Wadsworth Center

New York State Department of Health

TRACE ELEMENTS IN WHOLE BLOOD

Event #2, 2010

June 21, 2010

STATE OF NEW YORK
DEPARTMENT OF HEALTH

Wadsworth Center The Governor Nelson A. Rockefeller Empire State Plaza P.O. Box 509 Albany, New York 12201-0509

Richard F. Daines, M.D.
Commissioner

James W. Clyne, Jr..
Executive Deputy Commisioner

June 21, 2010

Trace Elements in Whole Blood
Event #2, 2010

Dear Laboratory Director:

Results from the second proficiency test (PT) event in 2010 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 June 1st, 2010, and are reproduced here for completeness.

PT Materials

Test materials for the second 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 different amounts of arsenic (as As^{3+}, DMA, MMA and arsenobetaine), cadmium (as Cd^{2+}) and mercury as both inorganic (Hg^{2+}) and as methylmercury (CH_3Hg^+) species. In addition to As, Cd, Pb and Hg, blood pools were supplemented with the trace elements manganese, thallium and tin.

Assignment of Target Values for Trace Elements

Except for blood lead, we have implemented robust statistics for assigning target values for all trace element panels. Method specific and additional trace element data will continue to be calculated utilizing traditional statistics. The use of robust statistics for assigning target values for proficiency testing pools is one approach that is acceptable under ISO 13528. In collaboration with other trace element PT scheme organizers, we have conducted an evaluation of robust statistics. As a result of our evaluation, we have elected to introduce this approach in our program.

The next PT event for trace elements in whole blood is scheduled to be mailed Wednesday, September 22nd, 2010. Please inform our laboratory staff at (518) 474-4484 if the test materials have not arrived within five days of the scheduled mail out date. **The deadline for reporting results is Wednesday, October 13th, 2010.**

Thank you for your participation in this event.

Yours sincerely,

Patrick J. Parsons, Ph.D.
Section Head, Trace Elements PT Program

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 different arsenic species: inorganic As^{3+}, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), and arsenobetaine.

Sample	Arsenic species added
BE10-06	As^{3+} and MMA
BE10-07	As^{3+}
BE10-08	As^{3+}, MMA and DMA
BE10-09	As^{3+}, DMA and arsenobetaine
BE10-10	As^{3+}, MMA, DMA and arsenobetaine

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 14.7 µg/L (0.20 µmol/L) to 69.2 µg/L (0.92 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, 100% of test results reported were judged as satisfactory, with none of the 19 participant laboratories reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Arsenic Test Results, 2010 Event #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
Robust Mean	**24.8**	**14.7**	**41.6**	**69.2**	**49.6**
Robust Standard Deviation	3.2	2.4	3.6	6.5	3.6
Standard Uncertainty	0.9	0.7	1.0	1.9	1.0
RSD (%)	13.0	16.7	8.6	9.3	7.3
Acceptable Range:					
Upper Limit	30.8	20.7	49.9	83.0	59.5
Lower Limit	18.8	8.7	33.3	55.4	39.7

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, 2010 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE10-06	BE10-07	BE10-08	BE10-09	BE10-10	
	Target Values:	24.8	14.7	41.6	69.2	49.6	
103	DRC/CC-ICP-MS	23.5	13.9	40.8	67.3	47.6	Info
110	DRC/CC-ICP-MS	23.8	15.5	42.3	73.9	46.9	
114	ICP-MS	30	19	48	74	56	
147	ICP-MS	22.8	14.2	39.0	65.1	47.9	Info
156	ICP-MS	21.9	11.5	39.6	55.4	49.1	
159	ICP-MS	28	16	46	76	52	
164	ICP-MS	21	12	36	60	42	
179	ICP-MS	27	17	43	73	53	
197	DRC/CC-ICP-MS	28	14	42	71	50	
206	ICP-MS	28.2	<10.0	44.8	71.5	50.6	
208	ICP-MS	25	16	42	66	48	
293	DRC/CC-ICP-MS	27.7	15.8	46.3	77.5	53.3	Info
305	DRC/CC-ICP-MS	22.4	13.1	39.2	68	49.7	
312	DRC/CC-ICP-MS	24	18	40	58	46	
324	DRC/CC-ICP-MS	21.7	11.3	38.7	66.3	43.4	Info
339	HR-ICP-MS	26.7	15.5	43.4	74.8	51.9	Info
359	ICP-MS	20.2	12.7	35.6	68.5	52.1	
391	ICP-MS	26.7	16.5	44.3	76.3	53.5	Info
395	DRC/CC-ICP-MS	23.4	12.8	39.5	67.2	46.4	

Percent satisfactory results for all participants: 100.0 %

notes: ↑ reported outside upper limit
↓ reported outside lower limit
◥: Unacceptable result

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, 2010 Event #2
STATISTICAL SUMMARY BY METHOD

	Results (μg/L whole blood)				
	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
DRC/CC-ICP-MS					
Number of Sample Measurements:	8	8	8	8	8
Mean:	24.3	14.3	41.1	68.7	47.9
Standard Deviation:	2.3	2.1	2.5	5.8	3.0
RSD (%):	9.5	14.6	6.0	8.4	6.3
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	26.7	15.5	43.4	74.8	51.9
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	10	9	10	10	10
Mean:	25.1	15.0	41.8	68.6	50.4
Standard Deviation:	3.4	2.5	4.2	7.0	3.9
RSD (%):	13.6	16.9	10.0	10.2	7.8
All Laboratories					
Number of Sample Measurements:	19	18	19	19	19
Mean:	24.8	14.7	41.6	68.9	49.4
Standard Deviation:	2.9	2.2	3.4	6.3	3.6
RSD (%):	11.6	15.1	8.1	9.1	7.3

notes: ? Insufficient data for calculation.

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 1.6 µg/L (14 nmol/L) to 15.7 µg/L (140 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, 95.3% of the results reported by all participants were satisfactory, with two out of 30 laboratories (6.7%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Cadmium Test Results, 2010 Event #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE10-06	**BE10-07**	**BE10-08**	**BE10-09**	**BE10-10**
Robust Mean	**15.7**	**1.6**	**10.9**	**5.8**	**2.8**
Robust Standard Deviation	1.2	0.1	0.8	0.4	0.2
Standard Uncertainty	0.3	0.0	0.2	0.1	0.1
RSD (%)	7.4	8.1	6.9	7.2	8.3
Acceptable Range:					
Upper Limit	18.1	2.6	12.5	6.8	3.8
Lower Limit	13.3	0.6	9.3	4.8	1.8

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, 2010 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood) BE10-06	BE10-07	BE10-08	BE10-09	BE10-10	Info Only
	Target Values:	15.7	1.6	10.9	5.8	2.8	
103	DRC/CC-ICP-MS	16.8	1.6	11.7	6.2	2.9	Info
106	ICP-MS	16.6	1.6	11.5	6.1	3.0	Info
107	ICP-MS	17.2	1.6	12.1	6.1	3.0	Info
109	ICP-MS	16.4	1.6	11.3	5.8	2.9	Info
110	ICP-MS	15.7	1.6	11.2	6.2	2.7	
114	ICP-MS	15.2	1.5	10.8	5.7	2.7	
116	ICP-MS	16.7	1.5	11.7	5.9	2.9	Info
147	ICP-MS	15.8	1.6	11.1	5.9	2.9	Info
156	ICP-MS	15.8	1.6	11.2	5.6	3.1	
159	ICP-MS	16.5	1.6	11.7	6.2	2.9	
164	ICP-MS	16.1	1.6	10.8	5.6	2.3	
179	ICP-MS	16.8	1.6	11.2	6.3	2.9	
197	DRC/CC-ICP-MS	17.7	1.6	11.6	6.2	2.9	
206	ICP-MS	15.3	1.5	10.9	6	2.6	
208	ICP-MS	14.1	1.5	10.6	5.4	2.7	
293	ICP-MS	14.7	1.4	7.7 ↓	5.2	2.5	Info
305	ICP-MS	15.9	1.7	10.9	6.4	3	
312	ICP-MS	15	2.2	11	6	3.3	
324	ICP-MS	12.4 ↓	1.5	9.0 ↓	5.4	2.3	Info
339	HR-ICP-MS	15.6	1.5	10.9	5.9	2.9	Info
359	ICP-MS	14.3	1.4	10.2	5.7	2.8	
366	ETAAS-Z	10.0 ↓	1.1	6.5 ↓	4.3 ↓	1.9	Info
367	ETAAS-Z	16.8	1.4	11.5	5.9	2.6	Info
383	ETAAS-Z	15.1	1.7	9.5	4.9	2.5	
385	ICP-MS	16.9	1.8	11.9	6.3	3.1	Info
391	ICP-MS	16.6	1.7	11.2	6.0	2.9	Info
395	ICP-MS	15.1	1.3	10.2	5.6	2.6	
401	ETAAS-Z	13.5	1.2	9.0 ↓	5.0	2.3	Info
408	ICP-MS	15.0	<1.2	10.2	5.1	2.4	Info
410	ICP-MS	16.0	1.5	11.0	5.6	2.7	Info

Percent satisfactory results for all participants: 95.3 %

notes: ↑ reported outside upper limit
↓ reported outside lower limit
◥: Unacceptable result

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, 2010 Event #2
STATISTICAL SUMMARY BY METHOD

	Results (µg/L whole blood)				
	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	17.3	1.6	11.7	6.2	2.9
Standard Deviation:	0.6	0.0	0.1	0.0	0.0
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	4	4	4	4	4
Mean:	13.9	1.4	9.1	5.0	2.3
Standard Deviation:	2.9	0.3	2.1	0.7	0.3
RSD (%):	20.9	19.6	22.5	13.1	13.3
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	15.6	1.5	10.9	5.9	2.9
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	23	22	23	23	23
Mean:	15.7	1.6	10.8	5.8	2.8
Standard Deviation:	1.1	0.2	1.0	0.4	0.3
RSD (%):	7.1	11.1	8.8	6.2	9.3
All Laboratories					
Number of Sample Measurements:	30	29	30	30	30
Mean:	15.5	1.6	10.7	5.8	2.7
Standard Deviation:	1.6	0.2	1.2	0.5	0.3
RSD (%):	10.0	12.5	11.7	8.4	10.9

notes: ? Insufficient data for calculation.

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 both inorganic (Hg^{2+}) and organometallic (as methylmercury, CH_3Hg^+) species.

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 1.2 µg/L (6 nmol/L) to 44.4 µg/L (221 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, 99.4% of results reported by all participants were satisfactory, with none of the 31 laboratories reporting 2 or more of the 5 results outside the acceptable ranges. Note: Some methods based on cold vapor generation (e.g., CV-AAS) may only detect inorganic Hg thus leading to a low bias compared to methods based on total Hg measurement (e.g., ICP-MS, and CV-AAS combined with on-line microwave digestion). See Barbosa et al. (2004) JAAS (1) for more details on total Hg in blood using CV-AAS.

(1) Barbosa F, Palmer CD, Krug FJ, Parsons PJ. Determination of total mercury in whole blood by flow injection cold vapor atomic absorption spectrometry with room temperature digestion using tetramethylammonium hydroxide. Journal of Analytical Atomic Spectrometry 2004;19(8):1000-1005.

New York State Department of Health
Blood Mercury Test Results, 2010 Event #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
Robust Mean	**6.1**	**1.2**	**10.5**	**24.7**	**44.4**
Robust Standard Deviation	0.5	0.3	0.9	2.1	3.3
Standard Uncertainty	0.1	0.1	0.2	0.5	0.7
RSD (%)	7.7	26.6	8.8	8.6	7.4
Acceptable Range:					
Upper Limit	9.1	4.2	13.7	32.1	57.7
Lower Limit	3.1	0.0	7.4	17.3	31.1

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, 2010 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood) BE10-06	BE10-07	BE10-08	BE10-09	BE10-10	Info Only
	Target Values:	6.1	1.2	10.5	24.7	44.4	
103	DRC/CC-ICP-MS	6.2	1.2	10.5	24.4	44.2	Info
106	ICP-MS	6.1	1.3	10.6	25.5	46.4	Info
107	ICP-MS	6.6	1.3	11.4	26.2	47.1	Info
109	ICP-MS	6.0	1.1	10.4	24.3	40.6	Info
110	ICP-MS	6.1	1.3	10.6	24.6	45.6	
114	ICP-MS	6.2	1.8	10.7	25.2	44.7	
116	ICP-MS	6.7	1.3	11.5	27.0	48.7	Info
147	ICP-MS	6.0	1.2	10.4	25.1	45.9	Info
156	ICP-MS	6	<3.0	9.9	23.8	42.8	
159	ICP-MS	7	<2.0	12	27	47	
164	ICP-MS	6	1	10	24	43	
179	ICP-MS	6	1	9	25	42	
197	DRC/CC-ICP-MS	7	<5.0	11	26	44	
200	ICP-MS	6.5	1.7	10.8	24.1	44.4	Info
206	ICP-MS	7	<3.0	10	21	41	
208	ICP-MS	5.3	1	9.5	21.7	40.8	
293	ICP-MS	5.1	0.9	8.9	21.0	38.0	Info
305	ICP-MS	10.7 ↑	2.8	12.2	28.2	50.3	
312	ICP-MS	6.3	1.1	11	23	46	
324	CV-AAS	5.8	1.1	10.1	23.2	41.8	Info
339	HR-ICP-MS	6.1	1.2	10.3	23.8	42.9	Info
359	ICP-MS	5.7	1.2	9.8	23	41.8	
366	ICP-MS	6.9	1.7	9.2	23.0	42.0	Info
367	CV-AAS	5.6	0.8	11.6	27.4	49.4	Info
385	ICP-MS	7.1	2.0	11.9	26.0	46.8	Info
391	CV-AAS	4.4	0.4	9.7	30.7	44.8	Info
395	ICP-MS	5.6	1	10.2	23.3	42.8	
401	CV-AAS	4.9	1.1	9.1	18.0	34.0	Info
408	ICP-MS	6.0	<2.7	10.2	23.1	42.6	Info
410	ICP-MS	6.0	0.7	11.3	27.0	49.4	Info
453	CV-AAS	6.0	<2	12.0	29.5	54.6	Info

Percent satisfactory results for all participants: 99.4 %

notes: ↑ reported outside upper limit
↓ reported outside lower limit
◥: Unacceptable result

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, 2010 Event #2
STATISTICAL SUMMARY BY METHOD

	Results (µg/L whole blood)				
	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
CV-AAS					
Number of Sample Measurements:	5	4	5	5	5
Mean:	5.3	0.9	10.5	25.8	44.9
Standard Deviation:	0.7	0.3	1.2	5.2	7.8
RSD (%):	12.5	39.0	11.9	20.2	17.3
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	1	2	2	2
Mean:	6.6	1.2	10.8	25.2	44.1
Standard Deviation:	0.6	?	0.4	1.1	0.1
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	6.1	1.2	10.3	23.8	42.9
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	23	18	23	23	23
Mean:	6.4	1.3	10.5	24.4	44.3
Standard Deviation:	1.1	0.3	0.9	1.9	3.1
RSD (%):	16.8	27.3	8.9	7.9	7.1
All Laboratories					
Number of Sample Measurements:	31	24	31	31	31
Mean:	6.2	1.2	10.5	24.7	44.4
Standard Deviation:	1.0	0.4	0.9	2.6	3.9
RSD (%):	16.7	29.9	8.8	10.5	8.9

notes: ? Insufficient data for calculation.

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 19 measurements performed by 17 reference laboratories using ICP-MS, ETAAS and ASV methods. Values range from 3 µg/dL to 53 µg/dL. Among the reference group, imprecision (SD) varied from 0.7 - 2.3 µg/dL, increasing with Pb concentration.

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, 96.2% of results reported by all participants were judged as satisfactory, with 5 out of 100 participant laboratories (5.0%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Lead Test Results, 2010 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood) BE10-06	BE10-07	BE10-08	BE10-09	BE10-10	Normalized Mean	Info Only
	Target values:	3	17	33	53	11		
103	ASV-LeadCare	3	17	33	53	9	1.00	Info
103	DRC/CC-ICP-MS	3	16	32	51	10	0.96	
104	ETAAS-Z	4	18	34	56	3 ↓	1.05	Info
106	ICP-MS	3	17	33	54	11	1.00	Info
107	ICP-MS	3	17	34	55	11	1.02	
107	ASV-LeadCare	<3	15	30	52	8	0.92	Info
108	ETAAS-Z	4	18	35	56	12	1.07	
109	ETAAS-Z	4	19	37	56	12	1.10	
109	ICP-MS	3	17	33	52	10	0.99	
109	ASV-LeadCare	3	16	33	56	9	1.00	Info
109	ASV-LeadCare	<3	16	31	51	9	0.95	Info
110	ETAAS-Z	3	18	33	56	11	1.03	
110	ASV-LeadCare	3	16	33	54	9	0.99	Info
110	ASV-LeadCare	<3	18	34	54	9	1.04	Info
110	ICP-MS	3	17	34	54	11	1.01	
112	ASV-3010	<2	13	29	49	9	0.86	
114	ETAAS-Z	4	19	36	56	12	1.09	
116	ICP-MS	2	17	34	54	10	1.02	Info
121	ETAAS-Z	3	17	33	53	11	1.00	Info
123	ETAAS-Z	4	17	33	52	11	1.00	
126	ETAAS-Z	3	17	33	56	11	1.01	
131	ETAAS-Z	<2	20	33	50	12	1.05	
132	ETAAS-Z	3	18	34	53	11	1.02	
143	ETAAS-Z	2	15	31	50	10	0.92	
144	ETAAS-Z	2	16	33	50	9	0.96	
146	ETAAS-Z	3	17	34	49	10	0.98	
147	ICP-MS	3	17	33	53	11	1.00	
150	ASV-LeadCare	3	15	27 ↓	45 ↓	9	0.85	
156	ICP-MS	2	16	32	50	11	0.96	
158	ETAAS-Z	3	18	34	54	12	1.05	

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.

New York State Department of Health
Blood Lead Test Results, 2010 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood) BE10-06	BE10-07	BE10-08	BE10-09	BE10-10	Normalized Mean	Info Only
	Target values:	3	17	33	53	11		
159	ICP-MS	3	18	34	52	11	1.02	
160	ETAAS-Z	5	23 ↑	39 ↑	53	13	1.18	
164	ICP-MS	3	16	32	50	11	0.96	
166	ASV-3010	3	16	35	55	11	1.01	
168	ETAAS-Z	4	17	36	54	11	1.03	
179	ICP-MS	3	18	34	55	11	1.03	
197	ICP-MS	4	17	34	54	11	1.01	
198	ETAAS-Z	3	17	33	52	11	1.00	
199	ETAAS-Z	3	17	32	50	11	0.98	
200	ETAAS-Z	4	19	35	54	11	1.05	
204	ASV-3010	2	12 ↓	31	50	8	0.86	
206	ICP-MS	3	17	35	55	11	1.02	
208	ETAAS-Z	3	17	25 ↓	45 ↓	12	0.92	
215	ETAAS-Z	5	17	32	49	11	0.97	
221	ETAAS-Z	4	17	31	49	11	0.97	
232	ASV-3010	2	15	36	55	9	1.00	
237	ETAAS-Z	3	16	32	50	10	0.95	
243	ASV-3010	1	14	34	53	9	0.95	
249	ASV-3010	2	15	34	53	10	0.97	
254	ETAAS-Z	3	18	33	58	10	1.05	
255	ETAAS-Z	3	18	34	54	11	1.03	
261	ETAAS-Z	3	16	32	49	10	0.95	
269	ETAAS-Z	3	17	33	52	11	1.00	
271	ASV-3010	5	14	33	56	14	1.04	
272	ETAAS-Z	3	17	35	54	11	1.02	
279	ETAAS-Z	3	15	32	54	9	0.96	
282	ASV-3010	1	14	32	48	8	0.90	
290	ICP-MS	3	16	32	50	10	0.95	
291	ASV-3010	4	16	33	54	10	0.99	
293	ICP-MS	3	16	26 ↓	49	10	0.88	Info

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.

New York State Department of Health
Blood Lead Test Results, 2010 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood) BE10-06	BE10-07	BE10-08	BE10-09	BE10-10	Normalized Mean	Info Only
	Target values:	3	17	33	53	11		
295	ASV-3010	1	14	33	52	9	0.93	
300	ASV-3010	<3	16	35	57	11	1.02	
301	ETAAS-Z	2	15	29	48	9	0.89	
305	ETAAS-Z	3	16	30	51	10	0.94	
312	ICP-MS	3	17	34	54	11	1.01	
317	ETAAS-Z	13 ↑	17	33	53	11	1.67	
324	ICP-MS	4	18	32	56	11	1.02	
325	ETAAS-Z	6	16	30	45 ↓	10	0.90	Info
333	ETAAS-Z	4	17	34	53	11	1.01	
339	HR-ICP-MS	3	16	31	49	10	0.94	Info
340	ETAAS-Z	4	18	34	51	11	1.01	
343	ASV-LeadCare	3	14	31	51	8	0.91	Info
348	ETAAS-Z	3	19	37	58	11	1.08	
349	ETAAS-Z	3	19	35	57	11	1.06	
350	ASV-3010	3	16	33	52	15	1.07	
352	ASV-3010	4	19	37	60 ↑	12	1.12	
353	ETAAS-Z	3	14	29	45 ↓	9	0.85	
359	ICP-MS	3	13	28 ↓	49	9	0.85	
365	ETAAS-Z	3	16	31	50	9	0.94	
366	ETAAS-Z	3	17	31	50	11	0.97	Info
367	ETAAS-Z	3	18	36	56	12	1.07	Info
368	ASV-3010	4	21	36	52	12	1.10	
369	ASV-3010	3	16	37	58	11	1.04	
374	ASV-3010	3	16	36	56	12	1.04	
376	ASV-LeadCare	2	13	31	49	8	0.88	
383	ETAAS-Z	3	16	31	48	10	0.93	
384	ASV-3010	<1	14	32	52	8	0.92	
385	ICP-MS	4	18	34	55	11	1.03	Info
388	ASV-LeadCare	2	18	40 ↑	59 ↑	9	1.13	
389	ETAAS-Z	3	17	33	53	11	1.00	

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.

New York State Department of Health
Blood Lead Test Results, 2010 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood) BE10-06	BE10-07	BE10-08	BE10-09	BE10-10	Normalized Mean	Info Only
	Target values:	3	17	33	53	11		
391	ETAAS-Z	3	17	34	52	11	1.00	Info
395	ICP-MS	2	16	31	51	10	0.95	
401	ETAAS-Z	4	19	35	56	12	1.08	Info
408	ICP-MS	3	16	31	49	10	0.94	Info
410	ICP-MS	3	17	35	55	11	1.02	Info
449	ASV-LeadCare	3	16	3 ↓	4 ↓	1 ↓	0.94	
453	ETAAS-Z	2	16	32	53	10	0.97	Info
455	ASV-LeadCare	<3	14	31	50	9	0.90	
456	ASV-LeadCare	<3	14	33	51	7	0.93	
461	ASV-3010	<1	13	30	49	9	0.87	

Percent satisfactory results for all participants: 96.2 %

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.

New York State Department of Health
Blood Lead Test Results, 2010 Event #2
STATISTICAL SUMMARY

Lab Code	Method	TARGET VALUE ASSIGNMENT AND STATISTICS Results (µg/dL whole blood) BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
103	DRC/CC-ICP-MS	3	16	32	51	10
107	ICP-MS	3	17	34	55	11
109	ETAAS-Z	4	19	37	56	12
109	ICP-MS	3	17	33	52	10
110	ETAAS-Z	3	18	33	56	11
110	ICP-MS	3	17	34	54	11
112	ASV-3010	<2	13	29	49	9
147	ICP-MS	3	17	33	53	11
156	ICP-MS	2	16	32	50	11
159	ICP-MS	3	18	34	52	11
164	ICP-MS	3	16	32	50	11
166	ASV-3010	3	16	35	55	11
179	ICP-MS	3	18	34	55	11
198	ETAAS-Z	3	17	33	52	11
199	ETAAS-Z	3	17	32	50	11
200	ETAAS-Z	4	19	35	54	11
243	ASV-3010	1	14	34	53	9
324	ICP-MS	4	18	32	56	11
350	ASV-3010	3	16	33	52	15
	Number of Sample Measurements:	18	19	19	19	19
	Mean (target value):	**3**	**17**	**33**	**53**	**11**
	Standard Deviation:	0.7	1.5	1.7	2.3	1.2
	RSD (%):	22.9	9.0	5.0	4.3	11.2
	Acceptable Range:					
	Upper Limit:	7	21	37	58	15
	Lower Limit:	0	13	29	48	7

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, 2010 Event #2
STATISTICAL SUMMARY BY METHOD

	Results (µg/dL whole blood)				
	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
ASV-3010					
Number of Sample Measurements:	14	18	18	18	18
Mean:	2.7	15.2	33.7	53.4	10.4
Standard Deviation:	1.3	2.2	2.3	3.3	2.0
RSD (%):	46.7	14.2	6.9	6.2	19.6
ASV-LeadCare					
Number of Sample Measurements:	8	13	12	12	12
Mean:	2.8	15.5	32.3	52.1	8.6
Standard Deviation:	0.5	1.6	3.1	3.6	0.7
RSD (%):	16.8	10.0	9.5	6.8	7.8
DRC/CC-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	3.0	16.0	32.0	51.0	10.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	43	46	46	46	46
Mean:	3.3	17.3	33.1	52.2	10.6
Standard Deviation:	0.7	1.5	2.4	3.3	1.5
RSD (%):	21.3	8.8	7.3	6.4	13.9
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	3.0	16.0	31.0	49.0	10.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	21	21	21	21	21
Mean:	3.0	16.7	32.6	52.7	10.6
Standard Deviation:	0.5	1.1	2.2	2.4	0.6
RSD (%):	18.3	6.6	6.8	4.5	5.6
All Laboratories					
Number of Sample Measurements:	88	100	99	99	99
Mean:	3.1	16.5	32.9	52.5	10.3
Standard Deviation:	0.8	1.8	2.4	3.1	1.5
RSD (%):	25.5	10.6	7.4	6.0	14.6

notes: ? Insufficient data for calculation.

New York State Department of Health
Blood Lead Test Results, 2010 Event #2
STATISTICAL SUMMARY BY CLASS

	Results (µg/dL whole blood)				
	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
Evaluated					
Number of Sample Measurements:	52	59	58	58	58
Mean:	3.1	16.4	33.1	52.3	10.3
Standard Deviation:	0.9	2.0	2.7	3.5	1.4
RSD (%):	28.7	12.3	8.2	6.7	13.3
Info					
Number of Sample Measurements:	18	22	22	22	22
Mean:	3.1	16.7	32.5	52.6	9.7
Standard Deviation:	0.5	1.1	2.2	2.9	1.9
RSD (%):	17.6	6.8	6.8	5.5	19.3
Reference					
Number of Sample Measurements:	18	19	19	19	19
Mean:	3.0	16.8	33.2	52.9	10.9
Standard Deviation:	0.7	1.5	1.7	2.3	1.2
RSD (%):	22.9	9.0	5.0	4.3	11.2
All Laboratories					
Number of Sample Measurements:	88	100	99	99	99
Mean:	3.1	16.5	32.9	52.5	10.3
Standard Deviation:	0.8	1.8	2.4	3.1	1.5
RSD (%):	25.5	10.6	7.4	6.0	14.6

notes: ? Insufficient data for calculation.

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 additional trace elements as indicated below.

Additional Elements

Mn, Sn, Tl

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Blood Barium Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
110	ICP-MS	11.4	10.2	14.0	12.1	13.8
197	ICP-MS	10	8.9	12.4	9.4	11.7
312	ICP-MS	13.1	10.9	15.2	12.2	13.8
	Arithmetic Mean, n=3	**11.5**	**10.0**	**13.9**	**11.2**	**13.1**
	SD	1.6	1.0	1.4	1.6	1.2

Blood Beryllium Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
110	ICP-MS	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
197	ICP-MS	NA	NA	NA	NA	NA

Blood Cobalt Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
110	ICP-MS	3.0	2.3	6.7	3.7	4.4
147	ICP-MS	3.1	2.5	7.1	3.4	4.3
159	ICP-MS	2.6	2	6.1	2.9	3.8
197	ICP-MS	3.2	2.1	6.5	3.3	4.2
312	ICP-MS	3.1	2.2	7	3.5	4.2
391	ICP-MS	2.9	2.2	6.5	3.0	4.1
	Arithmetic Mean, n=6	**3.0**	**2.2**	**6.7**	**3.3**	**4.2**
	SD	0.21	0.17	0.37	0.30	0.21

Blood Chromium Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
197	DRC/CC-ICP-MS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
312	DRC/CC-ICP-MS	0.5	0.5	0.5	0.6	1.9

Blood Cesium Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
110	ICP-MS	0.62	0.61	0.57	0.52	0.42

Blood Copper Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
110	ICP-MS	1283	1608	1177	1154	1044
147	ICP-MS	1226	1633	1144	1137	997
197	ICP-MS	*1.2	*1.5	*1.1	*1.1	*1
312	ICP-MS	1210	1550	1110	1130	980
	Arithmetic Mean, n=3 (*outlier omitted)	**1240**	**1597**	**1144**	**1140**	**1007**
	SD	38	43	34	12	33

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Blood Manganese Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
107	DRC/CC-ICP-MS	19.7	13.5	27.4	28.8	29.0
110	ETAAS-Z	17.3	12.1	23.9	25.5	25.7
147	ICP-MS	20.3	13.2	27.4	28.3	29.1
159	ICP-MS	21	15	27	29	27
179	ETAAS-Z	19	12.8	26.4	27.4	27.6
293	ICP-MS	14.6	10.8	22.9	21.5	23.9
305	ICP-MS	18.4	13.6	23.7	27.9	27.8
312	DRC/CC-ICP-MS	22	14	29	30	31
391	ICP-MS	16.0	13.0	21.0	22.0	23.8
	Arithmetic Mean, n=9	**18.7**	**13.1**	**25.4**	**26.7**	**27.2**
	SD	2.4	1.2	2.6	3.1	2.4

Blood Molybdenum Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
147	ICP-MS	8.992	5.211	10.077	11.42	7.179

Blood Platinum Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
110	ICP-MS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Blood Antimony Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
110	ICP-MS	3.4	1.5	1.1	4.5	2.5

Blood Selenium Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
109	ICP-MS	294	349	375	303	350
147	ICP-MS	303	357	400	322	382
197	ICP-MS	273	303	345	295	321
305	ICP-MS	338	406	424	342	392
312	ICP-MS	325	387	401	326	372
	Arithmetic Mean, n=5	**307**	**360**	**389**	**318**	**363**
	SD	25.6	39.4	30.1	18.8	28.4

Blood Tin Results (µg/L)

Lab Code	Method	BE10-06	BE10-07	BE10-08	BE10-09	BE10-10
110	ICP-MS	2.2	6.1	3.7	14.0	3.5
197	ICP-MS	< 5.0	5.6	< 5.0	12.5	< 5.0

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Blood Thallium Results (µg/L)						
Lab Code	**Method**	**BE10-06**	**BE10-07**	**BE10-08**	**BE10-09**	**BE10-10**
110	ICP-MS	4.0	1.5	2.7	6.5	0.9
159	ICP-MS	3.9	1.5	2.8	6.4	< 1.0
197	ICP-MS	3.5	1.4	2.5	5.6	< 1.0
312	ICP-MS	3.8	1.4	2.6	6.3	0.9
	Arithmetic Mean, n=4	**3.8**	**1.5**	**2.7**	**6.2**	**0.9**
	SD	0.2	0.1	0.1	0.4	0.0

Blood Uranium Results (µg/L)						
Lab Code	**Method**	**BE10-06**	**BE10-07**	**BE10-08**	**BE10-09**	**BE10-10**
110	ICP-MS	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
312	ICP-MS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

Blood Zinc Results (µg/L)						
Lab Code	**Method**	**BE10-06**	**BE10-07**	**BE10-08**	**BE10-09**	**BE10-10**
110	ICP-MS	2069	1878	2418	3371	2303
114	ICP-MS	*266	*146	*241	*483	*223
147	ICP-MS	2124	1902	2536	3451	2379
312	ICP-MS	2110	1960	2490	3540	2290
	Arithmetic Mean, n=3 (*outlier omitted)	**2101**	**1913**	**2481**	**3454**	**2324**
	SD	29	42	59	85	48

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)

A-7 Other

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)

P-7 Other

ELECTROCHEMICAL METHODS

E-1 ASV (Anodic stripping voltammetry without digestion)

E-2 ASV-LeadCare® (Anodic stripping voltammetry using the ESA LeadCare® system)

E-3 Fluoride specific electrode

E-4 Other

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)

F-4 Other

OTHER METHODS

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