

ERNDIM - Quantitative Schemes Pterins in Urine



Prof. Dr. N. Blau
University Children's Hospital
Dietmar-Hopp Metabolic Center
Im Neuenheimer Feld 669
D-69120 Heidelberg
Germany
e-mail: nenad.blau@med.uni-heidelberg.de

Dr. C.W. Weykamp
Queen Beatrix Hospital
MCA Laboratory
P.O. Box 9005
NL – 7100 GG Winterswijk
e-mail : c.w.weykamp@skbwinterswijk.nl

Heidelberg-Winterswijk, 10 January 2018

Annual Report ERNDIM-EQAS 2017

1. **Purpose**

The purpose of the ERNDIM External Quality Assurance Scheme for Pterins in Urine is the monitoring of the analytical quality of the assay of pterins in laboratories involved in the screening and diagnosis of patients with inherited metabolic disorders. The scheme consists of a quantitative assay of pterins in urine and will be discussed in this report. For details: www.erndim.org / www.ERNDIMQA.nl

2. **Participants**

A total of 31 datasets have been submitted, for 1 of them an annual report could not be generated due to insufficient data submission. Two laboratories did not submit results at all.

3. **Design**

The Scheme has been designed, planned and coordinated by Prof. Dr. Nenad Blau as scientific advisor and Dr. Cas Weykamp as scheme organizer (subcontractor on behalf of SKML), both appointed by and according and in line with the procedures of the ERNDIM Board. The design includes samples and reports which are connected to provide information with a balance between short-term and long-term reports and between detailed and aggregated information.

Samples

The scheme consisted of 8 lyophilized samples, all prepared from the same basic urine, but with various amounts of added analytes. The analytes included are biopterin, neopterin, and primapterin and results are expressed in both micromol/L and mmol/mol creatinine. The samples were identical two by two: the pairs, the biochemical and (mimicked) clinical characteristics are in the table below. Samples have been tested for stability and homogeneity according to ISO 13528.

Table 1. Samples

Sample Pair	Biochemical Characteristics	Clinical Characteristics
1 and 7		6-pyruvoyl-tetrahydropterin synthase (PTSP) deficiency
2 and 5	Normal levels	Normal pattern
3 and 6		Pterin-4a-carbinolamine dehydratase (PCD) deficiency
4 and 8		Dihydropteridone reductase (DHPR) deficiency

Reports

All data-transfer, the submission of data as well as request and viewing of reports proceeded via the interactive website www.erndimga.nl which can also be reached through the ERNDIM website (www.erndim.org). The results of your laboratory are confidential and only accessible to you (with your name and password). The anonymised mean results of all labs are accessible to all participants. Statistics of the respective reports are explained in the general information section of the website.

An important characteristic of the website is that it supplies short-term and long-term reports. Short-term reports are associated with the eight individual specimens, for each of which there has been a specific deadline in the year 2017. Two weeks after the respective deadlines participants could request their reports and as such had eight times up-to-date information on their analytical performance. Although technically not required (the website can work with a delay time zero) a delay time of 14 days has been chosen to enable the scientific advisor to inspect the results and add his comment to the report. Contrary to the early short-term report is the annual long-term report. The annual report is based on the design-anchored connection between samples, which enables to report a range of analytical parameters (accuracy, precision, linearity, recovery and interlab dispersion) once an annual cycle has been completed. The annual report is discussed below.

A second important characteristic of the website is the wide range in aggregation of results which permits labs to make an individual choice for detailed and/or aggregated reports. The most detailed report which can be requested from the website is the "Analyte in Detail" which shows results of a specific analyte in a specific sample (56 such Analyte-in-Detail-reports can be requested in the year 2017 cycle). A more condensed report is the "Current Report" which summarizes the performance of all analytes in a specific sample (8 such Current Reports can be requested in 2017). The highest degree of aggregation has the Annual Report, which summarizes the performance of all analytes of all 8 samples (1 such Annual-Report can be requested in 2017). Depending on their position in the laboratory one can choose to have a glance at only the annual report (managers) or at all 56 detailed reports (technicians).

4. Discussion of Results in the Annual Report 2017

In this part, the results as seen in the annual report 2017 will be discussed. Subsequently we will focus on accuracy, recovery, precision, linearity, interlab CV and cross-sectional relations. Please print your annual report from the Interactive Website when you read the "guided tour" below and keep in mind that we only discuss the results of "all labs": it is up to you to inspect and interpret the specific results of your laboratory.

4.1 Accuracy

A first approach to describe the accuracy is comparison of your mean outcome in the eight samples with the mean of all labs. This is shown in the columns "your lab" and "all labs" under the heading "Accuracy", respectively. E.g. for biopterin the mean of all labs is 2.62 micromol/L with which you can compare the mean of your lab.

4.2 Recovery

A second approach to describe accuracy is the percentage recovery of added analyte. In this approach, it is assumed that the recovery of the weighed quantities is the target value. The correlation between weighed quantities as added to the samples (on the x-axis) and your measured quantities (on the y-axis) have been calculated. The slope of the correlation multiplied with 100% is your recovery of the added amounts. Outcome for your lab in comparison to median outcome of all labs is shown in the column "Recovery" in the annual report. For all labs the recovery ranges from 97% for primapterin in mmol/mol creatinine to 101% for biopterin and neopterin. The overall recovery is 100%.

4.3 Precision

Reproducibility is an important parameter for quality in the laboratory and is encountered in the schemes' design. Samples come in pairs, which can be regarded as duplicates from which CV's can be calculated (Intra Laboratory CV as indicator for reproducibility). Outcome for your lab in comparison to the median of all labs is shown in the column "Precision" of the Annual Report. Precision ranges from 11.7% for biopterin to 29.8% for primapterin in mmol/mol creatinine. The overall intralab CV is 15.7%.

4.4 Linearity

Linearity over the whole relevant analytical range is another important parameter for analytical quality. Again, this is encountered in the schemes' design. With weighed quantities on the x-axis and your measured quantities on the y-axis the coefficient of regression (-r-) has been calculated. Outcome for your lab in comparison to the median of all labs is in the column "Linearity" of the annual report. The coefficient of regression ranges from 0.943 for biopterin in mmol/mol creatinine to 0.997 for neopterin and primapterin.

4.5 Interlab CV

For comparison of outcome for one patient in different hospitals and for use of shared reference values it is relevant to have a high degree of harmonization between results of various laboratories. Part of the schemes' design is to monitor this by calculating the Interlaboratory CV. This, along with the number of laboratories who submitted results, is shown in the column "Data All labs" in the Annual Report. Most laboratories submitted results for neopterin and biopterin in mmol/mol creatinine (28) whereas only 15 labs assayed primapterin. The Interlab CV ranges from 18.5% for biopterin to 101% for primapterin. The mean Interlab CV for all analytes is 44.8%.

4.6 Cross Sectional Relations

The various parameters as described above often have an interrelation: often more than one parameter directs towards good or bad analytical control. This pattern, clearly seen in the other ERNDIM schemes is less prominent in the pterins scheme.

4.7 Your laboratory performance: Flags

After some years of discussion and planning a system to judge performance of individual laboratories is implemented starting from January 2009. In the annual

report an individual laboratory flags indicate poor performance for accuracy, precision, linearity and recovery. Analytes with satisfactory performance for at least three of the four parameters (thus no or only one flag or no result) receive a green flag. Thus, a green flag indicates satisfactory performance for analysis of that particular analyte while a flag indicates that your laboratory has failed to attain satisfactory performance. Criteria for red flags can be found in the general information on the website (general information; interactive website, explanation annual report).

4.8 **Poor Performance Policy**

A wide dispersion in the overall performance of individual laboratories is evident. Table 2 shows the percentage of flags observed. 29% of the laboratories have no flag at all and thus have attained excellent overall performance. In contrast, at the other extreme there are also 12% of laboratories with more than 25% flags. Following intensive discussion within the ERNDIM board and Scientific Advisory Board (SAB) and feedback from participants we could agree on a harmonised scoring system for the various branches of the Diagnostic Proficiency schemes and qualitative schemes. We have also tested a scoring system for the quantitative schemes as described in our Newsletter of Spring 2009. In parallel to this the SAB has agreed levels of adequate performance for all the schemes and these will be re-evaluated annually. The scoring systems have been carefully evaluated by members of the SAB and have been applied to assess performance in our schemes from 2007 onwards. The ERNDIM Board has decided that the Scientific Advisor will judge the performance of the individual laboratories based on these levels of satisfactory performance and issue a letter of advice of failure to achieve satisfactory performance to those laboratories, which do not achieve satisfactory performance. The letter is intended to instigate dialogue between the EQA scheme organiser and the participating laboratory to solve any analytical problems to improve quality of performance of labs in the pursuit of our overall aim to improve quality of diagnostic services in this field.

Table 2. Percentage Flags

% Red Flags seen in Annual Report	Percentage Labs in this Category	Cumulative Percentage of Labs
>25%	14%	14%
20 – 25%	11%	25%
15 – 20%	4%	29%
10 – 15%	14%	43%
5 – 10%	4%	47%
0 – 5%	0%	47%
0%	53%	100%

4.9 **Interpretation**

In this scheme, we also requested the interpretation. Table 3 shows the interpretation frequency for the respective sample pairs. The correct interpretation is marked with a green box. For sample #1 24 laboratories reported the correct interpretation “normal pterins pattern”; 2 labs reported the incorrect pterin-4a-carbinolamine dehydratase deficiency. In the paired sample (sample #7) 25 laboratories reported the correct interpretation and 1 laboratory reported the incorrect pterin-4a-carbinolamine dehydratase deficiency. In general, the reported interpretation of the laboratories is nearly always correct. Interestingly, 13 laboratories did not report primapterin, but 8 of them hit the correct diagnosis of PCD deficiency. These laboratories may miss the diagnosis of a rather benign hyperphenylalaninemia, which however present with a late-onset diabetes type 2 (MODY).

Table 3. Interpretation

Description	Pair 1-7	Pair 2-5	Pair 3-6	Pair 4-8
Normal pterins pattern	0 – 0	25 – 25	5 – 2	26 – 24
Pterin-4a-carbinolamine dehydratase def.	2 – 1	0 – 0	22 – 22	0 – 0
Dihydropteridine reductase deficiency	0 – 0	1 – 2	0 – 0	1 – 3
6-pyruvoyl-tetrahydropterin synthase def.	24 – 25	0 – 0	1 – 0	0 – 0

5. **Certificates**

Starting from 2017 the pterins are included on the certificates.

As for other schemes the performance as it is indicated by the red/green flags in the individual laboratories annual report is summarised in the new style of annual participation certificate. The certificate lists the total number of pterins in the scheme, the number for which results have been submitted and the number for which satisfactory performance has been achieved. It is important to bear in mind that the certificate has to be backed up by the individual annual report in the case of internal or external auditing.

6. **Preview Scheme 2018**

The design of the pterins in urine scheme is essentially the same as in 2017.

7. **Questions, Remarks, Suggestions**

If you have any questions, remarks or suggestions please address to the scientific advisor Prof. Dr. Nenad Blau (nenad.blau@med.uni-heidelberg.de) or the scheme organizer Dr. Cas Weykamp (c.w.weykamp@skbwinterswijk.nl).