
Wadsworth Center

New York State Department of Health

TRACE ELEMENTS IN WHOLE BLOOD

Event #1, 2011

March 11, 2011

DOH 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

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

March 11, 2011

Trace Elements in Whole Blood Event #1, 2011

Dear Laboratory Director:

Results from the first 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 February 16th, 2011, and are reproduced here for completeness.

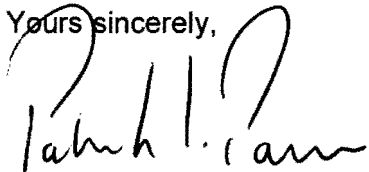
PT Materials

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, thallium, tin and cobalt.

The next PT event for trace elements in whole blood is scheduled to be mailed Wednesday, April 27th, 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, May 18th, 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 #1, 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
BE11-01	As ³⁺
BE11-02	As ⁵⁺ and MMA
BE11-03	As ³⁺ , MMA and DMA
BE11-04	As ⁵⁺ , DMA and arsenobetaine
BE11-05	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 10.9 µg/L (0.15 µmol/L) to 74.4 µg/L (0.99 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, 91.0% of test results reported were judged as satisfactory, with three of the 20 laboratories (15.0%) reporting 2 or more of the 5 results outside the acceptable ranges.

**New York State Department of Health
Blood Arsenic Test Results, 2011 Event #1
ROBUST STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
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Robust Mean	10.9	19.1	40.2	44.8	74.4
Robust Standard Deviation	3.0	2.4	4.4	5.1	6.2
Standard Uncertainty	0.9	0.7	1.2	1.4	1.7
RSD (%)	27.9	12.8	10.8	11.4	8.3
Acceptable Range:					
Upper Limit	16.9	25.1	48.2	53.8	89.3
Lower Limit	4.9	13.1	32.2	35.8	59.5

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE11-01	BE11-02	BE11-03	BE11-04	BE11-05	
Target Values:		10.9	19.1	40.2	44.8	74.4	
103	DRC/CC-ICP-MS	9.7	17.5	39.7	43.4	75.0	Info
110	DRC/CC-ICP-MS	9.6	17.7	37.6	42.1	72.3	
114	ICP-MS	18.0 ↑	26.0 ↑	50.0 ↑	53.0	82.0	
147	ICP-MS	9.4	17.2	37.9	41.1	63.4	Info
156	ICP-MS	5.7	13.8	34.5	37.1	64.1	
159	ICP-MS	13.0	23.0	43.0	51.0	79.0	
164	ICP-MS	12.0	21.0	45.0	46.0	82.0	
179	ICP-MS	<12.0	17.0	36.0	41.0	69.0	
197	DRC/CC-ICP-MS	13.0	22.0	44.0	47.0	77.0	
200	ICP-MS	11.4	20.3	42.0	46.3	77.1	Info
206	ICP-MS	15.5	21.7	41.5	45.3	72.0	
208	ICP-MS	17.2 ↑	18.9	37.6	43.9	62.6	
293	DRC/CC-ICP-MS	11.4	45.5 ↑	41.6	19.8 ↓	80.3	Info
305	DRC/CC-ICP-MS	9.0	17.0	30.0 ↓	29.0 ↓	62.0	
312	DRC/CC-ICP-MS	15.0	22.0	48.0	51.0	78.0	
324	HR-ICP-MS	7.3	17.6	34.6	49.4	77.1	Info
339	HR-ICP-MS	9.7	18.0	40.4	44.3	76.9	Info
359	ICP-MS	6.7	16.9	43.4	61.5 ↑	71.0	
391	DRC/CC-ICP-MS	9.8	17.8	38.3	42.3	71.8	Info
395	DRC/CC-ICP-MS	9.9	19.4	40.3	45.0	80.8	
Percent satisfactory results for all participants:							91.0 %

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, 2011 Event #1
STATISTICAL SUMMARY BY METHOD

Results ($\mu\text{g/L}$ whole blood)					
	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
DRC/CC-ICP-MS					
Number of Sample Measurements:	8	7	8	8	8
Mean:	10.9	19.1	39.9	40.0	74.7
Standard Deviation:	2.1	2.1	5.2	10.3	6.1
RSD (%):	19.1	11.2	13.1	25.8	8.2
HR-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	8.5	17.8	37.5	46.9	77.0
Standard Deviation:	1.7	0.3	4.1	3.6	0.1
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	9	10	10	10	10
Mean:	12.1	19.6	41.1	46.6	72.2
Standard Deviation:	4.3	3.5	4.7	7.0	7.5
RSD (%):	35.9	18.1	11.4	15.1	10.4
All Laboratories					
Number of Sample Measurements:	19	19	20	20	20
Mean:	11.2	19.2	40.3	44.0	73.7
Standard Deviation:	3.4	2.9	4.7	8.6	6.6
RSD (%):	30.2	14.9	11.8	19.6	8.9

notes: ? Insufficient data for calculation.

New York State Department of Health
Event #1, 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 1.5 µg/L (13 nmol/L) to 12.5 µg/L (111 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, 96.8% of the results reported by all participants were satisfactory, with two of the 31 laboratories (6.4%) reporting 2 or more of the 5 results outside the acceptable ranges.

**New York State Department of Health
Blood Cadmium Test Results, 2011 Event #1
ROBUST STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
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Robust Mean	1.5	2.8	12.5	6.6	11.7
Robust Standard Deviation	0.2	0.2	1.1	0.5	0.7
Standard Uncertainty	0.0	0.0	0.2	0.1	0.2
RSD (%)	11.0	6.0	8.8	7.0	5.9
Acceptable Range:					
Upper Limit	2.5	3.8	14.4	7.6	13.5
Lower Limit	0.5	1.8	10.6	5.6	9.9

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE11-01	BE11-02	BE11-03	BE11-04	BE11-05	
Target Values:		1.5	2.8	12.5	6.6	11.7	
103	DRC/CC-ICP-MS	1.6	3.0	13.8	7.0	12.4	Info
106	ICP-MS	1.5	2.8	12.5	6.5	11.9	Info
107	ICP-MS	1.5	2.9	14.1	7.0	12.4	Info
109	ICP-MS	1.6	3.1	13.9	7.1	13.0	Info
110	ICP-MS	1.6	2.9	12.5	6.6	11.5	
114	ICP-MS	1.8	2.9	13.2	6.8	12.1	
116	ICP-MS	1.4	2.8	13.3	6.8	12.3	Info
147	ICP-MS	1.5	2.7	12.0	6.3	11.4	Info
156	ICP-MS	1.2	2.5	11.4	6.0	10.1	
159	ICP-MS	1.6	3.3	14.1	7.3	12.6	
164	ICP-MS	1.3	2.7	11.8	6.2	11.2	
179	ICP-MS	1.4	2.9	12.7	6.4	11.6	
197	DRC/CC-ICP-MS	1.4	2.5	11.2	5.6	10.9	
199	ICP-MS	2.4	2.4	11.6	6.2	11.0	Info
206	ICP-MS	1.4	2.7	12.2	6.6	12.1	
208	ICP-MS	2.0	2.9	12.0	7.0	11.6	
293	ICP-MS	1.6	3.1	13.9	7.2	13.2	Info
305	ICP-MS	1.3	3.1	13.0	6.9	12.0	
312	ICP-MS	1.5	2.9	12.0	6.6	12.0	
324	HR-ICP-MS	1.5	2.8	12.8	6.9	11.8	Info
339	HR-ICP-MS	1.4	2.7	11.8	6.4	11.4	Info
359	ICP-MS	1.6	2.8	12.2	6.8	11.7	
366	ETAAS-Z	1.0	2.8	9.8 ↓	6.1	11.0	Info
367	ICP-MS	1.7	3.3	13.7	7.4	11.4	Info
383	ETAAS-Z	1.2	2.6	14.3	6.4	11.3	
385	ICP-MS	1.4	2.7	12.2	6.6	11.5	Info
391	DRC/CC-ICP-MS	2.1	2.8	10.4 ↓	5.6	9.6 ↓	Info
395	ICP-MS	1.6	3.1	12.6	6.7	13.4	
401	ETAAS-Z	1.4	2.7	10.7	5.3 ↓	9.5 ↓	Info
408	ICP-MS	<1.3	2.4	11.8	5.8	11.3	Info
410	ICP-MS	1.6	3.0	13.1	6.9	12.3	Info
Percent satisfactory results for all participants:							96.8 %

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 #1
STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ whole blood)				
	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	1.7	2.8	11.8	6.1	11.0
Standard Deviation:	0.4	0.3	1.8	0.8	1.4
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	3	3	3	3	3
Mean:	1.2	2.7	11.6	5.9	10.6
Standard Deviation:	0.2	0.1	2.4	0.6	1.0
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	1.5	2.8	12.3	6.7	11.6
Standard Deviation:	0.1	0.1	0.7	0.4	0.3
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	22	23	23	23	23
Mean:	1.6	2.9	12.7	6.7	11.9
Standard Deviation:	0.3	0.2	0.8	0.4	0.7
RSD (%):	16.3	8.5	6.6	6.1	6.3
All Laboratories					
Number of Sample Measurements:	30	31	31	31	31
Mean:	1.5	2.8	12.5	6.5	11.7
Standard Deviation:	0.3	0.2	1.1	0.5	0.9
RSD (%):	17.8	8.1	9.1	7.9	7.7

notes: ? Insufficient data for calculation.

New York State Department of Health
Event #1, 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 1.2 µg/L (6 nmol/L) to 25.5 µg/L (127 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, 98.1% of results reported by all participants were satisfactory, with one of the 32 laboratories (3.1%) 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 #1
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

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

	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
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Robust Mean	14.6	5.6	25.5	1.2	2.9
Robust Standard Deviation	1.0	0.5	2.5	0.2	0.5
Standard Uncertainty	0.2	0.1	0.5	0.0	0.1
RSD (%)	6.8	9.7	9.8	13.1	15.7
Acceptable Range:					
Upper Limit	19.0	8.6	33.2	4.2	5.9
Lower Limit	10.2	2.6	17.9	0.0	0.0

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE11-01	BE11-02	BE11-03	BE11-04	BE11-05	
Target Values:		14.6	5.6	25.5	1.2	2.9	
103	DRC/CC-ICP-MS	14.5	5.7	25.8	1.2	2.9	Info
106	ICP-MS	14.7	5.8	26.4	1.2	2.9	Info
107	ICP-MS	14.9	5.9	26.9	1.3	3.5	Info
109	ICP-MS	14.2	5.4	24.9	1.1	2.7	Info
110	ICP-MS	13.7	5.6	24.0	1.1	2.8	
114	ICP-MS	16.3	6.1	28.5	1.3	3.4	
116	ICP-MS	14.7	5.6	26.6	1.1	2.8	Info
147	ICP-MS	14.1	5.3	25.5	1.1	2.7	Info
156	ICP-MS	14.9	5.9	26.8	<3.0	<3.0	
159	ICP-MS	13.0	5.0	25.0	<2.0	2.0	
164	ICP-MS	15.0	6.0	27.0	1.1	2.8	
179	ICP-MS	14.0	6.0	25.0	<1.0	3.0	
197	DRC/CC-ICP-MS	11.0	5.0	22.0	<5.0	<5.0	
199	ICP-MS	14.2	5.2	22.1	0.9	2.6	Info
200	ICP-MS	15.3	5.6	24.6	3.4	3.5	Info
206	ICP-MS	17.0	6.0	32.0	<3.0	3.0	
208	ICP-MS	14.7	<5.0	24.1	<5.0	<5.0	
293	ICP-MS	16.4	6.3	28.7	1.1	3.2	Info
305	ICP-MS	15.0	6.0	27.0	<2.0	3.0	
312	ICP-MS	15.0	5.6	25.0	1.4	3.3	
324	CV-AAS	12.7	4.7	21.6	0.8	2.4	Info
339	HR-ICP-MS	21.4 ↑	8.7 ↑	39.7 ↑	1.6	4.5	Info
359	ICP-MS	12.7	4.9	22.2	1.3	2.8	
366	ICP-MS	16.2	6.7	28.0	1.0	2.7	Info
367	CV-AAS	14.3	5.2	24.9	1.1	2.4	Info
385	ICP-MS	15.6	6.4	27.5	<2.0	3.5	Info
391	CV-AAS	14.1	5.4	20.6	1.4	2.3	Info
395	ICP-MS	15.3	5.7	27.7	1.1	3.4	
401	CV-AAS	14.9	5.4	24.0	1.0	2.3	Info
408	ICP-MS	13.4	5.3	24.6	<2.6	2.8	Info
410	ICP-MS	14.7	6.1	26.3	1.6	3.4	Info
453	CV-AAS	11.1	3.4	22.5	<2	<2	Info

Percent satisfactory results for all participants: 98.1 %

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 Mercury Test Results, 2011 Event #1
STATISTICAL SUMMARY BY METHOD

Results ($\mu\text{g/L}$ whole blood)					
	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
CV-AAS					
Number of Sample Measurements:	5	5	5	4	4
Mean:	13.4	4.8	22.7	1.1	2.4
Standard Deviation:	1.5	0.8	1.7	0.3	0.1
RSD (%):	11.4	17.5	7.7	23.3	2.5
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	2	1	1
Mean:	12.8	5.4	23.9	1.2	2.9
Standard Deviation:	2.5	0.5	2.7	?	?
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	21.4	8.7	39.7	1.6	4.5
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	24	23	24	15	22
Mean:	14.8	5.8	26.1	1.2	3.0
Standard Deviation:	1.1	0.4	2.2	0.2	0.4
RSD (%):	7.1	7.7	8.3	14.7	12.6
All Laboratories					
Number of Sample Measurements:	32	31	32	21	28
Mean:	14.7	5.7	25.9	1.2	3.0
Standard Deviation:	1.8	0.8	3.5	0.2	0.5
RSD (%):	12.4	14.6	13.5	17.3	17.1

notes: ? Insufficient data for calculation.

New York State Department of Health
Event #1, 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 8 µg/dL to 40 µg/dL. Among the reference group, imprecision (SD) varied from 0.9 - 1.8 µg/dL.

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

Discussion Based on the CLIA '88 criteria, 96.1%^a of results reported by all participants were judged as satisfactory, with 3 out of 103 participant laboratories (2.9%) reporting 2 or more of the 5 results outside the acceptable ranges.

^a Report was amended after original February 16, 2011 release.

**New York State Department of Health
Blood Lead Test Results, 2011 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-01	BE11-02	BE11-03	BE11-04	BE11-05		
Target values:		28	40	16	8	10		
103	DRC/CC-ICP-MS	27	38	16	8	10	0.97	
103	ASV-LeadCare	30	43	16	8	12	1.09	Info
104	ETAAS-Z	28	42	18	9	10	1.06	
106	ICP-MS	28	40	16	8	11	1.03	Info
107	ICP-MS	28	41	17	8	11	1.05	
107	ASV-LeadCare	27	40	15	7	12	1.03	Info
107	ASV-LeadCare	26	39	14	6	12	0.99	Info
109	ETAAS-Z	28	39	17	9	11	1.03	
109	ICP-MS	28	40	16	8	10	1.00	
109	ASV-LeadCare	26	39	16	6	11	1.00	Info
109	ASV-LeadCare	26	40	17	9	12	1.05	Info
110	ETAAS-Z	30	42	18	8	11	1.09	
110	ICP-MS	28	40	16	8	10	1.00	
110	ASV-LeadCare	28	40	16	7	12	1.05	Info
110	ASV-LeadCare	24	36	16	7	9	0.92	Info
112	ASV-3010	26	38	14	5	8	0.92	
114	ETAAS-Z	29	44	17	8	12	1.10	
116	ICP-MS	29	41	16	8	11	1.04	Info
121	ETAAS-Z	28	38	15	8	10	0.96	
123	ETAAS-Z	26	37	15	8	10	0.93	
126	ETAAS-Z	27	39	16	8	11	1.01	
131	ETAAS-Z	33 ↑	44	18	8	10	1.13	
132	ETAAS-Z	30	41	18	8	11	1.08	
143	ETAAS-Z	25	37	15	7	9	0.92	
144	ETAAS-Z	31	42	17	8	11	1.08	
146	ETAAS-Z	26	38	16	7	10	0.96	
147	ICP-MS	26	37	15	8	10	0.93	
150	ASV-LeadCare	26	30 ↓	12	5	10	0.81	
156	ICP-MS	25	36	14	7	9	0.89	
158	ICP-MS	28	41	16	8	10	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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-01	BE11-02	BE11-03	BE11-04	BE11-05		
Target values:		28	40	16	8	10		
159	ICP-MS	28	41	18	9	11	1.06	
160	ETAAS-Z	29	45 ↑	18	9	12	1.12	
164	ICP-MS	28	39	16	8	10	0.99	
166	ASV-3010	28	40	16	8	12	1.05	
168	ETAAS-Z	29	44	17	9	12	1.10	
179	ICP-MS	28	41	16	8	11	1.03	
197	ICP-MS	26	38	15	9	10	0.94	
198	ETAAS-Z	26	40	17	8	10	1.00	
199	ICP-MS	28	37	15	7	10	0.95	
200	ETAAS-Z	31	45 ↑	18	8	11	1.11	Info
204	ASV-3010	25	36	14	6	10	0.89	
206	ICP-MS	27	37	15	8	10	0.94	
208	ETAAS-Z	26	39	16	8	11	1.00	
215	ETAAS-Z	25	35 ↓	16	10	12	0.99	
221	ETAAS-Z	31	45 ↑	19	9	13	1.18	
232	ASV-3010	29	42	17	7	10	1.05	
237	ETAAS-Z	28	38	15	8	10	0.96	
243	ASV-3010	27	41	15	7	9	0.98	
249	ASV-3010	26	40	15	7	9	0.96	
254	ETAAS-Z	24	37	15	7	9	0.91	
255	ETAAS-Z	28	40	17	8	11	1.04	
261	ETAAS-Z	29	40	17	8	11	1.05	
269	ETAAS-Z	24	35 ↓	14	6	7	0.87	
271	ASV-3010	26	42	18	9	13	1.10	
272	ETAAS-Z	29	39	16	8	11	1.03	
279	ETAAS-Z	27	40	15	8	9	0.97	
282	ASV-3010	27	42	16	6	11	1.03	
286	ASV-LeadCare	27	41	16	6	11	1.02	
290	ICP-MS	28	42	17	9	10	1.04	
291	ASV-3010	30	45 ↑	19	11	13	1.21	

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-01	BE11-02	BE11-03	BE11-04	BE11-05		
Target values:		28	40	16	8	10		
293	ICP-MS	30	42	17	8	11	1.07	
295	ASV-3010	24	38	15	5	8	0.91	
300	ASV-3010	29	43	15	7	12	1.06	
301	ETAAS-Z	22 ↓	34 ↓	13	7	9	0.82	
305	ETAAS-Z	27	37	16	8	10	0.96	
312	ICP-MS	28	41	17	8	10	1.03	
317	ETAAS-Z	27	36	15	8	10	0.93	
324	HR-ICP-MS	27	38	16	8	10	0.97	
325	ETAAS-Z	29	40	16	8	11	1.03	
333	ETAAS-Z	26	38	15	8	9	0.94	
337	ASV-LeadCare	27		16	8	12	1.05	
339	HR-ICP-MS	28	41	17	8	11	1.05	Info
340	ETAAS-Z	27	39	16	8	11	1.01	
343	ASV-LeadCare	26	39	15	7	13	1.04	Info
348	ETAAS-Z	28	39	16	8	11	1.02	
349	ETAAS-Z	27	38	15	8	10	0.95	
350	ASV-3010	28	41	19	9	12	1.10	
352	ASV-3010	28	40	16	6	9	1.00	
353	ETAAS-Z	25	35 ↓	14	8	9	0.88	
365	ETAAS-Z	26	34 ↓	13	8	9	0.86	
366	ETAAS-Z	23 ↓	43	19	8	12	1.07	Info
367	ICP-MS	28	40	17	8	11	1.04	Info
368	ASV-3010	29	44	17	8	12	1.10	
369	ASV-3010	26	38	15	7	10	0.94	
374	ASV-3010	30	44	18	9	12	1.12	
376	ASV-LeadCare	20 ↓	36	13	6	12	0.91	
383	ETAAS-Z	28	42	16	6	10	1.02	
384	ASV-3010	28	44	14	5	10	0.99	
385	ICP-MS	29	41	17	8	11	1.06	Info
388	ASV-3010	26	37	15	7	10	0.93	

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE11-01	BE11-02	BE11-03	BE11-04	BE11-05		
Target values:		28	40	16	8	10		
389	ETAAS-Z	27	39	16	8	11	1.01	
391	ETAAS-Z	29	43	17	8	10	1.06	Info
393	ASV-LeadCare	28	>37	16	8	11	1.03	
395	ICP-MS	28	40	16	8	11	1.03	
401	ETAAS-Z	27	39	15	8	9	0.96	Info
408	ICP-MS	26	37	15	7	10	0.93	Info
410	ICP-MS	28	40	16	8	11	1.03	Info
449	ASV-LeadCare	21 ↓	34 ↓	11 ↓	4	10	0.76	
453	ETAAS-Z	31	43	16	8	10	1.06	Info
455	ASV-LeadCare	29	41	17	7	11	1.06	
461	ASV-3010	26	37	14	8	10	0.91	
463	ASV-LeadCare	29	39	17	7	11	1.04	
464	ASV-LeadCare	28	<37 ▀	14	<6 ▀	>11 ▀	0.94	

Percent satisfactory results for all participants: 96.1 %

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 #1
STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS						
Lab Code	Method	Results ($\mu\text{g/dL}$ whole blood)				
		BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
103	DRC/CC-ICP-MS	27	38	16	8	10
104	ETAAS-Z	28	42	18	9	10
107	ICP-MS	28	41	17	8	11
109	ETAAS-Z	28	39	17	9	11
109	ICP-MS	28	40	16	8	10
110	ETAAS-Z	30	42	18	8	11
110	ICP-MS	28	40	16	8	10
112	ASV-3010	26	38	14	5	8
147	ICP-MS	26	37	15	8	10
156	ICP-MS	25	36	14	7	9
159	ICP-MS	28	41	18	9	11
164	ICP-MS	28	39	16	8	10
166	ASV-3010	28	40	16	8	12
179	ICP-MS	28	41	16	8	11
198	ETAAS-Z	26	40	17	8	10
199	ICP-MS	28	37	15	7	10
243	ASV-3010	27	41	15	7	9
293	ICP-MS	30	42	17	8	11
324	HR-ICP-MS	27	38	16	8	10
325	ETAAS-Z	29	40	16	8	11
350	ASV-3010	28	41	19	9	12
Number of Sample Measurements:		21	21	21	21	21
Mean (target value):		28	40	16	8	10
Standard Deviation:		1.2	1.8	1.3	0.9	1.0
RSD (%):		4.5	4.5	8.0	11.2	9.3
Acceptable Range:						
Upper Limit:		32	44	20	12	14
Lower Limit:		24	36	12	4	6

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 #1
STATISTICAL SUMMARY BY METHOD**

	Results (µg/dL whole blood)				
	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
ASV-3010					
Number of Sample Measurements:	19	19	19	19	19
Mean:	27.3	40.6	15.9	7.2	10.5
Standard Deviation:	1.7	2.7	1.7	1.6	1.6
RSD (%):	6.2	6.7	10.5	22.0	15.0
ASV-LeadCare					
Number of Sample Measurements:	17	14	17	16	16
Mean:	26.4	38.4	15.1	6.8	11.3
Standard Deviation:	2.6	3.3	1.8	1.2	1.0
RSD (%):	10.0	8.7	11.7	18.3	9.0
DRC/CC-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	27.0	38.0	16.0	8.0	10.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	42	42	42	42	42
Mean:	27.5	39.6	16.1	8.0	10.4
Standard Deviation:	2.3	3.1	1.4	0.7	1.1
RSD (%):	8.4	7.8	8.9	9.0	11.0
HR-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	27.5	39.5	16.5	8.0	10.5
Standard Deviation:	0.7	2.1	0.7	0.0	0.7
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	22	22	22	22	22
Mean:	27.7	39.6	16.0	8.0	10.4
Standard Deviation:	1.1	1.8	1.0	0.5	0.6
RSD (%):	4.0	4.6	5.9	6.7	5.7
All Laboratories					
Number of Sample Measurements:	103	100	103	102	102
Mean:	27.3	39.6	15.9	7.6	10.6
Standard Deviation:	2.1	2.8	1.5	1.1	1.1
RSD (%):	7.5	7.1	9.2	14.2	10.9

notes: ? Insufficient data for calculation.

**New York State Department of Health
Blood Lead Test Results, 2011 Event #1
STATISTICAL SUMMARY BY CLASS**

Results ($\mu\text{g/dL}$ whole blood)					
	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
Evaluated					
Number of Sample Measurements:	62	59	62	61	61
Mean:	27.1	39.3	15.7	7.6	10.5
Standard Deviation:	2.3	3.3	1.6	1.2	1.2
RSD (%):	8.3	8.3	10.0	16.3	11.5
Info					
Number of Sample Measurements:	20	20	20	20	20
Mean:	27.5	40.5	16.2	7.6	11.1
Standard Deviation:	2.1	2.2	1.2	0.8	1.1
RSD (%):	7.6	5.3	7.1	9.9	9.5
Reference					
Number of Sample Measurements:	21	21	21	21	21
Mean:	27.7	39.7	16.3	7.9	10.3
Standard Deviation:	1.2	1.8	1.3	0.9	1.0
RSD (%):	4.5	4.5	8.0	11.2	9.3
All Laboratories					
Number of Sample Measurements:	103	100	103	102	102
Mean:	27.3	39.6	15.9	7.6	10.6
Standard Deviation:	2.1	2.8	1.5	1.1	1.1
RSD (%):	7.5	7.1	9.2	14.2	10.9

notes: ? Insufficient data for calculation.

New York State Department of Health
Event #1, 2011

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	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Blood Aluminum (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	< 10.8	< 10.8	< 10.8	< 10.8	< 10.8

Blood Barium (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
110	ICP-MS	8.1	7.4	7.6	8.5	14.3
147	ICP-MS	7.61	6.89	6.7	7.92	12.7
197	ICP-MS	7.2	6.3	6.5	8.0	13.1
312	ICP-MS	6.7	6.4	6.2	7.7	13.6
Arithmetic Mean (n=4)		7.4	6.7	6.8	8.0	13.4
SD		0.6	0.5	0.6	0.3	0.7

Blood Beryllium (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
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	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

Blood Cobalt (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
110	ICP-MS	8.29	5.33	4.42	1.58	0.86
147	ICP-MS	8.13	5.22	4.33	1.65	0.884
159	ICP-MS	7.9	4.9	4.4	1.5	0.8
197	ICP-MS	8.2	5.1	4.4	1.4	<1.0
312	ICP-MS	8.3	5.5	4.4	1.7	0.9
391	DRC/CC-ICP-MS	7.9	4.8	4	1.4	0.7
Arithmetic mean (n=6)		8.1	5.1	4.3	1.5	0.8
SD		0.2	0.3	0.2	0.1	0.1

Blood Chromium (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	0.344	0.33	0.312	0.325	0.333
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	0.6	0.9	0.6	0.7	0.7

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Blood Cesium (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
110	ICP-MS	0.55	0.64	0.53	0.48	0.45

Blood Copper (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
110	ICP-MS	1202	1180	1251	1257	1060
147	ICP-MS	1144	1131	1188	1201	991
197	ICP-MS	1270	1260	1310	1350	1160
312	ICP-MS	1080	1120	1160	1190	1040
Arithmetic mean (n=4)		1174	1173	1227	1250	1063
SD		81	64	67	73	71

Blood Iodine (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	48.1	47.5	39	40.6	49.7

Blood Manganese (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
103	DRC/CC-ICP-MS	83.9	26.2	12.5	48.9	19.1
107	DRC/CC-ICP-MS	88.1	28.7	14.4	54	21.1
110	ETAAS-Z	87.1	26.4	12.9	50.6	20.1
114	ICP-MS	73.5	23.9	11.0	40.6	17.6
147	ICP-MS	86.8	28	13.7	51.8	20.2
156	ICP-MS	88.8	27.6	14.7	47.0	20.2
159	ICP-MS	92.0	29.0	15.0	59.0	22.0
179	ETAAS-Z	87.7	28.9	13.1	52.2	17.2
197	ICP-MS	79.9	25.2	12.2	46.6	18.3
293	ICP-MS	83.9	26.5	11.4	48.0	20.6
305	ICP-MS	87.7	29.7	15.6	52.7	21.4
312	DRC/CC-ICP-MS	92.0	32.0	15.0	57.0	23.0
391	DRC/CC-ICP-MS	67.0	21.6	10.7	39.9	17.6
Arithmetic mean (n=13)		84.5	27.2	13.2	49.9	19.9
SD		7.2	2.7	1.6	5.6	1.8

Blood Molybdenum (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	18	5.68	12.6	17.4	20.5

Blood Nickel (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	0.9	0.816	0.658	0.593	0.725

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Blood Platinum (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
110	ICP-MS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Blood Selenium (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
109	ICP-MS	327	382	401	369	284
110	DRC/CC-ICP-MS	323	379	406	380	284
147	ICP-MS	325	379	405	381	280
197	ICP-MS	303	349	357	361	281
305	ICP-MS	346	412	492	424	328
312	ICP-MS	367	461	445	466	343
391	DRC/CC-ICP-MS	344.6	409.4	438.0	417.3	314.4
Arithmetic mean (n=7)		334	396	421	400	302
SD		21	36	43	38	26

Blood Tin (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
110	ICP-MS	< 1.14	<1.14	3.62	3.95	8.57
147	ICP-MS	0.238	0.759	3.430	3.690	8.10
156	ICP-MS	<11.0	<11.0	<11.0	<11.0	<11.0
197	ICP-MS	<5.0	<5.0	<5.0	<5.0	10.6
Arithmetic mean (n=4)				3.5	3.8	9.1
SD						1.3

Blood Tellurium (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	<0.38	<0.38	<0.38	<0.38	<0.38

Blood Thallium (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
110	ICP-MS	0.22	0.95	3.38	4.14	8.94
147	ICP-MS	0.239	0.859	3.25	3.82	8.3
156	ICP-MS	<11.0	<11.0	<11.0	<11.0	<11.0
159	ICP-MS	<1.0	1.0	3.7	4.6	9.6
179	ICP-MS	<1.0	<1.0	3.0	4.0	8.0
197	ICP-MS	<1.0	<1.0	3.2	3.7	8.3
312	ICP-MS	0.2	1.0	3.5	4.2	9.1
Arithmetic mean (n=7)		0.22	1.0	3.3	4.1	8.7
SD			0.1	0.2	0.3	0.6

Blood Thorium (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	<0.12	<0.12	<0.12	<0.12	<0.12

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Blood Uranium (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
103	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	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
147	ICP-MS	0.0287	0.031	0.0225	0.0257	0.0487

Blood Zinc (µg/L)

Lab Code	Method	BE11-01	BE11-02	BE11-03	BE11-04	BE11-05
110	ICP-MS	2140	2445	2018	4023	1818
114	ICP-MS	*288.0	*298.0	*250.0	*467.0	*193.0
147	ICP-MS	2072	2392	1980	3908	1693
197	ICP-MS	1800	2200	1900	3510	1790
312	ICP-MS	2030	2500	1970	4230	1750
Arithmetic mean (n=4)		2011	2384	1967	3918	1763
(*omitted)						
SD		147	131	49	303	54

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., 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.
