Wadsworth Center

New York State Department of Health

TRACE ELEMENTS IN WHOLE BLOOD

Event #3, 2011

November 25, 2011

NEW YORK
state department of
HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

November 25, 2011

Trace Elements in Whole Blood
Event #3, 2011

Dear Laboratory Director:

Results from the third proficiency test (PT) event in 2011 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 November 3rd, 2011, and are reproduced here for completeness.

PT Materials

Test materials for the first 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 arsenic species [inorganic As^{3+} and As^{5+}, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), 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 (Mn), thallium (Tl), tin (Sn) and cobalt (Co).

The next PT event for trace elements in whole blood is scheduled to be mailed Wednesday, January 25th, 2012. 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, February 15th, 2012.**

Thank you for your participation in this event.

Yours sincerely,

Patrick J. Parsons, Ph.D.
Chief
Laboratory of Inorganic and Nuclear Chemistry

Mary Frances Verostek, Ph.D.
Assistant Section Head
PT Program for Blood Lead /EP/Trace Elements

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+} and As^{5+}, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), and arsenobetaine.

Sample	Arsenic species added
BE11-11	As^{3+}
BE11-12	As^{3+} and MMA
BE11-13	As^{3+}, As^{5+}, MMA, and DMA
BE11-14	As^{3+} and MMA
BE11-15	As^{3+}, As^{5+}, 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 10.3 µg/L (0.14 µmol/L) to 56.6 µg/L (0.76 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, 97.9% of test results reported were judged as satisfactory, with none of the 19 laboratories reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Arsenic Test Results, 2011 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE11-11	**BE11-12**	**BE11-13**	**BE11-14**	**BE11-15**
Robust Mean	**10.3**	**19.7**	**45.5**	**20.1**	**56.6**
Robust Standard Deviation	2.4	1.9	4.6	2.7	5.8
Standard Uncertainty	0.7	0.5	1.3	0.8	1.7
RSD (%)	23.3	9.7	10.1	13.6	10.3
Acceptable Range:					
Upper Limit	16.3	25.7	54.6	26.1	67.9
Lower Limit	4.3	13.7	36.4	14.1	45.3

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, 2011 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE11-11	BE11-12	BE11-13	BE11-14	BE11-15	
	Target Values:	10.3	19.7	45.5	20.1	56.6	
103	DRC/CC-ICP-MS	8.3	18.1	43.5	18.8	54.4	Info
110	DRC/CC-ICP-MS	8.5	18.7	47.1	18.1	55.9	
114	ICP-MS	11.0	19.0	40.0	19.0	49.0	
147	ICP-MS	8.2	17.7	41.9	18.1	53.7	Info
156	ICP-MS	5.3	16.5	40.0	14.1	49.2	
159	ICP-MS	13.0	25.0	53.0	25.0	67.0	
164	ICP-MS	13.0	21.0	58.0 ↑	21.0	60.0	
179	ICP-MS	<12.0	19.0	43.0	16.0	51.0	
197	DRC/CC-ICP-MS	<10.0	18.0	44.0	18.0	55.0	
200	ICP-MS	11.3	21.0	47.5	21.5	64.5	Info
206	ICP-MS	13.1	19.6	45.7	20.9	54.8	
208	ICP-MS	11.7	21.9	47.4	24.0	62.0	
293	DRC/CC-ICP-MS	9.7	20.4	47.6	20.5	58.6	Info
305	DRC/CC-ICP-MS	8.0	18.0	44.0	19.0	56.0	
312	DRC/CC-ICP-MS	15.5	20.9	41.0	22.3	51.8	
324	HR-ICP-MS	9.4	19.9	45.9	20.6	58.4	Info
339	HR-ICP-MS	9.0	20.6	50.3	20.7	59.8	Info
359	ICP-MS	9.2	18.7	39.3	18.1	51.5	
391	DRC/CC-ICP-MS	12.2	24.4	55.3 ↑	24.7	66.8	Info

Percent satisfactory results for all participants: 97.9 %

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, 2011 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (μg/L whole blood)				
	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	6	7	7	7	7
Mean:	10.4	19.8	46.1	20.2	56.9
Standard Deviation:	3.0	2.4	4.6	2.5	4.8
RSD (%):	28.5	11.9	10.1	12.4	8.4
HR-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	9.2	20.3	48.1	20.7	59.1
Standard Deviation:	0.3	0.5	3.1	0.1	1.0
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	9	10	10	10	10
Mean:	10.6	19.9	45.6	19.8	56.3
Standard Deviation:	2.6	2.4	6.1	3.4	6.6
RSD (%):	24.7	12.1	13.4	17.2	11.7
All Laboratories					
Number of Sample Measurements:	17	19	19	19	19
Mean:	10.4	19.9	46.0	20.0	56.8
Standard Deviation:	2.5	2.2	5.2	2.8	5.5
RSD (%):	24.4	11.0	11.3	14.1	9.7

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 1.7 µg/L (15 nmol/L) to 13.1 µg/L (117 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, 93.1% of the results reported by all participants were satisfactory, with three of the 29 laboratories (10.3%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Cadmium Test Results, 2011 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE11-11	**BE11-12**	**BE11-13**	**BE11-14**	**BE11-15**
Robust Mean	**7.0**	**2.4**	**6.8**	**1.7**	**13.1**
Robust Standard Deviation	0.5	0.2	0.6	0.2	1.2
Standard Uncertainty	0.1	<0.1	0.1	<0.1	0.3
RSD (%)	7.2	7.8	8.5	10.6	9.1
Acceptable Range:					
Upper Limit	8.1	3.4	7.8	2.7	15.1
Lower Limit	6.0	1.4	5.8	0.7	11.1

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, 2011 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE11-11	BE11-12	BE11-13	BE11-14	BE11-15	
	Target Values:	7.0	2.4	6.8	1.7	13.1	
103	DRC/CC-ICP-MS	7.5	2.5	7.2	1.7	14.0	Info
107	DRC/CC-ICP-MS	7.1	2.4	6.9	1.5	13.4	Info
109	ICP-MS	7.3	2.5	7.3	1.8	13.7	Info
110	ICP-MS	7.5	2.9	7.2	1.8	14.3	
114	ICP-MS	6.7	2.3	6.2	1.6	12.2	
116	ICP-MS	7.0	2.3	6.7	1.5	13.2	Info
147	ICP-MS	7.0	2.4	6.7	1.6	12.7	Info
156	ICP-MS	6.9	2.2	6.5	1.8	13.1	
159	ICP-MS	7.6	2.7	6.9	1.8	13.4	
164	ICP-MS	6.2	2.3	7.4	1.5	12.2	
179	ICP-MS	7.2	2.6	6.7	1.7	13.1	
197	DRC/CC-ICP-MS	6.3	2.0	6.1	1.4	12.1	
200	ICP-MS	6.7	2.7	8.1 ↑	1.8	15.1	Info
206	ICP-MS	7.8	2.7	7.2	2.0	14.5	
208	ICP-MS	7.4	2.3	7.0	1.6	14.1	
293	ICP-MS	7.2	2.4	6.6	1.6	13.6	Info
305	ICP-MS	6.9	2.3	6.5	1.8	12.4	
312	ICP-MS	7.0	2.7	6.8	1.9	12.8	
324	ICP-MS	6.3	2.3	5.9	1.6	11.8	Info
339	HR-ICP-MS	6.9	2.5	6.7	1.7	13.1	Info
359	ICP-MS	7.3	2.5	7.0	1.7	12.6	
366	ETAAS-Z	5.6 ↓	2.1	5.2 ↓	1.4	11.0 ↓	Info
367	DRC/CC-ICP-MS	6.9	2.4	6.8	1.6	53.3 ↑	Info
383	ETAAS-Z	8.3 ↑	2.8	8.1 ↑	2.0	14.1	
385	ICP-MS	7.5	2.8	7.2	1.9	13.6	Info
391	DRC/CC-ICP-MS	5.0 ↓	1.6	4.7 ↓	1.2	8.6 ↓	Info
401	ETAAS other	6.5	2.1	6.3	1.4	11.2	Info
408	ICP-MS	6.9	2.3	6.3	1.5	12.4	Info
410	ICP-MS	8.0	2.9	7.5	2.0	14.5	Info

Percent satisfactory results for all participants: 93.1 %

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, 2011 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (μg/L whole blood)				
	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	5	5	5	5	4
Mean:	6.6	2.2	6.3	1.5	12.0
Standard Deviation:	1.0	0.4	1.0	0.2	2.4
RSD (%):	14.8	17.3	15.8	13.0	20.1
ETAAS other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	6.5	2.1	6.3	1.4	11.2
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	7.0	2.5	6.7	1.7	12.6
Standard Deviation:	1.9	0.5	2.1	0.4	2.2
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	6.9	2.5	6.7	1.7	13.1
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	20	20	20	20	20
Mean:	7.1	2.5	6.9	1.7	13.3
Standard Deviation:	0.5	0.2	0.5	0.2	0.9
RSD (%):	6.4	9.0	7.4	9.2	6.8
All Laboratories					
Number of Sample Measurements:	29	29	29	29	28
Mean:	7.0	2.4	6.7	1.7	13.0
Standard Deviation:	0.7	0.3	0.7	0.2	1.3
RSD (%):	9.7	11.8	10.7	12.0	10.2

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 0.8 µg/L (4 nmol/L) to 18.6 µg/L (93 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 29 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, 2011 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L whole blood)				
	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
Robust Mean	**0.8**	**1.6**	**8.8**	**2.7**	**18.6**
Robust Standard Deviation	0.1	0.1	0.9	0.4	1.7
Standard Uncertainty	<0.1	<0.1	0.2	0.1	0.4
RSD (%)	19.0	9.6	10.7	14.8	9.2
Acceptable Range:					
Upper Limit	3.0	4.6	11.8	5.7	24.2
Lower Limit	0.0	0.0	5.8	0.0	13.0

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, 2011 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE11-11	BE11-12	BE11-13	BE11-14	BE11-15	
	Target Values:	0.8	1.6	8.8	2.7	18.6	
103	DRC/CC-ICP-MS	0.6	1.5	8.3	2.5	18.0	Info
107	DRC/CC-ICP-MS	0.8	1.6	8.6	2.6	18.4	Info
109	ICP-MS	0.7	1.5	8.6	2.8	18.3	Info
110	ICP-MS	0.8	1.5	7.7	2.9	17.8	
114	ICP-MS	<1.0	1.5	8.9	2.2	19.0	
116	ICP-MS	0.4	1.3	8.7	2.3	18.8	Info
147	ICP-MS	0.7	1.4	8.5	2.4	18.0	Info
156	ICP-MS	<3.0	<3.0	9.2	<3.0	18.6	
159	ICP-MS	<2.0	<2.0	9.0	3.0	19.0	
164	ICP-MS	0.7	1.6	11.0	2.8	20.0	
179	ICP-MS	<1.0	1.0	9.0	2.0	17.0	
197	DRC/CC-ICP-MS	<5.0	<5.0	8.0	<5.0	18.0	
200	ICP-MS	1.1	2.0	11.5	5.2	25.2 ↑	Info
206	ICP-MS	<3.0	4.0	8.0	3.0	16.0	
208	ICP-MS	<5.0	<5.0	9.8	<5.0	22.5	
293	ICP-MS	1.2	2.1	9.6	3.1	20.9	Info
305	ICP-MS	2.0	<2.0	8.0	<2.0	17.0	
312	ICP-MS	0.7	1.5	8.2	2.3	17.5	
324	AFS	1.2	2.2	6.5	3.2	19.7	Info
339	HR-ICP-MS	0.6	1.6	8.7	2.4	18.6	Info
359	ICP-MS	0.7	1.4	7.3	2.3	14.6	
366	ICP-MS	0.8	1.5	7.9	2.5	16.6	Info
367	CV-AAS	0.7	1.4	9.1	3.1	20.0	Info
385	ICP-MS	<2.0	2.3	9.6	3.1	19.7	Info
391	CV-AAS	0.6	1.7	15.1 ↑	2.5	19.6	Info
401	CV-AAS	0.7	1.5	8.4	2.5	15.9	Info
408	ICP-MS	0.9	1.7	8.2	2.6	17.4	Info
410	ICP-MS	1.2	2.1	9.5	3.0	19.4	Info
453	CV-AAS	<2	<2	9.8	2.4	21.6	Info

Percent satisfactory results for all participants: 98.6 %

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, 2011 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (μg/L whole blood)				
	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
AFS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	1.2	2.2	6.5	3.2	19.7
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
CV-AAS					
Number of Sample Measurements:	3	3	4	4	4
Mean:	0.7	1.5	10.6	2.6	19.3
Standard Deviation:	0.1	0.2	3.1	0.3	2.4
RSD (%):	—	—	28.8	12.2	12.5
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	3	2	3
Mean:	0.7	1.6	8.3	2.6	18.1
Standard Deviation:	0.1	0.1	0.3	0.1	0.2
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	0.6	1.6	8.7	2.4	18.6
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	12	15	20	16	20
Mean:	0.8	1.6	8.9	2.6	18.7
Standard Deviation:	0.2	0.4	1.1	0.4	2.3
RSD (%):	28.8	21.6	11.9	13.7	12.5
All Laboratories					
Number of Sample Measurements:	19	22	29	24	29
Mean:	0.8	1.6	9.0	2.6	18.7
Standard Deviation:	0.2	0.3	1.6	0.3	2.1
RSD (%):	28.6	19.6	17.3	12.9	11.3

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 22 measurements performed by 20 reference laboratories using ICP-MS, ETAAS and ASV methods. Values range from 3 µg/dL to 41 µg/dL. Among the reference group, imprecision (SD) varied from 0.6 - 1.5 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, 96.7% of results reported by all participants were judged as satisfactory, with 4 out of 96 participant laboratories (4.2%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Lead Test Results, 2011 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-11	BE11-12	BE11-13	BE11-14	BE11-15		
	Target values:	30	25	16	41	3		
103	DRC/CC-ICP-MS	31	27	17	42	3	1.05	
103	ASV-LeadCare	34	34 ↑	18	43	4	1.17	Info
104	ETAAS-Z	30	26	16	42	3	1.02	
107	DRC/CC-ICP-MS	31	26	17	42	3	1.04	
107	ASV-LeadCare	29	25	15	40	<3	0.97	Info
107	ASV-LeadCare	29	24	15	39	3	0.95	Info
109	ETAAS-Z	30	25	16	41	4	1.00	
109	ICP-MS	31	26	17	41	4	1.03	
109	ASV-LeadCare	31	25	13	41	3	0.96	Info
109	ASV-LeadCare	30	25	16	42	<3	1.01	Info
110	ETAAS-Z	32	26	17	44	3	1.06	
110	ICP-MS	31	26	16	42	3	1.02	
110	ASV-LeadCare	32	27	16	44	3	1.05	Info
110	ASV-LeadCare	30	26	14	41	<3	0.98	Info
112	ETAAS-Z	31	25	16	40	3	1.00	
114	ETAAS-Z	31	26	16	41	3	1.02	
116	ICP-MS	32	27	17	43	3	1.06	Info
121	ETAAS-Z	33	36 ↑	17	43	3	1.16	Info
123	ETAAS-Z	29	23	15	38	3	0.94	
126	ETAAS-Z	30	26	16	40	3	1.00	
131	ETAAS-Z	32	27	16	42	4	1.04	
143	ETAAS-Z	29	24	15	39	2	0.95	
144	ETAAS-Z	27	25	15	38	2	0.94	
146	ETAAS-Z	29	24	15	39	3	0.95	
147	ICP-MS	29	24	15	40	3	0.96	
150	ASV-LeadCare	29	23	15	35 ↓	3	0.92	
156	ICP-MS	29	23	15	41	2	0.96	
158	ICP-MS	32	26	17	42	4	1.05	
159	ICP-MS	32	27	17	43	3	1.06	
160	ETAAS-Z	30	27	17	39	4	1.02	

notes: ↑ reported value outside upper limit

↓ reported value outside lower limit

◤: Unacceptable result

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, 2011 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood) BE11-11	BE11-12	BE11-13	BE11-14	BE11-15	Normalized Mean	Info Only
	Target values:	30	25	16	41	3		
164	ICP-MS	30	25	16	40	3	0.99	
166	ASV-3010	32	25	17	42	2	1.04	
168	ETAAS-Z	32	28	17	43	3	1.07	
179	ICP-MS	30	25	16	42	3	1.01	
197	ICP-MS	27	22	14	37	3	0.89	
198	ETAAS-Z	30	25	16	42	3	1.01	
199	ETAAS-Z	29	26	16	40	3	1.00	
200	ETAAS-Z	30	26	18	41	2	1.04	
204	ASV-3010	30	25	17	40	4	1.01	
206	ICP-MS	32	27	18	44	3	1.09	
208	ETAAS-Z	25 ↓	23	15	33 ↓	5	0.87	
221	ETAAS-Z	34	27	18	44	3	1.10	
232	ASV-3010	30	26	15	42	4	1.00	
237	ETAAS-Z	32	27	17	42	2	1.06	
243	ASV-3010	31	25	16	41	4	1.01	
249	ASV-3010	29	25	17	42	4	1.01	
254	ETAAS-Z	32	26	16	42	3	1.03	
255	ETAAS-Z	29	25	15	39	3	0.96	
261	ETAAS-Z	29	26	16	39	4	0.99	
269	ETAAS-Z	31	24	15	38	3	0.96	
271	ASV-3010	30	25	16	41	2	1.00	
272	ETAAS-Z	31	26	16	41	3	1.02	
279	ETAAS-Z	31	26	17	41	3	1.03	
282	ASV-3010	31	26	17	41	5	1.03	
290	ICP-MS	36 ↑	30 ↑	19	51 ↑	4	1.21	
291	ASV-3010	31	27	18	44	4	1.08	
293	ICP-MS	31	26	16	42	3	1.02	
295	ASV-3010	29	25	15	41	2	0.98	
301	ETAAS Other	30	23	14	39	1	0.94	
305	ETAAS-Z	30	26	16	41	3	1.01	

notes: ↑ reported value outside upper limit

↓ reported value outside lower limit

◤: Unacceptable result

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, 2011 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-11	BE11-12	BE11-13	BE11-14	BE11-15		
	Target values:	30	25	16	41	3		
312	ICP-MS	32	27	17	44	3	1.07	
317	ETAAS-Z	29	24	17	39	3	0.99	
324	ICP-MS	32	26	16	43	3	1.04	
325	ETAAS-Z	26	21	15	37	3	0.89	
333	ETAAS-Z	31	26	17	42	4	1.04	
337	ASV-LeadCare	31	26	15	43	4	1.01	
339	HR-ICP-MS	29	24	16	40	3	0.98	Info
340	ETAAS-Z	30	26	17	40	4	1.02	
343	ASV-LeadCare	28	25	16	41	3	0.98	Info
348	ETAAS-Z	30	25	16	39	3	0.99	
349	ETAAS-Z	30	25	16	40	3	0.99	
350	ASV-3010	37 ↑	32 ↑	20	51 ↑	8 ↑	1.25	
352	ASV-3010	32	28	18	40	5	1.07	
353	ETAAS-Z	30	28	15	39	<2	1.00	
365	ETAAS-Z	28	23	15	37	3	0.92	
366	ETAAS-Z	33	27	16	47 ↑	3	1.08	Info
367	DRC/CC-ICP-MS	32	27	18	45	4	1.09	Info
368	ASV-3010	30	25	16	39	4	0.99	
369	ASV-3010	31	27	16	44	4	1.05	
374	ASV-3010	32	25	15	42	3	1.01	
383	ETAAS-Z	31	27	16	43	3	1.04	
384	ASV-3010	33	24	16	41	2	1.02	
385	ICP-MS	31	26	17	42	3	1.04	Info
388	ASV-3010	30	26	17	45	4	1.05	
389	ETAAS-Z	31	26	16	43	2	1.03	
391	ETAAS-Z	32	28	18	45	4	1.10	Info
393	ASV-LeadCare	26	22	14	32 ↓	<3	0.85	
401	ETAAS Other	29	25	15	40	3	0.97	Info
408	ICP-MS	28	24	15	38	3	0.94	Info
410	ICP-MS	31	27	17	43	3	1.06	Info

notes: ↑ reported value outside upper limit

↓ reported value outside lower limit

◤: Unacceptable result

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, 2011 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood) BE11-11	BE11-12	BE11-13	BE11-14	BE11-15	Normalized Mean	Info Only
	Target values:	30	25	16	41	3		
453	ETAAS-Z	33	24	16	44	2	1.03	Info
455	ASV-LeadCare	35 ↑	28	19	46 ↑	<3	1.15	
461	ASV-3010	30	26	17	43	4	1.04	
463	ASV-LeadCare	27	23	14	38	4	0.91	
464	ASV-LeadCare	33	29	19	44	3	1.13	
470	ASV-LeadCare	28	22	14	38	<3	0.90	

Percent satisfactory results for all participants: 96.7 %

notes: ↑ reported value outside upper limit
↓ reported value outside lower limit
◤: Unacceptable result

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, 2011 Event #3
STATISTICAL SUMMARY

Lab Code	Method	TARGET VALUE ASSIGNMENT AND STATISTICS Results (µg/dL whole blood) BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
103	DRC/CC-ICP-MS	31	27	17	42	3
104	ETAAS-Z	30	26	16	42	3
107	DRC/CC-ICP-MS	31	26	17	42	3
109	ETAAS-Z	30	25	16	41	4
109	ICP-MS	31	26	17	41	4
110	ETAAS-Z	32	26	17	44	3
110	ICP-MS	31	26	16	42	3
112	ETAAS-Z	31	25	16	40	3
147	ICP-MS	29	24	15	40	3
156	ICP-MS	29	23	15	41	2
159	ICP-MS	32	27	17	43	3
160	ETAAS-Z	30	27	17	39	4
164	ICP-MS	30	25	16	40	3
166	ASV-3010	32	25	17	42	2
179	ICP-MS	30	25	16	42	3
198	ETAAS-Z	30	25	16	42	3
199	ETAAS-Z	29	26	16	40	3
200	ETAAS-Z	30	26	18	41	2
243	ASV-3010	31	25	16	41	4
293	ICP-MS	31	26	16	42	3
324	ICP-MS	32	26	16	43	3
325	ETAAS-Z	26	21	15	37	3
Number of Sample Measurements:		22	22	22	22	22
Mean (target value):		**30**	**25**	**16**	**41**	**3**
Standard Deviation:		1.4	1.4	0.8	1.5	0.6
RSD (%):		4.5	5.4	4.7	3.7	18.9
Acceptable Range:						
Upper Limit:		34	29	20	45	7
Lower Limit:		26	21	12	37	0

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, 2011 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/dL whole blood)				
	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
ASV-3010					
Number of Sample Measurements:	17	17	17	17	16
Mean:	31.1	26.0	16.6	42.3	3.6
Standard Deviation:	1.9	1.8	1.3	2.7	1.0
RSD (%):	6.1	7.1	7.6	6.5	28.9
ASV-LeadCare					
Number of Sample Measurements:	15	15	15	15	9
Mean:	30.1	25.6	15.5	40.5	3.3
Standard Deviation:	2.6	3.1	1.8	3.7	0.5
RSD (%):	8.5	12.1	11.9	9.0	15.0
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	31.3	26.7	17.3	43.0	3.3
Standard Deviation:	0.6	0.6	0.6	1.7	0.6
RSD (%):	—	—	—	—	—
ETAAS Other					
Number of Sample Measurements:	2	2	2	2	2
Mean:	29.5	24.0	14.5	39.5	2.0
Standard Deviation:	0.7	1.4	0.7	0.7	1.4
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	40	40	40	40	39
Mean:	30.3	25.8	16.1	40.7	3.1
Standard Deviation:	1.8	2.2	0.9	2.6	0.7
RSD (%):	6.1	8.7	5.5	6.3	21.6
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	29.0	24.0	16.0	40.0	3.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	18	18	18	18	18
Mean:	30.9	25.8	16.4	42.1	3.1
Standard Deviation:	2.0	1.8	1.2	2.9	0.5
RSD (%):	6.4	7.0	7.3	6.9	15.2
All Laboratories					
Number of Sample Measurements:	96	96	96	96	88
Mean:	30.5	25.8	16.2	41.2	3.2
Standard Deviation:	2.0	2.2	1.3	2.9	0.7
RSD (%):	6.4	8.5	7.8	7.0	23.1

notes: ? Insufficient data for calculation.

New York State Department of Health
Blood Lead Test Results, 2011 Event #3
STATISTICAL SUMMARY BY CLASS

	Results (µg/dL whole blood)				
	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
Evaluated					
Number of Sample Measurements:	55	55	55	55	51
Mean:	30.5	25.6	16.2	40.9	3.4
Standard Deviation:	2.2	2.0	1.4	3.4	1.1
RSD (%):	7.3	7.7	8.6	8.3	32.0
Info					
Number of Sample Measurements:	19	19	19	19	16
Mean:	30.8	26.6	16.1	42.2	3.1
Standard Deviation:	1.8	3.2	1.4	2.3	0.5
RSD (%):	5.9	12.1	8.4	5.4	16.0
Reference					
Number of Sample Measurements:	22	22	22	22	22
Mean:	30.4	25.4	16.3	41.2	3.0
Standard Deviation:	1.4	1.4	0.8	1.5	0.6
RSD (%):	4.5	5.4	4.7	3.7	18.9
All Laboratories					
Number of Sample Measurements:	96	96	96	96	89
Mean:	30.5	25.8	16.2	41.2	3.2
Standard Deviation:	2.0	2.2	1.3	2.9	0.9
RSD (%):	6.4	8.5	7.8	7.0	27.6

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, Co

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Blood Silver (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	0.143	0.149	0.145	0.117	0.112

Blood Aluminum (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	< 10.8	< 10.8	< 10.8	< 10.8	< 10.8

Blood Barium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
110	ICP-MS	9.3	8.2	17.9	10.5	10.8
147	ICP-MS	9.26	8.19	15.28	10.08	8.85
197	ICP-MS	9.6	6.1	10.2	10.3	8.9
312	ICP-MS	10.4	8.5	15.7	12.1	9.1
Arithmetic Mean (n=4)		**9.6**	**7.7**	**14.8**	**10.7**	**9.4**
SD		0.5	1.1	3.3	0.9	0.9

Blood Beryllium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
110	ICP-MS	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
147	ICP-MS	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
197	ICP-MS	<0.2	<0.2	<0.2	<0.2	<0.2

Blood Bismuth (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

Blood Cobalt (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
110	ICP-MS	3.1	1.8	6.1	8.2	13.2
147	ICP-MS	2.73	1.66	5.76	7.9	12.2
159	ICP-MS	3	1.9	6	8.3	12.9
197	ICP-MS	2.3	1.4	5.1	7	10.7
312	ICP-MS	2.9	1.8	6	8.2	13
391	DRC/CC-ICP-MS	3.4	1.8	6.8	9.6	13.0
Arithmetic mean (n=6)		**2.9**	**1.7**	**6.0**	**8.2**	**12.5**
SD		0.4	0.2	0.5	0.8	0.9

Blood Chromium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	0.728	0.78	0.78	0.707	0.78
159	DRC/CC-ICP-MS	<0.5	<0.5	<0.5	<0.5	<0.5
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0
312	DRC/CC-ICP-MS	1	0.7	1.1	0.6	0.9
391	DRC/CC-ICP-MS	5.9	6.3	6.1	6.2	6.6

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Blood Cesium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
110	ICP-MS	0.7	0.79	0.71	0.8	0.7

Blood Copper (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
110	ICP-MS	1238	1285	1260	1297	1255
147	ICP-MS	1086	1156	1131	1175	1156
197	ICP-MS	1060	1140	1130	1210	1080
312	ICP-MS	1069	1190	1127	1140	1107
Arithmetic mean (n=4)		**1113**	**1193**	**1162**	**1206**	**1150**
SD		84	65	65	67	77

Blood Iodine (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	48.61	42.53	42.41	45.82	41.39

Blood Lithium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	1.96	1.04	1.36	1.74	0.777

Blood Manganese (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
103	DRC/CC-ICP-MS	24.7	18.1	23.4	27.4	44.0
107	DRC/CC-ICP-MS	25.2	18.6	24.2	28.2	44.4
110	ETAAS-Z	27.9	19.8	25.9	30.1	47.8
147	ICP-MS	27.36	20.6	26.87	31.54	48.9
156	ICP-MS	25.8	21.4	22.4	30.6	48.8
159	ICP-MS	28.0	21.0	28.0	29.0	50.0
179	ETAAS-Z	24.8	18.5	23.8	27.4	43.5
197	ICP-MS	23.7	18.8	23.7	27.2	45.2
293	ICP-MS	22.7	17.2	20.9	26.8	45.6
305	ICP-MS	21.6	16.6	22.3	27.3	43.0
312	DRC/CC-ICP-MS	26.0	22.3	29.6	32.6	53.0
391	DRC/CC-ICP-MS	25.7	20.7	25.2	30.9	47.3
Arithmetic mean (n=12)		**25.3**	**19.5**	**24.7**	**29.1**	**46.8**
SD		2.0	1.8	2.5	2.0	3.0

Blood Molybdenum (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	6.24	28.98	9.3	15.36	7.89

Blood Antimony (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
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

Blood Platinum (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
110	ICP-MS	<0.10	<0.10	<0.10	<0.10	<0.10

Blood Selenium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
107	DRC/CC-ICP-MS	430.9	364.9	372.1	333.5	402.7
109	ICP-MS	438	362	361	320	386
110	ICP-MS	447	361	355	335	409
147	ICP-MS	416	352	361	321	400
197	ICP-MS	397	368	376	300	382
305	ICP-MS	503	431	417	383	478
312	ICP-MS	465	403	397	355	427
359	ICP-MS	374.7	327.5	323.6	288.3	345.3
391	DRC/CC-ICP-MS	549	482	469	413	566
Arithmetic mean (n=9)		**447**	**383**	**381**	**339**	**422**
SD		53	47	42	40	65

Blood Tin (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
110	ICP-MS	3.65	0.49	0.04	7.48	3.21
156	ICP-MS	<11.0	<11.0	<11.0	<11.0	<11.0
197	ICP-MS	<5.0	<5.0	<5.0	8.6	<5.0

Blood Tellurium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38

Blood Thorium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12

Blood Thallium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
110	ICP-MS	7.49	1.17	0.3	6.85	4.96
147	ICP-MS	9.33	1.59	0.424	8.7	6.07
159	ICP-MS	7.5	1.2	<1.0	6.8	4.8
156	ICP-MS	<11.0	<11.0	<11.0	<11.0	<11.0
197	ICP-MS	6.3	1	<1.0	5.6	4
312	ICP-MS	7.4	1.1	0.3	6.8	4.8
179	ICP-MS	7	1	<1.0	7	5
Arithmetic mean (n=6)		**7.5**	**1.2**		**7.0**	**4.9**
SD		1.0	0.2		1.0	0.7

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Blood Uranium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
103	DRC/CC-ICP-MS	0.0	0.0	0.0	0.0	0.0
110	ICP-MS	<0.02	<0.02	<0.02	<0.02	<0.02
147	ICP-MS	<0.007	<0.007	<0.007	<0.007	<0.007
312	ICP-MS	<0.1	<0.1	<0.1	<0.1	<0.1

Blood Vanadium (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
147	ICP-MS	0.054	0.041	0.045	0.049	0.044

Blood Zinc (µg/L)

Lab Code	Method	BE11-11	BE11-12	BE11-13	BE11-14	BE11-15
110	ICP-MS	3052	2294	2489	2088	1986
147	ICP-MS	2824	2078	2248	1928	1784
197	ICP-MS	2400	1920	2020	1940	1670
312	ICP-MS	3129	2355	2562	2212	2083
Arithmetic mean (n=4)		**2851**	**2162**	**2330**	**2042**	**1881**
SD		328	200	246	135	188

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.