
Wadsworth Center

New York State Department of Health

TRACE ELEMENTS IN SERUM

Event #3, 2007

October 25, 2007

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**Trace Elements in Serum
Event #3, 2007**

Dear Laboratory Director:

Results from the third Trace Elements in Serum proficiency test (PT) event have been tabulated and are summarized. Target values for Aluminum, Copper, Selenium and Zinc have been established along with acceptable ranges, except as noted for serum aluminum sample SE07-13.

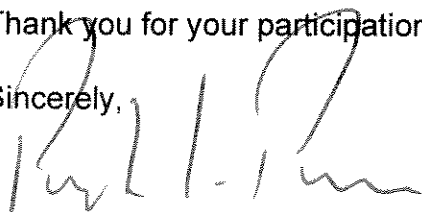
Materials

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.

The next PT event for trace elements in serum is scheduled to be mailed January 8th, 2008. Please inform our laboratory staff at (518) 474-4484 if the test materials have not arrived within five days of the scheduled mail out date. **The deadline for reporting results is February 5th, 2008.**

Thank you for your participation.

Sincerely,



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

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 STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were dispensed into acid-washed 1-L polypropylene containers to make up serum pools; these pools were spiked with a suite of additional trace elements including aluminum as Al³⁺.

Target values were established as the mean of 11 referee laboratories using either ETAAS or quadrupole-based ICP-MS instrumentation. Values ranged from 51.9 µg/L (1.92 µmol/L) to 150.0 µg/L (5.56 µmol/L). Among the referee pool, imprecision (SD) varied from ±4.0 µg/L (0.15 µmol/L) to ±10.1 µg/L (0.37 µmol/L).

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

Sample SE07-13. We were unable to evaluate the data for serum aluminum PT sample SE07-13 due to a lack of consensus among participant laboratories. Consequently, all results for PT sample SE07-13 will be treated as “acceptable” for grading purposes.

Discussion. Based on the above criteria, 92.9% of test results reported (including ungradable SE07-13) were satisfactory, with 2 out of 28 laboratories (7.1%) reporting 2 or more of the 4 results outside the acceptable range.

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. *Clin. Chem.* 2002 48 2000-2007.

New York State Department of Health
Serum Aluminum Test Results, 2007 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results ($\mu\text{g/L}$ serum)					Info Only
		SE07-11	SE07-12	SE07-13	SE07-14	SE07-15	
Target Values:		61.5	51.9		104.9	150.0	
110	ETAAS-Z	54	44	20	96	140	
114	ETAAS-Z	66	58	41	95	151	
126	ETAAS-Z	62	50	28	103	142	
147	ETAAS-Z	77 \uparrow	58	31	115	162	Info
156	ICP-MS	72	62	34	125	175	
159	ETAAS-Z	60	51	28	102	133	
160	ETAAS-Z	66	58	32	109	154	
164	ICP-MS	59	49	26	102	144	
179	ICP-MS	68	60	30	116	164	
197	ICP-MS	64	67 \uparrow	38	113	161	
200	DRC/CC-ICP-MS	62	51	28	111	149	
206	ICP-MS	44 \downarrow	39 \downarrow	20	72 \downarrow	135	
287	ETAAS-Z	70	60	31	115	183 \uparrow	
293	ETAAS other	54	48	52	84	108 \downarrow	Info
301	ETAAS-Z	59	49	27	105	146	
305	ICP-MS	54	53	29	114	150	
314	ICP-MS	59	53	28	105	142	
324	DRC/CC-ICP-MS	58	47	21	104	163	
325	ETAAS-Z	73	65 \uparrow	39	127 \uparrow	171	Info
355	ICP-MS	63	52	26	111	162	
357	ICP-AES/OES	61	58	25	118	163	
358	ICP-MS	58	54	28	100	137	
361	ETAAS Other	58	49	25	95	125	
362	ICP-MS	70	62	33	117	155	
363	ICP-MS	65	60	33	111	154	
366	ETAAS-Z	52	42	25	85	113 \downarrow	Info
377	ICP-MS	59	51	18	100	146	
401	ICP-AES/OES	59	49	30	103	148	

Percent satisfactory results for all participants: 92.9 %

notes: \uparrow reported outside upper limit
 \downarrow 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, 2007 Event #3
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

Lab Code	Method	Results ($\mu\text{g/L}$ serum)				
		SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
110	ETAAS-Z	54	44		96	140
114	ETAAS-Z	66	58		95	151
126	ETAAS-Z	62	50		103	142
159	ETAAS-Z	60	51		102	133
164	ICP-MS	59	49		102	144
179	ICP-MS	68	60		116	164
200	DRC/CC-ICP-MS	62	51		111	149
324	DRC/CC-ICP-MS	58	47		104	163
355	ICP-MS	63	52		111	162
363	ICP-MS	65	60		111	154
401	ICP-AES/OES	59	49		103	148
Number of Sample Measurements:		11	11		11	11
Target value:		61.5	51.9		104.9	150.0
Standard Deviation:		4.0	5.3		6.6	10.1
RSD (%):		6.5	10.1		6.3	6.7
Acceptable Range:						
Upper Limit:		73.8	62.3		125.9	180.0
Lower Limit:		49.2	41.5		83.9	120.0

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, 2007 Event #3
STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ serum)				
	SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	60.0	49.0	24.5	107.5	156.0
Standard Deviation:	2.8	2.8	4.9	4.9	9.9
RSD (%):	—	—	—	—	—
ETAAS Other					
Number of Sample Measurements:	2	2	2	2	2
Mean:	56.0	48.5	38.5	89.5	116.5
Standard Deviation:	2.8	0.7	19.1	7.8	12.0
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	10	10	10	10	10
Mean:	63.9	53.5	30.2	105.2	149.5
Standard Deviation:	8.0	7.4	6.2	12.0	19.8
RSD (%):	12.6	13.9	20.6	11.4	13.2
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	60.0	53.5	27.5	110.5	155.5
Standard Deviation:	1.4	6.4	3.5	10.6	10.6
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	12	12	12	12	12
Mean:	61.3	55.2	28.6	107.2	152.1
Standard Deviation:	7.6	7.5	5.7	13.4	12.0
RSD (%):	12.4	13.6	20.0	12.5	7.9
All Laboratories					
Number of Sample Measurements:	28	28	28	28	28
Mean:	61.6	53.5	29.5	105.5	149.1
Standard Deviation:	7.1	6.9	7.1	12.3	17.1
RSD (%):	11.5	12.9	23.9	11.6	11.5

notes: ? Insufficient data for calculation.

New York State Department of Health
Serum Aluminum Test Results, 2007 Event #3
STATISTICAL SUMMARY BY CLASS

	Results ($\mu\text{g/L}$ serum)				
	SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
Evaluated					
Number of Sample Measurements:	13	13		13	13
Mean:	61.1	55.0		106.8	151.7
Standard Deviation:	7.6	7.3		13.5	16.1
RSD (%):	12.4	13.3		12.6	10.6
Info					
Number of Sample Measurements:	4	4		4	4
Mean:	64.0	53.3		102.8	138.5
Standard Deviation:	12.8	10.2		21.6	32.6
RSD (%):	20.1	19.2		21.1	23.5
Reference					
Number of Sample Measurements:	11	11		11	11
Mean:	61.5	51.9		104.9	150.0
Standard Deviation:	4.0	5.3		6.6	10.1
RSD (%):	6.5	10.1		6.3	6.7
All Laboratories					
Number of Sample Measurements:	28	28	28	28	28
Mean:	61.6	53.5	29.5	105.5	149.1
Standard Deviation:	7.1	6.9	7.1	12.3	17.1
RSD (%):	11.5	12.9	23.9	11.6	11.5

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 STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were dispensed into acid-washed 1-L polypropylene containers to make up serum pools; these pools were spiked with a suite of additional trace elements including copper as Cu²⁺.

Target values were established as the mean of 11 referee laboratories using quadrupole-based ICP-MS or Flame AAS instrumentation. Values ranged from 1074.3 µg/L (16.91 µmol/L) to 2977.9 µg/L (46.86 µmol/L). Among the referee pool, imprecision (SD) varied between ±44.4 µg/L (0.70 µmol/L) and ±116.7 µg/L (1.84 µmol/L), increasing with Cu concentration.

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) for trace elements in serum, and are slightly less stringent than those previously suggested for NYS (± 10%).

Discussion. Based upon these criteria, 96.7% of all reported test results were satisfactory, with only 1 out of 24 laboratories (4.2%) reporting 2 or more of the 5 results outside the acceptable range.

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

New York State Department of Health
Serum Copper Test Results, 2007 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results ($\mu\text{g/L}$ serum)					Info Only
		SE07-11	SE07-12	SE07-13	SE07-14	SE07-15	
Target Values:		2161.5	1508.2	1074.3	2977.9	1182.9	
107	DRC/CC-ICP-MS	2300	1534	1116	3079	1270	
110	ICP-MS	2103	1554	1089	2955	1150	
114	DRC/CC-ICP-MS	1990	1410	1060	2730	1130	
147	ICP-MS	2084	1487	1048	2929	1125	
156	FAAS	2000	1300	1000	2600	1000 ↓	
159	ICP-AES/OES	2030	1440	1060	2830	1140	
160	ETAAS-Z	1920	1300	940	2600	850 ↓	
164	ICP-MS	2153	1501	1079	2960	1238	
179	ICP-AES/OES	2200	1510	1080	3000	1180	
197	ICP-MS	2170	1480	1100	2920	1150	
200	FAAS	2146	1486	1060	2896	1092	
206	ICP-MS	1970	1390	1000	2700	1050	
287	ETAAS-Z	2106	1453	1012	2972	1125	
290	FAAS	2070	1420	960	2870	1200	
293	ICP-MS	2201	1526	1113	3078	1196	
305	ICP-MS	2026	1359	1010	2658	1157	
324	ICP-AES/OES	1960	1360	960	2750	1030	Info
325	FAAS	2280	1560	1160	3040	1200	Info
360	FAAS	2260	1540	1170	3020	1260	
362	ICP-MS	2260	1530	1180	3280	1330	
366	ETAAS other	2176	1547	1125	2990	1184	
377	ICP-MS	1837 ↓	1230 ↓	958	2732	1019	
401	ICP-AES/OES	2319	1652	1112	3240	1271	
404	HR-ICP-MS	2072	1449	1101	2930	1196	Info

Percent satisfactory results for all participants: 96.7 %

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, 2007 Event #3
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

Lab Code	Method	Results ($\mu\text{g/L}$ serum)				
		SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
107	DRC/CC-ICP-MS	2300	1534	1116	3079	1270
110	ICP-MS	2103	1554	1089	2955	1150
147	ICP-MS	2084	1487	1048	2929	1125
159	ICP-AES/OES	2030	1440	1060	2830	1140
164	ICP-MS	2153	1501	1079	2960	1238
179	ICP-AES/OES	2200	1510	1080	3000	1180
197	ICP-MS	2170	1480	1100	2920	1150
200	FAAS	2146	1486	1060	2896	1092
290	FAAS	2070	1420	960	2870	1200
293	ICP-MS	2201	1526	1113	3078	1196
401	ICP-AES/OES	2319	1652	1112	3240	1271
Number of Sample Measurements:		11	11	11	11	11
Target value:		2161.5	1508.2	1074.3	2977.9	1182.9
Standard Deviation:		90.8	61.6	44.4	116.7	58.7
RSD (%):		4.2	4.1	4.1	3.9	5.0
Acceptable Range:						
Upper Limit:		2485.7	1734.4	1235.4	3424.6	1360.3
Lower Limit:		1837.3	1282.0	913.2	2531.2	1005.5

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, 2007 Event #3
STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ serum)				
	SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	2145.0	1472.0	1088.0	2904.5	1200.0
Standard Deviation:	219.2	87.7	39.6	246.8	99.0
RSD (%):	—	—	—	—	—
ETAAS other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2176.0	1547.0	1125.0	2990.0	1184.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	2013.0	1376.5	976.0	2786.0	987.5
Standard Deviation:	131.5	108.2	50.9	263.0	194.5
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	5	5	5	5	5
Mean:	2151.2	1461.2	1070.0	2885.2	1150.4
Standard Deviation:	120.3	105.2	93.8	175.9	103.6
RSD (%):	5.6	7.2	8.8	6.1	9.0
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2072.0	1449.0	1101.0	2930.0	1196.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	4	4	4	4	4
Mean:	2127.3	1490.5	1053.0	2955.0	1155.3
Standard Deviation:	162.8	123.9	65.6	216.7	99.9
RSD (%):	7.7	8.3	6.2	7.3	8.6
ICP-MS					
Number of Sample Measurements:	9	9	9	9	9
Mean:	2089.3	1450.8	1064.1	2912.4	1157.2
Standard Deviation:	129.6	105.0	67.6	196.6	93.3
RSD (%):	6.2	7.2	6.3	6.8	8.1
All Laboratories					
Number of Sample Measurements:	24	24	24	24	24
Mean:	2109.7	1459.1	1062.2	2906.6	1147.6
Standard Deviation:	128.1	98.7	69.5	180.9	104.6
RSD (%):	6.1	6.8	6.5	6.2	9.1

notes: ? Insufficient data for calculation.

**New York State Department of Health
Serum Copper Test Results, 2007 Event #3
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/L}$ serum)				
	SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
Evaluated					
Number of Sample Measurements:	10	10	10	10	10
Mean:	2054.5	1405.9	1045.5	2828.2	1110.5
Standard Deviation:	142.3	111.2	85.3	225.1	137.8
RSD (%):	6.9	7.9	8.2	8.0	12.4
Info					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2104.0	1456.3	1073.7	2906.7	1142.0
Standard Deviation:	162.4	100.2	102.8	146.4	97.0
RSD (%):	—	—	—	—	—
Reference					
Number of Sample Measurements:	11	11	11	11	11
Mean:	2161.5	1508.2	1074.3	2977.9	1182.9
Standard Deviation:	90.8	61.6	44.4	116.7	58.7
RSD (%):	4.2	4.1	4.1	3.9	5.0
All Laboratories					
Number of Sample Measurements:	24	24	24	24	24
Mean:	2109.7	1459.1	1062.2	2906.6	1147.6
Standard Deviation:	128.1	98.7	69.5	180.9	104.6
RSD (%):	6.1	6.8	6.5	6.2	9.1

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 STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were dispensed into acid-washed 1-L polypropylene containers to make up serum pools; these pools were spiked with a suite of additional trace elements including selenium as Se⁴⁺.

Target values were established as the mean of 17 referee laboratories using either ETAAS, quadrupole-based ICP-MS or other instrumentation. Values ranged from 111.6 µg/L (1.41 µmol/L) to 339.7 µg/L (4.30 µmol/L). Among the referee pool, imprecision (SD) varied between ±10.2 µg/L (0.13 µmol/L) and ±21.6 µg/L (0.27 µmol/L), increasing with Se concentration.

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) 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 upon these criteria, 92.0% of all reported test results were satisfactory, with only 2 out of 20 laboratories (10%) reporting 2 or more of the 5 results outside the acceptable range.

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

New York State Department of Health
Serum Selenium Test Results, 2007 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results ($\mu\text{g/L}$ serum)					Info Only
		SE07-11	SE07-12	SE07-13	SE07-14	SE07-15	
Target Values:		244.5	204.8	111.6	339.7	122.5	
107	DRC/CC-ICP-MS	274	218	114	349	138	
110	DRC/CC-ICP-MS	249	206	113	346	124	
114	ICP-MS	226	189	106	289	112	
147	ICP-MS	248	214	122	340	127	
156	ETAAS-Z	250	220	130	360	140	
159	ETAAS-Z	250	219	121	372	136	
164	ETAAS-Z	266	205	111	321	123	
179	ICP-MS	243	205	112	343	122	
197	ICP-MS	268	222	132	375	139	
200	DRC/CC-ICP-MS	236	198	107	327	115	
206	ICP-MS	208	186	98	301	83 ↓	
293	ETAAS-Z	237	196	107	335	109	
305	ICP-MS	287	235	150 ↑	410 ↑	142	
324	DRC/CC-ICP-MS	230	195	105	334	118	
366	ETAAS-Z	239	179	105	311	119	
367	ETAAS-Z	242	223	112	360	118	
381	Other	235	196	110	330	134	
401	ETAAS other	228	196	99	332	107	
403	ETAAS-Z	236	200	92	351	102	
404	HR-ICP-MS	556 ↑	463 ↑	282 ↑	802 ↑	306 ↑	Info

Percent satisfactory results for all participants: 92.0 %

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, 2007 Event #3
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

Lab Code	Method	Results ($\mu\text{g/L}$ serum)				
		SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
107	DRC/CC-ICP-MS	274	218	114	349	138
110	DRC/CC-ICP-MS	249	206	113	346	124
114	ICP-MS	226	189	106	289	112
147	ICP-MS	248	214	122	340	127
156	ETAAS-Z	250	220	130	360	140
159	ETAAS-Z	250	219	121	372	136
164	ETAAS-Z	266	205	111	321	123
179	ICP-MS	243	205	112	343	122
197	ICP-MS	268	222	132	375	139
200	DRC/CC-ICP-MS	236	198	107	327	115
293	ETAAS-Z	237	196	107	335	109
324	DRC/CC-ICP-MS	230	195	105	334	118
366	ETAAS-Z	239	179	105	311	119
367	ETAAS-Z	242	223	112	360	118
381	Other	235	196	110	330	134
401	ETAAS other	228	196	99	332	107
403	ETAAS-Z	236	200	92	351	102
Number of Sample Measurements:		17	17	17	17	17
Target value:		244.5	204.8	111.6	339.7	122.5
Standard Deviation:		14.0	12.8	10.2	21.6	11.8
RSD (%):		5.7	6.3	9.1	6.4	9.6
Acceptable Range:						
Upper Limit:		293.4	245.8	133.9	407.6	147.0
Lower Limit:		195.6	163.8	89.3	271.8	98.0

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, 2007 Event #3
STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ serum)				
	SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	4	4	4	4	4
Mean:	247.3	204.3	109.8	339.0	123.8
Standard Deviation:	19.5	10.3	4.4	10.3	10.2
RSD (%):	7.9	5.0	4.0	3.0	8.3
ETAAS other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	228.0	196.0	99.0	332.0	107.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	7	7	7	7	7
Mean:	245.7	206.0	111.1	344.3	121.0
Standard Deviation:	10.6	15.9	12.1	22.5	13.6
RSD (%):	4.3	7.7	10.9	6.5	11.2
HR-ICP-MS					
Number of Sample Measurements:	0	0	0	0	0
Mean:					
Standard Deviation:					
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	6	6	6	6	6
Mean:	246.7	208.5	120.0	343.0	120.8
Standard Deviation:	28.4	19.0	18.9	45.2	21.6
RSD (%):	11.5	9.1	15.8	13.2	17.9
Other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	235.0	196.0	110.0	330.0	134.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
All Laboratories					
Number of Sample Measurements:	19	19	19	19	19
Mean:	244.8	205.4	112.9	341.4	121.5
Standard Deviation:	18.7	14.7	13.5	27.8	15.2
RSD (%):	7.6	7.2	12.0	8.1	12.5

notes: ? Insufficient data for calculation.

**New York State Department of Health
Serum Selenium Test Results, 2007 Event #3
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/L}$ serum)				
	SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
Evaluated					
Number of Sample Measurements:	2	2	2	2	2
Mean:	247.5	210.5	124.0	355.5	112.5
Standard Deviation:	55.9	34.6	36.8	77.1	41.7
RSD (%):	—	—	—	—	—
Info					
Number of Sample Measurements:	0	0	0	0	0
Mean:					
Standard Deviation:					
RSD (%):	—	—	—	—	—
Reference					
Number of Sample Measurements:	17	17	17	17	17
Mean:	244.5	204.8	111.6	339.7	122.5
Standard Deviation:	14.0	12.8	10.2	21.6	11.8
RSD (%):	5.7	6.3	9.1	6.4	9.6
All Laboratories					
Number of Sample Measurements:	19	19	19	19	19
Mean:	244.8	205.4	112.9	341.4	121.5
Standard Deviation:	18.7	14.7	13.5	27.8	15.2
RSD (%):	7.6	7.2	12.0	8.1	12.5

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 STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were dispensed into acid-washed 1-L polypropylene containers to make up serum pools; these pools were spiked with a suite of additional trace elements including zinc as Zn²⁺.

Target values were established as the mean of 13 referee laboratories using either quadrupole-based ICP-MS or Flame AAS instrumentation. Values ranged from 840.3 µg/L (12.85 µmol/L) to 4456.8 µg/L (68.16 µmol/L). Among the referee pool, imprecision (SD) varied between ±46.2 µg/L (0.71 µmol/L) to ±237.3 µg/L (3.63 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 upon these criteria, 94.5% of all reported test results were satisfactory, with only 1 out of 29 laboratories (3.4%) reporting 2 or more of the 5 results outside the acceptable range.

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

New York State Department of Health
Serum Zinc Test Results, 2007 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results ($\mu\text{g/L}$ serum)					Info Only
		SE07-11	SE07-12	SE07-13	SE07-14	SE07-15	
Target Values:		2834.8	1058.4	840.3	4456.8	811.7	
107	DRC/CC-ICP-MS	3656 ↑	1145	890	5000	1083 ↑	Info
110	ICP-MS	2966	1096	941	4688	865	
114	DRC/CC-ICP-MS	2680	1050	810	4100	78 ↓	
147	ICP-MS	2859	1065	817	4549	791	
156	ICP-MS	2900	1000	780	4200	650 ↓	
159	ICP-AES/OES	2760	1070	860	4310	840	
160	FAAS	2770	1070	840	4100	820	
164	ICP-MS	2621	954	741	4129	771	
179	ICP-AES/OES	2920	1080	880	4630	820	
197	ICP-MS	2890	1090	870	4650	810	
200	FAAS	2845	1059	863	4500	811	
206	ICP-MS	2780	1030	780	4360	730	
287	FAAS	2860	980	750	4560	740	
290	FAAS	2440	820 ↓	740	4020	740	
293	ICP-MS	2681	968	759	4244	739	
305	ICP-MS	2575	885 ↓	721	3870	758	
324	ICP-AES/OES	2735	1065	875	4345	845	
325	FAAS	3200	1200	960	4640	880	Info
355	ICP-MS	2888	1056	856	4778	861	
357	ICP-AES/OES	2570	977	843	4150	721	
358	ICP-MS	3031	1132	906	3533 ↓	921	
360	FAAS	3240	1060	830	3120 ↓	800	
361	FAAS	2712	1023	868	4686	840	
362	ICP-MS	2780	1070	820	4270	810	
363	ICP-MS	2980	1090	871	4720	849	
366	FAAS	2603	1064	874	4047	820	Info
377	ICP-MS	3084	1133	914	4924	893	
401	ICP-AES/OES	2942	1079	784	4510	817	
404	HR-ICP-MS	3085	1186	923	4845	912	Info

Percent satisfactory results for all participants: 94.5 %

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, 2007 Event #3
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

Lab Code	Method	Results ($\mu\text{g/L}$ serum)				
		SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
110	ICP-MS	2966	1096	941	4688	865
147	ICP-MS	2859	1065	817	4549	791
159	ICP-AES/OES	2760	1070	860	4310	840
160	FAAS	2770	1070	840	4100	820
164	ICP-MS	2621	954	741	4129	771
179	ICP-AES/OES	2920	1080	880	4630	820
197	ICP-MS	2890	1090	870	4650	810
200	FAAS	2845	1059	863	4500	811
206	ICP-MS	2780	1030	780	4360	730
293	ICP-MS	2681	968	759	4244	739
324	ICP-AES/OES	2735	1065	875	4345	845
377	ICP-MS	3084	1133	914	4924	893
401	ICP-AES/OES	2942	1079	784	4510	817
Number of Sample Measurements:		13	13	13	13	13
Target value:		2834.8	1058.4	840.3	4456.8	811.7
Standard Deviation:		127.1	49.2	60.5	237.3	46.2
RSD (%):		4.5	4.7	7.2	5.3	5.7
Acceptable Range:						
Upper Limit:		3260.0	1217.2	966.3	5125.3	933.5
Lower Limit:		2409.6	899.6	714.3	3788.3	689.9

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, 2007 Event #3
STATISTICAL SUMMARY BY METHOD**

	Results ($\mu\text{g/L}$ serum)				
	SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	2	2	1
Mean:	3168.0	1097.5	850.0	4550.0	1083.0
Standard Deviation:	690.1	67.2	56.6	636.4	?
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	8	8	8	8	8
Mean:	2833.8	1034.5	840.6	4209.1	806.4
Standard Deviation:	274.4	106.8	70.8	518.4	47.5
RSD (%):	9.7	10.3	8.4	12.3	5.9
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	3085.0	1186.0	923.0	4845.0	912.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	5	5	5	5	5
Mean:	2785.4	1054.2	848.4	4389.0	808.6
Standard Deviation:	151.8	43.6	38.8	185.8	50.5
RSD (%):	5.5	4.1	4.6	4.2	6.2
ICP-MS					
Number of Sample Measurements:	13	13	13	13	13
Mean:	2848.8	1043.8	828.9	4378.1	803.7
Standard Deviation:	155.4	73.7	70.2	394.8	75.0
RSD (%):	5.5	7.1	8.5	9.0	9.3
All Laboratories					
Number of Sample Measurements:	29	29	29	29	28
Mean:	2863.9	1051.6	840.2	4361.3	819.2
Standard Deviation:	243.5	80.8	63.4	413.7	80.9
RSD (%):	8.5	7.7	7.5	9.5	9.9

notes: ? Insufficient data for calculation.

**New York State Department of Health
Serum Zinc Test Results, 2007 Event #3
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/L}$ serum)				
	SE07-11	SE07-12	SE07-13	SE07-14	SE07-15
Evaluated					
Number of Sample Measurements:	12	12	12	12	11
Mean:	2804.7	1011.9	816.3	4167.3	790.0
Standard Deviation:	224.8	87.9	57.9	497.9	76.9
RSD (%):	8.0	8.7	7.1	11.9	9.7
Info					
Number of Sample Measurements:	4	4	4	4	4
Mean:	3136.0	1148.8	911.8	4633.0	923.8
Standard Deviation:	432.5	61.1	38.1	417.6	112.8
RSD (%):	13.8	5.3	4.2	9.0	12.2
Reference					
Number of Sample Measurements:	13	13	13	13	13
Mean:	2834.8	1058.4	840.3	4456.8	811.7
Standard Deviation:	127.1	49.2	60.5	237.3	46.2
RSD (%):	4.5	4.7	7.2	5.3	5.7
All Laboratories					
Number of Sample Measurements:	29	29	29	29	28
Mean:	2863.9	1051.6	840.2	4361.3	819.2
Standard Deviation:	243.5	80.8	63.4	413.7	80.9
RSD (%):	8.5	7.7	7.5	9.5	9.9

notes: ? Insufficient data for calculation.

**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., D₂, S-H background correction)
- A-3 FAAS (Flame atomic absorption spectrometry)
- A-4 CV-AAS (Cold vapor atomic absorption spectrometry)
- A-5 HG-AAS (Hydride generation atomic absorption spectrometry)
- A-6 AFS (Atomic fluorescence spectrometry)
- A-7 Other

INDUCTIVELY COUPLED PLASMA

- P-1 ICP-MS (Inductively coupled plasma - mass spectrometry)
- P-2 DRC/CC-ICP-MS (ICP-MS used in the Dynamic Reaction Cell or Collision Cell mode)
- P-3 ICP-AES/OES (ICP atomic/optical emission spectrometry)
- P-4 HR-ICP-MS (High resolution ICP-MS)
- P-5 ETV-ICP-MS (Electrothermal vaporization ICP-MS)
- P-6 ID-ICP-MS (Isotope dilution ICP-MS)
- P-7 Other

ELECTROCHEMICAL METHODS

- E-1 ASV (Anodic stripping voltammetry without digestion)
- E-2 ASV-LeadCare[®] (Anodic stripping voltammetry using the ESA LeadCare[®] system)
- E-3 Fluoride specific electrode
- E-4 Other

MOLECULAR FLUORIMETRY

- F-1 EtOAc (Ethyl acetate-acetic acid extraction method for determination of erythrocyte protoporphyrin)
- F-2 Aviv hematofluorometry (for determination of EP at hematocrit 35)
- F-3 Helena ZPP (for determination of zinc protoporphyrin in $\mu\text{mol ZPP/mol heme}$)
- F-4 Other

OTHER METHODS

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