
Wadsworth Center

New York State Department of Health

TRACE ELEMENTS IN WHOLE BLOOD

Event #2, 2011

June 21, 2011

June 21, 2011

**Trace Elements in Whole Blood
Event #2, 2011**

Dear Laboratory Director:

Results from the second 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 June 21st, 2011, and are reproduced here for completeness.

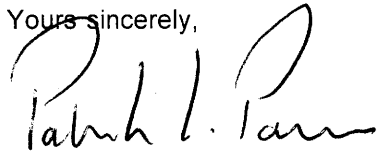
PT Materials

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).

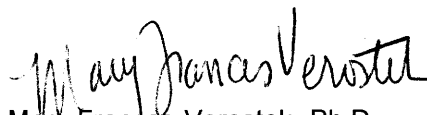
The next PT event for trace elements in whole blood is scheduled to be mailed Wednesday, September 21st, 2011. Please inform our laboratory staff at (518) 474-4484 if the test materials have not arrived within five days of the scheduled mail out date. **The deadline for reporting results is Wednesday, October 12th, 2011.**

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

New York State Department of Health
Event #2, 2011

Whole Blood Arsenic

Test materials for arsenic were prepared from caprine (goat) whole blood preserved with K₂EDTA anticoagulant. A total of five pools were supplemented with different arsenic species: inorganic As³⁺ and As⁵⁺, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), and arsenobetaine.

Sample	Arsenic species added
BE11-06	As ³⁺ , DMA and arsenobetaine
BE11-07	As ³⁺ and MMA
BE11-08	As ³⁺ , MMA, DMA and arsenobetaine
BE11-09	As ³⁺
BE11-10	As ³⁺ , MMA and DMA

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 17.7 µg/L (0.24 µmol/L) to 58.6 µg/L (0.78 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, 95.6% of test results reported were judged as satisfactory, with one of the 18 laboratories (5.6%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Arsenic Test Results, 2011 Event #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

Results ($\mu\text{g/L}$ whole blood)

	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
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Robust Mean	54.5	25.5	58.6	17.7	41.2
Robust Standard Deviation	4.5	2.1	5.0	2.9	4.2
Standard Uncertainty	1.3	0.6	1.5	0.9	1.2
RSD (%)	8.3	8.1	8.6	16.4	10.2
Acceptable Range:					
Upper Limit	65.4	31.5	70.3	23.7	49.4
Lower Limit	43.6	19.5	46.9	11.7	33.0

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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE11-06	BE11-07	BE11-08	BE11-09	BE11-10	
Target Values:		54.5	25.5	58.6	17.7	41.2	
103	DRC/CC-ICP-MS	54.4	24.2	57.1	15.8	39.8	Info
110	DRC/CC-ICP-MS	53.7	23.7	58.4	16.3	41.2	
114	ICP-MS	54.0	27.0	57.0	21.0	41.0	
147	ICP-MS	47.9	21.1	49.4	13.8	34.7	
156	ICP-MS	49.3	22.9	44.4 ↓	14.2	36.4	
159	ICP-MS	58.0	28.0	61.0	19.0	45.0	Info
164	ICP-MS	58.0	26.0	63.0	20.0	47.0	
179	ICP-MS	53.0	26.0	57.0	17.0	39.0	
197	DRC/CC-ICP-MS	57.0	25.0	62.0	17.0	44.0	
200	ICP-MS	52.1	24.5	57.3	20.4	39.1	
206	ICP-MS	57.4	25.4	61.6	20.0	41.6	Info
208	ICP-MS	50.9	28.7	57.7	20.7	44.4	
293	DRC/CC-ICP-MS	59.9	27.0	64.8	18.2	43.7	
305	DRC/CC-ICP-MS	55.0	24.0	60.0	16.0	41.0	
312	DRC/CC-ICP-MS	62.0	34.0 ↑	71.0 ↑	23.0	47.0	
324	HR-ICP-MS	58.5	27.1	62.5	17.3	43.4	Info
359	ICP-MS	42.5 ↓	24.4	56.4	15.6	37.9	
391	DRC/CC-ICP-MS	53.6	24.3	49.1	14.4	34.1	Info
Percent satisfactory results for all participants:							95.6 %

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 Arsenic Test Results, 2011 Event #2
STATISTICAL SUMMARY BY METHOD

Results ($\mu\text{g/L}$ whole blood)					
	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
DRC/CC-ICP-MS					
Number of Sample Measurements:	7	7	7	7	7
Mean:	56.5	26.0	60.3	17.2	41.5
Standard Deviation:	3.3	3.7	6.8	2.8	4.1
RSD (%):	5.8	14.2	11.3	16.2	9.8
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	58.5	27.1	62.5	17.3	43.4
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	10	10	10	10	10
Mean:	52.3	25.4	56.5	18.2	40.6
Standard Deviation:	5.0	2.3	5.7	2.8	4.0
RSD (%):	9.5	9.0	10.0	15.3	9.7
All Laboratories					
Number of Sample Measurements:	18	18	18	18	18
Mean:	54.3	25.7	58.3	17.8	41.1
Standard Deviation:	4.7	2.8	6.2	2.7	3.8
RSD (%):	8.7	10.8	10.6	15.0	9.3

notes: ? Insufficient data for calculation.

New York State Department of Health
Event #2, 2011

Whole Blood Cadmium

Test materials for cadmium were prepared from caprine (goat) whole blood preserved with K₂EDTA anticoagulant. A total of five blood pools were supplemented with different amounts of cadmium (as Cd²⁺).

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 2.2 µg/L (20 nmol/L) to 17.8 µg/L (158 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, 95.6% of the results reported by all participants were satisfactory, with two of the 27 laboratories (7.4%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Cadmium Test Results, 2011 Event #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

Results ($\mu\text{g/L}$ whole blood)

	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
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Robust Mean	17.8	11.2	7.2	2.2	4.3
Robust Standard Deviation	1.3	0.7	0.5	0.2	0.3
Standard Uncertainty	0.3	0.2	0.1	<0.1	0.1
RSD (%)	7.5	6.6	6.6	7.3	7.0
Acceptable Range:					
Upper Limit	20.5	12.9	8.3	3.2	5.3
Lower Limit	15.1	9.5	6.1	1.2	3.3

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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE11-06	BE11-07	BE11-08	BE11-09	BE11-10	
Target Values:		17.8	11.2	7.2	2.2	4.3	
103	DRC/CC-ICP-MS	19.4	11.9	7.8	2.4	4.7	Info
107	DRC/CC-ICP-MS	19.2	12.0	7.7	2.3	4.7	Info
109	ICP-MS	19.4	11.8	7.6	2.2	4.5	Info
110	ICP-MS	18.1	11.3	7.3	2.4	4.4	
114	ICP-MS	18.8	11.4	7.6	2.4	4.4	
116	ICP-MS	18.2	11.2	7.0	1.7	4.0	Info
147	ICP-MS	19.0	12.0	7.6	2.2	4.6	Info
156	ICP-MS	16.2	9.8	6.3	2.0	3.8	
159	ICP-MS	18.5	11.5	7.3	2.3	4.6	
164	ICP-MS	16.1	10.0	6.6	2.2	3.9	
179	ICP-MS	18.9	11.6	7.8	2.3	4.5	
197	DRC/CC-ICP-MS	18.5	11.5	7.7	2.3	4.6	
200	ICP-MS	16.9	10.8	7.0	2.1	4.2	Info
206	ICP-MS	18.9	11.6	7.4	2.4	4.2	
208	ICP-MS	16.5	10.1	7.3	2.0	4.4	
293	ICP-MS	16.9	10.7	6.7	2.0	3.9	Info
305	ICP-MS	17.0	10.7	6.8	2.1	4.2	
312	ICP-MS	17.0	12.0	6.8	2.8	4.5	
324	HR-ICP-MS	18.4	11.2	7.1	2.4	4.4	Info
359	ICP-MS	17.9	11.3	7.1	2.3	4.1	
366	ETAAS-Z	16.5	10.6	7.5	2.8	4.2	Info
367	ICP-MS	18.7	11.7	7.6	2.4	4.6	Info
385	ICP-MS	17.7	11.5	6.7	1.9	4.0	Info
391	DRC/CC-ICP-MS	11.8 ↓	7.2 ↓	4.3 ↓	1.4	2.5 ↓	Info
401	ETAAS-Z	13.1 ↓	8.9 ↓	6.3	2.1	3.5	Info
408	ICP-MS	17.6	10.9	7.1	2.1	4.3	Info
410	ICP-MS	19.3	12.2	7.8	2.3	4.7	Info

Percent satisfactory results for all participants: 95.6 %

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 Cadmium Test Results, 2011 Event #2
STATISTICAL SUMMARY BY METHOD

Results ($\mu\text{g/L}$ whole blood)					
	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
DRC/CC-ICP-MS					
Number of Sample Measurements:	4	4	4	4	4
Mean:	17.2	10.7	6.9	2.1	4.1
Standard Deviation:	3.6	2.3	1.7	0.5	1.1
RSD (%):	21.1	21.7	25.0	22.3	26.3
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	14.8	9.8	6.9	2.5	3.9
Standard Deviation:	2.4	1.2	0.8	0.5	0.5
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	18.4	11.2	7.1	2.4	4.4
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	20	20	20	20	20
Mean:	17.9	11.2	7.2	2.2	4.3
Standard Deviation:	1.1	0.7	0.4	0.2	0.3
RSD (%):	5.9	6.1	6.0	10.7	6.3
All Laboratories					
Number of Sample Measurements:	27	27	27	27	27
Mean:	17.6	11.0	7.1	2.2	4.2
Standard Deviation:	1.8	1.1	0.7	0.3	0.5
RSD (%):	10.3	9.9	10.1	13.0	11.0

notes: ? Insufficient data for calculation.

New York State Department of Health
Event #2, 2011

Whole Blood Mercury

Test materials for mercury were prepared from caprine (goat) whole blood preserved with K₂EDTA anticoagulant. A total of five pools were supplemented with different amounts of mercury as both inorganic (Hg²⁺) and organometallic (as methylmercury, CH₃Hg⁺) 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 2.0 µg/L (10 nmol/L) to 44.2 µg/L (220 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, 100% of results reported by all participants were satisfactory, with none of the 27 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 #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

Results ($\mu\text{g/L}$ whole blood)

	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
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Robust Mean	44.2	5.0	2.0	8.9	26.2
Robust Standard Deviation	3.4	0.3	0.2	1.0	2.3
Standard Uncertainty	0.8	0.1	<0.1	0.2	0.5
RSD (%)	7.7	6.8	8.3	11.1	8.6
Acceptable Range:					
Upper Limit	57.5	8.0	5.0	11.9	34.1
Lower Limit	30.9	2.0	0.0	5.9	18.3

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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE11-06	BE11-07	BE11-08	BE11-09	BE11-10	
Target Values:		44.2	5.0	2.0	8.9	26.2	
103	DRC/CC-ICP-MS	45.2	4.9	2.0	8.9	26.9	Info
107	DRC/CC-ICP-MS	43.7	4.8	1.9	9.2	26.4	Info
109	ICP-MS	47.0	4.8	2.0	8.8	26.3	Info
110	ICP-MS	42.4	4.8	1.8	8.4	25.5	
114	ICP-MS	46.2	6.0	2.4	9.7	27.4	
116	ICP-MS	45.4	5.2	2.2	9.3	27.6	Info
147	ICP-MS	44.1	4.8	1.8	8.7	27.5	Info
156	ICP-MS	47.4	5.9	<3.0	9.8	28.2	
159	ICP-MS	48.0	5.0	2.0	10.0	29.0	
164	ICP-MS	45.0	5.0	<4.0	10.0	28.0	
179	ICP-MS	41.0	4.0	2.0	8.0	24.0	
197	DRC/CC-ICP-MS	45.0	5.0	<5.0	9.0	27.0	
200	ICP-MS	42.0	4.5	1.7	8.0	24.5	Info
206	ICP-MS	43.0	5.0	<3.0	8.0	24.0	
208	ICP-MS	44.7	5.4	<5.0	11.5	33.5	
293	ICP-MS	37.7	5.0	2.1	7.9	21.7	Info
305	ICP-MS	52.0	6.0	2.0	10.0	31.0	
312	ICP-MS	32.0	4.0	1.7	6.9	20.0	
324	CV-AAS	40.6	5.0	2.2	9.3	23.6	Info
359	ICP-MS	31.7	4.6	1.9	6.9	21.0	
366	ICP-MS	38.0	5.3	2.0	9.1	25.0	Info
367	CV-AAS	44.8	5.2	2.0	9.4	26.9	Info
385	ICP-MS	47.5	4.9	<2.0	8.9	27.4	Info
391	CV-AAS	50.0	6.0	2.1	10.1	24.8	Info
408	ICP-MS	42.0	4.7	<3.0	8.6	25.2	Info
410	ICP-MS	45.9	5.1	2.1	9.4	27.9	Info
453	CV-AAS	44.8	3.2	1.2	6.7	25.7	Info

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 Mercury Test Results, 2011 Event #2
STATISTICAL SUMMARY BY METHOD

Results ($\mu\text{g/L}$ whole blood)					
	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
CV-AAS					
Number of Sample Measurements:	4	4	4	4	4
Mean:	45.1	4.9	1.9	8.9	25.3
Standard Deviation:	3.8	1.2	0.5	1.5	1.4
RSD (%):	8.5	24.4	24.4	16.8	5.5
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	2	3	3
Mean:	44.6	4.9	2.0	9.0	26.8
Standard Deviation:	0.8	0.1	0.1	0.2	0.3
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	20	20	14	20	20
Mean:	43.2	5.0	2.0	8.9	26.2
Standard Deviation:	5.1	0.5	0.2	1.1	3.3
RSD (%):	11.9	11.0	9.7	12.7	12.4
All Laboratories					
Number of Sample Measurements:	27	27	20	27	27
Mean:	43.6	5.0	2.0	8.9	26.1
Standard Deviation:	4.7	0.6	0.2	1.1	2.9
RSD (%):	10.7	12.5	12.6	12.2	10.9

notes: ? Insufficient data for calculation.

New York State Department of Health
Event #2, 2011

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 K₂EDTA anticoagulant.

Target values were established as the mean of 21 measurements performed by 19 reference laboratories using ICP-MS, ETAAS and ASV methods. Values range from 5 µg/dL to 34 µg/dL. Among the reference group, imprecision (SD) varied from 0.4 - 1.6 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 95 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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-06	BE11-07	BE11-08	BE11-09	BE11-10		
Target values:		5	32	21	34	11		
103	DRC/CC-ICP-MS	5	31	21	34	11	0.99	
103	ASV-LeadCare	6	33	21	35	11	1.02	Info
104	ETAAS-Z	5	32	22	34	12	1.03	
107	ASV-LeadCare	5	35	24	38	14	1.16	Info
107	DRC/CC-ICP-MS	5	31	20	33	11	0.97	
107	ASV-LeadCare	5	34	25	34	10	1.08	Info
109	ETAAS-Z	5	32	21	34	11	1.00	
109	ICP-MS	5	32	21	34	11	1.00	
109	ASV-LeadCare	4	30	20	32	9	0.94	Info
109	ASV-LeadCare	5	31	21	34	11	0.99	Info
110	ETAAS-Z	6	33	22	35	12	1.05	
110	ASV-LeadCare	4	30	19	32	7	0.93	Info
110	ASV-LeadCare	6	35	17	36	11	0.99	Info
110	ICP-MS	5	32	21	35	11	1.01	
112	ASV-3010	5	33	22	36	11	1.03	
114	ETAAS-Z	6	37 ↑	23	39 ↑	14	1.17	
116	ICP-MS	5	32	21	35	12	1.03	Info
121	ETAAS-Z	6	35	22	38	13	1.11	Info
123	ETAAS-Z	5	32	20	33	11	0.98	
126	ETAAS-Z	5	31	19	33	11	0.96	
131	ETAAS-Z	7	32	21	35	13	1.05	
132	ETAAS-Z	5	32	21	36	12	1.04	
143	ETAAS-Z	5	29	20	32	11	0.95	
144	ETAAS-Z	5	34	22	35	12	1.06	
146	ETAAS-Z	5	32	20	34	11	0.99	
147	ICP-MS	5	29	19	32	11	0.94	
150	ASV-LeadCare	5	34	20	36	10	1.02	
156	ICP-MS	5	33	20	35	11	1.00	
158	ICP-MS	5	34	22	37	12	1.07	
159	ICP-MS	5	32	21	34	11	1.00	

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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-06	BE11-07	BE11-08	BE11-09	BE11-10		
Target values:		5	32	21	34	11		
160	ETAAS-Z	5	32	23	34	12	1.05	
164	ICP-MS	5	33	21	37	12	1.05	
166	ASV-3010	4	33	20	35	11	1.00	
168	ETAAS-Z	6	35	23	37	13	1.11	
179	ICP-MS	5	33	21	36	12	1.05	
197	ICP-MS	5	29	20	33	10	0.94	
198	ETAAS-Z	6	34	21	35	11	1.02	
199	ETAAS-Z	5	29	19	31	10	0.91	
200	ETAAS-Z	6	33	23	37	12	1.08	
204	ASV-3010	6	30	17	32	9	0.90	
206	ICP-MS	5	34	22	37	12	1.07	
208	ETAAS-Z	3	27 ↓	19	31	11	0.92	
221	ETAAS-Z	6	38 ↑	26 ↑	40 ↑	14	1.22	
232	ASV-3010	6	33	21	37	10	1.04	
237	ETAAS-Z	5	35	22	38	12	1.09	
243	ASV-3010	5	31	19	33	10	0.95	
249	ASV-3010	3	29	18	32	10	0.90	
254	ETAAS-Z	5	36	20	34	11	1.02	
255	ETAAS-Z	5	31	20	34	12	1.00	
261	ETAAS-Z	9	28	19	32	12	0.95	
269	ETAAS-Z	4	30	19	32	10	0.93	
271	ASV-3010	5	33	22	36	10	1.05	
272	ETAAS-Z	6	32	21	34	12	1.02	
279	ETAAS-Z	5	28	21	38	11	1.00	
282	ASV-3010	7	33	23	34	12	1.05	
290	ICP-MS	5	29	18	31	10	0.89	
291	ASV-3010	9	42 ↑	26 ↑	43 ↑	16 ↑	1.32	
293	ICP-MS	5	30	18	33	10	0.92	
295	ASV-3010	4	32	21	36	10	1.02	
300	ASV-3010	5	31	20	37	11	1.00	

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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-06	BE11-07	BE11-08	BE11-09	BE11-10		
Target values:		5	32	21	34	11		
301	ETAAS Other	3	32	18	30	9	0.91	
305	ETAAS-Z	5	29	19	31	10	0.91	
312	ICP-MS	5	32	21	34	11	1.00	
317	ETAAS-Z	5	31	20	33	11	0.97	
324	HR-ICP-MS	5	29	20	35	10	0.96	
325	ETAAS-Z	5	30	19	32	10	0.93	
333	ETAAS-Z	5	31	20	35	12	1.01	
337	ASV-LeadCare	8	31	21	29 ↓	10	0.94	
340	ETAAS-Z	7	32	22	36	12	1.05	
343	ASV-LeadCare	5	31	20	33	10	0.96	Info
348	ETAAS-Z	6	31	21	34	12	1.01	
349	ETAAS-Z	5	31	20	35	11	0.99	
350	ASV-3010	11 ↑	35	24	37	12	1.32	
352	ASV-3010	4	30	19	31	9	0.92	
353	ETAAS-Z	5	30	24	32	11	1.01	
365	ETAAS-Z	5	31	18	33	10	0.93	
366	ETAAS-Z	6	35	24	38	12	1.11	Info
367	ICP-MS	6	33	21	36	12	1.05	Info
368	ASV-3010	7	30	20	32	11	0.96	
369	ASV-3010	4	31	19	35	10	0.97	
374	ASV-3010	6	35	23	40 ↑	13	1.14	
383	ETAAS-Z	4	29	19	32	10	0.92	
384	ASV-3010	8	30	20	35	13	1.03	
385	ICP-MS	5	33	20	34	11	1.00	Info
388	ASV-3010	4	29	18	35	10	0.93	
389	ETAAS-Z	5	31	20	32	11	0.97	
391	ETAAS-Z	5	31	21	35	12	1.02	Info
393	ASV-LeadCare	4	34	19	34	10	0.99	
401	ETAAS-Z	5	35	22	37	9	1.08	Info
408	ICP-MS	5	29	19	32	11	0.94	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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-06	BE11-07	BE11-08	BE11-09	BE11-10		
Target values:		5	32	21	34	11		
410	ICP-MS	5	33	21	35	12	1.04	Info
455	ASV-LeadCare	5	33	20	34	11	1.00	
461	ASV-3010	6	31	20	33	10	0.96	
463	ASV-LeadCare	4	27 ↓	15 ↓	30	8	0.81	
464	ASV-LeadCare	5	33	20	33	8	0.98	
466	ETAAS-Z	7	32	24	28 ↓	11	0.99	

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 #2
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS						
Lab Code	Method	Results (µg/dL whole blood)				
		BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
103	DRC/CC-ICP-MS	5	31	21	34	11
104	ETAAS-Z	5	32	22	34	12
107	DRC/CC-ICP-MS	5	31	20	33	11
109	ETAAS-Z	5	32	21	34	11
109	ICP-MS	5	32	21	34	11
110	ETAAS-Z	6	33	22	35	12
110	ICP-MS	5	32	21	35	11
112	ASV-3010	5	33	22	36	11
147	ICP-MS	5	29	19	32	11
159	ICP-MS	5	32	21	34	11
160	ETAAS-Z	5	32	23	34	12
164	ICP-MS	5	33	21	37	12
166	ASV-3010	4	33	20	35	11
179	ICP-MS	5	33	21	36	12
198	ETAAS-Z	6	34	21	35	11
199	ETAAS-Z	5	29	19	31	10
200	ETAAS-Z	6	33	23	37	12
243	ASV-3010	5	31	19	33	10
293	ICP-MS	5	30	18	33	10
324	HR-ICP-MS	5	29	20	35	10
325	ETAAS-Z	5	30	19	32	10
Number of Sample Measurements:		21	21	21	21	21
Mean (target value):		5	32	21	34	11
Standard Deviation:		0.4	1.5	1.4	1.6	0.7
RSD (%):		8.6	4.7	6.6	4.6	6.7
Acceptable Range:						
Upper Limit:		9	36	25	38	15
Lower Limit:		1	28	17	30	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, 2011 Event #2
STATISTICAL SUMMARY BY METHOD**

	Results (µg/dL whole blood)				
	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
ASV-3010					
Number of Sample Measurements:	17	19	19	19	19
Mean:	5.2	32.2	20.6	35.2	10.9
Standard Deviation:	1.3	3.0	2.3	2.9	1.7
RSD (%):	25.7	9.3	11.0	8.3	15.4
ASV-LeadCare					
Number of Sample Measurements:	14	14	14	14	14
Mean:	5.1	32.2	20.1	33.6	10.0
Standard Deviation:	1.1	2.3	2.5	2.4	1.7
RSD (%):	21.1	7.1	12.3	7.1	17.1
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	5.0	31.0	20.5	33.5	11.0
Standard Deviation:	0.0	0.0	0.7	0.7	0.0
RSD (%):	—	—	—	—	—
ETAAS Other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	3.0	32.0	18.0	30.0	9.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	40	41	41	41	41
Mean:	5.3	31.9	21.0	34.3	11.5
Standard Deviation:	0.8	2.5	1.8	2.5	1.1
RSD (%):	14.9	7.8	8.4	7.4	9.4
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	5.0	29.0	20.0	35.0	10.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	18	18	18	18	18
Mean:	5.1	31.8	20.4	34.4	11.2
Standard Deviation:	0.2	1.8	1.2	1.8	0.7
RSD (%):	4.7	5.6	5.9	5.2	6.5
All Laboratories					
Number of Sample Measurements:	93	96	96	96	96
Mean:	5.2	31.9	20.6	34.4	11.1
Standard Deviation:	0.9	2.4	1.9	2.5	1.3
RSD (%):	17.5	7.5	9.2	7.2	12.2

notes: ? Insufficient data for calculation.

**New York State Department of Health
Blood Lead Test Results, 2011 Event #2
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/dL}$ whole blood)				
	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
Evaluated					
Number of Sample Measurements:	55	58	58	58	58
Mean:	5.2	31.8	20.5	34.2	11.1
Standard Deviation:	1.1	2.7	2.0	2.8	1.4
RSD (%):	21.1	8.5	9.9	8.3	13.0
Info					
Number of Sample Measurements:	17	17	17	17	17
Mean:	5.2	32.6	21.1	34.9	11.0
Standard Deviation:	0.6	2.0	2.0	2.0	1.7
RSD (%):	12.3	6.2	9.4	5.9	15.1
Reference					
Number of Sample Measurements:	21	21	21	21	21
Mean:	5.1	31.6	20.7	34.2	11.0
Standard Deviation:	0.4	1.5	1.4	1.6	0.7
RSD (%):	8.6	4.7	6.6	4.6	6.7
All Laboratories					
Number of Sample Measurements:	93	96	96	96	96
Mean:	5.2	31.9	20.6	34.4	11.1
Standard Deviation:	0.9	2.4	1.9	2.5	1.3
RSD (%):	17.5	7.5	9.2	7.2	12.2

notes: ? Insufficient data for calculation.

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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	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Blood Aluminum (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	< 10.8	< 10.8	< 10.8	< 10.8	< 10.8

Blood Barium (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
110	ICP-MS	8.5	10.1	8.5	16.8	9.3
147	ICP-MS	7.91	9.31	8.32	13.11	8.55
197	ICP-MS	8.0	9.3	8.2	13.3	8.5
312	ICP-MS	8.7	10.7	8.5	14.3	8.8
Arithmetic Mean (n=4)		8.3	9.9	8.4	14.4	8.8
SD		0.4	0.7	0.1	1.7	0.4

Blood Beryllium (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
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	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

Blood Cobalt (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
110	ICP-MS	7.2	4.3	3.2	5.3	9.5
147	ICP-MS	6.78	3.71	2.83	4.7	8.9
159	ICP-MS	7.4	4.3	2.9	5.3	9.4
197	ICP-MS	6.9	3.7	3.0	5.0	8.9
312	ICP-MS	7.4	4.1	3.1	5.3	9.6
391	DRC/CC-ICP-MS	7.4	4.1	2.8	4.9	8.4
Arithmetic mean (n=6)		7.2	4.0	3.0	5.1	9.1
SD		0.3	0.3	0.2	0.3	0.5

Blood Chromium (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	< 0.31	< 0.31	< 0.31	< 0.31	< 0.31
159	DRC/CC-ICP-MS	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
197	ICP-MS	< 1.0	< 1.0	1.4	< 1.0	< 1.0
312	DRC/CC-ICP-MS	0.8	0.7	0.4	0.5	0.6
391	DRC/CC-ICP-MS	1.3	1.3	1.2	1.6	1.3

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Blood Cesium (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
110	ICP-MS	0.60	0.43	0.46	0.49	0.55

Blood Copper (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
110	ICP-MS	1219	1217	1201	1212	1279
147	ICP-MS	1131	1125	1093	1105	1163
197	ICP-MS	1100	1010	1020	1080	1180
312	ICP-MS	116.0*	120.0*	116.0*	119.0*	121.0*
Arithmetic mean (n=3)		1150	1117	1105	1132	1207
SD		62	104	91	70	63

Blood Iodine (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	67.22	48.86	55.57	52.28	57.34

Blood Manganese (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
103	DRC/CC-ICP-MS	15.0	56.2	21.8	42.1	17.0
107	DRC/CC-ICP-MS	16.2	60.4	23.3	46.7	17.5
110	ETAAS-Z	15.9	59.2	22.8	45.3	18.2
147	ICP-MS	16.37	57.69	23.41	44.12	18.07
156	ICP-MS	16.2	56.4	24.0	39.4	23.8
159	ICP-MS	19.0	61.0	26.0	47.0	21.0
179	ETAAS-Z	16.8	60.6	24.3	45.6	18.7
197	ICP-MS	17.4	66.5	26.0	46.7	19.0
293	ICP-MS	13.4	55.8	20.2	40.2	14.8
305	ICP-MS	14.1	53.8	22.6	39.3	16.5
312	DRC/CC-ICP-MS	21	71	28	52	24
391	DRC/CC-ICP-MS	19.1	50.7	26.2	40.9	17.5
Arithmetic mean (n=12)		16.7	59.1	24.1	44.1	18.8
SD		2.2	5.5	2.2	3.8	2.8

Blood Molybdenum (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	5.06	7.49	2.98	10.36	6.64

Blood Nickel (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	0.68	< 0.29	< 0.29	< 0.29	0.49

Blood Antimony (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
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

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Blood Selenium (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
107	DRC/CC-ICP-MS	353.4	323.3	376.7	355.4	318.0
109	ICP-MS	372.0	340.0	397.0	365.0	330.0
110	DRC/CC-ICP-MS	366	344	402	377	336
147	ICP-MS	364.93	338.86	399.00	370.00	338.86
197	ICP-MS	353	328	391	349	327
305	ICP-MS	411	356	399	400	373
312	ICP-MS	433	394	475	441	394
359	ICP-MS	391	341	417	381	314
391	DRC/CC-ICP-MS	365.5	340.2	346	338.6	282.2
Arithmetic mean (n=9)		379	345	400	375	335
SD		27	21	34	31	33

Blood Tin (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
110	ICP-MS	15.5	4.3	3.7	9.8	2.0
147	ICP-MS	15.8	4.51	3.69	10.58	2.03
156	ICP-MS	14.4	< 11.0	< 11.0	< 11.0	< 11.0
197	ICP-MS	15.2	< 5.0	< 5.0	9.2	< 5.0
Arithmetic mean		15.2	4.4	3.7	9.9	2.0
SD		0.6			0.7	

Blood Tellurium (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38

Blood Thorium (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12

Blood Thallium (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
110	ICP-MS	3.5	15.7	2.2	5.3	11.9
147	ICP-MS	3.27	13.55	2.02	4.84	11.3
156	ICP-MS	< 11.0	14.6	< 11.0	< 11.0	11.4
159	ICP-MS	3.4	15.6	2.1	5.3	12.6
179	ICP-MS	3.0	14.0	2.0	5.0	5.0*
197	ICP-MS	3.0	14.4	2.2	5.2	11.2
312	ICP-MS	3.6	16.0	2.3	5.5	12.0
Arithmetic mean		3.3	14.8	2.1	5.2	11.7
SD		0.3	0.9	0.1	0.2	0.5

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Blood Uranium (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
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	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
147	ICP-MS	0.057	0.062	0.042	0.053	0.049

Blood Zinc (µg/L)

Lab Code	Method	BE11-06	BE11-07	BE11-08	BE11-09	BE11-10
110	ICP-MS	2238	3255	1869	2432	2110
147	ICP-MS	2137	3039	1752	2255	1980
197	ICP-MS	2090	2860	1760	2130	1960
312	ICP-MS	229.0*	336.0*	191.0*	253.0*	213.0*
Arithmetic mean (n=3)		2155	3051	1794	2272	2017
SD		76	198	65	152	81

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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., D₂, 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 $\mu\text{mol ZPP/mol heme}$)
- F-4 Other

OTHER METHODS

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