Al-Rasheed University College
Medical Analysis Department
Clinical Chemistry Lab.
Fourth Stage

كليـــــــة الرشيد الجامعـــــــــة
قســـــــم التحليلات المرضيـــة
مختبر الكيميـــاء السريريـــــة
المرحلـــــــــة الرابعـــــــــة

Quality Control

[Part 3]

Lecture (6)

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Coefficient of Variation [CV]

The Coefficient of Variation [CV] is the ratio of the standard deviation to the mean and is expressed as a percentage. The CV allows the technologist to make easier comparisons of the overall precision. Since standard deviation typically increases as the concentration of the analyte increases, the CV can be regarded as a statistical equalizer. If the technologist/technician is comparing precision for two different methods and uses only standard deviation, he or she can be easily misled.

For example, a comparison between hexokinase and glucose oxidase (two methods for assaying glucose) is required. The standard deviation for the hexokinase method is 4.8 and it is 4.0 for glucose oxidase. If the comparison only uses standard deviation, it can be incorrectly assumed that the glucose oxidase method is more precise that the hexokinase method. If, however, a CV is calculated, it might show that both methods are equally precise. Assume the mean for the hexokinase method is 120 and the glucose oxidase mean is100. The CV then, for both methods, is 4%. They are equally precise.

Formula 4: Calculating the Coefficient of Variation [CV]

$$CV = (s \div \bar{x})\,100$$

Where:

s = standard deviation

$\bar{x}$ = mean

The Coefficient of Variation can also be used when comparing instrument performance. Consider the data in Table (2).

Table 2: Imprecision Differences Due to Instrument or Reagent

	Level I (Normal Control) Chemistry Control Lot No. 12345	Level I (Normal Control) Chemistry Control Lot No. 12345
	Instrument #1 / Reagent #1 ▾ **CV**	Instrument #2 / Reagent #2 ▾ **CV**
Calcium	6.1%	5.9%
Phosphorus	5.2%	9.9%
Glucose	4.4%	4.2%

In the example shown in Table 2, Instrument #1 and Instrument #2 have similar precision for calcium and glucose, but Instrument #1 demonstrates much better precision than Instrument #2 for phosphorus. Because the precision was calculated from data for the same lot number and level of control, the differences in precision are likely due to the instrument or reagent.

In Table 3, the difference in performance is probably due to the change from Reagent #1 to Reagent #2. However, it could also be due to lack of regular maintenance or some other cause.

Table 3: Imprecision Differences Due to Instrument or Reagent or Lack of Regular Maintenance

	Level I (Normal Control) Chemistry Control Lot No. 12345	Level I (Normal Control) Chemistry Control Lot No. 12345
	Instrument #1 / Reagent #1 ▾ **CV**	Instrument #1 / Reagent #2 ▾ **CV**
Calcium	4.2%	6.8%

Exercises:

Q_1 - Calculate the normal and/or abnormal control (mean, standard deviation, and Coefficient of Variation) for each of the following sets of control data:

- **Level I (Normal Control):**

  Unassayed Chemistry Control, Lot No. 12345
  Test: Creatine Kinase
  Instrument: ABC
  Units: U/L
  Control Values are:
  {94, 93, 97, 95, 95, 100, 100, 99, 100, 99}
- **Level II (Abnormal Control):**
  Unassayed Chemistry Control, Lot No. 12345
  Test: Creatine Kinase
  Instrument: ABC
  Units: U/L
  Control Values are:
  [327, 325, 321, 323, 315, 308, 304, 298, 327, 334].

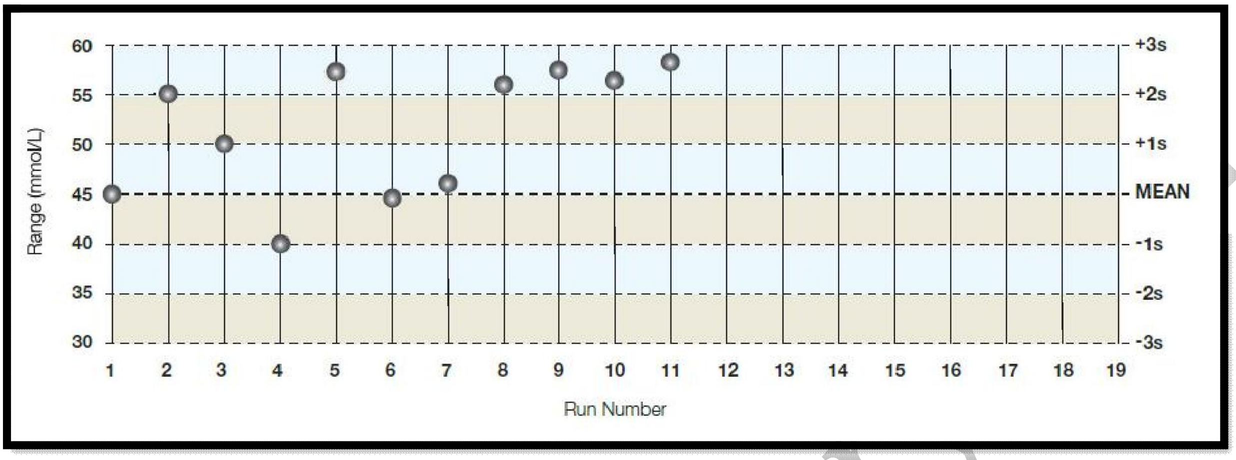
Q_2 - Compare between two laboratory (A, and B) in Precision and accuracy according to the following sets of control data:

- **Laboratory (A):**

  Control Values are: [180 ,182 ,181 ,182 ,185 ,183, 182, 181, 179, 181] m mol/L.
- **Laboratory (B):**

  Control Values are: [86, 93, 97, 90, 95, 100, 103, 99, 104, 92] m mol/L.

Q_3 - Study the following Levey-Jennings charts. Identify the Westgard Rules for (2 ,5, 8,10) run (if any), and the type of error most likely associated with the control rule violation (i.e, systematic or random error).



Q_4 - Study the following Levey-Jennings charts. Identify the Westgard Rules for (6,11, 12) run (if any), and the type of error most likely associated with the control rule violation (i.e, systematic or random error).