Diagnostic Tests for Covid-19

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Covid-19 is an infectious disease resulting from infection by SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) virus. The virus mainly spreads from person to person by exposure to the droplets emitted by the infected person. Testing of Covid-19 infection or any other viral infection is based on two basic principles viz. detection of viral load by identifying viral RNA/DNA and detection of antibodies developed in the patient in response to the infection. The third method available for testing is medical imaging using CT Scan, but it is not recommended for Covid-19.

The major advantage with the methods detecting the presence of viruses is that they can detect the infection at early stages as well as asymptomatic cases also, which is a major problem in this pandemic. The main limitation with this type of testing was that their results were much slower and by the time one is detected positive, the carrier can infect many other healthy persons.

The second or serological method testing the presence of antibodies is much faster but it shows results only after the body presents an immune response to the presence of a virus which may take up to 15 days. The limitations of these two types of testing principles have actually been the underlying cause for the authorities being not able to control the spread of this infection timely.

While detection of viral RNA/DNA can be carried out with a variety of body fluids like sputum, nasal swab, saliva and blood, the antibody testing requires testing using blood samples. However, Covid-19 being a pandemic, nasopharyngeal or oropharyngeal swab is the most common, safe and recommended sampling methods for routine screening, and provides sufficient amount of viral material for efficient testing. In case of Covid-19, the testing using saliva samples has proven to be having high sensitivity and consistency. In this article we will compare the two types of methods and the kits currently available for testing.

A. **Detection of Viral RNA/DNA** – Every organism has different genetic makeup with specific nucleic acid sequence which can be identified with the help of gene expression and quantification studies. SARS-CoV-2 is an RNA virus and can be detected with high efficiency using RT-PCR, which is based upon Polymerase Chain Reaction. The test shows positive results if the sample contains the specific viral RNA, which is only possible in case of the current infection. The nucleic acid sequence obtained from the sample is compared the standard SARS-CoV-2 sequence available in the public database like GISAID. RT-PCR method is gold standard for such testing but is time consuming and delays results. Therefore, lot of research is being done to develop rapid testing kits and many such kits are now available in hospitals which considerably reduce the testing time.

Another detection method is isothermal nucleic acid amplification assays which also includes transcription-mediated amplification and CRISPER-based methodologies. Isothermal amplification of nucleic acids is a simple process that rapidly and efficiently accumulates nucleic acid sequences at constant temperature. These assays when introduced into microsystems or portable devices improve nucleic acid-based on-site assays and confer high sensitivity. Single-cell and single-molecule analyses have also been implemented based on integrated microfluidic systems[1]. Isothermal technologies appear to be promising because of their characteristics such as simplicity, cost-effectiveness, robustness, sensitivity and specificity. In some cases, these methods have been reported to perform even better than PCR and other traditional diagnostic methods, which are more cumbersome and demanding in their application[2].

B. **Detection of Antibodies** – Identification of individuals who have developed antibodies to the SARS-CoV-2 virus require serological tests, including enzyme-linked immunosorbent assay (ELISA), lateral flow immunoassay and also on fully automated systems e.g. CLIA. Commercial immunoassay tests to detect COVID-19 include a dual ELISA test to be performed. This detects specific IgM and IgG against the virus in the blood of infected patients. There is also an automated fluorescent immunoassay system to measure quantitative or semi-quantitative concentration of the target analyte, which can be the viral antigen or IgM/IgG. The newly developed immunoassay kits identify IgG, IgM, and IgA, the complete set of immunoglobulins. This approach is considered to be more sensitive when compared to assays against a single immunoglobulin[3].

This is a two-part article and the Part 2 will cover the different commercially available testing kits.

References

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