NEW YORK STATE | Department of Health | Wadsworth Center

TRACE ELEMENTS IN WHOLE BLOOD

Proficiency Test Report

Event #3, 2015

November 12th, 2015

NEW YORK STATE OF OPPORTUNITY | Department of Health

ANDREW M. CUOMO
Governor

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Commissioner

SALLY DRESLIN, M.S., R.N.
Executive Deputy Commissioner

November 12, 2015

Trace Elements in Whole Blood
Event #3, 2015

Dear Laboratory Director:

Results from the third proficiency test (PT) event in 2015 for Trace Elements in Whole Blood have been tabulated and summarized. Target values for Arsenic, Cadmium, Mercury and Lead in whole blood have been established along with acceptable ranges. Results are graded using element-specific criteria as indicated in each narrative section. A laboratory with an unacceptable significant analytical bias relative to the target value will be expected to investigate the source of the error. A confidential three-digit code number assigned by the PT program identifies participant laboratories. The data for blood lead were previously reported in the Blood Lead PT Report issued October 27th, 2015, and are reproduced here for completeness.

PT Materials

Test materials for the third event were prepared from caprine (goat) whole blood obtained from animals dosed with lead acetate to create physiologically bound lead (Pb). A total of five blood pools were supplemented with arsenic (as inorganic As^{3+}), cadmium (as Cd^{2+}) and mercury (as inorganic Hg^{2+}). In addition to As, Cd, Pb and Hg, blood pools were supplemented with the trace elements manganese (Mn), thallium (Tl), tin (Sn), titanium (Ti), nickel (Ni), cobalt (Co), chromium (Cr), silver (Ag), tungsten (W) and vanadium (V).

Additional Elements to Become Graded for Performance Assessment

PT results for select trace elements, including Co and Cr, are graded as part of this PT event, although the data are used for "Educational Purposes" only, to inform laboratory participants of where improved practices may be necessary. Laboratories that test and report these, and other, trace elements on patient specimens should continue to report results obtained for whole blood PT samples.

Thank you for your participation.

Sincerely,

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Deputy Director, Division of Environmental Health

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Whole Blood Arsenic

Test materials for arsenic were prepared from caprine (goat) whole blood preserved with K_2EDTA anticoagulant. A total of five pools were supplemented with arsenic as inorganic As^{3+}.

The Target Value assigned for each PT material is the robust mean of the results reported by all participants in this event. The robust statistics were obtained utilizing algorithms based on those presented in **ISO 13528:2005E** Statistical methods for use in proficiency testing by interlaboratory comparisons. Values for whole blood arsenic range from 7.1 µg/L (0.09 µmol/L) to 39.8 µg/L (0.53 µmol/L).

Acceptable range: The acceptable range for arsenic is set at ±6 µg/L or ±20%, whichever is greater. Thus, it is fixed at ±6 µg/L for concentrations below 30 µg/L.

Discussion: Based upon the above criteria, 95.0% of test results reported were judged as satisfactory, with one of the 20 laboratories (5.0%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Arsenic Test Results, 2015 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
Robust Mean	**15.2**	**21.5**	**11.2**	**39.8**	**7.1**
Robust Standard Deviation	1.4	1.2	1.7	1.9	1.4
Standard Uncertainty	0.4	0.3	0.5	0.5	0.4
RSD (%)	9.3	5.6	15.3	4.7	19.2
Number of Sample Measurements	20	20	20	20	18
Acceptable Range:					
Upper Limit	21.2	27.5	17.2	47.8	13.1
Lower Limit	9.2	15.5	5.2	31.8	1.1

notes: Results reported as less than the method detection limit are excluded from statistical calculations.

New York State Department of Health
Blood Arsenic Test Results, 2015 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE15-11	BE15-12	BE15-13	BE15-14	BE15-15	
	Target Values:	15.2	21.5	11.2	39.8	7.1	
103	DRC/CC-ICP-MS	14.8	21.3	10.4	40.4	6.2	Info
110	DRC/CC-ICP-MS	14.9	21.7	10.8	39.5	6.5	
114	ICP-MS	16	22	14	39	10	
147	ICP-MS	15.0	21.3	10.5	39.6	6.1	Info
156	DRC/CC-ICP-MS	10.0	16.0	6.9	39.0	<5.0	
160	ICP-MS	15	22	11	40	7	
164	ICP-MS	16.0	22.0	12.0	41.0	8.0	
179	DRC/CC-ICP-MS	15.0	23.0	12.0	41.0	6.0	
197	DRC/CC-ICP-MS	15.0	21.0	11.0	36.0	<10.0	
200	ICP-MS	19.8	24.8	14.5	40.9	9.2	Info
206	DRC/CC-ICP-MS	18.5	20.7	14.4	39	13.1	
208	ICP-MS	24.3 ↑	32 ↑	25.3 ↑	49.7 ↑	15.1 ↑	
293	DRC/CC-ICP-MS	14.1	19.7	9.9	37.9	5.9	Info
305	ICP-MS	16.0	23.0	10.0	41.0	7.0	
312	DRC/CC-ICP-MS	15.0	22.0	11.0	41.0	6.4	
339	HR-ICP-MS	14.5	20.6	10.3	39.2	6.0	Info
359	ICP-MS	17.5	21.7	12.5	41.6	9.4	
388	ICP-MS	14.2	21.4	12.6	43.3	7.6	
391	DRC/CC-ICP-MS	13.3	17.8	8.3	34.3	5.5	Info
484	ICP-MS	13.8	18.9	9.7	36.2	5.6	

Percent satisfactory results for all participants: 95.0 %

notes: ↑ Reported outside upper limit
↓ Reported outside lower limit
◥: Result unacceptable
◢: Result not reported

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Arsenic Test Results, 2015 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	9	9	9	9	7
Mean:	14.5	20.4	10.5	38.7	7.1
Standard Deviation:	2.2	2.2	2.1	2.3	2.7
RSD (%):	15.2	10.8	20.2	5.9	37.7
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	14.5	20.6	10.3	39.2	6.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	10	10	9	10	9
Mean:	16.8	22.9	11.9	41.2	7.8
Standard Deviation:	3.2	3.5	1.7	3.5	1.5
RSD (%):	18.9	15.3	14.4	8.5	19.5
All Laboratories					
Number of Sample Measurements:	20	20	19	20	17
Mean:	15.6	21.6	11.1	40.0	7.4
Standard Deviation:	2.8	3.1	1.9	3.1	2.0
RSD (%):	18.2	14.3	17.5	7.8	27.3

notes: ? Insufficient data for calculation.
A Standard Deviation displayed as 0.0 should be interpreted as <0.1

Whole Blood Cadmium

Test materials for cadmium were prepared from caprine (goat) whole blood preserved with K_2EDTA anticoagulant. A total of five blood pools were supplemented with different amounts of cadmium (as Cd^{2+}).

The Target Value assigned for each PT material is the robust mean of the results reported by all participants in this event. The robust statistics were obtained utilizing algorithms based on those presented in **ISO 13528:2005E** Statistical methods for use in proficiency testing by interlaboratory comparisons. Values for whole blood cadmium range from 2.4 µg/L (21 nmol/L) to 14.7 µg/L (131 nmol/L).

Acceptable ranges are based on the OSHA criteria of ±15%, or ±1 µg/L around the target value, whichever is greater. So, the range is fixed at ±1 µg/L for concentrations below 6.6 µg/L, where above 6.6 µg/L, it is ±15%.

Discussion: Based upon the above criteria, 97.9% of the results reported by all participants were satisfactory, with one of the 28 laboratories (3.6%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Cadmium Test Results, 2015 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
Robust Mean	**2.4**	**14.7**	**4.6**	**9.9**	**6.7**
Robust Standard Deviation	0.2	0.9	0.3	0.7	0.3
Standard Uncertainty	<0.1	0.2	0.1	0.2	0.1
RSD (%)	7.5	6.4	6.9	7.2	4.2
Number of Sample Measurements	28	28	28	28	28
Acceptable Range:					
Upper Limit	3.4	16.9	5.6	11.4	7.7
Lower Limit	1.4	12.5	3.6	8.4	5.7

notes: Results reported as less than the method detection limit are excluded from statistical calculations.

New York State Department of Health
Blood Cadmium Test Results, 2015 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE15-11	BE15-12	BE15-13	BE15-14	BE15-15	
	Target Values:	2.4	14.7	4.6	9.9	6.7	
103	DRC/CC-ICP-MS	2.4	15.3	4.6	10.3	6.9	Info
106	ICP-MS	2.4	15.5	4.6	10.1	6.7	Info
107	ICP-MS	2.4	15	4.6	10	6.9	Info
109	ICP-MS	2.8	16.8	4.9	11.3	7.4	Info
110	ICP-MS	2.5	15.4	4.6	10.2	6.8	
114	ICP-MS	2.1	13.1	3.8	8.4	6.4	
116	DRC/CC-ICP-MS	2.6	15.7	4.9	10.8	7.5	Info
147	ICP-MS	2.4	14.2	4.2	9.4	6.4	Info
156	DRC/CC-ICP-MS	2.3	13.0	4.5	9.4	6.2	
160	ICP-MS	2.7	15.2	4.8	10.2	6.9	
164	ICP-MS	2.3	13.2	4.1	9.3	6.3	
179	DRC/CC-ICP-MS	2.4	15.5	4.7	10.2	6.8	
197	DRC/CC-ICP-MS	2.5	15.4	4.7	10.6	6.9	
200	ICP-MS	2.1	12.1 ↓	3.4 ↓	9.1	6.1	Info
206	ICP-MS	2.6	15.6	5.3	10.9	7.2	
208	ICP-MS	2.7	15.1	4.7	9.9	6.9	
293	ICP-MS	2.5	15.4	4.7	10.0	6.6	Info
305	ICP-MS	2.0	13.4	4.4	9.1	6.6	
312	ICP-MS	2.5	15.0	5.0	9.7	6.9	
325	ETAAS-Z	2.8	15.6	4.9	10.8	7.4	Info
339	HR-ICP-MS	2.2	13.5	4.2	8.9	6.0	Info
359	ICP-MS	2.5	13.4	4.6	9.8	6.9	
366	ETAAS-Z	2.2	15.0	5.0	10.0	7.5	Info
367	DRC/CC-ICP-MS	2.3	12.4 ↓	4.6	10.1	6.7	Info
388	ICP-MS	2.4	14.7	4.6	11.2	6.5	
391	DRC/CC-ICP-MS	2.0	13.1	3.9	8.8	5.9	Info
401	DRC/CC-ICP-MS	2.2	14.4	4.4	9.7	6.6	Info
410	ICP-MS	2.3	14.7	4.5	10.0	6.6	Info

Percent satisfactory results for all participants: 97.9 %

notes: ↑ Reported outside upper limit
↓ Reported outside lower limit
◥: Result unacceptable
◢: Result not reported

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Cadmium Test Results, 2015 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	8	8	8	8	8
Mean:	2.3	14.4	4.5	10.0	6.7
Standard Deviation:	0.2	1.3	0.3	0.7	0.5
RSD (%):	7.9	9.3	6.6	6.6	7.2
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	2.5	15.3	5.0	10.4	7.5
Standard Deviation:	0.4	0.4	0.1	0.6	0.1
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2.2	13.5	4.2	8.9	6.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	17	17	17	17	17
Mean:	2.4	14.6	4.5	9.9	6.7
Standard Deviation:	0.2	1.2	0.4	0.8	0.3
RSD (%):	9.1	8.1	9.9	7.6	4.9
All Laboratories					
Number of Sample Measurements:	28	28	28	28	28
Mean:	2.4	14.5	4.5	9.9	6.7
Standard Deviation:	0.2	1.2	0.4	0.7	0.4
RSD (%):	9.1	8.1	8.8	7.2	6.4

notes: ? Insufficient data for calculation.
A Standard Deviation displayed as 0.0 should be interpreted as <0.1

Whole Blood Mercury

Test materials for mercury were prepared from caprine (goat) whole blood preserved with K_2EDTA anticoagulant. A total of five pools were supplemented with different amounts of mercury as inorganic Hg^{2+}.

The Target Value assigned for each PT material is the robust mean of the results reported by all participants in this event. The robust statistics were obtained utilizing algorithms based on those presented in **ISO 13528:2005E** Statistical methods for use in proficiency testing by interlaboratory comparisons. Values for whole blood mercury range from 2.4 µg/L (12 nmol/L) to 49.5 µg/L (247 nmol/L).

Acceptable ranges were fixed at ±30%, or ±3 µg/L around the target value, whichever is greater. That is, the range is fixed at ±3 µg/L for concentrations below 10 µg/L, while above 10 µg/L, it is ±30%.

Discussion: Based on the above criteria, 98.6% of results reported by all participants were satisfactory, with none of the 28 laboratories reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Mercury Test Results, 2015 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
Robust Mean	**26.8**	**11.3**	**49.5**	**2.4**	**6.5**
Robust Standard Deviation	2.1	0.9	3.2	0.4	0.6
Standard Uncertainty	0.5	0.2	0.8	0.1	0.1
RSD (%)	7.9	8.0	6.5	15.0	9.2
Number of Sample Measurements	28	28	28	22	28
Acceptable Range:					
Upper Limit	34.8	14.7	64.4	5.4	9.5
Lower Limit	18.8	7.9	34.6	0.0	3.5

notes: Results reported as less than the method detection limit are excluded from statistical calculations.

New York State Department of Health
Blood Mercury Test Results, 2015 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood) BE15-11	BE15-12	BE15-13	BE15-14	BE15-15	Info Only
	Target Values:	26.8	11.3	49.5	2.4	6.5	
103	DRC/CC-ICP-MS	26.4	11.3	49.2	3.1	6.7	Info
106	DRC/CC-ICP-MS	27.6	12.1	51.6	2.4	6.8	Info
107	DRC/CC-ICP-MS	27	11	49	2.1	6.6	Info
109	ICP-MS	28.8	11.1	48.3	2.1	6.5	Info
110	ICP-MS	25.8	11.2	48.9	2.5	6.4	
114	ICP-MS	26.8	11.2	47.6	2.7	5.8	
116	DRC/CC-ICP-MS	27.9	11.6	51.7	2.3	7.0	Info
147	ICP-MS	26.5	11.3	47.3	2.5	6.3	Info
156	ICP-MS	24.0	10.0	50.0	<3.0	6.5	
164	ICP-MS	27.0	11.0	47.0	<4.0	6.0	
179	DRC/CC-ICP-MS	29.0	12.0	53.0	2.0	7.0	
197	DRC/CC-ICP-MS	26.0	11.0	47.0	<5.0	6.0	
200	ICP-MS	26.8	12.4	52.2	2.4	6.8	Info
206	ICP-MS	26.0	11.0	48.0	<3.0	6.0	
208	ICP-MS	34.7	15.5 ↑	59.0	<5.0	7.1	
293	ICP-MS	24.5	10.5	46.5	2.4	6.3	Info
305	ICP-MS	24.0	11.0	50.0	7.0 ↑	6.0	
312	ICP-MS	33.0	13.0	57.0	2.6	7.7	
339	HR-ICP-MS	23.4	10.1	46.7	2.0	5.9	Info
359	ICP-MS	30.0	12.5	54.8	2.9	7.2	
366	ICP-MS	26.0	11.7	48.0	2.7	6.6	Info
367	CV-AAS	27.8	11.8	51.4	2.1	6.8	Info
388	ICP-MS	30.2	12.8	58.2	2.7	7.7	
391	CV-AAS	30.8	8.7	51.0	2.5	8.3	Info
401	DRC/CC-ICP-MS	25.5	11.0	44.3	2.2	6.2	Info
410	ICP-MS	27.7	11.7	50.5	2.6	6.6	Info
453	Atomic Spectrometry Other	23.8	10.2	46.2	1.8	5.4	Info
484	ICP-MS	22.9	9.3	43.8	<5.0	5.8	

Percent satisfactory results for all participants: 98.6 %

notes: ↑ Reported outside upper limit
↓ Reported outside lower limit
◥: Result unacceptable
◢: Result not reported

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Mercury Test Results, 2015 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
Atomic Spectrometry					
Number of Sample Measurements:	1	1	1	1	1
Mean:	23.8	10.2	46.2	1.8	5.4
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
CV-AAS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	29.3	10.3	51.2	2.3	7.6
Standard Deviation:	2.1	2.2	0.3	0.3	1.1
RSD (%):	—	—	—	—	—
DRC/CC-ICP-MS					
Number of Sample Measurements:	7	7	7	6	7
Mean:	27.1	11.4	49.4	2.4	6.6
Standard Deviation:	1.2	0.5	3.0	0.4	0.4
RSD (%):	4.5	4.2	6.1	16.8	5.8
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	23.4	10.1	46.7	2.0	5.9
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	17	17	17	11	17
Mean:	27.3	11.6	50.4	2.6	6.5
Standard Deviation:	3.2	1.4	4.4	0.2	0.6
RSD (%):	11.6	12.0	8.7	8.3	9.1
All Laboratories					
Number of Sample Measurements:	28	28	28	21	28
Mean:	27.1	11.4	49.9	2.4	6.6
Standard Deviation:	2.8	1.3	3.8	0.3	0.6
RSD (%):	10.3	11.2	7.7	13.5	9.9

notes: ? Insufficient data for calculation.
A Standard Deviation displayed as 0.0 should be interpreted as <0.1

Additional Trace Elements Reported in Whole Blood

Participant laboratories reported their analytical results for any additional trace elements (other than As, Cd, Hg and Pb) that are routinely reported so that a more complete characterization can be recorded for these proficiency test materials. Results for the additional trace elements cobalt (Co) and chromium (Cr) are reported here. Although these data are provided solely for educational and informational purposes, target values and acceptable ranges are provided. The New York State grading criteria were established after discussions with the FDA and with other trace element PT scheme organizers. Departures from the acceptable ranges should trigger an internal Quality Assurance review.

Additional Elements

Co and Cr

Whole Blood Chromium

Test materials for chromium were prepared from caprine (goat) whole blood preserved with K_2EDTA anticoagulant. A total of five pools were supplemented with chromium as inorganic Cr^{3+}.

The Target Values assigned for each PT material is the arithmetic mean of the results reported by all participants for the event. Values for whole blood chromium range from 2.8 µg/L (54 nmol/L) to 14.8 µg/L (285 nmol/L) after outlier exclusion.

Acceptable range: The acceptable range for chromium is set at ±2 µg/L or ±20%, whichever is greater. Thus, it is fixed at ±2 µg/L for concentrations below 10 µg/L. These NYS grading criteria were established after discussions with the FDA and with other trace element PT scheme organizers.

Discussion: Based upon the above criteria, 94.0% of test results reported were within the acceptable ranges, with one of the 10 laboratories (10%) reporting 2 or more of the 5 results outside the acceptable ranges. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment (QA) program. Note that this grading scheme is intended for educational purposes. Departures from the acceptable ranges should trigger an internal QA review.

New York State Department of Health
Blood Chromium Test Results, 2015 Event #3
STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
Arithmetic Mean*	**2.8**	**14.8**	**4.9**	**10.1**	**7.3**
Standard Deviation	0.3	1.9	0.5	0.9	0.8
RSD (%)	10.8	12.6	10.1	9.1	10.4
Number of Sample Measurements*	10	10	10	10	10
Acceptable Range:					
Upper Limit	4.8	17.8	6.9	12.1	9.3
Lower Limit	0.8	11.8	2.9	8.1	5.3

notes: Results reported as less than the method detection limit are excluded from statistical calculations.

* Outliers identified by Grubbs' test excluded

New York State Department of Health
Blood Chromium Test Results, 2015 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE15-11	BE15-12	BE15-13	BE15-14	BE15-15	
	Target Values:	2.8	14.8	4.9	10.1	7.3	
103	DRC/CC-ICP-MS	3.08	15.9	5.03	10.6	7.63	Info
110	DRC/CC-ICP-MS	2.6	16.0	5.1	10.7	7.6	
147	DRC/CC-ICP-MS	2.94	16.2	5.29	11.1	7.99	Info
156	DRC/CC-ICP-MS	2.8	14	4.9	9.7	7	
164	DRC/CC-ICP-MS	2.5	13.9	4.5	9.4	6.9	
197	DRC/CC-ICP-MS	2.9	14.4	4.8	9.8	7.3	
305	ICP-MS	2.4	14.9	4.6	10.2	7.2	
312	DRC/CC-ICP-MS	3.4	18 ↑	5.8	11	8.6	
366	DRC/CC-ICP-MS	2.7	12.6	4.6	10.0	7.5	Info
391	DRC/CC-ICP-MS	3.1	11.7 ↓	4.0	8.0 ↓	5.7	Info

Percent satisfactory results for all participants: 94.0 %

notes: ↑ Reported outside upper limit
↓ Reported outside lower limit
◥: Result unacceptable
◢: Result not reported

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Chromium Test Results, 2015 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	9	9	9	9	9
Mean:	2.9	14.7	4.9	10.0	7.4
Standard Deviation:	0.3	2.0	0.5	1.0	0.8
RSD (%):	9.7	13.3	10.4	9.7	10.9
ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2.4	14.9	4.6	10.2	7.2
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
All Laboratories					
Number of Sample Measurements:	10	10	10	10	10
Mean:	2.8	14.8	4.9	10.1	7.3
Standard Deviation:	0.3	1.9	0.5	0.9	0.8
RSD (%):	10.8	12.6	10.1	9.1	10.4

notes: ? Insufficient data for calculation.
A Standard Deviation displayed as 0.0 should be interpreted as <0.1

Whole Blood Cobalt

Test materials for cobalt were prepared from caprine (goat) whole blood preserved with K_2EDTA anticoagulant. A total of five pools were supplemented with cobalt as inorganic Co^{2+}.

The Target Values assigned for each PT material is the arithmetic mean of the results reported by all participants for the event. Values for whole blood cobalt range from 4.1 µg/L to 13.1 µg/L after outlier exclusion.

Acceptable range: The acceptable range for cobalt is set at ±1.5 µg/L or ±20%, whichever is greater. Thus, it is fixed at ±1.5 µg/L for concentrations below 7.5 µg/L. These NYS grading criteria were established after discussions with the FDA and with other trace element PT scheme organizers.

Discussion: Based upon the above criteria, 100% of test results reported were within the acceptable ranges, with none of the 11 laboratories reporting 2 or more of the 5 results outside the acceptable ranges. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment (QA) program. Note that this grading scheme is intended for educational purposes. Departures from the acceptable ranges should trigger an internal QA review.

New York State Department of Health
Blood Cobalt Test Results, 2015 Event #3
STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
Arithmetic Mean*	**8.1**	**13.1**	**9.9**	**4.1**	**9.3**
Standard Deviation	0.8	1.0	0.7	0.4	0.9
RSD (%)	9.5	7.5	7.6	8.6	9.8
Number of Sample Measurements*	11	11	11	11	11
Acceptable Range:					
Upper Limit	9.7	15.7	11.9	5.6	11.2
Lower Limit	6.5	10.5	7.9	2.6	7.4

notes: Results reported as less than the method detection limit are excluded from statistical calculations.

* Outliers identified by Grubbs' test excluded

New York State Department of Health
Blood Cobalt Test Results, 2015 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE15-11	BE15-12	BE15-13	BE15-14	BE15-15	
	Target Values:	8.1	13.1	9.9	4.1	9.3	
103	DRC/CC-ICP-MS	8.25	13.8	10.1	4.20	9.57	Info
110	ICP-MS	9.0	14.3	10.6	4.3	10.1	
147	ICP-MS	8.66	14.1	10.7	4.50	10.1	Info
156	DRC/CC-ICP-MS	7.4	12	9.6	3.8	8.7	
164	ICP-MS	7.4	12.6	9.6	3.7	8.4	
197	ICP-MS	7.3	12.5	9.4	3.8	8.6	
206	ICP-MS	8.6	13.6	10.3	4.5	9.9	
305	ICP-MS	7.4	12.6	9.1	3.9	8.8	
312	ICP-MS	8.7	14	11	4.4	11	
366	ICP-MS	9.0	13.0	10.1	4.5	8.8	Info
391	DRC/CC-ICP-MS	7.0	11.2	8.5	3.6	8.1	Info

Percent satisfactory results for all participants: 100.0 %

notes: ↑ Reported outside upper limit
↓ Reported outside lower limit
◥: Result unacceptable
◢: Result not reported

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Cobalt Test Results, 2015 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	7.6	12.3	9.4	3.9	8.8
Standard Deviation:	0.6	1.3	0.8	0.3	0.7
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	8	8	8	8	8
Mean:	8.3	13.3	10.1	4.2	9.5
Standard Deviation:	0.8	0.7	0.7	0.3	0.9
RSD (%):	9.1	5.6	6.7	8.1	9.9
All Laboratories					
Number of Sample Measurements:	11	11	11	11	11
Mean:	8.1	13.1	9.9	4.1	9.3
Standard Deviation:	0.8	1.0	0.7	0.4	0.9
RSD (%):	9.5	7.5	7.6	8.6	9.8

notes: ? Insufficient data for calculation.
A Standard Deviation displayed as 0.0 should be interpreted as <0.1

Whole Blood Lead

Test materials for lead were prepared from caprine (goat) whole blood obtained from animals dosed with lead acetate to create physiologically-bound Pb. Whole blood was collected into collection bags containing K_2EDTA anticoagulant.

Target values were established as the mean of 18 measurements performed by 16 reference laboratories using ICP-MS and ETAAS methods. Values range from 5 µg/dL to 52 µg/dL. Among the reference group, imprecision (SD) varied from 0.5 - 2.0 µg/dL.

Acceptable ranges are based on the CLIA '88 criteria (Federal Register Volume 57, Number 40, §§ 493.2 and 493.937, February 28, 1992). The criteria are set at ±10% or ±4 µg/dL, whichever is greater.

Discussion Based on the CLIA '88 criteria, 98.1% of results reported by all participants were judged as satisfactory, with none of 83 participant laboratories reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Lead Test Results, 2015 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood) BE15-11	BE15-12	BE15-13	BE15-14	BE15-15	Normalized Mean	Info Only
	Target values:	13	8	52	11	5		
103	ASV-LeadCare II	13	9	59 ↑	11	7	1.04	Info
103	DRC/CC-ICP-MS	13	8	53	10	5	1.01	
104	ETAAS-Z	13	8	50	12	6	1.02	
106	ICP-MS	13	8	54	11	6	1.01	Info
107	ICP-MS	13	8.2	54	11	5.6	1.01	
109	ETAAS-Z	12	7	52	10	4	0.96	
109	ASV-LeadCare II	11	8	62 ↑	10	6	1.02	Info
109	ICP-MS	13.3	8.0	52.2	10.5	5.4	1.00	
110	ICP-MS	12	8	53	10	5	0.97	
110	ETAAS-Z	12	7	52	10	5	0.96	
110	ASV-LeadCare II	13.1	7.6	63.4 ↑	11.3	5.5	1.07	Info
112	ETAAS-Z	13	8	50	11	6	0.99	
114	ICP-MS	13	8	53	11	5	1.01	
116	DRC/CC-ICP-MS	13	8	54	11	6	1.01	Info
121	ETAAS-Z	13	8	50	11	5	0.99	Info
123	ETAAS-Z	10	7	50	9	5	0.96	
126	ICP-MS	12	9	52	10	5	0.96	
131	ETAAS-Z	13	8	51	10	5	0.99	
143	ETAAS-Z	12	7	49	10	5	0.93	
144	ETAAS-Z	11	6	49	10	5	0.89	
147	ICP-MS	13	9	56	12	6	1.06	
150	ETAAS-Z	10	8	53	10	4	1.02	
156	DRC/CC-ICP-MS	12	8	52	10	5	0.96	

Notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized Mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info Only: results included for informational purposes only.
ND: non-detect
◥: Result unacceptable

New York State Department of Health
Blood Lead Test Results, 2015 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood) BE15-11	BE15-12	BE15-13	BE15-14	BE15-15	Normalized Mean	Info Only
	Target values:	13	8	52	11	5		
158	ICP-MS	12	8	53	10	5	0.97	
160	ICP-MS	12	8	49	10	5	0.93	
164	ICP-MS	12	8	51	10	5	0.95	
166	ETAAS-Z	12	7	51	10	5	0.95	
168	ETAAS-Z	13	8	52	11	6	1.00	
179	DRC/CC-ICP-MS	13	8	55	11	6	1.02	
197	ICP-MS	12	8	49	10	5	0.93	
198	ETAAS-Z	13	8	49	11	6	0.98	
200	ICP-MS	12	8	51	10	5	0.95	
204	ASV-LeadCare Ultra	12	8	49	10	6	0.93	
206	ICP-MS	13	8	54	10	6	1.02	
208	ETAAS-Z	11	7	46 ↓	10	4	0.87	
237	ETAAS-Z	12	8	53	11	6	0.98	
254	ETAAS-Z	12	7	51	10	5	0.95	
255	ETAAS-Z	13	8	49	10	5	0.97	
269	ETAAS-Z	11	7	47	9	5	0.88	
272	ETAAS-Z	11	7	48	9	4	0.88	
279	ETAAS-Z	12	8	51	11	5	0.97	
287	ETAAS-Z	12	8	55	10	5	0.99	
290	ICP-MS	11	8	49	10	5	0.89	
291	ASV-LeadCare Ultra	12	8	52	11	5	0.97	
293	ICP-MS	12	8	50	10	5	0.94	
295	ASV-LeadCare Ultra	10	7	44 ↓	9	4	0.85	

Notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized Mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info Only: results included for informational purposes only.
ND: non-detect
◥: Result unacceptable

New York State Department of Health
Blood Lead Test Results, 2015 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood) BE15-11	BE15-12	BE15-13	BE15-14	BE15-15	Normalized Mean	Info Only
	Target values:	13	8	52	11	5		
301	ETAAS Other	12	8	56	10	5	1.00	
305	FAAS	12	8	52	10	5	0.96	
312	ICP-MS	13	8	53	10	6	1.01	
317	ETAAS-Z	13	9	54	11	6	1.01	
325	ETAAS-Z	13	8	54	11	6	1.01	
333	ETAAS-Z	14	9	54	11	6	1.04	
337	ASV-LeadCare II	12	7	54	10	6	0.98	
339	HR-ICP-MS	11	7	47	9	5	0.88	Info
340	ETAAS-Z	13	8	48	10	5	0.96	
343	ASV-LeadCare	11	8	59 ↑	11	6	0.99	Info
343	ASV-LeadCare II	12	7	57	10	6	1.01	Info
343	ASV-LeadCare Ultra	13	9	57	12	6	1.06	Info
345	ASV-LeadCare II	12	8	58 ↑	11	6	1.01	
349	ETAAS-Z	11	7	48	10	5	0.88	
350	ASV-LeadCare Ultra	10	7	48	9	5	0.92	
365	ETAAS-Z	13	8	53	10	5	1.01	
366	ICP-MS	14	9	55	12	6	1.08	Info
367	DRC/CC-ICP-MS	13	8	56	11	6	1.03	Info
368	ASV-3010	13	10	52	11	7	1.00	
369	ASV-LeadCare Ultra	13	7	49	9	5	0.97	
374	ASV-LeadCare II	14	8	65 ↑	11	6	1.11	
384	ASV-LeadCare	12	7	48	9	5	0.92	
388	ICP-MS	12	8	51	11	5	0.97	

Notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized Mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info Only: results included for informational purposes only.
ND: non-detect
◥: Result unacceptable

New York State Department of Health
Blood Lead Test Results, 2015 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE15-11	BE15-12	BE15-13	BE15-14	BE15-15		
	Target values:	13	8	52	11	5		
389	ETAAS-Z	12	8	48	10	5	0.92	
391	ETAAS-Z	12.10	7.9	48.7	10.0	5.1	0.93	Info
393	ASV-LeadCare II	11	7	>37	10	5	0.85	
401	DRC/CC-ICP-MS	11.4	7.5	50.3	9.7	5.0	0.90	Info
410	ICP-MS	12.6	8.0	53.4	10.5	5.4	1.01	Info
461	ASV-LeadCare Ultra	12	8	50	10	5	0.94	
464	ASV-LeadCare II	16	9	<65	11	7	1.12	
466	ASV-LeadCare II	11	8	53	9	5	0.93	
469	ICP-MS	12	7	49	10	5	0.93	
470	ASV-LeadCare II	12	8	55	11	6	0.99	
476	ASV-LeadCare	13	7	>55	11	5	1.00	
477	ASV-LeadCare II	10	7	47	8	6	0.90	
482	ASV-LeadCare II	11	8	54	9	6	0.94	
484	ICP-MS	11	7	49	10	5	0.89	

Percent satisfactory results for all participants: 98.1 %

Notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized Mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info Only: results included for informational purposes only.
ND: non-detect
◥: Result unacceptable

New York State Department of Health
Blood Lead Test Results, 2015 Event #3
STATISTICAL SUMMARY

Lab Code	Method	TARGET VALUE ASSIGNMENT AND STATISTICS Results (µg/dL whole blood) BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
103	DRC/CC-ICP-MS	13	8	53	10	5
104	ETAAS-Z	13	8	50	12	6
107	ICP-MS	13	8.2	54	11	5.6
109	ETAAS-Z	12	7	52	10	4
109	ICP-MS	13.3	8.0	52.2	10.5	5.4
110	ICP-MS	12	8	53	10	5
110	ETAAS-Z	12	7	52	10	5
112	ETAAS-Z	13	8	50	11	6
147	ICP-MS	13	9	56	12	6
156	DRC/CC-ICP-MS	12	8	52	10	5
160	ICP-MS	12	8	49	10	5
164	ICP-MS	12	8	51	10	5
166	ETAAS-Z	12	7	51	10	5
179	DRC/CC-ICP-MS	13	8	55	11	6
198	ETAAS-Z	13	8	49	11	6
200	ICP-MS	12	8	51	10	5
293	ICP-MS	12	8	50	10	5
325	ETAAS-Z	13	8	54	11	6
	Number of Sample Measurements:	18	18	18	18	18
	Mean (target value):	**13**	**8**	**52**	**11**	**5**
	Standard Deviation:	0.5	0.5	2.0	0.7	0.6
	RSD (%):	4.3	6.0	3.8	6.6	10.7
	Acceptable Range:					
	Upper Limit:	17	12	57	15	9
	Lower Limit:	9	4	47	7	1

notes: Results reported as less than the detection limits are treated as zero for statistical and grading purposes.

New York State Department of Health
Blood Lead Test Results, 2015 Event #3
STATISTICAL SUMMARY BY CLASS

	Results (µg/dL whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
Evaluated					
Number of Sample Measurements:	50	50	47	50	50
Mean:	12.0	7.7	51.2	10.1	5.3
Standard Deviation:	1.2	0.7	3.5	0.7	0.7
RSD (%):	9.7	9.3	6.9	7.4	12.6
Info					
Number of Sample Measurements:	15	15	15	15	15
Mean:	12.4	8.0	55.1	10.7	5.7
Standard Deviation:	0.9	0.6	4.7	0.8	0.6
RSD (%):	7.6	7.8	8.6	7.8	9.7
Reference					
Number of Sample Measurements:	18	18	18	18	18
Mean:	12.5	7.9	51.9	10.5	5.3
Standard Deviation:	0.5	0.5	2.0	0.7	0.6
RSD (%):	4.3	6.0	3.8	6.6	10.7
All Laboratories					
Number of Sample Measurements:	83	83	80	83	83
Mean:	12.2	7.8	52.1	10.3	5.4
Standard Deviation:	1.0	0.7	3.8	0.8	0.6
RSD (%):	8.5	8.5	7.3	7.7	12.0

notes: ? Insufficient data for calculation.

New York State Department of Health
Blood Lead Test Results, 2015 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/dL whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
ASV-3010					
Number of Sample Measurements:	1	1	1	1	1
Mean:	13.0	10.0	52.0	11.0	7.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ASV-LeadCare					
Number of Sample Measurements:	3	3	2	3	3
Mean:	12.0	7.3	53.5	10.3	5.3
Standard Deviation:	1.0	0.6	7.8	1.2	0.6
RSD (%):	—	—	—	—	—
ASV-LeadCare II					
Number of Sample Measurements:	13	13	11	13	13
Mean:	12.2	7.8	57.0	10.2	6.0
Standard Deviation:	1.6	0.7	5.2	1.0	0.6
RSD (%):	13.0	8.8	9.2	9.9	10.0
ASV-LeadCare Ultra					
Number of Sample Measurements:	7	7	7	7	7
Mean:	11.7	7.7	49.9	10.0	5.1
Standard Deviation:	1.3	0.8	4.0	1.2	0.7
RSD (%):	10.7	9.8	8.0	11.5	13.4
DRC/CC-ICP-MS					
Number of Sample Measurements:	6	6	6	6	6
Mean:	12.6	7.9	53.4	10.5	5.5
Standard Deviation:	0.7	0.2	2.1	0.6	0.5
RSD (%):	5.6	2.6	3.9	5.9	10.0
ETAAS Other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	12.0	8.0	56.0	10.0	5.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	29	29	29	29	29
Mean:	12.1	7.7	50.5	10.3	5.1
Standard Deviation:	1.0	0.7	2.3	0.7	0.6
RSD (%):	8.2	8.7	4.6	6.8	12.4
FAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	12.0	8.0	52.0	10.0	5.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—

notes: ? Insufficient data for calculation.
A Standard Deviation displayed as 0.0 should be interpreted as <0.1 (see DRC/CC-ICP-MS and HR-ICP-MS participants)

New York State Department of Health
Blood Lead Test Results, 2015 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/dL whole blood)				
	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	11.0	7.0	47.0	9.0	5.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	21	21	21	21	21
Mean:	12.4	8.1	51.9	10.4	5.3
Standard Deviation:	0.7	0.5	2.2	0.7	0.4
RSD (%):	6.0	6.2	4.2	6.3	8.1
All Laboratories					
Number of Sample Measurements:	83	83	80	83	83
Mean:	12.2	7.8	52.1	10.3	5.4
Standard Deviation:	1.0	0.7	3.8	0.8	0.6
RSD (%):	8.5	8.5	7.3	7.7	12.0

notes: ? Insufficient data for calculation.
A Standard Deviation displayed as 0.0 should be interpreted as <0.1 (see DRC/CC-ICP-MS and HR-ICP-MS participants)

Additional Trace Elements Reported in Whole Blood

Participant laboratories reported their analytical results for any additional trace elements (other than As, Cd, Hg and Pb) that are routinely reported so that a more complete characterization can be recorded for these proficiency test materials. Results for additional trace elements are reported here, but no target value is implied nor are any acceptable ranges provided. These data are provided solely for educational and informational purposes.

In addition to As, Cd, Pb and Hg, the whole blood pools were supplemented with the following additional trace elements as indicated below

Additional Elements

Mn, Sn, Tl, Ti, V, W, Ni, Ag

New York State Department of Health
Whole Blood Additional Elements, 2015 Event #3
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Blood Aluminum (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
147	ICP-MS	<5.4	<5.4	<5.4	<5.4	<5.4
305	ICP-MS	14	10.5	10.6	8.5	12.8
359	ICP-MS	21.3	19.7	22.7	18.8	23.5

Blood Antimony (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
103	DRC/CC-ICP-MS	<0.258	<0.258	<0.258	<0.258	<0.258
110	ICP-MS	<0.10	<0.10	<0.10	<0.10	<0.10
147	ICP-MS	<0.037	<0.037	<0.037	<0.037	<0.037
206	DRC/CC-ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

Blood Barium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
147	ICP-MS	23.5	23.3	35.2	43.9	26.9
197	ICP-MS	*19.8	21.2	31.4	39.5	23.4
312	ICP-MS	23.6	24	36.1	44.6	27.4
**Outlier*	**Arithmetic Mean**	**23.6**	**22.8**	**34.2**	**42.7**	**25.9**
	SD	-	1.5	2.5	2.8	2.2
	n	-	3	3	3	3

Blood Beryllium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
110	ICP-MS	<0.14	<0.14	<0.14	<0.14	<0.14
147	ICP-MS	<1.8	<1.8	<1.8	<1.8	<1.8
197	ICP-MS	<0.2	<0.2	<0.2	<0.2	<0.2

Blood Bismuth (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0
206	DRC/CC-ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0
305	ICP-MS	<0.5	<0.5	<0.5	<0.5	<0.5

Blood Cesium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
110	ICP-MS	0.6	0.4	0.5	0.4	0.5

Blood Copper (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
110	ICP-MS	1239	1106	1113	1306	1158
147	ICP-MS	1201	1093	1080	1302	1213
197	ICP-MS	1100	1010	970	1180	1080
312	ICP-MS	1130	1010	1000	1160	1080
	Arithmetic mean	**1168**	**1055**	**1041**	**1237**	**1133**
	SD	64	52	67	78	65
	n	4	4	4	4	4

Blood Iodine (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
147	ICP-MS	47.3	38.2	34.3	29.7	41.4

Blood Lithium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
147	ICP-MS	4.79	8.67	5.84	7.08	5.95

Blood Manganese (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
103	DRC/CC-ICP-MS	17.9	36.1	15.6	40.0	23.2
107	DRC/CC-ICP-MS	18	35	16	39	22
110	ETAAS-Z	17.6	35.2	15.7	40.0	22.7
147	ICP-MS	18.6	36.9	16.4	42.3	27.2
197	ICP-MS	14.9	31.5	13.4	38.0	20.9
156	ICP-MS	17	34	16	38	22
179	DRC/CC-ICP-MS	18.3	36.3	17.1	41.5	24.5
206	DRC/CC-ICP-MS	19.1	38.7	16.7	43.0	25.3
293	ICP-MS	16.1	36.6	17.6	40.3	22.8
305	ICP-MS	16.2	34.4	14.8	39.5	23.8
312	DRC/CC-ICP-MS	18	37	16	42	23
391	DRC/CC-ICP-MS	18.1	30.0	14.7	39.6	22.0
	Arithmetic mean	**17.5**	**35.1**	**15.8**	**40.3**	**23.3**
	SD	1.2	2.4	1.1	1.6	1.7
	n	12	12	12	12	12

Blood Molybdenum (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
103	DRC/CC-ICP-MS	7.17	17.6	8.76	16.5	4.49
147	ICP-MS	7.31	17.2	8.58	16.2	4.43
197	ICP-MS	6.7	17.1	8.6	15.9	4.2
305	ICP-MS	7.2	17.9	9.1	*18.2	4.9
312	ICP-MS	7.0	17	8.5	16	4.5
**Outlier*	**Arithmetic mean**	**7.1**	**17.4**	**8.7**	**16.2**	**4.5**
	SD	0.2	0.4	0.2	0.3	0.3
	n	5	5	5	4	5

Blood Nickel (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
110	DRC/CC-ICP-MS	4.5	10.2	2.7	11.9	6.6
147	ICP-MS	4.32	11.3	2.95	12.7	6.87
197	ICP-MS	5.8	11.2	4.1	13.8	7.8
312	ICP-MS	4	10	3	12	6
	Arithmetic mean	**4.7**	**10.7**	**3.2**	**12.6**	**6.8**
	SD	0.8	0.7	0.6	0.9	0.7
	n	4	4	4	4	4

Blood Platinum (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
110	ICP-MS	<0.10	<0.10	<0.10	<0.10	<0.10
312	ICP-MS	<0.05	<0.05	<0.05	<0.05	<0.05

Blood Selenium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
103	DRC/CC-ICP-MS	275	287	247	268	314
107	DRC/CC-ICP-MS	290	290	260	280	320
109	ICP-MS	311	303	260	286	331
147	ICP-MS	265	282	242	266	318
305	ICP-MS	282	312	267	290	344
312	ICP-MS	293	293	254	277	330
359	ICP-MS	*0.3	*0.3	*0.2	*0.3	*0.3
**Outlier*	**Arithmetic Mean**	**286**	**295**	**255**	**278**	**326**
	SD	16	11	9	10	11
	n	6	6	6	6	6

Blood Silver (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
147	ICP-MS	0.124	6.26	3.32	2.31	2.35
197	ICP-MS	<1.0	5.8	2.9	1.7	1.7

Blood Strontium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
103	DRC/CC-ICP-MS	34.9	34.0	50.5	44.1	33.9

Blood Tellurium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
147	ICP-MS	<0.077	<0.077	<0.077	<0.077	<0.077

Blood Thorium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
147	ICP-MS	<0.028	<0.028	<0.028	<0.028	<0.028

Blood Thallium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
103	DRC/CC-ICP-MS	2.39	3.26	12.9	5.42	15.9
110	ICP-MS	2.5	3.4	13.4	5.5	16.9
147	ICP-MS	2.47	3.31	12.6	5.38	15.7
156	DRC/CC-ICP-MS	2.3	3.3	13	6	15
179	ICP-MS	3	*4	14	6	17
197	ICP-MS	2.1	3.0	11.8	4.8	14.4
206	ICP-MS	2.6	3.4	13.5	5.8	16.1
305	ICP-MS	2.0	3.0	11.6	5.1	13.9
312	ICP-MS	2.5	3.4	13	5.6	16
**Outlier*	**Arithmetic mean**	**2.4**	**3.3**	**12.9**	**5.5**	**15.7**
	SD	0.3	0.2	0.8	0.4	1.1
	n	9	8	9	9	9

Blood Tin (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
110	ICP-MS	2.3	5.6	9.6	4.5	11.8
147	ICP-MS	2.15	5.12	8.58	4.10	11.3
156	DRC/CC-ICP-MS	<2	5.2	9.4	5.1	10
197	ICP-MS	<5.0	5.6	9.5	<5.0	11.4
	Arithmetic Mean	**2.2**	**5.4**	**9.3**	**4.6**	**11.1**
	SD	-	0.3	0.5	0.5	0.8
	n	-	4	4	3	4

Blood Tungsten (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
200	ICP-MS	0.1	2.2	6.8	8.5	1.1

Blood Uranium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
103	DRC/CC-ICP-MS	<0.00748	<0.00748	<0.00748	<0.00748	<0.00748
110	ICP-MS	<0.02	<0.02	<0.02	<0.02	<0.02
147	DRC/CC-ICP-MS	<0.0071	<0.0071	<0.0071	<0.0071	<0.0071
312	ICP-MS	<0.02	<0.02	<0.02	<0.02	<0.02

Blood Vanadium (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
110	DRC/CC-ICP-MS	15.5	6.8	6.2	2.3	17.9
147	DRC/CC-ICP-MS	15.2	6.63	6.07	2.39	17.4
312	DRC/CC-ICP-MS	18	8.0	6.7	2.8	21
	Arithmetic Mean	**16.2**	**7.1**	**6.3**	**2.5**	**18.8**
	SD	1.5	0.7	0.3	0.3	2.0
	n	3	3	3	3	3

Blood Zinc (µg/L)

Lab Code	Method	BE15-11	BE15-12	BE15-13	BE15-14	BE15-15
147	ICP-MS	2346	2105	2248	2039	1954
197	ICP-MS	2090	2030	2000	2000	1670
206	DRC/CC-ICP-MS	2250	2029	2185	1956	1899
312	ICP-MS	2430	2160	2370	2060	2320
	Arithmetic mean	**2279**	**2081**	**2201**	**2014**	**1961**
	SD	146	64	154	46	269
	n	4	4	4	4	4

New York State Department of Health
Trace Elements in Whole Blood
METHOD NOTES

ATOMIC SPECTROMETRY METHODS

A-1 ETAAS-Z (Electrothermal atomic absorption spectrometry with Zeeman background correction)

A-2 ETAAS Other (i.e., D_2, S-H background correction)

A-3 FAAS (Flame atomic absorption spectrometry)

A-4 CV-AAS (Cold vapor atomic absorption spectrometry)

A-5 HG-AAS (Hydride generation atomic absorption spectrometry)

A-6 AFS (Atomic fluorescence spectrometry)

INDUCTIVELY COUPLED PLASMA

P-1 ICP-MS (Inductively coupled plasma - mass spectrometry)

P-2 DRC/CC-ICP-MS (ICP-MS used in the Dynamic Reaction Cell or Collision Cell mode)

P-3 ICP-AES/OES (ICP atomic/optical emission spectrometry)

P-4 HR-ICP-MS (High resolution ICP-MS)

P-5 ETV-ICP-MS (Electrothermal vaporization ICP-MS)

P-6 ID-ICP-MS (Isotope dilution ICP-MS)

ELECTROCHEMICAL METHODS

E-1 ASV (Anodic stripping voltammetry without digestion)

E-2 ASV-LeadCare® Blood Lead Testing System

E-5 ASV-LeadCare® II Blood Lead Testing System

E-6 ASV-LeadCare® Ultra™ Blood Lead Testing System

E-3 Fluoride specific electrode

MOLECULAR FLUORIMETRY

F-1 EtOAc (Ethyl acetate-acetic acid extraction method for determination of erythrocyte protoporphyrin)

F-2 Aviv hematofluorometry (for determination of EP at hematocrit 35)

F-3 Helena ZPP (for determination of zinc protoporphyrin in μmol ZPP/mol heme)

OTHER METHODS

If your method is not listed in the above list, please describe it briefly.