# Biotechnology and Pandemic 19 (corona virus)

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# Introduction:

Biotechnology is boon in field of medical science and research field. It is a technology in field of biology with many new emerging technology as well doing best in medical, research, especially life saving boon for human being. It is not a new discipline, but it is advancing by step wise step and it creating more and more applications in our day-to-day lives: from medical, pharmaceutical development, to food production and the treatment of polluting waste. Scientist even a lay man can explore this exciting field below and try to determine how far it might go in the future. Its giving a good opportunities in entrepreneurship development also.

Corona virus outbreak first case found in Wuhan, China in December 2019 [[1](https://www.intechopen.com/chapters/75737#B1)]. Further, it became a pandemic, affecting the whole world. On February 2020, World Health Organisation (WHO) announced an official name for Coronavirus spread disease as COVID-19 [[2](https://www.intechopen.com/chapters/75737#B2)]. It primarily targets a respiratory system in humans, as the appearance of symptoms depends on the incubation period, which further relies on the patient’s age and the immune system [[3](https://www.intechopen.com/chapters/75737#B3)].Biotechnology in pandemic covid 19 is the only field that boosts up all around the world in treating from beginning diagnosis to treatment and saving life.

Working with human cells and gene mechanisms, biotechnologists improve their understanding of viral mechanisms by studying their genetics and transcribing this information into knowledge and tools to search for a vaccine. These biotech vaccines may trigger an immediate immune response in symptomatic patients, rather than traditional vaccines, which are preventive in nature.

In recent years biotechnology **has become one of the spearheads in the fight against the COVID-19 global pandemic,** since it helps to identify the virus' genome and understand how the our body's defence mechanism works against infectious agents. Biotechnology brings solutions for the different strains of corona virus attacking body and how to get rid off from them.

**Different Aspects:**

Modern biotechnology provides breakthrough products and technologies by utilizing biological systems and living organisms or parts of them.

Biotechnology worked in various aspects of pandemic 19 from identification of virus to diagnose, treatment, recovery in all. Biotechnology has helped develop more than 1,200 diagnostic tests in clinical use today. With only a blood sample or mouth swab, many of these tests are able to diagnose conditions faster and with greater accuracy than ever before. The faster a condition can be diagnosed, the quicker a patient can begin treatment. Many of these diagnostic tools are now portable, allowing physicians to conduct tests, interpret results and determine treatment on-the-spot. These tools have had a profound effect on access to health care in developing countries, where the health care infrastructure is often undeveloped. Antibiotics, genetic testing, genome mapping, and artificial tissue growth are among the most well-known products in this field [4]. Here in this chapter including various essential, beneficial aspects, methodological Biotechnology which are going to use in this pandemic era.

# CRISPR-Based Assays:

Clustered Regularly Interspaced Short Palindrome Repeats (CRISPR) represents a family of nucleic acid sequences found in prokaryotic organisms, such as bacteria. These sequences can be recognized and cut by a set of bacterial enzymes, called CRISPR-associated enzymes, exemplified by Cas9, Cas12, and Cas13. Certain enzymes in the Cas12 and Cas13 families can be programmed to target and cut viral RNA.

This technology work like best represented in the fig.1.,as the virus invade bacterial release there nucleic material that get integrated with bacterial genome and produce CRSPR RNA .

This CRISPR direct the molecules machinery to destroy viral genome.

So this technology isshowed postive results in pandemic condition.



Fig:1:Process of CRISPR based assay

# Enzyme-Linked Immunosorbent Assay (ELISA):

# ELISA is a micro well, plate-based assay technique designed for detecting and quantifying substances such as peptides, proteins, antibodies, and hormones. The test can be qualitative or quantitative, and the time to results is typically 1–5 h.in figure .2,various steps are described how the ELISA worked.

In pandemic 19, it was a very important tool for the diagnosis of corona different stains.



# Fig-2: various steps of ELISA assay

# Lateral Flow Immunoassay:

This test is typically a qualitative (positive or negative) chromatographic assay that is small, portable, and used at the point-of-care. The test is a type of rapid diagnostic test (RDT) as the result can be obtained in 10–30 min. In practice, fluid samples are applied to a substrate material that allows the sample to flow past a band of immobilized viral antigen. Basically, it is a simple to use diagnostic device used to confirm the presence or absence of a target analyte, such as pathogens or biomarkers in humans or animals, or contaminants in water supplies, foodstuffs, or animal feeds. The most commonly known type of lateral flow rapid test strip is the pregnancy test.

 For example, COVID-19 rapid antibody tests that detect IgG antibodies that target the SARS-CoV-2 spike protein, use whole blood with a buffer.

**Sandwich assays** – A positive test is represented by the presence of a coloured line at the test line position.

**Competitive assays** – A positive test is represented by the absence of a coloured line at the test line position.

This type of kits were very beneficial in pandemic corona to self detect the virus and make isolate themselves surrounding and get fast proper treatment before pandemic severe effects.

Fig:3: Lateral Flow Immunoassay showing positive result

# Microarray:

Biotech diagnostic tools use genetic information to help doctors detect and diagnose conditions faster and with greater ease and accuracy. Doctors can now tailor disease prevention and treatment to individual patients using an individual’s genetic information. Biotechnology has helped develop more than 1,200 diagnostic tests in clinical use today.



Fig-4 : Steps involved in cDNA based Micrroarray

# Droplet digital PCR:

The droplet digital polymerase chain reaction (ddPCR), is a modification of PCR methods. The principle of ddPCR is to divide a traditional PCR reaction mixture into smaller reaction system either by diluting to microwell plates, capillaries, or oil emulsion. [5]

Droplet Digital PCR (ddPCR) is a method for performing digital PCR that is based on water-oil emulsion droplet technology. A sample is fractionated into 20,000 droplets, and PCR amplification of the template molecules occurs in each individual droplet. Droplet Digital PCR addresses these shortcomings by massively partitioning the sample in the fluid phase in one step. The creation of tens of thousands of droplets means that a single sample can generate tens of thousands of data points rather than a single result, bringing the power of statistical analysis inherent in digital PCR into practical application.

## RT-PCR for SARS-CoV-2 diagnosis:

In addition to prevention methods (e.g., hygiene, social distance, isolation of infected individuals, and travel restriction), rigorous community infection testing is essential to track the transmission of the disease as well as educating public policies . Nations that have implemented large research strategies at an early stage like South Korea, Vietnam, and New Zealand have been better able to restrict the spread of the disease. Tests should ideally be simple to sample and evaluate, precise, reliable, scalable and inexpensive. Often, point-of-care tests (POCT) based on antibodies match this definition. However, rapidly emerging epidemics due to novel viruses do not allow antibody-based tests to evolve in a timely manner . Because of the simple adaptability to the nucleotide sequence of the target, viral load tests based on real-time, quantitative RT-PCR (referred to as RTqPCR) are thus an ideal test .

PCR method was discovered in 1986 and since then the method is serving medical sectors. In the future, as potential molecular diagnostic methods, PCR will play a significant role. Lots of PCR methods are already used in various research and medical fields, but as we know currently under this pandemic situation RT-PCR has turned out to be a boon in healthcare sectors. Lots of kits have been manufactured throughout the world with some or little variation, thus making it more sensitive, specific and less time consuming.

### Nucleic Acid Testing:

Nucleic acid tests using isothermal amplification are currently in development for SARS-CoV-2 detection. Isothermal amplification techniques are conducted at a single temperature and do not need specialized laboratory equipment to provide similar analytical sensitivities to PCR. [7]. These techniques include recombinase polymerase amplification, helicase-dependent amplification, and loop-mediated isothermal amplification (LAMP). Several academic laboratories have developed and clinically tested reverse transcription LAMP (RT-LAMP) tests for SARS-CoV-2. [8].

#### Designing a Nucleic Acid Test for SARS-CoV-2

1. Nucleic acid testing is the primary method of diagnosing COVID-19.[9]  The design process generally involves two main steps:
2. (1) sequence alignment and primer design
3. (2) assay optimization and testing.

Corman *et al*. aligned and analyzed a number of SARS-related viral genome sequences to design a set of primers and probes. [10]

# RNAi Therapy of COVID-19:

A promising approach to develop a more specific anti-viral therapy could be based on endogenous RNA interference (RNAi) mechanism whose physiological goal is to regulate protein synthesis events. RNAi has been adopted for therapy by silencing desired genes based on blockage and degradation of corresponding mRNAs. RNAi can be implemented with synthetic short interfering RNAs (siRNAs; 19–27 nucleotide long double-stranded RNAs), or *in situ* production of short hairpin RNAs (shRNAs) through typically plasmid DNA (pDNA)-based expression vectors. While the latter relies on nuclear targeting for efficient expression, siRNAs can be delivered to cytoplasmic space to engage the RNA-induced silencing complex (RISC) directly with minimal processing by host cells. Silencing a wide range of targets with RNAi are being effectively implemented at will, so that a broad therapy platform could be envisioned in this pursuit. The exciting possibilities with RNAi was recently (2018) confirmed with the FDA-approval of the first siRNA based drug (Patisiran by Alnylam) to treat the nerve damage caused by the rare disease hereditary transthyretin-mediated amyloidosis (hATTR) in adults.[11]

Developing RNAi based drugs for SARS-CoV-2 will be a lengthier process than the re-purposed, already approved drugs but it is likely to offer more specific therapies. Past attempts to control SARS-CoV infections using RNAi may guide the efforts in the current pandemic.

### Protein Testing:

Viral protein antigens and antibodies that are created in response to a SARS-CoV-2 infection can be used for diagnosing COVID-19. Changes in viral load over the course of the infection may make viral proteins difficult to detect. For example, Lung *et al*. showed high salivary viral loads in the first week after onset of symptoms, which gradually declined with time. [12]

**Viral Sequencing:**

The outbreak investigation must also determine clusters of patients and the pathway of the dissemination of the causative agent to stop the viral dissemination. Until now, [Sanger sequencing](https://www.sciencedirect.com/topics/medicine-and-dentistry/sanger-sequencing) method is used to obtain partial sequence of [viral genome](https://www.sciencedirect.com/topics/medicine-and-dentistry/virus-genome) necessary to identify clusters of cases. However, many technical limitations, especially the small amount of viral genome in the biological samples, make this approach not very effective for the management of the outbreak. High-throughput sequencing (HTS) technologies provide the possibility to rapidly obtain the full sequence of pathogen genomes. Notably whole-genome sequencing (WGS) of viruses is a powerful tool for the development of novel treatments and vaccines, for studying virus evolution and genetic association to diseases or for tracking outbreaks. Recently, HTS has been used to investigate viral outbreaks in health-care setting[13].

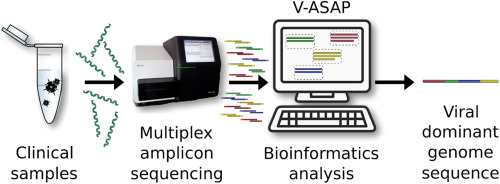


Fig-5: Viral Sequencing steps (source: [Garvey et al., 2017](https://www.sciencedirect.com/science/article/pii/S0042682219300728#bib6))

**Summary:**

Biotechnology is boon in field of medical science that proved in pandemic 19 .Diagnosis is very important process in health care industries, as fast as diagnosis as fast treatment provides relief to patient. Different variants of corona virus occurred in world that brought number of deaths, in that emergency fast diagnosis by various techniques like Protein Testing, RNAi Therapy, Droplet digital PCR various number of tools provided by biotechnology.

Biotechnology shows there future prospects in various field lke agriculture, waste management, food production etc. In pandemic from diagnosis to treatment even in precautionary equipment plays a vital role.

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