
Wadsworth Center

NEW YORK STATE DEPARTMENT OF HEALTH

Trace Elements Laboratory

TRACE ELEMENTS IN SERUM

Proficiency Test Report

Event #1, 2013

March 25th, 2013

March 25, 2013

**Trace Elements in Serum
Event #1, 2013**

Dear Laboratory Director:

Results from the first proficiency test (PT) event for 2013 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

Serum materials were obtained from the Dutch EQA (External Quality Assessment) scheme SKML (Stichting Kwaliteitsbewaking Medische Laboratoria) as part of a global collaborative exercise to harmonize international measurements of aluminum (Al), copper (Cu), selenium (Se) and zinc (Zn) in serum. Additionally, serum pools were spiked with a suite of trace elements: cobalt (Co), chromium (Cr), lithium (Li), magnesium (Mg), manganese (Mn), thallium (Tl), and vanadium (V). The serum has been tested and found to be negative for BSE (Bovine Spongiform Encephalopathy), and free of pathogens. The Certificate of Analysis provided by SKML is available upon request.

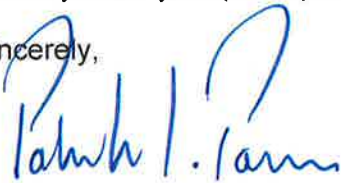
Serum Selenium

Since switching to the serum materials obtained from the Dutch EQA, we have become aware of a potential interference on Se in ICP-MS when sera from bovine sources are used for PT sample pools. Please refer to the Se narrative for further details.

The next PT event for trace elements in serum is scheduled to be mailed Wednesday, May 8th, 2013. 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 Wednesday, June 5th, 2013.**

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

New York State Department of Health
Event #1, 2013

Serum Aluminum

Serum materials were obtained from the Dutch EQA (External Quality Assessment) scheme SKML (Stichting Kwaliteitsbewaking Medische Laboratoria) as part of a global collaborative exercise to harmonize international measurements of Al, Cu, Se and Zn in serum. Additionally, serum pools were spiked with a suite of trace elements (Co, Cr, Li, Mg, Mn, Tl, and V), including aluminum as AlCl_3 at various concentrations. The serum has been tested and found to be negative for BSE (Bovine Spongiform Encephalopathy), and free of pathogens. The Certificate of Analysis provided by SKML is available upon request.

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 13 $\mu\text{g/L}$ ($0.48 \mu\text{mol/L}$) to 288 $\mu\text{g/L}$ ($10.67 \mu\text{mol/L}$).

Acceptable ranges for serum aluminum are based on fixed criteria of $\pm 20\%$, or $\pm 5 \mu\text{g/L}$ below 25 $\mu\text{g/L}$. These criteria are based on consensus recommendations from several EQAS organizers (1).

Discussion. Based on the above criteria, 87.0% of test results reported were judged as satisfactory, with four out of 23 participant laboratories (17.4%) 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, 2013 Event #1
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

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

	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
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Robust Mean	13	288	95	177	124
Robust Standard Deviation	3	35	8	19	14
Standard Uncertainty	1	10	2	5	4
RSD (%)	22.4	12.2	8.7	10.8	11.2
Number of Sample Measurements	21	20	23	22	22
Acceptable Range:					
Upper Limit:	18	346	114	212	149
Lower Limit:	8	230	76	142	99

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, 2013 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE13-01	SE13-02	SE13-03	SE13-04	SE13-05	
	Target Values:	13	288	95	177	124	
110	ETAAS-Z	12	258	90	179	118	
114	ICP-MS	11	256	80	151	121	
147	FAAS	11	255	94	167	118	Info
156	ICP-MS	12	247	94	172	122	
160	ETAAS-Z	14	247	91	152	102	
164	ICP-MS	14	272	85	87 ↓	110	
179	DRC/CC-ICP-MS	25 ↑	264	89	168	117	
197	ICP-MS	<20	322	109	200	146	
200	DRC/CC-ICP-MS	24 ↑	286	125 ↑	226 ↑	190 ↑	Info
206	DRC/CC-ICP-MS	12	>100	93	>100	>100	
287	ETAAS-Z	9	297	87	176	114	
293	ICP-MS	14	292	95	163	123	Info
305	ICP-MS	16	301	101	180	131	
324	ICP-MS	20 ↑	540 ↑	118 ↑	354 ↑	271 ↑	Info
325	ETAAS-Z	13	347 ↑	101	221 ↑	133	Info
355	ICP-MS	11	271	89	169	116	
357	ICP-MS	11	300	90	180	103	
358	ICP-MS	13	>250	104	196	138	
362	ICP-MS	17	284	95	187	127	
363	ICP-MS	<10	>250	97	190	126	
367	ETAAS-Z	12	268	94	169	123	Info
401	ICP-AES/OES	16	321	111	159	108	Info
458	ETAAS Other	10	375 ↑	83	183	156 ↑	

Percent satisfactory results for all participants: 87.0 %

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 Aluminum Test Results, 2013 Event #1
STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ serum)				
	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	3	2	2
Mean:	18	275	102	197	154
Standard Deviation:	8	16	20	41	52
RSD (%):	—	—	—	—	—
ETAAS Other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	10	375	83	183	156
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	5	5	5	5	5
Mean:	12	283	93	179	118
Standard Deviation:	2	40	5	26	11
RSD (%):	15.6	14.2	5.7	14.2	9.7
FAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	11	255	94	167	118
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	1	1	1	1	1
Mean:	16	321	111	159	108
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	10	10	12	11	11
Mean:	14	309	96	170	124
Standard Deviation:	3	84	10	31	12
RSD (%):	21.6	27.3	10.9	18.3	9.7
All Laboratories					
Number of Sample Measurements:	20	20	23	21	21
Mean:	14	300	96	175	126
Standard Deviation:	4	66	11	28	20
RSD (%):	26.4	21.9	11.5	16.0	15.7

notes: ? Insufficient data for calculation.

Serum Copper

Serum materials were obtained from the Dutch EQA (External Quality Assessment) scheme SKML (Stichting Kwaliteitsbewaking Medische Laboratoria) as part of a global collaborative exercise to harmonize international measurements of Al, Cu, Se and Zn in serum. Additionally, serum pools were spiked with a suite of trace elements (Co, Cr, Li, Mg, Mn, Ti, and V), including copper as CuCl_2 at various concentrations. The serum has been tested and found to be negative for BSE (Bovine Spongiform Encephalopathy), and free of pathogens. The Certificate of Analysis provided by SKML is available upon request.

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 694 $\mu\text{g/L}$ (10.92 $\mu\text{mol/L}$) to 2365 $\mu\text{g/L}$ (37.22 $\mu\text{mol/L}$).

Acceptable ranges for serum copper are based on fixed criteria of $\pm 15\%$, or $\pm 95 \mu\text{g/L}$ below 635 $\mu\text{g/L}$. 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 ($\pm 10\%$).

Discussion. Based on the above criteria, 93.3% of test results reported were judged as satisfactory, with one out of 18 participant laboratories (5.6%) 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, 2013 Event #1
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results ($\mu\text{g/L}$ serum)				
	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
Robust Mean	694	2365	1171	1667	1336
Robust Standard Deviation	26	154	85	110	94
Standard Uncertainty	8	45	25	32	28
RSD (%)	3.7	6.5	7.3	6.6	7.1
Number of Sample Measurements	18	18	18	18	18
Acceptable Range:					
Upper Limit:	798	2720	1347	1917	1536
Lower Limit:	590	2010	995	1417	1136

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, 2013 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE13-01	SE13-02	SE13-03	SE13-04	SE13-05	
	Target Values:	694	2365	1171	1667	1336	
107	DRC/CC-ICP-MS	715	2447	1247	1778	1423	Info
110	ICP-MS	737	2506	1254	1758	1442	
114	ICP-MS	680	2200	1210	1600	1310	
147	ICP-MS	680	2338	1074	1512	1233	Info
156	ICP-AES/OES	694	2350	1200	1650	1310	
160	ETAAS-Z	690	2490	1180	1750	1340	
164	ICP-MS	625	2191	1110	1578	1266	
179	DRC/CC-ICP-MS	700	2420	1200	1720	1370	
197	ICP-MS	690	2370	1170	1660	1360	
200	ICP-MS	711	2457	1257	1765	1441	Info
206	ICP-MS	630	2270	1160	1580	1360	
293	ICP-MS	699	2028	1017	1583	1049 ↓	Info
305	ICP-MS	730	2360	1170	1660	1270	
324	ICP-MS	693	2511	1228	1763	1402	Info
325	FAAS	840 ↑	2730 ↑	1410 ↑	1950 ↑	1560 ↑	Info
359	ICP-MS	628	2178	1046	1483	1188	
401	DRC/CC-ICP-MS	699	2498	1087	1703	1360	Info
457	ICP-AES/OES	675	2255	1143	1615	1288	Info

Percent satisfactory results for all participants: 93.3 %

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 Copper Test Results, 2013 Event #1
STATISTICAL SUMMARY BY METHOD

Results ($\mu\text{g/L}$ serum)					
	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	705	2455	1178	1734	1384
Standard Deviation:	9	40	82	39	34
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	1	1	1	1	1
Mean:	690	2490	1180	1750	1340
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	840	2730	1410	1950	1560
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	685	2303	1172	1633	1299
Standard Deviation:	13	67	40	25	16
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	11	11	11	11	11
Mean:	682	2310	1154	1631	1302
Standard Deviation:	39	152	83	99	118
RSD (%):	5.8	6.6	7.2	6.1	9.1
All Laboratories					
Number of Sample Measurements:	18	18	18	18	18
Mean:	695	2367	1176	1673	1332
Standard Deviation:	48	163	92	113	112
RSD (%):	6.9	6.9	7.8	6.8	8.4

notes: ? Insufficient data for calculation.

New York State Department of Health
Event #1, 2013

Serum Selenium

Serum materials were obtained from the Dutch EQA (External Quality Assessment) scheme SKML (Stichting Kwaliteitsbewaking Medische Laboratoria) as part of a global collaborative exercise to harmonize international measurements of Al, Cu, Se and Zn in serum. Additionally, serum pools were spiked with a suite of trace elements (Co, Cr, Li, Mg, Mn, Tl, and V), including selenium as SeO₂ at various concentrations. The serum has been tested and found to be negative for BSE (Bovine Spongiform Encephalopathy), and free of pathogens. The Certificate of Analysis provided by SKML is available upon request.

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 39 µg/L (0.49 µmol/L) to 174 µg/L (2.20 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. We have become aware of a potential interference on Se in ICP-MS when sera from bovine sources are used for PT sample pools. We are currently investigating this and will report on our findings in due course. Until that time, grading for serum Se is suspended, and unsatisfactory performances and event failures based on analysis of bovine sera will be expunged from the record. We ask that participants continue to analyze our serum pools for Se, along with other trace elements, to aid in the investigation. We are considering including human sera for comparison purposes in the next two PT events. We request participant's cooperation by analyzing these additional materials for Se, and we will shortly be circulating a questionnaire asking for more details of the analytical methods used for Se.

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, 2013 Event #1
ROBUST STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results ($\mu\text{g/L}$ serum)				
	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
Robust Mean	174	39	133	91	116
Robust Standard Deviation	11	5	9	9	9
Standard Uncertainty	4	2	3	3	3
RSD (%)	6.5	13.4	6.6	9.4	8.1
Number of Sample Measurements	14	14	14	14	14
Acceptable Range:					
Upper Limit:	209	47	160	109	139
Lower Limit:	139	31	106	73	93

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, 2013 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE13-01	SE13-02	SE13-03	SE13-04	SE13-05	
	Target Values:	174	39	133	91	116	
107	DRC/CC-ICP-MS	168	33	128	85	113	Info
110	DRC/CC-ICP-MS	167	35	127	86	111	
114	ICP-MS	198	67	151	110	145	
147	ICP-MS	167	46	126	93	116	Info
156	ICP-MS	182	61	148	111	123	
164	ICP-MS	171	39	134	83	117	
179	DRC/CC-ICP-MS	179	37	134	94	118	
200	DRC/CC-ICP-MS	177	35	137	83	111	Info
206	DRC/CC-ICP-MS	170	39	136	89	121	
293	DRC/CC-ICP-MS	143	37	117	88	99	Info
305	ICP-MS	192	48	139	97	134	
324	ETAAS-Z	145	21	102	72	90	Info
367	DRC/CC-ICP-MS	177	36	134	95	105	Info
401	DRC/CC-ICP-MS	181	39	133	96	121	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, 2013 Event #1
STATISTICAL SUMMARY BY METHOD

Results ($\mu\text{g/L}$ serum)					
	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
DRC/CC-ICP-MS					
Number of Sample Measurements:	8	8	8	8	8
Mean:	170	36	131	90	112
Standard Deviation:	12	2	7	5	8
RSD (%):	7.2	5.7	5.0	5.5	6.9
ETAAS-Z					
Number of Sample Measurements:	1	1	1	1	1
Mean:	145	21	102	72	90
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	5	5	5	5	5
Mean:	182	52	140	99	127
Standard Deviation:	13	11	10	12	12
RSD (%):	7.3	22.0	7.3	12.0	9.7
All Laboratories					
Number of Sample Measurements:	14	14	14	14	14
Mean:	173	41	132	92	116
Standard Deviation:	15	12	12	10	14
RSD (%):	8.8	28.4	9.2	11.4	11.7

notes: ? Insufficient data for calculation.

Serum Zinc

Serum materials were obtained from the Dutch EQA (External Quality Assessment) scheme SKML (Stichting Kwaliteitsbewaking Medische Laboratoria) as part of a global collaborative exercise to harmonize international measurements of Al, Cu, Se and Zn in serum. Additionally, serum pools were spiked with a suite of trace elements (Co, Cr, Li, Mg, Mn, Tl, and V), including zinc as ZnCl_2 at various concentrations. The serum has been tested and found to be negative for BSE (Bovine Spongiform Encephalopathy), and free of pathogens. The Certificate of Analysis provided by SKML is available upon request.

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 1196 $\mu\text{g/L}$ (18.29 $\mu\text{mol/L}$) to 2070 $\mu\text{g/L}$ (31.66 $\mu\text{mol/L}$).

Acceptable ranges for serum zinc are based on fixed criteria of $\pm 15\%$, or $\pm 15 \mu\text{g/L}$ below 100 $\mu\text{g/L}$. 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, 91.2% of test results reported were judged as satisfactory, with three out of 25 participant laboratories (12.0 %) 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 Zinc Test Results, 2013 Event #1
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

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

	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
Robust Mean	2070	1196	1790	1529	1708
Robust Standard Deviation	103	58	98	72	99
Standard Uncertainty	26	15	24	18	25
RSD (%)	5.0	4.9	5.5	4.7	5.8
Number of Sample Measurements	25	25	25	25	25
Acceptable Range:					
Upper Limit:	2380	1375	2058	1758	1964
Lower Limit:	1760	1017	1522	1300	1452

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, 2013 Event #1
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE13-01	SE13-02	SE13-03	SE13-04	SE13-05	
Target Values:		2070	1196	1790	1529	1708	
107	DRC/CC-ICP-MS	2098	1197	1814	1548	1730	Info
110	ICP-MS	2222	1271	1886	1623	1820	
114	ICP-MS	1780	1090	1640	1380	1530	
147	ICP-MS	1987	1163	1647	1484	1654	
156	ICP-AES/OES	2020	1170	1780	1490	1660	
160	FAAS	2150	1240	1770	1500	1660	
164	ICP-MS	1961	1145	1739	1481	1661	
179	DRC/CC-ICP-MS	2100	1230	1830	1580	1740	
197	ICP-MS	2050	1200	1760	1510	1710	
200	ICP-MS	2112	1204	1823	1539	1771	Info
206	ICP-MS	2050	1280	1850	1530	1860	
287	FAAS	2140	1180	1830	1550	1690	
293	ICP-MS	2072	1216	1817	1575	1726	Info
305	ICP-MS	1720 ↓	1090	1620	1360	1450 ↓	
324	ICP-MS	2006	1149	1740	1478	1643	Info
325	FAAS	2730 ↑	1515 ↑	2280 ↑	1890 ↑	2040 ↑	
355	ICP-MS	2018	1197	1812	1535	1726	
357	ICP-MS	2070	1210	1880	1540	1780	
358	ICP-MS	2110	570 ↓	1390 ↓	990 ↓	1240 ↓	
359	ICP-MS	1912	1081	1614	1374	1559	
362	ICP-MS	2030	1200	1710	1570	1690	
363	ICP-MS	2140	1170	1800	1540	1730	
401	DRC/CC-ICP-MS	2223	1301	1942	1674	1851	Info
457	ICP-AES/OES	2012	1171	1772	1515	1642	
458	FAAS	2256	1321	1992	1656	1821	

Percent satisfactory results for all participants: 91.2 %

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, 2013 Event #1
STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ serum)				
	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2140	1243	1862	1601	1774
Standard Deviation:	72	53	70	65	67
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	4	4	4	4	4
Mean:	2319	1314	1968	1649	1803
Standard Deviation:	279	146	228	173	173
RSD (%):	12.0	11.1	11.6	10.5	9.6
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	2016	1171	1776	1503	1651
Standard Deviation:	6	1	6	18	13
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	16	16	16	16	16
Mean:	2015	1140	1733	1469	1659
Standard Deviation:	127	163	128	148	154
RSD (%):	6.3	14.3	7.4	10.1	9.3
All Laboratories					
Number of Sample Measurements:	25	25	25	25	25
Mean:	2079	1182	1790	1516	1695
Standard Deviation:	183	155	159	152	151
RSD (%):	8.8	13.1	8.9	10.0	8.9

notes: ? Insufficient data for calculation.

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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.

Serum materials were obtained from the Dutch EQA (External Quality Assessment) scheme SKML (Stichting Kwaliteitsbewaking Medische Laboratoria) as part of a global collaborative exercise to harmonize international measurements of Al, Cu, Se and Zn in serum. Additionally, serum pools were spiked with a suite of trace elements at various concentrations including cobalt as CoCl_2 , chromium as CrCl_3 , lithium as LiCl , magnesium as MgCl_2 , manganese as MnCl_2 , thallium as TlNO_3 , and vanadium as VOSO_4 . The serum has been tested and found to be negative for BSE (Bovine Spongiform Encephalopathy), and free of pathogens. The Certificate of Analysis provided by SKML is available upon request.

Additional Elements

Co, Cr, Li, Mg, Mn, Tl, V

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Serum Antimony (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	19.5	19.7	19.8	19.7	19.5

Serum Arsenic (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	0.79	0.64	0.76	0.59	0.84
197	DRC/CC-ICP-MS	<10	<10	<10	<10	<10

Serum Barium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	42	44	40.9	44.5	44.5
197	ICP-MS	55.6	54.3	54.4	53.2	51.3

Serum Beryllium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	<0.45	<0.45	<0.45	<0.45	<0.45
197	ICP-MS	<0.2	<0.2	<0.2	<0.2	<0.2

Serum Bismuth (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	1.86	1.65	1.59	1.72	1.82

Serum Cadmium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	0.3	0.28	0.26	0.26	0.26
197	DRC/CC-ICP-MS	<0.5	<0.5	<0.5	<0.5	<0.5

Serum Chromium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
114	ICP-MS	52.7	5.8	39.4	25.2	35.4
147	ICP-MS	59	6.19	43.2	27.7	39.3
156	DRC/CC-ICP-MS	55.2	5.59	41.7	25.4	34.4
164	ICP-MS	52.9	4.8	38.5	24.5	33.1
179	DRC/CC-ICP-MS	59.0	5.6	42.9	27.1	37.9
197	DRC/CC-ICP-MS	60.8	5.5	43.1	26.5	37.6
206	DRC/CC-ICP-MS	52	6	37	23	37
305	ICP-MS	63.1	6.4	49.8	30.9	41.9
324	ETAAS-Z	58	6	42	27	36
Arithmetic mean		57	5.8	42	26	37
SD		4	0.5	4	2	3
n		9	9	9	9	9

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Serum Cobalt (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
114	ICP-MS	1.2	41.8	12.8	25.0	17.8
147	ICP-MS	1.09	46	13.3	27.3	19.2
156	DRC/CC-ICP-MS	<1	42.3	13.0	24.9	16.8
164	ICP-MS	1.1	41.9	14.3	30.0	19.8
179	ICP-MS	1.3	*51	16	31	20
197	ICP-MS	<1.0	43.3	13.7	26.7	17.9
206	ICP-MS	1	44	14	27	19
<i>*Omitted</i>	Arithmetic mean	1.1	43.2	13.9	27.4	18.6
	SD	0.1	1.6	1.1	2.3	1.2
	n	5	6	7	7	7

Serum Iodine (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	146	146	147	148	152
179	ICP-MS	158	159	157	160	160

Serum Iron (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
457	ICP-AES/OES	1665	1658	1651	1649	1635

Serum Lead (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	0.71	0.7	0.62	0.68	0.77
197	DRC/CC-ICP-MS	0.6	0.5	0.6	0.6	0.7

Serum Lithium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	19431	1846	13255	8952	12908

Serum Manganese (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
114	ICP-MS	148.2	144.9	142.0	142.0	145.0
147	ICP-MS	135	136	134	135	138
179	DRC/CC-ICP-MS	>100	>100	>100	>100	>100
197	DRC/CC-ICP-MS	145.5	144.5	145.5	158.0	138.0
206	ICP-MS	>125	>125	>125	70	>125
324	ICP-MS	*211	*255	*174	277	*307
305	ICP-MS	140.3	140.6	140.0	141.7	142.5
<i>*Omitted</i>	Arithmetic mean	142	142	140	154	141
	SD	6	4	5	68	3
	n	4	4	4	6	4

Serum Mercury (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	<0.1	<0.1	<0.1	<0.1	<0.1

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Serum Molybdenum (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	9.16	8.96	8.99	9.09	9.22
179	ICP-MS	9.4	9.8	9.9	9.8	9.0

Serum Nickel (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	1.04	0.78	0.8	0.7	0.96

Serum Silver (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	0.23	0.17	0.17	0.15	0.15

Serum Tellurium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	<0.09	<0.09	<0.09	<0.09	<0.09
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

Serum Thallium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	0.03	8.2	2.21	4.76	3.05
197	ICP-MS	<1.0	8.1	2.5	5.1	3.2

Serum Thorium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	<0.03	<0.03	<0.03	<0.03	<0.03

Serum Tin (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	0.76	0.71	0.63	0.66	0.68
197	ICP-MS	<5.0	<5.0	<5.0	<5.0	<5.0

Serum Tungsten (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	<0.4	<0.4	<0.4	<0.4	<0.4

Serum Uranium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	0.2	0.21	0.19	0.19	0.18

Serum Vanadium (µg/L)						
Lab Code	Method	SE13-01	SE13-02	SE13-03	SE13-04	SE13-05
147	ICP-MS	9.34	1.69	7.5	5.05	6.63
179	DRC/CC-ICP-MS	10.0	1.6	7.7	5.0	6.9

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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.
