Standards Council of Canada
Conseil canadien des normes

Institut national de santé publique Québec
Centre de toxicologie

**APLAC T086R PROFICIENCY TESTING PROGRAM**

**INVITATION TO PARTICIPATE**

Dear Participating ABs,

**Re: <u>APLAC T086R Metals in biological matrices Proficiency Testing Program</u>**

This is an invitation to testing laboratories to participate in the **APLAC T086R Metals in biological matrices Proficiency Testing Program** coordinated by the Standards Council of Canada (SCC) in partnership with our collaborator, the *Centre de toxicologie du Québec (CTQ) of the Institut national de santé publique du Québec (INSPQ).*

A limited number of (2 to 4) participants from each accreditation body (except for Canada and USA) will be selected. Note that preference will be given to laboratories that are accredited for these specific tests. The ABs that are members of APLAC can nominate up to 4 participants, while non-APLAC member can nominate up to 2 participants.

This APLAC T086R PT program is specifically designed to evaluate the analytical quality of laboratories for some of the most commonly used parameters for biomonitoring in environmental health. The PT program will consist of:

| Parameter | Preservative | Bottles | Concentration Range | |
|---|---|---|---|---|
| Urine metals | pH 4.8 (HCl) + Gentamicin (antibiotic) | 12 ml urine in 13 ml plastic | Arsenic | 7 to 1500 µg/L |
| | | | Cadmium | 0.5 to 17 µg/L |
| | | | Chromium | 1 to 80 µg/L |
| | | | Lead | 2 to 1050 µg/L |
| | | | Selenium | 20 to 400 µg/L |
| Blood metals | Gentamicin (antibiotic) | 6 ml blood in 7 ml plastic | Arsenic | 1.5 to 40 µg/L |
| | | | Cadmium | 0.5 to 17 µg/L |
| | | | Chromium | 0.5 to 10 µg/L |
| | | | Lead | 10 to 1050 µg/L |
| | | | Selenium | 50 to 800 µg/L |
| Hair metals | None | 125 mg in 8 ml plastic | Arsenic | 0.06 to 4 µg/g |
| | | | Cadmium | 0.06 to 10 µg/g |
| | | | Chromium | 0.4 to 15 µg/g |
| | | | Lead | 0.05 to 30 µg/g |

**APLAC T086R PROFICIENCY TESTING PROGRAM**

**INVITATION TO PARTICIPATE**

| | | | | |
|---|---|---|---|---|
| | | | Selenium | 0.6 to 10 µg/g |

A separately labelled package will be prepared for each participating laboratory. Each package will consist of:

| Matrices | Number of samples | Labels |
|---|---|---|
| Blood | 3 | APLAC-G1, APLAC-G2 and APLAC-G3 |
| Urine | 3 | APLAC-H1, APLAC-H2 and APLAC-H3 |
| Hair | 2 | APLAC-I1 and APLAC-I2 |

**Note: By subscribing to this PT evaluation, the laboratories agree to participate in the study and submit their analytical results, in accordance with the timelines.**

Please email the completed nomination forms to:

Rassoulou Diallo or Vivek Kulasingham; SCC Coordinators, APLAC T086R PT Program; E-mail : vivekananthan.kulasingham@scc.ca

Institut national de santé publique du Québec (INSPQ)

# PROGRAM FOR THE COORDINATION OF PROFICIENCY TESTING SCHEMES FOR THE APLAC PT PROGRAM, T86r

- **Metals in biological materials**

**Submitted by**

Standards Council of Canada
Conseil canadien des normes

**August 2016**

**PROGRAM FOR THE ORGANIZATION OF AN APLAC PROFICIENCY TESTING STUDY**

# Analysis of metals in three different human biological matrices

## 1.0 Nature and purpose of the program

### Introduction

The objective of this study is to assess the quality of environmental health testing laboratories. For that purpose, we offer materials of biological matrices (*urine*, *blood,* and *hair)*.

The selected metals are ***arsenic*, *cadmium*, *chromium*, *lead,* and *selenium***.

Metals are present everywhere in the environment. Most of them are found in small amounts in biological tissues and fluids of unexposed populations. Many of these metals are essential for human life, such as chromium and selenium, because they play important roles in various biological functions. However, acute or chronic exposure to excessive amounts of metals called essential can produce toxic effects.

Toxicity becomes apparent through effects in the cardiovascular system, the central nervous system (lead), the liver, and kidney (arsenic, cadmium) or the hematological and musculoskeletal systems. Selenium toxicity can result from an overdose, and cause nausea, hair loss, and fatigue. Chromium toxicity varies greatly depending on its chemical form (particle, ion, oxide, valence). Chromium deficiency may affect the potential of insulin to regulate sugar levels in the body.

Metals can be absorbed by inhalation, ingestion or skin penetration. Inhalation is the most common route in occupational exposure. Once absorbed, metals remain in the body until their excretion. They are stored in tissues and bones, and can accumulate over long periods. They are excreted in the urine or stool, and also in the hair.

### Objective

The PT study proposed to APLAC is specifically designed to evaluate the analytical quality of laboratories for some of the most commonly used parameters for biomonitoring in environmental health.

### Program Management

The proficiency testing program proposed will be co-coordinated by the Standards Council of Canada and will be organised and managed by the *Centre de toxicologie du Québec (CTQ)* belonging to the *Institut national de santé publique du Québec (INSPQ)*.

## 2.0 Background of the CTQ-INSPQ

The *Centre de toxicologie du Québec (CTQ)* belonging to the *Institut national de santé publique du Québec (INSPQ)* is a public organization that has been offering human toxicology expertise (environmental, clinical and occupational) to the provincial health network of Quebec (Canada), as well as to external clients from around the world. Since 1979, the CTQ operates several permanent external quality assessment schemes that enable participating laboratories to evaluate the accuracy and precision of their analytical methods on a continuous basis. Approximately 250 laboratories from over 30 countries participate in these proficiency testing (PT) schemes to analyse a wide variety of elements in biological materials of human origin, such as blood, serum, urine and hair.

The CTQ laboratory is accredited by the Standards Council of Canada (SCC) under ISO/IEC 17025 and ISO/IEC 17043, and is presently on the list of Proficiency Testing providers for SCC. The accreditation scope covers the PT projects of the current proposal.

## 3.0 Invitation and selection of participants

APLAC members will be invited to participate in this program. Invitations will be sent to all APLAC members through their accreditation bodies once this proposal is approved by the APLAC Proficiency Testing Committee.

The number of participants will be limited to 80 laboratories.

Four (4) APLAC member participants and two (2) non APLAC members from each respective accreditation body (except for Canada and USA) will be selected.

Laboratories will be required to report results for the matrices they have ordered and received.

## 4.0 Program schedule

The dispatch of materials is scheduled for **February 2017.**

The SCC and CTQ-INSPQ will be responsible to send to appropriate accrediting bodies a letter detailing the study, and requesting that they nominate laboratories to participate in this study. The letter will be sent four months prior to the scheduled start of the PT study. Included in the invitation will be the number of participants allowed, a description of the samples (matrix, concentration range) and parameters to be measured, and a nomination form to be completed by each participating accreditation body. Preference will be given to the laboratories that are accredited for the test. The information provided will be used to register the laboratories and assign a unique identification for reporting PT results.

The deadline for returning the nomination form will be two months prior to the start of the PT study **(December 2016)**.

The samples will be prepared by the CTQ-INSPQ prior to the shipment, respecting the time frame necessary for the shipment, reception, and analysis of the PT samples within the deadline.

The samples with a sample receipt form, instructions to accreditation bodies and laboratories will be sent around **February 2017** to the participating accreditation bodies. Upon reception, the accreditation bodies will have to check the samples integrity, complete and return the sample receipt form to the SCC/CTQ-INSPQ. Packages with PT samples, instructions, and result sheets should be distributed as soon as possible to each participant laboratory. An Excel file for the Report Form will be sent directly by email to the laboratories.

The laboratories will have about eight weeks to analyze the samples and to report the test results, test methods, and measurement uncertainties. The participating laboratories are asked to use the testing method which is consistent with their analysis. The Excel file should be submitted to the SCC/CTQ-INSPQ and the nominating accreditation body via email by the end of **April 2017**.

The SCC/CTQ-INSPQ will prepare an interim report to be sent to each participant laboratory by the end of **May 2017**, detailing the assigned values for each test with an indication of the laboratory performance.

The draft of the final report will be prepared and submitted to the APLAC Proficiency Committee for review before the end of **June 2017**. After approval by the APLAC committee, copy of the final report will be forwarded to the participating accreditation bodies for distribution to the participating laboratories.

## 5.0 Samples and shipping

The PT study will consist of three samples of each matrix except for hair. In some cases, a preservative is added as indicated in the following table. Each set of three samples will be sealed in a leak-proof plastic sleeve and placed in a standard packing carton, an absorbent paper, and Styrofoam.

Biological PTMs sold commercially are usually prepared by spiking an analyte into a biological matrix followed by freeze-drying. This process greatly alters the matrix, which significantly differs from human biological specimens. For this study, PT materials such as blood, urine and hair are all obtained from unexposed human volunteers. The bulk materials are first analyzed to determine the baseline values and then spiked, if necessary, based on the needs of the proficiency test. Samples are stable for the duration of the PT exercise.

**Sample Concentration Range**

| Parameter | Preservative | Bottles | Concentration Range | |
|---|---|---|---|---|
| Urine metals | pH 4.8 (HCl) + Gentamicin (antibiotic) | 12 ml urine in 13 ml plastic | Arsenic | 7 to 1500 µg/L |
| | | | Cadmium | 0.5 to 17 µg/L |
| | | | Chromium | 1 to 80 µg/L |
| | | | Lead | 2 to 1050 µg/L |
| | | | Selenium | 20 to 400 µg/L |
| Blood metals | Gentamicin (antibiotic) | 6 ml blood in 7 ml plastic | Arsenic | 1.5 to 40 µg/L |
| | | | Cadmium | 0.5 to 17 µg/L |
| | | | Chromium | 0.5 to 10 µg/L |
| | | | Lead | 10 to 1050 µg/L |
| | | | Selenium | 50 to 800 µg/L |
| Hair metals | None | 125 mg in 8 ml plastic | Arsenic | 0.06 to 4 µg/g |
| | | | Cadmium | 0.06 to 10 µg/g |
| | | | Chromium | 0.4 to 15 µg/g |
| | | | Lead | 0.05 to 30 µg/g |
| | | | Selenium | 0.6 to 10 µg/g |

Each package will consist of:

| Matrices | Number of samples | Labels |
|---|---|---|
| Blood | 3 | APLAC-G1, APLAC-G2 and APLAC-G3 |
| Urine | 3 | APLAC-H1, APLAC-H2 and APLAC-H3 |
| Hair | 2 | APLAC-I1 and APLAC-I2 |

- Participant Instruction sheets
- Receipt of Samples Form-participating laboratory and Report Form.

The packages for laboratories nominated from each accrediting body will be packaged into a larger package and shipped to the appropriate accrediting body. Each of these packages will contain:

- The laboratory samples;
- A copy of the laboratory instruction sheet;
- A sample report form;
- A receipt of samples form-accrediting body;
- Instructions to the accrediting body

These packages will be shipped by Federal Express to the respective accrediting body two to three weeks before the scheduled start of the study, to provide time for them to distribute the samples to each laboratory. All documents and forms will respect the requirements of the APLAC PT002 documents.

## 6.0 Homogeneity and stability testing

Homogeneity and stability studies will be done after the completion of the sample preparation, according to ISO/IEC 17043 and ISO 13528.

Homogeneity is verified by measuring the concentration of the analyte in eight (8) PTM materials. Testing is performed under repeatability conditions. We use the procedure described in the standard with the amendments of Fearn and Thompson: the procedure described in Annex B of ISO 13528: 2005 is applied with the revision proposed by Fearn and Thompson to adequately perform the homogeneity test considering the variability of the variance estimation inter-tube.

Stability is verified by measuring the concentration of the analyte in nine (9) materials of PTM kept at different temperatures (-20°C, 4°C and room temperature) for eight weeks. The material stored at - 20°C is used as the reference temperature (previous data from the quality control of the toxicology laboratory has shown that PTMs are stable for at least five years at this temperature).

## 7.0 Results reporting

All results will be reported by email to the SCC/CTQ-INSPQ. Within forty-eight hours of results reception, the laboratory will receive a confirmation email.

A week prior to the reporting deadline, accrediting bodies will notify participants if they have not yet reported results.

## 8.0 PT evaluation

The CTQ-INSPQ uses a PT evaluation procedure consistent with the ISO 13528 *Statistical Methods for use in Proficiency Testing by interlaboratory Comparisons*. The steps involved are:

- Results with a < qualifier are temporarily removed from the data set.
- Robust average and robust standard deviation are determined using robust Algorithm A. (Outliers have no influence on the values of the robust estimates).
- The robust average is established as the assigned value $x_{pt}$ and the robust standard deviation ($s^*$) is established as the standard deviation for proficiency assessment $\sigma_{pt}$.
- The standard uncertainty of the assigned value ( $u(x_{pt})$ ) is calculated according to Algorithm A:

  $\boldsymbol{u(x_{pt}) = 1{,}25 \times s^* / \sqrt{N}}$ where N is the number of numerical results reported.
- Z' scores are calculated for each result.

$$z' = \frac{(x - x_{pt})}{\sqrt{\sigma_{pt}^2 + u^2(x_{pt})}}$$

## 9.0 PT reports

**Interim Report**

Within four weeks after the end of the study, an interim report will be produced and sent by e-mail to each participant laboratory.

**Draft Report**

A draft PT report will be submitted to the accrediting bodies and the APLAC Proficiency Testing Committee. This report will contain study statistics, including robust average following Algorithm A, robust standard deviation, and median values, the reported results for each laboratory with the Z' score (identification with a confidential number), a copy of the instruction sheet, and a sample results reporting form. All the requirements for the report indicated in the APLAC PT002 will be followed.

For some matrices, it is possible that the samples contain more metals than those included in this list. In that case, statistics will be provided to participating laboratories for information purposes. A certificate indicating the assigned values will then be given to laboratories, in order for them to be able to assess their own performance.