Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

TRACE ELEMENTS IN SERUM

Proficiency Test Report

Event #2, 2014

July 7th, 2014

NEW YORK
state department of
HEALTH

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

Sue Kelly
Executive Deputy Commissioner

July 7, 2014

Trace Elements in Serum
Event #2, 2014

Dear Laboratory Director:

Results from the second 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, some serum pools were supplemented with the trace elements arsenic (As), antimony (Sb), barium (Ba), beryllium (Be), cadmium (Cd), manganese (Mn), molybdenum (Mo), lead (Pb), nickel (Ni), cobalt, (Co), chromium (Cr), caesium (Cs), thallium (Tl), tellurium (Te), tin (Sn), platinum (Pt), vanadium (V), tungsten (W) and uranium (U).

The next PT event for trace elements in serum is scheduled to be mailed Wednesday, September 10th, 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, October 8th, 2014.**

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 Non-reactive for Anti-HIV-1/2, Anti-HCV 3.0 and HBsAg. The serum has also been found to be STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were 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 21 µg/L (0.78 µmol/L) to 101 µg/L (3.74 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, 95.8% of test results reported were judged as satisfactory, with one out of 24 participant laboratories (4.2%) 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 #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE14-31	SE14-32	SE14-33	SE14-34	SE14-35
Robust Mean	**41**	**21**	**72**	**101**	**90**
Robust Standard Deviation	3	2	6	9	8
Standard Uncertainty	0.8	0.4	1.5	2.2	2.0
RSD (%)	7.4	7.4	8.3	8.4	8.8
Number of Sample Measurements	24	24	24	23	23
Acceptable Range:					
Upper Limit:	49	26	86	121	108
Lower Limit:	33	16	58	81	72

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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE14-31	SE14-32	SE14-33	SE14-34	SE14-35	
	Target Values:	41	21	72	101	90	
110	ETAAS-Z	35	16	62	90	78	
114	ICP-MS	38	19	69	98	86	
147	FAAS	43	22	76	108	97	Info
156	ICP-MS	43	20	75	110	97	
160	ICP-MS	37	20	67	99	86	
164	ICP-MS	42	21	71	102	90	
179	DRC/CC-ICP-MS	43	21	76	109	97	
197	ICP-MS	42	21	87 ↑	121	105	
200	DRC/CC-ICP-MS	38	15 ↓	77	96	86	Info
206	DRC/CC-ICP-MS	55 ↑	26	87 ↑	>100	>100	
287	ETAAS-Z	41	22	70	95	82	
293	ICP-MS	38	22	66	95	85	Info
305	ICP-MS	47	28 ↑	81	112	104	
324	ICP-MS	40	21	70	101	90	Info
325	ETAAS-Z	38	20	61	87	76	Info
355	ICP-MS	41	22	73	103	92	
357	ICP-MS	41	19	73	104	88	
358	ICP-MS	43	20	80	114	99	
362	ICP-MS	41	21	73	101	91	
363	ICP-MS	41	20	71	102	89	
366	ETAAS-Z	40	21	72	96	85	Info
367	ETAAS-Z	44	22	76	108	96	Info
401	ICP-AES/OES	38	16	62	97	92	Info
458	ETAAS other	33	17	61	91	77	

Percent satisfactory results for all participants: 95.8 %

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 #2
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-31	SE14-32	SE14-33	SE14-34	SE14-35
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	2	2
Mean:	45	21	80	103	92
Standard Deviation:	9	6	6	9	8
RSD (%):	—	—	—	—	—
ETAAS other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	33	17	61	91	77
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	5	5	5	5	5
Mean:	40	20	68	95	83
Standard Deviation:	3	2	6	8	8
RSD (%):	8.5	12.3	9.5	8.4	9.4
FAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	43	22	76	108	97
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	1	1	1	1	1
Mean:	38	16	62	97	92
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	13	13	13	13	13
Mean:	41	21	74	105	92
Standard Deviation:	3	2	6	7	7
RSD (%):	6.3	10.9	8.1	7.0	7.2
All Laboratories					
Number of Sample Measurements:	24	24	24	23	23
Mean:	41	21	72	102	90
Standard Deviation:	4	3	7	8	8
RSD (%):	10.5	13.9	10.0	8.1	8.8

notes: ? Insufficient data for calculation.

Serum Copper

The test materials for serum Cu were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be Non-reactive for Anti-HIV-1/2, Anti-HCV 3.0 and HBsAg. The serum has also been found to be STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were 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 1371 µg/L (21.57 µmol/L) to 1745 µg/L (27.46 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, 91.0% of test results reported were judged as satisfactory, with two out of 20 participant laboratories (10.0%) 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 #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (μg/L serum)				
	SE14-31	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
Robust Mean	**1371**	**1625**	**1419**	**1538**	**1745**
Robust Standard Deviation	57	70	75	96	98
Standard Uncertainty	16	19	21	77	27
RSD (%)	4.2	4.3	5.3	6.3	5.6
Number of Sample Measurements	20	20	20	20	20
Acceptable Range:					
Upper Limit:	1577	1869	1632	1769	2007
Lower Limit:	1165	1381	1206	1307	1483

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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum) SE14-31	SE14-32	SE14-33	SE14-34	SE14-35	Info Only
	Target Values:	1371	1625	1419	1538	1745	
107	DRC/CC-ICP-MS	1320	1590	1400	1520	1710	Info
110	ICP-MS	1403	1668	1418	1551	1741	
114	ICP-MS	1320	1580	1380	1470	1690	
147	ICP-MS	1404	1639	1436	1518	1804	Info
156	ICP-AES/OES	1400	1600	1400	1500	1700	
160	ICP-MS	1370	1650	1420	1560	1810	
164	ICP-MS	132 ↓	159 ↓	141 ↓	150 ↓	171 ↓	
179	DRC/CC-ICP-MS	1390	1650	1460	1570	1800	
197	ICP-MS	1340	1570	1380	1480	1700	
200	ICP-MS	1403	1657	1473	1619	1826	Info
206	ICP-MS	1298	1462	1248	1346	1520	
293	ICP-MS	1329	1602	1405	1526	1742	Info
305	ICP-MS	1461	1676	1517	1663	1946	
324	ICP-MS	1351	1564	1349	1476	1669	Info
325	ICP-MS	1640 ↑	2120 ↑	1480	1670	2000	Info
359	ICP-MS	1246	1468	1335	1388	1256 ↓	
366	ETAAS-Z	1372	1624	1400	1554	1729	Info
401	DRC/CC-ICP-MS	1512	1830	1557	1703	2027 ↑	Info
457	ICP-AES/OES	1408	1711	1491	1625	1769	Info
481	ICP-MS	1373	1660	1488	1579	1768	

Percent satisfactory results for all participants: 91.0 %

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 #2
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-31	SE14-32	SE14-33	SE14-34	SE14-35
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	1407	1690	1472	1598	1846
Standard Deviation:	97	125	79	95	163
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	1	1	1	1	1
Mean:	1372	1624	1400	1554	1729
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	1404	1656	1446	1563	1735
Standard Deviation:	6	78	64	88	49
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	13	13	13	13	13
Mean:	1380	1640	1410	1527	1729
Standard Deviation:	95	161	73	97	186
RSD (%):	6.9	9.8	5.2	6.3	10.8
All Laboratories					
Number of Sample Measurements:	19	19	19	19	19
Mean:	1386	1648	1423	1543	1748
Standard Deviation:	85	140	72	92	168
RSD (%):	6.2	8.5	5.0	5.9	9.6

notes: ? Insufficient data for calculation.

Serum Selenium

The test materials for serum Se were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be Non-reactive for Anti-HIV-1/2, Anti-HCV 3.0 and HBsAg. The serum has also been found to be STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were 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 119 µg/L (1.51 µmol/L) to 271 µg/L (3.43 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, 96.0% of test results reported were judged as satisfactory, with one of the 15 participant laboratories (6.7%) 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 #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (μg/L serum)				
	SE14-31	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
Robust Mean	**140**	**189**	**119**	**208**	**271**
Robust Standard Deviation	11	15	9	17	21
Standard Uncertainty	3	5	3	5	7
RSD (%)	7.7	8.0	7.4	8.1	7.9
Number of Sample Measurements	15	15	15	15	15
Acceptable Range:					
Upper Limit:	168	227	143	250	325
Lower Limit:	112	151	95	166	217

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 #2

PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE14-31	SE14-32	SE14-33	SE14-34	SE14-35	
	Target Values:	140	189	119	208	271	
107	DRC/CC-ICP-MS	127	171	108	192	245	Info
110	DRC/CC-ICP-MS	137	183	116	204	258	
114	ICP-MS	133	176	115	194	254	
147	ICP-MS	135	176	111	193	250	Info
156	DRC/CC-ICP-MS	130	180	110	190	250	
164	DRC/CC-ICP-MS	127	176	110	196	262	
179	DRC/CC-ICP-MS	143	187	119	202	254	
200	DRC/CC-ICP-MS	159	208	142	217	306	Info
206	DRC/CC-ICP-MS	145	188	122	202	262	
293	DRC/CC-ICP-MS	149	202	126	220	290	Info
305	ICP-MS	162	214	128	241	284	
324	ICP-MS	146	187	124	418 ↑	528 ↑	Info
325	ETAAS-Z	132	185	112	206	276	Info
366	ETAAS-Z	140	208	127	240	333 ↑	Info
401	DRC/CC-ICP-MS	146	201	124	216	298	Info

Percent satisfactory results for all participants: 96.0 %

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 #2
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-31	SE14-32	SE14-33	SE14-34	SE14-35
DRC/CC-ICP-MS					
Number of Sample Measurements:	9	9	9	9	9
Mean:	140	188	120	204	269
Standard Deviation:	11	13	11	11	22
RSD (%):	7.8	6.7	8.9	5.4	8.3
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	136	197	120	223	305
Standard Deviation:	6	16	11	24	40
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	4	4	4	3	3
Mean:	144	188	120	209	263
Standard Deviation:	13	18	8	27	19
RSD (%):	9.2	9.5	6.6	—	—
All Laboratories					
Number of Sample Measurements:	15	15	15	14	14
Mean:	141	189	120	208	273
Standard Deviation:	11	14	9	17	26
RSD (%):	7.6	7.2	7.7	8.0	9.5

notes: ? Insufficient data for calculation.

Serum Zinc

The test materials for serum Zn were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be Non-reactive for Anti-HIV-1/2, Anti-HCV 3.0 and HBsAg. The serum has also been found to be STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were 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 647 µg/L (9.89 µmol/L) to 1541 µg/L (23.57 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, 95.6% of test results reported were judged as satisfactory, with one out of 27 participant laboratories (3.7%) 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 #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (μg/L serum)				
	SE14-31	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
Robust Mean	**794**	**647**	**1000**	**1239**	**1541**
Robust Standard Deviation	44	33	55	76	73
Standard Uncertainty	11	8	13	18	17
RSD (%)	5.6	5.1	5.5	6.2	4.7
Number of Sample Measurements	27	27	27	27	27
Acceptable Range:					
Upper Limit:	913	744	1150	1425	1772
Lower Limit:	675	550	850	1053	1310

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 #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum) SE14-31	SE14-32	SE14-33	SE14-34	SE14-35	Info Only
	Target Values:	794	647	1000	1239	1541	
107	DRC/CC-ICP-MS	806	664	1040	1290	1570	Info
110	ICP-MS	847	686	1063	1320	1603	
114	ICP-MS	790	660	990	1210	1510	
147	ICP-MS	771	626	961	1203	1523	Info
156	ICP-AES/OES	760	650	1000	1200	1500	
160	ICP-MS	810	660	1000	1250	1580	
164	ICP-MS	79 ↓	67 ↓	103 ↓	129 ↓	158 ↓	
179	DRC/CC-ICP-MS	790	640	1010	1260	1560	
197	ICP-MS	760	620	1000	1210	1510	
200	ICP-MS	912	687	1122	1409	1655	Info
206	ICP-MS	824	640	962	1181	1442	
287	FAAS	750	600	930	1160	1430	
293	ICP-MS	804	660	1026	1281	1562	Info
305	ICP-MS	785	610	989	1228	1577	
324	ICP-MS	774	611	913	1130	1506	Info
325	ICP-MS	860	740	960	1330	1750	Info
355	ICP-MS	792	666	1019	1249	1549	
357	ICP-MS	746	594	929	1135	1374	
358	ICP-MS	810	670	1010	1250	1520	
359	ICP-MS	725	568	948	1137	1114 ↓	
362	ICP-MS	755	635	983	1160	1470	
363	ICP-MS	860	700	1090	1400	1710	
366	FAAS	833	670	1001	1211	1508	Info
401	DRC/CC-ICP-MS	817	680	1046	1295	1681	Info
457	ICP-AES/OES	762	637	1011	1255	1550	Info
458	FAAS	842	651	1072	1394	1607	
481	ICP-MS	790	640	1050	1270	1560	

Percent satisfactory results for all participants: 95.6 %

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 #2
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-31	SE14-32	SE14-33	SE14-34	SE14-35
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	804	661	1032	1282	1604
Standard Deviation:	14	20	19	19	67
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	808	640	1001	1255	1515
Standard Deviation:	51	36	71	123	89
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	761	644	1006	1228	1525
Standard Deviation:	1	9	8	39	35
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	18	19	19	19	19
Mean:	801	618	954	1183	1456
Standard Deviation:	47	139	213	268	341
RSD (%):	5.8	22.5	22.3	22.6	23.4
All Laboratories					
Number of Sample Measurements:	26	27	27	27	27
Mean:	799	627	971	1205	1484
Standard Deviation:	43	118	181	229	290
RSD (%):	5.4	18.7	18.6	19.0	19.5

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

Ba, Cd, Co, Cr, Mn, Mo, Sn, Tl, V

Serum Antimony (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	<0.0304	<0.0304	<0.0304	<0.0304	<0.0304

Serum Arsenic (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
197	DRC/CC-ICP-MS	<10	<10	<10	<10	<10

Serum Barium (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
110	ICP-MS	1.0	16	1.2	3.0	0.9
147	ICP-MS	1.16	1.28	1.32	3.21	1.05
197	ICP-MS	<2.0	<2.0	<2.0	3.3	<2.0
	Arithmetic mean	-	-	-	3.2	-
	SD	-	-	-	0.2	-
	n	2	2	2	3	2

Serum Beryllium (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	<0.360	<0.360	<0.360	<0.360	<0.360
197	ICP-MS	<0.2	<0.2	<0.2	<0.2	<0.2

Serum Bismuth (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	<0.0418	<0.0418	<0.0418	<0.0418	<0.0418
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

Serum Cadmium (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	0.155	<0.0225	3.71	0.671	1.20
197	DRC/CC-ICP-MS	<0.5	<0.5	3.5	0.6	1.2

Serum Chromium (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	DRC/CC-ICP-MS	1.29	<0.156	*0.227	0.366	0.842
156	DRC/CC-ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0
164	DRC/CC-ICP-MS	1.1	0.2	0.2	0.6	0.8
179	DRC/CC-ICP-MS	1.0	0.1	0.2	0.3	0.7
197	DRC/CC-ICP-MS	1.3	<1.0	<1.0	<1.0	<1.0
206	DRC/CC-ICP-MS	1.2	<1.0	<1.0	<1.0	1.2
305	ICP-MS	0.8	<0.2	<0.2	<0.2	0.4
**Outlier*	**Arithmetic mean**	**1.1**	**-**	**-**	**0.4**	**0.8**
	SD	0.2	-	-	0.2	0.3
	n	6	2	2	3	5

Serum Cobalt (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
110	ICP-MS	0.51	0.39	1.24	2.38	0.56
147	ICP-MS	0.414	0.288	1.11	2.33	0.493
156	DRC/CC-ICP-MS	<1.0	<1.0	1.0	2.2	<1.0
164	ICP-MS	0.4	0.3	1.0	2.1	0.4
179	DRC/CC-ICP-MS	0.3	0.3	1.1	2.3	0.4
197	ICP-MS	<1.0	<1.0	1.3	2.6	<1.0
206	ICP-MS	<1.0	<1.0	1.1	2.3	<1.0
324	HR-ICP-MS	0.46	0.36	1.08	*0.98	0.56
*Outlier	**Arithmetic mean**	**0.42**	**0.33**	**1.1**	**2.3**	**0.48**
	SD	0.08	0.04	0.1	0.2	0.08
	n	5	5	8	7	5

Serum Iodine (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	71.9	47.1	59.1	59.7	78.1
156	DRC/CC-ICP-MS	69	44	56	57	73
164	DRC/CC-ICP-MS	58	38	49	50	63
179	ICP-MS	71	48	60	60	78
197	ICP-MS	54.8	36.4	46.8	49.4	60.8
206	ICP-MS	74.7	47.5	61.8	59.8	75.1
	Arithmetic mean	**67**	**44**	**55**	**56**	**71**
	SD	8	5	6	5	8
	n	6	6	6	6	6

Serum Iron (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
457	ICP-AES/OES	278	542	265	243	351

Serum Lead (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	<0.0642	<0.0642	<0.0642	<0.0642	<0.0642
197	DRC/CC-ICP-MS	<0.4	<0.4	<0.4	<0.4	<0.4

Serum Lithium (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	0.371	0.577	0.587	0.522	0.491

Serum Manganese (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
110	ICP-MS	0.5	1.3	0.6	1.8	<0.4
147	ICP-MS	1.03	1.71	1.07	2.57	1.08
179	DRC/CC-ICP-MS	0.9	1.5	1.0	2.6	1.0
197	DRC/CC-ICP-MS	1.1	1.8	1.4	2.7	1.2
206	ICP-MS	1.1	2.0	1.3	2.6	1.2
305	ICP-MS	1.8	2.5	1.1	3.7	*2.1
324	HR-ICP-MS	0.82	1.8	0.33	2.26	0.90
*Omitted	**Arithmetic mean**	**1.0**	**2**	**1.0**	**2.6**	**1.1**
	SD	0.4	0.4	0.4	0.6	0.1
	n	7	7	7	7	5

Serum Mercury (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	<0.160	<0.160	<0.160	<0.160	<0.160
197	ICP-MS	<5.0	<5.0	<5.0	<5.0	<5.0

Serum Molybdenum (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
110	ICP-MS	2.2	0.88	0.93	4.41	1.23
147	ICP-MS	2.31	0.840	1.140	4.40	1.28
179	ICP-MS	2.5	0.9	1.2	4.4	1.5
197	ICP-MS	2.7	<2.0	<2.0	*5.0	<2.0
*Omitted	**Arithmetic mean**	2.4	0.87	1.1	4.40	1.337
	SD	0.2	0.03	0.1	0.01	0.144
	n	4	3	3	3	3

Serum Nickel (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	3.90	2.23	0.728	1.43	2.21
179	DRC/CC-ICP-MS	3.7	2.1	0.5	0.9	1.8
197	ICP-MS	4.8	3.0	<2.0	<2.0	2.7
206	ICP-MS	<10	<10	<10	<10	<10
	Arithmetic mean	4.1	2.4	-	-	2.2
	SD	0.6	0.5	-	-	0.5
	n	3	3	2	2	3

Serum Platinum (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
179	ICP-MS	<10	<10	<10	<10	<10

Serum Silver (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
179	ICP-MS	<0.2	0.6	<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**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	<0.0766	<0.0766	<0.0766	<0.0766	<0.0766
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

Serum Thallium (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
110	ICP-MS	0.38	1.79	6.61	3.67	1.44
147	ICP-MS	0.407	1.86	6.85	3.72	1.41
197	ICP-MS	<1.0	1.6	5.9	3.3	1.3
	Arithmetic mean	-	1.8	6.5	3.6	1.38
	SD	-	0.1	0.5	0.2	0.07
	n	2	3	3	3	3

Serum Thorium (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	<0.00696	<0.00696	<0.00696	<0.00696	<0.00696

Serum Tin (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	2.51	5.19	0.175	0.586	1.44
197	ICP-MS	<5.0	5.1	<5.0	<5.0	<5.0

Serum Tungsten (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	<0.239	<0.239	<0.239	<0.239	<0.239

Serum Uranium (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	ICP-MS	<0.00714	<0.00714	<0.00714	<0.00714	<0.00714

Serum Vanadium (µg/L)						
Lab Code	**Method**	**SE14-31**	**SE14-32**	**SE14-33**	**SE14-34**	**SE14-35**
147	DRC/CC-ICP-MS	0.415	0.178	0.643	2.67	1.94
179	DRC/CC-ICP-MS	0.4	0.2	0.6	2.5	1.6

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.