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New York State Biomonitoring Program for Trace Elements

Event #2, 2016

Trace Elements in Whole Blood, Urine, and Serum

September, 2016

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #2, 2016:
Trace Elements in Whole Blood, Urine, and Serum

9/6/2016

Dear Laboratory Director,

This report summarizes performance for the second 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 #3 of 2016) will be shipped October 12th 2016. Comments about this report may be directed to trel@health.ny.gov

Sincerely,

Patrick J. Parsons, PhD
Chief, Inorganic and Nuclear Chemistry
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Wadsworth Center

Aubrey L. Galusha, PhD
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Event #2, 2016

Trace Elements in Whole Blood

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Event #2, 2016:
Trace Elements in Whole Blood

PT Materials

Caprine (goat) whole blood was collected in Hospira "empty container" blood bags and preserved with K_2EDTA. 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 homogenized 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 24 elements (beyond the seven graded) were reported by at least one participant: Ag, Al, Ba, Be, Bi, Cs, Cu, I, Li 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 #2, 2016
Whole Blood Arsenic (As)

Summary Statistics

Whole Blood As (µg/L)	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Target (Arithmetic Mean ($\bar{x}$))	8.35	5.34	18.6	13.2	34.5
Upper Limit	14.35	11.34	24.6	19.2	41.4
Lower Limit	2.35	0.00	12.6	7.2	27.6
Arithmetic SD (s)	3.35	3.50	1.8	3.1	2.4
Arithmetic RSD (%)	40.1	65.5	9.91	23.3	7.19
Number of Sample Measurements (N)	9	9	8	9	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 #2, 2016
Whole Blood Arsenic (As)
Performance of Participating Laboratories

		Whole Blood As (µg/L)				
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
	Target	**8.35**	**5.34**	**18.6**	**13.2**	**34.5**
103	DRC/CC-ICP-MS	6.44	2.97	17.8	11.3	32.7
110	DRC/CC-ICP-MS	6.4	3.1	17.6	11.4	34.7
147	ICP-MS	5.83	2.8	18.1	11.2	33.2
200	ICP-MS	12.0	9.8	19.5	13.5	33.8
293	DRC/CC-ICP-MS	6.61	3.5	17.23	11.61	33.71
391	DRC/CC-ICP-MS	7.03	3.7	17.779	11.86	34.818
596	ICP-MS	11.1	6.74	22.9	17.2	40.4
597	DRC/CC-ICP-MS	5.12	3.17	18.2	11.7	33.0
598	DRC/CC-ICP-MS	14.70 ↑	12.3 ↑	*27.3 ↑	19.8 ↑	*45.8 ↑

Based on the grading criteria for As in Whole Blood, 88% of results were satisfactory, with 1 of the 9 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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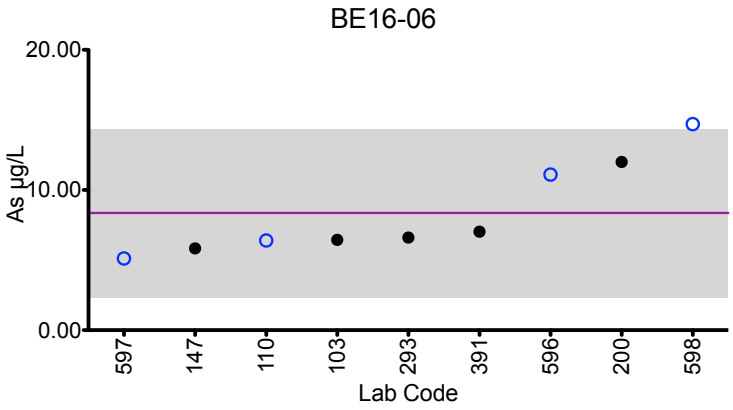
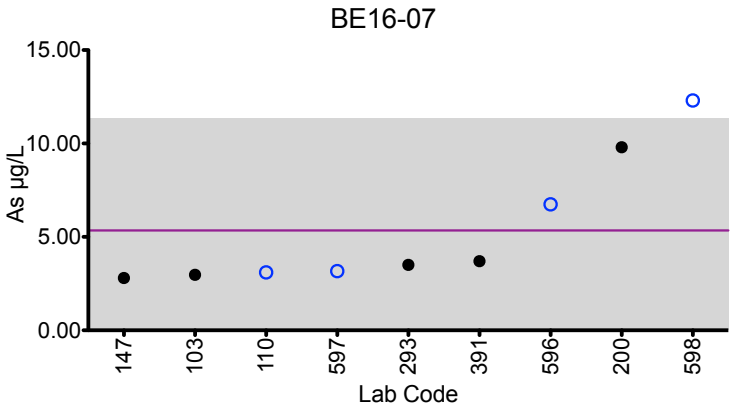
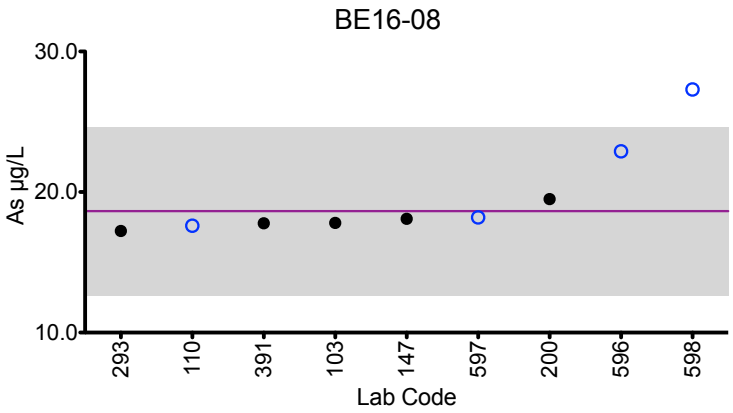
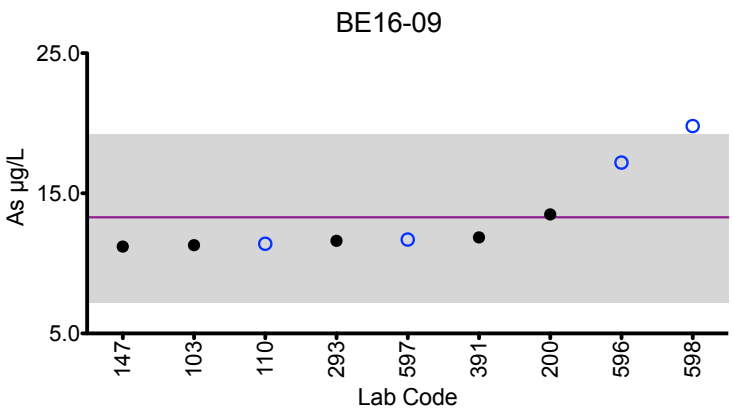
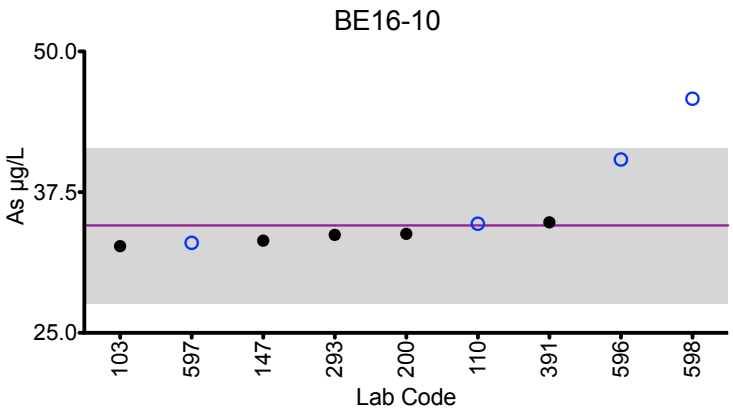
Results for Event #2, 2016: Whole Blood As











Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Whole Blood Cadmium (Cd)

Summary Statistics

Whole Blood Cd (µg/L)	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Target (Robust Mean (x*))	7.59	5.10	3.91	0.891	1.69
Upper Limit	8.73	6.10	4.91	1.891	2.69
Lower Limit	6.45	4.10	2.91	0.000	0.69
Robust SD (s*)	0.57	0.33	0.25	0.161	0.16
Robust RSD (%)	7.62	6.52	6.62	18.0	9.86
Number of Sample Measurements (N)	15	15	15	15	15
Standard Uncertainty (*u*)	0.186	0.107	0.083	0.052	0.053

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

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Results for Event #2, 2016
Whole Blood Cadmium (Cd)
Performance of Participating Laboratories

		Whole Blood Cd (µg/L)				
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
	Target	**7.59**	**5.10**	**3.91**	**0.891**	**1.69**
103	DRC/CC-ICP-MS	8.33	5.48	4.01	0.958	1.68
107	ICP-MS	8.2	5.3	4.1	0.92	1.8
110	ICP-MS	8.2	5.4	4.1	0.9	1.8
116	DRC/CC-ICP-MS	7.88	5.37	4.02	0.860	1.71
147	ICP-MS	7.78	5.33	4.26	1.01	2.02
200	ICP-MS	7.3	4.8	3.8	0.9	1.7
293	ICP-MS	7.39	4.62	3.39	0.82	1.54
391	DRC/CC-ICP-MS	7.7	5.316	3.806	0.945	1.619
596	HR-ICP-MS	7.10	4.37	3.29	0.658	1.03
597	DRC/CC-ICP-MS	6.14 ↓	4.95	3.92	0.80	1.53
598	ICP-MS	6.75	4.75	3.53	1.09	1.8
599	DRC/CC-ICP-MS	6.73	4.25	3.23	0.589	1.25
605	ICP-MS	7.85	5.07	3.95	0.659	1.63
606	ICP-MS	7.84	5.40	4.32	1.61	2.21
686	ICP-MS	7.86	5.19	3.98	1.02	1.8

Based on the grading criteria for Cd in Whole Blood, 98% of results were satisfactory, with 0 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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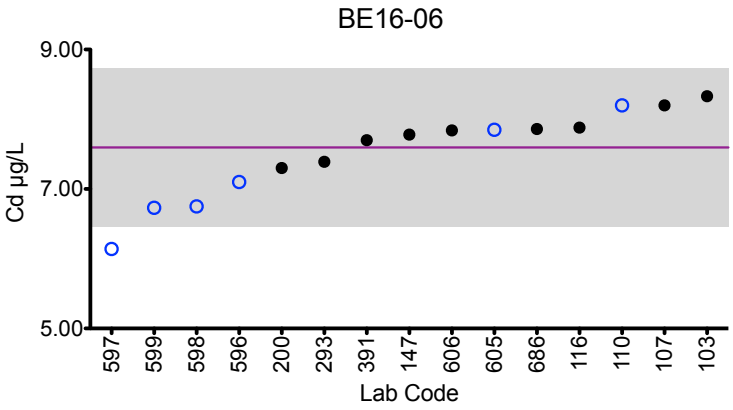
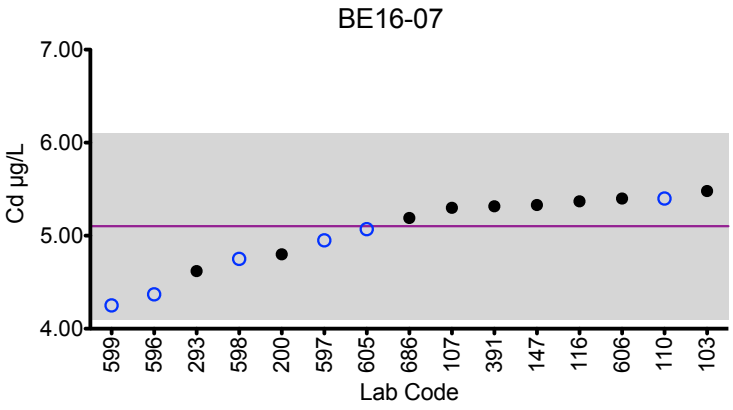
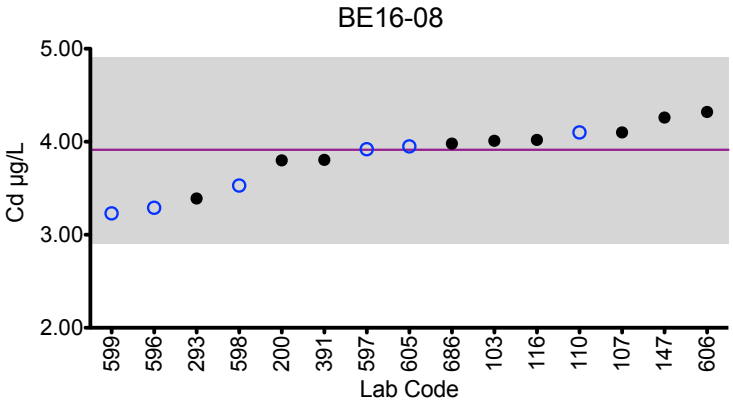
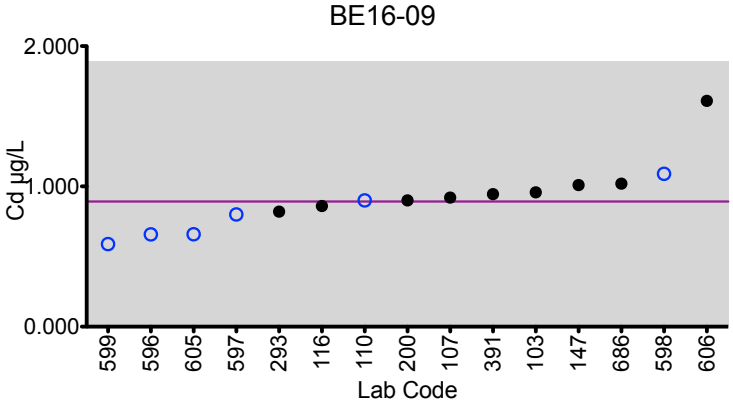
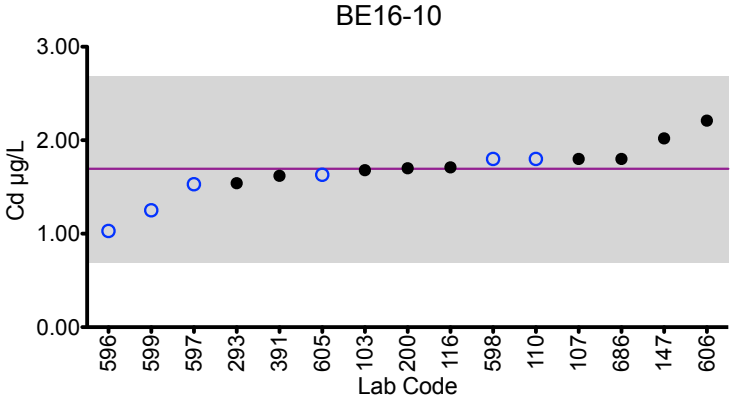
Results for Event #2, 2016: Whole Blood Cd











Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Whole Blood Cobalt (Co)

Summary Statistics

	Whole Blood Co (µg/L)				
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Target (Arithmetic Mean ($\bar{x}$))	10.1	4.06	6.73	15.3	9.66
Upper Limit	12.2	5.56	8.23	18.4	11.59
Lower Limit	8.1	2.56	5.23	12.2	7.73
Arithmetic SD (s)	1.1	0.31	0.46	1.0	0.67
Arithmetic RSD (%)	11.1	7.75	6.90	6.83	7.02
Number of Sample Measurements (N)	8	8	8	8	8

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

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Results for Event #2, 2016
Whole Blood Cobalt (Co)
Performance of Participating Laboratories

		Whole Blood Co (µg/L)				
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
	Target	**10.1**	**4.06**	**6.73**	**15.3**	**9.66**
103	DRC/CC-ICP-MS	11.1	4.24	6.88	16.1	9.96
110	ICP-MS	11.3	4.5	7.4	17.1	10.5
147	ICP-MS	10.4	4.06	6.95	15.6	10
293	DRC/CC-ICP-MS	10.6	4.07	6.71	15.31	10.01
391	DRC/CC-ICP-MS	10.629	4.281	6.895	15.611	10.043
596	ICP-MS	10.6	4.13	6.90	15.3	9.44
597	DRC/CC-ICP-MS	8.13	3.60	6.23	14.1	8.51
598	ICP-MS	8.73	3.61	5.9	13.8	8.84

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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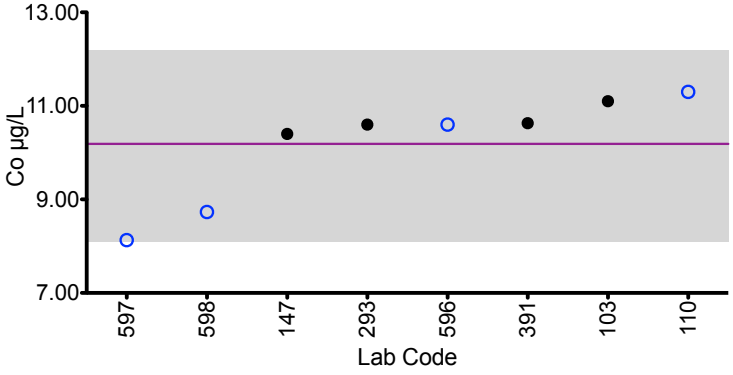
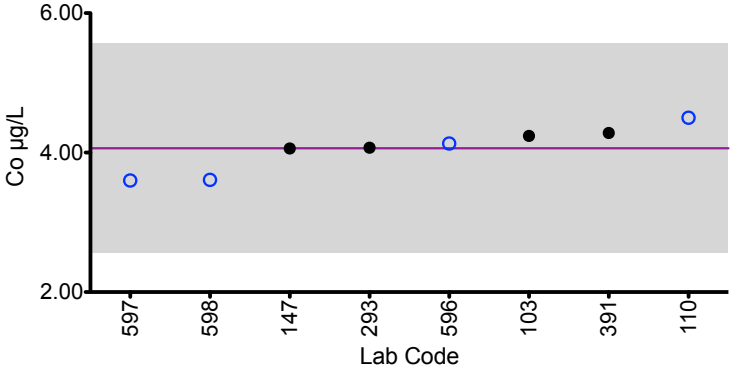
Results for Event #2, 2016: Whole Blood Co

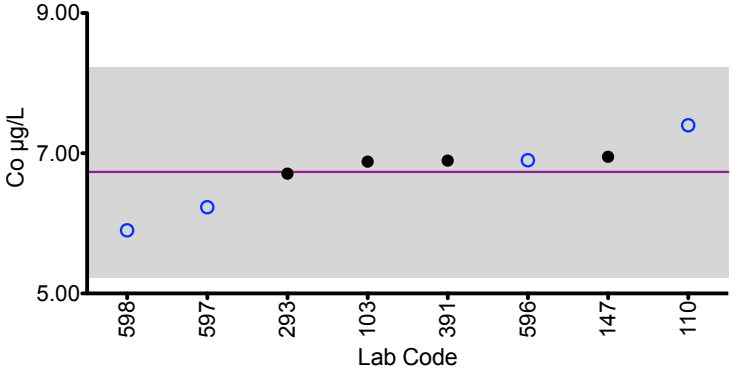
BE16-06



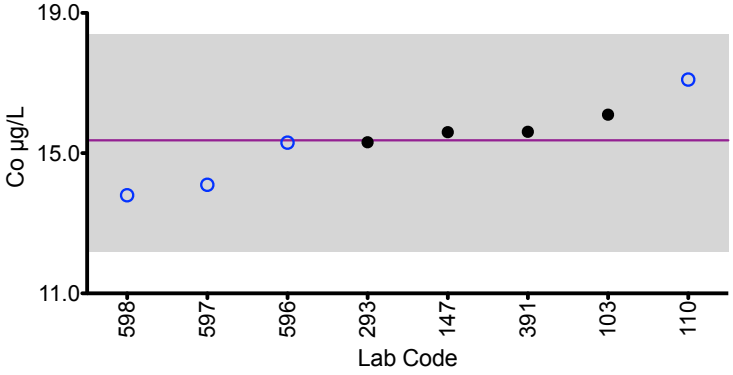
BE16-07



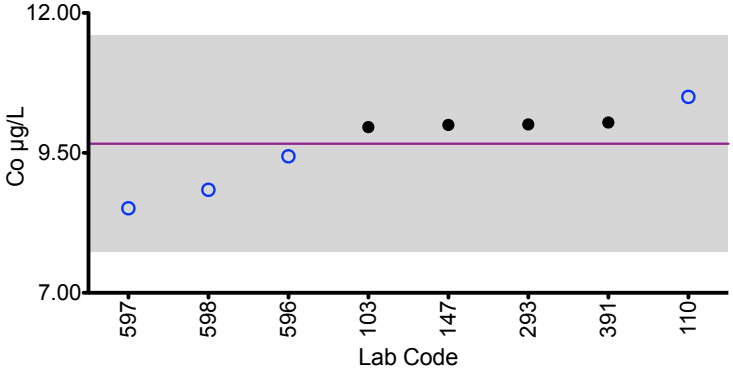
BE16-08



BE16-09



BE16-10



Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Whole Blood Chromium (Cr)

Summary Statistics

	Whole Blood Cr (µg/L)				
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Target (Arithmetic Mean ($\bar{x}$))	4.75	7.00	11.6	3.09	1.39
Upper Limit	6.75	9.00	13.9	5.09	3.39
Lower Limit	2.75	5.00	9.2	1.09	0.00
Arithmetic SD (s)	1.01	0.80	1.6	1.22	1.25
Arithmetic RSD (%)	21.3	11.5	14.4	39.4	89.9
Number of Sample Measurements (N)	8	8	8	7	7

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

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Results for Event #2, 2016
Whole Blood Chromium (Cr)
Performance of Participating Laboratories

		Whole Blood Cr (µg/L)				
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
	Target	**4.75**	**7.00**	**11.6**	**3.09**	**1.39**
103	DRC/CC-ICP-MS	4.50	6.36	10.7	2.34	0.773
110	DRC/CC-ICP-MS	4.7	6.9	11.0	4.5	1.0
147	DRC/CC-ICP-MS	4.12	6.45	11.1	2.29	0.889
293	DRC/CC-ICP-MS	5.72	7.28	13.36	3.28	2.3
391	DRC/CC-ICP-MS	3.715	6.383	12.505	1.897	0.014
596	ICP-MS	4.98	8.52	9.29	<LOD	<LOD
597	DRC/CC-ICP-MS	3.66	6.35	10.5	2.35	0.98
598	DRC/CC-ICP-MS	6.62	7.8	14.4 ↑	5.02	3.78 ↑

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

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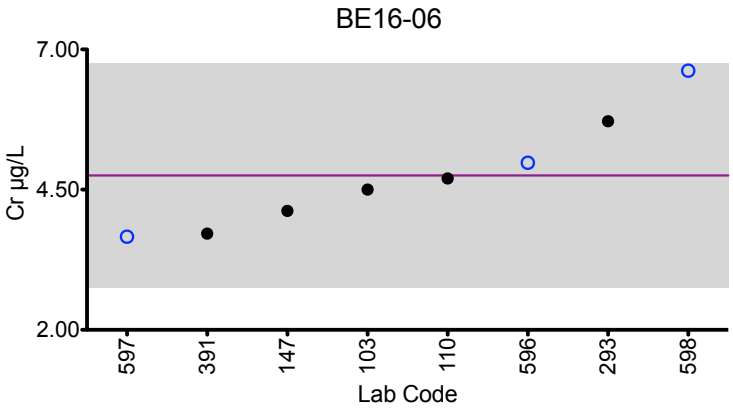
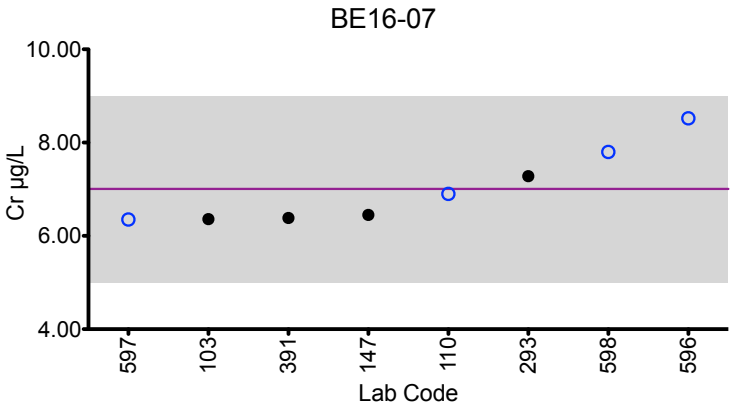
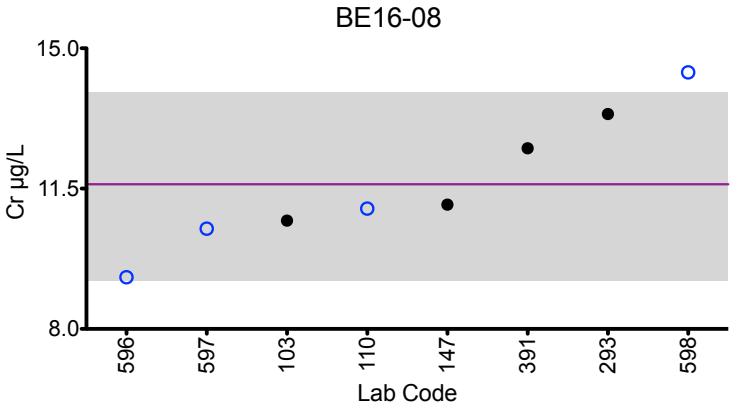
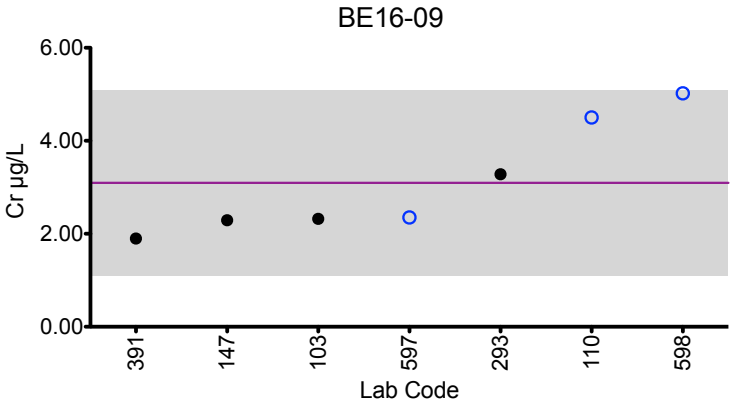
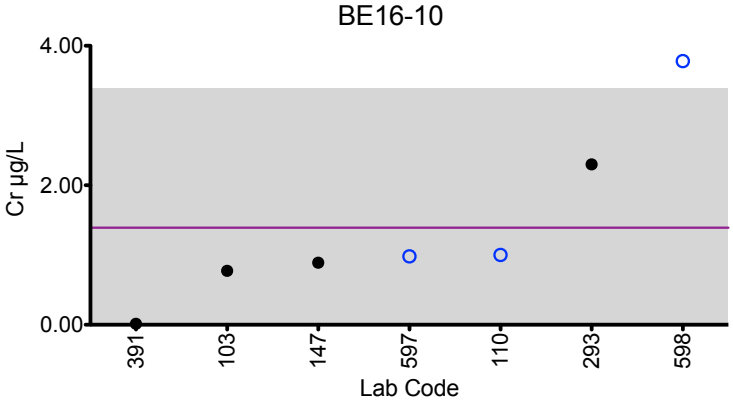
Results for Event #2, 2016: Whole Blood Cr











Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Whole Blood Mercury (Hg)

Summary Statistics

Whole Blood Hg (µg/L)

	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Target (Robust Mean (x*))	0.949	25.6	5.83	16.0	2.40
Upper Limit	3.949	33.2	8.83	20.8	5.40
Lower Limit	0.000	17.9	2.83	11.2	0.00
Robust SD (s*)	0.205	2.5	0.29	2.0	0.27
Robust RSD (%)	21.6	9.98	5.03	12.9	11.6
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.068	0.853	0.098	0.694	0.093

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

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Results for Event #2, 2016
Whole Blood Mercury (Hg)
Performance of Participating Laboratories

		Whole Blood Hg (µg/L)				
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
	Target	**0.949**	**25.6**	**5.83**	**16.0**	**2.40**
103	DRC/CC-ICP-MS	0.852	24.3	5.76	14.2	2.19
107	DRC/CC-ICP-MS	1.2	28	6.2	16	2.9
110	ICP-MS	0.9	24.9	6.0	16.5	2.4
116	DRC/CC-ICP-MS	0.925	28.1	6.05	18.1	2.50
147	ICP-MS	0.678	24.1	6.02	14.7	2.16
200	ICP-MS	0.6	25.7	6.0	14.2	18.0 ↑
293	ICP-MS	0.98	19.32	5.13	11.42	2.06
391	HG-AAS	2.94	59.47 ↑	4.52	26.27 ↑	4.85
596	ICP-MS	0.983	22.7	5.33	15.0	2.37
597	DRC/CC-ICP-MS	1.10	26.5	4.97	17.8	2.17
598	ICP-MS	1.17	23.2	5.62	14.9	2.3
605	ICP-MS	0.985	26.0	6.02	17.6	2.46
606	ICP-MS	0.742	27.8	6.15	17.8	2.39
686	ICP-MS	0.869	25.9	5.89	15.9	2.20

Based on the grading criteria for Hg in Whole Blood, 95% of results were satisfactory, with 1 of the 14 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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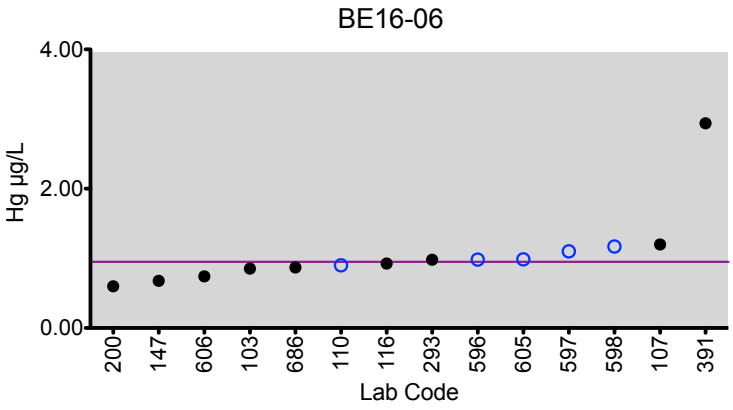
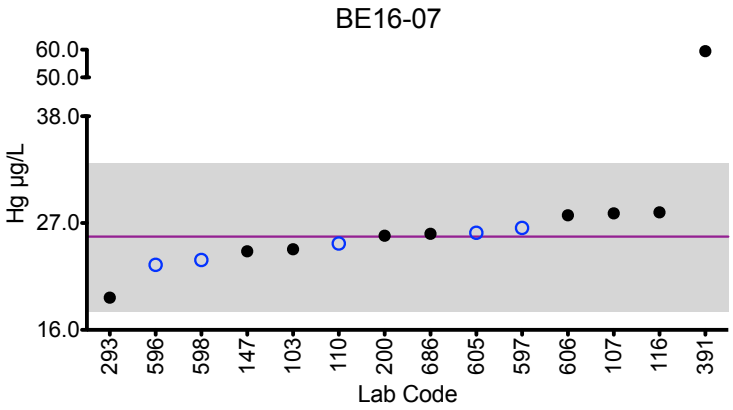
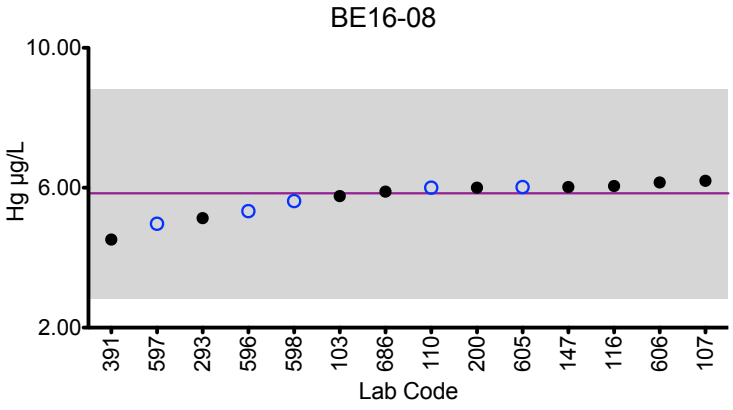
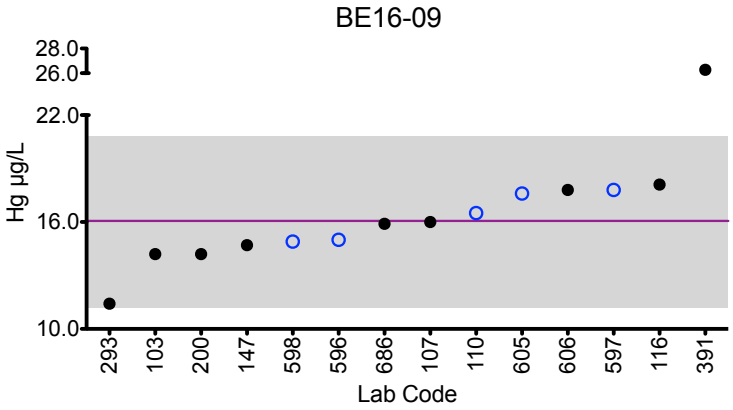
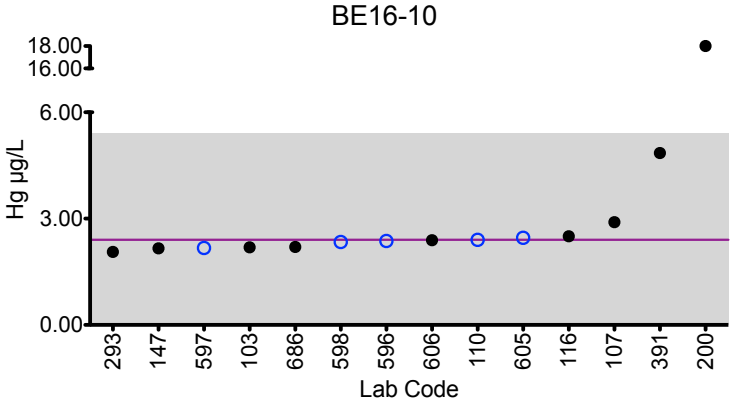
Results for Event #2, 2016: Whole Blood Hg











Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Whole Blood Manganese (Mn)

Summary Statistics

	Whole Blood Mn (µg/L)				
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Target (Robust Mean (x*))	19.4	15.3	16.9	23.6	29.9
Upper Limit	22.7	18.3	19.9	27.6	35.0
Lower Limit	16.1	12.3	13.9	19.6	24.8
Robust SD (s*)	2.1	1.1	1.2	1.9	2.7
Robust RSD (%)	11.2	7.78	7.5	8.42	9.16
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	0.861	0.473	0.503	0.786	1.08

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 #2, 2016
Whole Blood Manganese (Mn)
Performance of Participating Laboratories

		Whole Blood Mn (µg/L)				
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
	Target	**19.4**	**15.3**	**16.9**	**23.6**	**29.9**
103	DRC/CC-ICP-MS	19.1	15.3	16.6	22.7	30.1
107	DRC/CC-ICP-MS	22	17	18	28 ↑	34
110	ICP-MS	19.8	15.7	17	24.5	29.6
147	ICP-MS	18.1	14.9	16.9	23	30.4
293	ICP-MS	17.54	12.8	13.73 ↓	19.89	25.33
391	DRC/CC-ICP-MS	22.018	19.051 ↑	17.855	24.864	30.74
596	ICP-MS	18.9	14.8	16.2	22.1	27.6
597	DRC/CC-ICP-MS	15.5 ↓	14.1	15.7	22.4	27.1
598	ICP-MS	21.3	15.3	17.6	23.8	30.2
606	DRC/CC-ICP-MS	19.2	16.2	20.9 ↑	27.1	39.4 ↑

Based on the grading criteria for Mn in Whole Blood, 88% of results were satisfactory, with 1 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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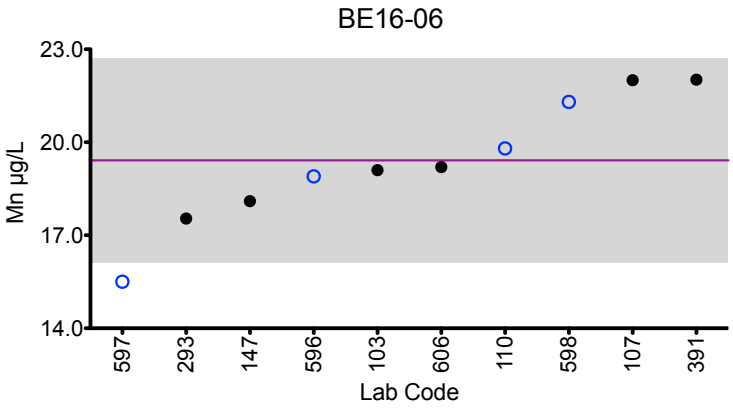
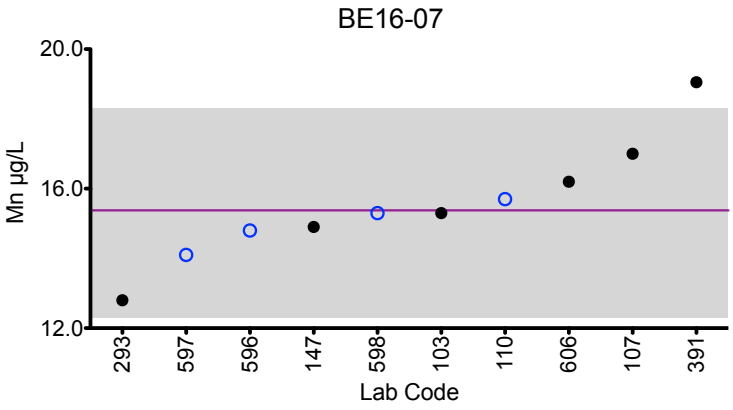
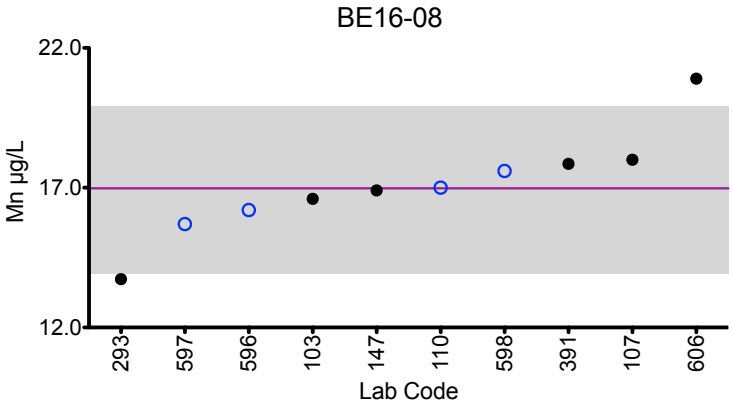
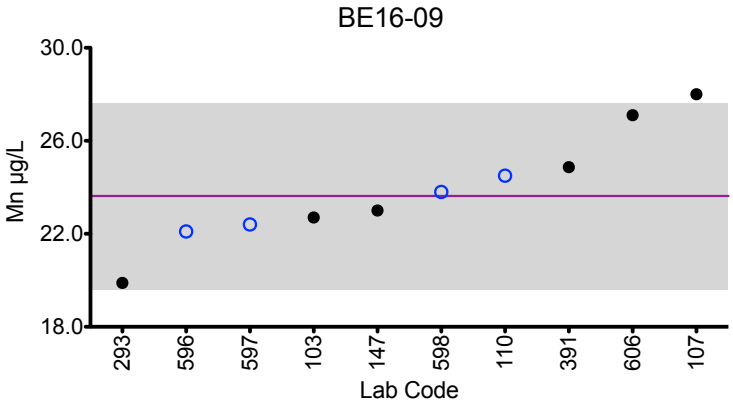
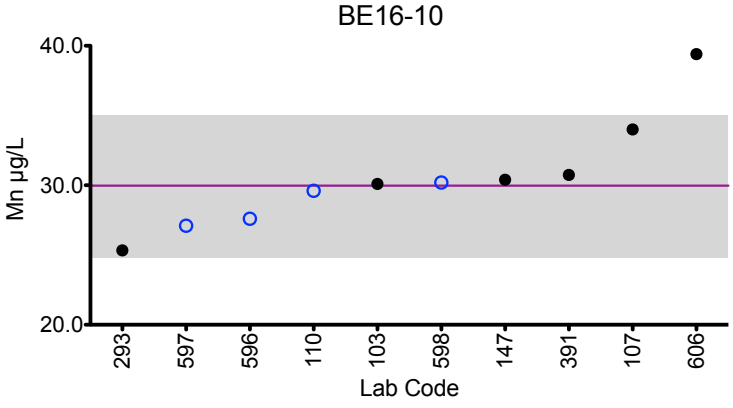
Results for Event #2, 2016: Whole Blood Mn











Legend:

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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 #2, 2016
Whole Blood Lead (Pb)

Summary Statistics

Whole Blood Pb (µg/dL)	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Target (Robust Mean (x*))	0.420	0.680	0.940	2.40	1.40
Upper Limit	2.420	2.680	2.940	4.40	3.40
Lower Limit	0.000	0.000	0.000	0.40	0.00
Robust SD (s*)	0.090	0.130	0.140	0.20	0.10
Robust RSD (%)	21.6	19.8	15.6	10.3	12.3
Number of Sample Measurements (N)	13	13	14	15	15
Standard Uncertainty (*u*)	0.031	0.046	0.049	0.082	0.057

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) 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. (http://shop.clsi.org/C40.html)

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Results for Event #2, 2016
Whole Blood Lead (Pb)
Performance of Participating Laboratories

		Whole Blood Pb (µg/dL)				
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
	Target	**0.420**	**0.680**	**0.940**	**2.40**	**1.40**
103	DRC/CC-ICP-MS	0.426	0.732	1.01	2.61	1.52
107	ICP-MS	0.46	0.73	1.0	2.6	1.6
110	ICP-MS	0.42	0.71	0.99	2.51	1.49
116	DRC/CC-ICP-MS	0.500	0.757	0.998	2.69	1.57
147	ICP-MS	0.365	0.64	0.916	2.3	1.4
200	ICP-MS	0.8	1.2	1.2	2.7	2.1
293	ICP-MS	0.42	0.62	0.83	2.29	1.25
391	ETAAS-Z	0.14	0.28	0.4	2.67	1.37
596	ICP-MS	0.42	0.705	0.973	2.50	1.41
597	DRC/CC-ICP-MS	0.314	0.588	0.848	2.08	1.21
598	ICP-MS	0.435	0.543	0.748	1.89	1.17
599	DRC/CC-ICP-MS	0.322	0.563	0.843	1.94	1.28
605	ICP-MS	PLC	PLC	PLC	2.50	1.49
606	ICP-MS	0.791	1.02	1.32	2.73	1.7
686	ICP-MS	<1.00	<1.00	1.01	2.53	1.52

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

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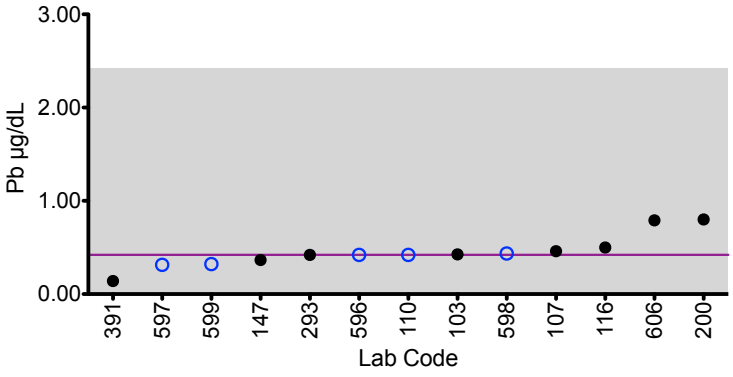
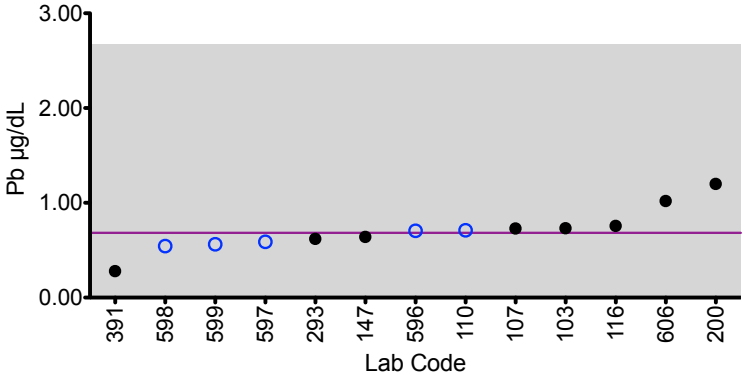
Results for Event #2, 2016: Whole Blood Pb

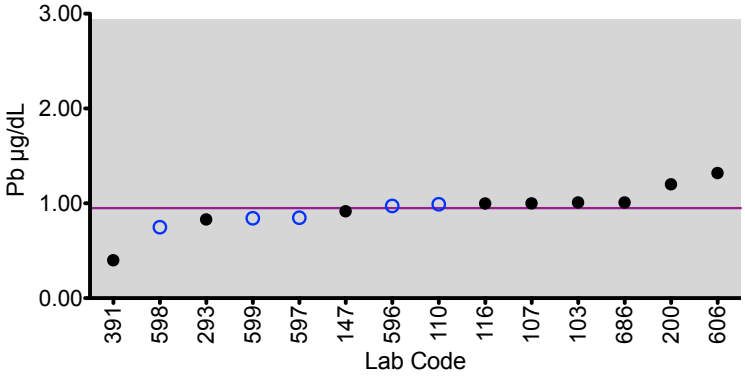
BE16-06



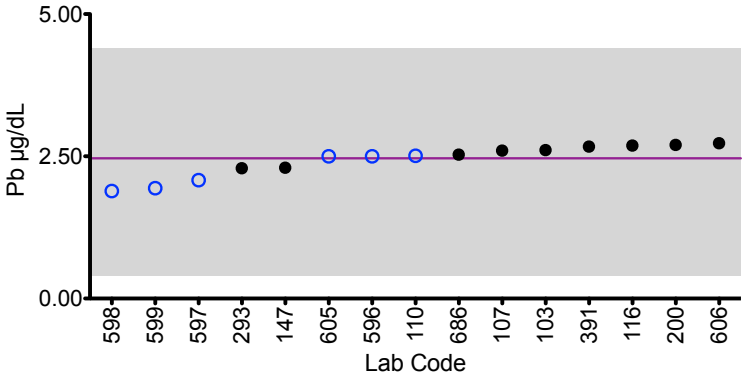
BE16-07



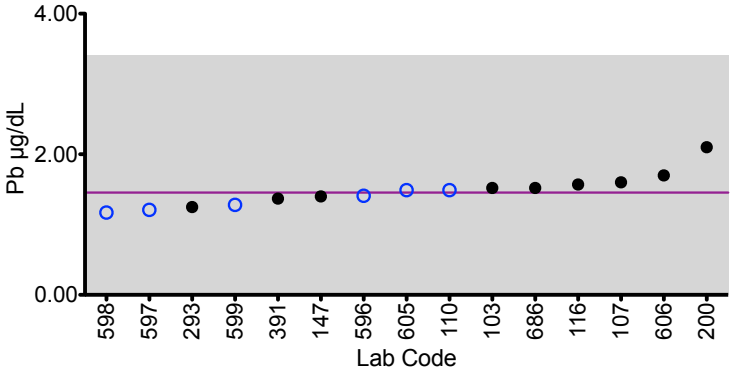
BE16-08



BE16-09



BE16-10



Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Additional Elements in Whole Blood: Selenium (Se)

Whole Blood Se (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
103	DRC/CC-ICP-MS	277	359	338	269	330
107	DRC/CC-ICP-MS	330	400	380	330	380
110	DRC/CC-ICP-MS	293	370	339	292	342
147	ICP-MS	288	361	360	284	339
597	DRC/CC-ICP-MS	272	442	423	360	395

Summary Statistics

	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Arithmetic Mean ($\bar{x}$)	292	386	368	307	357
Arithmetic SD (s)	22	35	35	37	28
Arithmetic RSD (%)	7.82	9.09	9.58	12.1	7.98
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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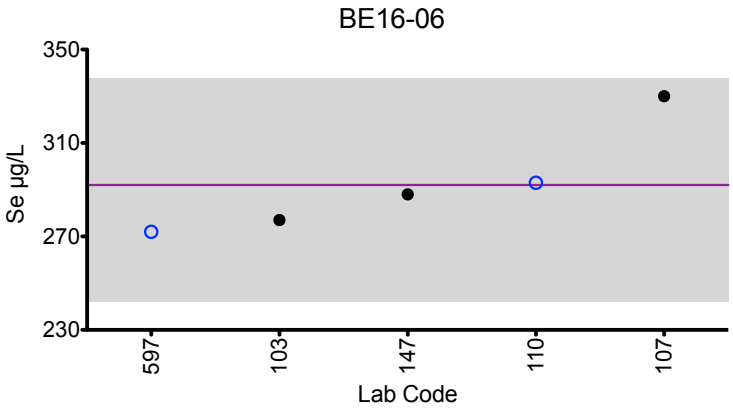
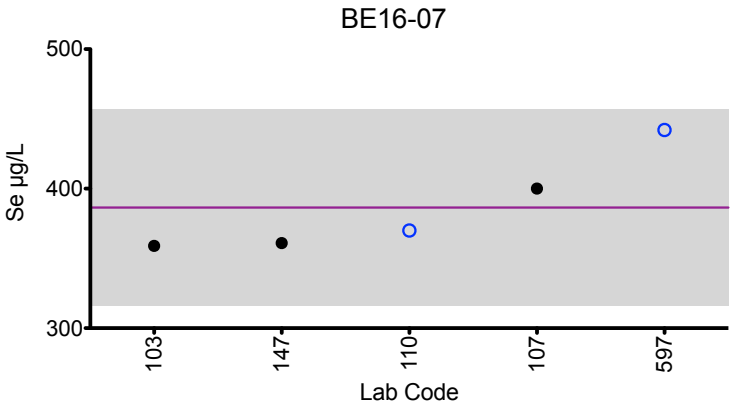
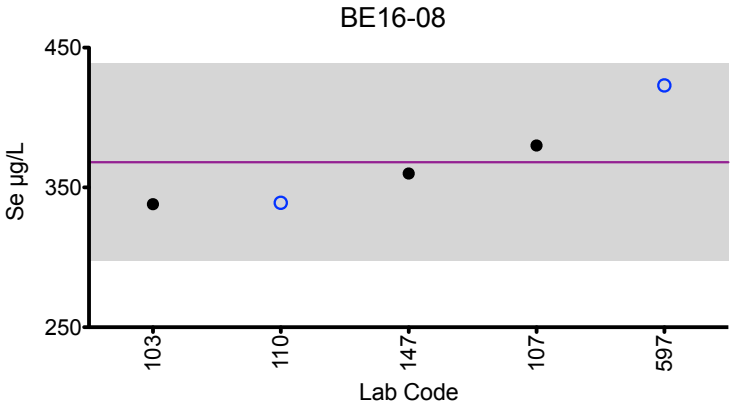
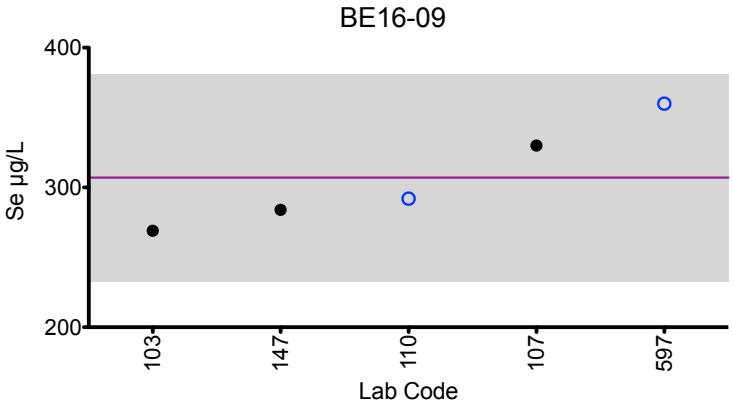
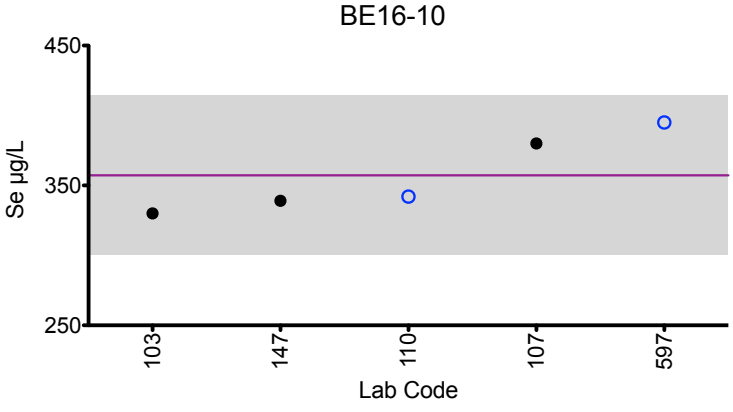
Results for Event #2, 2016: Whole Blood Se











Legend:

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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 #2, 2016
Additional Elements in Whole Blood: Vanadium (V)

Whole Blood V (µg/L)						
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
110	DRC/CC-ICP-MS	23.7	8.3	4.2	1.3	16
147	DRC/CC-ICP-MS	23.1	7.81	4.27	1.19	15.9
596	HR-ICP-MS	18.5	6.18	3.20	0.835	11.0
597	DRC/CC-ICP-MS	16.8	6.90	3.58	0.99	13.3
599	DRC/CC-ICP-MS	35.8	12.4	6.37	1.20	25.4

Summary Statistics					
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Arithmetic Mean ($\bar{x}$)	23.5	8.31	4.32	1.10	16.3
Arithmetic SD (s)	7.4	2.42	1.22	0.18	5.4
Arithmetic RSD (%)	31.5	29.1	28.3	16.9	33.5
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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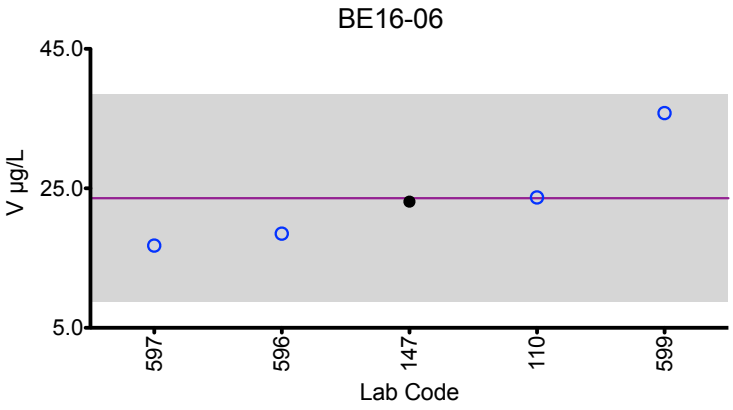
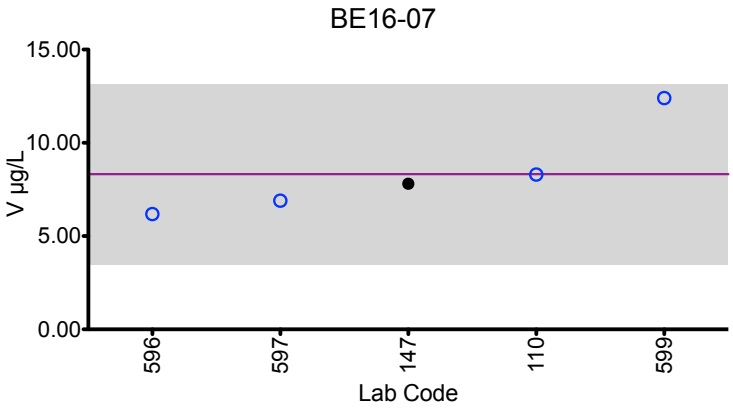
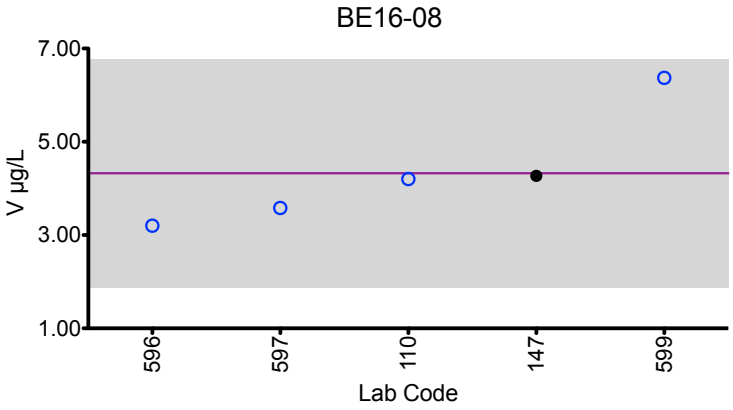
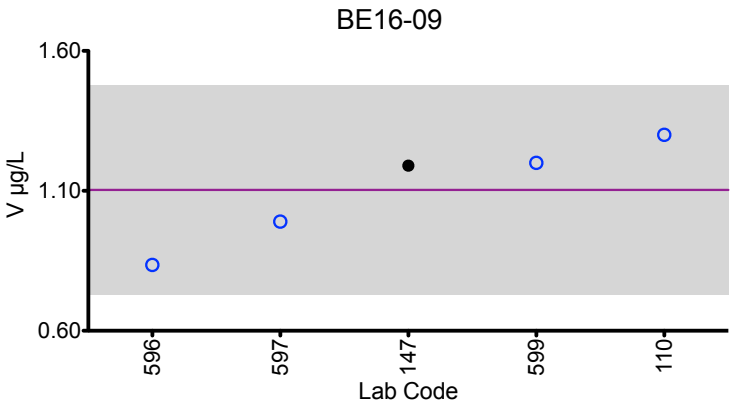
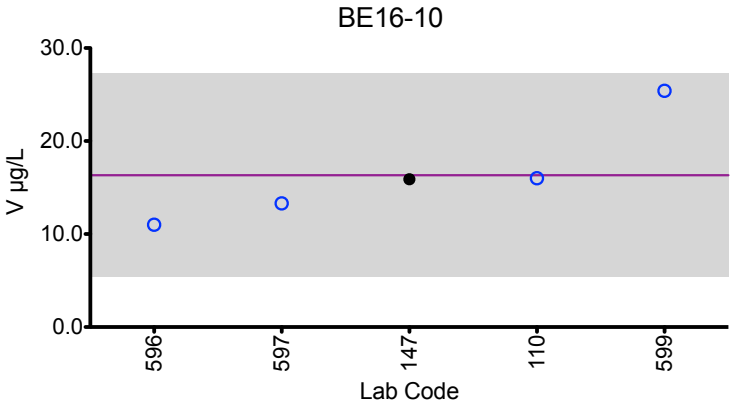
Results for Event #2, 2016: Whole Blood V











Legend:

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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 #2, 2016
Additional Elements in Whole Blood: Barium (Ba)

Whole Blood Ba (µg/L)						
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
110	ICP-MS	30.5	18.9	26.6	24.0	16.9
147	ICP-MS	27.9	17.6	26.1	22.9	16.6
596	HR-ICP-MS	25.1	15.1	*11.0	19.4	13.4
599	DRC/CC-ICP-MS	27.8	16.9	25.3	19.0	15.6

Summary Statistics					
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Arithmetic Mean ($\bar{x}$)	27.8	17.1	26.0	21.3	15.6
Arithmetic SD (s)	2.2	1.5	0.6	2.4	1.5
Arithmetic RSD (%)	7.92	9.24	2.52	11.7	10.1
Number of Sample Measurements (N)	4	4	3	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Beryllium (Be)

Whole Blood Be (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
110	ICP-MS	2.2	3.2	0.2	0.8	1.2
147	ICP-MS	2.21	2.83	<1.17	<1.17	<1.17
599	DRC/CC-ICP-MS	*3.14	4.23	0.235	0.742	1.51

Summary Statistics

	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Arithmetic Mean ($\bar{x}$)	2.20	3.42	0.217	0.771	1.35
Arithmetic SD (s)	0.00	0.72	0.024	0.041	0.21
Arithmetic RSD (%)	0.32	21.2	11.3	5.31	16.1
Number of Sample Measurements (N)	2	3	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Cesium (Cs)

Whole Blood Cs (µg/L)						
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
110	ICP-MS	0.3	0.3	0.3	0.3	0.3
599	DRC/CC-ICP-MS	0.395	0.219	0.245	0.131	0.175

Summary Statistics					
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Arithmetic Mean ($\bar{x}$)	0.347	0.259	0.272	0.215	0.237
Arithmetic SD (s)	0.067	0.057	0.038	0.119	0.088
Arithmetic RSD (%)	19.3	22.0	14.2	55.4	37.2
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Copper (Cu)

Whole Blood Cu (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
110	ICP-MS	1304	1507	1564	1472	1466
147	ICP-MS	1264	1461	1620	1423	1436
596	ICP-AES/OES	1210	1410	1800	1600	1640
597	DRC/CC-ICP-MS	947	1257	1397	1230	1189

Summary Statistics

	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Arithmetic Mean ($\bar{x}$)	1181	1408	1595	1431	1432
Arithmetic SD (s)	160	108	166	153	185
Arithmetic RSD (%)	13.6	7.71	10.4	10.7	12.9
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Molybdenum (Mo)

Whole Blood Mo (µg/L)						
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
103	DRC/CC-ICP-MS	28.4	28.8	30.5	78.3	75.2
147	ICP-MS	27.7	28.7	31.3	78.8	76.8
596	HR-ICP-MS	26.8	26.3	29.2	72.6	64.4
599	DRC/CC-ICP-MS	31.7	31.7	35	76.3	85.5

Summary Statistics					
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Arithmetic Mean ($\bar{x}$)	28.6	28.8	31.5	76.5	75.4
Arithmetic SD (s)	2.1	2.2	2.4	2.8	8.6
Arithmetic RSD (%)	7.45	7.65	7.90	3.68	11.4
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Nickel (Ni)

Whole Blood Ni (µg/L)						
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
110	DRC/CC-ICP-MS	2.6	3.9	6.5	14.4	2.6
147	ICP-MS	7.4	14.7	3.96	1.87	6.05
597	DRC/CC-ICP-MS	6.68	14	4.16	2.41	5.54

Summary Statistics					
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Arithmetic Mean ($\bar{x}$)	5.56	10.8	4.87	6.22	4.73
Arithmetic SD (s)	2.58	6.0	1.41	7.08	1.86
Arithmetic RSD (%)	46.5	55.6	28.9	113	39.3
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Platinum (Pt)

Whole Blood Pt (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
110	ICP-MS	2.91	1.15	1.80	0.28	0.85
596	HR-ICP-MS	3.50	1.31	2.05	*0.338	0.896
599	DRC/CC-ICP-MS	2.94	1.23	1.63	0.281	0.78

Summary Statistics

	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Arithmetic Mean ($\bar{x}$)	3.11	1.23	1.82	0.28	0.841
Arithmetic SD (s)	0.33	0.08	0.21	0.00	0.058
Arithmetic RSD (%)	10.6	6.50	11.5	0.252	6.93
Number of Sample Measurements (N)	3	3	3	2	3

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Antimony (Sb)

Whole Blood Sb (µg/L)						
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
103	DRC/CC-ICP-MS	2.24	0.504	1.05	0.390	0.0880
110	ICP-MS	1.92	0.54	1.00	0.35	0.14
147	ICP-MS	1.86	0.548	1.07	0.36	0.164

Summary Statistics					
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Arithmetic Mean ($\bar{x}$)	2.0	0.530	1.04	0.366	0.130
Arithmetic SD (s)	0.2	0.023	0.03	0.020	0.038
Arithmetic RSD (%)	10.1	4.41	3.46	5.67	29.7
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Tin (Sn)

Whole Blood Sn (µg/L)						
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
110	ICP-MS	10.4	6.1	2.8	5.0	1.2
147	ICP-MS	9.43	5.87	2.64	4.77	1.06
596	ICP-MS	8.63	5.11	2.40	4.24	0.834

Summary Statistics					
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Arithmetic Mean ($\bar{x}$)	9.48	5.69	2.61	4.67	1.03
Arithmetic SD (s)	0.88	0.51	0.20	0.38	0.18
Arithmetic RSD (%)	9.34	9.10	7.70	8.34	17.9
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Thallium (Tl)

Whole Blood Tl (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
103	DRC/CC-ICP-MS	6.41	11.3	1.05	0.560	2.19
110	ICP-MS	6.3	10.8	1.0	0.6	2.2
147	ICP-MS	5.29	9.59	0.981	0.487	2.03
596	HR-ICP-MS	5.48	8.98	0.936	0.467	1.86

Summary Statistics

	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Arithmetic Mean ($\bar{x}$)	5.87	10.1	0.991	0.528	2.06
Arithmetic SD (s)	0.56	1.0	0.047	0.062	0.16
Arithmetic RSD (%)	9.66	10.5	4.75	11.7	7.73
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Uranium (U)

Whole Blood U (µg/L)						
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
103	DRC/CC-ICP-MS	0.0200	0.0222	0.0520	<0.00748	0.0421
110	ICP-MS	0.03	0.03	0.06	<0.02	0.05
147	ICP-MS	0.0142	0.0226	0.0486	<0.0136	0.04612
596	HR-ICP-MS	0.0355	0.0396	0.0705	0.0181	0.0593

Summary Statistics					
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Arithmetic Mean ($\bar{x}$)	0.024	0.028	0.057	0.018	0.049
Arithmetic SD (s)	0.009	0.008	0.009	NA	0.007
Arithmetic RSD (%)	38.5	28.5	16.8	NA	14.8
Number of Sample Measurements (N)	4	4	4	1	4

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Tungsten (W)

Whole Blood W (µg/L)						
Lab Code	**Method**	**BE16-06**	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
110	ICP-MS	1.0	00.5	9.4	2.8	5.7
200	ICP-MS	*1.3	0.6	10.8	3.4	6.6
596	HR-ICP-MS	1.00	0.395	9.12	2.57	5.22

Summary Statistics					
	BE16-06	**BE16-07**	**BE16-08**	**BE16-09**	**BE16-10**
Arithmetic Mean ($\bar{x}$)	1.00	0.498	9.77	2.92	5.84
Arithmetic SD (s)	0.00	0.102	0.90	0.42	0.70
Arithmetic RSD (%)	0.00	20.5	9.2	14.6	11.9
Number of Sample Measurements (N)	2	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood: Zinc (Zn)

Whole Blood Zn (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
110	ICP-MS	1992	2207	2522	2624	2907
147	ICP-MS	2000	2268	2706	2686	3039
596	ICP-AES/OES	1950	2130	2490	2450	2860
597	DRC/CC-ICP-MS	*1479	1893	2237	2316	2523

Summary Statistics

	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
Arithmetic Mean ($\bar{x}$)	1980	2124	2488	2519	2832
Arithmetic SD (s)	26	164	192	168	219
Arithmetic RSD (%)	1.35	7.73	7.75	6.67	7.75
Number of Sample Measurements (N)	3	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Whole Blood

Whole Blood Ag (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
147	ICP-MS	9.02	0.454	1.92	7.49	3.75

Whole Blood Al (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
147	ICP-MS	<9.17	<9.17	<9.17	<9.17	<9.17
596	ICP-AES/OES	263	263	288	338	400

Whole Blood Bi (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
147	ICP-MS	<0.0836	<0.0836	<0.0836	<0.0836	<0.0836

Whole Blood I (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
147	ICP-MS	60.1	62.7	64.4	72.2	68.5

Whole Blood Li (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
147	ICP-MS	0.874	0.93	0.978	1.02	1.15

Whole Blood Sr (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
103	DRC/CC-ICP-MS	36.9	35.5	35.0	35.7	32.9

Whole Blood Te (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
147	ICP-MS	<0.128	<0.128	<0.128	<0.128	<0.128

Whole Blood Th (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
147	ICP-MS	<0.0148	<0.0148	<0.0148	<0.0148	<0.0148

Whole Blood Ti (µg/L)

Lab Code	Method	BE16-06	BE16-07	BE16-08	BE16-09	BE16-10
599	DRC/CC-ICP-MS	6.00	10.1	0.984	0.425	2.08

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Event #2, 2016

Trace Elements in Urine

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Trace Elements Laboratory

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Event #2, 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 23 elements (beyond the nine graded) were reported by at least one participant: Al, B, Bi, Co, Cr, Cs, Cu, Fe, I, Li, 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 #2, 2016
Urine Arsenic (As)

Summary Statistics

	Urine As (µg/L)				
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Target (Robust Mean (x*))	8.05	96.9	58.3	43.0	25.7
Upper Limit	14.05	116.3	70.0	51.6	31.7
Lower Limit	2.05	77.5	46.7	34.4	19.7
Robust SD (s*)	0.98	7.4	3.5	2.8	2.3
Robust RSD (%)	12.1	7.66	6.04	6.69	9.08
Number of Sample Measurements (N)	19	19	19	19	19
Standard Uncertainty (*u*)	0.281	2.13	1.01	0.825	0.670

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

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Results for Event #2, 2016
Urine Arsenic (As)
Performance of Participating Laboratories

		Urine As (µg/L)				
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
	Target	**8.05**	**96.9**	**58.3**	**43.0**	**25.7**
103	DRC/CC-ICP-MS	7.57	97.1	57.7	42.9	25.6
107	DRC/CC-ICP-MS	7.3	90	54	39	24
110	DRC/CC-ICP-MS	9.6	97.9	58.3	43.3	26.4
116	DRC/CC-ICP-MS	7.37	93.5	55.6	40.6	24.4
147	ICP-MS	7.47	90.6	54.5	42.2	24.3
200	ICP-MS	9.0	99.8	60.0	43.5	27.0
293	DRC/CC-ICP-MS	7.47	94.38	56.0	42.55	24.87
324	HR-ICP-MS	7.66	108.399	64.83	46.928	28.408
391	DRC/CC-ICP-MS	8.24	112.091	66.6	47.839	29.839
399	DRC/CC-ICP-MS	7.95	102	60.9	44.4	26.3
596	ICP-MS	7.36	90.5	57.2	41.6	24.1
596	HR-ICP-MS	7.93	88.9	55.7	38.0	21.6
597	DRC/CC-ICP-MS	6.84	88.1	56.7	41.1	24.7
598	ICP-MS	8.52	97	57.5	43	23.8
599	DRC/CC-ICP-MS	8.80	114.5	68.72	51.03	28.41
604	DRC/CC-ICP-MS	6.28	90.8	54.2	39.3	22.8
605	ICP-MS	9.77	95.0	58.5	44.0	26.5
606	DRC/CC-ICP-MS	9.64	101	63.9	45.0	28.6
632	DRC/CC-ICP-MS	9.59	101	61.4	44.8	28

Based on the grading criteria for As in Urine, 100% of results were satisfactory, with 0 of the 19 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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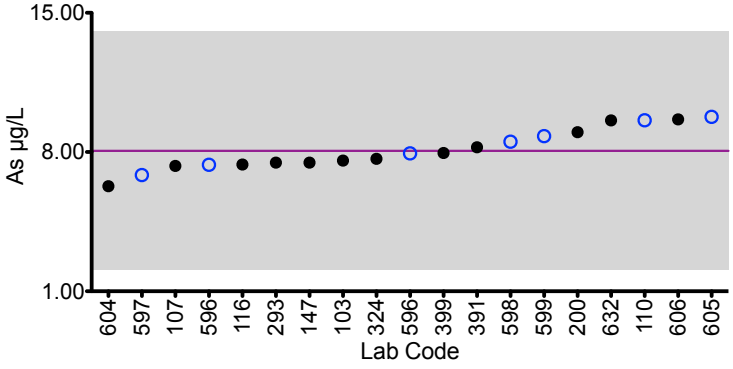
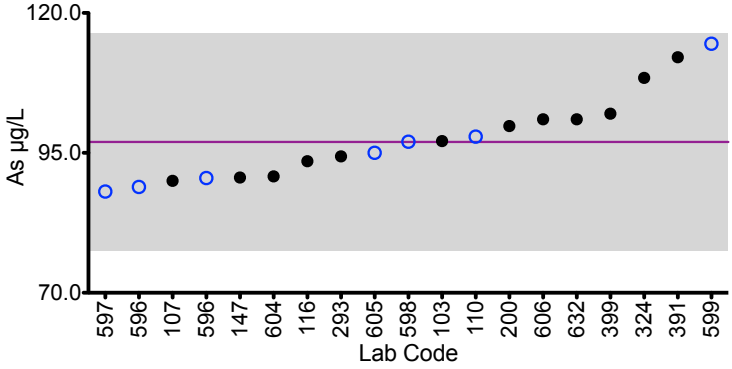
Results for Event #2, 2016: Urine As

UE16-06



UE16-07



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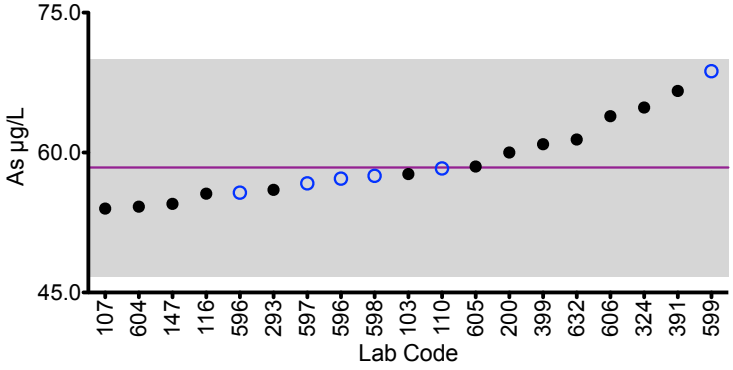

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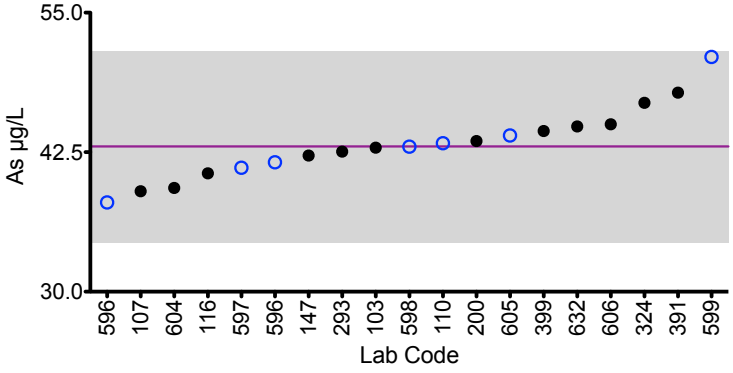
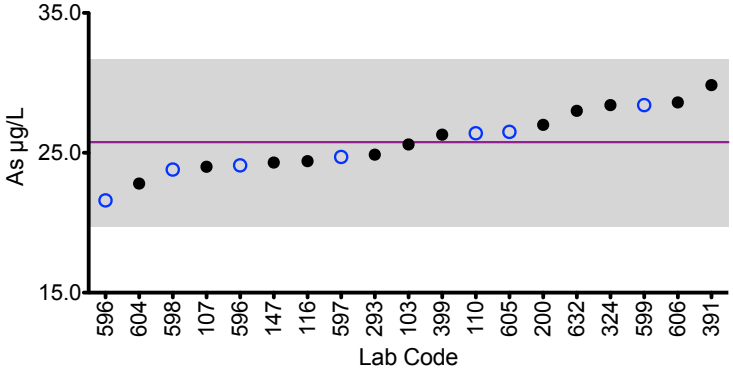


UE16-10



Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Urine Barium (Ba)

Summary Statistics

	Urine Ba (µg/L)				
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Target (Robust Mean (x*))	1.27	5.07	1.05	3.31	4.77
Upper Limit	2.27	6.08	2.05	4.31	5.77
Lower Limit	0.27	4.05	0.05	2.31	3.77
Robust SD (s*)	0.09	0.28	0.12	0.18	0.29
Robust RSD (%)	7.28	5.58	11.4	5.43	6.16
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (*u*)	0.032	0.098	0.041	0.062	0.102

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

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Results for Event #2, 2016
Urine Barium (Ba)
Performance of Participating Laboratories

		Urine Ba (µg/L)				
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
	Target	**1.27**	**5.07**	**1.05**	**3.31**	**4.77**
107	ICP-MS	1.2	4.8	1.0	3.2	4.6
110	ICP-MS	1.28	5.11	1.02	3.35	4.82
116	DRC/CC-ICP-MS	1.29	5.05	1.05	3.24	4.85
147	ICP-MS	1.31	5.21	1.05	3.54	4.88
399	ICP-MS	1.40	5.27	1.12	3.43	4.97
596	ICP-MS	1.26	5.04	1.25	3.27	5.52
597	DRC/CC-ICP-MS	1.10	4.35	0.90	3.10	4.32
598	ICP-MS	1.35	5.57	1.61	3.52	4.55
599	DRC/CC-ICP-MS	1.41	5.29	1.25	3.47	4.88
605	ICP-MS	1.21	4.76	0.959	3.12	4.56
606	ICP-MS	1.13	4.86	0.869	3.09	4.49
607	ICP-MS	1.29	5.09	1.05	3.30	4.74
632	ICP-MS	1.32	5.32	1.09	3.44	5.15

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

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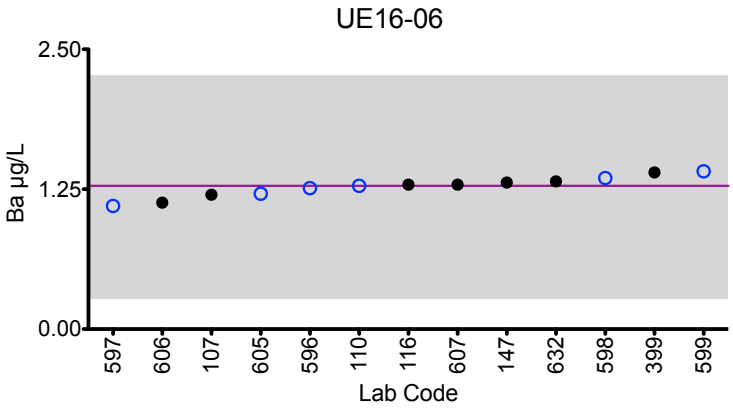
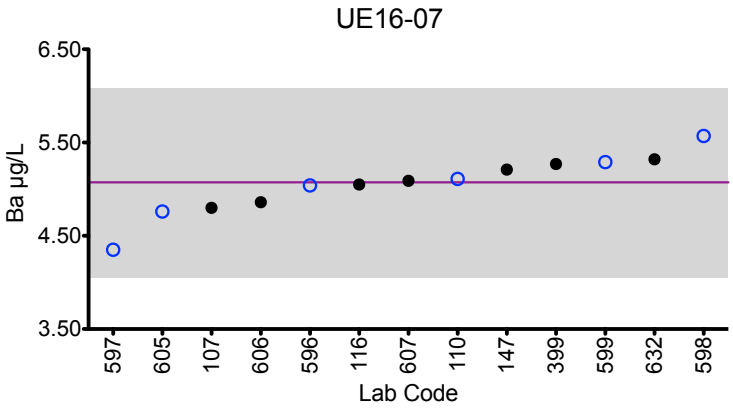
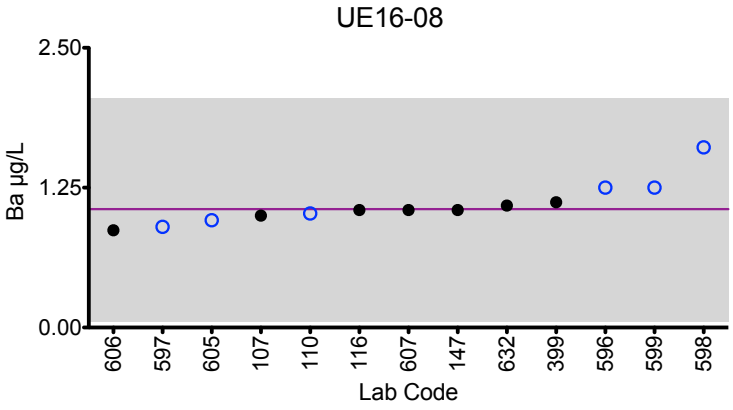
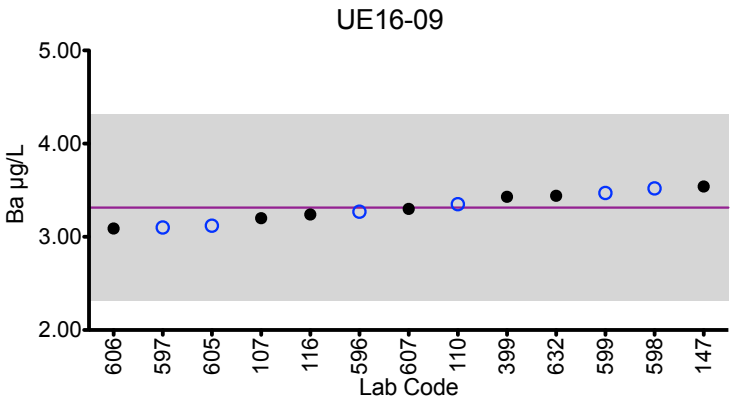
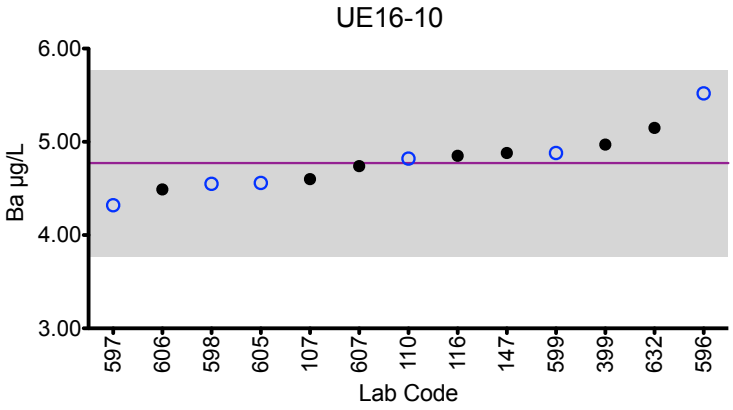
Results for Event #2, 2016: Urine Ba











Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Urine Beryllium (Be)

Summary Statistics

	Urine Be (µg/L)				
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Target (Robust Mean (x*))	0.316	1.13	1.40	2.53	0.535
Upper Limit	1.316	2.13	2.40	3.53	1.535
Lower Limit	0.000	0.13	0.40	1.53	0.000
Robust SD (s*)	0.028	0.05	0.12	0.19	0.050
Robust RSD (%)	9.11	4.51	9.15	7.82	9.36
Number of Sample Measurements (N)	10	11	11	11	11
Standard Uncertainty (*u*)	0.011	0.019	0.048	0.074	0.018

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

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Results for Event #2, 2016
Urine Beryllium (Be)
Performance of Participating Laboratories

		Urine Be (µg/L)				
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
	Target	**0.316**	**1.13**	**1.40**	**2.53**	**0.535**
107	ICP-MS	0.28	1.1	1.3	2.3	0.46
110	ICP-MS	0.33	1.15	1.34	2.69	0.59
116	ICP-MS	0.282	1.05	1.28	2.35	0.513
147	ICP-MS	<0.450	1.12	1.57	2.72	0.568
399	ICP-MS	0.305	1.15	1.40	2.52	0.514
596	ICP-MS	0.321	1.13	1.49	2.55	0.541
598	ICP-MS	0.36	1.28	1.45	2.47	0.57
599	DRC/CC-ICP-MS	0.364	1.12	1.42	2.56	0.508
605	ICP-MS	0.324	1.21	1.52	2.78	0.633
607	ICP-MS	0.292	1.07	1.20	2.25	0.48
632	ICP-MS	0.307	1.17	1.52	2.64	0.537

Based on the grading criteria for Be 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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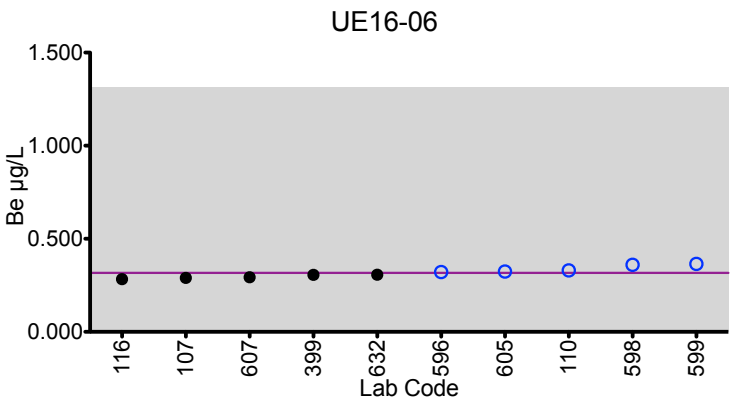
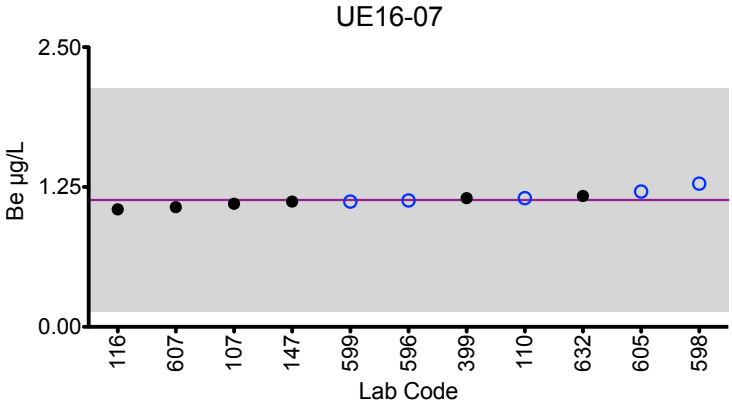
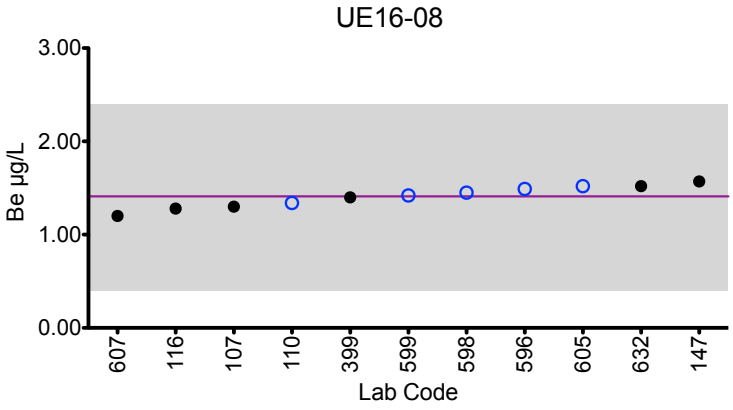
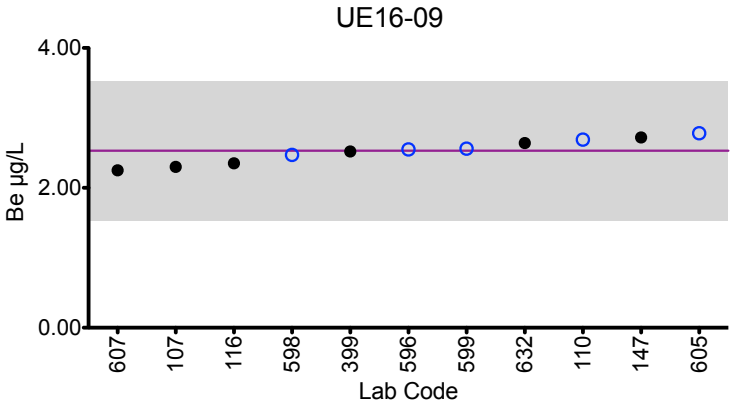
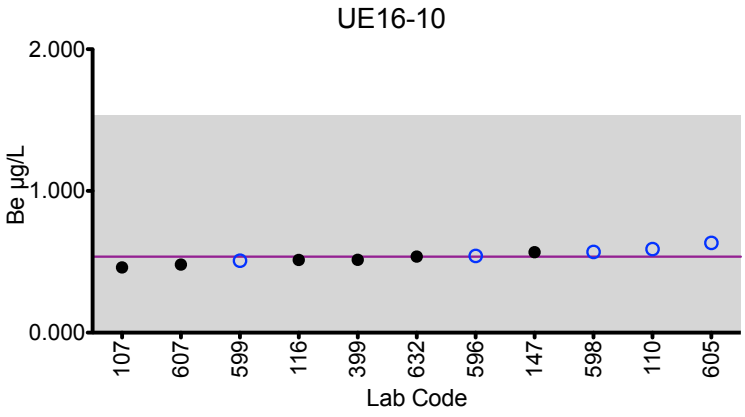
Results for Event #2, 2016: Urine Be











Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Urine Cadmium (Cd)

Summary Statistics

	Urine Cd (µg/L)				
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Target (Robust Mean (x*))	3.90	0.229	0.589	1.64	0.860
Upper Limit	4.90	1.229	1.589	2.64	1.860
Lower Limit	2.90	0.000	0.000	0.64	0.000
Robust SD (s*)	0.16	0.063	0.079	0.06	0.043
Robust RSD (%)	4.10	27.8	13.5	4.22	5.02
Number of Sample Measurements (N)	19	17	18	19	18
Standard Uncertainty (*u*)	0.050	0.019	0.023	0.019	0.012

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

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Results for Event #2, 2016
Urine Cadmium (Cd)
Performance of Participating Laboratories

		Urine Cd (µg/L)				
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
	Target	**3.90**	**0.229**	**0.589**	**1.64**	**0.860**
103	DRC/CC-ICP-MS	3.97	0.223	0.647	1.74	0.891
107	DRC/CC-ICP-MS	4.1	0.18	0.56	1.7	0.88
110	ICP-MS	4.02	0.22	0.66	1.61	0.87
116	DRC/CC-ICP-MS	3.86	0.220	0.583	1.59	0.851
147	ICP-MS	4.11	0.143	0.541	1.71	0.858
200	ICP-MS	3.8	0.3	0.8	1.6	0.8
293	ICP-MS	3.81	0.24	0.6	1.66	0.87
324	ICP-MS	4.13	<1	<1	1.68	<1
391	DRC/CC-ICP-MS	4.054	0.303	0.628	1.697	0.779
399	DRC/CC-ICP-MS	3.89	0.181	0.54	1.67	0.869
596	ICP-MS	3.71	0.195	0.558	1.58	0.797
597	DRC/CC-ICP-MS	3.46	0.19	0.49	1.52	0.79
598	ICP-MS	3.83	0.37	0.74	1.7	0.84
599	DRC/CC-ICP-MS	3.76	0.345	0.473	1.64	0.730
604	DRC/CC-ICP-MS	4.06	0.2	0.55	1.72	0.91
605	ICP-MS	3.82	PLC	0.628	1.56	0.868
606	DRC/CC-ICP-MS	3.80	0.150	0.435	1.53	2.08 ↑
607	ICP-MS	3.99	0.237	0.673	1.65	0.922
632	DRC/CC-ICP-MS	3.84	0.409	0.596	1.69	0.884

Based on the grading criteria for Cd in Urine, 98% of results were satisfactory, with 0 of the 19 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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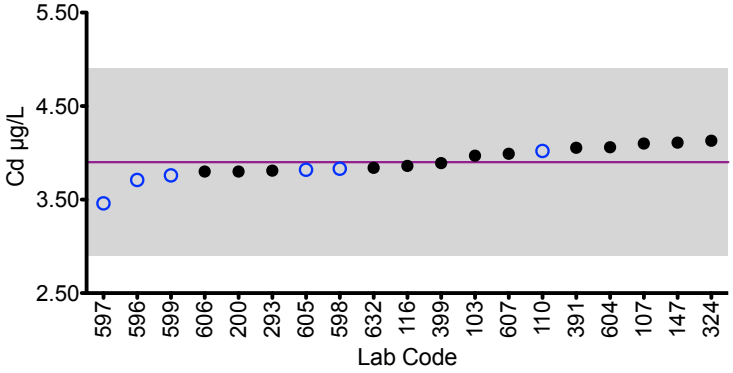
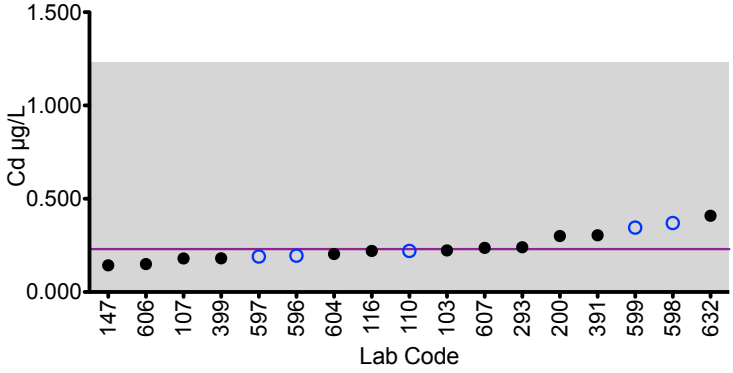
Results for Event #2, 2016: Urine Cd

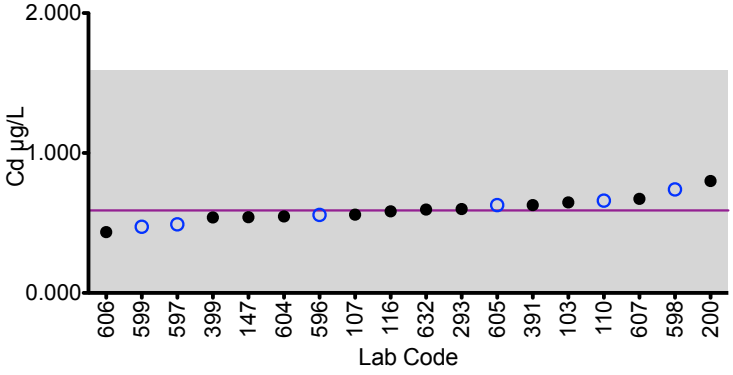
UE16-06



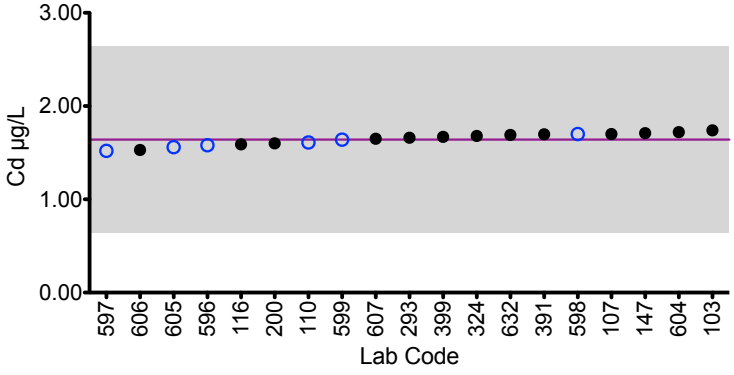
UE16-07



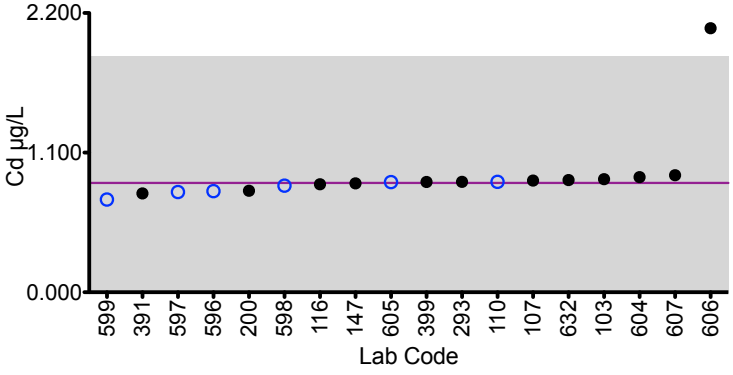
UE16-08



UE16-09



UE16-10



Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Urine Mercury (Hg)

Summary Statistics

	Urine Hg (µg/L)				
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Target (Robust Mean (x*))	1.74	3.31	9.80	6.86	15.9
Upper Limit	4.74	6.31	12.80	9.86	20.7
Lower Limit	0.00	0.31	6.80	3.86	11.1
Robust SD (s*)	0.43	0.38	0.63	0.65	1.3
Robust RSD (%)	24.9	11.6	6.47	9.49	8.54
Number of Sample Measurements (N)	12	14	14	14	14
Standard Uncertainty (*u*)	0.156	0.129	0.212	0.217	0.456

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

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Results for Event #2, 2016
Urine Mercury (Hg)
Performance of Participating Laboratories

		Urine Hg (µg/L)				
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
	Target	**1.74**	**3.31**	**9.80**	**6.86**	**15.9**
103	DRC/CC-ICP-MS	1.46	3.14	9.60	6.68	15.6
107	DRC/CC-ICP-MS	1.3	2.8	8.8	6.1	14
110	ICP-MS	2.36	3.65	10.3	7.25	16.9
147	CV-AAS	1.39	3.12	9.39	6.5	15.5
200	ICP-MS	1.6	3.0	9.6	6.4	15.4
293	ICP-MS	1.7	3.29	9.46	6.73	14.97
391	DRC/CC-ICP-MS	2.509	4.056	11.13	8.53	17.474
596	ICP-MS	1.29	2.82	9.33	5.95	15.7
597	DRC/CC-ICP-MS	2.24	3.78	10.79	7.69	17.61
598	ICP-MS	1.97	3.14	9.2	6.52	13.68
604	DRC/CC-ICP-MS	1.89	3.74	10.6	7.69	17.3
605	ICP-MS	PLC	3.32	10.0	6.92	16.5
606	ICP-MS	<2.00	3.44	10.9	7.41	17.1
632	ICP-MS	1.50	3.32	9.60	6.65	15.9

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

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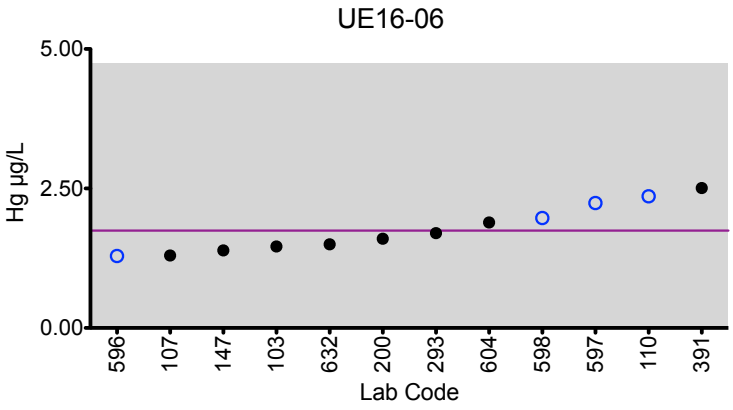
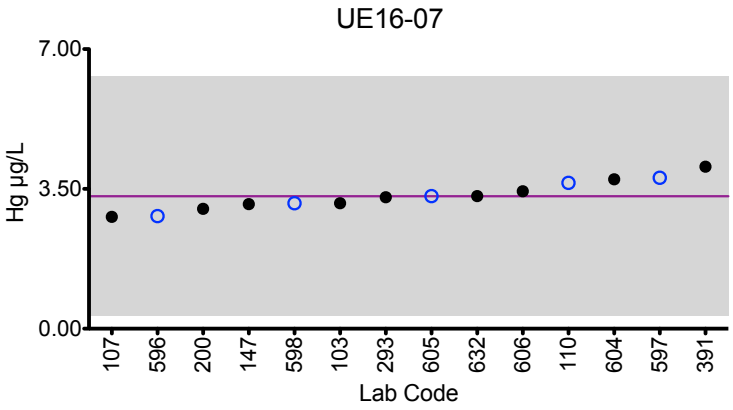
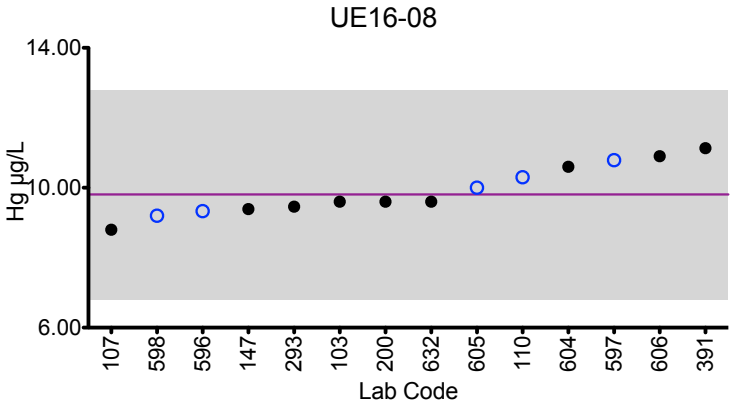
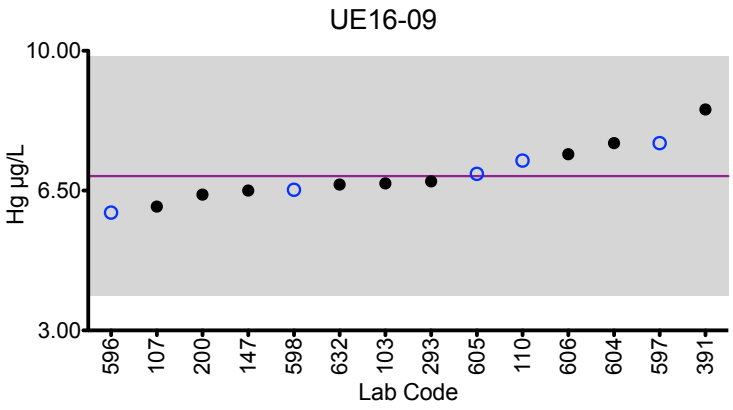
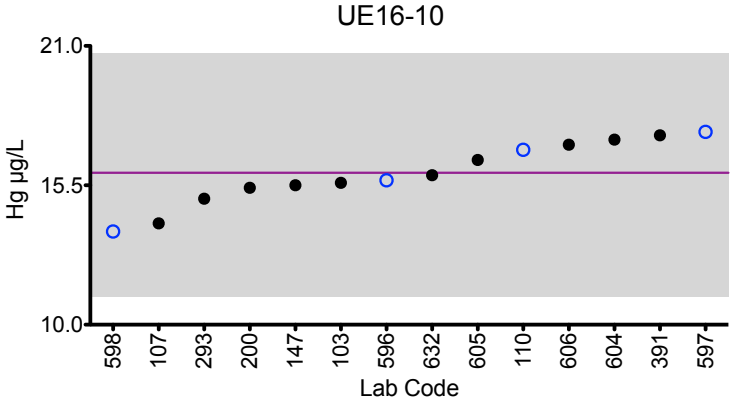
Results for Event #2, 2016: Urine Hg











Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Urine Manganese (Mn)

Summary Statistics

	Urine Mn (µg/L)				
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Target (Robust Mean (x*))	0.869	0.348	1.00	1.60	0.502
Upper Limit	1.249	0.728	1.38	1.98	0.882
Lower Limit	0.489	0.000	0.62	1.22	0.122
Robust SD (s*)	0.074	0.111	0.16	0.19	0.090
Robust RSD (%)	8.62	31.9	16.2	12.1	17.9
Number of Sample Measurements (N)	14	13	14	15	14
Standard Uncertainty (*u*)	0.025	0.038	0.054	0.063	0.030

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.)

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Results for Event #2, 2016
Urine Manganese (Mn)
Performance of Participating Laboratories

		Urine Mn (µg/L)				
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
	Target	**0.869**	**0.348**	**1.00**	**1.60**	**0.502**
103	DRC/CC-ICP-MS	0.781	0.254	0.899	1.52	0.416
107	DRC/CC-ICP-MS	1.2	0.33	0.96	1.5	0.48
110	DRC/CC-ICP-MS	0.88	0.31	1.00	1.63	0.50
116	DRC/CC-ICP-MS	0.860	0.262	0.806	1.37	0.415
147	DRC/CC-ICP-MS	0.834	0.309	0.89	1.53	0.513
324	HR-ICP-MS	1.164	0.728 ↑	1.123	1.646	0.625
391	DRC/CC-ICP-MS	0.809	0.732 ↑	1.692 ↑	2.06 ↑	0.553
399	DRC/CC-ICP-MS	0.86	0.332	0.963	1.62	0.544
596	ICP-MS	0.645	<LOD	0.874	1.35	0.375
597	DRC/CC-ICP-MS	0.81	0.27	0.83	1.42	0.46
598	ICP-MS	0.9	0.81 ↑	1.59 ↑	1.81	0.78
604	DRC/CC-ICP-MS	0.87	0.3	0.95	1.8	0.5
605	ICP-MS	PLC	PLC	PLC	1.52	PLC
606	DRC/CC-ICP-MS	0.892	0.203	1.13	1.68	0.453
632	DRC/CC-ICP-MS	1.20	0.474	1.27	1.90	0.618

Based on the grading criteria for Mn in Urine, 92% of results were satisfactory, with 2 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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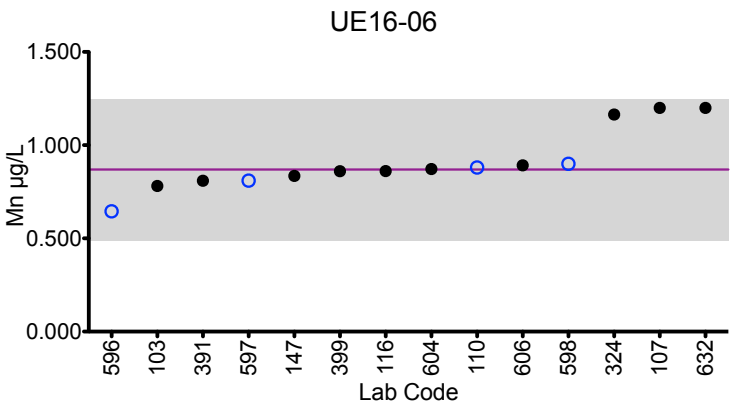
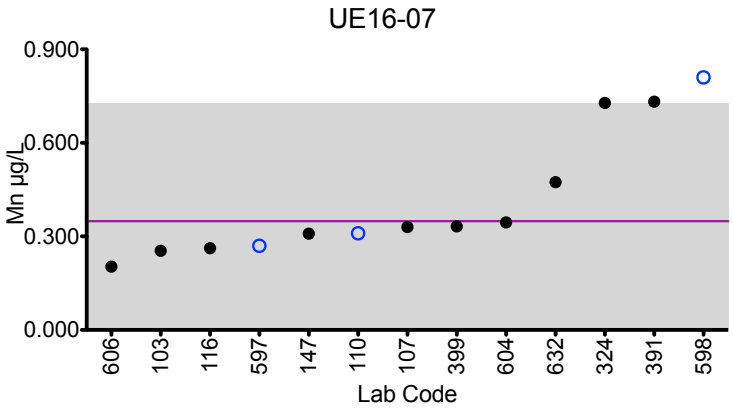
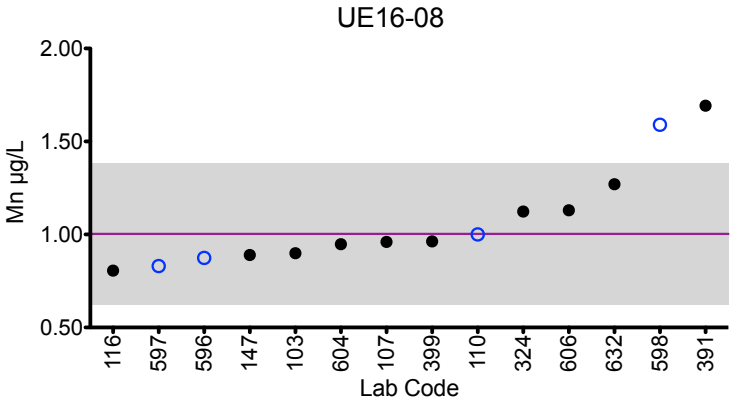
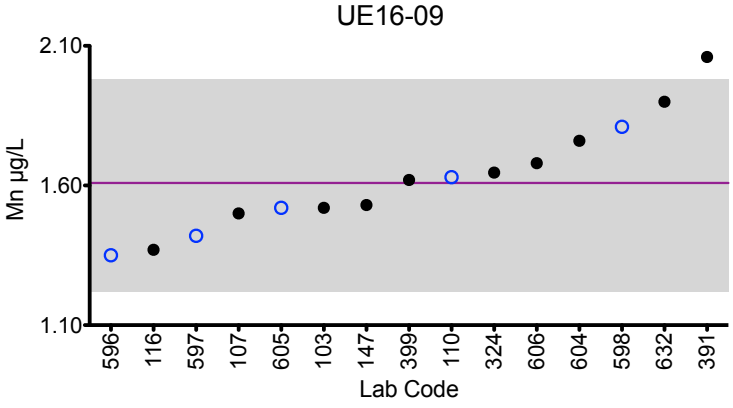
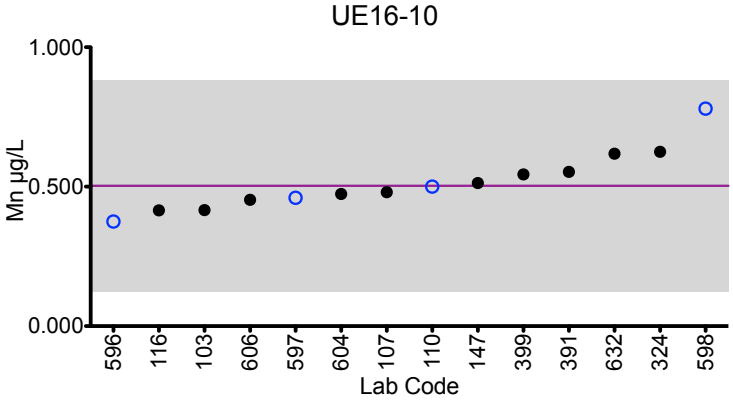
Results for Event #2, 2016: Urine Mn











Legend:

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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 #2, 2016
Urine Lead (Pb)

Summary Statistics

	Urine Pb (µg/L)				
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Target (Robust Mean (x*))	1.73	8.38	2.48	1.04	4.02
Upper Limit	2.73	10.06	3.48	2.04	5.02
Lower Limit	0.73	6.70	1.48	0.04	3.02
Robust SD (s*)	0.18	0.52	0.21	0.14	0.41
Robust RSD (%)	10.3	6.20	8.77	13.6	10.1
Number of Sample Measurements (N)	18	18	18	18	18
Standard Uncertainty (*u*)	0.053	0.153	0.064	0.042	0.120

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

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Results for Event #2, 2016
Urine Lead (Pb)
Performance of Participating Laboratories

		Urine Pb (µg/L)				
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
	Target	**1.73**	**8.38**	**2.48**	**1.04**	**4.02**
103	DRC/CC-ICP-MS	1.74	8.68	2.50	1.01	4.08
107	ICP-MS	1.8	8.9	2.7	1.1	4.20
110	ICP-MS	1.7	8.5	2.5	1.0	4.1
116	ICP-MS	1.72	8.46	2.45	0.971	3.87
147	ICP-MS	1.6	8.12	2.36	0.976	3.75
200	ICP-MS	2.2	8.2	2.2	1.4	4.2
293	ICP-MS	1.6	7.71	2.22	0.58	3.17
324	HR-ICP-MS	1.944	8.024	2.542	1.225	3.81
391	DRC/CC-ICP-MS	1.896	9.606	2.816	1.173	4.466
399	ICP-MS	1.76	9.19	2.62	1.05	4.2
596	ICP-MS	2.00	9.84	3.02	1.13	4.58
597	DRC/CC-ICP-MS	1.46	7.3	2.10	0.92	3.59
598	ICP-MS	1.56	7.88	2.47	1.19	3.41
599	DRC/CC-ICP-MS	1.85	8.30	3.10	1.31	4.41
605	ICP-MS	1.65	8.38	2.43	0.969	3.92
606	ICP-MS	1.53	7.98	2.26	0.911	3.70
607	ICP-MS	1.73	8.60	2.52	1.02	4.01
632	ICP-MS	1.65	8.33	2.44	0.904	10.2 ↑

Based on the grading criteria for Pb in Urine, 98% 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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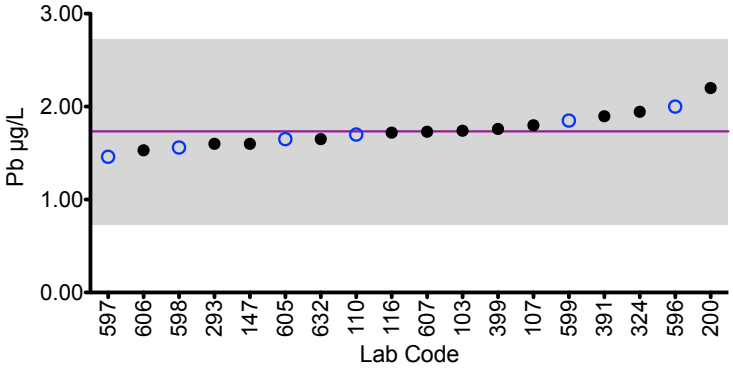
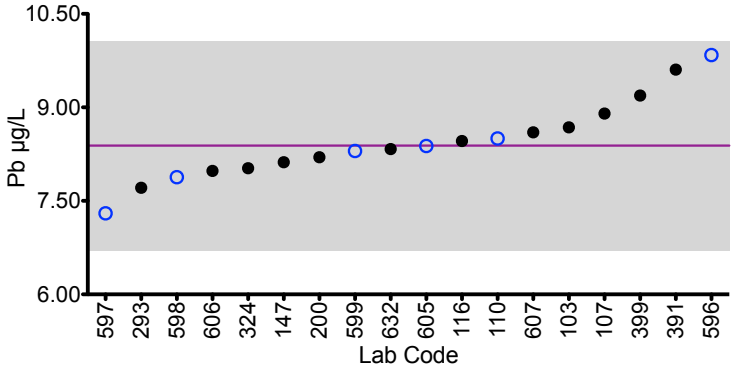
Results for Event #2, 2016: Urine Pb

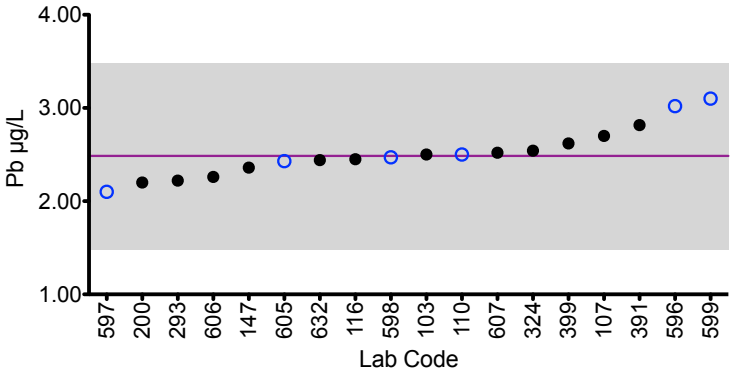
UE16-06



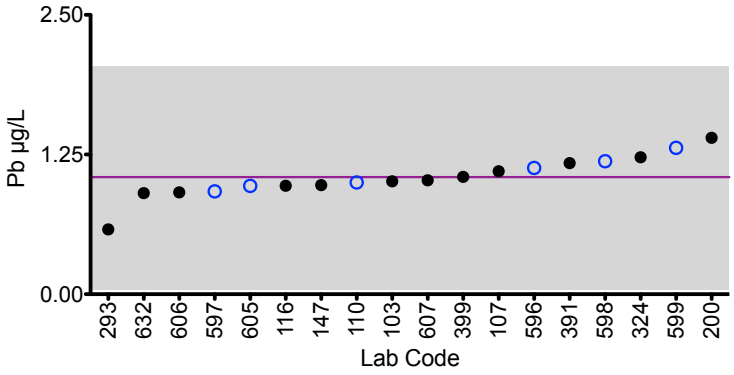
UE16-07



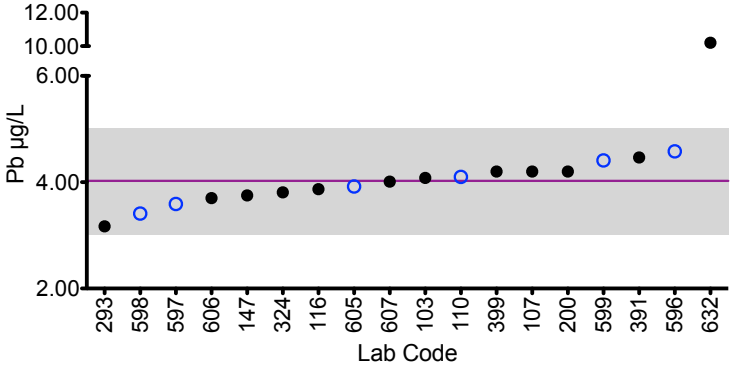
UE16-08



UE16-09



UE16-10



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 #2, 2016
Urine Thallium (Tl)

Summary Statistics

	Urine Tl (µg/L)				
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Target (Robust Mean (x*))	2.19	0.475	0.778	1.65	0.227
Upper Limit	2.63	0.675	0.978	1.98	0.427
Lower Limit	1.75	0.275	0.578	1.32	0.027
Robust SD (s*)	0.10	0.024	0.033	0.03	0.016
Robust RSD (%)	4.82	5.20	4.24	2.18	7.27
Number of Sample Measurements (N)	13	13	13	13	13
Standard Uncertainty (*u*)	0.036	0.0085	0.011	0.012	0.0057

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

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Results for Event #2, 2016
Urine Thallium (Tl)
Performance of Participating Laboratories

		Urine Tl (µg/L)				
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
	Target	**2.19**	**0.475**	**0.778**	**1.65**	**0.227**
103	DRC/CC-ICP-MS	2.14	0.459	0.753	1.64	0.219
107	ICP-MS	2.3	0.50	0.82	1.8	0.25
110	ICP-MS	2.19	0.46	0.77	1.66	0.21
116	ICP-MS	2.19	0.481	0.755	1.66	0.228
147	ICP-MS	2.11	0.462	0.736	1.64	0.221
399	ICP-MS	2.28	0.489	0.830	1.77	0.209
596	ICP-MS	2.49	0.565	0.917	1.81	0.265
598	ICP-MS	2.04	0.54	0.75	1.54	0.26
599	DRC/CC-ICP-MS	2.30	0.474	0.795	1.63	0.227
605	ICP-MS	2.16	0.448	0.767	1.64	0.214
606	ICP-MS	2.08	0.442	0.749	1.57	0.218
607	ICP-MS	2.22	0.462	0.789	1.69	0.232
632	ICP-MS	2.17	0.486	0.801	1.65	0.237

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

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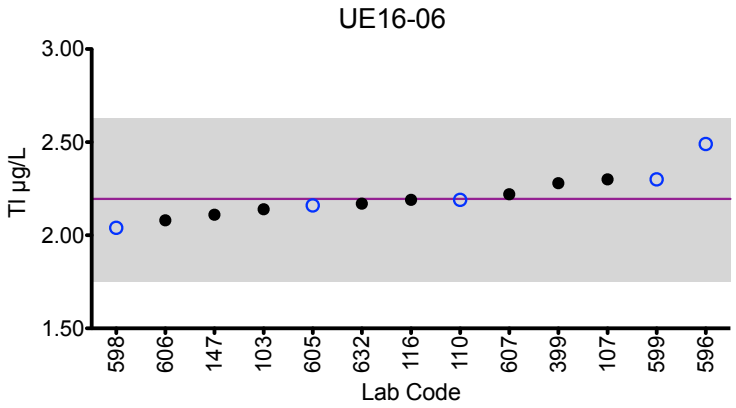
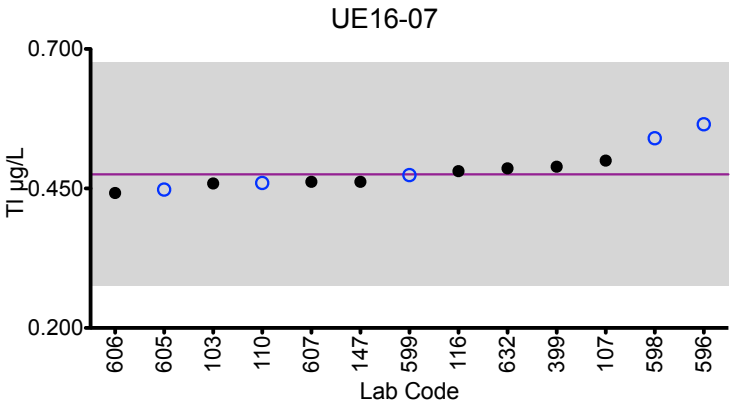
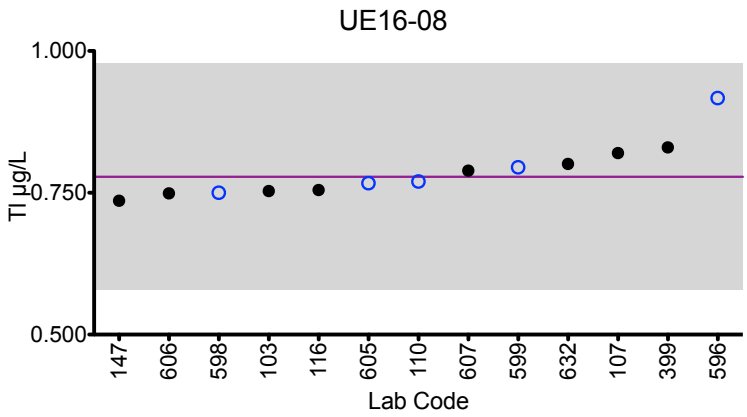
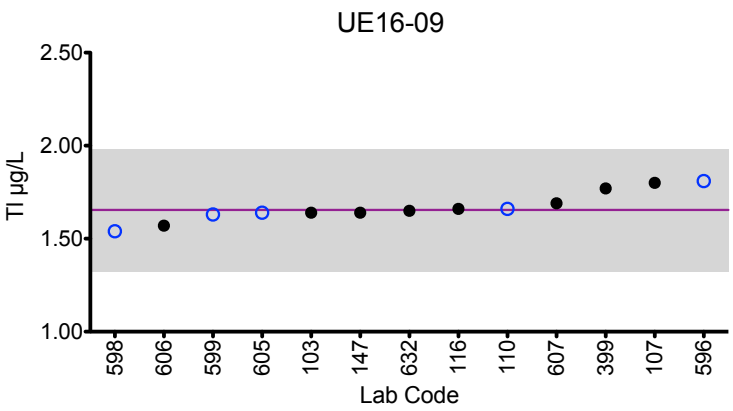
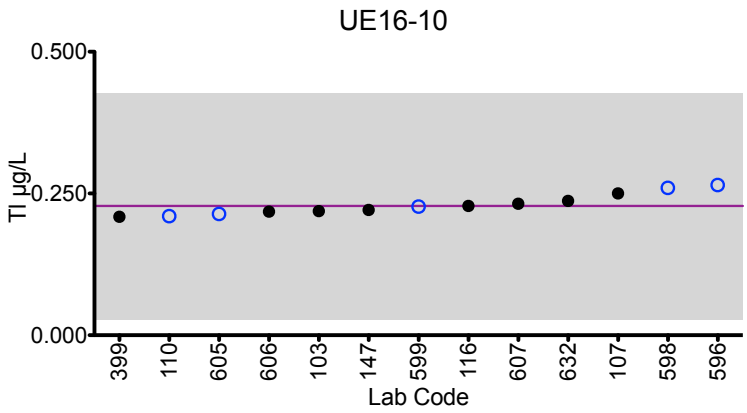
Results for Event #2, 2016: Urine Tl











Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Urine Uranium (U)

Summary Statistics

	Urine U (µg/L)				
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Target (Robust Mean (x*))	0.007	0.012	0.019	0.064	0.037
Upper Limit	0.037	0.042	0.049	0.094	0.067
Lower Limit	0.000	0.000	0.000	0.034	0.007
Robust SD (s*)	0.001	0.002	0.002	0.003	0.003
Robust RSD (%)	13.9	19.7	15.4	5.22	9.93
Number of Sample Measurements (N)	11	14	14	14	14
Standard Uncertainty (*u*)	0.00040	0.00083	0.00098	0.0011	0.0012

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 .15 µg/L. These quality specifications are based on the same criteria used by the US Centers for Disease Control Prevention (CDC) for public health labs participating in the Laboratory Response Network (LRN) PT program for Toxic Metals.

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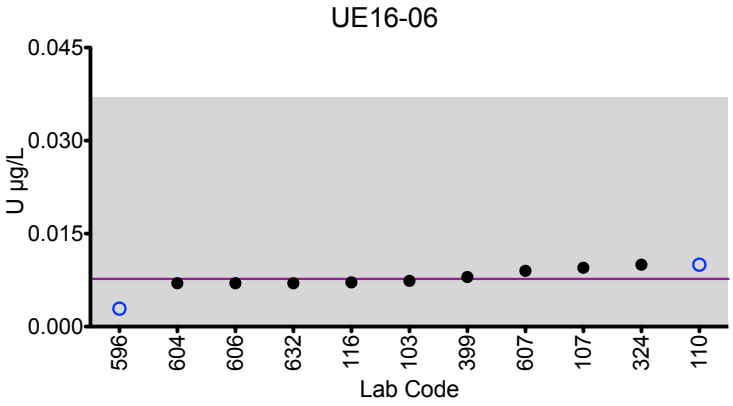
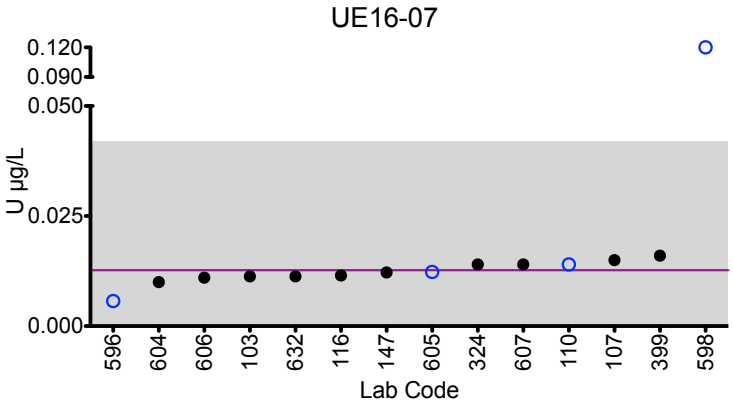
Results for Event #2, 2016
Urine Uranium (U)
Performance of Participating Laboratories

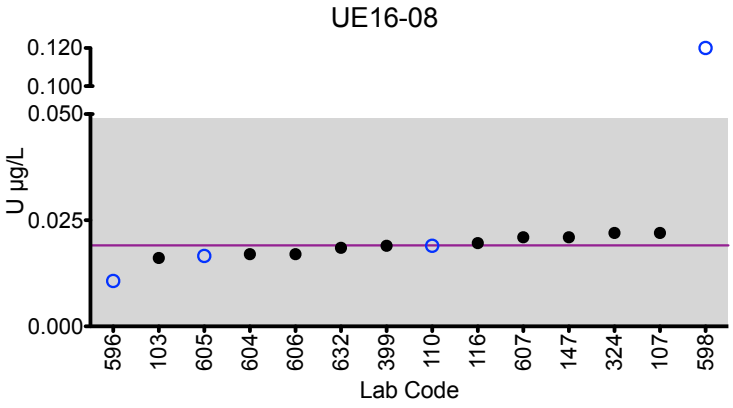
		Urine U (µg/L)				
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
	Target	**0.007**	**0.012**	**0.019**	**0.064**	**0.037**
103	DRC/CC-ICP-MS	0.00739	0.0113	0.0161	0.0632	0.0361
107	ICP-MS	0.0095	0.015	0.022	0.076	0.043
110	ICP-MS	0.010	0.014	0.019	0.065	0.038
116	ICP-MS	0.00714	0.0115	0.0196	0.0601	0.0366
147	ICP-MS	<0.0105	0.0122	0.021	0.0674	0.0395
324	ICP-MS	0.010	0.014	0.022	0.069	0.041
399	ICP-MS	0.008	0.016	0.019	0.064	0.035
596	HR-ICP-MS	0.00290	0.00570	0.0107	0.0610	0.0288
598	ICP-MS	<0.1	0.12 ↑	0.12 ↑	0.15 ↑	0.1 ↑
599	DRC/CC-ICP-MS	<0.02	<0.02	<0.02	<0.02 ↓	<0.02
604	ICP-MS	0.007	0.010	0.017	0.063	0.034
605	ICP-MS	PLC	0.0123	0.0166	0.0630	0.0344
606	ICP-MS	0.007	0.011	0.017	0.064	0.036
607	ICP-MS	0.009	0.014	0.021	0.069	0.041
632	ICP-MS	0.0070	0.0113	0.0185	0.0642	0.0341

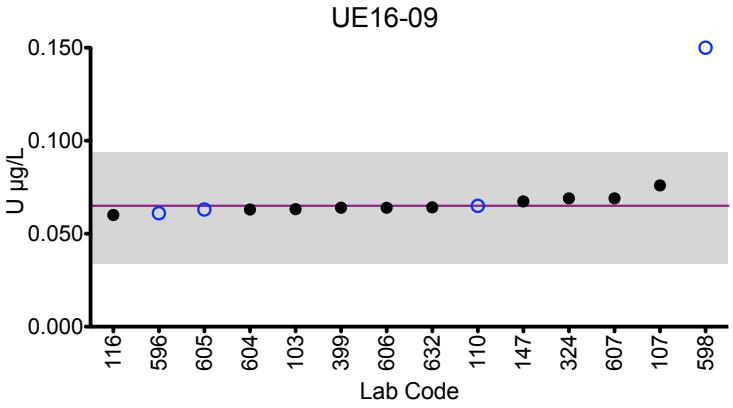
Based on the grading criteria for U in Urine, 92% of results were satisfactory, with 1 of the 15 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

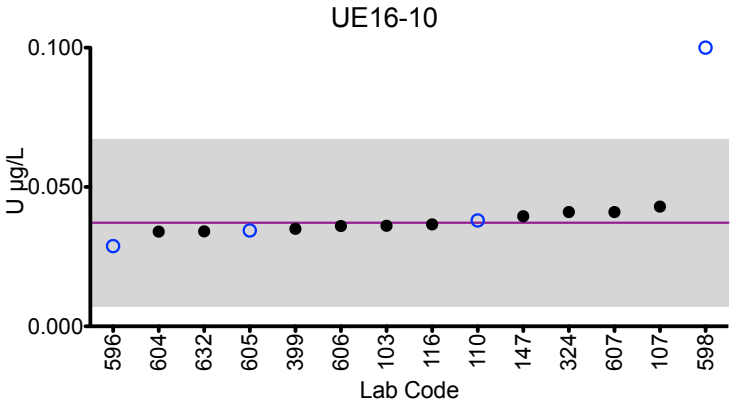
Results for Event #2, 2016: Urine U











Legend:

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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 .15 µg/L.

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Results for Event #2, 2016
Additional Elements in Urine: Cobalt (Co)

Urine Co (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
103	DRC/CC-ICP-MS	2.05	0.780	0.572	1.18	1.61
107	ICP-MS	2.1	0.80	0.62	1.2	1.6
110	ICP-MS	2.05	0.78	0.59	1.17	1.55
116	DRC/CC-ICP-MS	1.94	0.791	0.564	1.09	1.49
147	ICP-MS	2.06	0.784	0.625	1.23	1.61
324	HR-ICP-MS	2.399	1.309	0.891	1.485	1.859
391	DRC/CC-ICP-MS	2.277	0.8	0.679	1.203	1.755
399	DRC/CC-ICP-MS	2.04	0.777	0.577	1.22	1.58
485	HR-ICP-MS	2.1	0.776	0.594	1.19	1.57
596	ICP-MS	1.94	0.775	0.634	1.14	1.49
597	DRC/CC-ICP-MS	1.73	0.66	0.46	1.04	1.42
605	ICP-MS	2.05	0.806	0.610	1.22	1.62
606	ICP-MS	1.95	0.700	0.516	1.11	1.49
632	ICP-MS	2.16	0.870	0.658	1.28	1.69

Summary Statistics

	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
Robust Mean (x*)	2.05	0.785	0.603	1.19	1.58
Robust SD (s*)	0.11	0.021	0.051	0.05	0.10
Robust RSD (%)	5.62	2.73	8.59	4.45	6.76
Number of Sample Measurements (N)	14	14	14	14	14
Standard Uncertainty (*u*)	0.038	0.0071	0.017	0.017	0.035

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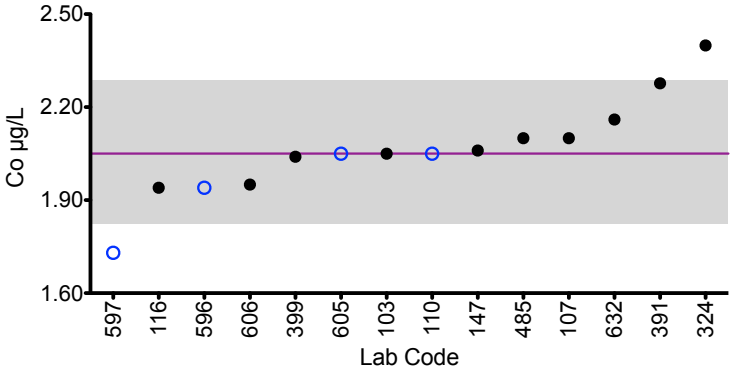
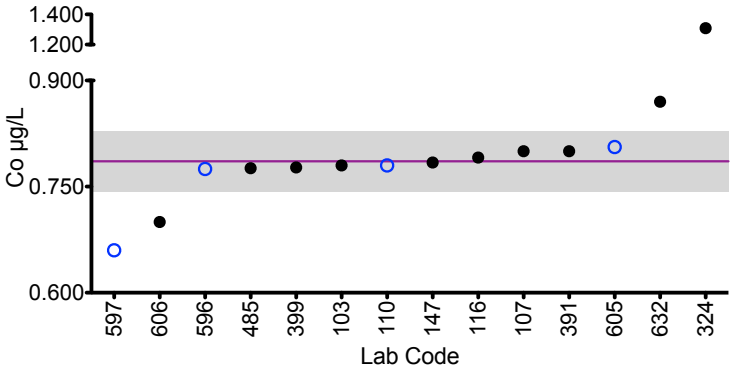
Results for Event #2, 2016: Urine Co

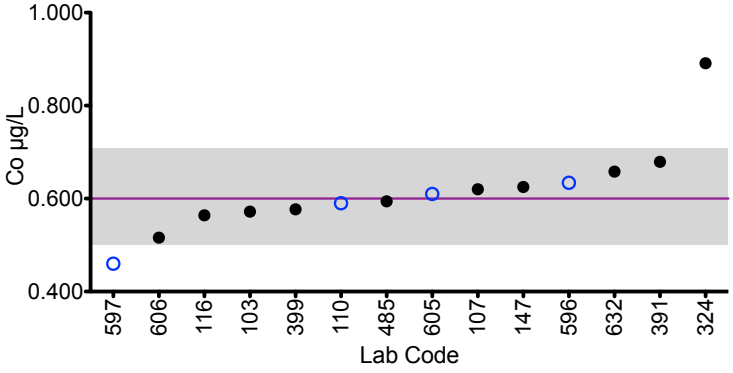
UE16-06



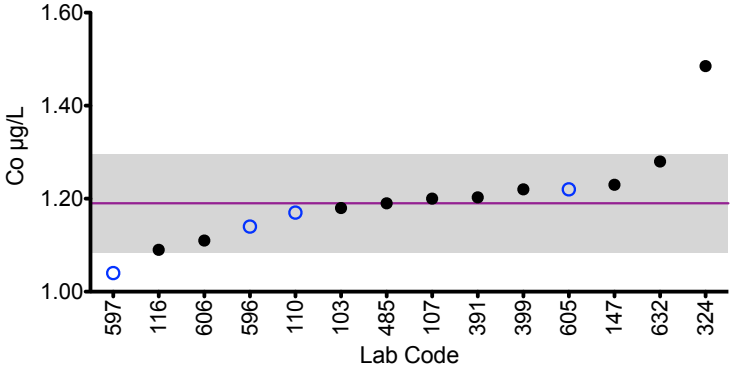
UE16-07



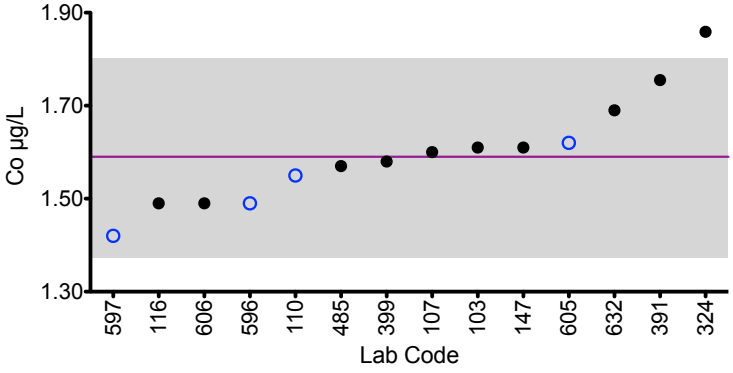
UE16-08



UE16-09



UE16-10



Legend:

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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 #2, 2016
Additional Elements in Urine: Chromium (Cr)

Urine Cr (µg/L)						
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
103	DRC/CC-ICP-MS	11.7	2.87	14.7	6.87	0.746
107	DRC/CC-ICP-MS	10	2.6	13	6.2	0.95
110	DRC/CC-ICP-MS	12.1	3.0	14.9	7.2	1.1
116	DRC/CC-ICP-MS	11.1	2.65	13.7	6.39	0.836
147	DRC/CC-ICP-MS	10.6	2.49	12.8	6.08	0.738
324	HR-ICP-MS	11.445	3.098	14.428	6.906	0.985
391	DRC/CC-ICP-MS	12.662	2.999	15.905	7.267	0.813
485	HR-ICP-MS	11.8	2.80	14.4	6.36	0.805
596	ICP-MS	9.79	2.60	18.3	5.54	2.11
597	DRC/CC-ICP-MS	10.3	2.45	12.2	6.09	0.73
632	DRC/CC-ICP-MS	10.8	2.51	13.4	6.04	0.299

Summary Statistics					
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Robust Mean (x*)	11.1	2.72	14.1	6.42	0.838
Robust SD (s*)	1.0	0.24	1.4	0.54	0.143
Robust RSD (%)	9.29	9.02	10.3	8.46	17.1
Number of Sample Measurements (N)	11	11	11	11	11
Standard Uncertainty (*u*)	0.389	0.092	0.552	0.205	0.054

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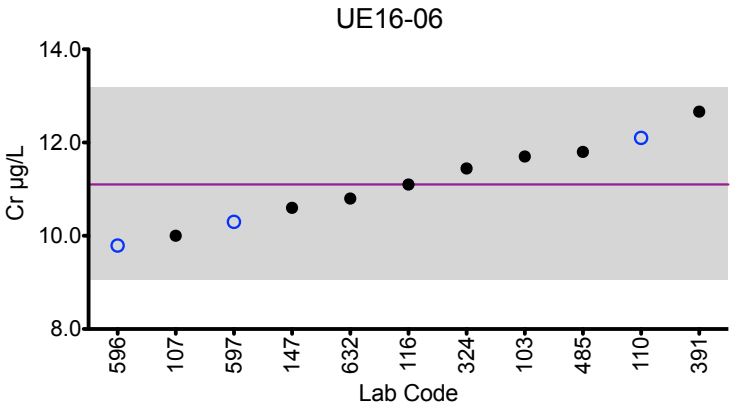
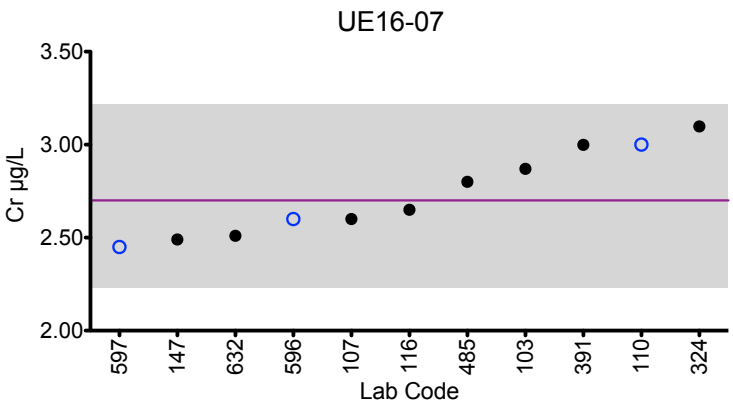
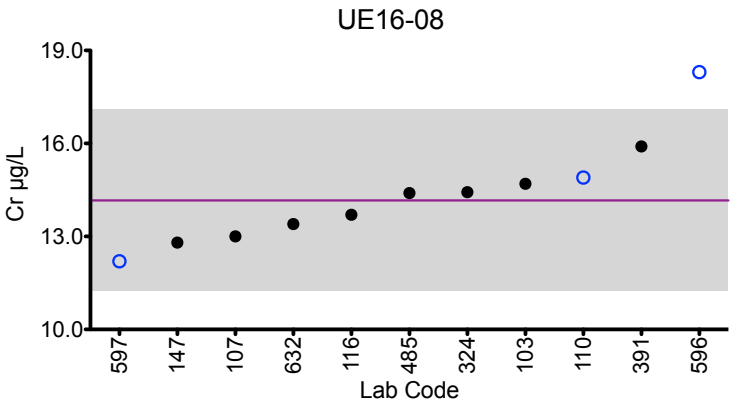
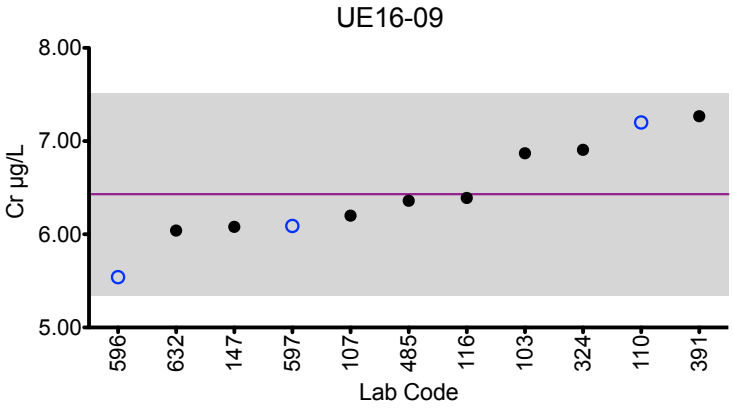
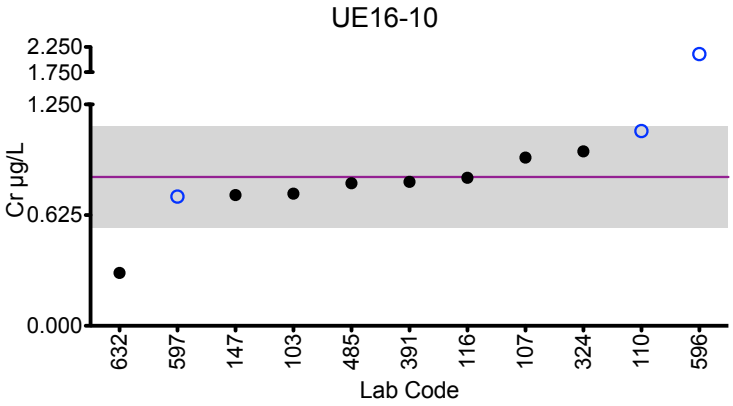
Results for Event #2, 2016: Urine Cr











Legend:

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Gray area = ±2SD of the mean.

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Results for Event #2, 2016
Additional Elements in Urine: Cesium (Cs)

Urine Cs (µg/L)						
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
107	ICP-MS	3.5	10	6.7	5.1	2.7
110	ICP-MS	3.7	11.1	7.1	5.4	2.8
147	ICP-MS	3.79	11.2	7.2	5.62	2.78
399	ICP-MS	3.77	11.4	7.33	5.48	2.85
597	DRC/CC-ICP-MS	2.99	9.09	5.91	4.52	2.36
599	DRC/CC-ICP-MS	4.33	11.6	7.52	5.57	2.86
605	ICP-MS	3.45	10.4	6.74	5.05	2.60
606	ICP-MS	3.42	10.5	6.56	4.95	2.56
632	ICP-MS	3.82	11.7	7.69	5.58	2.99

Summary Statistics					
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Arithmetic Mean ($\bar{x}$)	3.64	10.7	6.97	5.25	2.72
Arithmetic SD (s)	0.36	0.8	0.55	0.37	0.19
Arithmetic RSD (%)	10.0	7.94	7.91	7.08	6.98
Number of Sample Measurements (N)	9	9	9	9	9

*Denotes a statistical Outlier.

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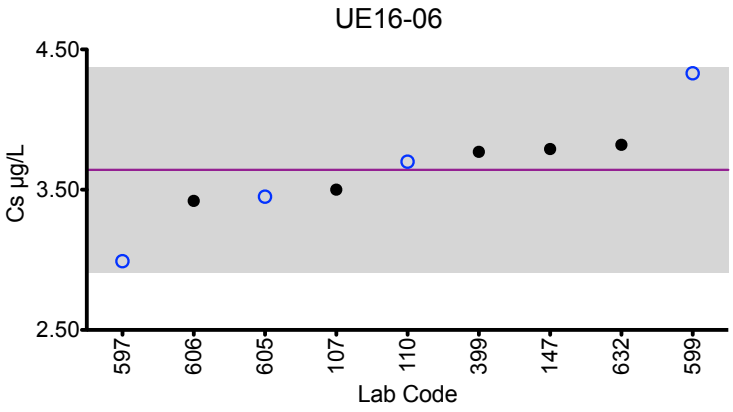
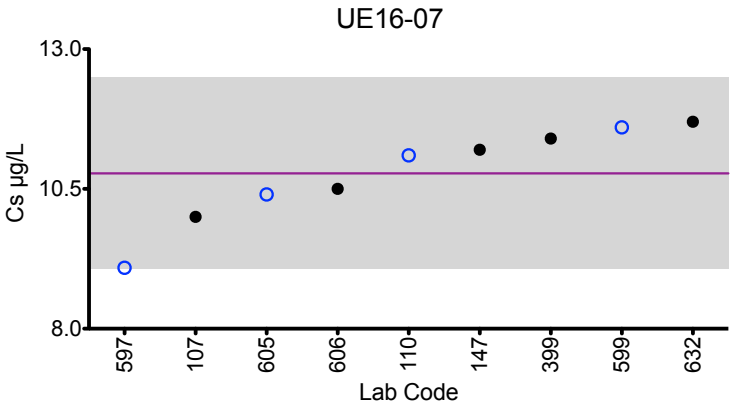
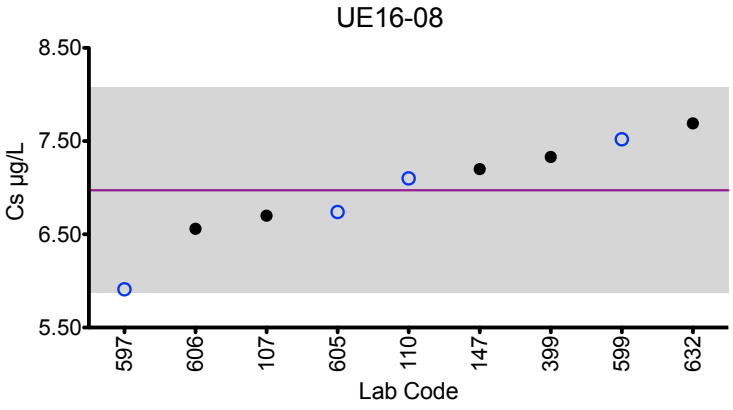
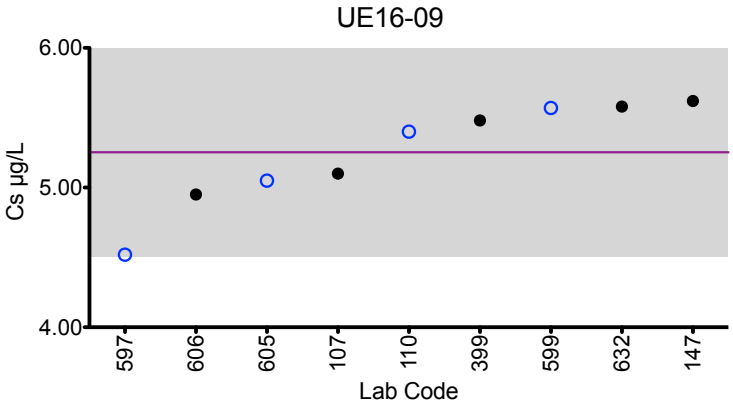
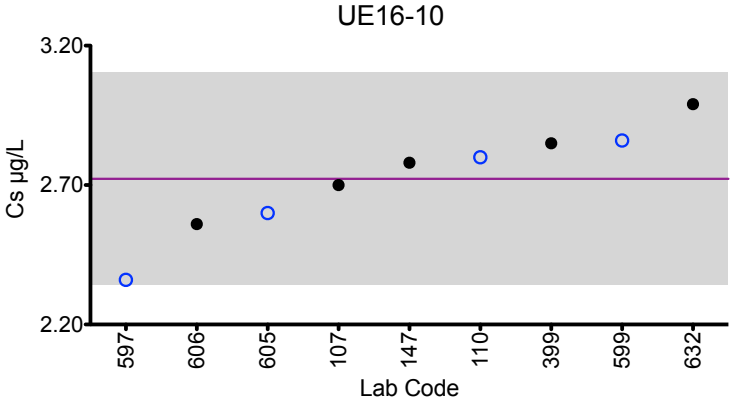
Results for Event #2, 2016: Urine Cs











Legend:

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Gray area = ±2SD of the mean.

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Results for Event #2, 2016
Additional Elements in Urine: Copper (Cu)

Urine Cu (µg/L)						
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
110	ICP-MS	2.3	40.9	23.1	17.2	8.6
116	DRC/CC-ICP-MS	ND	34.2	16.6	10.0	ND
147	ICP-MS	2.88	43.9	25.5	18.5	9.59
324	HR-ICP-MS	2.177	37.793	21.762	14.821	7.373
391	DRC/CC-ICP-MS	2.967	41.613	23.002	21.242	13.66
596	ICP-AES/OES	*15.7	43.7	31.7	19.7	9.67
597	DRC/CC-ICP-MS	1.60	34.4	19.9	14.7	7.52
632	ICP-MS	4.78	46.9	29.4	20.0	13.0

Summary Statistics					
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Arithmetic Mean ($\bar{x}$)	2.78	40.4	23.8	17.0	9.91
Arithmetic SD (s)	1.09	4.6	4.9	3.6	2.50
Arithmetic RSD (%)	39.4	11.3	20.5	21.7	25.2
Number of Sample Measurements (N)	6	8	8	8	7

*Denotes a statistical Outlier.

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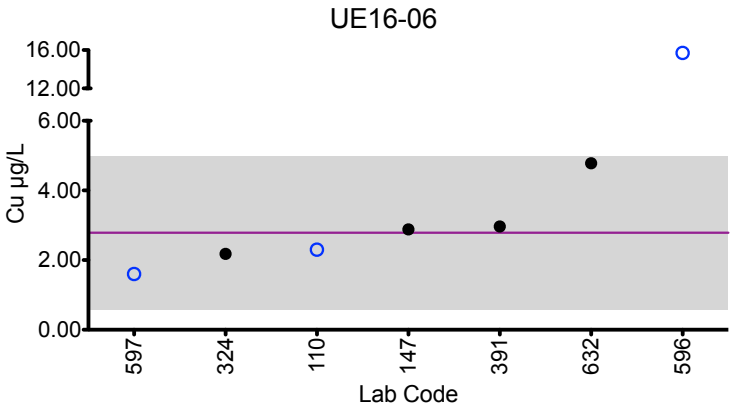
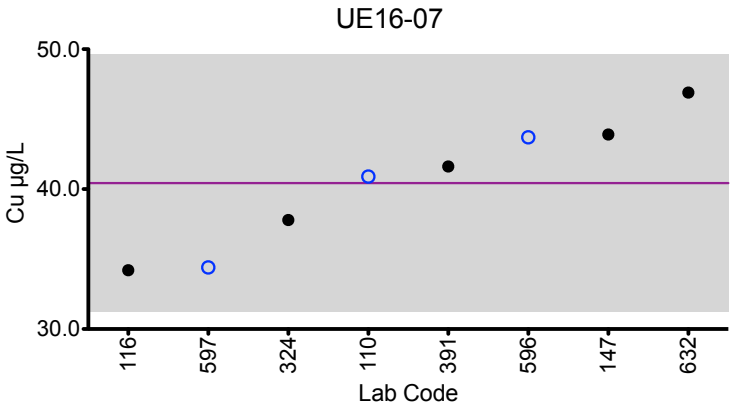
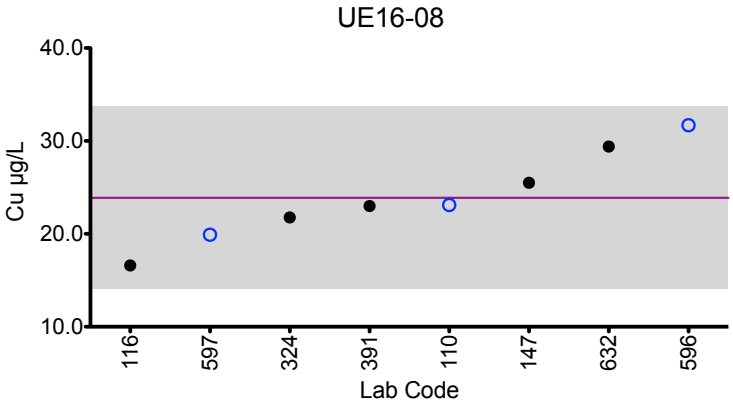
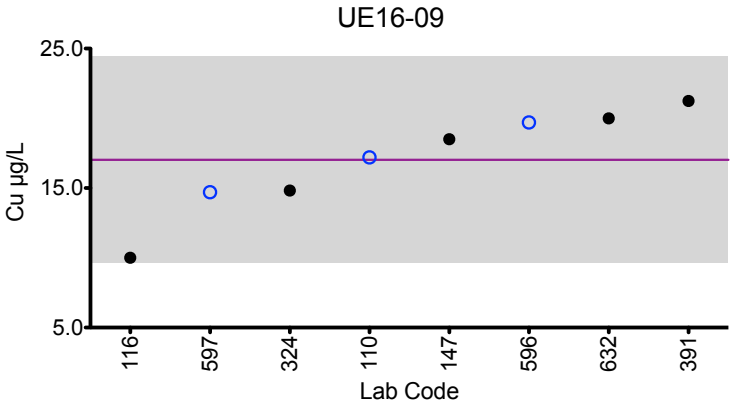
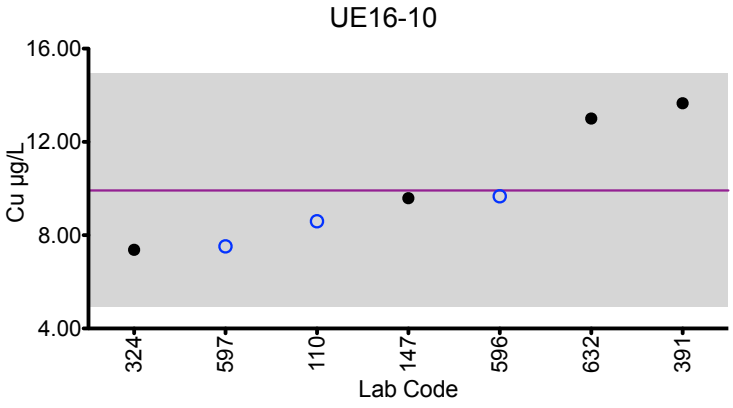
Results for Event #2, 2016: Urine Cu











Legend:

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Results for Event #2, 2016
Additional Elements in Urine: Molybdenum (Mo)

Urine Mo (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
103	DRC/CC-ICP-MS	133	18.9	67.2	27.4	43.0
107	ICP-MS	130	19	68	27	43
110	ICP-MS	137	19.5	68.7	27.5	43.7
147	ICP-MS	126	19.3	63.8	27.3	40.7
324	HR-ICP-MS	127.654	18.496	64.672	26.763	41.791
399	ICP-MS	139	19.9	70.5	28.7	44.9
485	HR-ICP-MS	143	19.6	69.6	28.6	45.1
596	HR-ICP-MS	123	18.8	63.4	25.1	36.9
599	DRC/CC-ICP-MS	142.3	19.8	70.3	29.0	44.6
605	ICP-MS	127	17.7	64.6	26.0	41.1
606	ICP-MS	135	18.4	67.6	26.9	42.9
632	ICP-MS	147	23.5	75.3	30.6	47.6

Summary Statistics

	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
Robust Mean (x*)	134	19.1	67.5	27.4	43.0
Robust SD (s*)	8	0.7	3.3	1.3	2.3
Robust RSD (%)	6.47	4.12	4.95	5.00	5.36
Number of Sample Measurements (N)	12	12	12	12	12
Standard Uncertainty (*u*)	3.13	0.285	1.20	0.496	0.833

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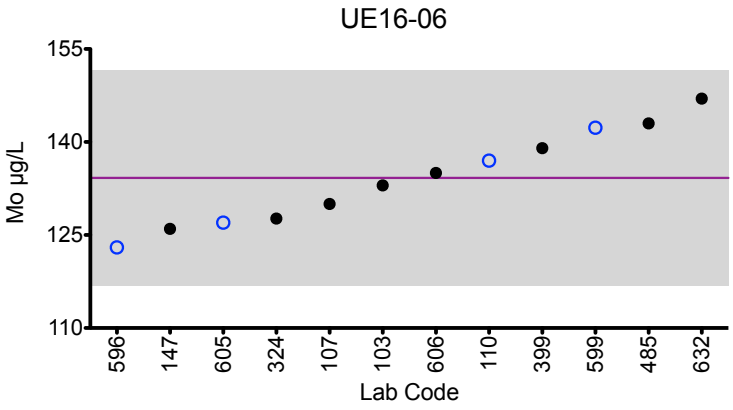
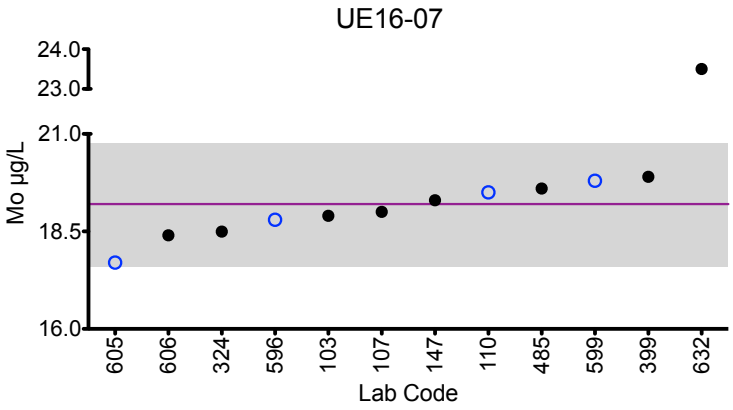
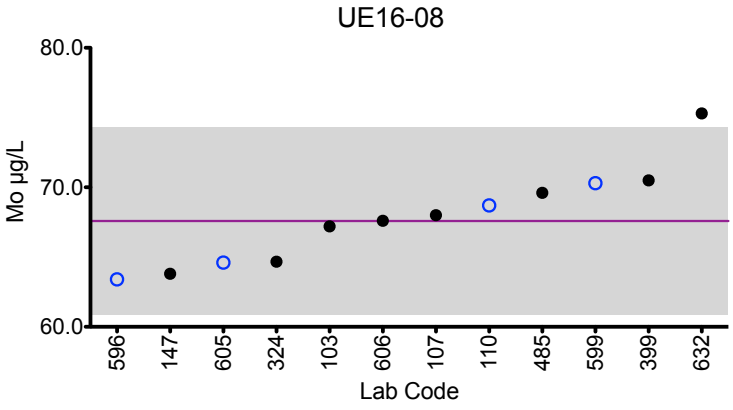
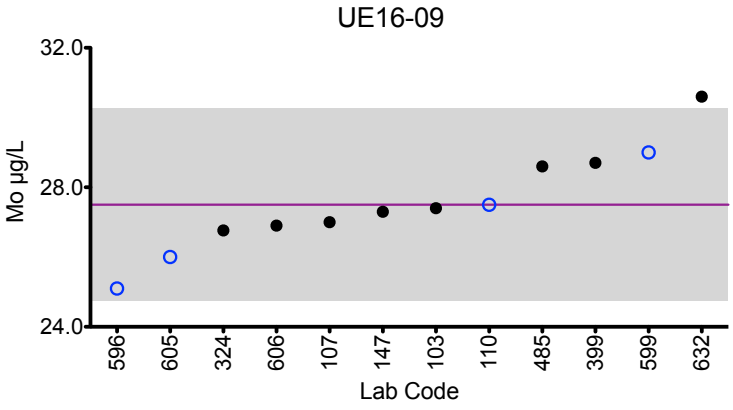
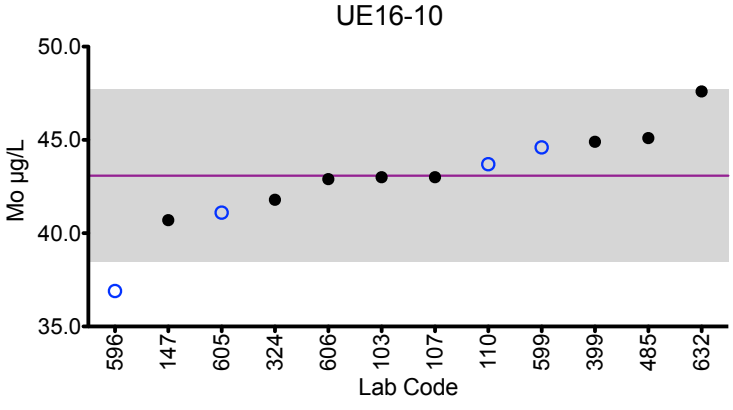
Results for Event #2, 2016: Urine Mo











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Results for Event #2, 2016
Additional Elements in Urine: Nickel (Ni)

Urine Ni (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
107	DRC/CC-ICP-MS	7.2	5.9	4.9	3.8	2.0
110	ICP-MS	7.8	6.3	5.4	4.1	2.6
147	DRC/CC-ICP-MS	7.52	6.35	5.13	3.73	2.25
324	ICP-MS	7.260	6.380	5.140	3.870	2.250
391	DRC/CC-ICP-MS	8.55	7.435	6.136	5.02	3.156
485	HR-ICP-MS	7.79	5.95	4.84	3.73	1.96
596	ICP-AES/OES	6.00	8.00	*8.00	<LOD	4.00
597	DRC/CC-ICP-MS	6.7	5.18	4.4	3.48	2.10
599	DRC/CC-ICP-MS	6.47	5.1	4.03	3.02	1.70

Summary Statistics

	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
Arithmetic Mean ($\bar{x}$)	7.25	6.28	4.99	3.84	2.44
Arithmetic SD (s)	0.77	0.94	0.63	0.57	0.71
Arithmetic RSD (%)	10.7	15.0	12.7	14.8	29.3
Number of Sample Measurements (N)	9	9	8	8	9

*Denotes a statistical Outlier.

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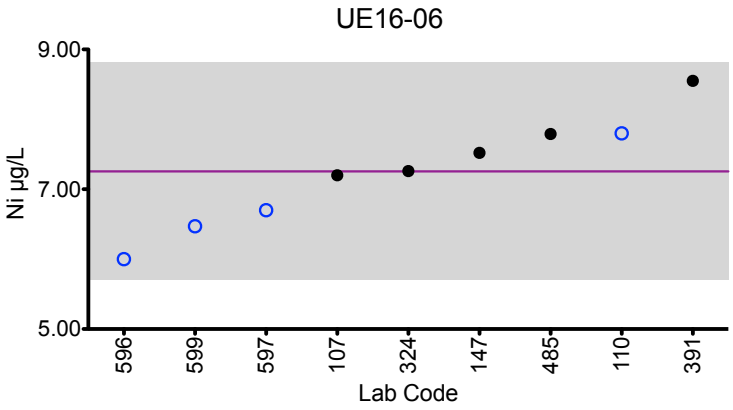
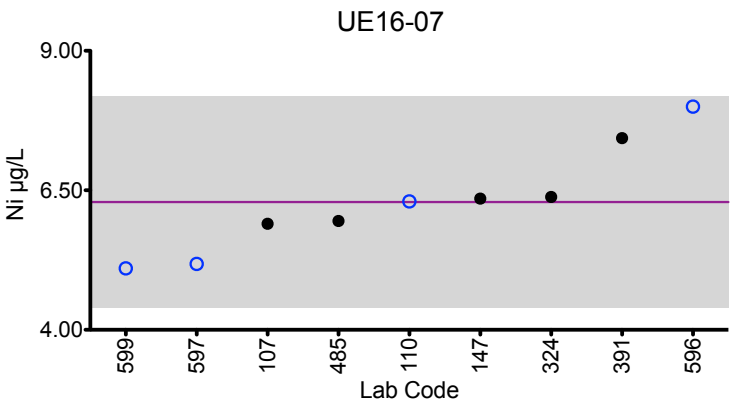
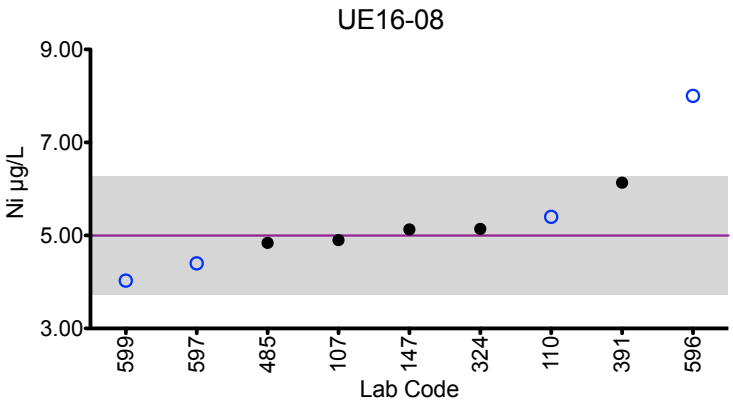
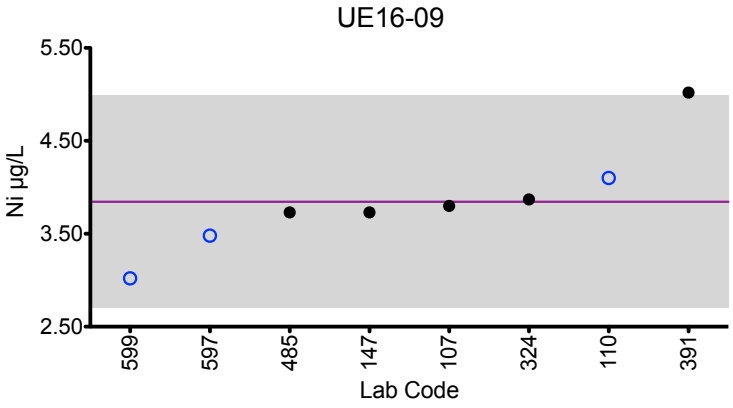
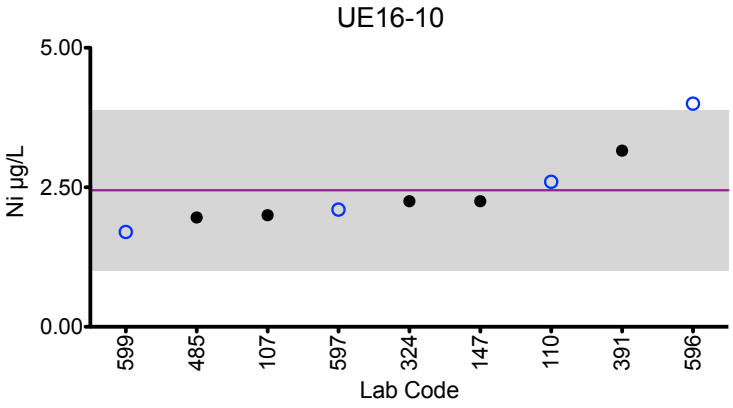
Results for Event #2, 2016: Urine Ni











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Results for Event #2, 2016
Additional Elements in Urine: Platinum (Pt)

Urine Pt (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
107	ICP-MS	0.53	0.29	0.14	0.46	0.61
110	ICP-MS	0.47	0.21	0.09	0.38	0.54
147	ICP-MS	0.690	0.365	0.175	0.488	0.579
399	ICP-MS	0.515	0.276	0.132	0.462	0.582
596	ICP-MS	0.646	0.395	0.18	0.528	0.703
605	ICP-MS	0.503	0.268	0.143	0.439	0.548
632	ICP-MS	0.559	0.320	0.179	0.472	0.617

Summary Statistics

	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
Arithmetic Mean ($\bar{x}$)	0.559	0.303	0.148	0.461	0.596
Arithmetic SD (s)	0.080	0.062	0.032	0.045	0.054
Arithmetic RSD (%)	14.3	20.5	22.0	9.84	9.17
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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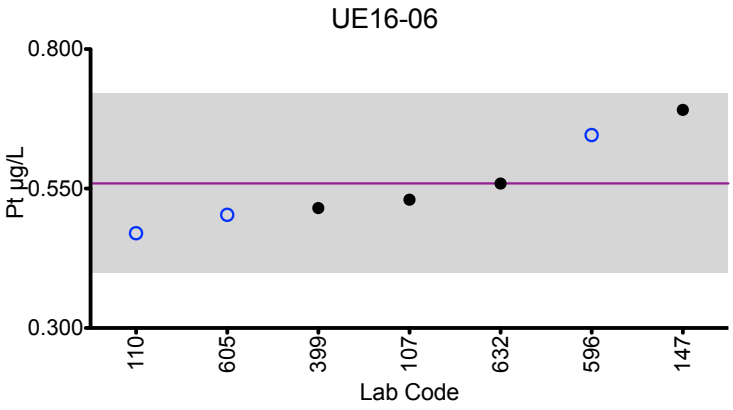
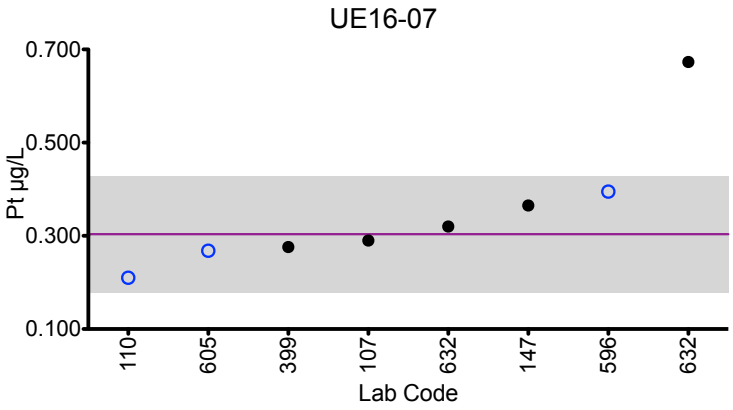
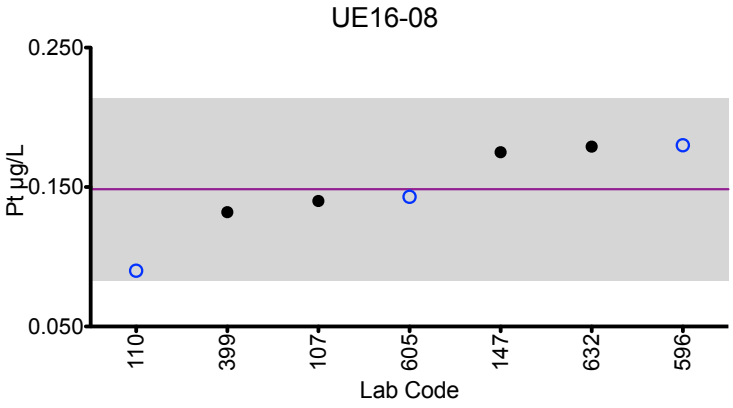
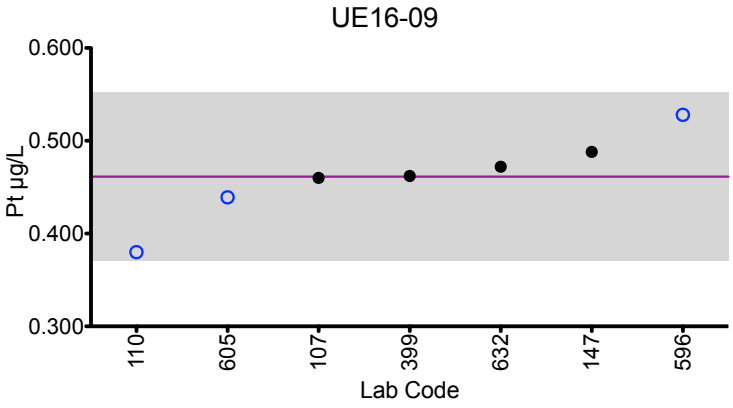
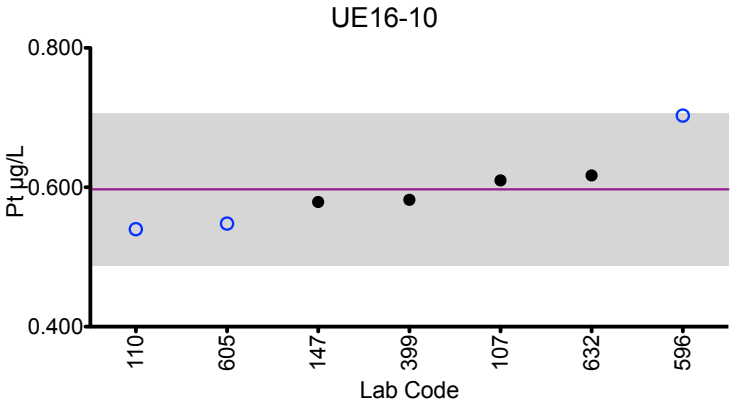
Results for Event #2, 2016: Urine Pt











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Results for Event #2, 2016
Additional Elements in Urine: Antimony (Sb)

Urine Sb (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
103	DRC/CC-ICP-MS	0.420	0.230	0.103	0.555	0.842
107	ICP-MS	0.37	0.22	0.11	0.55	0.84
110	ICP-MS	0.39	0.23	0.12	0.59	0.86
147	ICP-MS	0.363	0.219	0.105	0.538	0.849
399	ICP-MS	0.411	0.242	0.120	0.604	0.878
597	DRC/CC-ICP-MS	0.49	0.35	0.39	0.71	1.01
599	DRC/CC-ICP-MS	0.849	*0.712	0.370	0.683	0.985
605	ICP-MS	0.368	PLC	PLC	0.497	0.824
606	ICP-MS	0.407	0.181	<0.080	0.541	0.731
632	ICP-MS	0.510	0.324	0.200	0.691	1.02

Summary Statistics

	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
Robust Mean (x*)	0.421	0.250	0.190	0.581	0.863
Robust SD (s*)	0.061	0.057	0.121	0.059	0.047
Robust RSD (%)	14.6	23.0	64.0	10.2	5.46
Number of Sample Measurements (N)	10	8	8	10	10
Standard Uncertainty (*u*)	0.024	-	-	0.023	0.018

*Statistical Outlier. Arithmetic statistics were compiled for sample UE16-07 and UE16-08 due to an insufficient number of sample measurements to perform robust statistics.

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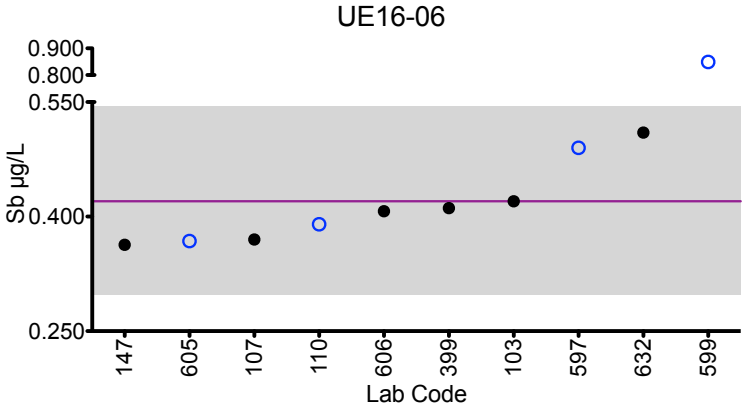
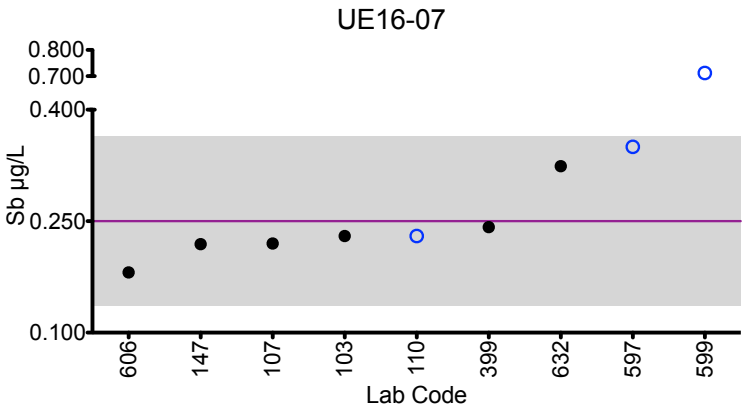
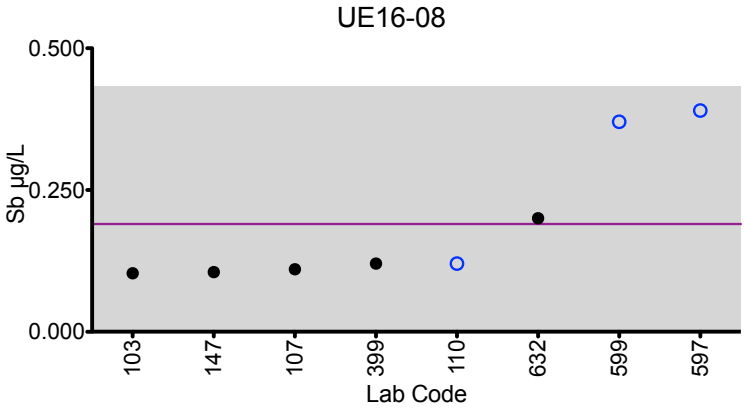
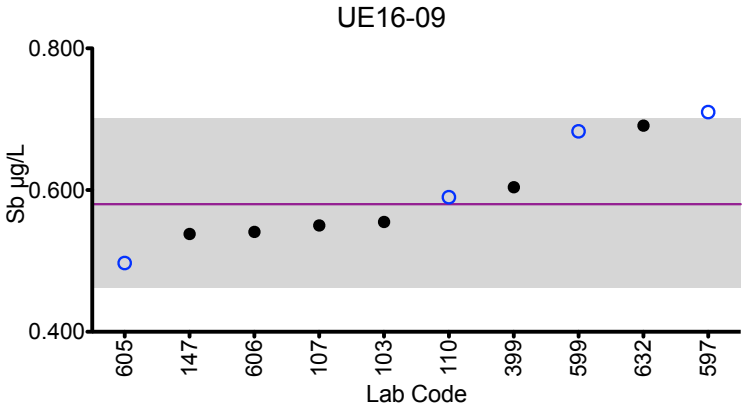
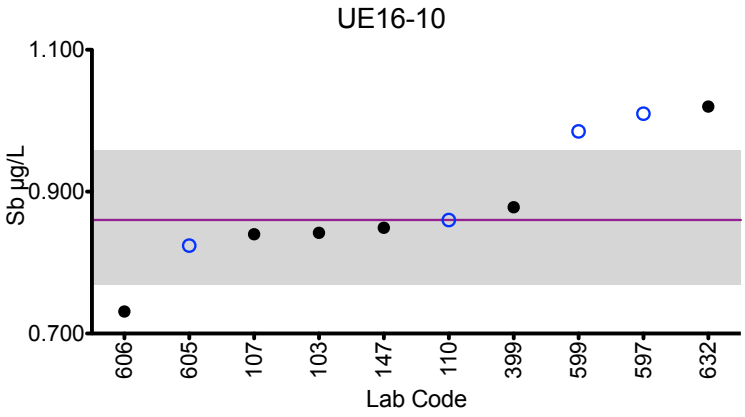
Results for Event #2, 2016: Urine Sb











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Results for Event #2, 2016
Additional Elements in Urine: Selenium (Se)

Urine Se (µg/L)						
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
103	DRC/CC-ICP-MS	48.6	181	98.4	62.7	132
110	DRC/CC-ICP-MS	9.8	139	56.1	17.0	88.9
147	ICP-MS	10.5	133	54.3	20	88.5
596	ICP-MS	26.5	145	74.6	37.8	104
596	HR-ICP-MS	6.61	130	52.0	15.2	76.8
597	DRC/CC-ICP-MS	10.3	121	53.5	20.8	86.9
632	DRC/CC-ICP-MS	47.8	168	93.5	51.3	123

Summary Statistics					
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Arithmetic Mean ($\bar{x}$)	22.8	145	68.9	32.1	100
Arithmetic SD (s)	18.4	21	20.0	18.8	20
Arithmetic RSD (%)	81.0	14.8	29	58.6	20.5
Number of Sample Measurements (N)	7	7	7	7	7

*Denotes a statistical Outlier.

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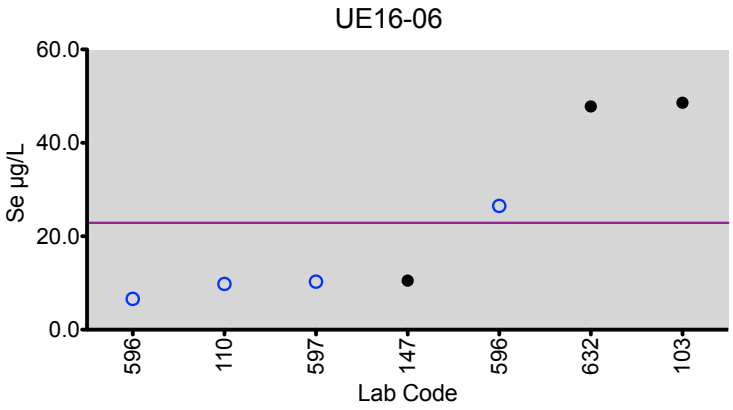
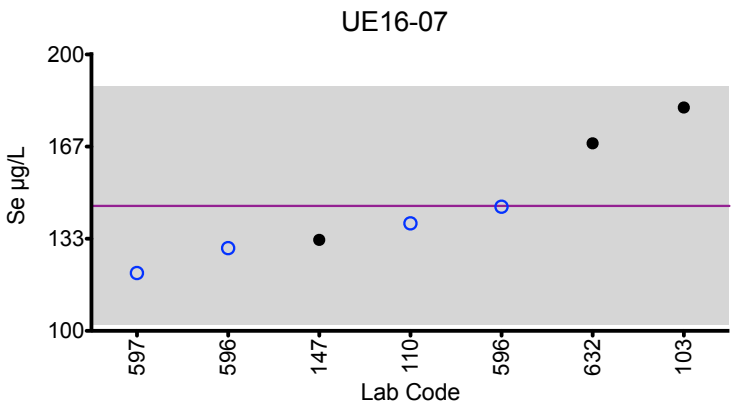
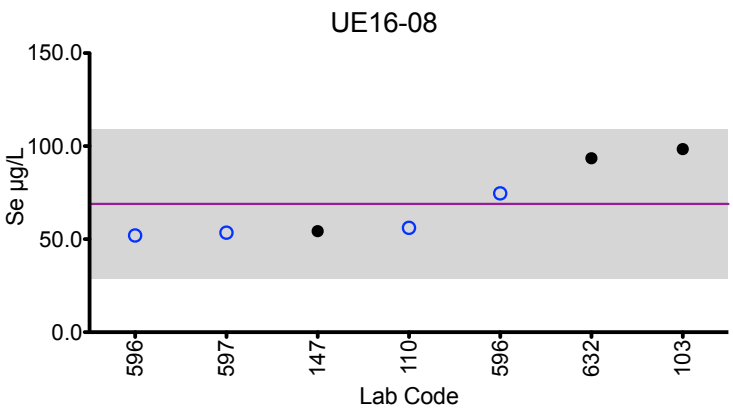
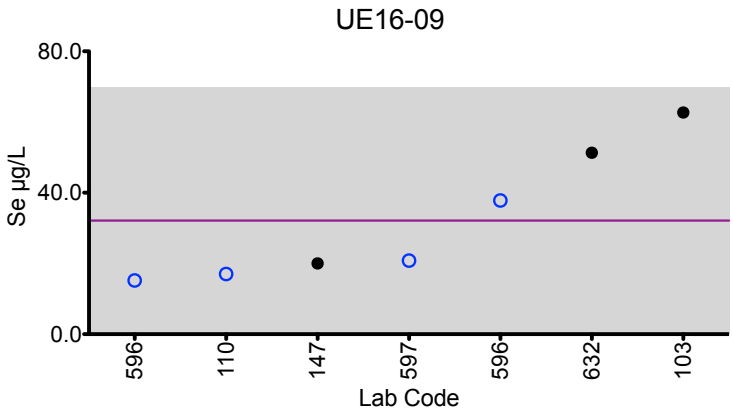
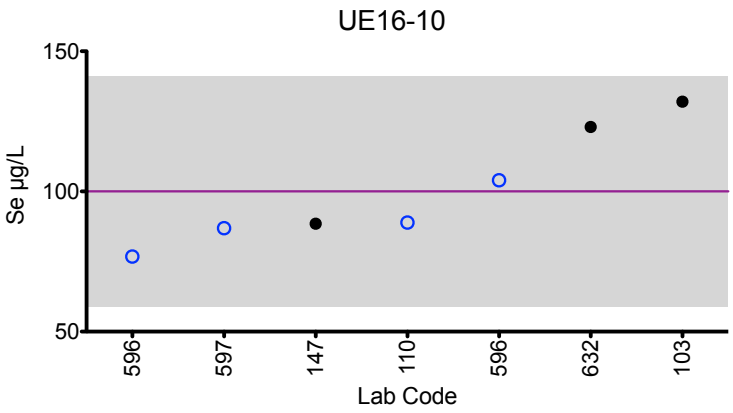
Results for Event #2, 2016: Urine Se











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Results for Event #2, 2016
Additional Elements in Urine: Tin (Sn)

Urine Sn (µg/L)						
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
107	ICP-MS	2.3	12	0.94	6.3	1.1
110	ICP-MS	2.34	13.3	0.67	6.74	0.96
147	ICP-MS	2.32	12.9	0.659	6.71	1
399	ICP-MS	2.39	13.8	0.663	6.84	0.996
596	ICP-MS	1.97	11.6	0.45	6.00	0.720
599	DRC/CC-ICP-MS	2.81	13.5	0.925	6.96	1.24
605	ICP-MS	2.37	13.1	PLC	6.75	1.74

Summary Statistics					
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Arithmetic Mean ($\bar{x}$)	2.35	12.8	0.717	6.61	1.10
Arithmetic SD (s)	0.24	0.8	0.185	0.33	0.31
Arithmetic RSD (%)	10.4	6.23	25.8	5.12	28.8
Number of Sample Measurements (N)	7	7	6	7	7

*Denotes a statistical Outlier.

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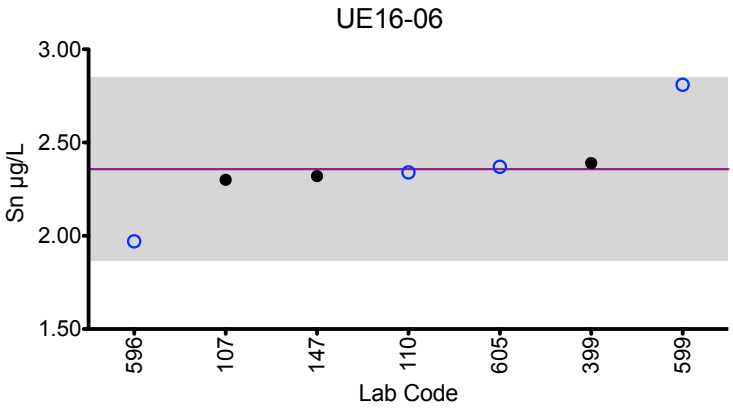
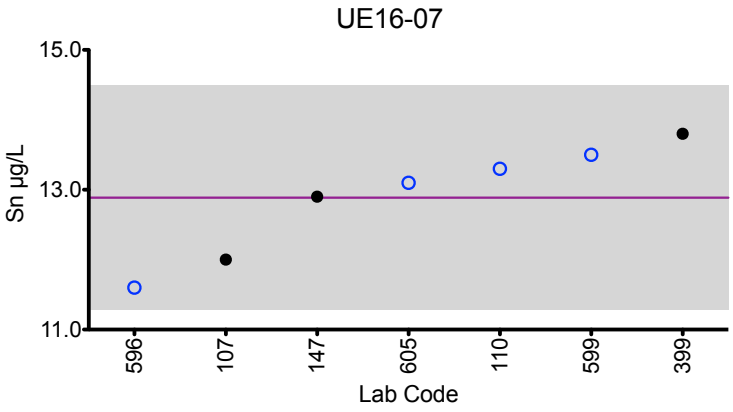
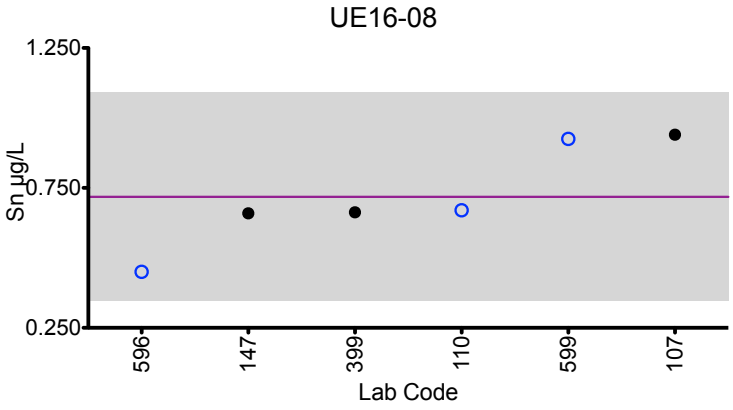
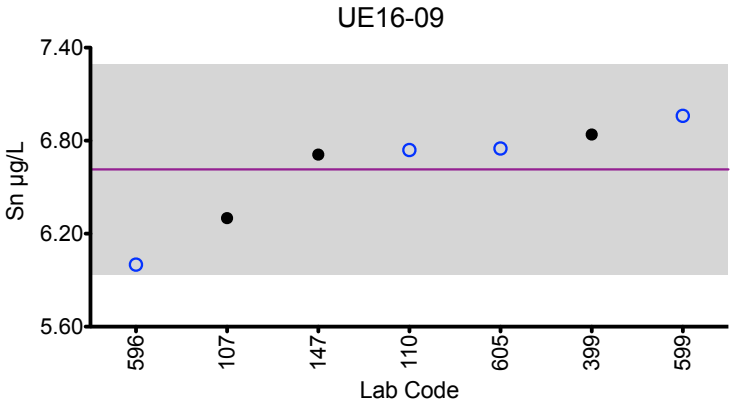
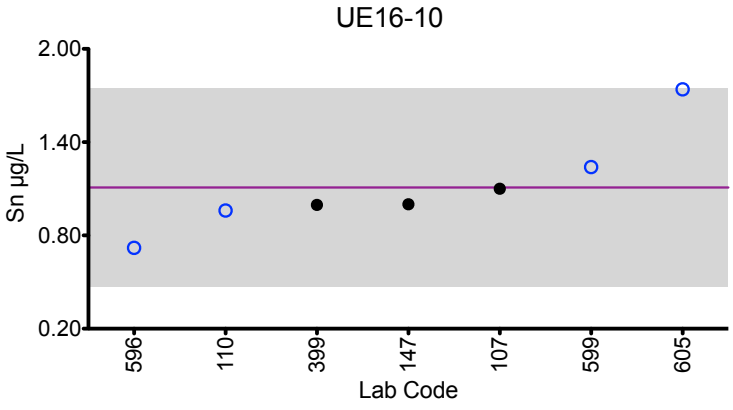
Results for Event #2, 2016: Urine Sn











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Results for Event #2, 2016
Additional Elements in Urine: Strontium (Sr)

Urine Sr (µg/L)						
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
103	DRC/CC-ICP-MS	26.9	25.6	25.8	25.8	25.8
107	ICP-MS	29	28	28	28	28
200	ICP-MS	23.7	27.2	26.3	28.0	27.2
399	DRC/CC-ICP-MS	29.7	29.7	29.6	30	29.6
605	ICP-MS	28.8	28.2	28.4	28.3	28.5

Summary Statistics					
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Arithmetic Mean ($\bar{x}$)	27.6	27.7	27.6	28.0	27.8
Arithmetic SD (s)	2.4	1.4	1.5	1.4	1.4
Arithmetic RSD (%)	8.77	5.40	5.64	5.33	5.12
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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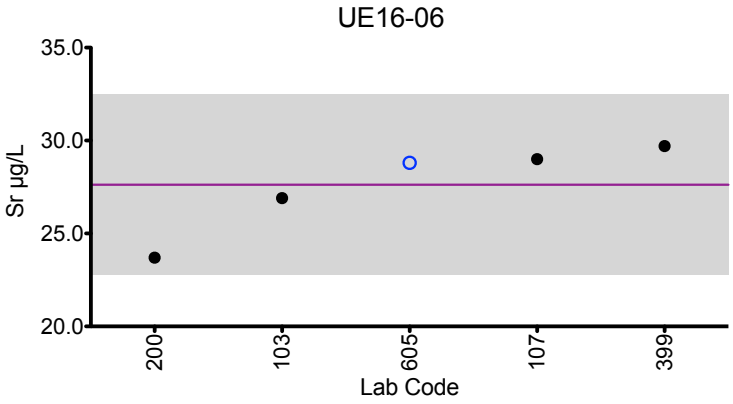
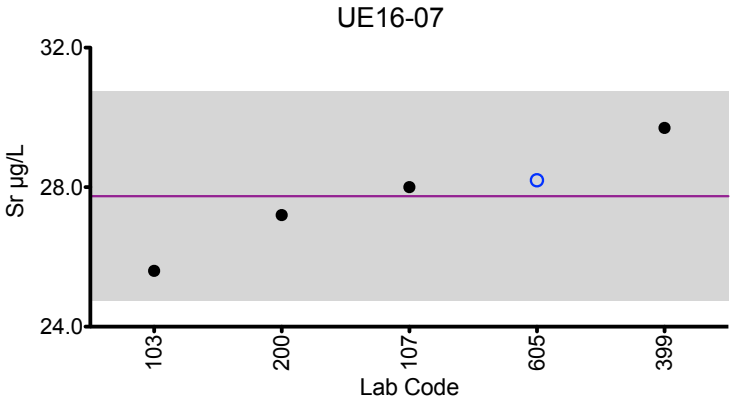
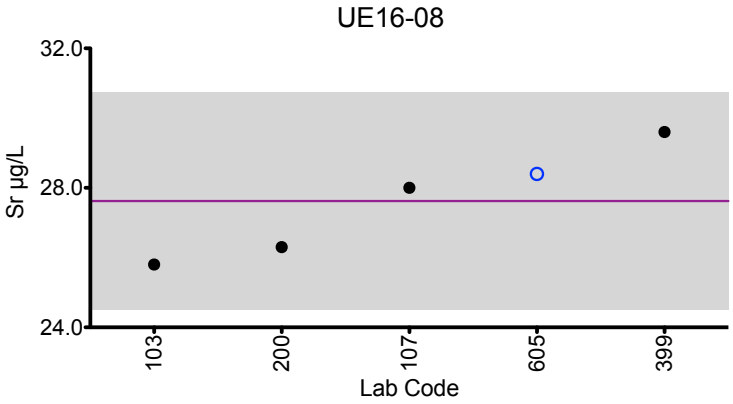
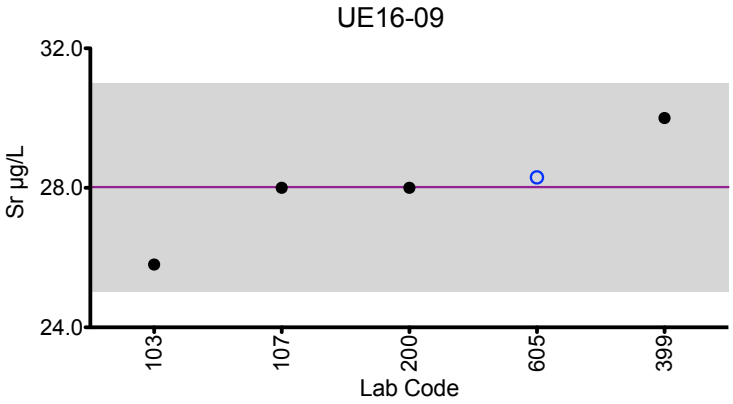
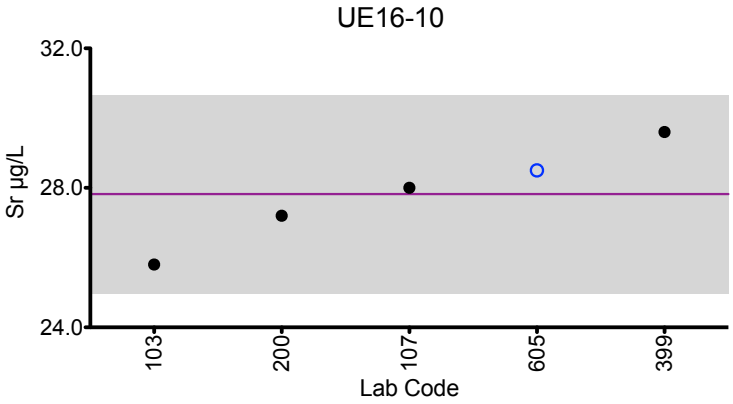
Results for Event #2, 2016: Urine Sr











Legend:

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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 #2, 2016
Additional Elements in Urine: Vanadium (V)

Urine V (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
116	DRC/CC-ICP-MS	0.132	1.46	ND	0.214	0.788
147	DRC/CC-ICP-MS	0.098	1.43	<0.0408	0.223	0.791
485	HR-ICP-MS	0.146	1.63	<0.012	0.245	0.923
596	HR-ICP-MS	<LOD	1.21	<LOD	<LOD	0.491
597	DRC/CC-ICP-MS	0.13	1.31	0.02	0.22	0.75
599	DRC/CC-ICP-MS	0.189	1.49	<0.02	0.242	0.818

Summary Statistics

	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
Arithmetic Mean ($\bar{x}$)	0.139	1.42	0.02	0.228	0.760
Arithmetic SD (s)	0.033	0.14	NA	0.013	0.144
Arithmetic RSD (%)	23.7	10.2	NA	5.95	18.9
Number of Sample Measurements (N)	5	6	1	5	6

*Denotes a statistical Outlier.

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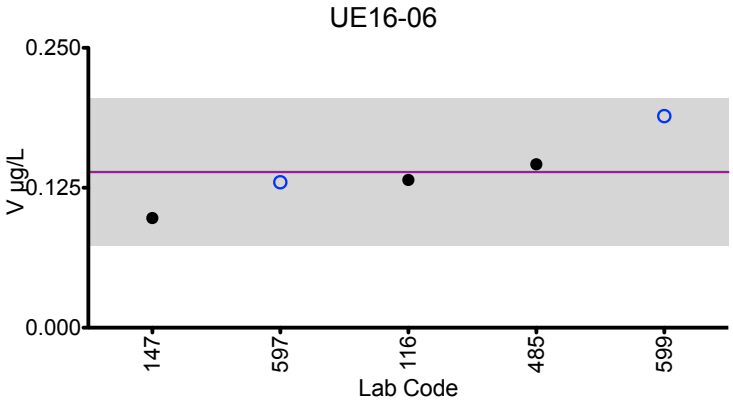
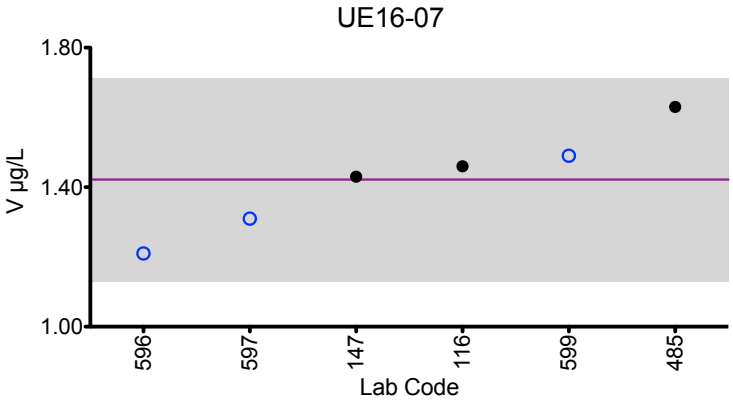
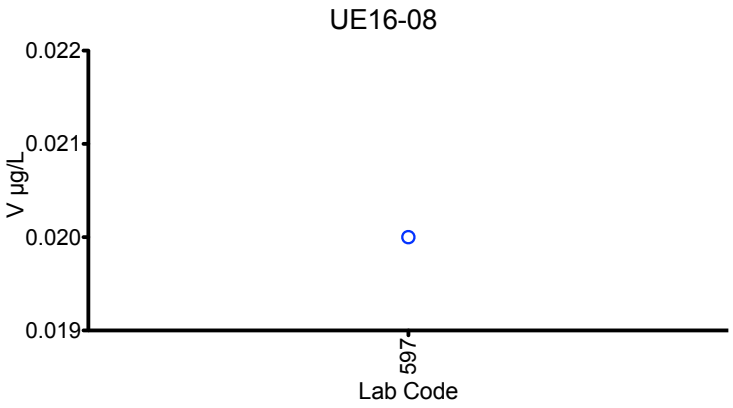
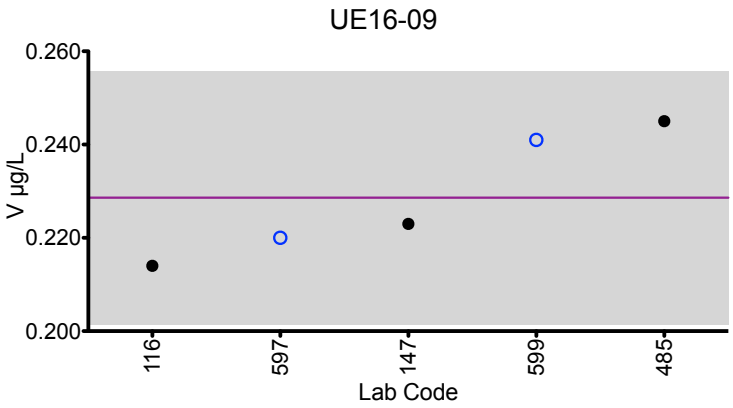
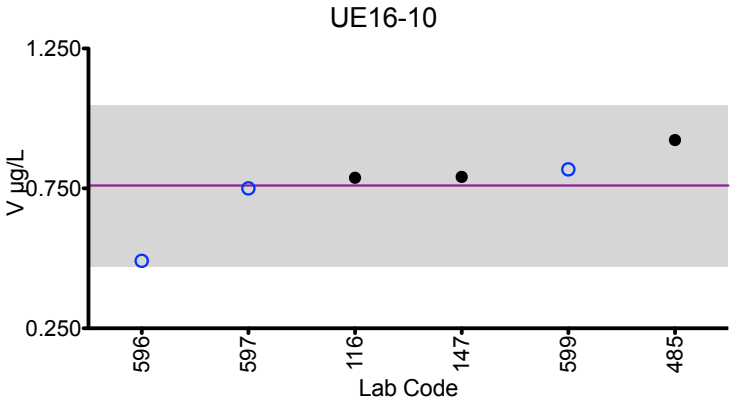
Results for Event #2, 2016: Urine V











Legend:

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Horizontal purple line = arithmetic mean of all laboratories.

Gray area = ±2SD of the mean.

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Results for Event #2, 2016
Additional Elements in Urine: Tungsten (W)

Urine W (µg/L)						
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
107	ICP-MS	0.34	0.16	1.1	0.59	0.33
110	ICP-MS	0.36	0.09	0.98	0.50	0.25
147	ICP-MS	0.333	0.132	1.05	0.556	0.331
200	ICP-MS	1.8	0.3	1.2	0.7	0.4
324	ICP-MS	<1	<1	1.000	<1	<1
399	ICP-MS	0.309	0.167	1.08	0.499	0.343
596	ICP-MS	0.341	0.153	1.1	0.558	1.02
599	DRC/CC-ICP-MS	5.72	*2.01	2.21	1.34	0.903
605	ICP-MS	0.317	PLC	1.05	0.572	0.323
606	ICP-MS	0.314	0.083	1.05	0.466	0.255
632	ICP-MS	0.700	0.379	1.29	0.733	0.459

Summary Statistics					
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Robust Mean (x*)	0.350	0.183	1.08	0.586	0.368
Robust SD (s*)	0.039	0.104	0.05	0.103	0.103
Robust RSD (%)	11.3	57.0	5.31	17.7	28.1
Number of Sample Measurements (N)	10	8	11	10	10
Standard Uncertainty (*u*)	0.015	-	0.021	0.041	0.041

*Statistical Outlier. Arithmetic statistics were compiled for sample UE16-07 due to an insufficient number of sample measurements to perform robust statistics.

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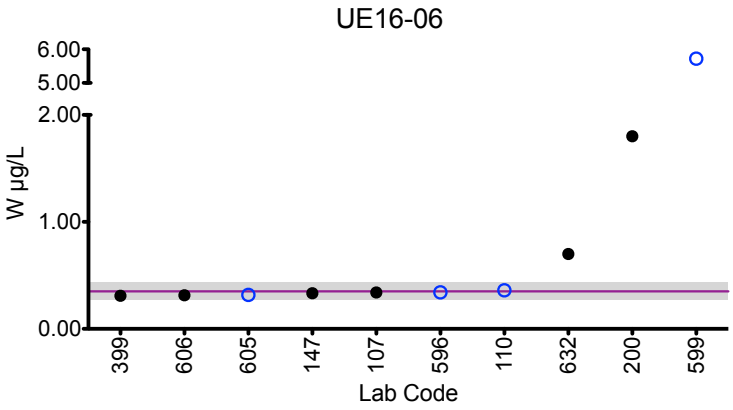
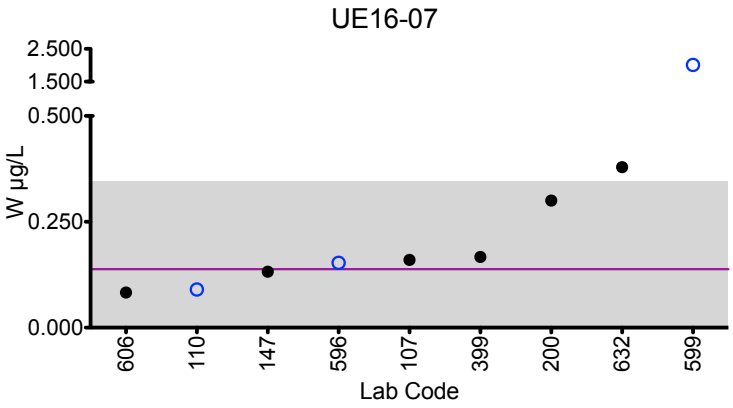
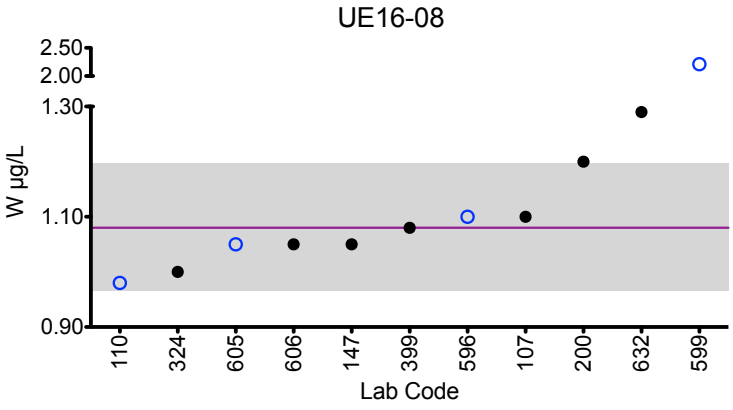
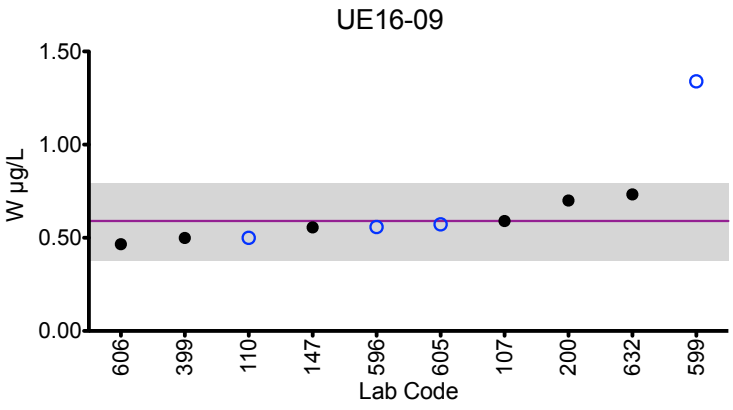
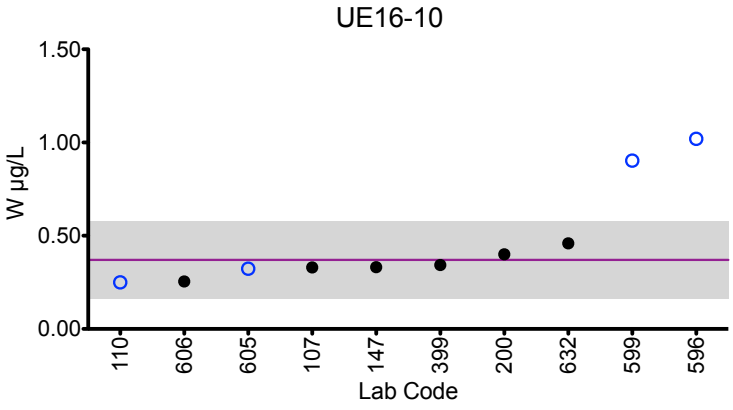
Results for Event #2, 2016: Urine W











Legend:

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Horizontal purple line = robust mean of all laboratories.

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Results for Event #2, 2016
Additional Elements in Urine: Zinc (Zn)

Urine Zn (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
110	ICP-MS	468	95	209	742	134
147	ICP-MS	527	125	235	856	192
324	HR-ICP-MS	450.334	84.625	189.056	682.683	130.966
596	ICP-AES/OES	407	50.7	159	687	86.7
597	DRC/CC-ICP-MS	397	76.8	173	657	121
632	ICP-MS	511	106	232	814	150

Summary Statistics

	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
Arithmetic Mean ($\bar{x}$)	460	89.6	199	739	135
Arithmetic SD (s)	52	25.5	31	79	34
Arithmetic RSD (%)	11.5	28.4	15.6	10.8	25.5
Number of Sample Measurements (N)	6	6	6	6	6

*Denotes a statistical Outlier.

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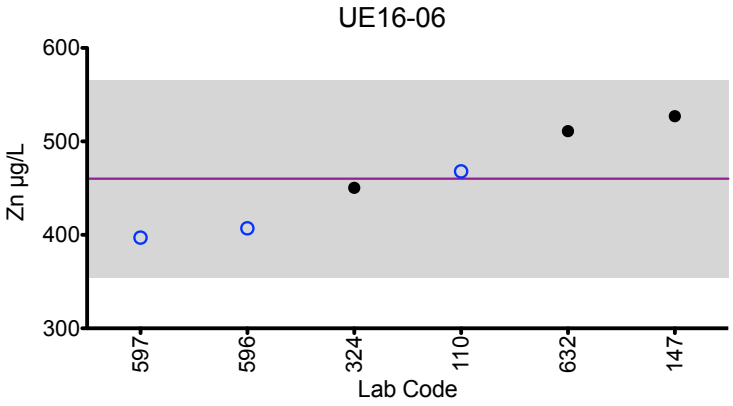
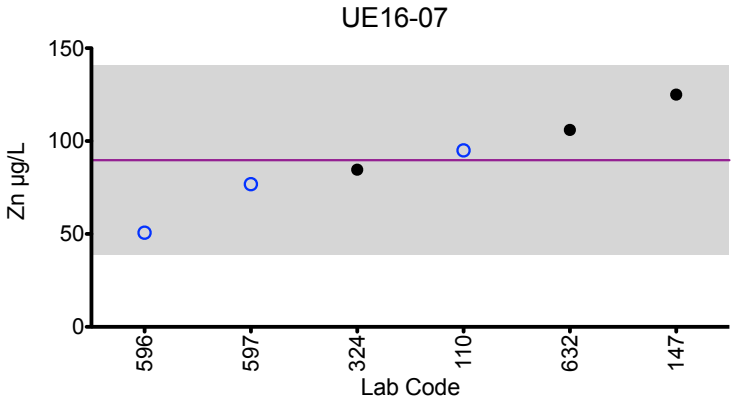
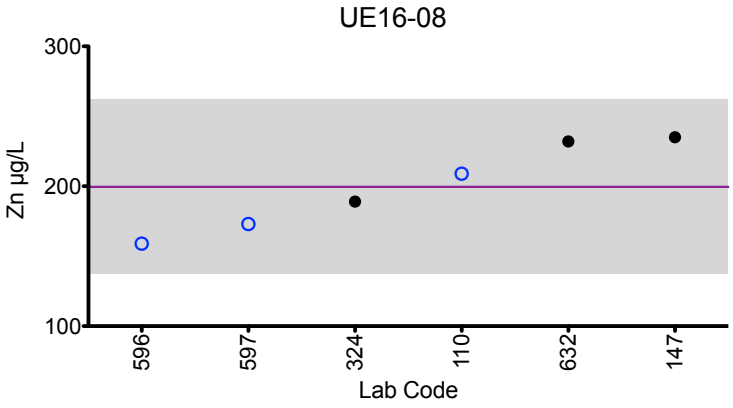
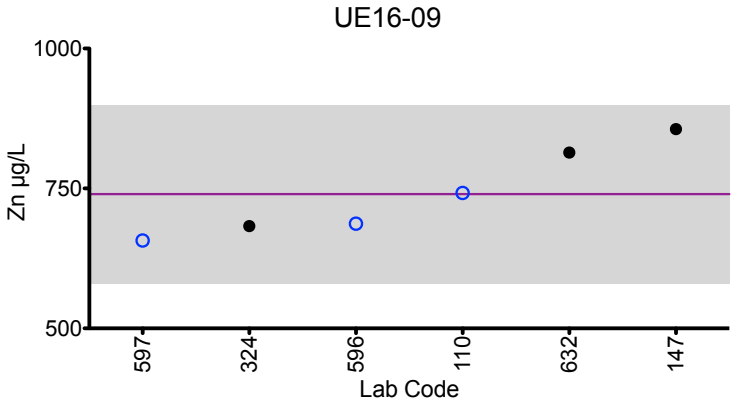
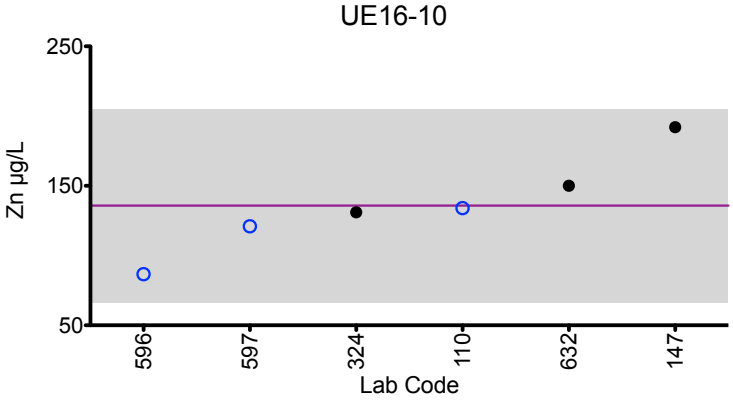
Results for Event #2, 2016: Urine Zn











Legend:

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Results for Event #2, 2016
Additional Elements in Urine: Aluminum (Al)

Urine Al (µg/L)						
Lab Code	**Method**	**UE16-06**	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
147	DRC/CC-ICP-MS	<13.8	<13.8	<13.8	<13.8	<13.8
324	HR-ICP-MS	9.552	19.139	9.179	7.420	12.533
485	HR-ICP-MS	7.72	15.8	9.01	NR	11.1

Summary Statistics					
	UE16-06	**UE16-07**	**UE16-08**	**UE16-09**	**UE16-10**
Arithmetic Mean ($\bar{x}$)	8.63	17.4	9.09	7.42	11.8
Arithmetic SD (s)	1.29	2.3	0.11	NA	1.0
Arithmetic RSD (%)	15.0	13.5	1.25	NA	8.57
Number of Sample Measurements (N)	2	2	2	1	2

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Urine: Tellurium (Te)

Urine Te (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
110	ICP-MS	1.18	1.33	0.40	0.88	<MDL
596	ICP-MS	0.99	1.23	0.470	0.733	0.373
599	DRC/CC-ICP-MS	1.33	1.57	0.656	0.902	0.571

Summary Statistics

	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
Arithmetic Mean ($\bar{x}$)	1.16	1.37	0.508	0.838	0.471
Arithmetic SD (s)	0.17	0.17	0.132	0.091	0.140
Arithmetic RSD (%)	14.6	12.6	26.0	10.9	29.6
Number of Sample Measurements (N)	3	3	3	3	2

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Urine

Urine B (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
200	ICP-MS	257	198	220	206	275

Urine Bi (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
147	ICP-MS	<0.230	<0.230	<0.230	<0.230	<0.230

Urine Fe (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
324	HR-ICP-MS	2.874	2.698	2.821	2.246	1.596

Urine I (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
107	ICP-MS	59	57	57	56	57

Urine Li (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
147	ICP-MS	8.61	8.54	8.61	9.02	8.47

Urine Th (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
147	ICP-MS	<0.00557	<0.00557	<0.00557	<0.00557	<0.00557

Urine Ti (µg/L)

Lab Code	Method	UE16-06	UE16-07	UE16-08	UE16-09	UE16-10
485	HR-ICP-MS	<0.49	<0.49	<0.49	<0.49	<0.49

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Event #2, 2016

Trace Elements in Serum

Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

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Event #2, 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: Cu, Se, and Zn. 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 30 elements (beyond the three graded) were reported by at least one participant: Ag, Al, 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 #2, 2016
Serum Copper (Cu)

Summary Statistics

	Serum Cu (µg/L)				
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Target (Robust Mean (x*))	1948	1320	741	1072	1365
Upper Limit	2240	1518	852	1233	1570
Lower Limit	1656	1122	630	911	1160
Robust SD (s*)	80	54	47	56	85
Robust RSD (%)	4.12	4.12	6.34	5.24	6.27
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	31.7	21.5	18.5	22.2	33.8

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

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Results for Event #2, 2016
Serum Copper (Cu)
Performance of Participating Laboratories

		Serum Cu (µg/L)				
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
	Target	**1948**	**1320**	**741**	**1072**	**1365**
107	DRC/CC-ICP-MS	1900	1300	740	1100	1300
110	ICP-MS	1924	1355	752	1072	1373
147	ICP-MS	1938	1366	781	1112	1366
200	ICP-MS	2045	1435	806	1143	1492
293	ICP-MS	1811.82	1246.03	692.94	1010.81	1290.53
457	ICP-AES/OES	1980	1306	782	1118	1428
483	DRC/CC-ICP-MS	1990	1310	735	1050	1390
596	ICP-AES/OES	2130	1350	738	1100	1350
597	DRC/CC-ICP-MS	1744	1163	657	980	1171
598	ICP-MS	1960	1330	717	998	1430

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

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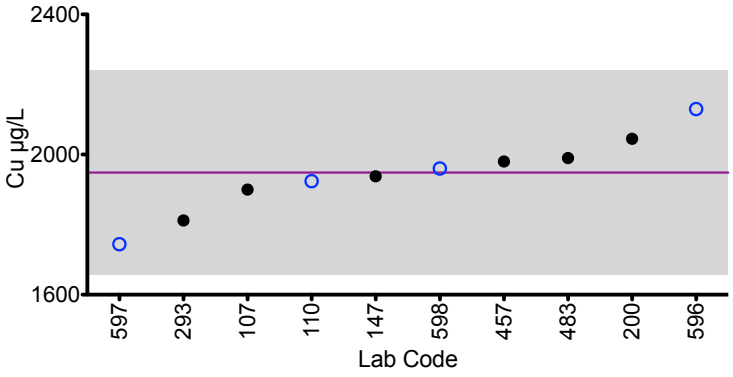
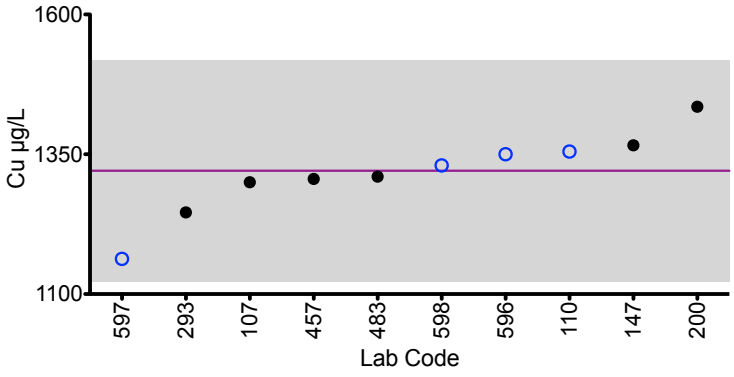
Results for Event #2, 2016: Serum Cu

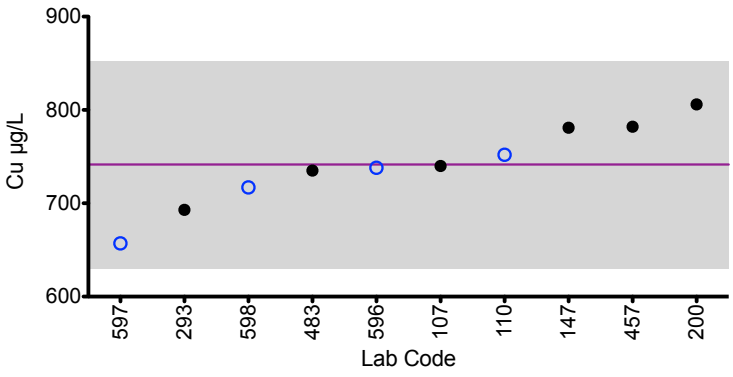
SE16-06



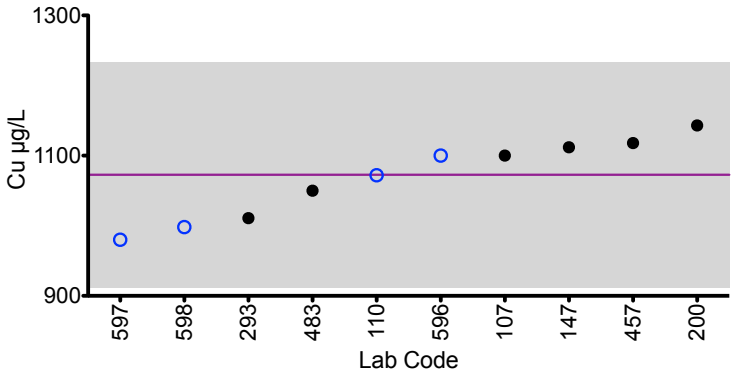
SE16-07



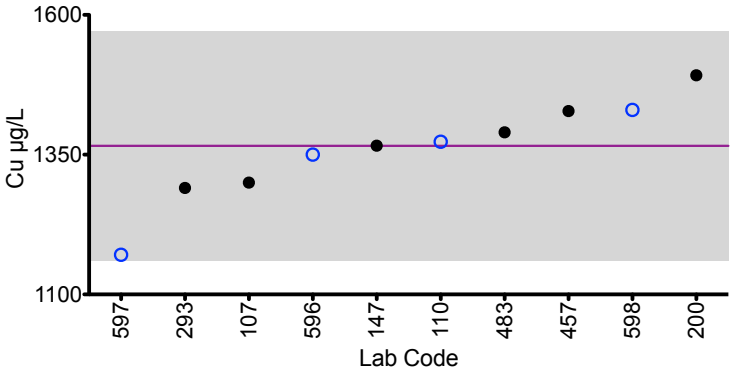
SE16-08



SE16-09



SE16-10



Legend:

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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 #2, 2016
Serum Selenium (Se)

Summary Statistics

Serum Se (µg/L)

	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
Target (Robust Mean (x*))	146	160	103	212	122
Upper Limit	176	192	124	255	147
Lower Limit	117	128	82	170	98
Robust SD (s*)	14	12	5	12	7
Robust RSD (%)	10.0	7.90	5.02	5.91	5.84
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	5.83	5.02	2.05	4.97	2.82

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

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Results for Event #2, 2016
Serum Selenium (Se)
Performance of Participating Laboratories

		Serum Se (µg/L)				
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
	Target	**146**	**160**	**103**	**212**	**122**
103	DRC/CC-ICP-MS	143	159	104	213	122
107	DRC/CC-ICP-MS	140	160	100	210	120
110	DRC/CC-ICP-MS	144	163	102	207	123
147	ICP-MS	134	156	100	199	108
200	DRC/CC-ICP-MS	156	171	108	221	127
293	DRC/CC-ICP-MS	130.33	151.66	104.27	199.05	124.01
483	DRC/CC-ICP-MS	156	139	99.7	205	119
596	ICP-MS	135	186	115	231	135
597	DRC/CC-ICP-MS	163	152	97	217	99.9
598	ICP-MS	182 ↑	203 ↑	126 ↑	250	156 ↑

Based on the grading criteria for Se in Serum, 92% of results were satisfactory, with 1 of the 10 laboratories reporting 2 or more of the 5 results outside of the acceptable ranges.

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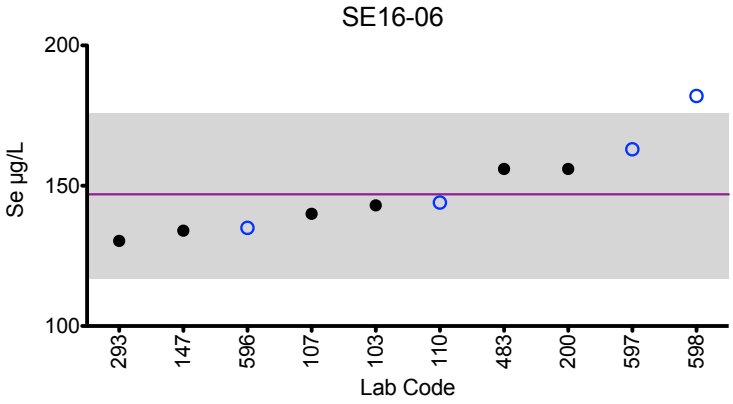
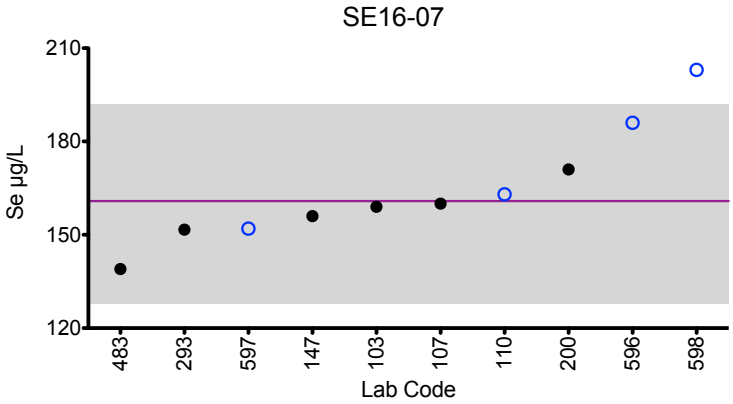
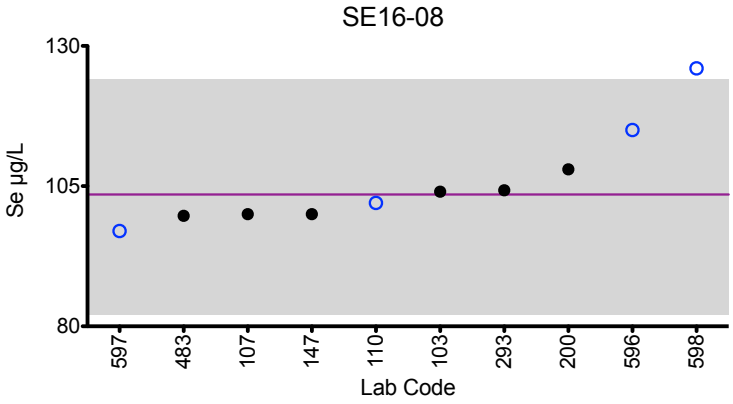
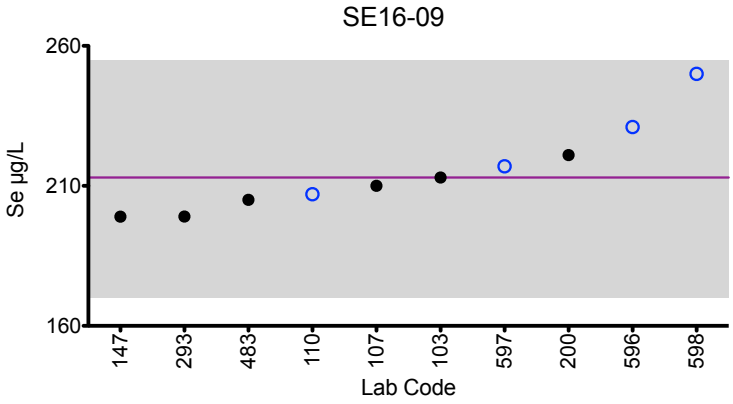
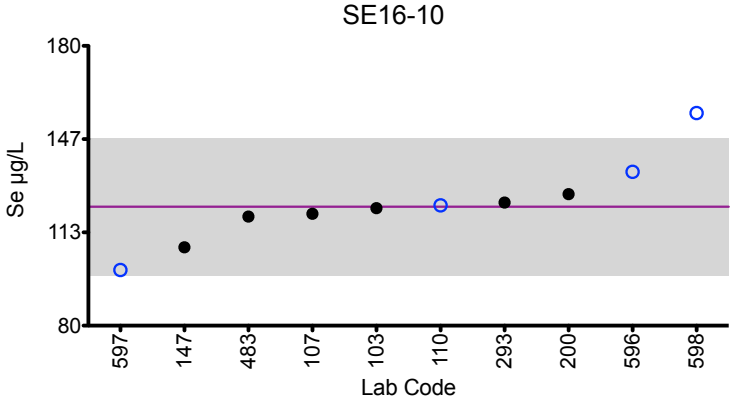
Results for Event #2, 2016: Serum Se











Legend:

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

Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Serum Zinc (Zn)

Summary Statistics

	Serum Zn (µg/L)				
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Target (Robust Mean (x*))	965	1364	1077	689	546
Upper Limit	1110	1569	1238	793	628
Lower Limit	820	1159	915	586	464
Robust SD (s*)	59	91	49	25	33
Robust RSD (%)	6.20	6.74	4.63	3.72	6.05
Number of Sample Measurements (N)	10	10	10	10	10
Standard Uncertainty (*u*)	23.6	36.3	19.7	10.1	13.0

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

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Results for Event #2, 2016
Serum Zinc (Zn)
Performance of Participating Laboratories

		Serum Zn (µg/L)				
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
	Target	**965**	**1364**	**1077**	**689**	**546**
107	DRC/CC-ICP-MS	960	1300	1000	690	520
110	ICP-MS	972	1390	1116	696	541
147	ICP-MS	933	1366	1090	703	532
200	ICP-MS	1020	1491	1177	746	602
293	ICP-MS	915.03	1320.26	1026.140	679.74	533.33
457	ICP-AES/OES	944	1294	1079	691	537
483	DRC/CC-ICP-MS	1020	1390	1100	674	566
596	ICP-AES/OES	1140 ↑	1480	1110	739	564
597	DRC/CC-ICP-MS	871	1218	977	636	469
598	ICP-MS	966	1380	1060	660	586

Based on the grading criteria for Zn in Serum, 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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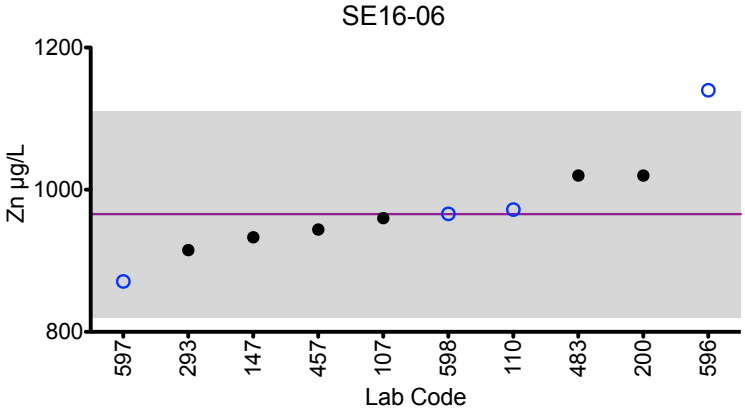
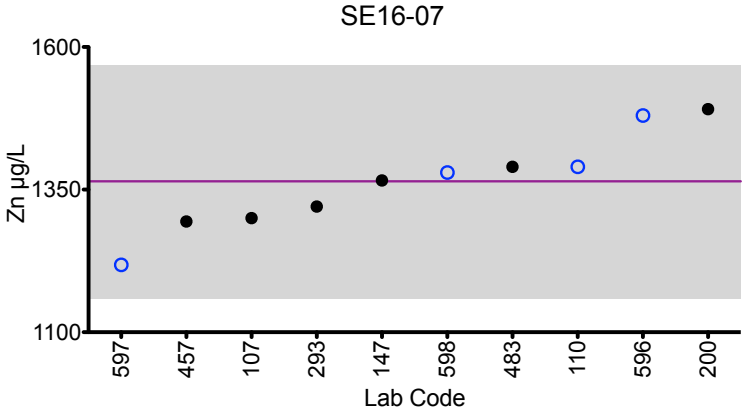
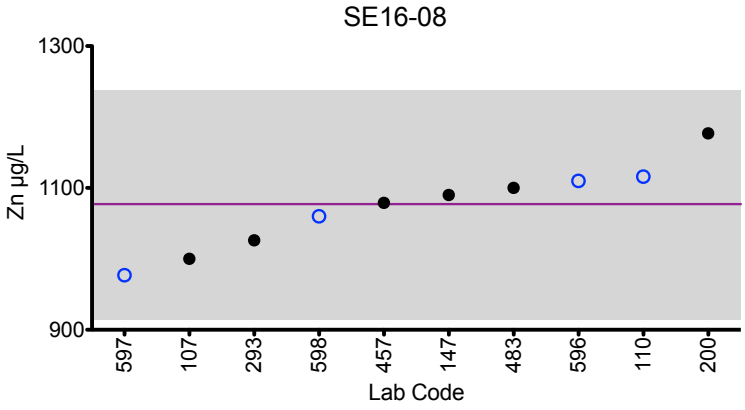
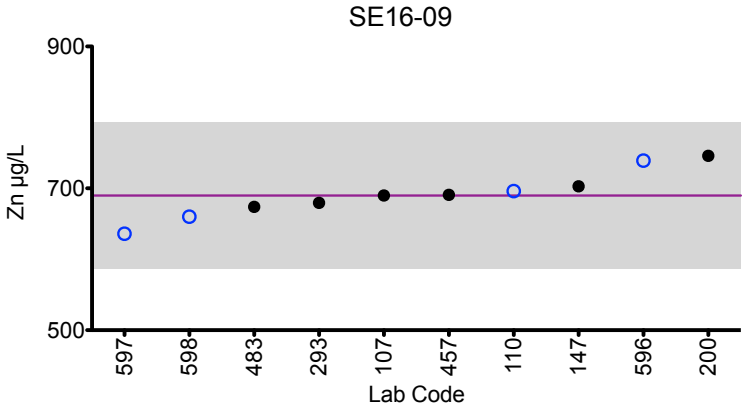
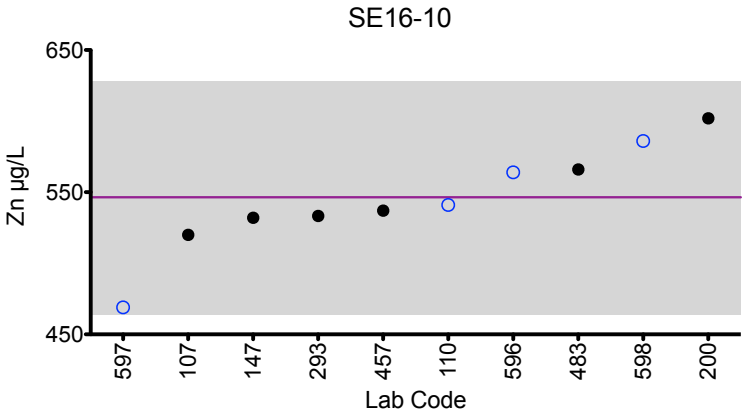
Results for Event #2, 2016: Serum Zn











Legend:

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Gray area = acceptable range based on quality specifications:

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

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Results for Event #2, 2016
Additional Elements in Serum: Aluminum (Al)

Serum Al (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
147	ETAAS-Z	40.60	82.8	53.1	17.6	36
200	DRC/CC-ICP-MS	50.5	73.7	52.1	25.4	36.2
293	ICP-MS	43.17	83.92	60.71	15.92	35.35
485	HR-ICP-MS	39.9	84.5	58.4	15.6	34.4
596	ICP-AES/OES	62.50	150	100	37.5	100
598	ICP-MS	93.30	116	95.3	51.3	116

Summary Statistics

	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
Arithmetic Mean ($\bar{x}$)	44.7	80.1	55.3	19.6	35.8
Arithmetic SD (s)	5.1	5.6	4.7	5.0	0.4
Arithmetic RSD (%)	11.4	6.99	8.51	25.7	1.23
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

Serum Al was not graded for Event #2, 2016 due to lack of a consensus value. The mean values reported here are based on three laboratories (147, 200, and 293) that have a long history of successful proficiency testing in this scheme.

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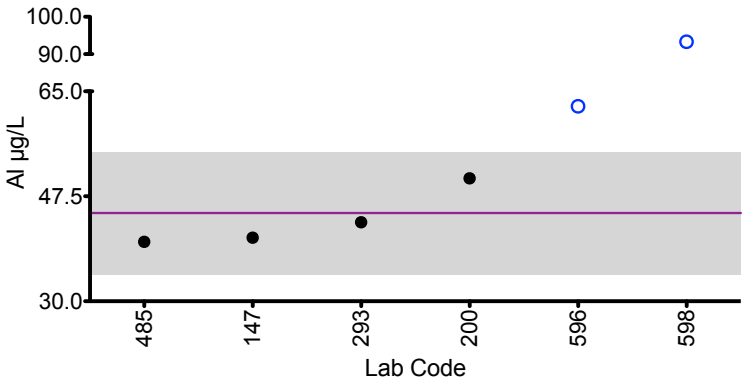
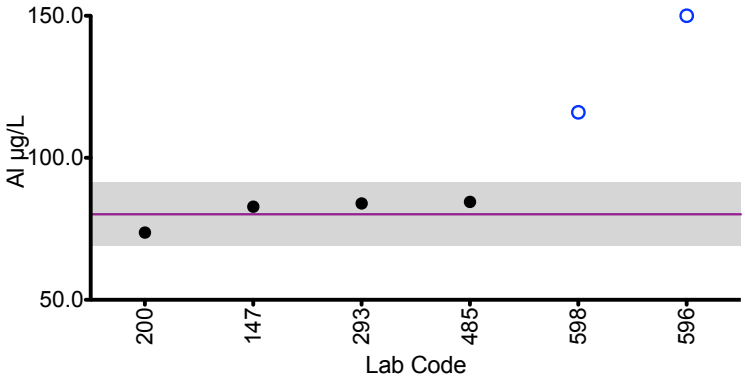
Results for Event #2, 2016: Serum Al

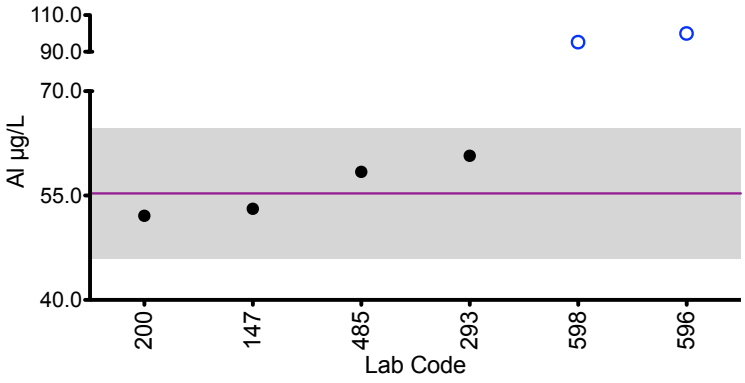
SE16-06



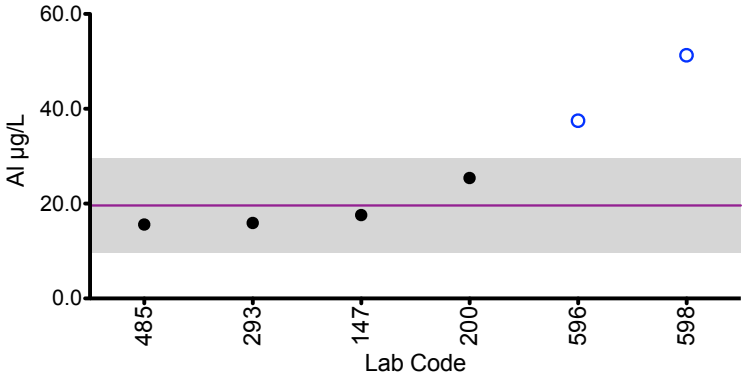
SE16-07



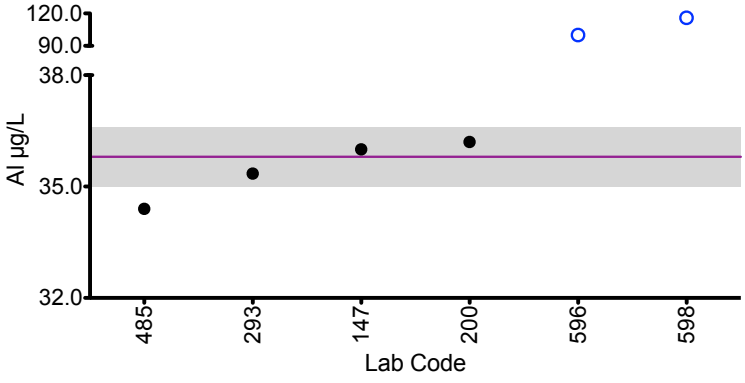
SE16-08



SE16-09



SE16-10



Legend:

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Horizontal purple line = arithmetic mean of all laboratories.

Gray area = ±2SD of the mean.

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Results for Event #2, 2016
Additional Elements in Serum: Arsenic (As)

Serum As (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
103	DRC/CC-ICP-MS	2.97	5.27	2.96	9.41	15.7
110	DRC/CC-ICP-MS	3.0	5.0	2.9	9.0	14.8
147	ICP-MS	3.28	5.77	3.76	9.36	14.5
596	ICP-MS	*5.03	*9.53	*8.23	*14.3	*19.2
597	DRC/CC-ICP-MS	2.82	5.21	3.14	9.34	14.8

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	3.01	5.31	3.19	9.27	14.9
Arithmetic SD (s)	0.19	0.32	0.39	0.18	0.5
Arithmetic RSD (%)	6.35	6.14	12.3	2.01	3.47
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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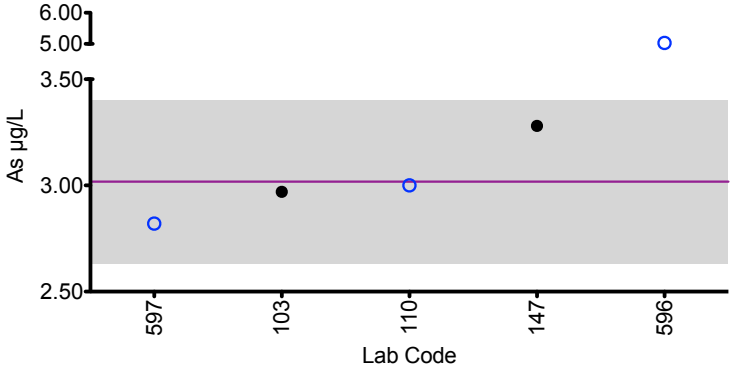
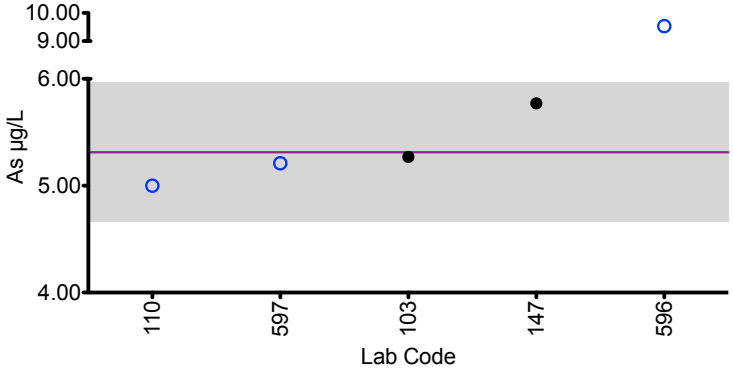
Results for Event #2, 2016: Serum As

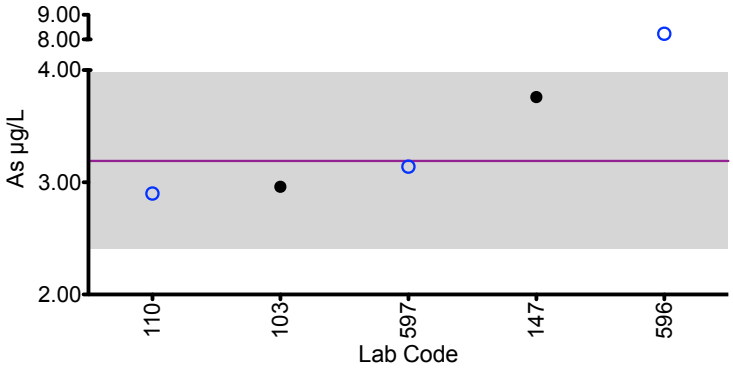
SE16-06



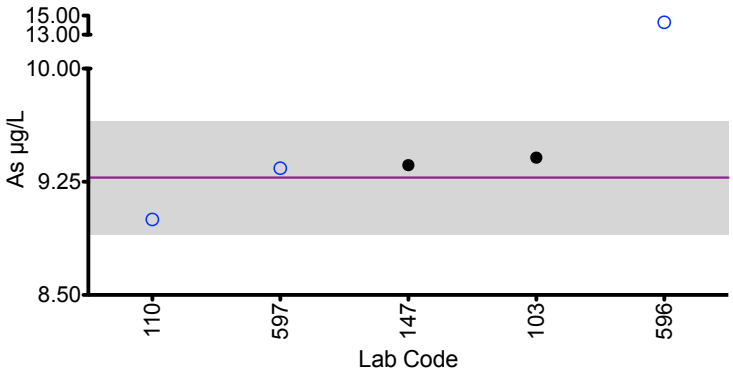
SE16-07



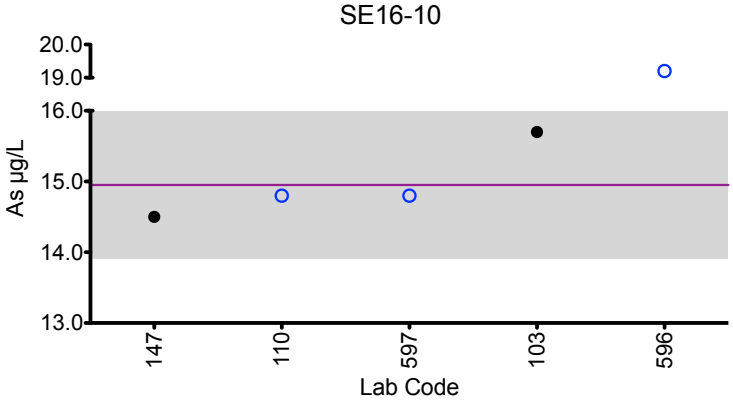
SE16-08



SE16-09



SE16-10



Legend:

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Results for Event #2, 2016
Additional Elements in Serum: Cadmium (Cd)

Serum Cd (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
103	DRC/CC-ICP-MS	0.353	1.47	3.38	0.668	0.811
110	ICP-MS	0.3	1.5	3.5	0.7	0.9
147	ICP-MS	0.263	1.63	3.53	0.722	0.864
596	HR-ICP-MS	0.117	*0.937	*2.27	*0.277	*0.450
597	DRC/CC-ICP-MS	0.31	1.51	3.49	0.68	0.86

Summary Statistics

	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
Arithmetic Mean ($\bar{x}$)	0.268	1.52	3.47	0.692	0.858
Arithmetic SD (s)	0.090	0.07	0.06	0.023	0.036
Arithmetic RSD (%)	33.7	4.60	1.88	3.42	4.25
Number of Sample Measurements (N)	5	4	4	4	4

*Denotes a statistical Outlier.

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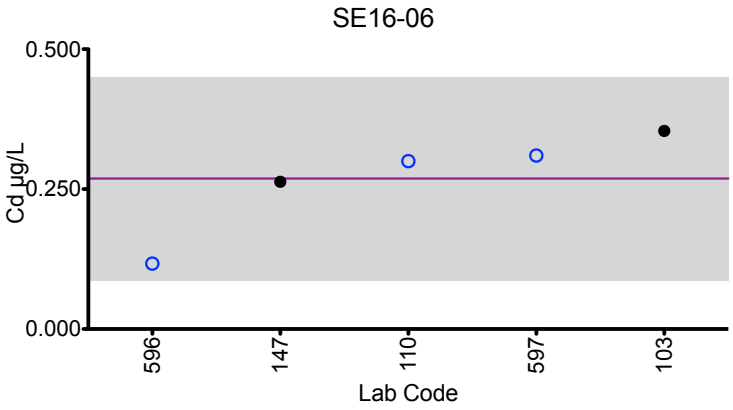
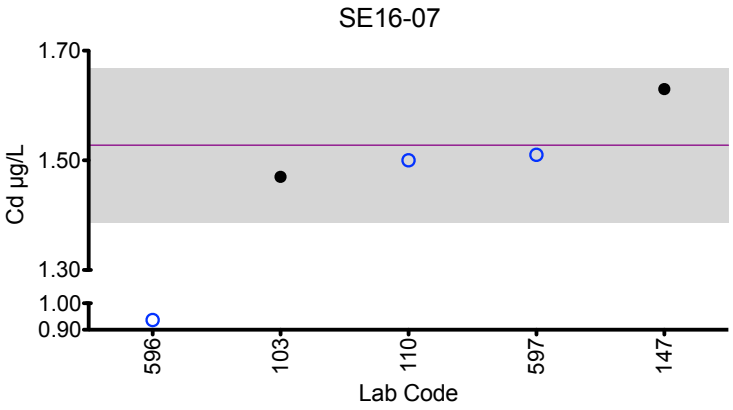
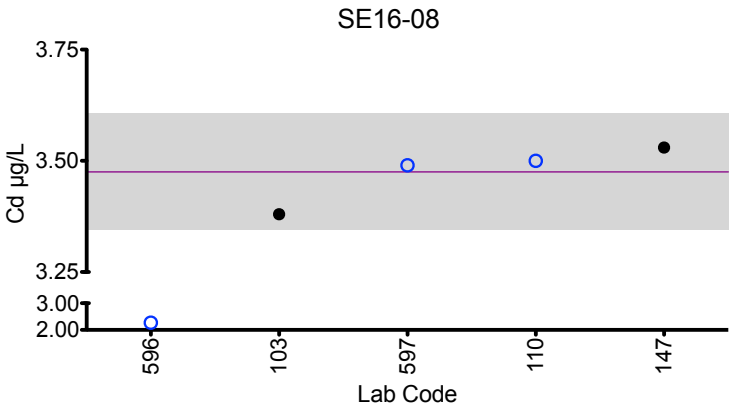
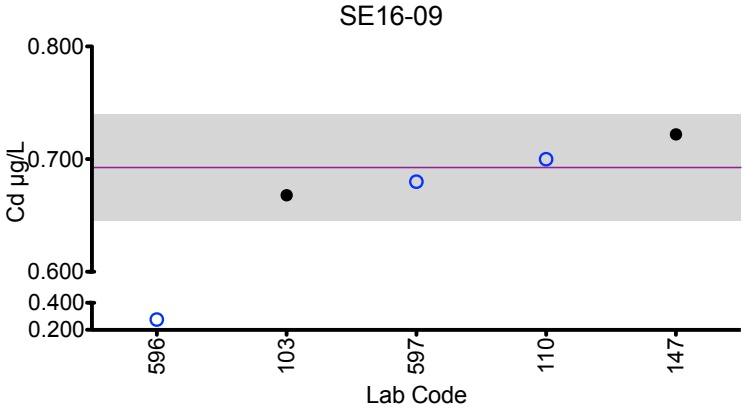
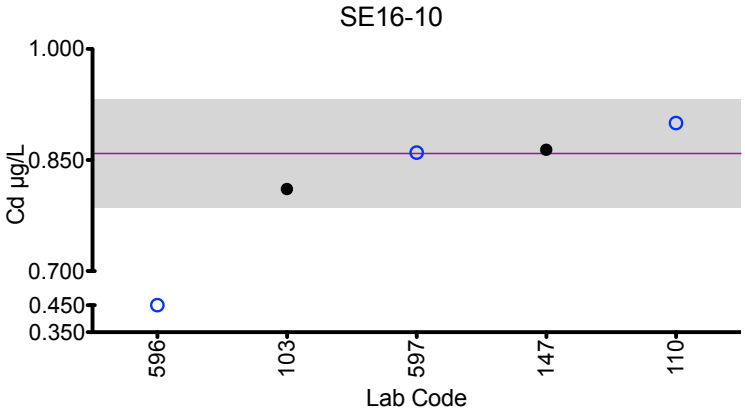
Results for Event #2, 2016: Serum Cd











Legend:

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Results for Event #2, 2016
Additional Elements in Serum: Cobalt (Co)

Serum Co (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
103	DRC/CC-ICP-MS	1.35	4.49	0.936	3.70	0.0922
110	ICP-MS	1.5	4.5	0.9	3.6	0.2
147	ICP-MS	1.31	4.08	0.897	3.39	0.201
485	HR-ICP-MS	1.43	4.44	0.909	3.86	0.106
596	ICP-MS	1.72	4.67	1.09	3.74	0.370
597	DRC/CC-ICP-MS	1.18	*2.98	0.63	*2.58	0.08

Summary Statistics

	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
Arithmetic Mean ($\bar{x}$)	1.42	4.43	0.894	3.65	0.175
Arithmetic SD (s)	0.18	0.21	0.148	0.17	0.110
Arithmetic RSD (%)	12.7	4.89	16.6	4.82	62.9
Number of Sample Measurements (N)	6	5	6	5	6

*Denotes a statistical Outlier.

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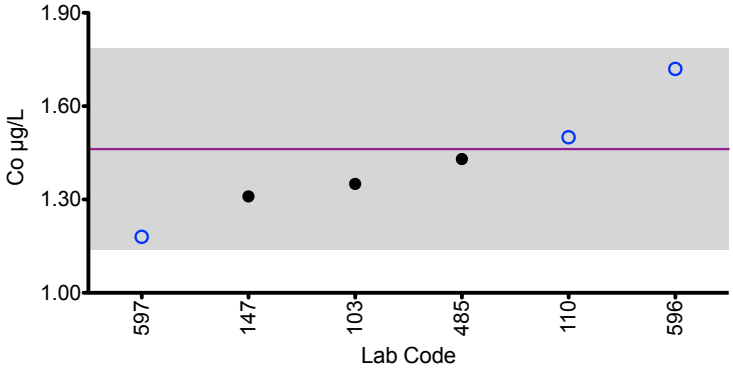
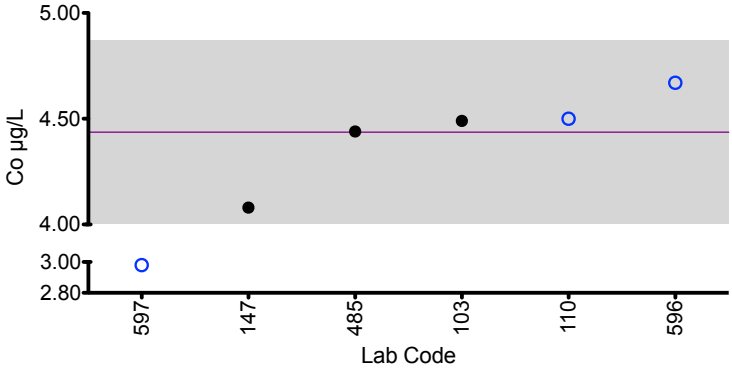
Results for Event #2, 2016: Serum Co

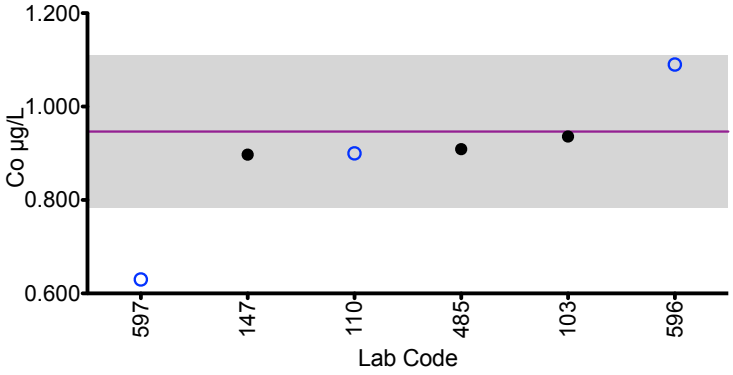
SE16-06



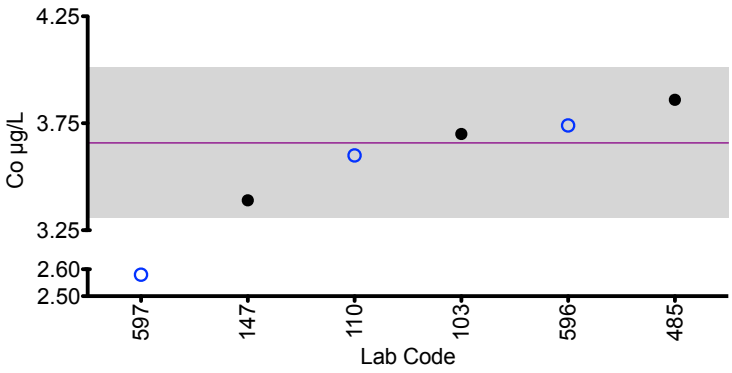
SE16-07



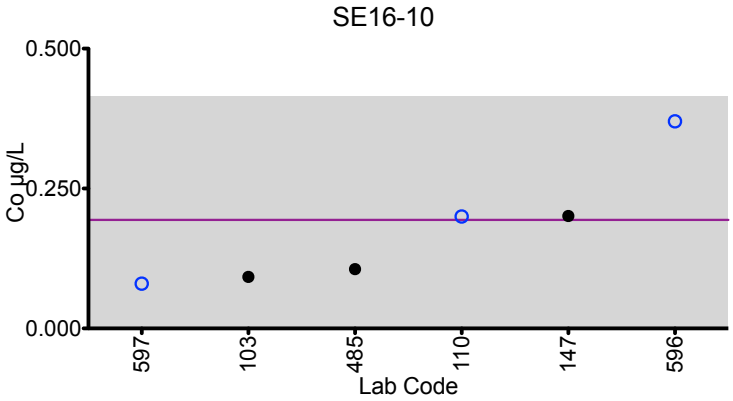
SE16-08



SE16-09



SE16-10



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Results for Event #2, 2016
Additional Elements in Serum: Chromium (Cr)

Serum Cr (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
103	DRC/CC-ICP-MS	0.546	00.312	3.13	0.349	2.37
110	DRC/CC-ICP-MS	0.6	0.4	3.2	*0.7	2.3
147	DRC/CC-ICP-MS	0.671	0.372	2.92	0.405	2.17
485	HR-ICP-MS	0.576	0.341	3.08	0.402	2.34
596	ICP-MS	<LOD	<LOD	*17.0	<LOD	<LOD
597	DRC/CC-ICP-MS	0.63	0.33	3.09	0.44	2.20

Summary Statistics

	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
Arithmetic Mean ($\bar{x}$)	0.604	0.351	3.08	0.399	2.27
Arithmetic SD (s)	0.048	0.035	0.10	0.037	0.08
Arithmetic RSD (%)	7.96	9.97	3.34	9.40	3.83
Number of Sample Measurements (N)	5	5	5	4	5

*Denotes a statistical Outlier.

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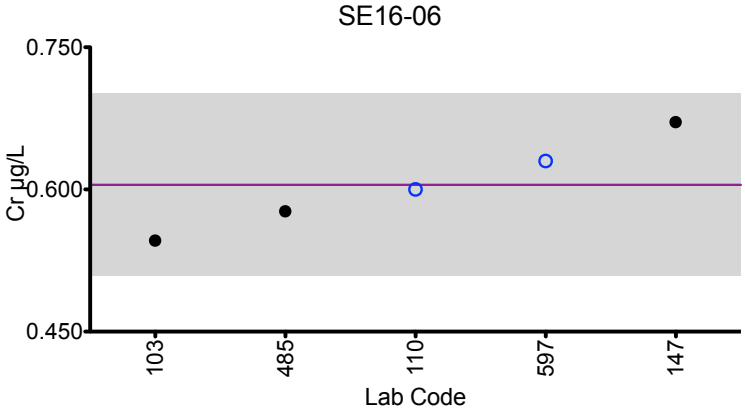
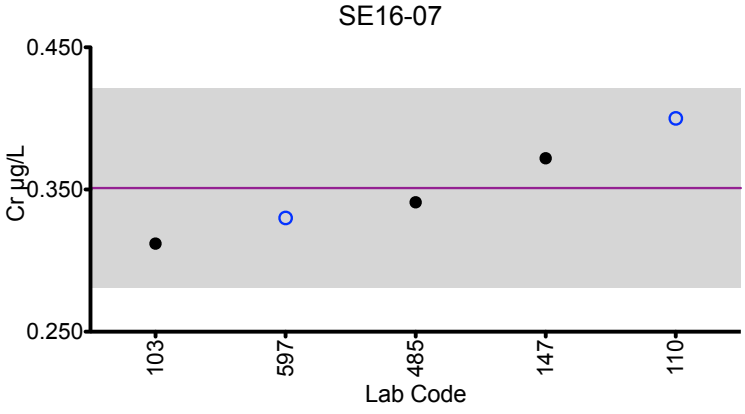
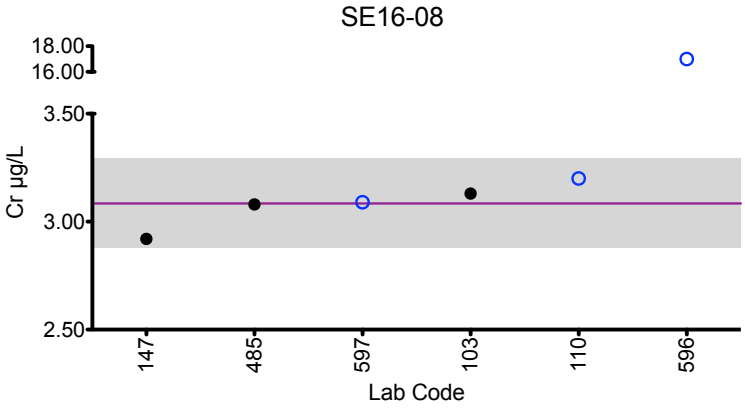
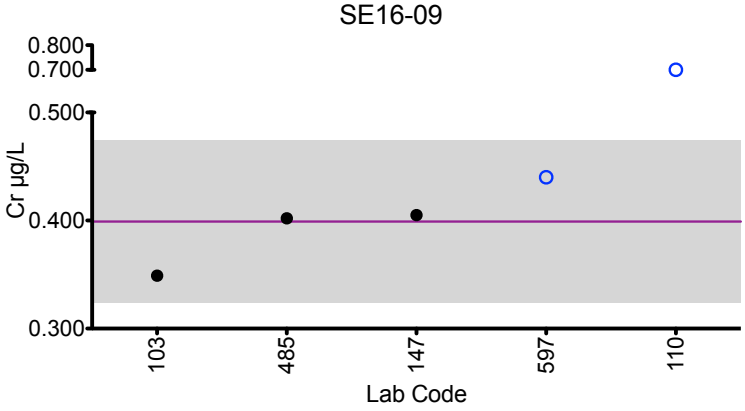
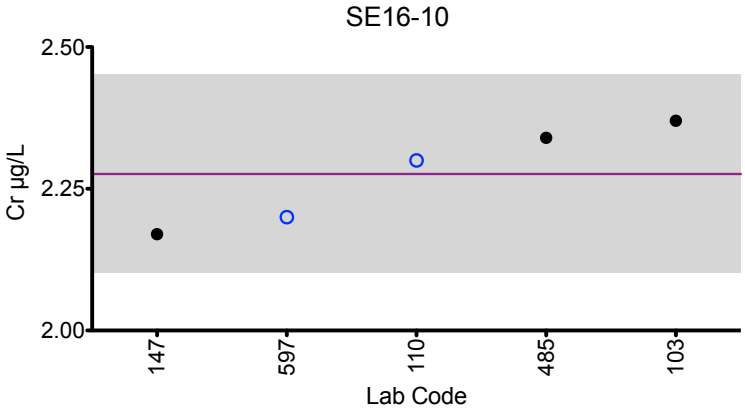
Results for Event #2, 2016: Serum Cr











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Results for Event #2, 2016
Additional Elements in Serum: Mercury (Hg)

Serum Hg (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
103	DRC/CC-ICP-MS	1.77	3.04	0.781	2.31	2.18
110	ICP-MS	1.8	3.1	0.7	2.3	2.0
147	ICP-MS	1.58	2.69	0.702	2.13	1.98
596	ICP-MS	1.85	2.62	0.765	2.1	1.75
597	DRC/CC-ICP-MS	1.73	3.05	0.92	2.51	2.18

Summary Statistics

	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
Arithmetic Mean ($\bar{x}$)	1.74	2.90	0.773	2.27	2.01
Arithmetic SD (s)	0.10	0.22	0.089	0.16	0.17
Arithmetic RSD (%)	5.87	7.79	11.5	7.25	8.79
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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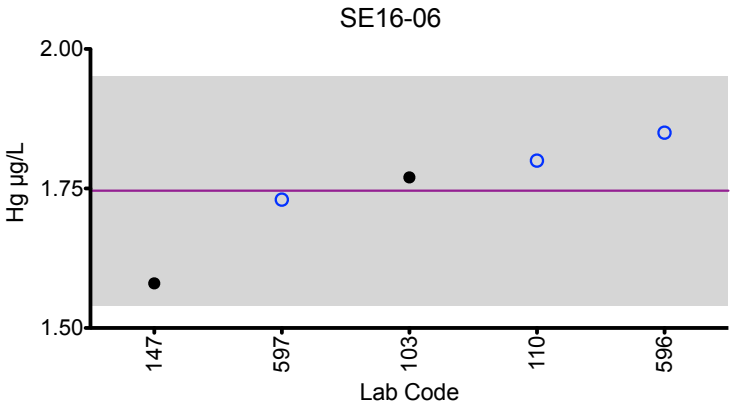
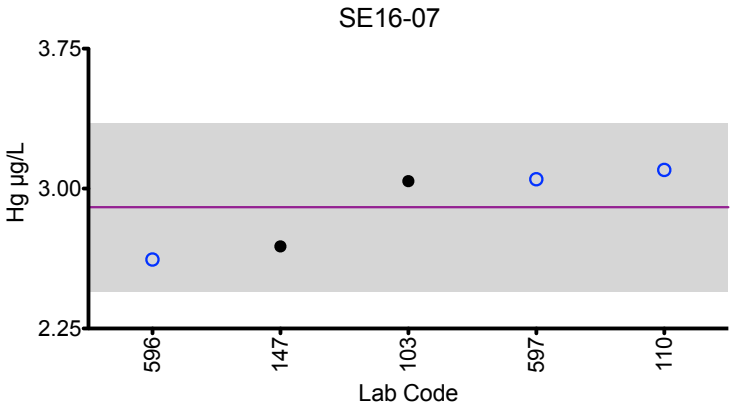
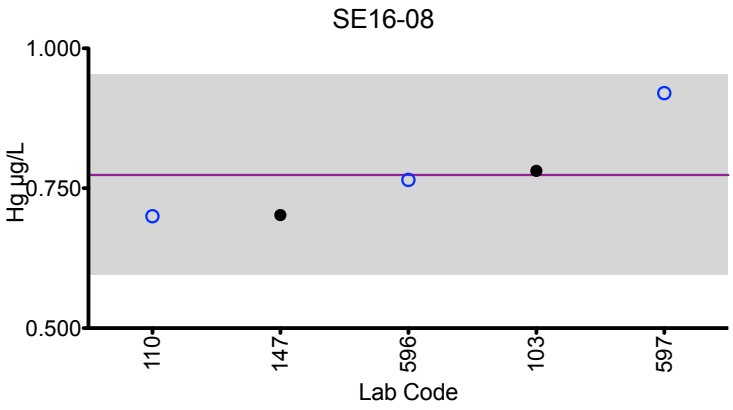
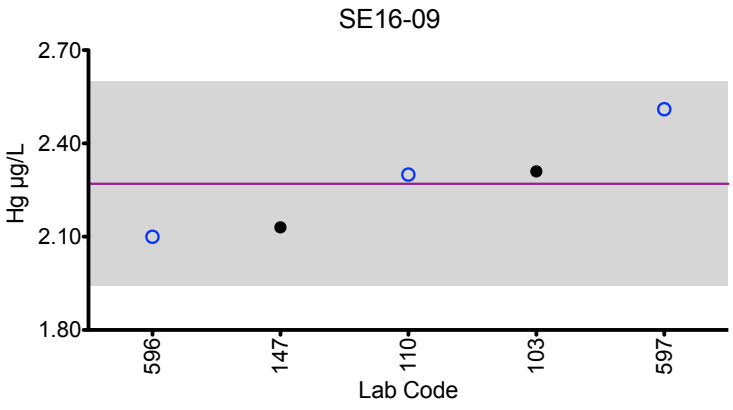
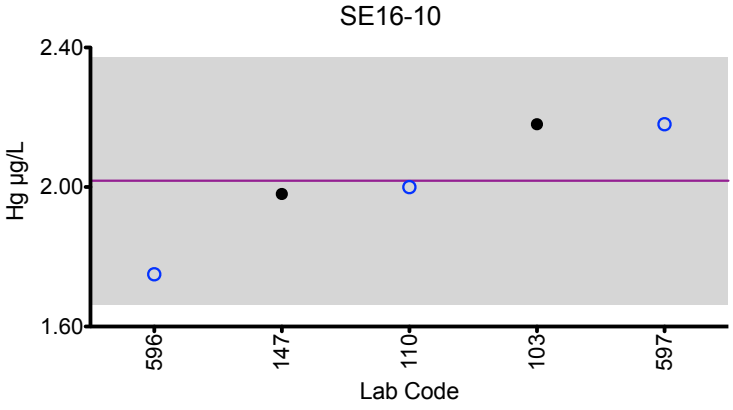
Results for Event #2, 2016: Serum Hg











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Results for Event #2, 2016
Additional Elements in Serum: Manganese (Mn)

Serum Mn (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
103	DRC/CC-ICP-MS	6.91	2.31	5.69	3.33	10.4
110	ICP-MS	6.8	2.6	5.7	3.5	10.0
147	ICP-MS	7.09	2.80	5.77	3.43	9.95
596	ICP-MS	6.97	2.12	4.94	2.85	9.44
597	DRC/CC-ICP-MS	6.52	2.27	5.12	3.08	8.71

Summary Statistics

	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
Arithmetic Mean ($\bar{x}$)	6.85	2.42	5.44	3.23	9.69
Arithmetic SD (s)	0.21	0.27	0.38	0.26	0.65
Arithmetic RSD (%)	3.15	11.3	7.06	8.30	6.70
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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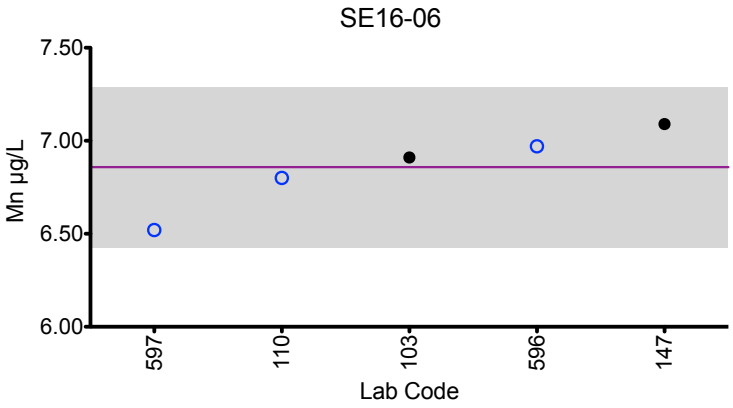
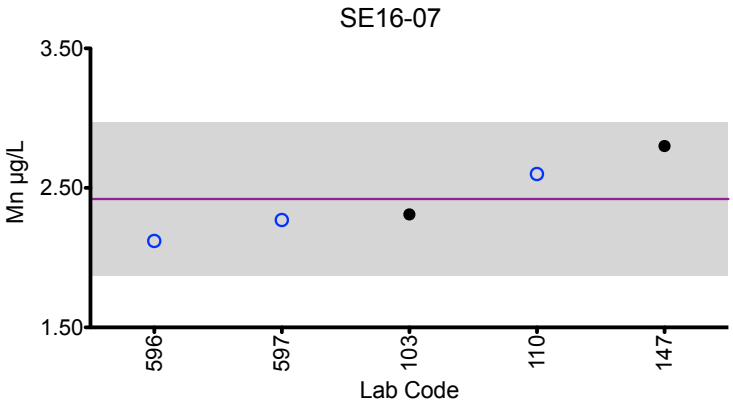
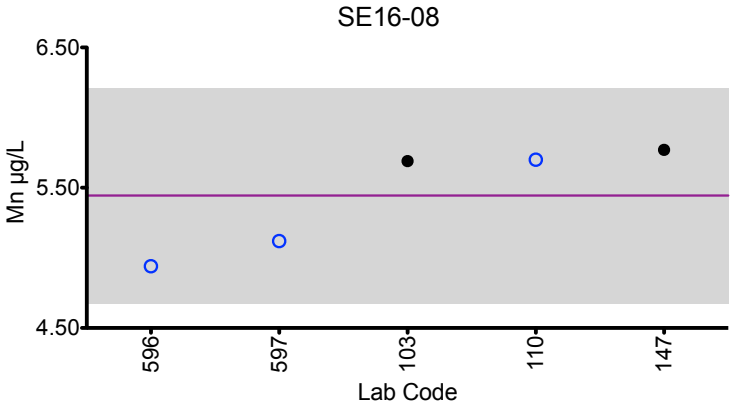
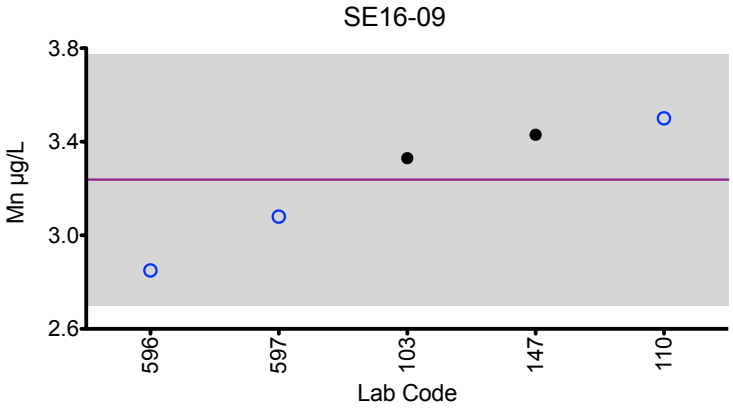
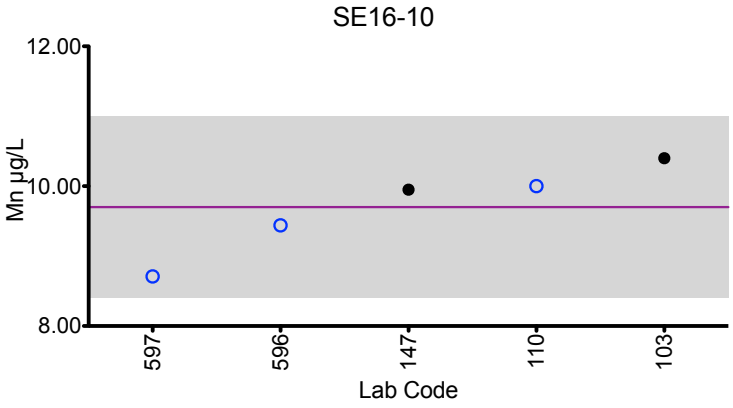
Results for Event #2, 2016: Serum Mn











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Results for Event #2, 2016
Additional Elements in Serum: Molybdenum (Mo)

Serum Mo (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
103	DRC/CC-ICP-MS	0.998	1.17	2.15	4.83	2.35
110	ICP-MS	*1.3	1.5	2.5	5.2	2.4
147	ICP-MS	0.950	1.23	2.16	4.78	2.12
485	HR-ICP-MS	0.980	1.09	2.34	5.09	2.35
596	HR-ICP-MS	0.92	1.41	1.81	4.07	2.00

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	0.961	1.28	2.19	4.79	2.24
Arithmetic SD (s)	0.034	0.17	0.25	0.44	0.17
Arithmetic RSD (%)	3.56	13.3	11.7	9.20	7.77
Number of Sample Measurements (N)	4	5	5	5	5

*Denotes a statistical Outlier.

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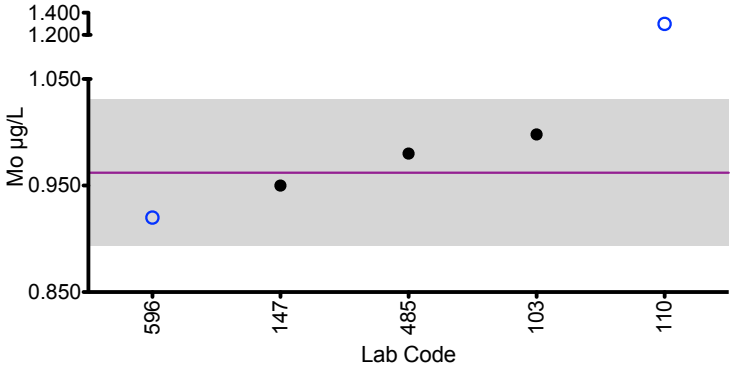
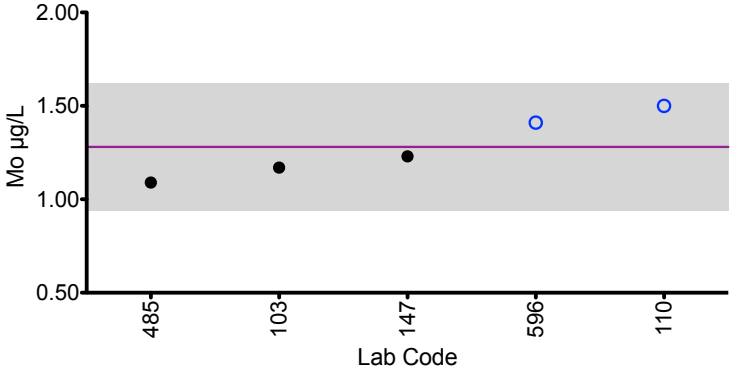
Results for Event #2, 2016: Serum Mo

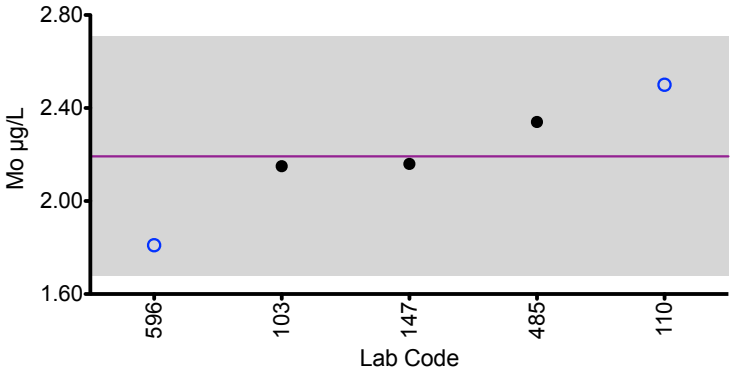
SE16-06



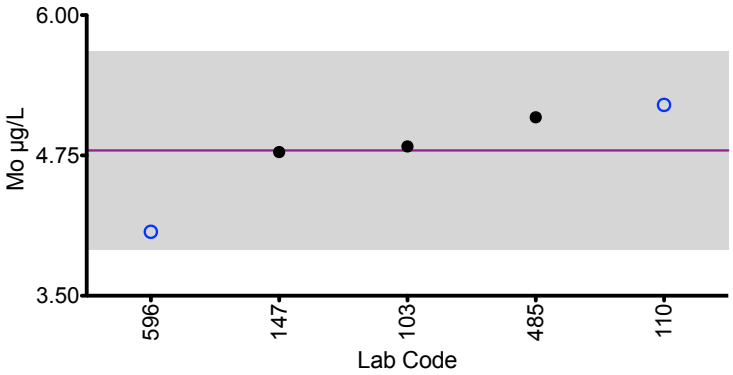
SE16-07



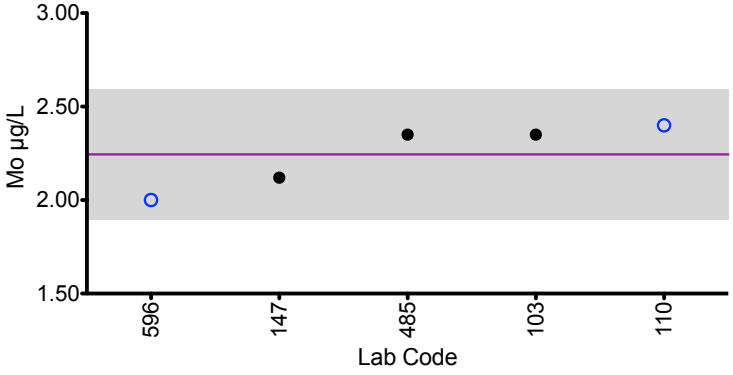
SE16-08



SE16-09



SE16-10



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Results for Event #2, 2016
Additional Elements in Serum: Nickel (Ni)

Serum Ni (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
110	DRC/CC-ICP-MS	2.9	1.7	7.4	5.8	00.7
147	ICP-MS	2.66	1.21	7.40	5.93	1.01
485	HR-ICP-MS	2.55	1.06	7.56	6.29	0.732
596	ICP-MS	3.03	1.68	7.59	5.96	1.46
597	DRC/CC-ICP-MS	3.24	1.59	6.93	5.95	0.66

Summary Statistics

	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
Arithmetic Mean ($\bar{x}$)	2.87	1.44	7.37	5.98	0.912
Arithmetic SD (s)	0.27	0.29	0.26	0.18	0.335
Arithmetic RSD (%)	9.67	20.2	3.58	3.03	36.7
Number of Sample Measurements (N)	5	5	5	5	5

*Denotes a statistical Outlier.

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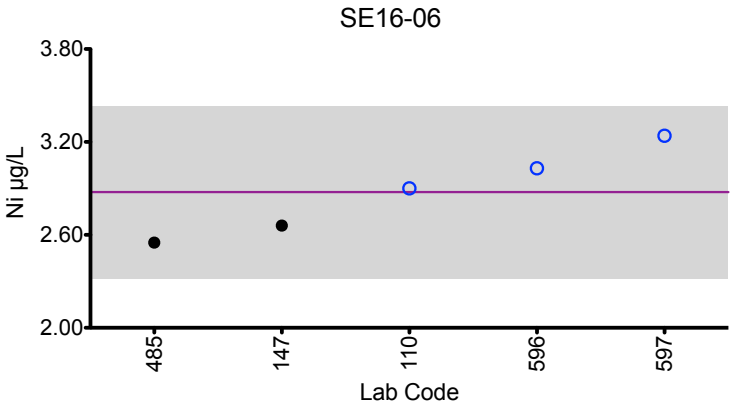
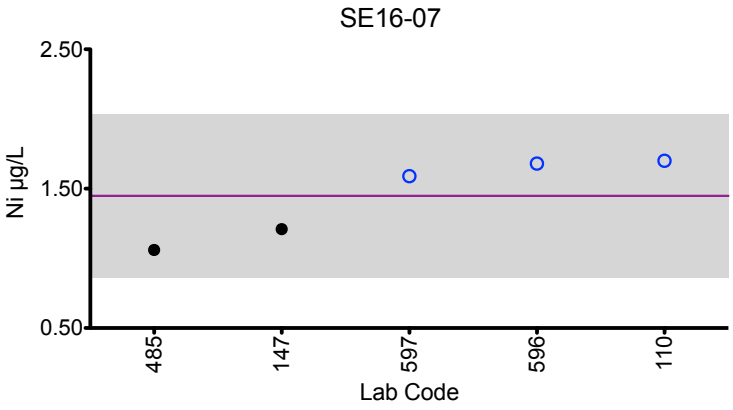
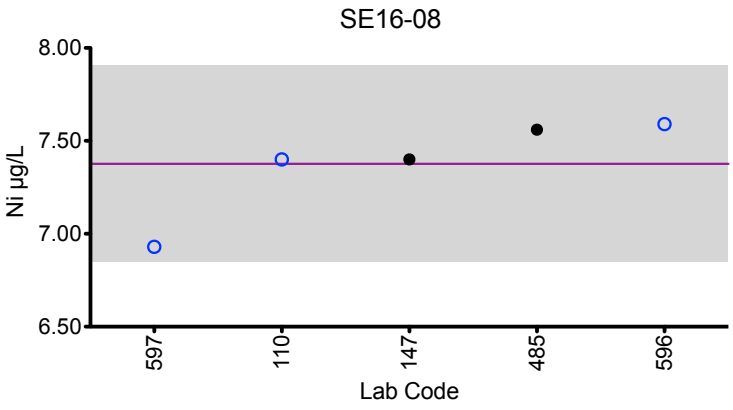
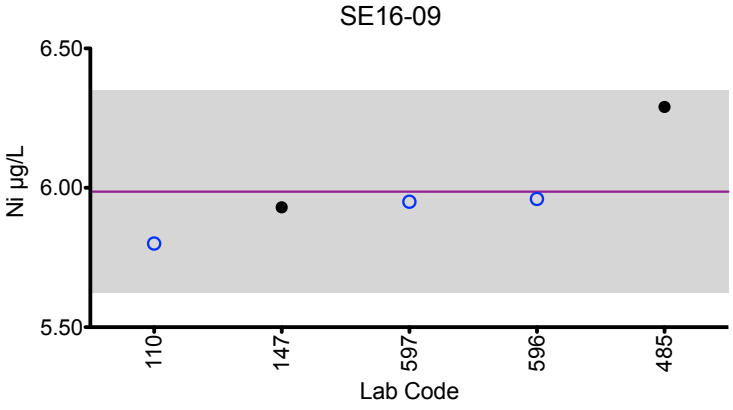
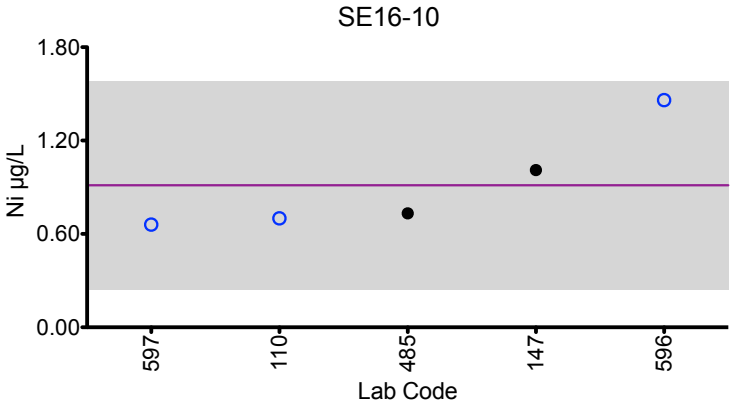
Results for Event #2, 2016: Serum Ni











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Results for Event #2, 2016
Additional Elements in Serum: Lead (Pb)

Serum Pb (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
103	DRC/CC-ICP-MS	2.71	10.0	1.10	8.10	5.35
110	ICP-MS	2.8	10	1.1	8.2	5.3
147	ICP-MS	3.21	10.5	*12.1	8.81	5.45
596	ICP-MS	2.78	9.98	1.02	7.84	5.19
597	DRC/CC-ICP-MS	2.42	8.69	0.96	7.29	*4.47

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	2.78	9.83	1.04	8.04	5.32
Arithmetic SD (s)	0.28	0.67	0.06	0.55	0.10
Arithmetic RSD (%)	10.1	6.87	6.51	6.87	2.03
Number of Sample Measurements (N)	5	5	4	5	4

*Denotes a statistical Outlier.

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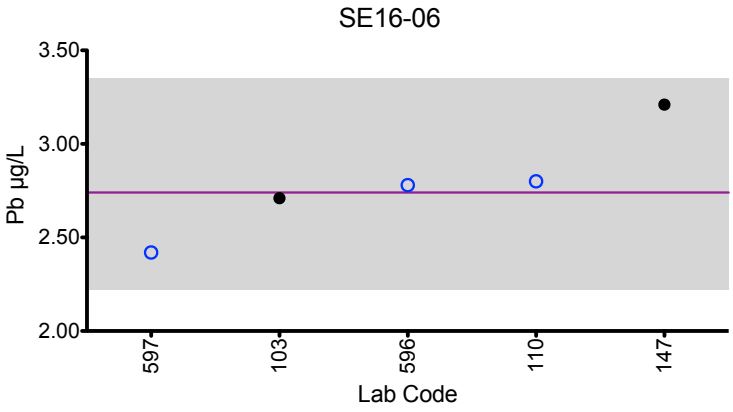
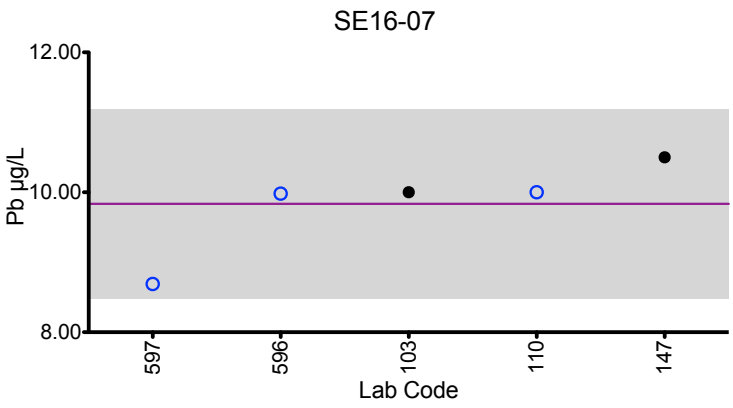
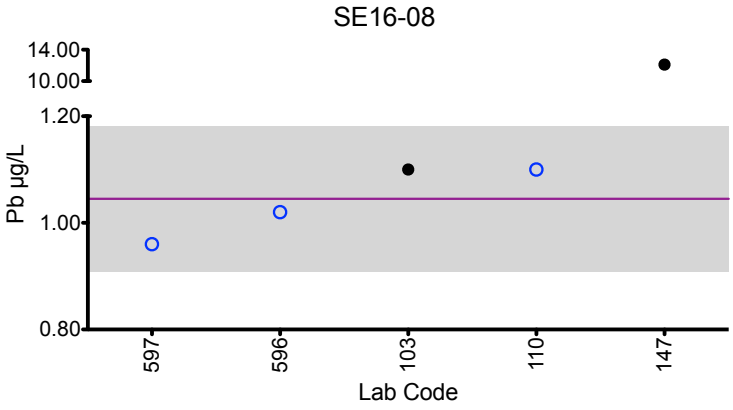
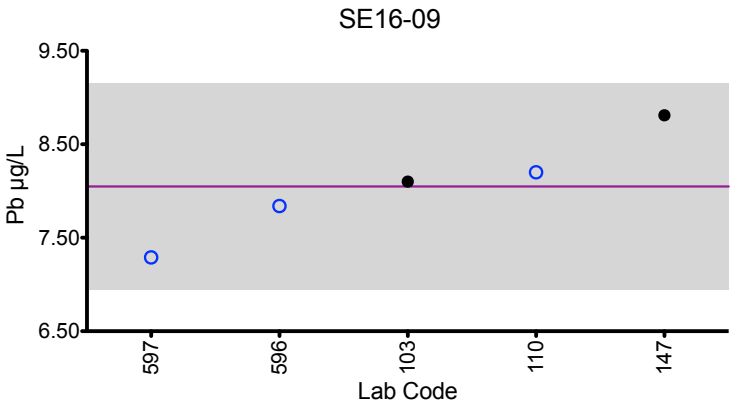
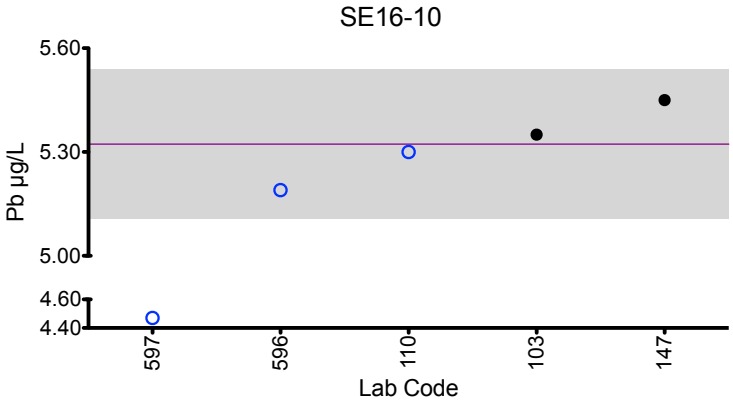
Results for Event #2, 2016: Serum Pb











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Results for Event #2, 2016
Additional Elements in Serum: Barium (Ba)

Serum Ba (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
110	ICP-MS	0.4	0.4	0.9	1.1	0.4
147	ICP-MS	0.385	0.412	0.971	1.15	0.451
596	HR-ICP-MS	0.368	0.334	0.764	0.848	0.365
597	DRC/CC-ICP-MS	0.38	0.43	0.88	0.97	0.39

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	0.383	0.394	0.878	1.01	0.401
Arithmetic SD (s)	0.012	0.041	0.085	0.13	0.036
Arithmetic RSD (%)	3.35	10.6	9.77	13.3	8.99
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Beryllium (Be)

Serum Be (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
110	ICP-MS	7.2	1.2	0.4	4.3	2.1
147	ICP-MS	6.54	1.13	0.572	4.31	1.75

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	6.87	1.16	0.485	4.3	1.92
Arithmetic SD (s)	0.46	0.04	0.121	0.0	0.24
Arithmetic RSD (%)	6.79	4.24	25	0.164	12.8
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Cesium (Cs)

Serum Cs (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
110	ICP-MS	0.9	0.9	0.3	0.3	0.7
597	DRC/CC-ICP-MS	0.79	0.77	0.25	0.25	0.52

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	0.844	0.834	0.275	0.275	0.610
Arithmetic SD (s)	0.077	0.091	0.035	0.035	0.127
Arithmetic RSD (%)	9.20	11.0	12.8	12.8	20.8
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Iron (Fe)

Serum Fe (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
457	ICP-AES/OES	1026	974	620	579	290
483	DRC/CC-ICP-MS	860	860	540	540	300

Summary Statistics

	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
Arithmetic Mean ($\bar{x}$)	943	917	580	559	295
Arithmetic SD (s)	117	80	56	27	7
Arithmetic RSD (%)	12.4	8.79	9.75	4.92	2.39
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Platinum (Pt)

Serum Pt (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
110	ICP-MS	1.32	0.33	0.04	0.52	1.79
596	HR-ICP-MS	1.52	0.321	0.0789	0.587	1.92

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	1.42	0.325	0.059	0.553	1.85
Arithmetic SD (s)	0.14	0.006	0.027	0.047	0.09
Arithmetic RSD (%)	9.95	1.95	46.2	8.55	4.95
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Antimony (Sb)

Serum Sb (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
103	DRC/CC-ICP-MS	8.34	4.53	3.51	11.7	1.40
110	ICP-MS	7.6	4.2	3.2	10.7	1.2
147	ICP-MS	6.81	3.87	2.97	10.3	1.16
597	DRC/CC-ICP-MS	6.58	3.68	2.85	8.92	1.26

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	7.33	4.07	3.13	10.4	1.25
Arithmetic SD (s)	0.80	0.37	0.29	1.10	0.10
Arithmetic RSD (%)	10.9	9.19	9.27	11	8.36
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Tin (Sn)

Serum Sn (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
110	ICP-MS	5.6	1.7	1.0	4.1	2.8
147	ICP-MS	5.07	1.57	0.852	4.01	2.60
596	ICP-MS	5.42	1.59	0.812	3.59	2.67

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	5.36	1.62	0.888	3.90	2.69
Arithmetic SD (s)	0.26	0.07	0.099	0.27	0.10
Arithmetic RSD (%)	5.02	4.32	11.1	6.97	3.77
Number of Sample Measurements (N)	3	3	3	3	3

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Strontium (Sr)

Serum Sr (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
103	DRC/CC-ICP-MS	28.0	28.3	17.8	18.3	35.2
200	ICP-MS	26.3	27.2	16.6	16.6	33.3

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	27.1	27.7	17.2	17.4	34.2
Arithmetic SD (s)	1.2	0.7	0.8	1.2	1.3
Arithmetic RSD (%)	4.42	2.80	4.93	6.88	3.92
Number of Sample Measurements (N)	2	2	2	2	2

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Thallium (Tl)

Serum Tl (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
103	DRC/CC-ICP-MS	1.99	5.42	3.98	1.06	3.41
110	ICP-MS	2.2	5.7	4.3	1.2	3.7
147	ICP-MS	1.93	5.48	4.21	1.16	3.45
596	HR-ICP-MS	2.12	5.24	3.44	1.02	3.18

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	2.06	5.46	3.98	1.11	3.43
Arithmetic SD (s)	0.12	0.18	0.38	0.08	0.21
Arithmetic RSD (%)	5.94	3.47	9.69	7.57	6.20
Number of Sample Measurements (N)	4	4	4	4	4

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Uranium (U)

Serum U (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
103	DRC/CC-ICP-MS	0.0231	0.0225	0.00958	0.0412	0.0139
110	ICP-MS	0.024	0.026	0.014	0.05	0.017
147	ICP-MS	0.025	0.0255	0.0145	0.0424	<0.0145
596	HR-ICP-MS	0.032	0.0314	0.0159	0.0458	0.0246

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	0.026	0.026	0.013	0.044	0.018
Arithmetic SD (s)	0.004	0.003	0.002	0.003	0.005
Arithmetic RSD (%)	15.9	14.0	20.2	8.80	29.7
Number of Sample Measurements (N)	4	4	4	4	3

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum: Vanadium (V)

Serum V (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
110	DRC/CC-ICP-MS	3.3	*0.8	6.5	1.7	4.4
147	DRC/CC-ICP-MS	2.71	0.462	5.92	1.24	4.29
485	HR-ICP-MS	3.01	0.420	6.22	1.27	4.63
597	DRC/CC-ICP-MS	2.52	0.41	5.56	1.09	3.93

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	2.88	0.430	6.05	1.32	4.31
Arithmetic SD (s)	0.34	0.027	0.40	0.26	0.29
Arithmetic RSD (%)	11.8	6.40	6.66	19.7	6.76
Number of Sample Measurements (N)	4	3	4	4	4

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Results for Event #2, 2016
Additional Elements in Serum: Tungsten (W)

Serum W (µg/L)						
Lab Code	**Method**	**SE16-06**	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
110	ICP-MS	3.4	2.3	0.2	1.3	0.9
147	ICP-MS	3.79	2.37	0.197	1.31	0.896
200	ICP-MS	3.7	2.6	0.4	1.4	*1.2
596	HR-ICP-MS	4.32	2.42	0.132	1.33	0.910

Summary Statistics					
	SE16-06	**SE16-07**	**SE16-08**	**SE16-09**	**SE16-10**
Arithmetic Mean ($\bar{x}$)	3.80	2.42	0.232	1.33	0.902
Arithmetic SD (s)	0.38	0.12	0.116	0.04	0.007
Arithmetic RSD (%)	10.0	5.29	50.0	3.37	0.799
Number of Sample Measurements (N)	4	4	4	4	3

*Denotes a statistical Outlier.

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Results for Event #2, 2016
Additional Elements in Serum

Serum Ag (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
147	ICP-MS	<0.248	<0.248	<0.248	<0.248	<0.248

Serum B (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
200	ICP-MS	117	67	36	42	52

Serum Bi (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
147	ICP-MS	<0.200	<0.200	<0.200	<0.200	<0.200

Serum I (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
147	ICP-MS	47.0	47.2	35.1	35.1	184

Serum Li (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
147	ICP-MS	0.458	0.459	0.396	0.457	2.53

Serum Te (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
147	ICP-MS	<0.0880	<0.0880	<0.0880	<0.0880	<0.0880
596	HR-ICP-MS	<LOD	<LOD	<LOD	<LOD	<LOD

Serum Th (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
147	ICP-MS	<0.00789	<0.00789	<0.00789	<0.00789	<0.00789

Serum Ti (µg/L)

Lab Code	Method	SE16-06	SE16-07	SE16-08	SE16-09	SE16-10
485	HR-ICP-MS	97.20	48.1	18.9	15.0	9.13

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.