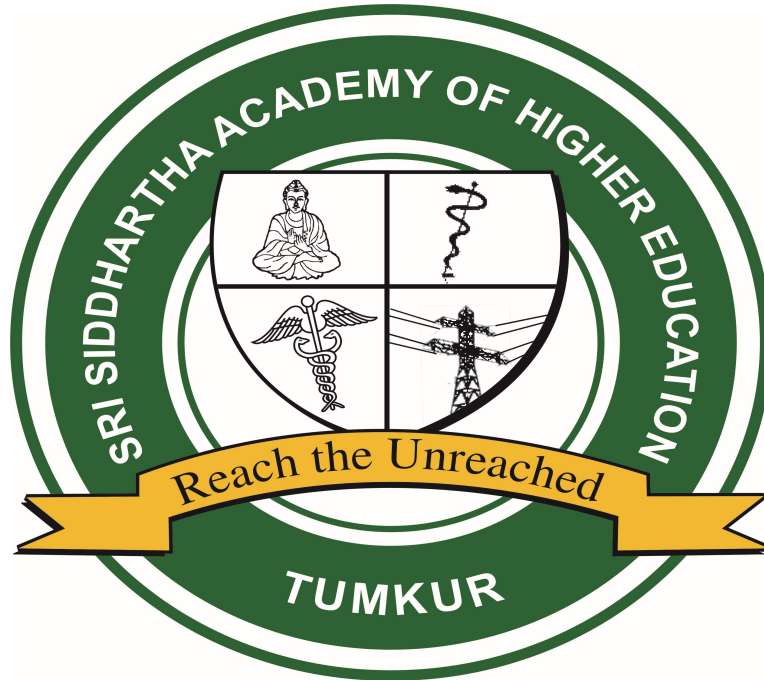


# Sri Siddhartha Academy of Higher Education



## COVID -19: BULLETIN:-1

02/05/2020

Under the **Guidance** of Honorable Vice Chancellor Dr. Balakrishna Shetty P, Sri Siddhartha Academy of Higher Education has prepared COVID-19 Bulletin.

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## POLITICAL SCENARIO

### USA

- Three US states have allowed some shops to reopen after measures imposed to curb the spread of the coronavirus, as the country's death toll passed 51,000.
- Salons and spas could reopen in Georgia and Oklahoma while Alaska lifted restrictions on restaurants.
- New York to allow tests in pharmacies
- Georgia, Oklahoma and Alaska lift some restrictions despite warnings that it may be too soon.
- More US states begin lifting virus lockdown orders.

### SPAIN

- Spain says it has overcome the 'toughest phase' of coronavirus as the country reports its lowest number of deaths in one day for more than a month.
- Spain's children run free from lockdown - but not all
- Spanish PM Sánchez sees 'slow and gradual' end to lockdown

### ITALY

- Lockdown's heavy toll on Italy's mental health.
- Coronavirus in Italy may have started unnoticed in January
- Italian COVID-19 cases fall as Rome grapples with easing lockdown
- Italy reopen first in 'Phase Two' of lockdown
- Italian PM vows to reopen schools in September

### FRANCE

- France has banned the online sale of nicotine products and limited their sale in pharmacies, after researchers suggested that nicotine may play a role in protecting against coronavirus.
- The authorities are planning to gradually lift the lockdown from 11 May.
- Number of Covid-19 hospital cases in France continues to fall
- With the country's health system still under strain, Prime Minister Edouard Philippe will set out his strategy for ending the lockdown before parliament on Tuesday.
- Ministers have identified 17 priorities for gradually bringing the country out of eight weeks of confinement in a "controlled, progressive" manner from May 11.
- Schools in some areas are expected to reopen, with companies returning to work and public transport going back to a more normal timetable

### GERMANY

- German Chancellor Angela Merkel has urged the nation to remain "clever and cautious" in handling the next phase of the coronavirus epidemic.
- Germany gears up for second coronavirus wave amid steps back to normalcy
- German official asks Poland to ease border restrictions
- Across Germany, the first pupils returned to the classroom in about half of all the country's 16 states
- Wearing a face mask became obligatory throughout Germany starting on Monday.
- German government set to introduce permanent 'right to work from home'

<b>UK</b>
<ul style="list-style-type: none"> <li>• People should seek medical care when they need it and not be put off by the coronavirus epidemic, say doctors, charities and the health service.</li> <li>• The first human trial in Europe of a coronavirus vaccine has begun in Oxford.</li> </ul>
<ul style="list-style-type: none"> <li>• Boris Johnson's return to work 'a boost for the country'</li> <li>• Care home staff struggling to get tests</li> <li>• Military to test key workers in mobile units</li> </ul>
<ul style="list-style-type: none"> <li>• Prime Minister Boris Johnson says the UK is at point of "maximum risk" and he won't ease restrictions too quickly</li> <li>• Rare syndrome seen in UK children, this includes "multi-system inflammation" with flu-like symptoms.</li> </ul>

<b>RUSSIA</b>
<ul style="list-style-type: none"> <li>• Authorities in Russia's western exclave of Kaliningrad will end the region's coronavirus lockdown for most residents starting April 29, Governor Anton Alikhanov said, making it the first Russian region to do so.</li> <li>• All of Moscow's doctors and nurses will take an express test to detect the presence of coronavirus antibodies and test their immunity to the virus, Rakova told reporters.</li> </ul>
<ul style="list-style-type: none"> <li>• Two Russian lawmakers — Leonid Kalashnikov and Dmitry Novikov, both of the Communist Party — have been infected with the coronavirus</li> </ul>
<ul style="list-style-type: none"> <li>• President Vladimir Putin is not waiting out the coronavirus pandemic in a bunker, his spokesman Dmitry Peskov said.</li> <li>• Russia's coronavirus lockdown measures may be gradually lightened as soon as May 12</li> </ul>

<b>CHINA</b>
<ul style="list-style-type: none"> <li>• China has rejected calls for an independent international investigation into the origin of the coronavirus.</li> <li>• Scientists have poured cold water on speculation that the virus could have been engineered in a Wuhan laboratory.</li> </ul>
<ul style="list-style-type: none"> <li>• China says all Wuhan virus patients discharged</li> </ul>
<ul style="list-style-type: none"> <li>• Schools start reopening in China's biggest cities</li> </ul>

<b>INDIA</b>
<ul style="list-style-type: none"> <li>• Coronavirus lockdown: Nobel prize economist says India must do more for poor</li> <li>• India's main medical research organisation has asked states to pause the use of rapid testing kits over concerns that they are faulty.</li> </ul>
<ul style="list-style-type: none"> <li>• Hotspot districts moving towards being non-hotspot districts: Health Minister Harsh Vardhan</li> <li>• Trials of Mw vaccine for treatment of Covid-19 patients to be initiated soon: PGIMER Chandigarh</li> </ul>
<ul style="list-style-type: none"> <li>• 10 TablighiJamaat members who recovered from Covid-19 donate blood plasma to treat seriously ill coronavirus patients in Delhi</li> <li>• 5 NE states completely Covid-19 free</li> <li>• ICMR advises states to go for RT-PCR test</li> </ul>

## EPIDEMIOLOGY SCENARIO

Country	Current Scenario*	Strategic Measures	Impact on the pandemic
<b>USA</b>	1,035,765	Community containment measures were delegated to states and were not backed by epidemiological data or a clear central directive.	This may have led to extensive spread of the infection across the country
<b>Spain</b>	2,32,128	Six weeks of General Lockdown (28 <sup>th</sup> March 2020) Will continue into May with some restrictions (further 15 days)	The rate of increase of new daily infections has dropped from 35% to 1.5%. The number of people cured exceeds the number of new infections
<b>Italy</b>	201,505	Flights from China were cancelled and thermal screening was started after the first case. Lockdown was not implemented universally.	Might have led to greater spread of the disease, in a country with high elderly population.
<b>France</b>	165,911	Measures were taken to reduce contact and travel to minimum throughout France from 16 <sup>th</sup> March until May 11	There was a drop in COVID 19 deaths and health ministry reaffirmed that a plateau appeared have been reached.
<b>Germany</b>	159,912	Infection rate has increased to 1.0 from 0.7 after the lockdown measures were eased	Number of new cases per day have increased
<b>UK</b>	161,145	Isolation of positive cases and quarantine of contacts to push the epidemic to the summer which would help the NHS to cope better. Reaching 100,000 tests per day	Recently reported lowest daily rise in COVID19 deaths in nearly four weeks.
<b>China</b>	82,858	Public gatherings were cancelled though countrywide lockdown was never implemented. Neighbour informs about the neighbour strategy. Strict large scale contact tracing, testing and isolation were conducted.	Delay in notification and response may have contributed to the spread of the disease in mainland China and other countries of the world.
<b>India</b>	31,332	Lockdown imposed for 3 weeks 25 <sup>th</sup> March till 14 <sup>th</sup> April and it was extended for another 3 weeks till 3 <sup>rd</sup> May. The states are instructed to plan for the way ahead after two phases of lockdown.	The spread of the virus has been contained by enforcing necessary public health measures.

\*Total cases as on 29<sup>th</sup> April 2020

## EPIDEMIOLOGY SCENARIO

**Agent:** Severe Acute Respiratory Syndrome Coronavirus 2 (**SARS-CoV-2**)

**Source** – not been determined yet, wild animals – bats

**Intermediate host** – pangolin

**Human to human transmission** – respiratory droplets ( $< 4$  micrometers – aerosol?), direct contact, indirect contact through surface contamination. The virus is also shed in fecal matter for several weeks, but it is likely a non replicating form of the virus. Patient is infectious during incubation period.

**Incubation Period** – 2-14 days

**Case Fatality Rate** = 3.4% as compared to seasonal flu (CFR  $< 1\%$ )

**Secondary Attack Rate** = 35% (27 - 44)

**Basic Reproduction Number  $R_0$**  = 2.4

**Serial interval**- 4 days

**‘Stringency Index’** – describes the overall severity of a country’s response to the coronavirus outbreak and allows responses to be compared

The index takes into account seven control measures – school closures and restrictions on people’s movements.

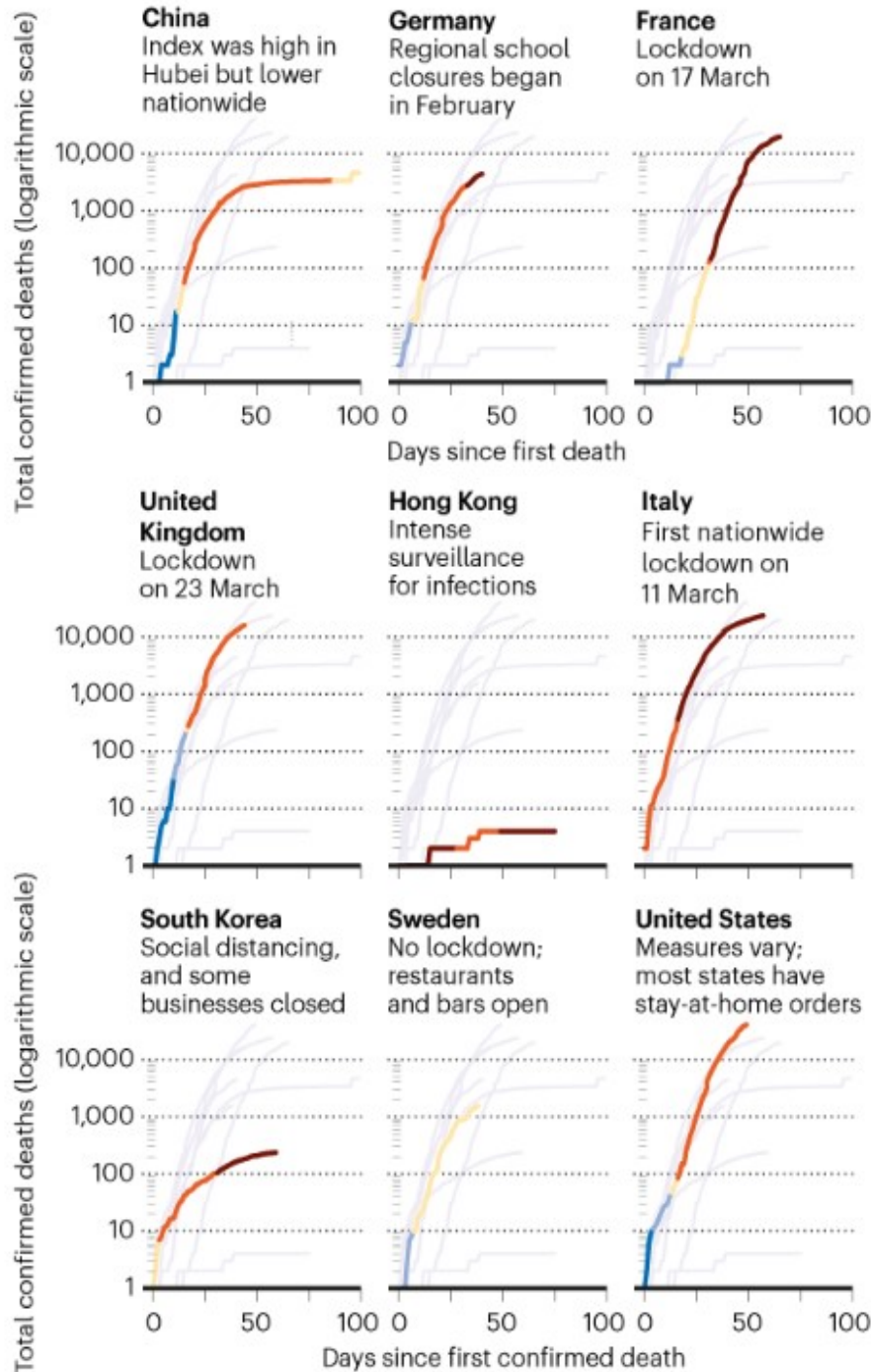
**SEIR model** – Susceptible-Exposed-Infectious-Recovered model to capture the natural history of COVID19 and its transmission dynamics. This model has been adopted by ICMR.

**Sieges surveillance** – tracking the spread of the disease by tracing individuals.

## PANDEMIC PROTECTIONS

Researchers have created a 'stringency index' that describes the overall severity of a country's response to the coronavirus outbreak and allows responses to be compared. The index takes into account seven control measures, such as school closures and restrictions on people's movements.

**Stringency Index:** Low — High



Confirmed deaths undercount true COVID-19 mortality. Stringency index developed by the Oxford COVID-19 Government Response Tracker. Data downloaded on 21 April; countries vary in day of most recent data update.

©nature

## CLINICAL SCENARIO

### CDC USA:-

Reports new symptoms like chills, repeated shaking with chills, muscle pain, headache and new loss of taste or smell.

These symptoms are not among the ones listed on the WHO FAQ webpage.

WHO list of symptoms include fever dry cough, tiredness, aches and pains, nasal congestion, sore throat and diarrhea.

### NHS UK:-

There is a growing concern that a corona virus related inflammatory syndrome is emerging in the children in the UK. This includes multi system inflammation with flu like symptoms.

### WUHAN CHINA:-

At two hospitals in wuhan, china researchers found bits of viruses genetic material floating in the air of hospital toilets, an indoor space, housing large crowds and rooms where medical staff takeoff protective gear.

### USA:-

Details of sunlight study conducted in USA, The amount of virus on a non porous surface shrunk by half in just 2 minutes when sunlight was present. The temperate was 21- 24 degree celsius and humidity was 80%. The amount of virus suspended in air shrunk to half its amount in one and half minutes at room temperate and 20% humidity.

### WHO:-

Children may be at relatively low risk from severe disease and death from the respiratory illness caused by NOVEL corona virus, but can be at high risk from other diseases that can be prevented from vaccine like polio, measles, cholera, yellow fever and meningitis.

# TESTING STRATEGY

## COVID-19 TESTING

### Test methods

#### RT-PCR

Using real-time [reverse transcription polymerase chain reaction](#) (rRT-PCR) the test can be done on respiratory samples obtained by various methods, including a [nasopharyngeal swab](#) or [sputum](#) sample. Results are generally available within a few hours to 2 days. The RT-PCR test performed with throat swabs is only reliable in the first week of the disease. Later on the virus can disappear in the throat while it continues to multiply in the lungs. For infected people tested in the second week, alternatively sample material can then be taken from the deep airways by suction catheter, or coughed up material (sputum) can be used.

The Malaysian Institute for Medical Research (IMR) successfully produced the “primers and probes” specific to SARS-CoV-2 on the very same day.

[Public Health England](#) developed a test by 10<sup>th</sup> January, using real-time RT-PCR (RdRp gene) assay based on oral swabs. The test detected the presence of any type of coronavirus including specifically identifying SARS-CoV-2.

In China, [BGI Group](#) was one of the first companies to receive emergency use approval from China's [National Medical Products Administration](#) for a PCR-based SARS-CoV-2 detection kit

US commercial labs began testing in early March 2020. As of 5<sup>th</sup> March [LabCorp](#) announced nationwide availability of COVID-19 testing based on RT-PCR. [Quest Diagnostics](#) similarly made nationwide COVID-19 testing available as of 9<sup>th</sup> March .

In Russia, the COVID-19 test was developed and produced by the [State Research Center of Virology and Biotechnology VECTOR](#).

On 12<sup>th</sup> March, [Mayo Clinic](#) was reported to have developed a test to detect COVID-19 infection.

On 19<sup>th</sup> March , the FDA issued EUA to [Abbott Laboratories](#) for a test on Abbott's m2000 system; the FDA had previously issued similar authorization to [Hologic](#), [LabCorp](#), and [Thermo Fisher Scientific](#). On 21<sup>st</sup> March, [Cepheid](#) similarly received an EUA from the FDA for a test that takes about 45 minutes on its GeneXpert system; the same system that runs the [GeneXpert MTB/RIF](#).

#### Isothermal amplification assays

On 27<sup>th</sup> March , the FDA approved an "automated assay" from Abbott Diagnostics that uses an [isothermal](#) nucleic acid amplification method

#### Serology

Most [serology tests](#) are in the research stage of development. As of 15<sup>th</sup> April, four tests had been approved for diagnosis in the United States, all under [FDA Emergency Use Authorization](#) (EUA). The tests are by Chembio Diagnostic System, Ortho Clinical Diagnostics, Mount Sinai Laboratory and Cellex. All four tests must be performed in a laboratory

#### Medical imaging

Chest CT scans are not recommended for routine screening. Radiologic findings in COVID19 are not specific. Typical features on CT initially include bilateral multilobar [ground-glass opacities](#) with a peripheral, asymmetric and posterior distribution. [Subpleural dominance](#), [crazy paving](#), and [consolidation](#) may develop as the disease evolves.



### **Centres for Disease Control and Prevention**

- <https://www.cdc.gov/coronavirus/2019-ncov/php/laboratory-work.html>
- <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/testing.html>
- <https://www.cdc.gov/coronavirus/2019-nCoV/lab/guidelines-clinical-specimens.html>
- <https://www.cdc.gov/coronavirus/2019-ncov/testing/testing-overview.html>
- <https://www.cdc.gov/coronavirus/2019-ncov/testing/serology-overview.html>
- <https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-criteria.html>
- <https://www.cdc.gov/coronavirus/2019-nCoV/lab/lab-biosafety-guidelines.html>
- <https://www.cdc.gov/coronavirus/2019-ncov/lab/rt-pcr-panel-primer-probes.html>
- <https://www.cdc.gov/coronavirus/2019-ncov/lab/tool-virus-requests.html>
- <https://www.cdc.gov/coronavirus/2019-ncov/lab/testing-laboratories.html>

### **World Health Organization**

- <https://www.who.int/who-documents-detail/2019-novel-coronavirus-overview-of-the-state-of-the-art-and-outline-of-key-knowledge-gaps-slides>
- [https://www.who.int/who-documents-detail/covid-19-public-health-emergency-of-international-concern-\(phec\)-global-research-and-innovation-forum](https://www.who.int/who-documents-detail/covid-19-public-health-emergency-of-international-concern-(phec)-global-research-and-innovation-forum)
- <https://www.who.int/who-documents-detail/who-working-group-viruses-reagents-and-immune-assays>

### **Ministry of Health and Family Welfare. Government of India.**

- Specimen Collection, Packaging and Transport Guidelines for 2019 novel Coronavirus (2019-nCoV)  
[https://www.mohfw.gov.in/pdf/5Sample%20collection\\_packaging%20%202019-nCoV.pdf](https://www.mohfw.gov.in/pdf/5Sample%20collection_packaging%20%202019-nCoV.pdf)
- ICMR Strategy for COVID-19 testing in India  
<https://www.mohfw.gov.in/pdf/ICMRstrategyforCOVID19testinginIndia.pdf>
- Revised Strategy of COVID19 testing in India  
<https://www.mohfw.gov.in/pdf/ICMRrevisedtestingstrategyforCOVID.pdf>  
<https://www.mohfw.gov.in/pdf/LabTestingAdvisory.pdf>
- Notification of ICMR guidelines for COVID-19 testing in Private Laboratories  
<https://www.mohfw.gov.in/pdf/NotificationofICMguidelinesforCOVID19testinginprivatelaboratoriesIndia.pdf>
- Advisory to start rapid antibody based blood test for COVID-19  
<https://www.mohfw.gov.in/pdf/Advisory&StrategyforUseofRapidAntibodyBasedBloodTest.pdf>, <https://www.mohfw.gov.in/pdf/ProtocolRapidAntibodytest.pdf>
- Guidelines for Handling, Treatment and Disposal of Waste Generated during Treatment/Diagnosis/ Quarantine of COVID-19 Patients  
<https://www.mohfw.gov.in/pdf/63948609501585568987wasteguidelines.pdf>
- Hospitals can't insist on coronavirus test before treatment, says Govt.

### **Indian Council of Medical Research, New Delhi**

- Strategy of COVID19 testing in India  
[https://www.icmr.gov.in/pdf/covid/strategy/Strategy\\_COVID19\\_testing\\_India.pdf](https://www.icmr.gov.in/pdf/covid/strategy/Strategy_COVID19_testing_India.pdf)
- Strategy for COVID19 testing in India (Version 4, dated 09/04/2020)

[https://www.icmr.gov.in/pdf/covid/strategy/Strategy\\_for\\_COVID19\\_Test\\_v4\\_09042020.pdf](https://www.icmr.gov.in/pdf/covid/strategy/Strategy_for_COVID19_Test_v4_09042020.pdf)

- Protocol for using 'Rapid antibody test' in Hot area - epidemiological studies and surveillance  
[https://www.icmr.gov.in/pdf/covid/strategy/Rapid\\_Antibody\\_test\\_Protocol.pdf](https://www.icmr.gov.in/pdf/covid/strategy/Rapid_Antibody_test_Protocol.pdf)
- Strategy for COVID19 testing for pregnant women in India  
[https://www.icmr.gov.in/pdf/covid/strategy/COVID19\\_Testing\\_Strategy\\_for\\_Pregnant\\_Women.pdf](https://www.icmr.gov.in/pdf/covid/strategy/COVID19_Testing_Strategy_for_Pregnant_Women.pdf)
- Protocol for using Rapid antibody test – regarding  
[https://www.icmr.gov.in/pdf/covid/strategy/Letter\\_to\\_Chief\\_Secretary.pdf](https://www.icmr.gov.in/pdf/covid/strategy/Letter_to_Chief_Secretary.pdf)
- "ICMR has validated Truenat-TM beta CoV test on TruelabTM workstation and has recommended it as a screening test for coronavirus testing."
- Advisory for use of Cartridge Based Nucleic Acid Amplification Test (CBNAAT) using Cepheid Xpert Xpress SARS-CoV2
- ICMR Specimen Referral Form for COVID-19 (SARS-CoV2)  
[https://www.icmr.gov.in/pdf/covid/labs/SRF\\_v9.pdf](https://www.icmr.gov.in/pdf/covid/labs/SRF_v9.pdf)
- Status of new COVID-19 Govt. & Private laboratories for RTPCR based testing as per request of the State Govt. <https://www.icmr.gov.in/ctestlab.html>
- List of Private Laboratories to test COVID-19  
[https://www.icmr.gov.in/pdf/covid/labs/Pvt\\_Labs\\_28042020.pdf](https://www.icmr.gov.in/pdf/covid/labs/Pvt_Labs_28042020.pdf)
- Total Operational (initiated independent testing) Government Laboratories reporting to ICMR: [https://www.icmr.gov.in/pdf/covid/labs/Govt\\_Labs\\_28042020.pdf](https://www.icmr.gov.in/pdf/covid/labs/Govt_Labs_28042020.pdf)
- **Time Line of COVID19 (lab wise)**

**Day 0:** infected

**Upto Day 5:** Onset of symptoms

**Day 7:** IgM positive (D7- D 21)

**Day 14:** IgG positive

**Days 1-28:** SARS CoV2 RNA & Antigens will be positive

**Day 21:** IgM disappears

**Day 28:** SARS CoV2 RNA & Antigens disappear

**D0 - D5:** ASYMPTOMATIC PHASE

**D0 -D7:** WINDOW PERIOD (ONLY PCR IS POSITIVE IN THIS PHASE)

**D 14- D21:** DECLINE PHASE (STILL INFECTIVE)

**D 21- D28:** CONVALESCENCE PHASE (STILL INFECTIVE)

#### **NEW CONCEPTS**<https://www.icmr.nic.in/>

- Researchers have identified at least eight strains of the novel coronavirus that has infected more than one million people across the globe, and say the mutations are useful in determining just how the virus is spreading.
- The strain of new coronavirus in India is not as virulent as the ones which are devastating Italy, Spain and the US. In an in depth genomic analysis of rapidly revolving SARS-CoV-2(COVID-19) viruses, top Indian microbiologist Rup Lal, and his team of 16 scientists have discovered that strain found in India, matches with the sequence of new coronavirus found in Wuhan, and is less virulent.
- A team of scientists from Peking University and Institute Pasteur of Shanghai have identified the two viral strains as S and L types.
- There could as many as 11 types of SARS CoV 2 -- the virus behind the global COVID-19 pandemic -- but a type that is more adapted to infect human lungs has emerged as the dominant type driving the outbreak worldwide, including in India, two

Indian scientists have found.

- The scientists attached with the National Institute of Biomedical Genomics under the department of biotechnology of the Union government have discovered that from O or ancestral type of virus that originated from Wuhan, China, there are 10 more types that have evolved over time but a type named A2a started to overtake other types.
- The A2a type of the coronavirus has gained this efficiency because of the amino acid change to glycine from aspartic acid. All other types of SARS-CoV-2 possess aspartic acid," the researchers found.

## **THERAPEUTIC SCENARIO**

### **Current Drugs used as far as management of Novel Corona Virus is concerned**

*(Guidelines on Clinical Management of COVID – 19 as per Ministry of Health, Government of India)*

The following drugs may be considered as an off – label indication in patients with severe disease and requiring ICU management as per the current directive by the:

- **Hydroxychloroquine** (Dose 400mg BD – for 1 day followed by 200mg BD for 4 days)  
In combination with
- **Azithromycin** (500 mg OD for 5 days)

These drugs should be administered under close medical supervision, with monitoring for side effects including QTc interval

An NGO, People for Better Treatment has filed a Writ petition on the controversial, unproven, non-specific and potentially toxic off-label” use of anti-malarial drug **Hydroxychloroquine** and broad-spectrum antibiotic **Azithromycin** with the supreme court, which has been referred to ICMR

### **Covid- 19 Registered Trails and Analysis**

There are around a total of 382 registered trials at present now which are ongoing. There are 23 registered studies on Chloroquine around the world. Some of the important studies being done are Chloroquine and hydroxychloroquine (23), Corticosteroids (6), Umifenovir (5), Interferons (4), Favipiravir (4), ASC09HIV(protease inhibitor) (4), Azvudine (4), Inhaled gases (4), Lopinavir + ritonavir (2), and Remdesivir (2).

### **Experiences on Drugs used in management of Novel Corona Virus around the World**

**Remdesivir** , a potential drug used for Ebola is found to be useful in management of Coronavirus. Hopes have been raised after an infected Italian man in his 70s recovered with the help of an experimental Ebola drug, say the Doctors at San Martino Hospital in Genoa

Experts at the University of Palermo in Italy, as well as a team in Israel, collated the research on **Chloroquine phosphate** in treating the coronavirus. South Korea and China both say the drug is an 'effective' antiviral treatment against the disease.

As far as the less toxic alternative **hydroxychloroquine** is concerned, Wuhan Institute of Virology scientists admitted they are still lacking evidence to prove it is as effective as chloroquine phosphate

Virologists have described the results of the study on **lopinavir–ritonavir**, a combination which is branded as Kaletra and Aluvia, as 'disappointing'

Doctors in China claimed that **Favipiravir** sped up patients' recovery, reduced lung damage and did not cause any obvious side effects

**Sarilumab**, a rheumatoid arthritis drug is available to be prescribed on the NHS, is set to be trialled on patients in the US

A patient treated by combination of **lopinavir and ritonavir** recovered at Virgen del Rocio Hospital in Seville, Spain.

Tanja Nickel and Katharina Obladen of germany whoa are still in high school have patented an idea to disinfect escalator handrails using **UV light**.

**Regeneron**, a biotech company, is developing a set of therapeutic antibodies that can be administered to a patient and help their immune system counteract SARS-CoV-2 right away. These antibodies are generated from mice engineered to have genetically human immune systems, which means they produce human antibodies.

### **Vaccine Update for Novel Corona Virus**

Germany has authorised its first clinical test of a vaccine for the novel coronavirus, the country's regulatory body green-lighting trials on human volunteers for an RNA vaccine developed by German firm Biontech and US giant Pfizer.

Even as researchers at Oxford University have begun testing their potential vaccine against COVID-19 on a small group of human volunteers, they hope to expand the tests soon after getting positive results from the initial trial. If the trial is successful in the UK, then the Oxford team will approach scientists in the Kenya Medical Research Institute (KEMRI) and will approach the Government of Kenya for permission to evaluate in Kenya

Six Indian companies are working on a vaccine for COVID-19, joining global efforts to find a quick preventive for the deadly infection spreading rapidly across the world. Nearly 70 'vaccine candidates' are being tested and at least three have moved to the human clinical trial stage.

Zyklus Cadila is working on two vaccines, Serum Institute, Biological E, Bharat Biotech, Indian Immunologicals, and Mynvax are developing one vaccine each.