Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

TRACE ELEMENTS IN SERUM

Proficiency Test Report

Event #1, 2014

March 24th, 2014

NEW YORK
state department of
HEALTH

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

Sue Kelly
Executive Deputy Commissioner

March 24, 2014

Trace Elements in Serum
Event #1, 2014

Dear Laboratory Director:

Results from the first 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).

Summary of Bovine Serum Investigation

Throughout 2013, the PT program investigated potential problems with the use of bovine calf serum and concluded that this matrix can be problematic for certain types of inorganic mass spectrometry when analyzing for serum selenium at *m/z* 82. Consequently, the program will revert to using human serum supplemented with trace elements of clinical interest, effective immediately. In addition, grading for serum selenium will resume based on the previous criteria (±20% or ±2 µg/L, whichever is greater). A summary of the investigation findings will be distributed separately.

The next PT event for trace elements in serum is scheduled to be mailed Wednesday, May 7th, 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, May 28th, 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 14 µg/L (0.52 µmol/L) to 60 µg/L (2.22 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, 93.6% of test results reported were judged as satisfactory, with three out of 22 participant laboratories (13.6%) 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 #1
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
Robust Mean	**52**	**14**	**24**	**60**	**54**
Robust Standard Deviation	5	2	3	4	4
Standard Uncertainty	1.3	0.5	0.7	1.2	1.0
RSD (%)	9.2	12.5	10.5	7.5	7.1
Number of Sample Measurements	22	21	22	22	22
Acceptable Range:					
Upper Limit	62	19	29	72	65
Lower Limit	42	9	19	48	43

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum) SE14-26	SE14-27	SE14-28	SE14-29	SE14-30	Info Only
	Target Values:	52	14	24	60	54	
110	ETAAS-Z	58	17	28	66	59	
147	FAAS	59	16	29	65	59	Info
156	ICP-MS	49	13	22	57	52	
160	ICP-MS	51	13	25	57	50	
164	ICP-MS	50	13	22	60	54	
179	DRC/CC-ICP-MS	57	14	26	65	59	
197	ICP-MS	44	<20	21	53	48	
200	DRC/CC-ICP-MS	45	9	19	47 ↓	43 ↓	Info
206	DRC/CC-ICP-MS	57	14	26	64	56	
287	ETAAS-Z	53	14	26	62	55	
293	ICP-MS	56	19	26	62	54	Info
305	ICP-MS	56	13	23	62	57	
324	HR-ICP-MS	38 ↓	10	20	44 ↓	40 ↓	Info
325	ETAAS-Z	53	15	28	64	58	Info
355	ICP-MS	52	13	25	62	55	
357	ICP-MS	53	14	24	61	55	
358	ICP-MS	53	16	26	57	53	
362	ICP-MS	50	14	24	58	53	
363	ICP-MS	55	14	26	63	59	
366	ETAAS-Z	48	10	20	58	56	Info
401	ICP-AES/OES	51	3 ↓	13 ↓	57	49	Info
458	ETAAS Other	49	12	25	59	56	

Percent satisfactory results for all participants: 93.6 %

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.

New York State Department of Health
Serum Aluminum Test Results, 2014 Event #1
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	53	12	24	59	53
Standard Deviation:	7	3	4	10	9
RSD (%):	—	—	—	—	—
ETAAS Other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	49	12	25	59	56
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	4	4	4	4	4
Mean:	53	14	26	63	57
Standard Deviation:	4	3	4	3	2
RSD (%):	7.7	21.0	14.8	5.5	3.2
FAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	59	16	29	65	59
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	38	10	20	44	40
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	1	1	1	1	1
Mean:	51	3	13	57	49
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	11	10	11	11	11
Mean:	52	14	24	59	54
Standard Deviation:	4	2	2	3	3
RSD (%):	6.8	13.6	7.5	5.2	5.7
All Laboratories					
Number of Sample Measurements:	22	21	22	22	22
Mean:	52	13	24	59	54
Standard Deviation:	5	3	4	6	5
RSD (%):	9.7	24.9	15.3	9.4	9.4

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 1414 µg/L (22.25 µmol/L) to 2074 µg/L (32.64 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 two out of 19 participant laboratories (10.5%) 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 #1
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
Robust Mean	**2074**	**1820**	**1414**	**2047**	**1429**
Robust Standard Deviation	112	107	80	118	74
Standard Uncertainty	32	31	23	34	21
RSD (%)	5.4	5.9	5.7	5.8	5.2
Number of Sample Measurements	19	19	19	19	19
Acceptable Range:					
Upper Limit	2385	2093	1626	2354	1643
Lower Limit	1763	1547	1202	1740	1215

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum) SE14-26	SE14-27	SE14-28	SE14-29	SE14-30	Info Only
	Target Values:	2074	1820	1414	2047	1429	
107	DRC/CC-ICP-MS	2437 ↑	2109 ↑	1555	2282	1593	Info
110	ICP-MS	2127	1883	1456	2090	1468	
147	ICP-MS	2154	1906	1474	2128	1506	Info
156	ICP-AES/OES	2100	1800	1400	2100	1400	
160	ICP-MS	2010	1740	1330	1900	1320	
164	ICP-MS	1945	1692	1326	1905	1330	
179	DRC/CC-ICP-MS	2120	1860	1440	2100	1470	
197	ICP-MS	2030	1800	1440	2010	1450	
200	ICP-MS	2115	1880	1448	2127	1486	Info
206	ICP-MS	1930	1680	1330	2180	1480	
293	ICP-MS	1958	1723	1341	1958	1348	Info
305	ICP-MS	2070	1940	1510	2250	1400	
324	HR-ICP-MS	2066	1809	1427	1969	1406	Info
325	ICP-MS	2650 ↑	1740	1160 ↓	1620 ↓	960 ↓	Info
359	ICP-MS	1909	1742	1294	2009	1333	
366	ETAAS-Z	1979	1700	1384	1986	1408	Info
401	DRC/CC-ICP-MS	2078	1868	1424	2059	1449	Info
457	ICP-AES/OES	2107	1878	1434	2091	1508	Info
481	ICP-MS	2306	2030	1537	1946	1475	

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.

New York State Department of Health
Serum Copper Test Results, 2014 Event #1
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2212	1946	1473	2147	1504
Standard Deviation:	196	142	71	119	78
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	1	1	1	1	1
Mean:	1979	1700	1384	1986	1408
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2066	1809	1427	1969	1406
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	2104	1839	1417	2096	1454
Standard Deviation:	5	55	24	6	76
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	12	12	12	12	12
Mean:	2100	1813	1387	2010	1380
Standard Deviation:	207	112	108	166	149
RSD (%):	9.9	6.2	7.8	8.2	10.8
All Laboratories					
Number of Sample Measurements:	19	19	19	19	19
Mean:	2110	1831	1406	2037	1410
Standard Deviation:	183	116	94	147	130
RSD (%):	8.7	6.3	6.7	7.2	9.2

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 92 µg/L (1.17 µmol/L) to 229 µg/L (2.90 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, 100% of test results reported were judged as satisfactory, with none of the 15 participant laboratories 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 #1
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
Robust Mean	**221**	**143**	**92**	**101**	**229**
Robust Standard Deviation	17	10	8	9	19
Standard Uncertainty	5	3	3	3	6
RSD (%)	7.5	6.8	8.8	8.5	8.4
Number of Sample Measurements	15	15	15	15	15
Acceptable Range:					
Upper Limit	265	172	110	121	275
Lower Limit	177	114	74	81	183

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum) SE14-26	SE14-27	SE14-28	SE14-29	SE14-30	Info Only
	Target Values:	221	143	92	101	229	
107	DRC/CC-ICP-MS	231	149	104	111	246	Info
110	DRC/CC-ICP-MS	212	134	88	96	218	
147	ICP-MS	222	141	94	103	227	Info
156	DRC/CC-ICP-MS	200	130	76	94	200	
164	DRC/CC-ICP-MS	224	146	91	99	237	
179	DRC/CC-ICP-MS	228	149	95	104	239	
200	DRC/CC-ICP-MS	222	153	97	111	246	Info
206	DRC/CC-ICP-MS	214	139	93	101	226	
293	DRC/CC-ICP-MS	248	153	101	114	253	Info
305	ICP-MS	212	139	85	97	224	
324	HR-ICP-MS	223	145	91	98	221	Info
325	ETAAS-Z	191	116	78	87	184	Info
366	ETAAS-Z	200	130	80	90	214	Info
367	DRC/CC-ICP-MS	235	149	96	104	235	Info
401	DRC/CC-ICP-MS	249	163	100	114	258	Info

Percent satisfactory results for all participants: 100.0 %

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.

New York State Department of Health
Serum Selenium Test Results, 2014 Event #1
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
DRC/CC-ICP-MS					
Number of Sample Measurements:	10	10	10	10	10
Mean:	226	147	94	105	236
Standard Deviation:	15	10	8	7	17
RSD (%):	6.8	6.7	8.4	7.0	7.4
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	196	123	79	89	199
Standard Deviation:	6	10	1	2	21
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	223	145	91	98	221
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	217	140	90	100	226
Standard Deviation:	7	1	6	4	2
RSD (%):	—	—	—	—	—
All Laboratories					
Number of Sample Measurements:	15	15	15	15	15
Mean:	221	142	91	102	229
Standard Deviation:	17	12	8	8	20
RSD (%):	7.5	8.2	9.3	8.2	8.7

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 594 µg/L (9.08 µmol/L) to 2409 µg/L (36.84 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, 91.5% of test results reported were judged as satisfactory, with two out of 26 participant laboratories (7.7%) 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 #1
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
Robust Mean	**2409**	**1022**	**594**	**642**	**2063**
Robust Standard Deviation	183	75	47	52	202
Standard Uncertainty	45	18	12	13	50
RSD (%)	7.6	7.4	7.9	8.2	9.8
Number of Sample Measurements	26	26	26	26	26
Acceptable Range:					
Upper Limit	2770	1175	683	738	2373
Lower Limit	2048	869	505	546	1753

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum) SE14-26	SE14-27	SE14-28	SE14-29	SE14-30	Info Only
	Target Values:	2409	1022	594	642	2063	
107	DRC/CC-ICP-MS	2919 ↑	1196 ↑	703 ↑	746 ↑	2480 ↑	Info
110	ICP-MS	2457	1050	632	649	2136	
147	ICP-MS	2484	1013	573	660	2294	Info
156	ICP-AES/OES	2300	940	560	610	1900	
160	ICP-MS	2340	960	560	580	1900	
164	ICP-MS	2224	939	563	585	1900	
179	DRC/CC-ICP-MS	2560	1050	610	660	2160	
197	ICP-MS	2280	960	570	590	2020	
200	ICP-MS	2531	1112	634	706	2197	Info
206	ICP-MS	2510	930	570	680	2320	
287	FAAS	2250	1000	550	580	1930	
293	ICP-MS	2294	987	596	641	1954	Info
305	ICP-MS	2170	970	570	620	1810	
324	HR-ICP-MS	2452	1035	619	631	2038	Info
325	ICP-MS	3610 ↑	990	370 ↓	360 ↓	1670 ↓	Info
355	ICP-MS	2543	1096	648	680	2243	
357	ICP-MS	2250	942	536	592	1920	
358	ICP-MS	2390	1010	600	640	2050	
359	ICP-MS	2195	967	545	614	1910	
362	ICP-MS	2227	1026	611	641	1934	
363	ICP-MS	2630	1130	650	720	2270	
366	FAAS	2462	1070	712 ↑	730	2230	Info
401	DRC/CC-ICP-MS	2629	1131	647	687	2256	Info
457	ICP-AES/OES	2257	961	553	616	2014	Info
458	FAAS	2549	1058	611	639	2324	
481	ICP-MS	2280	1450 ↑	590	670	1860	

Percent satisfactory results for all participants: 91.5 %

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.

New York State Department of Health
Serum Zinc Test Results, 2014 Event #1
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2703	1126	653	698	2299
Standard Deviation:	191	73	47	44	164
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2420	1043	624	650	2161
Standard Deviation:	154	37	82	76	206
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2452	1035	619	631	2038
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	2279	951	557	613	1957
Standard Deviation:	30	15	5	4	81
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	17	17	17	17	17
Mean:	2436	1031	578	625	2023
Standard Deviation:	333	124	64	80	190
RSD (%):	13.7	12.0	11.0	12.8	9.4
All Laboratories					
Number of Sample Measurements:	26	26	26	26	26
Mean:	2454	1037	592	636	2066
Standard Deviation:	293	109	65	73	197
RSD (%):	12.0	10.5	10.9	11.5	9.5

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 (SE14-26)

As, Ba, Be, Cd, Co, Cr, Cs, Mn, Mo, Ni, Pb, Pt, Sb, Sn, Te, Tl, V, W and U

Additional Elements (SE14-27 and SE14-29)

Mn, Cr, V

Serum Antimony (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
110	ICP-MS	6.9	<0.069	<0.069	<0.069	<0.069
147	ICP-MS	6.45	<0.030	<0.030	<0.030	<0.030

Serum Arsenic (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
197	DRC/CC-ICP-MS	16	<10	<10	<10	<10

Serum Barium (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
110	ICP-MS	8.1	1.8	0.16	1.7	0.79
147	ICP-MS	7.25	1.80	0.317	1.65	0.883
197	ICP-MS	8.5	*2.1	<2.0	<2.0	<2.0
**Outlier*	**Arithmetic mean**	8.0	-	-	-	-
	SD	0.6	-	-	-	-
	n	3	-	-	-	-

Serum Beryllium (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
147	ICP-MS	6.77	<0.450	<0.450	<0.450	<0.450
197	ICP-MS	7.1	<0.2	<0.2	<0.2	<0.2

Serum Bismuth (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

Serum Cadmium (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
110	ICP-MS	6.99	<0.032	<0.032	<0.032	0.19
147	ICP-MS	6.73	<0.045	<0.045	-	0.181
197	DRC/CC-ICP-MS	6.3	<0.5	<0.5	<0.5	<0.5
	Arithmetic mean	6.67	-	-	-	-
	SD	0.35	-	-	-	-
	n	3	-	-	-	-

Serum Chromium (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
147	DRC/CC-ICP-MS	6.66	1.47	2.77	1.59	0.272
156	DRC/CC-ICP-MS	6.5	1.0	2.3	1.1	<1.0
164	DRC/CC-ICP-MS	6.3	1.3	2.2	1.4	*1.7
179	DRC/CC-ICP-MS	6.8	1.3	2.7	1.4	0.2
197	DRC/CC-ICP-MS	6.9	1.4	2.7	1.5	<1.0
206	DRC/CC-ICP-MS	7.0	1.3	2.5	1.3	<1.0
305	ICP-MS	6.5	1.0	2.3	1.1	<0.2
324	HR-ICP-MS	6.89	1.23	2.81	1.48	0.28
**Outlier*	**Arithmetic mean**	**6.7**	**1.3**	**2.5**	**1.4**	**0.25**
	SD	0.2	0.2	0.2	0.2	0.04
	n	8	8	8	8	3

Serum Cobalt (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
110	ICP-MS	2.2	0.24	0.47	0.37	0.49
147	ICP-MS	1.99	0.099	0.353	0.280	0.331
156	DRC/CC-ICP-MS	1.9	<1.0	<1.0	<1.0	<1.0
164	ICP-MS	1.9	0.2	0.4	0.3	0.4
179	DRC/CC-ICP-MS	2.0	<0.2	0.3	0.3	0.3
197	ICP-MS	1.6	<1.0	<1.0	<1.0	<1.0
206	ICP-MS	2.4	<1.0	<1.0	*1.0	*1.0
324	HR-ICP-MS	1.90	0.06	0.29	0.22	0.31
**Outlier*	**Arithmetic mean**	**2.0**	**0.15**	**0.36**	**0.29**	**0.37**
	SD	0.2	0.08	0.07	0.05	0.08
	n	8	4	5	5	5

Serum Iodine (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
147	ICP-MS	56.1	55.1	66.3	39.0	55.4
164	DRC/CC-ICP-MS	48	47	57	33	46
179	ICP-MS	58	56	66	39	57
197	ICP-MS	47.2	43.8	56.1	28.4	44.0
206	ICP-MS	55.6	50.8	62.3	34.9	51.9
	Arithmetic mean	**53**	**51**	**62**	**35**	**51**
	SD	5	5	5	4	6
	n	5	5	5	5	5

Serum Iron (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
457	ICP-AES/OES	531	1110	245	342	520

Serum Lead (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
147	ICP-MS	34.0	<0.414	<0.414	<0.414	<0.414
197	DRC/CC-ICP-MS	30.0	<0.4	<0.4	<0.4	<0.4

Serum Lithium (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
147	ICP-MS	0.372	0.965	0.694	1.32	0.847

Serum Manganese (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
110	ICP-MS	8.9	11.5	3.6	2.3	1.0
147	ICP-MS	8.30	10.9	3.05	2.10	0.984
179	DRC/CC-ICP-MS	9.2	12.7	3.2	2.2	0.9
197	DRC/CC-ICP-MS	8.3	10.9	3.1	2.1	1.0
206	ICP-MS	9.3	11.7	4.0	2.7	*1.5
305	ICP-MS	7.8	10.3	3.0	2.7	0.9
324	HR-ICP-MS	8.04	10.59	2.88	1.75	0.72
**Omitted*	**Arithmetic mean**	**8.5**	**11**	**3.3**	**2.3**	**0.9**
	SD	0.6	0.8	0.4	0.3	0.1
	n	7	7	7	7	6

Serum Mercury (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
147	ICP-MS	1.08	-	-	-	-
197	ICP-MS	<5.0	<5.0	<5.0	<5.0	<5.0

Serum Molybdenum (µg/L)

Lab Code	Method	SE14-26	SE14-27	SE14-28	SE14-29	SE14-30
110	ICP-MS	7.9	0.55	0.59	0.51	0.70
147	ICP-MS	7.37	0.778	0.760	0.734	0.703
179	ICP-MS	7.6	0.9	0.8	0.7	0.7
197	ICP-MS	*14.0	*3.8	*2.6	*2.0	<2.0
**Omitted*	**Arithmetic mean**	7.6	0.7	0.7	0.6	0.701
	SD	0.3	0.2	0.1	0.1	0.002
	n	3	3	3	3	3

Serum Nickel (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
147	ICP-MS	7.34	-	-	0.681	4.73
179	DRC/CC-ICP-MS	6.3	<0.2	0.2	0.3	5.5
197	ICP-MS	7.8	<2.0	<2.0	<2.0	5.3
206	ICP-MS	<10	<10	<10	<10	<10
	Arithmetic mean	7.1	-	-	-	-
	SD	0.8	-	-	-	-
	n	3	-	-	-	-

Serum Platinum (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
110	ICP-MS	3.39	<0.16	<0.16	<0.16	<0.16
179	ICP-MS	<10	<10	<10	<10	<10

Serum Silver (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
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**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
147	ICP-MS	3.19	<0.089	<0.089	<0.089	<0.089
197	ICP-MS	3.4	<1.0	<1.0	<1.0	<1.0

Serum Thallium (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
110	ICP-MS	3.4	<0.0097	<0.0097	0.072	0.018
197	ICP-MS	3.0	<1.0	<1.0	<1.0	<1.0

Serum Thorium (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
147	ICP-MS	<0.03	<0.03	<0.03	<0.03	<0.03

Serum Tin (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
110	ICP-MS	8.4	0.25	0.16	0.52	0.33
147	ICP-MS	7.70	<0.238	<0.238	<0.238	<0.238
197	ICP-MS	7.9	<5.0	<5.0	<5.0	<5.0
	Arithmetic mean	8.0	-	-	-	-
	SD	0.4	-	-	-	-
	n	3	-	-	-	-

Serum Tungsten (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
147	ICP-MS	6.73	<0.368	<0.368	<0.368	<0.368

Serum Uranium (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
147	ICP-MS	0.690	<0.0143	<0.0143	<0.0143	<0.0143

Serum Vanadium (µg/L)						
Lab Code	**Method**	**SE14-26**	**SE14-27**	**SE14-28**	**SE14-29**	**SE14-30**
147	DRC/CC-ICP-MS	6.89	9.69	-	0.643	0.168
179	DRC/CC-ICP-MS	7.2	10.6	<0.1	0.7	0.1

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)

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 μmol ZPP/mol heme)

F-4 Other

OTHER METHODS

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