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# **Wadsworth Center**

NEW YORK STATE DEPARTMENT OF HEALTH

*Trace Elements Laboratory*

## **TRACE ELEMENTS IN WHOLE BLOOD**

### **Proficiency Test Report**

**Event #3, 2013**

**November 6<sup>th</sup>, 2013**

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**NEW YORK**  
state department of  
**HEALTH**

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

Sue Kelly  
Executive Deputy Commissioner

November 6, 2013

**Trace Elements in Whole Blood  
Event #3, 2013**

Dear Laboratory Director:

Results from the third proficiency test (PT) event in 2013 for Trace Elements in Whole Blood have been tabulated and summarized. Target values for Arsenic, Cadmium, Mercury and Lead in whole blood have been established along with acceptable ranges. Results are graded using element-specific criteria as indicated in each narrative section. A laboratory with an unacceptable significant analytical bias relative to the target value will be expected to investigate the source of the error. A confidential three-digit code number assigned by the PT program identifies participant laboratories. The data for blood lead were previously reported in the Blood Lead PT Report issued October 16th, 2013, and are reproduced here for completeness.

**PT Materials**

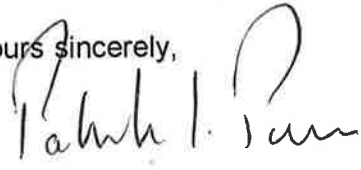
Test materials for the third event were prepared from caprine (goat) whole blood obtained from animals dosed with lead acetate to create physiologically bound lead (Pb). A total of five blood pools were supplemented with arsenic (as inorganic  $\text{As}^{3+}$ ), cadmium (as  $\text{Cd}^{2+}$ ) and mercury as both inorganic ( $\text{Hg}^{2+}$ ) and organic (ethylmercury ( $\text{CH}_3\text{CH}_2\text{Hg}^+$ ) and methylmercury ( $\text{CH}_3\text{Hg}^+$ )) species. In addition to As, Cd, Pb and Hg, blood pools were supplemented with the trace elements manganese (Mn), thallium (Tl), tin (Sn), titanium (Ti), nickel (Ni), cobalt (Co), chromium (Cr), tungsten (W) and vanadium (V).

**Additional Elements to Become Graded for Performance Assessment**

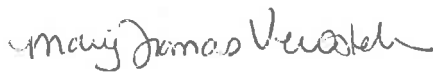
PT results for select trace elements, including Co and Cr, are graded as part of this PT event, although the data is used for "Educational Purposes" only, to inform laboratory participants of where improved practices may be necessary. Laboratories that test and report these, and other, trace elements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

**The next PT event for trace elements in whole blood is scheduled to be mailed Wednesday, January 15th, 2014.** Please inform our laboratory staff at (518) 474-7161 if the test materials have not arrived within five days of the scheduled mail out date. **The deadline for reporting results is Wednesday, February 5th, 2014.**

Thank you for your participation in this event.

Yours sincerely,  


Patrick J. Parsons, Ph.D.  
Chief, Laboratory of Inorganic and Nuclear Chemistry  
Deputy Director, Division of Environmental Health



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

New York State Department of Health  
Event #3, 2013

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**Whole Blood Arsenic**

Test materials for arsenic were prepared from caprine (goat) whole blood preserved with K<sub>2</sub>EDTA anticoagulant. A total of five pools were supplemented with arsenic as inorganic As<sup>3+</sup>.

**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 6.4 µg/L (0.09 µmol/L) to 57.0 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, 94.0% of test results reported were judged as satisfactory, with one of the 20 laboratories (5.0%) reporting 2 or more of the 5 results outside the acceptable ranges.

**New York State Department of Health**  
**Blood Arsenic Test Results, 2013 Event #3**  
**ROBUST STATISTICAL SUMMARY**

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**TARGET VALUE ASSIGNMENT AND STATISTICS**

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

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	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
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<b>Robust Mean</b>	<b>6.4</b>	<b>44.4</b>	<b>14.8</b>	<b>31.4</b>	<b>57.0</b>
Robust Standard Deviation	2.4	2.1	2.4	2.5	2.8
Standard Uncertainty	0.8	0.6	0.7	0.7	0.8
RSD (%)	38.0	4.8	16.5	8.0	4.9
Number of Sample Measurements	16	20	20	20	20
Acceptable Range:					
Upper Limit	12.4	53.3	20.8	37.7	68.4
Lower Limit	0.4	35.5	8.8	25.1	45.6

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**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, 2013 Event #3**  
**PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15	
Target Values:		6.4	44.4	14.8	31.4	57.0	
103	DRC/CC-ICP-MS	4.5	43.1	12.9	30.7	57.6	Info
110	DRC/CC-ICP-MS	4.8	47.5	14.0	32.9	57.9	
114	ICP-MS	8.0	44.0	18.0	33.0	58.0	
147	ICP-MS	4.5	43.2	12.4	29.2	56.9	
156	ICP-MS	<5.0	48.7	13.0	33.6	63.5	
164	ICP-MS	7.0	49.0	16.0	35.0	62.0	Info
179	ICP-MS	<12.0	49.0	17.0	34.0	59.0	
197	DRC/CC-ICP-MS	<10.0	43.0	14.0	30.0	52.0	
200	ICP-MS	5.0	43.4	13.5	30.6	56.8	
206	DRC/CC-ICP-MS	12.0	44.2	18.3	31.5	55.9	
208	ICP-MS	<10.0	44.7	18.8	32.9	57.5	Info
293	DRC/CC-ICP-MS	4.4	44.2	13.0	29.4	58.4	
305	ICP-MS	4.0	43.0	12.0	30.0	51.0	
312	DRC/CC-ICP-MS	9.9	36.0	15.0	28.0	44.0 ↓	
324	ICP-MS	12.2	45.2	19.5	32.6	55.7	
339	HR-ICP-MS	4.4	46.5	13.4	31.3	58.9	Info
359	ICP-MS	8.1	41.6	15.7	27.8	53.5	Info
391	DRC/CC-ICP-MS	6.5	44.5	14.1	32.1	56.9	
469	ICP-MS	21.7 ↑	58.2 ↑	26.6 ↑	48.3 ↑	78.2 ↑	
481	ICP-MS	4.0	37.0	11.8	26.8	49.9	
Percent satisfactory results for all participants:						94.0 %	

**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, 2013 Event #3**  
**STATISTICAL SUMMARY BY METHOD**

Results ( $\mu\text{g/L}$ whole blood)					
	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
<b>DRC/CC-ICP-MS</b>					
Number of Sample Measurements:	6	7	7	7	7
Mean:	7.0	43.2	14.5	30.7	54.7
Standard Deviation:	3.2	3.5	1.8	1.7	5.2
RSD (%):	45.7	8.1	12.7	5.5	9.5
<b>HR-ICP-MS</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	4.4	46.5	13.4	31.3	58.9
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
<b>ICP-MS</b>					
Number of Sample Measurements:	7	12	12	12	12
Mean:	5.8	45.6	16.2	32.8	58.5
Standard Deviation:	1.8	5.2	4.3	5.5	7.4
RSD (%):	31.8	11.5	26.3	16.8	12.6
<b>All Laboratories</b>					
Number of Sample Measurements:	14	20	20	20	20
Mean:	6.2	44.8	15.5	32.0	57.2
Standard Deviation:	2.5	4.6	3.5	4.4	6.6
RSD (%):	39.9	10.3	22.8	13.8	11.5

**notes:** ? Insufficient data for calculation.

A Standard Deviation displayed as 0.0 should be interpreted as <0.1

New York State Department of Health  
Event #3, 2013

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**Whole Blood Cadmium**

Test materials for cadmium were prepared from caprine (goat) whole blood preserved with K<sub>2</sub>EDTA anticoagulant. A total of five blood pools were supplemented with different amounts of cadmium (as Cd<sup>2+</sup>).

**The Target Value** assigned for each PT material is the robust mean of the results reported by all participants in this event. The robust statistics were obtained utilizing algorithms based on those presented in **ISO 13528:2005E** Statistical methods for use in proficiency testing by interlaboratory comparisons. Values for whole blood cadmium range from 2.4 µg/L (21 nmol/L) to 14.5 µg/L (129 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, 96.3% of the results reported by all participants were satisfactory, with one of the 27 laboratories (3.7%) reporting 2 or more of the 5 results outside the acceptable ranges.

**New York State Department of Health**  
**Blood Cadmium Test Results, 2013 Event #3**  
**ROBUST STATISTICAL SUMMARY**

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**TARGET VALUE ASSIGNMENT AND STATISTICS**

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

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	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
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<b>Robust Mean</b>	<b>14.5</b>	<b>12.8</b>	<b>6.1</b>	<b>9.1</b>	<b>2.4</b>
Robust Standard Deviation	1.1	0.8	0.3	0.7	0.3
Standard Uncertainty	0.3	0.2	0.1	0.2	0.1
RSD (%)	7.7	6.2	5.2	7.7	12.3
Number of Sample Measurements	27	27	27	27	27
Acceptable Range:					
Upper Limit	16.7	14.7	7.1	10.5	3.4
Lower Limit	12.3	10.9	5.1	7.7	1.4

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**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, 2013 Event #3**  
**PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15	
Target Values:		14.5	12.8	6.1	9.1	2.4	
103	DRC/CC-ICP-MS	15.3	13.1	6.1	9.5	2.4	Info
106	ICP-MS	15.2	13.5	6.3	9.4	2.5	Info
107	DRC/CC-ICP-MS	15.0	13.3	6.3	9.6	2.4	Info
109	ICP-MS	16.3	14.7	6.6	10.4	2.6	Info
110	ICP-MS	14.8	13.1	6.2	9.2	2.5	
114	ICP-MS	13.3	12.4	6.1	8.8	2.3	
116	ICP-MS	15.2	13.7	6.4	9.6	2.4	Info
147	ICP-MS	14.3	12.6	6.0	8.9	2.3	Info
156	ICP-MS	13.9	11.7	5.9	8.8	2.8	
164	ICP-MS	12.6	11.1	5.3	7.8	2.0	
179	ICP-MS	14.1	12.0	5.7	8.6	2.2	
197	DRC/CC-ICP-MS	14.5	13.0	6.2	9.5	2.9	
200	ICP-MS	13.8	10.6 ↓	5.5	8.5	2.2	Info
206	ICP-MS	15.3	12.8	6.2	9.8	3.0	
208	ICP-MS	14.5	12.4	6.1	9.0	2.3	
293	ICP-MS	14.5	12.6	6.0	8.4	2.4	Info
305	ICP-MS	14.5	12.5	6.0	9.3	2.6	
312	ICP-MS	14.0	13.0	6.2	8.7	2.7	
324	ICP-MS	12.4	10.9	5.1	7.6 ↓	2.0	Info
339	HR-ICP-MS	15.1	13.5	6.2	9.4	2.5	Info
359	ICP-MS	12.7	12.3	6.1	8.1	2.6	
366	ETAAS-Z	14.0	12.6	6.0	8.6	2.3	Info
367	DRC/CC-ICP-MS	17.5 ↑	16.0 ↑	6.9	11.4 ↑	3.0	Info
391	DRC/CC-ICP-MS	16.3	13.8	6.3	10.0	2.5	Info
401	ETAAS other	13.6	12.5	5.5	8.7	1.9	Info
410	ICP-MS	16.0	13.5	6.5	9.7	2.6	Info
469	ICP-MS	13.3	12.4	5.1	9.3	1.9	

Percent satisfactory results for all participants: 96.3 %

**notes:** ↑ reported outside upper limit  
↓ reported outside lower limit  
▼: Unacceptable result

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

**New York State Department of Health**  
**Blood Cadmium Test Results, 2013 Event #3**  
**STATISTICAL SUMMARY BY METHOD**

Results (µg/L whole blood)					
	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
<b>DRC/CC-ICP-MS</b>					
Number of Sample Measurements:	5	5	5	5	5
Mean:	15.7	13.8	6.4	10.0	2.6
Standard Deviation:	1.2	1.2	0.3	0.8	0.3
RSD (%):	7.6	9.0	4.9	8.1	10.9
<b>ETAAS other</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	13.6	12.5	5.5	8.7	1.9
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
<b>ETAAS-Z</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	14.0	12.6	6.0	8.6	2.3
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
<b>HR-ICP-MS</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	15.1	13.5	6.2	9.4	2.5
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
<b>ICP-MS</b>					
Number of Sample Measurements:	19	19	19	19	19
Mean:	14.2	12.5	6.0	8.9	2.4
Standard Deviation:	1.1	1.0	0.4	0.7	0.3
RSD (%):	7.7	8.0	7.3	7.9	11.8
<b>All Laboratories</b>					
Number of Sample Measurements:	27	27	27	27	27
Mean:	14.5	12.8	6.0	9.1	2.4
Standard Deviation:	1.2	1.1	0.4	0.8	0.3
RSD (%):	8.2	8.6	7.1	8.7	12.3

**notes:** ? Insufficient data for calculation.

A Standard Deviation displayed as 0.0 should be interpreted as <0.1

**New York State Department of Health**  
**Event #3, 2013**

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**Whole Blood Mercury**

Test materials for mercury were prepared from caprine (goat) whole blood preserved with K<sub>2</sub>EDTA anticoagulant. A total of five pools were supplemented with different amounts of mercury as both inorganic (Hg<sup>2+</sup>) and organometallic (as both ethylmercury, CH<sub>3</sub>CH<sub>2</sub>Hg<sup>+</sup>, and methylmercury, CH<sub>3</sub>Hg<sup>+</sup>) species.

<b>Sample</b>	<b>Mercury species added</b>
BE13-11	Hg <sup>2+</sup> , CH <sub>3</sub> Hg <sup>+</sup> , and CH <sub>3</sub> CH <sub>2</sub> Hg <sup>+</sup>
BE13-12	Hg <sup>2+</sup>
BE13-13	Hg <sup>2+</sup> and CH <sub>3</sub> Hg <sup>+</sup> , and CH <sub>3</sub> CH <sub>2</sub> Hg <sup>+</sup>
BE13-14	Hg <sup>2+</sup> and CH <sub>3</sub> Hg <sup>+</sup> , and CH <sub>3</sub> CH <sub>2</sub> Hg <sup>+</sup>
BE13-15	Hg <sup>2+</sup> and CH <sub>3</sub> Hg <sup>+</sup>

**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 1.8 µg/L (9 nmol/L) to 62.0 µg/L (309 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, 96.6% of results reported by all participants were satisfactory, with two of the 29 laboratories (6.9%) reporting 2 or more of the 5 results outside the acceptable ranges.

**New York State Department of Health**  
**Blood Mercury Test Results, 2013 Event #3**  
**ROBUST STATISTICAL SUMMARY**

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**TARGET VALUE ASSIGNMENT AND STATISTICS**

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

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	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
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<b>Robust Mean</b>	<b>10.8</b>	<b>1.8</b>	<b>17.1</b>	<b>62.0</b>	<b>4.7</b>
Robust Standard Deviation	1.2	0.3	1.8	6.2	0.5
Standard Uncertainty	0.3	0.1	0.4	1.4	0.1
RSD (%)	11.1	16.0	10.4	9.9	11.1
Number of Sample Measurements	29	22	29	29	28
Acceptable Range:					
Upper Limit	14.0	4.8	22.2	80.6	7.7
Lower Limit	7.6	0.0	12.0	43.4	1.7

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**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, 2013 Event #3**  
**PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15	
Target Values:		10.8	1.8	17.1	62.0	4.7	
103	DRC/CC-ICP-MS	11.1	1.9	17.8	64.4	4.6	Info
106	DRC/CC-ICP-MS	10.7	2.0	17.1	61.7	4.6	Info
107	DRC/CC-ICP-MS	10.8	1.9	17.1	61.7	4.6	Info
109	ICP-MS	11.7	2.0	18.2	65.3	4.9	Info
110	ICP-MS	10.0	1.5	16.2	57.1	4.1	
114	ICP-MS	11.2	1.9	17.4	65.1	4.8	
116	ICP-MS	10.9	1.7	17.5	63.2	4.7	Info
147	ICP-MS	10.9	1.7	17.3	62.8	4.6	Info
156	ICP-MS	12.6	<3.0	19.3	68.4	5.5	
164	ICP-MS	10.0	<4.0	15.0	57.0	4.0	
179	ICP-MS	10.0	2.0	16.0	60.0	5.0	
197	DRC/CC-ICP-MS	10.0	<5.0	15.0	45.0	5.0	
200	ICP-MS	10.8	1.4	15.6	57.4	4.2	Info
206	ICP-MS	10.0	<3.0	15.0	59.0	4.0	
208	ICP-MS	12.0	<5.0	18.3	66.1	5.1	
293	ICP-MS	11.3	3.0	16.5	57.5	5.0	Info
305	ICP-MS	14.0	<2.0	21.0	75.0	6.0	
312	ICP-MS	12.0	1.8	20.0	74.0	4.8	
324	AFS	10.3	1.7	16.9	57.9	4.5	Info
339	HR-ICP-MS	9.1	1.7	14.7	57.7	3.4	Info
359	ICP-MS	10.4	2.1	18.0	61.0	5.3	
366	ICP-MS	10.4	1.5	16.0	60.0	4.7	Info
367	CV-AAS	12.4	2.2	20.8	72.7	5.4	Info
391	CV-AAS	15.1 ↑	2.3	26.6 ↑	107.8 ↑	6.0	Info
401	CV-AAS	5.6 ↓	1.2	8.8 ↓	55.4	2.6	Info
410	ICP-MS	11.7	2.1	18.6	66.9	5.0	Info
453	Atomic Spectrometry Other	10.4	1.6	16.7	65.0	5.3	Info
469	ICP-MS	7.8	1.9	15.7	50.8	3.5	
481	ICP-MS	9.8	<5.0	16.6	57.3	<5.0	

Percent satisfactory results for all participants: 96.6 %

**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, 2013 Event #3**  
**STATISTICAL SUMMARY BY METHOD**

Results (µg/L whole blood)					
	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
<b>AFS</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	10.3	1.7	16.9	57.9	4.5
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
<b>Atomic Spectrometry</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	10.4	1.6	16.7	65.0	5.3
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
<b>CV-AAS</b>					
Number of Sample Measurements:	3	3	3	3	3
Mean:	11.0	1.9	18.7	78.6	4.7
Standard Deviation:	4.9	0.6	9.1	26.7	1.8
RSD (%):	—	—	—	—	—
<b>DRC/CC-ICP-MS</b>					
Number of Sample Measurements:	4	3	4	4	4
Mean:	10.7	1.9	16.8	58.2	4.7
Standard Deviation:	0.5	0.1	1.2	8.9	0.2
RSD (%):	4.4	—	7.2	15.3	4.3
<b>HR-ICP-MS</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	9.1	1.7	14.7	57.7	3.4
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
<b>ICP-MS</b>					
Number of Sample Measurements:	19	13	19	19	18
Mean:	10.9	1.9	17.3	62.3	4.7
Standard Deviation:	1.3	0.4	1.7	6.1	0.6
RSD (%):	12.0	21.4	9.7	9.8	12.8
<b>All Laboratories</b>					
Number of Sample Measurements:	29	22	29	29	28
Mean:	10.8	1.9	17.2	63.2	4.7
Standard Deviation:	1.7	0.4	2.9	10.7	0.7
RSD (%):	16.0	19.8	16.8	17.0	15.9

**notes:** ? Insufficient data for calculation.

A Standard Deviation displayed as 0.0 should be interpreted as <0.1

**New York State Department of Health**  
**Event #3, 2013**

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**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<sub>2</sub>EDTA 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 2 µg/dL to 25 µg/dL. Among the reference group, imprecision (SD) varied from 0.5 - 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, 97.2% of results reported by all participants were judged as satisfactory, with one of 87 participant laboratories (1.2%) reporting 2 or more of the 5 results outside the acceptable ranges.

**New York State Department of Health**  
**Blood Lead Test Results, 2013 Event #3**  
**PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15		
Target values:		2	18	25	12	5		
103	ASV-LeadCare	<3.3	19	26	13	5	1.06	Info
103	DRC/CC-ICP-MS	2	19	27	13	5	1.07	
104	ETAAS-Z	2	18	26	12	5	1.01	
106	ICP-MS	ND	18	26	13	5	1.04	Info
107	ASV-LeadCare	<3.3	21	29	14	6	1.16	Info
107	DRC/CC-ICP-MS	2	18	26	13	5	1.04	
109	ETAAS-Z	1	17	24	12	4	0.97	
109	ICP-MS	1.9	19.2	26.8	13.4	5.4	1.07	
110	ETAAS-Z	3	20	27	13	6	1.09	
110	ASV-LeadCare	<3	19	25	12	5	1.02	Info
110	ICP-MS	2	16	23	11	4	0.91	
112	ETAAS-Z	2	19	27	13	5	1.07	
114	ICP-MS	2	18	26	13	5	1.04	
116	ICP-MS	2	18	26	13	5	1.04	Info
121	ETAAS-Z	1	19	27	14	6	1.10	Info
123	ETAAS-Z	3	16	23	11	6	0.91	
126	ETAAS-Z	<3	18	24	12	4	0.99	
131	ETAAS-Z	3	18	24	13	5	1.01	
143	ETAAS-Z	<1	15	23	11	4	0.89	
144	ETAAS-Z	<2	16	23	11	4	0.91	
147	ICP-MS	2	17	25	12	5	0.98	
150	ETAAS-Z	<2	18	26	12	5	1.01	
156	ICP-MS	2	18	26	13	5	1.04	
158	ICP-MS	<3	18	26	12	5	1.01	

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

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



**New York State Department of Health**  
**Blood Lead Test Results, 2013 Event #3**  
**PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15		
Target values:		2	18	25	12	5		
160	ICP-MS	2	17	24	12	5	0.97	
164	ICP-MS	<2	18	25	13	5	1.03	
166	ASV-3010	<2	14	23	10	4	0.85	
168	ETAAS-Z	2	19	26	13	5	1.06	
179	ICP-MS	2	19	26	13	5	1.06	
198	ETAAS-Z	<2	18	25	13	5	1.03	
200	ICP-MS	1	18	25	12	5	1.00	
204	ASV-3010	2	13 ↓	23	9	<2	0.82	
206	ICP-MS	<2	19	27	13	5	1.07	
208	ETAAS-Z	<3	17	26	12	5	0.99	
232	ASV-3010	3	16	24	11	3	0.92	
237	ETAAS-Z	2	21	30 ↑	15	6	1.21	
243	ASV-3010	1	19	27	13	5	1.07	
254	ETAAS-Z	1	17	24	12	5	0.97	
255	ETAAS-Z	2	17	24	12	5	0.97	
269	ETAAS-Z	<1	14	20 ↓	10	4	0.79	
272	ETAAS-Z	2	17	25	13	5	1.01	
279	ETAAS-Z	1	13 ↓	18 ↓	9	3	0.72	
290	ICP-MS	2	16	23	12	5	0.94	
291	ASV-3010	3	14	23	13	4	0.93	
293	ICP-MS	2	16	24	12	5	0.95	
295	ASV-3010	2	19	27	13	5	1.07	
301	ETAAS Other	<1	15	20 ↓	10	3	0.82	
305	ETAAS-Z	2	17	23	12	5	0.95	

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

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

**New York State Department of Health**  
**Blood Lead Test Results, 2013 Event #3**  
**PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15		
Target values:		2	18	25	12	5		
312	ICP-MS	2	18	26	13	5	1.04	
317	ETAAS-Z	2	20	27	14	6	1.12	
324	ICP-MS	2	15	22	10	4	0.86	
325	ETAAS-Z	2	18	25	12	5	1.00	
333	ETAAS-Z	3	20	28	14	6	1.13	
337	ASV-LeadCare	<3	20	26	14	5	1.11	
339	HR-ICP-MS	2	18	24	12	4	0.99	Info
340	ETAAS-Z	<2	18	27	13	5	1.05	
343	ASV-LeadCare	2	19	27	12	5	1.05	Info
345	ASV-LeadCare	<3	20	27	15	7	1.15	
348	ETAAS-Z	1	19	26	13	5	1.06	
349	ETAAS-Z	1	16	22	11	4	0.90	
350	ASV-3010	2	17	23	11	<4	0.93	
353	ETAAS-Z	<2	15	22	10	3	0.86	
365	ETAAS-Z	<2	18	25	13	5	1.03	
366	ETAAS-Z	2	17	24	11	5	0.94	Info
367	DRC/CC-ICP-MS	2	19	28	14	6	1.11	Info
368	ASV-3010	3	19	27	15	6	1.13	
369	ASV-3010	3	18	27	13	6	1.05	
374	ASV-3010	<2	17	23	10	3	0.93	
388	ASV-3010	<2	13 ↓	21	12	5	0.85	
389	ETAAS-Z	2	16	23	11	4	0.91	
391	ETAAS-Z	1.3	16.6	25.4	12.4	4.4	0.98	Info
393	ASV-LeadCare	<3	20	28	16	5	1.19	

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

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

**New York State Department of Health**  
**Blood Lead Test Results, 2013 Event #3**  
**PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15		
Target values:		2	18	25	12	5		
401	ETAAS Other	2	20	27	13	6	1.09	Info
410	ICP-MS	2	19	27	13	5	1.07	Info
461	ASV-3010	2	17	25	12	6	0.98	
463	ASV-LeadCare	<3	21	28	14	6	1.15	
464	ASV-LeadCare	6	16	42 ↑	16	4	1.30	
466	ASV-LeadCare	2	20	23	12	5	1.01	
469	ICP-MS	2	17	24	12	5	0.97	
470	ASV-LeadCare	<3	18	26	13	5	1.04	
473	ASV-LeadCare	<3	19	30 ↑	15	6	1.17	
475	ASV-LeadCare	<3	22	31 ↑	15	6	1.24	
476	ASV-LeadCare	<2	16	26	11	4	0.95	
477	ASV-LeadCare	<3	19	25	14	5	1.07	
478	ASV-LeadCare	>8 ↑	22	28	15	6	1.20	
481	ID-ICP-MS	1	15	23	10	4	0.88	
482	ASV-LeadCare	<3	22	34 ↑	16	5	1.31	

Percent satisfactory results for all participants: 97.2 %

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

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

**New York State Department of Health**  
**Blood Lead Test Results, 2013 Event #3**  
**STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS						
Lab Code	Method	Results (µg/dL whole blood)				
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
103	DRC/CC-ICP-MS	2	19	27	13	5
104	ETAAS-Z	2	18	26	12	5
107	DRC/CC-ICP-MS	2	18	26	13	5
109	ETAAS-Z	1	17	24	12	4
109	ICP-MS	1.9	19.2	26.8	13.4	5.4
110	ETAAS-Z	3	20	27	13	6
110	ICP-MS	2	16	23	11	4
112	ETAAS-Z	2	19	27	13	5
147	ICP-MS	2	17	25	12	5
156	ICP-MS	2	18	26	13	5
160	ICP-MS	2	17	24	12	5
164	ICP-MS	<2	18	25	13	5
166	ASV-3010	<2	14	23	10	4
179	ICP-MS	2	19	26	13	5
198	ETAAS-Z	<2	18	25	13	5
200	ICP-MS	1	18	25	12	5
243	ASV-3010	1	19	27	13	5
293	ICP-MS	2	16	24	12	5
324	ICP-MS	2	15	22	10	4
325	ETAAS-Z	2	18	25	12	5
350	ASV-3010	2	17	23	11	<4
Number of Sample Measurements:		18	21	21	21	20
<b>Mean (target value):</b>		<b>2</b>	<b>18</b>	<b>25</b>	<b>12</b>	<b>5</b>
Standard Deviation:		0.5	1.5	1.5	1.0	0.5
RSD (%):		25.0	8.4	6.1	8.2	10.3
Acceptable Range:						
Upper Limit:		6	22	29	16	9
Lower Limit:		0	14	21	8	1

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

**New York State Department of Health  
Blood Lead Test Results, 2013 Event #3  
STATISTICAL SUMMARY BY METHOD**

	Results (µg/dL whole blood)				
	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
<b>ASV-3010</b>					
Number of Sample Measurements:	9	12	12	12	10
Mean:	2.3	16.3	24.4	11.8	4.7
Standard Deviation:	0.7	2.3	2.1	1.7	1.2
RSD (%):	30.3	14.1	8.6	14.3	24.7
<b>ASV-LeadCare</b>					
Number of Sample Measurements:	2	17	17	17	17
Mean:	2.0	19.6	28.3	13.9	5.3
Standard Deviation:	0.0	1.8	4.4	1.6	0.8
RSD (%):	—	9.2	15.4	11.2	14.6
<b>DRC/CC-ICP-MS</b>					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2.0	18.7	27.0	13.3	5.3
Standard Deviation:	0.0	0.6	1.0	0.6	0.6
RSD (%):	—	—	—	—	—
<b>ETAAS Other</b>					
Number of Sample Measurements:	1	2	2	2	2
Mean:	2.0	17.5	23.5	11.5	4.5
Standard Deviation:	?	3.5	4.9	2.1	2.1
RSD (%):	—	—	—	—	—
<b>ETAAS-Z</b>					
Number of Sample Measurements:	22	32	32	32	32
Mean:	1.9	17.4	24.7	12.2	4.8
Standard Deviation:	0.7	1.8	2.4	1.3	0.8
RSD (%):	37.0	10.2	9.6	10.7	16.8
<b>HR-ICP-MS</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2.0	18.0	24.0	12.0	4.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
<b>ICP-MS</b>					
Number of Sample Measurements:	15	19	19	19	19
Mean:	1.9	17.6	25.1	12.4	4.9
Standard Deviation:	0.3	1.2	1.4	0.9	0.3
RSD (%):	13.4	6.7	5.8	6.9	6.8
<b>ID-ICP-MS</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	1.0	15.0	23.0	10.0	4.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—

**notes:** ? Insufficient data for calculation.

A Standard Deviation displayed as 0.0 should be interpreted as <0.1 (see DRC/CC-ICP-MS and HR-ICP-MS participants)

**New York State Department of Health  
Blood Lead Test Results, 2013 Event #3  
STATISTICAL SUMMARY BY CLASS**

	Results ( $\mu\text{g/dL}$ whole blood)				
	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
<b>Evaluated</b>					
Number of Sample Measurements:	27	53	53	53	52
Mean:	2.1	17.6	25.4	12.6	4.9
Standard Deviation:	0.7	2.3	3.7	1.8	0.9
RSD (%):	32.6	13.0	14.5	14.1	19.1
<b>Info</b>					
Number of Sample Measurements:	9	13	13	13	13
Mean:	1.8	18.7	26.3	12.8	5.2
Standard Deviation:	0.4	1.2	1.5	0.9	0.6
RSD (%):	21.1	6.2	5.5	7.1	12.3
<b>Reference</b>					
Number of Sample Measurements:	18	21	21	21	20
Mean:	1.9	17.6	25.1	12.2	4.9
Standard Deviation:	0.5	1.5	1.5	1.0	0.5
RSD (%):	25.0	8.4	6.1	8.2	10.3
<b>All Laboratories</b>					
Number of Sample Measurements:	54	87	87	87	85
Mean:	2.0	17.8	25.5	12.5	4.9
Standard Deviation:	0.6	2.0	3.0	1.5	0.8
RSD (%):	29.2	11.3	11.9	12.1	16.4

**notes:** ? Insufficient data for calculation.

**New York State Department of Health**  
**Event #3, 2013**

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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 the additional trace elements cobalt (Co) and chromium (Cr) are reported here. Although these data are provided solely for educational and informational purposes, target values and acceptable ranges are provided. The New York State grading criteria were established after discussions with the FDA and with other trace element PT scheme organizers. Departures from the acceptable ranges should trigger an internal Quality Assurance review.

**Additional Elements**

Co and Cr

**New York State Department of Health**  
**Event #3, 2013**

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**Whole Blood Cobalt**

Test materials for chromium were prepared from caprine (goat) whole blood preserved with K<sub>2</sub>EDTA anticoagulant. A total of five pools were supplemented with cobalt as inorganic Co<sup>2+</sup>.

**The Target Values** assigned for each PT material is the robust mean of the results reported by all participants for the 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 cobalt range from 2.8 µg/L to 18.7 µg/L.

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

**Discussion:** Based upon the above criteria, 90.0% of test results reported were within the acceptable ranges. One of the 10 laboratories (10.0%) reported 2 or more of the 5 results outside the acceptable ranges. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment (QA) program. Note that this grading scheme is intended for educational purposes. Departures from the acceptable ranges should trigger an internal QA review.



**New York State Department of Health**  
**Blood Cobalt Test Results, 2013 Event #3**  
**ROBUST STATISTICAL SUMMARY**

**TARGET VALUE ASSIGNMENT AND STATISTICS**

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

**BE13-11      BE13-12      BE13-13      BE13-14      BE13-15**

<b>Robust Mean</b>	<b>2.8</b>	<b>8.8</b>	<b>18.7</b>	<b>10.7</b>	<b>6.8</b>
Robust Standard Deviation	0.4	0.9	1.2	1.0	0.5
Standard Uncertainty	0.2	0.4	0.5	0.4	0.2
RSD (%)	13.9	10.2	6.5	9.6	7.9
Number of Sample Measurements	10	10	10	10	10
Acceptable Range:					
Upper Limit	4.3	10.6	22.4	12.8	8.3
Lower Limit	1.3	7.0	15.0	8.6	5.3

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

**New York State Department of Health**  
**Blood Cobalt Test Results, 2013 Event #3**  
**PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15	
Target Values:		2.8	8.8	18.7	10.7	6.8	
110	ICP-MS	2.9	9.4	19.8	11.5	7.2	Info
147	ICP-MS	2.72	9.55	19.5	11	7.13	
156	ICP-MS	2.5	8.5	18.8	10.6	6.4	
164	ICP-MS	2.4	7.9	17.4	9.2	6.3	
197	ICP-MS	2.3	7.9	17.1	9.6	6.2	
206	ICP-MS	3.0	9.5	20.0	11.2	7.2	
305	ICP-MS	3.0	9.2	19.4	11.3	7.1	Info
312	ICP-MS	3.1	9.6	19.0	12.0	7.3	
324	ICP-MS	14.7 ↑	3.9 ↓	3.6 ↓	7.5 ↓	0.9 ↓	
391	DRC/CC-ICP-MS	2.6	8.6	18.4	10.5	6.7	

Percent satisfactory results for all participants: 90.0 %

**NOTE: Grading is for educational purposes only**

**notes:** ↑ Reported outside upper limit  
↓ Reported outside lower limit  
▼: Result unacceptable  
▲: Result not reported

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

**New York State Department of Health**  
**Blood Cobalt Test Results, 2013 Event #3**  
**STATISTICAL SUMMARY BY METHOD**

<b>Results (<math>\mu\text{g/L}</math> whole blood)</b>					
	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
<b>DRC/CC-ICP-MS</b>					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2.6	8.6	18.4	10.5	6.7
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
<b>ICP-MS</b>					
Number of Sample Measurements:	8	9	9	9	9
Mean:	2.7	8.4	17.2	10.4	6.2
Standard Deviation:	0.3	1.8	5.2	1.4	2.0
RSD (%):	11.2	21.7	30.2	13.6	32.8
<b>All Laboratories</b>					
Number of Sample Measurements:	9	10	10	10	10
Mean:	2.7	8.4	17.3	10.4	6.2
Standard Deviation:	0.3	1.7	4.9	1.3	1.9
RSD (%):	10.7	20.4	28.4	12.8	30.8

**notes:** ? Insufficient data for calculation.

A Standard Deviation displayed as 0.0 should be interpreted as <0.1

**New York State Department of Health**  
**Event #3, 2013**

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**Whole Blood Chromium**

Test materials for chromium were prepared from caprine (goat) whole blood preserved with K<sub>2</sub>EDTA anticoagulant. A total of five pools were supplemented with chromium as inorganic Cr<sup>3+</sup>.

**The Target Values** assigned for each PT material is the arithmetic mean of the results reported by all participants for the event. Values for whole blood chromium range from 2.8 µg/L (54 nmol/L) to 25.4 µg/L (488 nmol/L) after outlier exclusion.

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

**Discussion:** Based upon the above criteria, 80.0% of test results reported were within the acceptable ranges. Three of the 8 laboratories (37.5%) reported 2 or more of the 5 results outside the acceptable ranges. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment (QA) program. Note that this grading scheme is intended for educational purposes. Departures from the acceptable ranges should trigger an internal QA review.

**New York State Department of Health**  
**Blood Chromium Test Results, 2013 Event #3**  
**STATISTICAL SUMMARY**

**TARGET VALUE ASSIGNMENT AND STATISTICS**

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

**BE13-11      BE13-12      BE13-13      BE13-14      BE13-15**

<b>Arithmetic Mean*</b>	<b>7.7</b>	<b>6.1</b>	<b>2.8</b>	<b>25.4</b>	<b>11.8</b>
Standard Deviation	0.9	1.1	0.6	4.3	2.0
RSD (%)	11.6	17.9	20.1	16.9	17.1
Number of Sample Measurements*	7	8	7	7	8
Acceptable Range:					
Upper Limit	9.7	8.1	4.8	30.5	14.2
Lower Limit	5.7	4.1	0.8	20.3	9.4

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

\* Outliers identified by Grubbs' test excluded

**New York State Department of Health**  
**Blood Chromium Test Results, 2013 Event #3**  
**PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE13-11	BE13-12	BE13-13	BE13-14	BE13-15	
Target Values:		7.7	6.1	2.8	25.4	11.8	
110	DRC/CC-ICP-MS	9.0	6.7	3.7	27.7	12.3	
147	DRC/CC-ICP-MS	8.68	6.71	2.98	▲	12.3	Info
156	ICP-MS	8.0	5.7	2.4	25.4	11.2	
164	DRC/CC-ICP-MS	6.7	4.7	2.2	20.1 ↓	9.3 ↓	
197	DRC/CC-ICP-MS	7.7	5.8	2.8	22.9	10.2	
305	ICP-MS	6.8	5.2	2.2	22	9.8	
312	DRC/CC-ICP-MS	12.0 ↑	8.2 ↑	3.2	33.0 ↑	14.0	
391	DRC/CC-ICP-MS	7.2	5.7	5.3 ↑	26.8	14.9 ↑	Info
Percent satisfactory results for all participants:						80.0 %	

**NOTE: Grading is for educational purposes only**

**notes:** ↑ Reported outside upper limit  
↓ Reported outside lower limit  
▼: Result unacceptable  
▲: Result not reported

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

**New York State Department of Health**  
**Blood Chromium Test Results, 2013 Event #3**  
**STATISTICAL SUMMARY BY METHOD**

Results ( $\mu\text{g/L}$ whole blood)					
	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
<b>DRC/CC-ICP-MS</b>					
Number of Sample Measurements:	6	6	6	5	6
Mean:	8.5	6.3	3.4	26.1	12.2
Standard Deviation:	1.9	1.2	1.1	4.9	2.1
RSD (%):	22.3	18.9	31.8	18.9	17.6
<b>ICP-MS</b>					
Number of Sample Measurements:	2	2	2	2	2
Mean:	7.4	5.5	2.3	23.7	10.5
Standard Deviation:	0.8	0.4	0.1	2.4	1.0
RSD (%):	—	—	—	—	—
<b>All Laboratories</b>					
Number of Sample Measurements:	8	8	8	7	8
Mean:	8.3	6.1	3.1	25.4	11.8
Standard Deviation:	1.7	1.1	1.0	4.3	2.0
RSD (%):	20.9	17.9	33.2	16.9	17.1

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

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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 the following additional trace elements as indicated below

**Additional Elements**

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

*NOTE: Report amended 11/26/13 to omit duplicate vanadium results.*



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<b>Blood Aluminum (µg/L)</b>						
Lab Code	Method	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
147	ICP-MS	<10.8	<10.8	<10.8	<10.8	<10.8
305	ICP-MS	16.2	10.7	13.2	16.8	11.1
359	ICP-MS	26.9	23.3	26.1	23.3	30.9

<b>Blood Antimony (µg/L)</b>						
Lab Code	Method	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
110	ICP-MS	<0.1	<0.1	<0.1	<0.1	<0.1
206	ICP-MS	<2.0	<2.0	<2.0	<2.0	<2.0

<b>Blood Barium (µg/L)</b>						
Lab Code	Method	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
147	ICP-MS	15.8	15.9	20.6	15.9	35.4
197	ICP-MS	15.6	15.4	*19.8	14.7	34.3
312	ICP-MS	17.8	17.9	20.6	17.2	41.0
<i>*Outlier</i>	<b>Arithmetic Mean</b>	<b>16.4</b>	<b>16.4</b>	<b>-</b>	<b>15.9</b>	<b>36.9</b>
	SD	1.2	1.3	-	1.3	3.6
	n	3	3	-	3	3

<b>Blood Beryllium (µg/L)</b>						
Lab Code	Method	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
147	ICP-MS	<0.901	<0.901	<0.901	<0.901	<0.901
197	ICP-MS	<0.2	0.3	0.3	<0.2	<0.2

<b>Blood Bismuth (µg/L)</b>						
Lab Code	Method	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0
206	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0
305	ICP-MS	<0.5	<0.5	<0.5	<0.5	<0.5

<b>Blood Cesium (µg/L)</b>						
Lab Code	Method	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
110	ICP-MS	0.42	0.42	0.27	0.53	0.34

<b>Blood Copper (µg/L)</b>						
Lab Code	Method	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
110	ICP-MS	1108	1327	1206	1379	1241
147	ICP-MS	1061	1264	1131	1334	1175
197	ICP-MS	1040	1320	1110	1300	1150
312	ICP-MS	1130	1310	1200	1410	1200
	<b>Arithmetic mean</b>	<b>1085</b>	<b>1305</b>	<b>1162</b>	<b>1356</b>	<b>1192</b>
	SD	41	28	48	49	39
	n	4	4	4	4	4

<b>Blood Iodine (µg/L)</b>						
Lab Code	Method	BE13-11	BE13-12	BE13-13	BE13-14	BE13-15
147	ICP-MS	33.2	34.6	33.7	39.5	39.5

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<b>Blood Lithium (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
147	ICP-MS	1.42	0.916	1.43	1.78	1.13

<b>Blood Manganese (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
103	DRC/CC-ICP-MS	33.1	16.6	20.3	39.1	30.6
107	DRC/CC-ICP-MS	31.4	14.9	19.2	37.4	29.6
110	ETAAS-Z	33.2	15.3	19.2	39.2	29.8
114	ICP-MS	30.4	14.5	18.2	38.2	29.4
147	ICP-MS	32.9	16.9	20.7	39.8	31.7
156	ICP-MS	38.8	*23.6	27.4	46.8	36.8
179	DRC/CC-ICP-MS	30.3	14.8	18.0	38.6	28.3
197	DRC/CC-ICP-MS	32.5	13.8	18.5	38.5	29.1
206	ICP-MS	>25.0	18.4	20.5	>25.0	>25.0
293	ICP-MS	30.1	13.6	18.2	38.3	28.8
305	ICP-MS	28.4	14.4	16.6	37.2	27.8
312	DRC/CC-ICP-MS	36.0	18.0	23.0	45.0	34.0
324	ICP-MS	22.2	15.6	*40.1	31.7	21.4
391	DRC/CC-ICP-MS	31.9	15.4	19.6	37.9	30.3
<i>*Outlier</i>	<b>Arithmetic mean</b>	<b>31.6</b>	<b>15.6</b>	<b>20.0</b>	<b>39.1</b>	<b>29.8</b>
	<b>SD</b>	<b>3.9</b>	<b>1.5</b>	<b>2.7</b>	<b>3.6</b>	<b>3.5</b>
	<b>n</b>	<b>13</b>	<b>13</b>	<b>13</b>	<b>13</b>	<b>13</b>

<b>Blood Molybdenum (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
147	ICP-MS	8.58	6.29	21.4	9.43	9.56
197	ICP-MS	10.8	10.3	27.0	12.8	12.4
305	ICP-MS	8.3	6.6	20.7	9.4	10.0
312	ICP-MS	9.4	7.0	24.0	11.0	10.0
324	ICP-MS	*20.8	*26.2	17.3	*22.2	10.5
<i>*Outlier</i>	<b>Arithmetic mean</b>	<b>9.3</b>	<b>7.5</b>	<b>22.1</b>	<b>10.7</b>	<b>10.5</b>
	<b>SD</b>	<b>1.1</b>	<b>1.9</b>	<b>3.6</b>	<b>1.6</b>	<b>1.1</b>
	<b>n</b>	<b>4</b>	<b>4</b>	<b>5</b>	<b>4</b>	<b>5</b>

<b>Blood Nickel (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
110	DRC/CC-ICP-MS	22.9	3.3	10.7	13.4	6.0
197	ICP-MS	23.1	<2.0	11.4	15.0	7.0
312	ICP-MS	27.0	<3.0	10.0	16.0	10.0
391	DRC/CC-ICP-MS	21.5	<0.5	8.9	13.1	4.2
	<b>Arithmetic mean</b>	<b>24</b>	<b>-</b>	<b>10.3</b>	<b>14</b>	<b>7</b>
	<b>SD</b>	<b>2</b>	<b>-</b>	<b>1.1</b>	<b>1</b>	<b>2</b>
	<b>n</b>	<b>4</b>	<b>-</b>	<b>4</b>	<b>4</b>	<b>4</b>

<b>Blood Platinum (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
110	ICP-MS	<0.1	<0.1	<0.1	<0.1	<0.1
312	ICP-MS	<0.2	<0.2	<0.2	<0.2	<0.2

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<b>Blood Selenium (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
107	DRC/CC-ICP-MS	286	347	297	321	285
109	ICP-MS	311	369	314	337	305
114	ICP-MS	280	362	292	314	280
147	ICP-MS	276	336	285	303	274
305	ICP-MS	314	388	333	348	326
312	ICP-MS	324	382	323	346	313
359	ICP-MS	290	360	326	306	302
<b>Arithmetic Mean</b>		<b>297</b>	<b>363</b>	<b>310</b>	<b>325</b>	<b>298</b>
SD		19	18	19	19	19
n		7	7	7	7	7

<b>Blood Silver (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
110	ICP-MS	1.3	0.3	0.6	0.9	0.3
147	ICP-MS	1.84	0.221	0.764	1.26	0.407
197	ICP-MS	1.6	<1.0	<1.0	1.1	<1.0
<b>Arithmetic mean</b>		<b>1.6</b>	<b>-</b>	<b>-</b>	<b>1.1</b>	<b>-</b>
SD		0.3	-	-	0.2	-
n		3	-	-	3	-

<b>Blood Tellurium (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
147	ICP-MS	<0.06	<0.06	<0.06	<0.06	<0.06
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

<b>Blood Thorium (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
147	ICP-MS	<0.12	<0.12	<0.12	<0.12	<0.12

<b>Blood Thallium (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
110	ICP-MS	14.3	0.1	7.1	4.3	18.4
147	ICP-MS	13.3	0.219	7.13	4.17	18.6
156	ICP-MS	15.0	<0.5	7.9	5.0	20.8
179	ICP-MS	13.0	<1.0	7.0	4.0	18.0
197	ICP-MS	12.5	<1.0	6.6	3.9	17.3
206	ICP-MS	14.2	<1.0	7.5	4.2	19.0
305	ICP-MS	10.6	<0.2	6.0	3.3	15.1
312	ICP-MS	14.0	0.1	7.3	4.4	19.0
324	ICP-MS	*4.5	*8.6	7.1	*17.2	*0.0
<i>*Outlier</i>	<b>Arithmetic mean</b>	<b>13.4</b>	<b>0.1</b>	<b>7.1</b>	<b>4.2</b>	<b>18.3</b>
SD		1.4	0.1	0.5	0.5	1.6
n		8	3	9	8	8

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<b>Blood Tin (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
110	ICP-MS	7.9	0.2	4.3	13.5	17.5
147	ICP-MS	7.78	0.14	4.47	13.8	18.4
156	ICP-MS	7.7	<2.0	4.5	14.4	20.1
197	ICP-MS	8.4	<5.0	<5.0	14.9	18.6
	<b>Arithmetic Mean</b>	<b>7.9</b>	<b>-</b>	<b>4.4</b>	<b>14.2</b>	<b>18.7</b>
	SD	0.3	-	0.1	0.6	1.1
	n	4	-	3	4	4

<b>Blood Tungsten (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
110	ICP-MS	8.8	0.1	5.2	2.4	3.4
103	DRC/CC-ICP-MS	8.8	0.05	5.3	2.3	3.4

<b>Blood Uranium (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
110	ICP-MS	<0.1	<0.1	<0.1	<0.1	<0.1
147	ICP-MS	<0.07	<0.07	<0.07	<0.07	<0.07
312	ICP-MS	<0.1	<0.1	<0.1	<0.1	<0.1

<b>Blood Vanadium (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
110	DRC/CC-ICP-MS	10.9	0.2	6.4	3.5	4.8
147	DRC/CC-ICP-MS	11.5	0.176	6.84	3.56	4.57
312	DRC/CC-ICP-MS	18.0	0.5	10.0	*6.0	7.7
<i>*Outlier</i>	<b>Arithmetic Mean</b>	<b>13.5</b>	<b>0.3</b>	<b>7.7</b>	<b>-</b>	<b>5.7</b>
	SD	3.9	0.2	2.0	-	1.7
	n	3	3	3	-	3

<b>Blood Zinc (µg/L)</b>						
<b>Lab Code</b>	<b>Method</b>	<b>BE13-11</b>	<b>BE13-12</b>	<b>BE13-13</b>	<b>BE13-14</b>	<b>BE13-15</b>
110	ICP-MS	2077	1855	2056	2135	2149
114	ICP-MS	2120	1890	2100	2290	2160
147	ICP-MS	2072	1869	2078	2170	2163
197	ICP-MS	1910	1710	1890	1980	1960
312	ICP-MS	2240	1970	2250	2490	2230
	<b>Arithmetic mean</b>	<b>2084</b>	<b>1859</b>	<b>2075</b>	<b>2213</b>	<b>2132</b>
	SD	118	94	128	190	102
	n	5	5	5	5	5

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**Trace Elements in Whole Blood**  
**METHOD NOTES**

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**ATOMIC SPECTROMETRY METHODS**

- A-1 ETAAS-Z (Electrothermal atomic absorption spectrometry with Zeeman background correction)
- A-2 ETAAS other (i.e., D<sub>2</sub>, 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.

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