
Wadsworth Center

New York State Department of Health

TRACE ELEMENTS IN SERUM

Event #1, 2007

May 3, 2007

May 3, 2007

Trace Elements in Serum

Event #1, 2007

Dear Laboratory Director:

Results from the first 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.

PT Materials

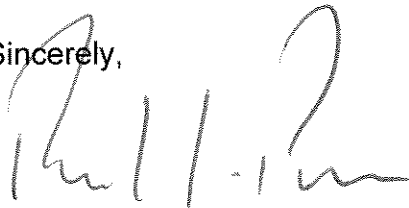
The test materials were prepared from human serum obtained from Tennessee Blood Services, Inc. Serum units were spiked with a suite of additional trace elements as described in each narrative.

**The 2nd PT event for trace elements in serum was mailed April 17th, 2007.
The postmark deadline for reporting results is May 15th, 2007.**

We apologize for the delay in getting the results of the 1st survey back to you. We will try to get these reports back to you in a more timely fashion in the future.

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 12 referee laboratories using either ETAAS, ICP-MS or DRC/CC-ICP-MS instrumentation. Values ranged from 26.6 µg/L (0.99 µmol/L) to 100.8 µg/L (3.74 µmol/L). Among the referee pool, imprecision (SD) varied from ± 2.7 µg/L (0.10 µmol/L) to ± 5.6 µg/L (0.21 µmol/L), increasing with Al concentration.

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).

Discussion. Based upon these criteria, 79.3% of all reported results were satisfactory, with 6 out of 28 laboratories (21.4%) reporting 2 or more of the 5 results outside the acceptable range. It is evident from the data for this event that a number of laboratories have some difficulty maintaining performance at ± 20%. We recognize that it may take some time and effort for such laboratories to improve their performance for serum aluminum to achieve ± 20%. Thus, we encourage laboratories to re-validate and re-optimize their methods for serum aluminum. Continued poor performance may lead to closer scrutiny of laboratory methods and practices.

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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results ($\mu\text{g/L}$ serum)					Info Only
		SE07-01	SE07-02	SE07-03	SE07-04	SE07-05	
Target Values:		76.8	100.8	59.6	43.2	26.6	
110	ETAAS-Z	70	91	54	38	22	
114	ETAAS-Z	80	107	59	47	29	
126	ETAAS-Z	74	95	56	41	26	
147	ETAAS-Z	80	105	64	46	29	
156	ICP-MS	101 ↑	128 ↑	86 ↑	62 ↑	41 ↑	
159	ETAAS-Z	76	92	55	42	59 ↑	
160	ETAAS-Z	74	95	57	46	28	
164	ICP-MS	77	102	59	42	25	
179	ICP-MS	82	106	63	44	25	
197	ICP-MS	69	101	50	36	21 ↓	
200	DRC/CC-ICP-MS	81	104	60	45	27	
206	ICP-MS	79	101	56	44	26	
287	ETAAS-Z	98 ↑	126 ↑	86 ↑	64 ↑	37 ↑	
293	ETAAS other	79	95	61	51	32 ↑	Info
301	ETAAS-Z	87	106	58	42	23	
305	ICP-MS	74	105	65	45	29	
314	ICP-MS	77	100	58	42	25	
324	DRC/CC-ICP-MS	80	99	63	40	28	
355	ICP-MS	79	106	61	49	27	
357	ICP-AES/OES	71	90	44 ↓	32 ↓	15 ↓	
358	ICP-MS	77	99	59	41	25	
361	ETAAS other	102 ↑	144 ↑	92 ↑	58 ↑	41 ↑	
362	ICP-MS	90	112	70	49	33 ↑	
363	ICP-MS	75	97	60	43	30	
367	ETAAS-Z	86	113	73 ↑	48	30	Info
377	ICP-MS	82	105	64	61 ↑	39 ↑	
401	ICP-AES/OES	70	93	51	38	22	
404	HR-ICP-MS	60.6 ↓	56.0 ↓	36.4 ↓	20.0 ↓	23.9	Info

Percent satisfactory results for all participants: 79.3 %

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.

**New York State Department of Health
Serum Aluminum Test Results, 2007 Event #1
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

Lab Code	Method	Results ($\mu\text{g/L}$ serum)				
		SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
110	ETAAS-Z	70	91	54	38	22
114	ETAAS-Z	80	107	59	47	29
126	ETAAS-Z	74	95	56	41	26
147	ETAAS-Z	80	105	64	46	29
164	ICP-MS	77	102	59	42	25
179	ICP-MS	82	106	63	44	25
200	DRC/CC-ICP-MS	81	104	60	45	27
305	ICP-MS	74	105	65	45	29
324	DRC/CC-ICP-MS	80	99	63	40	28
355	ICP-MS	79	106	61	49	27
363	ICP-MS	75	97	60	43	30
401	ICP-AES/OES	70	93	51	38	22
Number of Sample Measurements:		12	12	12	12	12
Target value:		76.8	100.8	59.6	43.2	26.6
Standard Deviation:		4.2	5.6	4.2	3.5	2.7
RSD (%):		5.4	5.6	7.0	8.1	10.1
Acceptable Range:						
Upper Limit:		92.2	121.0	71.5	51.8	31.9
Lower Limit:		61.4	80.6	47.7	34.6	21.3

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 #1**

STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ serum)				
	SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	80.5	101.5	61.5	42.5	27.5
Standard Deviation:	0.7	3.5	2.1	3.5	0.7
RSD (%):	—	—	—	—	—
ETAAS other					
Number of Sample Measurements:	2	2	2	2	2
Mean:	90.5	119.5	76.5	54.5	36.5
Standard Deviation:	16.3	34.6	21.9	4.9	6.4
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	9	9	9	9	8
Mean:	80.6	103.3	62.4	46.0	28.0
Standard Deviation:	8.6	11.5	10.6	7.5	4.7
RSD (%):	10.7	11.1	17.0	16.3	16.6
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	60.6	56.0	36.4	20.0	23.9
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	70.5	91.5	47.5	35.0	18.5
Standard Deviation:	0.7	2.1	4.9	4.2	4.9
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	12	12	12	12	12
Mean:	80.2	105.2	62.6	46.5	28.8
Standard Deviation:	8.3	8.2	8.9	7.8	6.0
RSD (%):	10.4	7.8	14.2	16.8	21.0
All Laboratories					
Number of Sample Measurements:	28	28	28	28	27
Mean:	79.7	102.6	61.4	44.9	28.1
Standard Deviation:	9.4	15.0	11.8	9.1	6.1
RSD (%):	11.8	14.6	19.2	20.3	21.7

notes: ? Insufficient data for calculation.

**New York State Department of Health
Serum Aluminum Test Results, 2007 Event #1
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/L}$ serum)				
	SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
Evaluated					
Number of Sample Measurements:	13	13	13	13	12
Mean:	83.3	107.6	64.2	47.6	29.5
Standard Deviation:	11.3	15.9	14.9	10.4	8.5
RSD (%):	13.6	14.8	23.2	21.8	29.0
Info					
Number of Sample Measurements:	3	3	3	3	3
Mean:	75.2	88.0	56.8	39.7	28.6
Standard Deviation:	13.1	29.1	18.7	17.1	4.2
RSD (%):	—	—	—	—	—
Reference					
Number of Sample Measurements:	12	12	12	12	12
Mean:	76.8	100.8	59.6	43.2	26.6
Standard Deviation:	4.2	5.6	4.2	3.5	2.7
RSD (%):	5.4	5.6	7.0	8.1	10.1
All Laboratories					
Number of Sample Measurements:	28	28	28	28	27
Mean:	79.7	102.6	61.4	44.9	28.1
Standard Deviation:	9.4	15.0	11.8	9.1	6.1
RSD (%):	11.8	14.6	19.2	20.3	21.7

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 12 referee laboratories using either ICP-MS, ICP-AES/OES, or Flame AAS instrumentation. Values ranged from 609.3 µg/L (9.59 µmol/L) to 2317.1 µg/L (36.46 µmol/L). Among the referee pool, imprecision (SD) varied between ±26.8 µg/L (0.42 µmol/L) and ±109.5 µg/L (1.72 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, 90.0% of all reported test results were satisfactory, with only 3 out of 24 laboratories (12.5%) 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 #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results ($\mu\text{g/L}$ serum)					Info Only
		SE07-01	SE07-02	SE07-03	SE07-04	SE07-05	
Target Values:		2317.1	1242.9	609.3	964.1	1215.8	
107	DRC/CC-ICP-MS	2244	1215	617	976	1185	
110	ICP-MS	2367	1256	631	991	1232	
114	DRC/CC-ICP-MS	1960 ↓	1070	520	830	1070	
147	ICP-MS	2300	1233	621	972	1207	
156	FAAS	2290	1250	600	970	1220	
159	ICP-AES/OES	2458	1311	649	1011	1302	
160	ETAAS-Z	2240	1110	620	910	1190	
164	ICP-MS	2258	1220	614	947	1202	
179	ICP-AES/OES	2300	1280	610	980	1240	
197	ICP-MS	2330	1310	610	990	1240	
200	FAAS	2299	1226	584	921	1175	
206	ICP-MS	1950 ↓	1050 ↓	540	800 ↓	980 ↓	
208	ICP-MS	2303	1246	598	977	1203	
287	ETAAS-Z	2487	1304	622	939	1245	
290	FAAS	2210	1130	570	880	1090	
293	FAAS	2449	1361	617	560 ↓	1361	Info
305	ICP-MS	2367	1288	572	963	1226	
324	DRC/CC-ICP-MS	1882 ↓	1262	622	948	1202	Info
325	FAAS	1845 ↓	1071	513 ↓	876	1035	Info
360	FAAS	2400	1280	670	1010	1250	
362	ICP-MS	2220	1120	570	850	1140	
377	ICP-MS	2130	1118	586	896	1162	
401	ICP-AES/OES	2542	1328	648	1042	1328	
404	HR-ICP-MS	2036	1007 ↓	443 ↓	745 ↓	1103	Info

Percent satisfactory results for all participants: 90.0 %

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 Copper Test Results, 2007 Event #1
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

Lab Code	Method	Results ($\mu\text{g/L}$ serum)				
		SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
107	DRC/CC-ICP-MS	2244	1215	617	976	1185
110	ICP-MS	2367	1256	631	991	1232
147	ICP-MS	2300	1233	621	972	1207
159	ICP-AES/OES	2458	1311	649	1011	1302
164	ICP-MS	2258	1220	614	947	1202
179	ICP-AES/OES	2300	1280	610	980	1240
197	ICP-MS	2330	1310	610	990	1240
200	FAAS	2299	1226	584	921	1175
290	FAAS	2210	1130	570	880	1090
305	ICP-MS	2367	1288	572	963	1226
377	ICP-MS	2130	1118	586	896	1162
401	ICP-AES/OES	2542	1328	648	1042	1328
Number of Sample Measurements:		12	12	12	12	12
Target value:		2317.1	1242.9	609.3	964.1	1215.8
Standard Deviation:		109.5	67.4	26.8	46.7	62.6
RSD (%):		4.7	5.4	4.4	4.8	5.2
Acceptable Range:						
Upper Limit:		2664.7	1429.3	704.6	1108.7	1398.2
Lower Limit:		1969.5	1056.5	514.1	819.5	1033.4

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 #1
STATISTICAL SUMMARY BY METHOD**

	Results ($\mu\text{g/L}$ serum)				
	SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2028.7	1182.3	586.3	918.0	1152.3
Standard Deviation:	190.5	100.1	57.5	77.5	71.8
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	2363.5	1207.0	621.0	924.5	1217.5
Standard Deviation:	174.7	137.2	1.4	20.5	38.9
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	6	6	6	6	6
Mean:	2248.8	1219.7	592.3	869.5	1188.5
Standard Deviation:	215.3	104.6	52.1	160.3	116.6
RSD (%):	9.6	8.6	8.8	18.4	9.8
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2036.0	1007.0	443.0	745.0	1103.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2433.3	1306.3	635.7	1011.0	1290.0
Standard Deviation:	122.9	24.3	22.2	31.0	45.2
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	9	9	9	9	9
Mean:	2247.2	1204.6	593.6	931.8	1176.9
Standard Deviation:	134.3	88.0	29.2	68.1	80.6
RSD (%):	6.0	7.3	4.9	7.3	6.9
All Laboratories					
Number of Sample Measurements:	24	24	24	24	24
Mean:	2244.5	1210.3	593.6	916.0	1191.2
Standard Deviation:	189.7	99.8	50.1	104.6	88.7
RSD (%):	8.5	8.2	8.4	11.4	7.4

notes: ? Insufficient data for calculation.

**New York State Department of Health
Serum Copper Test Results, 2007 Event #1
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/L}$ serum)				
	SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
Evaluated					
Number of Sample Measurements:	8	8	8	8	8
Mean:	2231.3	1178.8	592.5	910.8	1162.3
Standard Deviation:	191.0	101.5	48.2	76.6	94.5
RSD (%):	8.6	8.6	8.1	8.4	8.1
Info					
Number of Sample Measurements:	4	4	4	4	4
Mean:	2053.0	1175.3	548.8	782.3	1175.3
Standard Deviation:	276.7	164.5	86.6	170.3	141.5
RSD (%):	13.5	14.0	15.8	21.8	12.0
Reference					
Number of Sample Measurements:	12	12	12	12	12
Mean:	2317.1	1242.9	609.3	964.1	1215.8
Standard Deviation:	109.5	67.4	26.8	46.7	62.6
RSD (%):	4.7	5.4	4.4	4.8	5.2
All Laboratories					
Number of Sample Measurements:	24	24	24	24	24
Mean:	2244.5	1210.3	593.6	916.0	1191.2
Standard Deviation:	189.7	99.8	50.1	104.6	88.7
RSD (%):	8.5	8.2	8.4	11.4	7.4

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 10 referee laboratories using either ETAAS, ICP-MS or DRC/CC-ICP-MS instrumentation. Values ranged from 99.9 µg/L (1.27 µmol/L) to 261.8 µg/L (3.32 µmol/L). Among the referee pool, imprecision (SD) varied between ±5.0 µg/L (0.06 µmol/L) and ±14.6 µg/L (0.18 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) 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, 86.3% of all reported test results were satisfactory, with only 3 out of 19 laboratories (15.8%) reporting 2 or more of the 5 results outside the acceptable range.

**New York State Department of Health
Serum Selenium Test Results, 2007 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results ($\mu\text{g/L}$ serum)					Info Only
		SE07-01	SE07-02	SE07-03	SE07-04	SE07-05	
Target Values:		261.8	213.0	113.2	99.9	126.3	
107	DRC/CC-ICP-MS	249	209	108	101	120	
110	DRC/CC-ICP-MS	276	224	119	104	131	
114	ICP-MS	244	211	145 \uparrow	100	121	
147	ICP-MS	279	221	111	103	133	
156	ETAAS-Z	218	203	108	18 \downarrow	124	
159	ETAAS-Z	266	217	114	102	133	
164	ETAAS-Z	263	215	123	92	127	
179	ICP-MS	264	215	106	98	126	
197	ICP-MS	289	242	193 \uparrow	120 \uparrow	146	
200	DRC/CC-ICP-MS	257	205	107	97	122	
206	ICP-MS	231	184	175 \uparrow	93	105	
208	ICP-MS	291	244	173 \uparrow	117	144	
293	ETAAS-Z	228	186	96	93	108	
305	ICP-MS	268	216	134	108	134	
324	DRC/CC-ICP-MS	268	222	114	101	129	
381	Atomic Spectrometry Other	313	247	133	118	148	
401	ICP-AES/OES	309	246	103	101	129	Info
403	ETAAS-Z	201 \downarrow	147 \downarrow	29 \downarrow	22 \downarrow	47 \downarrow	Info
404	HR-ICP-MS	312	246	221 \uparrow	114	153 \uparrow	Info

Percent satisfactory results for all participants: 86.3 %

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 Selenium Test Results, 2007 Event #1
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

Lab Code	Method	Results ($\mu\text{g/L}$ serum)				
		SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
107	DRC/CC-ICP-MS	249	209	108	101	120
110	DRC/CC-ICP-MS	276	224	119	104	131
147	ICP-MS	279	221	111	103	133
159	ETAAS-Z	266	217	114	102	133
164	ETAAS-Z	263	215	123	92	127
179	ICP-MS	264	215	106	98	126
200	DRC/CC-ICP-MS	257	205	107	97	122
293	ETAAS-Z	228	186	96	93	108
305	ICP-MS	268	216	134	108	134
324	DRC/CC-ICP-MS	268	222	114	101	129
Number of Sample Measurements:		10	10	10	10	10
Target value:		261.8	213.0	113.2	99.9	126.3
Standard Deviation:		14.6	11.1	10.4	5.0	8.0
RSD (%):		5.6	5.2	9.2	5.0	6.3
Acceptable Range:						
Upper Limit:		314.2	255.6	135.8	119.9	151.6
Lower Limit:		209.4	170.4	90.6	79.9	101.0

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 #1**

STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ serum)				
	SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
Atomic Spectrometry					
Number of Sample Measurements:	1	1	1	1	1
Mean:	313.0	247.0	133.0	118.0	148.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
DRC/CC-ICP-MS					
Number of Sample Measurements:	4	4	4	4	4
Mean:	262.5	215.0	112.0	100.8	125.5
Standard Deviation:	11.9	9.4	5.6	2.9	5.3
RSD (%):	4.5	4.4	5.0	2.9	4.2
ETAAS-Z					
Number of Sample Measurements:	5	5	5	5	5
Mean:	235.2	193.6	94.0	65.4	107.8
Standard Deviation:	28.5	28.8	37.6	41.7	35.2
RSD (%):	12.1	14.9	40.0	63.7	32.7
HR-ICP-MS					
Number of Sample Measurements:	1	1	0	1	1
Mean:	312.0	246.0		114.0	153.0
Standard Deviation:	?	?		?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	1	1	1	1	1
Mean:	309.0	246.0	103.0	101.0	129.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	7	7	7	7	7
Mean:	266.6	219.0	148.1	105.6	129.9
Standard Deviation:	22.5	20.3	33.5	10.0	14.1
RSD (%):	8.4	9.3	22.6	9.5	10.9
All Laboratories					
Number of Sample Measurements:	19	19	18	19	19
Mean:	264.5	215.8	121.7	94.8	125.3
Standard Deviation:	31.3	25.2	36.0	27.7	22.6
RSD (%):	11.8	11.7	29.6	29.2	18.1

notes: ? Insufficient data for calculation.

**New York State Department of Health
Serum Selenium Test Results, 2007 Event #1
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/L}$ serum)				
	SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
Evaluated					
Number of Sample Measurements:	6	6	6	6	6
Mean:	264.3	221.8	154.5	94.3	131.3
Standard Deviation:	38.4	26.2	31.5	39.0	17.4
RSD (%):	14.5	11.8	20.4	41.3	13.2
Info					
Number of Sample Measurements:	3	3	2	3	3
Mean:	274.0	213.0	66.0	79.0	109.7
Standard Deviation:	63.2	57.2	52.3	49.8	55.6
RSD (%):	—	—	—	—	—
Reference					
Number of Sample Measurements:	10	10	10	10	10
Mean:	261.8	213.0	113.2	99.9	126.3
Standard Deviation:	14.6	11.1	10.4	5.0	8.0
RSD (%):	5.6	5.2	9.2	5.0	6.3
All Laboratories					
Number of Sample Measurements:	19	19	18	19	19
Mean:	264.5	215.8	121.7	94.8	125.3
Standard Deviation:	31.3	25.2	36.0	27.7	22.6
RSD (%):	11.8	11.7	29.6	29.2	18.1

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 16 referee laboratories using either ICP-MS, ICP-AES/OES or Flame AAS instrumentation. Values ranged from 593.3 µg/L (9.07 µmol/L) to 3348.9 µg/L (51.21 µmol/L). Among the referee pool, imprecision (SD) varied between ±39.4 µg/L (0.60 µmol/L) to ±180.8 µg/L (2.76 µmol/L), increasing with Zn concentration.

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, 89.0% of all reported test results were satisfactory, with only 5 out of 29 laboratories (17.2%) 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 Zinc Test Results, 2007 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results ($\mu\text{g/L}$ serum)					Info Only
		SE07-01	SE07-02	SE07-03	SE07-04	SE07-05	
Target Values:		3348.9	1090.0	1510.1	593.3	708.3	
107	DRC/CC-ICP-MS	3030	1016	1445	623	672	
110	ICP-MS	3529	1145	1601	622	749	
114	DRC/CC-ICP-MS	2900	950	1320	510	630	
147	ICP-MS	3516	1124	1588	623	745	
156	ICP-MS	2980	991	1250 ↓	501 ↓	563 ↓	
159	ICP-AES/OES	3465	1122	1559	599	739	
160	FAAS	3430	1010	1500	570	660	
164	ICP-MS	3284	1018	1392	533	660	
179	ICP-AES/OES	3490	1140	1590	610	760	
197	ICP-MS	3510	1160	1540	600	730	
200	FAAS	3427	1171	1570	628	778	
206	ICP-MS	3160	1080	1490	620	700	
208	ICP-MS	3361	1103	1475	660	798	
287	FAAS	3600	1150	1600	640	750	
290	FAAS	3210	1210	1520	710 ↑	910 ↑	
293	FAAS	3368	1118	1517	615	700	
305	ICP-MS	3279	1050	1429	566	692	
324	DRC/CC-ICP-MS	3423	1073	1483	532	607	
325	FAAS	3390	723 ↓	987 ↓	366 ↓	468 ↓	Info
355	ICP-MS	3354	1108	1493	592	701	
357	ICP-AES/OES	3090	965	1310	530	702	
358	ICP-MS	3332	1184	1459	680	757	
360	FAAS	3360	1080	1490	600	720	
361	FAAS	3210	1230	1640	610	700	
362	ICP-MS	3510	1180	1580	640	770	
363	ICP-MS	4060 ↑	1200	1750 ↑	670	820 ↑	
377	ICP-MS	3542	1107	1539	608	737	
401	ICP-AES/OES	3412	1183	1647	641	791	
404	HR-ICP-MS	2703 ↓	874 ↓	1271 ↓	476 ↓	756	Info

Percent satisfactory results for all participants: 89.0 %

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 Zinc Test Results, 2007 Event #1
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

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

Lab Code	Method	Results ($\mu\text{g/L}$ serum)				
		SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
107	DRC/CC-ICP-MS	3030	1016	1445	623	672
110	ICP-MS	3529	1145	1601	622	749
114	DRC/CC-ICP-MS	2900	950	1320	510	630
147	ICP-MS	3516	1124	1588	623	745
159	ICP-AES/OES	3465	1122	1559	599	739
160	FAAS	3430	1010	1500	570	660
164	ICP-MS	3284	1018	1392	533	660
179	ICP-AES/OES	3490	1140	1590	610	760
197	ICP-MS	3510	1160	1540	600	730
200	FAAS	3427	1171	1570	628	778
206	ICP-MS	3160	1080	1490	620	700
293	FAAS	3368	1118	1517	615	700
305	ICP-MS	3279	1050	1429	566	692
324	DRC/CC-ICP-MS	3423	1073	1483	532	607
360	FAAS	3360	1080	1490	600	720
401	ICP-AES/OES	3412	1183	1647	641	791
Number of Sample Measurements:		16	16	16	16	16
Target value:		3348.9	1090.0	1510.1	593.3	708.3
Standard Deviation:		180.8	67.0	85.2	39.4	52.7
RSD (%):		5.4	6.1	5.6	6.6	7.4
Acceptable Range:						
Upper Limit:		3851.2	1253.5	1736.6	682.3	814.5
Lower Limit:		2846.6	926.5	1283.6	504.3	602.1

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

DL (Detection Limit): varies by laboratory

**New York State Department of Health
Serum Zinc Test Results, 2007 Event #1
STATISTICAL SUMMARY BY METHOD**

	Results ($\mu\text{g/L}$ serum)				
	SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	3117.7	1013.0	1416.0	555.0	636.3
Standard Deviation:	272.3	61.6	85.3	59.9	33.0
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	8	8	8	8	8
Mean:	3374.4	1086.5	1478.0	592.4	710.8
Standard Deviation:	126.1	163.0	205.1	100.0	124.0
RSD (%):	3.7	15.0	13.9	16.9	17.4
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	2703.0	874.0	1271.0	476.0	756.0
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	4	4	4	4	4
Mean:	3364.3	1102.5	1526.5	595.0	748.0
Standard Deviation:	185.7	95.2	148.9	46.8	37.4
RSD (%):	5.5	8.6	9.8	7.9	5.0
ICP-MS					
Number of Sample Measurements:	13	13	13	13	13
Mean:	3416.7	1111.5	1506.6	608.8	724.8
Standard Deviation:	254.4	64.3	119.4	52.0	65.4
RSD (%):	7.4	5.8	7.9	8.5	9.0
All Laboratories					
Number of Sample Measurements:	29	29	29	29	29
Mean:	3342.2	1085.0	1484.0	592.2	716.0
Standard Deviation:	252.3	110.3	148.8	70.1	82.6
RSD (%):	7.5	10.2	10.0	11.8	11.5

notes: ? Insufficient data for calculation.

**New York State Department of Health
Serum Zinc Test Results, 2007 Event #1
STATISTICAL SUMMARY BY CLASS**

	Results ($\mu\text{g/L}$ serum)				
	SE07-01	SE07-02	SE07-03	SE07-04	SE07-05
Evaluated					
Number of Sample Measurements:	11	11	11	11	11
Mean:	3386.3	1129.8	1510.5	621.9	746.2
Standard Deviation:	293.0	86.8	141.5	63.1	86.9
RSD (%):	8.7	7.7	9.4	10.2	11.6
Info					
Number of Sample Measurements:	2	2	2	2	2
Mean:	3046.5	798.5	1129.0	421.0	612.0
Standard Deviation:	485.8	106.8	200.8	77.8	203.6
RSD (%):	—	—	—	—	—
Reference					
Number of Sample Measurements:	16	16	16	16	16
Mean:	3348.9	1090.0	1510.1	593.3	708.3
Standard Deviation:	180.8	67.0	85.2	39.4	52.7
RSD (%):	5.4	6.1	5.6	6.6	7.4
All Laboratories					
Number of Sample Measurements:	29	29	29	29	29
Mean:	3342.2	1085.0	1484.0	592.2	716.0
Standard Deviation:	252.3	110.3	148.8	70.1	82.6
RSD (%):	7.5	10.2	10.0	11.8	11.5

notes: ? Insufficient data for calculation.

Additional Trace Elements Reported in Serum

For this interlaboratory study, we requested that participant laboratories report 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 materials. Results for additional trace elements are reported here, but no target values are implied nor are any acceptable ranges provided. These data are provided solely for educational and informational purposes.

In addition to Al, Cu, Se and Sn, 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

**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.
