TRACE ELEMENTS IN WHOLE BLOOD

Proficiency Test Report

Event #1, 2014

March 13th, 2014
Dear Laboratory Director:

Results from the first proficiency test (PT) event in 2014 for Trace Elements in Whole Blood have been tabulated and summarized. Target values for Mercury (Hg) and Lead (Pb) in whole blood have been established along with acceptable ranges. For Hg and Pb, 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. Due to an internal error, these PT pools were not supplemented with either Arsenic (as inorganic As\(^{3+}\) or Cadmium (as Cd\(^{2+}\)). The values reported by participants reflect background levels that are largely below laboratory reportable limits. Consequently, all participants will receive a satisfactory score for whole blood As and Cd. A confidential three-digit code number assigned by the PT program identifies participant laboratories. The data for blood lead were previously reported in the Blood Lead PT Report issued March 13, 2014.

PT Materials

Test materials for the first event were prepared from caprine (goat) whole blood obtained from animals dosed with lead acetate to create physiologically bound lead (Pb). A total of five blood pools were supplemented with mercury as both inorganic (Hg\(^{2+}\)) and organic (ethylmercury (CH\(_3\)CH\(_2\)Hg\(^{+}\)) and methylmercury (CH\(_3\)Hg\(^{+}\)) species. In addition to Pb and Hg, blood pools were supplemented with the trace elements manganese (Mn), thallium (Tl), tin (Sn), titanium (Ti), nickel (Ni), cobalt (Co), chromium (Cr), silver (Ag), tungsten (W) and vanadium (V).

Additional Elements to Become Graded for Performance Assessment

PT results for select trace elements, including Co and Cr, are graded as part of this PT event, although the data is used for “Educational Purposes” only, to inform laboratory participants of where improved practices may be necessary. Laboratories that test and report these, and other, trace elements on patient specimens should continue to report results obtained for whole blood PT samples.

The next PT event for trace elements in whole blood is scheduled to be mailed Wednesday, May 7th, 2014. Please inform our laboratory staff at (518) 474-7161 if the test materials have not arrived within five days of the scheduled mail out date. The deadline for reporting results is Wednesday, May 28th, 2014.

Thank you for your participation in this event.

Yours 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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Trace Elements PT Program
Biggs Laboratory - Wadsworth Center
New York State Department of Health - PO Box 509
Albany NY 12201-0509

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facebook.com/NYSDOH
twitter.com/HealthNYGov
Whole Blood Arsenic

Test materials for arsenic were prepared from caprine (goat) whole blood preserved with K$_2$EDTA anticoagulant. Although a total of five pools were drawn, supplementation with arsenic as inorganic As$^{3+}$ did not occur as planned. Consequently, the concentrations in the five pools distributed are representative of background levels of arsenic in caprine blood. All participants will be given a “satisfactory” score for whole blood arsenic these PT samples.
### Performance of Participating Laboratories

**New York State Department of Health**  
**Blood Arsenic Test Results, 2014 Event #1**

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<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
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</table>

Percent satisfactory results for all participants: 100.0 %

**Notes:**
- ↑: Reported outside upper limit
- ↓: Reported outside lower limit
- ◊: Result unacceptable
- ◇: Result not reported

**Info Only:** results included for informational purposes only.
Whole Blood Cadmium

Test materials for cadmium were prepared from caprine (goat) whole blood preserved with K$_2$EDTA anticoagulant. Although a total of five blood pools were drawn, supplementation with different amounts of cadmium (as Cd$^{2+}$) did not occur as planned. Consequently, the concentrations in the five pools distributed are representative of background levels of cadmium in caprine blood. All participants will be given a “satisfactory” score for whole blood cadmium these PT samples.
# Performance of Participating Laboratories

## Blood Cadmium Test Results, 2014 Event #1

**New York State Department of Health**

### Results (µg/L whole blood)

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<th>Method</th>
<th>BE14-01</th>
<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
<th>Info Only</th>
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</table>

**Percent satisfactory results for all participants:** 100.0%

**Notes:**
- ↑ Reported outside upper limit
- ↓ Reported outside lower limit
- ⨳ Result unacceptable
- ⨺ Result not reported

**Info only:** results included for informational purposes only.
Whole Blood Mercury

Test materials for mercury were prepared from caprine (goat) whole blood preserved with K$_2$EDTA anticoagulant. A total of five pools were supplemented with different amounts of mercury as both inorganic (Hg$^{2+}$) and organometallic (as both ethylmercury, CH$_3$CH$_2$Hg$^+$, and methylmercury, CH$_3$Hg$^+$) species.

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<thead>
<tr>
<th>Sample</th>
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<td>Hg$^{2+}$</td>
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<td>CH$_3$Hg$^+$</td>
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<td>Hg$^{2+}$ and CH$_3$Hg$^+$</td>
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<td>BE14-05</td>
<td>Hg$^{2+}$ and CH$_3$Hg$^+$</td>
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</table>

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 whole blood mercury range from 2.9 µg/L (14 nmol/L) to 47.0 µg/L (234 nmol/L).

Acceptable ranges were fixed at ±30%, or ±3 µg/L around the target value, whichever is greater. That is, the range is fixed at ±3 µg/L for concentrations below 10 µg/L, while above 10 µg/L, it is ±30%.

Discussion: Based on the above criteria, 98.5% of results reported by all participants were satisfactory, with none of the 27 laboratories reporting 2 or more of the 5 results outside the acceptable ranges.
New York State Department of Health  
Blood Mercury Test Results, 2014 Event #1  
ROBUST STATISTICAL SUMMARY

<table>
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<tr>
<th>TARGET VALUE ASSIGNMENT AND STATISTICS</th>
<th>Results (µg/L whole blood)</th>
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<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
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notes: Results reported as less than the method detection limit are excluded from statistical calculations.
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<th>Lab Code</th>
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Percent satisfactory results for all participants: 98.5 %

**Notes:**
- †: Result unacceptable
- ▼: Result reported outside lower limit
- ‡: Result not reported

*Info only:* results included for informational purposes only.
## STATISTICAL SUMMARY BY METHOD

### Results (µg/L whole blood)

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**Notes:** Insufficient data for calculation.
Whole Blood Lead

Test materials for lead were prepared from caprine (goat) whole blood obtained from animals dosed with lead acetate to create physiologically-bound Pb. Whole blood was collected into collection bags containing K$_2$EDTA anticoagulant.

**Target values** were established as the mean of 19 measurements performed by 17 reference laboratories using ICP-MS, ETAAS and ASV methods. Values range from 2 µg/dL to 18 µg/dL. Among the reference group, imprecision (SD) varied from 0.5 - 1.0 µg/dL, increasing with Pb concentration.

**Acceptable ranges** are based on the CLIA ‘88 criteria (Federal Register Volume 57, Number 40, §§ 493.2 and 493.937, February 28, 1992). The criteria are set at ±10% or ±4 µg/dL, whichever is greater.

**Discussion** Based on the CLIA ‘88 criteria, 97.0% of results reported by all participants were judged as satisfactory, with three of 87 participant laboratories (3.4%) reporting 2 or more of the 5 results outside the acceptable ranges.
## New York State Department of Health
### Blood Lead Test Results, 2014 Event #1
#### PERFORMANCE OF PARTICIPATING LABORATORIES

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**Notes:**
- `†` reported value outside upper limit
- `↓` reported value outside lower limit

**Normalized Mean:** The average of each reported result divided by the corresponding target value. It measures bias.

**Info Only:** results included for informational purposes only.

**ND:** non-detect

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**Notes:**
- ▼: reported value outside upper limit
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**Info Only:** results included for informational purposes only.

**ND:** non-detect

▼: Result unacceptable
# PERFORMANCE OF PARTICIPATING LABORATORIES

## Blood Lead Test Results, 2014 Event #1

### New York State Department of Health

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**Notes:**
- †: reported value outside upper limit
- ▼: reported value outside lower limit
- ND: non-detect
- ▼: Result unacceptable

**Normalized Mean:** The average of each reported result divided by the corresponding target value. It measures bias.

**Info Only:** results included for informational purposes only.
### New York State Department of Health
### Blood Lead Test Results, 2014 Event #1
### PERFORMANCE OF PARTICIPATING LABORATORIES

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Percent satisfactory results for all participants: 97.0%

**Notes:**
- ↑ reported value outside upper limit
- ↓ reported value outside lower limit

**Normalized Mean:** The average of each reported result divided by the corresponding target value. It measures bias.

**Info Only:** results included for informational purposes only.

**ND:** non-detect

▼: Result unacceptable
### New York State Department of Health
### Blood Lead Test Results, 2014 Event #1
### STATISTICAL SUMMARY

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**Number of Sample Measurements:** 19 19 19 19 19

**Mean (target value):**
- 11 18 8 2 18

**Standard Deviation:**
- 0.7 0.9 0.5 0.5 1.0

**RSD (%):**
- 6.2 5.2 5.8 20.6 5.4

**Acceptable Range:**
- **Upper Limit:** 15 22 12 6 22
- **Lower Limit:** 7 14 4 0 14

**Notes:** Results reported as less than the detection limits are treated as zero for statistical and grading purposes.
### STATISTICAL SUMMARY BY METHOD

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**Notes:**
- ? Insufficient data for calculation.
- A Standard Deviation displayed as 0.0 should be interpreted as <0.1
New York State Department of Health  
Blood Lead Test Results, 2014 Event #1  
STATISTICAL SUMMARY BY CLASS

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<tr>
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</table>

**Notes:** Insufficient data for calculation.
Additional Trace Elements Reported in Whole Blood

Participant laboratories reported their analytical results for any additional trace elements (other than As, Cd, Hg and Pb) that are routinely reported so that a more complete characterization can be recorded for these proficiency test materials. Results for the additional trace elements cobalt (Co) and chromium (Cr) are reported here. Although these data are provided solely for educational and informational purposes, target values and acceptable ranges are provided. The New York State grading criteria were established after discussions with the FDA and with other trace element PT scheme organizers. Departures from the acceptable ranges should trigger an internal Quality Assurance review.

Additional Elements

Co and Cr
Whole Blood Cobalt

Test materials for chromium were prepared from caprine (goat) whole blood preserved with K$_2$EDTA anticoagulant. A total of five pools were supplemented with cobalt as inorganic Co$^{2+}$.

**The Target Values** assigned for each PT material is the robust mean of the results reported by all participants for the 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 whole blood cobalt range from 1.5 µg/L to 15.4 µg/L.

**Acceptable range:** The acceptable range for cobalt is set at ±1.5 µg/L or ±20%, whichever is greater. Thus, it is fixed at ±1.5 µg/L for concentrations below 7.5 µg/L. These NYS grading criteria were established after discussions with the FDA and with other trace element PT scheme organizers.

**Discussion:** Based upon the above criteria, 92.7% of test results reported were within the acceptable ranges, with one of the 11 laboratories (9.1%) reported 2 or more of the 5 results outside the acceptable ranges. Upward and downward indicator arrows next to individual results should be used as part of a laboratory's on-going internal quality assessment (QA) program. Note that this grading scheme is intended for educational purposes. Departures from the acceptable ranges should trigger an internal QA review.
New York State Department of Health  
Blood Cobalt Test Results, 2014 Event #1  
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

<table>
<thead>
<tr>
<th>Results (µg/L whole blood)</th>
<th>BE14-01</th>
<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
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Acceptable Range:
- Upper Limit: 4.9, 3.0, 9.2, 15.4, 18.5
- Lower Limit: 1.9, 0.0, 6.2, 10.2, 12.3

**notes:** Results reported as less than the method detection limit are excluded from statistical calculations.
## New York State Department of Health

### Blood Cobalt Test Results, 2014 Event #1

#### PERFORMANCE OF PARTICIPATING LABORATORIES

<table>
<thead>
<tr>
<th>Lab Code</th>
<th>Method</th>
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<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
<th>Info Only</th>
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<td>6.1↓</td>
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<td>1.7</td>
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<td>9.0↓</td>
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<td>391</td>
<td>DRC/CC-ICP-MS</td>
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<td>1.5</td>
<td>9.6↑</td>
<td>18.6↑</td>
<td>16.2</td>
<td>Info</td>
</tr>
</tbody>
</table>

Percent satisfactory results for all participants: 92.7%

### NOTE:

Grading is for educational purposes only

---

**notes:**
- ↑: Reported outside upper limit
- ↓: Reported outside lower limit
- ✗: Result unacceptable
- ▼: Result not reported

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

**Info only:** results included for informational purposes only.
## STATISTICAL SUMMARY BY METHOD

### Results (µg/L whole blood)

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<th></th>
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<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
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<td>15.4</td>
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</table>

### Notes:
- Insufficient data for calculation.
- A Standard Deviation displayed as 0.0 should be interpreted as <0.1
Whole Blood Chromium

Test materials for chromium were prepared from caprine (goat) whole blood preserved with K₂EDTA anticoagulant. A total of five pools were supplemented with chromium as inorganic Cr³⁺.

The Target Values assigned for each PT material is the arithmetic mean of the results reported by all participants for the event. Values for whole blood chromium range from 1.5 µg/L (29 nmol/L) to 19.5 µg/L (375 nmol/L) after outlier exclusion.

Acceptable range: The acceptable range for chromium is set at ±2 µg/L or ±20%, whichever is greater. Thus, it is fixed at ±2 µg/L for concentrations below 10 µg/L. These NYS grading criteria were established after discussions with the FDA and with other trace element PT scheme organizers.

Discussion: Based upon the above criteria, 90.0% of test results reported were within the acceptable ranges, with one of the 10 laboratories (10.0%) reported 2 or more of the 5 results outside the acceptable ranges. Upward and downward indicator arrows next to individual results should be used as part of a laboratory’s on-going internal quality assessment (QA) program. Note that this grading scheme is intended for educational purposes. Departures from the acceptable ranges should trigger an internal QA review.
# New York State Department of Health
# Blood Chromium Test Results, 2014 Event #1
# STATISTICAL SUMMARY

## TARGET VALUE ASSIGNMENT AND STATISTICS

<table>
<thead>
<tr>
<th>Results (μg/L whole blood)</th>
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<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
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<td>10</td>
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</table>

### Acceptable Range:
- **Upper Limit**: 3.5, 5.6, 9.8, 16.2, 23.4
- **Lower Limit**: 0.0, 1.6, 5.8, 10.8, 15.6

### Notes:
- Results reported as less than the method detection limit are excluded from statistical calculations.
- Outliers identified by Grubbs' test excluded
<table>
<thead>
<tr>
<th>Lab Code</th>
<th>Method</th>
<th>BE14-01</th>
<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
<th>Info Only</th>
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<tbody>
<tr>
<td>110</td>
<td>DRC/CC-ICP-MS</td>
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<td>7.8</td>
<td>13.5</td>
<td>19.5</td>
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<td>6.5</td>
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<td>20.4</td>
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</tbody>
</table>

Percent satisfactory results for all participants: 90.0 %

NOTE: Grading is for educational purposes only

notes: ↑ Reported outside upper limit ↓ Reported outside lower limit ↗ Result unacceptable ↗ Result not reported

notes: Results reported as less than the method detection limit are excluded from statistical calculations. Info only: results included for informational purposes only.
# New York State Department of Health

## Blood Chromium Test Results, 2014 Event #1

### STATISTICAL SUMMARY BY METHOD

<table>
<thead>
<tr>
<th>Method</th>
<th>BE14-01</th>
<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
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<td>23.2</td>
<td>10.7</td>
</tr>
</tbody>
</table>

**Notes:**
- Insufficient data for calculation.
- A Standard Deviation displayed as 0.0 should be interpreted as <0.1.
Additional Trace Elements Reported in Whole Blood

Participant laboratories reported their analytical results for any additional trace elements (other than As, Cd, Hg and Pb) that are routinely reported so that a more complete characterization can be recorded for these proficiency test 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.

In addition to As, Cd, Pb and Hg, the whole blood pools were supplemented with the following additional trace elements as indicated below

Additional Elements

Mn, Sn, Tl, Ti, V, W, Ni, Ag
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**Arithmetic mean**

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**Arithmetic mean**

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*Outlier*  

**Arithmetic mean**  

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## Blood Tin (µg/L)

<table>
<thead>
<tr>
<th>Lab Code</th>
<th>Method</th>
<th>BE14-01</th>
<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>ICP-MS</td>
<td>&lt;0.10</td>
<td>17.3</td>
<td>14.6</td>
<td>10.9</td>
<td>5.1</td>
</tr>
<tr>
<td>147</td>
<td>ICP-MS</td>
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<td>14.4</td>
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<tr>
<td>156</td>
<td>DRC/CC-ICP-MS</td>
<td>&lt;2.0</td>
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<td>14</td>
<td>9.3</td>
<td>6.3</td>
</tr>
<tr>
<td>197</td>
<td>ICP-MS</td>
<td>&lt;5.0</td>
<td>16.4</td>
<td>13.7</td>
<td>10.3</td>
<td>5.6</td>
</tr>
</tbody>
</table>

**Arithmetic Mean**

- 17
- 14
- 10
- 5.4

**SD**

- 0.6
- 0.4
- 0.8
- 0.7

**n**

- 4
- 4
- 4
- 4

## Blood Tungsten (µg/L)

<table>
<thead>
<tr>
<th>Lab Code</th>
<th>Method</th>
<th>BE14-01</th>
<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>DRC/CC-ICP-MS</td>
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<td>10.2</td>
</tr>
<tr>
<td>110</td>
<td>ICP-MS</td>
<td>8.6</td>
<td>0.1</td>
<td>2.9</td>
<td>2.4</td>
<td>10.1</td>
</tr>
<tr>
<td>324</td>
<td>HR-ICP-MS</td>
<td>8.8</td>
<td>&lt;0.7</td>
<td>3.1</td>
<td>2.1</td>
<td>10.6</td>
</tr>
</tbody>
</table>

**Arithmetic Mean**

- 8.6
- 3.0
- 2.3
- 10

**SD**

- 0.3
- 0.1
- 0.2
- 0.3

**n**

- 3
- 3
- 3
- 3

## Blood Uranium (µg/L)

<table>
<thead>
<tr>
<th>Lab Code</th>
<th>Method</th>
<th>BE14-01</th>
<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>ICP-MS</td>
<td>&lt;0.02</td>
<td>&lt;0.02</td>
<td>&lt;0.02</td>
<td>&lt;0.02</td>
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<tr>
<td>147</td>
<td>ICP-MS</td>
<td>&lt;0.007</td>
<td>&lt;0.007</td>
<td>&lt;0.007</td>
<td>&lt;0.007</td>
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<tr>
<td>312</td>
<td>ICP-MS</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
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<tr>
<td>324</td>
<td>HR-ICP-MS</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
</tbody>
</table>

**Arithmetic Mean**

- 1.2
- 0.6
- 3.4
- 13
- 6

**SD**

- 0.1
- 0.2
- 0.9
- 3
- 2

**n**

- 3
- 4
- 4
- 4
- 4

## Blood Vanadium (µg/L)

<table>
<thead>
<tr>
<th>Lab Code</th>
<th>Method</th>
<th>BE14-01</th>
<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>DRC/CC-ICP-MS</td>
<td>1.1</td>
<td>0.5</td>
<td>3.1</td>
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<td>DRC/CC-ICP-MS</td>
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<td>5.56</td>
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<tr>
<td>324</td>
<td>HR-ICP-MS</td>
<td>1.1</td>
<td>0.6</td>
<td>2.7</td>
<td>10.5</td>
<td>4.5</td>
</tr>
<tr>
<td>312</td>
<td>DRC/CC-ICP-MS</td>
<td>*2.2</td>
<td>0.9</td>
<td>4.7</td>
<td>18</td>
<td>8.2</td>
</tr>
</tbody>
</table>

*Outlier*

**Arithmetic Mean**

- 1.2
- 0.6
- 3.4
- 13
- 6

**SD**

- 0.1
- 0.2
- 0.9
- 3
- 2

**n**

- 3
- 4
- 4
- 4
- 4

## Blood Zinc (µg/L)

<table>
<thead>
<tr>
<th>Lab Code</th>
<th>Method</th>
<th>BE14-01</th>
<th>BE14-02</th>
<th>BE14-03</th>
<th>BE14-04</th>
<th>BE14-05</th>
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<tbody>
<tr>
<td>110</td>
<td>ICP-MS</td>
<td>2123</td>
<td>2200</td>
<td>1957</td>
<td>3471</td>
<td>1854</td>
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<td>147</td>
<td>ICP-MS</td>
<td>1935</td>
<td>2020</td>
<td>1837</td>
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<td>ICP-MS</td>
<td>1730</td>
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<td>2930</td>
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<td>ICP-MS</td>
<td>2210</td>
<td>2320</td>
<td>2110</td>
<td>3540</td>
<td>1990</td>
</tr>
</tbody>
</table>

**Arithmetic Mean**

- 2000
- 2083
- 1901
- 3324
- 1830

**SD**

- 213
- 231
- 174
- 273
- 126

**n**

- 4
- 4
- 4
- 4
- 4
## 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\textsuperscript{®} (Anodic stripping voltammetry using the ESA LeadCare\textsuperscript{®} 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.