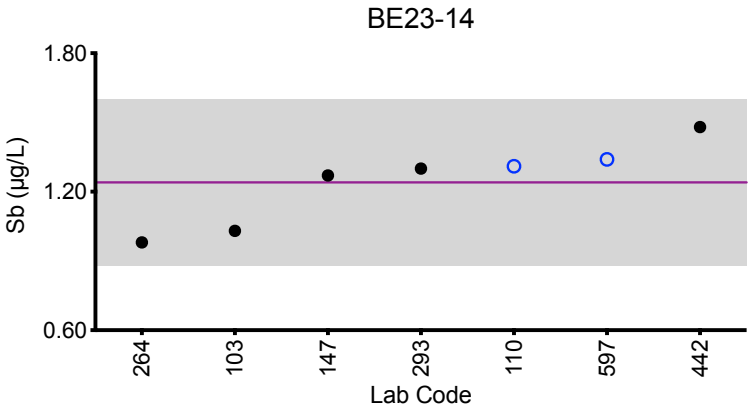
Results for Event #3, 2023: Summary Figures

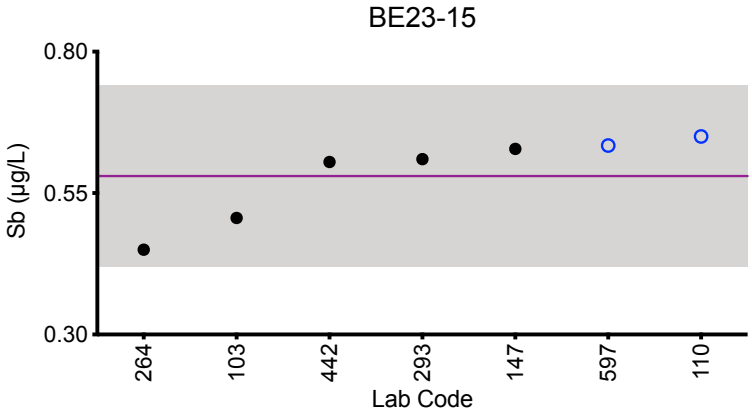
Whole Blood Sb











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Se (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
103	ICP-MS/MS	366	135	149	139	287
107	ICP-MS/MS	375.2	132.7	147.7	134.7	282.0
110	ICP-MS/MS	359	129	148	131	286
147	ICP-MS	352	129	145	137	279
247	ICP-MS/MS	346	120	134	122	268
264	ICP-MS	330.8	131.0	140.3	127.8	262.7
293	DRC/CC-ICP-MS	*200.63	*281.99	*113.74	116.90	*102.69
597	ICP-MS/MS	337	134	146	138	274

Summary Statistics

	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
Arithmetic Mean ($\bar{x}$)	352	130	144	131	277
Arithmetic SD (s)	16	5	5	8	9
Arithmetic RSD (%)	4.5	3.8	3.5	6.1	3.2
Number of Sample Measurements (N)	7	7	7	8	7

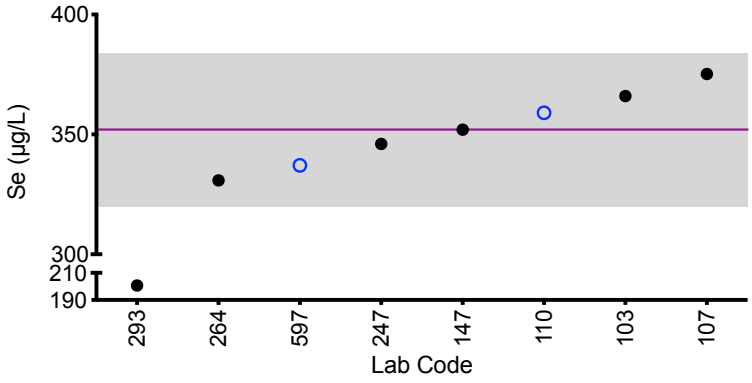
*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

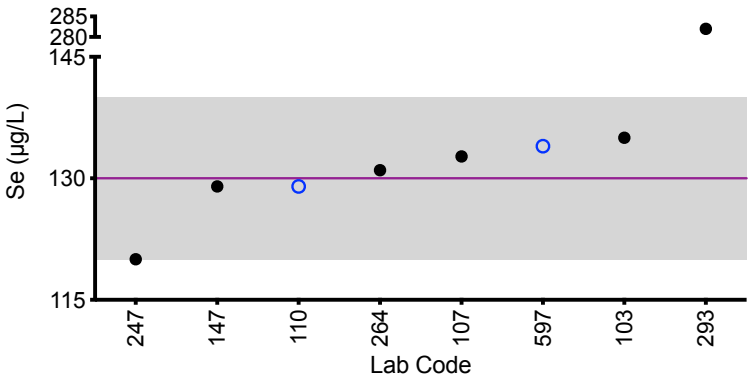
Results for Event #3, 2023: Summary Figures

Whole Blood Se

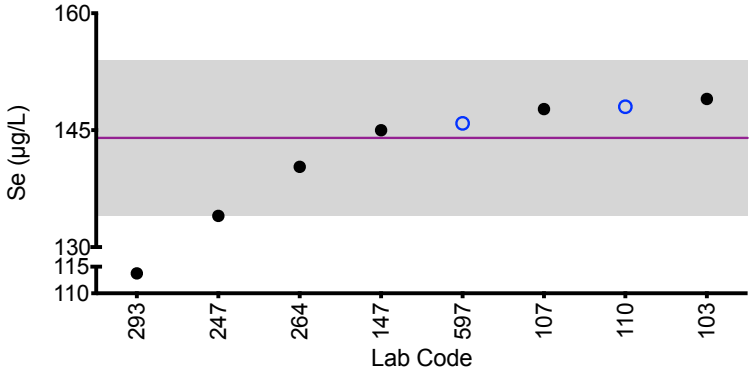
BE23-11



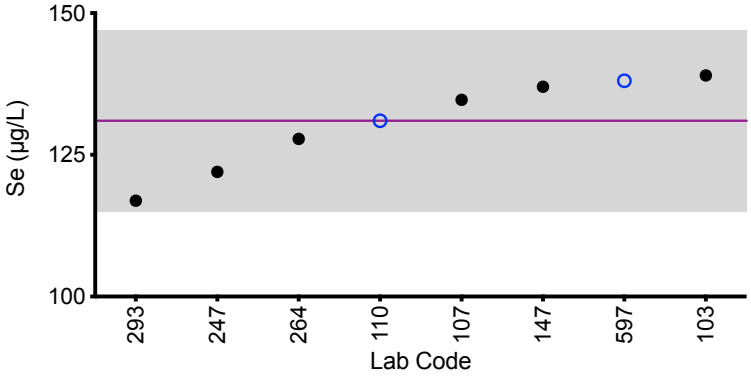
BE23-12



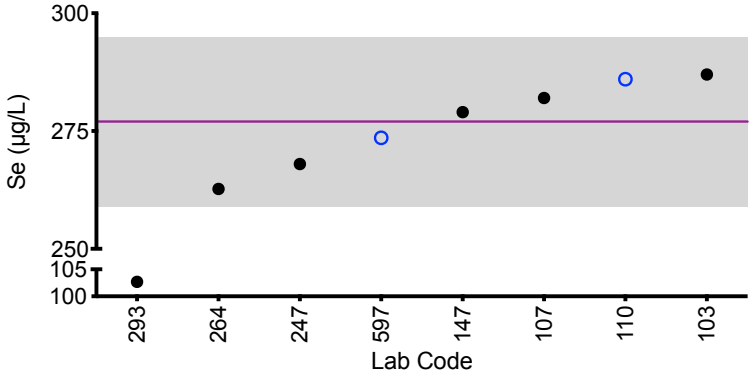
BE23-13



BE23-14



BE23-15



Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

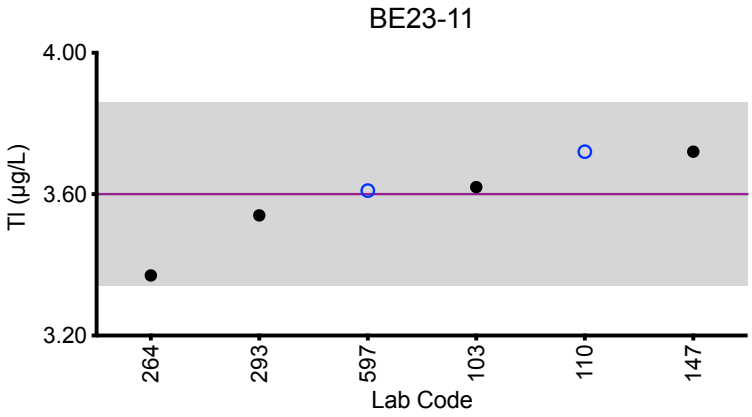
Whole Blood Tl (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
103	ICP-MS/MS	3.62	0.263	0.610	1.46	0.119
110	ICP-MS/MS	3.72	0.30	0.64	1.63	0.12
147	ICP-MS	3.72	0.311	0.638	1.66	0.126
264	ICP-MS	3.37	0.26	0.56	1.42	*0.10
293	DRC/CC-ICP-MS	3.54	0.28	0.60	1.49	0.12
597	ICP-MS/MS	3.61	0.279	0.627	1.58	0.120
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		3.60	0.282	0.61	1.54	0.121
Arithmetic SD (s)		0.13	0.020	0.03	0.10	0.003
Arithmetic RSD (%)		3.6	7.1	4.9	6.5	2.3
Number of Sample Measurements (N)		6	6	6	6	5

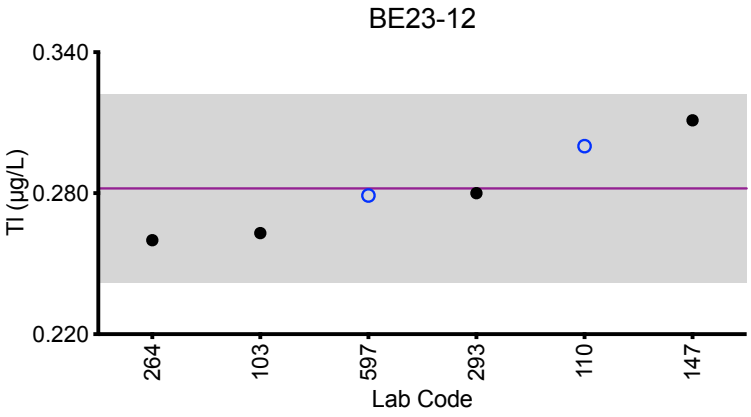
*Denotes a statistical Outlier.

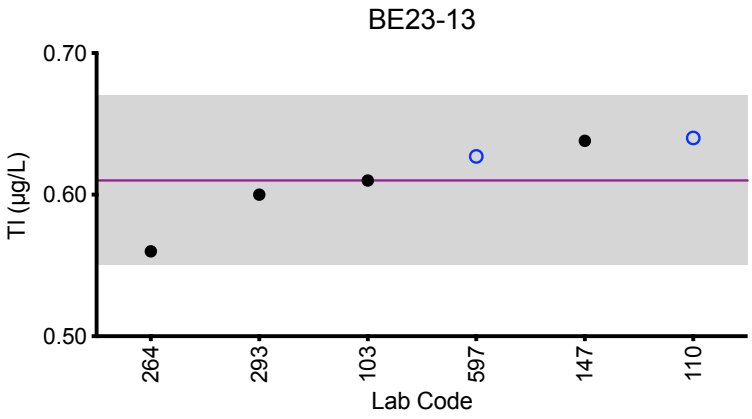
NEW YORK STATE | Department of Health | Wadsworth Center

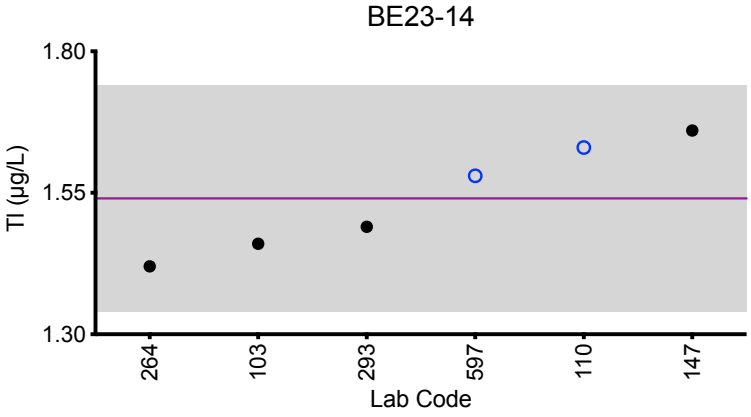
Results for Event #3, 2023: Summary Figures

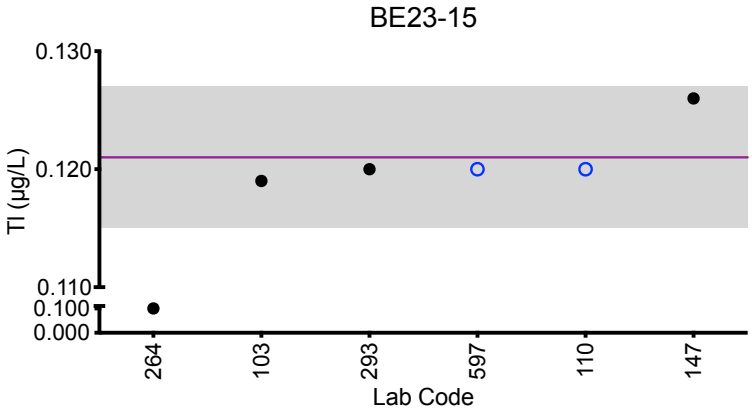
Whole Blood Tl











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
110	ICP-MS/MS	2.97	4.23	10.3	3.77	1.76
147	ICP-MS	2.47	4.01	9.52	3.46	1.69
597	ICP-MS/MS	2.70	4.49	9.92	3.91	1.95
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		2.7	4.2	9.9	3.7	1.80
Arithmetic SD (s)		0.3	0.2	0.4	0.2	0.13
Arithmetic RSD (%)		9.2	5.7	3.9	6.2	7.2
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
110	ICP-MS/MS	0.94	3.57	1.29	0.48	6.14
147	ICP-MS	<0.991	3.21	1.28	<0.991	6.22
293	ICP-MS	0.9	3.3	1.3	0.5	6.3
597	ICP-MS/MS	1.03	3.53	1.43	0.419	6.55
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		0.96	3.40	1.33	0.47	6.30
Arithmetic SD (s)		0.07	0.17	0.07	0.04	0.18
Arithmetic RSD (%)		7.3	5.1	5.3	8.5	2.9
Number of Sample Measurements (N)		3	4	4	3	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Bi (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
147	ICP-MS	<0.0334	0.0420	<0.0334	<0.0334	<0.0334
597	ICP-MS/MS	<0.0282	0.0402	<0.0282	<0.0282	<0.0282
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		NA	0.0411	NA	NA	NA
Arithmetic SD (s)		NA	0.0013	NA	NA	NA
Arithmetic RSD (%)		NA	3.2	NA	NA	NA
Number of Sample Measurements (N)		NA	2	NA	NA	NA

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
110	ICP-MS/MS	3.34	1.27	2.01	2.15	4.71
147	ICP-MS	3.35	1.30	1.97	2.11	4.47
597	ICP-MS/MS	3.36	1.26	1.96	2.19	4.60
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		3.35	1.28	1.98	2.15	4.59
Arithmetic SD (s)		0.01	0.02	0.03	0.04	0.12
Arithmetic RSD (%)		0.30	1.6	1.5	1.9	2.6
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Cu (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
110	ICP-MS/MS	1400	818	685	2560	1070
147	ICP-MS	1455	832	712	2560	1074
247	ICP-MS/MS	1366	813	667	2503	1036
597	ICP-MS/MS	1490	862	716	2720	1110

Summary Statistics					
	BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)	1430	831	695	2590	1070
Arithmetic SD (s)	60	22	23	90	30
Arithmetic RSD (%)	4.2	2.6	3.3	3.5	2.8
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Ni (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
103	ICP-MS/MS	3.28	<1.50	7.68	<1.50	9.48
110	ICP-MS/MS	3.67	0.88	7.44	1.09	10.1
147	ICP-MS	3.44	0.746	6.81	0.752	9.45
597	ICP-MS/MS	3.88	0.939	7.41	1.49	10.7
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		3.6	0.85	7.3	1.1	9.9
Arithmetic SD (s)		0.3	0.10	0.4	0.4	0.6
Arithmetic RSD (%)		7.3	12	5.5	36	6.1
Number of Sample Measurements (N)		4	3	4	3	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
110	ICP-MS/MS	3.95	0.39	7.33	0.89	2.25
147	ICP-MS	3.71	0.462	6.73	0.867	1.98
293	DRC/CC-ICP-MS	3.95	0.36	6.91	0.84	2.20
597	ICP-MS/MS	3.92	0.374	7.09	0.864	2.16
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		3.88	0.40	7.0	0.87	2.15
Arithmetic SD (s)		0.12	0.05	0.3	0.02	0.12
Arithmetic RSD (%)		3.1	13	3.7	2.3	5.6
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Sr (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
103	ICP-MS/MS	38.7	47.8	24.9	34.9	25.3
110	ICP-MS/MS	39.5	48.7	25.1	36.6	25.9
147	ICP-MS	37.4	47.2	23.8	36.2	24.6
597	ICP-MS/MS	39.6	48.1	25.2	36.8	26.1
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		38.8	48.0	24.8	36.1	25.5
Arithmetic SD (s)		1.0	0.6	0.6	0.9	0.7
Arithmetic RSD (%)		2.6	1.3	2.4	2.5	2.7
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Ti (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
200	DRC/CC-ICP-MS	5.9	3.3	9.2	2.8	3.7
597	ICP-MS/MS	6.43	3.98	9.97	3.06	4.40
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		6.2	3.6	9.6	2.9	4.1
Arithmetic SD (s)		0.4	0.5	0.5	0.2	0.5
Arithmetic RSD (%)		6.5	14	5.2	6.1	12
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood U (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
103	ICP-MS/MS	0.126	0.184	<0.0500	0.0622	0.0919
110	ICP-MS/MS	0.139	0.186	0.0457	0.0786	0.0936
147	ICP-MS	0.116	0.164	0.0386	0.0629	0.0829
597	ICP-MS/MS	0.133	0.167	0.0394	0.0698	0.0803

Summary Statistics

	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
Arithmetic Mean ($\bar{x}$)	0.129	0.175	0.041	0.068	0.087
Arithmetic SD (s)	0.010	0.011	0.004	0.008	0.007
Arithmetic RSD (%)	7.8	6.3	9.8	12	7.5
Number of Sample Measurements (N)	4	4	3	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood V (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
110	ICP-MS/MS	1.04	3.74	0.73	1.93	0.48
147	DRC/CC-ICP-MS	1.11	4.32	0.806	2.24	0.531
597	ICP-MS/MS	0.975	3.49	0.704	1.94	0.427

Summary Statistics

	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
Arithmetic Mean ($\bar{x}$)	1.04	3.9	0.75	2.0	0.48
Arithmetic SD (s)	0.07	0.4	0.05	0.2	0.05
Arithmetic RSD (%)	6.7	10	6.7	8.8	10
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood W (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
110	ICP-MS/MS	0.99	3.75	0.78	1.91	0.44
200	ICP-MS	1.0	4.4	0.9	2.1	0.5
597	ICP-MS/MS	1.00	3.68	0.744	1.84	0.429
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		0.997	3.9	0.81	1.95	0.46
Arithmetic SD (s)		0.006	0.4	0.08	0.13	0.04
Arithmetic RSD (%)		0.58	10	9.9	6.7	8.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Whole Blood Zn (µg/L)						
Lab Code	**Method**	**BE23-11**	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
110	ICP-MS/MS	5060	6070	5370	5370	6320
147	ICP-MS	4627	5379	4837	4824	5595
247	ICP-MS/MS	4255	5013	4536	4542	5288
597	ICP-MS/MS	5440	6400	5710	5800	6670
Summary Statistics						
		BE23-11	**BE23-12**	**BE23-13**	**BE23-14**	**BE23-15**
Arithmetic Mean ($\bar{x}$)		4800	5700	5100	5100	6000
Arithmetic SD (s)		500	600	500	600	600
Arithmetic RSD (%)		10	11	9.8	12	10
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
147	ICP-MS	<0.151	<0.151	<0.151	<0.151	<0.151

Whole Blood Al (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
147	ICP-MS	<4.86	<4.86	<4.86	<4.86	<4.86
597	ICP-MS/MS	6.01	9.18	6.77	4.91	4.14

Whole Blood I (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
147	ICP-MS	34.4	31.0	36.2	25.6	31.9

Whole Blood Li (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
147	ICP-MS	0.749	0.708	0.909	0.902	1.39

Whole Blood Mg (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
597	ICP-MS/MS	27700	28200	30000	28200	38100

Whole Blood Pt (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
293	DRC/CC-ICP-MS	4.20	0.58	1.76	2.59	0.79

Whole Blood Te (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
110	ICP-MS/MS	0.01	0.02	0.01	0.01	0.01
147	ICP-MS	<0.0561	<0.0561	<0.0561	<0.0561	<0.0561

Whole Blood Th (µg/L)

Lab Code	Method	BE23-11	BE23-12	BE23-13	BE23-14	BE23-15
147	ICP-MS	<0.0255	<0.0255	<0.0255	<0.0255	<0.0255
597	ICP-MS/MS	0.0197	0.00824	0.00654	0.00715	0.00658

NEW YORK STATE | Department of Health | Wadsworth Center

Event #3, 2023

Trace Elements in Urine

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

NEW YORK STATE | Department of Health | Wadsworth Center

Event #3, 2023:
Trace Elements in Urine

PT Materials

Urine was collected from volunteer donors into polyethylene containers and stored at 4°C. Following collection, urine was acidified to 1% (v/v) with nitric acid and mixed with a sulfamic acid solution (stock solution contained 200 mg/mL sulfamic acid and 10% (v/v) Triton-X 100) to a final concentration of 1% (v/v) to stabilize Hg. Urine was stored frozen at -80°C pending further preparation. The urine was thawed at room temperature and precipitated salts removed by centrifugation. Urine supernatants were combined into five separate pools. Each urine pool was supplemented with arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), cobalt (Co),chromium (Cr), mercury (Hg), manganese (Mn), lead (Pb), thallium (Tl), uranium (U), aluminum (Al), cesium (Cs), copper (Cu), molybdenum (Mo), nickel (Ni), platinum (Pt), antimony (Sb) selenium (Se), tin (Sn), strontium (Sr), tellurium (Te), titanium (Ti), vanadium (V), tungsten (W), and zinc (Zn). PT samples were stored at -80°C until the week of the PT event, when they were thawed at 4°C prior to circulation to laboratories for analysis.

Graded Elements

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

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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine As (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	2.6	48.2	77	10.9	26.3
Upper Limit	8.6	57.8	92	16.9	32.3
Lower Limit	0.0	38.6	62	4.9	20.3
Robust SD (s*)	0.3	1.9	4	0.7	0.9
Robust RSD (%)	10	3.9	5.6	6.4	3.4
Number of Sample Measurements (N)	12	14	14	14	14
Standard Uncertainty (*u*)	0.1	0.6	1	0.2	0.3

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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

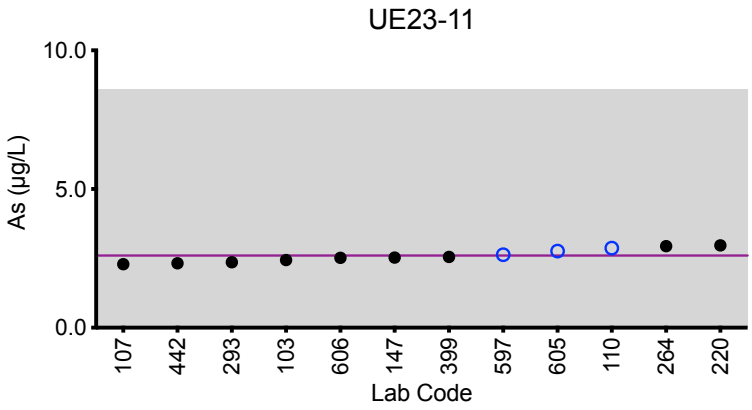
Urine As (µg/L)						
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**2.6**	**48.2**	**77**	**10.9**	**26.3**
103	ICP-MS/MS	2.44	48.0	75.9	10.5	25.7
107	DRC/CC-ICP-MS	2.29	42.42	73.91	9.03	24.81
110	DRC/CC-ICP-MS	2.87	52.9	84.9	11.8	28.7
116	ICP-MS/MS	<6.00	48.4	79.4	10.7	26.8
147	ICP-MS	2.53	48.5	76.4	10.7	26.3
220	DRC/CC-ICP-MS	2.97	54.4	85.0	11.9	28.6
264	ICP-MS	2.94	51.50	83.55	11.23	28.22
293	DRC/CC-ICP-MS	2.36	45.97	70.49	10.43	25.21
399	DRC/CC-ICP-MS	2.55	48.4	74.4	10.6	26.5
442	ICP-MS/MS	2.32	47.1	73.7	10.2	26.2
597	ICP-MS/MS	2.63	46.4	74.5	10.4	25.4
605	ICP-MS	2.76	47.5	76.7	11.7	26.2
606	ICP-MS/MS	2.52	47.9	80.6	12.1	25.8
686	DRC/CC-ICP-MS	<6.00	49.4	77.7	11.1	26.3

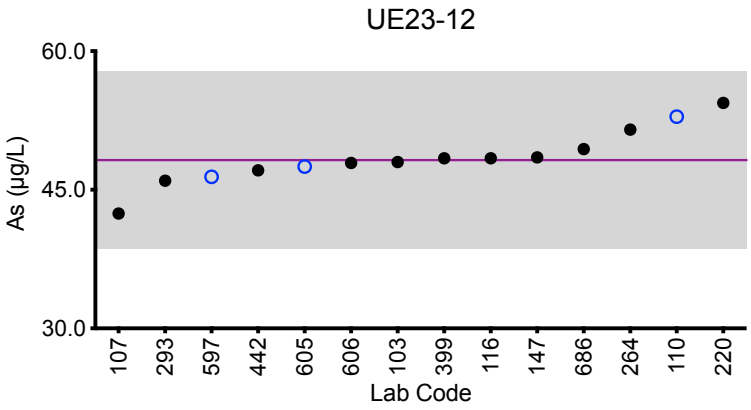
Based on the grading criteria for As in Urine, 100% of results were satisfactory, with 0 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

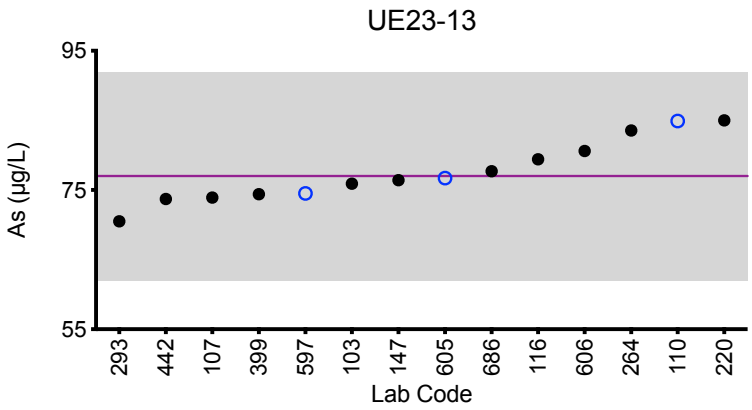
NEW YORK STATE | Department of Health | Wadsworth Center

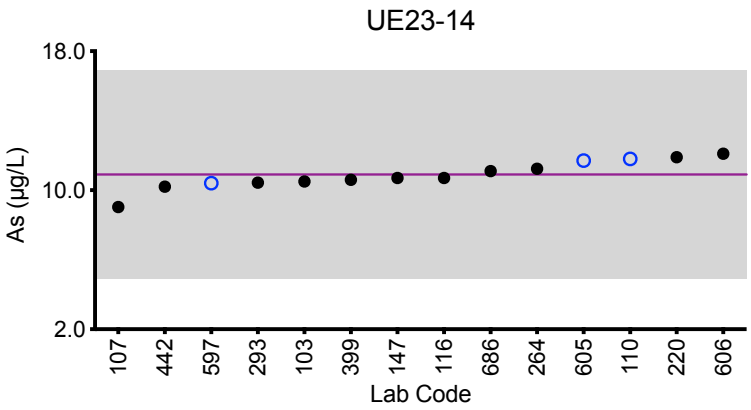
Results for Event #3, 2023: Summary Figures

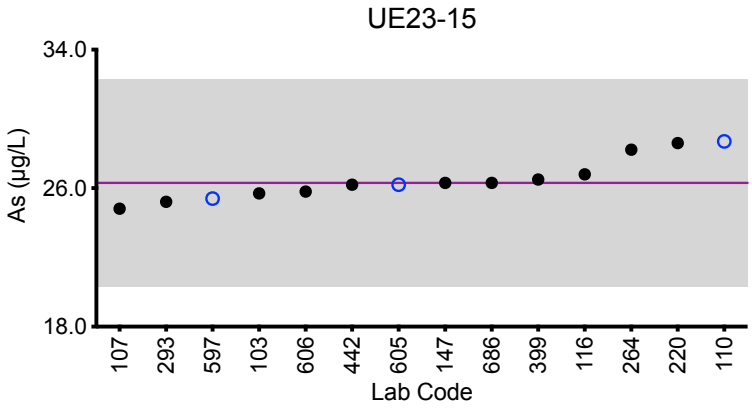
Urine As











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine Ba (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	0.73	8.1	5.8	2.99	3.9
Upper Limit	1.73	9.7	7.0	3.99	4.9
Lower Limit	0.00	6.5	4.6	1.99	2.9
Robust SD (s*)	0.08	0.4	0.4	0.21	0.5
Robust RSD (%)	11	4.9	7.1	7.0	13
Number of Sample Measurements (N)	12	12	12	12	12
Standard Uncertainty (*u*)	0.03	0.2	0.1	0.08	0.2

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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

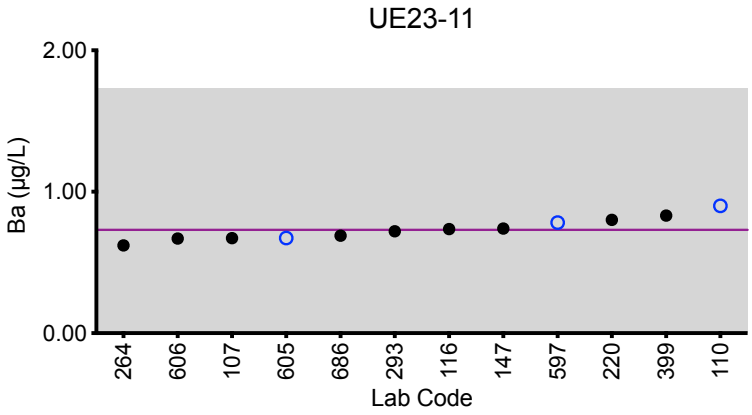
		Urine Ba (µg/L)				
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**0.73**	**8.1**	**5.8**	**2.99**	**3.9**
107	ICP-MS	0.672	7.978	5.670	2.892	3.551
110	ICP-MS	0.90	9.36	6.78	3.43	4.43
116	ICP-MS/MS	0.736	8.21	5.96	3.15	4.2
147	ICP-MS	0.740	8.45	5.77	2.95	4.01
220	ICP-MS	0.801	8.52	8.91 ↑	3.08	4.08
264	ICP-MS	0.62	7.18	4.93	2.56	3.21
293	DRC/CC-ICP-MS	0.72	8.51	6.44	3.03	4.64
399	ICP-MS/MS	0.831	8.22	5.76	3.14	3.85
597	ICP-MS/MS	0.782	7.80	5.54	2.82	3.74
605	ICP-MS	0.673	7.84	5.36	2.85	3.44
606	ICP-MS/MS	0.669	7.76	5.82	3.17	4.15
686	ICP-MS	0.689	8.07	5.51	2.81	3.58

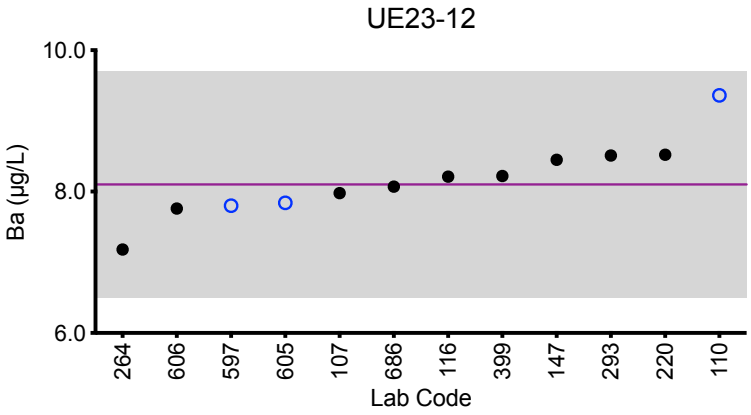
Based on the grading criteria for Ba in Urine, 98% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

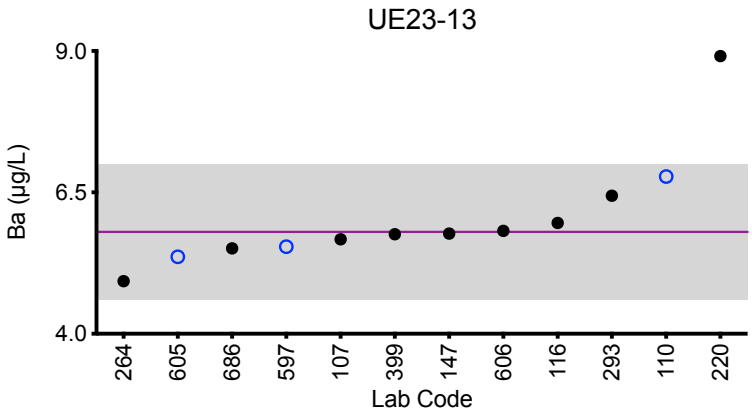
NEW YORK STATE | Department of Health | Wadsworth Center

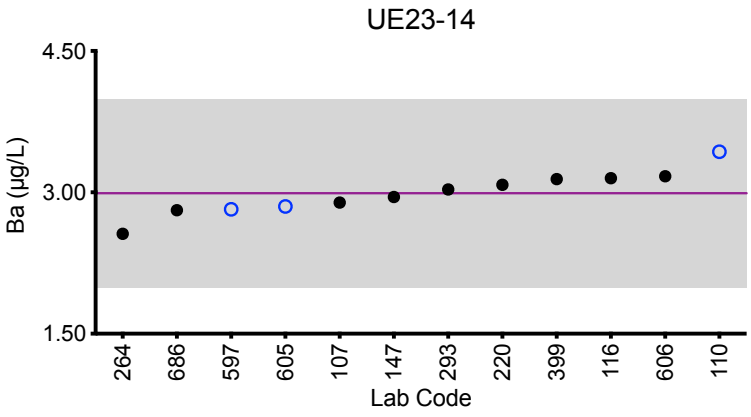
Results for Event #3, 2023: Summary Figures

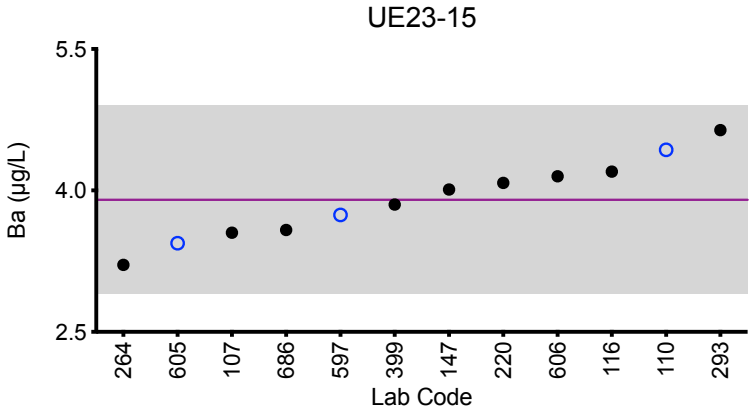
Urine Ba











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine Be (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	2.33	0.98	0.60	1.25	4.41
Upper Limit	3.33	1.98	1.60	2.25	5.41
Lower Limit	1.33	0.00	0.00	0.25	3.41
Robust SD (s*)	0.13	0.05	0.03	0.04	0.23
Robust RSD (%)	5.6	5.1	5.5	2.9	5.2
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.05	0.02	0.01	0.01	0.09

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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

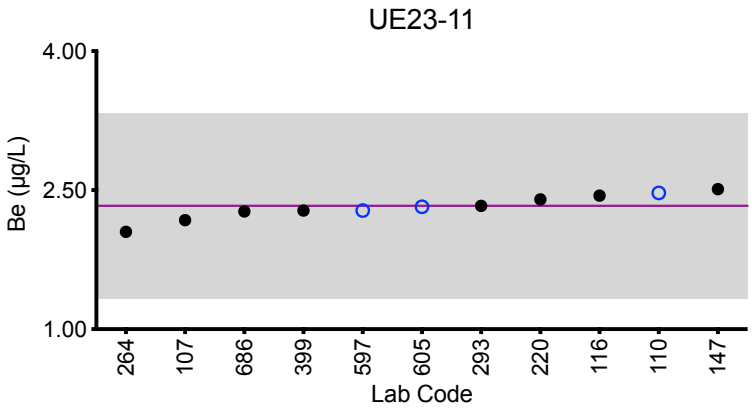
Urine Be (µg/L)						
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**2.33**	**0.98**	**0.60**	**1.25**	**4.41**
107	ICP-MS	2.176	0.940	0.602	1.201	4.204
110	ICP-MS	2.47	1.00	0.632	1.27	4.64
116	ICP-MS/MS	2.44	0.966	0.649	1.32	4.57
147	ICP-MS	2.51	1.06	0.571	1.33	4.91
220	ICP-MS	2.40	1.01	0.608	1.27	4.50
264	ICP-MS	2.05	0.86	0.56	1.13	3.90
293	ICP-MS	2.33	0.98	0.64	1.22	2.27 ↓
399	ICP-MS/MS	2.28	0.929	0.617	1.23	4.43
597	ICP-MS/MS	2.28	1.05	0.590	1.24	4.31
605	ICP-MS	2.32	0.982	0.580	1.25	4.43
686	ICP-MS	2.27	0.977	0.591	1.25	4.46

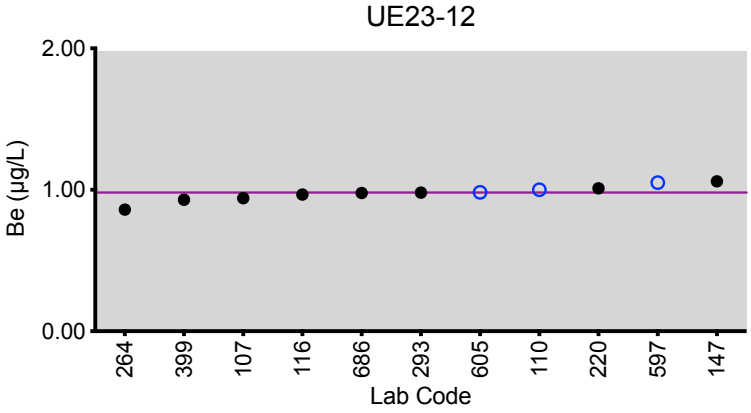
Based on the grading criteria for Be in Urine, 98% of results were satisfactory, with 0 of the 11 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

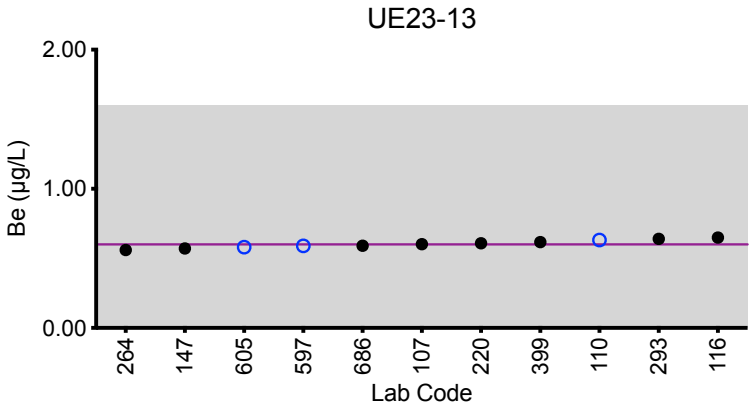
NEW YORK STATE | Department of Health | Wadsworth Center

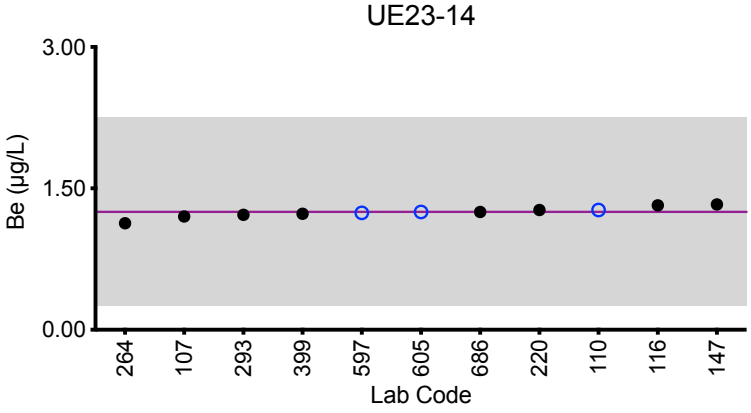
Results for Event #3, 2023: Summary Figures

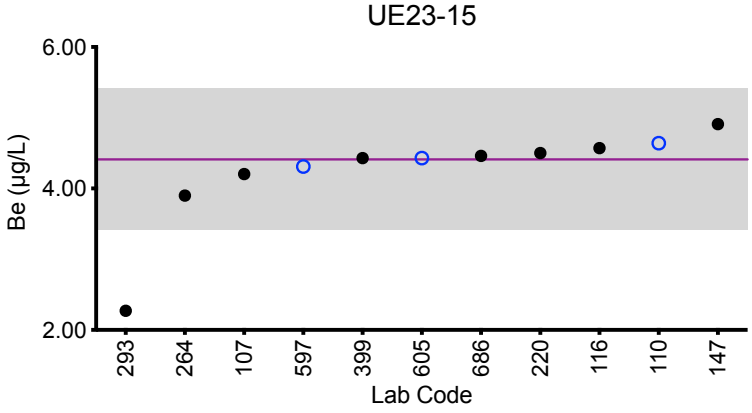
Urine Be











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine Cd (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	2.18	3.47	0.384	0.96	5.7
Upper Limit	3.18	4.47	1.384	1.96	6.7
Lower Limit	1.18	2.47	0.000	0.00	4.7
Robust SD (s*)	0.09	0.16	0.026	0.06	0.3
Robust RSD (%)	4.1	4.6	6.8	6.3	5.3
Number of Sample Measurements (N)	15	15	14	14	15
Standard Uncertainty (*u*)	0.03	0.05	0.009	0.02	0.1

The acceptable range is based on quality specifications:
±1 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 6.6 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

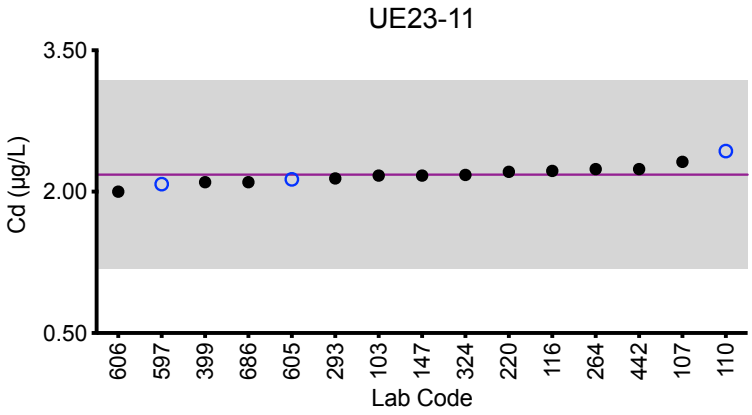
Urine Cd (µg/L)						
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**2.18**	**3.47**	**0.384**	**0.96**	**5.7**
103	ICP-MS/MS	2.17	3.55	0.391	0.941	5.61
107	DRC/CC-ICP-MS	2.317	3.603	0.411	1.008	6.143
110	ICP-MS	2.43	3.80	0.414	1.04	6.10
116	ICP-MS/MS	2.22	3.38	0.406	0.864	5.77
147	ICP-MS	2.17	3.64	0.378	0.979	5.99
220	ICP-MS	2.21	3.43	0.374	0.924	5.60
264	ICP-MS	2.24	3.57	0.41	1.03	6.05
293	DRC/CC-ICP-MS	2.14	3.47	0.39	1	5.47
324	ICP-MS	2.178	3.302	<1	<1	5.505
399	DRC/CC-ICP-MS	2.10	3.38	0.370	0.918	5.52
442	ICP-MS/MS	2.24	3.66	0.405	0.960	5.83
597	ICP-MS/MS	2.08	3.32	0.350	0.892	5.36
605	ICP-MS	2.13	3.47	0.351	0.963	5.80
606	ICP-MS/MS	2.00	3.19	0.359	0.966	5.18
686	ICP-MS	2.10	3.39	0.368	0.921	5.48

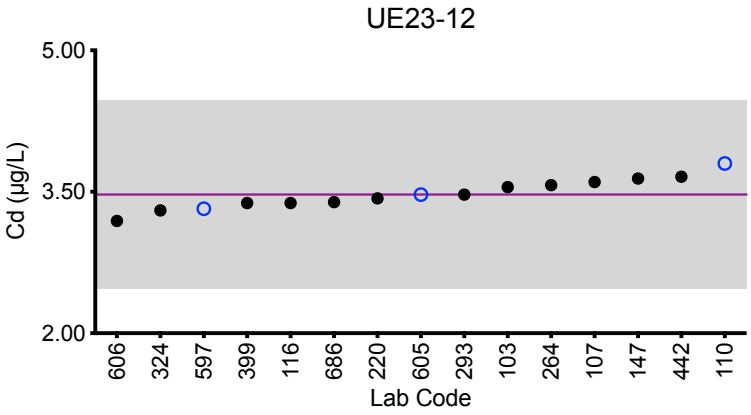
Based on the grading criteria for Cd in Urine, 100% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

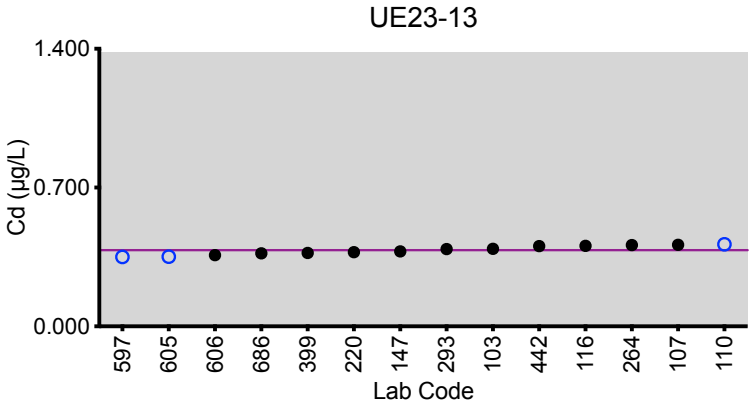
NEW YORK STATE | Department of Health | Wadsworth Center

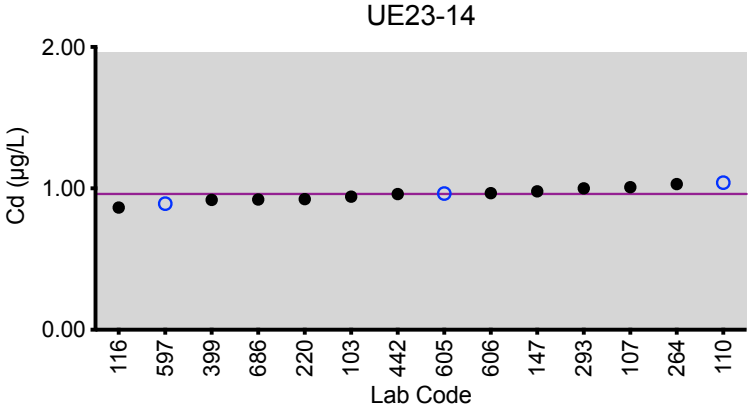
Results for Event #3, 2023: Summary Figures

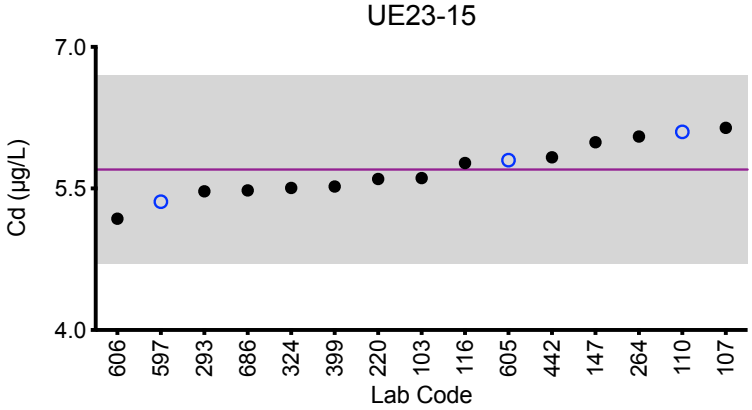
Urine Cd











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine Co (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	0.49	25.3	2.30	8.3	8.5
Upper Limit	1.99	29.1	3.80	9.8	10.0
Lower Limit	0.00	21.5	0.80	6.8	7.0
Robust SD (s*)	0.04	1.0	0.14	0.5	0.4
Robust RSD (%)	8.2	4.0	6.0	6.2	4.7
Number of Sample Measurements (N)	11	12	12	12	12
Standard Uncertainty (*u*)	0.02	0.4	0.05	0.2	0.2

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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

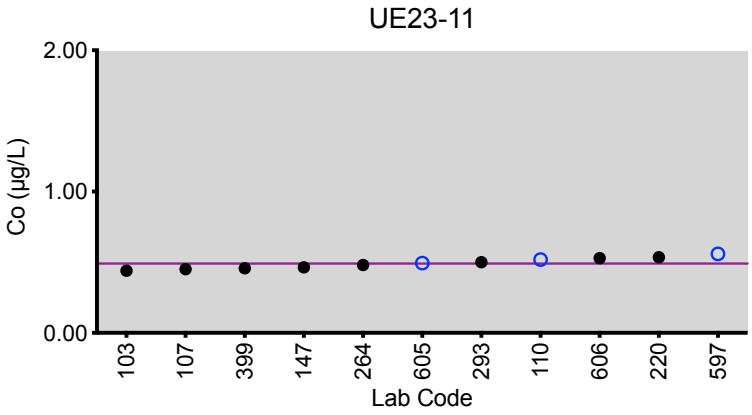
		Urine Co (µg/L)				
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**0.49**	**25.3**	**2.30**	**8.3**	**8.5**
103	ICP-MS/MS	0.440	24.6	2.22	7.86	8.15
107	ICP-MS	0.451	22.535	2.135	7.572	7.616
110	ICP-MS	0.519	26.9	2.43	8.77	9.09
147	ICP-MS	0.464	25.1	2.20	8.01	8.37
220	ICP-MS	0.535	26.5	2.43	8.66	8.87
264	ICP-MS	0.48	25.78	2.33	8.32	8.60
293	DRC/CC-ICP-MS	0.5	26.1	2.28	8.64	9.01
324	ICP-MS	<1	25.703	2.511	8.333	8.670
399	DRC/CC-ICP-MS	0.457	23.2	2.15	7.66	8.16
597	ICP-MS/MS	0.559	25.2	2.26	8.25	8.51
605	ICP-MS	0.494	25.3	2.27	8.21	8.49
606	ICP-MS/MS	0.529	24.7	2.45	9.18	8.09

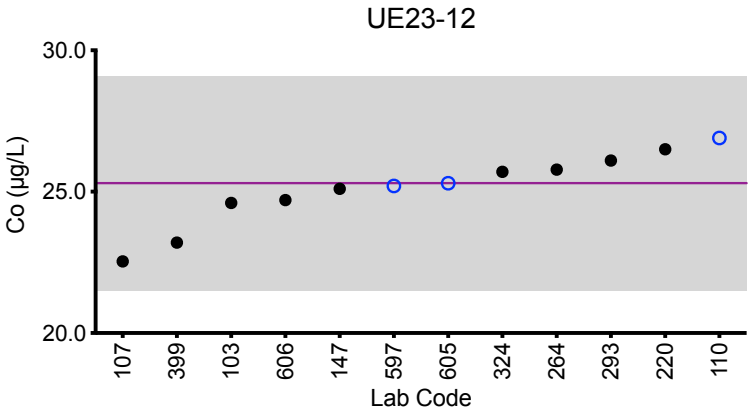
Based on the grading criteria for Co in Urine, 100% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

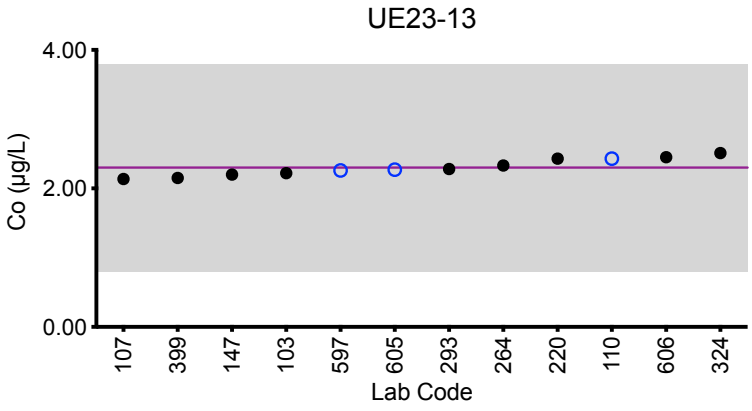
NEW YORK STATE | Department of Health | Wadsworth Center

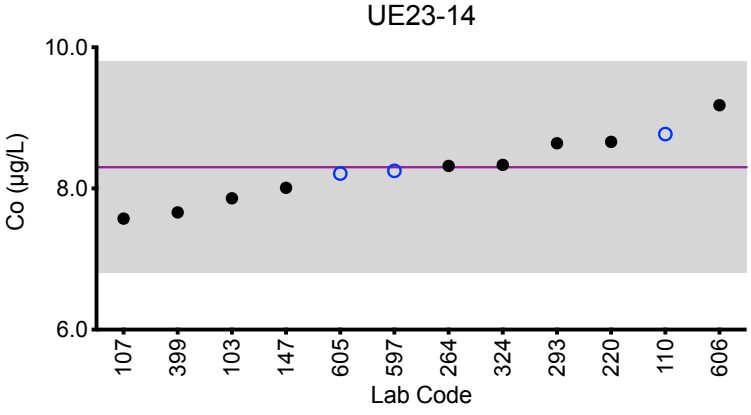
Results for Event #3, 2023: Summary Figures

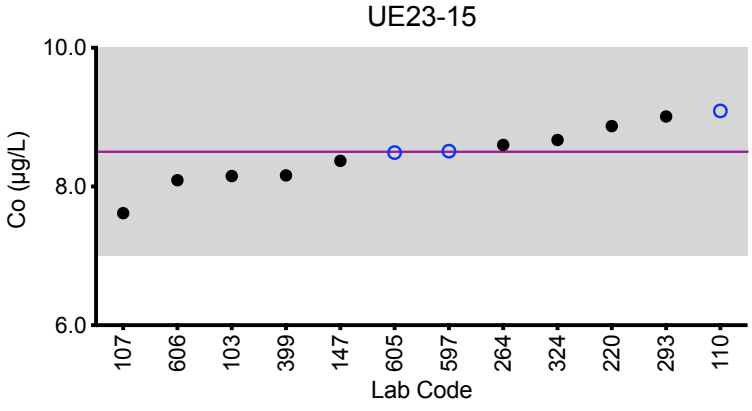
Urine Co











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine Cr (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	7.4	0.81	4.22	4.8	6.33
Upper Limit	10.4	3.81	7.22	7.8	9.33
Lower Limit	4.4	0.00	1.22	1.8	3.33
Robust SD (s*)	0.3	0.15	0.22	0.3	0.21
Robust RSD (%)	4.0	19	5.2	6.9	3.3
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.1	0.06	0.09	0.1	0.08

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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

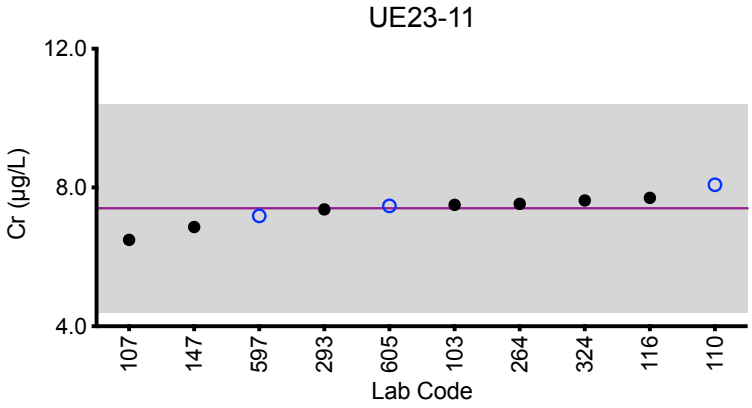
		Urine Cr (µg/L)				
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**7.4**	**0.81**	**4.22**	**4.8**	**6.33**
103	ICP-MS/MS	7.50	0.672	4.51	4.52	6.32
107	DRC/CC-ICP-MS	6.49	0.79	4.16	3.81	5.93
110	DRC/CC-ICP-MS	8.08	1.28	5.19	5.75	7.11
116	ICP-MS/MS	7.7	0.78	4.1	4.58	6.22
147	DRC/CC-ICP-MS	6.86	0.733	4.00	4.53	5.88
264	ICP-MS	7.53	0.84	4.42	4.89	6.42
293	DRC/CC-ICP-MS	7.37	2.74	4.11	4.92	6.47
324	ICP-MS	7.628	1.117	4.933	5.294	6.462
597	ICP-MS/MS	7.18	0.561	3.99	4.56	6.15
605	ICP-MS	7.47	0.737	4.10	4.88	6.42

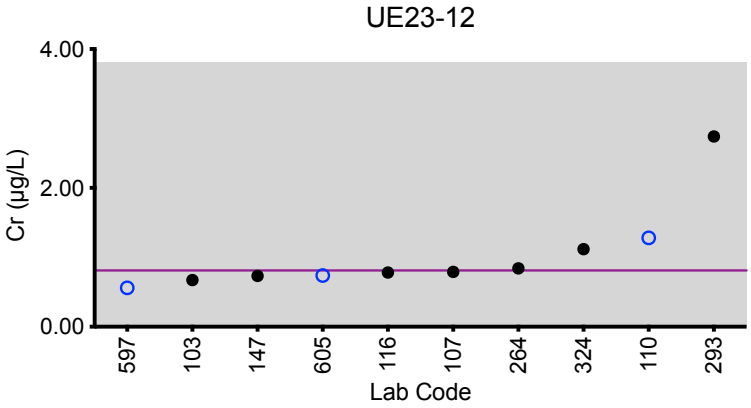
Based on the grading criteria for Cr in Urine, 100% of results were satisfactory, with 0 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

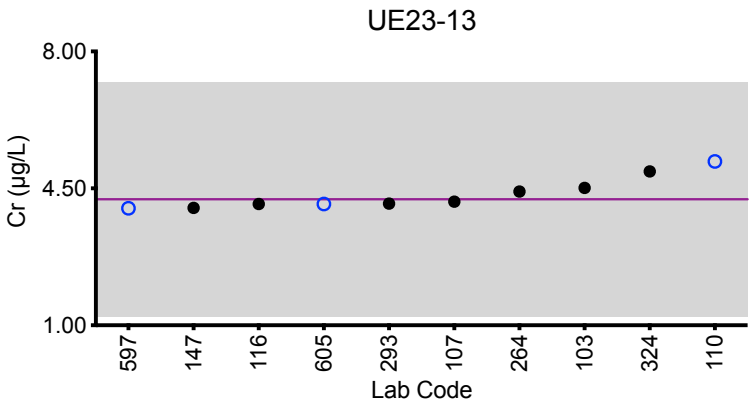
NEW YORK STATE | Department of Health | Wadsworth Center

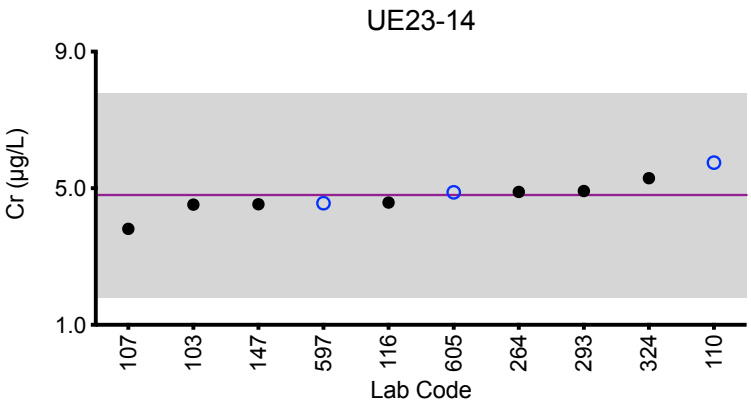
Results for Event #3, 2023: Summary Figures

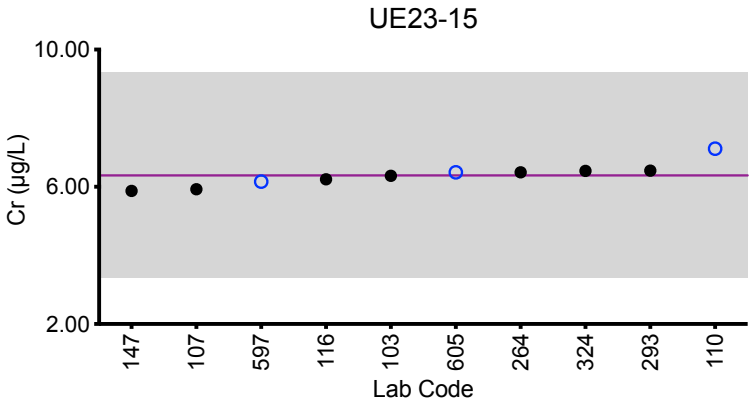
Urine Cr











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine Hg (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	5.5	3.5	25.3	2.2	0.25
Upper Limit	8.5	6.5	32.9	5.2	3.25
Lower Limit	2.5	0.5	17.7	0.0	0.00
Robust SD (s*)	0.6	0.4	2.1	0.3	0.05
Robust RSD (%)	11	12	8.3	14	21
Number of Sample Measurements (N)	12	12	12	12	8
Standard Uncertainty (*u*)	0.2	0.1	0.8	0.1	NA

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.

An arithmetic mean, SD, RSD and n are provided for sample UE23-15.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

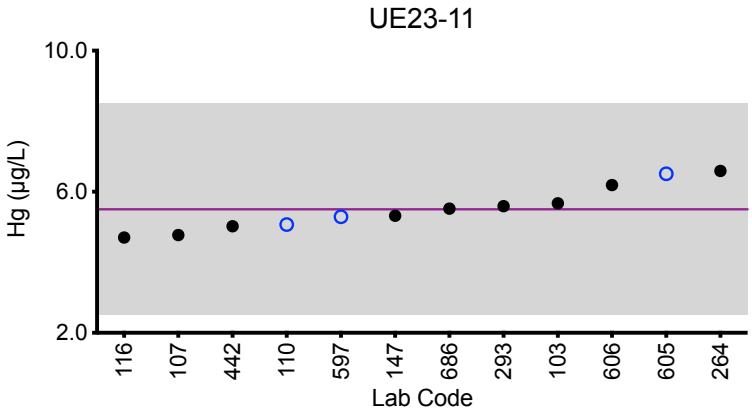
		Urine Hg (µg/L)				
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**5.5**	**3.5**	**25.3**	**2.2**	**0.25**
103	ICP-MS/MS	5.67	3.64	26.6	2.39	0.242
107	DRC/CC-ICP-MS	4.77	2.67	20.19	1.69	0.24
110	ICP-MS	5.07	3.30	24.9	2.00	0.162
116	ICP-MS/MS	4.70	3.04	23.2	1.79	<0.500
147	ICP-MS	5.32	3.27	25.1	2.11	0.223
264	ICP-MS	6.59	4.49	26.46	2.52	0.23
293	DRC/CC-ICP-MS	5.59	3.48	24.24	2.21	0.31
442	ICP-MS/MS	5.02	3.40	25.2	2.06	0.238
597	ICP-MS/MS	5.29	3.16	23.5	2.07	0.322
605	ICP-MS	6.51	3.91	26.9	2.74	<1.00
606	ICP-MS/MS	6.19	3.95	29.5	2.46	<1.00
686	ICP-MS	5.52	3.42	27.3	2.18	<1.00

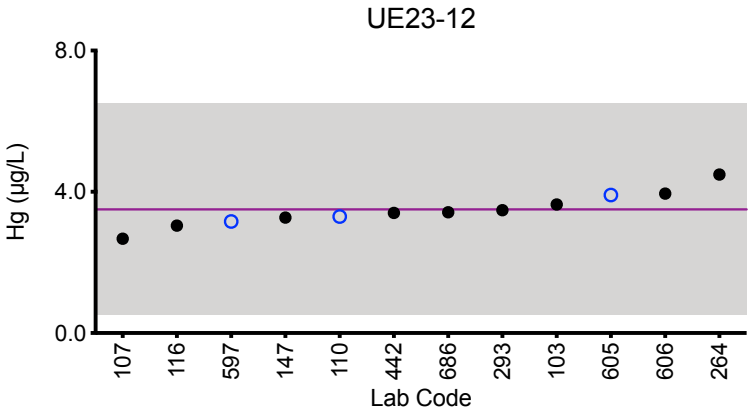
Based on the grading criteria for Hg in Urine, 100% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

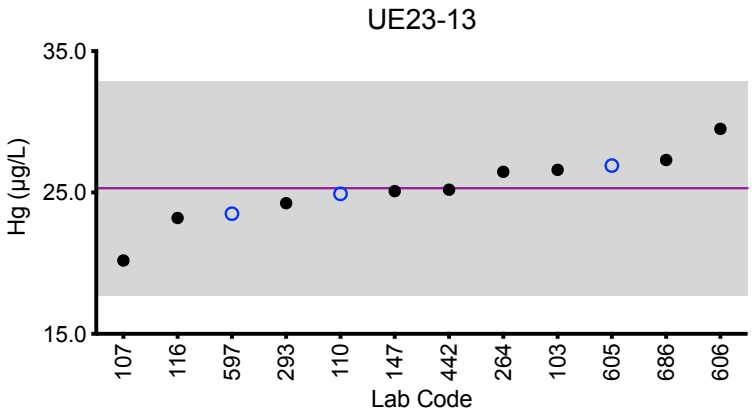
NEW YORK STATE | Department of Health | Wadsworth Center

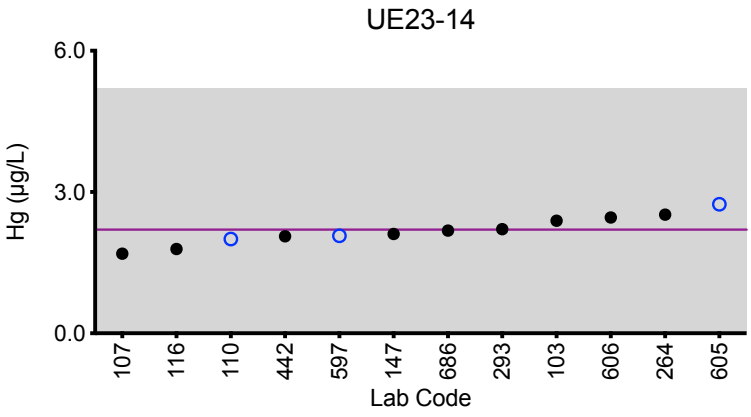
Results for Event #3, 2023: Summary Figures

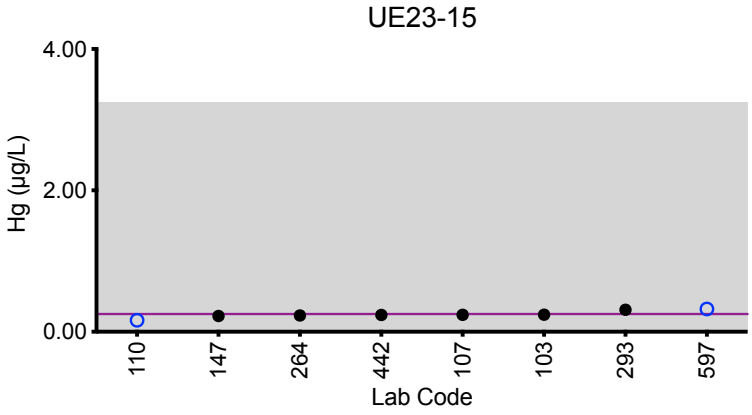
Urine Hg











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine Mn (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	4.90	8.5	3.51	1.58	0.26
Upper Limit	6.13	10.6	4.39	2.13	0.81
Lower Limit	3.68	6.4	2.63	1.03	0.00
Robust SD (s*)	0.20	0.4	0.18	0.12	0.05
Robust RSD (%)	4.1	4.3	5.1	7.6	20
Number of Sample Measurements (N)	13	13	13	13	9
Standard Uncertainty (*u*)	0.07	0.1	0.06	0.04	NA

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).

An arithmetic mean, SD, RSD and n are provided for sample UE23-15.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

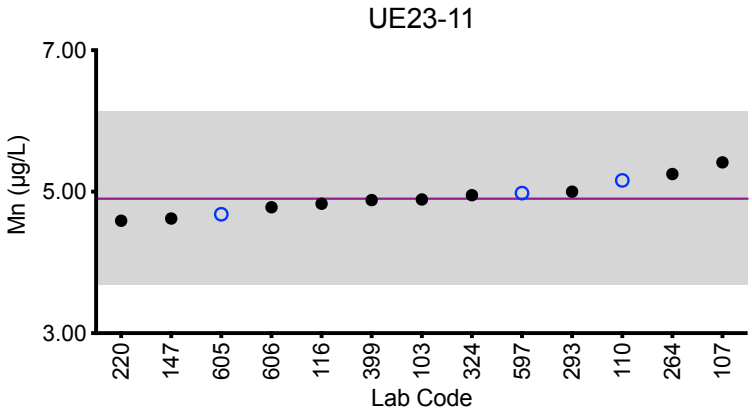
		Urine Mn (µg/L)				
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**4.90**	**8.5**	**3.51**	**1.58**	**0.26**
103	ICP-MS/MS	4.89	8.55	3.48	1.46	0.257
107	DRC/CC-ICP-MS	5.414	9.332	3.722	1.668	0.249
110	DRC/CC-ICP-MS	5.16	8.96	3.59	1.53	0.181
116	ICP-MS/MS	4.83	8.39	3.31	1.22	<0.300
147	DRC/CC-ICP-MS	4.62	8.19	3.42	1.57	0.272
220	DRC/CC-ICP-MS	4.59	7.86	3.20	1.38	0.25
264	ICP-MS	5.25	8.83	3.68	1.64	0.35
293	DRC/CC-ICP-MS	5	9.5	3.43	19 ↑	<0.27
324	ICP-MS	4.950	8.788	3.772	1.670	<1
399	DRC/CC-ICP-MS	4.88	8.21	3.40	1.59	0.315
597	ICP-MS/MS	4.98	8.41	3.42	1.54	0.259
605	ICP-MS	4.68	8.27	3.51	1.61	<0.300
606	ICP-MS/MS	4.78	8.31	3.68	1.69	0.194

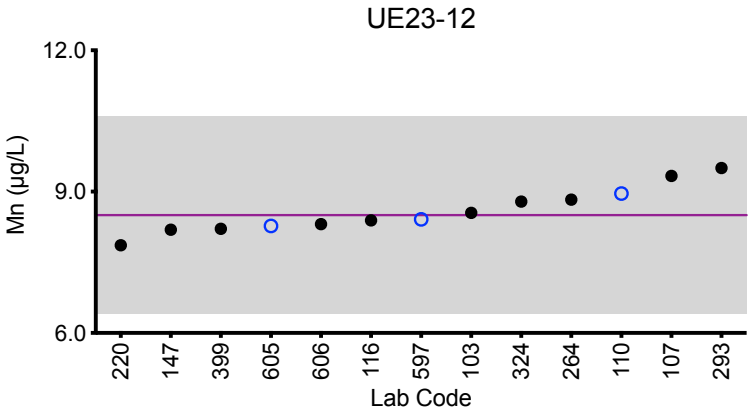
Based on the grading criteria for Mn in Urine, 98% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

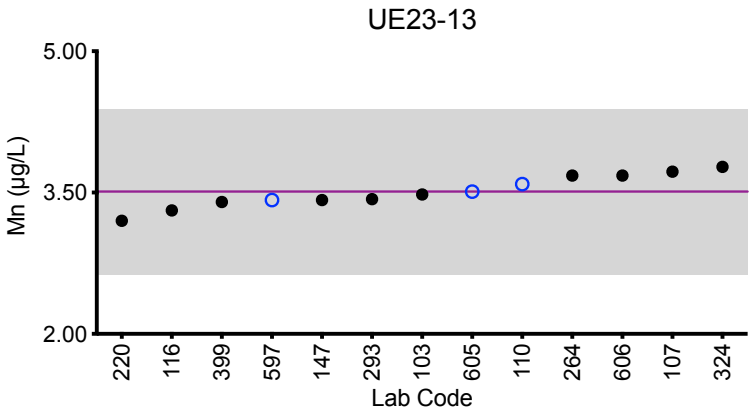
NEW YORK STATE | Department of Health | Wadsworth Center

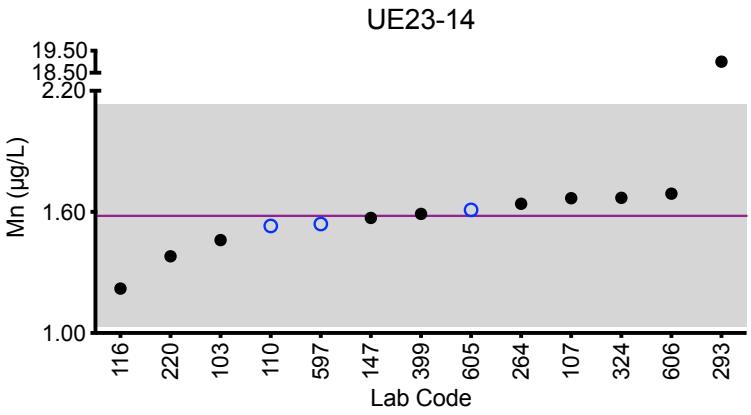
Results for Event #3, 2023: Summary Figures

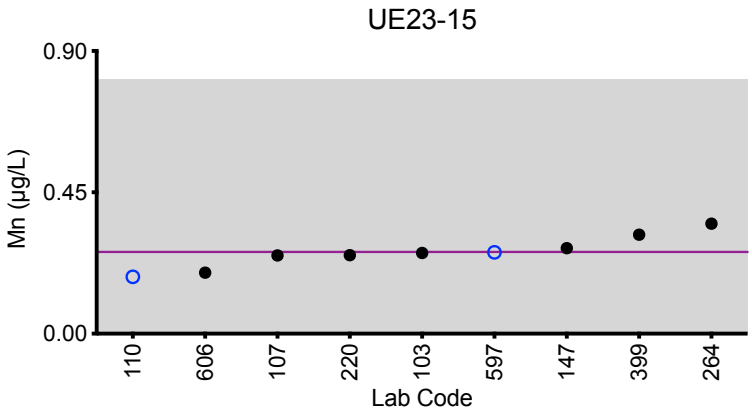
Urine Mn











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine Pb (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	9.02	1.53	0.79	5.14	2.57
Upper Limit	10.82	2.53	1.79	6.17	3.57
Lower Limit	7.22	0.53	0.00	4.11	1.57
Robust SD (s*)	0.29	0.05	0.04	0.12	0.11
Robust RSD (%)	3.2	3.3	5.2	2.3	4.3
Number of Sample Measurements (N)	15	15	14	15	15
Standard Uncertainty (*u*)	0.09	0.02	0.01	0.04	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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

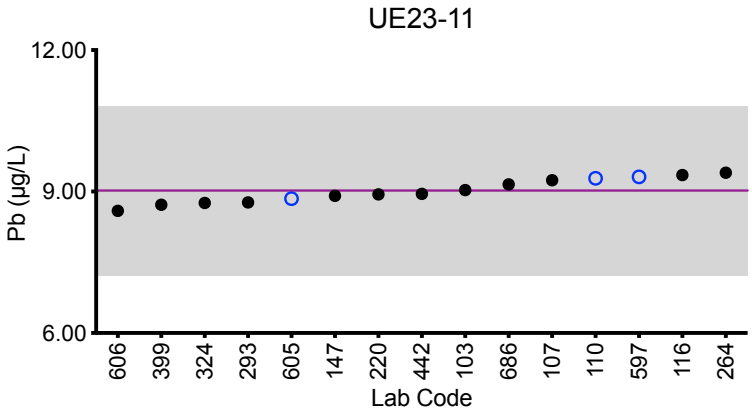
		Urine Pb (µg/L)				
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**9.02**	**1.53**	**0.79**	**5.14**	**2.57**
103	ICP-MS/MS	9.03	1.49	0.714	5.09	2.48
107	ICP-MS	9.240	1.560	0.809	5.209	2.621
110	ICP-MS	9.28	1.57	0.80	5.15	2.65
116	ICP-MS/MS	9.35	1.50	0.855	5.22	2.96
147	ICP-MS	8.91	1.54	0.847	5.18	2.55
220	ICP-MS	8.94	1.56	0.797	4.98	2.59
264	ICP-MS	9.40	1.54	0.78	5.53	2.62
293	DRC/CC-ICP-MS	8.77	1.53	0.7	5.1	2.5
324	ICP-MS	8.758	1.535	<1	4.952	2.507
399	ICP-MS/MS	8.72	1.48	0.766	4.87	2.45
442	ICP-MS/MS	8.95	1.65	0.760	5.09	2.57
597	ICP-MS/MS	9.31	1.60	0.814	5.25	2.74
605	ICP-MS	8.85	1.47	0.729	5.04	2.51
606	ICP-MS/MS	8.59	1.43	0.772	5.32	2.42
686	ICP-MS	9.15	1.54	0.802	5.16	2.69

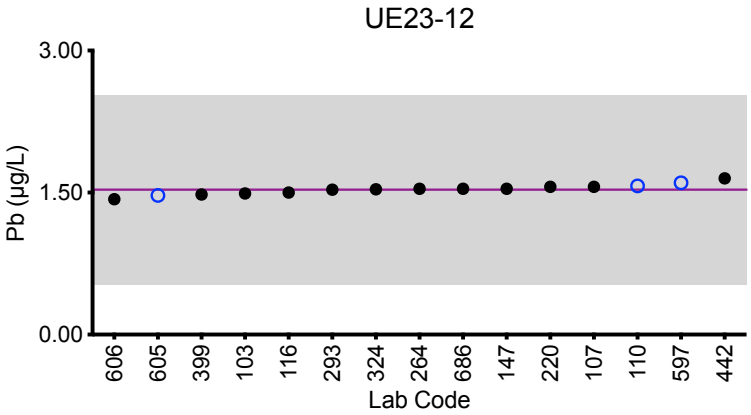
Based on the grading criteria for Pb in Urine, 100% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

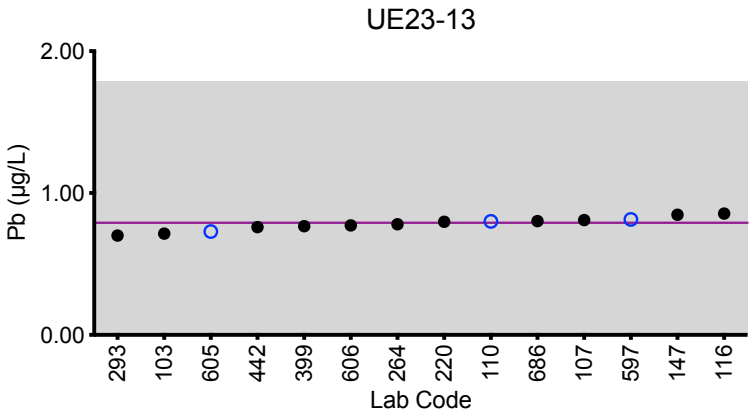
NEW YORK STATE Department of Health | Wadsworth Center

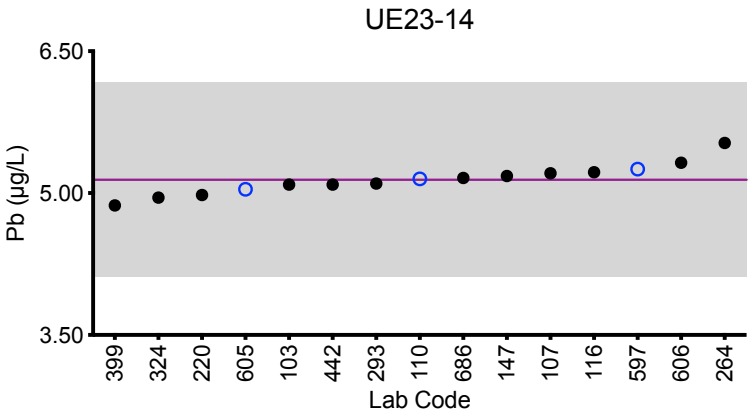
Results for Event #3, 2023: Summary Figures

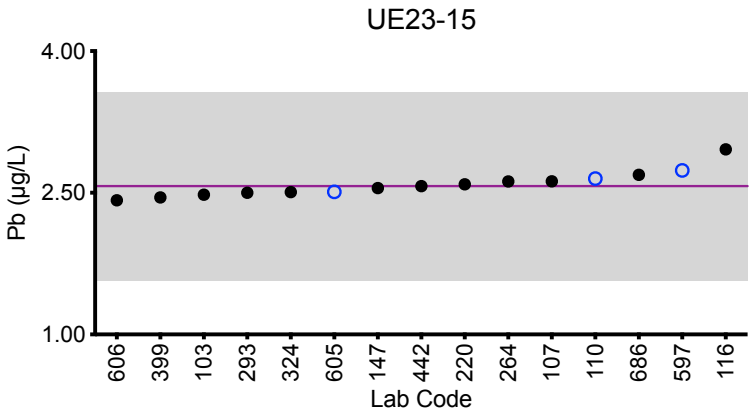
Urine Pb











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

Urine Tl (µg/L)					
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	2.23	1.70	3.71	0.938	0.367
Upper Limit	2.68	2.04	4.45	1.138	0.567
Lower Limit	1.78	1.36	2.97	0.738	0.167
Robust SD (s*)	0.06	0.03	0.06	0.016	0.010
Robust RSD (%)	2.7	1.9	1.6	1.7	2.7
Number of Sample Measurements (N)	12	12	12	12	12
Standard Uncertainty (*u*)	0.02	0.01	0.02	0.006	0.003

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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

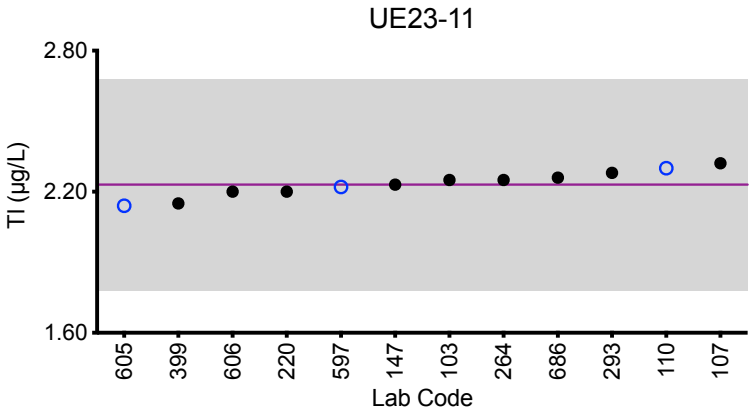
Urine Tl (µg/L)						
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**2.23**	**1.70**	**3.71**	**0.938**	**0.367**
103	ICP-MS/MS	2.25	1.70	3.74	0.935	0.359
107	ICP-MS	2.321	1.777	3.897	0.977	0.373
110	ICP-MS	2.30	1.71	3.75	0.950	0.383
147	ICP-MS	2.23	1.71	3.72	0.930	0.362
220	ICP-MS	2.20	1.70	3.60	0.924	0.373
264	ICP-MS	2.25	1.72	3.71	0.94	0.37
293	DRC/CC-ICP-MS	2.28	1.7	3.67	0.94	0.37
399	ICP-MS/MS	2.15	1.65	3.57	0.887	0.358
597	ICP-MS/MS	2.22	1.67	3.73	0.940	0.356
605	ICP-MS	2.14	1.64	3.61	0.923	0.360
606	ICP-MS/MS	2.20	1.68	3.77	0.970	0.362
686	ICP-MS	2.26	1.73	3.73	0.934	0.378

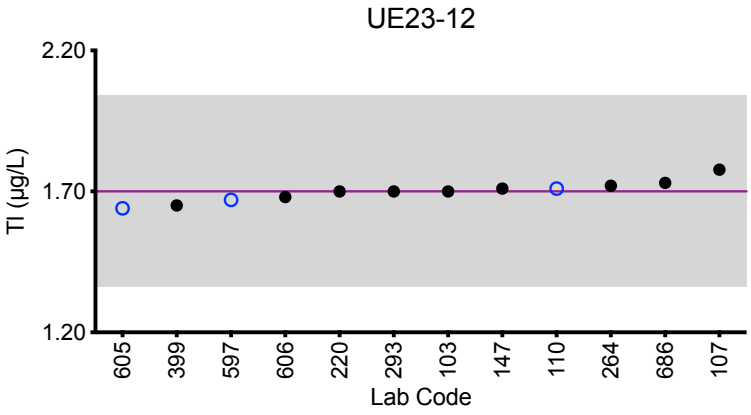
Based on the grading criteria for Tl in Urine, 100% of results were satisfactory, with 0 of the 12 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

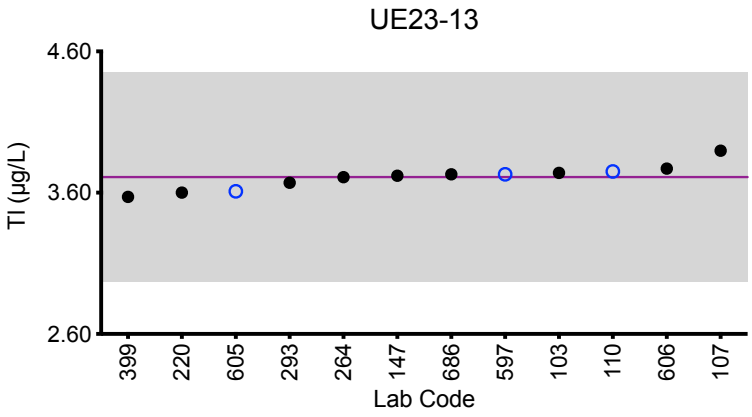
NEW YORK STATE | Department of Health | Wadsworth Center

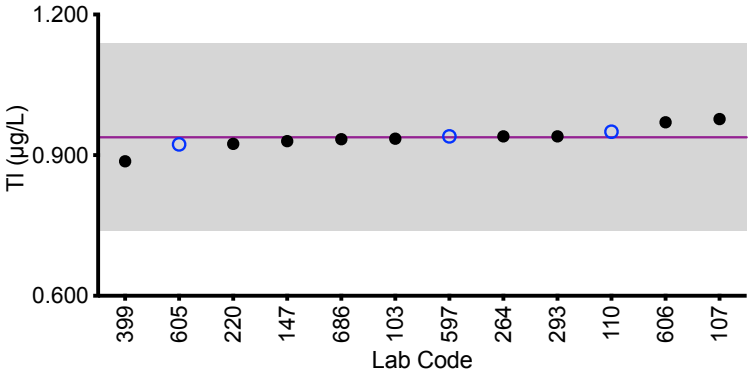
Results for Event #3, 2023: Summary Figures

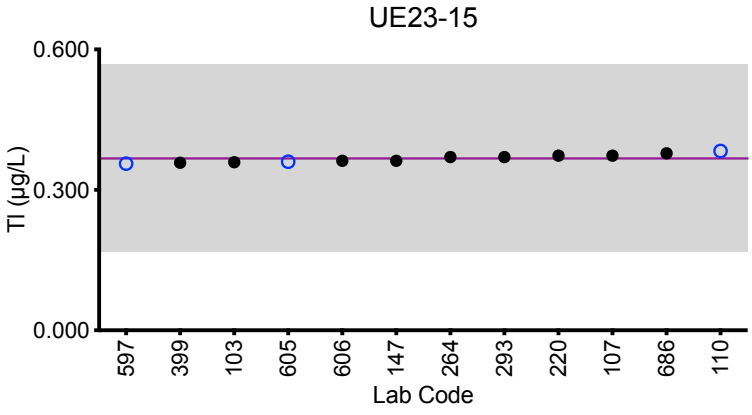
Urine Tl











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Urine U (µg/L)				
	UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Target (Robust Mean (x*))	0.108	0.168	0.0396	0.058	0.005
Upper Limit	0.138	0.202	0.0696	0.088	0.035
Lower Limit	0.078	0.134	0.0096	0.028	0.000
Robust SD (s*)	0.005	0.005	0.0020	0.003	0.001
Robust RSD (%)	4.6	2.8	5.1	5.2	18
Number of Sample Measurements (N)	13	13	13	13	5
Standard Uncertainty (*u*)	0.002	0.002	0.0007	0.001	NA

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.

An arithmetic mean, SD, RSD and n are provided for sample UE23-15.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

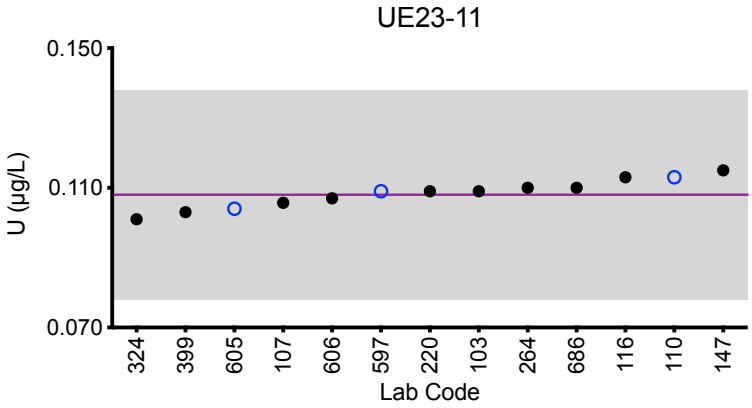
		Urine U (µg/L)				
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
	Target	**0.108**	**0.168**	**0.0396**	**0.058**	**0.005**
103	ICP-MS/MS	0.109	0.171	0.0470	0.0679	<0.0200
107	ICP-MS	0.1057	0.1689	0.0374	0.0569	0.0038
110	ICP-MS	0.113	0.174	0.0403	0.0600	0.0049
116	ICP-MS/MS	0.113	0.172	0.0412	0.0611	<0.0150
147	ICP-MS	0.115	0.168	0.0417	0.0569	<0.00810
220	ICP-MS	0.109	0.171	0.039	0.057	<0.005
264	ICP-MS	0.11	0.17	0.04	0.06	*0.01
324	ICP-MS	0.101	0.160	0.037	0.056	0.004
399	ICP-MS/MS	0.103	0.157	0.037	0.051	0.005
597	ICP-MS/MS	0.109	0.153	0.0409	0.0550	0.00588
605	ICP-MS	0.104	0.166	0.0380	0.0560	<0.00500
606	ICP-MS/MS	0.107	0.165	0.040	0.064	<0.005
686	ICP-MS	0.110	0.172	0.0393	0.0588	<0.0150

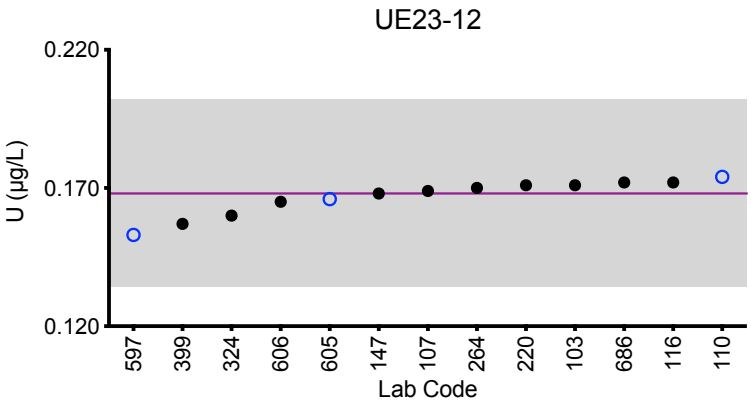
Based on the grading criteria for U in Urine, 100% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

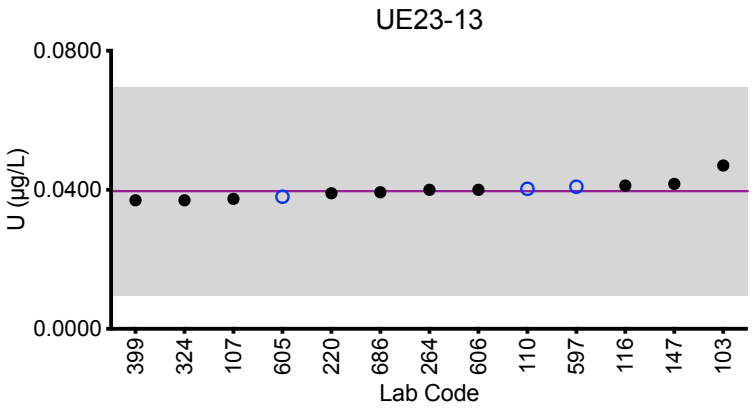
NEW YORK STATE Department of Health | Wadsworth Center

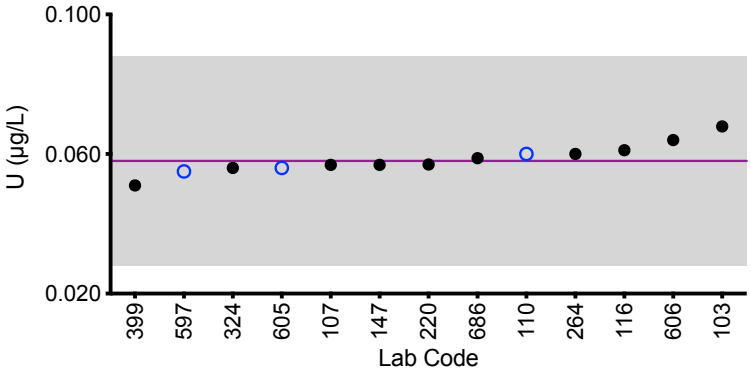
Results for Event #3, 2023: Summary Figures

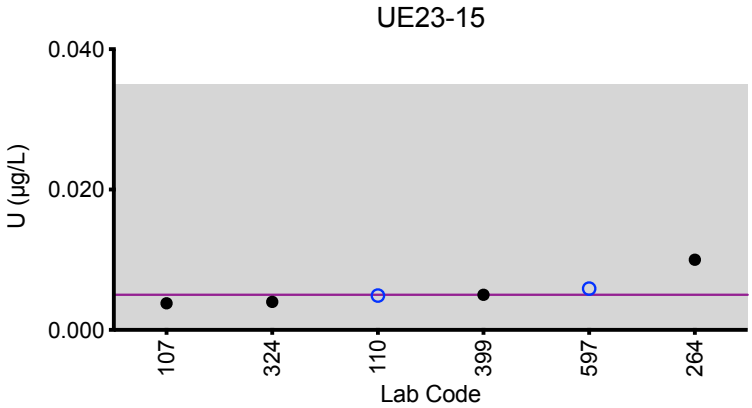
Urine U











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine Al (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
147	ICP-MS	24.9	<13.8	<13.8	19.1	<13.8
264	ICP-MS	20.71	9.18	11.42	16.73	6.63
293	DRC/CC-ICP-MS	22.93	12.41	14.3	18.35	7.82
324	ICP-MS	17.604	9.166	13.156	16.006	6.186
597	ICP-MS/MS	23.0	9.26	12.2	15.8	8.32

Summary Statistics

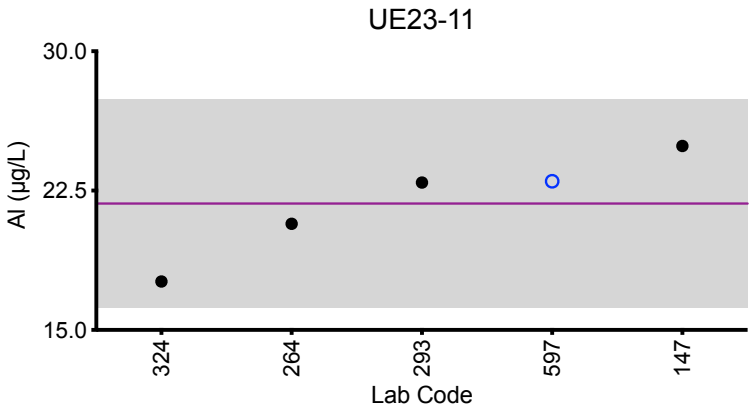
	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Arithmetic Mean ($\bar{x}$)	21.8	10.0	12.8	17.2	7.2
Arithmetic SD (s)	2.8	1.6	1.2	1.5	1.0
Arithmetic RSD (%)	13	16	9.4	8.7	14
Number of Sample Measurements (N)	5	4	4	5	4

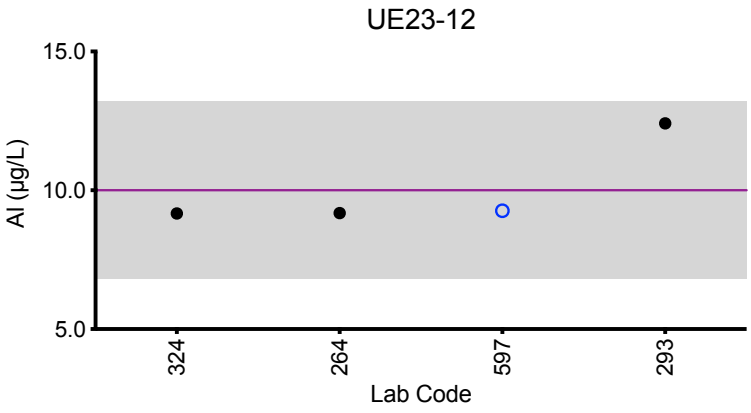
*Denotes a statistical Outlier.

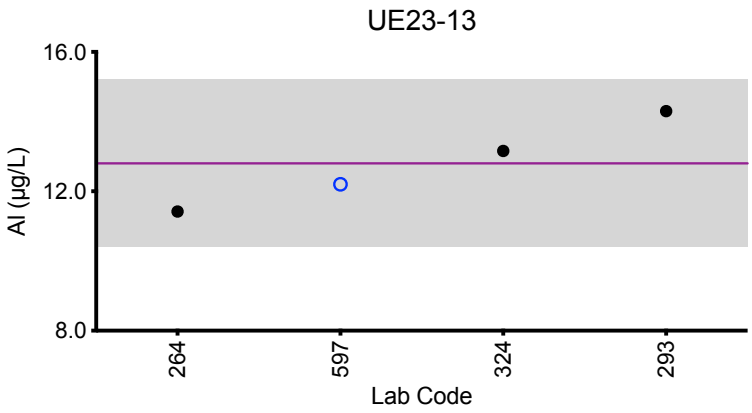
NEW YORK STATE | Department of Health | Wadsworth Center

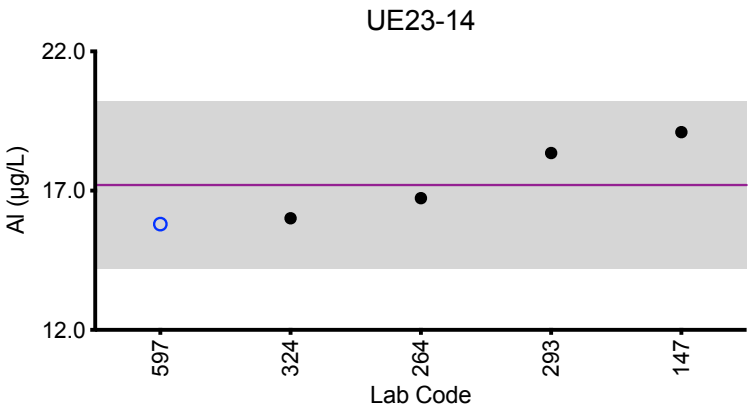
Results for Event #3, 2023: Summary Figures

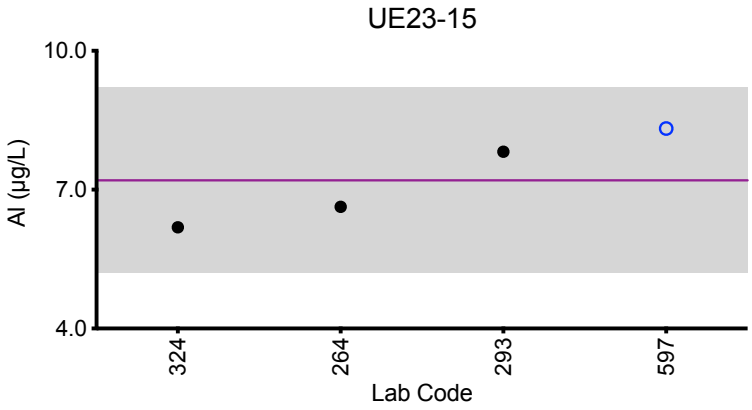
Urine Al











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

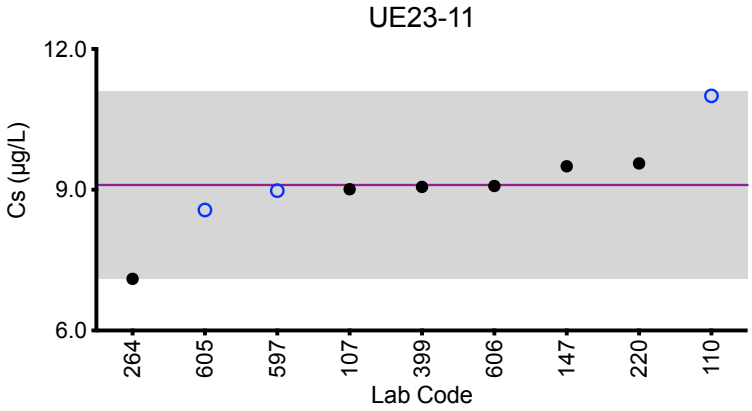
Urine Cs (µg/L)						
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
107	ICP-MS	9.01	1.79	3.56	1.21	4.02
110	ICP-MS	11.0	2.07	4.17	1.40	4.89
147	ICP-MS	9.50	1.77	3.51	1.20	4.28
220	ICP-MS	9.56	1.84	3.58	1.21	4.21
264	ICP-MS	7.10	1.36	2.71	0.91	3.21
399	ICP-MS/MS	9.06	1.77	3.48	1.20	4.14
597	ICP-MS/MS	8.98	1.67	3.30	1.13	3.98
605	ICP-MS	8.57	1.67	3.22	1.09	3.95
606	ICP-MS/MS	9.08	1.70	3.67	1.33	3.96
Summary Statistics						
		UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Arithmetic Mean ($\bar{x}$)		9.1	1.74	3.5	1.19	4.1
Arithmetic SD (s)		1.0	0.19	0.4	0.14	0.4
Arithmetic RSD (%)		11	11	11	12	11
Number of Sample Measurements (N)		9	9	9	9	9

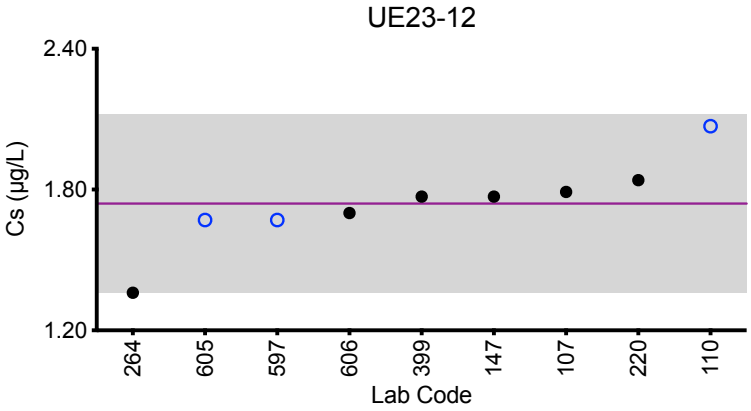
*Denotes a statistical Outlier.

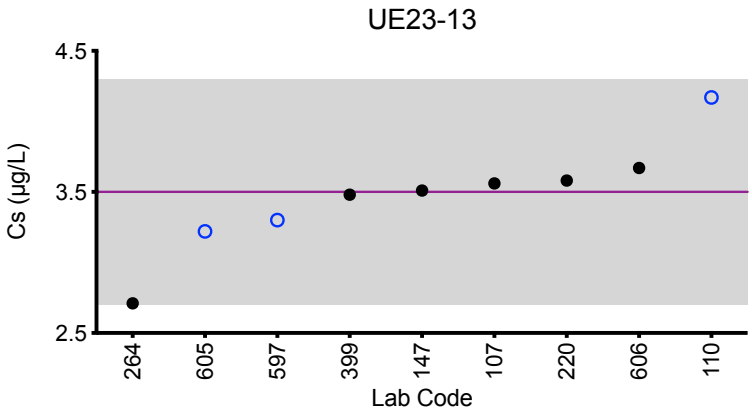
NEW YORK STATE Department of Health | Wadsworth Center

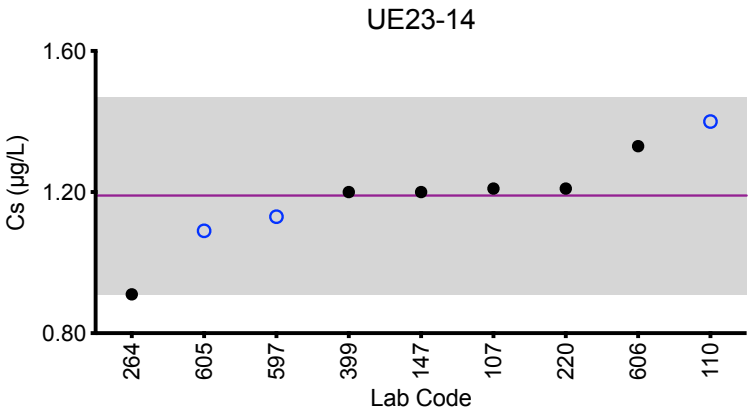
Results for Event #3, 2023: Summary Figures

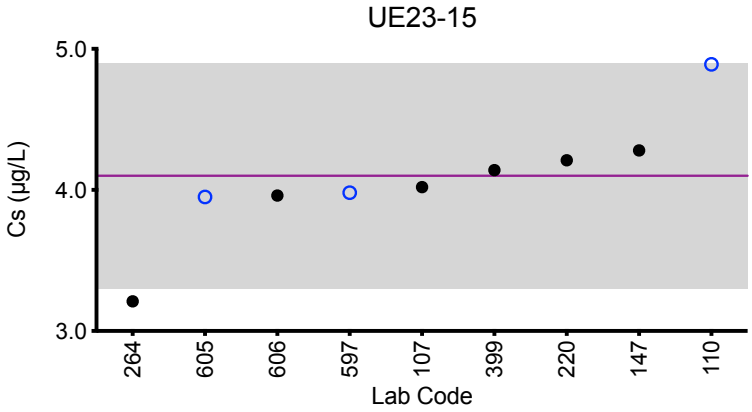
Urine Cs











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine Cu (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
110	ICP-MS	105	19.4	70.0	45.6	5.84
116	ICP-MS/MS	98.3	14.2	61.7	37.5	<6.00
147	ICP-MS	109	20.0	71.2	45.9	4.70
264	ICP-MS	107.6	16.2	66.3	41.5	3.73
293	DRC/CC-ICP-MS	95.99	13.99	59.76	36.87	3.18
324	ICP-MS	98.226	14.903	61.931	38.488	3.681
597	ICP-MS/MS	102	14.7	63.3	39.5	3.45

Summary Statistics

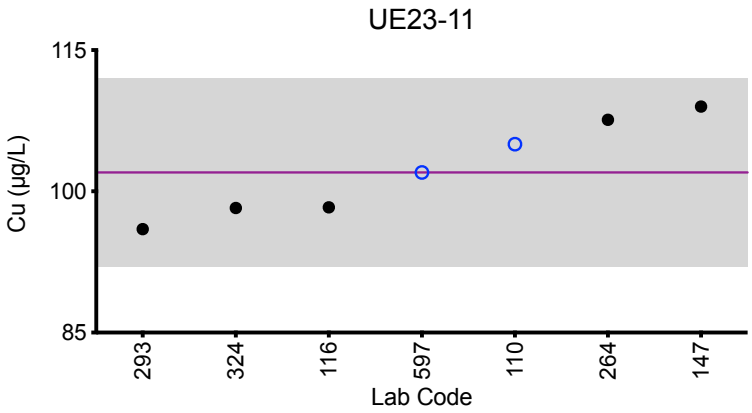
	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Arithmetic Mean ($\bar{x}$)	102	16.2	65	41	4.1
Arithmetic SD (s)	5	2.5	4	4	1.0
Arithmetic RSD (%)	4.9	15	6.2	9.1	24
Number of Sample Measurements (N)	7	7	7	7	6

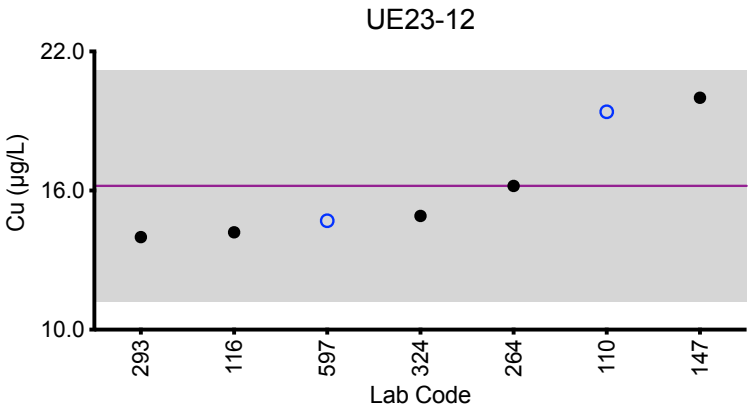
*Denotes a statistical Outlier.

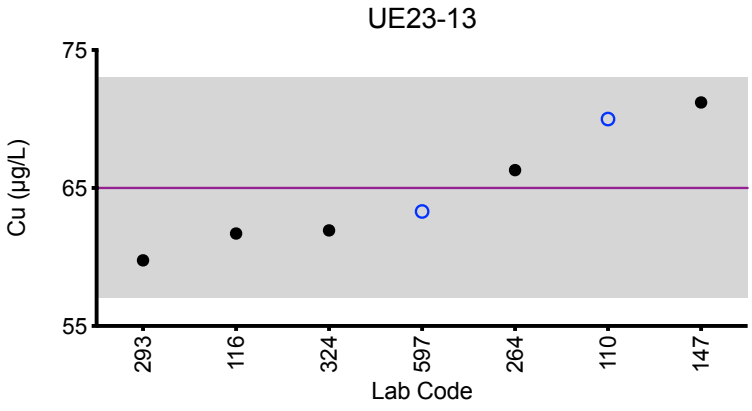
NEW YORK STATE | Department of Health | Wadsworth Center

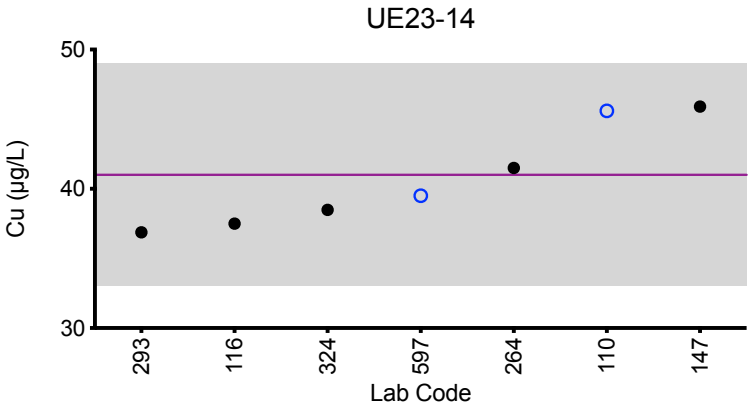
Results for Event #3, 2023: Summary Figures

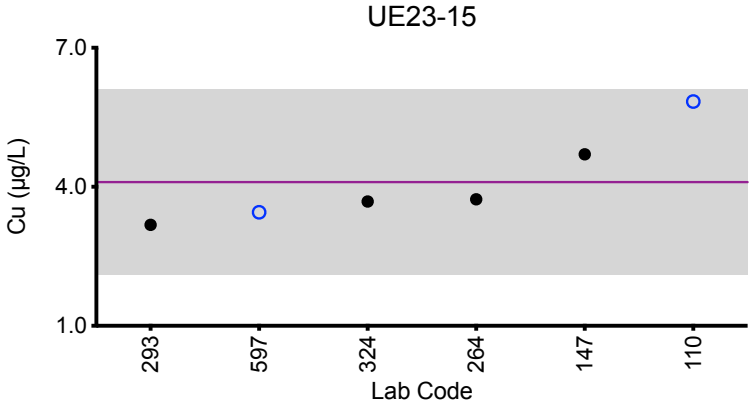
Urine Cu











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine Mo (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
103	ICP-MS/MS	77.9	45.0	15.3	31.4	113
107	ICP-MS	77.99	44.93	16.00	31.73	113.00
110	ICP-MS	82.6	47.7	16.9	33.5	123
147	ICP-MS	75.3	43.8	15.5	30.7	111
220	ICP-MS	80.3	45.7	16.1	32.1	116
264	ICP-MS	58.26	33.66	10.11	22.20	85.71
293	DRC/CC-ICP-MS	79.66	46.05	16.95	33.4	127.37
324	ICP-MS	74.977	42.804	15.078	29.838	108.987
399	ICP-MS/MS	75.6	43.8	15.2	30.2	112
597	ICP-MS/MS	72.1	40.7	14.3	28.4	103
605	ICP-MS	72.9	42.6	15.4	30.2	109
606	ICP-MS/MS	75.1	42.7	16.0	33.5	107

Summary Statistics

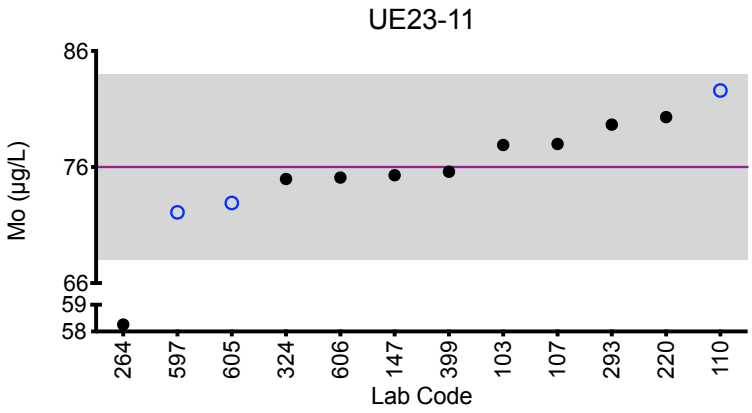
	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Robust Mean (x*)	76	43.8	15.5	31.1	111
Robust SD (s*)	4	2.1	0.9	2.0	6
Robust RSD (%)	5.0	4.8	5.8	6.4	5.4
Number of Sample Measurements (N)	12	12	12	12	12
Standard Uncertainty (*u*)	1	0.7	0.3	0.7	2

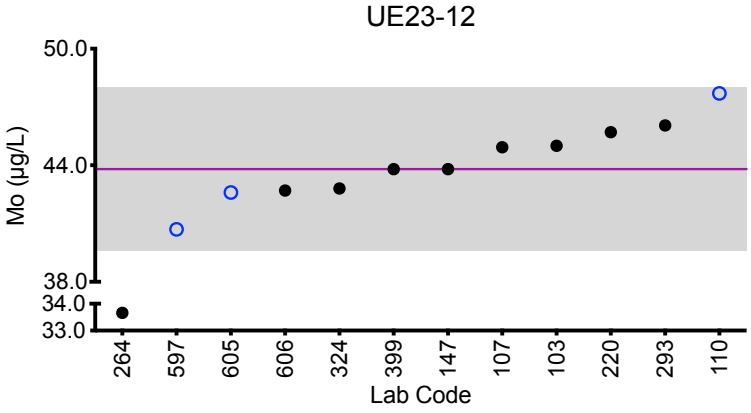
*Denotes a statistical Outlier.

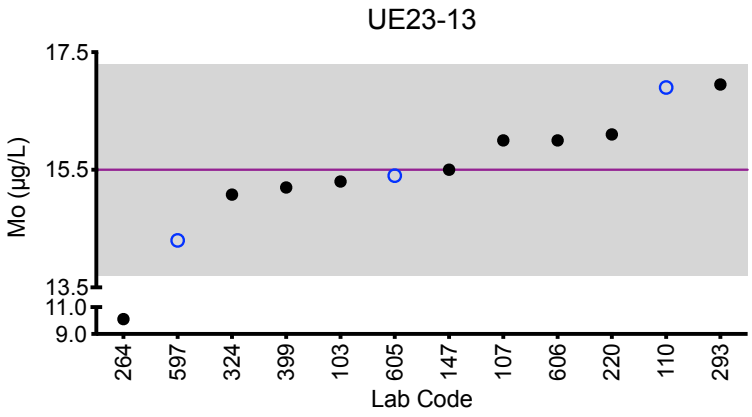
NEW YORK STATE | Department of Health | Wadsworth Center

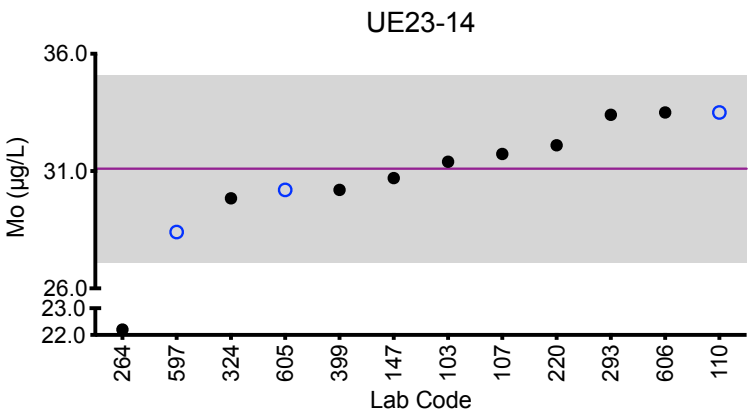
Results for Event #3, 2023: Summary Figures

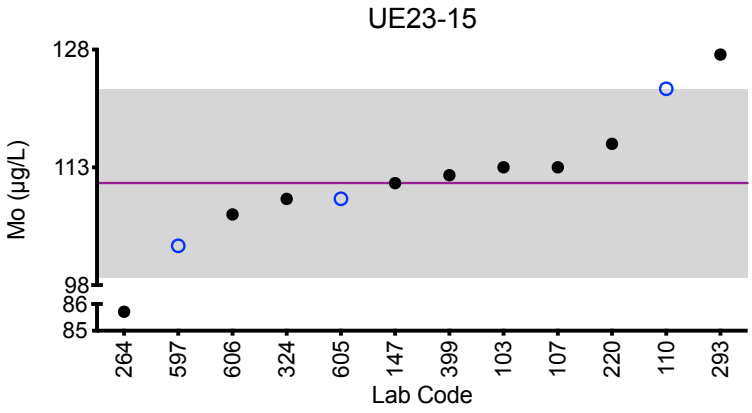
Urine Mo











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine Ni (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
103	ICP-MS/MS	1.57	13.2	4.50	3.95	2.82
107	DRC/CC-ICP-MS	1.58	12.41	4.45	3.72	3.01
110	ICP-MS	2.70	15.2	5.62	5.31	4.07
147	ICP-MS	1.89	14.7	4.80	4.51	3.15
264	ICP-MS	0.63	12.89	3.53	3.13	2.00
293	DRC/CC-ICP-MS	1.53	13.4	4.39	4.18	3.63
324	ICP-MS	1.892	13.431	4.837	4.499	3.211
442	DRC/CC-ICP-MS	1.75	14.6	4.66	4.34	3.18
597	ICP-MS/MS	3.57	13.9	4.94	5.02	3.40
605	ICP-MS	1.61	13.2	4.64	4.08	2.87

Summary Statistics

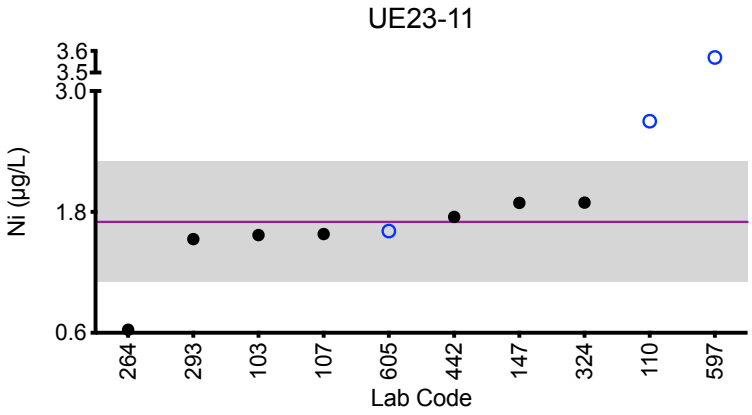
	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Robust Mean (x*)	1.7	13.6	4.7	4.3	3.2
Robust SD (s*)	0.3	0.8	0.3	0.5	0.4
Robust RSD (%)	17	5.9	6.5	12	13
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.1	0.3	0.1	0.2	0.2

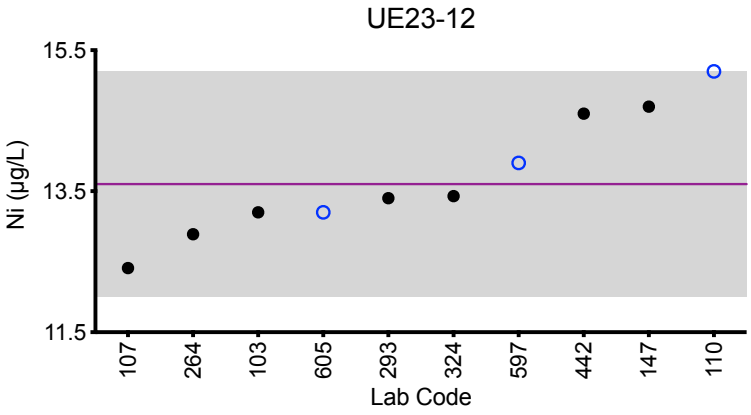
*Denotes a statistical Outlier.

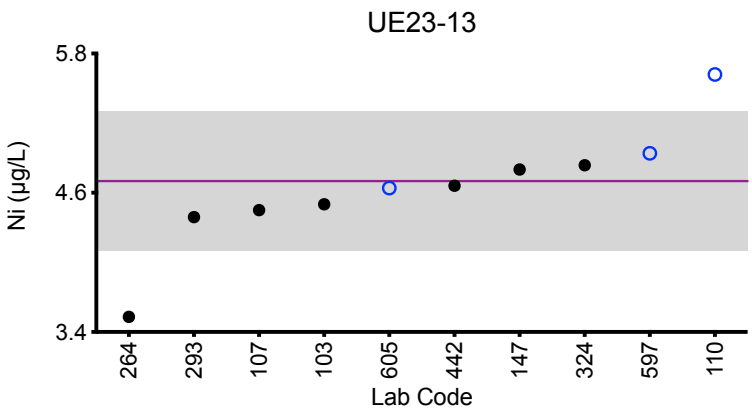
NEW YORK STATE | Department of Health | Wadsworth Center

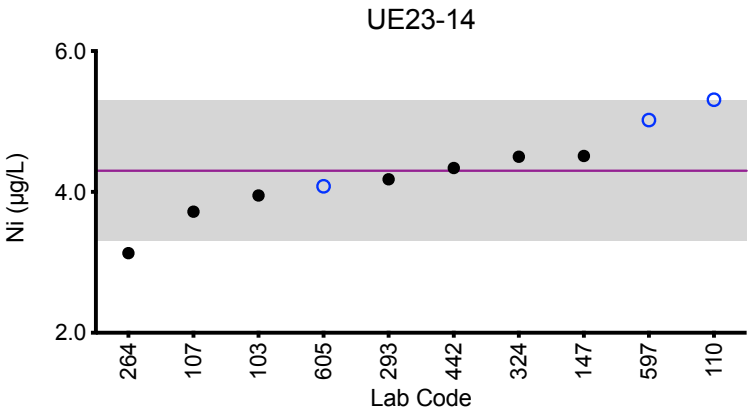
Results for Event #3, 2023: Summary Figures

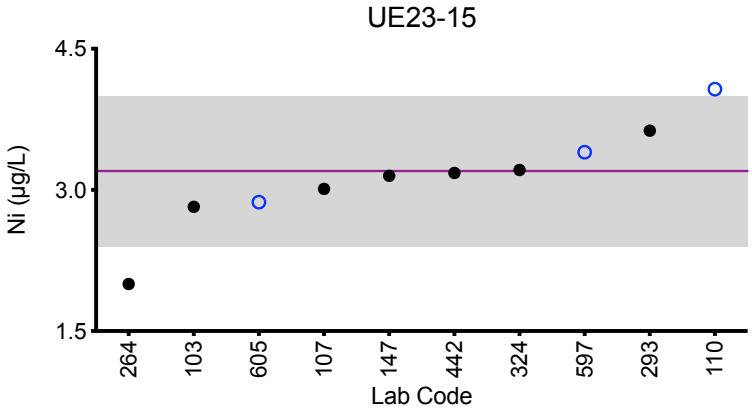
Urine Ni











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine Pt (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
107	ICP-MS	4.0776	1.2594	0.1819	0.3750	0.9687
110	ICP-MS	4.15	1.25	0.191	0.385	0.965
220	ICP-MS	3.97	1.21	0.19	0.37	0.91
264	ICP-MS	3.81	1.16	0.17	0.33	0.92
293	DRC/CC-ICP-MS	4.07	1.2	0.2	0.37	1
399	ICP-MS/MS	3.98	1.22	0.199	0.352	0.931
605	ICP-MS	3.72	1.14	0.175	0.348	0.886

Summary Statistics

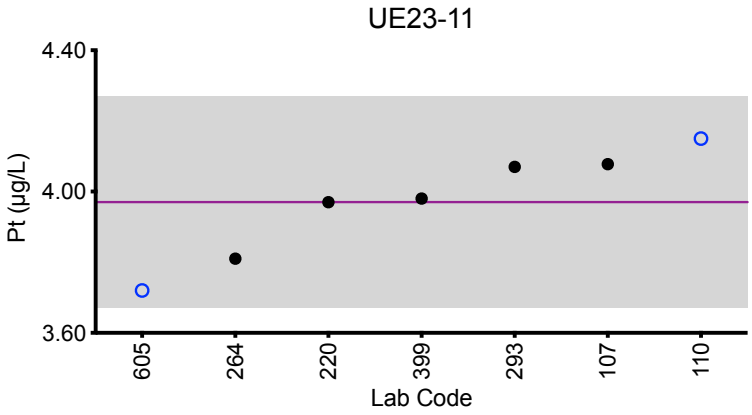
	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Arithmetic Mean ($\bar{x}$)	3.97	1.21	0.187	0.361	0.94
Arithmetic SD (s)	0.15	0.04	0.012	0.019	0.04
Arithmetic RSD (%)	3.8	3.3	6.4	5.3	4.1
Number of Sample Measurements (N)	7	7	7	7	7

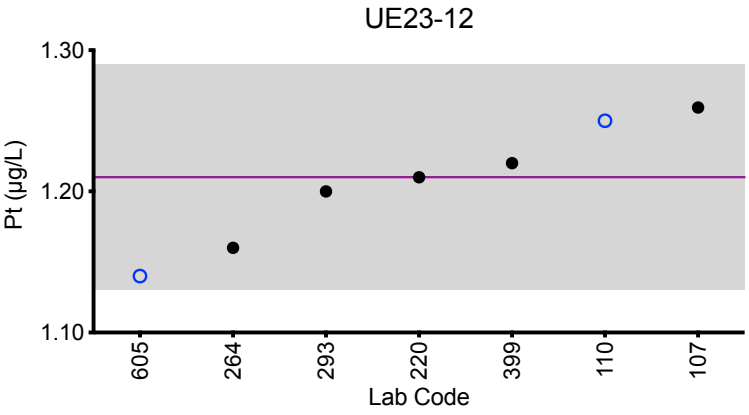
*Denotes a statistical Outlier.

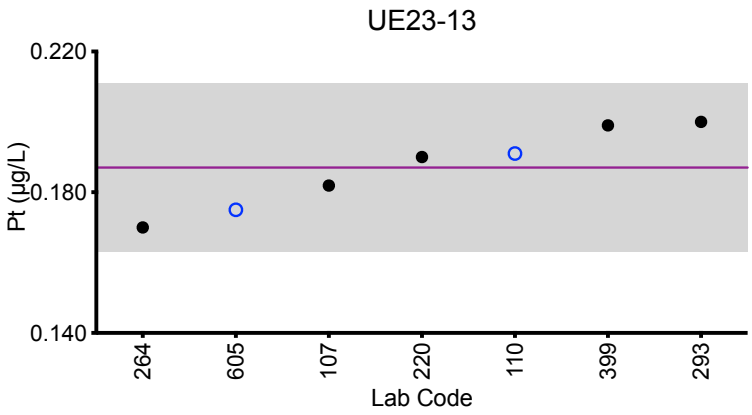
NEW YORK STATE | Department of Health | Wadsworth Center

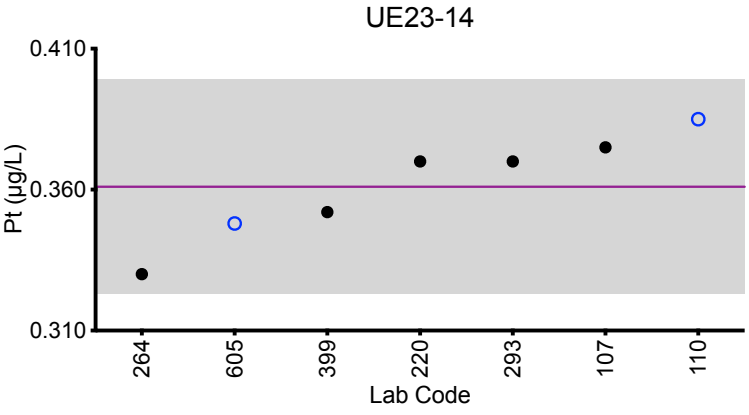
Results for Event #3, 2023: Summary Figures

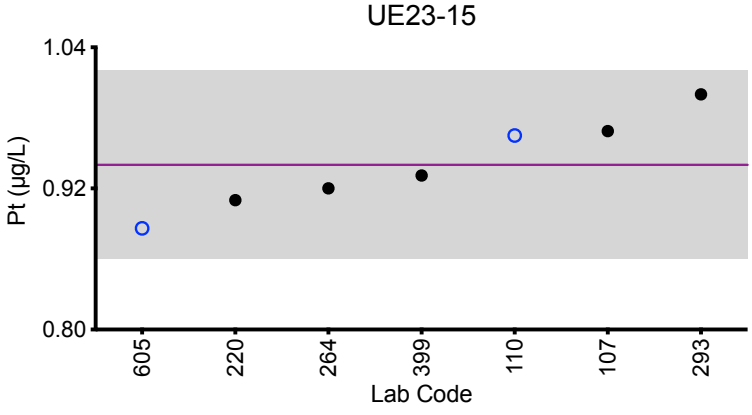
Urine Pt











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine Sb (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
103	ICP-MS/MS	1.15	0.298	0.961	0.113	2.22
107	ICP-MS	1.195	0.345	1.002	0.124	2.196
110	ICP-MS	1.36	0.653	1.09	0.143	2.49
147	ICP-MS	1.19	0.360	0.959	0.135	2.23
220	ICP-MS	1.22	0.361	1.01	0.137	2.28
264	ICP-MS	0.79	0.23	0.66	0.07	1.57
293	DRC/CC-ICP-MS	1.3	0.36	1.06	0.13	2.53
324	ICP-MS	1.148	<1	<1	<1	2.098
399	ICP-MS/MS	1.16	0.334	0.962	0.132	2.20
597	ICP-MS/MS	1.09	0.329	0.930	0.113	2.03
605	ICP-MS	1.26	<0.800	0.876	<0.800	2.25
606	ICP-MS/MS	1.25	0.374	1.02	0.115	2.13

Summary Statistics

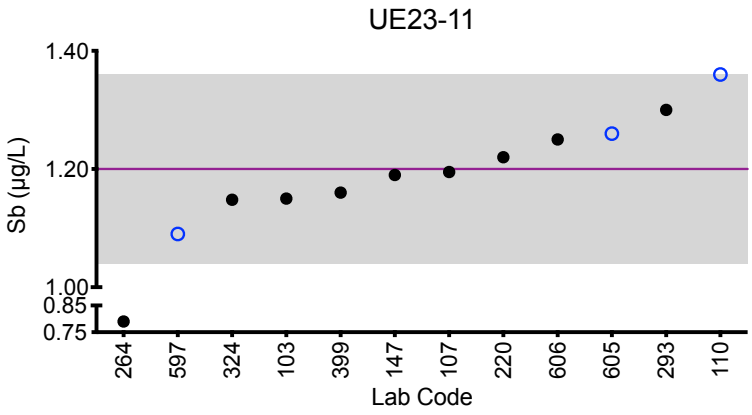
	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Robust Mean (x*)	1.20	0.35	0.97	0.124	2.20
Robust SD (s*)	0.08	0.03	0.08	0.015	0.13
Robust RSD (%)	6.7	9.2	8.2	12	5.9
Number of Sample Measurements (N)	12	10	11	10	12
Standard Uncertainty (*u*)	0.03	0.01	0.03	0.006	0.05

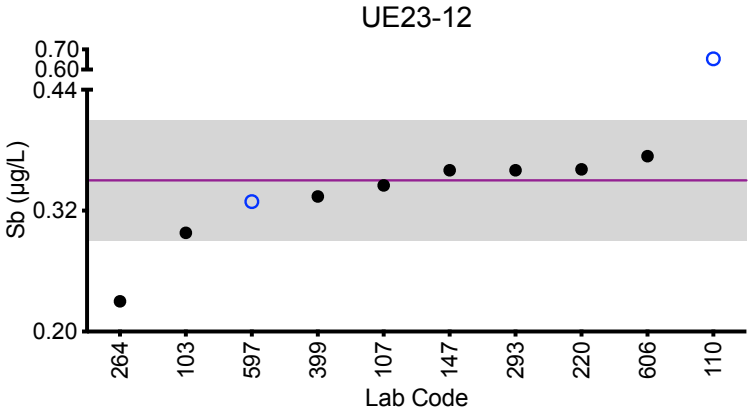
*Denotes a statistical Outlier.

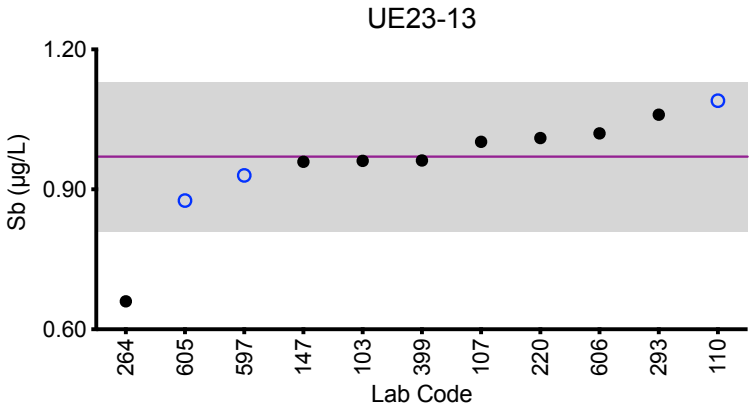
NEW YORK STATE | Department of Health | Wadsworth Center

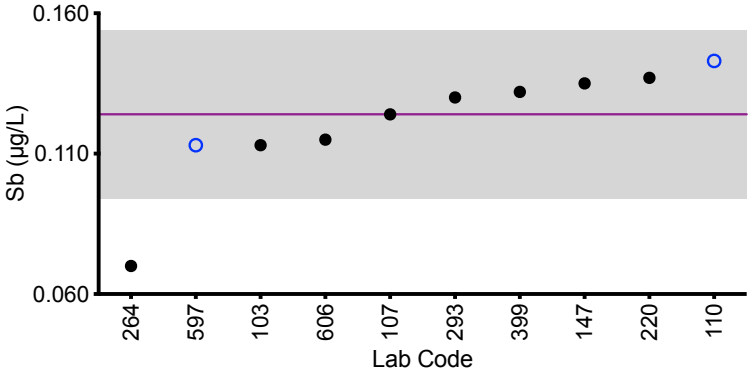
Results for Event #3, 2023: Summary Figures

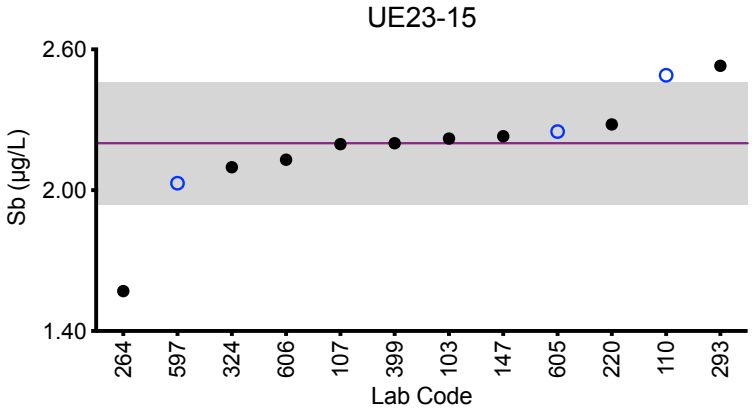
Urine Sb











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

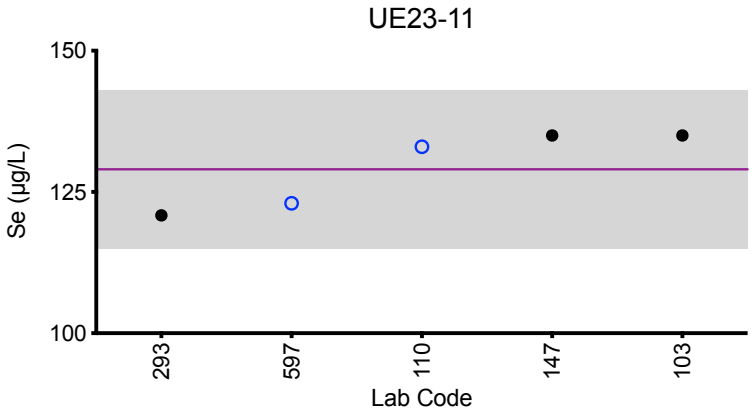
Urine Se (µg/L)						
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
103	ICP-MS/MS	135	54.3	92.1	180	221
110	DRC/CC-ICP-MS	133	53.0	89.6	180	225
147	ICP-MS	135	53.4	90.8	183	231
293	DRC/CC-ICP-MS	120.85	47.39	78.99	160.35	202.21
597	ICP-MS/MS	123	50.8	84.6	166	209
Summary Statistics						
		UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Arithmetic Mean ($\bar{x}$)		129	51.8	87	174	218
Arithmetic SD (s)		7	2.8	5	10	12
Arithmetic RSD (%)		5.4	5.4	5.7	5.7	5.5
Number of Sample Measurements (N)		5	5	5	5	5

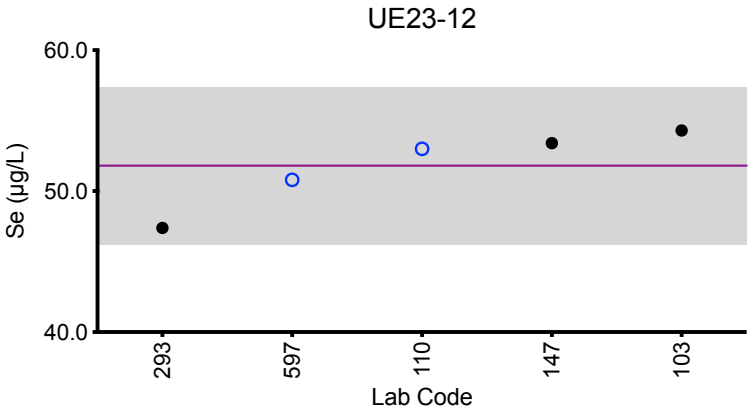
*Denotes a statistical Outlier.

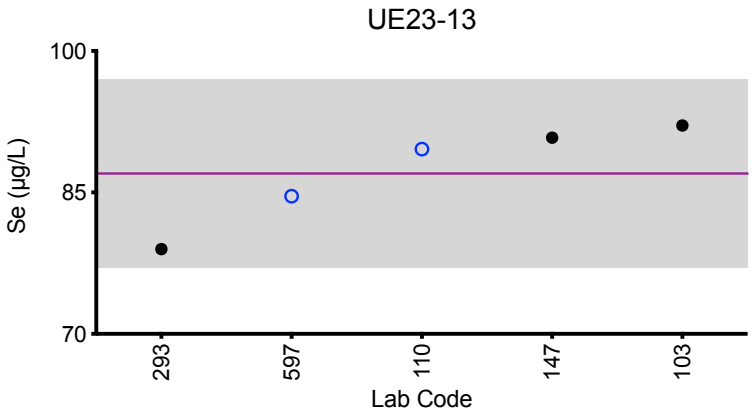
NEW YORK STATE | Department of Health | Wadsworth Center

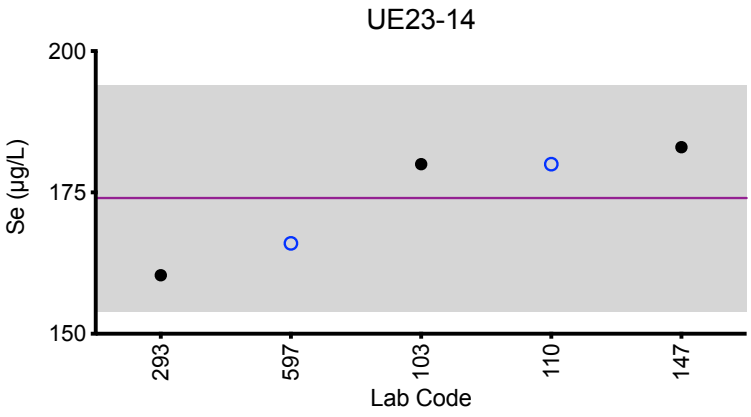
Results for Event #3, 2023: Summary Figures

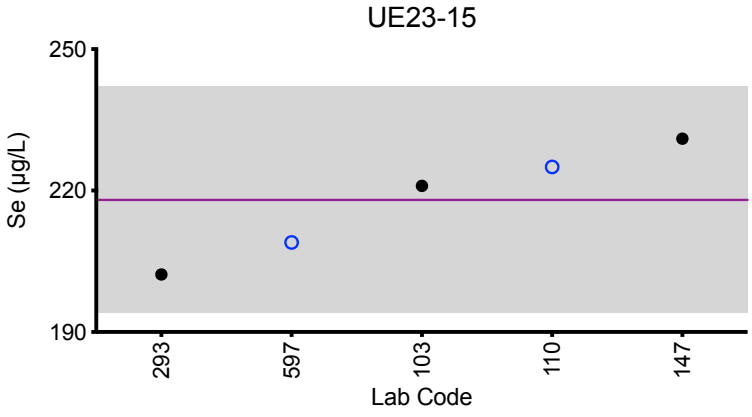
Urine Se











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine Sn (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
107	ICP-MS	2.73	0.78	5.55	2.21	3.13
110	ICP-MS	3.31	0.95	6.79	2.85	3.65
147	ICP-MS	2.41	0.664	5.15	2.04	2.81
220	ICP-MS	2.76	0.714	5.22	2.23	3.31
264	ICP-MS	1.49	*0.23	2.11	0.70	1.73
293	DRC/CC-ICP-MS	2.88	0.78	4.75	2.19	3.11
324	ICP-MS	2.461	<1	4.942	1.962	2.869
399	ICP-MS/MS	2.58	0.729	5.24	2.31	3.24
597	ICP-MS/MS	2.17	0.493	3.43	0.994	2.30
605	ICP-MS	2.53	<0.900	5.51	2.24	2.94

Summary Statistics

	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Robust Mean (x*)	2.6	0.73	5.1	2.14	3.0
Robust SD (s*)	0.3	0.14	0.6	0.21	0.4
Robust RSD (%)	13	19	12	9.8	12
Number of Sample Measurements (N)	10	7	10	10	10
Standard Uncertainty (*u*)	0.1	NA	0.2	0.08	0.1

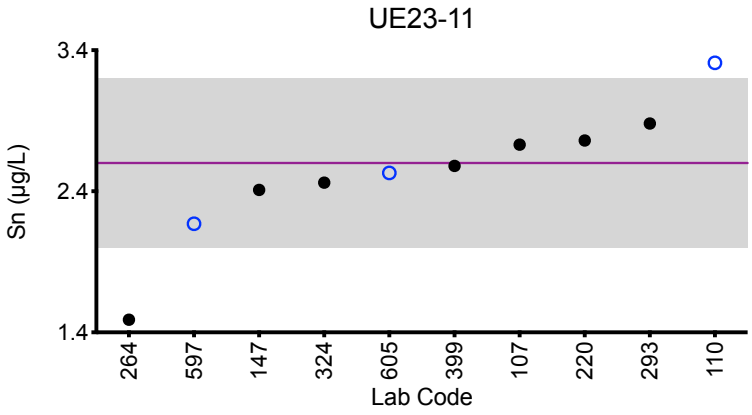
*Denotes a statistical Outlier.

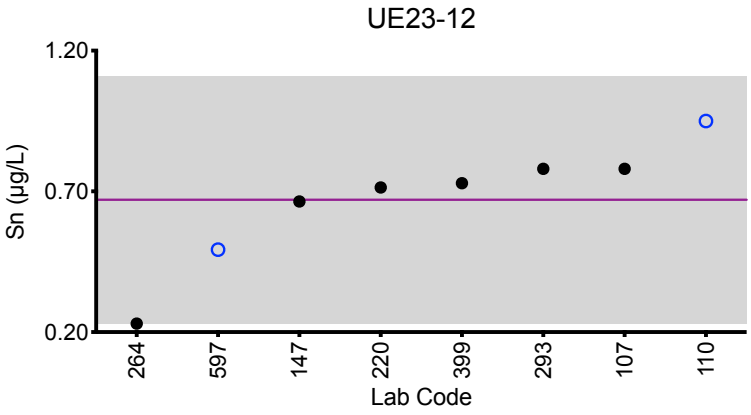
An arithmetic mean, SD, RSD and n are provided for sample UE23-12.

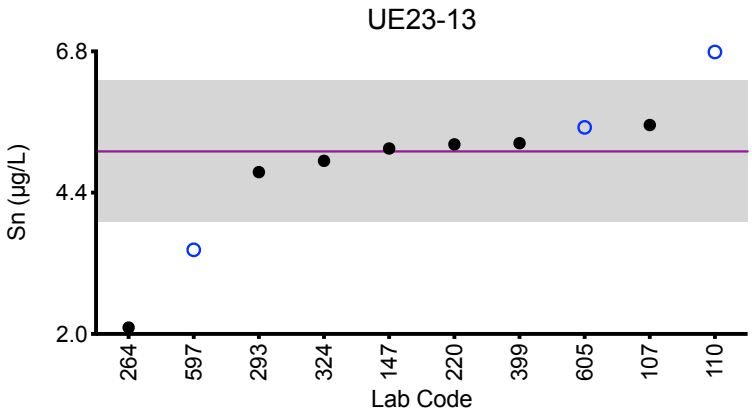
NEW YORK STATE | Department of Health | Wadsworth Center

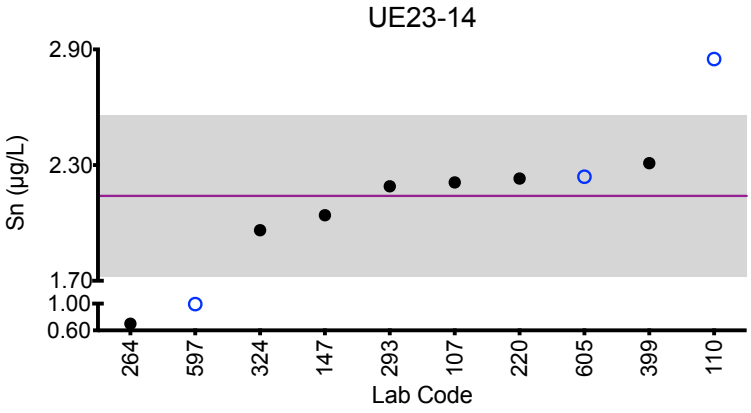
Results for Event #3, 2023: Summary Figures

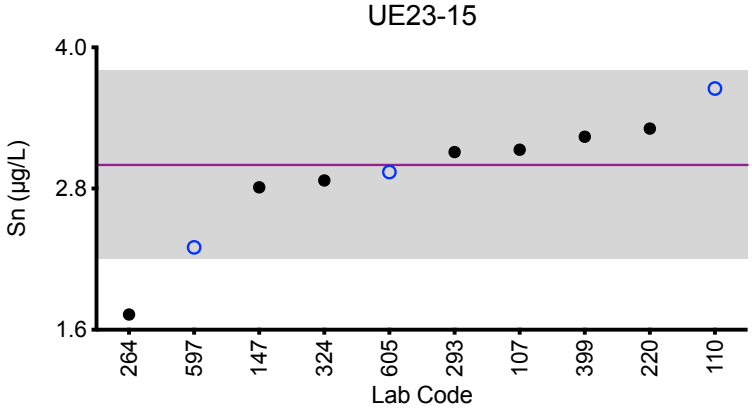
Urine Sn











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

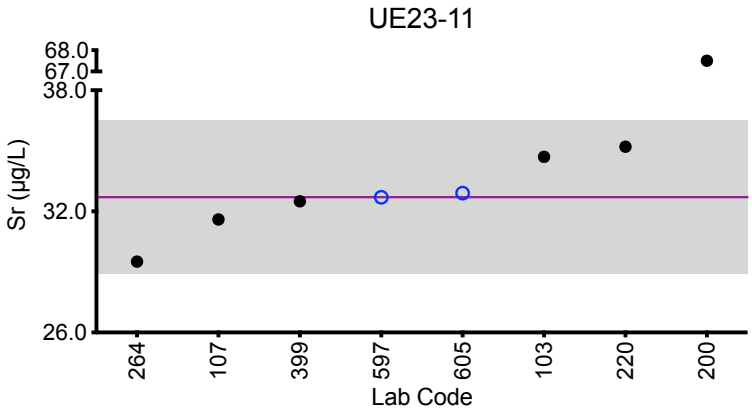
Urine Sr (µg/L)						
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
103	ICP-MS/MS	34.7	135	274	72.2	131
107	ICP-MS	31.6	118.7	288.0	65.7	114.2
200	ICP-MS	*67.5	122.7	264.6	67.5	117.4
220	ICP-MS	35.2	134	281	72.5	129
264	ICP-MS	29.51	112.7	240.0	61.9	107.2
399	DRC/CC-ICP-MS	32.5	122	264	66.9	121
597	ICP-MS/MS	32.7	120	254	65.7	117
605	ICP-MS	32.9	126	266	70.6	124
Summary Statistics						
		UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Arithmetic Mean ($\bar{x}$)		32.7	124	266	67.9	120
Arithmetic SD (s)		1.9	8	15	3.7	8
Arithmetic RSD (%)		5.8	6.5	5.6	5.4	6.7
Number of Sample Measurements (N)		7	8	8	8	8

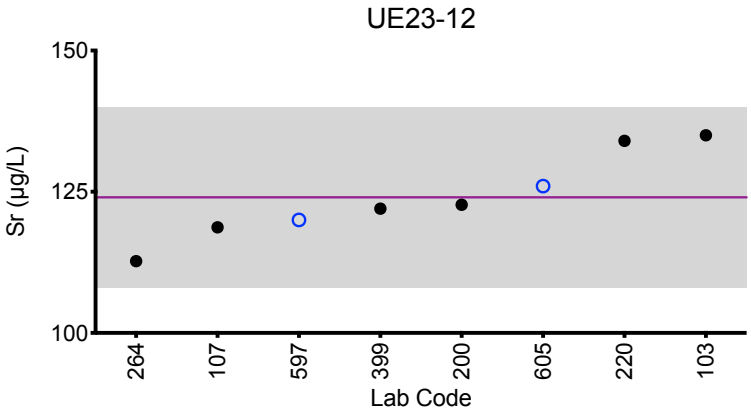
*Denotes a statistical Outlier.

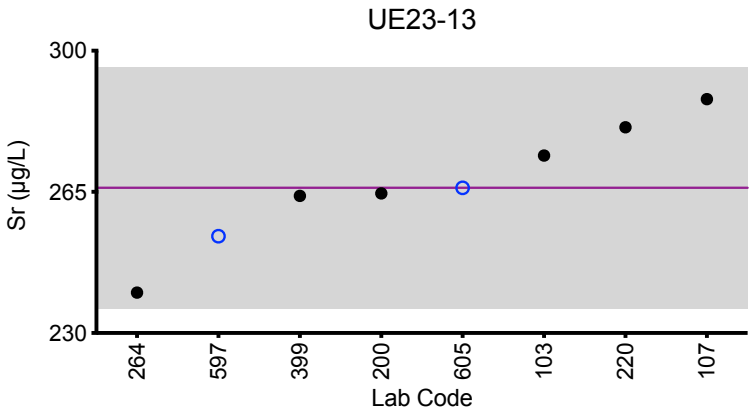
NEW YORK STATE | Department of Health | Wadsworth Center

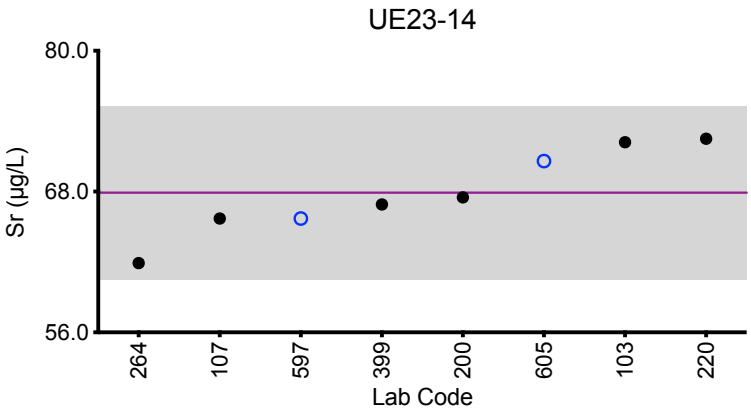
Results for Event #3, 2023: Summary Figures

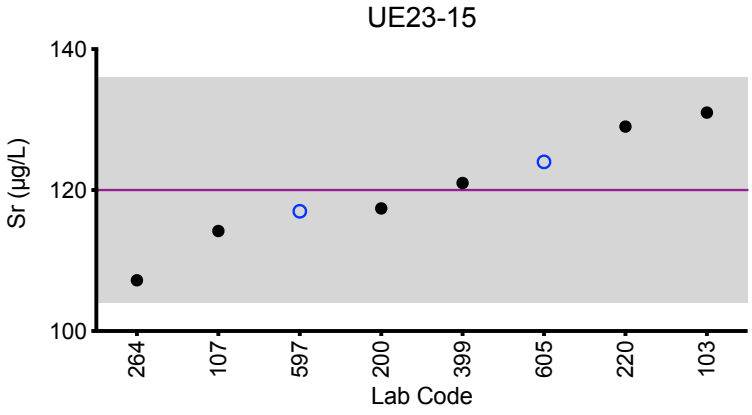
Urine Sr











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine V (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
116	ICP-MS/MS	0.916	3.33	1.37	0.436	6.04
147	DRC/CC-ICP-MS	0.944	3.46	1.36	0.466	6.38
293	DRC/CC-ICP-MS	0.93	3.46	*1.48	0.51	6.54
597	ICP-MS/MS	0.911	3.30	1.36	0.411	6.15
605	ICP-MS	*0.802	3.31	1.33	0.383	5.99

Summary Statistics

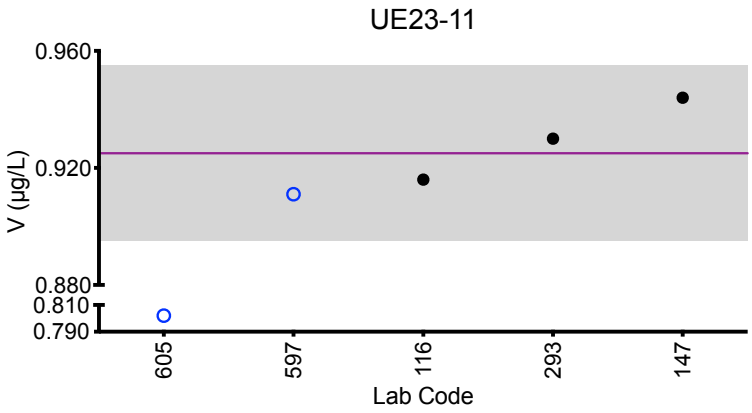
	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Arithmetic Mean ($\bar{x}$)	0.925	3.37	1.36	0.44	6.2
Arithmetic SD (s)	0.015	0.08	0.02	0.05	0.2
Arithmetic RSD (%)	1.6	2.4	1.3	11	3.7
Number of Sample Measurements (N)	4	5	4	5	5

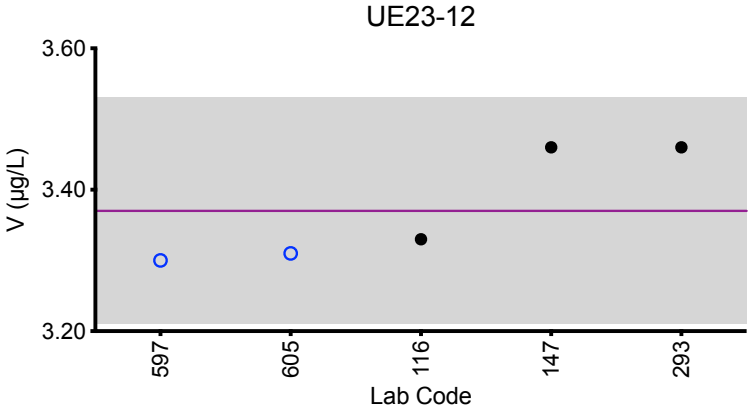
*Denotes a statistical Outlier.

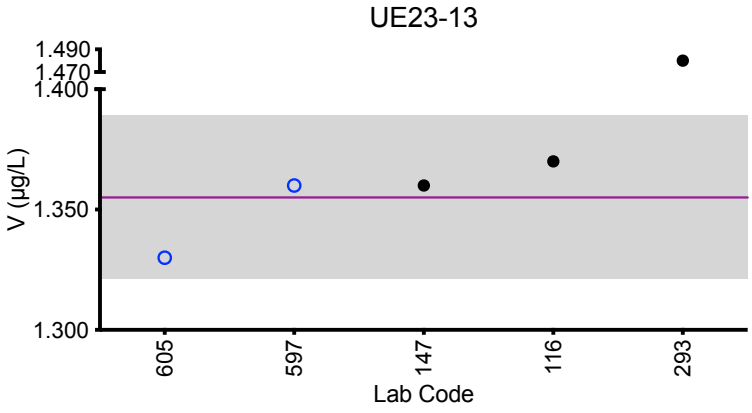
NEW YORK STATE | Department of Health | Wadsworth Center

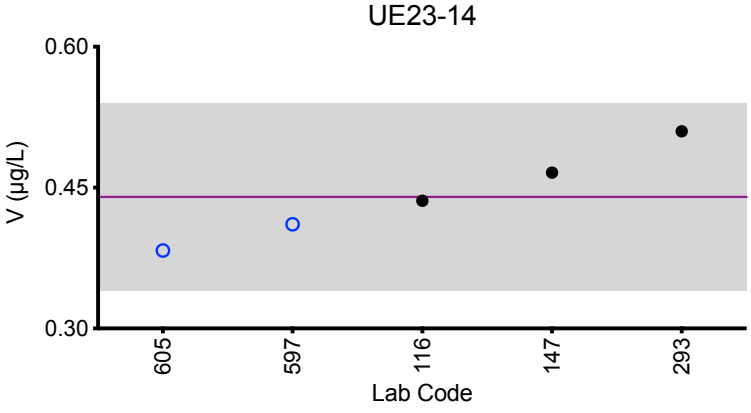
Results for Event #3, 2023: Summary Figures

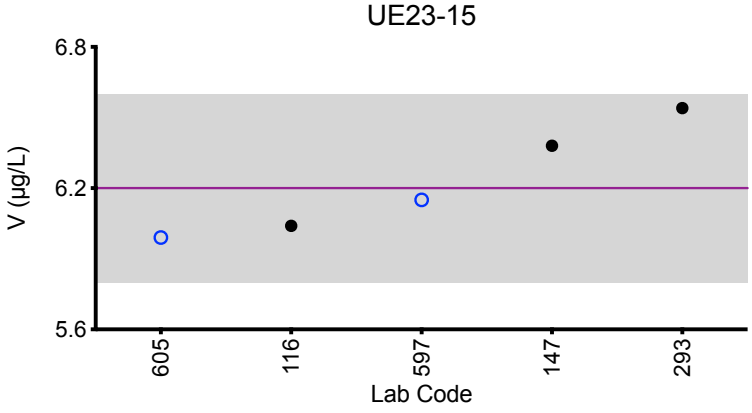
Urine V











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine W (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
107	ICP-MS	1.166	4.144	0.855	2.268	0.507
110	ICP-MS	1.20	4.22	0.872	2.23	0.519
147	ICP-MS	1.05	3.97	0.859	2.19	0.474
200	ICP-MS	0.92	3.71	0.88	2.24	0.44
220	ICP-MS	1.20	4.25	0.852	2.32	0.519
264	ICP-MS	1.08	3.93	0.78	2.08	0.44
324	ICP-MS	1.130	3.881	<1	2.044	<1
399	ICP-MS/MS	1.16	4.09	0.821	2.22	0.523
597	ICP-MS/MS	1.20	3.98	0.826	2.20	0.521
605	ICP-MS	1.06	3.99	0.806	2.14	0.465
606	ICP-MS/MS	1.12	3.89	0.878	2.38	0.487

Summary Statistics

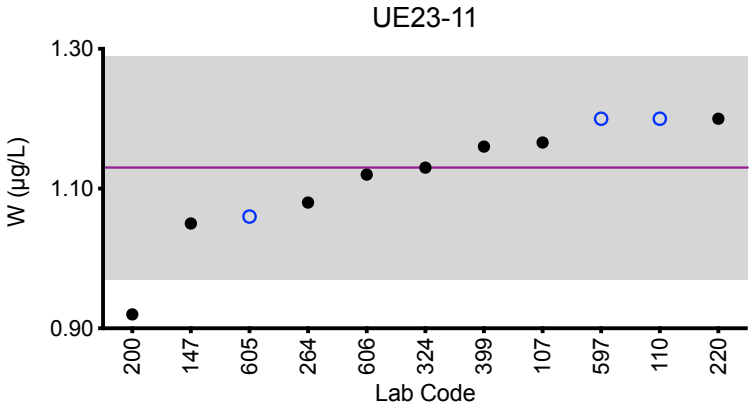
	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Robust Mean (x*)	1.13	4.00	0.84	2.21	0.49
Robust SD (s*)	0.08	0.16	0.03	0.08	0.04
Robust RSD (%)	7.1	4.0	4.0	3.6	7.3
Number of Sample Measurements (N)	11	11	10	11	10
Standard Uncertainty (*u*)	0.03	0.06	0.01	0.03	0.01

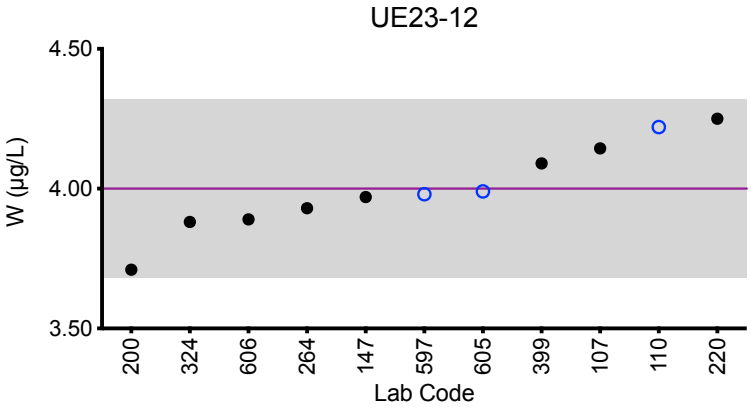
*Denotes a statistical Outlier.

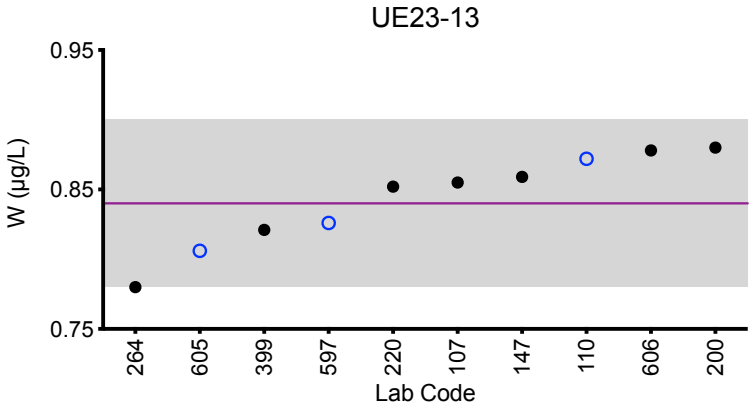
NEW YORK STATE | Department of Health | Wadsworth Center

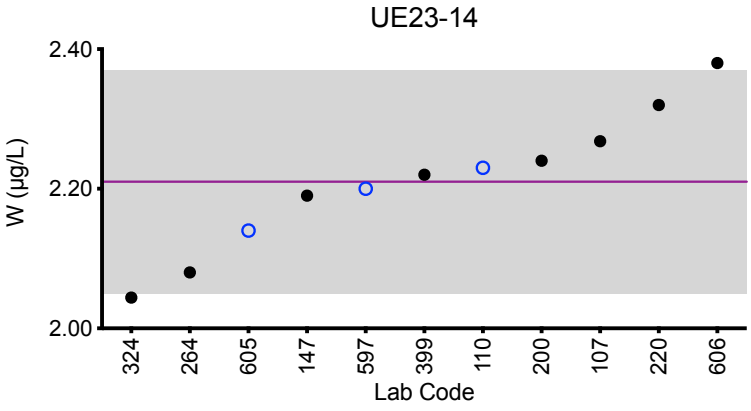
Results for Event #3, 2023: Summary Figures

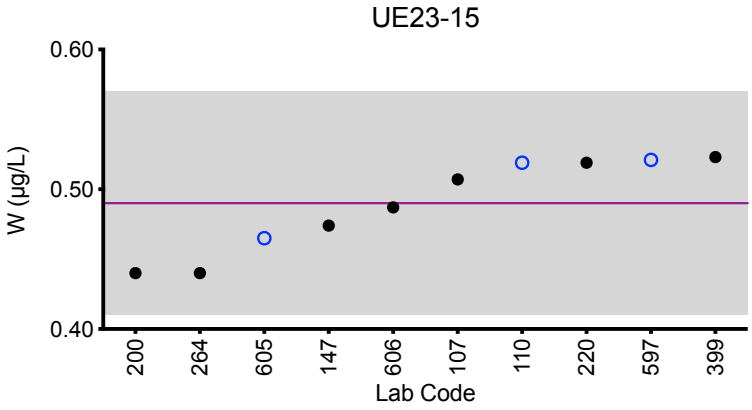
Urine W











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine Zn (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
110	ICP-MS	476	121	211	741	210
147	ICP-MS	541	*140	238	830	246
264	ICP-MS	518.5	122.5	228.5	808.8	220.6
293	DRC/CC-ICP-MS	465.36	119.61	207.84	720.26	223.53
324	ICP-MS	474.964	115.610	209.825	745.595	207.073
597	ICP-MS/MS	500	116	218	784	214

Summary Statistics

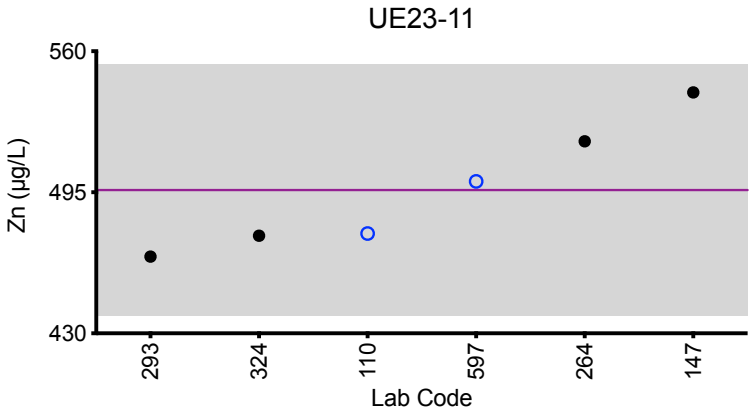
	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Arithmetic Mean ($\bar{x}$)	496	119	219	770	220
Arithmetic SD (s)	29	3	12	40	14
Arithmetic RSD (%)	5.8	2.5	5.5	5.2	6.4
Number of Sample Measurements (N)	6	5	6	6	6

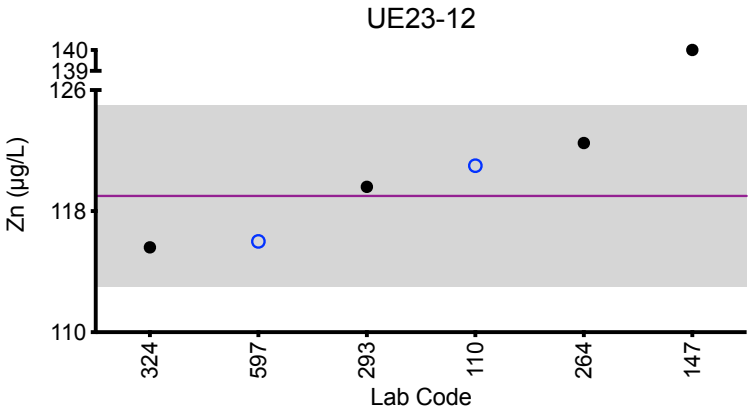
*Denotes a statistical Outlier.

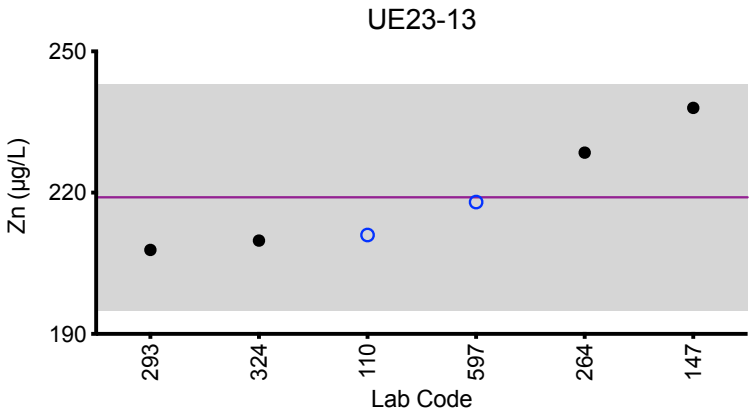
NEW YORK STATE | Department of Health | Wadsworth Center

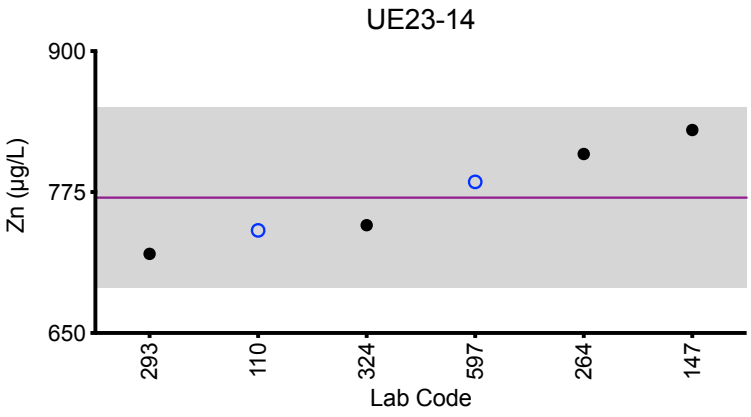
Results for Event #3, 2023: Summary Figures

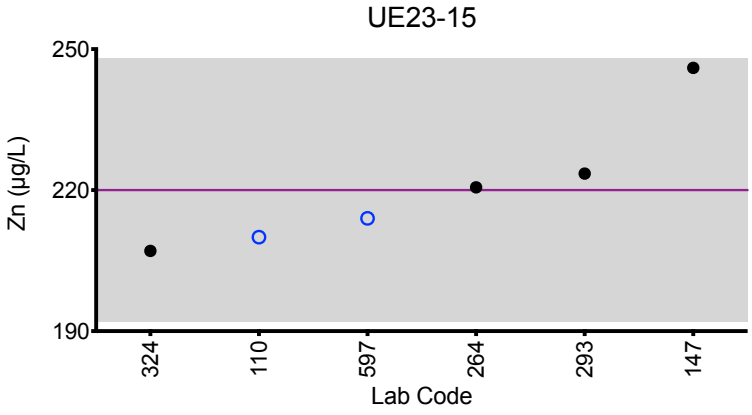
Urine Zn











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine I (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
110	ICP-MS	106	156	147	143	74.6
147	ICP-MS	92.7	146	144	135	75.9

Summary Statistics

	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
Arithmetic Mean ($\bar{x}$)	99	151	146	139	75.3
Arithmetic SD (s)	9	7	2	6	0.9
Arithmetic RSD (%)	9.1	4.6	1.4	4.3	1.2
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Urine Te (µg/L)						
Lab Code	**Method**	**UE23-11**	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
110	ICP-MS	0.257	1.37	0.762	0.664	3.10
147	ICP-MS	0.222	1.34	0.676	0.666	3.25
Summary Statistics						
		UE23-11	**UE23-12**	**UE23-13**	**UE23-14**	**UE23-15**
Arithmetic Mean ($\bar{x}$)		0.24	1.36	0.72	0.665	3.17
Arithmetic SD (s)		0.02	0.02	0.06	0.001	0.11
Arithmetic RSD (%)		8.3	1.5	8.3	0.21	3.5
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Additional Elements in Urine

Urine Ag (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
147	ICP-MS	<0.151	<0.151	<0.151	<0.151	<0.151

Urine B (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
200	ICP-MS	216	400	400	367	162

Urine Bi (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
147	ICP-MS	<0.0794	<0.0794	<0.0794	<0.0794	<0.0794
597	ICP-MS/MS	<0.0196	<0.0196	<0.0196	<0.0196	<0.0196

Urine Fe (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
324	ICP-MS	15.463	56.207	15.009	73.875	11.200

Urine Li (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
147	ICP-MS	5.36	8.74	9.37	8.88	4.14

Urine Mg (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
597	ICP-MS/MS	12300	20000	24200	22300	11700

Urine Th (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
147	ICP-MS	<0.102	<0.102	<0.102	<0.102	<0.102
597	ICP-MS/MS	0.0257	0.0310	0.0220	<0.0169	<0.0169

Urine Ti (µg/L)

Lab Code	Method	UE23-11	UE23-12	UE23-13	UE23-14	UE23-15
597	ICP-MS/MS	4.68	2.26	6.76	1.79	2.73

NEW YORK STATE | Department of Health | Wadsworth Center

Event #3, 2023

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

NEW YORK STATE | Department of Health | Wadsworth Center

Event #3, 2023:
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 27 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, Te, Th, Ti, Tl, U, V, and W. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Serum Al (µg/L)				
	SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Target (Arithmetic Mean ($\bar{x}$))	23.0	35.1	11.9	65.5	9.1
Upper Limit	28.0	42.1	16.9	78.6	14.1
Lower Limit	18.0	28.1	6.9	52.4	4.1
Arithmetic SD (s)	0.5	1.7	2.4	3.2	2.5
Arithmetic RSD (%)	2.2	4.8	20	4.9	27
Number of Sample Measurements (N)	5	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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

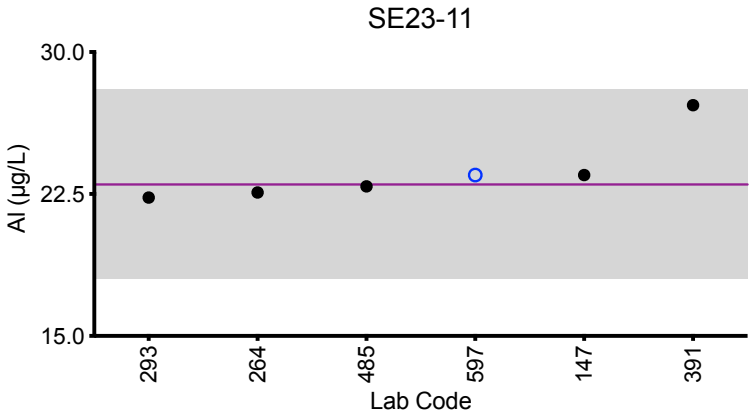
		Serum Al (µg/L)				
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
	Target	**23.0**	**35.1**	**11.9**	**65.5**	**9.1**
147	ETAAS-Z	23.5	35.3	11.6	67.6	5.86
264	ICP-MS	22.58	36.90	8.96	65.10	8.62
293	DRC/CC-ICP-MS	22.31	35.22	13.17	68.82	8.33
391	ETAAS-Z	*27.19	32.41	15.84	59.64	13.32
485	HR-ICP-MS	22.9	36.7	10.5	65.7	8.18
597	ICP-MS/MS	23.5	34.0	11.5	66.2	10.1

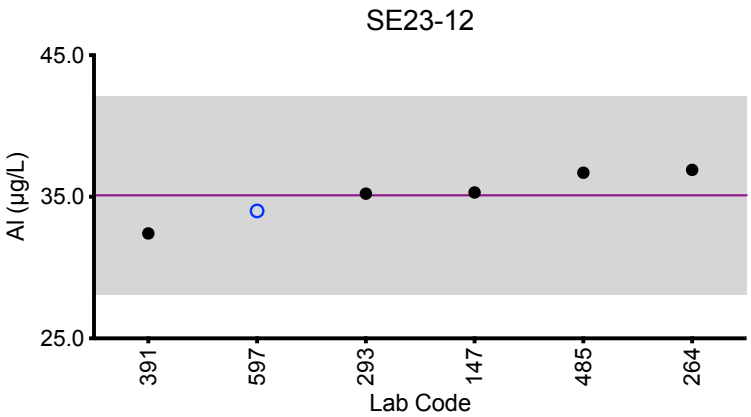
Based on the grading criteria for Al in Serum, 100% of results were satisfactory, with 0 of the 6 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

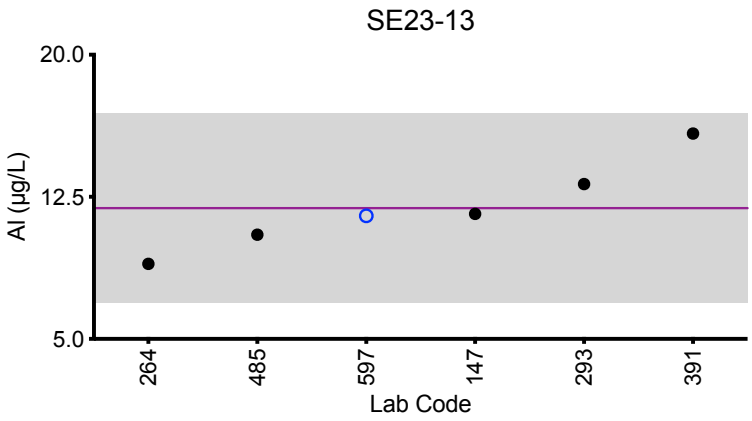
NEW YORK STATE | Department of Health | Wadsworth Center

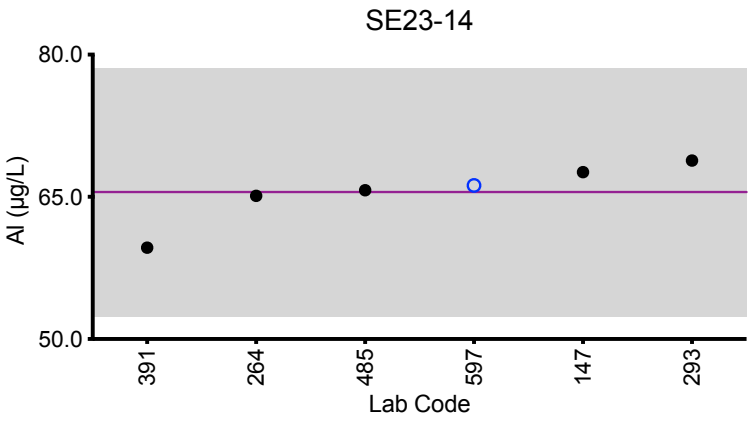
Results for Event #3, 2023: Summary Figures

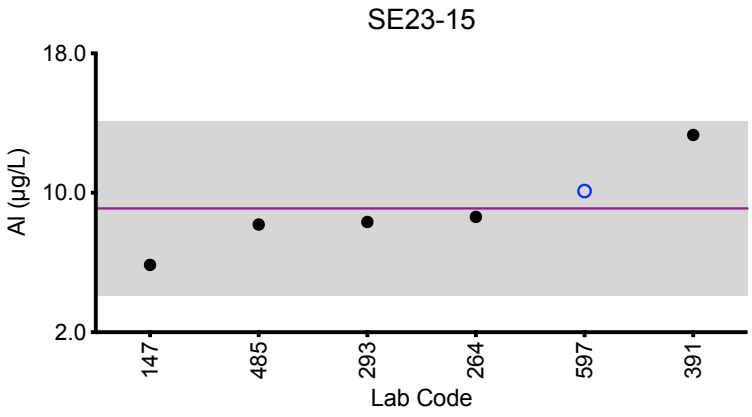
Serum Al











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Summary Statistics

	Serum Co (µg/L)				
	SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Target (Arithmetic Mean ($\bar{x}$))	3.34	8.6	5.25	1.99	0.87
Upper Limit	4.84	10.1	6.75	3.49	2.37
Lower Limit	1.84	7.1	3.75	0.49	0.00
Arithmetic SD (s)	0.08	0.4	0.25	0.08	0.06
Arithmetic RSD (%)	2.4	4.5	4.8	4.0	6.9
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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

Serum Co (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
	Target	**3.34**	**8.6**	**5.25**	**1.99**	**0.87**
103	ICP-MS/MS	*2.95	7.98	4.87	1.85	0.818
110	ICP-MS/MS	3.45	8.98	5.51	2.10	0.93
147	DRC/CC-ICP-MS	3.30	8.43	5.10	1.97	0.925
264	ICP-MS	3.33	8.51	5.18	2.01	0.80
293	DRC/CC-ICP-MS	3.4	8.90	5.59	1.99	0.92
485	HR-ICP-MS	3.33	9.08	5.3	2.06	0.828
597	ICP-MS/MS	3.23	8.46	5.19	1.96	0.863

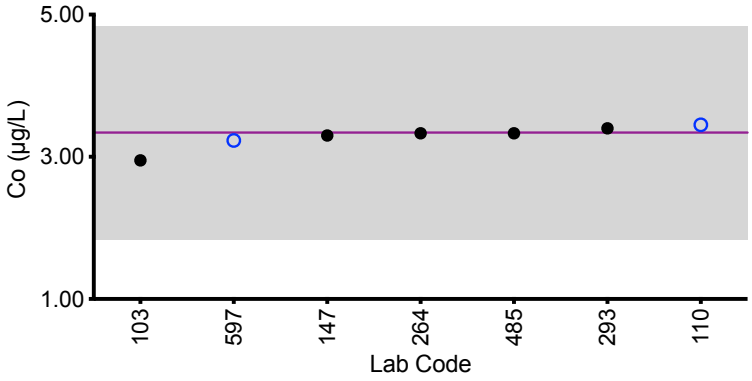
Based on the grading criteria for Co in Serum, 100% of results were satisfactory, with 0 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

NEW YORK STATE | Department of Health | Wadsworth Center

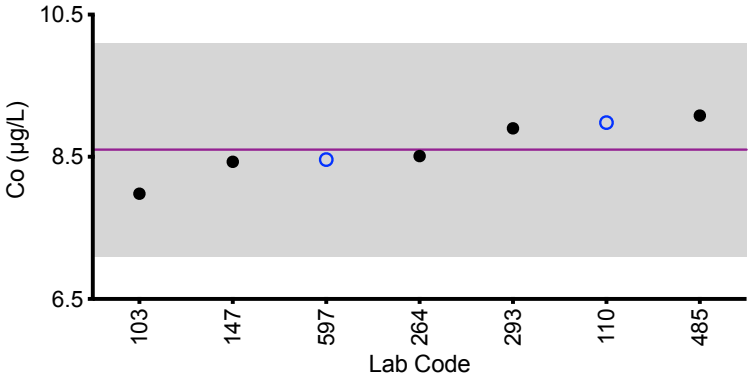
Results for Event #3, 2023: Summary Figures

Serum Co

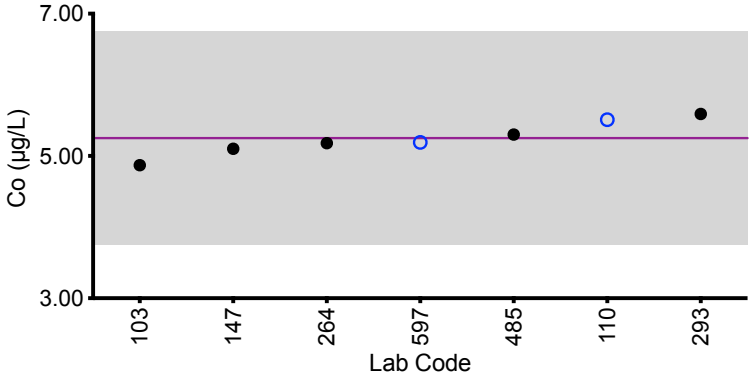
SE23-11



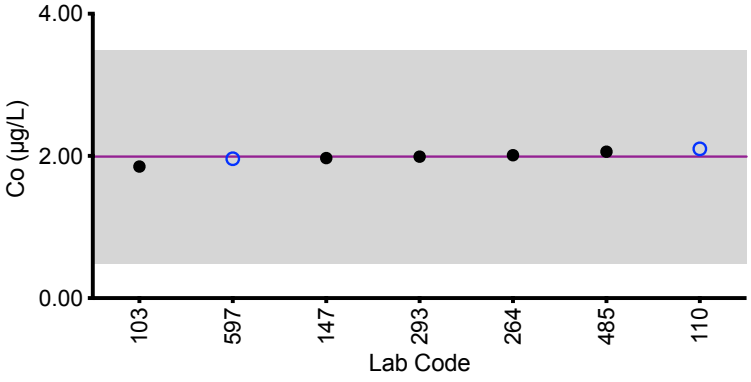
SE23-12



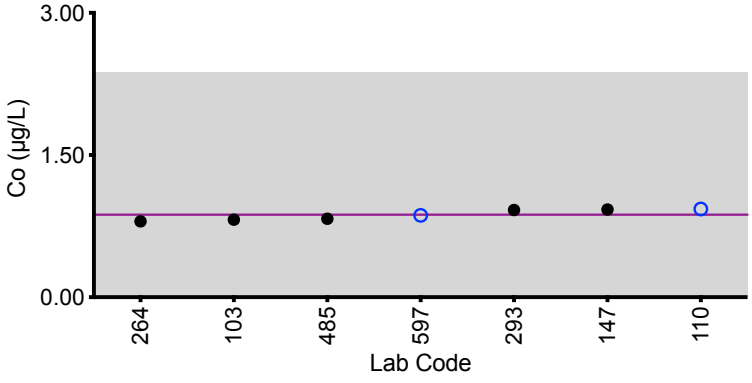
SE23-13



SE23-14



SE23-15



Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

	Serum Cr (µg/L)				
	SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Target (Arithmetic Mean ($\bar{x}$))	0.65	11.2	1.33	3.79	4.6
Upper Limit	2.65	13.4	3.33	5.79	6.6
Lower Limit	0.00	9.0	0.00	1.79	2.6
Arithmetic SD (s)	0.08	0.6	0.07	0.13	0.3
Arithmetic RSD (%)	12	5.4	5.3	3.4	6.1
Number of Sample Measurements (N)	6	7	7	6	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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

		Serum Cr (µg/L)				
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
	Target	**0.65**	**11.2**	**1.33**	**3.79**	**4.6**
103	ICP-MS/MS	0.530	10.8	1.30	3.73	4.11
110	ICP-MS/MS	*1.45	11.8	1.34	*4.57	4.74
147	DRC/CC-ICP-MS	0.593	10.3	1.22	3.62	4.41
264	ICP-MS	0.60	11.61	1.46	3.99	4.87
293	DRC/CC-ICP-MS	0.72	11.71	1.34	3.75	4.87
485	HR-ICP-MS	0.68	11.6	1.29	3.84	4.43
597	ICP-MS/MS	0.747	10.9	1.36	3.83	4.59

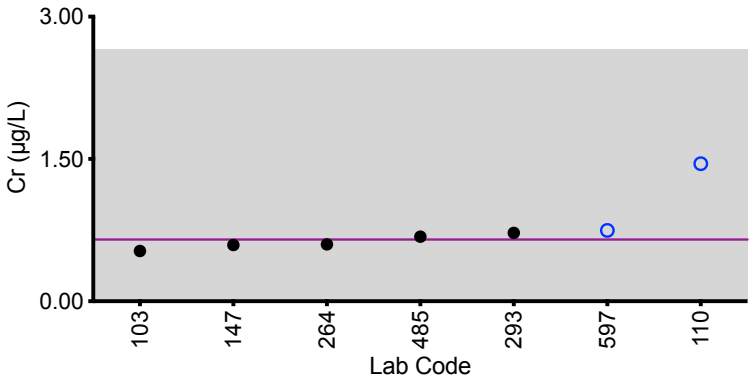
Based on the grading criteria for Cr in Serum, 100% of results were satisfactory, with 0 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

NEW YORK STATE | Department of Health | Wadsworth Center

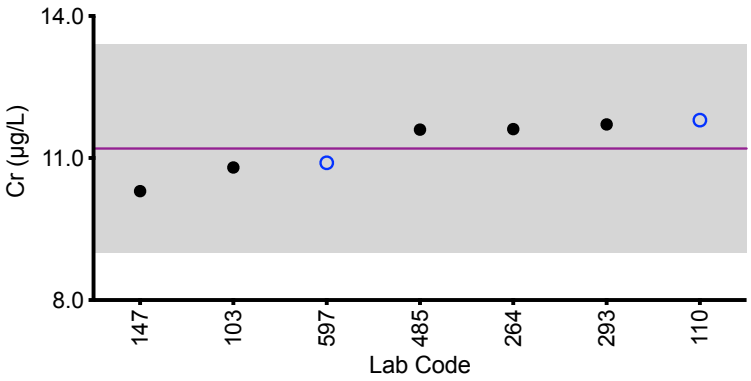
Results for Event #3, 2023: Summary Figures

Serum Cr

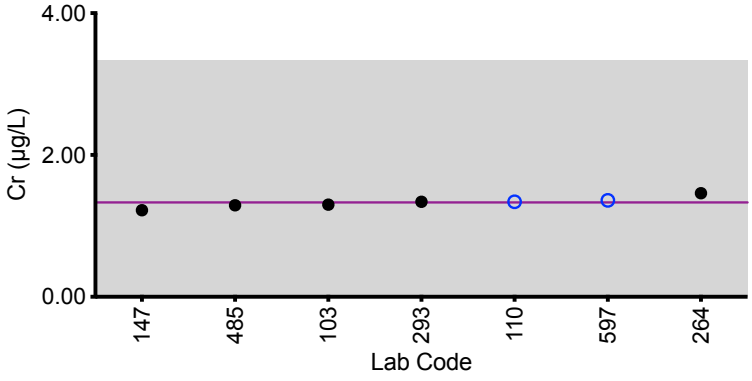
SE23-11



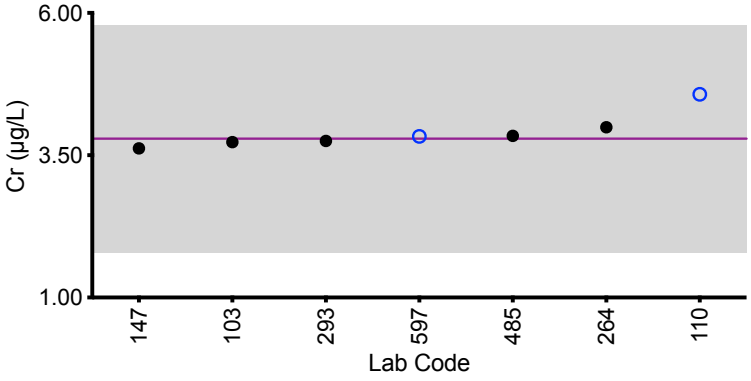
SE23-12



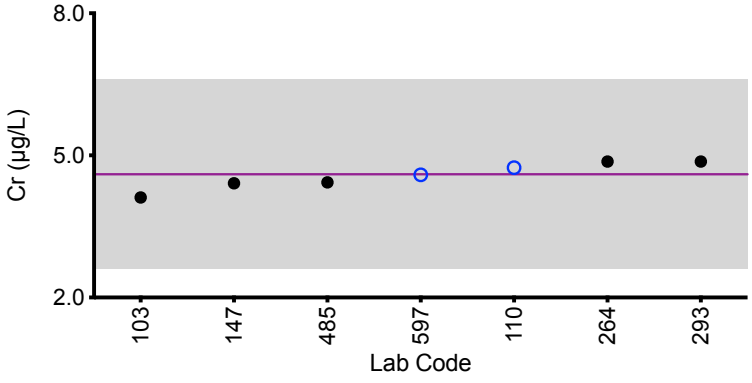
SE23-13



SE23-14



SE23-15



Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Summary Statistics

Serum Cu (µg/L)					
	SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Target (Arithmetic Mean ($\bar{x}$))	1050	1170	1420	790	1720
Upper Limit	1210	1350	1630	909	1980
Lower Limit	890	990	1210	672	1460
Arithmetic SD (s)	50	50	60	34	80
Arithmetic RSD (%)	4.8	4.3	4.2	4.3	4.7
Number of Sample Measurements (N)	7	7	7	7	7

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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

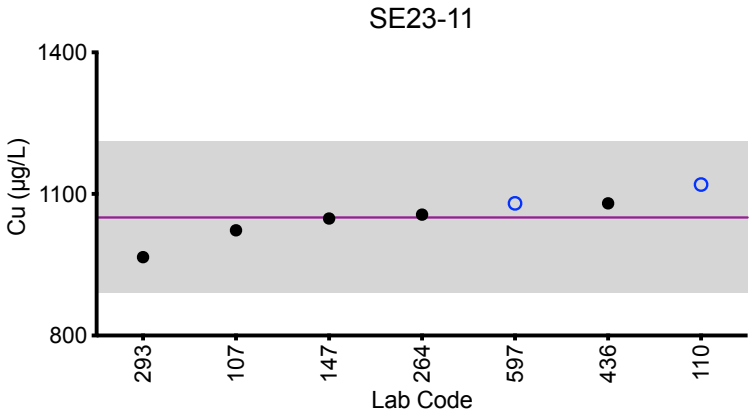
Serum Cu (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
	Target	**1050**	**1170**	**1420**	**790**	**1720**
107	DRC/CC-ICP-MS	1023	1165	1424	784	1754
110	ICP-MS/MS	1120	1230	1480	840	1820
147	DRC/CC-ICP-MS	1048	1163	1391	769	1684
264	ICP-MS	1056.2	1175.7	1397.3	791.1	1703.9
293	DRC/CC-ICP-MS	966	1087	1322	731	1570
436	FAAS	1080	1207	1509	800	1735
597	ICP-MS/MS	1080	1190	1430	814	1760

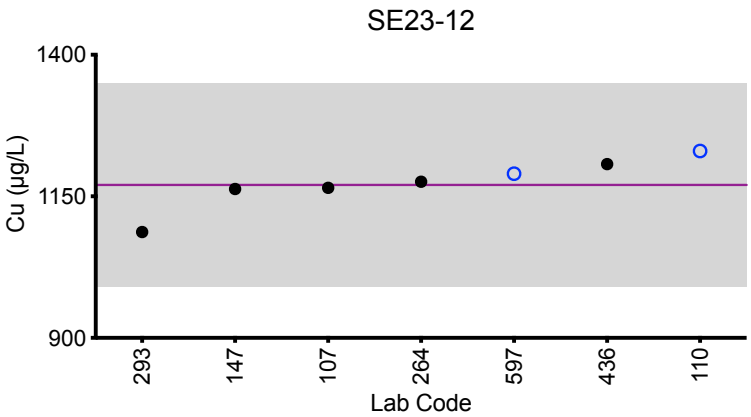
Based on the grading criteria for Cu in Serum, 100% of results were satisfactory, with 0 of the 7 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

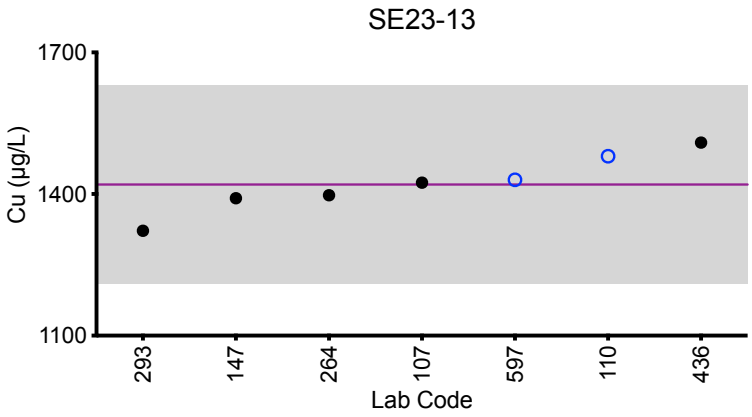
NEW YORK STATE | Department of Health | Wadsworth Center

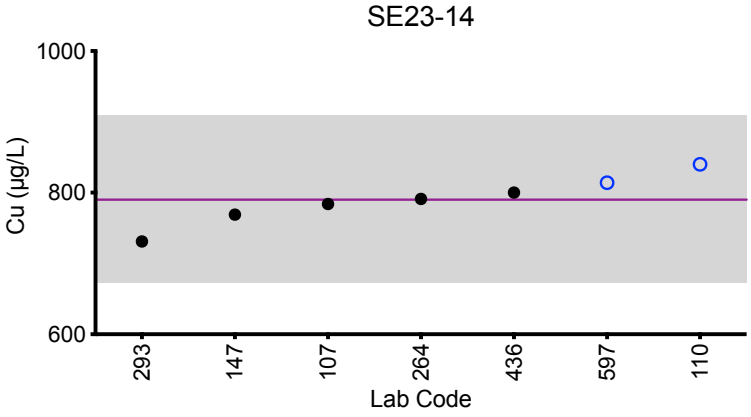
Results for Event #3, 2023: Summary Figures

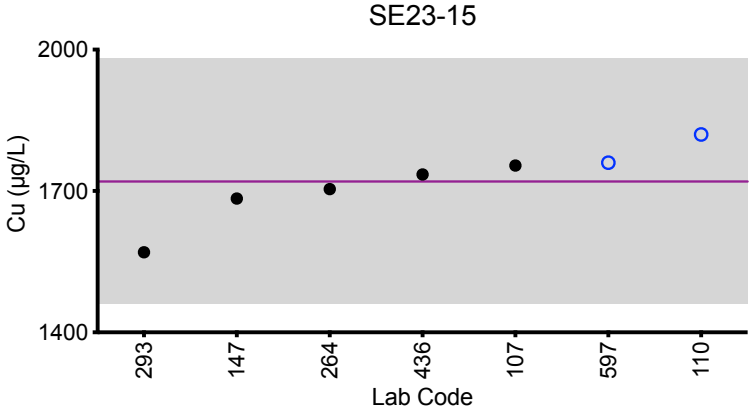
Serum Cu











Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Summary Statistics

Serum Se (µg/L)					
	SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Target (Arithmetic Mean ($\bar{x}$))	107	140	238	201	123
Upper Limit	128	168	286	241	148
Lower Limit	86	112	190	161	98
Arithmetic SD (s)	4	5	8	6	3
Arithmetic RSD (%)	3.5	3.6	3.4	3.1	2.8
Number of Sample Measurements (N)	7	8	8	8	8

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

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
	Target	**107**	**140**	**238**	**201**	**123**
103	ICP-MS/MS	106	145	241	203	123
107	DRC/CC-ICP-MS	103.2	138.1	236.4	198.2	124.1
110	ICP-MS/MS	111	147	251	208	129
147	DRC/CC-ICP-MS	104	139	232	191	120
264	ICP-MS	108.49	142.02	233.59	200.07	125.81
293	DRC/CC-ICP-MS	102	137	234	194	122
436	ETAAS-Z	*90.00	131.00	227.00	202.00	118.00
597	ICP-MS/MS	111	143	248	209	123

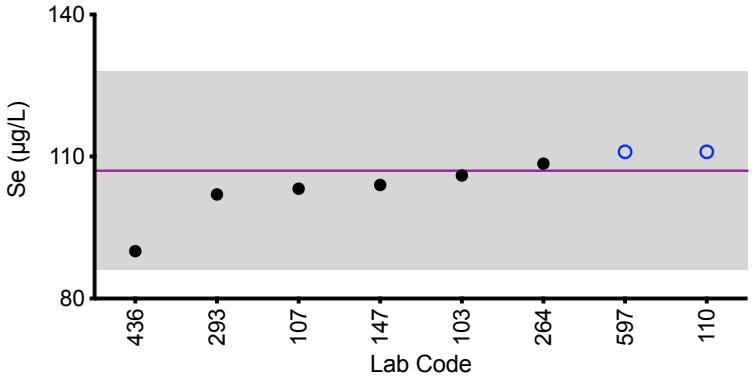
Based on the grading criteria for Se in Serum, 100% of results were satisfactory, with 0 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

NEW YORK STATE | Department of Health | Wadsworth Center

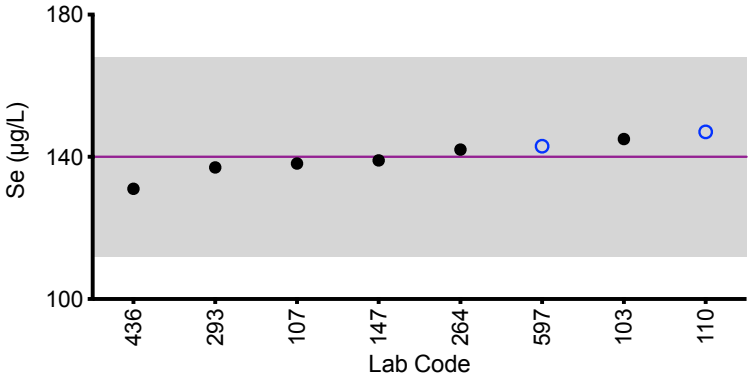
Results for Event #3, 2023: Summary Figures

Serum Se

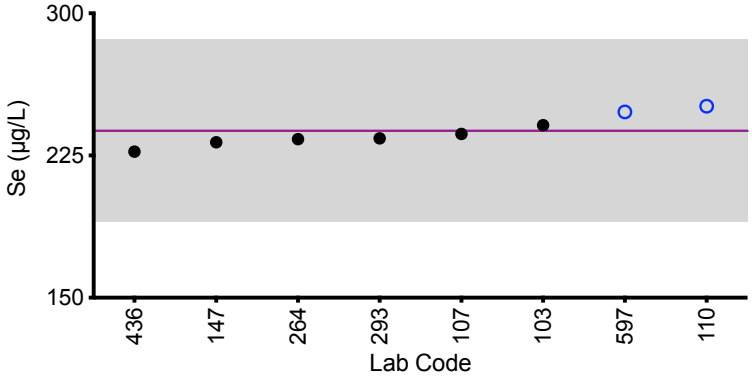
SE23-11



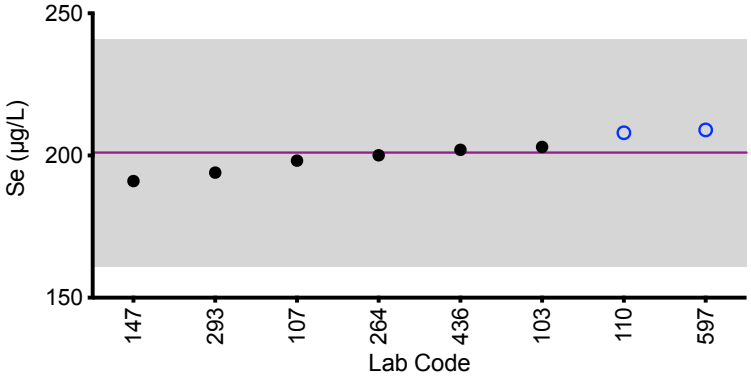
SE23-12



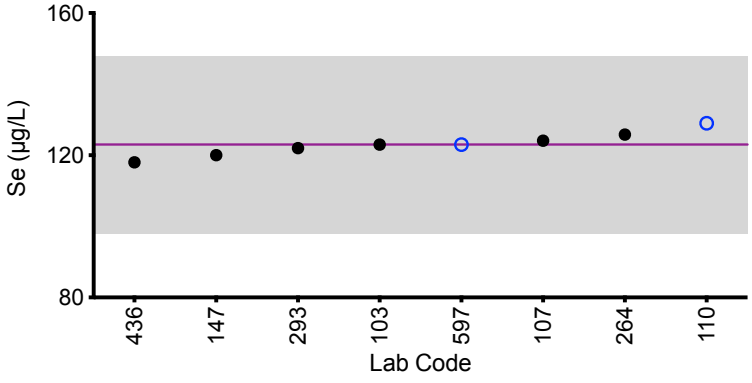
SE23-13



SE23-14



SE23-15



Legend:

o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Summary Statistics

Serum Zn (µg/L)					
	SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Target (Arithmetic Mean ($\bar{x}$))	860	1030	1310	660	1170
Upper Limit	990	1180	1510	760	1350
Lower Limit	730	880	1110	560	990
Arithmetic SD (s)	50	50	80	40	70
Arithmetic RSD (%)	5.8	4.9	6.1	6.1	6.4
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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Performance of Participating Laboratories

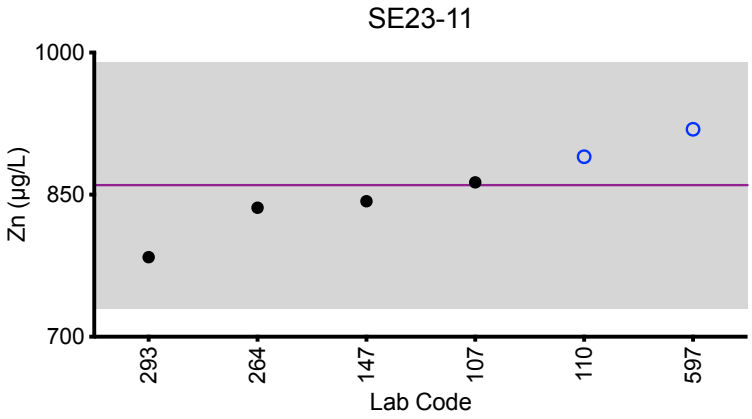
		Serum Zn (µg/L)				
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
	Target	**860**	**1030**	**1310**	**660**	**1170**
107	DRC/CC-ICP-MS	863	1055	1340	667	1221
110	ICP-MS/MS	890	1080	1360	687	1230
147	DRC/CC-ICP-MS	843	1007	1261	632	1118
264	ICP-MS	836.2	1001.0	1248.5	633.2	1107.5
293	DRC/CC-ICP-MS	784	954	1216	608	1078
597	ICP-MS/MS	919	1100	1410	707	1250

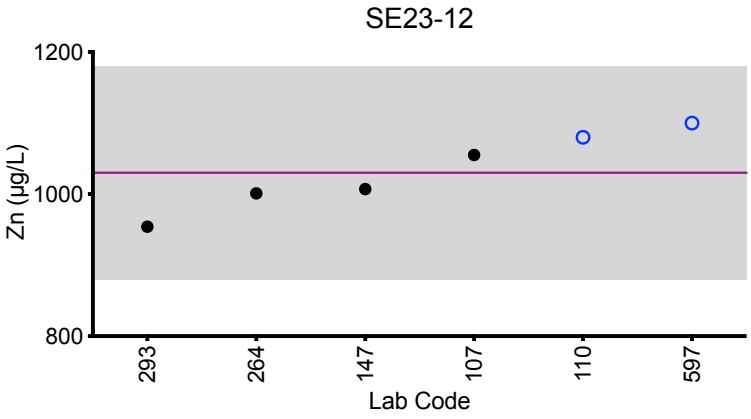
Based on the grading criteria for Zn in Serum, 100% of results were satisfactory, with 0 of the 6 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

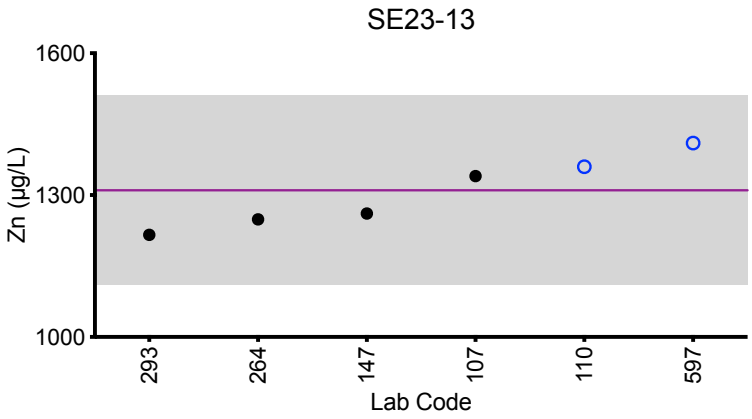
NEW YORK STATE | Department of Health | Wadsworth Center

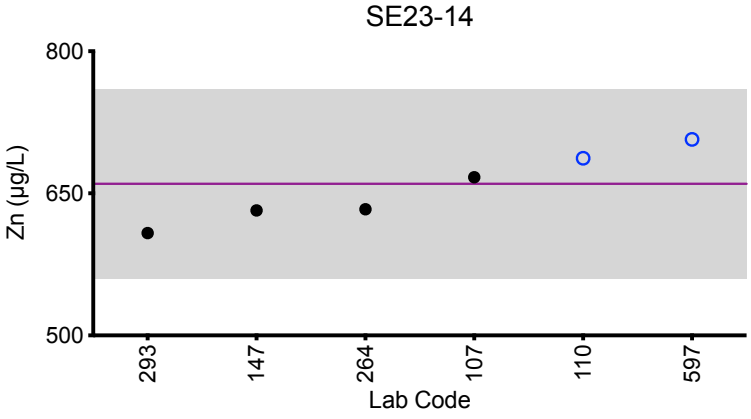
Results for Event #3, 2023: Summary Figures

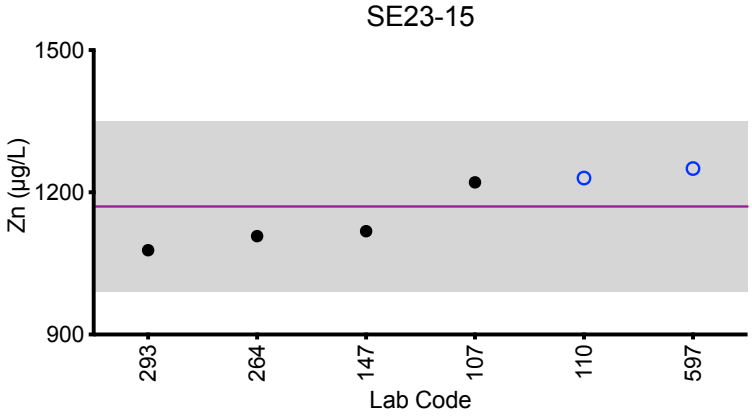
Serum Zn











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

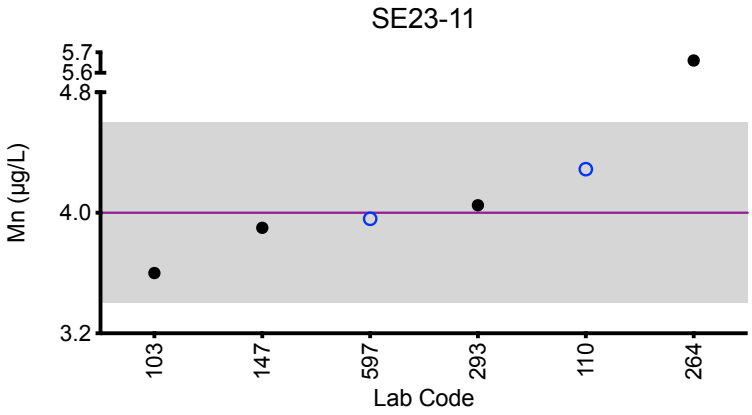
Serum Mn (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
103	ICP-MS/MS	3.60	17.0	6.74	10.4	6.60
110	ICP-MS/MS	4.29	18.5	7.35	11.7	7.18
147	DRC/CC-ICP-MS	3.90	15.6	6.87	10.3	6.65
264	ICP-MS	*5.66	21.44	*8.82	13.15	*8.27
293	DRC/CC-ICP-MS	4.050	18.15	7.31	11.47	6.960
597	ICP-MS/MS	3.96	17.6	7.21	11.2	6.90
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		4.0	18.0	7.1	11.4	6.9
Arithmetic SD (s)		0.3	1.9	0.3	1.0	0.2
Arithmetic RSD (%)		6.3	11	3.8	8.8	3.5
Number of Sample Measurements (N)		5	6	5	6	5

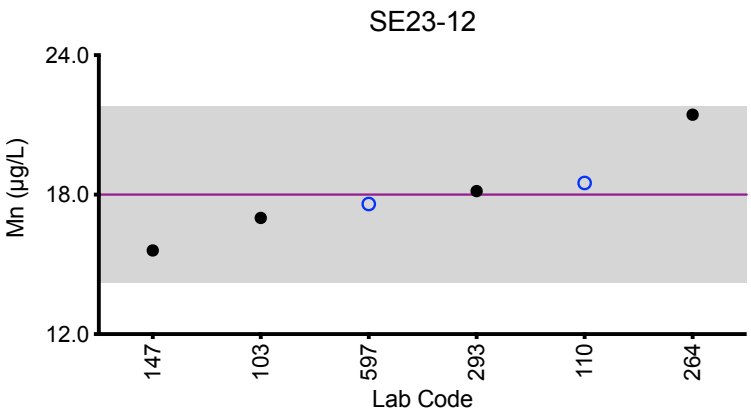
*Denotes a statistical Outlier.

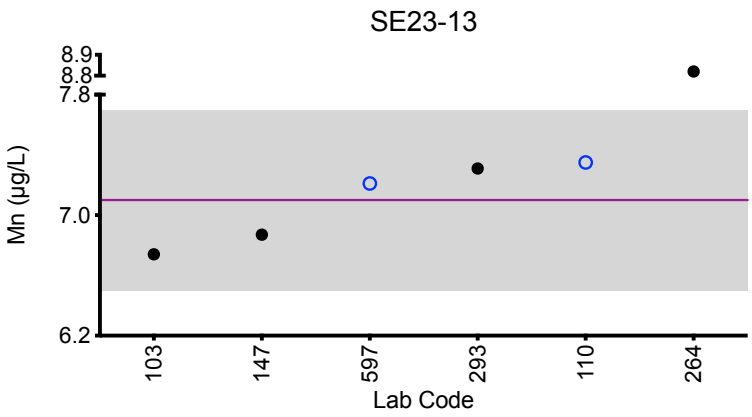
NEW YORK STATE | Department of Health | Wadsworth Center

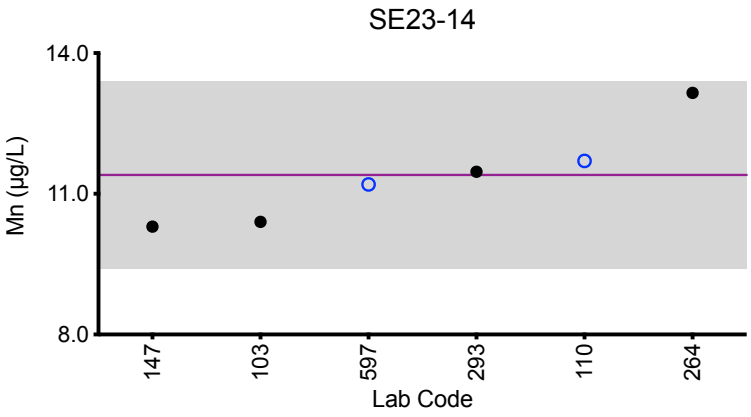
Results for Event #3, 2023: Summary Figures

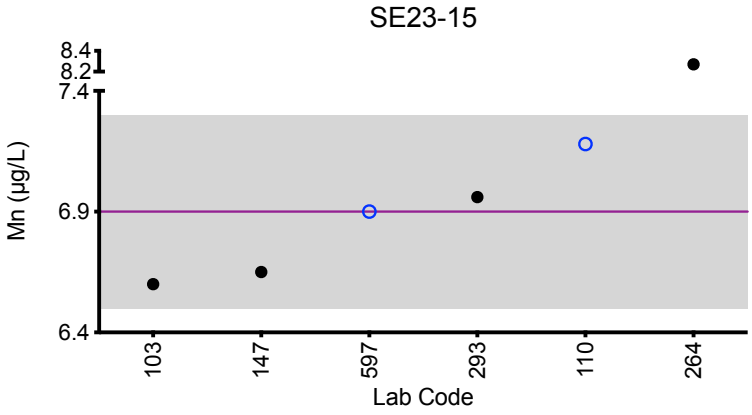
Serum Mn











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

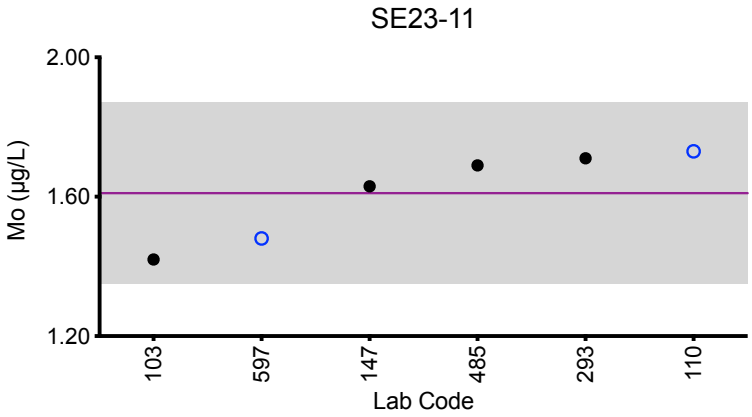
Serum Mo (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
103	ICP-MS/MS	1.42	0.852	5.80	3.37	2.04
110	ICP-MS/MS	1.73	0.91	6.05	3.63	2.16
147	DRC/CC-ICP-MS	1.63	0.953	5.56	3.26	1.91
293	DRC/CC-ICP-MS	1.710	0.920	6.380	3.540	2.310
485	HR-ICP-MS	1.69	1.02	5.92	3.38	2.01
597	ICP-MS/MS	1.48	0.801	5.56	3.27	1.91
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		1.61	0.91	5.9	3.41	2.06
Arithmetic SD (s)		0.13	0.08	0.3	0.15	0.16
Arithmetic RSD (%)		8.1	8.8	5.3	4.4	7.8
Number of Sample Measurements (N)		6	6	6	6	6

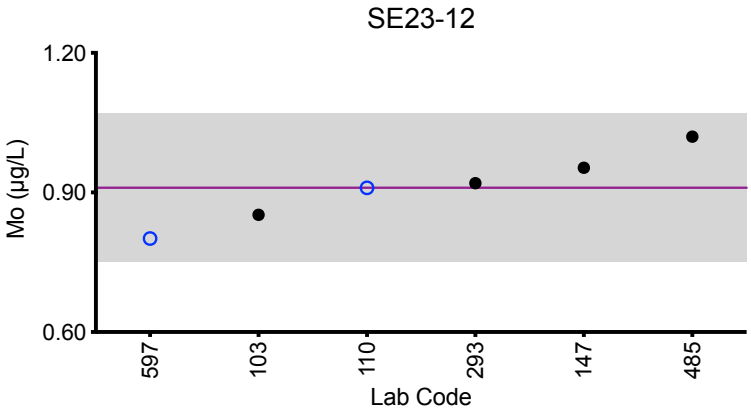
*Denotes a statistical Outlier.

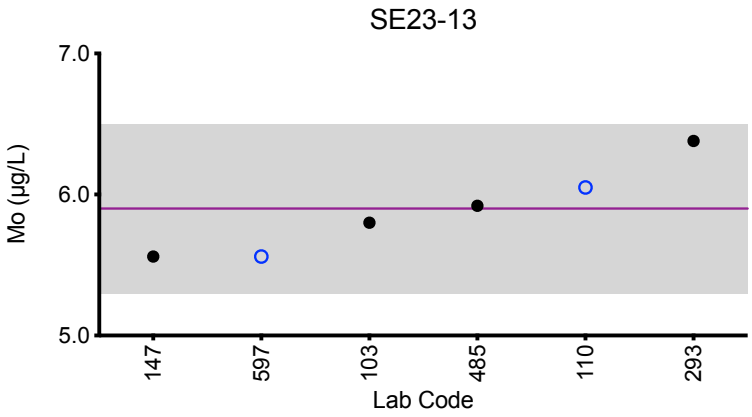
NEW YORK STATE | Department of Health | Wadsworth Center

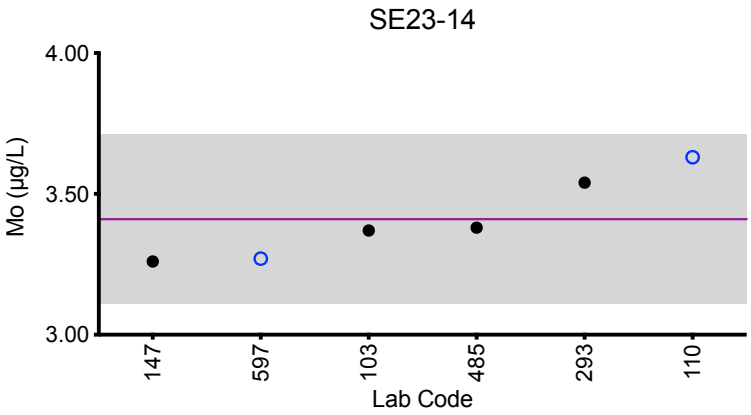
Results for Event #3, 2023: Summary Figures

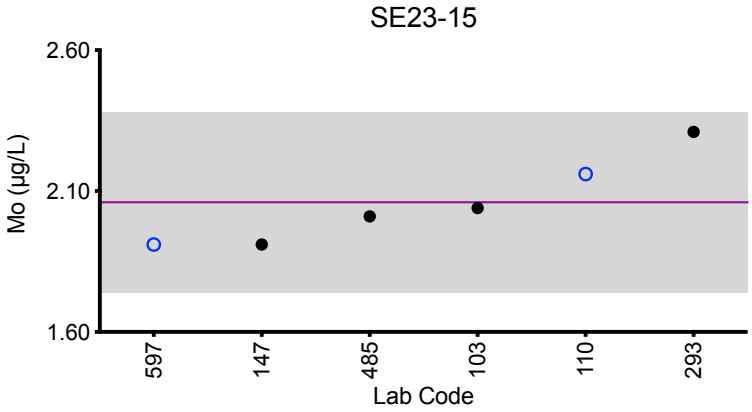
Serum Mo











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Ni (µg/L)

Lab Code	Method	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
103	ICP-MS/MS	4.85	6.57	1.14	2.68	0.625
110	ICP-MS/MS	5.58	7.93	1.54	*3.38	1.22
147	DRC/CC-ICP-MS	5.11	7.16	1.35	2.82	0.722
293	DRC/CC-ICP-MS	5.50	7.13	1.33	2.85	0.96
442	DRC/CC-ICP-MS	5.36	7.44	1.35	2.98	0.713
485	HR-ICP-MS	4.84	7.10	1.26	2.69	0.730
597	ICP-MS/MS	5.10	6.99	1.69	2.88	0.912

Summary Statistics

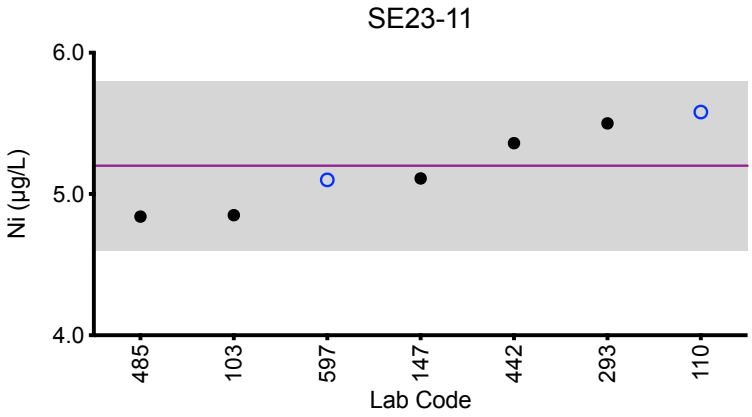
	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
Arithmetic Mean ($\bar{x}$)	5.2	7.2	1.38	2.82	0.84
Arithmetic SD (s)	0.3	0.4	0.18	0.12	0.21
Arithmetic RSD (%)	5.8	5.6	13	4.3	25
Number of Sample Measurements (N)	7	7	7	6	7

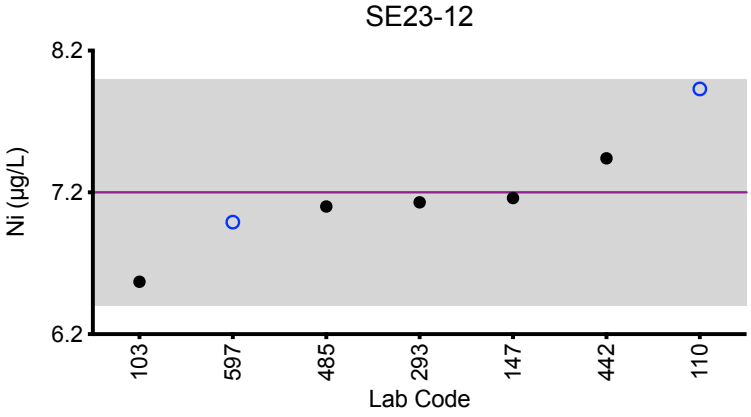
*Denotes a statistical Outlier.

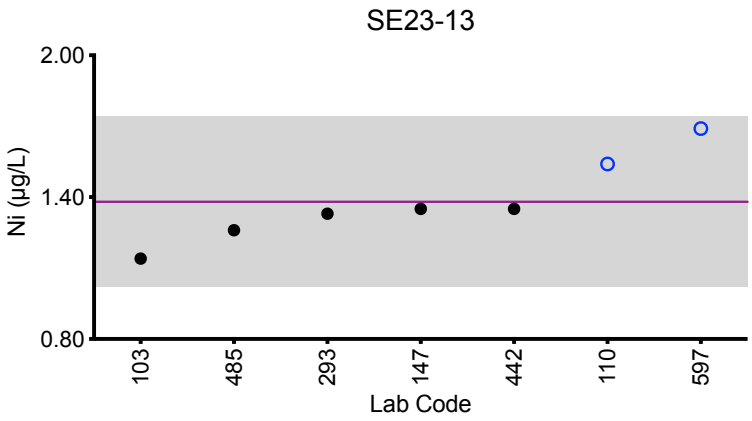
NEW YORK STATE | Department of Health | Wadsworth Center

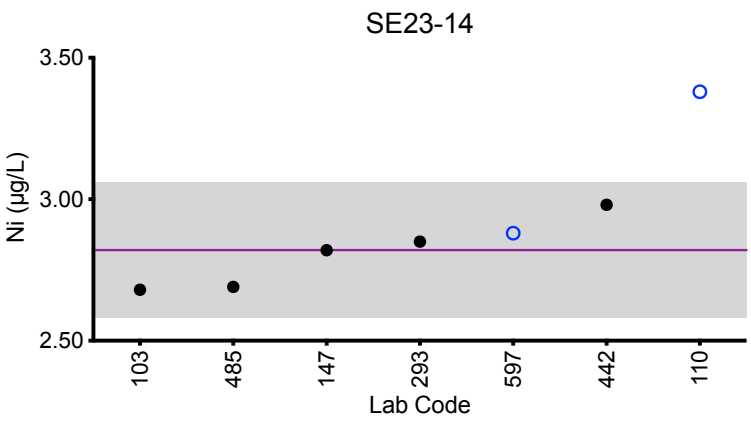
Results for Event #3, 2023: Summary Figures

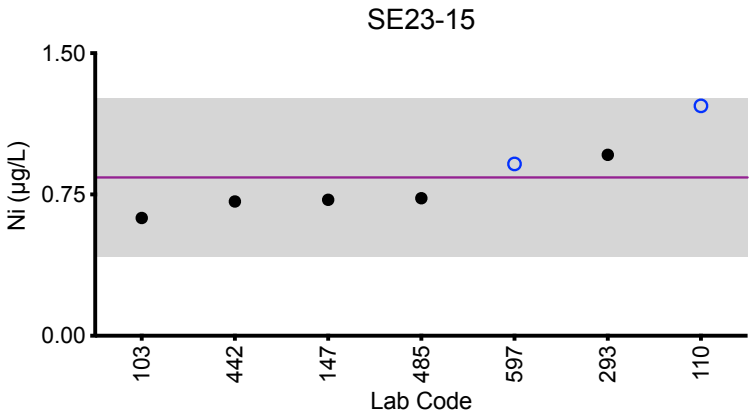
Serum Ni











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

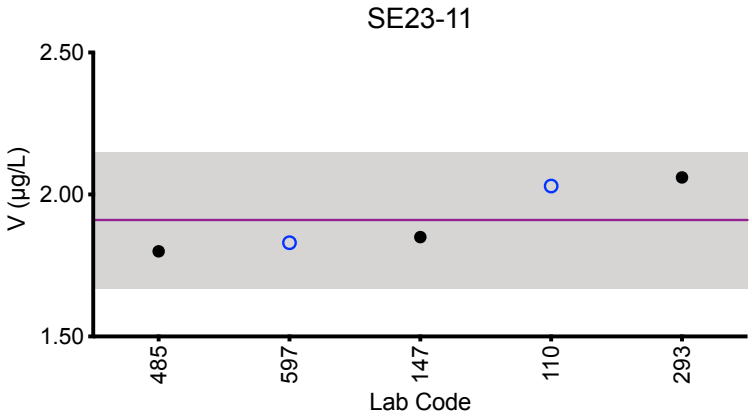
Serum V (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
110	ICP-MS/MS	2.03	3.77	0.87	3.09	1.12
147	DRC/CC-ICP-MS	1.85	3.45	0.745	2.72	0.954
293	DRC/CC-ICP-MS	2.06	3.67	0.97	3.10	1.3
485	HR-ICP-MS	1.80	3.48	0.748	2.75	1.00
597	ICP-MS/MS	1.83	3.44	0.797	2.84	1.03
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		1.91	3.56	0.83	2.90	1.08
Arithmetic SD (s)		0.12	0.15	0.10	0.18	0.14
Arithmetic RSD (%)		6.3	4.2	12	6.2	13
Number of Sample Measurements (N)		5	5	5	5	5

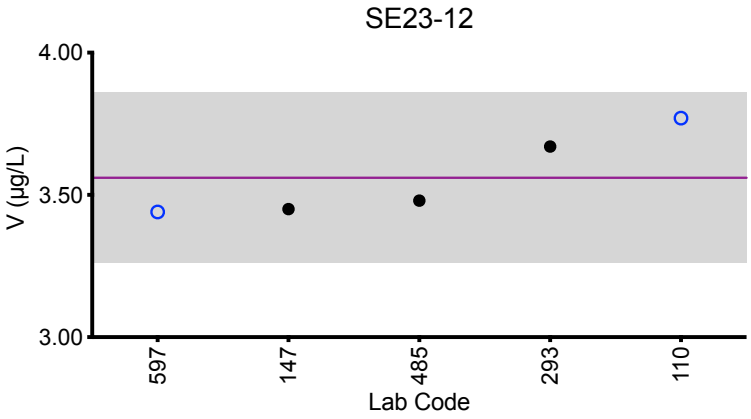
*Denotes a statistical Outlier.

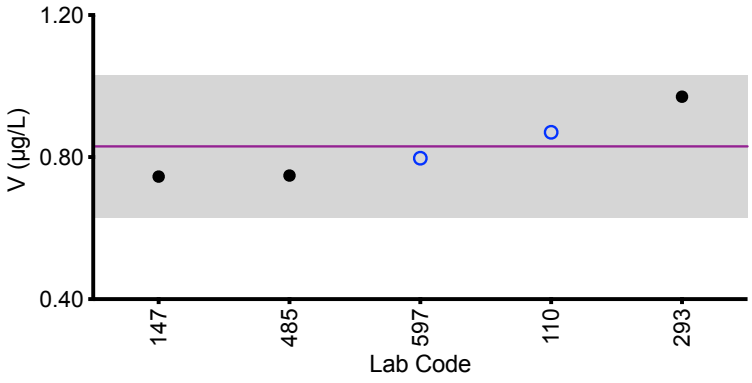
NEW YORK STATE | Department of Health | Wadsworth Center

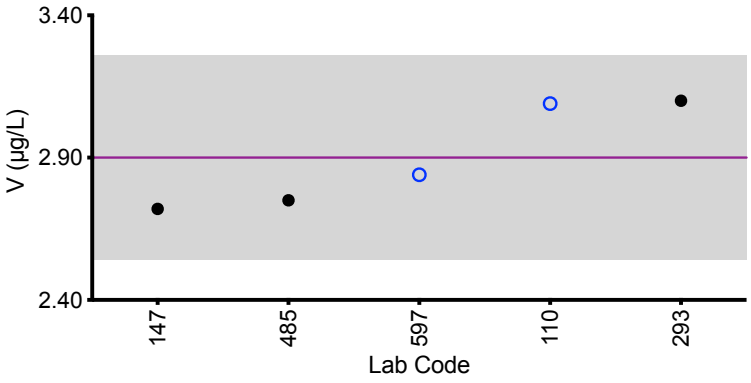
Results for Event #3, 2023: Summary Figures

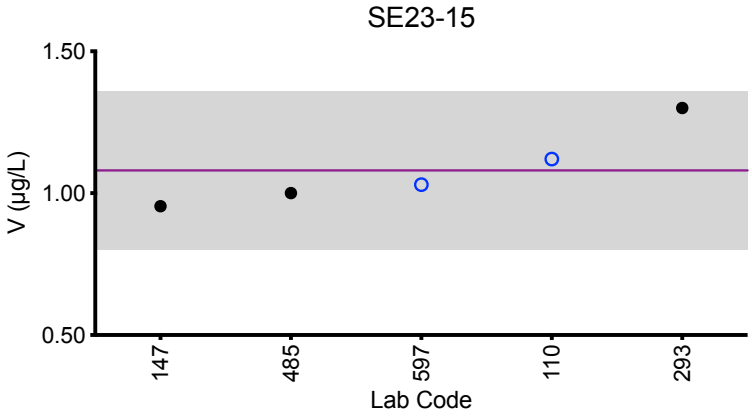
Serum V











Legend:
o 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.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum As (µg/L)

Lab Code	Method	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
103	ICP-MS/MS	19.5	2.86	9.06	1.18	4.39
110	ICP-MS/MS	20.3	2.92	9.43	1.25	4.59
147	DRC/CC-ICP-MS	19.2	2.76	8.91	1.18	4.23
597	ICP-MS/MS	18.8	2.73	9.00	1.17	4.37

Summary Statistics

	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
Arithmetic Mean ($\bar{x}$)	19.5	2.82	9.1	1.20	4.39
Arithmetic SD (s)	0.6	0.09	0.2	0.04	0.15
Arithmetic RSD (%)	3.1	3.2	2.5	3.3	3.4
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Ba (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
110	ICP-MS/MS	3.64	3.23	2.87	3.78	4.21
147	ICP-MS	3.87	3.20	2.69	3.45	3.68
597	ICP-MS/MS	3.44	3.17	2.83	3.55	3.69
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		3.7	3.20	2.80	3.6	3.9
Arithmetic SD (s)		0.2	0.03	0.09	0.2	0.3
Arithmetic RSD (%)		5.9	0.94	3.2	4.7	7.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Be (µg/L)

Lab Code	Method	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
110	ICP-MS/MS	0.47	5.67	3.44	1.31	0.78
147	ICP-MS	0.536	5.11	3.33	1.25	0.784
293	ICP-MS	0.52	5.39	3.40	1.19	0.79
597	ICP-MS/MS	0.437	5.08	3.36	1.19	0.838

Summary Statistics

	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
Arithmetic Mean ($\bar{x}$)	0.49	5.3	3.38	1.24	0.80
Arithmetic SD (s)	0.05	0.3	0.05	0.06	0.03
Arithmetic RSD (%)	10	5.3	1.5	4.8	3.4
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Cd (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
103	ICP-MS/MS	0.447	1.47	2.96	5.72	0.865
110	ICP-MS/MS	0.45	1.48	3.14	5.90	0.91
147	ICP-MS	0.418	1.39	2.81	5.29	0.816
597	ICP-MS/MS	0.426	1.40	2.95	5.56	0.841
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		0.435	1.44	2.96	5.6	0.86
Arithmetic SD (s)		0.016	0.05	0.14	0.3	0.04
Arithmetic RSD (%)		3.7	3.5	4.7	4.6	4.7
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Cs (µg/L)

Lab Code	Method	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
110	ICP-MS/MS	0.82	0.91	1.99	0.68	0.34
597	ICP-MS/MS	0.772	0.862	1.88	0.640	0.332

Summary Statistics

	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
Arithmetic Mean ($\bar{x}$)	0.80	0.89	1.94	0.66	0.336
Arithmetic SD (s)	0.03	0.03	0.08	0.03	0.006
Arithmetic RSD (%)	3.8	3.4	4.1	4.5	1.8
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Hg (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
103	ICP-MS/MS	8.91	4.19	2.12	5.08	1.14
110	ICP-MS/MS	9.57	4.35	2.29	5.45	1.21
597	ICP-MS/MS	8.40	3.90	2.14	4.80	1.09
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		9.0	4.1	2.18	5.1	1.15
Arithmetic SD (s)		0.6	0.2	0.09	0.3	0.06
Arithmetic RSD (%)		6.7	5.5	4.1	5.9	5.2
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum I (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
147	ICP-MS	58.1	58.9	66.7	57.3	48.5
442	ICP-MS	53.9	57.5	68.1	57.6	48.4
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		56.0	58.2	67.4	57.5	48.5
Arithmetic SD (s)		3.0	1.0	1.0	0.2	0.1
Arithmetic RSD (%)		5.4	1.7	1.5	0.35	0.14
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Mg (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
264	ICP-MS	20266.0	21702.0	21702.0	19225.0	19893.5
597	ICP-MS/MS	20800	22300	23100	20400	20000
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		20500	22000	22400	19800	19950
Arithmetic SD (s)		400	400	1000	800	80
Arithmetic RSD (%)		1.8	1.8	4.5	4.2	0.38
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Pb (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
103	ICP-MS/MS	4.74	1.08	2.26	3.37	9.54
110	ICP-MS/MS	4.97	1.16	2.38	3.73	14.5
597	ICP-MS/MS	4.93	1.21	2.26	3.41	9.57
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		4.88	1.15	2.30	3.5	11
Arithmetic SD (s)		0.12	0.07	0.07	0.2	3
Arithmetic RSD (%)		2.5	6.1	3.0	5.7	27
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Pt (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
110	ICP-MS/MS	0.398	0.940	1.88	1.24	0.610
264	ICP-MS	0.48	1.09	2.16	1.37	0.64
293	DRC/CC-ICP-MS	0.38	0.95	1.98	1.19	0.62
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		0.42	0.99	2.01	1.27	0.623
Arithmetic SD (s)		0.05	0.08	0.14	0.09	0.015
Arithmetic RSD (%)		12	8.1	7.1	7.1	2.4
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Sb (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
103	ICP-MS/MS	1.11	2.77	2.02	3.97	5.99
110	ICP-MS/MS	1.09	2.72	1.97	3.80	5.83
147	ICP-MS	1.09	2.53	1.81	3.53	5.42
597	ICP-MS/MS	0.959	2.32	1.69	3.31	5.11
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		1.06	2.6	1.87	3.7	5.6
Arithmetic SD (s)		0.07	0.2	0.15	0.3	0.4
Arithmetic RSD (%)		6.6	7.7	8.1	7.9	7.1
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Sn (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
110	ICP-MS/MS	6.75	4.04	2.52	0.95	1.79
597	ICP-MS/MS	5.80	3.65	2.17	0.793	1.53
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		6.3	3.8	2.3	0.87	1.7
Arithmetic SD (s)		0.7	0.3	0.2	0.11	0.2
Arithmetic RSD (%)		11	7.9	8.7	13	11
Number of Sample Measurements (N)		2	2	2	2	2

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Sr (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
103	ICP-MS/MS	101	116	85.5	117	116
200	ICP-MS	105.1	120.9	87.6	114.8	128.8
597	ICP-MS/MS	101	114	85.8	120	115
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		102	117	86.3	117	120
Arithmetic SD (s)		2	4	1.1	3	8
Arithmetic RSD (%)		2.3	3.4	1.3	2.6	6.7
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Ti (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
200	DRC/CC-ICP-MS	5.3	3.2	5.3	4.1	6.9
442	ICP-MS/MS	7.80	3.60	4.43	5.93	11.2
485	HR-ICP-MS	7.16	3.09	3.87	5.33	9.83
597	ICP-MS/MS	9.42	5.29	6.22	8.16	12.3
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		7.4	3.8	5.0	5.9	10
Arithmetic SD (s)		1.7	1.0	1.0	1.7	2
Arithmetic RSD (%)		23	26	20	29	23
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum Tl (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
103	ICP-MS/MS	3.04	1.55	2.11	0.899	0.683
110	ICP-MS/MS	3.15	1.56	2.12	0.93	0.69
147	ICP-MS	3.09	1.50	1.97	0.861	0.656
597	ICP-MS/MS	3.07	1.51	2.11	0.910	0.684
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		3.09	1.53	2.08	0.90	0.678
Arithmetic SD (s)		0.05	0.03	0.07	0.03	0.015
Arithmetic RSD (%)		1.6	1.9	3.4	3.2	2.2
Number of Sample Measurements (N)		4	4	4	4	4

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum U (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
103	ICP-MS/MS	0.146	0.121	0.166	0.101	0.0606
110	ICP-MS/MS	0.158	0.123	0.183	0.106	0.0616
597	ICP-MS/MS	0.144	0.118	0.177	0.0994	0.0554
Summary Statistics						
		SE23-11	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
Arithmetic Mean ($\bar{x}$)		0.149	0.121	0.175	0.102	0.059
Arithmetic SD (s)		0.008	0.003	0.009	0.003	0.003
Arithmetic RSD (%)		5.4	2.1	5.1	2.9	5.1
Number of Sample Measurements (N)		3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023:
Laboratory Data and Summary Statistics

Serum W (µg/L)

Lab Code	Method	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
110	ICP-MS/MS	1.64	0.54	2.42	1.07	0.24
200	ICP-MS	1.69	0.57	2.67	1.18	0.26
597	ICP-MS/MS	1.48	0.515	2.31	1.00	0.240

Summary Statistics

	SE23-11	SE23-12	SE23-13	SE23-14	SE23-15
Arithmetic Mean ($\bar{x}$)	1.60	0.54	2.5	1.08	0.247
Arithmetic SD (s)	0.11	0.03	0.2	0.09	0.012
Arithmetic RSD (%)	6.9	5.6	7.3	8.3	4.9
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

NEW YORK STATE | Department of Health | Wadsworth Center

Results for Event #3, 2023: Additional Elements in Serum

Serum B (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
200	ICP-MS	49	53	62	49	56

Serum Bi (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
147	ICP-MS	<0.0397	<0.0397	<0.0397	<0.0397	<0.0397
597	ICP-MS/MS	<0.0278	<0.0278	0.0500	<0.0278	0.0298

Serum Fe (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
264	ICP-MS	1005.5	831.1	609.9	738.9	1309.6

Serum Li (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
147	ICP-MS	1.17	0.756	1.07	0.951	1.60

Serum Te (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
110	ICP-MS/MS	0.00	0.00	0.00	0.01	0.00

Serum Th (µg/L)						
Lab Code	**Method**	**SE23-11**	**SE23-12**	**SE23-13**	**SE23-14**	**SE23-15**
597	ICP-MS/MS	<0.0155	<0.0155	<0.0155	<0.0155	<0.0155

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.