PCR Testing and How it Works

COVID-19 is an RNA virus. RNA must be extracted from patient and then converted into DNA.1

Process is shown in Fig 3.1 and described below.

A. Sample Collection

- Sample of RNA is taken from area on patient that COVID-19 affects (nasal or throat swab).5
- RNA Extraction: Chemicals like guanidine salts or phenol-based compounds are used to extract RNA without degradation occurring.
- Reverse Transcription: Sample is reverse transcribed into DNA using reverse transcriptase, and nucleotides, primers and fluorescent dyes are then added to the DNA.11
- RT-PCR Amplification: Nucleotides build upon the DNA strands while primers build on the DNA for amplification and fluorescent dyes are used as markers.11 DNA polymerase is used to determine the sections of the strand that needs to be amplified.

B. Analysis

- i. Mixture is placed in a RT-PCR machine (buffer) which makes billions of copies of the specific region of DNA taken.11
- ii. Tag polymerase binds copies of DNA strands and release fluorescent dyes. A computer tracks amount of fluorescence in the sample, once fluorescence reaches a certain level, confirms that the virus is present.11

How the Tests Work

COVID-19 is a virus that affects the respiratory system, which can be fatal where underlying conditions are apparent.2

Three possible testing methods for COVID-19:

1. Antibody Testing
   - Determines if a person has previously had COVID-19.2
   - Determines if a person currently has COVID-19.2
   - Has a high false negative rate.2

2. Antigen Testing
   - Determines if a person currently has COVID-19.2
   - Food and Drug Administration deemed this to be the most reliable test.2

3. Molecular (PCR) Testing
   - PCR was first discovered in 1982 by Kary Mullis to study sickle cell anemia. It can also be used for DNA fingerprinting, diagnosing genetic disorders and detecting bacteria/viruses.3

PCR testing is most accurate for COVID-19 testing, but there could be complications. Examples including if the sample was kept at a proper temperature, the timing of when the patient took the test, or trouble shipping the test.17

The false negative rate depends on timing of how long the virus is present in the patient. If a patient goes to get tested and the virus has been active for less than five days, a study shows that the rate was at 100%. If the patient gets tested after having the active virus for more than five days, the rate drops to 20%.20 With the antigen tests, 1 in 2 people are incorrectly told that they don’t have the virus.

False positive rate is close to 0 percent.17

Due to rapid results of antigen tests, most people take them. However, there are a high false negative rate so doctors will order a PCR test if result is negative.2

Figure 4.1 shows a map of the percentage of COVID-19 tests that come back positive.

Figure 4.2 shows the amount of COVID-19 tests that are taken daily.


References