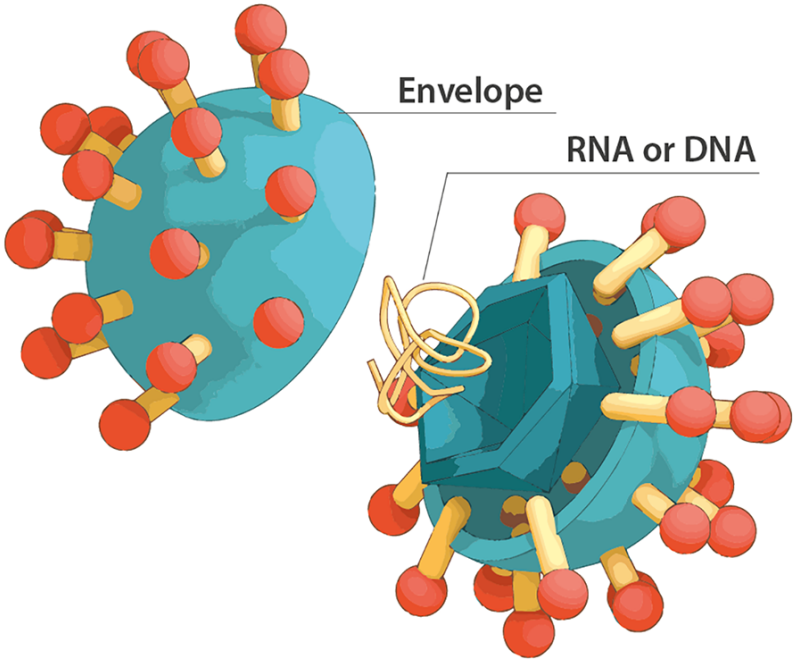
The endless battle between living beings and those minute, hardly visible organisms (read Coronavirus) is still on with no end in sight. While the whole world is struggling with Covid, let's dive in and get acquainted with this deadly virus.
SARS-CoV-2(a member of the large Coronavirus family), the cause of the lethal COVID-19 pandemic, is a microscopic protein wrapped RNA(ribonucleic acid, single strand molecule) genetic material within a molecular envelope. The characteristic crown-like thorns on its surface, reminiscent of the solar corona, is the reason behind this virus being named as the "CORONAvirus. Viruses contain either or both of the genetic materials — RNA and/or DNA (deoxyribonucleic acid, double-strand molecule).



The DNA viruses have less mutation (a permanent change in the genetic material) rates as compared to RNA ones leading to the RNA viruses being more prone to fast evolution. Mutation is the consequence of the mistakes which viruses (DNA or RNA) make while copying themselves. DNA viruses possess a "proofreading" property which helps them correct the mistakes happening while copying whereas the RNA viruses lack this property leading to higher probability of mutations.
In case of SARS-Cov-2, RNA is the only genetic material present which multiplies and survives by infiltrating healthy cells. When inside the cell, COVID-19 virus administers to reprogram the cells using its own genetic code turning them into "virus-manufacturing factories".

One of the most popular diagnostic techniques used for COVID-19 Virus detection, RT-PCR has now become a familiar name around the globe. The aforementioned abbreviation stands for Reverse Transcription-Polymerase Chain Reaction (RT-PCR). But hold on! The "Chain-Reaction" mentioned here has nothing to do with a fissionable chain reaction nor with the emission of neutrons. Instead, radioisotope markers were in use to detect targeted genetic

material (RNA, in case of COVID-19). Due to the size of the virus and its way of functioning made it difficult to be detected. PCR (polymerase chain reaction) was developed to identify small fragments of the virus and by creating multiple copies it made the detection much easier. Radioisotopes were used to mark these copies. The amount of radiation emitted by the copies was dependent on the quantity of the viral material in them. But the usage of radioisotopes made the technique cumbersome with the result being available only at the end of the process. Hence, radioisotopes have now been replaced with special markers, mostly fluorescent dyes, which on the contrary provides immediate results (i.e. real time) even when the process is still undergoing. Due to the use of radioactive markers in its nascent days, it is termed as a nuclear-derived technique.

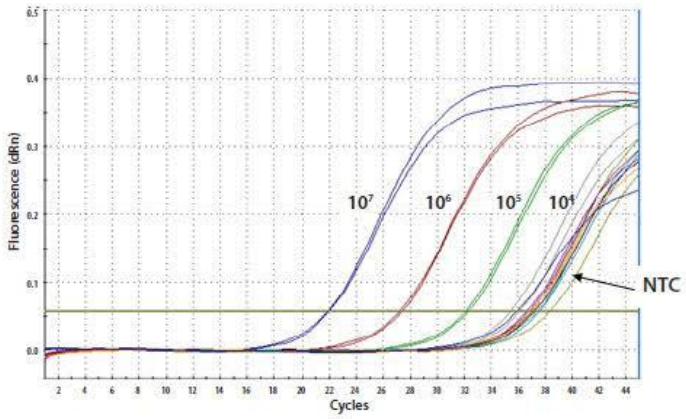
Working principle of the detection technique of RNA-based viruses is as follows:

- Collection of blood, swab or mucous sample from the person and extraction of nucleic acid from the sample by chemical treatment to remove proteins and fats.
- The extracted RNA comprises the person's own genetic material and if present, the DNA/RNA of the virus
- The single-stranded genetic material, RNA, needs to be converted to double-stranded DNA by reverse transcription (RT) using a specific enzyme called reverse transcriptase.
- The process of RT is carried out as DNA can only be identically copied and used for amplification, the basic principle of the RT-PCR technique.

(PCR is used for DNA-based viruses and bacteria. It was used for diagnosing Ebola, Zika, etc.)

- Chemical reagents are added to the sample to build copies of the genetic material which include probes with fluorescent dyes. If any DNA is found, the fluorescent dyes will mark it.
- After placing the mixture in the RT-PCR machine, new identical copies of the target sections of the viral DNA are being created as an impact of triggered chemical reactions caused by the cyclic temperature fluctuation (heat and cool) the machine undergoes.
- The cycle is repeated continuously over and over, provided a standard set-up undergoes 35 cycles. Each succeeding cycle doubles the corresponding preceding cycle. For example, if two copies are being created in cycle 1, in cycle 2, the number of copies would be four, similarly eight copies would be created in cycle 3.

- The marker labels get attached to the viral-sectioned DNA strand releasing fluorescence, which is being measured by the computerized machine and displayed as real-time results (plot fluorescence vs number of cycles) on the screen.



- The amount of fluorescence in the sample after each cycle is monitored. Post exceeding a certain level of fluorescence, presence of virus is confirmed.
- The less the number of cycles, the more severe the viral infection.

In comparison to other available methods, real-time RT-PCR is considered the most efficient and an acceptable detection method as it is significantly faster and provides the most accurate information (real-time) for detection of the COVID-19 virus.

Here's to hoping that this battle ends soon and brings back the carefree era of mask-free days.

References:

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