
Wadsworth Center

NEW YORK STATE DEPARTMENT OF HEALTH

Trace Elements Laboratory

TRACE ELEMENTS IN SERUM

Event #3, 2012

November 30th, 2012

November 30, 2012

**Trace Elements in Serum
Event #3, 2012**

Dear Laboratory Director:

Results from the third proficiency test (PT) event for 2012 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

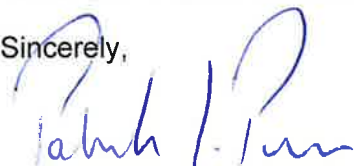
This year, the program has decided to move away from using human serum of U.S. origin, to using bovine serum of Australian origin. The reasons for this change include the high level of endogenous selenium found in North American sera and the opportunity to collaborate with the other PT program for Trace Elements in Serum.

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.

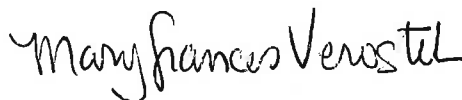
The next PT event for trace elements in serum is scheduled to be mailed Wednesday, January 16th, 2013. Please inform our laboratory staff at (518) 474-4484 if the test materials have not arrived within five days of the scheduled mail out date. **The deadline for reporting results is Wednesday, February 13th, 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

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 304 $\mu\text{g/L}$ ($11.27 \mu\text{mol/L}$).

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, 89.2% of test results reported were judged as satisfactory, with two out of 24 participant laboratories (8.3%) 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, 2012 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

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

	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
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Robust Mean	39	300	13	304	65
Robust Standard Deviation	6	23	3	20	5
Standard Uncertainty	1	6	1	5	1
RSD (%)	14.3	7.7	23	6.6	7.3
Acceptable Range:					
Upper Limit	47	360	18	365	78
Lower Limit	31	240	8	243	52

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, 2012 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE12-11	SE12-12	SE12-13	SE12-14	SE12-15	
Target Values:		39	300	13	304	65	
110	ETAAS-Z	38	298	10	314	65	Info
114	ICP-MS	44	306	14	300	64	
147	FAAS	38	291	12	302	67	
156	ICP-MS	26 ↓	276	<11	328	57	
159	ETAAS-Z	44	300	12	300	64	
160	ETAAS-Z	67 ↑	241	93 ↑	228 ↓	64	Info
164	ICP-MS	38	305	11	298	61	
179	DRC/CC-ICP-MS	35	291	10	294	62	
197	ICP-MS	33	315	<20	320	69	
200	DRC/CC-ICP-MS	35	295	12	301	67	
206	DRC/CC-ICP-MS	40	>100	10	>100	62	Info
287	ETAAS-Z	40	303	14	312	66	
293	ICP-MS	42	318	20 ↑	316	70	
305	ICP-MS	45	313	17	303	67	
324	ETAAS-Z	55 ↑	354	28 ↑	349	72	
325	ETAAS-Z	24 ↓	172 ↓	14	60 ↓	41 ↓	Info
355	ICP-MS	38	292	10	292	70	Info
357	ICP-MS	42	322	15	311	84 ↑	
358	ICP-MS	35	>250	<10	>250	57	
362	ICP-MS	41	282	15	280	65	
363	ICP-MS	43	>250	11	>250	72	
366	ETAAS-Z	35	251	11	256	61	Info
401	ICP-AES/OES	35	332	5 ↓	324	65	Info
458	ETAAS Other	45	318	13	334	68	

Percent satisfactory results for all participants: 89.2 %

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 Aluminum Test Results, 2012 Event #3
STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ serum)				
	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	2	3	2	3
Mean:	37	293	11	298	64
Standard Deviation:	3	3	1	5	3
RSD (%):	—	—	—	—	—
ETAAS Other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	45	318	13	334	68
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	7	7	5	7	7
Mean:	43	274	12	260	62
Standard Deviation:	14	58	2	97	10
RSD (%):	32.4	21.3	14.7	37.2	15.8
FAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	38	291	12	302	67
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	1	1	1	1	1
Mean:	35	332	5	324	65
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	11	9	8	9	11
Mean:	39	303	14	305	67
Standard Deviation:	6	16	3	15	8
RSD (%):	14.6	5.4	24.1	4.9	11.4
All Laboratories					
Number of Sample Measurements:	24	21	19	21	24
Mean:	40	294	12	292	65
Standard Deviation:	9	38	3	59	8
RSD (%):	21.5	12.8	25.8	20.3	11.6

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 680 $\mu\text{g/L}$ (10.70 $\mu\text{mol/L}$) to 2504 $\mu\text{g/L}$ (39.40 $\mu\text{mol/L}$).

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, 96.0% of test results reported were judged as satisfactory, with one out of 20 participant laboratories (5.0%) reporting 2 or more of the 5 results outside the acceptable ranges.

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

2. J. Arnaud, J.-P. Weber, C.W. Weykamp, P.J. Parsons, J. Angerer, E. Mairiaux, O. Mazarrasa, S. Valkonen, A. Menditto, M. Patriarca, and A. Taylor Clinical Chemistry 2008 54 1892-1899.

New York State Department of Health
Serum Copper Test Results, 2012 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

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

	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
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Robust Mean	850	2497	680	2504	1022
Robust Standard Deviation	69	161	47	141	48
Standard Uncertainty	19	45	13	39	13
RSD (%)	8.1	6.4	6.9	5.6	4.7
Acceptable Range:					
Upper Limit	978	2872	782	2880	1175
Lower Limit	722	2122	578	2128	869

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, 2012 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE12-11	SE12-12	SE12-13	SE12-14	SE12-15	
Target Values:		850	2497	680	2504	1022	
107	DRC/CC-ICP-MS	921	2780	747	2730	1110	Info
110	ICP-MS	891	2639	713	2708	1075	
114	ICP-MS	790	2330	630	2350	940	
147	ICP-MS	858	2446	693	2452	997	
156	Other	806	2470	638	2470	1010	
159	ICP-AES/OES	890	2610	720	2590	1050	
160	ETAAS-Z	740	2310	630	2400	900	
164	ICP-MS	787	2463	639	2442	956	
179	DRC/CC-ICP-MS	880	2560	710	2560	1050	
197	ICP-MS	950	2450	510 ↓	1950 ↓	750 ↓	
200	ICP-MS	832	2457	711	2464	1041	Info
206	ICP-MS	790	2270	640	2310	930	
293	ICP-MS	871	2586	699	2593	1036	Info
305	ICP-MS	782	2540	701	2580	1014	
324	ICP-MS	874	2647	697	2614	1037	Info
325	FAAS	960	2040 ↓	750	2610	1080	Info
359	ICP-MS	909	2771	686	2478	1091	
366	ETAAS-Z	877	2500	682	2430	1012	Info
401	DRC/CC-ICP-MS	795	2366	655	2398	1043	Info
457	ICP-AES/OES	798	2580	632	2626	1003	Info

Percent satisfactory results for all participants: 96.0 %

notes: ↑ reported outside upper limit
↓ reported outside lower limit

Info only: results included for informational purposes only.

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

New York State Department of Health
Serum Copper Test Results, 2012 Event #3
STATISTICAL SUMMARY BY METHOD

Results (µg/L serum)					
	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	865	2569	704	2563	1068
Standard Deviation:	64	207	46	166	37
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	2	2	2	2	2
Mean:	809	2405	656	2415	956
Standard Deviation:	97	134	37	21	79
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	960	2040	750	2610	1080
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	844	2595	676	2608	1027
Standard Deviation:	65	21	62	25	33
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	11	11	11	11	11
Mean:	849	2509	665	2449	988
Standard Deviation:	57	146	60	203	95
RSD (%):	6.7	5.8	9.0	8.3	9.6
Other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	806	2470	638	2470	1010
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
All Laboratories					
Number of Sample Measurements:	20	20	20	20	20
Mean:	850	2491	674	2488	1006
Standard Deviation:	62	175	54	171	82
RSD (%):	7.3	7.0	8.1	6.9	8.1

notes: ? Insufficient data for calculation.

New York State Department of Health
Event #3, 2012

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, Ti, 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 25 µg/L (0.32 µmol/L) to 178 µg/L (2.25 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, 88.6% of test results reported were judged as satisfactory, with three of the 14 participant laboratories (21.4%) 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, 2012 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

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

	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
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Robust Mean	160	25	178	26	151
Robust Standard Deviation	10	4	14	4	16
Standard Uncertainty	3	1	5	1	5
RSD (%)	6.4	15.4	7.9	14.2	10.3
Acceptable Range:					
Upper Limit	192	30	214	31	181
Lower Limit	128	20	142	21	121

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, 2012 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE12-11	SE12-12	SE12-13	SE12-14	SE12-15	
Target Values:		160	25	178	26	151	
107	DRC/CC-ICP-MS	156	23	171	24	143	Info
110	DRC/CC-ICP-MS	129	22	143	23	122	
114	ICP-MS	170	53 ↑	185	53 ↑	170	
147	ICP-MS	180	49 ↑	196	50 ↑	160	Info
156	ICP-MS	158	31 ↑	190	30	158	
164	DRC/CC-ICP-MS	164	23	181	24	157	
179	DRC/CC-ICP-MS	157	21	171	22	144	
200	DRC/CC-ICP-MS	161	23	168	22	138	Info
206	DRC/CC-ICP-MS	156	28	171	27	143	
293	DRC/CC-ICP-MS	150	22	161	22	137	Info
305	ICP-MS	151	29	175	25	144	
324	ICP-MS	189	40 ↑	203	38 ↑	171	Info
366	ETAAS-Z	175	20	204	26	184 ↑	Info
401	DRC/CC-ICP-MS	159	23	173	24	154	Info

Percent satisfactory results for all participants: 88.6 %

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 Selenium Test Results, 2012 Event #3
STATISTICAL SUMMARY BY METHOD

Results ($\mu\text{g/L}$ serum)					
	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	8	8	8	8	8
Mean:	154	23	167	24	142
Standard Deviation:	11	2	11	2	11
RSD (%):	7.1	9.1	6.7	7.2	7.6
ETAAS-Z					
Number of Sample Measurements:	1	1	1	1	1
Mean:	175	20	204	26	184
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	5	3	5	3	5
Mean:	170	33	190	31	161
Standard Deviation:	16	6	11	7	11
RSD (%):	9.2	—	5.6	—	6.8
All Laboratories					
Number of Sample Measurements:	14	12	14	12	14
Mean:	161	25	178	26	152
Standard Deviation:	15	6	17	5	16
RSD (%):	9.0	22.5	9.4	17.8	10.7

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 1102 $\mu\text{g/L}$ (16.85 $\mu\text{mol/L}$) to 2021 $\mu\text{g/L}$ (30.91 $\mu\text{mol/L}$).

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, 89.6% of test results reported were judged as satisfactory, with four out of 27 participant laboratories (14.8 %) 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, 2012 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

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

SE12-11 SE12-12 SE12-13 SE12-14 SE12-15

Robust Mean	1956	1102	2021	1102	1854
Robust Standard Deviation	167	69	118	77	153
Standard Uncertainty	40	17	28	18	37
RSD (%)	8.5	6.2	5.8	7.0	8.3
Acceptable Range:					
Upper Limit	2249	1267	2324	1267	2132
Lower Limit	1663	937	1718	937	1576

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, 2012 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE12-11	SE12-12	SE12-13	SE12-14	SE12-15	
	Target Values:	1956	1102	2021	1102	1854	
107	DRC/CC-ICP-MS	2120	1190	2200	1150	1980	Info
110	ICP-MS	1868	986	1957	982	1792	
114	ICP-MS	1790	1040	1860	1040	1700	
147	ICP-MS	1987	1098	2065	1111	1817	Info
156	Other	1840	1080	1930	1080	1850	
159	ICP-AES/OES	1900	1100	2140	1100	1810	
160	FAAS	1770	1080	2000	1140	1820	
164	ICP-MS	1871	1035	1979	1030	1811	
179	DRC/CC-ICP-MS	2070	1110	2070	1110	1930	
197	ICP-MS	2150	1050	1530 ↓	850 ↓	1370 ↓	
200	ICP-MS	1893	1101	2029	1101	1861	Info
206	ICP-MS	1870	1040	1910	1060	1780	
287	FAAS	2260 ↑	1150	2330 ↑	1190	2070	
293	ICP-MS	1902	1072	1968	1079	1804	Info
305	ICP-MS	1685	1055	1940	1060	1740	
324	ICP-MS	1864	1101	1944	1034	1778	Info
325	FAAS	2250 ↑	1320 ↑	2220	1230	2070	Info
355	ICP-MS	1881	1123	1965	1134	1827	
357	ICP-MS	2135	1165	2261	1195	1991	
358	ICP-MS	1904	1066	1978	1048	1757	
359	ICP-MS	2048	1196	1961	1065	2197 ↑	
362	ICP-MS	1640 ↓	930 ↓	1680 ↓	920 ↓	1540 ↓	
363	ICP-MS	2180	1070	2150	1170	1420 ↓	
366	FAAS	2130	1250	2074	1202	1988	Info
401	DRC/CC-ICP-MS	1974	1105	2072	1118	2040	Info
457	ICP-AES/OES	1841	1129	2092	1128	1921	Info
458	FAAS	2187	1240	2283	1234	2076	

Percent satisfactory results for all participants: 89.6 %

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 Zinc Test Results, 2012 Event #3
STATISTICAL SUMMARY BY METHOD

	Results ($\mu\text{g/L}$ serum)				
	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	2055	1135	2114	1126	1983
Standard Deviation:	74	48	74	21	55
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	5	5	5	5	5
Mean:	2119	1208	2181	1199	2005
Standard Deviation:	202	94	140	38	110
RSD (%):	9.5	7.8	6.4	3.2	5.5
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	1871	1115	2116	1114	1866
Standard Deviation:	42	21	34	20	78
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	16	16	16	16	16
Mean:	1917	1071	1949	1055	1762
Standard Deviation:	153	64	167	86	198
RSD (%):	8.0	5.9	8.6	8.2	11.2
Other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	1840	1080	1930	1080	1850
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
All Laboratories					
Number of Sample Measurements:	27	27	27	27	27
Mean:	1963	1107	2022	1095	1842
Standard Deviation:	169	82	172	88	191
RSD (%):	8.6	7.4	8.5	8.1	10.4

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	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	20.1	19.8	20	20	20.6
Serum Arsenic (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
197	DRC/CC-ICP-MS	<10	<10	<10	<10	<10
Serum Barium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	45.7	44.6	45.6	44.5	45.7
197	ICP-MS	45.9	46.0	45.6	44.0	46.0
Serum Beryllium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
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	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	1.67	1.6	1.55	1.55	1.63
Serum Cadmium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	0.283	0.252	0.264	0.26	0.293
197	DRC/CC-ICP-MS	<0.5	<0.5	<0.5	<0.5	<0.5
Serum Chromium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	55.1	0.315	61.9	0.471	51.6
164	DRC/CC-ICP-MS	50.2	0.6	53.6	0.5	42.7
179	DRC/CC-ICP-MS	58.4	0.3	64.2	0.4	51.4
197	DRC/CC-ICP-MS	57.7	<1.0	62.1	<1.0	49.8
206	DRC/CC-ICP-MS	49	<1	52	<1	44
305	ICP-MS	54	<0.2	58.6	<0.2	47.8
Arithmetic mean		54	0.4	59	0.46	48
SD		4	0.2	5	0.05	4
n		6	3	6	3	6
Serum Cobalt (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	5.62	51.7	1.13	50.7	10.4
164	ICP-MS	5.0	45.9	1.0	46.8	9.4
179	ICP-MS	6.0	54	1.3	54	11
197	ICP-MS	5.7	50.1	1.2	49.6	10.3
206	ICP-MS	5	46	1	47	9
Arithmetic mean		5.5	50	1.1	50	10.0
SD		0.4	4	0.1	3	0.8
n		5	5	5	5	5
Serum Iodine (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	144	146	142	143	144

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Serum Lead (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	0.771	0.711	0.777	0.659	0.812
197	DRC/CC-ICP-MS	0.6	0.5	0.6	0.6	0.6

Serum Manganese (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	146	148	146	147	144
179	DRC/CC-ICP-MS	>100	>100	>100	>100	>100
197	DRC/CC-ICP-MS	132.8	133.6	130.9*	134.4	132.5
206	ICP-MS	>125	>125	>125	>125	>125
305	ICP-MS	154.9	145.2	147.3	148.6	151.6
<i>*Omitted</i>	Arithmetic mean	145	142	-	143	143
	SD	11	8	-	8	10
	n	3	3	-	3	3

Serum Mercury (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	<0.1	<0.1	<0.1	<0.1	<0.1

Serum Molybdenum (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	8.93	8.9	9.09	8.92	9.09

Serum Selenium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	180	49.4	196	50.4	160

Serum Tellurium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

Serum Thallium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	0.822	10	0.048	9.91	1.68
197	ICP-MS	<1.0	10.2	<1.0	9.8	1.8

Serum Thorium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	<0.03	<0.03	<0.03	<0.03	<0.03

Serum Tin (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	0.681	0.656	0.698	0.635	0.676
197	ICP-MS	<5.0	<5.0	<5.0	<5.0	<5.0

Serum Uranium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
147	ICP-MS	0.201	0.195	0.202	0.189	0.207

Serum Vanadium (µg/L)						
Lab Code	Method	SE12-11	SE12-12	SE12-13	SE12-14	SE12-15
179	DRC/CC-ICP-MS	8.1	0.7	8.7	0.8	7.0

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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.
