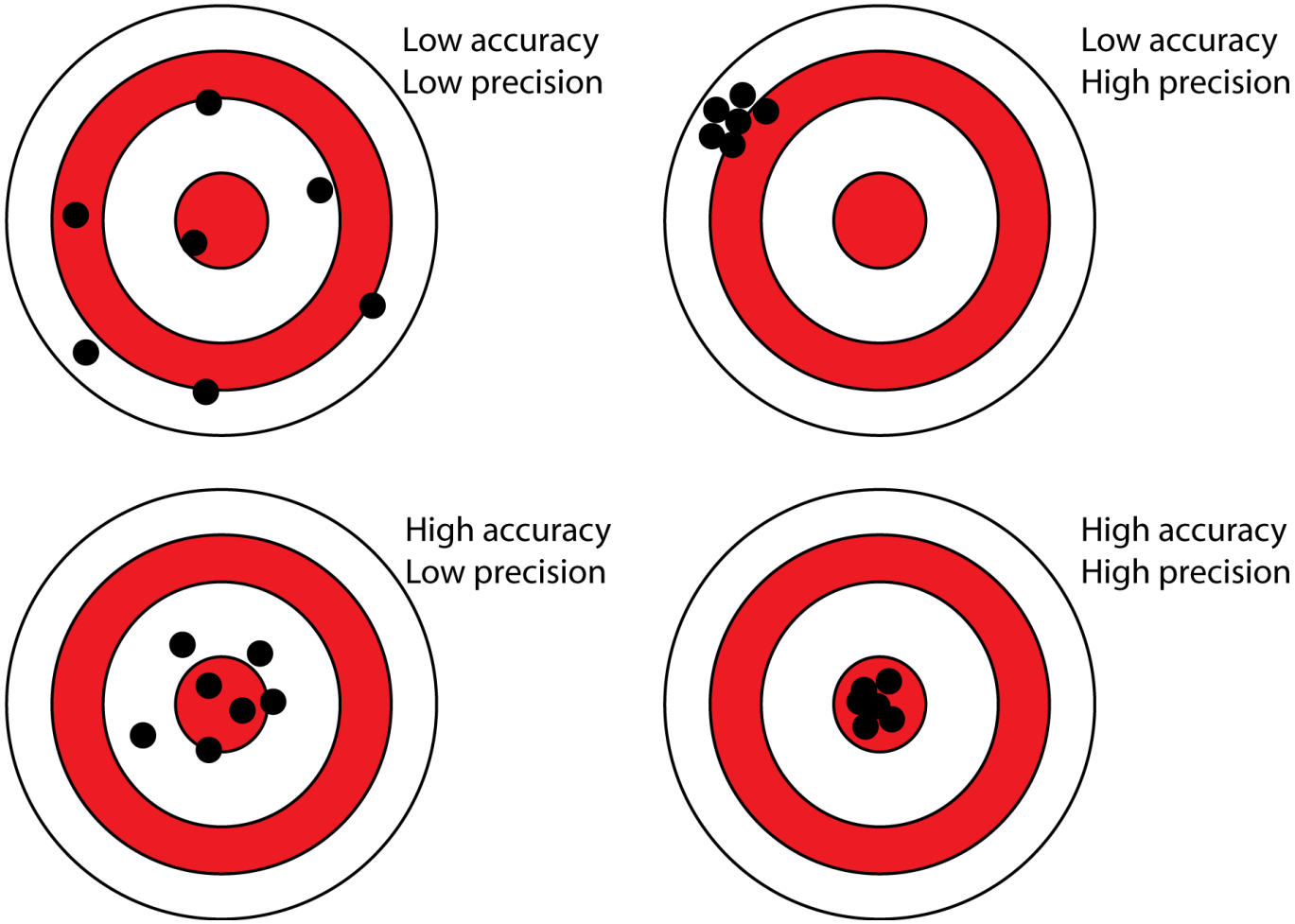
Aug 2023
ISSUE 08

IN THIS ISSUE:

PROFICIENCY TESTING

News bulletin of AMBI
West Bengal Chapter

The Biochemistry Chronicles



PROFICIENCY TESTING

Proficiency testing determines the performance of individual laboratories for specific tests or measurements and is used to monitor laboratories continuing performance. The purpose of proficiency testing (PT) is to monitor the laboratory results by an external agency **retrospectively** and assess the **accuracy** of measurements. The main goal of proficiency testing is to measure the accuracy and estimate the bias if any. This may also help the laboratory to redefine their Internal Quality Assurance procedures too. The term External Quality assessment (EQA) is often used interchangeably with Proficiency testing (PT). Besides serving as a yardstick for monitoring laboratory performance it is Mandatory requirement for applicant & accredited laboratory as per ISO 15189:2022. Non-participation in PT program or even two successive failures in in an EQA or PT programme may result in temporary suspension or cancellation of accreditation for those non EQA tests. But PT program is not available for all the analytes in that case laboratory should adopt:

1. Inter-laboratory Comparison with the reference laboratory
2. Split Sample testing (mainly for Hematology & Clinical Pathology samples)

History of EQA: Looking back at the history of EQA, Belk and Sunderman first performed the first PT scheme in late 1940. However in India, the program of EQA was first initiated in the year 1977 by Dr. A. S. Kanagasabapathy, Dr. Peter G. Hill and Dr. S. Swaminathan using Bovine Sera at CMC,Vellore. But, they started using human sera from 2011 and more than 6000 laboratories are participating in various schemes included under the program. Till date there are various PT providers in India like BIORAD, CMC Vellore and Randox for Biochemistry. Organisations like ISHTM-AIIMS and Indian Association of Medical Microbiologists (IAMM) for Hematology and Microbiology.

Dos and Don'ts of PT sample testing:

DOs

1. PT samples should be treated **exactly as the patient samples**

DON'Ts

1. Run the calibration/Weekly mainten - ance on the day of reporting PT sample if it is not a scheduled /required calibration.
2. Repeat the samples and give the mean of multiple runs.
3. Fix a specific technician to run the PT sample.

Interpretation of EQA:

A EQA result can be calculated by assessment of Various numerical scores like:

1. Standard Deviation Index
2. Z-score
3. Variance Index Score
4. En Number

- **Standard Deviation Index (SDI):** This statistical tool measures Difference between your result and group mean in terms of the number of standard deviations from the overall mean'. It has no unit as it's a ratio. **Any SDI of 2.0 or greater** in an EQA cycle for any analyte deserves special concern – indicates Warning signal. SDI score $\geq$ 2 successively or $\geq$ 3 once warrants corrective and preventive action. The results of CMC Vellore EQA is reported as SDI.
- **Z-score:** It is again of two varieties like classical and Robust. The classical Z-score is just like the SDI. It is expressed as

  Z score = (Your Lab's result- Mean result of all labs) / Standard deviation
  - **Robust Z-score:** Robust Z score statistic is used when the distribution of results of participating labs is non- Gaussian and there are outliers. Interestingly, both accuracy and precision are assessed in terms of robust Z score - both within and

between labs Z score (ZB & ZW). The participant labs are asked to analyze the same sample TWICE and submit both results to the PT provider. This Robust Z-score statistics is used by ISHTM-AIIMS EQAP program for Hematology. Since the results of the laboratory are in non-Gaussian distribution the Medians are used for analysis. The formula thus stands to be

Robust Z score = (Normalised Lab's result- Median result of all labs)
Normalized IQR (Inter Quartile Range)

It is calculated based on the "**median**" value (central value) and the '**interquartile range**' (IQR).
Normalized inter quartile range (NIQR): NIQR = IQR x 0.7413 (a constant) and IQR is difference between the 75th & 25th percentile.

- Within Laboratory Z-score (ZW) : **(D-median) / (IQR X 0.7413),**
  Where D= (A - B)/ [square root of (2)] = standardized difference between the two results for a laboratory.

- Between Laboratory Z-score (ZB): **(S - median) / (IQR x 0.7413)**
  Where S = (A + B)/[square root of (2)] = standardised sum of the two results for a laboratory (where A and B are results of two samples of the same test).

While assessing results both ZW and ZS should be used any single parameter will be misleading

- ZW < 2 ZB > 2 = Higher bias i.e low reproducibility
- ZB < 2 ZW > 2 = low precision (i.e., low repeatability)

- **Variance Index Score (VIS):** It was first proposed by the United Kingdom National Quality Control Scheme (UKNEQUAS) It is estimated using CCV (Chosen Co-efficient of Variation) & DV (Designated Value) used to calculate VIS.CCV is nothing but the Allowable Limit of Error for an analyte (TEa).It was recommended by WHO after studying the performance of many Indian laboratories. It is calculated as follows:

$$\%\ \text{Variation [\%V]} = \frac{\text{Participant's Result - Designated value}}{\text{Designated value}} \times 100$$

Where **Designated Value** is the value obtained after excluding results, from laboratories with same method, which are > 3SD of Method Mean and recalculating the mean after eliminating the outliers.

- Variance Index Score (VIS)= (% Variation X 100)/CCV

The figure below enlists the CCV of common laboratory analytes:

Glucose	7.5	Sodium	2.3
Urea	10	Potassium	5.0
Creatinine	10	Chloride	6.0
CK	7.3	AST	12.5
T.Bilirubin	19.2	ALT	17.3
T.Protein	7.5	ALP	15.5
Albumin	7.5	Amylase	15.5
Calcium	6.0	LDH	15.5
Uric acid	7.7	Phosphorus	7.8
Cholesterol	7.5	Bicarbonate	9.0
TGL	14	HDL- C	7.6
HDL	7.6	Iron	15

Interpretation of VIS

VIS	Performance
< 100	Very good
100 -150	Good
150 – 200	Satisfactory room for improvement
> 200	Not acceptable

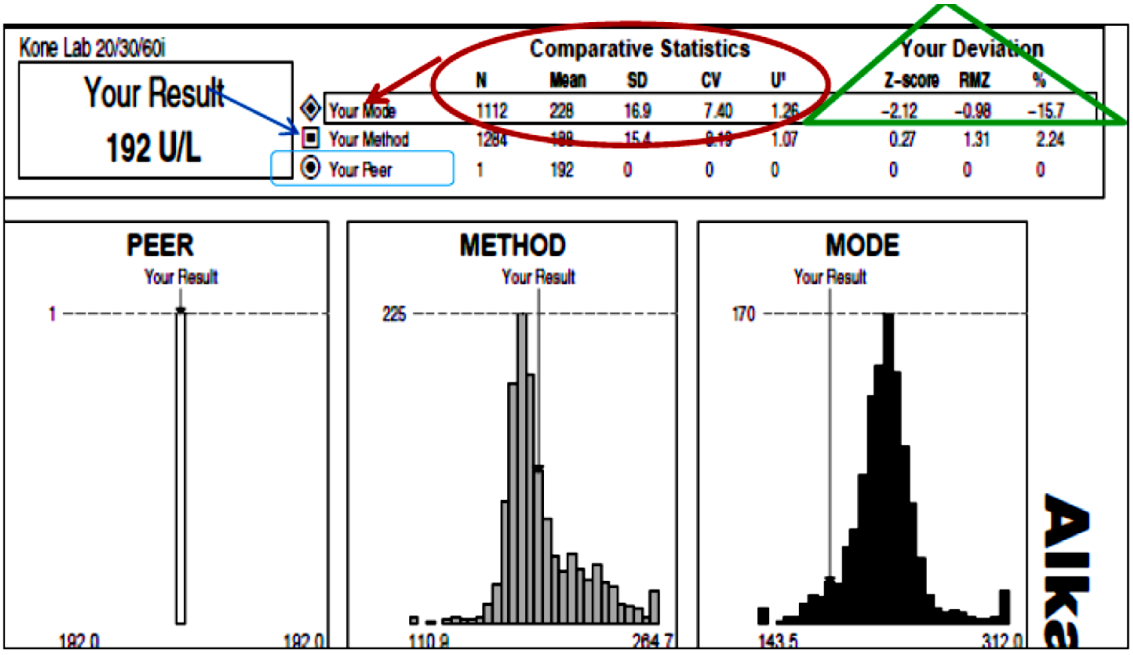
OMVIS/ (Overall Mean VIS) measures the cumulative performance over a period. A

laboratory with OMVIS <100 suggests very good performance.

- **En Number:** The En-value is calculated as follows: = $(V_{Lab} - V_{Ref})\sqrt{(U_{Lab}^2+U_{Ref}^2)}$

Where :
V_{Lab} is the value reported by the participating laboratory
V_{Ref} is the reference value
U_{Lab} is the uncertainty reported by the participating laboratory and
U_{Ref} is the uncertainty of the reference value. The uncertainties shall be expressed using k=2, which corresponds to a 95 % coverage. The result is considered successful, if the result of the proficiency test is $-1 \leq En \leq 1$.

BIORAD EQAS Explained:



This a report of BIORAD look at the figures there are 3 methods of comparison:

1. Mode
2. Method
3. Peer

Peer level of comparison is used when other laboratories use the same analyte, method, instrument, and reagent combination as yours. If <9 results are received for Your Peer, your comparison is Your **Method** for a uni-modal distribution or Your **Mode** for a multi-modal distribution of data. Here in the figure only 1 participant was there so Peer was not used as comparison. Mode was used as this Data was for Alkaline Phosphatase as it has multimodal distribution for methods disparity like DGKC, AMP buffer, DEA buffer.

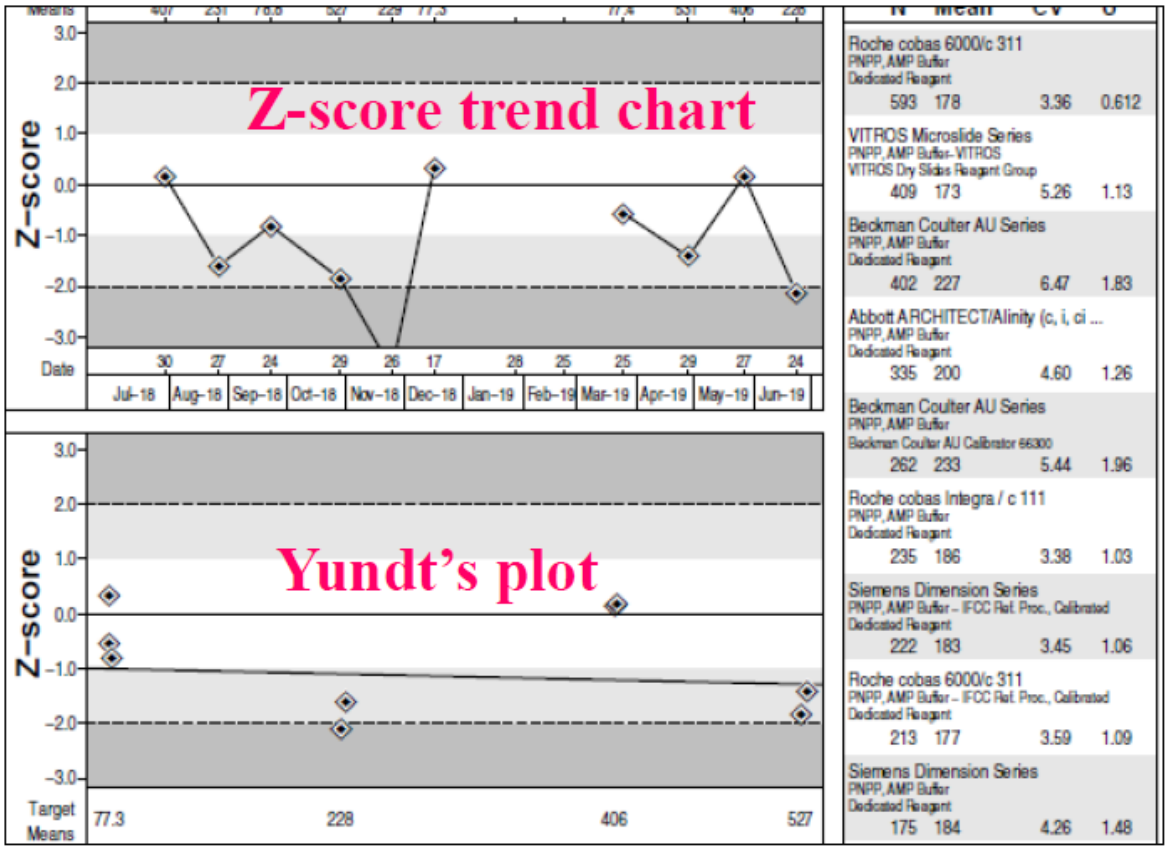
In the comparison statistics we have the following parameters (marked in Red Oval):

- N= No of Laboratories
- Mean= Group Mean
- SD= Group SD
- CV= Coefficient of variation.CV = (SD/mean) × 100, Here CV= 16.9/228= 7.4%
- U^1 = Expected uncertainty (U) of the consensus mean expressed as 95% confidence interval using coverage factor of k=2, (1.25*Robust SD *2)/√N. The Coverage factor

is provided at the lower side of the EQAS result page of BIORAD. Here U^1= (1.25*16.9*2)/√1112 = 42.25/33.34=1.26

Let's have a look at the Deviation (Marked in Green triangle):

- Z-score
- RMZ= Running Mean Z-score. An ongoing (within or across cycles) average of the Z-scores of the last six samples for a given analyte.
- % Deviation: The bias of your laboratory's result expressed as a percentage of the reported comparator mean. [Your result – Comparator Mean]/ Comparator Mean *100



Plots and Graphs:

Z score trend Chart:

• Sample dates are displayed along the X axis .Your laboratory's Z score is indicated on the Y axis. Comparator means for each sample date appears along the top of the chart Z- score plots are connected, and it is disconnected if a result is missing

Yundt Plot : Concentration of the reported samples displayed along the bottom of the chart.Our laboratory's Z score is indicated on the Y axis Visually identifying concentration bias, systematic mistakes, and linearity flaws are all possible using the Yundt Plot. There are 12 samples in a BIORAD cycle with 4 batches.

Conclusion:

To sum up EQA SUPPLEMENTS Internal Quality Control but NEVER a SUBSTITUTE for Internal QC. Both measure 2 different aspects of quality. EQA results should only be used for motivating staff. Inaccurate laboratory results are not due to technicians But due to failure of laboratory systems and methodology

References:

1. 1. Belk WP, Sunderman FW. A survey of the accuracy of chemical analyses in clinical laboratories.Am J Clin Pathol. 1947;17:853–96. https://doi.org/10.1093/ajcp/17.11.853 10.1093/ajcp/17.11.853

Contribution:

Dr. Sanghamitra Chakraborty, MD,DNB (MNAMS), Assistant Professor, Department of Biochemistry BSMC

Compilation:

Dr Manali Sinharay, Associate Professor, Department of Biochemistry, CNMCH, Kolkata
Dr Abhra Ghosh, Associate Professor, Department of Biochemistry, DMCH, Ludhiana