Wadsworth Center
NEW YORK STATE DEPARTMENT OF HEALTH
Trace Elements Laboratory

TRACE ELEMENTS IN SERUM

Educational Event

Proficiency Test Report

Event #3, 2013

May 8ᵗʰ, 2014

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

Sue Kelly
Executive Deputy Commissioner

May 8, 2014

Trace Elements in Serum
Event #3, 2013

Dear Laboratory Director:

Results from the second of two educational proficiency test (PT) events 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. Although these PT materials were circulated as ungraded educational samples, "Acceptable Ranges" are included so that participants can evaluate their own laboratory bias. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment scheme. A confidential three-digit code number assigned by the PT program identifies participant laboratories.
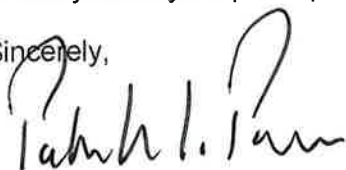
PT Materials

Test materials were prepared from human serum obtained from Tennessee Blood Services, Inc. Serum units were spiked with a suite of additional trace elements as described in each narrative. In addition to Al, Cu, Se and Zn, some serum pools were supplemented with the trace elements arsenic (As), antimony (Sb), barium (Ba), beryllium (Be), cadmium (Cd), manganese (Mn), molybdenum (Mo), lead (Pb), nickel (Ni), cobalt, (Co), chromium (Cr), caesium (Cs), thallium (Tl), tellurium (Te), tin (Sn), platinum (Pt), vanadium (V), tungsten (W) and uranium (U).

Summary of Bovine Calf Serum Investigation

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

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

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www.wadsworth.org/testing/lead/index.htm

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Serum Aluminum

The test materials for serum Al were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be Non-reactive for Anti-HIV-1/2, Anti-HCV 3.0 and HBsAg. The serum has also been found to be STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were dispensed into acid-washed 500-mL polypropylene containers to make up five (5) serum pools. Each pool was spiked with a suite of additional trace elements including aluminum as Al^{3+} at various concentrations.

These are archived PT materials previously circulated.

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 22 µg/L (0.82 µmol/L) to 113 µg/L (4.19 µmol/L).

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

Discussion. Based on the above criteria, 93.0% of test results reported were judged as satisfactory, with one out of 23 participant laboratories (4.3%) reporting 2 or more of the 5 results outside the acceptable ranges. Although these PT materials were circulated as ungraded educational samples, an "Acceptable Range" is included so that participants can evaluate their own laboratory bias. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment scheme.

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 Educational Test Results, 2013 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE13-21	SE13-22	SE13-23	SE13-24	SE13-25
Robust Mean	**22**	**84**	**103**	**113**	**86**
Robust Standard Deviation	3	5	7	8	5
Standard Uncertainty	1	1	2	2	1
RSD (%)	14.0	6.2	6.9	7.3	5.4
Number of Sample Measurements	22	23	22	22	23
Acceptable Range:					
Upper Limit	27	101	124	136	103
Lower Limit	17	67	82	90	69

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

New York State Department of Health
Serum Aluminum Educational Test Results, 2013 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE13-21	SE13-22	SE13-23	SE13-24	SE13-25	
	Target Values:	22	84	103	113	86	
110	ETAAS-Z	32 ↑	92	110	117	91	
114	ICP-MS	20	90	105	118	88	
147	FAAS	27	87	110	111	90	
156	ICP-MS	25	85	106	115	88	
160	ICP-MS	21	85	98	110	84	
164	ICP-MS	26	82	101	106	86	
179	DRC/CC-ICP-MS	19	85	105	112	87	
197	ICP-MS	20	90	112	127	96	
200	DRC/CC-ICP-MS	19	81	107	107	87	
206	ICP-MS	21	92	>100	>100	100	
287	ETAAS-Z	24	78	103	111	80	
293	ICP-MS	22	86	102	106	82	
305	ICP-MS	23	86	93	113	90	
324	ICP-MS	◢	81	95	101	83	
325	ETAAS-Z	24	90	62 ↓	122	91	
355	ICP-MS	31 ↑	88	108	122	91	
357	ICP-MS	22	82	99	106	83	
358	ICP-MS	21	81	96	109	85	
362	ICP-MS	17.9	79.8	100.0	108.0	77.1	
363	ICP-MS	22	83	100	128	85	
366	ETAAS-Z	22	74	116	78 ↓	72	
401	ICP-AES/OES	16 ↓	73	100	116	84	
458	ETAAS other	22	83	135 ↑	141 ↑	86	

Percent satisfactory results for all participants: 93.0 %

NOTE: Grading is for educational purposes only

notes: ↑ reported outside upper limit **Info only:** results included for informational purposes only.
↓ reported outside lower limit

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
◢: Result not reported

New York State Department of Health
Serum Aluminum Educational Test Results, 2013 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE13-21	SE13-22	SE13-23	SE13-24	SE13-25
DRC/CC-ICP-MS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	19	83	106	110	87
Standard Deviation:	0	3	1	4	0
RSD (%):	—	—	—	—	—
ETAAS other					
Number of Sample Measurements:	1	1	1	1	1
Mean:	22	83	135	141	86
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	4	4	4	4	4
Mean:	26	84	98	107	84
Standard Deviation:	4	9	24	20	9
RSD (%):	17.4	10.6	25.0	18.6	11.1
FAAS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	27	87	110	111	90
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	1	1	1	1	1
Mean:	16	73	100	116	84
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	13	14	13	13	14
Mean:	22	85	101	113	87
Standard Deviation:	3	4	5	9	6
RSD (%):	14.8	4.5	5.4	7.5	6.8
All Laboratories					
Number of Sample Measurements:	22	23	22	22	23
Mean:	23	84	103	113	86
Standard Deviation:	4	5	13	12	6
RSD (%):	17.1	6.1	12.4	10.6	6.8

notes: ? Insufficient data for calculation.

Serum Copper

The test materials for serum Cu were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be Non-reactive for Anti-HIV-1/2, Anti-HCV 3.0 and HBsAg. The serum has also been found to be STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were dispensed into acid-washed 500-mL polypropylene containers to make up five (5) serum pools. Each pool was spiked with a suite of additional trace elements including copper as Cu^{2+} at various concentrations.

These are archived PT materials previously circulated.

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 1026 µg/L (16.15 µmol/L) to 1370 µg/L (21.56 µmol/L).

Acceptable ranges for serum copper are based on fixed criteria of ±15%, or ±95 µg/L below 635 µg/L. These criteria are consistent with those proposed by the OELM Network of EQAS organizers (1, 2) for trace elements in serum, and are slightly _less_ stringent than those previously suggested for NYS (±10%).

Discussion. Based on the above criteria, 96.0% of test results reported were judged as satisfactory, with none of 20 participant laboratories reporting 2 or more of the 5 results outside the acceptable ranges. Although these PT materials were circulated as ungraded educational samples, an "Acceptable Range" is included so that participants can evaluate their own laboratory bias. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment scheme.

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 Educational Test Results, 2013 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (μg/L serum)				
	SE13-21	SE13-21	SE13-23	SE13-24	SE13-25
Robust Mean	**1321**	**1026**	**1251**	**1090**	**1370**
Robust Standard Deviation	77	64	68	63	107
Standard Uncertainty	22	18	19	18	30
RSD (%)	5.8	6.2	5.4	5.8	7.8
Number of Sample Measurements	19	20	20	20	20
Acceptable Range:					
Upper Limit	1519	1180	1439	1254	1576
Lower Limit	1123	872	1063	926	1164

New York State Department of Health
Serum Copper Educational Test Results, 2013 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE13-21	SE13-21	SE13-23	SE13-24	SE13-25	
	Target Values:	1321	1026	1251	1090	1370	
107	DRC/CC-ICP-MS	1290	1290 ↑	1240	1130	1370	Info
110	ICP-MS	1378	1041	1315	1118	1438	
114	ICP-MS	1270	1010	1210	1070	1310	
147	ICP-MS	1372	1042	1277	1112	1423	Info
156	ICP-AES/OES	1380	1060	1290	1130	1470	
160	ICP-MS	1330	1030	1250	1090	1370	
164	ICP-MS	1248	956	1177	1037	1311	
179	DRC/CC-ICP-MS	1400	1070	1300	1140	1470	
197	ICP-MS	1330	1020	1200	1090	1400	
200	ICP-MS	1480	1118	1372	1200	1543	Info
206	ICP-MS	1220	920	1240	1020	1230	
293	ICP-MS	1297	998	1246	1068	1399	Info
305	ICP-MS	1180	900	1130	950	1280	
324	ICP-MS	◤	892	1101	963	1228	Info
325	ICP-MS	1200	950	1100	1020	1020 ↓	Info
359	ICP-MS	1345	1034	1268	1070	1439	
366	ETAAS-Z	1250	990	1285	1060	135 ↓	Info
401	DRC/CC-ICP-MS	1366	1055	1296	1125	1411	Info
457	ICP-AES/OES	1383	1114	1355	1200	1480	Info
481	ICP-MS	1366	1068	1254	1154	1390	

Percent satisfactory results for all participants: 96.0 %

NOTE: Grading is for educational purposes only

New York State Department of Health
Serum Copper Educational Test Results, 2013 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE13-21	SE13-21	SE13-23	SE13-24	SE13-25
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	1352	1138	1279	1132	1417
Standard Deviation:	56	132	34	8	50
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	1	1	1	1	1
Mean:	1250	990	1285	1060	135
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	1382	1087	1323	1165	1475
Standard Deviation:	2	38	46	49	7
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	13	14	14	14	14
Mean:	1309	999	1224	1069	1342
Standard Deviation:	84	66	78	68	127
RSD (%):	6.4	6.6	6.4	6.4	9.5
All Laboratories					
Number of Sample Measurements:	19	20	20	20	20
Mean:	1320	1028	1245	1087	1306
Standard Deviation:	78	89	75	68	299
RSD (%):	5.9	8.6	6.0	6.2	22.9

notes: ? Insufficient data for calculation.

Serum Selenium

The test materials for serum Se were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be Non-reactive for Anti-HIV-1/2, Anti-HCV 3.0 and HBsAg. The serum has also been found to be STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were dispensed into acid-washed 500-mL polypropylene containers to make up five (5) serum pools. Each pool was spiked with a suite of additional trace elements including selenium as Se^{4+} at various concentrations.

These are archived PT materials previously circulated.

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 109 µg/L (1.38 µmol/L) to 283 µg/L (3.58 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, 97.3% of test results reported were judged as satisfactory, with none of the 15 participant laboratories reporting 2 or more of the 5 results outside the acceptable ranges. Although these PT materials were circulated as ungraded educational samples, an "Acceptable Range" is included so that participants can evaluate their own laboratory bias. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment scheme.

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 Educational Test Results, 2013 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

	Results (µg/L serum)				
	SE13-21	SE13-22	SE13-23	SE13-24	SE13-25
Robust Mean	**168**	**205**	**109**	**283**	**121**
Robust Standard Deviation	11	8	6	17	8
Standard Uncertainty	4	3	2	5	3
RSD (%)	6.7	4.0	5.8	5.9	6.8
Number of Sample Measurements	14	15	15	15	15
Acceptable Range:					
Upper Limit	202	246	131	340	145
Lower Limit	134	164	87	226	97

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

New York State Department of Health
Serum Selenium Educational Test Results, 2013 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE13-21	SE13-22	SE13-23	SE13-24	SE13-25	
	Target Values:	168	205	109	283	121	
107	DRC/CC-ICP-MS	153	191	103	276	114	Info
110	DRC/CC-ICP-MS	159	198	104	272	115	
114	ICP-MS	181	202	117	295	127	
147	ICP-MS	155	192	102	258	113	Info
156	ICP-MS	166	202	105	279	122	
164	DRC/CC-ICP-MS	182	239	118	362 ↑	128	
179	DRC/CC-ICP-MS	155	201	108	268	112	
200	DRC/CC-ICP-MS	172	209	113	279	124	Info
206	ICP-MS	176	210	112	320	129	
293	DRC/CC-ICP-MS	164	204	107	284	121	Info
305	ICP-MS	177	216	116	294	134	
324	ICP-MS	◢	206	111	285	129	Info
366	ETAAS-Z	175	220	95	296	110	Info
367	DRC/CC-ICP-MS	167	204	107	281	120	Info
401	DRC/CC-ICP-MS	163	201	109	267	123	Info

Percent satisfactory results for all participants: 97.3 %

NOTE: Grading is for educational purposes only

notes: ↑ reported outside upper limit   **Info only:** results included for informational purposes only.
↓ reported outside lower limit

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
◢: Result not reported

New York State Department of Health
Serum Selenium Educational Test Results, 2013 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE13-21	SE13-22	SE13-23	SE13-24	SE13-25
DRC/CC-ICP-MS					
Number of Sample Measurements:	8	8	8	8	8
Mean:	164	206	109	286	120
Standard Deviation:	9	14	5	31	6
RSD (%):	5.7	7.0	4.5	10.9	4.6
ETAAS-Z					
Number of Sample Measurements:	1	1	1	1	1
Mean:	175	220	95	296	110
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	5	6	6	6	6
Mean:	171	205	111	289	126
Standard Deviation:	11	8	6	20	7
RSD (%):	6.1	4.0	5.4	7.1	5.8
All Laboratories					
Number of Sample Measurements:	14	15	15	15	15
Mean:	168	206	108	288	121
Standard Deviation:	10	12	6	25	7
RSD (%):	5.9	5.8	5.8	8.8	6.0

notes: ? Insufficient data for calculation.

Serum Zinc

The test materials for serum Zn were prepared from human serum obtained from Tennessee Blood Services, Inc. The units were tested by FDA approved methods and found to be Non-reactive for Anti-HIV-1/2, Anti-HCV 3.0 and HBsAg. The serum has also been found to be STS (RPR) Non-reactive and Negative for HIV-1 and HCV by PCR. Serum units were dispensed into acid-washed 500-mL polypropylene containers to make up five (5) serum pools. Each pool was spiked with a suite of additional trace elements including copper as Zn^{2+} at various concentrations.

These are archived PT materials previously circulated.

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 805 µg/L (12.31 µmol/L) to 2606 µg/L (39.85 µmol/L).

Acceptable ranges for serum zinc are based on fixed criteria of ±15%, or ±15 µg/L below 100 µg/L. These criteria are consistent with those proposed by the OELM network of EQAS organizers (1) for trace elements in serum.

Discussion. Based on the above criteria, 88.9% of test results reported were judged as satisfactory, with three out of 27 participant laboratories (11.1 %) reporting 2 or more of the 5 results outside the acceptable ranges. Although these PT materials were circulated as ungraded educational samples, an "Acceptable Range" is included so that participants can evaluate their own laboratory bias. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment scheme.

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 Educational Test Results, 2013 Event #3
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

Results (μg/L serum)

	SE13-21	SE13-22	SE13-23	SE13-24	SE13-25
Robust Mean	**838**	**814**	**805**	**2606**	**739**
Robust Standard Deviation	63	45	60	180	55
Standard Uncertainty	15	11	14	43	13
RSD (%)	7.5	5.6	7.4	6.9	7.5
Number of Sample Measurements	26	27	27	27	27
Acceptable Range:					
Upper Limit	964	936	926	2997	850
Lower Limit	712	692	684	2215	628

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

New York State Department of Health
Serum Zinc Educational Test Results, 2013 Event #3
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L serum)					Info Only
		SE13-21	SE13-22	SE13-23	SE13-24	SE13-25	
	Target Values:	838	814	805	2606	739	
107	DRC/CC-ICP-MS	733	702	738	2620	705	Info
110	ICP-MS	921	881	893	2778	830	
114	ICP-MS	810	800	780	2390	730	
147	ICP-MS	915	915	876	2758	856 ↑	Info
156	ICP-AES/OES	847	811	798	2650	761	
160	ICP-MS	790	780	760	2460	690	
164	ICP-MS	811	822	796	2635	733	
179	DRC/CC-ICP-MS	870	830	830	2710	780	
197	ICP-MS	720	700	670 ↓	2590	630	
200	ICP-MS	935	883	870	2766	798	Info
206	ICP-MS	770	740	800	2440	660	
287	FAAS	850	820	820	2650	750	
293	ICP-MS	824	824	824	2549	765	Info
305	ICP-MS	720	680 ↓	680 ↓	2060 ↓	650	
324	ICP-MS	◣	677 ↓	676 ↓	2060 ↓	638	Info
325	ICP-MS	830	780	750	2470	580 ↓	Info
355	ICP-MS	884	816	818	2643	743	
357	ICP-MS	827	785	767	2430	708	
358	ICP-MS	890	830	860	2800	780	
359	ICP-MS	808	792	768	2412	743	
362	ICP-MS	802	820	860	2640	735	
363	ICP-MS	910	1070 ↑	980 ↑	3020 ↑	870 ↑	
366	ETAAS-Z	797	826	819	2420	734	Info
401	DRC/CC-ICP-MS	857	824	824	2668	772	Info
457	ICP-AES/OES	912	865	846	4057 ↑	725	Info
458	FAAS	828	819	815	2755	750	
481	ICP-MS	880	821	790	2666	753	

Percent satisfactory results for all participants: 88.9 %

NOTE: Grading is for educational purposes only

notes: ↑   reported outside upper limit   **Info only:** results included for informational purposes only.
        ↓   reported outside lower limit

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
    ◣: Result not reported

New York State Department of Health
Serum Zinc Educational Test Results, 2013 Event #3
STATISTICAL SUMMARY BY METHOD

	Results (µg/L serum)				
	SE13-21	SE13-22	SE13-23	SE13-24	SE13-25
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	3
Mean:	820	785	797	2666	752
Standard Deviation:	76	72	51	45	41
RSD (%):	—	—	—	—	—
ETAAS-Z					
Number of Sample Measurements:	1	1	1	1	1
Mean:	797	826	819	2420	734
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
FAAS					
Number of Sample Measurements:	2	2	2	2	2
Mean:	839	820	818	2703	750
Standard Deviation:	16	1	4	74	0
RSD (%):	—	—	—	—	—
ICP-AES/OES					
Number of Sample Measurements:	2	2	2	2	2
Mean:	880	838	822	3354	743
Standard Deviation:	46	38	34	995	25
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	18	19	19	19	19
Mean:	836	811	801	2556	731
Standard Deviation:	65	90	79	239	78
RSD (%):	7.8	11.0	9.9	9.4	10.6
All Laboratories					
Number of Sample Measurements:	26	27	27	27	27
Mean:	836	812	804	2633	736
Standard Deviation:	61	78	68	353	66
RSD (%):	7.3	9.7	8.5	13.4	9.0

notes: ? Insufficient data for calculation.

Additional Trace Elements Reported in Serum

Participant laboratories reported their analytical results for any additional trace elements (other than Al, Cu, Se and Zn) that are routinely reported so that a more complete characterization can be recorded for these PT materials. However, results for these additional trace elements are not reported here.

Human serum samples were selected from archived PT material based upon selenium (Se) concentrations, and were relabeled for distribution with bovine serum samples with similar Se levels for analysis during 2013 PT Event 3. The levels of aluminum (Al), copper (Cu) and Zinc (Zn), and the additional trace elements, if any, were not a consideration. We asked that participants consider analyzing both the bovine PT samples (SE13-10 through 15) and the human educational samples (SE13-21 through 25) within the same run, if possible, to minimize intralaboratory variability. We were only able to provide one set of the educational samples (SE13-21 through 25), and the priority for analysis was for Se analysis, followed by Al, Cu and Zn. With any remaining material, analysis of serum additional elements should be considered. Consequently, the small number of values reported for the additional trace elements by participants for some of the educational PT materials reflects background levels that are largely below laboratory reportable limits.

ATOMIC SPECTROMETRY METHODS

A-1   ETAAS-Z (Electrothermal atomic absorption spectrometry with Zeeman background correction)

A-2   ETAAS other (i.e., D_2, S-H background correction)

A-3   FAAS (Flame atomic absorption spectrometry)

A-4   CV-AAS (Cold vapor atomic absorption spectrometry)

A-5   HG-AAS (Hydride generation atomic absorption spectrometry)

A-6   AFS (Atomic fluorescence spectrometry)

A-7   Other

INDUCTIVELY COUPLED PLASMA

P-1   ICP-MS (Inductively coupled plasma - mass spectrometry)

P-2   DRC/CC-ICP-MS (ICP-MS used in the Dynamic Reaction Cell or Collision Cell mode)

P-3   ICP-AES/OES (ICP atomic/optical emission spectrometry)

P-4   HR-ICP-MS (High resolution ICP-MS)

P-5   ETV-ICP-MS (Electrothermal vaporization ICP-MS)

P-6   ID-ICP-MS (Isotope dilution ICP-MS)

P-7   Other

ELECTROCHEMICAL METHODS

E-1   ASV (Anodic stripping voltammetry without digestion)

E-2   ASV-LeadCare® (Anodic stripping voltammetry using the ESA LeadCare® system)

E-3   Fluoride specific electrode

E-4   Other

MOLECULAR FLUORIMETRY

F-1   EtOAc (Ethyl acetate-acetic acid extraction method for determination of erythrocyte protoporphyrin)

F-2   Aviv hematofluorometry (for determination of EP at hematocrit 35)

F-3   Helena ZPP (for determination of zinc protoporphyrin in μmol ZPP/mol heme)

F-4   Other

OTHER METHODS

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