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New York State Biomonitoring Program for Trace Elements

Event #3, 2016

Trace Elements in Whole Blood, Urine, and Serum

December, 2016

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #3, 2016:
Trace Elements in Whole Blood, Urine, and Serum

12/15/2016

Dear Laboratory Director,

This report summarizes performance for the third biomonitoring proficiency test (PT) event of 2016 for **Trace Elements in Whole Blood, Urine, and Serum**. One of the key goals of this PT program is to achieve harmonization of biomonitoring data for trace elements.

Target Value Assignment and Performance Evaluation

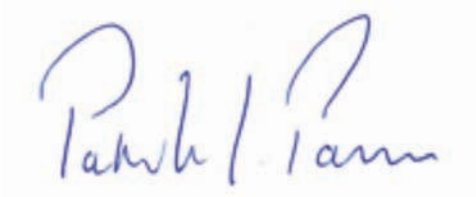
For these PT materials, target values have been assigned for a limited number of trace elements that are gradable under criteria set by the NYS DOH Biomonitoring PT program. See assay-specific narratives for details. Data for additional trace elements are reported and are included here in order to characterize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

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

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

Samples for the next PT event (Event #1 of 2017) will be shipped February 22, 2017. If you have not yet enrolled for 2017 and would like to continue your participation, please contact Dr. Galusha at aubrey.galusha@health.ny.gov. Comments about this report may be directed to trel@health.ny.gov.

Sincerely,



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Event #3, 2016

Trace Elements in Whole Blood

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Trace Elements Laboratory

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Event #3, 2016:
Trace Elements in Whole Blood

PT Materials

Human whole blood was purchased from ZenBio, 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. Each unit of whole blood was transferred into polypropylene containers and supplemented with arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), mercury (Hg), manganese (Mn), lead (Pb), silver (Ag), 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 placed on a rocker overnight prior to aliquoting 2-mL into polypropylene vials. PT samples were stored at 4°C prior to circulation to laboratories for analysis.

Graded Elements

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

Additional Elements

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

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

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Results for Event #3, 2016
Whole Blood Arsenic (As)

Summary Statistics

	Whole Blood As (µg/L)				
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Target (Arithmetic Mean ($\bar{x}$))	31.6	5.0	17.5	44.9	11.0
Upper Limit	37.9	11.0	23.5	53.9	17.0
Lower Limit	25.3	0.0	11.5	35.9	5.0
Arithmetic SD (s)	3.4	0.3	2.0	2.4	1.1
Arithmetic RSD (%)	10.8	6.0	11.4	5.4	10.0
Number of Sample Measurements (N)	9	8	9	8	8

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

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Results for Event #3, 2016
Whole Blood Arsenic (As)
Performance of Participating Laboratories

		Whole Blood As (µg/L)				
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
	Target	**31.6**	**5.0**	**17.5**	**44.9**	**11.0**
103	DRC/CC-ICP-MS	30.5	4.55	15.8	45.8	11.1
110	DRC/CC-ICP-MS	30.3	5.1	16.6	45.6	10.3
147	ICP-MS	27.4	5.22	15.1	40.4	10.6
200	ICP-MS	32.3	*13.4 ↑	19	44.4	*17.5 ↑
293	DRC/CC-ICP-MS	30.7	4.8	16.0	45.6	10.5
391	DRC/CC-ICP-MS	28.31	4.8	18.08	43.488	10.417
597	DRC/CC-ICP-MS	32.31	5.09	16.66	48.90	11.10
598	DRC/CC-ICP-MS	38.8 ↑	5.4	21.3	*58.9 ↑	13.6
599	DRC/CC-ICP-MS	34.0	5.12	19.4	45.2	10.4

Based on the grading criteria for As in Whole Blood, 91% of results were satisfactory, with 2 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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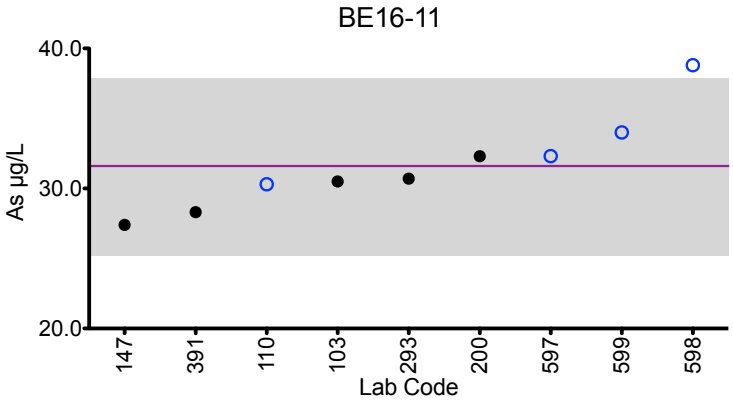
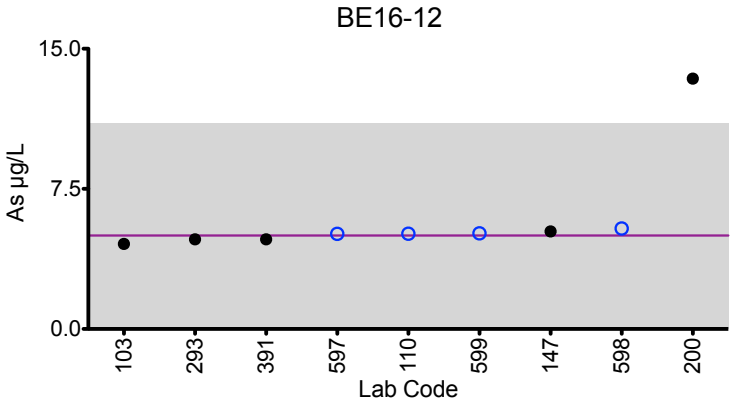
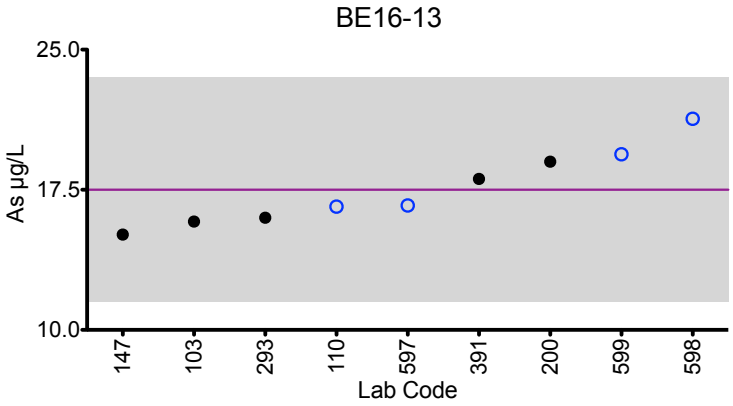
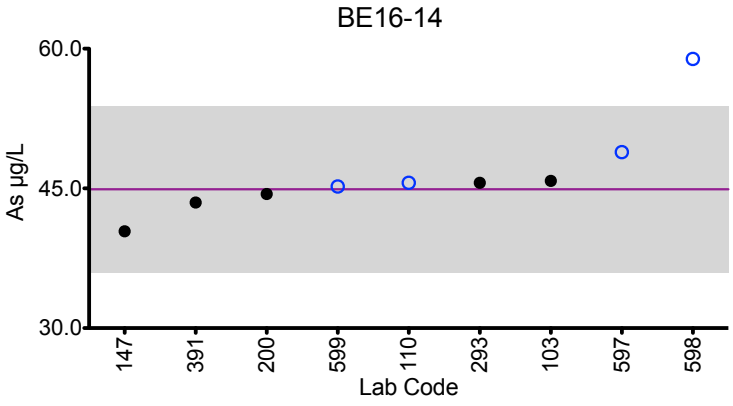
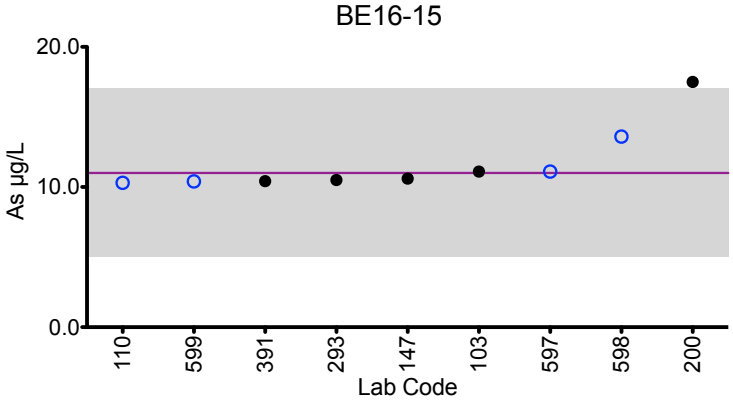
Results for Event #3, 2016: Whole Blood As











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Whole Blood Cadmium (Cd)

Summary Statistics

	Whole Blood Cd (µg/L)				
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Target (Robust Mean (x*))	15.6	0.32	3.8	5.7	5.5
Upper Limit	17.9	1.32	4.8	6.7	6.5
Lower Limit	13.3	0.00	2.8	4.7	4.5
Robust SD (s*)	1.1	0.08	0.2	0.5	0.4
Robust RSD (%)	7.0	25.4	5.9	8.2	7.3
Number of Sample Measurements (N)	13	11	14	14	13
Standard Uncertainty (*u*)	0.377	0.031	0.075	0.155	0.140

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

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Results for Event #3, 2016
Whole Blood Cadmium (Cd)
Performance of Participating Laboratories

		Whole Blood Cd (µg/L)				
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
	Target	**15.6**	**0.32**	**3.8**	**5.7**	**5.5**
103	DRC/CC-ICP-MS	16.6	0.342	4.11	6.21	5.75
107	ICP-MS	16	0.32	3.9	6.0	5.8
110	ICP-MS	16.0	0.36	3.9	5.8	5.7
116	DRC/CC-ICP-MS	16.6	0.391	3.78	6.02	6.45
147	ICP-MS	13.6	0.255	3.30	4.55 ↓	5.07
200	ICP-MS	14.3	0.2	3.3	5.1	5.1
293	DRC/CC-ICP-MS	16	0.31	4.07	5.7	5.57
391	DRC/CC-ICP-MS	15.063	0.416	3.892	5.557	5.376
597	DRC/CC-ICP-MS	17.1	0.390	3.97	6.06	5.98
598	ICP-MS	15.5	0.19	4.02	5.82	5.51
599	DRC/CC-ICP-MS	11.6 ↓	<0.1	1.96 ↓	3.29 ↓	3.12 ↓
605	ICP-MS	*5.99 ↓	0.333	3.94	6.08	*17.4 ↑
606	DRC/CC-ICP-MS	15.8	<0.500	3.62	5.44	5.47
686	ICP-MS	15.2	< 0.500	3.65	5.27	5.25

Based on the grading criteria for Cd in Whole Blood, 90% of results were satisfactory, with 2 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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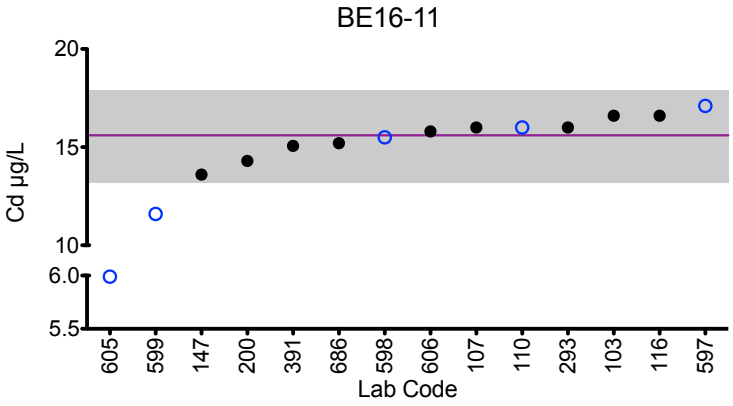
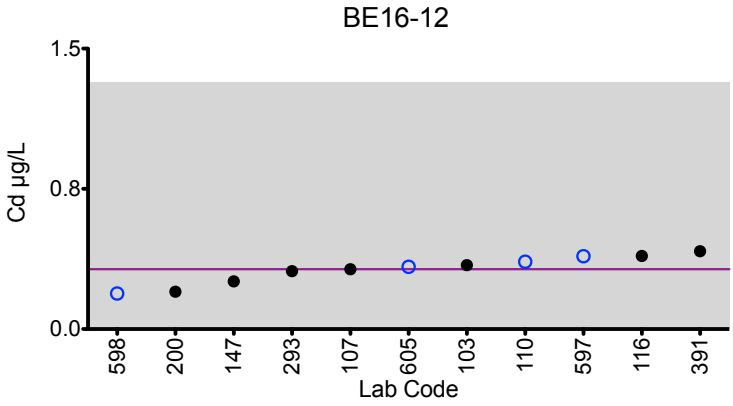
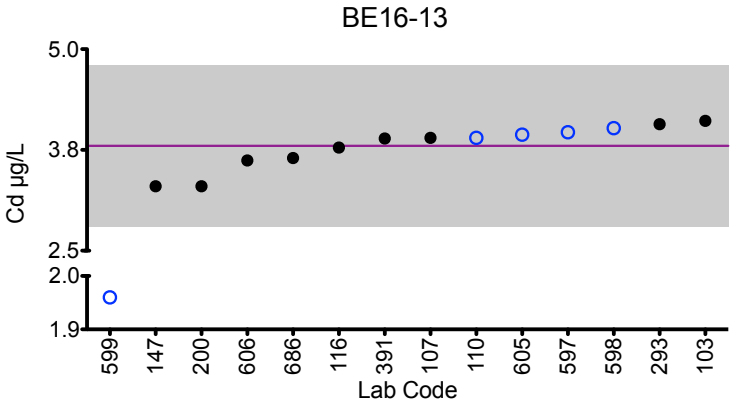
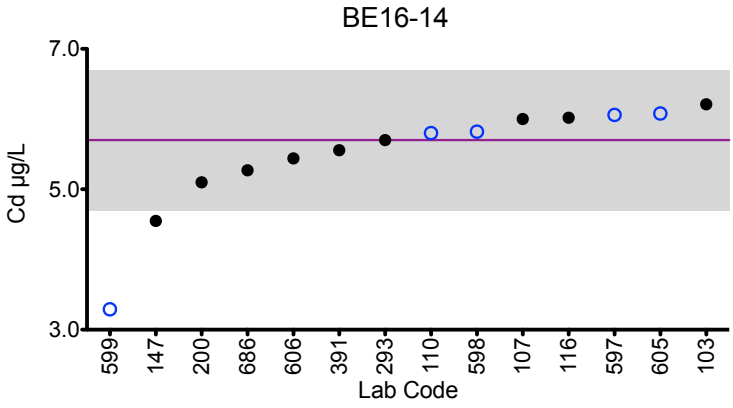
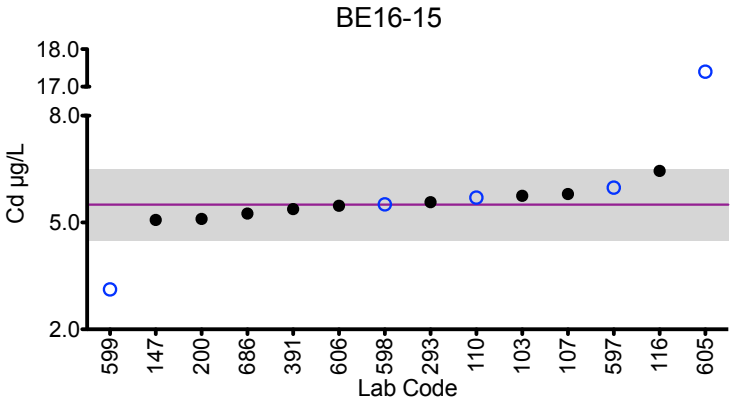
Results for Event #3, 2016: Whole Blood Cd











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±1 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±1 µg/L at concentrations less than or equal to 6.7 µg/L.

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Results for Event #3, 2016
Whole Blood Cobalt (Co)

Summary Statistics

	Whole Blood Co (µg/L)				
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Target (Arithmetic Mean ($\bar{x}$))	2.9	1.6	6.3	0.2	13.6
Upper Limit	4.4	3.1	7.8	1.7	16.3
Lower Limit	1.4	0.1	4.8	0	10.9
Arithmetic SD (s)	0.2	0.1	0.5	0.1	0.6
Arithmetic RSD (%)	6.9	6.3	7.9	50	4.4
Number of Sample Measurements (N)	8	8	8	7	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

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Results for Event #3, 2016
Whole Blood Cobalt (Co)
Performance of Participating Laboratories

		Whole Blood Co (µg/L)				
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
	Target	**2.9**	**1.6**	**6.3**	**0.2**	**13.6**
103	DRC/CC-ICP-MS	2.83	1.50	5.75	0.0934	13.2
110	ICP-MS	3.1	1.7	6.3	0.2	13.9
147	ICP-MS	3.11	1.82	6.78	0.187	13.7
293	DRC/CC-ICP-MS	2.87	1.63	5.67	0.13	13.8
391	DRC/CC-ICP-MS	2.812	1.724	6.518	0.161	13.292
597	DRC/CC-ICP-MS	3.08	1.77	6.41	0.138	14.5
598	ICP-MS	2.89	1.59	6.92	0.28	13.72
599	DRC/CC-ICP-MS	2.71	1.44	5.66	<0.1	12.6

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.

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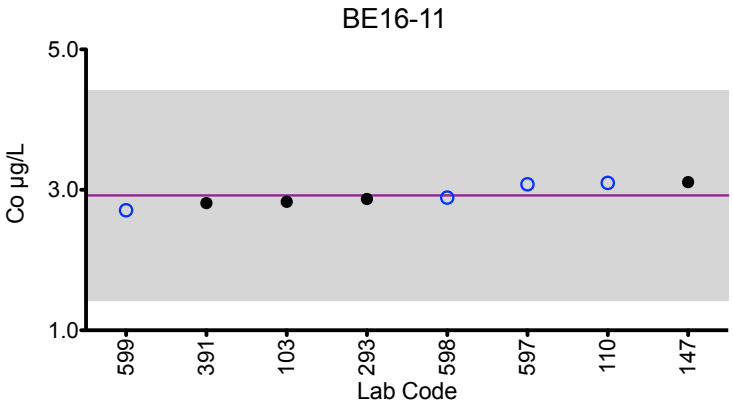
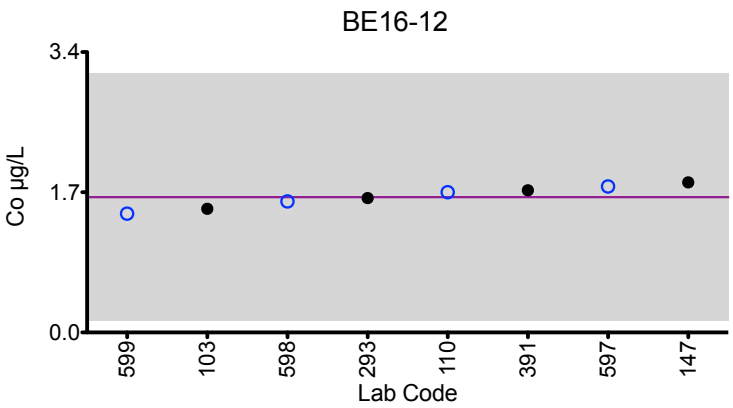
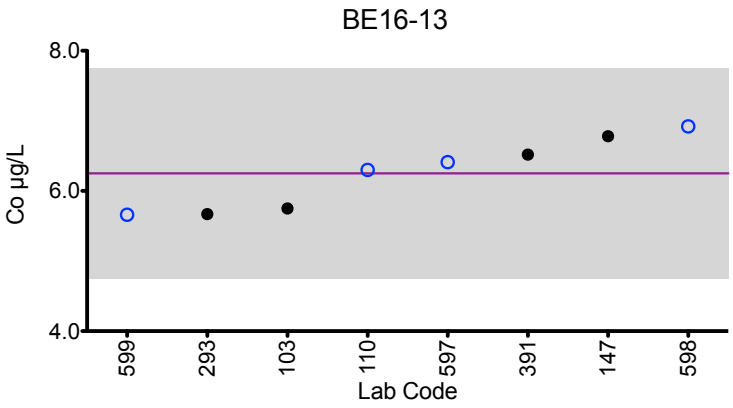
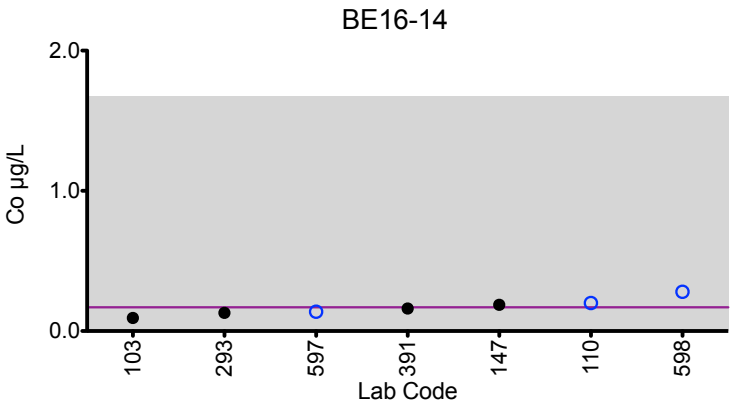
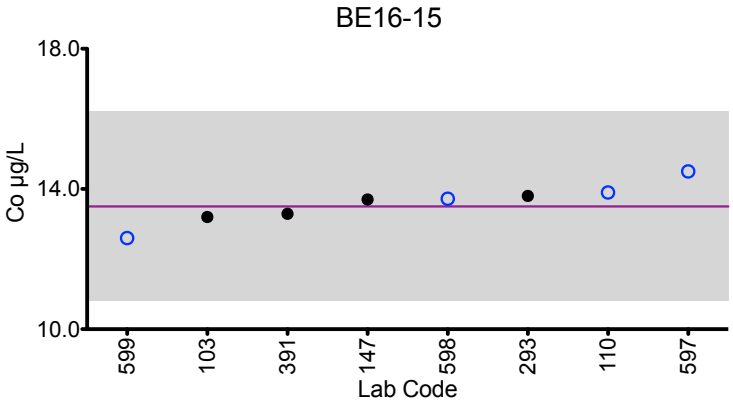
Results for Event #3, 2016: Whole Blood Co











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Whole Blood Chromium (Cr)

Summary Statistics

	Whole Blood Cr (µg/L)				
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Target (Arithmetic Mean ($\bar{x}$))	1.7	3.7	0.42	5.5	17.8
Upper Limit	3.7	5.7	2.42	7.5	21.4
Lower Limit	0.0	1.7	0.00	3.5	14.2
Arithmetic SD (s)	0.7	1.7	0.43	0.8	3.4
Arithmetic RSD (%)	41	456	102	14.5	19.1
Number of Sample Measurements (N)	7	8	5	7	8

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

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Results for Event #3, 2016
Whole Blood Chromium (Cr)
Performance of Participating Laboratories

		Whole Blood Cr (µg/L)				
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
	Target	**1.7**	**3.7**	**0.42**	**5.5**	**17.8**
103	DRC/CC-ICP-MS	1.56	3.12	< 0.257	5.39	17.0
110	DRC/CC-ICP-MS	1.7	3.1	0.09	5.6	17.9
147	DRC/CC-ICP-MS	1.35	3.00	0.102	4.68	16.3
293	DRC/CC-ICP-MS	2.76	3.81	0.88	5.93	18.4
391	DRC/CC-ICP-MS	*6.179 ↑	*7.226 ↑	*5.138 ↑	*9.726 ↑	24.307 ↑
597	DRC/CC-ICP-MS	2.52	4.29	0.904	6.38	19.0
598	DRC/CC-ICP-MS	0.59	1.28 ↓	ND(0.1)	4.29	12.2 ↓
599	DRC/CC-ICP-MS	1.63	3.46	0.110	6.22	16.9

Based on the grading criteria for Cr in Whole Blood, 83% of results were satisfactory, with 2 of the 8 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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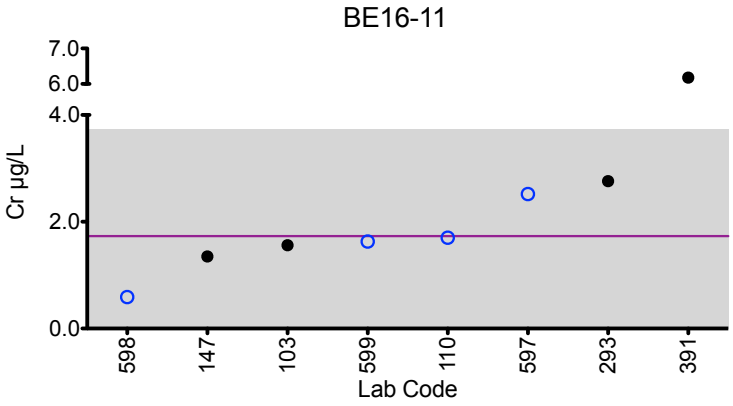
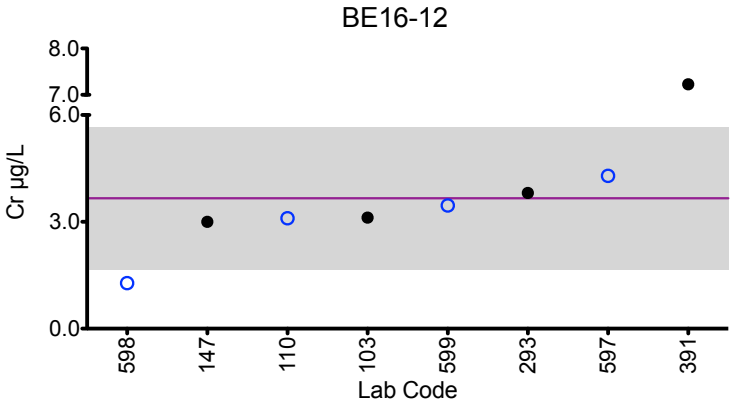
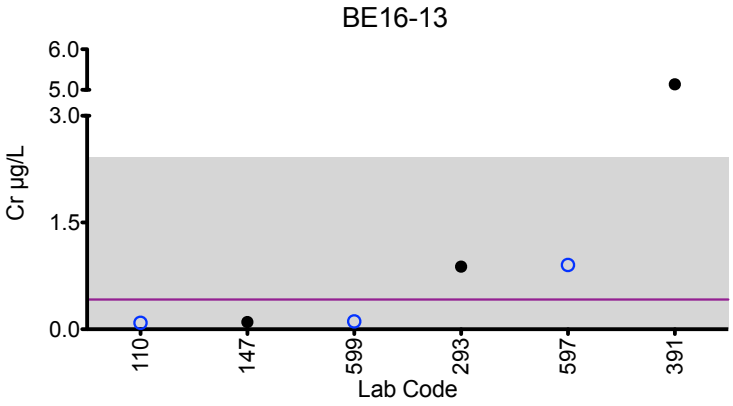
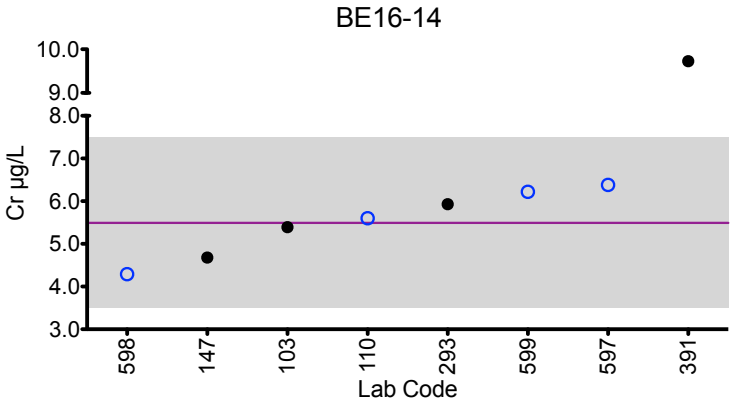
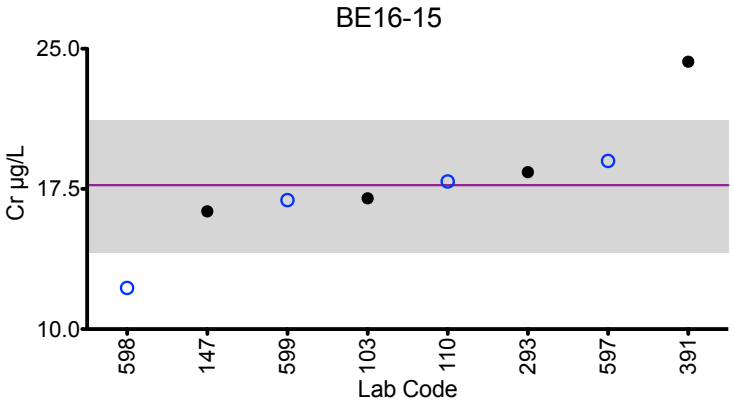
Results for Event #3, 2016: Whole Blood Cr











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Whole Blood Mercury (Hg)

Summary Statistics

Whole Blood Hg (µg/L)

	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
Target (Robust Mean (x*))	10.9	0.73	19.8	39.5	4.6
Upper Limit	14.2	3.73	25.7	51.4	7.6
Lower Limit	7.6	0.00	13.9	27.7	1.6
Robust SD (s*)	0.9	0.13	2.4	3.6	0.3
Robust RSD (%)	8.7	17.4	12.2	9.1	5.9
Number of Sample Measurements (N)	12	12	13	13	12
Standard Uncertainty (*u*)	0.340	0.046	0.832	1.24	0.097

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

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Results for Event #3, 2016
Whole Blood Mercury (Hg)
Performance of Participating Laboratories

		Whole Blood Hg (µg/L)				
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
	Target	**10.9**	**0.73**	**19.8**	**39.5**	**4.6**
103	DRC/CC-ICP-MS	11.8	0.746	21.9	41.7	4.52
107	DRC/CC-ICP-MS	11	0.62	21	41	4.7
110	ICP-MS	10.3	0.68	18.9	38.0	4.4
116	DRC/CC-ICP-MS	11.7	ND	22.4	40.8	4.55
147	ICP-MS	9.85	0.810	17.2	36.7	4.39
200	ICP-MS	11.2	0.8	18.0	36.2	5.4
293	DRC/CC-ICP-MS	7.9	0.55	11.3 ↓	30.2	3.39
391	HG-AAS	11.275	1.646	17.55	39.78	4.8305
597	DMA	11.96	0.8	22.23	44.18	4.94
598	ICP-MS	11.3	0.94	21.4	36.4	4.45
605	ICP-MS	*4.56 ↓	0.643	19.7	42.4	*12.4 ↑
606	DRC/CC-ICP-MS	8.15	0.690	21.4	43.8	4.70
686	ICP-MS	10.6	0.64	18.9	38.1	4.34

Based on the grading criteria for Hg in Whole Blood, 95% of results were satisfactory, with 1 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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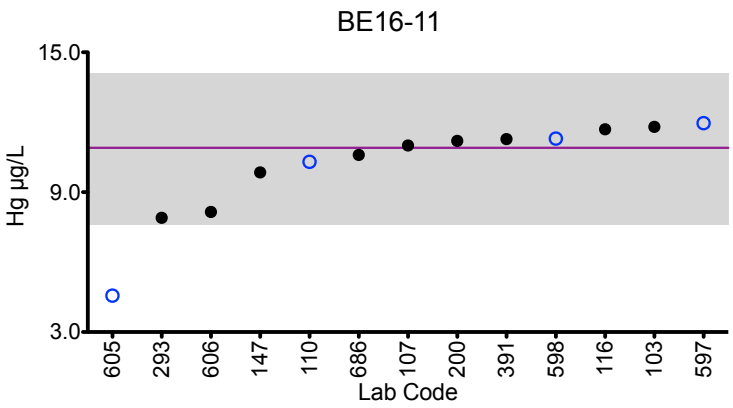
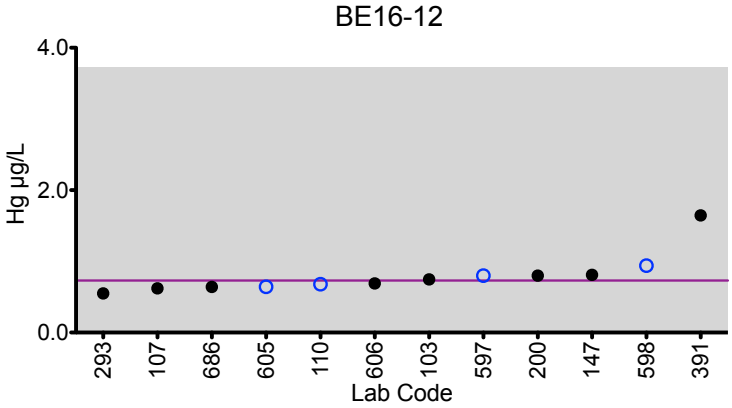
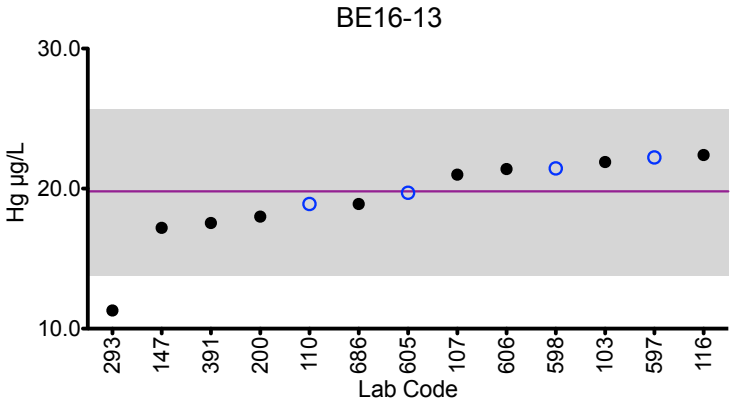
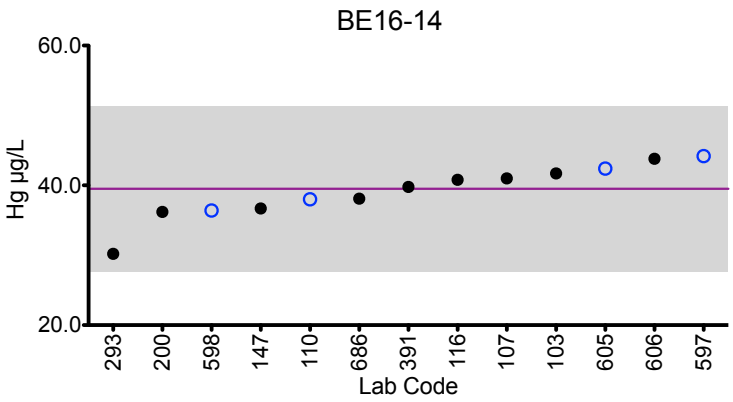
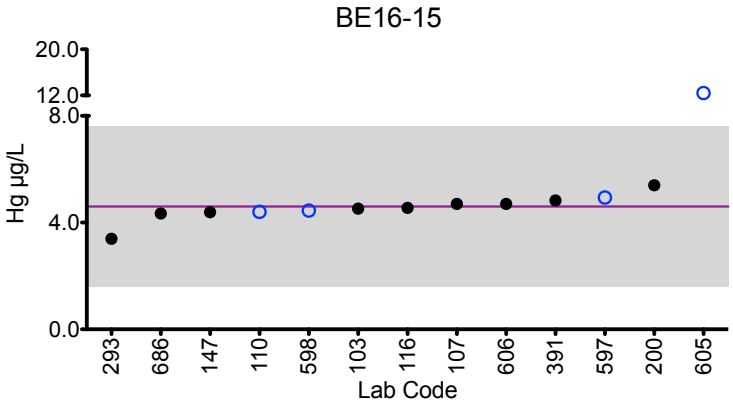
Results for Event #3, 2016: Whole Blood Hg











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Whole Blood Manganese (Mn)

Summary Statistics

	Whole Blood Mn (µg/L)				
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Target (Robust Mean (x*))	12.4	8.5	24.2	7.5	27.5
Upper Limit	15.4	11.5	28.3	10.5	32.2
Lower Limit	9.4	5.5	20.1	4.5	22.8
Robust SD (s*)	0.9	0.6	1.5	0.3	1.4
Robust RSD (%)	7.5	7.1	6.1	4.1	5.2
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.367	0.24	0.585	0.122	0.561

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 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 and Laboratory Medicine. 2016 In press.)

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Results for Event #3, 2016
Whole Blood Manganese (Mn)
Performance of Participating Laboratories

		Whole Blood Mn (µg/L)				
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
	Target	**12.4**	**8.5**	**24.2**	**7.5**	**27.5**
103	DRC/CC-ICP-MS	12.3	8.26	23.4	7.43	27.0
107	DRC/CC-ICP-MS	12	8.3	25	7.6	28
110	ICP-MS	12.6	8.7	23.1	7.5	27.8
147	ICP-MS	13.4	9.29	25.3	8.08	28.8
293	DRC/CC-ICP-MS	14.5	7.4	17.1	6.39	28.6
391	DRC/CC-ICP-MS	11.289	10.613	23.776	8.385	24.851
597	DRC/CC-ICP-MS	12.9	8.82	25.9	7.72	29.28
598	ICP-MS	11.8	7.33	24.9	7.38	26.1
599	DRC/CC-ICP-MS	12.5	8.24	25.6	7.66	28.1
606	DRC/CC-ICP-MS	11.1	8.84	23.1	6.59	25.5

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

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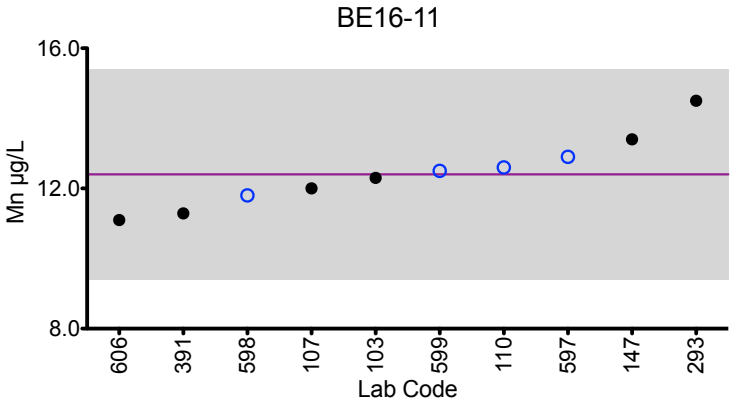
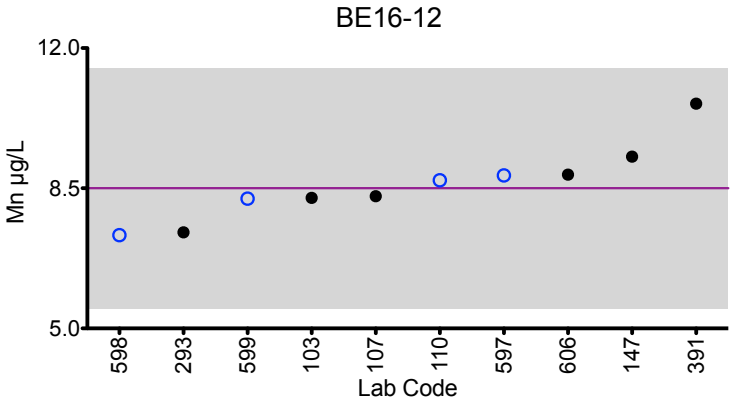
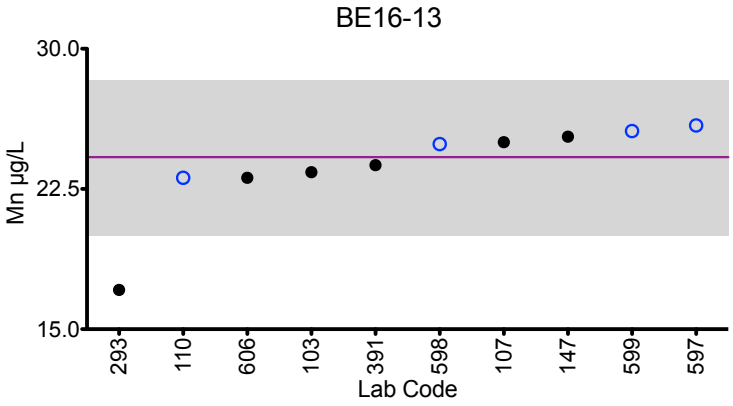
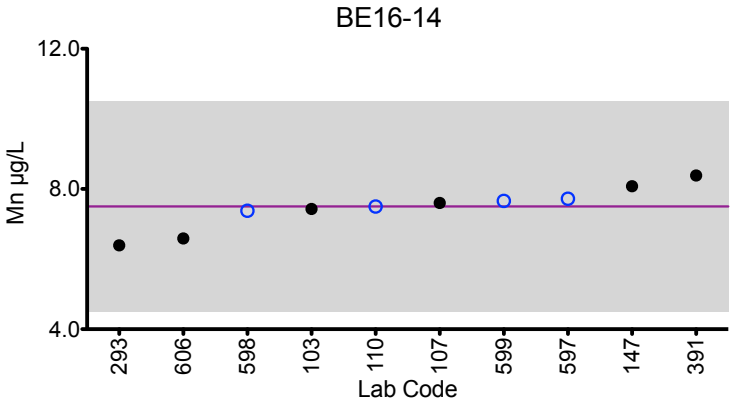
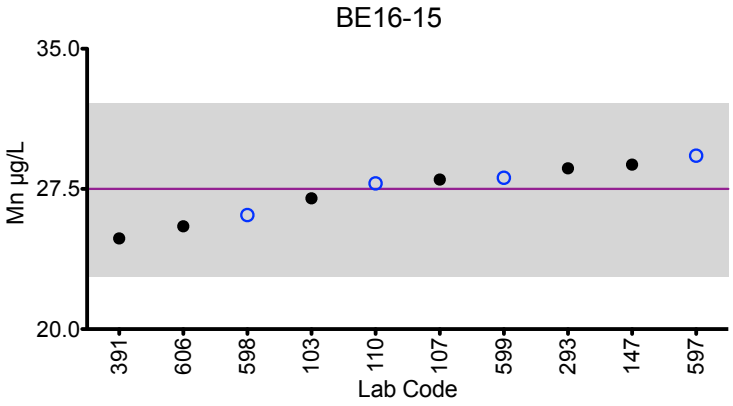
Results for Event #3, 2016: Whole Blood Mn











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Whole Blood Lead (Pb)

Summary Statistics

	Whole Blood Pb (µg/dL)				
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Target (Robust Mean (x*))	44.1	10.2	5.56	26.9	2.34
Upper Limit	48.5	12.2	7.56	29.6	4.34
Lower Limit	39.7	8.2	3.56	24.2	0.34
Robust SD (s*)	4.3	0.8	0.51	2.5	0.16
Robust RSD (%)	9.8	7.9	9.2	9.3	6.8
Number of Sample Measurements (N)	13	14	14	14	13
Standard Uncertainty (*u*)	1.49	0.268	0.170	0.835	0.055

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/L at concentrations less than or equal to 20 µg/dL. These quality specifications are recommended by the Clinical Laboratory Standards Institute (CLSI, C40-A2, http://shop.clsi.org/C40.html) 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.

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Results for Event #3, 2016
Whole Blood Lead (Pb)
Performance of Participating Laboratories

		Whole Blood Pb (µg/dL)				
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
	Target	**44.1**	**10.2**	**5.56**	**26.9**	**2.34**
103	DRC/CC-ICP-MS	48.1	10.6	5.91	29.0	2.43
107	ICP-MS	47	11	6.1	29	2.5
110	ICP-MS	47.1	10.6	6.07	28.1	2.42
116	DRC/CC-ICP-MS	47.8	10.5	5.96	27.5	2.35
147	ICP-MS	40.8	9.06	5.04	23.6 ↓	2.26
200	ICP-MS	44.7	9.9	5.6	27.3	2.3
293	DRC/CC-ICP-MS	45.3	10.2	5.41	28.5	2.29
391	ETAAS-Z	35.7 ↓	8 ↓	3.22 ↓	23.5 ↓	0.53
597	DRC/CC-ICP-MS	48.28	10.85	5.99	29.44	2.51
598	ICP-MS	37.2 ↓	8.37	5.31	21.8 ↓	1.9
599	DRC/CC-ICP-MS	40.1	8.45	4.69	23.2 ↓	1.93
605	ICP-MS	*2.42 ↓	10.8	5.81	29.3	*49.2 ↑
606	DRC/CC-ICP-MS	44.7	11.3	4.97	27.2	2.90
686	ICP-MS	44.2	9.91	5.77	26.5	2.37

Based on the grading criteria for Pb in Whole Blood, 86% of results were satisfactory, with 3 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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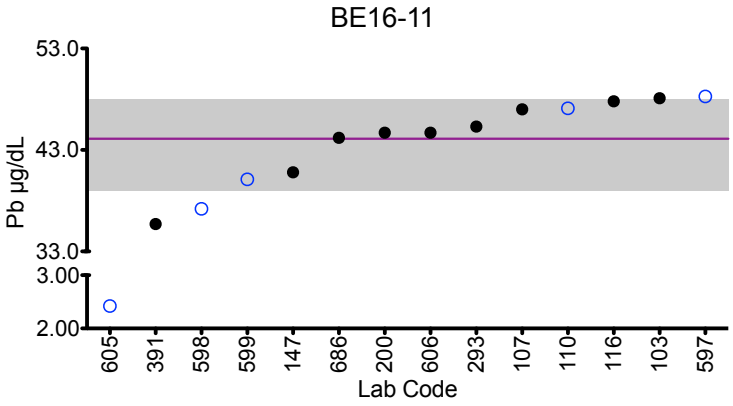
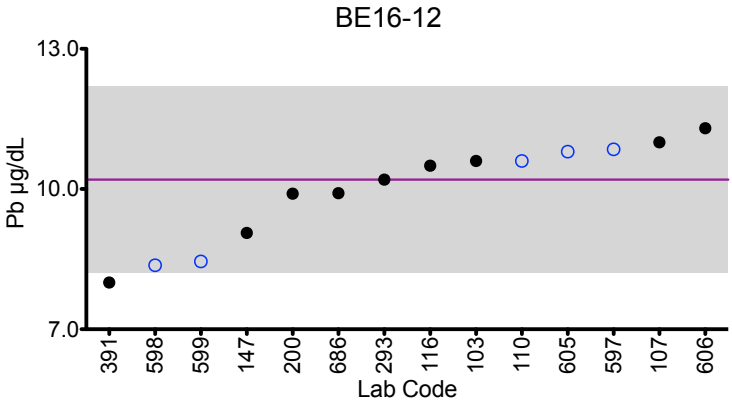
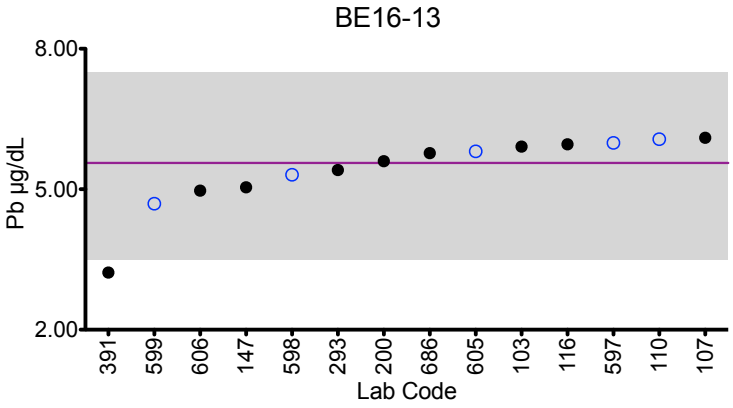
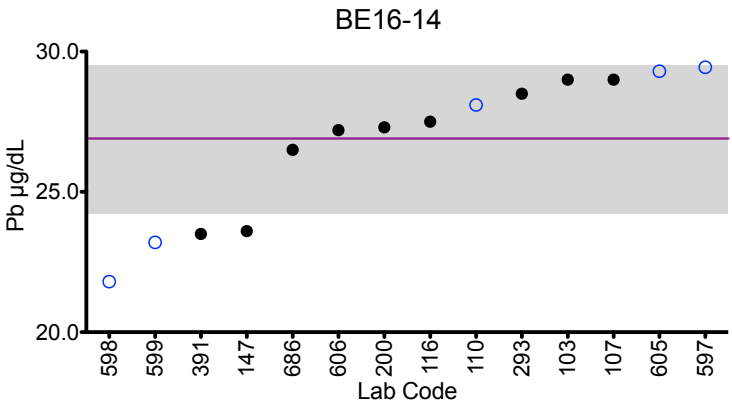
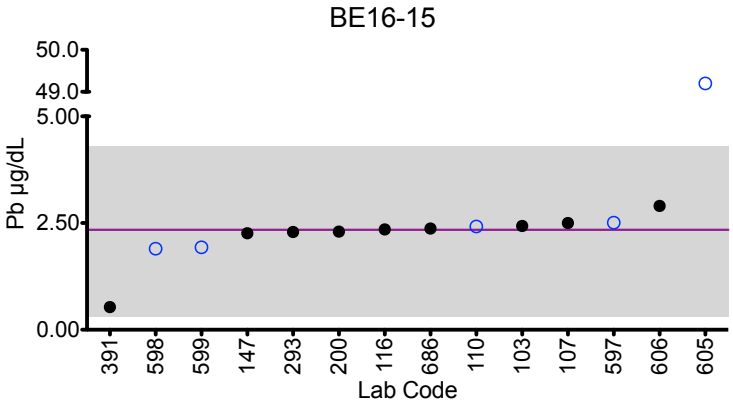
Results for Event #3, 2016: Whole Blood Pb











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Additional Elements in Whole Blood: Thallium (Tl)

Whole Blood Tl (µg/L)

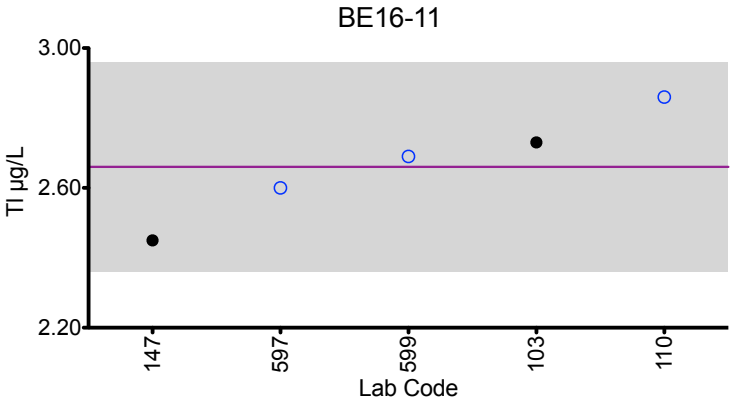
Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
103	DRC/CC-ICP-MS	2.73	<0.00810	0.571	3.33	1.86
110	ICP-MS	2.86	0.03	0.60	3.42	1.89
147	ICP-MS	2.45	< 0.0348	0.470	2.88	1.73
597	DRC/CC-ICP-MS	2.6	< DL	0.60	3.45	1.88
599	DRC/CC-ICP-MS	2.69	0.105	0.524	2.72	1.51

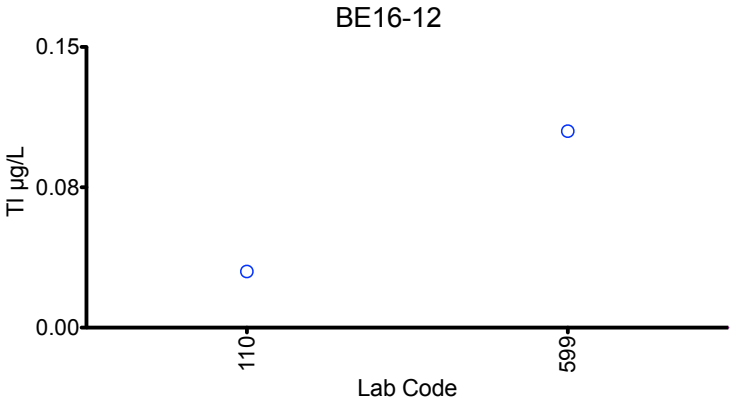
Summary Statistics

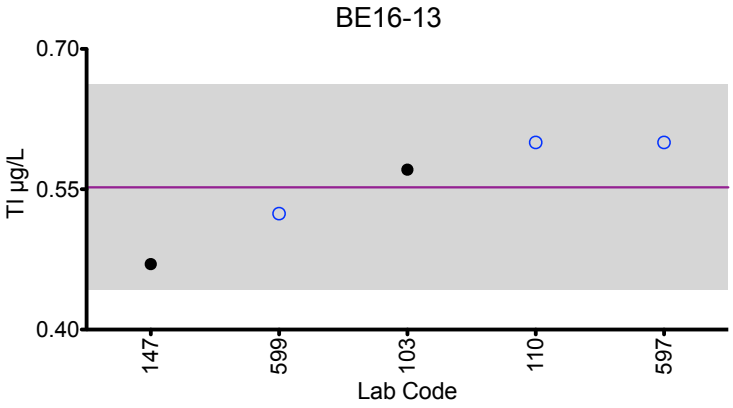
	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
Arithmetic Mean ($\bar{x}$)	2.67	NA	0.55	3.16	1.77
Arithmetic SD (s)	0.15	NA	0.06	0.34	0.16
Arithmetic RSD (%)	5.6	NA	10.9	10.8	9.0
Number of Sample Measurements (N)	5	NA	5	5	5

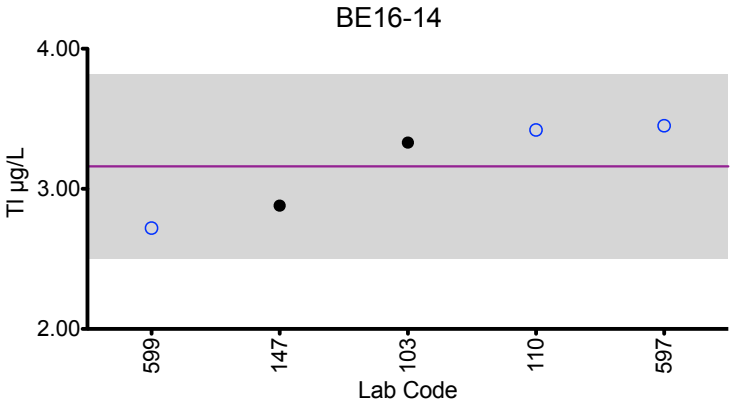
*Denotes a statistical Outlier.

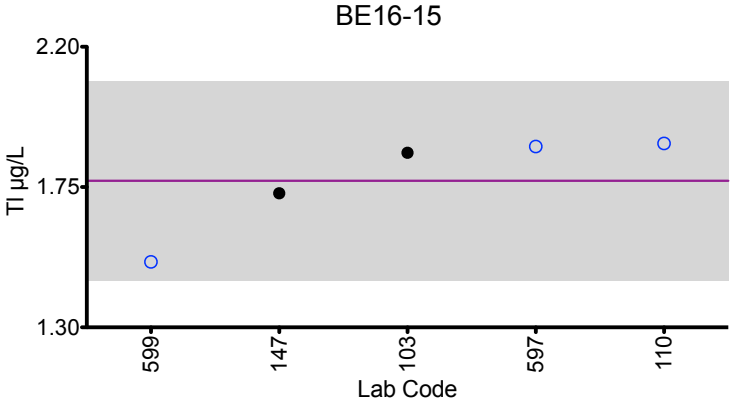
Results for Event #3, 2016:
Whole Blood Tl











Legend:
oCHEAR 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 not intended to be quality specifications and are included for informational purposes only.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Barium (Ba)

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
110	ICP-MS	1.3	2.2	10.5	5.5	32.8
147	ICP-MS	2.07	2.94	10.4	5.62	30.9
597	DRC/CC-ICP-MS	2.46	3.65	11.9	7.21	34.3

Summary Statistics					
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Arithmetic Mean ($\bar{x}$)	1.9	2.9	10.9	6.1	32.7
Arithmetic SD (s)	0.6	0.7	0.8	1.0	1.7
Arithmetic RSD (%)	32	24	7.3	16.4	5.2
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Beryllium (Be)

Whole Blood Be (µg/L)						
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
110	ICP-MS	1	<0.04	0.3	2.1	0.6
147	ICP-MS	<1.17	<1.17	<1.17	1.84	<1.17
599	DRC/CC-ICP-MS	0.915	<0.1	0.161	1.78	0.377

Summary Statistics					
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Arithmetic Mean ($\bar{x}$)	1.0	NA	0.23	1.9	0.49
Arithmetic SD (s)	0.1	NA	0.10	0.2	0.16
Arithmetic RSD (%)	10.0	NA	44	10.5	33
Number of Sample Measurements (N)	2	NA	2	3	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Cesium (Cs)

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
110	ICP-MS	1.7	1.5	3.0	1.6	1.8
597	DRC/CC-ICP-MS	1.60	1.50	2.97	1.55	1.73

Summary Statistics					
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Arithmetic Mean ($\bar{x}$)	1.7	1.5	3.0	1.6	1.8
Arithmetic SD (s)	0.1	0.0	0.0	0.0	0.0
Arithmetic RSD (%)	5.9	0.0	0.0	0.0	0.0
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Copper (Cu)

Whole Blood Cu (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
110	ICP-MS	1860	1090	765	1245	1082
147	ICP-MS	1836	1086	737	1277	1048
597	DRC/CC-ICP-MS	1925	1104	767	1306	1108
599	DRC/CC-ICP-MS	*1390	*707	*442	*846	*695

Summary Statistics

	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
Arithmetic Mean ($\bar{x}$)	1874	1093	756	1276	1079
Arithmetic SD (s)	46	9	17	31	30
Arithmetic RSD (%)	2.5	0.82	2.2	2.4	2.8
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Molybdenum (Mo)

Whole Blood Mo (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
103	DRC/CC-ICP-MS	3.55	0.691	1.78	4.60	1.30
147	ICP-MS	3.69	0.846	1.99	4.95	1.44
597	DRC/CC-ICP-MS	3.99	0.601	2.53	4.8	1.36
599	DRC/CC-ICP-MS	*8.87	0.763	1.12	3.95	*0.265

Summary Statistics

	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
Arithmetic Mean ($\bar{x}$)	3.74	0.725	1.86	4.58	1.37
Arithmetic SD (s)	0.22	0.104	0.58	0.44	0.07
Arithmetic RSD (%)	5.9	14.3	31.2	9.6	5.1
Number of Sample Measurements (N)	3	4	4	4	3

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Nickel (Ni)

Whole Blood Ni (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
110	DRC/CC-ICP-MS	0.5	2.6	1.1	5.4	10.1
147	ICP-MS	0.498	3.15	1.00	5.87	9.63
599	DRC/CC-ICP-MS	<0.1	1.67	0.498	5.02	7.83

Summary Statistics

	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
Arithmetic Mean ($\bar{x}$)	0.5	2.5	0.9	5.4	9.2
Arithmetic SD (s)	0.0	0.7	0.3	0.4	1.2
Arithmetic RSD (%)	0.0	28	33	7.4	13.0
Number of Sample Measurements (N)	2	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Antimony (Sb)

Whole Blood Sb (µg/L)						
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
103	DRC/CC-ICP-MS	4.08	<0.258	1.01	0.353	2.26
110	ICP-MS	3.64	<0.02	0.98	0.33	1.96
147	ICP-MS	2.69	< 0.0645	0.756	0.265	1.73
599	DRC/CC-ICP-MS	3.38	<0.1	0.665	<0.1	1.41

Summary Statistics					
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Arithmetic Mean ($\bar{x}$)	3.45	NA	0.85	0.32	1.84
Arithmetic SD (s)	0.58	NA	0.17	0.05	0.36
Arithmetic RSD (%)	16.8	NA	20	15.6	19.6
Number of Sample Measurements (N)	4	NA	4	3	4

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Selenium (Se)

Whole Blood Se (µg/L)						
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
103	DRC/CC-ICP-MS	142	168	239	230	253
107	DRC/CC-ICP-MS	160	180	250	240	260
110	DRC/CC-ICP-MS	139	164	232	204	232
147	ICP-MS	152	178	235	235	240

Summary Statistics					
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Arithmetic Mean ($\bar{x}$)	148	173	239	227	246
Arithmetic SD (s)	10	8	8	16	13
Arithmetic RSD (%)	6.8	4.6	3.3	7.0	5.3
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Tin (Sn)

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
110	ICP-MS	9.7	3.7	1.2	5.5	0.6
147	ICP-MS	8.31	3.24	1.10	4.61	0.600
599	DRC/CC-ICP-MS	7.33	1.98	<0.1	1.64	<0.1

Summary Statistics					
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Arithmetic Mean ($\bar{x}$)	8.4	3.0	1.2	3.9	0.6
Arithmetic SD (s)	1.2	0.9	0.1	2.0	0.0
Arithmetic RSD (%)	14.3	30	8.3	51.3	0.0
Number of Sample Measurements (N)	3	3	2	3	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Vanadium (V)

Whole Blood V (µg/L)						
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
110	DRC/CC-ICP-MS	7.05	0.08	2.20	9.02	4.80
147	DRC/CC-ICP-MS	5.82	0.0556	1.88	7.30	4.42
597	DRC/CC-ICP-MS	6.80	0.064	2.22	8.81	4.650

Summary Statistics					
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Arithmetic Mean ($\bar{x}$)	6.56	0.07	2.10	8.38	4.62
Arithmetic SD (s)	0.65	0.01	0.19	0.94	0.19
Arithmetic RSD (%)	9.9	14.3	9.0	11.2	4.1
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Tungsten (W)

Whole Blood W (µg/L)						
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
110	ICP-MS	<0.04	4.26	0.39	2.61	0.14
200	ICP-MS	0.1	4.5	0.4	2.5	0.2
599	DRC/CC-ICP-MS	150	*22.2	*4.9	*7.69	*2.87

Summary Statistics					
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Arithmetic Mean ($\bar{x}$)	NA	4.38	0.40	2.56	0.17
Arithmetic SD (s)	NA	0.17	0.01	0.08	0.04
Arithmetic RSD (%)	NA	3.9	2.5	3.1	24
Number of Sample Measurements (N)	NA	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood: Zinc (Zn)

Whole Blood Zn (µg/L)						
Lab Code	**Method**	**BE16-11**	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
110	ICP-MS	4052	3977	9340	4127	4815
147	ICP-MS	3451	3392	7778	3392	4405
597	DRC/CC-ICP-MS	4105	4000	9654	4041	4944

Summary Statistics					
	BE16-11	**BE16-12**	**BE16-13**	**BE16-14**	**BE16-15**
Arithmetic Mean ($\bar{x}$)	3869	3790	8924	3853	4721
Arithmetic SD (s)	363	345	1005	402	281
Arithmetic RSD (%)	9.4	9.1	11.3	10.4	6.0
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
147	ICP-MS	10.0	4.85	18.9	< 0.205	1.27

Whole Blood Al (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
147	ICP-MS	<9.17	<9.17	<9.17	<9.17	<9.17

Whole Blood Bi (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
147	ICP-MS	< 0.0836	< 0.0836	< 0.0836	< 0.0836	< 0.0836

Whole Blood I (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
147	ICP-MS	53.7	53.8	40.5	51.9	52.2

Whole Blood Li (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
147	ICP-MS	0.464	0.661	0.308	0.552	0.511

Whole Blood Mg (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
597	DRC/CC-ICP-MS	29754	27724	46056	29005	30642

Whole Blood Pt (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
110	ICP-MS	1.28	0.826	0.344	< 0.04	2.28

Whole Blood Sr (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
103	DRC/CC-ICP-MS	33.4	33.7	12.8	33.5	29.8

Whole Blood Te (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
147	ICP-MS	< 0.128	< 0.128	< 0.128	< 0.128	< 0.128

Whole Blood Th (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
147	ICP-MS	< 0.0148	< 0.0148	< 0.0148	< 0.0148	< 0.0148

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Results for Event #3, 2016
Additional Elements in Whole Blood

Whole Blood Ti (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
200		74.2	1.2	9.4	14.9	33.3

Whole Blood U (µg/L)

Lab Code	Method	BE16-11	BE16-12	BE16-13	BE16-14	BE16-15
103	DRC/CC-ICP-MS	0.0147	< 0.00748	0.0305	< 0.00748	< 0.00748
110	ICP-MS	0.038	0.011	0.053	0.022	<0.003
147	ICP-MS	0.0237	< 0.0136	0.0457	0.0195	< 0.0136

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Event #3, 2016

Trace Elements in Urine

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Trace Elements Laboratory

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Event #3, 2016:
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 and subsequently separated into five pools. Each urine pool was supplemented with arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), mercury (Hg), manganese (Mn), lead (Pb), thallium (Tl), uranium (U), aluminum (Al), cobalt (Co), chromium (Cr), cesium (Cs), copper (Cu), molybdenum (Mo), nickel (Ni), platinum (Pt), antimony (Sb), selenium (Se), tin (Sn), tellurium (Te), vanadium (V), tungsten (W), and zinc (Zn) and stirred overnight to ensure thorough mixing prior to aliquoting 10-mL into polypropylene vials. PT samples were stored at -80°C until the week of the PT event, when they were thawed at 4°C prior to circulation to laboratories for analysis.

Graded Elements

Nine elements in urine are formally graded: As, Ba, Be, Cd, Hg, Mn, Pb, Tl, and U. Target values for the graded elements are assigned to these pools based on the robust mean calculated from data reported by all laboratories.

Additional Elements

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

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

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Results for Event #3, 2016
Urine Arsenic (As)

Summary Statistics

	Urine As (µg/L)				
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Target (Robust Mean (x*))	3.8	62.9	40.3	14.5	67.4
Upper Limit	9.8	75.5	48.4	20.5	80.9
Lower Limit	0.0	50.3	32.2	8.5	53.9
Robust SD (s*)	0.4	3.1	1.9	0.6	5.3
Robust RSD (%)	9.6	4.9	4.7	3.9	7.8
Number of Sample Measurements (N)	17	18	18	18	18
Standard Uncertainty (*u*)	0.111	0.900	0.561	0.167	1.55

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

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Results for Event #3, 2016
Urine Arsenic (As)
Performance of Participating Laboratories

		Urine As (µg/L)				
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
	Target	**3.8**	**62.9**	**40.3**	**14.5**	**67.4**
103	DRC/CC-ICP-MS	3.71	64.6	41.0	14.7	66.6
107	DRC/CC-ICP-MS	3.5	61	38	13	65
110	DRC/CC-ICP-MS	7.5	71.3	45.0	18.6	72.4
116	DRC/CC-ICP-MS	3.93	72.3	45.3	16.8	78.9
147	ICP-MS	3.50	60.3	37.4	14.2	60.3
200	ICP-MS	7.1	57.6	34.7	14.3	66.2
293	DRC/CC-ICP-MS	3.18	54.8	34.8	13.2	58.1
324	ICP-MS	3.574	61.930	39.816	14.233	67.880
391	DRC/CC-ICP-MS	4.15	64.11	41.4	15.79	69.945
399	DRC/CC-ICP-MS	3.72	65.9	41.5	14.9	67.1
597	DRC/CC-ICP-MS	3.74	61.4	39.4	13.9	65.1
598	ICP-MS	4.56	60.0	37.3	14.3	60.8
599	DRC/CC-ICP-MS	3.83	63.5	41.30	14.7	70.7
604	DRC/CC-ICP-MS	3.74	61.9	39.7	14.2	62.4
605	ICP-MS	3.49	63.9	40.6	14.4	67.1
606	DRC/CC-ICP-MS	3.69	64.5	41.0	14.6	69.6
632	DRC/CC-ICP-MS	6.59	67.7	45.9	17.6	74.0
684	DRC/CC-ICP-MS	PLC	61.9	40.5	14.1	73.7

Based on the grading criteria for As in Urine, 100% of results were satisfactory, with 0 of the 18 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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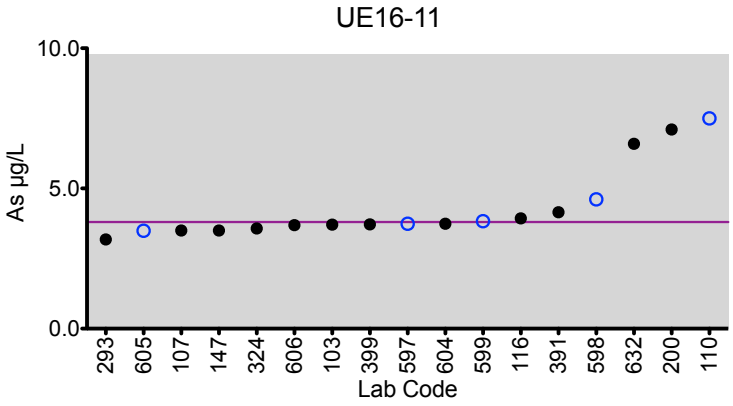
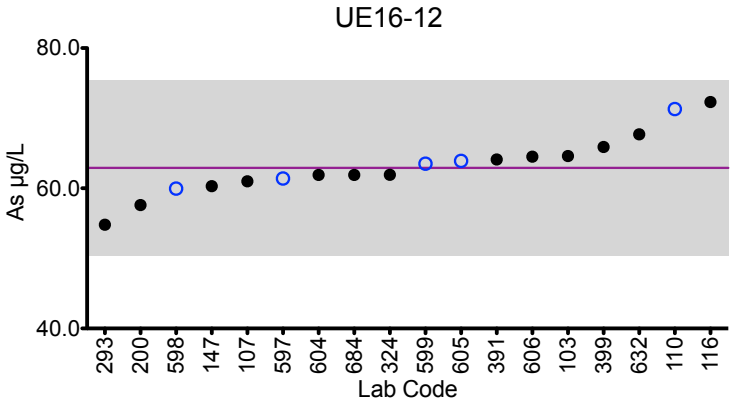
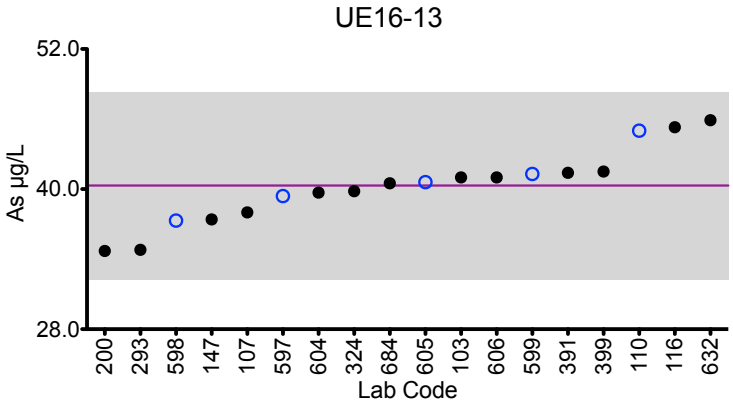
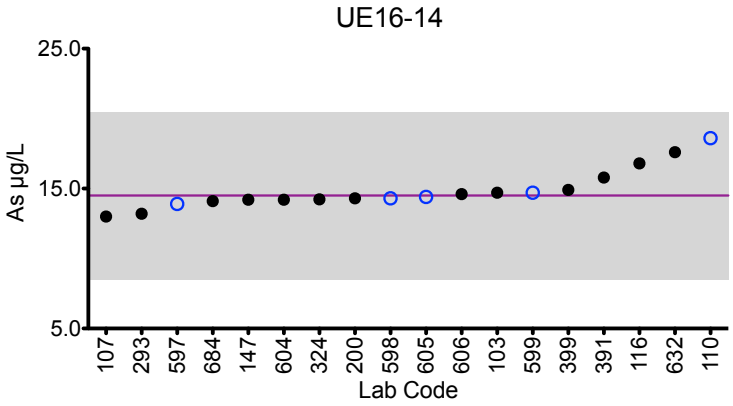
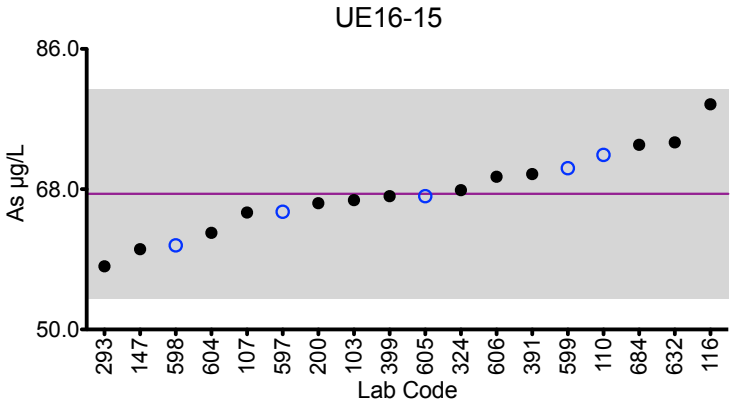
Results for Event #3, 2016: Urine As











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Urine Barium (Ba)

Summary Statistics

	Urine Ba (µg/L)				
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Target (Robust Mean (x*))	1.1	6.6	2.5	1.8	20.6
Upper Limit	2.1	7.9	3.5	2.8	24.7
Lower Limit	0.1	5.3	1.5	0.8	16.5
Robust SD (s*)	0.1	0.5	0.2	0.2	1.0
Robust RSD (%)	8.8	7.0	9.4	8.4	4.9
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.035	0.175	0.089	0.057	0.380

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

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Results for Event #3, 2016
Urine Barium (Ba)
Performance of Participating Laboratories

		Urine Ba (µg/L)				
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
	Target	**1.1**	**6.6**	**2.5**	**1.8**	**20.6**
107	ICP-MS	0.89	5.8	2.2	1.6	20
110	ICP-MS	1.0	6.8	2.5	1.8	21.3
116	DRC/CC-ICP-MS	1.01	6.87	2.50	1.83	21.7
147	ICP-MS	1.03	6.41	2.29	1.88	19.9
399	ICP-MS	1.7	7.18	2.8	1.91	19.5
597	DRC/CC-ICP-MS	1.15	7.17	2.79	1.97	21.2
598	ICP-MS	0.80	6.25	2.24	1.58	19.40
605	ICP-MS	1.08	6.35	2.40	1.69	19.7
606	DRC/CC-ICP-MS	1.07	6.18	2.70	1.66	20.6
607	ICP-MS	1.10	6.80	2.57	1.90	21.2
632	ICP-MS	1.10	6.80	2.50	1.79	21.7

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

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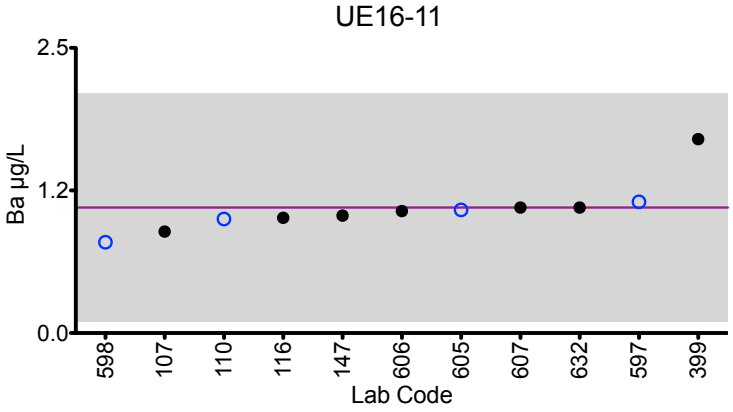
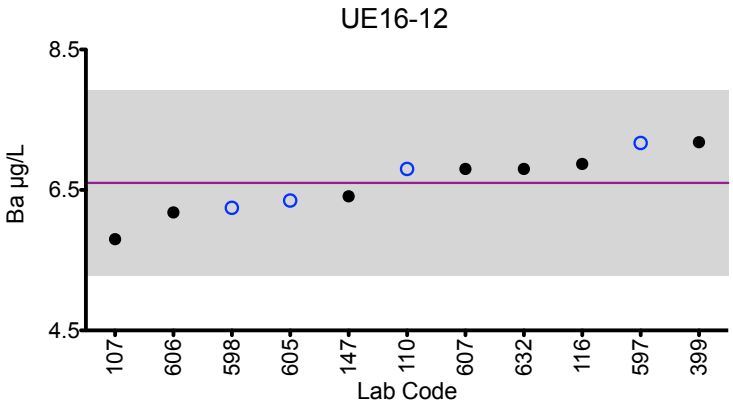
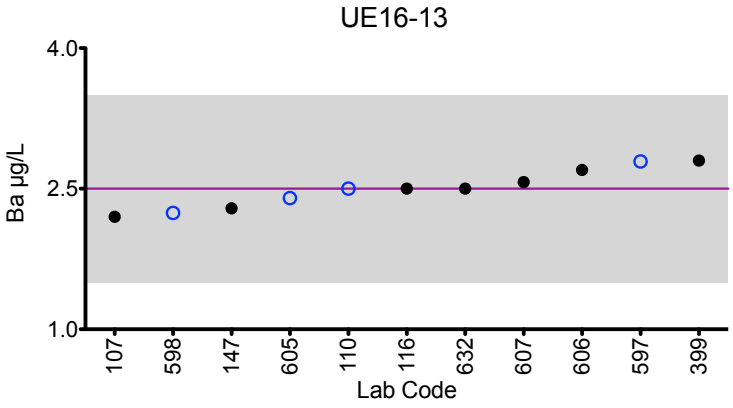
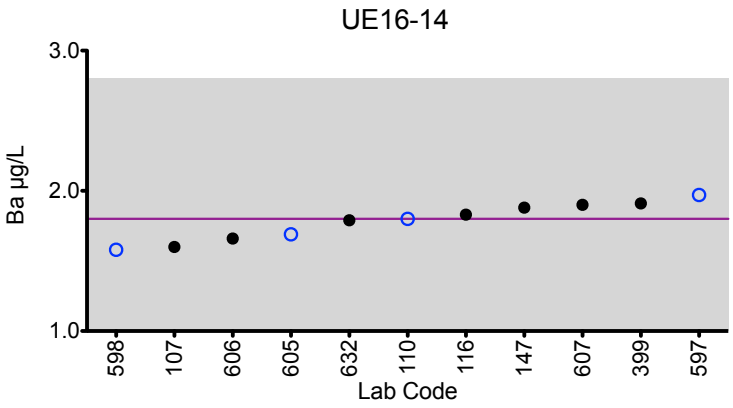
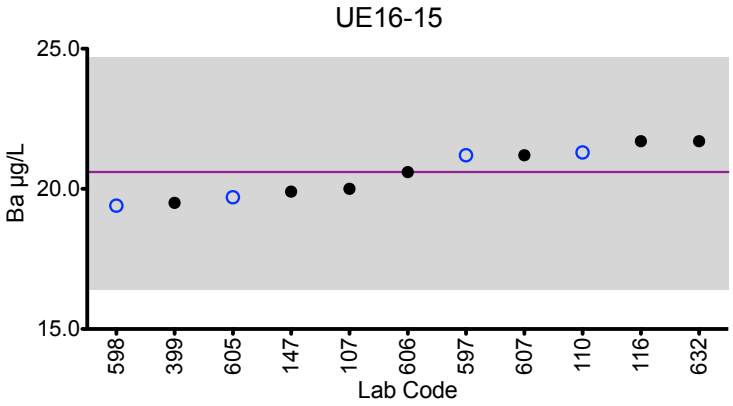
Results for Event #3, 2016: Urine Ba











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Urine Beryllium (Be)

Summary Statistics

	Urine Be (µg/L)				
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Target (Robust Mean (x*))	NA	3.2	2.2	0.65	6.3
Upper Limit	NA	4.2	3.2	1.65	7.6
Lower Limit	NA	2.2	1.2	0.00	5.0
Robust SD (s*)	NA	0.2	0.1	0.03	0.3
Robust RSD (%)	NA	6.3	4.7	4.2	4.3
Number of Sample Measurements (N)	NA	10	10	10	10
Standard Uncertainty (*u*)	NA	0.080	0.042	0.011	0.109

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.

Sample UE16-11 was treated as an educational challenges for the purposes of this event, and is not graded.

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Results for Event #3, 2016
Urine Beryllium (Be)
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
	Target	**NA**	**3.2**	**2.2**	**0.65**	**6.3**
107	ICP-MS	<0.016	3.2	2.2	0.65	6.4
110	ICP-MS	<MDL	3.5	2.5	0.7	6.0
116	ICP-MS	ND	3.10	2.22	0.651	6.50
147	ICP-MS	< 0.450	3.60	2.29	0.679	6.32
399	ICP-MS	ND	3.23	2.21	0.649	6.46
598	ICP-MS	ND(0.04)	2.84	1.91	0.64	4.90 ↓
599	DRC/CC-ICP-MS	<0.1	3.09	2.19	0.62	6.96
605	ICP-MS	ND	3.02	2.13	0.625	6.27
607	ICP-MS	< DL	3.30	2.35	0.710	6.07
632	ICP-MS	PLC	3.24	2.28	0.642	6.54

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

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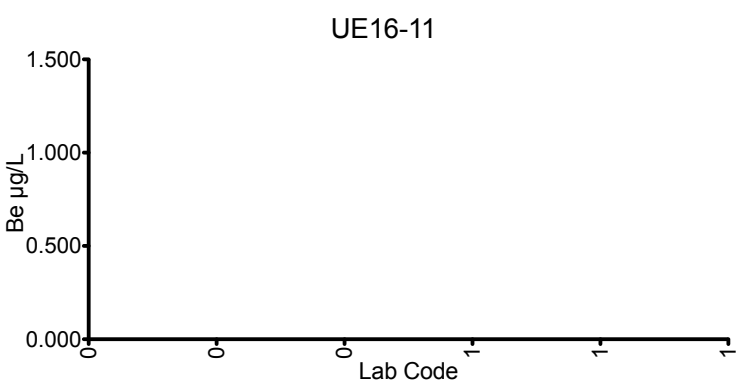
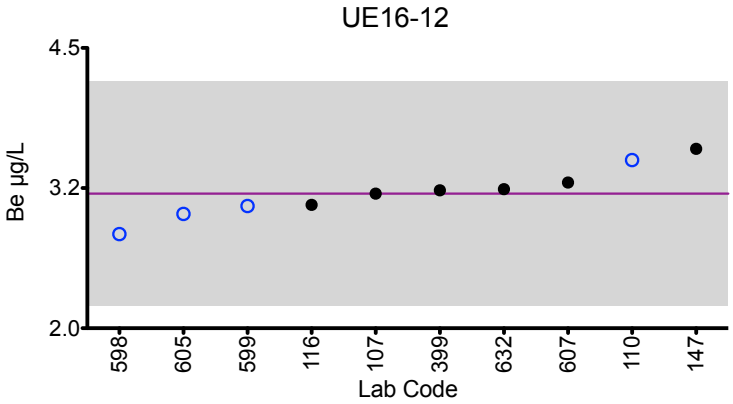
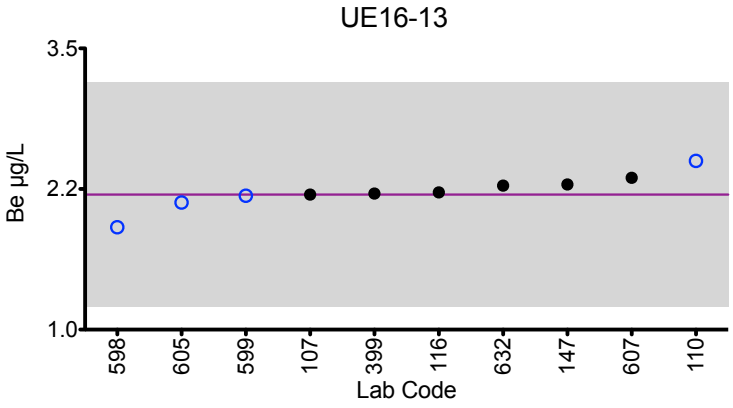
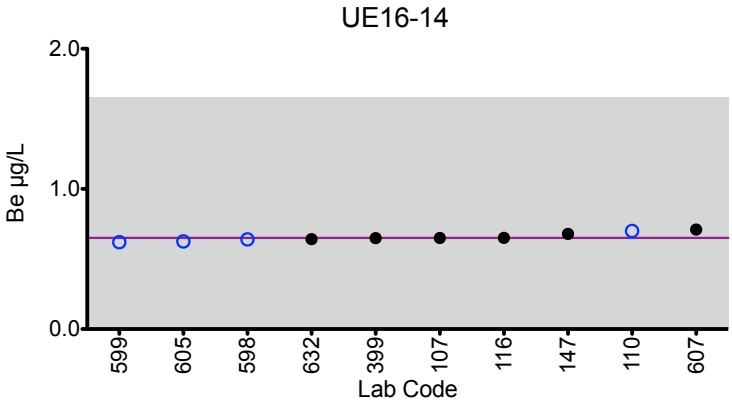
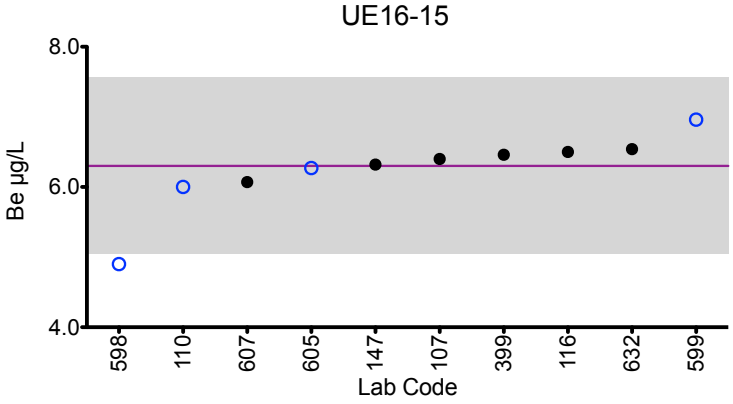
Results for Event #3, 2016: Urine Be











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Urine Cadmium (Cd)

Summary Statistics

	Urine Cd (µg/L)				
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Target (Robust Mean (x*))	0.24	2.73	0.89	0.59	1.46
Upper Limit	1.24	3.73	1.89	1.59	2.46
Lower Limit	0.00	1.73	0.00	0.00	0.46
Robust SD (s*)	0.04	0.17	0.07	0.05	0.15
Robust RSD (%)	15.6	6.1	7.6	8.7	10.0
Number of Sample Measurements (N)	16	18	17	17	18
Standard Uncertainty (*u*)	0.012	0.049	0.021	0.016	0.043

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, 2016
Urine Cadmium (Cd)
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
	Target	**0.24**	**2.73**	**0.89**	**0.59**	**1.46**
103	DRC/CC-ICP-MS	0.210	2.82	0.882	0.558	1.54
107	DRC/CC-ICP-MS	0.26	2.8	0.93	0.59	1.5
110	ICP-MS	0.26	2.87	0.89	0.62	1.56
116	DRC/CC-ICP-MS	0.244	2.74	0.896	0.633	1.48
147	ICP-MS	0.205	2.54	0.837	0.526	1.36
200	ICP-MS	0.20	2.90	1.00	0.70	1.60
293	DRC/CC-ICP-MS	0.21	2.70	0.75	0.63	1.43
324	ICP-MS	<1	2.613	<1	<1	1.343
391	DRC/CC-ICP-MS	3.626 ↑	4.867 ↑	1.554	3.128 ↑	2.83 ↑
399	DRC/CC-ICP-MS	0.234	2.7	0.881	0.576	1.43
597	DRC/CC-ICP-MS	0.308	2.62	1.07	0.578	1.53
598	ICP-MS	0.19	2.57	0.81	0.59	1.27
599	DRC/CC-ICP-MS	<0.1	2.20	0.717	0.404	1.23
604	DRC/CC-ICP-MS	0.222	2.65	0.897	0.563	1.34
605	ICP-MS	0.218	2.67	0.873	0.56	1.38
606	DRC/CC-ICP-MS	0.214	2.63	0.862	0.5550	1.39
607	ICP-MS	0.266	2.98	0.924	0.703	1.60
632	DRC/CC-ICP-MS	0.462	2.93	0.961	0.602	1.66

Based on the grading criteria for Cd in Urine, 96% of results were satisfactory, with 1 of the 18 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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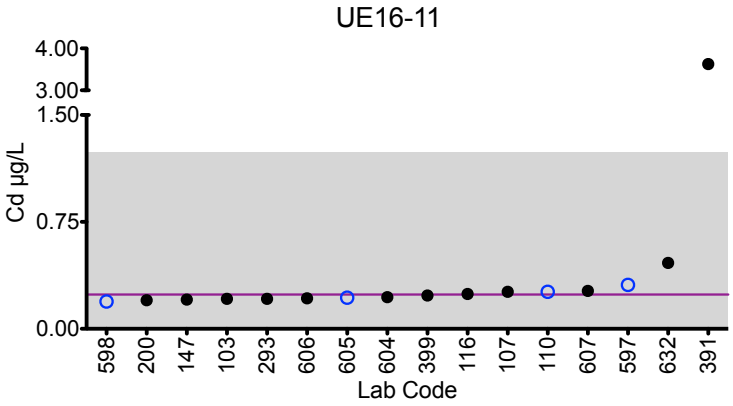
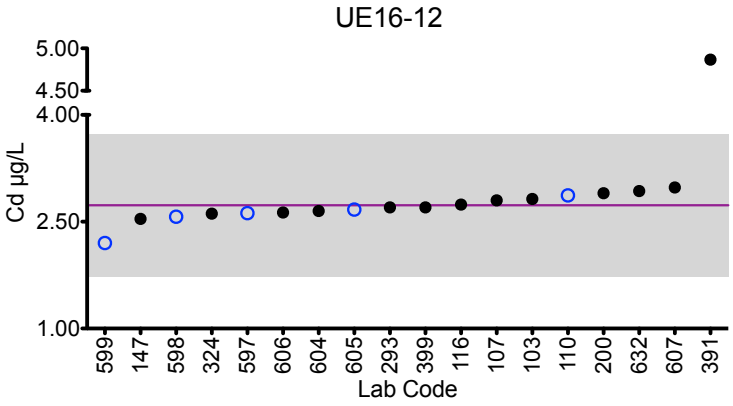
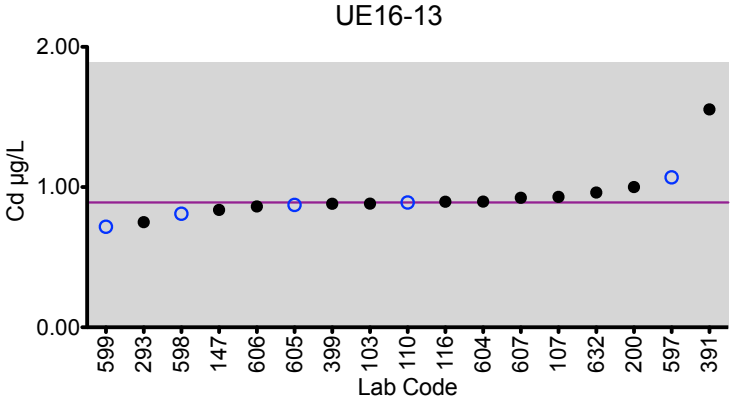
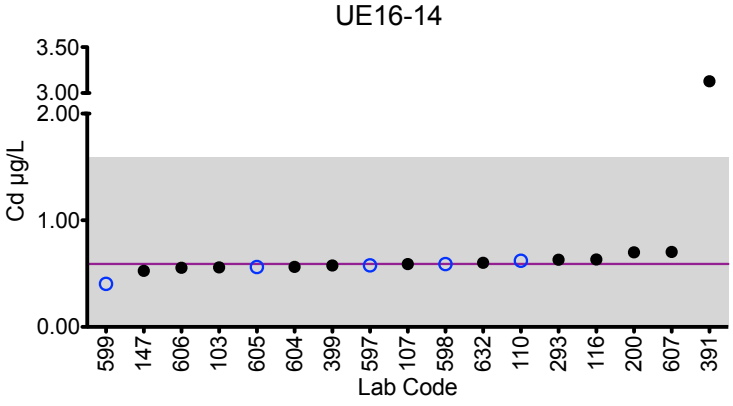
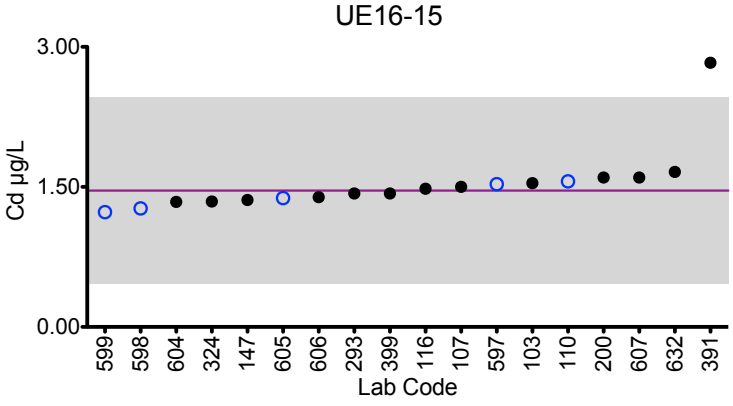
Results for Event #3, 2016: Urine Cd











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Urine Mercury (Hg)

Summary Statistics

	Urine Hg (µg/L)				
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Target (Robust Mean (x*))	0.29	11.9	33.4	13.6	110
Upper Limit	3.29	15.5	43.4	17.7	143
Lower Limit	0.00	8.3	23.4	9.5	77
Robust SD (s*)	0.24	1.0	4.0	0.7	10
Robust RSD (%)	83	8.1	12	5.5	9.1
Number of Sample Measurements (N)	9	13	13	13	12
Standard Uncertainty (*u*)	NA	0.333	1.39	0.259	3.62

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.

Sample UE16-11 was treated as an educational challenges for the purposes of this event, and is not graded. However, the statistical data are provided for informational purposes.

NEW YORK STATE | Department of Health | Wadsworth Center

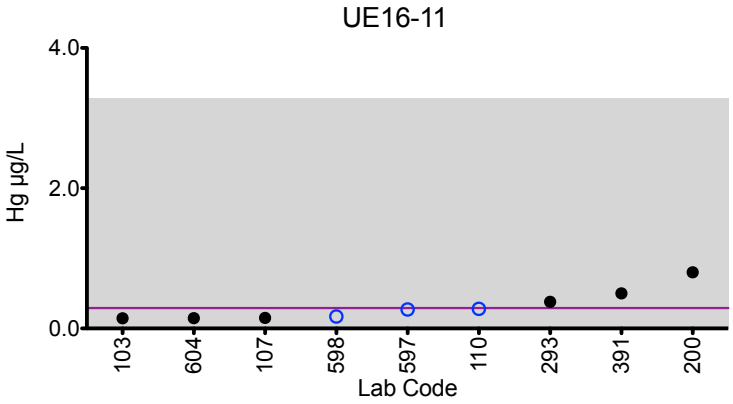
Results for Event #3, 2016
Urine Mercury (Hg)
Performance of Participating Laboratories

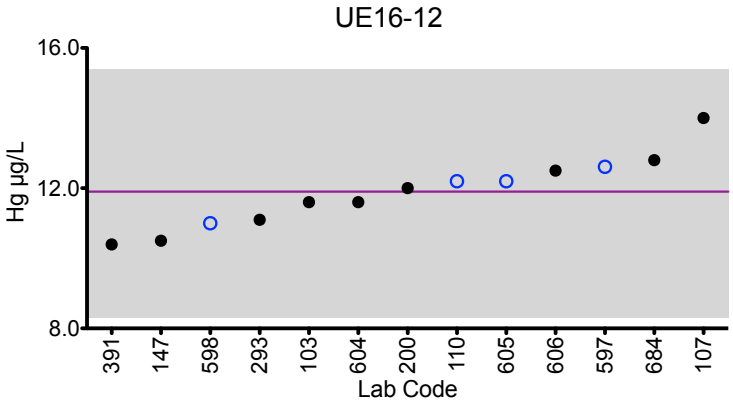
		Urine Hg (µg/L)				
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
	Target	**0.29**	**11.9**	**33.4**	**13.6**	**110**
103	DRC/CC-ICP-MS	0.144	11.6	32.7	13.7	113
107	DRC/CC-ICP-MS	0.15	14	39	15	110
110	ICP-MS	0.28	12.2	34.9	13.5	116
147	CV-AAS	< 0.241	10.5	30.8	13.1	105
200	ICP-MS	0.80	12.00	34.4	14.40	115.8
293	DRC/CC-ICP-MS	0.38	11.1	31.4	13.4	104
391	DRC/CC-ICP-MS	0.5	10.397	27.512	12.391	86.229
597	DMA	0.27	12.61	33.33	13.75	104.53
598	ICP-MS	0.17	11.00	26.6	11.30	83.5
604	DRC/CC-ICP-MS	0.146	11.6	32.1	13.2	109
605	ICP-MS	ND	12.20	37.8	14.6	PGC
606	DRC/CC-ICP-MS	<2.00	12.5	35.9	15.8	131
684	DRC/CC-ICP-MS	PLC	12.8	37	13.1	128

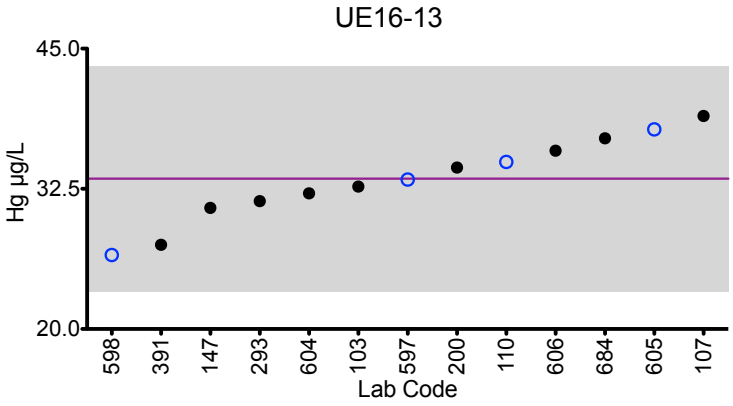
Based on the grading criteria for Hg in Urine, 100% of results were satisfactory, with 0 of the 13 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

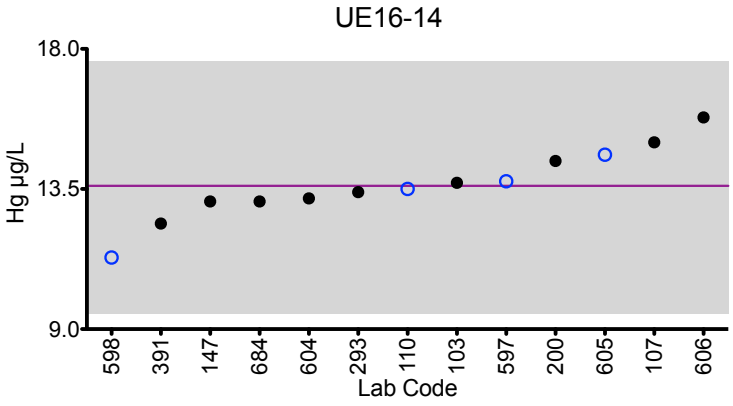
NEW YORK STATE | Department of Health | Wadsworth Center

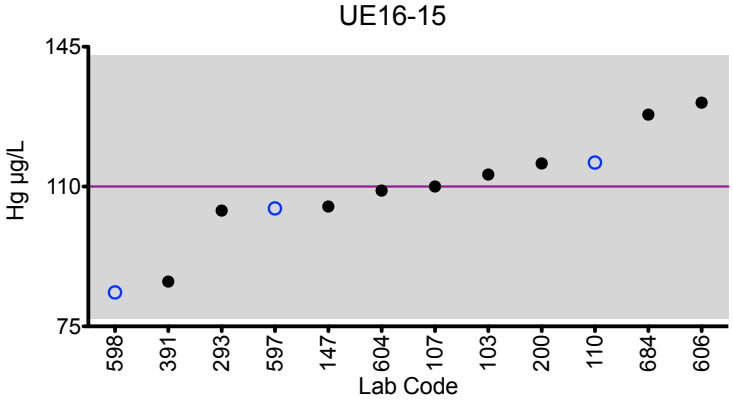
Results for Event #3, 2016: Urine Hg











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Urine Manganese (Mn)

Summary Statistics

	Urine Mn (µg/L)				
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Target (Robust Mean (x*))	0.32	3.3	0.91	0.82	1.5
Upper Limit	0.70	3.7	1.29	1.20	1.9
Lower Limit	0.00	2.9	0.53	0.44	1.1
Robust SD (s*)	0.24	0.3	0.10	0.15	0.1
Robust RSD (%)	75	9.9	11.1	17.7	9.9
Number of Sample Measurements (N)	9	16	16	15	16
Standard Uncertainty (*u*)	NA	0.101	0.032	0.047	0.047

The acceptable range is based on quality specifications:
±0.38 µg/L or ±10% around the target value, whichever is greater; thus, it is fixed at ±0.38 µg/L at concentrations less than or equal to 3.8 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 and Laboratory Medicine. 2016 In press.)

Sample UE16-11 was treated as an educational challenges for the purposes of this event, and is not graded. However, the statistical data are provided for informational purposes.

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Results for Event #3, 2016
Urine Manganese (Mn)
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
	Target	**0.32**	**3.3**	**0.91**	**0.82**	**1.5**
103	DRC/CC-ICP-MS	0.0719	3.22	0.947	0.763	1.45
107	DRC/CC-ICP-MS	0.17	3.4	0.93	0.81	1.6
110	DRC/CC-ICP-MS	<MDL	3.5	0.97	0.87	1.6
116	DRC/CC-ICP-MS	ND	3.42	0.910	0.835	1.51
147	DRC/CC-ICP-MS	0.116	3.08	0.841	0.731	1.48
324	ICP-MS	<1	3.366	1.011	<1	3.382 ↑
391	DRC/CC-ICP-MS	<0.000	3.541	0.953	0.708	1.347
399	DRC/CC-ICP-MS	0.274	3.22	0.881	0.78	1.52
597	DRC/CC-ICP-MS	0.726	4.10 ↑	1.42 ↑	1.42 ↑	2.09 ↑
598	ICP-MS	0.11	3.08	0.90	0.95	1.51
599	DRC/CC-ICP-MS	<0.1	2.62 ↓	0.378 ↓	0.188 ↓	0.928 ↓
604	DRC/CC-ICP-MS	ND	2.89 ↓	0.765	0.685	1.36
605	ICP-MS	0.299	3.04	0.821	0.709	1.46
606	DRC/CC-ICP-MS	<0.300	2.98	0.837	0.865	1.36
632	DRC/CC-ICP-MS	0.65	3.72 ↑	0.954	0.974	1.59
684	ICP-MS	0.496	3.47	1.1	1.01	2.4 ↑

Based on the grading criteria for Mn in Urine, 85% of results were satisfactory, with 2 of the 16 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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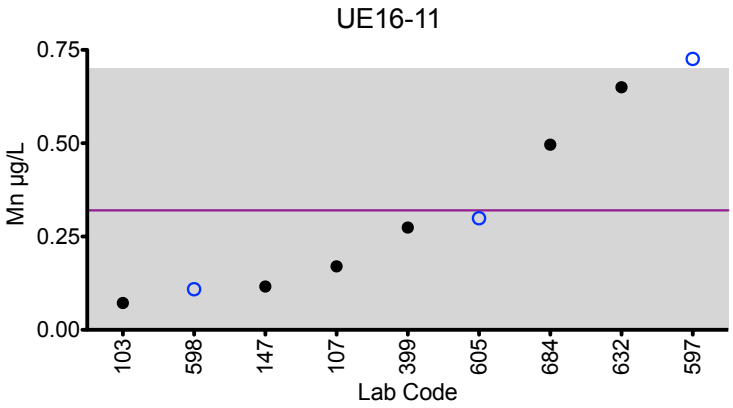
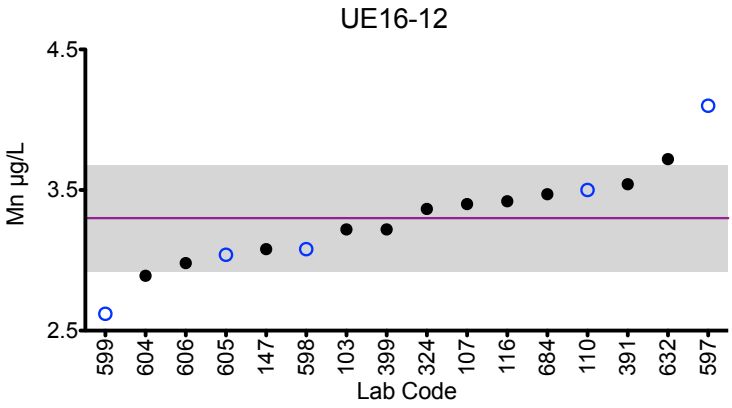
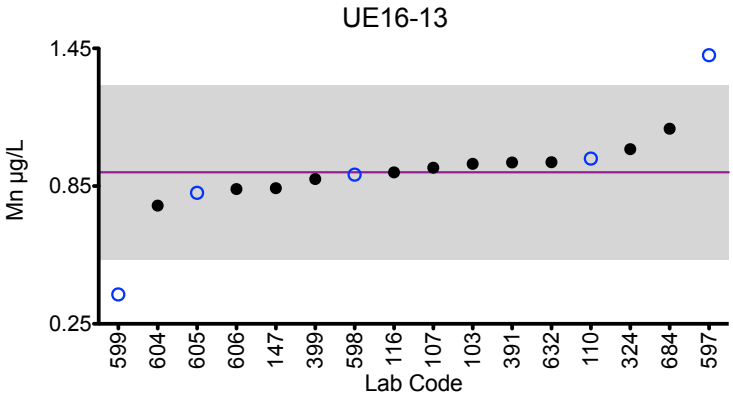
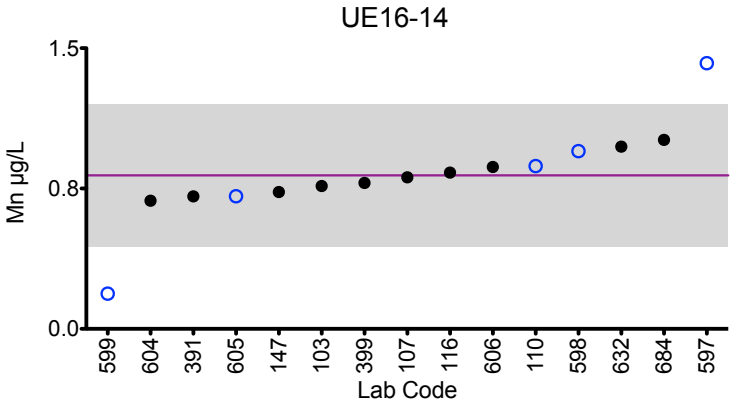
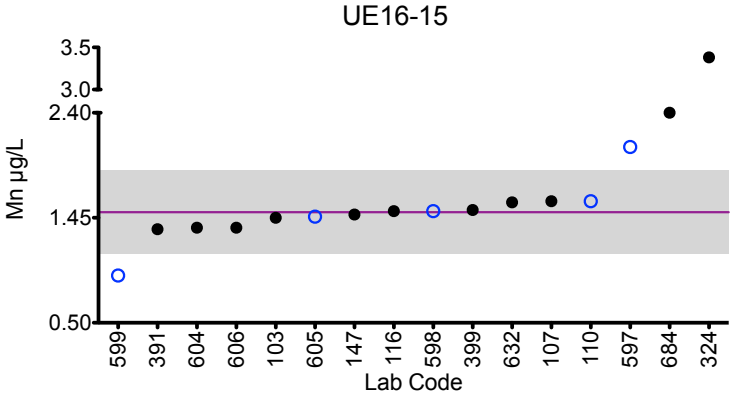
Results for Event #3, 2016: Urine Mn











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±0.38 µg/L or ±10% around the target value, whichever is greater; thus, it is fixed at ±0.38 µg/L at concentrations less than or equal to 3.8 µg/L.

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Results for Event #3, 2016
Urine Lead (Pb)

Summary Statistics

	Urine Pb (µg/L)				
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Target (Robust Mean (x*))	0.2	3.4	4.2	1.6	7.2
Upper Limit	1.2	4.4	5.2	2.6	8.6
Lower Limit	0.0	2.4	3.2	0.6	5.8
Robust SD (s*)	0.2	0.4	0.5	0.2	0.7
Robust RSD (%)	66	11.8	11.2	12.7	9.2
Number of Sample Measurements (N)	13	17	17	17	17
Standard Uncertainty (*u*)	0.055	0.120	0.142	0.063	0.201

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.

Sample UE16-11 was treated as an educational challenges for the purposes of this event, and is not graded. However, the statistical data are provided for informational purposes.

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Results for Event #3, 2016
Urine Lead (Pb)
Performance of Participating Laboratories

		Urine Pb (µg/L)				
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
	Target	**0.2**	**3.4**	**4.2**	**1.6**	**7.2**
103	DRC/CC-ICP-MS	0.158	3.45	4.33	1.72	7.57
107	ICP-MS	0.19	3.6	4.5	1.8	7.4
110	ICP-MS	<MDL	3.6	4.7	1.8	8.7 ↑
116	ICP-MS	0.147	3.67	4.22	1.72	7.21
147	ICP-MS	0.332	3.25	3.98	1.55	6.96
200	ICP-MS	0.2	2.7	3.3	1.4	6.6
293	DRC/CC-ICP-MS	0.01	3.31	3.94	1.53	7.48
324	ICP-MS	<1	3.125	3.863	1.479	5.775 ↓
391	DRC/CC-ICP-MS	0.113	3.125	3.993	1.554	6.858
399	ICP-MS	0.403	3.57	4.47	1.74	7.59
597	DRC/CC-ICP-MS	1.32	4.74 ↑	5.77 ↑	3.00 ↑	8.86 ↑
598	ICP-MS	0.09	2.82	3.51	1.36	5.44 ↓
599	DRC/CC-ICP-MS	<01	2.56	3.45	1.09	5.86
605	ICP-MS	0.326	3.37	4.22	1.66	7.16
606	DRC/CC-ICP-MS	0.273	3.12	3.94	1.57	6.79
607	ICP-MS	< DL	3.52	4.43	1.76	7.48
632	ICP-MS	19.5	8.13 ↑	6.67 ↑	2.48	9.46 ↑

Based on the grading criteria for Pb in Urine, 88% of results were satisfactory, with 2 of the 17 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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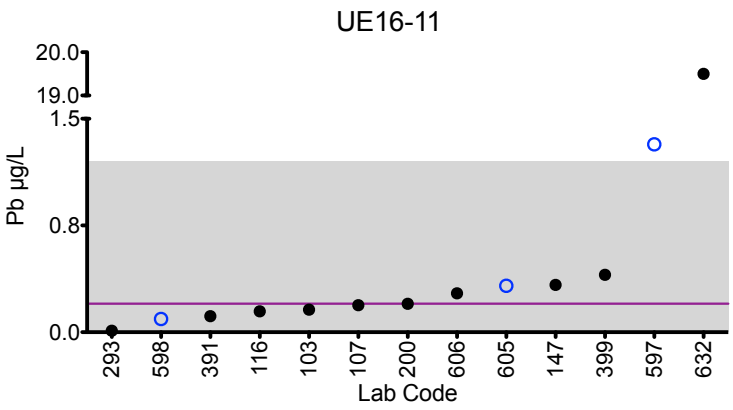
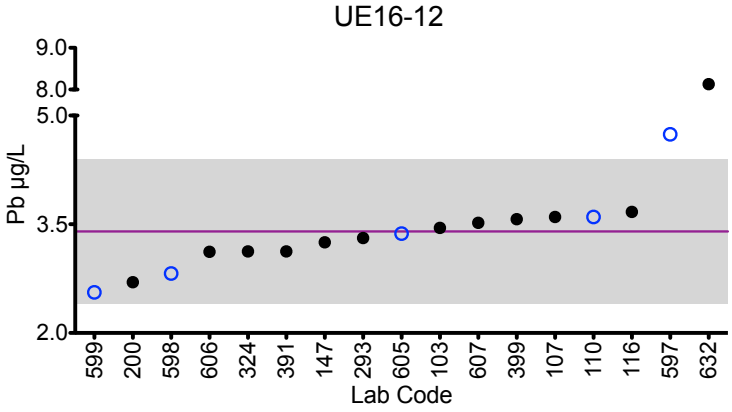
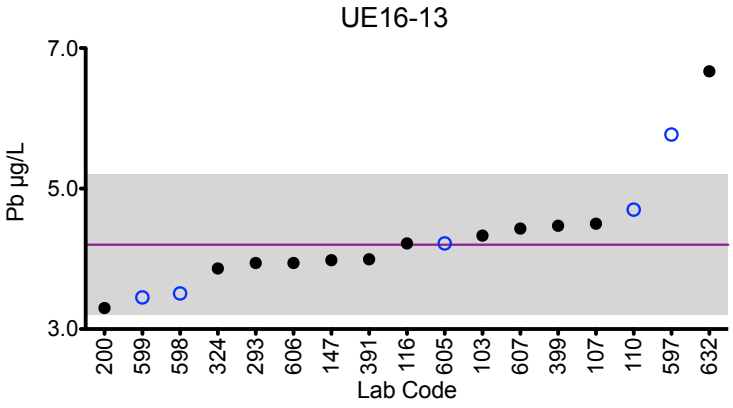
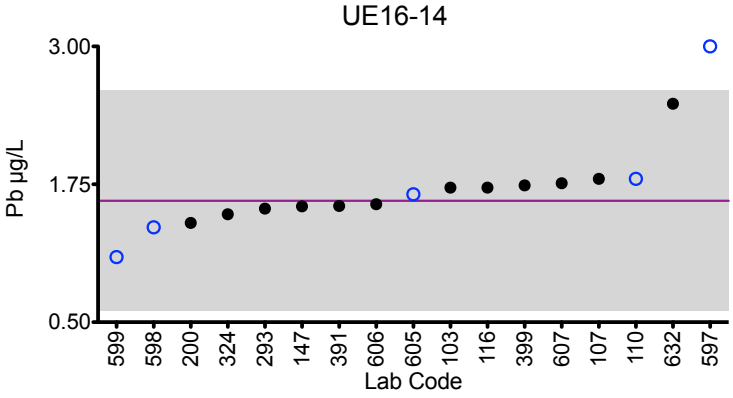
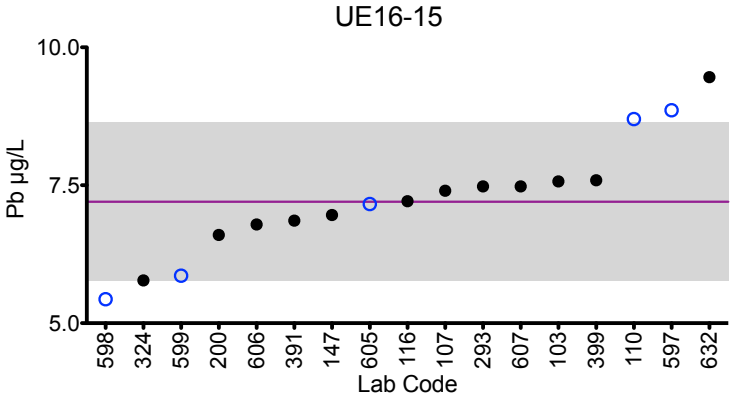
Results for Event #3, 2016: Urine Pb











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Urine Thallium (Tl)

Summary Statistics

	Urine Tl (µg/L)				
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Target (Robust Mean (x*))	0.08	1.31	1.71	0.32	4.36
Upper Limit	0.28	1.57	2.05	0.52	5.23
Lower Limit	0.00	1.05	1.37	0.12	3.49
Robust SD (s*)	0.01	0.07	0.09	0.02	0.26
Robust RSD (%)	12.3	5.1	5.3	6.2	6.0
Number of Sample Measurements (N)	12	13	13	13	13
Standard Uncertainty (*u*)	0.0035	0.023	0.031	0.007	0.091

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

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Results for Event #3, 2016
Urine Thallium (Tl)
Performance of Participating Laboratories

		Urine Tl (µg/L)				
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
	Target	**0.08**	**1.31**	**1.71**	**0.32**	**4.36**
103	DRC/CC-ICP-MS	0.0769	1.31	1.71	0.317	4.50
107	ICP-MS	0.091	1.4	1.8	0.34	4.5
110	ICP-MS	0.08	1.32	1.71	0.32	4.31
116	ICP-MS	0.0840	1.29	1.72	0.330	4.40
147	ICP-MS	0.0720	1.28	1.64	0.292	4.19
399	ICP-MS	0.067	1.35	1.76	0.325	4.57
597	DRC/CC-ICP-MS	0.187	1.56	1.95	0.475	4.93
598	ICP-MS	0.07	1.14	1.44	0.27	3.45 ↓
599	DRC/CC-ICP-MS	0.189	1.26	1.65	0.382	3.90
605	ICP-MS	0.0710	1.29	1.67	0.313	4.29
606	DRC/CC-ICP-MS	0.076	1.23	1.59	0.309	4.10
607	ICP-MS	0.084	1.38	1.78	0.353	4.62
632	ICP-MS	PLC	1.31	1.73	0.309	4.40

Based on the grading criteria for Tl 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.

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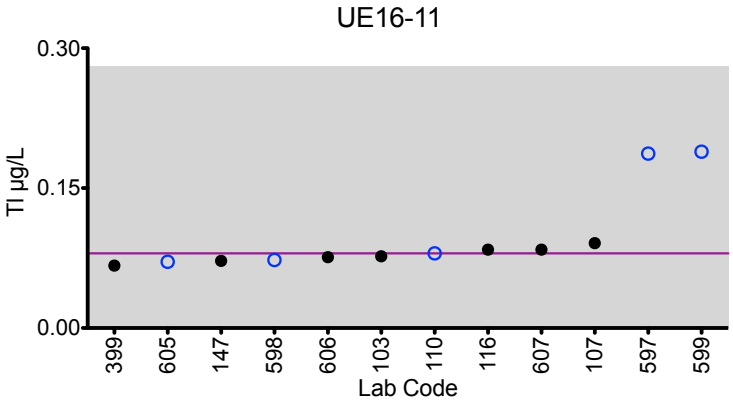
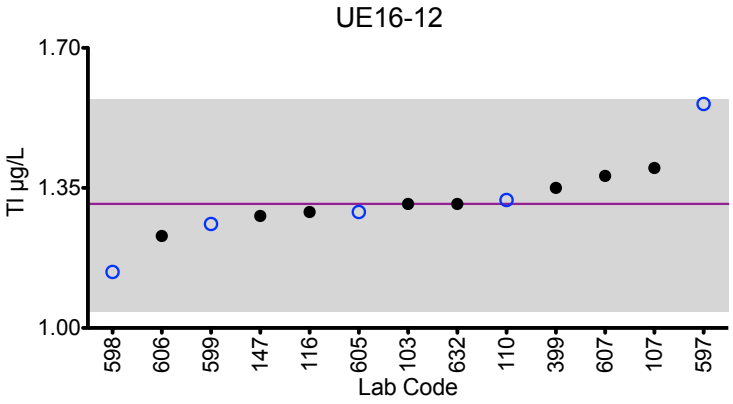
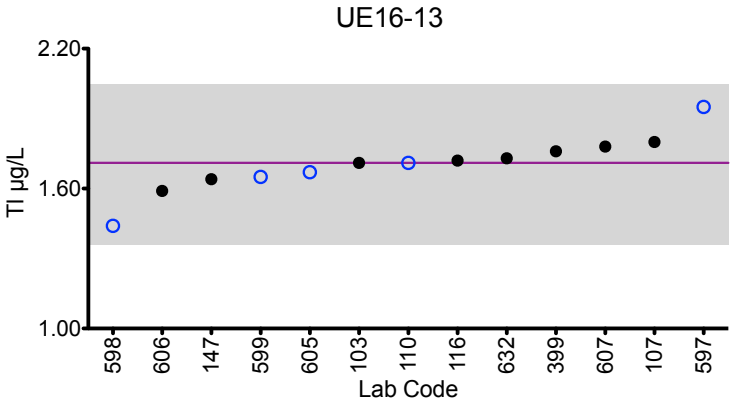
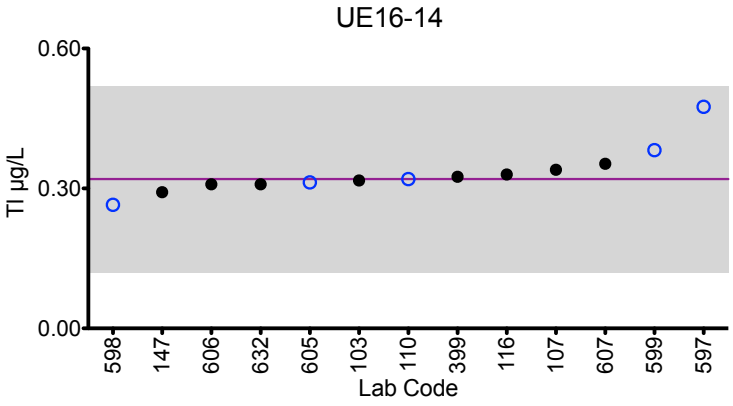
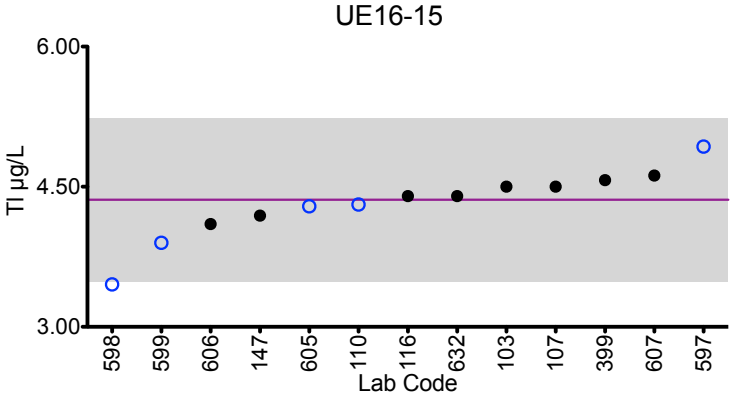
Results for Event #3, 2016: Urine Tl











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±0.2 µg/L or ±20% around the target value, whichever is greater; thus, it is fixed at ±0.2 µg/L at concentrations less than or equal to 1 µg/L.

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Results for Event #3, 2016
Urine Uranium (U)

Summary Statistics

	Urine U (µg/L)				
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Target (Robust Mean (x*))	NA	0.160	0.102	0.032	0.173
Upper Limit	NA	0.192	0.132	0.062	0.208
Lower Limit	NA	0.128	0.072	0.002	0.138
Robust SD (s*)	NA	0.012	0.006	0.003	0.009
Robust RSD (%)	NA	7.6	5.7	9.2	5.0
Number of Sample Measurements (N)	NA	14	14	14	14
Standard Uncertainty (*u*)	NA	0.0041	0.0019	0.00099	0.0029

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.

Sample UE16-11 was treated as an educational challenges for the purposes of this event, and is not graded.

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Results for Event #3, 2016
Urine Uranium (U)
Performance of Participating Laboratories

		Urine U (µg/L)				
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
	Target	**NA**	**0.160**	**0.102**	**0.032**	**0.173**
103	DRC/CC-ICP-MS	< 0.00120	0.163	0.106	0.0302	0.181
107	ICP-MS	<0.002	0.18	0.11	0.036	0.19
110	ICP-MS	<MDL	0.166	0.103	0.031	0.180
116	ICP-MS	ND	0.152	0.0991	0.0338	0.171
147	ICP-MS	< 0.0105	0.133	0.0821	0.0267	0.165
324	ICP-MS	0.001	0.164	0.104	0.034	0.177
399	ICP-MS	ND	0.158	0.096	0.031	0.165
598	ICP-MS	ND(0.01)	0.130	0.077	0.012	0.133 ↓
604	ICP-MS	ND	0.149	0.100	0.031	0.164
605	ICP-MS	ND	0.161	0.101	0.032	0.168
606	DRC/CC-ICP-MS	<0.005	0.154	0.101	0.034	0.173
607	ICP-MS	< DL	0.173	0.110	0.033	0.179
632	ICP-MS	PLC	0.164	0.106	0.0307	0.177
684	ICP-MS	PLC	0.171	0.105	0.039	0.174

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

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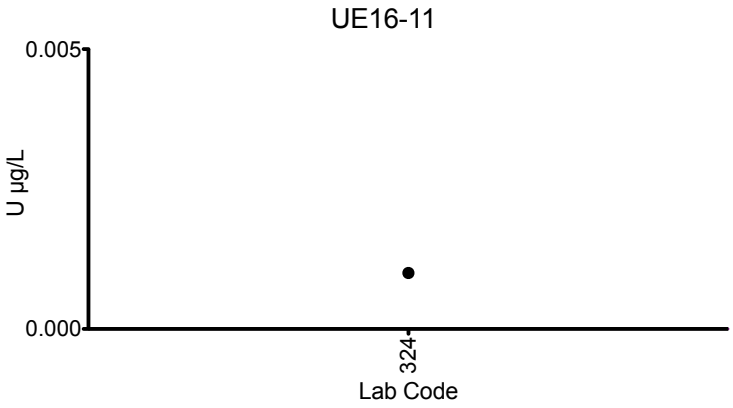
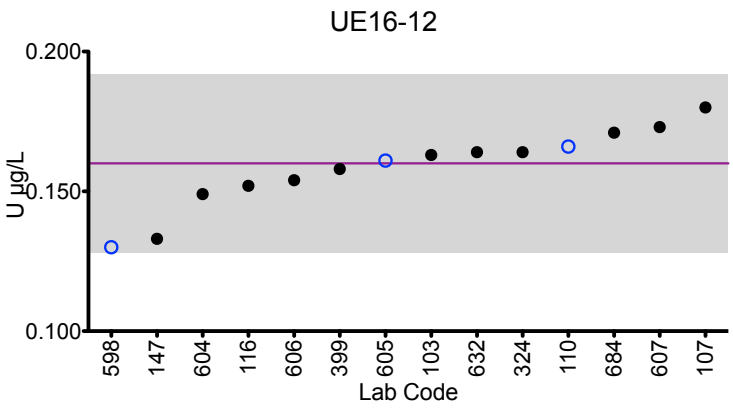
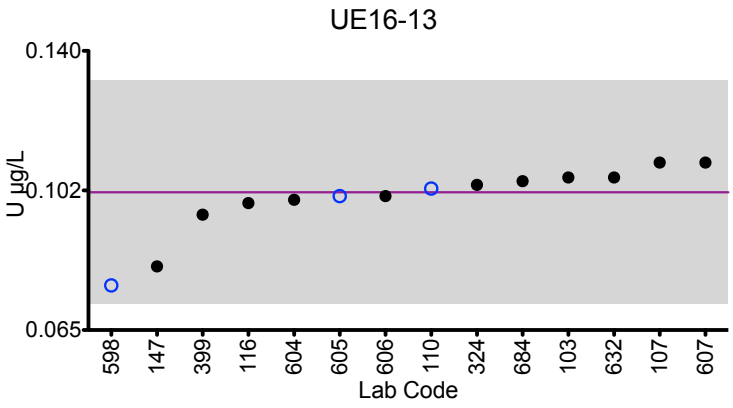
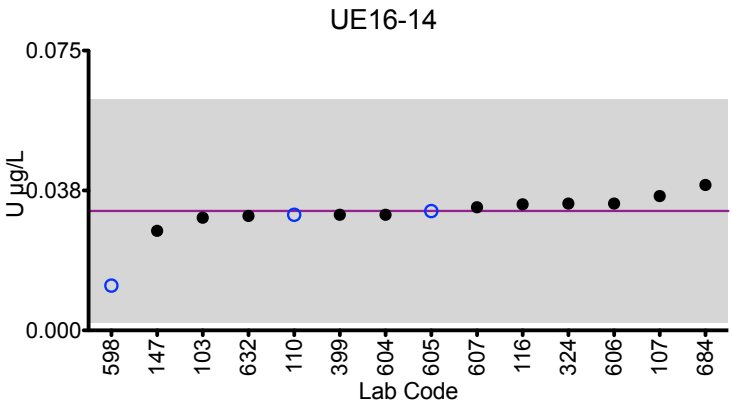
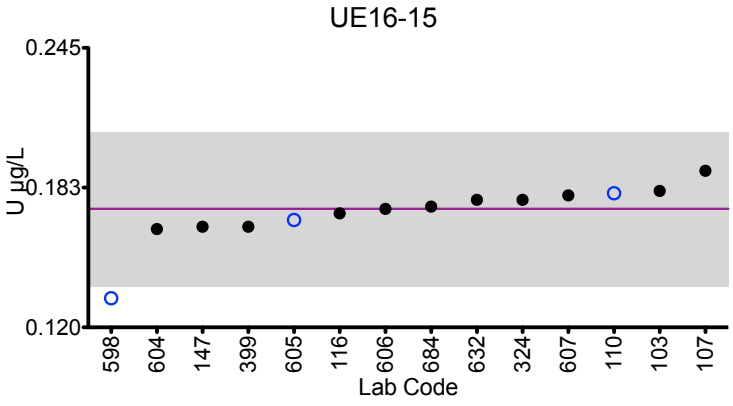
Results for Event #3, 2016: Urine U











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Additional Elements in Urine: Cobalt (Co)

Urine Co (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
103	DRC/CC-ICP-MS	8.91	5.42	1.59	7.13	0.488
107	ICP-MS	9.1	5.4	1.7	7.0	0.70
110	ICP-MS	8.99	5.48	1.72	7.04	0.57
147	ICP-MS	8.60	5.24	1.60	6.72	0.559
324	ICP-MS	8.917	5.319	1.663	6.873	<1
391	DRC/CC-ICP-MS	8.527	5.269	1.566	6.878	0.467
399	DRC/CC-ICP-MS	8.81	5.3	1.66	6.9	0.504
485	HR-ICP-MS	9.04	5.31	1.60	6.85	0.460
597	DRC/CC-ICP-MS	8.78	5.33	1.71	6.98	0.533
599	DRC/CC-ICP-MS	8.34	4.83	1.48	6.48	0.427
605	ICP-MS	8.6	5.09	1.54	6.82	0.486
606	DRC/CC-ICP-MS	8.62	5.11	1.45	6.82	0.445
632	ICP-MS	9.34	5.51	1.71	7.13	0.670

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Robust Mean (x*)	8.8	5.3	1.6	6.9	0.51
Robust SD (s*)	0.3	0.2	0.1	0.2	0.07
Robust RSD (%)	3.4	2.9	6.0	2.2	12.9
Number of Sample Measurements (N)	13	13	13	13	12
Standard Uncertainty (*u*)	0.102	0.053	0.034	0.053	0.024

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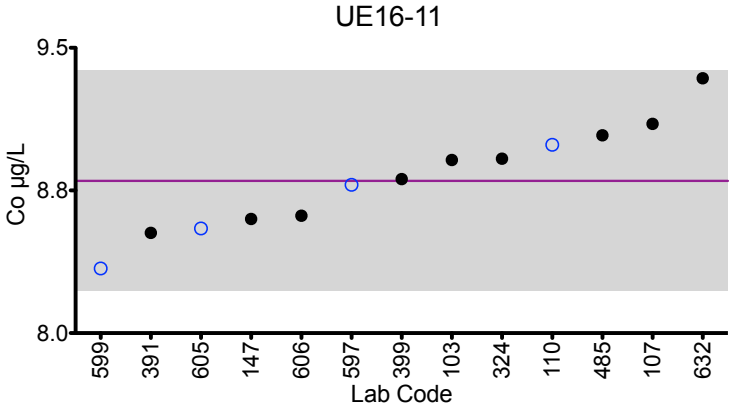
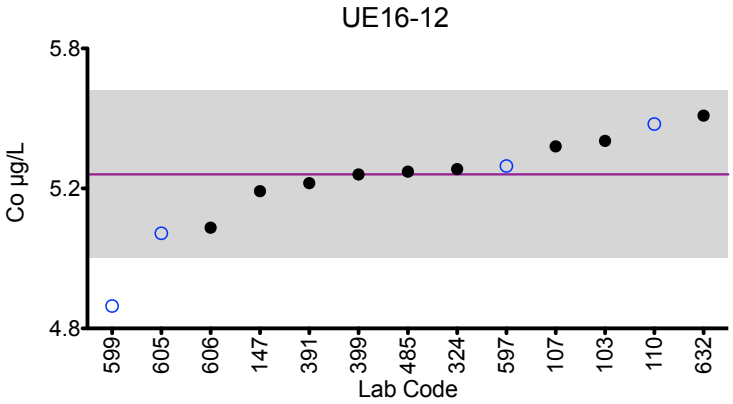
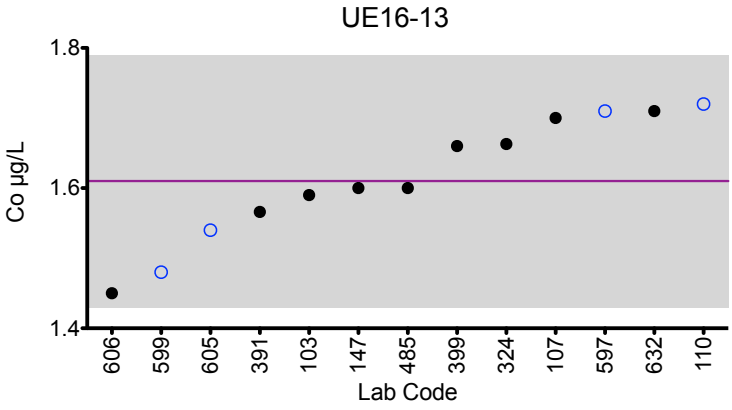
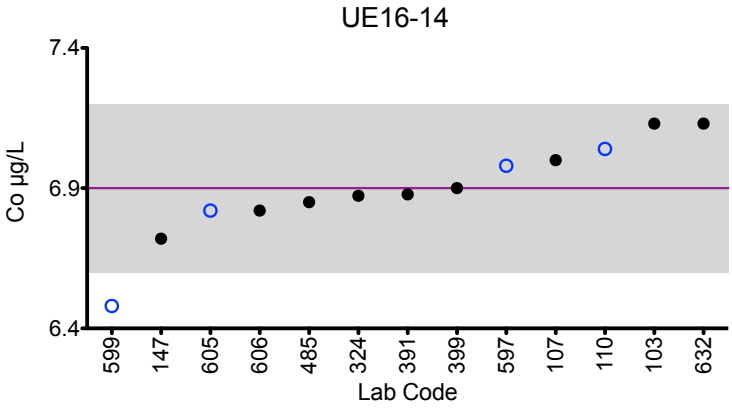
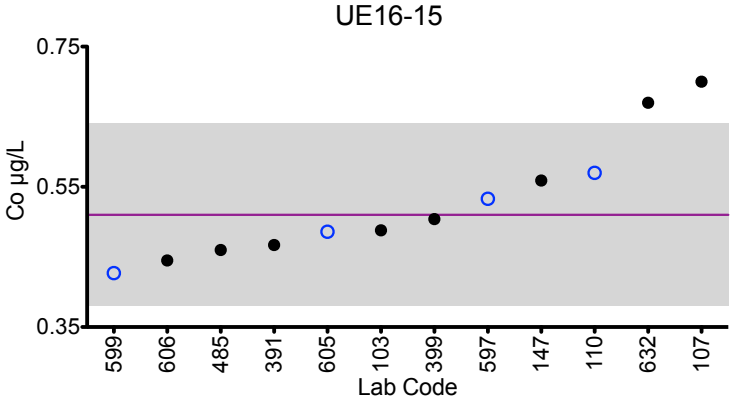
Results for Event #3, 2016: Urine Co











Legend:
o CHEAR 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 not intended to be quality specifications and are included for informational purposes only.

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Results for Event #3, 2016
Additional Elements in Urine: Chromium (Cr)

Urine Cr (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
103	DRC/CC-ICP-MS	0.133	3.34	0.967	0.717	1.78
107	DRC/CC-ICP-MS	0.36	3.3	1.1	0.90	2.5
110	DRC/CC-ICP-MS	<MDL	3.5	1.1	1.1	2.1
116	DRC/CC-ICP-MS	0.309	3.63	1.10	0.943	2.03
147	DRC/CC-ICP-MS	0.22	2.92	0.853	0.697	1.68
324	ICP-MS	<1	3.309	1.041	<1	1.349
391	DRC/CC-ICP-MS	0.22	3.353	0.871	0.78	1.861
485	HR-ICP-MS	0.161	3.18	0.881	0.760	1.68
597	DRC/CC-ICP-MS	1.03	4.13	1.67	1.35	2.57
599	DRC/CC-ICP-MS	0.14	2.92	0.887	0.74	1.75
632	DRC/CC-ICP-MS	1.31	3.32	0.962	0.381	1.62

Summary Statistics

	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
Robust Mean (x*)	0.43	3.3	0.99	0.81	1.8
Robust SD (s*)	0.43	0.2	0.13	0.16	0.3
Robust RSD (%)	100	7.2	13.1	20.0	14.5
Number of Sample Measurements (N)	9	11	11	10	11
Standard Uncertainty (*u*)	NA	0.090	0.049	0.064	0.100

An arithmetic mean, SD, RSD, and n are provided for sample UE16-11.

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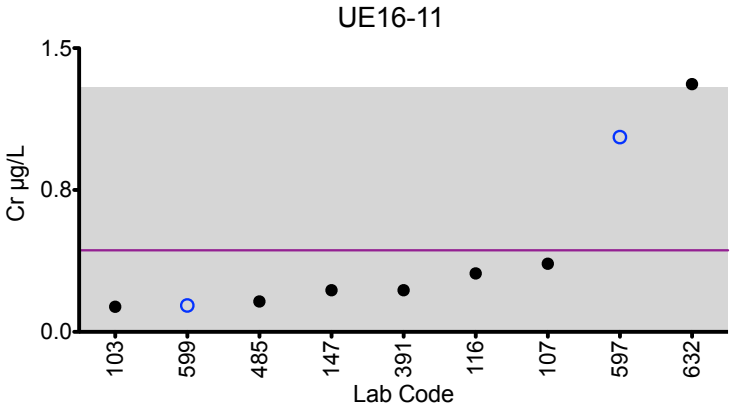
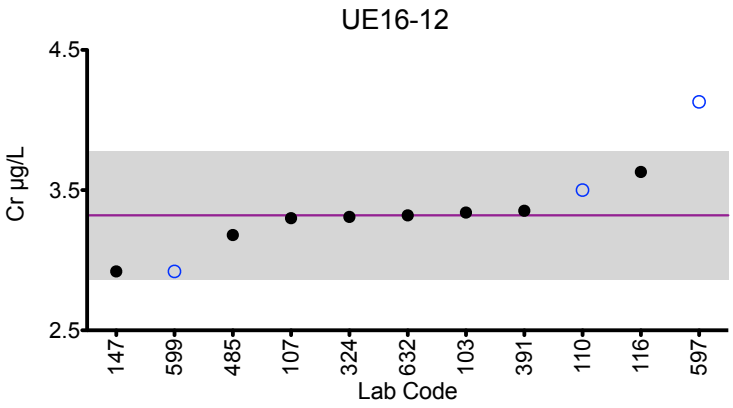
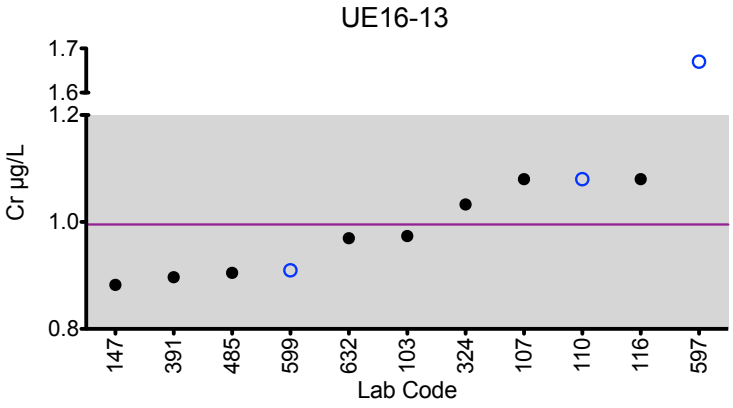
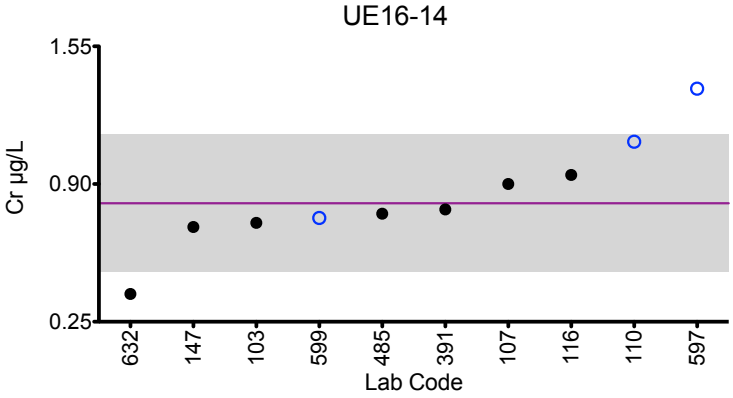
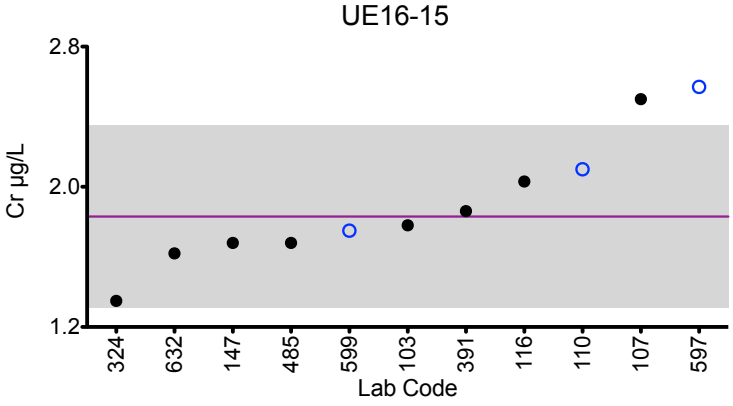
Results for Event #3, 2016: Urine Cr











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Results for Event #3, 2016
Additional Elements in Urine: Molybdenum (Mo)

Urine Mo (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
103	DRC/CC-ICP-MS	14.7	103	9.77	29.3	44.4
107	ICP-MS	16	110	10	31	47
110	ICP-MS	15	110	10	31	46
147	ICP-MS	15.00	98.8	10.3	28.0	42.3
324	ICP-MS	15.059	107.351	10.413	29.803	43.755
399	ICP-MS	15.90	110	10.5	30.8	46.8
485	HR-ICP-MS	14.8	112	10.5	29.0	45.1
597	DRC/CC-ICP-MS	13.3	91.0	9.86	25.6	39.6
599	DRC/CC-ICP-MS	16.07	103	10.11	31.0	49
605	ICP-MS	14.6	103	9.6	29.2	44.9
606	DRC/CC-ICP-MS	12.5	103	6.99	26.4	41.3
632	ICP-MS	16.9	115	11.2	32.3	48.9

Summary Statistics

	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
Robust Mean (x*)	15.1	106	10.1	29.5	45.0
Robust SD (s*)	1.1	6	0.5	2.1	3.1
Robust RSD (%)	7.0	6.0	4.5	7.2	6.8
Number of Sample Measurements (N)	12	12	12	12	12
Standard Uncertainty (*u*)	0.38	2.30	0.165	0.767	1.11

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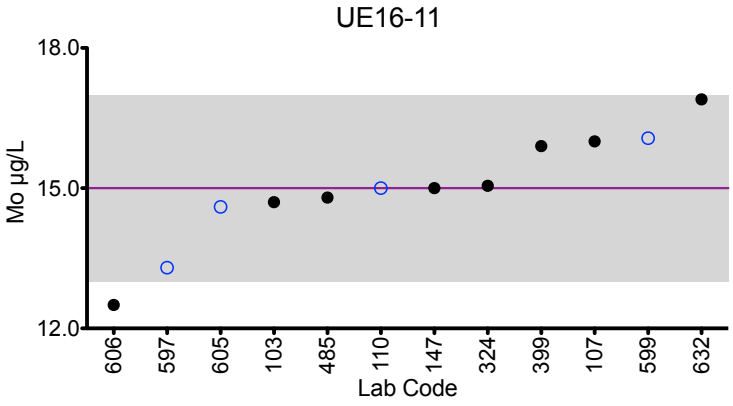
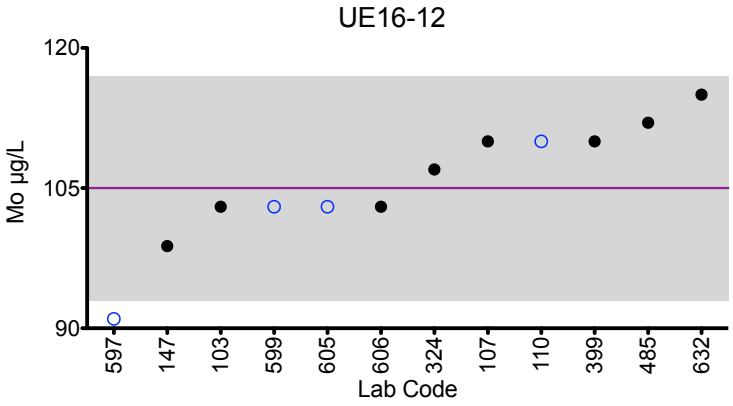
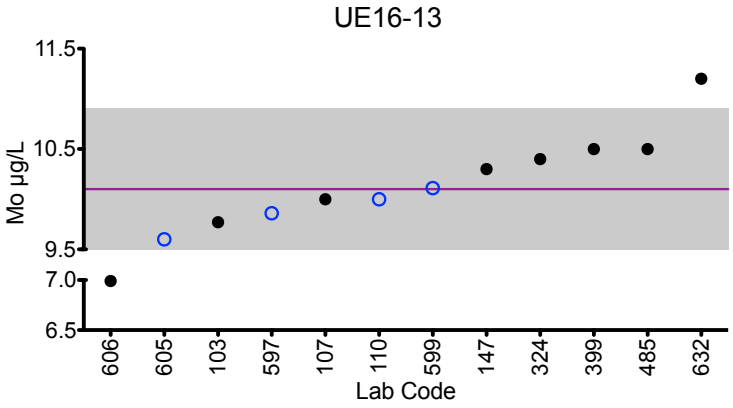
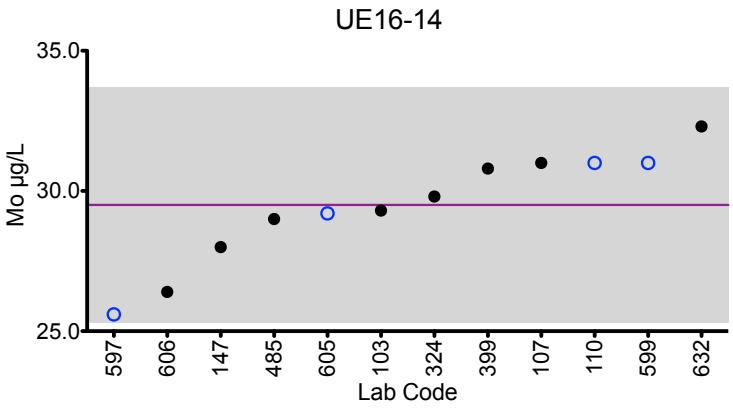
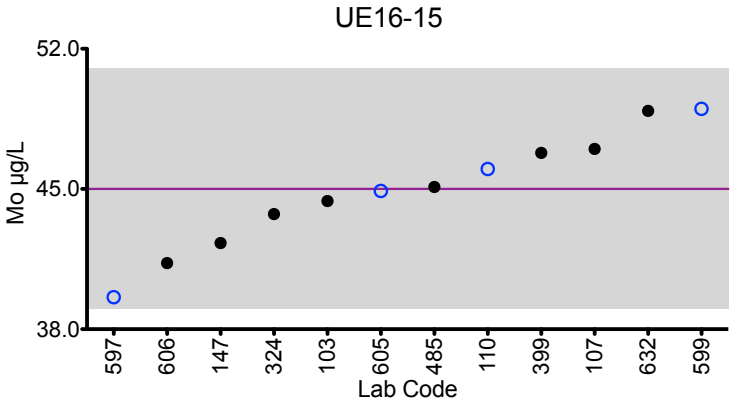
Results for Event #3, 2016: Urine Mo











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Results for Event #3, 2016
Additional Elements in Urine: Antimony (Sb)

Urine Sb (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
103	DRC/CC-ICP-MS	< 0.0101	2.66	0.861	0.530	1.56
107	ICP-MS	<0.022	2.5	0.78	0.53	1.3
110	ICP-MS	<MDL	2.6	0.8	0.6	1.5
147	ICP-MS	< 0.0134	2.79	0.839	0.556	1.41
399	ICP-MS	ND	2.64	0.822	0.554	1.4
597	DRC/CC-ICP-MS	0.261	3.23	1.16	0.767	1.76
599	DRC/CC-ICP-MS	<0.1	2.20	0.565	0.269	1.25
605	ICP-MS	ND	2.57	0.833	0.551	1.36
606	DRC/CC-ICP-MS	<0.080	2.28	0.740	0.507	1.44
632	ICP-MS	PLC	2.66	0.843	0.553	1.53

Summary Statistics

	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
Robust Mean (x*)	NA	2.61	0.82	0.55	1.44
Robust SD (s*)	NA	0.15	0.05	0.04	0.13
Robust RSD (%)	NA	5.7	6.1	6.9	9.3
Number of Sample Measurements (N)	NA	10	10	10	10
Standard Uncertainty (*u*)	NA	0.059	0.020	0.015	0.053

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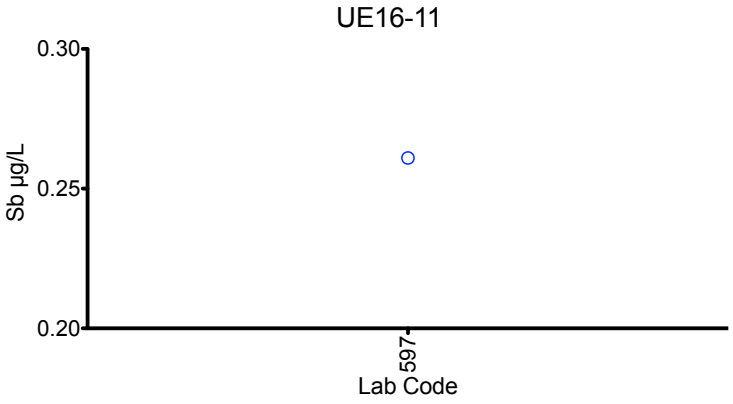
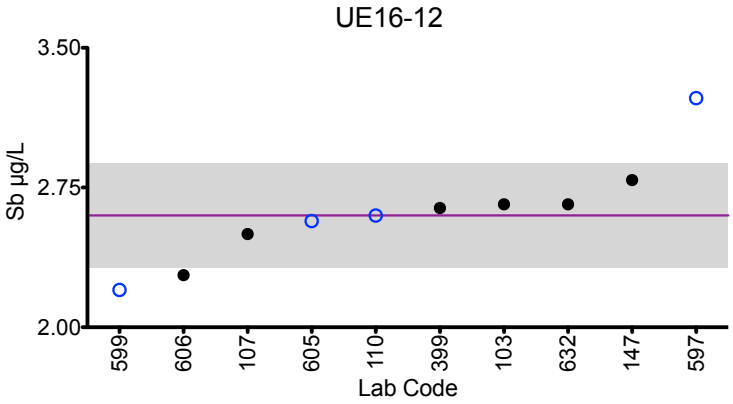
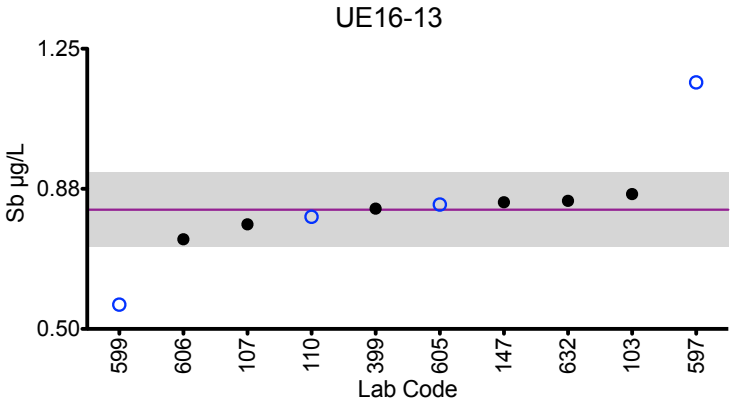
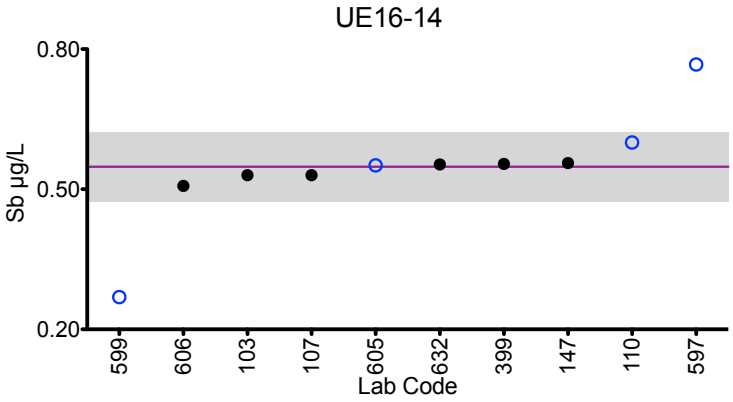
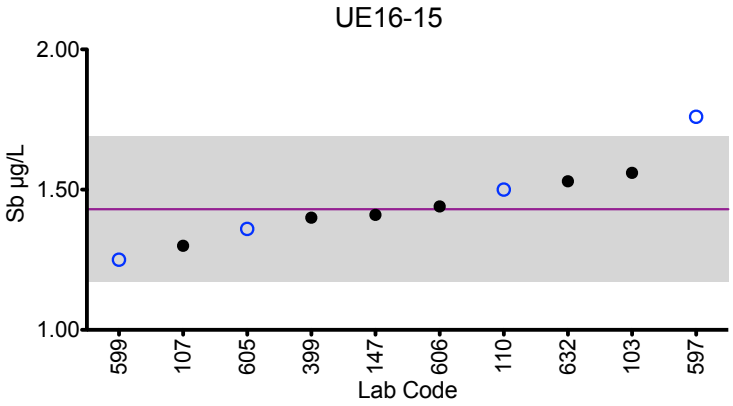
Results for Event #3, 2016: Urine Sb











Legend:

o CHEAR Labs ● Other Labs

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Results for Event #3, 2016
Additional Elements in Urine: Cesium (Cs)

Urine Cs (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
107	ICP-MS	1.7	6.7	5.1	2.2	10
110	ICP-MS	2.0	7.6	5.7	2.5	11.1
147	ICP-MS	1.82	6.99	5.17	2.27	10.1
399	ICP-MS	1.94	7.59	5.71	2.51	10.7
597	DRC/CC-ICP-MS	2.17	8.08	6.03	2.62	11.3
605	ICP-MS	1.9	7.33	5.51	2.45	10.3
606	DRC/CC-ICP-MS	1.79	7.05	5.34	2.41	10.3
632	ICP-MS	2.00	7.78	5.84	2.54	11.0

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	1.9	7.4	5.6	2.4	10.6
Arithmetic SD (s)	0.1	0.5	0.3	0.1	0.5
Arithmetic RSD (%)	5.3	6.8	5.4	4.2	4.7
Number of Sample Measurements (N)	8	8	8	8	8

*Denotes a statistical Outlier.

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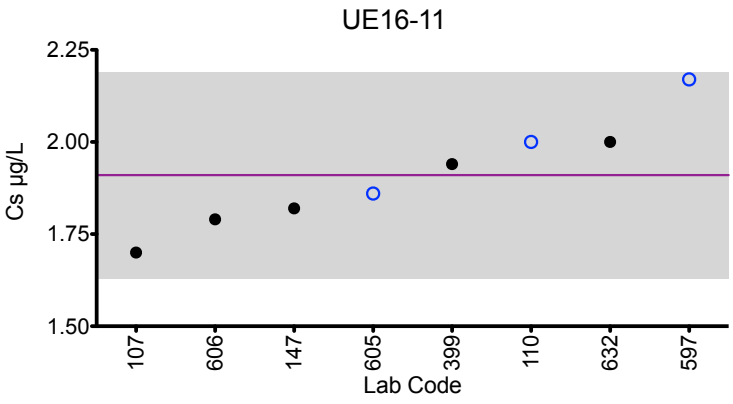
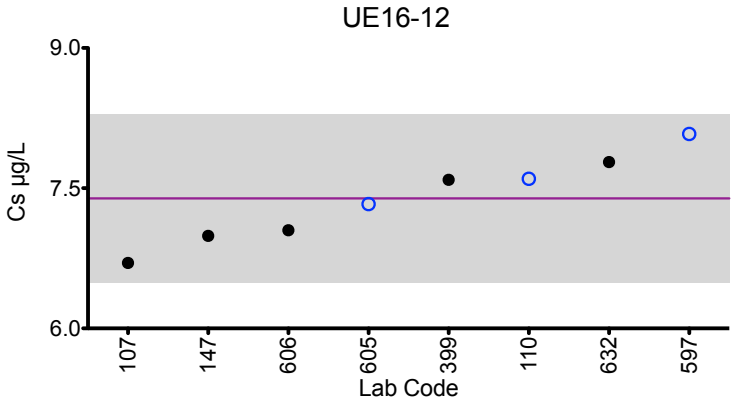
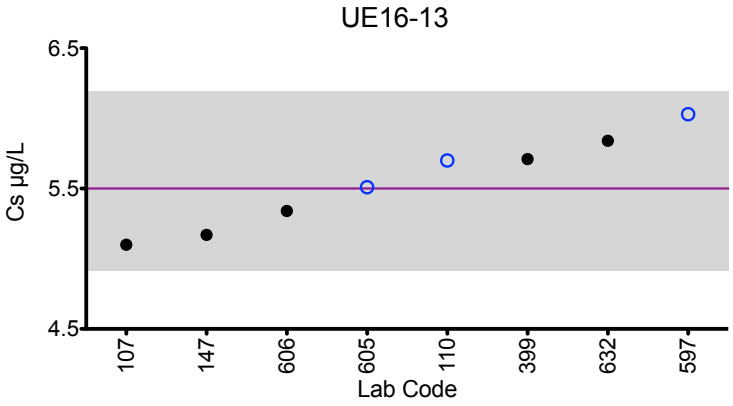
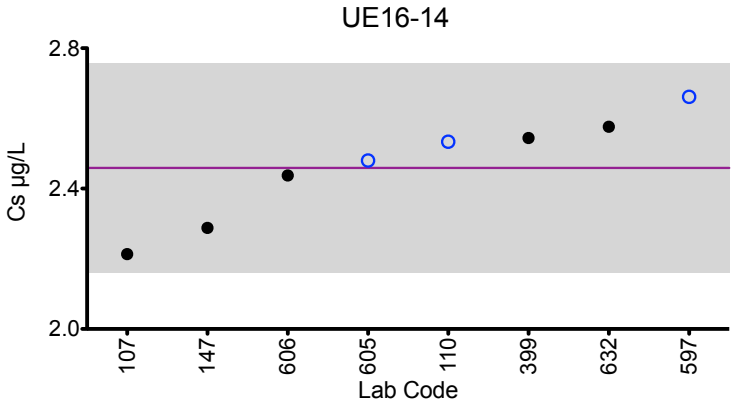
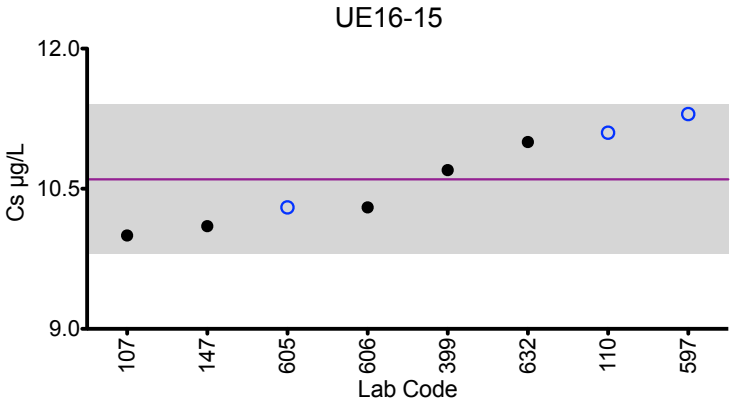
Results for Event #3, 2016: Urine Cs











Legend:
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Results for Event #3, 2016
Additional Elements in Urine: Copper (Cu)

Urine Cu (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
110	ICP-MS	5	139	111	31	173
116	DRC/CC-ICP-MS	2.09	136	105	28.9	182
147	ICP-MS	4.97	137	106	30.2	166
324	ICP-MS	3.249	134.258	106.793	29.132	183.557
391	DRC/CC-ICP-MS	2.184	130.39	100.4	26.192	167.577
597	DRC/CC-ICP-MS	4.09	138	110	32.2	185
599	DRC/CC-ICP-MS	<0.25	*107	*85.2	*16.4	140
632	ICP-MS	8.58	143	112	36.2	199

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	4.3	137	107	30.5	175
Arithmetic SD (s)	2.2	4	4	3.1	18
Arithmetic RSD (%)	51	2.9	3.7	10.2	10.3
Number of Sample Measurements (N)	7	7	7	7	8

*Denotes a statistical Outlier.

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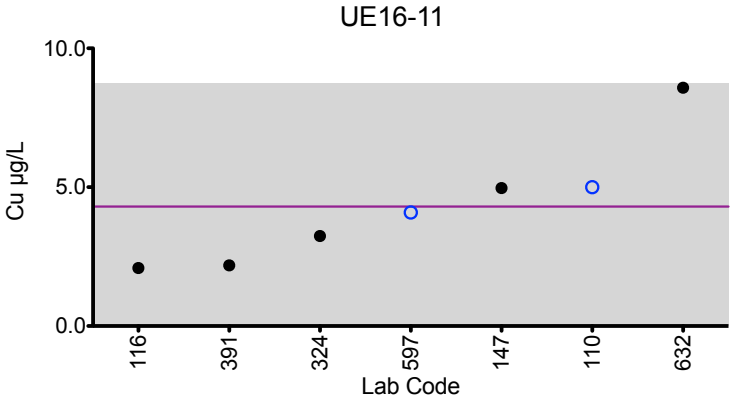
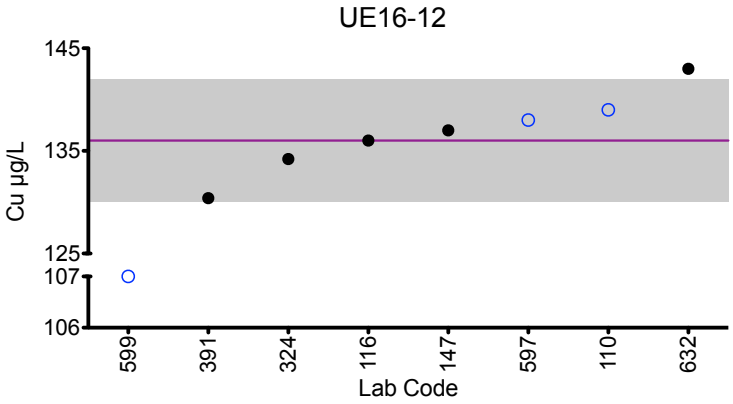
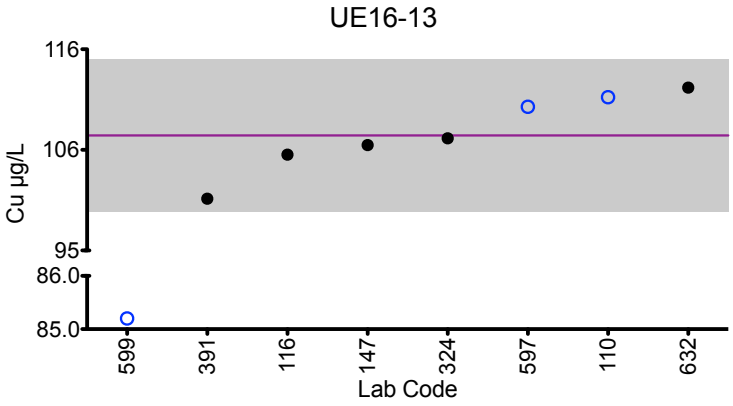
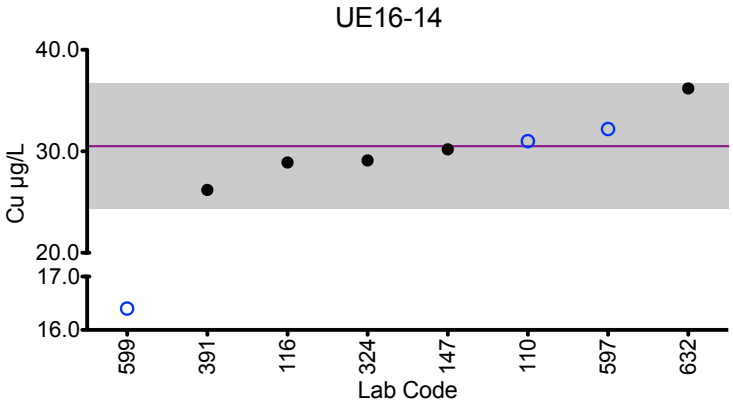
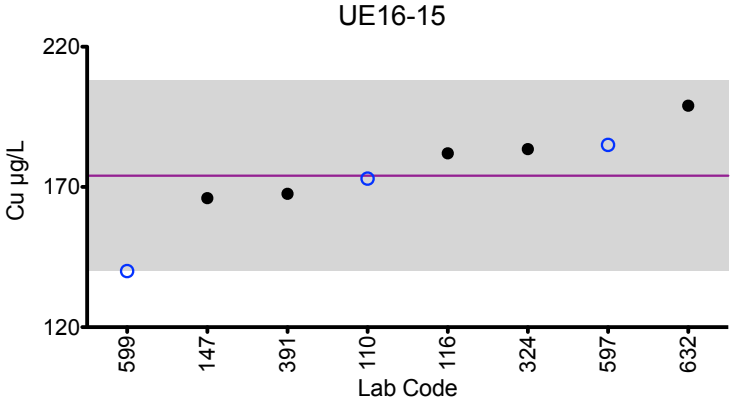
Results for Event #3, 2016: Urine Cu











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Results for Event #3, 2016
Additional Elements in Urine: Nickel (Ni)

Urine Ni (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
107	DRC/CC-ICP-MS	3.2	5.0	1.5	3.1	2.5
110	ICP-MS	4.3	5.2	2.0	3.7	4.1
147	DRC/CC-ICP-MS	4.18	5.32	1.34	3.32	2.45
324	ICP-MS	3.583	5.081	1.789	3.379	4.299
391	DRC/CC-ICP-MS	3.626	4.867	1.554	3.128	2.83
485	HR-ICP-MS	3.11	4.77	1.56	2.95	2.42
597	DRC/CC-ICP-MS	*12.0	*14.0	*11.2	*13.4	*12.6
599	DRC/CC-ICP-MS	2.53	3.81	0.976	2.40	2.00

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	3.5	4.9	1.5	3.1	2.9
Arithmetic SD (s)	0.6	0.5	0.3	0.4	0.9
Arithmetic RSD (%)	17.1	10.2	20	12.9	31
Number of Sample Measurements (N)	7	7	7	7	7

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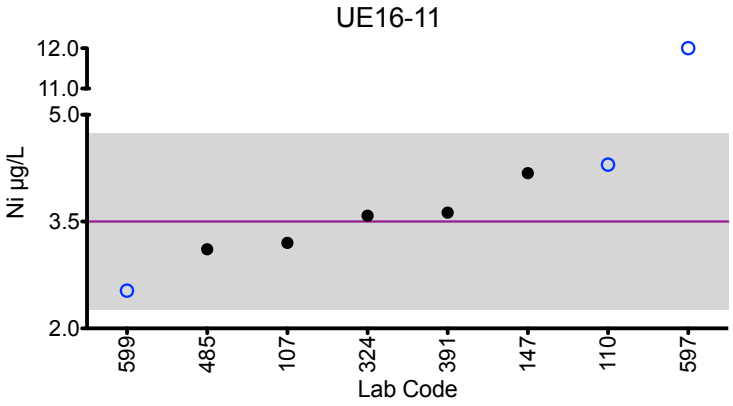
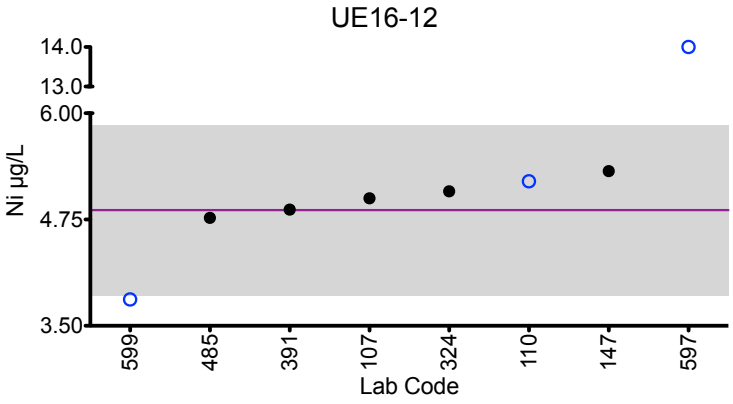
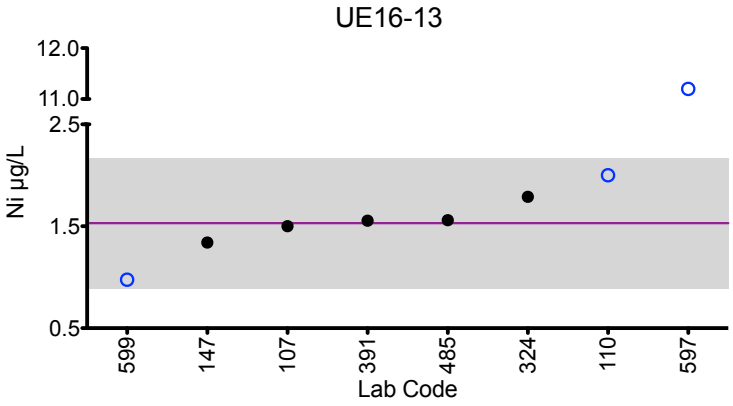
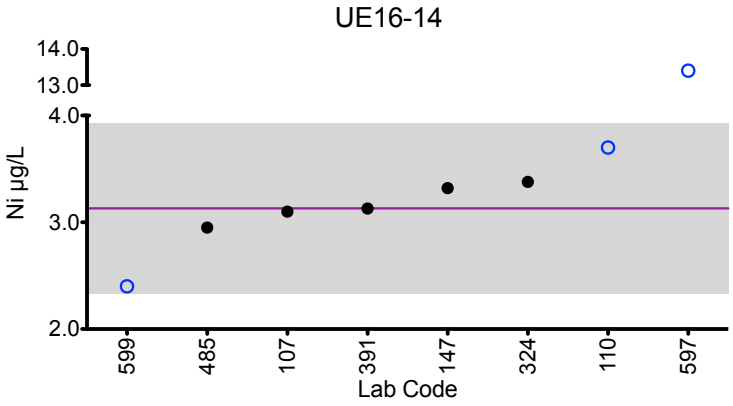
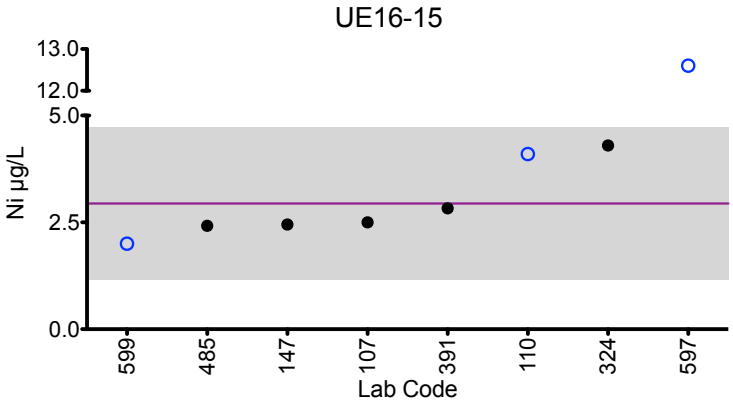
Results for Event #3, 2016: Urine Ni











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Results for Event #3, 2016
Additional Elements in Urine: Platinum (Pt)

Urine Pt (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
107	ICP-MS	0.020	0.76	0.39	0.18	0.69
110	ICP-MS	<MDL	0.75	0.35	0.13	0.64
147	ICP-MS	< 0.127	0.635	0.268	0.195	0.646
399	ICP-MS	ND	0.773	0.372	0.159	0.668
632	ICP-MS	PLC	0.711	0.343	0.121	0.642

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	NA	0.73	0.34	0.16	0.66
Arithmetic SD (s)	NA	0.06	0.05	0.03	0.02
Arithmetic RSD (%)	NA	8.2	14.7	18.8	3.0
Number of Sample Measurements (N)	NA	5	5	5	5

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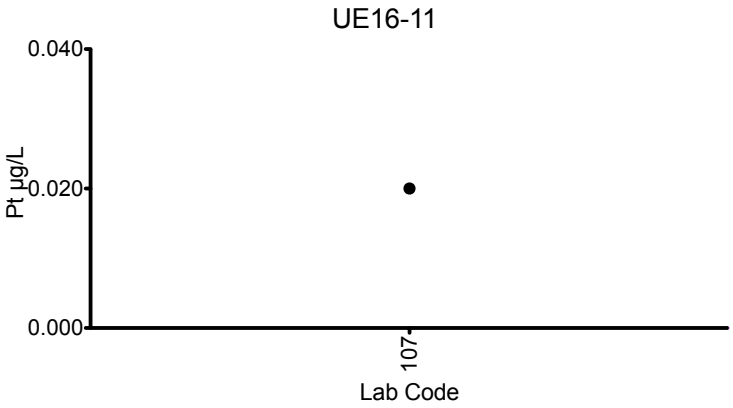
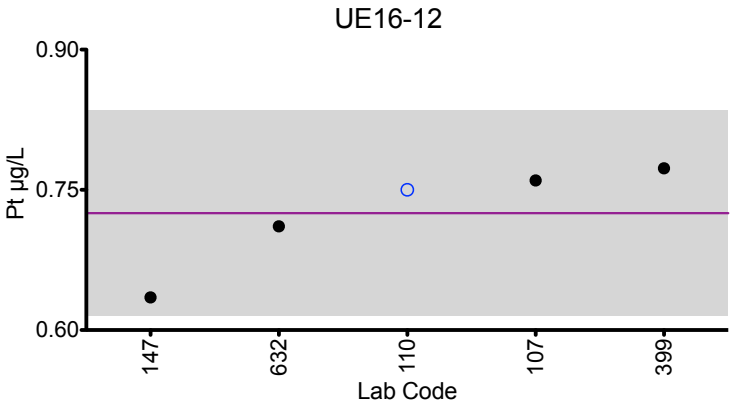
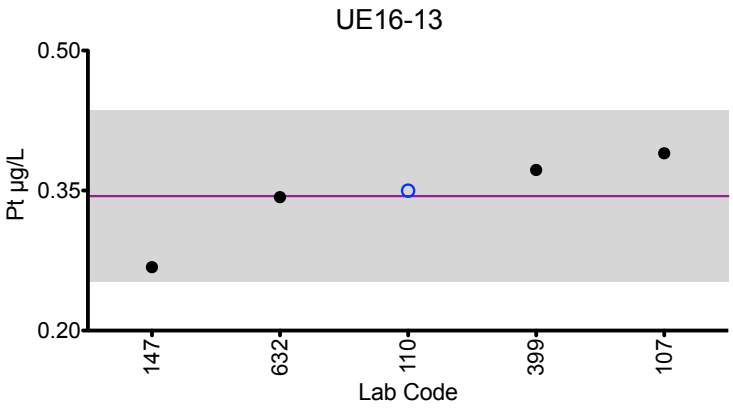
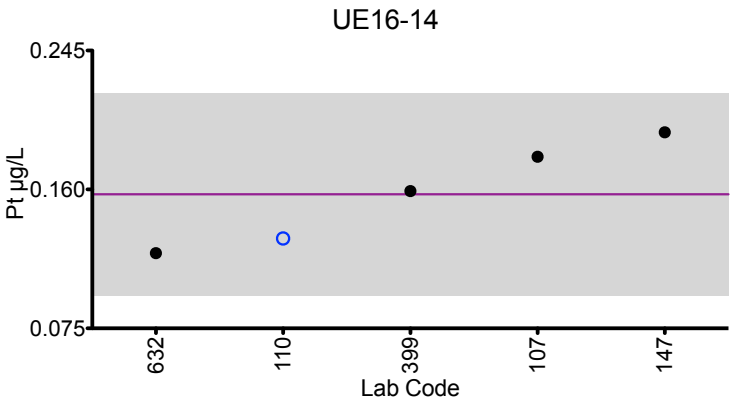
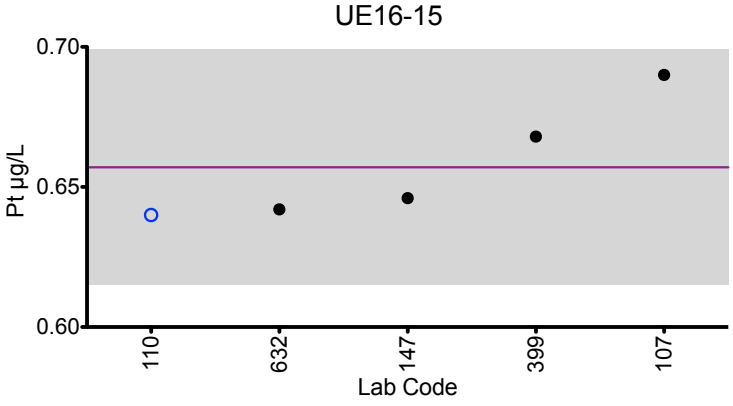
Results for Event #3, 2016: Urine Pt











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Results for Event #3, 2016
Additional Elements in Urine: Selenium (Se)

Urine Se (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
103	DRC/CC-ICP-MS	11.9	38.9	17.4	17.5	56.1
110	DRC/CC-ICP-MS	10	37	16	15	51
147	ICP-MS	13.3	37.2	18.3	17.7	51.7
597	DRC/CC-ICP-MS	11.5	34.6	17.4	16.0	46.8
632	DRC/CC-ICP-MS	PLC	29.7	*8.34	*6.48	*39.7
684	DRC/CC-ICP-MS	11.40	35	16.5	15.4	52.8

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	11.6	35.4	17.1	16.3	49.7
Arithmetic SD (s)	1.2	3.2	0.9	1.2	5.7
Arithmetic RSD (%)	10.3	9.0	5.3	7.4	11.5
Number of Sample Measurements (N)	5	6	5	5	6

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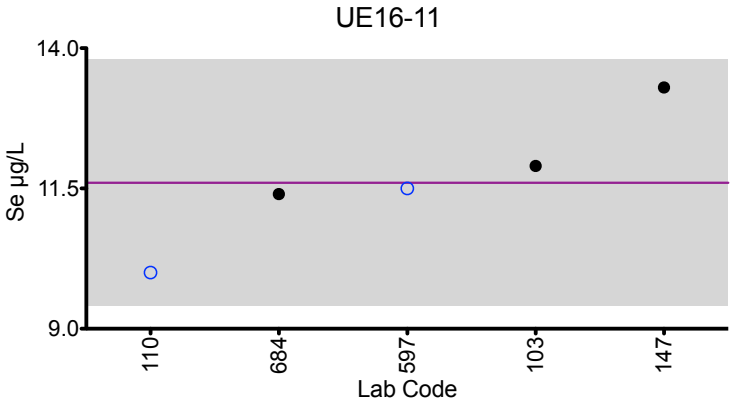
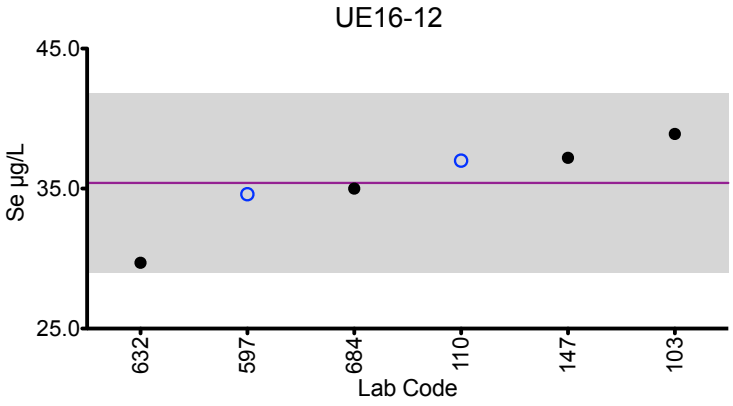
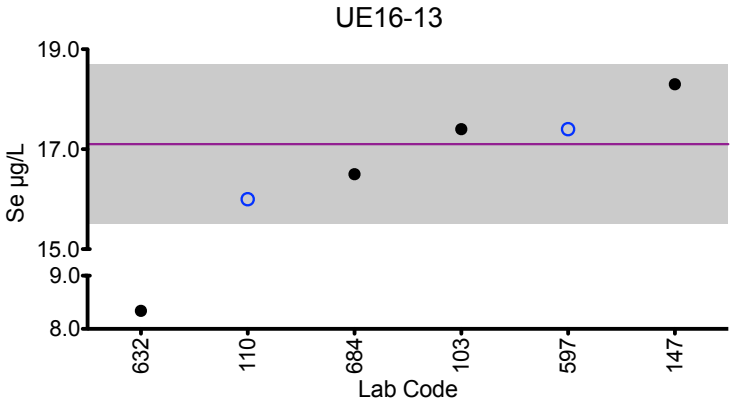
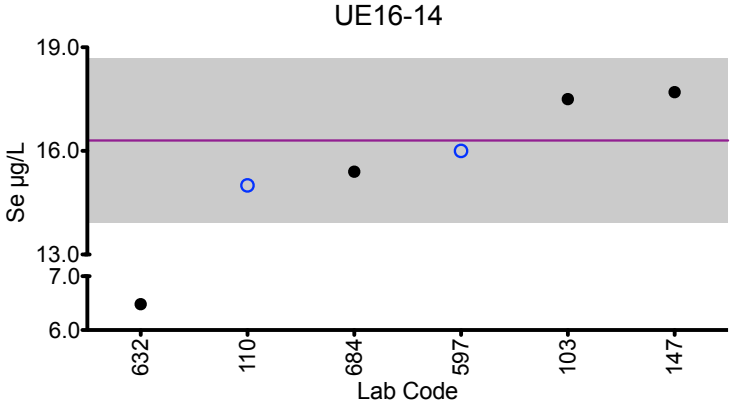
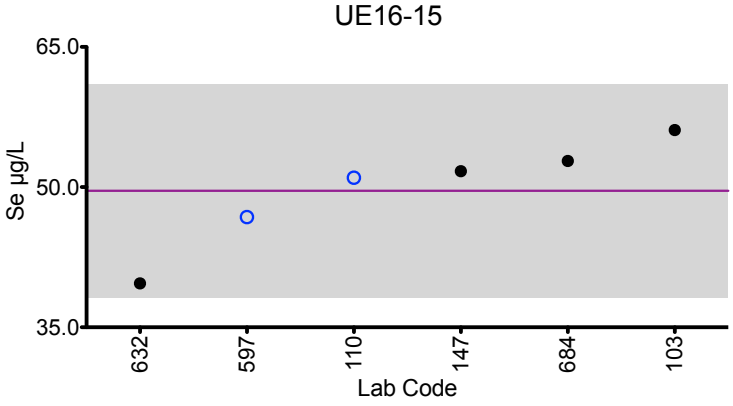
Results for Event #3, 2016: Urine Se











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Results for Event #3, 2016
Additional Elements in Urine: Tin (Sn)

Urine Sn (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
107	ICP-MS	0.17	10	0.98	1.6	1.6
110	ICP-MS	<MDL	10.0	0.9	2	1.8
147	ICP-MS	0.175	8.30	0.695	1.13	1.32
399	ICP-MS	ND	9.96	0.882	1.87	1.65
599	DRC/CC-ICP-MS	<0.1	8.09	<0.1	1.02	0.746
605	ICP-MS	*1.78	9.5	0.862	1.66	1.51

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	0.17	9.30	0.86	1.55	1.44
Arithmetic SD (s)	0.00	0.88	0.10	0.39	0.37
Arithmetic RSD (%)	0.0	9.5	11.6	25	26
Number of Sample Measurements (N)	2	6	5	6	6

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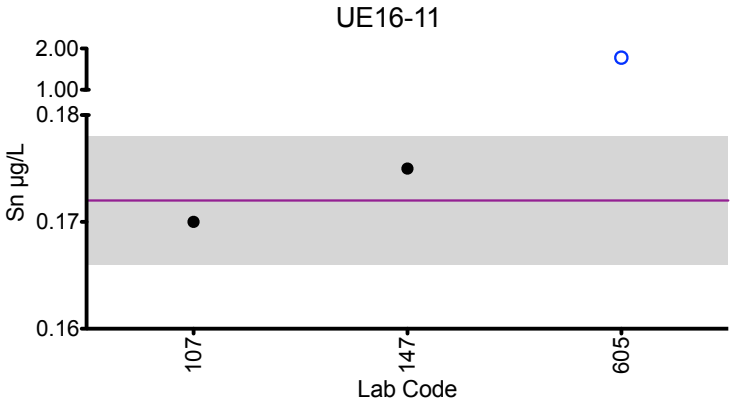
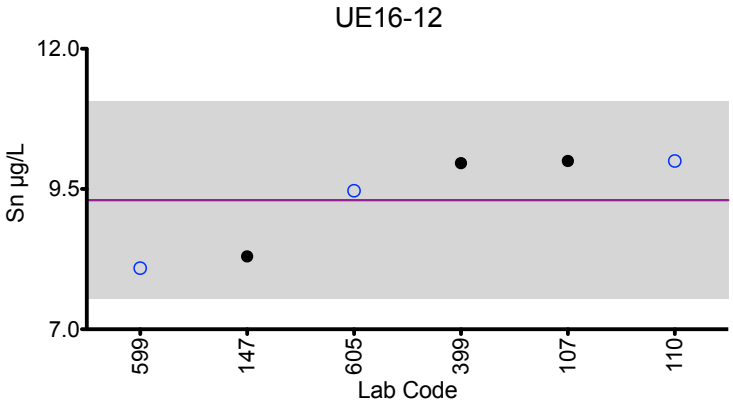
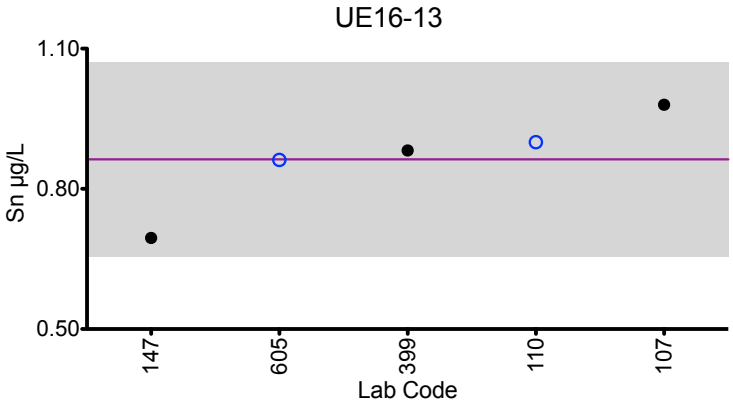
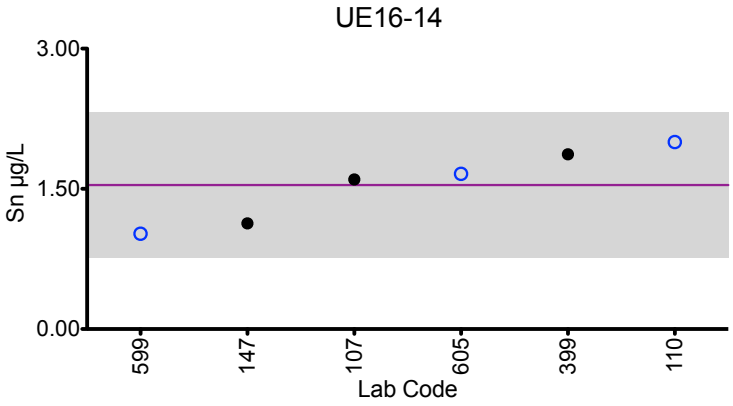
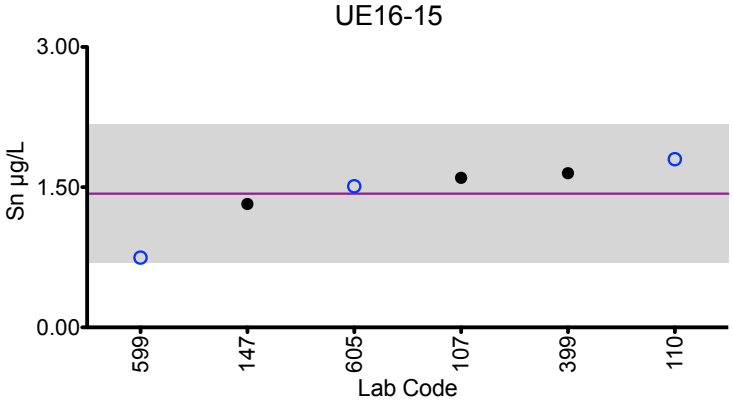
Results for Event #3, 2016: Urine Sn











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Results for Event #3, 2016
Additional Elements in Urine: Strontium (Sr)

Urine Sr (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
103	DRC/CC-ICP-MS	41.7	208	22.3	65.6	198
107	ICP-MS	44	210	24	66	190
200	ICP-MS	*55.2	208	25.4	69.2	192
399	DRC/CC-ICP-MS	43.2	*219	23.5	67.1	195
605	ICP-MS	41.6	210	22.4	65.8	190

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	42.6	209	23.5	66.7	193
Arithmetic SD (s)	1.2	1	1.3	1.5	3
Arithmetic RSD (%)	2.8	0.48	5.5	2.2	1.6
Number of Sample Measurements (N)	4	4	5	5	5

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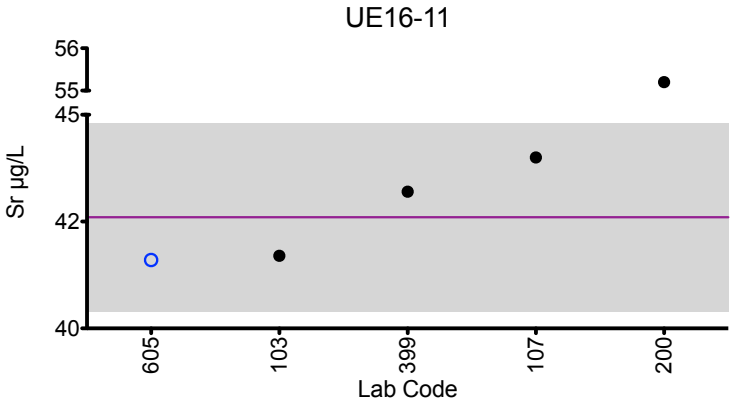
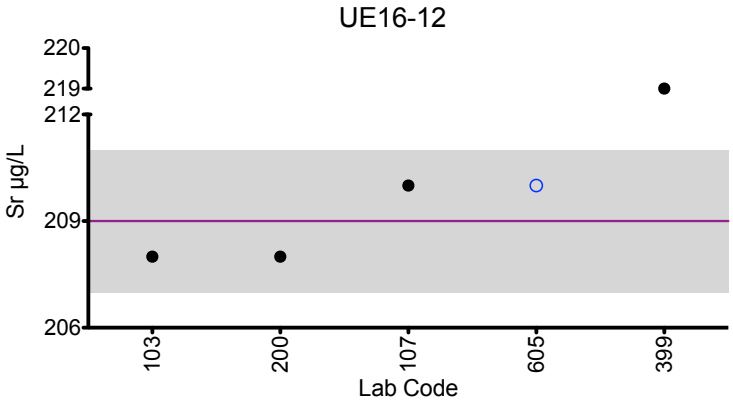
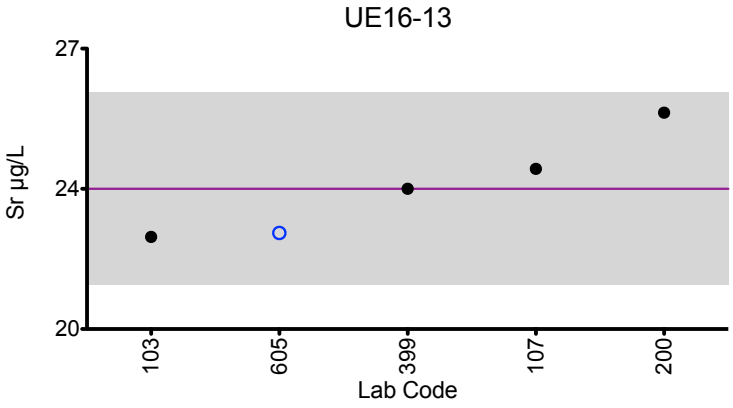
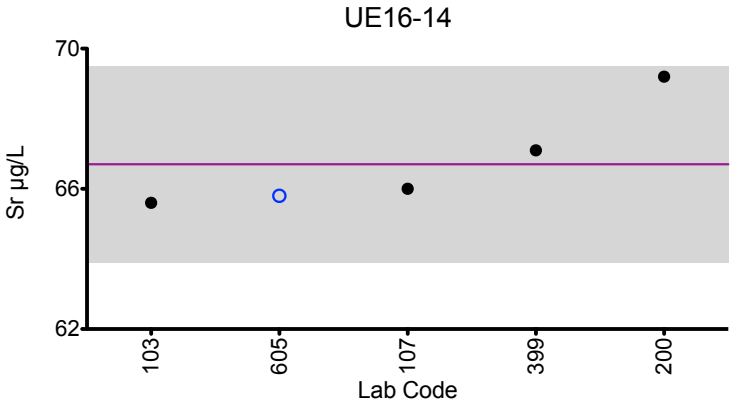
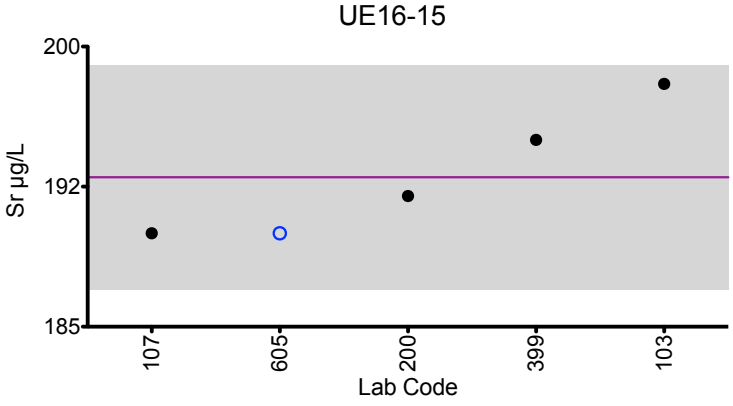
Results for Event #3, 2016: Urine Sr











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Results for Event #3, 2016
Additional Elements in Urine: Tungsten (W)

Urine W (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
107	ICP-MS	<0.018	2.0	0.43	0.42	0.85
110	ICP-MS	<MDL	1.90	0.38	0.36	0.75
147	ICP-MS	< 0.0570	1.88	0.39	0.403	0.813
200	ICP-MS	0.1	1.5	0.4	0.4	0.9
324	ICP-MS	<1	1.744	<1	<1	<1
399	ICP-MS	ND	1.98	0.43	0.428	0.85
599	DRC/CC-ICP-MS	<0.1	1.90	*0.207	*0.235	0.647
605	ICP-MS	ND	1.87	0.435	0.406	0.805
606	DRC/CC-ICP-MS	<0.060	1.81	0.38	0.356	0.748
632	ICP-MS	PLC	2.05	0.506	0.462	0.896

Summary Statistics

	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
Arithmetic Mean ($\bar{x}$)	NA	1.88	0.42	0.40	0.81
Arithmetic SD (s)	NA	0.13	0.04	0.03	0.08
Arithmetic RSD (%)	NA	6.9	9.5	7.5	9.9
Number of Sample Measurements (N)	NA	10	8	8	9

*Denotes a statistical Outlier.
A robust mean, SD, RSD, and n are provided for sample UE16-12.

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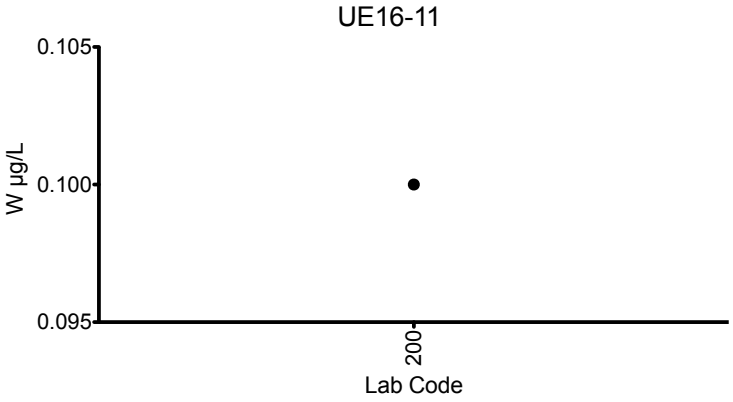
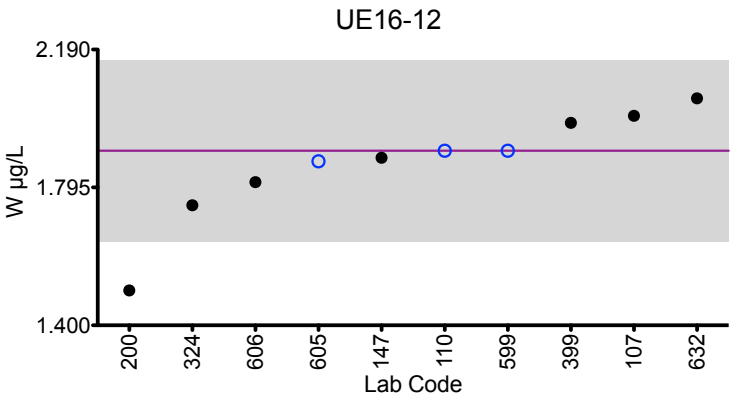
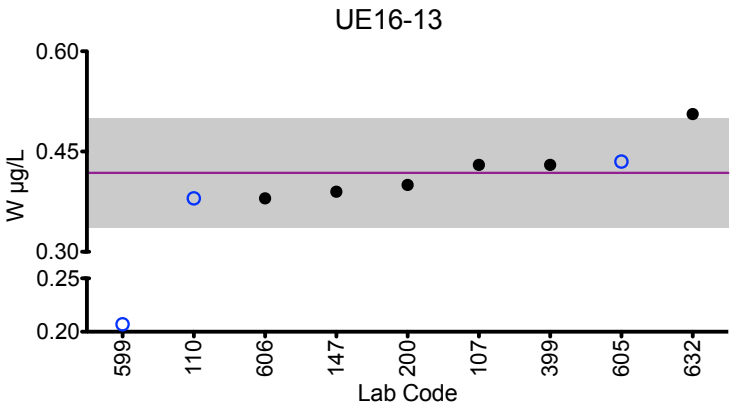
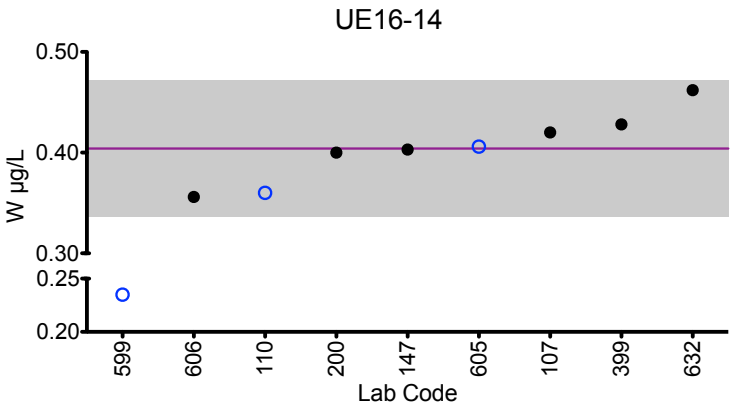
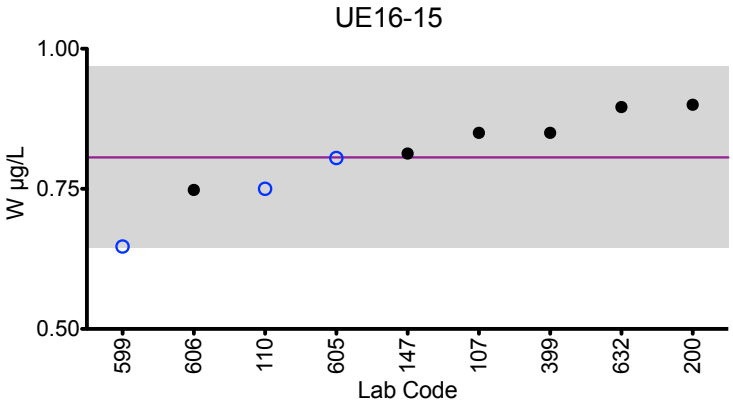
Results for Event #3, 2016: Urine W











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

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

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Results for Event #3, 2016
Additional Elements in Urine: Zinc (Zn)

Urine Zn (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
110	ICP-MS	96	207	277	131	474
147	ICP-MS	125	249	293	246	461
324	ICP-MS	84.438	172.902	240.351	111.639	505.068
597	DRC/CC-ICP-MS	101	211	282	139	519
632	ICP-MS	105	215	292	140	540

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	102	211	277	130	500
Arithmetic SD (s)	15	27	22	13	32
Arithmetic RSD (%)	14.7	12.8	7.9	10	6.4
Number of Sample Measurements (N)	5	5	5	4	5

*Denotes a statistical Outlier.

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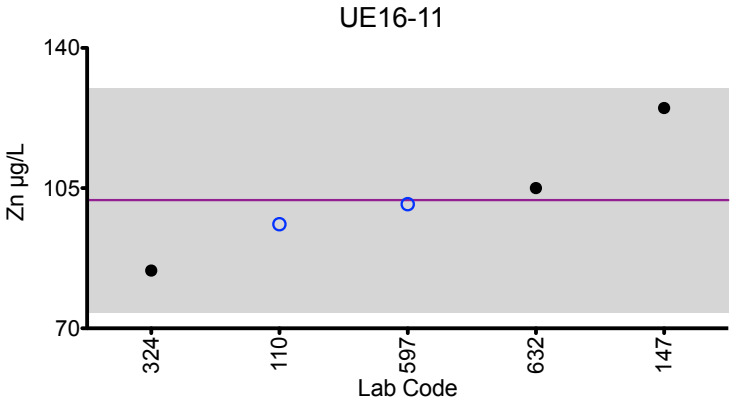
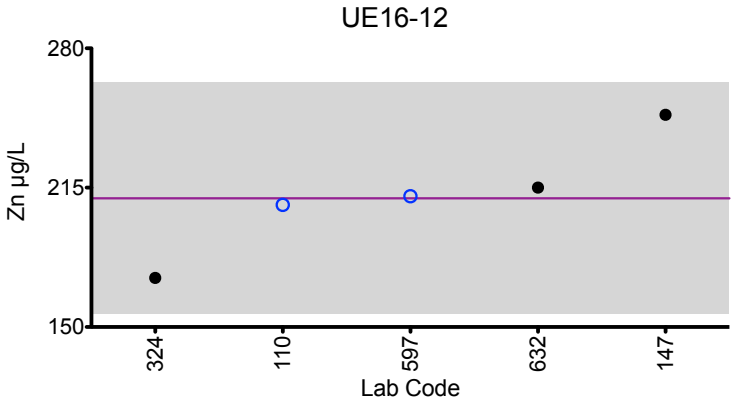
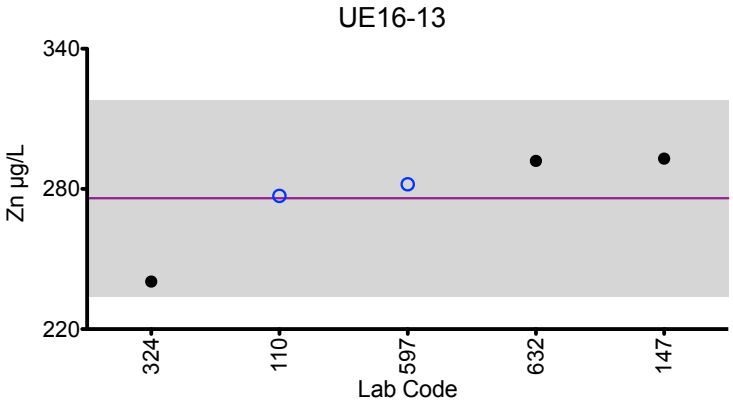
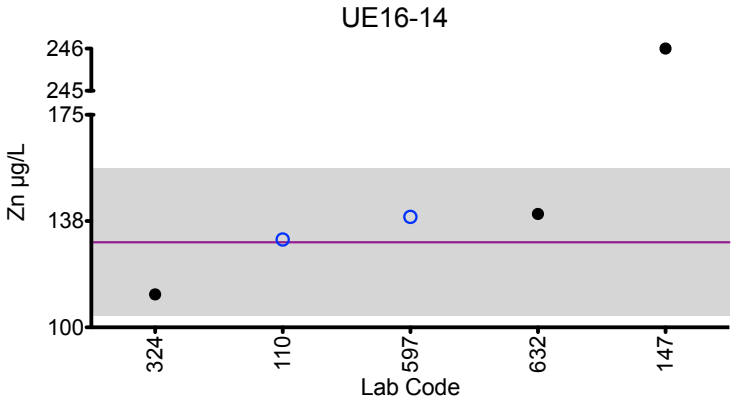
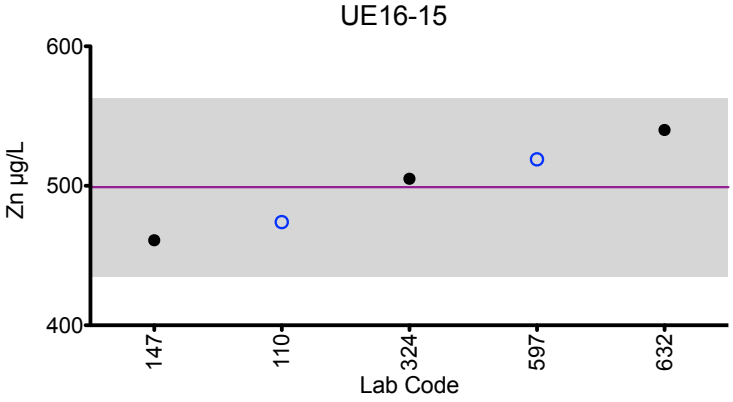
Results for Event #3, 2016: Urine Zn











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

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

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Results for Event #3, 2016
Additional Elements in Urine: Aluminum (Al)

Urine Al (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
147	DRC/CC-ICP-MS	14.5	*28.8	<13.8	<13.8	25.3
324	ICP-MS	8.977	21.496	11.357	10.286	*43.893
485	HR-ICP-MS	<2.52	19.5	6.63	4.42	18.9

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	12	20	9	7	22
Arithmetic SD (s)	4	1	3	4	5
Arithmetic RSD (%)	33	5	38	55	23
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Urine: Vanadium (V)

Urine V (µg/L)						
Lab Code	**Method**	**UE16-11**	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
116	DRC/CC-ICP-MS	ND	3.61	0.931	0.775	1.66
147	DRC/CC-ICP-MS	< 0.0408	2.70	0.745	0.582	1.37
485	HR-ICP-MS	<0.012	3.22	0.788	0.677	1.34
597	DRC/CC-ICP-MS	0.058	3.11	0.813	0.647	1.40

Summary Statistics					
	UE16-11	**UE16-12**	**UE16-13**	**UE16-14**	**UE16-15**
Arithmetic Mean ($\bar{x}$)	NA	3.16	0.819	0.67	1.44
Arithmetic SD (s)	NA	0.37	0.080	0.08	0.15
Arithmetic RSD (%)	NA	11.7	9.8	11.9	10.4
Number of Sample Measurements (N)	NA	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Urine

Urine Ag (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
147	ICP-MS	< 0.302	0.347	< 0.302	< 0.302	< 0.302

Urine B (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
200	ICP-MS	605	313	335	270	1285

Urine Bi (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
147	ICP-MS	< 0.230	< 0.230	< 0.230	< 0.230	0.539

Urine Fe (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
324	ICP-MS	10.803	6.775	8.829	13.462	40.266

Urine I (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
107	ICP-MS	39	25	31	71	130

Urine Li (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
147	ICP-MS	8.33	6.11	6.71	4.64	14.5

Urine Mg (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
597	DRC/CC-ICP-MS	26235	14044	17575	20739	53185

Urine Te (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
110	ICP-MS	<MDL	2.2	0.3	0.4	0.4

Urine Th (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
147	ICP-MS	< 0.00557	< 0.00557	< 0.00557	< 0.00557	< 0.00557

Urine Ti (µg/L)

Lab Code	Method	UE16-11	UE16-12	UE16-13	UE16-14	UE16-15
485	HR-ICP-MS	<0.5	<0.5	<0.5	<0.5	<0.5

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Event #3, 2016

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #3, 2016:
Trace Elements in Serum

PT Materials

Test materials were prepared from human serum obtained from Tennessee Blood Services, 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), copper (Cu), selenium (Se), zinc (Zn), arsenic (As), beryllium (Be), cadmium (Cd), cobalt (Co), chromium (Cr), mercury (Hg), manganese (Mn), molybdenum (Mo), nickel (Ni), lead (Pb), platinum (Pt), antimony (Sb), titanium (Ti), thallium (Tl), uranium (U), vanadium (V), and tungsten (W). Serum units were homogenized overnight prior to aliquoting 2-mL into polypropylene vials. PT samples were stored at -80°C until the week of the PT event, when they were thawed at 4°C prior to circulation to laboratories for analysis.

Graded Elements

Three elements in serum are formally graded: Al, 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, (b) where a robust mean is not possible, the arithmetic mean after outlier deletion, or (c) a group of reference laboratories with a history of successful PT.

Additional Elements

An additional 29 elements (beyond the three graded) were reported by at least one participant: Ag, As, B, Ba, Be, Bi, Cd, Co, Cr, Cs, Fe, Hg, I, Li, Mn, Mo, Ni, Pb, Pt, Sb, Sn, Sr, Te, Th, Ti, Tl, U, V, and W. These data are included here to provide a more complete characterization of the PT materials. All results reported by participant laboratories are tabulated and organized by lab code. The PT data are graphed for visual comparison purposes for all elements where at least five laboratories reported a value greater than the LOD. A statistical summary table is provided for samples where at least two comparable values were reported as above the LOD.

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

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Results for Event #3, 2016
Serum Aluminum (Al)

Summary Statistics

	Serum Al (µg/L)				
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Target (Arithmetic Mean ($\bar{x}$))	75.6	103	166	13.5	32.8
Upper Limit	90.7	124	199	18.5	39.4
Lower Limit	60.5	82	133	8.5	26.2
Arithmetic SD (s)	6.0	14	18	3.0	7.4
Arithmetic RSD (%)	7.9	13.6	10.8	22.2	22.6
Number of Sample Measurements (N)	3	3	3	3	3

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.

The target value for Al in serum was assigned as the arithmetic mean of an expert group, consistent with ISO 13528 recommendations for PT programs.

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Results for Event #3, 2016
Serum Aluminum (Al)
Performance of Participating Laboratories

		Serum Al (µg/L)				
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
	Target	**75.6**	**103**	**166**	**13.5**	**32.8**
147	ETAAS-Z	79.3	115	179	11.6	30.8
200		68.6	88.0	145.0	11.9	26.7
293	DRC/CC-ICP-MS	78.8	107	174	17.0	41.01 ↑
485	HR-ICP-MS	74.1	105	204 ↑	12.4	29.2
597	DRC/CC-ICP-MS	97.5 ↑	125 ↑	213 ↑	26.7 ↑	45.9 ↑
598	ICP-MS	85.8	*192 ↑	198	33.4 ↑	67.5 ↑

Based on the grading criteria for Al in Serum, 67% of results were satisfactory, with 2 of the 6 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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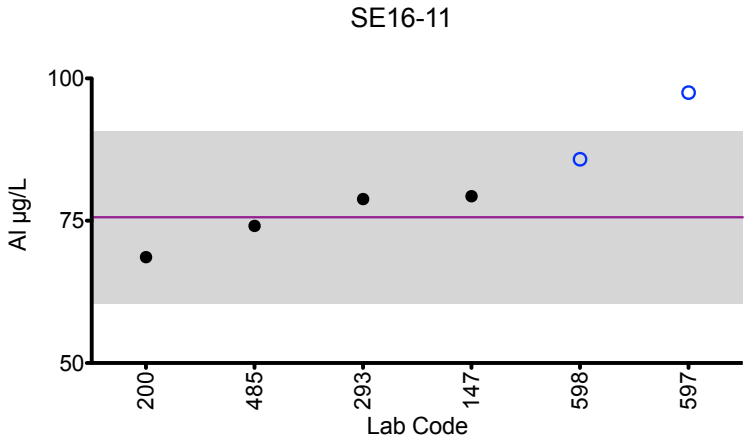
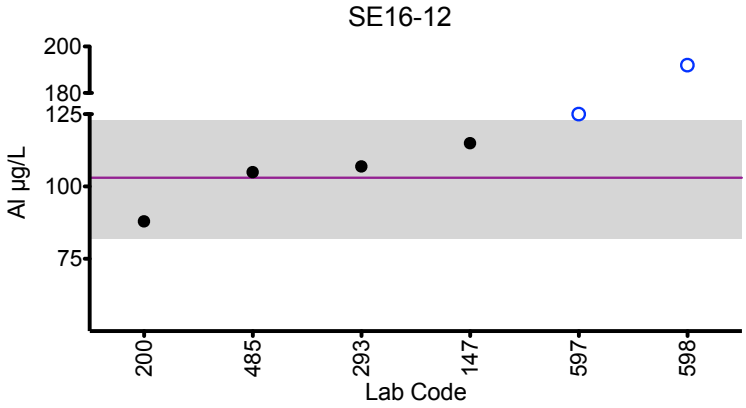
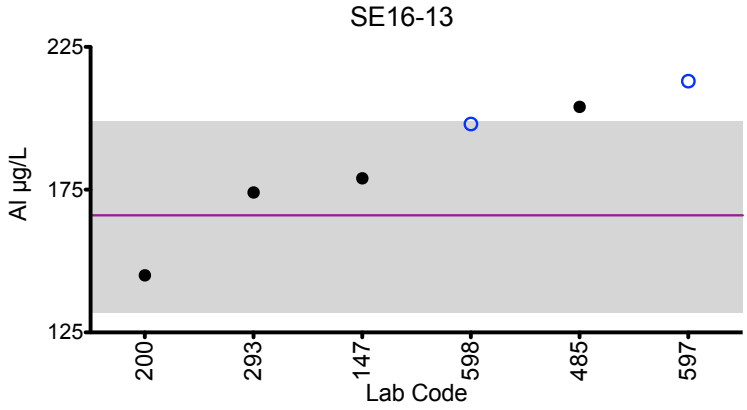
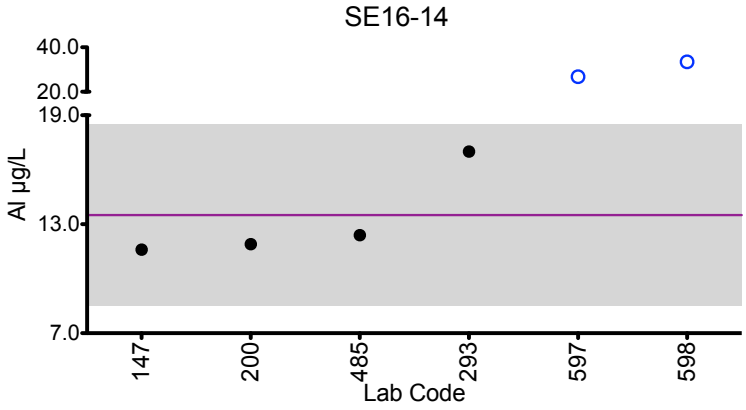
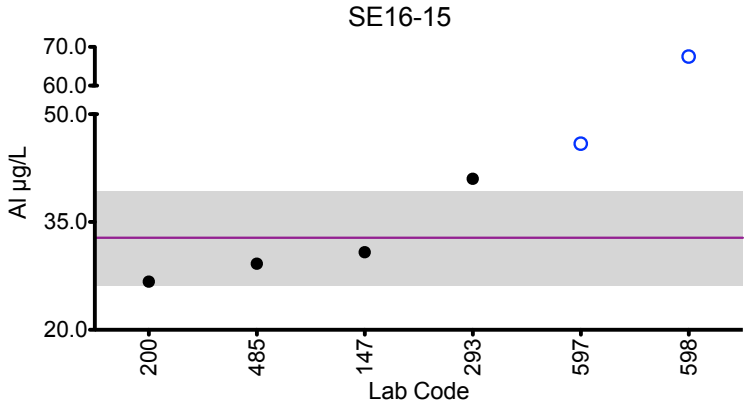
Results for Event #3, 2016: Serum Al











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Serum Copper (Cu)

Summary Statistics

	Serum Cu (µg/L)				
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Target (Robust Mean (x*))	2940	736	1118	860	1314
Upper Limit	3381	846	1286	989	1511
Lower Limit	2499	626	950	731	1117
Robust SD (s*)	198	50	91	82	106
Robust RSD (%)	6.7	6.8	8.2	9.5	8.1
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	78.1	19.9	36.1	32.3	42.1

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

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Results for Event #3, 2016
Serum Copper (Cu)
Performance of Participating Laboratories

		Serum Cu (µg/L)				
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
	Target	**2940**	**736**	**1118**	**860**	**1314**
107	DRC/CC-ICP-MS	3000	750	1100	1200 ↑	1300
110	ICP-MS	2960	710	1081	822	1260
147	ICP-MS	3234	851 ↑	1239	959	1518 ↑
200		3124	775	1187	902	1397
293	DRC/CC-ICP-MS	2840	713	1099	830	1280
457	ICP-AES/OES	2946	764	1149	903	1352
483	DRC/CC-ICP-MS	2860	735	1110	845	1300
597	DRC/CC-ICP-MS	3076	759	1207	869	1428
598	ICP-MS	2627	671	1023	758	1217
599	DRC/CC-ICP-MS	2390 ↓	577 ↓	867 ↓	644 ↓	997 ↓

Based on the grading criteria for Cu in Serum, 84% of results were satisfactory, with 2 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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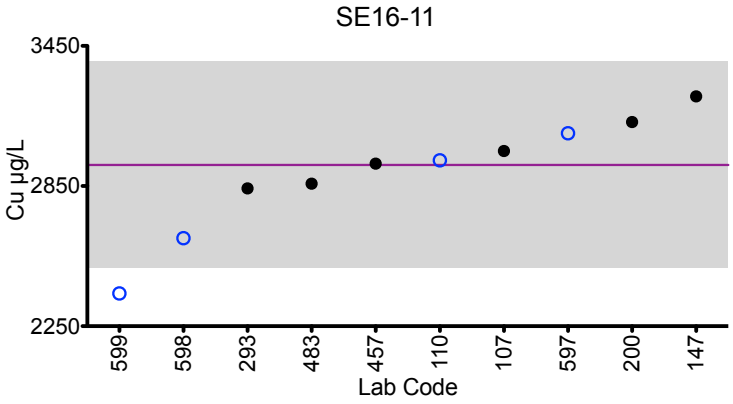
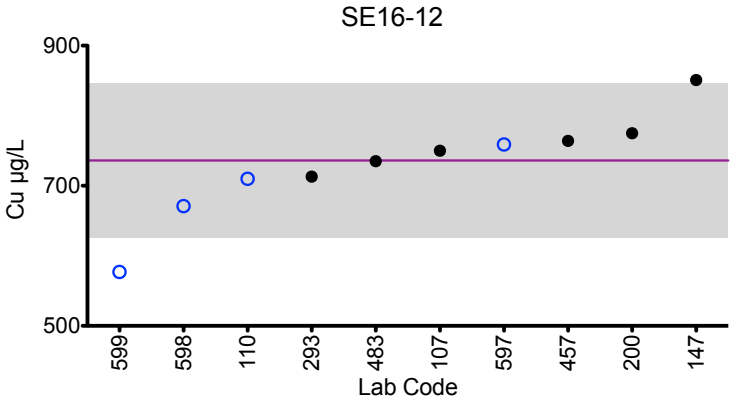
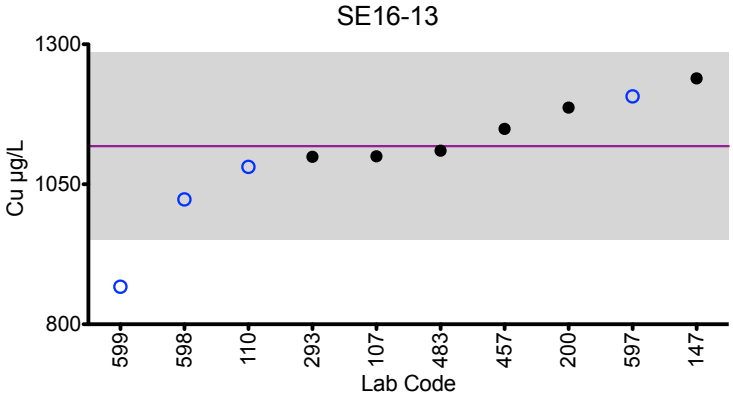
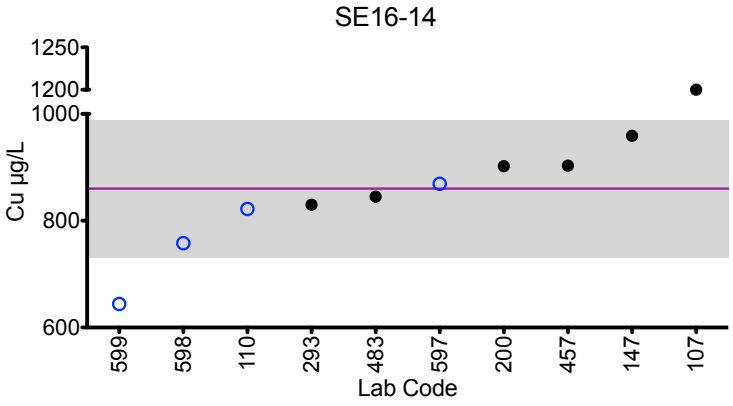
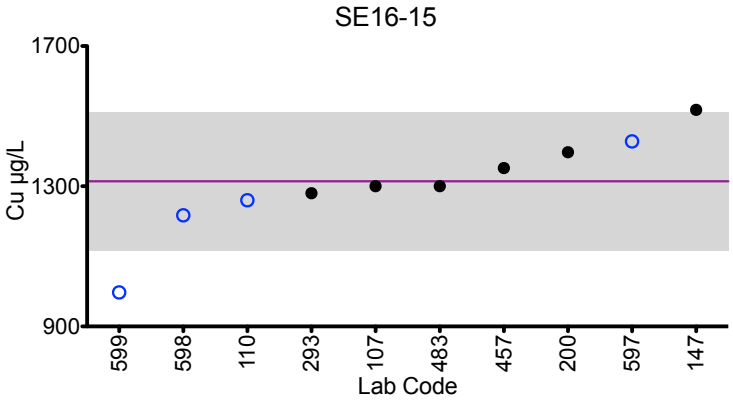
Results for Event #3, 2016: Serum Cu











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

±95 µg/L or ±15% around the target value, whichever is greater; thus, it is fixed at ±95 µg/L at concentrations less than or equal to 635 µg/L.

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Results for Event #3, 2016
Serum Selenium (Se)

Summary Statistics

	Serum Se (µg/L)				
	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
Target (Arithmetic Mean ($\bar{x}$))	120	145	244	169	98.5
Upper Limit	144	174	293	203	118.2
Lower Limit	96	116	195	135	78.8
Arithmetic SD (s)	10	16	14	17	10.2
Arithmetic RSD (%)	8.3	11.0	5.7	10.1	10.4
Number of Sample Measurements (N)	9	9	8	9	9

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

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Results for Event #3, 2016
Serum Selenium (Se)
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
	Target	**120**	**145**	**244**	**169**	**98.5**
103	DRC/CC-ICP-MS	120	148	260	176	98.5
107	DRC/CC-ICP-MS	120	150	250	160	97
110	DRC/CC-ICP-MS	119	144	249	168	95.0
147	ICP-MS	114	142	242	167	98.7
200		119	136	239	166	95
293	DRC/CC-ICP-MS	110	136	235	157	92.4
483	DRC/CC-ICP-MS	126	152	260	177	105
597	DRC/CC-ICP-MS	141	176 ↑	*311 ↑	206 ↑	121 ↑
598	ICP-MS	107	118	218	147	83.6

Based on the grading criteria for Se in Serum, 91% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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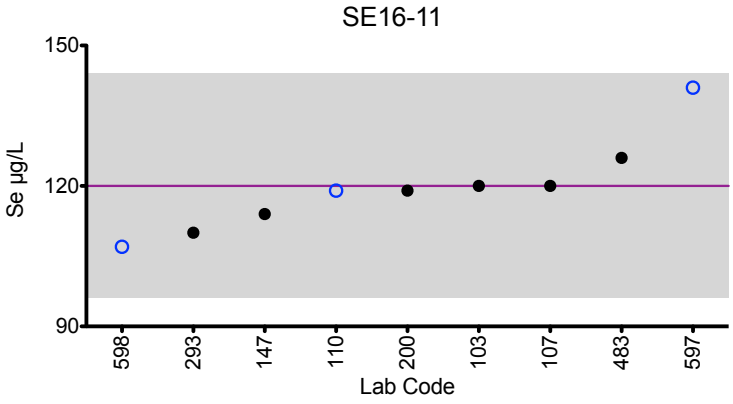
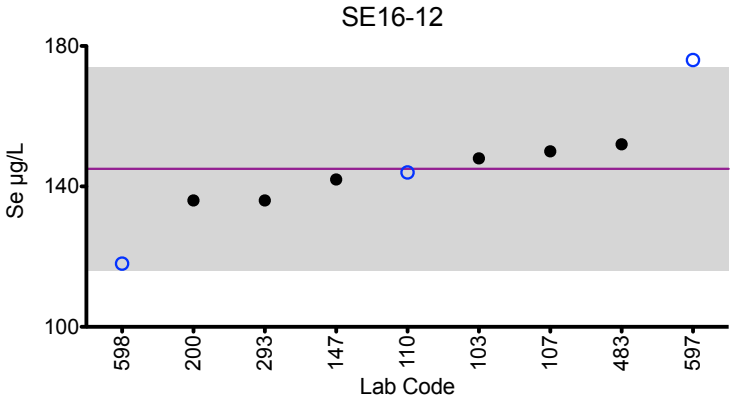
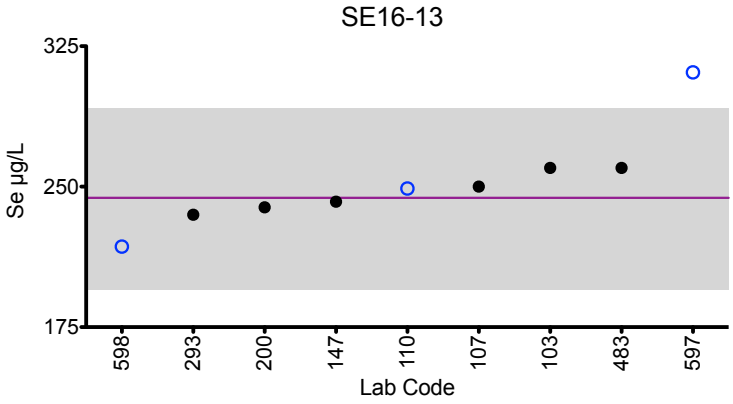
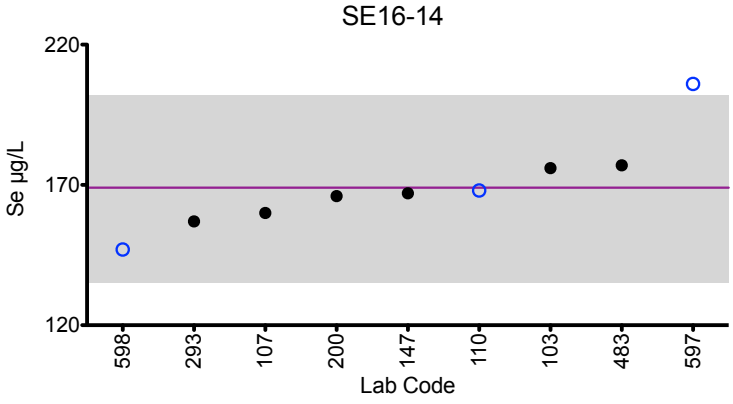
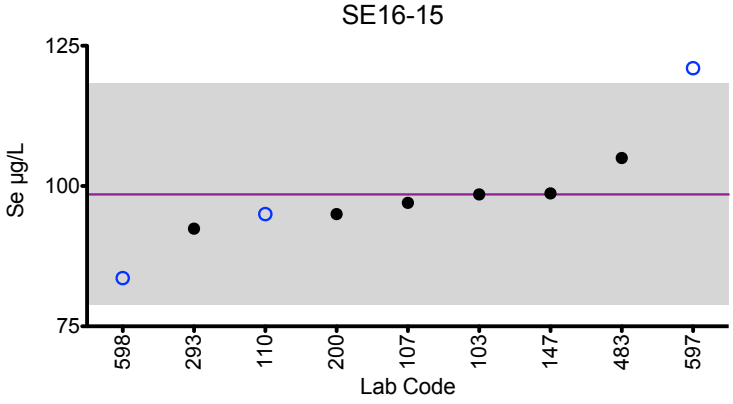
Results for Event #3, 2016: Serum Se











Legend:

○ CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Serum Zinc (Zn)

Summary Statistics

	Serum Zn (µg/L)				
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Target (Arithmetic Mean ($\bar{x}$))	1117	696	1144	1976	866
Upper Limit	1285	800	1316	2272	996
Lower Limit	949	592	972	1680	736
Arithmetic SD (s)	81	26	91	150	76
Arithmetic RSD (%)	7.3	3.7	8.0	7.6	8.8
Number of Sample Measurements (N)	9	8	9	9	9

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

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Results for Event #3, 2016
Serum Zinc (Zn)
Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
	Target	**1117**	**696**	**1144**	**1976**	**866**
107	DRC/CC-ICP-MS	1100	690	1100	2000	860
110	ICP-MS	1172	670	1149	1991	837
147	ICP-MS	1183	725	1216	2137	922
200		1230	732	1282	2197	955
293	DRC/CC-ICP-MS	1116	681	1129	1961	904
457	ICP-AES/OES	960	552 ↓	969 ↓	1704	705 ↓
483	DRC/CC-ICP-MS	1080	657	1110	1900	832
597	DRC/CC-ICP-MS	1163	703	1232	2051	939
598	ICP-MS	1050	709	1112	1842	843

Based on the grading criteria for Zn in Serum, 93% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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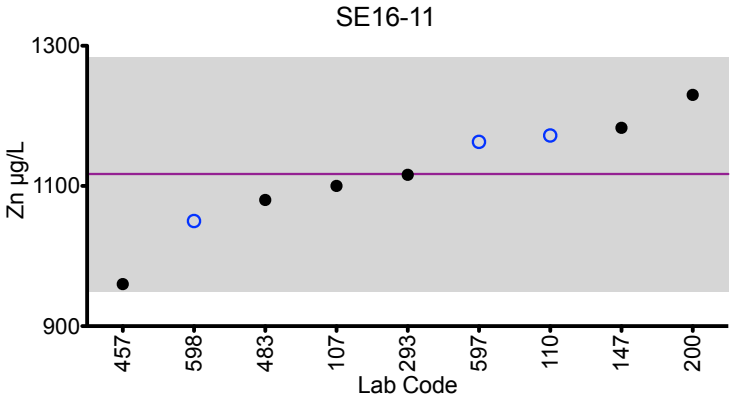
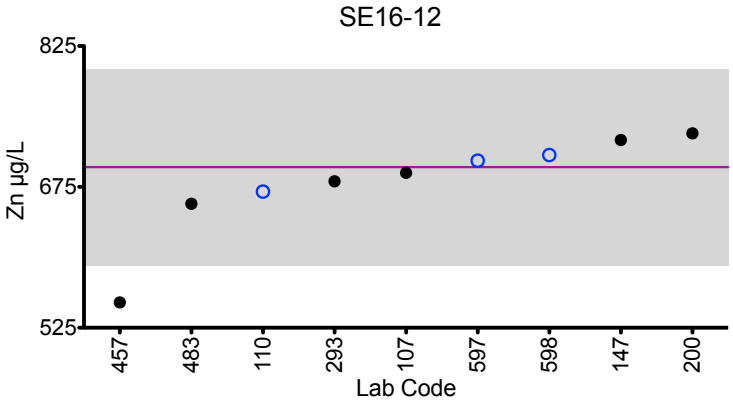
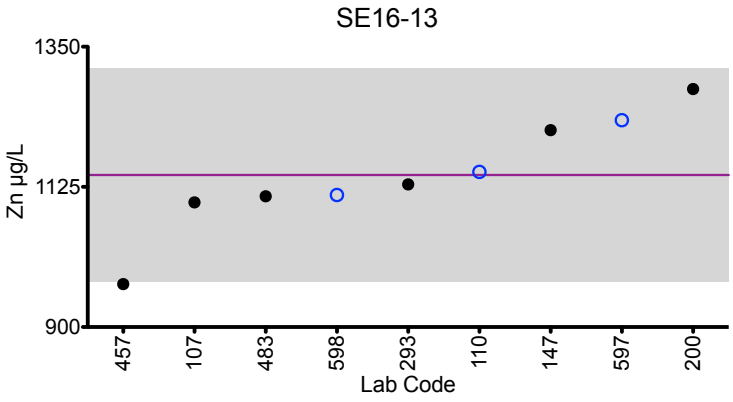
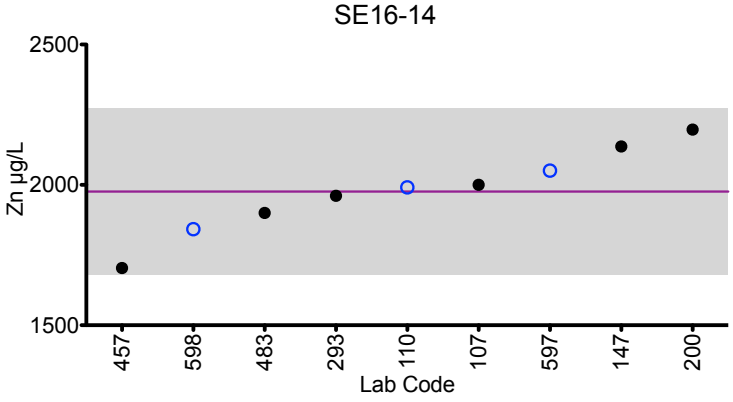
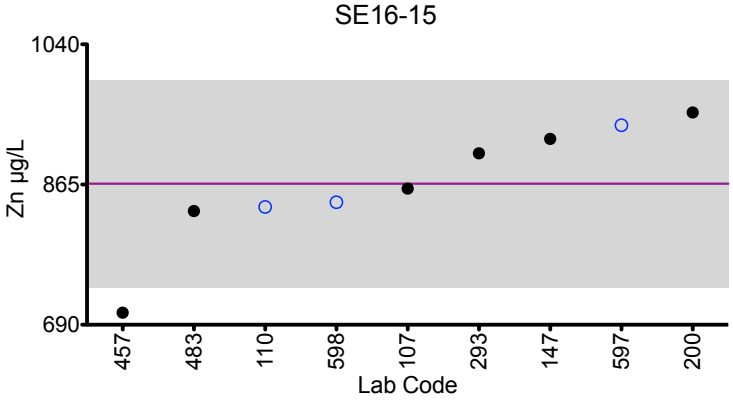
Results for Event #3, 2016: Serum Zn











Legend:

o CHEAR Labs ● Other Labs

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #3, 2016
Additional Elements in Serum: Arsenic (As)

Serum As (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	3.86	12.2	7.61	7.34	9.86
110	DRC/CC-ICP-MS	4.3	11.3	7.7	7.5	9.5
147	ICP-MS	4.44	13.0	8.34	7.79	10.5
597	DRC/CC-ICP-MS	4.09	12.7	8.11	7.69	10.6
599	DRC/CC-ICP-MS	3.56	8.68	5.79	*4.92	*6.67

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	4.1	11.6	7.5	7.6	10.1
Arithmetic SD (s)	0.4	1.7	1.0	0.2	0.5
Arithmetic RSD (%)	9.8	14.7	13.3	2.6	5.0
Number of Sample Measurements (N)	5	5	5	4	4

*Denotes a statistical Outlier.

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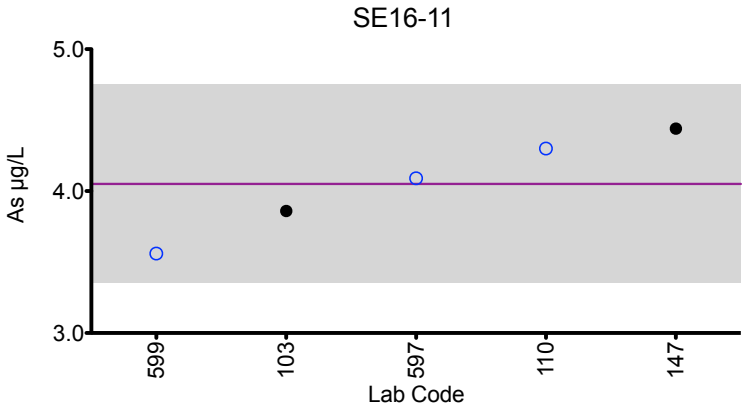
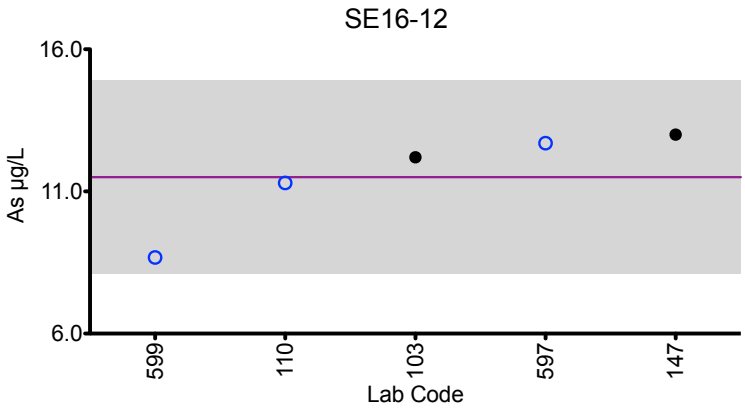
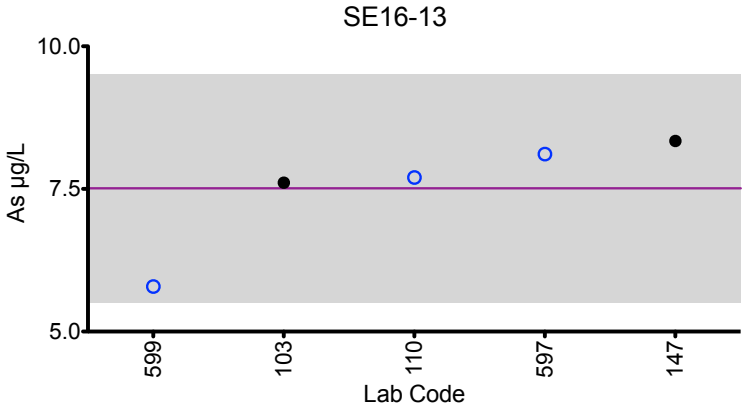
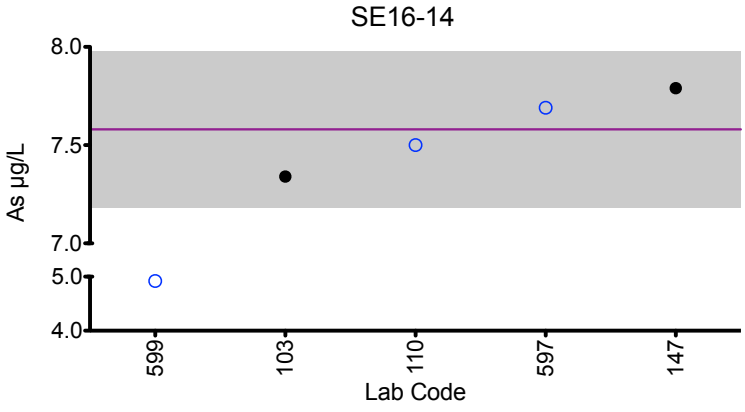
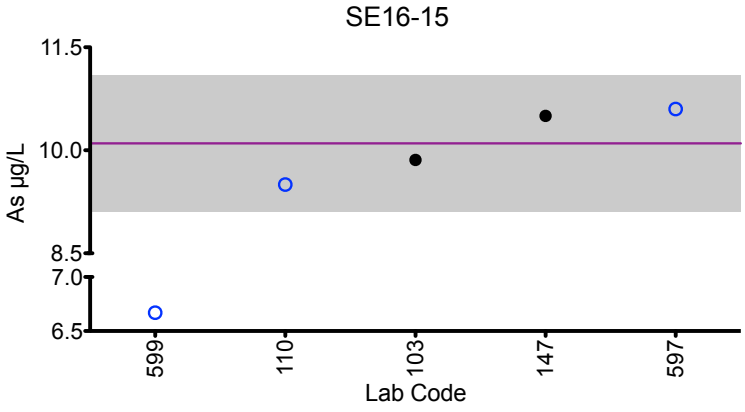
Results for Event #3, 2016: Serum As











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

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Results for Event #3, 2016
Additional Elements in Serum: Cadmium (Cd)

Serum Cd (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	1.42	0.255	0.724	2.56	5.71
110	ICP-MS	1.55	0.22	0.69	2.75	5.87
147	ICP-MS	1.54	0.307	0.746	2.63	6.01
597	DRC/CC-ICP-MS	1.55	0.28	0.78	2.74	6.23
599	DRC/CC-ICP-MS	*0.174	<0.1	<0.1	*0.994	*3.13

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	1.5	0.27	0.73	2.7	6.0
Arithmetic SD (s)	0.1	0.04	0.04	0.1	0.2
Arithmetic RSD (%)	6.7	14.8	5.5	3.7	3.3
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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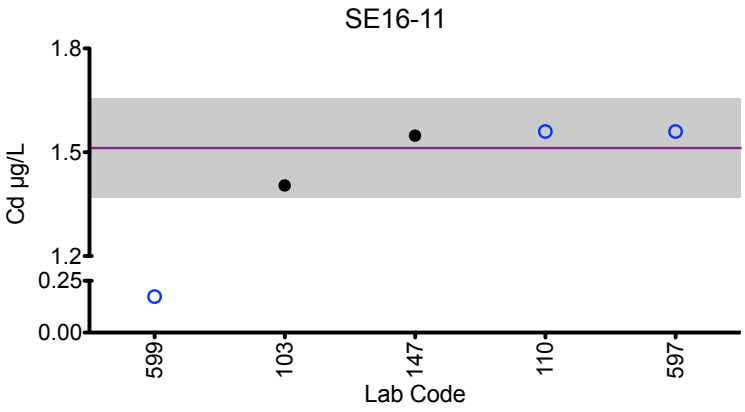
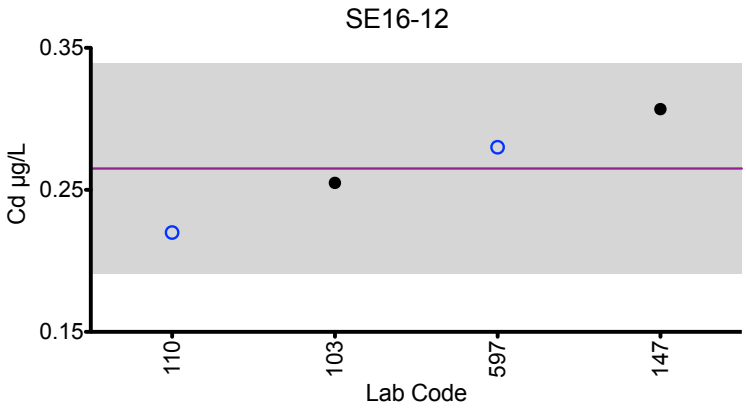
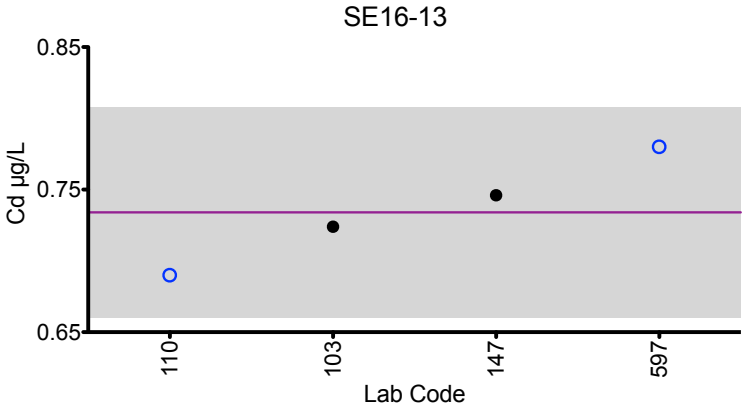
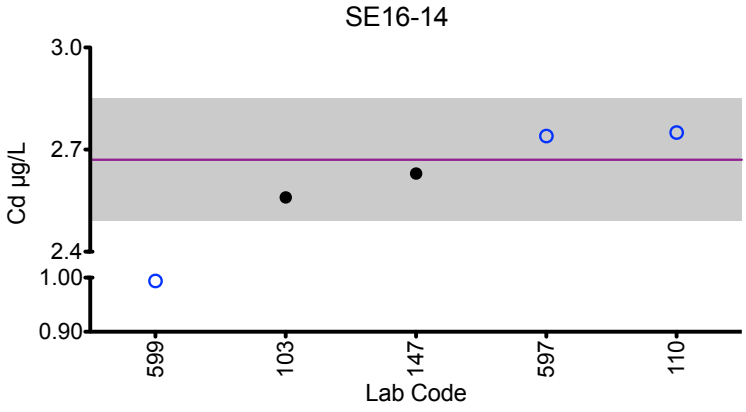
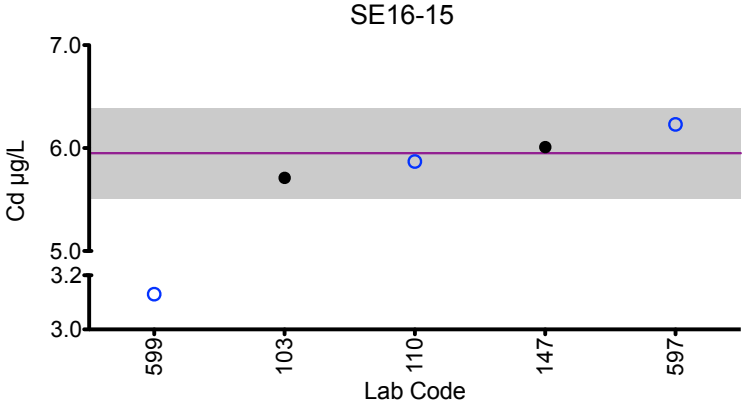
Results for Event #3, 2016: Serum Cd











Legend:
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Results for Event #3, 2016
Additional Elements in Serum: Cobalt (Co)

Serum Co (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	10.1	1.48	0.751	3.28	4.85
110	ICP-MS	10.8	1.5	0.88	3.3	4.9
147	ICP-MS	11.4	1.64	0.819	3.69	5.44
485	HR-ICP-MS	9.89	1.48	0.80	3.48	4.84
597	DRC/CC-ICP-MS	10.9	1.54	0.83	3.47	5.23
599	DRC/CC-ICP-MS	9.41	1.18	0.613	2.96	4.27

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	10.4	1.5	0.78	3.4	4.9
Arithmetic SD (s)	0.7	0.2	0.09	0.2	0.4
Arithmetic RSD (%)	6.7	13.3	11.5	5.9	8.2
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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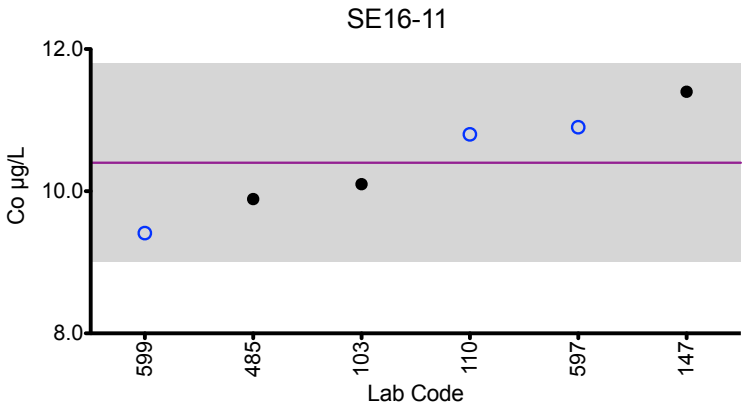
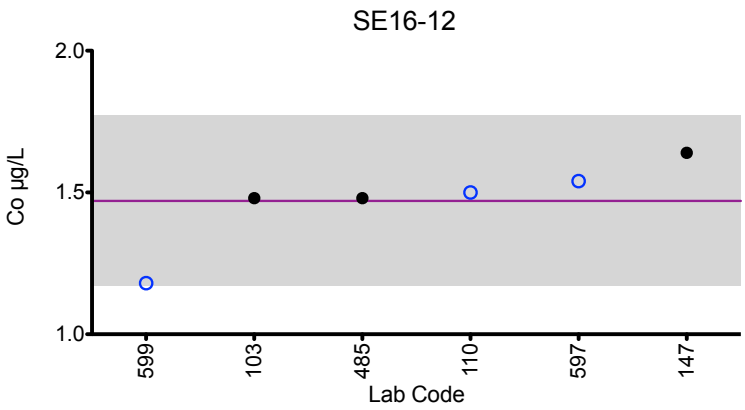
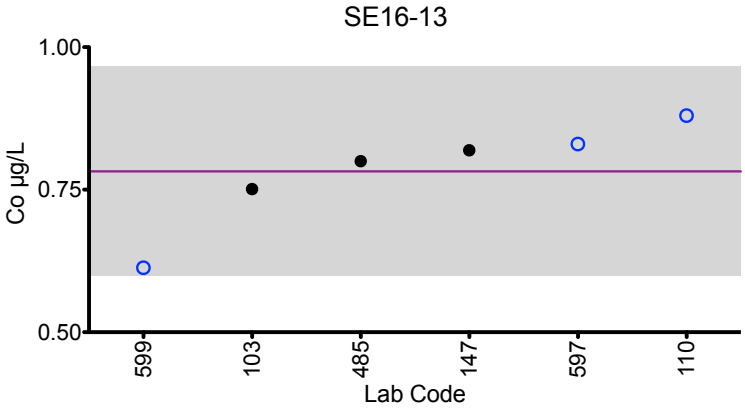
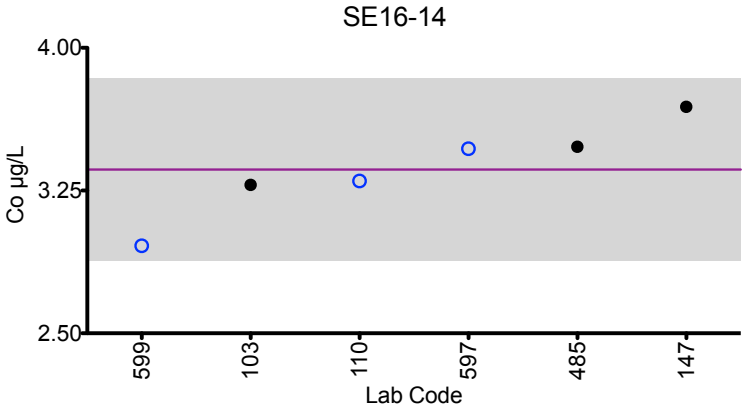
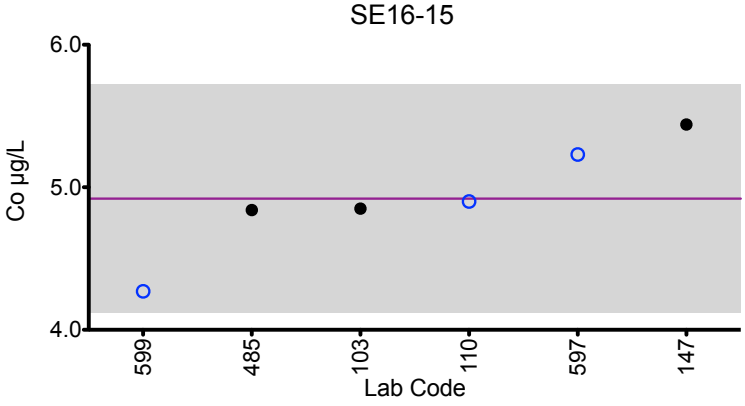
Results for Event #3, 2016: Serum Co











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Results for Event #3, 2016
Additional Elements in Serum: Chromium (Cr)

Serum Cr (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	0.928	6.53	3.17	1.67	11.1
110	DRC/CC-ICP-MS	0.92	6.3	3.2	1.7	10.4
147	DRC/CC-ICP-MS	0.79	6.6	3.05	1.50	11.5
485	HR-ICP-MS	0.912	5.91	3.33	1.70	10.9
597	DRC/CC-ICP-MS	*1.66	7.03	3.63	2.07	11.8
599	DRC/CC-ICP-MS	1.05	5.43	2.67	1.37	*19.7

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	0.92	6.3	3.2	1.7	11.1
Arithmetic SD (s)	0.09	0.6	0.3	0.2	0.5
Arithmetic RSD (%)	9.8	9.5	9.4	11.8	4.5
Number of Sample Measurements (N)	5	6	6	6	5

*Denotes a statistical Outlier.

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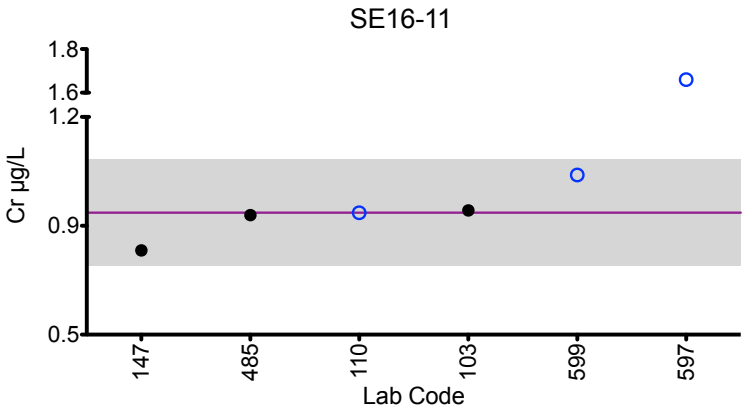
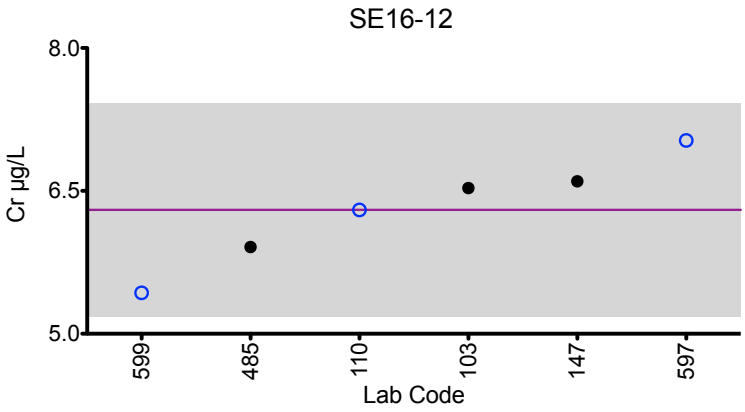
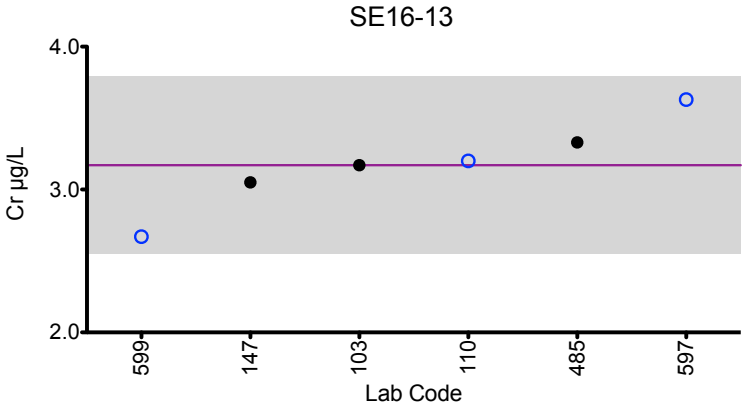
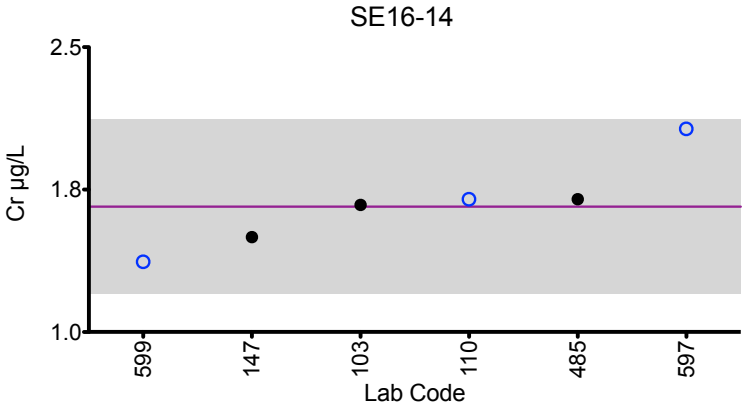
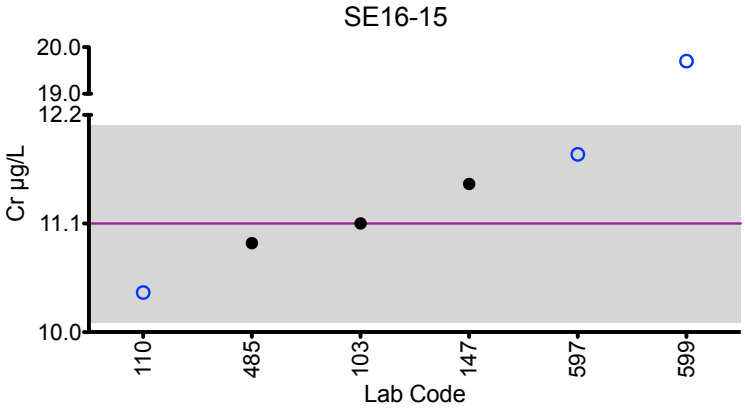
Results for Event #3, 2016: Serum Cr











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Results for Event #3, 2016
Additional Elements in Serum: Manganese (Mn)

Serum Mn (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
103	DRC/CC-ICP-MS	1.30	6.69	2.26	12.2	9.63
110	ICP-MS	1.6	6.9	2.3	12.0	9.4
147	ICP-MS	1.46	7.31	2.32	13.2	10.2
597	DRC/CC-ICP-MS	1.44	7.08	2.39	12.6	10.0
599	DRC/CC-ICP-MS	1.03	5.95	*1.70	11.5	8.90

Summary Statistics

	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
Arithmetic Mean ($\bar{x}$)	1.4	6.8	2.3	12.3	9.6
Arithmetic SD (s)	0.2	0.5	0.1	0.6	0.5
Arithmetic RSD (%)	14.3	7.4	4.3	4.9	5.2
Number of Sample Measurements (N)	5	5	4	5	5

*Denotes a statistical Outlier.

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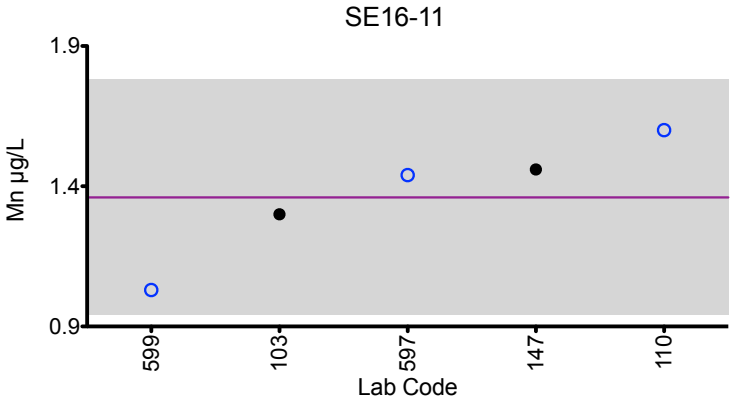
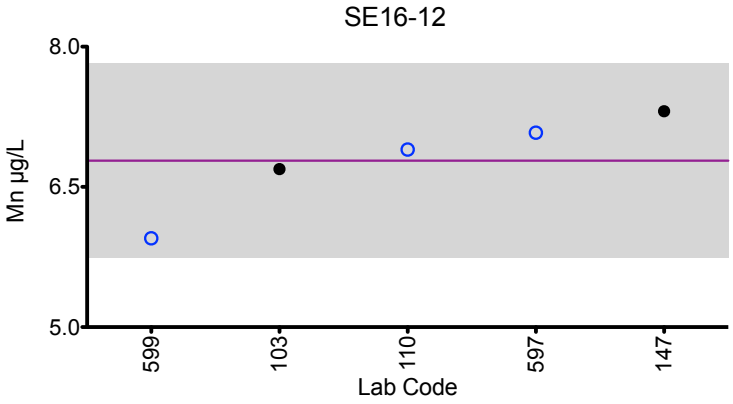
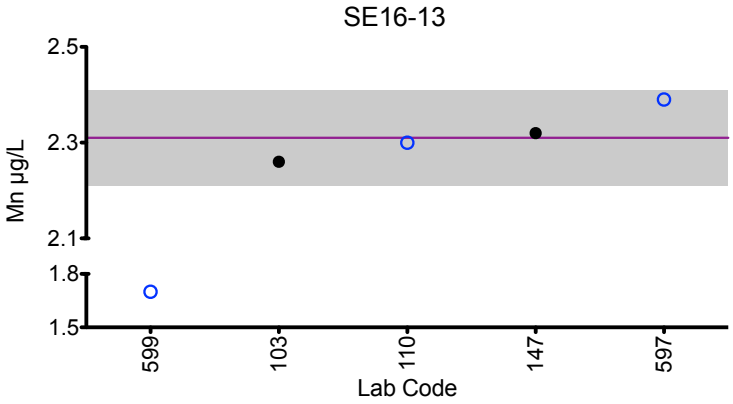
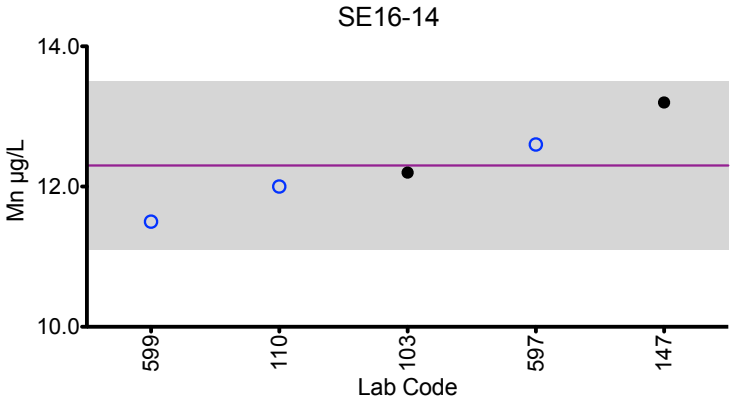
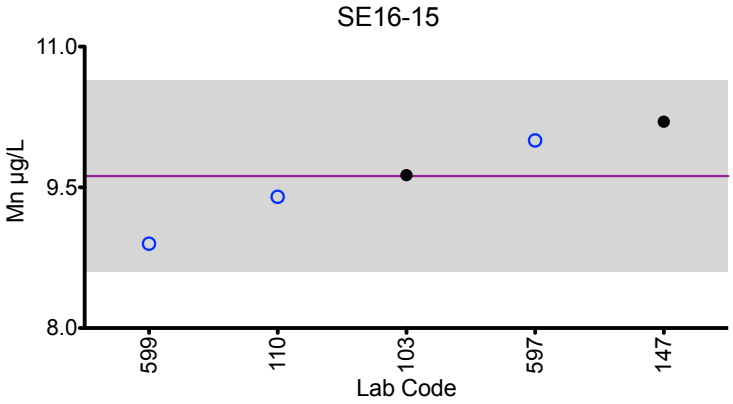
Results for Event #3, 2016: Serum Mn











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Results for Event #3, 2016
Additional Elements in Serum: Molybdenum (Mo)

Serum Mo (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	0.630	8.88	5.34	1.52	0.974
110	ICP-MS	0.77	8.6	5.5	1.6	1.1
147	ICP-MS	0.760	9.11	5.33	1.58	1.1
485	HR-ICP-MS	<1	7.89	5.28	1.8	1.05
597	DRC/CC-ICP-MS	0.61	8.42	5.18	1.30	1.26
599	DRC/CC-ICP-MS	<0.1	6.80	*3.69	<LOD	*0.14

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	0.69	8.28	5.33	1.56	1.1
Arithmetic SD (s)	0.08	0.84	0.12	0.18	0.1
Arithmetic RSD (%)	11.6	10.1	2.3	11.5	9.1
Number of Sample Measurements (N)	4	6	5	5	5

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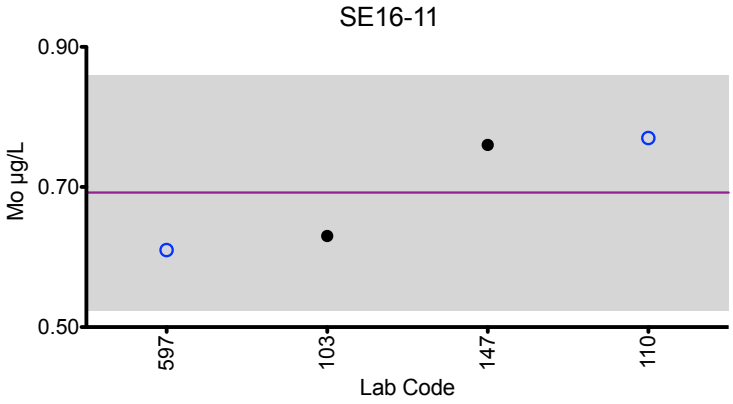
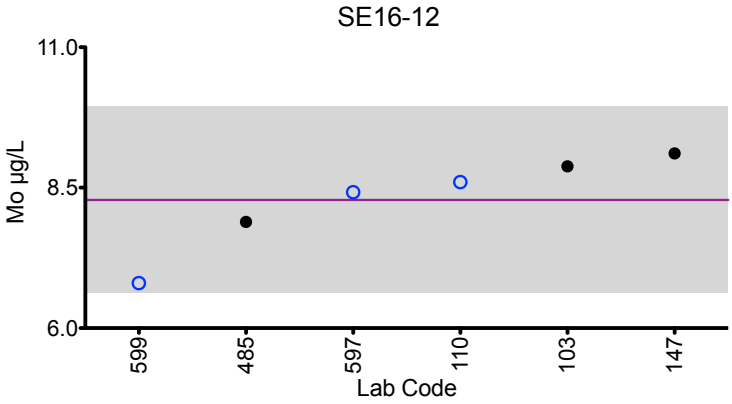
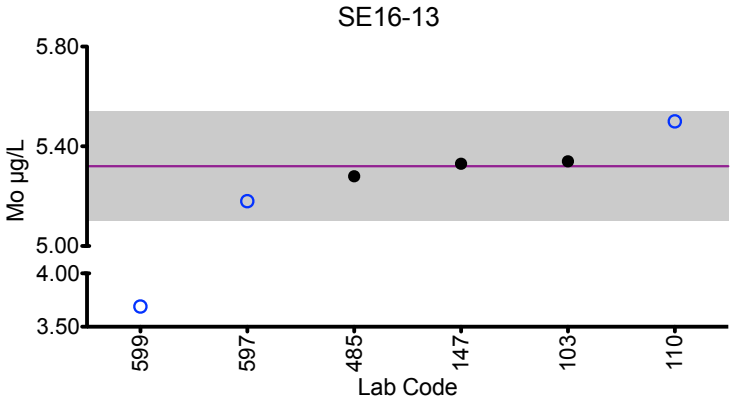
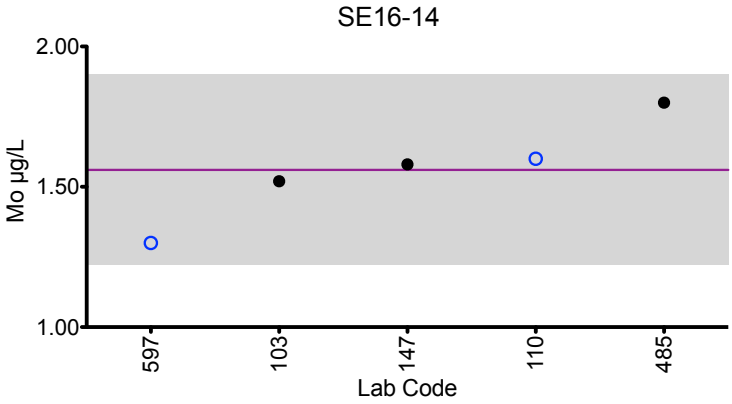
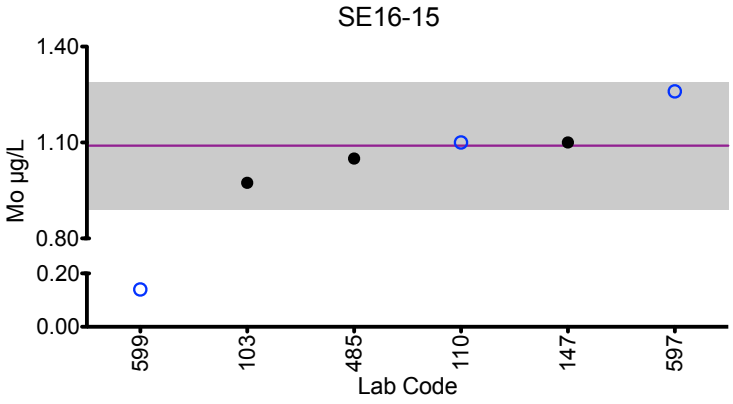
Results for Event #3, 2016: Serum Mo











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Results for Event #3, 2016
Additional Elements in Serum: Lead (Pb)

Serum Pb (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	7.17	3.96	11.6	2.04	0.938
110	ICP-MS	7.1	3.9	11.3	2.0	0.89
147	ICP-MS	8.04	4.58	12.8	2.28	1.06
597	DRC/CC-ICP-MS	7.85	4.56	12.6	2.49	1.36
599	DRC/CC-ICP-MS	5.79	2.79	9.19	1.34	0.407

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	7.2	4.0	11.5	2.0	0.93
Arithmetic SD (s)	0.9	0.7	1.4	0.4	0.35
Arithmetic RSD (%)	12.5	17.5	12.2	20.0	38
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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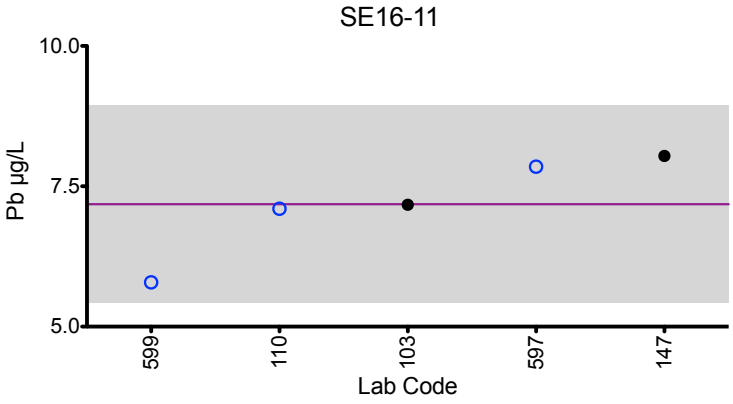
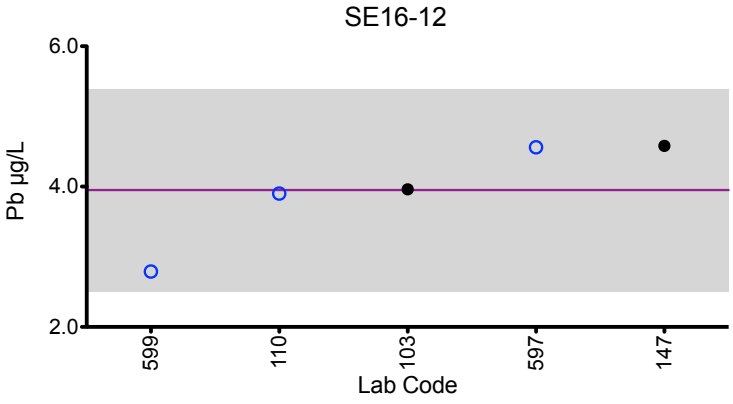
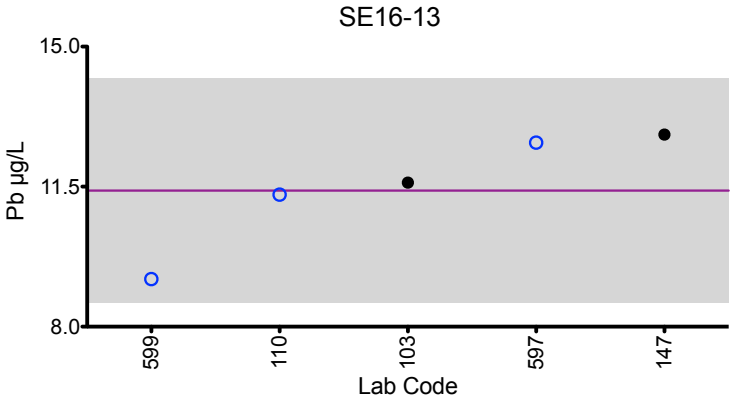
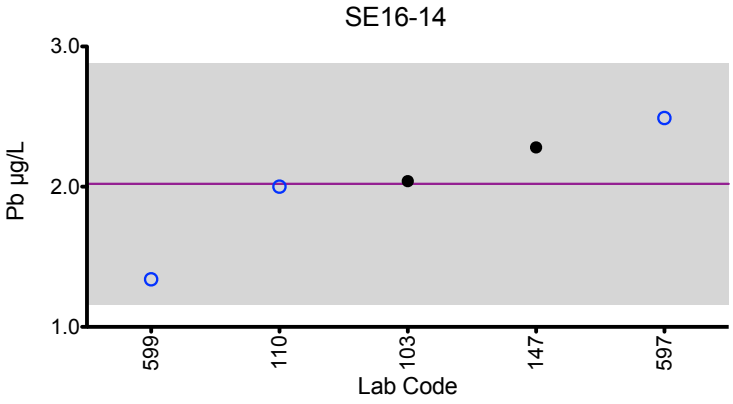
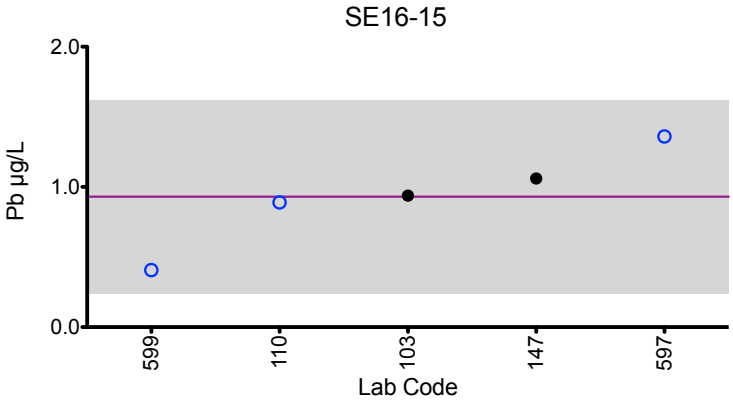
Results for Event #3, 2016: Serum Pb











Legend:
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Results for Event #3, 2016
Additional Elements in Serum: Antimony (Sb)

Serum Sb (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
103	DRC/CC-ICP-MS	4.60	4.38	1.10	1.82	0.915
110	ICP-MS	4.32	4.02	0.98	1.58	0.94
147	ICP-MS	4.01	3.96	0.952	1.52	0.822
597	DRC/CC-ICP-MS	4.56	4.43	1.70	1.80	1.30
599	DRC/CC-ICP-MS	3.29	*2.59	0.463	0.863	0.386

Summary Statistics

	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
Arithmetic Mean ($\bar{x}$)	4.2	4.2	1.0	1.5	0.87
Arithmetic SD (s)	0.5	0.2	0.4	0.4	0.33
Arithmetic RSD (%)	11.9	4.8	40	27	38
Number of Sample Measurements (N)	5	4	5	5	5

*Denotes a statistical Outlier.

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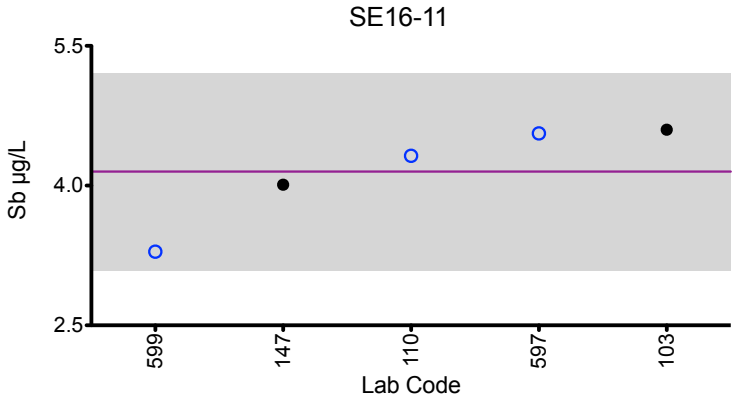
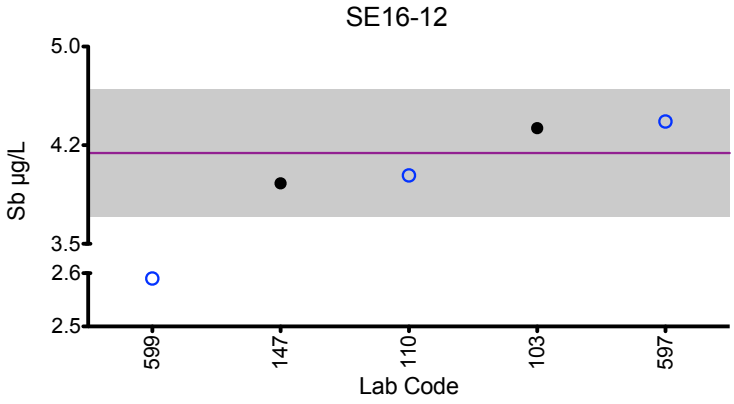
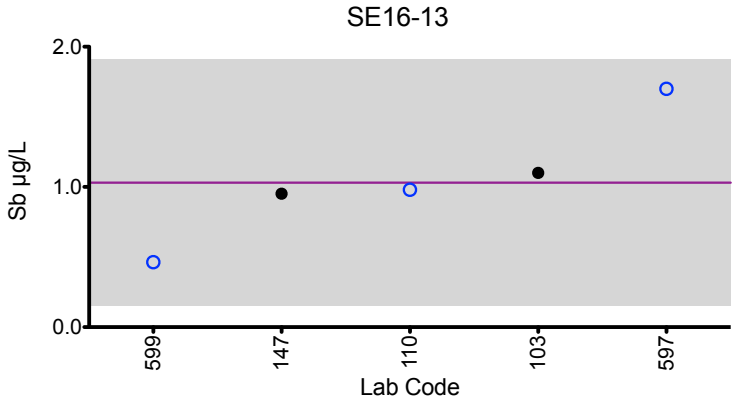
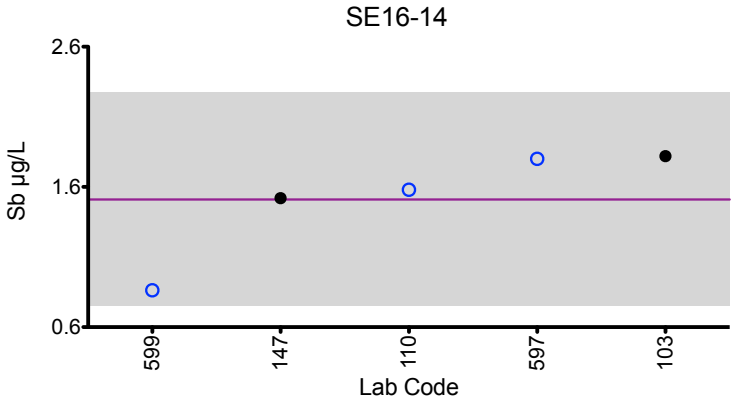
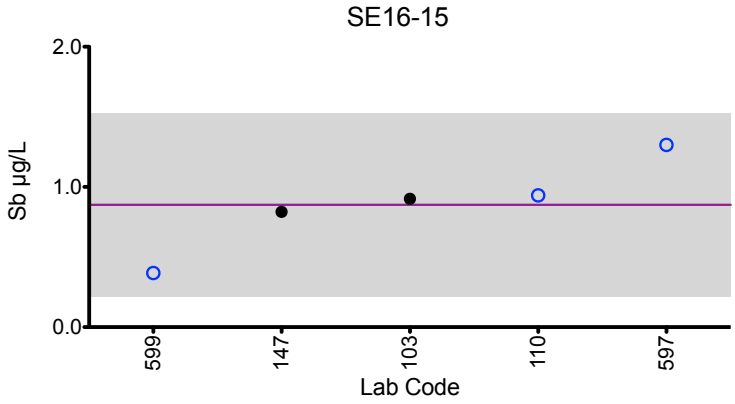
Results for Event #3, 2016: Serum Sb











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Results for Event #3, 2016
Additional Elements in Serum: Thallium (Tl)

Serum Tl (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	1.03	5.15	1.69	0.907	3.22
110	ICP-MS	1.0	5.2	1.7	0.91	3.3
147	ICP-MS	1.06	5.60	1.76	0.922	3.39
597	DRC/CC-ICP-MS	1.04	5.44	1.75	0.91	3.47
599	DRC/CC-ICP-MS	0.889	4.30	*1.44	*0.787	2.77

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	1.0	5.1	1.7	0.91	3.2
Arithmetic SD (s)	0.1	0.5	0.0	0.01	0.3
Arithmetic RSD (%)	10.0	9.8	0.0	1.1	9.4
Number of Sample Measurements (N)	5	5	4	4	5

*Denotes a statistical Outlier.

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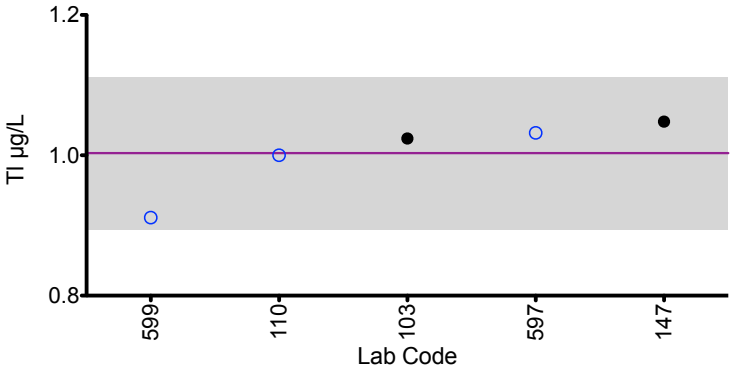
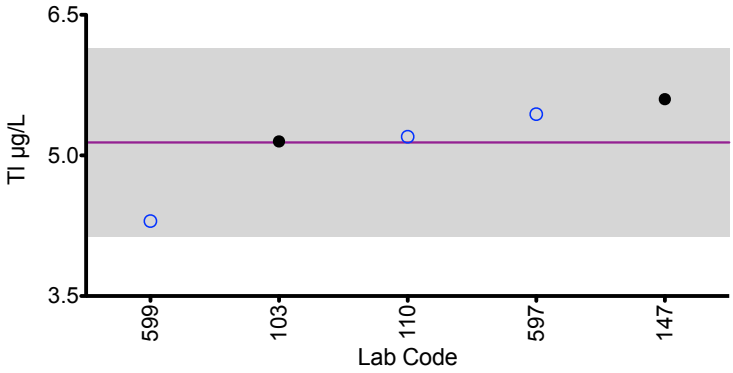
Results for Event #3, 2016: Serum Tl

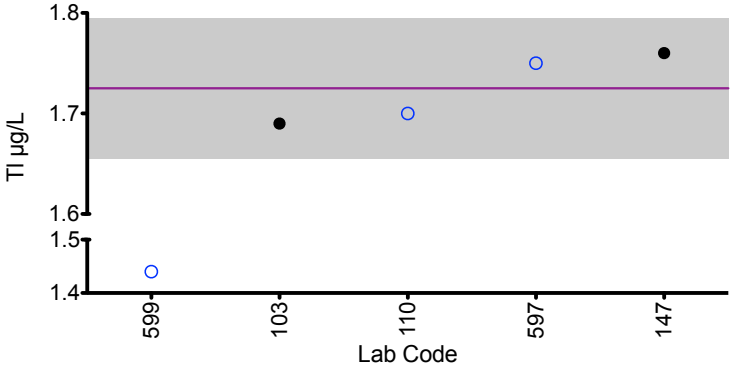
SE16-11



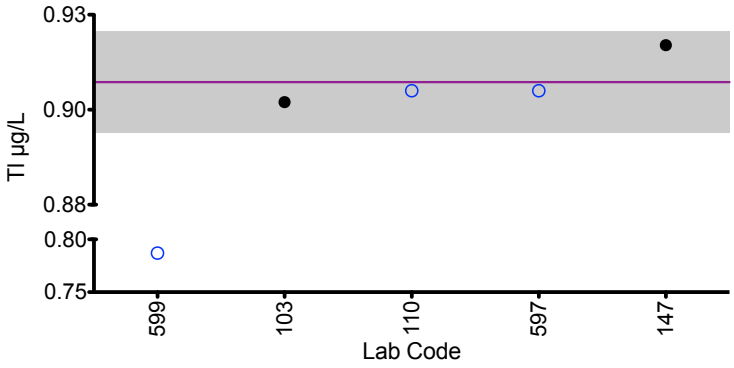
SE16-12



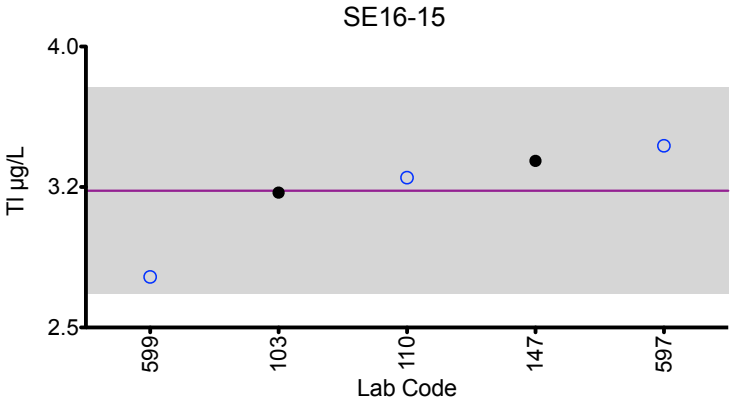
SE16-13



SE16-14



SE16-15



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Results for Event #3, 2016
Additional Elements in Serum: Barium (Ba)

Serum Ba (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
110	ICP-MS	8.2	1.6	0.56	10.7	13.6
147	ICP-MS	8.39	1.66	0.537	10.9	14.4
597	DRC/CC-ICP-MS	8.15	1.57	0.62	10.7	14.4

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	8.2	1.6	0.57	10.8	14.1
Arithmetic SD (s)	0.1	0.0	0.04	0.1	0.5
Arithmetic RSD (%)	1.2	0.00	7.0	0.93	3.5
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Beryllium (Be)

Serum Be (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
110	ICP-MS	3.2	1.5	4.0	<0.04	0.22
147	ICP-MS	3.05	1.75	4.37	< 0.441	< 0.441
599	DRC/CC-ICP-MS	2.48	1.14	3.54	<0.1	0.138

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	2.9	1.5	4.0	NA	0.18
Arithmetic SD (s)	0.4	0.3	0.4	NA	0.06
Arithmetic RSD (%)	13.8	20.0	10.0	NA	33.3
Number of Sample Measurements (N)	3	3	3	NA	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Cesium (Cs)

Serum Cs (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
110	ICP-MS	0.74	0.41	0.72	0.40	0.37
597	DRC/CC-ICP-MS	0.68	0.37	0.68	0.33	0.34

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	0.7	0.4	0.7	0.4	0.4
Arithmetic SD (s)	0.0	0.0	0.0	0.0	0.0
Arithmetic RSD (%)	0.0	0.0	0.0	0.0	0.0
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Iron (Fe)

Serum Fe (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
457	ICP-AES/OES	755.00	1145	743	1160	468
483	DRC/CC-ICP-MS	760	1150	720	1170	460

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	758	1148	732	1165	464
Arithmetic SD (s)	4	4	16	7	6
Arithmetic RSD (%)	0.53	0.35	2.2	0.60	1.3
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Mercury (Hg)

Serum Hg (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	2.96	4.47	0.323	1.38	9.34
110	ICP-MS	2.8	4.3	0.13	1.1	8.9
147	ICP-MS	2.96	4.41	0.388	1.43	9.44

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	2.9	4.4	0.28	1.3	9.2
Arithmetic SD (s)	0.1	0.1	0.13	0.2	0.3
Arithmetic RSD (%)	3.4	2.3	46	15.4	3.3
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Nickel (Ni)

Serum Ni (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
110	DRC/CC-ICP-MS	0.9	3.8	10.1	5.3	8.2
147	ICP-MS	1.11	4.13	11.6	5.55	10.8
485	HR-ICP-MS	0.840	3.45	11.3	5.38	8.39
599	DRC/CC-ICP-MS	1.38	2.57	8.24	*3.92	7.31

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	1.1	3.5	10.3	5.4	8.7
Arithmetic SD (s)	0.2	0.7	1.5	0.1	1.5
Arithmetic RSD (%)	18.2	20.0	14.6	1.9	17.2
Number of Sample Measurements (N)	4	4	4	3	4

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Tin (Sn)

Serum Sn (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
110	ICP-MS	10.9	3.7	5.9	2.7	1.1
147	ICP-MS	10.0	3.5	5.55	2.41	1.10
599	DRC/CC-ICP-MS	*3.73	*0.870	*1.4	<0.1	<0.1

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	10.5	3.6	5.7	2.6	1.1
Arithmetic SD (s)	0.6	0.1	0.2	0.2	0.0
Arithmetic RSD (%)	5.7	2.8	3.5	7.7	0.00
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Strontium (Sr)

Serum Sr (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	27.9	28	28.0	27.9	35.9
200	ICP-MS	28.9	28.0	42.0	39.4	48.2

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	28.4	28.0	35.0	33.7	42.1
Arithmetic SD (s)	0.7	0.0	9.9	8.1	8.7
Arithmetic RSD (%)	2.5	0.00	28	24	21
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Uranium (U)

Serum U (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
103	DRC/CC-ICP-MS	0.120	0.0232	0.0345	0.0118	0.00335
110	ICP-MS	0.110	0.031	0.032	0.019	0.003
147	ICP-MS	0.122	0.0219	0.0357	< 0.0145	< 0.0145
Summary Statistics						
		SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)		0.117	0.025	0.034	0.015	0.003
Arithmetic SD (s)		0.006	0.005	0.002	0.005	0.000
Arithmetic RSD (%)		5.1	20	5.9	33	0.0
Number of Sample Measurements (N)		3	3	3	2	2

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Vanadium (V)

Serum V (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
110	DRC/CC-ICP-MS	0.6	4.5	10.4	1.2	2.7
147	DRC/CC-ICP-MS	0.436	4.58	11.4	1.05	2.83
485	HR-ICP-MS	0.337	4.15	11.3	1.01	2.45
597	DRC/CC-ICP-MS	0.39	4.31	11.2	0.99	2.72

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	0.4	4.4	11.1	1.1	2.7
Arithmetic SD (s)	0.1	0.2	0.5	0.1	0.2
Arithmetic RSD (%)	25	4.5	4.5	9.1	7.4
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum: Tungsten (W)

Serum W (µg/L)						
Lab Code	**Method**	**SE16-11**	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
110	ICP-MS	0.67	1.5	0.39	3.9	2.4
147	ICP-MS	0.677	1.61	0.377	4.39	2.72
200	ICP-MS	1	1.5	0.4	4.9	2.9
599	DRC/CC-ICP-MS	*3.29	*3.20	*0.971	5.11	2.91

Summary Statistics					
	SE16-11	**SE16-12**	**SE16-13**	**SE16-14**	**SE16-15**
Arithmetic Mean ($\bar{x}$)	0.8	1.5	0.4	4.6	2.7
Arithmetic SD (s)	0.2	0.1	0.0	0.5	0.2
Arithmetic RSD (%)	25	6.7	0.00	10.9	7.4
Number of Sample Measurements (N)	3	3	3	4	4

*Denotes a statistical Outlier.

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Results for Event #3, 2016
Additional Elements in Serum

Serum Ag (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
147	ICP-MS	0.266	< 0.248	0.269	< 0.248	< 0.248

Serum B (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
200	ICP-MS	14.0	16.2	5.4	20.5	19.4

Serum Bi (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
147	ICP-MS	< 0.201	< 0.201	< 0.201	< 0.201	< 0.201

Serum I (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
147	ICP-MS	54.2	54.4	53.5	52.2	49.0

Serum Li (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
147	ICP-MS	0.640	0.373	0.694	0.343	0.527

Serum Pt (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
110	ICP-MS	0.95	0.11	1.25	0.27	0.17

Serum Te (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
147	ICP-MS	< 0.0880	< 0.0880	< 0.0880	< 0.0880	< 0.0880

Serum Th (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
147	ICP-MS	< 0.00789	< 0.00789	< 0.00789	< 0.00789	< 0.00789

Serum Ti (µg/L)

Lab Code	Method	SE16-11	SE16-12	SE16-13	SE16-14	SE16-15
200	DRC/CC-ICP-MS	32.6	12.8	105	46.0	83.3
485	HR-ICP-MS	56.3	19.5	229	85.1	160

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.