UK NEQAS
For Trace Elements

Participant's Manual

UK NEQAS for Trace Elements

SAS Trace Elements Centre

Surrey Research Park

15 Frederick Sanger Road, Guildford

Surrey. GU2 7YD

United Kingdom

Telephone: +44 (0)1483 571122 ext. 3611

Email: rsc-tr.guildford-eqa@nhs.net Website: www.ukneqasgphte.org.uk

UKAS PROFICIENCY TESTING
7496

Contents

1. Schemes Provided

Scheme	Analytes
Accredited Programmes	
Serum trace elements	Aluminium, chromium, cobalt, copper, selenium, zinc.
Whole blood trace elements	Arsenic, cadmium, chromium, cobalt, lead, manganese, mercury, selenium, thallium.
Urine trace elements	Arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, thallium, zinc.
Non-Accredited Programmes	
Whole blood trace elements	Magnesium, zinc.
Water and dialysis fluids (For educational purposes only)	Aluminium
Solid Matrix (For educational purposes only)	Copper, iron.

2. Background and Aims

The UK NEQAS for Trace Elements external quality assessment scheme operates from Guildford, Surrey in the United Kingdom from purpose built laboratories on the Surrey Research Park. The Scheme is managed and administered by staff employed by Royal Surrey Hospital NHS Foundation Trust. The scheme is part of Berkshire and Surrey Pathology Services (BSPS), the over-arching organisation that manages the various individual pathology departments that operate across the Foundation Trusts involved in the BSPS partnership: Ashford and St Peter's Hospital (ASPH), Surrey and Sussex Healthcare (SASH), Frimley Health (FH), Royal Berkshire Hospital (RBH) and Royal Surrey (RSFT).

The legal entity for the scheme is Frimley Health NHS Foundation Trust.

Specimens are sent from Guildford to UK and overseas participants by mail or courier service. Results are returned by logging onto a web-based system using a unique username and password, and the reports are available to download from the same website. Communication with the scheme via email (rsc-tr.Guildford-EQA@nhs.net) is the preferred option.

The aims of UK NEQAS for Trace Elements are consistent with the intentions of UK NEQAS, to:

- provide professionally-led and scientifically-based schemes with a primarily educational objective
- provide regular distributions of specimens
- provide rapid feedback of performance
- support participants where problems occur
- stimulate the overall improvement in performance among all participating laboratories

3. Address and Communication

UK NEQAS for Trace Elements
SAS Trace Elements Centre
Surrey Research Park
15 Frederick Sanger Road
Guildford
Surrey
GU2 7YD
United Kingdom

Telephone: + 44 (0) 1483 571122 ext. 3611
Email: rsc-tr.guildford-eqa@nhs.net

Opening Hours: 9:00 – 17:00 (UK time) with the exception of the bank and public holidays

An information web site for the scheme exists at www.ukneqasgphte.org.uk

The website for reporting a result is www.birminghamquality.org.uk

A website for the UK NEQAS organisation and which also gives specific information for certain UK NEQAS Centres and Schemes, including this scheme is at www.ukneqas.org.uk

Information about the SAS Trace Elements Laboratory at Guildford may be found at https://www.berkshireandsurreypathologyservices.nhs.uk/dept-info-tests/

Please quote your participant number in all communications with the Scheme. If no response is received within 5 working days please make contact again as the email communication may have been lost.

4. Staffing

Dr Gwen Wark **Scheme Director**	Tel. - + 44 (0) 1483 406715 Email: gwen.wark@nhs.net
Dr Chris Harrington **Scheme Deputy Director**	Tel. - + 44 (0) 1483 571122 ext. 3620 Email: chris.harrington1@nhs.net
Mr Godwin Tetteh **Scheme Manager**	Tel. - + 44 (0) 1483 571122 ext. 3611 Email: godwin.tetteh@nhs.net
Mr Stuart Kerr **Medical Technical Officer 2**	Tel. - + 44 (0) 1483 571122 ext. 3611 Email: stuart.kerr4@nhs.net
Ms Anissa Mukhambetzhan **Medical Laboratory Assistant**	Tel. - + 44 (0) 1483 571122 ext. 3611 Email: a.mukhambetzhan@nhs.net
Mr Lemuel Lewis Ronald **EQA Quality Manager**	Tel. - + 44 (0) 1483 571122 ext. 3611 Email: lemuel.lewis@nhs.net

5. Accreditation and Recognition

The schemes were formally recognised by the Joint Working Group for Quality Assurance according to the criteria developed for EQA providers in 1993. These have been superseded by the EQA accreditation standards of Clinical Pathology Accreditation (UK) Ltd. The schemes were fully accredited by CPA in 2000 and have been successfully re-assessed thereafter. In 2015 the blood, serum and urine programme was assessed and is a UKAS accredited proficiency testing provider, UKAS No. 7496. Element/matrix combinations with <=11 participants should be considered as out-with the scope of our accreditation. Currently, this is whole blood magnesium and whole blood zinc. The solid matrix and aluminium in water programmes are for educational purposes only and are not accredited to ISO 17043:2010.

6. Participation

6.1 Eligibility

The UK NEQAS for Trace Elements external quality assessment scheme is designed principally for laboratories serving clinicians and patients. Initially established for UK hospital laboratories there are now many non-UK health care participants, research laboratories and other establishments that take part in the scheme. All UK clinical service laboratories who are participants in the scheme must agree to current Joint Working Group (JWG) Conditions of Participation (see Appendix 1). By returning a completed registration form, participants are deemed by the scheme management to have agreed to these conditions of participation.

Participants should note that data generated by the scheme are the copyright of UK NEQAS for Trace Elements. Reports may only be distributed, published or used for publicity and promotion with the written consent of the Scheme Organizer. Permission for scientific use of reports and scheme data will not be unreasonably withheld but please ask in advance.

6.2 Enrolment

Intending participants should contact the scheme for enrolment documents which include:

- Registration Form
- Method Selection Form
- A schedule of specimen dispatch dates

Potential participants will only be enrolled on the scheme once a completed registration form AND a completed method selection form for the analytes/matrices they require has been received.

Although the main blood, serum and urine programmes operate a succession of six-monthly cycles which commence in April and October each year, it is possible for participation to begin at the first distribution after receipt of a completed registration form. Charges will be applied on a pro-rata basis.

6.3 Participant numbers

Each participant is assigned a unique number which should be common for each UK NEQAS scheme that the laboratory is enrolled in.

Please quote your participant number in all communications with the Scheme.

6.4 Confidentiality

The fact of participation, raw data and performance scores are confidential between the individual laboratory and the Scheme staff. For UK laboratories providing services to NHS organisations, performance scores (and some relevant raw data) may be shared with the Advisory Panel under defined circumstances (see Appendix 1) as part of the reporting of persistent poor performance.

The EQA schemes operated by UK NEQAS for Trace Elements participate in the United Kingdom EQA Governance and Assurance Framework. This framework is a collaboration between EQA providers, the Royal College of Pathologists (RCPath), professional bodies and regulatory organisations. As part of this framework any issues of persistent poor performance (PPP) identified in UK clinical laboratories will be reported to the relevant National Quality Assurance Advisory Panels (NQAAPs) for the benefit of patient safety. As per the NQAAP terms of reference (document WS10904) a

holistic approach to responding to PPP will be undertaken to ensure cross system performance is monitored. This will be achieved by requesting any laboratories that are identified to provide details to the NQAAP of their EQA performance in other areas and this will be shared with other NQAAPs and Quality Assurance in Pathology Committee (QAPC) as appropriate.

Reporting of performance issues will involve disclosure to the relevant NQAAP of your head of department, laboratory name, address and healthcare organisation, together with methodological and EQA performance information. Any details provided to the NQAAP will be securely shared with other NQAAPs and the QAPC.

6.5 Charges

The scale of charges is published annually and is available on request. The charging period is 1st April to 31st March and participation for part of a year will be charged pro-rata. All financial matters are managed by Frimley Health NHS Foundation Trust who arranges invoicing for the services provided. The financial details for payment are as follows:

For all laboratories:

Bank account name - Frimley Health NHS Foundation Trust

Bank name - Lloyds TSB, 19-23 Obelist Way, Camberley, Surrey, GU16 3SE

Sort code - 30-91-53

Account No – 01198646

Extra information for overseas laboratories:

Bank ID - Identifier Code Loyd GB21141 (*the words 'Identifier Code' does need to be quoted and spelling 'Loyd' with one 'L' is correct)*

IBAN No - GB96LOYD30915301198646

Swift Code - LOYD GB2L

7. Specimens

7.1 Types

Specimens are prepared using serum, whole blood, urine, dialysis fluids and deionised water as the base material. The solid matrix specimens are prepared using lyophilised, powdered muscle, tissue and other materials. Where possible, each matrix is spiked with trace elements to a level that reflects those found in clinical and occupational monitoring. Low levels of nutritional elements can be hard to achieve due to the endogenous concentration of elements in the material. In some instances specimens may be spiked with interferences that are found in clinical or occupational

settings, so that participants may test the accuracy of their procedures and the methods used to overcome such interferences. In this case the participants' performance for this specimen may not be scored, but will be used for educational purposes.

7.2 Sources

Serum: New born bovine calf serum is obtained from Life sciences.

Blood: Sterile equine blood, is collected and stored with EDTA as anticoagulant and is obtained from TCS Biosciences Ltd.

Urine: Human urine from anonymised surplus pathological 24hr urine collections.

Dialysis fluid and Water: Dialysis fluid concentrate, Renalyte, is purchased from Macarthays Medical Ltd., Romford, UK.

Solid matrix: European Reference Material, lyophilised and powdered muscle, tissue and other materials are obtained from IRMM, Geel, Belgium.

7.3 Preparation and treatment

Serum: New-born calf serum is chelexed for 7hrs then centrifuged for preparation of six serum pools. Five are supplemented with Al, Cr, Co, Cu, Se and Zn, the sixth serves as an endogenous pool and the ALTM values determined for this pool are used in the statistical calculations and to check spike recoveries. The serum is transferred to volumetric flasks which are mixed and dispensed into labelled tubes.

Blood: Equine blood is thoroughly mixed and transferred to volumetric flasks for the preparation of six blood pools. Five pools are supplementation with As, Cd, Cr, Co, Pb, Mg, Mn, Hg, Se, Tl and Zn. The sixth serves as an endogenous pool and the ALTM values determined for this pool are used in the statistical calculations and to check spike recoveries. The blood pools are mixed and dispensed into labelled tubes.

Urine: Human urine is acidified with concentrated nitric acid to a final volume of 1% and then kept at approximately -20 ^{o}C for at least 24 hours. After thawing to room temperature the urine is filtered to remove precipitates, placed into volumetric flasks for the preparation of six urine pools. For five pools the concentrations of As, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, Tl and Zn are augmented as for elements in serum or blood. The sixth serves as an endogenous pool and the ALTM values determined for this pool are used in the statistical calculations and to check spike recoveries. The pools are mixed and dispensed into labelled tubes.

Dialysis fluid and water: Dialysis concentrate 28 ml, is pipetted into a 1 l volumetric flask containing aluminium-free water. Nitric acid, 10 ml, and a solution of Al to increase the final concentration by a pre-determined amount, are added, made to volume with deionised water and thoroughly mixed. Water specimens are similarly prepared except for omission of the dialysis concentrate.

Solid Matrix: Lyophilised sample is dried to constant weight before weighing aliquots of approximately 0.005 g into 2 mL tubes. Samples may be supplemented with Cu and Fe.

Serum, blood and urine specimens are subjected to gamma-irradiation (25-38 kilogray) to destroy any bacterial contamination that may have occurred during preparation. These specimens are stored between 2.5°C and 7.5°C until dispatch.

The homogeneity and stability of sample batches have been demonstrated for representative batches of samples and this is checked on an ongoing basis.

7.4 Safety precautions

The procedures employed for the preparation and treatment of specimens should ensure that there are no risks associated with their use. **However, as for all clinical material, EQA samples should be handled with the same precautions as are normally adopted in the handling of patient specimens. Appropriate precautions should be used during receipt, storage, preparation for analysis and their disposal.**

8. Operation

8.1 Distribution cycle

For each annual cycle of the blood, serum and urine programme, a total of twelve pools are prepared as described above, resulting in a total of six pools for each of the 6 monthly dispatches. Two specimens are analysed every month and each pool is sent for analysis on two different occasions. Thus, the cycle provides 24 specimens with duplicate measurements on the 12 pools. The dialysis fluid and water specimens are prepared fresh each month and do not follow a fixed term cycle. The solid matrix samples are dispatched in a quarterly cycle providing 2 specimens for analysis in each distribution (2 solid samples requiring digestion). Distribution schedules for all schemes are available on the scheme website.

8.2 Mailing, storage and testing

Specimens for the blood, serum and urine are despatched as liquid samples and sent to the participants by post or courier at ambient temperature. Laboratories are requested to analyse

samples for the first month as soon as possible after receipt and to store the other specimens until the appropriate time, at a temperature of at least -20 °C. Once thawed the specimens should reach room temperature and be thoroughly mixed prior to analysis (this is particularly important for the whole blood samples). The dialysis fluid and water specimens are sent monthly, immediately after preparation and should be analysed as soon as possible after receipt. Precaution should be taken on opening against contamination of the samples by dust containing Al. The solid matrix scheme samples dispatched are lyophilised powdered samples. The specimens should be stored at 18°C ± 5°C. Care should be taken when opening the solid powdered samples so as not to lose any of the sample from the low mass distributed. As much as possible of the sample should be weighed and digested using the laboratory procedures usually used for patient samples.

Special arrangement may be made for overseas participants if delivery delays or other problems have been experienced. A schedule of specimen despatch dates is provided each year upon registration. Participants should expect to receive samples within 7 days of the dispatch date, but overseas participants may experience longer delays up to 3 weeks. If samples have not been received by the start of the first distribution in the set please get in contact with the scheme (section 3).

All packages are posted following the IATA guidelines.

The proficiency testing specimens should be tested in the same manner as the majority of routine samples that the participant laboratory receives for analysis. The method group is displayed on the report and should be kept up to date. The method can be updated on the reporting website by pressing the “method” button in the UK NEQAS for Trace Elements row or by e-mailing us the updated information. The specimens should be defrosted, allowed to reach room temperature and then thoroughly mixed before aliquoting the sample out for testing. The participant should use the same instrumentation and calibration methods that are used for the patient samples that they test.

8.3 Results documents

For the monthly Scheme participants should use their own form for recording their results, in the same way that they do for normal patient samples e.g. units and decimal places the same.

For the aluminium, and solid matrix schemes, result forms carrying the participation code number and showing the date by which results must be returned are sent with the specimens. Participants can use their own forms for sending in results but should make sure that there is no ambiguity concerning the units of concentration.

8.4 Reporting procedures

For the blood, urine and serum scheme, results should be reported using the password-protected website facility: UKNEQAS (www.birminghamquality.org.uk). Where this is not possible results may be returned by post or email to the Scheme office. Please make sure that results are written clearly and that decimal points are shown as there can be loss of clarity when scanned. Results received after the 'return by --' date will be included provided the reporting software has not yet been initiated. By the discretion of the Scheme Manager, Deputy Director or Director, other late results returned after the interim report has been issued, will be entered so that they contribute to the average Z-scoring.

Where the result is less than the limit of quantification (LOQ) of the assay it is recommended that the result is entered as "<LOQ value" (eg. if the LOQ = 1 then the result would be entered as "<1") rather than entered as 0 or as the LOQ value. The software is unable to process non-numeric data, so any participant returns containing alpha numeric entries e.g. "<value" will be excluded from the data set.

The on-screen report shows the date and time when the report was authorised. Reports issued within 5 working days of the reporting deadline and up to 1 month following the reporting deadline are interim reports. A final report will be issued on the same day as the next month's interim report. For this reason amendments to results will only be accepted up to one month after close of the distribution. Amendments will not usually be accepted following publication of the final report (see section 11.1 Blunders and Amendments to results).

For the aluminium, and solid matrix scheme samples, results should be returned to the office by the closing date of the distribution.

Null returns, i.e. a positive statement that no results are available, should be made when there are situations such as; no patients' samples available to analyse, instrument or staffing problems.

9. Data Processing

9.1 Assigned concentrations

In most situations the all laboratory trimmed mean (with data outside of 3 standard deviations removed) and standard deviation are used to represent the assigned concentration. These data have been demonstrated to represent a close approximation to the true value. However, where the number of participants in a particular element/matrix combination is <=11, then Algorithm A will be

used to calculate the statistical parameters shown in the report. This is described further in ISO 13528 Annex C3 Robust Analysis: Algorithm A.

Please note that participant performance will not be assessed when p<=11 and a comment will be added to the report to this effect "the minimum number of participants for performance evaluation is 11. When participation levels are 11 or less, performance will not be assessed. The values shown are for information only and not used to assess performance. The scoring of an element/matrix combination with <=11 participants should be considered as out-with the scope of our current accreditation. "

9.2 Validity of targets

Targets are checked at intervals by comparison with the recoveries of added analytes. Further work is undertaken from time to time with measurements of Certified Reference Materials, where traceability to a primary standard is possible, and by examination of results from reference laboratories.

9.3 Surveillance

As each distribution is processed, Organisers carefully check the resulting data. If you suspect that we have made an error, let us know immediately. It is important that we can act speedily and improve the way in which we manage the organisation.

10. Reports

10.1 Overview

Results reported by participants are downloaded from the website and entered into a computer programme for calculation of the robust mean and standard deviation, median and coefficient of variation for each of the matrix/analyte/specimen combinations. Unique monthly reports are prepared for each participant which show these values and also gives the participants own results and histogram displays of the distributions of results (Appendix 2). A performance score (z-score) is produced to accompany the report (see below). An email is automatically sent to all registered participants notifying them when a distribution opens and when it closes and reports are available for download. Participants can access a copy of their report via the website using their own password within 5 working days of the result submission deadline. Where this is not possible, copies can be printed at the Scheme Office and posted or emailed as pdf files to participants. The on-screen report shows the date and time when the report was authorised. Reports issued within 5 working

days of the reporting deadline and up to 1 month following the reporting deadline are interim reports. A final report will be issued on the same day as the next month's interim report. For this reason amendments to results will only be accepted up to one month after close of the distribution. Amendments will not be accepted following receipt of the final report (see section 11.1 Blunders and Amendments to results).

An annual report is prepared within one month of the close of the final distribution in March of each year. This is made available for download from the website by each participating laboratory and includes the final data set after all corrections and amendments have been made.

10.2 Performance scores: Z-scoring

Measurements of performance are based on deviations of results from target values. These deviations are used to calculate a Z-score.

As external quality assessment has developed, various organisations have produced documents that summarise best practice. Those from authoritative international bodies include:

- ISO 17043 (Conformity assessment - General requirements for proficiency testing).
- ISO 13528 (Statistical methods for use in proficiency testing by interlaboratory comparisons).
- IUPAC (The international harmonized protocol for the proficiency testing of analytical chemistry laboratories, Pure Appl. Chem. 2006; 78: 145–196, 2006).

All these documents recommend that assessment of performance should be based upon calculation of a Z-score (or a derivative which takes uncertainty into consideration). Z-scores are now widely used in EQA schemes around the world including other sectors in the UK.

The Z-score is calculated as

$$x - X / SD_{PT}$$

where x = laboratory result,

X = target value and

SD_{PT} = standard deviation for proficiency testing (also represented as σ)

The 'standard deviation for proficiency testing' is set by the scheme director but should ideally be a value that will allow the score to demonstrate whether or not the performance is fit for the purpose for which the assay is being used. It is recommended that this value be set so that a Z-score of up to ±2 indicates acceptable performance and a score of more than ±3 indicates unsatisfactory performance.

For the Trace Elements EQAS we have used quality specifications based on biological variation for the 'standard deviation for proficiency testing'. The determination of these quality specifications is described in Arnaud et al. Clinical Chemistry 2008; 54: 1892-9. For assays where there is insufficient data to prepare specifications in this way we have produced values that are related to performance within the scheme during recent years. All have been approved by the scheme Specialist Advisory Group.

The quality specifications and their corresponding SD_{PT} are shown in the table below. These are presented as either a percentage of the target value or a fixed value depending on the concentration of the target value, and the one used is whichever is the greater. This allows for the increase in imprecision at low concentrations and conforms to a 'funnel' shape as seen in the accompanying figure. The concentration at which the change from percentage to fixed value takes place (inflection point) is given by:

Inflection point = (fixed concentration/fixed percentage) * 100

Matrix-Analyte	Scheme Units	Quality specification		SD_{PT}		Inflection Point
		%	fixed	%	fixed	
Serum						
Aluminium	µmol/L	20	0.19	10	0.095	0.95
Chromium	nmol/L	20	40	10	20	200
Cobalt	nmol/L	15	25	7.5	12.5	167
Copper	µmol/L	12	0.84	6	0.42	7
Selenium	µmol/L	12	0.072	6	0.036	0.60
Zinc	µmol/L	15	1.2	7.5	0.6	8
Blood						
Arsenic	nmol/L	12.5	25	6.25	12.5	200
Cadmium	nmol/L	10	3	5	1.5	30
Chromium	nmol/L	20	40	10	20	200
Cobalt	nmol/L	20	25	10	12.5	125
Lead	µmol/L	10	0.145	5	0.0725	1.50
Magnesium	mmol/L	7.2	0.01	3.6	0.005	0.14
Manganese	nmol/L	15	75	7.5	37.5	500
Mercury	nmol/L	15	10	7.5	5	67
Selenium	µmol/L	12	0.072	6	0.036	0.60
Thallium	nmol/L	25	0.05	12.5	0.025	0.20
Zinc	µmol/L	10	1.5	5	0.75	15
Urine						
Arsenic	nmol/L	12.5	25	6.25	12.5	200
Cadmium	nmol/L	25	1	12.5	0.5	4
Chromium	nmol/L	20	60	10	30	300

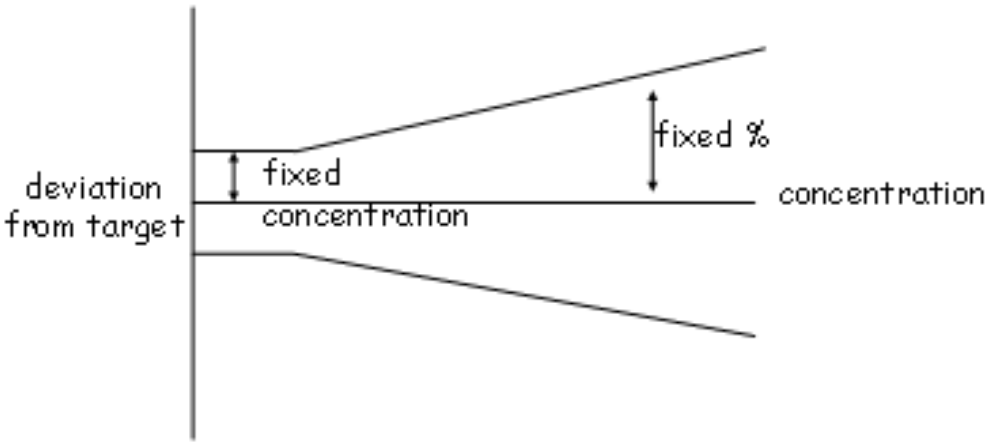
Cobalt	nmol/L	15	25	7.5	12.5	167
Copper	µmol/L	20	0.25	10	0.125	1.25
Iron	µmol/L	15	4	7.5	2	27
Lead	nmol/L	5	12.5	2.5	6.25	250
Manganese	nmol/L	25	10	12.5	5	40
Mercury	nmol/L	25	23	12.5	11.5	92
Nickel	nmol/L	7.5	25	3.75	12.5	333
Selenium	µmol/L	25	0.3	12.5	0.15	1.20
Thallium	nmol/L	5	2.5	2.5	1.25	50
Zinc	µmol/L	20	1	10	0.5	5

NB the quality specifications for urine cadmium and mercury, and blood cadmium and mercury where updated by the Specialist Advisory Group for Trace Elements at a meeting on 19th April 2017.

Examples:

A blood sample has a lead concentration of 2.0 µmol/L. The SD_{PT} could be 0.1 µmol/L (±5%) or 0.0725 µmol/L (fixed value). As 0.1 is the greater value this would be used. For a laboratory reporting a result of 2.2 µmol/L the calculation would be **(2.2-2.0)/0.1**, and the z-score is +2.00.

A serum samples has a zinc concentration of 5.0 µmol/L. The SD_{PT} could be 0.375 µmol/L (±7.5%) or 0.6 µmol/L (fixed value). As 0.6 is the greater value this would be used. For a laboratory reporting a result of 5.5 µmol/L the calculation would be **(5.5-5.0)/0.6,** and the z-score is +0.83.



Explanatory resources related to the use of z-scores and how to understand them are contained in a number of Technical Briefs, which are freely available on the Royal Society of Chemistry, Analytical Methods Committee website https://www.rsc.org/membership-and-community/connect-with-others/through-interests/divisions/analytical/amc/technical-briefs/

Technical Briefs of interest include:

- No 11 2002: Understanding and acting on z-scores obtained in proficiency testing schemes.
- No 16 2004: Proficiency testing (PT): assessing z-scores in the longer term.
- No 18A 2008: What is PT? A guide for end users of chemical data.
- No 68 2015: Fitness for purpose: the key feature in proficiency testing.
- No 74 2016: Z-scores and other scores in chemical proficiency testing.

10.3 Monthly reports

In addition to the descriptive statistics and histogram the monthly report shows a monthly z-score and the z-score performance, as well as the specimen bias vs. concentration, over the previous 12 months of the scheme. The reports can be downloaded from the UKNEQAS website www.birminghamquality.org.uk.

10.4 Collusion

It is a requirement of participation that results may not be shared among participants before reports have been issued (ISO 17043:2023; 7.2.1.3.i). In the event of collusion being suspected the laboratory will be asked to provide evidence that their results are genuine. If confirmed and there is no adequate explanation, the head of department and/or employing authority may be informed

11. Performance

11.1 Blunders and amendments to results

These are defined as errors, which may or may not be detected as outliers and a record is kept by the scheme of blunders that occur. Participants are allowed one blunder per scheme year. Depending on the circumstances and risk relating to the any further blunders, they may be considered poor performance. Blunders may be due to:

- assaying the wrong samples
- assaying the right samples in the wrong order
- Incorrectly transcribing laboratory results from computer systems or worksheets to the results document
- use of incorrect units and/or conversion factors
- technical errors e.g. incomplete mixing after thawing, faulty sampling/pipetting, incorrect preparation of calibration solutions etc.

Such errors will be corrected in most circumstances, so that they do not confuse the underlying assay performance. However, the fact that blunders have occurred will be recorded separately. The policy on blunder correction is:

1. Amendments prior to the reporting deadline. Amended copies of already entered results should be clearly marked “Amended Copy” with the change unambiguously highlighted and returned to us by email.

2. Amendments up to 2 working days after the reporting deadline. Please telephone or email to explain the problem. Results can usually be amended and an updated report produced.
   These should be reported in writing with an explanation for the reason for any amendment. Where investigation reveals the cause of the error and repeat results are available, correction of the original results is permissible. A copy or screen print of the experiment with evidence of the original results and analysis date will be requested. However, the fact that incorrect results were reported will be recorded as a blunder.

3. Amendments up to 1 month after receipt of reports. These should be reported in writing with an explanation for the reason for any amendment. Where investigation reveals the cause of the error and repeat results are available, correction of the original results is permissible. A copy or screen print of the experiment with evidence of the original results and analysis date will be requested. However, the fact that incorrect results were reported will be recorded as a blunder.

4. After 1 month following the reporting deadline a final report will be issued. Once a final report has been issued amendments to results will not be accepted. Only in exceptional circumstances will amendments be considered, however these will be made under discretion of the Scheme Manager or Director.

5. Amended reports will be given a unique identification with reference to the original report and include a statement concerning the reason for the amendment.

11.2 Performance criteria

A laboratories performance is assessed using the z- scores shown on the monthly reports and the number of participant blunders. More than one blunder in a scheme year may be considered poor performance. Scores of > ±2 indicate action is required to bring the method under control

11.3 Performance surveillance, the Advisory Panel and persistent poor performance

The poor performance criteria is as follows:

- 3 or more z-scores greater than 2 from the last 6 samples (ie covering a time span of 3 months) or,
- 2 or more z-scores greater than 3 from the last 4 samples (ie covering a time span of 2 months).

- More than one blunder per scheme year. The nature of all the blunders after the first has occurred will be assessed by the Scheme Manager and Scheme Director to determine if it should be considered poor performance.

The organisers will make informal contact with any UK NHS participant so identified and offer to assist in any work undertaken to rectify the problem. If performance fails to improve the organisers may notify the Chairman of the National Quality Assurance Advisory Panel for Clinical Chemistry who will follow up the situation as described in Appendix 1.

12. Comments, Complaints and Appeals

The on-line results documents include a section in which participants may include comments or remarks for the attention of the organisers. While these will generally refer to the samples or to analytical difficulties experienced by the participant any observation, at any time, is welcomed. The organisers also solicit comments when sending the annual registration forms and on various other occasions. The following criteria have been approved by the Scheme Steering Committee and the Advisory Panel (for memberships of these groups see our website at http://surreyeqas.org.uk/).

Complaints about any aspect of the scheme, whether scientific or operational are normally dealt with by the Scheme Manager or Director according to a written Complaints and Appeals Procedure. In the event of problems relating to day to day operational matters, please have at hand your participant number, the distribution date and specimen numbers. We will endeavour to rectify problems as soon as possible.

Participants may prefer to address comments or complaints, including an appeal against assessment of performance, to any member of the Scheme Steering Committee (the UK NEQAS Specialist Advisory Group for Trace Elements), the Steering Committee for Clinical Chemistry or the National Quality Assurance Advisory Panel for Chemical Pathology. Our website at http://ukneqasgphte.org.uk gives the current memberships of these Committees.

The Scheme Manager and/or Director shall follow up on the initial response with a thorough investigation of all aspects of the problem. He or she is ultimately responsible for ensuring that appropriate corrective action has been taken.

13. Sub-contracted Services

Various aspects of the proficiency test scheme can from time to time be sub-contracted. When sub-contracting occurs it is placed with a competent sub-contractor and the proficiency testing provider is responsible for this work.

Appendix 1: UK Governance and Assurance Framework for Quality Assurance: Conditions of EQA Scheme Participation

For the current conditions of the UK EQA governance and Assurance Framework, please visit their website (https://www.rcpath.org/profession/patient-safety-and-quality-improvement/technical-eqa.html in particular WS10904 NQAAP terms of reference) where the conditions are available to view.

Appendix 2a: Example of a Report, Serum Trace Elements

UK NEQAS
For Trace Elements

UK NEQAS for Trace Elements | Laboratory :

Distribution : **SEP2021** Date : 30-Sep-2021 | Page 2 of 30

Distribution Summary

	Specimen	Result	Target	Bias(%)	Z-score	Uncertainty
Serum Zinc (umol/L)	2021.11	5.9	5.68	+3.8	0.4	0.09
	2021.12	6.4	6.28	+1.9	0.2	0.10
Serum Copper (umol/L)	2021.11	11.6	11.30	+2.7	0.4	0.11
	2021.12	9.9	10.01	-1.1	-0.2	0.11
Serum Aluminium (umol/L)	2021.11	0.43	0.40	+6.6	0.3	0.01
	2021.12	1.54	1.50	+2.4	0.2	0.03
Serum Chromium (nmol/l)	2021.11	166	146.57	+13.3	1.0	5.17
	2021.12	32	26.82	+19.3	0.3	1.37
Serum Selenium (umol/L)	2021.11	2.67	2.53	+5.5	0.9	0.03
	2021.12	1.01	1.03	-1.6	-0.3	0.02
Serum Cobalt (nmol/l)	2021.11	36	34.03	+5.8	0.2	0.81
	2021.12	19	18.49	+2.8	0.0	0.45
Blood Lead (umol/L)	2021.11	1.96	1.98	-1.2	-0.2	0.03
	2021.12	0.49	0.49	-0.1	-0.0	0.01
Blood Arsenic (nmol/l)	2021.11	465	446.26	+4.2	0.7	8.85
	2021.12	232	229.78	+1.0	0.2	5.33
Blood Manganese (nmol/l)	2021.11	147	121.9	+20.6	0.7	4.2
	2021.12	159	141.0	+12.8	0.5	5.9
Blood Cadmium (nmol/l)	2021.11	88	85.84	+2.5	0.5	1.63
	2021.12	65	62.46	+4.1	0.8	1.32
Blood Chromium (nmol/l)	2021.11	102	89.85	+13.5	0.6	2.48
	2021.12	20	20.11	-0.6	-0.0	1.21
Blood Thallium (nmol/l)	2021.11	<1	0.04			0.01
	2021.12	27	27.16	-0.6	-0.0	0.41
Blood Cobalt (nmol/l)	2021.11	16	14.19	+12.8	0.1	0.33
	2021.12	202	191.44	+5.5	0.6	2.45
Blood Mercury (nmol/l)	2021.11	135	134.80	+0.1	0.0	3.40
	2021.12	158	161.80	-2.3	-0.3	4.49
Urine Mercury (nmol/l)	2021.11	208	240.21	-13.4	-1.1	8.00
	2021.12	13	17.07	-23.9	-0.4	0.62
Urine Chromium (nmol/l)	2021.11	87	96.56	-9.9	-0.3	3.89
	2021.12	8	8.68	-7.8	-0.0	0.51

This is an interim report
-The "FINAL" report will be available at the close of the next distribution

Frimley Health NHS Foundation Trust, operating UK NEQAS for Trace Elements (7496): Accredited to ISO/IEC 17043:2010

UK NEQAS for Trace Elements
Surrey Research Park, 15 Frederick Sanger Rd, Guildford, Surrey, UK,
GU2 7YD; Phone: +44 (0) 1483 571122 Ext 3611
email: rsc-tr.guildford-eqa@nhs.net

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UK NEQAS for Trace Elements | Laboratory :

Distribution : **SEP2021** Date : 30-Sep-2021 | Page 4 of 30

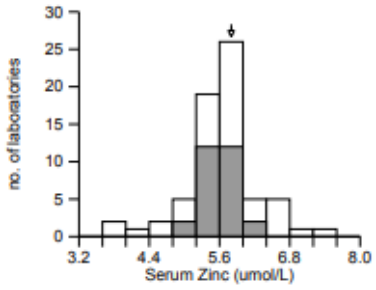
Analyte : Serum Zinc (umol/L)

Spec.	Pool	Pool description / Treatments / Additions
2021.11	S1050	Endogenous + Zn, Cu, Se, Co, Cr
2021.12	S1047	Endogenous + Zn, Al, Se and Co spikes

All methods
ICP-MS
ICP-MS (collision/reaction cell mode)

Specimen : 2021.11

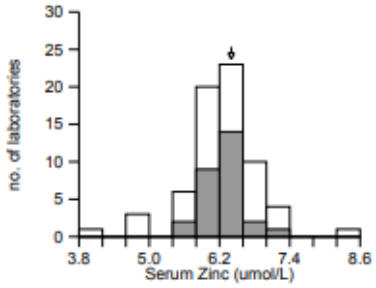
	n	Mean	SD	CV(%)
All methods [ALTM]	68	5.68	0.61	10.7
Colorimetry	6	5.70	1.03	18.1
FAAS after Deproteinization	1	6.22		
Flame A.A.S.	13	5.86	1.70	29.0
ICP-MS	18	5.83	0.55	9.5
ICP-MS (collision/reaction cell mode)	28	5.65	0.30	5.2



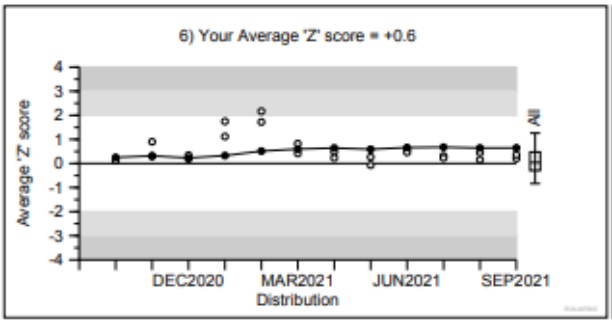
Your result	5.9
Target value (ALTM)	5.68
Uncertainty	0.09
Your bias (%)	+3.8
Your 'Z' score	+0.4
ALTM	5.68
Median	5.78
Your method mean	5.65
Absolute range	3.67
to	10.63

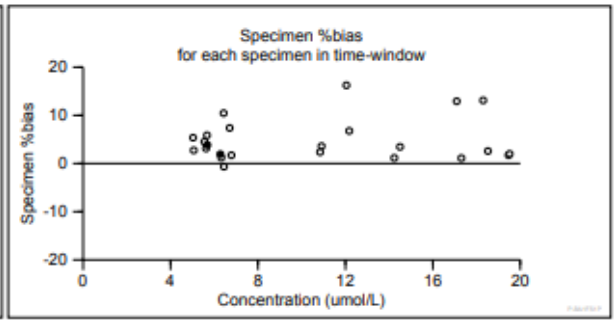
Specimen : 2021.12

	n	Mean	SD	CV(%)
All methods [ALTM]	69	6.28	0.64	10.2
Colorimetry	6	6.17	1.13	18.4
FAAS after Deproteinization	1	6.03		
Flame A.A.S.	14	5.94	0.74	12.4
ICP-MS	18	6.51	0.68	10.5
ICP-MS (collision/reaction cell mode)	28	6.30	0.38	6.0



Your result	6.4
Target value (ALTM)	6.28
Uncertainty	0.10
Your bias (%)	+1.9
Your 'Z' score	+0.2
ALTM	6.28
Median	6.37
Your method mean	6.30
Absolute range	4.00
to	11.53





UK NEQAS for Trace Elements
Surrey Research Park, 15 Frederick Sanger Rd, Guildford, Surrey, UK,
GU2 7YD; Phone: +44 (0) 1483 571122 Ext 3611
email: rsc-tr.guildford-eqa@nhs.net

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Appendix 2b: Example of a Report, Aluminium Water / Dialysis Fluid

UK NEQAS
For Trace Elements

Aluminium in Water | Laboratory :

Distribution : **JUL2023** Date : 31-Jul-2023 | Page 2 of 3

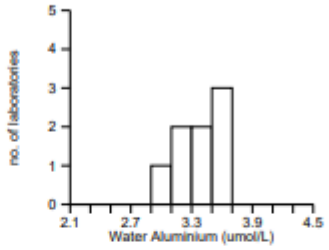
Analyte : Water Aluminium (umol/L)

Spec.	Pool	Pool description / Treatments / Additions
4013	4013	Water + 3.33 umol/L (90ug/L) Al
4014	4014	Water + 1.11 umol/L (30ug/L) Al

☐ All methods

Specimen : 4013

	n	Mean	SD	CV(%)
All methods [ALTM]	8	3.37	0.22	6.4
ICP-MS (collision/reaction cell mode)	3	3.25	0.12	3.8
ICP-MS (non-cell mode)	3	3.52	0.06	1.7

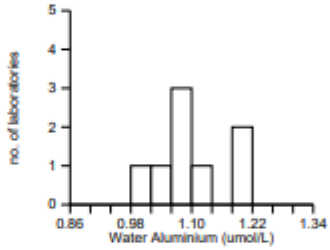


Your result

Target value (ALTM)	3.37
Uncertainty	0.10
Your bias (%)	
ALTM	3.37
Median	3.41
Your method mean	
Absolute range	3.04
to	3.63

Specimen : 4014

	n	Mean	SD	CV(%)
All methods [ALTM]	8	1.10	0.06	5.7
ICP-MS (collision/reaction cell mode)	3	1.11	0.07	6.3
ICP-MS (non-cell mode)	3	1.12	0.06	5.4



Your result

Target value (ALTM)	1.10
Uncertainty	0.03
Your bias (%)	
ALTM	1.10
Median	1.09
Your method mean	
Absolute range	1.01
to	1.19

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UK NEQAS
For Trace Elements

Aluminium in Water | Laboratory :

Distribution : **JUL2023** Date : 31-Jul-2023 | Page 3 of 3

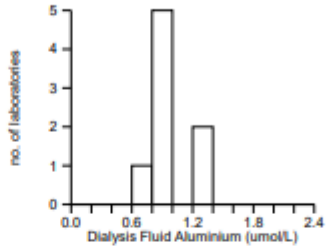
Analyte : Dialysis Fluid Aluminium (umol/L)

Spec.	Pool	Pool description / Treatments / Additions
4015	4015	Dialysis Fluid + 0.48 umol/L (20ug/L) Al
4016	4016	Dialysis Fluid + 1.85 umol/L (50ug/L) Al

☐ All methods

Specimen : 4015

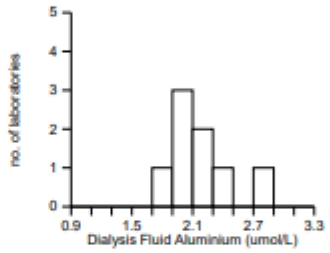
	n	Mean	SD	CV(%)
All methods [ALTM]	8	0.94	0.23	24.3
ICP-MS (collision/reaction cell mode)	3	0.81	0.07	8.6
ICP-MS (non-cell mode)	3	0.98	0.23	23.7



Your result	
Target value (ALTM)	0.94
Uncertainty	0.10
Your bias (%)	
ALTM	0.94
Median	0.84
Your method mean	
Absolute range	0.74
to	1.37

Specimen : 4016

	n	Mean	SD	CV(%)
All methods [ALTM]	8	2.18	0.30	13.9
ICP-MS (collision/reaction cell mode)	3	2.07	0.36	17.5
ICP-MS (non-cell mode)	3	2.33	0.33	14.3



Your result	
Target value (ALTM)	2.18
Uncertainty	0.13
Your bias (%)	
ALTM	2.18
Median	2.15
Your method mean	
Absolute range	1.80
to	2.71

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email: rsc-tr.guildford-eqa@nhs.net

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Appendix 2c: Example of a Report, Solid Matrix Scheme

UK NEQAS
For Trace Elements

Trace Elements External Quality Assessment Scheme
UK NEQAS for Trace Elements
Solid Matrix Scheme
Distribution: Aug 2021 | Report date: Oct 2021

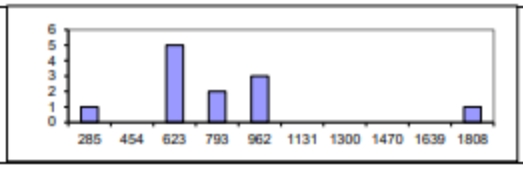
Laboratory

Specimen	Description	IRON
B1	Bovine Liver + Fe Spike	812.25 ug/g
B2	Bovine Liver + Cu Spike	175.00 ug/g
B3	Bovine Liver + FeCu Spike	2543.50 ug/L
B4	Bovine Liver + FeCu Spike	254 ug/L

Comments
3722 (B1) omitted.
278 (B2) omitted.
4000 (B3) omitted.
1200 (B4) omitted.

Specimen **B1 (ug/g)**

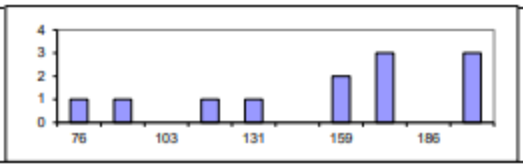
n	ALTM	SD	CV(%)
12	735.57	378.1	51.4



Your result	559.50
Spike value	812.25
Your bias	-31.12

Specimen **B2 (ug/g)**

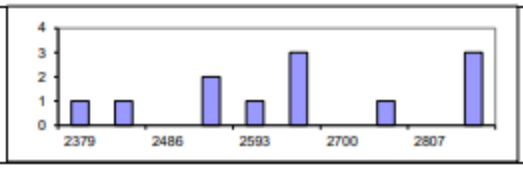
n	ALTM	SD	CV(%)
12	148.68	40.9	22.0



Your result	163.70
Certificate value	175.00
Your bias	-6.46

Specimen **B3 (ug/L)**

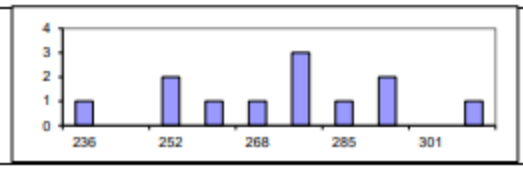
n	ALTM	SD	CV(%)
12	2622.75	166.1	5.9



Your result	2639.00
Spike value	2544
Your bias	3.75
All lab mean	

Specimen **B4 (ug/L)**

n	ALTM	SD	CV(%)
12	269.56	20.4	6.8



Your result	267.90
Spike value	254
Your bias	5.33

Surrey Research Park, SAS Trace Element Laboratory, 15 Frederick Sanger Road, Guildford, GU2 7YD
Clinical Biochemistry, Royal Surrey County Hospital, Guildford, UK.
Tel.: +44 (0) 1483 571122 ext. 3611

Email: rsc-tr.guildford-eqa@nhs.net
This report was authorised by the Scheme Manager on: **15/10/2021**

Page 1 of 2

Appendix 2d: Example of annual report