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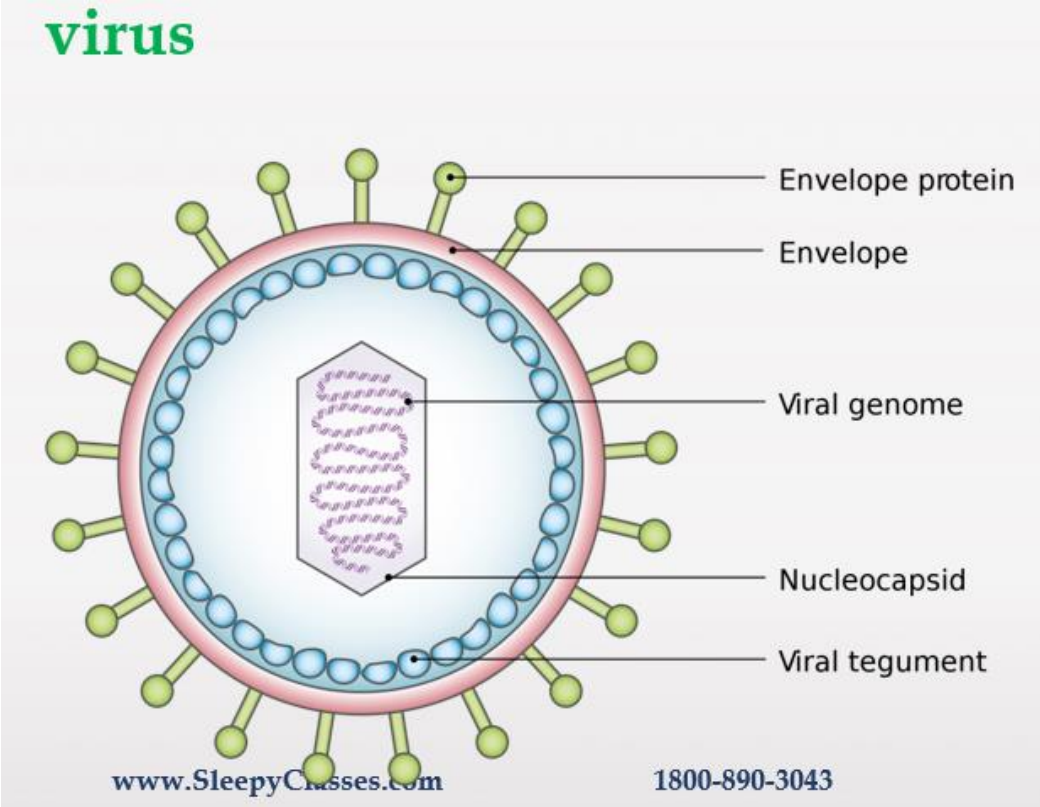
Covid - 19

Virus



Properties of Viruses

- Non-cellular organisms
- Do not grow, neither respire nor metabolize, but they reproduce.
- They are surrounded by a protein coat – capsid and have a nucleic acid core comprising DNA or RNA.
- Considered both as living and non-living things.

Bacteria	Virus
Cell wall	Not present
Living organism	Replicate within host cell
Host independent reproduction	Host dependent reproduction
Ribosomes present	Ribosomes absent
DNA or RNA	DNA or RNA

Naming of Disease

- The disease will be called "COVID-19"; the "CO" stands for coronavirus, "VI" for virus and "D" for disease.
- The coronavirus itself is called "nCoV-2019".
- WHO, in consultation with the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO), has identified best practices for naming new human diseases
- Names that are assigned by the WHO may or may not be approved by the International Classification of Diseases (ICD) at a later stage.
- The **ICD,** which is also managed by the WHO, provides a final standard name for each human disease according to standard guidelines that are aimed at reducing the negative impact from names while balancing science, communication and policy.

Terms to avoid

Should not include

- Geographical locations - Middle East Respiratory Syndrome, Spanish Flu, Japanese encephalitis
- People's names- Chagas disease
- Cultural or occupational references- miners, butchers, cooks, nurses etc
- Species or class of animal or food- swine flu, monkeypox etc
- Terms that incite "undue fear" such as death, fatal and epidemic.

Terms to Include

- Generic descriptive terms such as respiratory diseases, hepatitis, neurologic syndrome, watery diarrhoea
- Terms that may indicate the age group of the patients and the time course of the disease, such as progressive, juvenile or severe
- If the causative pathogen is known, it should be used as part of the disease name with additional descriptors such as the year when the disease was first reported or detected.
- As per the WHO, "severe" should be used only for those diseases that have a very high initial case fatality rate.
- "Novel" can be used to indicate a new pathogen of a previously known type.

Public Health Emergency of International Concern (PHEIC)

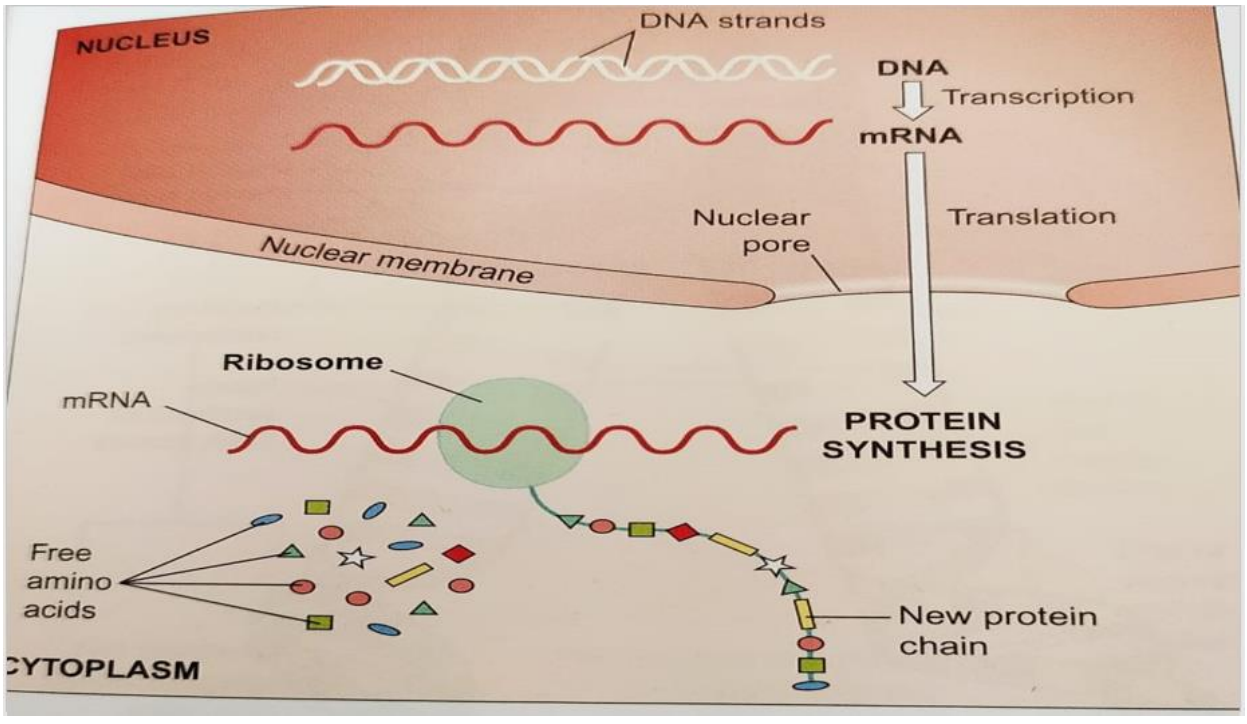
- The term Public Health Emergency of International Concern is defined in the IHR (2005) as "an extraordinary event which is determined, as provided in these Regulations:
- to constitute a public health risk to other States through the international spread of disease; and
- to potentially require a coordinated international response".
- This definition implies a situation that: is serious, unusual or unexpected; carries implications for public health beyond the affected State's national border; and may require immediate international action.

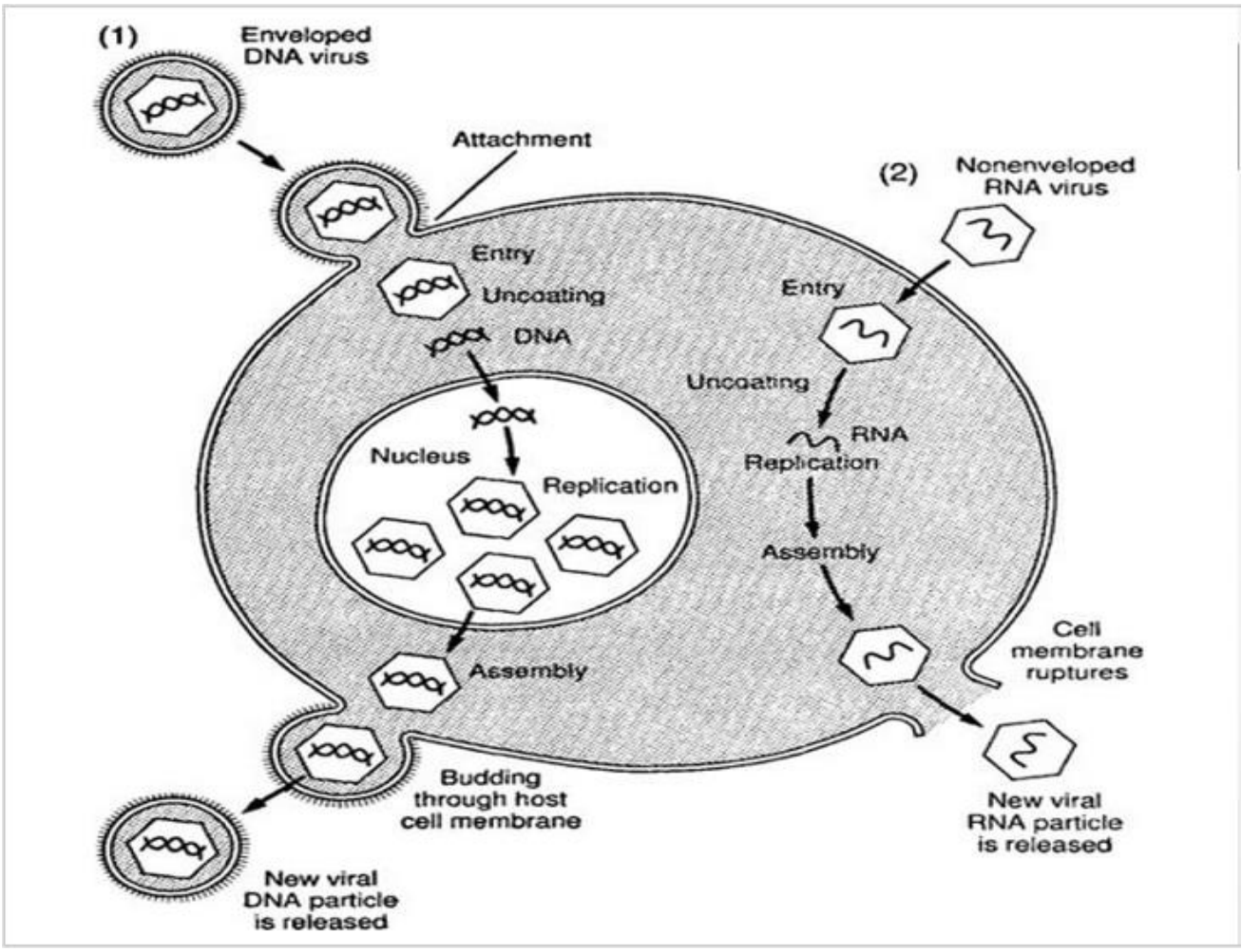
Previously declared global public health emergencies

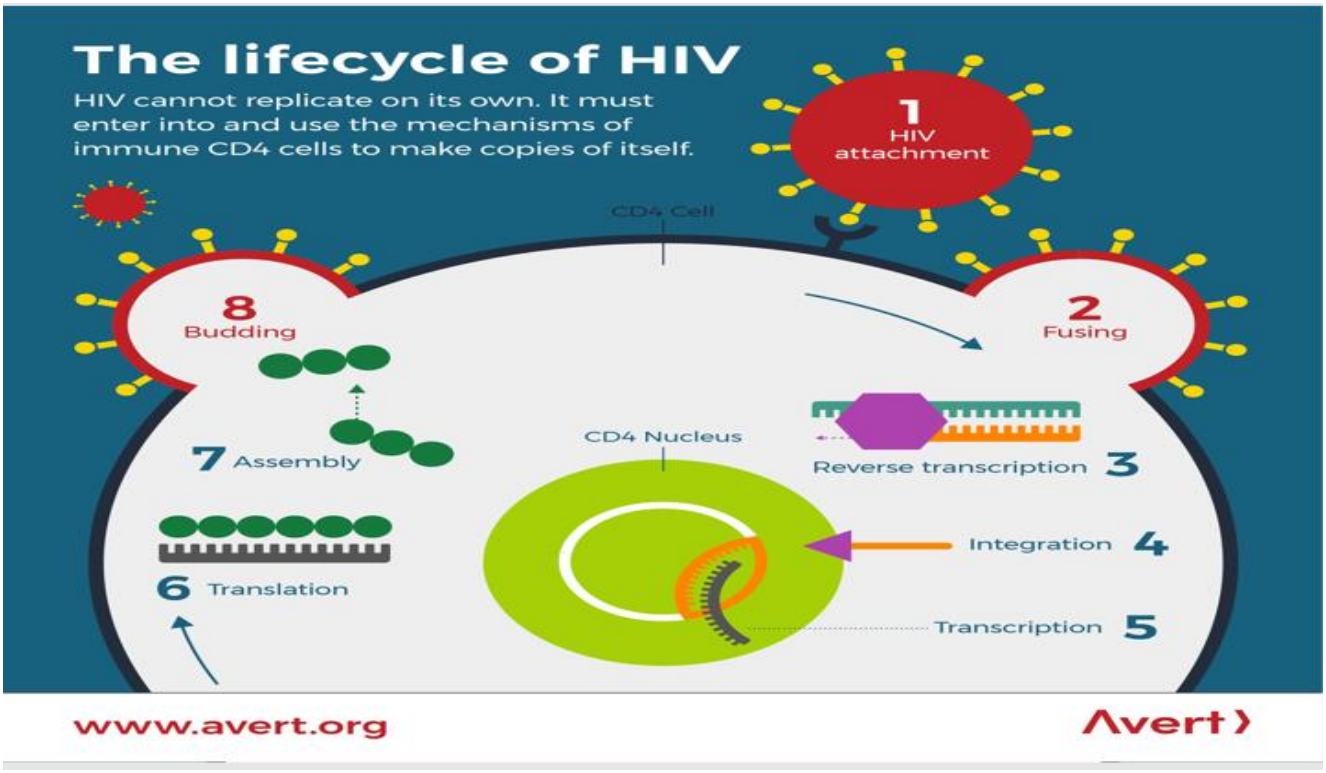
- **Swine flu, 2009 -** The H1N1 virus spread across the world in 2009, with death toll estimates ranging from 123,000 to 575,400
- **Polio, 2014** - Although closer than ever to eradication in 2012, polio numbers rose in 2013
- **Zika, 2016** - The WHO declared Zika a public health emergency in 2016 after the disease spread rapidly through the Americas
- **Ebola, 2014 and 2019** - The first emergency over the virus lasted from August 2014 to March 2016 as almost 30,000 people were infected and more than 11,000 died in West Africa. A second emergency was declared last year as an outbreak spread in DR Congo

Implications of a PHEIC being declared

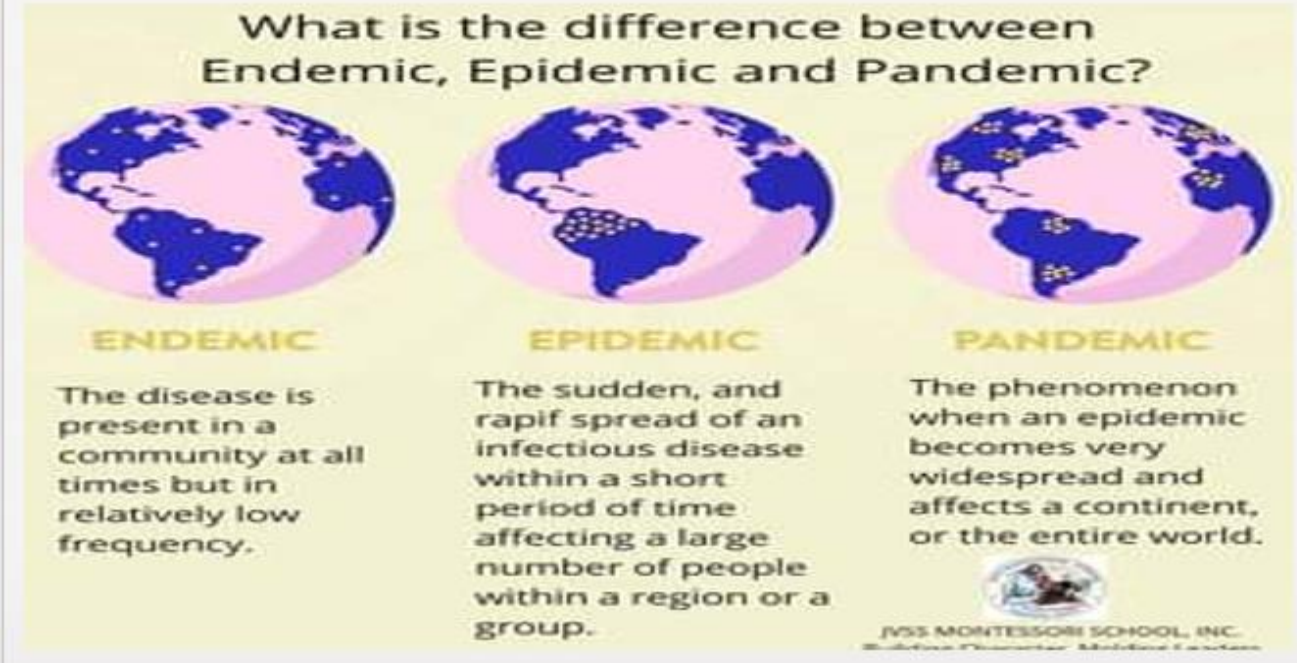
- May lead to restrictions on travel and trade.



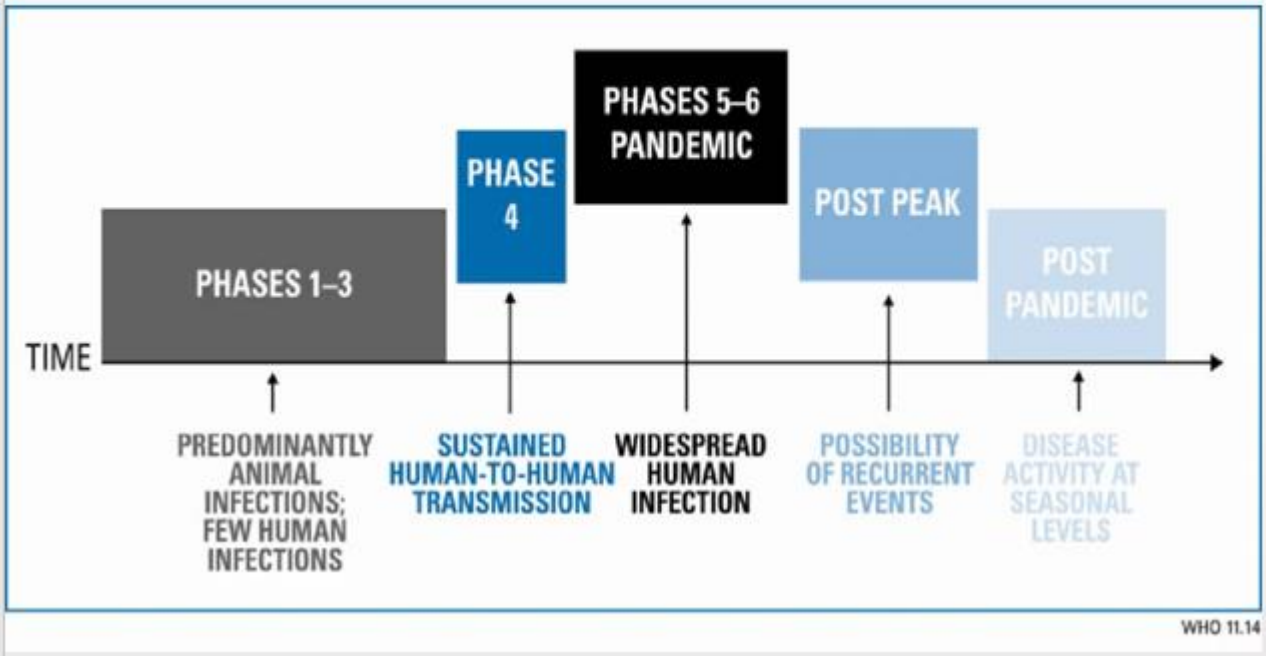

(1)
Enveloped DNA virus
Attachment
(2)
Nonenveloped RNA virus
Entry
Uncoating
DNA
Nucleus
Replication
Assembly
Entry
Uncoating
RNA
Replication
Assembly
Cell membrane ruptures
Budding through host cell membrane
New viral DNA particle is released
New viral RNA particle is released


The lifecycle of HIV
HIV cannot replicate on its own. It must enter into and use the mechanisms of immune CD4 cells to make copies of itself.
1 HIV attachment
CD4 Cell
2 Fusing
3 Reverse transcription
CD4 Nucleus
4 Integration
5 Transcription
6 Translation
7 Assembly
8 Budding
www.avert.org
Avert

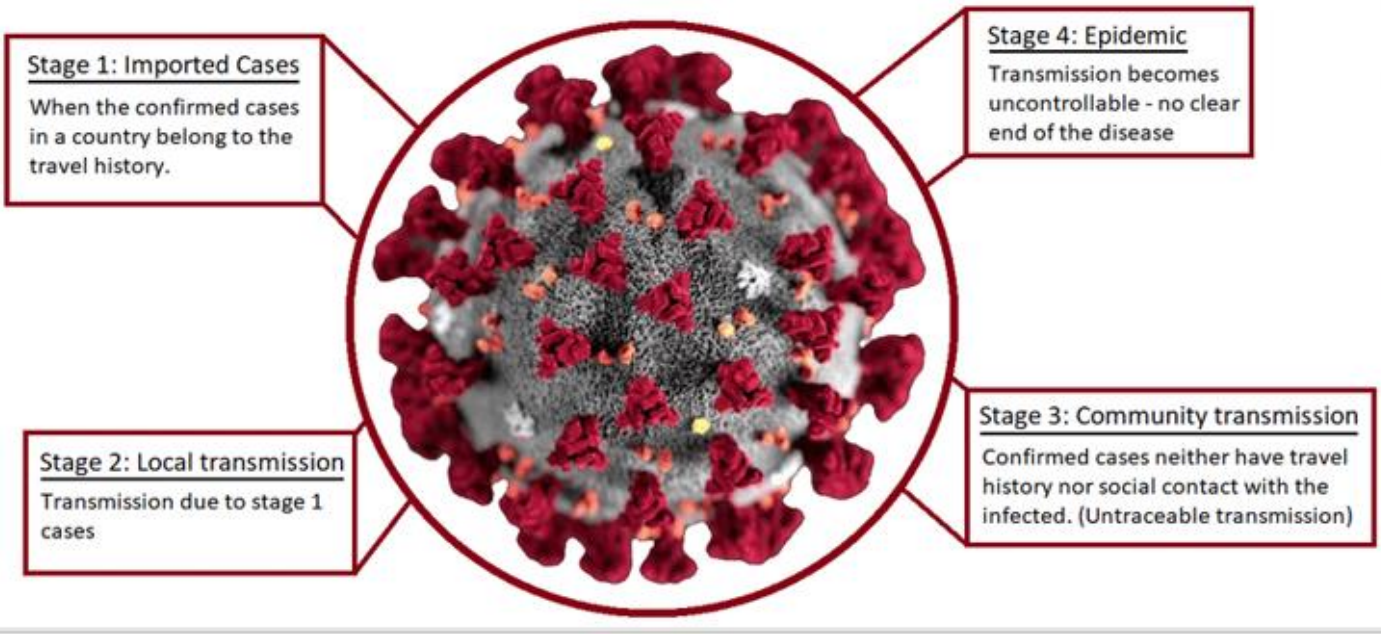
Pandemic declaration

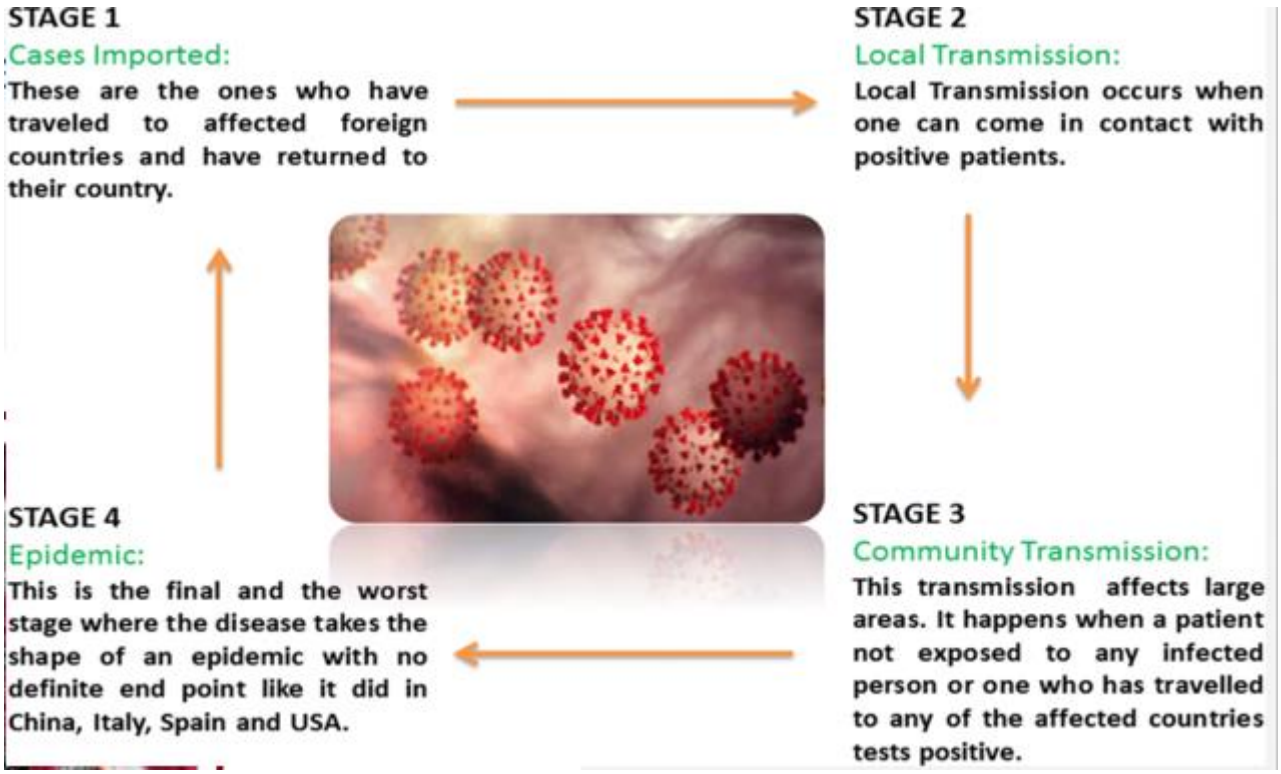


Pandemic declaration



Transmission stages





India resists 'community transmission' tag despite soaring cases (14 May 2021)

- Inspite of adding the highest number of cases in the world every day, **India continues to label itself as a country with no community transmission (CT), opting instead for the lower, less serious classification called 'cluster of cases'**, according to the latest weekly report by the World Health Organisation (WHO) on May 11.

No cases	No confirmed cases in the country.
Sporadic cases	One or more cases, imported or locally detected.
Clusters of cases	Cases are clustered in time, geographic location and by common exposure.
Community transmission	Larger outbreaks of local transmission, determined through an assessment of multiple factors, including large numbers of cases not linkable to transmission chains; large numbers of cases from sentinel lab surveillance; multiple unrelated clusters in several areas of the territory.

- Countries such as the United States, Brazil, United Kingdom, France labelled themselves as being in 'community transmission.

Community Transmission

- Broadly, CT is when new cases in the last 14 days can't be traced to those who have an international travel history, when cases can't be linked to specific cluster.

Subcategories of CT

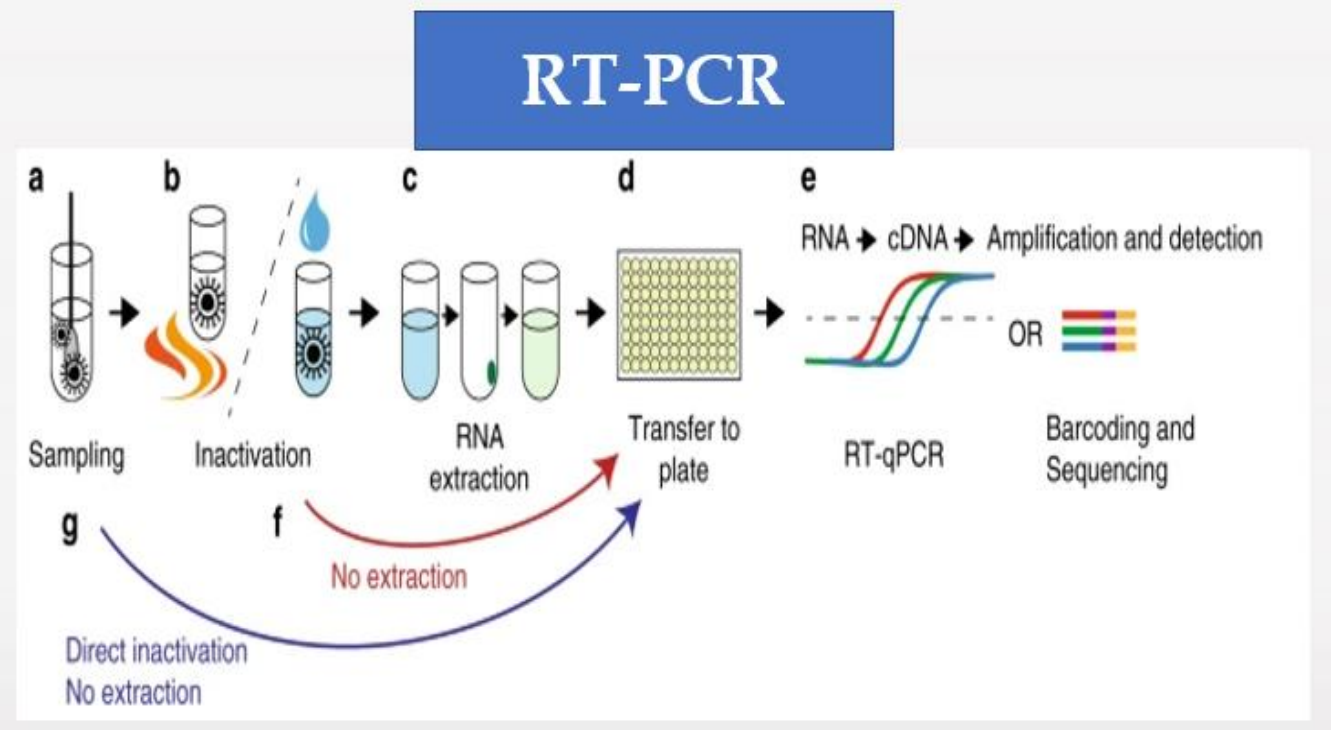
- CT-1 implying Low incidence of locally acquired, widely dispersed cases and low risk of infection for the general population
- CT-4 suggesting Very high incidence of locally acquired, widely dispersed cases in the past 14 days. Very high risk of infection for the general population.

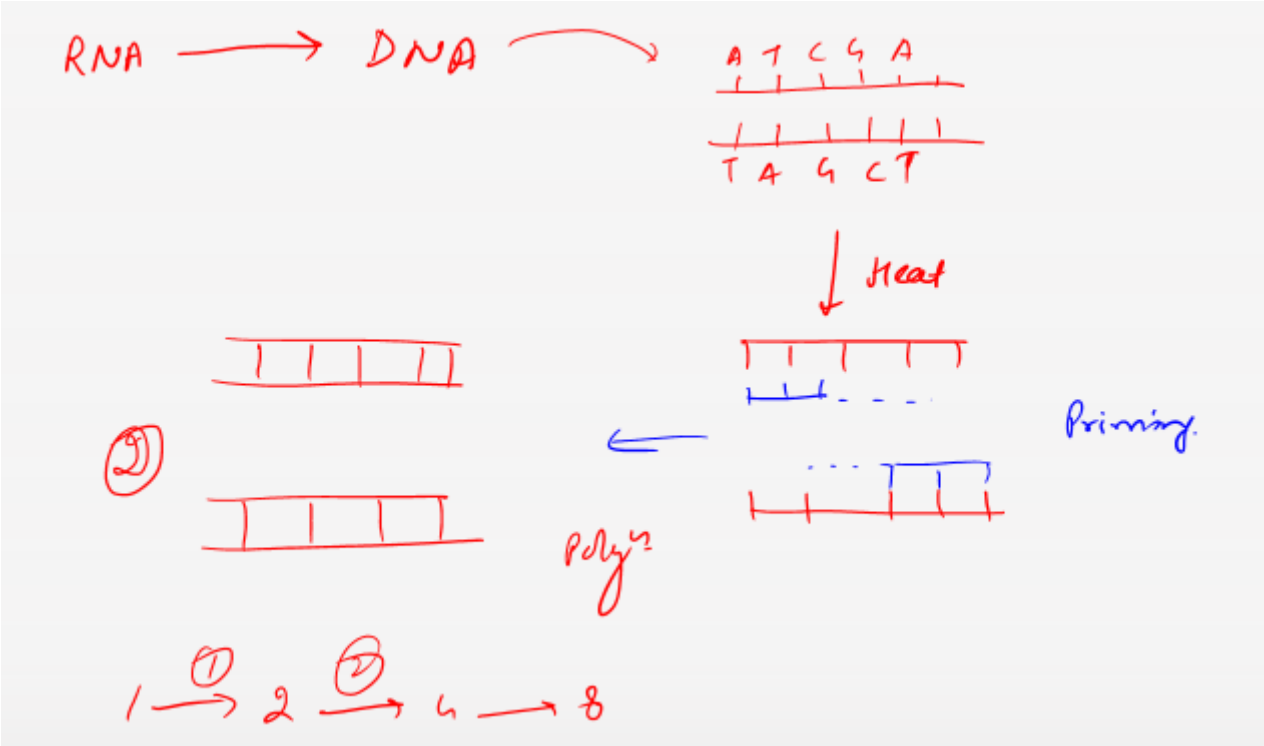
Cluster of Cases

- Cases detected in the past 14 days are predominantly limited to well-defined clusters that are not directly linked to imported cases.
- It is assumed that there are a number of unidentified cases in the area.
- This implies a low risk of infection to others in the wider community if exposure to these clusters is avoided.

Diagnostic Techniques

RT-PCR





COBAS 6800

- It is a fully automated, high end machine for performing real time PCR testing COVID-19 in the service of nation
- 1200 samples in 24 hours
- It can also detect other pathogens like Viral Hepatitis B & C, HIV, MTb (both rifampicin and isoniazide resistance), Papilloma, CMV, Chlamydia, Neiserreia etc.

The Ct value

- As per ICMR recent announcement All patients with a Ct value less than 35 may be considered as positive while those with a Ct value above 35 may be considered as negative.

What is Ct value

- Short for cycle threshold, Ct is a value that emerges during RT-PCR tests, the gold standard for detection of the SARS-CoV-2 coronavirus.
- In an RT-PCR test, RNA is extracted from the swab collected from the patient.
- It is then converted into DNA, 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 virus.

Significance

- According to the ICMR, a patient is considered Covid-positive if the Ct value is below **35**. In other words, if the virus is detectable after 35 cycles or earlier, then the patient is considered positive.
- A benchmark of 35, therefore, means that more patients would be considered positive than we would get if the benchmark were 24.

RT-LAMP

- Reverse Transcriptase loop-mediated isothermal amplification technology
- one-step nucleic acid amplification method to multiply specific sequences of RNA of the coronavirus
- RT-PCR test needs different temperatures in one cycle while RT-LAMP technology is done at 65 degrees Celsius, where the DNA amplification is done at a constant temperature (isothermal)

COVIRAP

- Indian Institute of Technology (IIT), Kharagpur.
- test is completed within an hour while RT-PCR test (Reverse Transcription Polymerase Chain Reaction) takes 3-4 hours for testing the sample.
- It is also better than the FELUDA test because the FELUDA employs a gene editing technology called CRISPR-cas9, which requires a lab testing environment

COROSURE

- RT-PCR test kit developed by IIT Delhi is INR 300.

Saline gargle RT-PCR test (TH)

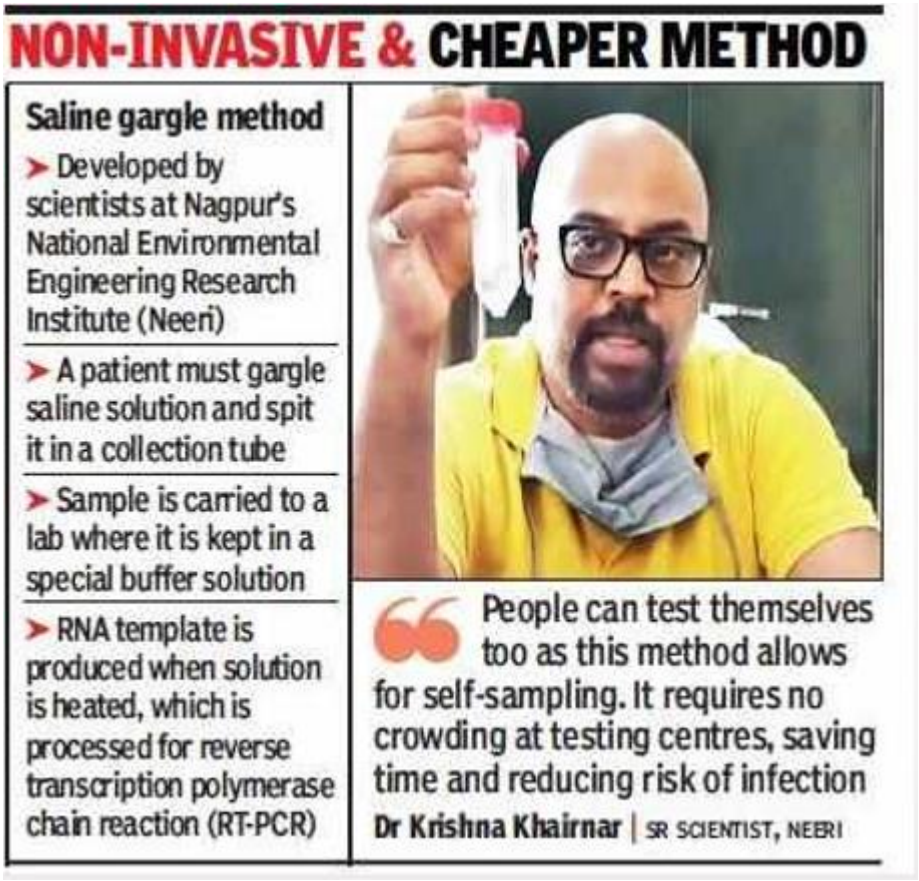
- The National Environmental Engineering Research Institute (NEERI) has transferred the know-how of the indigenously-developed saline gargle RT-PCR technique, used for testing Covid-19 samples, to the Union Micro, Small, and Medium Enterprises (MSME) Ministry
- It will enable the innovation to be commercialised and licensed to all capable parties, including private, government and various rural development schemes and departments, the Science and Technology.

Saline Gargle RT-PCR test

- The technology, developed by Nagpur-headquartered NEERI, is simple, fast, cost-effective, patient-friendly and comfortable technique, provides instant results and is well-suited for rural and tribal areas, given the minimal infrastructure requirements.
- The method is non-invasive and simple, and the patient himself/herself can collect the sample.
- Collection methods like nasopharyngeal and oropharyngeal swab collection require technical expertise, and are also time-consuming.
- In contrast, the saline gargle RT-PCR method uses a simple collection tube filled with saline solution. The patient gargles with the solution and rinses it inside the tube.

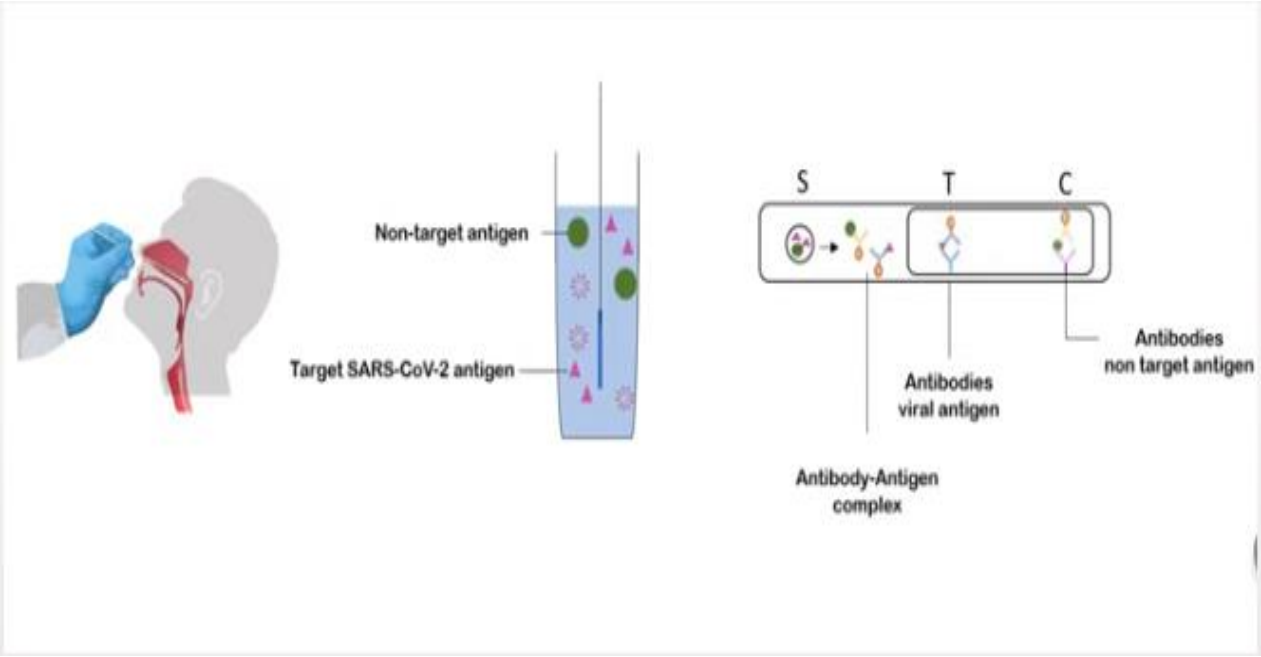
NEERI

- is an institute under the Council for Scientific and Industrial Research (CSIR).

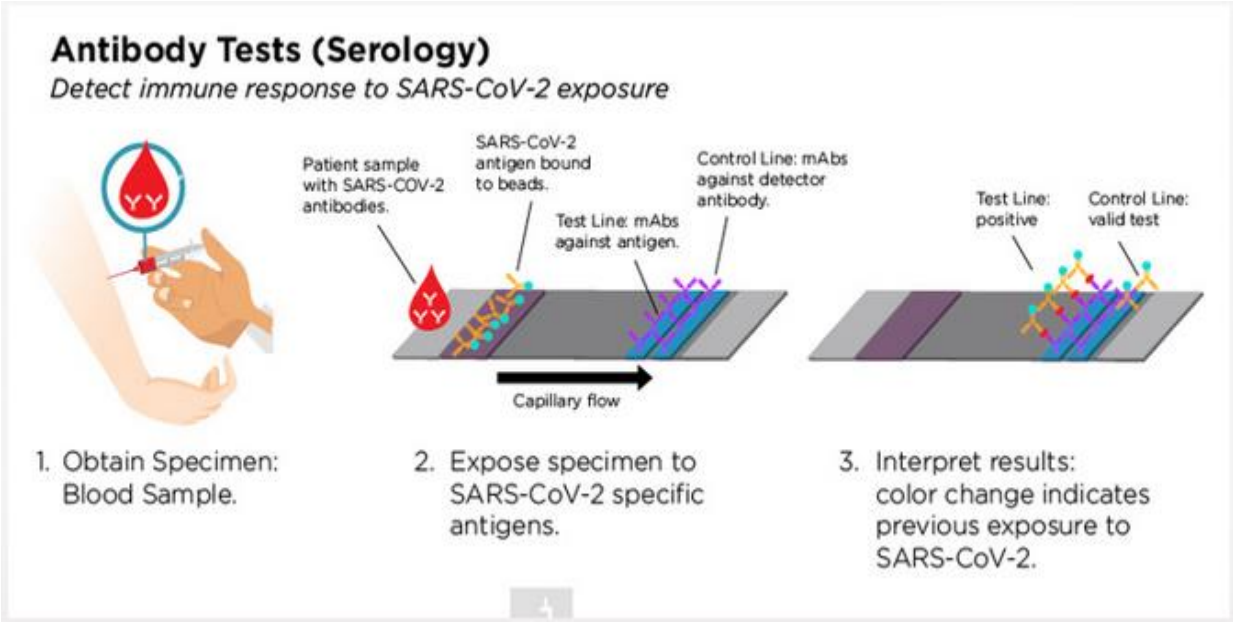


Antigen Test

- It is a test on swabbed nasal samples that detects antigens (foreign substances that induce an immune response in the body) that are found on or within the SARS-CoV-2 virus.



Antibody testing

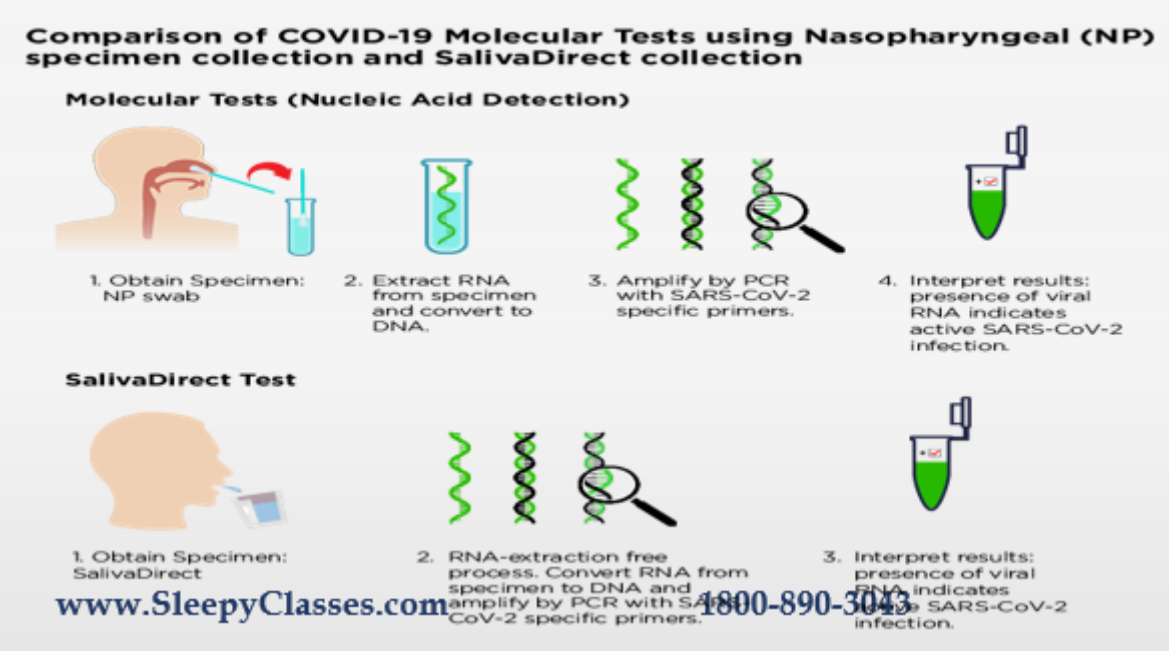


Covid Kavach Elisa

- It is India's first indigenous antibody detection test for COVID-19, developed by National Institute of Virology, Pune.
- Test will detect the Immunoglobulin G (IgG) antibodies in blood samples

Saliva Direct test

- approved by U.S. Food and Drug Administration.



eCovSens

- biosensor developed by National Institute of Animal Biotechnology, Hyderabad that can detect the novel coronavirus in saliva samples.

Feluda Test

- Council of Scientific and Industrial Research's Institute of Genomics and Integrative Biology (CSIR-IGIB) has developed India's first paper strip test for Covid-19 namely, 'Feluda'.
- Based on Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology.

miSHERLOCK (IE)

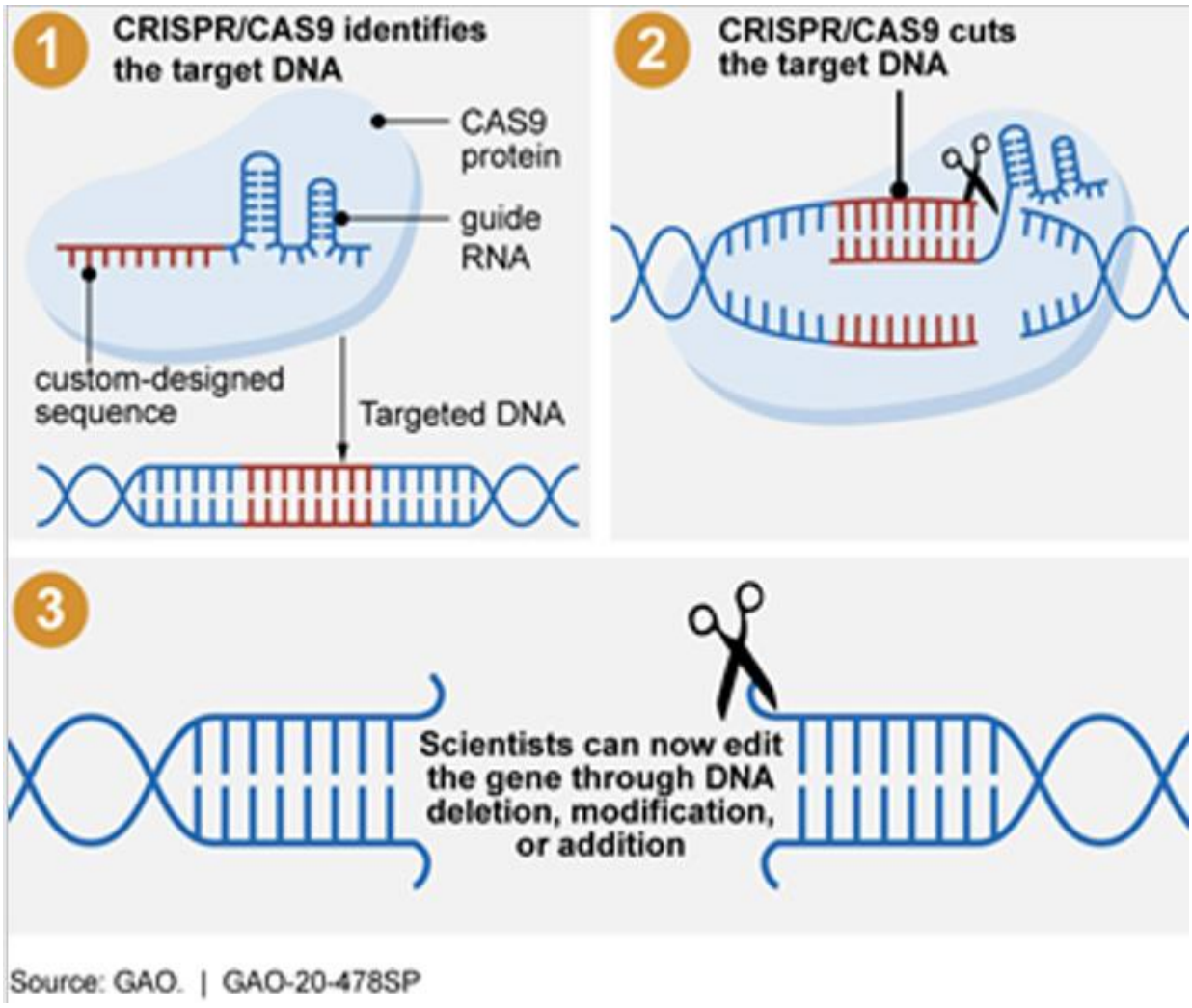
- Engineers at MIT and Harvard University have designed a small tabletop device that can detect SARS-CoV-2 from a saliva sample in about an hour.

About

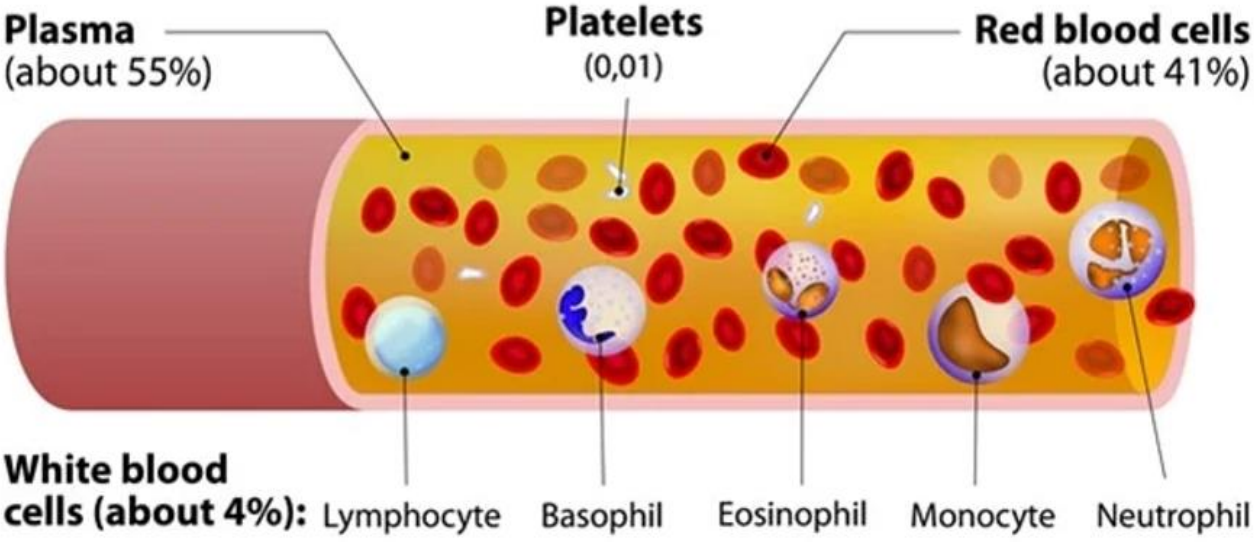
- The device can also be used to detect specific viral mutations linked to some of the variants now circulating.
- It is based on SHERLOCK, a CRISPR-based tool.
- The researchers designed the device, which they call minimally instrumented SHERLOCK (miSHERLOCK), so that it can have up to four modules that each look for a different target RNA sequence.

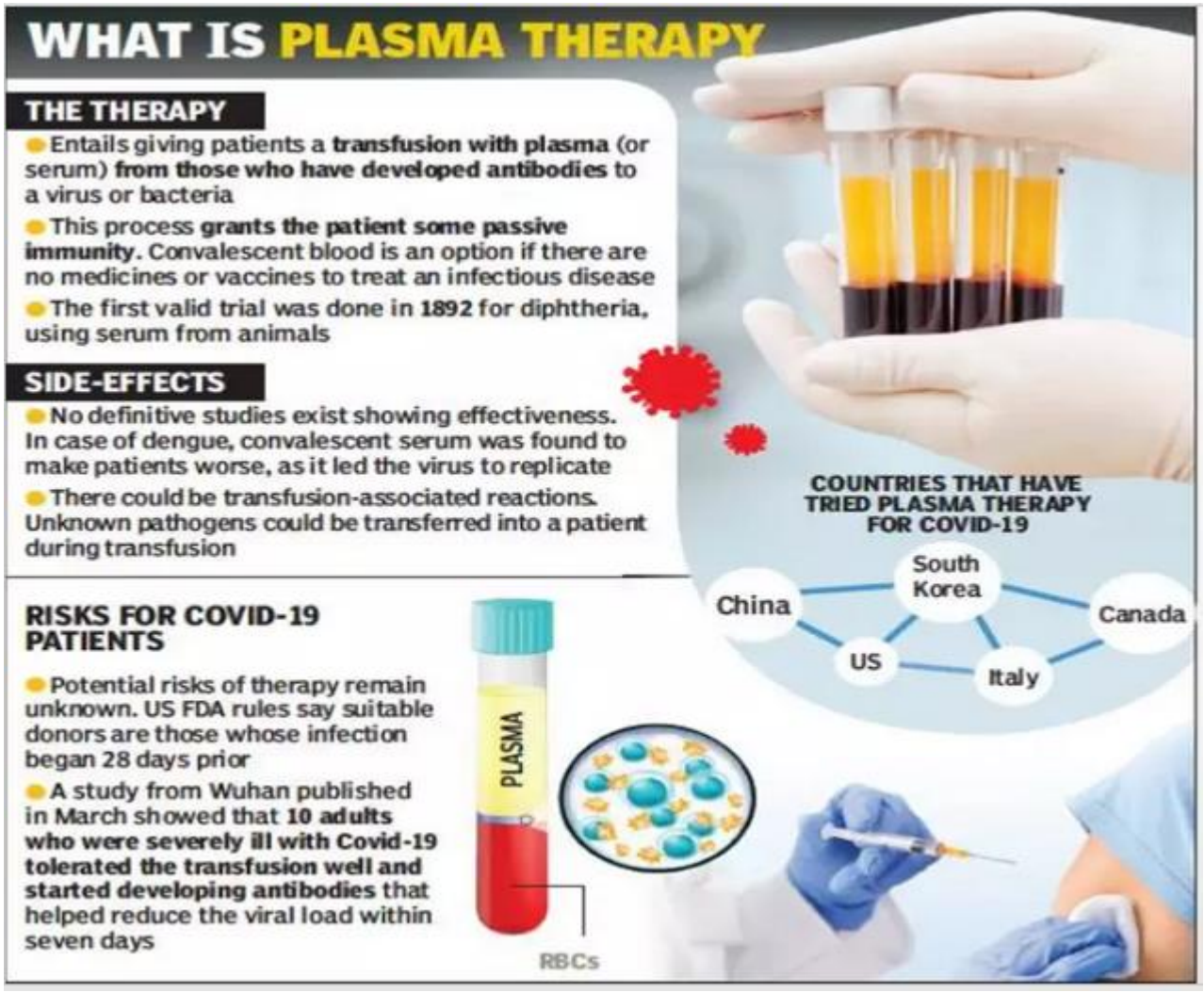
Working

- First, a pre-processing step disables enzymes called salivary nucleases, which destroy nucleic acids such as RNA.
- Once the sample goes into the device, the nucleases are inactivated by heat and two chemical reagents.
- Then, viral RNA is extracted and concentrated by passing the saliva through a membrane.
- This RNA sample is then exposed to freeze-dried CRISPR/Cas components.
- The reaction amplifies the RNA sample and then detects the target RNA sequence, if present.



The elements of blood





Antisera

- Developed by the Indian Council of Medical Research (ICMR) in collaboration with a Hyderabad-based bio-pharmaceutical firm- Biological E Limited.
- are blood serum raised in animals, which is high in antibodies against specific antigens and are injected in humans to help kickstart the immune system to fight specific infections.

Study

- Horses were immunised with inactivated SARS-CoV-2 as a part of the study and after 21 days of immunisation, the plasma samples were tested.
- The results indicated the presence of SARS-CoV-2 specific IgG antibodies in the plasma samples.

Project CARD

- Consortium for Affordable & Rapid Diagnostics.
- It was launched by NITI Aayog and Department of Biotechnology to scale up India's capacity to make coronavirus testing kits.
- Under this, private companies working on antibody test kits in India will get initial support in terms of procurement and availability of testing facilities to manufacture kits.

Next Generation Sequencing Machines

- CSIR is working on developing "mega labs" where large machines, called Next Generation Sequencing machines (NGS), will be used for sequencing human genomes.
- DNA sequencing is the process of determining the nucleic acid sequence – the order of nucleotides in DNA.
- These technologies allow for sequencing of DNA and RNA much more quickly and cheaply than the previously used Sanger sequencing, and as such revolutionized the study of genomics and molecular biology.
- The NGS tests has a sensitivity of 97.53% as compared to 70%-80% accuracy of RT-PCR (Reverse Transcription Polymerase Chain Reaction) and 50% accuracy of antigen tests.

ATULYA

- Defence Institute of Advanced Technology, Pune, a deemed university supported by Defence Research and Development Organisation has developed a microwave steriliser named as '*ATULYA*' to disintegrate (COVID-19).

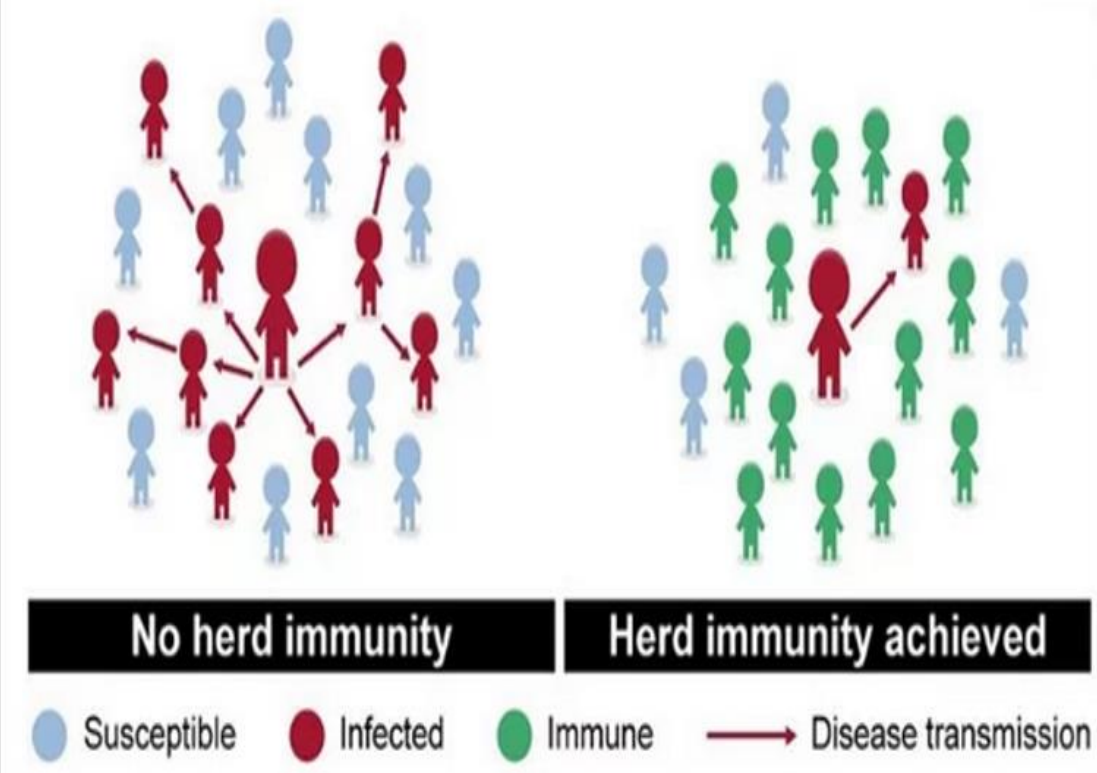
- The **virus** gets disintegrated by differential heating in the range of 56^0 to 60^0 Celsius temperatures
- Depending upon size and shape of various objects, time of sterilisation is from 30 seconds to one minute.
- It can be used for non-metallic objects only.

Reproductive Ratio (R0)

- It tells the average number of people who will catch the disease from one contagious person.
- Product of three numbers:
    - The number of days an infected person remains infectious (that is, can infect others).
    - The number of susceptible persons available to infect.
    - The chance that a susceptible person gets infected

Herd Immunity

- Occurs when a high percentage of the community is immune to a disease (**through** vaccination and/or prior illness), making the spread of this disease from person to person unlikely.
- For a highly infectious virus like SARS-CoV-2 [the virus that causes COVID-19], the minimal level to reach herd immunity – where we'd expect newly infected people to pass the virus to less than one additional person – is thought to be about 70% of the population.



Double Mutant Coronavirus

Mutation

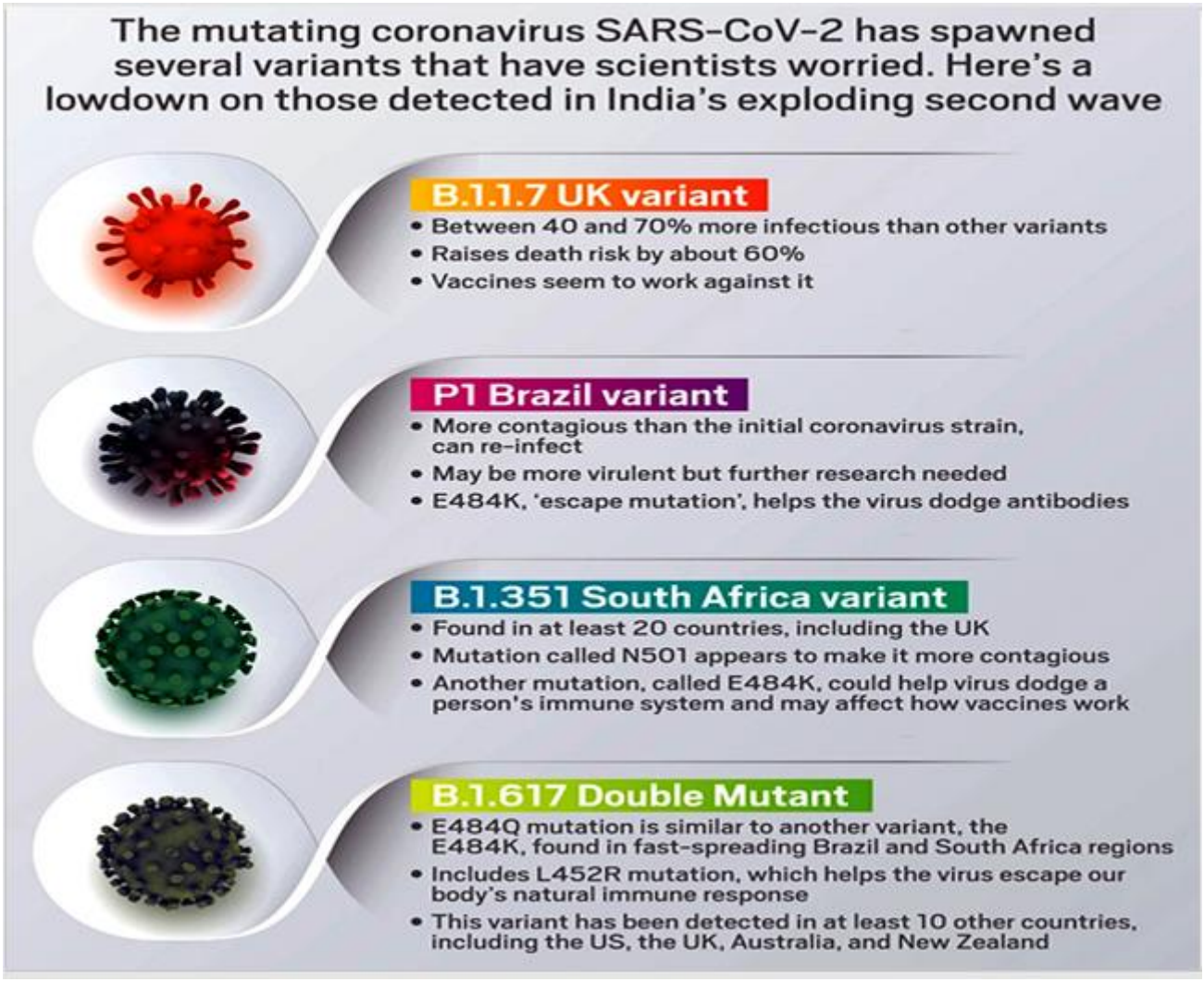
- an alteration in the genetic material of a cell of a living organism or of a virus that is more or less permanent and that can be transmitted to the cell's or the virus's descendants
- Indian SARS-CoV-2 Consortium on Genomics (INSACOG), revealed the presence of two mutations, E484Q and L452R together, in virus samples from states such as Maharashtra, Delhi, Punjab and Gujarat.

Indian SARS-CoV-2 Consortium on Genomics (INSACOG)

- Multi-laboratory, multi-agency, pan-India network to monitor genomic variations in the SARS-CoV-2.
- It helps in the understanding of how the virus spreads and evolves.

GISAID

- It is a public platform started by the WHO in 2008 for countries to share genome sequences.



Variant

- The variant is common in India — how much in every State is unclear though — and has a couple of defining mutations, E484Q and L425R, that enable it to become more infectious and evade antibodies.
- There is a third significant mutation, P614R.
- All three concerning mutations are on the spike protein.

Variant of Concern

- These are variants for which there is evidence of an increase in transmissibility, more severe disease (increased hospitalizations or deaths).
- Certain variants of the coronavirus, for instance, B.1.1.7 and B.1.351 — have been termed the "United Kingdom" and "South Africa" variant, respectively, because they have mutations associated with large spikes in these countries or reduce the efficacy of vaccines and are termed "variants of concern (VOC).

Lambda Variants

- Kappa and Lambda variants have been labelled as Variants of Interest **(VoI)** by WHO.
- It is dominant in Peru.
- India has not yet reported any case of LV.

Variant of Interest	• The genetic changes involved are **predicted or known to affect** transmissibility, disease severity, or immune escape. • An **acknowledgement of the fact that the variant has caused significant community transmission** • These variants are monitored because they **can lead to an increase in positive cases**
Variant of Concern	• There is **evidence of an increase in transmissibility**, more severe disease (e.g., increased hospitalizations or deaths), **significant reduction in neutralization** by antibodies generated during previous infection or vaccination • Previously effective **treatments may not work**, and diagnostic tests might fail to detect the VOCs.
Variants of High Consequence (VOHC)	• This type of variant has the **same characteristics as the VOCs.** • In addition, there is **unquestionable proof that treatment and other efforts to treat and contain the disease are ineffective.** • **Vaccine efficacy against VOHC is very low**, and those impacted by these variants are more likely to **require hospitalization.**

VARIANTS OF CONCERN

Increase in transmissibility or virulence

α	β	γ	δ
Alpha B117	Beta B1351	Gamma P1	Delta B16172
Dec 18, 2020	Dec 18, 2020	Jan 11, 2021	May 11, 2021
United Kingdom	South Africa	Brazil	India

VARIANTS OF INTEREST

Can cause community transmission or multiple clusters, or detected in multiple countries

ε	ζ	η
Epsilon B1427/B1429	Zeta P2	Eta B1525
March 5, 2021	March 17, 2021	March 17, 2021
United States	Brazil	Multiple countries

θ	ι	κ
Theta P3	Iota B1526	Kappa B16171
March 24, 2021	March 24, 2021	April 4, 2021
Philippines	United States	India

Greek alphabets as labels for Covid strains

- WHO recently announced that it will be using greek alphabets as labels for the two categories (VOI & VOC) of mutations.

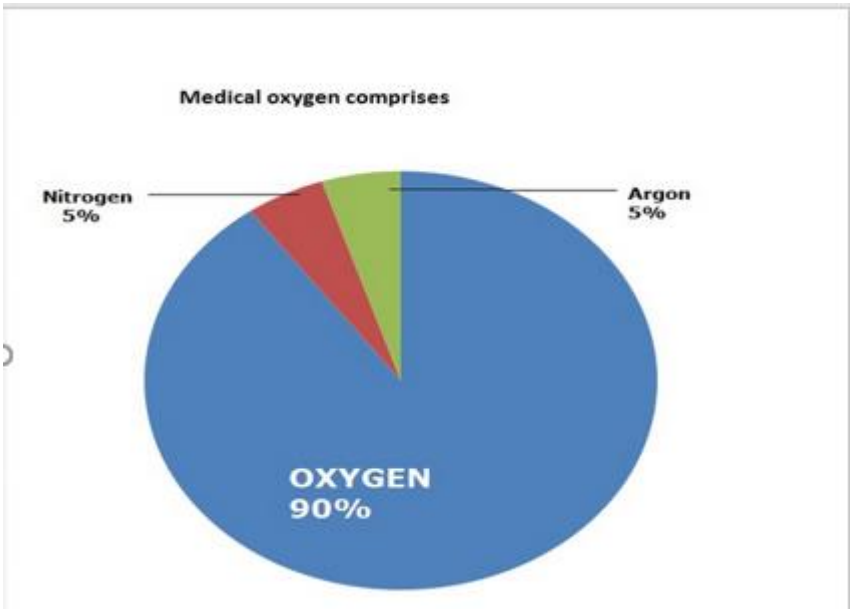
Naming

- **Alpha**
  - VOC B.1.1.7, samples earliest documented in United Kingdom (September 2020).
- **Beta**
  - VOC B.1.351, samples earliest documented in South Africa (May 2020) .
- **Gamma**
  - VOC P.1, samples earliest documented in Brazil (November 2020) .
- **Delta**
  - B.1.617.2,samples earliest documented in India (October 2020).
- **Significance**
  - Alpha, Beta, Gamma, which will be easier and more practical to discussed by non-scientific audiences.

Treatment

Medical Oxygen

- Medical oxygen comprises of minimum 90% oxygen with 5% nitrogen and 5% argon.
- Mostly, oxygen concentrators or **oxygen plants** contain 90-95% O2 with traces of nitrogen and argon.



Methods

- There are different ways of making oxygen but all the techniques eliminate nitrogen, moisture, hydrocarbons and CO2 are removed leaving behind only oxygen.

Pressure Swing Adsorption

- is a process that separates single gases from a gas mixture
- E.g.-separate oxygen (O_2) and nitrogen (N_2) from air.
- The adsorption process is based on gas molecules binding to an absorbent material.
- The adsorbent bed is specially selected depending on the gas to be absorbed.

Cryogenic air Separation

- Largely used in the making of oxygen plants.
- It functions by liquefaction of the atmospheric air in the air separation unit of the plant.
- Whatever technique is used it must meet the rules and regulations of Indian and European Pharmaceuticals standards.

How to maintain purity of Oxygen ?

- It is imperative that purity and the recommended composition of oxygen for medical oxygen must be maintained.
- It is therefore very necessary for compressors and molecular to be cleaned so that medical oxygen remains without impurities.
- Oxygen tanks used for storing oxygen for medical purposes must be properly cleaned to ensure there are no contaminants.
- And oxygen cylinders should also be properly vacuumed before filling them with oxygen.

Medical oxygen Vs Industrial Oxygen

Medical Oxygen

- Medical oxygen is high purity oxygen that is used for medical treatments and is developed for use in the human body.
- Medical oxygen cylinders contain a high purity of oxygen gas; no other types of gases are allowed in the cylinder to prevent contamination.
- There are additional requirements and rules for medical oxygen, including requiring a person to have a prescription to order medical oxygen.

Industrial Oxygen

- Industrial oxygen is focused on uses in industrial plants including combustion, oxidation, cutting and chemical reactions.
- The industrial oxygen purity levels are not appropriate for human use and there could be impurities from dirty equipment or industrial storage that could make people ill

Who controls the supply of medical grade oxygen?

Empowered Group

- The supply of medical oxygen is currently being allocated centrally and monitored by the empowered group, EG II, headed by the secretary in the department for promotion of industry and internal trade (DPIIT).
- The EG II has members nominated from all the states, along with representatives from all major oxygen manufactures, All India Industrial Gases Manufacturers' Association (AIIGMA), Petroleum and Explosives Safety Organisation (PESO), the Ministry of Road Transport, and the Indian Railways.
- It was constituted in March 2020.

Issue

- Most large plants producing medical oxygen are concentrated in Eastern and Western India.
- The densely populated areas of north and central India have limited capacities and therefore logistics becomes an issue for supply of the commodity in some regions.
- States of Bihar, UP, MP and Rajasthan, despite their huge population, have very limited medical oxygen producing capacities.
- The Health Ministry has repeatedly warned against oxygen wastage and unnecessary use.
- Industrial experts have raised concerns over possible leakages in hospital pipelines that supply oxygen.
- Last year, an expert committee under the Health Ministry fixed oxygen supply to 40 litres in intensive care units and 15 litres in normal wards per patient per minute.
- It has advised monitoring of patients on oxygen support daily, and that only those with oxygen saturation levels below 94% be put on oxygen support.

AMLEX

To increase the life of **medical oxygen cylinders** three fold, the Indian Institute of Technology, Ropar has developed a first-of-its-kind Oxygen Rationing Device – AMLEX

- It supplies a required volume of oxygen to the patient during inhalation and trips when the patient exhales CO2.
- This process saves oxygen which otherwise unnecessarily get wasted.
- The device can operate on both portable power supply (battery) as well as line supply (220V-50Hz).
- AMLEX can be easily connected between oxygen supply line and the mask worn by the patient.
- It uses a sensor which senses and successfully detects inhalation and exhalation of the user in any environmental condition.

Significance

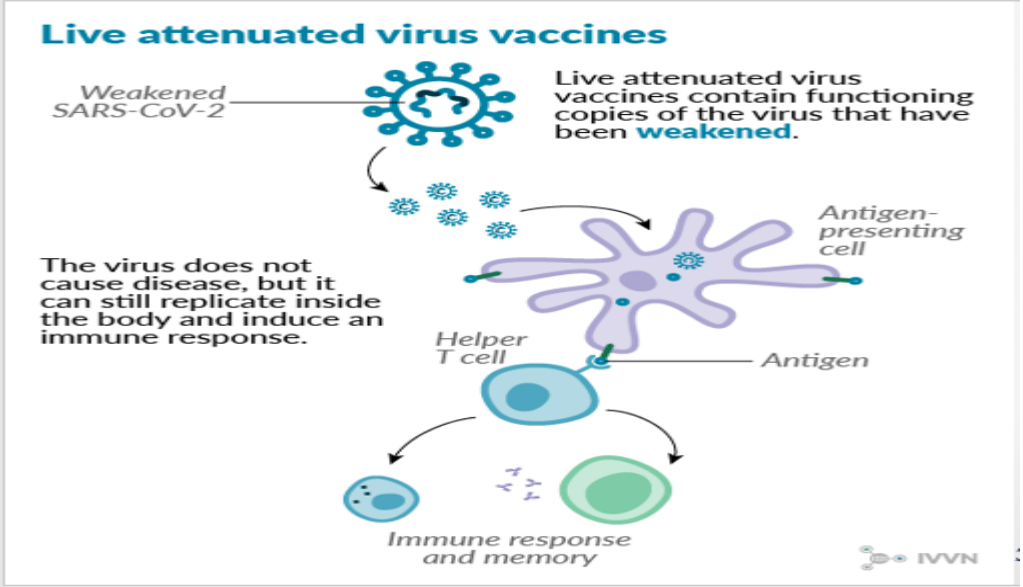
- So far, during exhalation, the oxygen in the oxygen cylinder/pipe is pushed out along with the exhaled CO2 by the user.
- This leads to wastage of a large volume of oxygen in long run.
- In addition to this, a large volume of oxygen escapes from the openings of the mask to the environment in the resting period (between inhalation and exhalation) due to continuous flow of life saving gas in the mask.
- This technology helps to save oxygen.

	DNA & RNA	Live Attenuated	Subunit	Inactivated	Viral vector
How it functions	Target the viral proteins by regulating the immunity system	Weakened the viral activity of the actual virus	Subunit vaccine is consisting the piece of virus surface, it target immunity system	Inactivation of whole virus by applied heat or chemicals & use as an inactivated vaccine	The virus used as vector system to deliver viral genes; stimulate the immunity
Advantages	The concept easy to design	The stimulation of the immunity response & robust it	It's well established, more affective, focuses targeted responses	It may safe and easy to develop	The virus-mediated delivery system is more effective
Disadvantages	Not applied before & currently no evidence is available	The concept been used earlier, may be safe by compromised immunity system	The substrate or catalysts are required to stimulate the strong response	Inactivated vaccines cause serious health issues. It may not as effective as a live virus	The selection of appropriate virus safe & host immune response may cause less effective
Existing example	None	Mumps Measles Chickenpox	Hepatitis B HPV Pertussis	Polio	Ebola
Group testing approaches for COVID-19	Moderna (RNA) Inovio (DNA)	Indian Immunologicals Ltd Cadogenix	Adapt Vac Novavax	Sinopharma Sinovac	CanSino Biologics Oxford University & AstraZeneca Johnson & Johnson

VACCINE

Live-attenuated Vaccines

- Live vaccines use a weakened (or attenuated) form of the germ that causes a disease.
- Because these vaccines are so similar to the natural infection that they help prevent, they create a strong and long-lasting immune response.
- Just 1 or 2 doses of most live vaccines can give you a lifetime of protection against a germ and the disease it causes.



Example

- COVI-VAC (codenamed CDX-005) is a COVID-19 vaccine developed by Codagenix, Inc.
- It is a live attenuated vaccine administered intranasally and requires just one dose. It is currently in Phase 1 clinical trials, involving 48 participants which runs from December 2020 to June 2021.

Positive

- Provide continual antigenic stimulation giving sufficient time for memory cell production.
- Attenuated pathogens are capable of replicating within host cells.

Challenges

- Can revert to original form & cause disease.
- Potential harm to individual with compromised immune system.
- Contamination of tissue culture.
- Not in pregnancy.
- Less safe than inactivated vaccine.

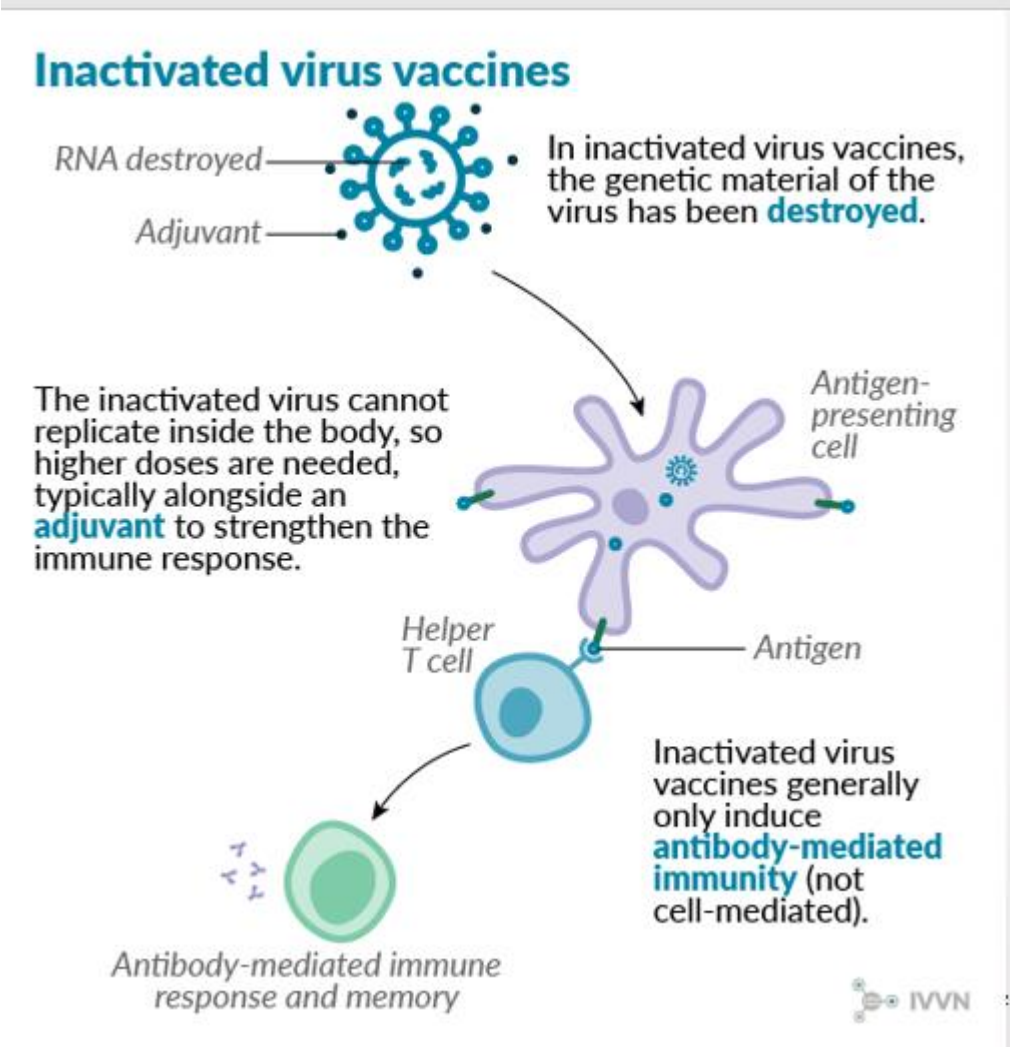
Inactivated Vaccines

- Inactivated vaccines use the **killed version** of the germ that causes a disease.

Example

COVAXIN

- Developed by Bharat Biotech, Hyderabad in collaboration with the Indian Council of Medical Research's National Institute of Virology, Pune.
- It is an inactivated vaccine which is developed by inactivating (killing) the live microorganisms that cause the disease.



Positives

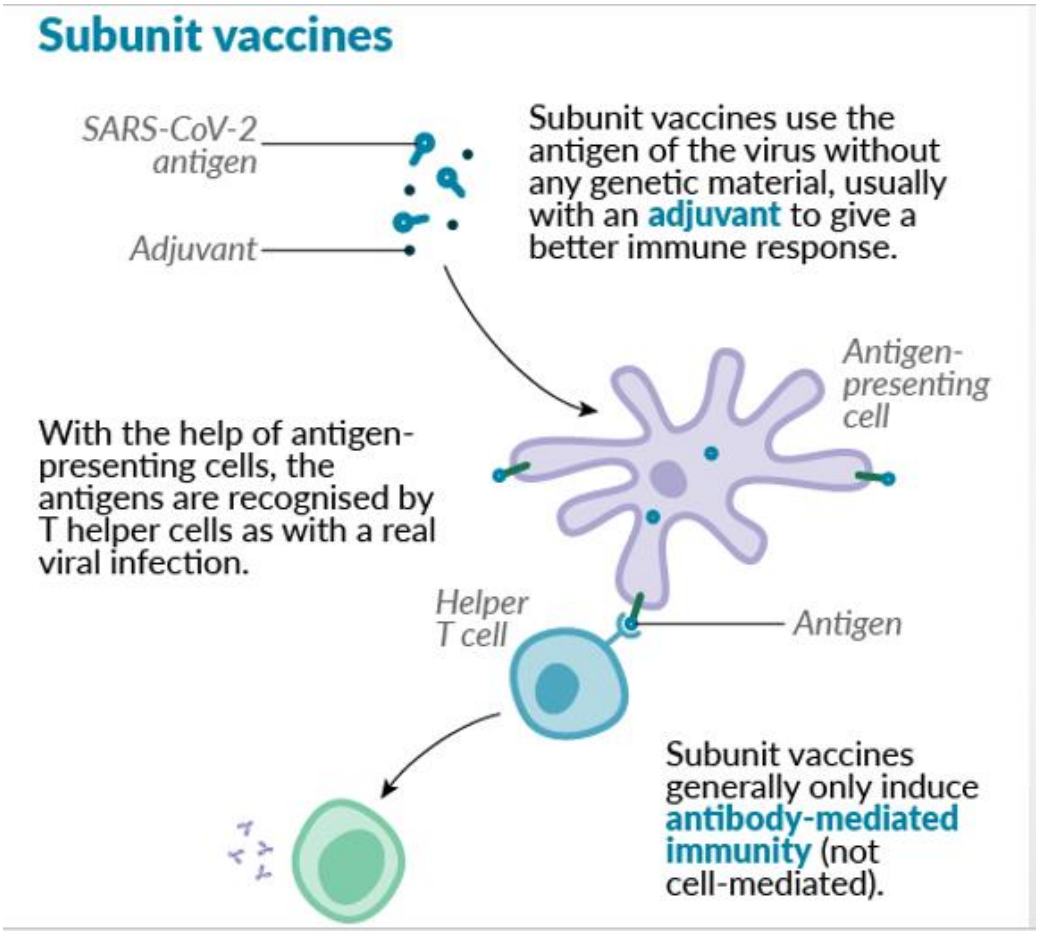
- No risk of the vaccine triggering disease.
- Can be safely given to a person with an impaired immune system response.
- Simple to manufacture.

Challenges

- Usually require multiple doses.
- Immunity weaker than Live attenuated.

Subunit, recombinant, polysaccharide, and conjugate vaccines

- Subunit, recombinant, polysaccharide, and conjugate vaccines use specific pieces of the germ — like its protein, sugar, or capsid (a casing around the germ).
- Example
    - Novavax



Positives

- Cannot replicate inside the body- Safe.

Challenges

- Usually require multiple doses.
- immune response induced by subunit vaccines is not as strong.

<u>Viral vector Vaccines</u>

- Viral vector vaccines use a modified version of a different virus as a vector to deliver protection.

Example

- **COVISHIELD**

Positives

- Strong immune response.

Challenges

- Previous exposure to the vector could reduce effectiveness.
- Relatively complex to manufacture.

How adenovirus vaccines work

Genetic instructions are given to human cells to make part of the virus

A section of the Covid-19 virus's genome that makes the 'spike protein' is isolated

The code is put into a harmless virus, like the common cold, known as an adenovirus

Once injected, the adenovirus connects to human cells and latches on to proteins on their surface

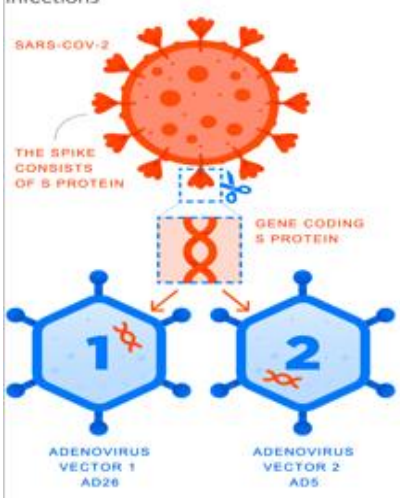
It then enters the cell, which reads the code contained in the genome and makes the Covid-19 'spike protein'

Sources: NHS; FT research
© FT

Two-vector vaccine against coronavirus

Vector creation

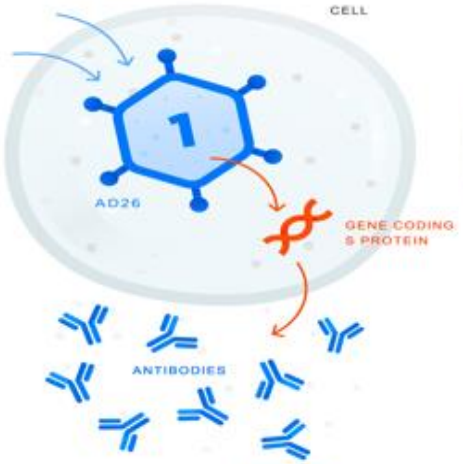
A vector is a virus that lacks a gene responsible for reproduction and is used to transport genetic material from another virus that is being vaccinated against into a cell. The vector does not pose any hazard to the body. The vaccine is based on an adenoviral vector which normally causes acute respiratory viral infections



A gene coding S protein of SARS-COV-2 spikes is inserted into each vector. The spikes form the "crown" from which the virus gets its name. The SARS-COV-2 virus uses spikes to get into a cell

First vaccination

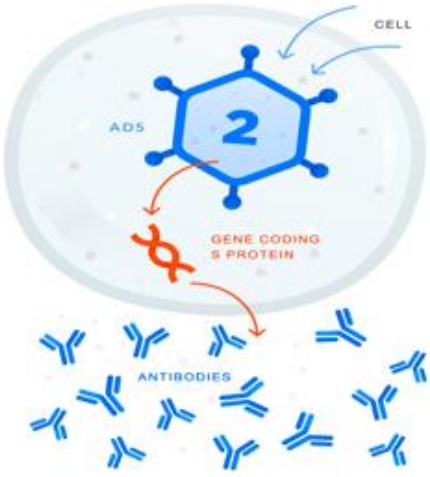
Vector with a gene coding S protein of coronavirus gets into a cell



The body synthesizes S protein, in response, the production of immunity begins

Second vaccination

Repeated vaccination takes place in 21 days

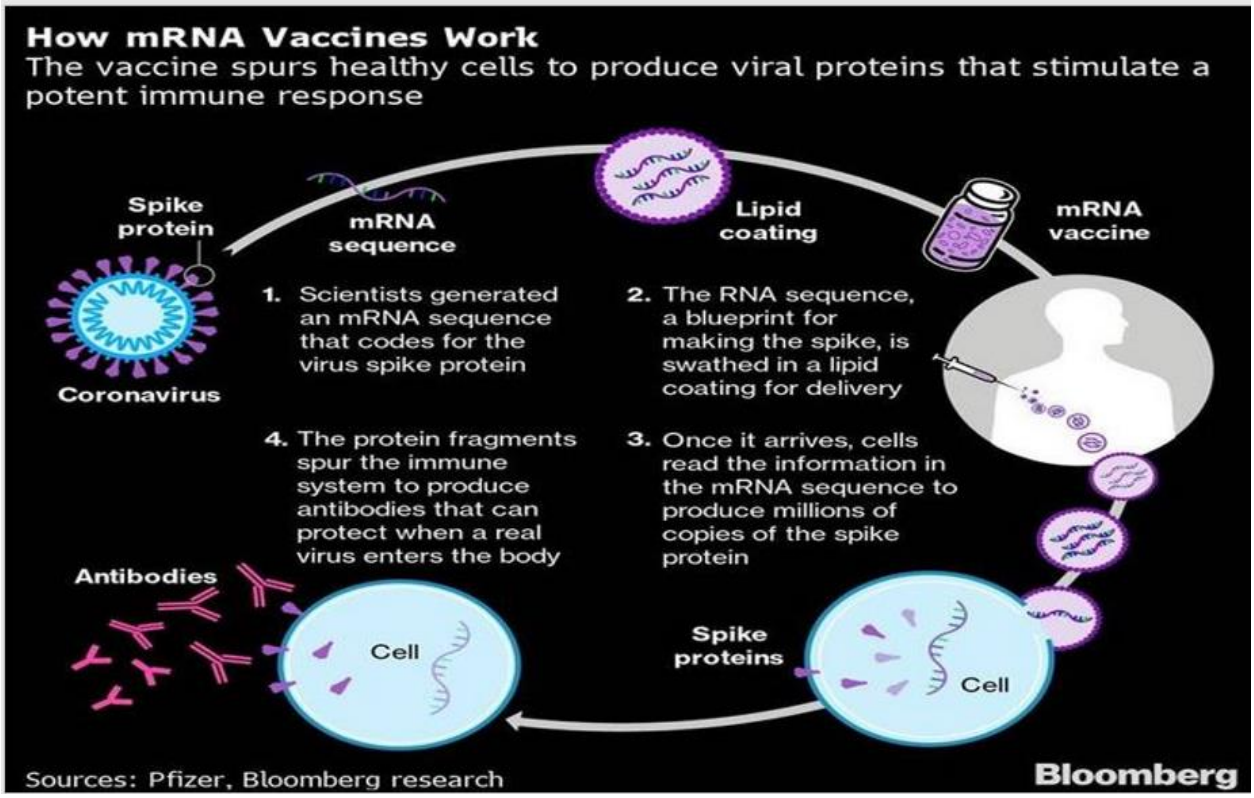


The vaccine based on another adenovirus vector unknown to the body boosts the immune response and provides for long-lasting immunity

The use of two vectors is a unique technology of the Gamaleya Center making the Russian vaccine different from other adenovirus vector-based vaccines being developed globally

mRna Vaccine

- The Department of Biotechnology (DBT), Ministry of Science & Technologyhas announced that it has approved additional funding towards clinical studies of India's 'first of its kind' mRNA-based COVID-19 vaccine - HGCO19, developed by Pune-based biotechnology company Gennova Biopharmaceuticals Ltd.



DNA Vaccine

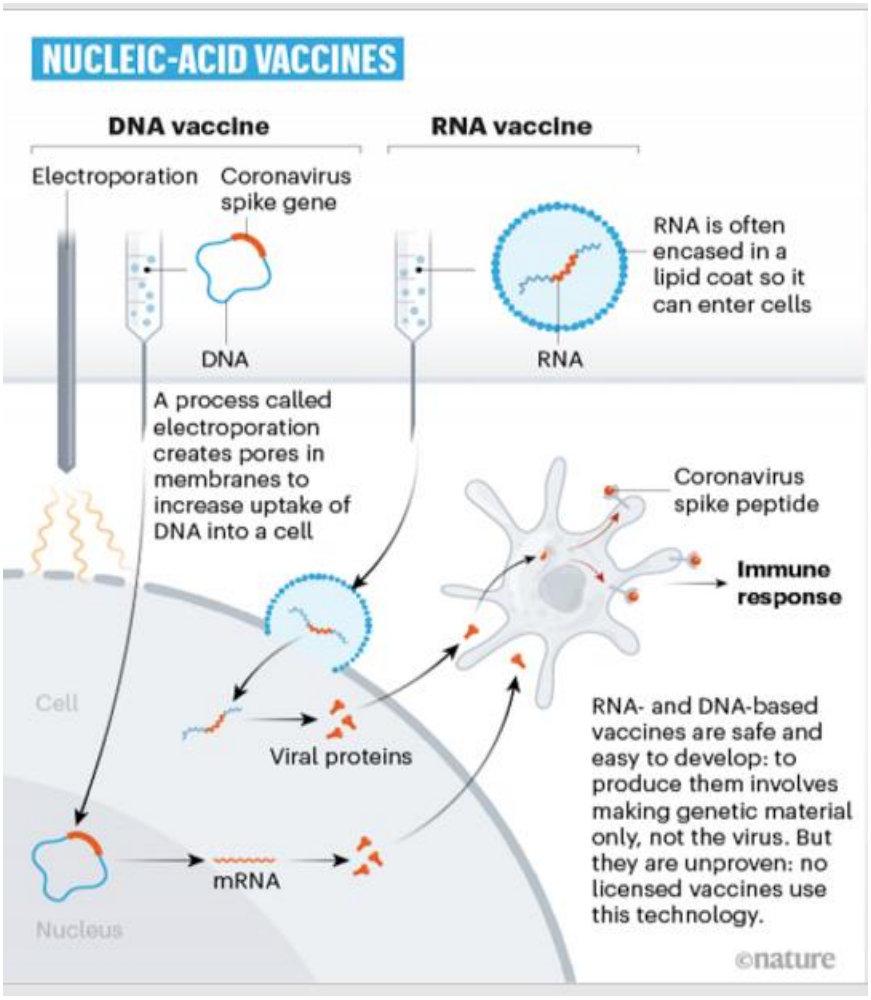
- DNA vaccines, which are often referred to as the third-generation vaccines, use engineered DNA to induce an immunologic response in the host against bacteria, parasites, viruses, and potentially cancer.

Positives RNA/DNA Vaccine

- No live components, so no risk of the vaccine triggering disease.
- Relatively easy to manufacture.

Challenges

- Some RNA vaccines require ultra-cold storage.

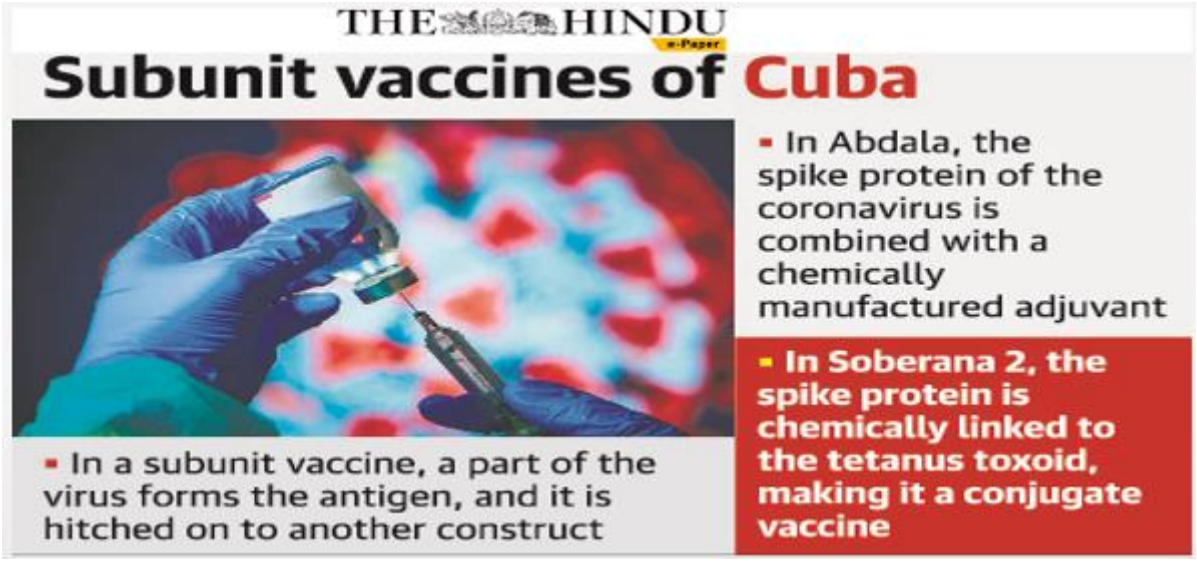


How some of the Covid-19 vaccines compare

Company	Doses	Storage
RNA		
Pfizer (BioNTech)	2	-80 to -60°C (6 months) and 2 to 8°C (for up to 5 days)
Moderna	2	-25 to -15°C (6 months) and 2 to 8°C (for 30 days)
Viral vector		
Oxford-AstraZeneca	2	2 to 8°C (6 months)
Sputnik V (Gamaleya)	2	-18.5°C (liquid form) 2 to 8°C (dry form)
Johnson & Johnson (Janssen)	1	2 to 8°C (3 months)
Inactivated virus		
CoronaVac (Sinovac)	2	2 to 8°C
Sinopharm	2	2 to 8°C
Covaxin (Bharat Biotech)	2	2 to 8°C
Protein-based		
Novavax	2	2 to 8°C

World's first Conjugate Vaccine for COVID-19

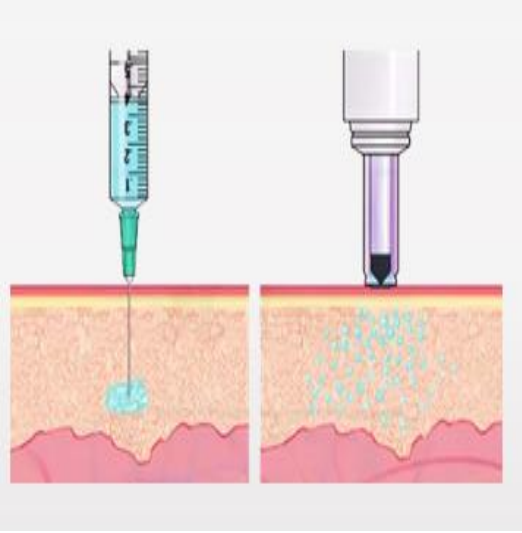
- In Soberana 2, the spike protein is chemically linked to the tetanus toxoid, making it a conjugate vaccine.

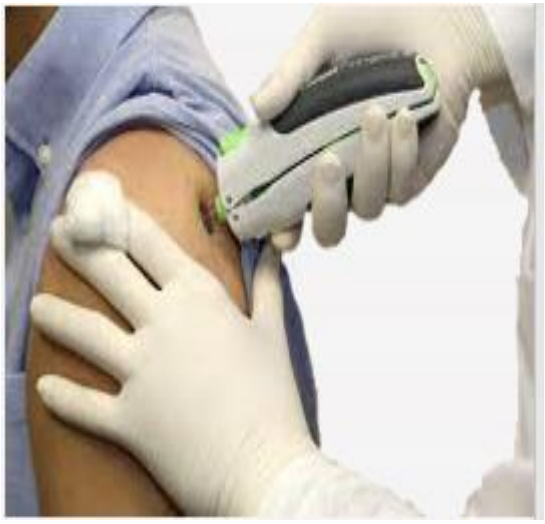


Needle-free system to administer Zydus Cadila's ZyCoV-D vaccine (Plasmid DNA Vaccine)

Tropis needle-free system

- Tropis delivers vaccines intradermally; technology that propels liquid at high pressure to deliver vaccines through the skin without utilising needles.





UV-C Technology

Union Minister of State for Science and Technology has said that **Ultraviolet-C or UV-C Disinfection Technology will soon be installed in Parliament** for the "mitigation of airborne transmission of SARS-COV-2

- The UV-C air duct disinfection system was developed by **CSIR-CSIO** (Central Scientific Instruments Organisation)
- The system is designed to fit into any existing air-ducts and the virucidal dosages using UV-C intensity and residence time can be optimised according to the existing space.
- The virus is deactivated in any aerosol particles by the calibrated levels of UV-C light.
- It can be used in auditoriums, malls, educational Institutions, AC buses, and in railways.

What is UV?

- Ultraviolet (UV) is a type of light or radiation naturally emitted by the Sun. It covers a wavelength range of 100-400 nm.
- The human visible light ranges from 380–700 nm.
- UV is divided into three bands: UV-C (100-280 nm), UV-B (280-315 nm) and UV-A (315-400 nm).

UV-A/B/C

- UV-A and UV-B rays from the Sun are transmitted through our atmosphere and all UV-C is filtered by the ozone layer.
- UV-A rays can penetrate the middle layer of your skin or the dermis and can cause aging of skin cells and indirect damage to cells' DNA
- UV-B rays can only reach the outer layer of our skin or epidermis and can cause sunburns and are also associated with skin cancer.
- UV-C radiation from man-made sources has been known to cause skin burns and eye injuries.

Can UV-C kill coronavirus ?

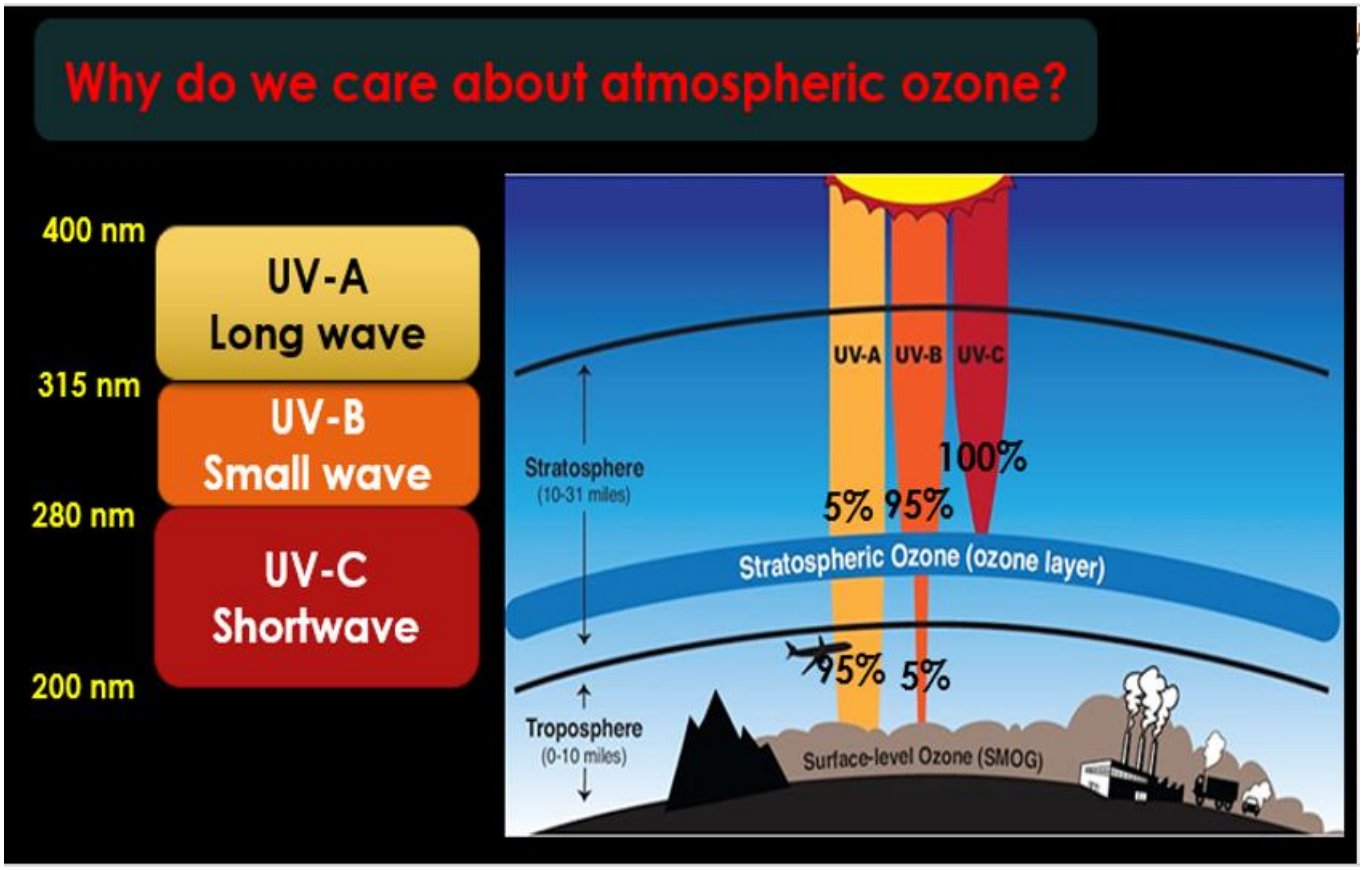
- UV-C radiation (wavelength around 254 nm) has been used for decades to disinfect the air in hospitals, laboratories, and also in water treatment.
- But these conventional germicidal treatments are done in unoccupied rooms as they can cause health problems.
- A paper published in June 2020 in Scientific Reports noted that UV-C radiation can destroy the outer protein coating of the SARS-Coronavirus.

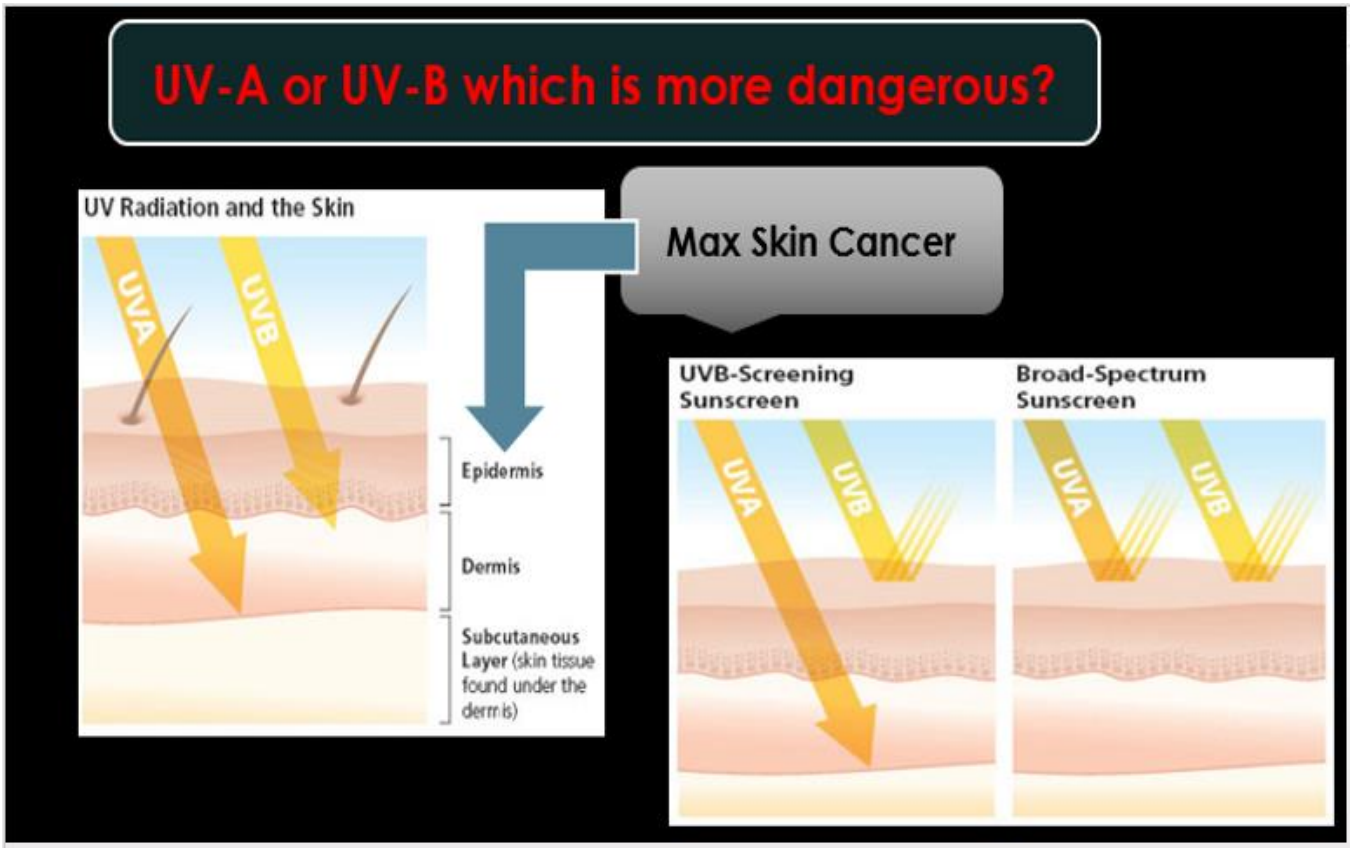
Harmful effects

- Researchers from the Indian Institute of Technology-Kanpur, who developed a portable disinfectant device that used UV-C radiation (222-254 nm), noted that the device was specifically developed to disinfect non-living things.
- UV-C radiation used in this device could be harmful to the skin and eyes of the living beings, therefore the operator of the device must use spectacles with UV-C radiation protection and use this device safely.
- It can take hours to get sunburn from UV-B, but with UV-C it takes seconds.

Not harmful

- The release from our Ministry of Science and Technology does not state the wavelength or duration used, but mentioned that the product was tested for more than 99% disinfection.
- Few studies have shown that far-UVC light (207–222 nm) does not harm mammalian skin.
- Far-UVC light has a very limited range and cannot penetrate through the outer dead-cell layer of human skin or the tear layer in the eye, so it's not a human health hazard.
- But because viruses and bacteria are much smaller than human cells, far-UVC light can reach their DNA and kill them.





Covid-19 endemicity

Reason

- Disease pathogens that don't have animals (another species) as a reservoir alone can be eradicated.
- If there is a virus/pathogen that is present in some animal reservoir like bats, camels or civet cats, then it can transmit again once the level of immunity wanes in the population against the disease caused by it.
- In the case of coronavirus disease, it will continue to circulate as it is present in the animal reservoir.

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