Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

TRACE ELEMENTS IN SERUM

Proficiency Test Report

Event #3, 2014

December 10th, 2014

NEW YORK
state department of
HEALTH

Howard A. Zucker, M.D., J.D.
Acting Commissioner of Health

Sue Kelly
Executive Deputy Commissioner

December 10, 2014

Trace Elements in Serum
Event #3, 2014

Dear Laboratory Director:

Results from the third proficiency test (PT) event for 2014 in the category Trace Elements in Serum have been tabulated and are summarized. Target values for aluminum, copper, selenium and zinc 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.

PT Materials

Test materials were prepared from human serum obtained from Tennessee Blood Services, Inc. Serum units were spiked with a suite of additional trace elements as described in each narrative. In addition to Al, Cu, Se and Zn, serum pools were supplemented with the trace elements antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), cobalt, (Co), chromium (Cr), manganese (Mn), lead (Pb), thallium (Tl), tellurium (Te), tin (Sn), and uranium (U).

The next PT event for trace elements in serum is scheduled to be mailed Wednesday, January 14th, 2015. 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 11th, 2015.**

Thank you for your participation.

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

Serum Aluminum

The test materials for serum Al were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be negative for HIV 1/2 and HIV-1 RNA, and non-reactive to HBsAg, HCV3 and STS. Serum was dispensed into acid-washed 500-mL polypropylene containers to make up five (5) serum pools. Each pool was spiked with a suite of additional trace elements including aluminum as Al^{3+} at various concentrations.

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 serum aluminum range from 5 µg/L (0.19 µmol/L) to 83 µg/L (3.08 µmol/L).

Acceptable ranges for serum aluminum are based on fixed criteria of ±20%, or ±5 µg/L below 25 µg/L. These criteria are based on consensus recommendations from several EQAS organizers (1).

Discussion. Based on the above criteria, 90.9% of test results reported were judged as satisfactory, with two out of 22 participant laboratories (9.1%) reporting 2 or more of the 5 results outside the acceptable ranges.

1. Taylor, A., Angerer, J., Claeys, F., Kristiansen, J., Mazarrasa, O., Menditto, A., Patriarca, M., Pineau, A., Schoeters, I., Sykes, C., Valkonen, S. and Weykamp, C. Comparison of procedures for evaluating laboratory performance in external quality assessment schemes for lead in blood and aluminum in serum demonstrates the need for common quality specifications. Clinical Chemistry 2002 48 2000-2007.

New York State Department of Health
Serum Aluminum Test Results, 2014 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
Robust Mean	**52**	**22**	**83**	**5**	**39**
Robust Standard Deviation	2	3	6	3	3
Standard Uncertainty	0.7	0.9	1.7	1.1	0.8
RSD (%)	4.7	14.3	7.8	60.2	7.9
Number of Sample Measurements	22	21	22	13	22
Acceptable Range:					
Upper Limit:	62	27	100	10	47
Lower Limit:	42	17	66	0	31

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

New York State Department of Health
Serum Aluminum Test Results, 2014 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum) SE14-36	SE14-37	SE14-38	SE14-39	SE14-40	Info Only
	Target Values:	52	22	83	5	39	
114	ICP-MS	57	20	88	<3	39	
147	FAAS	53	23	87	<2.70	42	Info
156	ICP-MS	54	21	94	<11	53 ↑	
160	ICP-MS	51	23	83	8	37	
164	ICP-MS	54	23	88	4	40	
179	DRC/CC-ICP-MS	51	26	83	2	37	
197	ICP-MS	46	<20	80	<20	34	
200	DRC/CC-ICP-MS	50	28 ↑	76	5	35	Info
206	DRC/CC-ICP-MS	51	18	94	7	41	
287	ETAAS-Z	52	23	81	<5	38	
293	ICP-MS	51	22	72	5	35	Info
305	ICP-MS	52	19	82	<5	39	
324	ICP-MS	50	25	84	11 ↑	41	Info
325	ETAAS-Z	34 ↓	13 ↓	62 ↓	0	24 ↓	Info
355	ICP-MS	57	23	88	3	42	
357	ICP-MS	49	19	80	<5	39	
358	ICP-MS	53	20	80	<10	39	
362	ICP-MS	53	25	89	5	37	
363	ICP-MS	55	22	90	11 ↑	42	
366	ETAAS-Z	53	27	85	3	39	Info
401	ICP-AES/OES	40 ↓	19	76	<3	24 ↓	Info
458	ETAAS other	52	20	81	6	39	

Percent satisfactory results for all participants: 90.9 %

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

Info only: results included for informational purposes only.

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
◢: Result not reported

New York State Department of Health
Serum Aluminum Test Results, 2014 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	51	24	84	5	38
Standard Deviation:	1	5	9	3	3
RSD (%):	—	—	—	—	—
ETAAS other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	52	20	81	6	39
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	3	3	3	1	3
Mean:	46	21	76	3	34
Standard Deviation:	11	7	12	?	8
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	1	1	1	0	1
Mean:	53	23	87		42
Standard Deviation:	?	?	?		?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	1	1	1	0	1
Mean:	40	19	76		24
Standard Deviation:	?	?	?		?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	13	12	13	5	13
Mean:	52	22	84	5	40
Standard Deviation:	3	2	6	2	5
RSD (%):	6.0	9.5	6.9	37.4	11.7
All Laboratories					
Number of Sample Measurements:	22	21	22	10	22
Mean:	51	22	83	5	38
Standard Deviation:	5	3	7	2	6
RSD (%):	10.2	15.7	8.8	39.0	15.5

notes: ? Insufficient data for calculation.

Serum Copper

The test materials for serum Al were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be negative for HIV 1/2 and HIV-1 RNA, and non-reactive to HBsAg, HCV3 and STS. Serum was dispensed into acid-washed 500-mL polypropylene containers to make up five (5) serum pools. Each pool was spiked with a suite of additional trace elements including copper as Cu^{2+} at various concentrations.

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 serum copper range from 1165 µg/L (18.33 µmol/L) to 2545 µg/L (40.05 µmol/L).

Acceptable ranges for serum copper are based on fixed criteria of ±15%, or ±95 µg/L below 635 µg/L. These criteria are consistent with those proposed by the OELM Network of EQAS organizers (1, 2) for trace elements in serum, and are slightly less stringent than those previously suggested for NYS (±10%).

Discussion. Based on the above criteria, 93.7% of test results reported were judged as satisfactory, with one out of 19 participant laboratories (5.3%) reporting 2 or more of the 5 results outside the acceptable ranges.

1. A. Taylor, J. Angerer, J. Arnaud, F. Claeys, R.L. Jones, O. Mazarrasa, E. Mairiaux, A. Menditto, P.J. Parsons, M. Patriarca, A. Pineau, S. Valkonen, J.-P. Weber and C. Weykamp Accreditation and Quality Assurance 2006 11 440-445.

2. J. Arnaud, J.-P. Weber, C.W. Weykamp, P.J. Parsons, J. Angerer, E. Mairiaux, O. Mazarrasa, S. Valkonen, A. Menditto, M. Patriarca, and A. Taylor Clinical Chemistry 2008 54 1892-1899.

New York State Department of Health
Serum Copper Test Results, 2014 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE14-36	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
Robust Mean	**2049**	**1366**	**2545**	**1165**	**1499**
Robust Standard Deviation	119	85	199	80	70
Standard Uncertainty	34	24	57	23	20
RSD (%)	5.8	6.2	7.8	6.9	4.7
Number of Sample Measurements	19	19	19	19	19
Acceptable Range:					
Upper Limit:	2356	1571	2927	1340	1724
Lower Limit:	1742	1161	2163	990	1274

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

New York State Department of Health
Serum Copper Test Results, 2014 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum) SE14-36	SE14-37	SE14-38	SE14-39	SE14-40	Info Only
	Target Values:	2049	1366	2545	1165	1499	
107	DRC/CC-ICP-MS	2100	1400	2700	1200	1500	Info
110	ICP-MS	2121	1399	2655	1170	1500	
114	ICP-MS	1960	1310	2230	1060	1350	
147	ICP-MS	2039	1379	2516	1048	1614	Info
156	ICP-AES/OES	2400 ↑	1500	2400	1300	1600	
160	ICP-MS	1940	1280	2370	1070	1390	
164	ICP-MS	1923	1245	2488	1093	1411	
179	DRC/CC-ICP-MS	2060	1360	2570	1150	1500	
197	ICP-MS	2070	1320	2460	1270	1460	
200	ICP-MS	2261	1461	2826	1251	1581	Info
206	ICP-MS	1948	1326	2792	1227	1502	
293	ICP-MS	2206	1513	2772	1202	1608	Info
305	ICP-MS	2050	1370	2540	1130	1460	
324	ETAAS-Z	1541 ↓	1011 ↓	2065 ↓	883 ↓	1110 ↓	Info
325	ICP-MS	2037	1375	2536	1208	1486	Info
359	ICP-MS	2061	1380	2589	1179	1543	
366	ETAAS-Z	2010	1402	2476	1200	1505	Info
401	DRC/CC-ICP-MS	1938	1265	2396	1099	1493	Info
457	ICP-AES/OES	2143	1434	2781	1191	1540	Info

Percent satisfactory results for all participants: 93.7 %

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

Info only: results included for informational purposes only.

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
◢: Result not reported

New York State Department of Health
Serum Copper Test Results, 2014 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2033	1342	2555	1150	1498
Standard Deviation:	84	69	153	51	4
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	1776	1207	2271	1042	1308
Standard Deviation:	332	276	291	224	279
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	2272	1467	2591	1246	1570
Standard Deviation:	182	47	269	77	42
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	12	12	12	12	12
Mean:	2051	1363	2565	1159	1492
Standard Deviation:	105	74	176	77	84
RSD (%):	5.1	5.5	6.9	6.7	5.7
All Laboratories					
Number of Sample Measurements:	19	19	19	19	19
Mean:	2043	1354	2535	1154	1482
Standard Deviation:	171	110	198	97	115
RSD (%):	8.4	8.2	7.8	8.4	7.7

notes: ? Insufficient data for calculation.

Serum Selenium

The test materials for serum Al were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be negative for HIV 1/2 and HIV-1 RNA, and non-reactive to HBsAg, HCV3 and STS. Serum was dispensed into acid-washed 500-mL polypropylene containers to make up five (5) serum pools. Each pool was spiked with a suite of additional trace elements including selenium as Se^{4+} at various concentrations.

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 serum selenium range from 112 µg/L (1.42 µmol/L) to 303 µg/L (3.84 µmol/L).

Acceptable ranges for serum selenium are based on fixed criteria of ±20%, or ±2 µg/L below 10 µg/L. These criteria are a little less stringent than those proposed by the OELM Network of EQAS organizers (±15% or ±8 µg/L below 55 µg/L) (1, 2) for trace elements in serum. As performance for serum Se improves among NYS-permit laboratories, consideration will be given to adopting the OELM criteria.

Discussion. Based on the above criteria, 96.3% of test results reported were judged as satisfactory, with one of the 16 participant laboratories (6.2%) reporting 2 or more of the 5 results outside the acceptable ranges.

1. A. Taylor, J. Angerer, J. Arnaud, F. Claeys, R.L. Jones, O. Mazarrasa, E. Mairiaux, A. Menditto, P.J. Parsons, M. Patriarca, A. Pineau, S. Valkonen, J.-P. Weber and C. Weykamp Accreditation and Quality Assurance 2006 11 440-445.

2. J. Arnaud, J.-P. Weber, C.W. Weykamp, P.J. Parsons, J. Angerer, E. Mairiaux, O. Mazarrasa, S. Valkonen, A. Menditto, M. Patriarca, and A. Taylor Clinical Chemistry 2008 54 1892-1899.

New York State Department of Health
Serum Selenium Test Results, 2014 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (μg/L serum)				
	SE14-36	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
Robust Mean	**228**	**163**	**303**	**112**	**198**
Robust Standard Deviation	11	8	10	8	15
Standard Uncertainty	3	2	3	3	5
RSD (%)	4.6	4.8	3.3	7.4	7.5
Number of Sample Measurements	16	16	16	16	16
Acceptable Range:					
Upper Limit:	274	196	364	134	238
Lower Limit:	182	130	242	90	158

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

New York State Department of Health

Serum Selenium Test Results, 2014 Event #3

PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE14-36	SE14-37	SE14-38	SE14-39	SE14-40	
	Target Values:	228	163	303	112	198	
107	DRC/CC-ICP-MS	230	160	310	110	190	Info
110	DRC/CC-ICP-MS	218	159	285	108	188	
114	ICP-MS	224	162	299	115	184	
147	ICP-MS	212	157	275	102	201	Info
156	DRC/CC-ICP-MS	210	150	290	100	160	
160	ICP-MS	240	176	324	121	207	
164	DRC/CC-ICP-MS	227	162	310	108	198	
179	DRC/CC-ICP-MS	223	164	300	109	193	
200	DRC/CC-ICP-MS	429 ↑	189	309	130	216	Info
206	DRC/CC-ICP-MS	233	166	307	115	210	
293	DRC/CC-ICP-MS	213	154	282	107	183	Info
305	ICP-MS	231	169	307	112	203	
324	ICP-MS	223	158	302	104	184	Info
325	ETAAS-Z	235	157	287	123	198	Info
366	ETAAS-Z	286 ↑	190	354	140 ↑	224	Info
401	DRC/CC-ICP-MS	233	167	310	117	212	Info

Percent satisfactory results for all participants: 96.3 %

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

Info only: results included for informational purposes only.

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
◢: Result not reported

New York State Department of Health
Serum Selenium Test Results, 2014 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
DRC/CC-ICP-MS					
Number of Sample Measurements:	9	9	9	9	9
Mean:	246	163	300	112	194
Standard Deviation:	69	11	12	8	17
RSD (%):	28.0	6.8	3.9	7.6	8.9
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	261	174	321	132	211
Standard Deviation:	36	23	47	12	18
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	5	5	5	5	5
Mean:	226	164	301	111	196
Standard Deviation:	10	8	18	8	11
RSD (%):	4.6	4.9	5.9	7.1	5.6
All Laboratories					
Number of Sample Measurements:	16	16	16	16	16
Mean:	242	165	303	114	197
Standard Deviation:	53	11	19	11	16
RSD (%):	21.9	6.9	6.2	9.3	8.0

notes: ? Insufficient data for calculation.

Serum Zinc

The test materials for serum Al were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be negative for HIV 1/2 and HIV-1 RNA, and non-reactive to HBsAg, HCV3 and STS. Serum was dispensed into acid-washed 500-mL polypropylene containers to make up five (5) serum pools. Each pool was spiked with a suite of additional trace elements including zinc as Zn^{2+} at various concentrations.

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 serum zinc range from 702 µg/L (10.74 µmol/L) to 3452 µg/L (52.79 µmol/L).

Acceptable ranges for serum zinc are based on fixed criteria of ±15%, or ±15 µg/L below 100 µg/L. These criteria are consistent with those proposed by the OELM network of EQAS organizers (1) for trace elements in serum.

Discussion. Based on the above criteria, 95.4% of test results reported were judged as satisfactory, with one out of 26 participant laboratories (3.8%) reporting 2 or more of the 5 results outside the acceptable ranges.

1. A. Taylor, J. Angerer, J. Arnaud, F. Claeys, R.L. Jones, O. Mazarrasa, E. Mairiaux, A. Menditto, P.J. Parsons, M. Patriarca, A. Pineau, S. Valkonen, J.-P. Weber and C. Weykamp Accreditation and Quality Assurance 2006 11 440-445.

2. J. Arnaud, J.-P. Weber, C.W. Weykamp, P.J. Parsons, J. Angerer, E. Mairiaux, O. Mazarrasa, S. Valkonen, A. Menditto, M. Patriarca, and A. Taylor Clinical Chemistry 2008 54 1892-1899.

New York State Department of Health
Serum Zinc Test Results, 2014 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE14-36	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
Robust Mean	**2398**	**855**	**3452**	**702**	**980**
Robust Standard Deviation	148	67	254	68	75
Standard Uncertainty	36	16	64	17	18
RSD (%)	6.2	7.8	7.4	9.7	7.6
Number of Sample Measurements	26	26	25	26	26
Acceptable Range:					
Upper Limit:	2758	983	3970	807	1127
Lower Limit:	2038	727	2934	597	833

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

New York State Department of Health
Serum Zinc Test Results, 2014 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum) SE14-36	SE14-37	SE14-38	SE14-39	SE14-40	Info Only
	Target Values:	2398	855	3452	702	980	
107	DRC/CC-ICP-MS	2500	890	3600	720	990	Info
110	ICP-MS	2480	895	3604	752	1012	
114	ICP-MS	2160	790	3140	610	890	
147	ICP-MS	2373	843	3510	656	1039	Info
156	ICP-AES/OES	2700	960	3900	790	1100	
160	ICP-MS	2140	770	3050	620	870	
164	ICP-MS	2303	789	3347	668	917	
179	DRC/CC-ICP-MS	2330	830	3400	660	960	
197	ICP-MS	2370	830	3420	750	950	
200	ICP-MS	2727	942	3950	765	1099	Info
206	ICP-MS	2284	812	3339	889 ↑	1076	
287	FAAS	2470	870	3580	650	960	
293	ICP-MS	2582	961	3752	726	1039	Info
305	ICP-MS	2260	820	3240	650	910	
324	ICP-MS	3518 ↑	1257 ↑	5076 ↑	1020 ↑	1452 ↑	Info
325	ICP-MS	2430	815	3527	702	968	Info
355	ICP-MS	2252	827	3253	661	952	
357	ICP-MS	2272	811	3249	655	912	
358	ICP-MS	2490	950	3580	800	1010	
359	ICP-MS	2416	888	3425	720	1034	
362	ICP-MS	2380	898	>3000	739	904	
363	ICP-MS	2470	880	3190	710	990	
366	FAAS	2219	780	3116	620	892	Info
401	DRC/CC-ICP-MS	2491	837	3525	700	1014	Info
457	ICP-AES/OES	2323	778	3335	663	965	Info
458	FAAS	2452	849	3644	651	969	

Percent satisfactory results for all participants: 95.4 %

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

Info only: results included for informational purposes only.

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
◢: Result not reported

New York State Department of Health
Serum Zinc Test Results, 2014 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2440	852	3508	693	988
Standard Deviation:	96	33	101	31	27
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2380	833	3447	640	940
Standard Deviation:	140	47	288	18	42
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	2512	869	3618	727	1033
Standard Deviation:	267	129	400	90	95
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	18	18	17	18	18
Mean:	2439	877	3509	727	1001
Standard Deviation:	306	111	464	100	131
RSD (%):	12.5	12.7	13.2	13.8	13.1
All Laboratories					
Number of Sample Measurements:	26	26	25	26	26
Mean:	2438	868	3510	713	995
Standard Deviation:	264	98	399	90	113
RSD (%):	10.8	11.3	11.4	12.6	11.3

notes: ? Insufficient data for calculation.

Additional Trace Elements Reported in Serum

Participant laboratories reported their analytical results for any additional trace elements (other than Al, Cu, Se and Zn) that are routinely reported so that a more complete characterization can be recorded for these PT 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 Al, Cu, Se and Zn, the serum pools were supplemented with additional trace elements as indicated below.

Additional Elements

As, Ba, Be, Cd, Co, Cr, Mn, Pb, Sb, Sn, Te, Tl and U

Serum Antimony (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
110	ICP-MS	6.1	2.2	10.0	<0.2	4.5
147	ICP-MS	6.56	2.26	10.5	<0.030	5.19

Serum Arsenic (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
147	ICP-MS	15.4	11.6	26.1	0.816	26.4
197	DRC/CC-ICP-MS	15	10	23	<10	21

Serum Barium (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
110	ICP-MS	7.2	3.4	11.2	1.0	6.5
147	ICP-MS	7.79	3.83	11.3	0.920	6.52
197	ICP-MS	7.7	3.6	11.2	<2.0	*9.9
**Outlier*	**Arithmetic mean**	7.6	3.6	11.2	-	-
	SD	0.3	0.2	0.1	-	-
	n	3	3	3	2	2

Serum Beryllium (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
110	ICP-MS	7.0	3.5	12	<0.3	6.9
147	ICP-MS	6.37	2.90	11.6	<0.27	6.77
197	ICP-MS	7.1	3.3	11.4	<0.2	6.6
	Arithmetic mean	6.8	3.2	11.7	-	6.8
	SD	0.4	0.3	0.3	-	0.2
	n	3	3	3	-	3

Serum Bismuth (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
147	ICP-MS	<0.042	<0.042	<0.042	<0.042	<0.042
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

Serum Cadmium (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
110	ICP-MS	6.0	2.3	10.4	<0.3	5.1
147	ICP-MS	6.27	2.48	10.3	0.0333	4.69
197	DRC/CC-ICP-MS	5.6	2.0	9.0	<0.5	4.1
	Arithmetic mean	6.0	2.3	9.9	-	4.6
	SD	0.3	0.2	0.8	-	0.5
	n	3	3	3	-	3

Serum Chromium (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
114	ICP-MS	6.8	6.2	10.8	0.4	12.0
147	DRC/CC-ICP-MS	6.60	5.62	9.98	<0.16	12.4
156	DRC/CC-ICP-MS	6.9	6	10	<1	11
160	ICP-MS	7	6	11	<1	13
164	DRC/CC-ICP-MS	6.1	5.7	9.9	0.2	11.4
179	DRC/CC-ICP-MS	6.4	5.7	10.4	0.1	11.8
197	DRC/CC-ICP-MS	6.4	5.9	10.7	<1.0	12.0
206	DRC/CC-ICP-MS	6.3	5.8	9.9	<1.0	12.2
305	ICP-MS	6.8	6.3	11.4	<0.2	12.8
	Arithmetic mean	**6.6**	**5.9**	**10.5**	**0.2**	**12.1**
	SD	0.3	0.2	0.6	0.2	0.6
	n	9	9	9	3	9

Serum Cobalt (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
110	ICP-MS	2.2	1.7	3.8	0.4	3.0
114	ICP-MS	2.0	1.6	3.2	<1.0	2.6
147	ICP-MS	1.96	1.48	3.45	0.29	3.05
156	DRC/CC-ICP-MS	1.8	1.3	3.3	<0.5	2.5
164	ICP-MS	2.0	1.4	3.5	0.3	2.6
179	DRC/CC-ICP-MS	2.0	1.4	3.4	0.3	2.7
197	ICP-MS	1.7	1.2	3.1	<1.0	2.4
206	ICP-MS	2.1	1.7	3.6	<1.0	3.0
324	ICP-MS	1.95	1.40	3.38	0.33	2.70
	Arithmetic mean	**2.0**	**1.5**	**3.4**	**0.32**	**2.7**
	SD	0.1	0.2	0.2	0.05	0.2
	n	9	9	9	5	9

Serum Iodine (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
114	ICP-MS	41.2	36.8	32.9	32.0	48.2
147	ICP-MS	56.8	49.0	44.8	43.4	64.3
156	DRC/CC-ICP-MS	61	54	44	46	66
164	ICP-MS	50	45	40	40	59
179	ICP-MS	60	51	48	46	69
197	ICP-MS	51.7	46.0	41.3	41.7	57.7
206	ICP-MS	51.6	45.8	41.2	39.0	59.2
	Arithmetic mean	**53**	**47**	**42**	**41**	**60**
	SD	7	5	5	5	7
	n	7	7	7	7	7

Serum Iron (µg/L)

Lab Code	Method	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
457	ICP-AES/OES	502	488	478	514	364

Serum Lead (µg/L)

Lab Code	Method	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
147	ICP-MS	30.9	34.6	50.1	0.2	70.0
197	DRC/CC-ICP-MS	31.3	33.0	50.6	<0.4	65.7

Serum Lithium (µg/L)

Lab Code	Method	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
147	ICP-MS	0.401	0.516	0.641	0.681	0.847

Serum Manganese (µg/L)

Lab Code	Method	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
114	ICP-MS	8.2	4.2	10.6	<2.5	5.8
147	ICP-MS	7.53	4.31	11.9	1.15	7.25
179	DRC/CC-ICP-MS	8.1	4.2	11.8	1.2	7.2
197	DRC/CC-ICP-MS	7.8	4.1	11.6	1.4	6.8
206	ICP-MS	7.1	4.3	11.0	1.3	9.6
305	ICP-MS	8.4	4.2	11.8	1.3	7.3
324	ICP-MS	6.90	*3.58	11.1	*0.60	6.22
*Outlier	**Arithmetic mean**	**7.7**	**4.22**	**11.4**	**1.3**	**7.2**
	SD	0.6	0.08	0.5	0.1	1.2
	n	7	6	7	5	7

Serum Mercury (µg/L)

Lab Code	Method	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
147	ICP-MS	0.965	0.596	0.778	0.397	0.959
197	ICP-MS	<5	<5	<5	<5	<5

Serum Molybdenum (µg/L)

Lab Code	Method	SE14-36	SE14-37	SE14-38	SE14-39	SE14-40
110	ICP-MS	7.2	29.4	11.4	1.6	61
147	ICP-MS	6.96	29.9	11.600	1.58	62.7
179	ICP-MS	7.7	30	12	1.5	61
197	ICP-MS	7.9	32.8	13.9	2.1	*79.0
*Outlier	**Arithmetic mean**	7.4	31	12	1.7	62
	SD	0.4	2	1	0.3	1
	n	4	4	4	4	3

Serum Nickel (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
114	ICP-MS	8.8	5.5	12.9	<2.5	8.0
147	ICP-MS	6.52	3.29	10.6	0.816	6.66
179	DRC/CC-ICP-MS	6.9	3.3	12	0.5	6.3
197	ICP-MS	6.3	2.7	10.6	<2.0	5.9
206	ICP-MS	<10.0	<10.0	11.7	<10.0	<10.0
	Arithmetic mean	7.1	3.7	11.6	-	6.7
	SD	1.1	1.2	1.0	-	0.9
	n	4	4	5	2	4

Serum Platinum (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
110	ICP-MS	3.2	1.2	5.0	<0.6	2.3
179	ICP-MS	<10	<10	<10	<10	<10

Serum Silver (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
147	ICP-MS	0.161	0.173	0.092	0.163	0.191
179	ICP-MS	<0.2	<0.2	<0.2	<0.2	<0.2
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

Serum Tellurium (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
147	ICP-MS	3.00	2.23	4.95	<0.077	4.40
197	ICP-MS	3.1	2.4	5.3	<1.0	4.5

Serum Thallium (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
110	ICP-MS	3.2	5.9	5.2	<0.02	12.1
147	ICP-MS	3.13	5.81	5.09	0.0211	11.8
197	ICP-MS	3.0	5.5	5.2	<1.0	12.3
	Arithmetic mean	3.1	5.7	5.2	-	12.1
	SD	0.1	0.2	0.1	-	0.3
	n	3	3	3	1	3

Serum Thorium (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
147	ICP-MS	<0.0070	<0.0070	<0.0070	<0.0070	<0.0070

NOTE: PT Result and summary statistics for SE14-38 nickel corrected on January 30th, 2015.

Serum Tin (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
110	ICP-MS	7.0	6.4	10.0	1.0	9.5
147	ICP-MS	7.65	7.00	11.2	0.872	13.2
197	ICP-MS	7.1	6.1	10.4	<5.0	14.7
	Arithmetic mean	7.3	6.5	10.5	-	12
	SD	0.4	0.5	0.6	-	3
	n	3	3	3	2	3

Serum Tungsten (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
147	ICP-MS	6.55	2.32	10.8	<0.24	4.76

Serum Uranium (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
110	ICP-MS	0.81	0.30	1.3	<0.05	0.54
147	ICP-MS	0.779	0.295	1.280	<0.0071	0.593

Serum Vanadium (µg/L)						
Lab Code	**Method**	**SE14-36**	**SE14-37**	**SE14-38**	**SE14-39**	**SE14-40**
147	DRC/CC-ICP-MS	6.73	2.53	10.9	0.0638	4.98
179	DRC/CC-ICP-MS	6.6	2.5	10.9	0.1	4.9

New York State Department of Health
Trace Elements in Serum
METHOD NOTES

ATOMIC SPECTROMETRY METHODS

A-1 ETAAS-Z (Electrothermal atomic absorption spectrometry with Zeeman background correction)

A-2 ETAAS Other (i.e., D_2, S-H background correction)

A-3 FAAS (Flame atomic absorption spectrometry)

A-4 CV-AAS (Cold vapor atomic absorption spectrometry)

A-5 HG-AAS (Hydride generation atomic absorption spectrometry)

A-6 AFS (Atomic fluorescence spectrometry)

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)

ELECTROCHEMICAL METHODS

E-1 ASV (Anodic stripping voltammetry without digestion)

E-2 ASV-LeadCare® Blood Lead Testing System

E-5 ASV-LeadCare® II Blood Lead Testing System

E-6 ASV-LeadCare® Ultra™ Blood Lead Testing System

E-3 Fluoride specific electrode

MOLECULAR FLUORIMETRY

F-1 EtOAc (Ethyl acetate-acetic acid extraction method for determination of erythrocyte protoporphyrin)

F-2 Aviv hematofluorometry (for determination of EP at hematocrit 35)

F-3 Helena ZPP (for determination of zinc protoporphyrin in μmol ZPP/mol heme)

OTHER METHODS

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