
Wadsworth Center

New York State Department of Health

TRACE ELEMENTS IN WHOLE BLOOD

Interlaboratory Study #1, 2002

September 16, 2002



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

Antonia C. Novello, M.D., M.P.H.
Commissioner

Dennis P. Whalen
Executive Deputy Commissioner

September 16, 2002

Trace Elements in Whole Blood Interlaboratory Study #1, 2002

Dear Laboratory Director:

Results from our first interlaboratory study of trace elements in whole blood have been tabulated and summarized in the enclosed report. Target values for Arsenic, Cadmium, Mercury and Lead have been established along with some proposed acceptable ranges. The upper and lower ranges were implemented in the report to provide some feedback to participants on their performance. For those laboratories that operate under a New York State clinical laboratory permit, this should not be construed in terms of a pass or failure since the criteria for successful performance have yet to be developed. Obviously, a laboratory with an apparent significant analytical bias relative to the target value will want to investigate the source of the error.

In the report, we provide a brief narrative on the nature of the test sample including the level of spike, establishment of the target value as well as the specific algorithm for the proposed acceptable ranges. The source of the test materials is bovine blood obtained from two cows: one was dosed with lead acetate followed by calcium arsenate a day later to provide one pool with physiologically-bound Pb and As. The other animal served as a control pool although it had been dosed previously with Pb and, thus, had an background concentration of endogenous Pb. Whole blood pools were generated from the control animal and spiked with additional elements as indicated in analyte specific narrative.

As with any new program, we expect to fine tune various aspects and fix any apparent problems as the program evolves. For example, we know that some laboratories required additional blood to complete all of the testing requested. Future shipments will take such requirements into account. Our hope is that you will find this exercise both helpful and educational. Any issues or problems should be brought to my attention, either by telephone at 518-474-5475 or by e-mail at patrick.parsons@wadsworth.org.

Thank you for your cooperation.

Your sincerely,

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

**New York State Department of Health
Interlaboratory Study #1, 2002**

Whole Blood Arsenic

The test materials for arsenic were prepared using whole blood from two animals. In one experiment, a cow was dosed with Pb, administered orally as lead acetate. The next day, the same animal was dosed with As, administered orally as calcium arsenate. Within two hours, whole blood was drawn into blood collection bags containing EDTA as the anticoagulant. This pool of blood formed the basis for specimen TE02-01. This pool was further enriched by spiking it with various As species: 5 µg/L As as dimethylarsenic acid (DMA); 5 µg/L As as monomethylarsonic acid (MMA); 1.5 µg/L As as arsenobetaine. Specimens TE02-02, TE02-03, TE02-04 and TE02-05 were prepared by spiking blood from an undosed animal with equal concentrations of DMA and MMA.

Sample	As Spike (approx)
TE02-01	(26 µg/L as a result of oral dosing with calcium arsenate) Spikes: 5 µg/L As as DMA 5 µg/L As as MMA 1.5 µg/L As as arsenobetaine
TE02-02	2.5 µg/L As as DMA 2.5 µg/L As as MMA
TE02-03	17 µg/L As as DMA 17 µg/L As as MMA
TE02-04	30 µg/L As as DMA 30 µg/L As as MMA
TE02-05	7 µg/L As as DMA 7 µg/L As as MMA

Target values: were established as the mean of 7 referee laboratories. All used quadrupole based ICP-MS instrumentation. At least one of the referee laboratories used a Dynamic Reaction Cell (DRC-) ICP-MS. Values range from 7.0 µg/L (0.09 µmol/L) to 62.0 µg/L (0.83 µmol/L). Among the referee group, imprecision (SD) was generally ±2-3 µg/L.

Acceptable ranges: were fixed at ±20%, or ±4 µg/L around the target value, whichever is greater. So the range is fixed at ±4 µg/L for concentrations below 20 µg/L. Above 20 µg/L, it is ±20%.

Discussion: of the four elements tested, arsenic proved the most difficult on which to reach consensus among participants reflecting, no doubt, the polyatomic interference from ⁴⁰Ar³⁵Cl in ICP-MS. Still, based on the proposed criteria, we had 78.8% satisfactory results from all participants.

**New York State Department of Health
Blood Arsenic Test Results, 2002 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Whole Blood Arsenic (µg/L)					Normalized Mean	Info Only
		TE02-01	TE02-02	TE02-03	TE02-04	TE02-05		
Target Values:		44.1	7.0	39.1	62.0	16.3		
110	DRC-ICP-MS	44.2	8.3	41.5	64.6	17.0	1.05	
114	ICP-MS	46.0	10.0	41.0	64.0	20.0	1.09	
125	ETAAS-ZL	40	<10	43	68	<10	1.04	
147	ICP-MS	41.9	5.1	35.5	56.5	14.1	0.92	
156	ETAAS-ZL	26.0 ↓	5.0	29.0 ↓	50.0	8.0 ↓	0.71	
159	ICP-MS	42	9	38	60	17	0.99	
164	ICP-MS	43.4	4.3	36.9	61.3	13.6	0.95	
179	ICP-MS	43	4.3	39	61	14	0.96	
197	DRC-ICP-MS	45	16 ↑	43	61	24 ↑	1.38	
206	ICP-MS	55.8 ↑	23.5 ↑	54.7 ↑	76.4 ↑	36.0 ↑	1.92	
208	ICP-MS	40	7	35	54	15	0.90	
293	HGAAS	27 ↓	7	<1	3 ↓	32 ↑	1.31	Info
305	ICP-MS	48.5	8.3	41.7	66.5	18.5	1.11	
312	ICP-MS	43.3	4.8	41.9	58.6	13.3	0.95	
359	ICP-MS	38.3	8.0	30.6 ↓	43.8 ↓	13.9	0.81	
364	ICP-MS	37.7	7.9	31.1 ↓	46.8 ↓	18.5	0.90	

Percent satisfactory results for all participants: 78.8 %

notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info only: results included for informational purposes only.

**New York State Department of Health
Blood Arsenic Test Results, 2002 Event #1
STATISTICAL SUMMARY**

Lab Code	Method	Whole Blood Arsenic ($\mu\text{g/L}$)				
		TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
110	DRC-ICP-MS	44.2	8.3	41.5	64.6	17.0
114	ICP-MS	46.0	10.0	41.0	64.0	20.0
147	ICP-MS	41.9	5.1	35.5	56.5	14.1
159	ICP-MS	42	9	38	60	17
164	ICP-MS	43.4	4.3	36.9	61.3	13.6
179	ICP-MS	43	4.3	39	61	14
305	ICP-MS	48.5	8.3	41.7	66.5	18.5
Number of Sample Measurements:		7	7	7	7	7
Target value:		44.1	7.0	39.1	62.0	16.3
Standard Deviation:		2.4	2.4	2.4	3.3	2.5
RSD (%):		5.4	34.1	6.2	5.4	15.2
Acceptable Range:						
Upper Limit:		52.9	11.0	46.9	74.4	20.3
Lower Limit:		35.3	3.0	31.3	49.6	12.3

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 Arsenic Test Results, 2002 Event #1
STATISTICAL SUMMARY BY METHOD**

	Whole Blood Arsenic ($\mu\text{g/L}$)				
	TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
DRC-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	44.6	12.2	42.3	62.8	20.5
Standard Deviation:	0.6	5.4	1.1	2.5	4.9
RSD (%):	—	—	—	—	—
ETAAS-ZL					
Number of Sample Measurements:	2	2	2	2	2
Mean:	33.0	2.5	36.0	59.0	4.0
Standard Deviation:	9.9	3.5	9.9	12.7	5.7
RSD (%):	—	—	—	—	—
HGAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	27.0	7.0	0.0	3.0	32.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	11	11	11	11	11
Mean:	43.6	8.4	38.7	59.0	17.6
Standard Deviation:	5.1	5.4	6.6	9.0	6.5
RSD (%):	11.7	64.3	17.0	15.2	37.0
All Laboratories					
Number of Sample Measurements:	16	16	16	16	16
Mean:	41.4	8.0	36.4	56.0	17.2
Standard Deviation:	7.2	5.4	11.5	16.3	8.5
RSD (%):	17.5	66.7	31.6	29.1	49.3

notes: ? Insufficient data for SD calculation.

**New York State Department of Health
Blood Arsenic Test Results, 2002 Event #1
STATISTICAL SUMMARY BY CLASS**

	Whole Blood Arsenic ($\mu\text{g/L}$)				
	TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
Evaluated					
Number of Sample Measurements:	8	8	8	8	8
Mean:	40.8	9.0	38.5	57.3	16.1
Standard Deviation:	8.3	7.4	8.7	11.0	10.7
RSD (%):	20.4	81.6	22.7	19.2	66.6
Info					
Number of Sample Measurements:	1	1	1	1	1
Mean:	27.0	7.0	0.0	3.0	32.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
Reference					
Number of Sample Measurements:	7	7	7	7	7
Mean:	44.1	7.0	39.1	62.0	16.3
Standard Deviation:	2.4	2.4	2.4	3.3	2.5
RSD (%):	5.4	34.1	6.2	5.4	15.2
All Laboratories					
Number of Sample Measurements:	16	16	16	16	16
Mean:	41.4	8.0	36.4	56.0	17.2
Standard Deviation:	7.2	5.4	11.5	16.3	8.5
RSD (%):	17.5	66.7	31.6	29.1	49.3

notes: ? Insufficient data for SD calculation.

**New York State Department of Health
Interlaboratory Study #1, 2002**

Whole Blood Cadmium

The test materials for cadmium were prepared using whole blood collected from two animals into blood collection bags containing EDTA anticoagulant. For sample TE02-01, bovine whole blood from an arsenic-dosed animal was spiked with cadmium. For all other pools, whole blood from an undosed animal was spiked with different amounts of cadmium:

Sample	Cd Spike (approx)
TE02-01	4 µg/L as Cd ²⁺
TE02-02	1 µg/L as Cd ²⁺
TE02-03	14 µg/L as Cd ²⁺
TE02-04	20 µg/L as Cd ²⁺
TE02-05	4 µg/L as Cd ²⁺

Target values: were established as the mean of 10 referee laboratories using either quadrupole based ICP-MS instrumentation and/or a furnace AAS method. Values range from 1.0 µg/L (9 nmol/L) to 18.6 µg/L (166 nmol/L). Among the referee group, imprecision (SD) varied from 0.2 – 1.1 µg/L increasing with Hg concentration.

Acceptable ranges: were fixed at ±20%, or ±5 µg/L around the target value, whichever is greater. So the range is fixed at ±1 µg/L for concentrations below 5 µg/L. Above 5 µg/L, it is ±20%.

**New York State Department of Health
Blood Cadmium Test Results, 2002 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/L whole blood)					Normalized Mean	Info Only
		TE02-01	TE02-02	TE02-03	TE02-04	TE02-05		
Target Values:		4.2	1.0	14.0	18.6	5.6		
107	ETAAS-ZL	4	1	13	18	5	0.94	
110	ICP-MS	4.4	1.1	14.5	19.3	6.0	1.04	
110	ETAAS-ZL	4.9	1.0	13.9	18.6	5.9	1.00	
114	ICP-MS	3.7	0.6	12.8	16.9	4.9	0.91	
126	ETAAS-ZL	3.6	0.7	15.2	19.8	6.4	1.06	
147	ICP-MS	4.6	1.1	14.9	19.0	6.0	1.04	
156	ICP-MS	4.3	<1.0	16.1	19.1	5.8	1.07	
159	ICP-MS	4.0	1.0	13.7	19.1	5.5	1.00	
164	ICP-MS	4.1	1.1	13.4	17.7	5.4	0.94	
179	ICP-MS	4.4	1.0	15.4	20.3	6.2	1.06	
197	ICP-MS	4.4	0.8	14.7	19.1	5.4	1.04	
200	ETAAS-ZL	4.4	1.2	15.0	20.0	6.2	1.06	
206	ICP-MS	3.8	0.6	13.7	17.5	5.1	0.97	
208	ICP-MS	4.6	1.0	14.2	19.5	5.6	1.03	
312	ICP-MS	4.0	0.8	13.7	18.5	5.4	1.00	
331	ICP-MS	4.3	0.8	13.9	19.4	4.6	1.00	
339	ETAAS-ZL	5.1	1.1	16.8	22.7 ↑	6.3	1.21	Info
347	ETAAS-ZL	3 ↓	1	12	16	5	0.85	Info
359	ICP-MS	23.4 ↑	19.3 ↑	31 ↑	41.1 ↑	24.7 ↑	6.66	
364	ICP-MS	4.3	1.1	14.8	19.6	5.7	1.06	

Percent satisfactory results for all participants: 93.0 %

notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info only: results included for informational purposes only.

**New York State Department of Health
Blood Cadmium Test Results, 2002 Event #1
STATISTICAL SUMMARY**

Lab Code	Method	Results (µg/L whole blood)				
		TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
107	ETAAS-ZL	4	1	13	18	5
110	ICP-MS	4.4	1.1	14.5	19.3	6.0
110	ETAAS-ZL	4.9	1.0	13.9	18.6	5.9
114	ICP-MS	3.7	0.6	12.8	16.9	4.9
147	ICP-MS	4.6	1.1	14.9	19.0	6.0
159	ICP-MS	4.0	1.0	13.7	19.1	5.5
164	ICP-MS	4.1	1.1	13.4	17.7	5.4
179	ICP-MS	4.4	1.0	15.4	20.3	6.2
200	ETAAS-ZL	4.4	1.2	15.0	20.0	6.2
206	ICP-MS	3.8	0.6	13.7	17.5	5.1
Number of Sample Measurements:		10	10	10	10	10
Target value:		4.2	1.0	14.0	18.6	5.6
Standard Deviation:		0.4	0.2	0.9	1.1	0.5
RSD (%):		8.8	21.2	6.3	5.9	8.9
Acceptable Range:						
Upper Limit:		5.2	2.0	16.8	22.3	6.7
Lower Limit:		3.2	0.0	11.2	14.9	4.5

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 Cadmium Test Results, 2002 Event #1
STATISTICAL SUMMARY BY METHOD**

	Results ($\mu\text{g/L}$ whole blood)				
	TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
ETAAS-ZL					
Number of Sample Measurements:	6	6	6	6	6
Mean:	4.2	1.0	14.3	19.2	5.8
Standard Deviation:	0.8	0.2	1.7	2.2	0.6
RSD (%):	19.1	16.7	12.0	11.7	11.1
ICP-MS					
Number of Sample Measurements:	14	14	14	14	14
Mean:	5.6	2.2	15.5	20.4	6.9
Standard Deviation:	5.1	4.9	4.5	6.0	5.1
RSD (%):	91.8	228.3	29.4	29.4	74.8
All Laboratories					
Number of Sample Measurements:	20	20	20	20	20
Mean:	5.2	1.8	15.1	20.1	6.6
Standard Deviation:	4.3	4.1	3.9	5.1	4.3
RSD (%):	83.6	227.2	25.8	25.6	65.6

notes: ? Insufficient data for SD calculation.

**New York State Department of Health
Blood Cadmium Test Results, 2002 Event #1
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/L}$ whole blood)				
	TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
Evaluated					
Number of Sample Measurements:	8	8	8	8	8
Mean:	6.6	3.1	16.7	22.0	8.0
Standard Deviation:	6.8	6.6	5.8	7.7	6.8
RSD (%):	102.7	214.5	34.9	35.1	85.4
Info					
Number of Sample Measurements:	2	2	2	2	2
Mean:	4.1	1.1	14.4	19.4	5.7
Standard Deviation:	1.5	0.1	3.4	4.7	0.9
RSD (%):	—	—	—	—	—
Reference					
Number of Sample Measurements:	10	10	10	10	10
Mean:	4.2	1.0	14.0	18.6	5.6
Standard Deviation:	0.4	0.2	0.9	1.1	0.5
RSD (%):	8.8	21.2	6.3	5.9	8.9
All Laboratories					
Number of Sample Measurements:	20	20	20	20	20
Mean:	5.2	1.8	15.1	20.1	6.6
Standard Deviation:	4.3	4.1	3.9	5.1	4.3
RSD (%):	83.6	227.2	25.8	25.6	65.6

notes: ? Insufficient data for SD calculation.

New York State Department of Health
Interlaboratory Study #1, 2002

Whole Blood Mercury

Test materials for mercury were prepared using whole blood collected from two animals into blood collection bags containing EDTA anticoagulant. For sample TE02-01, bovine whole blood from an arsenic-dosed animal was spiked with both inorganic Hg and methylmercury ions. For all other pools, whole blood from an undosed animal was spiked with various amounts of mercury as both inorganic and organometallic species:

Sample	Hg spike (approx.)
TE02-01	3 µg/L as Hg ²⁺ 3 µg/L Hg as CH ₃ Hg ⁺
TE02-02	0.5 µg/L Hg ²⁺ 0.5 µg/L Hg as CH ₃ Hg ⁺
TE02-03	10 µg/L Hg ²⁺ 10 µg/L Hg as CH ₃ Hg ⁺
TE02-04	20 µg/L Hg ²⁺ 20 µg/L Hg as CH ₃ Hg ⁺
TE02-05	3 µg/L Hg ²⁺ 3 µg/L Hg as CH ₃ Hg ⁺

Target values: were established as the mean of 11 referee laboratories using either quadrupole based ICP-MS instrumentation and/or a cold-vapor AAS method. Values range from 1.2 µg/L (6 nmol/L) to 33.9 µg/L (169 nmol/L). Among the referee group, imprecision (SD) varied from 0.3 – 4.0 µg/L increasing with Hg concentration.

Acceptable ranges: were fixed at ±20%, or ±3 µg/L around the target value, whichever is greater. So the range is fixed at ±3 µg/L for concentrations below 15 µg/L. Above 15 µg/L, it is ±20%.

Discussion: Based on the proposed criteria, 86.7% satisfactory results were reported by all participants. Some laboratories appeared to have a low bias with the higher Hg concentration samples TE02-03 and TE02-04.

**New York State Department of Health
Blood Mercury Test Results, 2002 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/L whole blood)					Normalized Mean	Info Only
		TE02-01	TE02-02	TE02-03	TE02-04	TE02-05		
Target Values:		5.2	1.2	17.8	33.9	7.3		
107	CVAAS	4.4	0.95	15.7	27.2	5.1	0.84	
109	CVAAS	6	2	21	38	7	1.14	
110	ICP-MS	4.7	1.1	16.3	31.2	7.1	0.90	
110	CVAAS	4.2	1.3	14.5	30.0	6.2	0.86	
114	ICP-MS	5.7	1.1	18.3	32.5	6.7	0.99	
147	CVAAS	6.1	1.1	19.9	39.1	6.7	1.13	
156	CVAAS	4.7	<3.0	16.7	27.6	5.2	0.88	
159	ICP-MS	3	1	10 ↓	19 ↓	5	0.56	
164	ICP-MS	4.9	0.9	17.7	34.6	9.9	1.01	
179	ICP-MS	5	1	17	34	8	0.97	
197	ICP-MS	<5	<5	9 ↓	18 ↓	6	0.53	
200	ICP-MS	5.5	1.1	19.1	34.2	6.4	1.03	
206	ICP-MS	4.7	1.3	15.7	31.3	9.0	0.90	
208	ICP-MS	6.2	1.4	20.4	40.4	8.2	1.14	
293	HGAAS	4.4	0.9	11.9 ↓	21.2 ↓	4.5	0.64	Info
305	ICP-MS	3.9	0.1	13.5 ↓	26.7 ↓	4.3	0.79	
312	ICP-MS	4.9	0.8	16.8	39.8	7.4	1.06	
331	ICP-MS	5.7	3.1	19.1	36.8	7.2	1.07	
347	CVAAS	5	2	8 ↓	17 ↓	1 ↓	0.50	Info
359	ICP-MS	2.6	2.5	2.6 ↓	2.8 ↓	2.5 ↓	??	
364	ICP-MS	5.7	1.5	20.1	35.9	9.4	1.08	

Percent satisfactory results for all participants: 86.7 %

notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info only: results included for informational purposes only.

**New York State Department of Health
Blood Mercury Test Results, 2002 Event #1
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

Lab Code	Method	Results (µg/L whole blood)				
		TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
107	CVAAS	4.4	0.95	15.7	27.2	5.1
109	CVAAS	6	2	21	38	7
110	ICP-MS	4.7	1.1	16.3	31.2	7.1
110	CVAAS	4.2	1.3	14.5	30.0	6.2
114	ICP-MS	5.7	1.1	18.3	32.5	6.7
147	CVAAS	6.1	1.1	19.9	39.1	6.7
164	ICP-MS	4.9	0.9	17.7	34.6	9.9
179	ICP-MS	5	1	17	34	8
200	ICP-MS	5.5	1.1	19.1	34.2	6.4
206	ICP-MS	4.7	1.3	15.7	31.3	9.0
208	ICP-MS	6.2	1.4	20.4	40.4	8.2
Number of Sample Measurements:		11	11	11	11	11
Target value:		5.2	1.2	17.8	33.9	7.3
Standard Deviation:		0.7	0.3	2.1	4.0	1.4
RSD (%):		13.6	25.3	12.1	11.9	18.7
Acceptable Range:						
Upper Limit:		8.2	4.2	21.4	40.7	10.3
Lower Limit:		2.2	0.0	14.2	27.1	4.3

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 Mercury Test Results, 2002 Event #1
STATISTICAL SUMMARY BY METHOD**

	Results ($\mu\text{g/L}$ whole blood)				
	TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
CVAAS					
Number of Sample Measurements:	6	6	6	6	6
Mean:	5.1	1.2	16.0	29.8	5.2
Standard Deviation:	0.8	0.7	4.6	8.1	2.2
RSD (%):	16.0	61.1	29.0	27.2	42.3
HGAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	4.4	0.9	11.9	21.2	4.5
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	14	14	14	14	14
Mean:	4.5	1.2	15.4	29.8	6.9
Standard Deviation:	1.6	0.8	5.0	10.2	2.0
RSD (%):	36.9	66.8	32.8	34.4	29.3
All Laboratories					
Number of Sample Measurements:	21	21	21	21	21
Mean:	4.6	1.2	15.4	29.4	6.3
Standard Deviation:	1.4	0.8	4.8	9.4	2.2
RSD (%):	30.6	62.9	30.9	32.0	34.3

notes: ? Insufficient data for SD calculation.

**New York State Department of Health
Blood Mercury Test Results, 2002 Event #1
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/L}$ whole blood)				
	TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
Evaluated					
Number of Sample Measurements:	8	8	8	8	8
Mean:	3.8	1.1	13.5	25.8	5.9
Standard Deviation:	1.9	1.2	5.9	12.3	2.1
RSD (%):	50.3	104.3	44.1	47.6	36.2
Info					
Number of Sample Measurements:	2	2	2	2	2
Mean:	4.7	1.5	10.0	19.1	2.8
Standard Deviation:	0.4	0.8	2.8	3.0	2.5
RSD (%):	—	—	—	—	—
Reference					
Number of Sample Measurements:	11	11	11	11	11
Mean:	5.2	1.2	17.8	33.9	7.3
Standard Deviation:	0.7	0.3	2.1	4.0	1.4
RSD (%):	13.6	25.3	12.1	11.9	18.7
All Laboratories					
Number of Sample Measurements:	21	21	21	21	21
Mean:	4.6	1.2	15.4	29.4	6.3
Standard Deviation:	1.4	0.8	4.8	9.4	2.2
RSD (%):	30.6	62.9	30.9	32.0	34.3

notes: ? Insufficient data for SD calculation.

**New York State Department of Health
Interlaboratory Study #1, 2002**

Whole Blood Lead

Test materials for blood lead were prepared using the same bovine blood pools used for the other trace elements. For sample TE02-01, bovine whole blood was obtained from an animal that received an oral dose of lead acetate on one day, and an oral dose of calcium arsenate a day later. Whole blood was collected into blood collection bags containing EDTA anticoagulant. For all other pools, whole blood from another animal (dosed the previous year with Pb) was used unspiked. Thus, there is no significant difference in the target values for the pools TE02-02 through TE02-05.

The inclusion of blood lead results for these pools is for informational purposes only. We operate a separate well-established PT program for blood lead that is used to certify clinical laboratories in the United States under CLIA '88 for this test. However, it makes sense to include Pb as an analyte in the Whole Blood Trace Elements profile here for completeness and because some ICP-MS laboratories would routinely report this parameter as part of a multielement analysis. Since these materials can be archived as validation materials for trace elements, including Pb is appropriate. In future rounds, we intend to spike some pools with Pb to provide a more interesting challenge.

**New York State Department of Health
Blood Lead (Trace Elements), 2002 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		TE02-01	TE02-02	TE02-03	TE02-04	TE02-05		
Target Values:		32.4	3.5	3.4	3.1	3.3		
107	ETAAS-ZL	32	4	3	3	4	1.00	
109	ETAAS-ZL	32	4	4	3	3	1.00	
110	ICP-MS	30.9	3.4	3.3	3.3	3.5	0.97	
110	ETAAS-ZL	34.3	4.3	4.2	3.8	4.3	1.06	
123	ETAAS-ZL	28 ↓	4	4	3	3	0.88	
125	ETAAS-ZL	31	4	5	5	4	0.97	
126	ETAAS-ZL	32	5	4	5	5	1.00	
147	ICP-MS	32.0	3.5	3.4	3.3	3.5	1.00	
156	ICP-MS	24.0 ↓	2.8	3.0	1.8	3.0	0.75	
159	ICP-MS	31	3	3	3	3	0.97	
179	ICP-MS	31	3	3	3	3	0.97	
185	ETAAS-ZL	32.6	11.0 ↑	1.5	2.5	2.2	1.89	
197	ICP-MS	35	4	4	4	4	1.09	
200	ETAAS-ZL	34.4	2.7	2.7	1.9	2.4	1.06	
206	ICP-MS	30.9	3.7	3.7	3.5	3.4	0.97	
208	ETAAS-ZL	33.2	3.0	3.4	4.2	3.9	1.03	
293	ETAAS-D2	32.7	3.7	3.7	3.5	3.7	1.03	
305	ICP-MS	32.9	3.7	3.8	3.6	3.6	1.03	
312	ICP-MS	28.8	2.9	3.0	3.4	3.5	0.91	
325	ETAAS-ZL	32.4	3	3	3.4	3	1.00	Info
331	ICP-MS	31.4	3.6	3.4	3.8	3.1	0.97	
339	ETAAS-ZL	38.7 ↑	5.7	5.8	5.4	5.9	1.22	Info
347	ETAAS-ZL	34	3	3	3	3	1.06	
359	ICP-MS	34.1	4.0	3.9	3.8	3.9	1.06	

Percent satisfactory results for all participants: 96.7 %

notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info only: results included for informational purposes only.

**New York State Department of Health
Blood Lead (Trace Elements), 2002 Event #1
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

Lab Code	Method	Results (µg/dL whole blood)				
		TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
107	ETAAS-ZL	32	4	3	3	4
109	ETAAS-ZL	32	4	4	3	3
110	ICP-MS	30.9	3.4	3.3	3.3	3.5
110	ETAAS-ZL	34.3	4.3	4.2	3.8	4.3
147	ICP-MS	32.0	3.5	3.4	3.3	3.5
179	ICP-MS	31	3	3	3	3
200	ETAAS-ZL	34.4	2.7	2.7	1.9	2.4
206	ICP-MS	30.9	3.7	3.7	3.5	3.4
293	ETAAS-D2	32.7	3.7	3.7	3.5	3.7
347	ETAAS-ZL	34	3	3	3	3
Number of Sample Measurements:		10	10	10	10	10
Target value:		32.4	3.5	3.4	3.1	3.3
Standard Deviation:		1.4	0.5	0.5	0.5	0.6
RSD (%):		4.3	14.5	14.4	16.4	16.4
Acceptable Range:						
Upper Limit:		36.4	7.5	7.4	7.1	7.4
Lower Limit:		28.4	0.0	0.0	0.0	0.0

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

**New York State Department of Health
Blood Lead (Trace Elements), 2002 Event #1
STATISTICAL SUMMARY BY METHOD**

	Results ($\mu\text{g/dL}$ whole blood)				
	TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
ETAAS-D2					
Number of Sample Measurements:	1	1	1	1	1
Mean:	32.7	3.7	3.7	3.5	3.7
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-ZL					
Number of Sample Measurements:	12	12	12	12	12
Mean:	32.9	4.5	3.6	3.6	3.6
Standard Deviation:	2.5	2.2	1.1	1.1	1.1
RSD (%):	7.6	50.0	31.0	30.4	29.8
ICP-MS					
Number of Sample Measurements:	11	11	11	11	11
Mean:	31.1	3.4	3.4	3.3	3.4
Standard Deviation:	2.9	0.4	0.4	0.6	0.4
RSD (%):	9.3	12.7	11.4	18.0	10.4
All Laboratories					
Number of Sample Measurements:	24	24	24	24	24
Mean:	32.1	4.0	3.5	3.5	3.5
Standard Deviation:	2.7	1.7	0.8	0.9	0.8
RSD (%):	8.5	41.9	23.5	24.9	22.5

notes: ? Insufficient data for SD calculation.

**New York State Department of Health
Blood Lead (Trace Elements), 2002 Event #1
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/dL}$ whole blood)				
	TE02-01	TE02-02	TE02-03	TE02-04	TE02-05
Evaluated					
Number of Sample Measurements:	12	12	12	12	12
Mean:	31.2	4.3	3.5	3.6	3.5
Standard Deviation:	3.0	2.2	0.9	0.9	0.7
RSD (%):	9.7	52.2	24.4	26.2	20.4
Info					
Number of Sample Measurements:	2	2	2	2	2
Mean:	35.6	4.4	4.4	4.4	4.5
Standard Deviation:	4.5	1.9	2.0	1.4	2.1
RSD (%):	—	—	—	—	—
Reference					
Number of Sample Measurements:	10	10	10	10	10
Mean:	32.4	3.5	3.4	3.1	3.4
Standard Deviation:	1.4	0.5	0.5	0.5	0.6
RSD (%):	4.3	14.5	14.4	16.4	16.4
All Laboratories					
Number of Sample Measurements:	24	24	24	24	24
Mean:	32.1	4.0	3.5	3.5	3.5
Standard Deviation:	2.7	1.7	0.8	0.9	0.8
RSD (%):	8.5	41.9	23.5	24.9	22.5

notes: ? Insufficient data for SD calculation.

New York State Department of Health
Trace Elements in Whole Blood
METHOD NOTES

ETAAS-ZL:

Electrothermal atomic absorption spectrometry with longitudinal Zeeman background correction, e.g., Perkin-Elmer (4100ZL, 4110ZL, 5100ZL, AAnalyst 600 or 800, SIMMA 6000 or 6100), etc.

ETAAS-Z:

Electrothermal atomic absorption spectrometry with transverse Zeeman background correction, e.g., Perkin-Elmer (Z5100), Varian (220Z, 300Z, 400Z, 880Z), Hitachi Z9000, etc.

ETAAS-D₂:

Electrothermal atomic absorption spectrometry with continuum (deuterium) background correction, e.g., Perkin-Elmer (3110, AAnalyst 700), Varian (200P, 300P, 400P), Thermo-Electron (PU 239), Hitachi 8200, etc.

ETAAS-Other:

Electrothermal atomic absorption spectrometry with S-H background correction, or unknown, e.g., TJA AtomSpec, etc.

ICP-MS:

Inductively-coupled plasma mass spectrometry.

FLAME AAS:

Flame atomic absorption spectroscopy.

ICP-MS:

Inductively-coupled plasma mass spectrometry (standard mode).

DRC-ICP-MS:

Inductively-coupled plasma mass spectrometry with Dynamic Reaction Cell.

CV-AAS:

Cold vapor atomic absorption spectrometry (eg, FIAS, FIMS or batch mode).

HG-AAS:

Hydride generation - heated tube atomic absorption.

HG-AFS:

Hydride generation - atomic fluorescence spectroscopy.
