



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.** //

WHAT IS CYCLE THRESHOLD VALUE

The CT value is the number of amplification cycles needed to find the virus in a sample

A CT value of 30 to 37 indicates moderate amounts of virus

Anything above means a minimal amount of the RNA

CT levels are inversely proportional to the amount of virus in the sample

Tests with thresholds so high may detect not just live virus but also genetic fragments, leftovers from infection that pose no particular risk

If CT value is lower than 30, it is indicative of abundant amounts of viral RNA

One solution would be to adjust the cycle threshold used now to decide that a patient is infected

The change would mean the amount of genetic material in a patient's sample would have to be 100-fold to 1,000-fold that of the current standard for the test to return a positive result

Experts suggest a more reasonable cut off would be 30 to 35

Most tests set the limit at 40, a few at 37. This means that you are positive for the infection if the test process required up to 40 cycles, or 37, to detect the virus

- 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](#)