Variability in Ct Values

For Prelims: Viral Load, Ct Values, RT-PCR Test.

For Mains: Significance of Ct Value in RT-PCR Test and factors of its Variability.

Why in News?

Recently, a survey of 700 laboratories in the US using standardised proficiency testing material from the same batch found **a variability in** Ct (Cycle Threshold) values **by 14 cycles.**

- Even within the same test at the same lab the **Ct values could vary by 3 cycles for different target genes**, and up to **12 cycles for the same target gene** across labs.

What is the Cause of Variability in Ct Values?

- **Dynamic Measure and Evolves Rapidly:**
  - A low Ct value at the time of diagnosis **does not mean that it will stay low the next day.**
  - Similarly, a swab done very early in the infection may reveal **a high Ct value, which if repeated a day or two later, may reveal a lower** Ct value.
  - It is possible for this reason that **Ct values have not been convincingly correlated with disease severity, and serve no role in predicting the trajectory** for a patient (yet, this is commonly used as an argument to prescribe tests and medicines).
- **Influence of Technical and Logistical factors:**
  - The way specimens are collected, the type of specimen, the medium in which the swab is transported, the time lag between collection of the specimen and processing.
  - All of **this can influence the quantum of viral genetic** material present, and **subsequently, the Ct value.**

What is RT-PCR Test and Ct Value?

- **RT-PCR Tests:**
  - In an **RT-PCR (Reverse Transcription Polymerase Chain Reaction) test, RNA (Ribonucleic acid)** is extracted from the swab collected from the patient. It is then converted into **DNA (Deoxyribonucleic acid)**, which is then amplified.
  - Amplification refers to the process of creating multiple copies of the genetic material - in this case, DNA.
    - This **improves the ability of the test to detect the presence of the virus.**
  - Amplification takes place through a series of cycles—one copy becomes two, two becomes four, and so on—and it is after multiple cycles that a detectable amount of virus is produced.
- **Ct Value:**
  - Ct is short for **'Cycle Threshold'.**
  - The Ct value refers to the **number of cycles after which the virus can be detected.**

- If a higher number of cycles is required, **it implies that the virus went undetected when the number of cycles was lower.**
- The lower the **Ct value, the higher the viral load-because** the virus has been spotted after fewer cycles.
- It has been found that the **time since the onset of symptoms has a stronger relationship with Ct values** as compared to the severity of the disease.

What is Viral Load?

- It refers to the **amount of genetic material, commonly RNA,** of a virus present in an infected person's blood.
- This is expressed as the **total number of viral particles present in each millilitre of blood.**
- A higher viral load in the blood means that **the virus is replicating and the infection is progressing.**
- An infected person with a high viral load is **more likely to shed more virus particles,** in the process known as "viral shedding".

Source: TH