COVID-19 BULLETIN

18 MAY 2020

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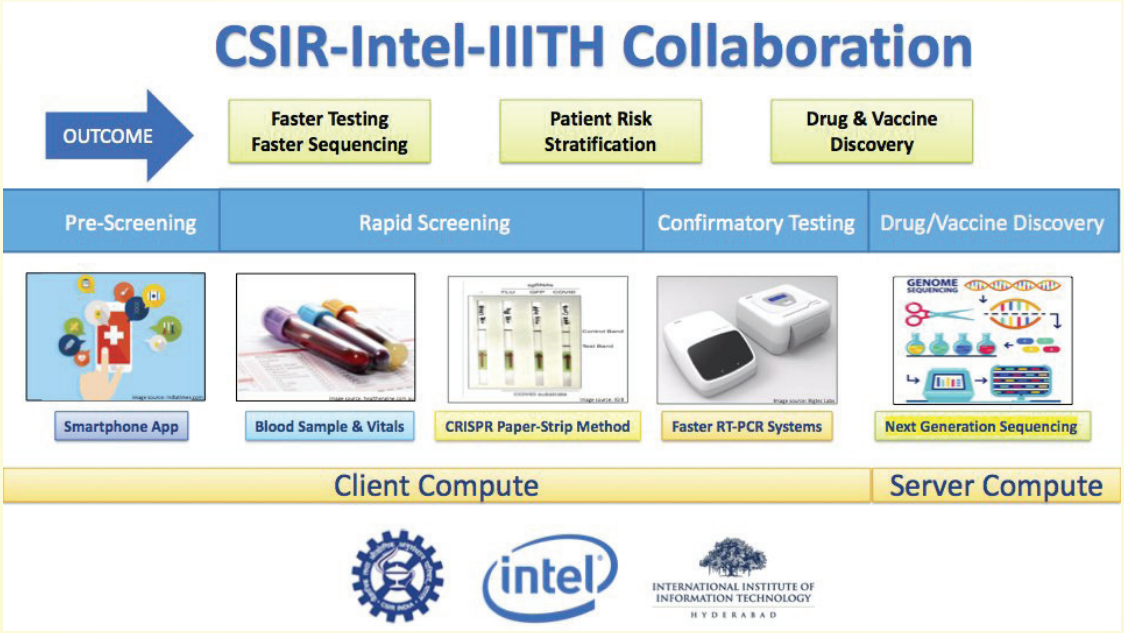
#CSIRFightsCovid19

Ever since the Coronavirus pandemic broke out, CSIR has mounted a strategic, well-coordinated and integrated approach towards mitigating the Coronavirus outbreak ranging from containing the spread of the virus by providing sanitisation and disinfection solutions to equipping the frontline workers and health warriors with protective gear, and from exploring repurposing of existing drugs to discovering new drugs and vaccines. Here are some major developments this week.

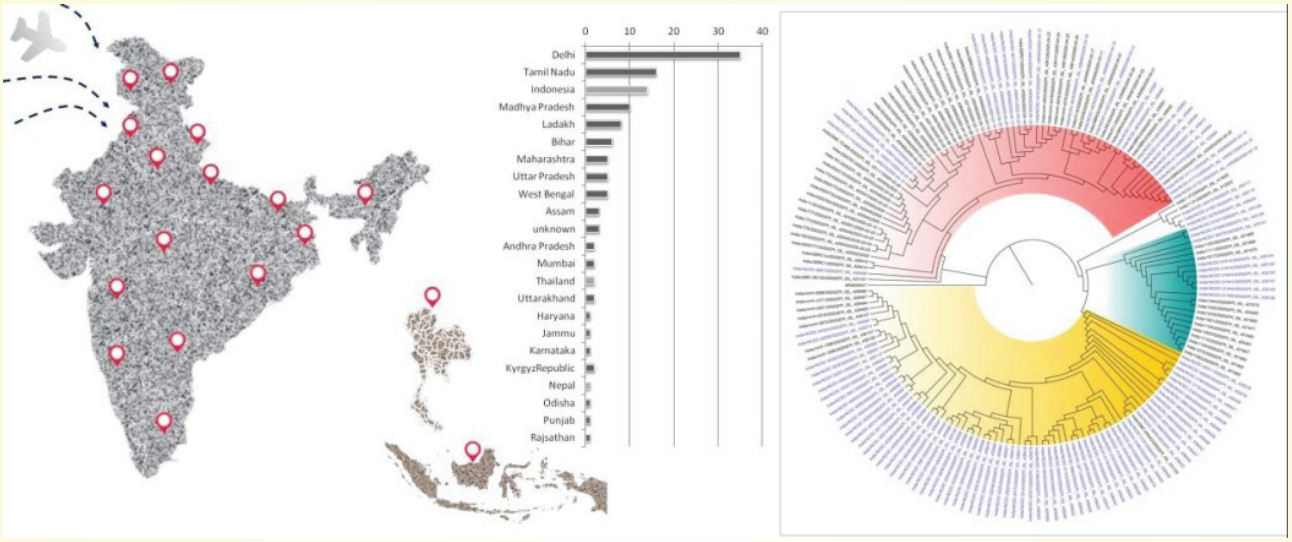
Virus Surveillance

Surveillance at the level of the virus, humans, and geographical origins and distributions is a critical step in combating Covid-19. While *molecular surveillance* involves large-scale sequencing of viral genomes, *digital surveillance* utilizes big data at the population level.

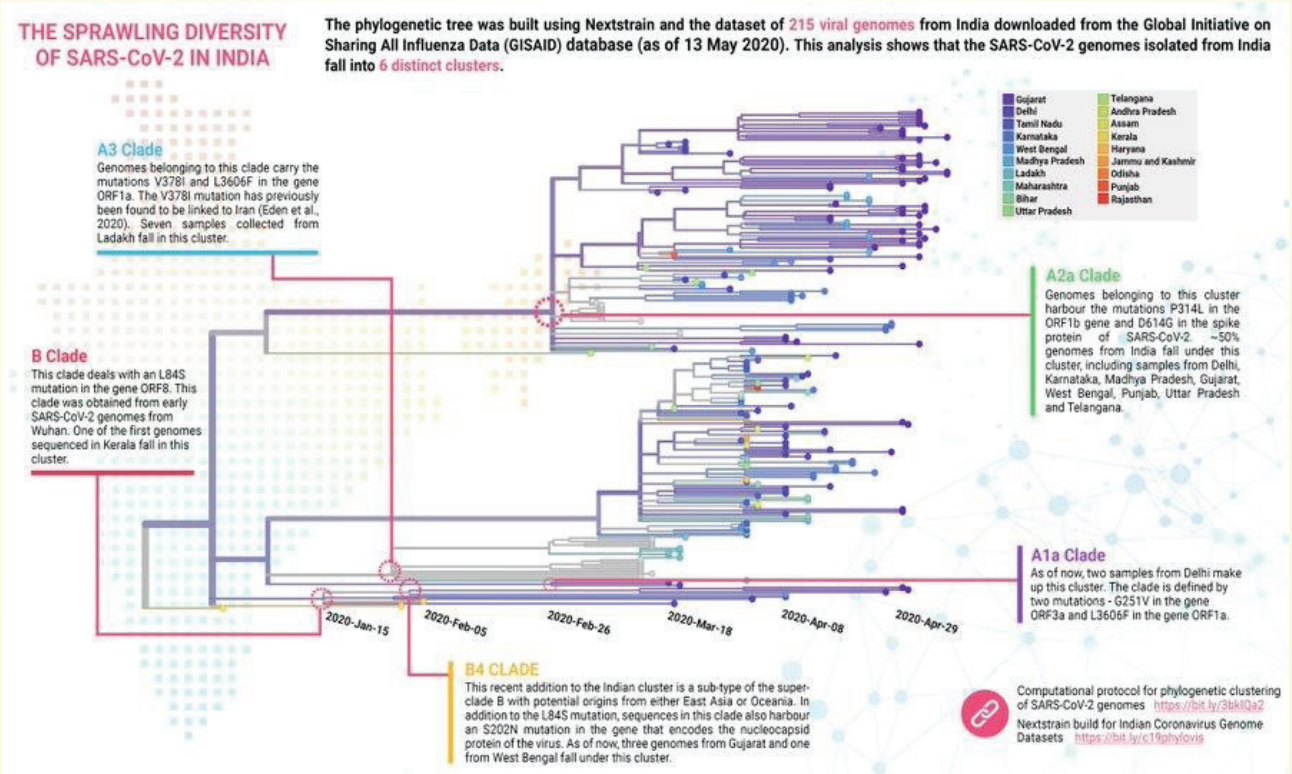
- CSIR has undertaken community-level screening at Kolar, Karnataka where CSIR-IGIB is leading the team in setting up a model for community surveillance. This is being done in collaboration with NIMHANS, THSTI (DBT), and TATA Sons. Around 1000 random samples that included 200 healthcare workers from a database of 1 million people were screened by a mix of RT-PCR assays and Rapid Antibody test and proper ELISA. This model was run successfully and can be replicated in different cities pan India.
- CSIR has also undertaken genome sequencing with samples from different geographical regions of the country. The computational support is being provided by IIIT, Hyderabad, and INTEL.



- Sequencing the viral genomes in India is the need of the hour to understand the virus dynamics such as its spread and mutation frequency and the impact on the severity of the disease and implications for the vaccine, drug and diagnostic development. From India about 200 sequences have been reported as on date, of which 104 sequences have been submitted by CSIR-IGIB in collaboration with National Centre for Disease Control. Additionally, CSIR-CCMB has sequenced 50 new viral genomes. Thus 174 genomes have been sequenced so far at CSIR.



Data based on 104 sequences from CSIR-IGIB and NCDC



Sequence analysis of all the (>200) Indian sequences in the database to understand the genetic diversity of strains which cover 19 states and union territories

Testing COVID-19 Samples

The key to flattening the curve of growth in Coronavirus cases is the detection of the infected at the earliest and isolating them. Rapid diagnosis therefore is the need of the hour towards which CSIR has made major contributions using multiple strategies.

- In the last one week (7-14 May) CSIR labs across the nation have tested 3023 samples for COVID-19. So far, in total, CSIR labs have tested >10,000 samples.

Labs	No of tests
CSIR-IIIM	1034
CSIR-IMTECH	956
CSIR-CCMB	348
CSIR-IITR	345
CSIR-IHBT	340
Total	3023

- CSIR-CFTRI and CSIR-CLRI have also contributed to 8544 in Mysuru and 5000 tests in Chennai respectively so far by providing the State Government with RT-PCR machines.
- 6 Research Scholars from CSIR-CLRI have also supported the King College of Preventive Medicine in testing 1300 samples over the last week.

Faster and Cheaper Diagnostics

CSIR-CCMB has been pooling samples that belong to areas with lower than 2% COVID-19 prevalence rates for diagnostics using RT-PCR. The SOP for this strategy is now publicly available.

It has now developed a new strategy to pool samples from all different districts of a state and test them together. Every single sample is barcoded using PCR at the sample collection centre. These samples will be sent to a central point like CSIR-CCMB which has Next-Gen Sequencing facilities, which can test up to 50,000 samples in two days.

The centre will now test its pilot run, with support from SynGene, Bengaluru. If successful, the plan would be extended to the states of Telangana and Karnataka. This strategy aims to do faster testing of a large population, at about 0.3$ (~Rs 25) per sample.

Drugs & Vaccines against COVID-19

As the research into SARS-CoV-2 is in its early days and our understanding is evolving each day, it is critical to deploy all possible strategies to combat the virus. CSIR's strategy has involved repurposing existing drugs against COVID-19, discovering new drugs and exploring natural products and phtypharmaceuticals for developing drugs. CSIR has achieved considerable success in this endeavour working with major pharma companies. Some recent developments are outlined here.

- **Clinical trials**: CSIR has received approval from the Drug Controller General of India (DGCI) for two clinical trial drugs – a phytopharmaceu tical and Favipiravir – to treat COVID-19. The trial will begin within a week.

- **Sepsivac against COVID-19 with Cadila:** CSIR and Cadila Pharmaceuticals have received regulatory approval for initiating clinical trials to evaluate the efficacy of an existing gram-negative sepsis drug called Sepsivac for COVID-19 patients. The clinical trials are being carried out among critically ill patients at PGI Chandigarh, AIIMS New Delhi and AIIMS

Bhopal). Clinical trial will also be carried out among subjects at risk of getting infected (4000 participants) and positive patients, hospitalized but not critically ill (480 participants).

- **Phytopharmaceutical ACQH with Sun Pharma:** ACQH has been developed by CSIR-IIIM and DBT-ICGEB and is active against all four subtypes of dengue virus. It is being repositioned for treating COVID-19. It has earlier completed human safety phase 1 trial and now approval has been granted for Phase II trials on COVID-19 patients.

- **Favipiravir with Cipla:** Favipiravir is a drug used for the treatment of influenza. It is a safe drug and its trial can be expected to be completed in about 1.5 months. If tests are successful, the drug could be available soon (as its patent has expired) at an affordable price. The synthetic process has been developed at CSIR-IICT, which has provided API and key starting materials to Cipla. Cipla has received approval for phase II clinical trials, which will begin soon.

- **Remdesivir:** CSIR-IICT has developed API and KSM and shared the process technology with industries. The API of Remdesivir is being provided by CSIR-IICT to CIPLA, which is one of the licensees that has received a voluntary license from Gilead.

- **Clinical trials with ICMR and Ministry of Ayush:** CSIR is collaborating with studies on Ayurveda interventions as prophylaxis and as an add-on to standard care to COVID-19. Ayurvedic medicines such as Ashwagandha, Yashtimadhu, Guduchi Pippali, and a polyherbal formulation (Ayush-64) will be tested on health workers and those working in COVID-19 high-risk areas.

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Home / India News / Trials for 4 AYUSH formulations against Covid-19 to start within a week, says minister

Trials for 4 AYUSH formulations against Covid-19 to start within a week, says minister

CSIR Director-General Shekhar Mande and Ayurveda and AYUSH secretary Vaidya Rajesh Kotecha had said on Wednesday that the result will come within three months.

INDIA Updated: May 14, 2020 12:05 IST

Agencies
Hindustan Times, New Delhi

Minister of State for AYUSH, Shripad Naik said he is hopeful that traditional medicines will show the way to overcome the Covid-19 pandemic.(Vipin Kumar/HT File Photo)

The AYUSH Ministry and the Council of Scientific and Industrial Research (CSIR) are working together on validating four Ayush formulations against Covid-19 , Union minister Shripad Y Naik said on Twitter on Thursday. He also said that trials will start within one week.

"The @moayush & the @CSIR_IND are working together on validating four Ayush formulations against #COVID19Pandemic and the trials will start within one week. These formulations will be tried as an add-on therapy and standard care for COVID-19 patients. I am sure and quite hopeful that, our traditional medicinal system will show the way to overcome this pandemic," Naik said on Twitter.

- **In-silico screening of existing drugs and natural products:** Virtual screening of about 7100 molecules is being carried out including FDA approved anti-virals, molecules from anti-tussive ayurvedic formulations, and phytochemicals by docking against the Main protease (Mpro) and RNA dependent RNA polymerase (RdRp), and Human ACE2, the key targets of SARS-CoV-2. Extensive docking studies have been carried out by CSIR-CLRI and CSIR-NEIST on Saquinavir, Sirolimus and Erythomycine, Zafirlinkast, Indinavir, Zanavir, Cefdivir, Tetracyclin, Darunvir, etc. CSIR-NEIST has obtained data on the interaction of 7 antivirals with 3 CL-Pro including Paritaprevir, Simaprevir,

etc. Docking studies of 750 analogues of derivatives of Hydroxychloroquine and chloroquine were initiated by CSIR-IITR which suggested two derivatives with spike protein as a target.

- **SARS-CoV-2 viral assays:** To provide impetus to the drug discovery and vaccine testing in the country CSIR-CCMB has set up the SARS-CoV-2 viral culture systems. It has entered into a collaboration with Eyestem Research Private Limited. The research team will use the human lung epithelial cell culture system provided by Eyestem as part of its anti-covid screening (ACS) platform.

- **Antibodies and serology approach:** CSIR through its NMITLI program has approved a project for the development of human monoclonal antibodies (hmAbs) that can neutralize SARS-CoV-2 in patients. The project would be implemented by a multi-institutional and multi-disciplinary team comprising NCCS, IIT-Indore, PredOmix Technologies and Bharat Biotech International. The project aims to generate hmAbs to SARS-CoV-2 from the convalescent phase of COVID-19 patients and select high affinity and neutralizing antibodies. The project also aims to anticipate future adaptation of the virus and generate hmAbs clones that can neutralize the mutated virus and could be readily available for combating future SARS-CoV infections.

- CSIR-CCMB has also entered into an MoU with the University of Hyderabad and Vins Bioproducts Ltd. to enable the development of antisera against SARS-CoV-2 using inactivated virus in horses, which is amenable for large-scale production. Antisera is the blood serum containing antibodies which can be used for passive immunity.

Hospital Assistive Devices & PPEs

Ever since the pandemic struck, CSIR has been introducing low-cost and effective hospital assistive devices and PPEs and consistently improving their efficiency and design. Many of them have been transferred to the industry while some are at the stage of beta testing, which will be followed by certification.

Bi-Level Positive Airway Pressure System by CSIR-NAL: The highlight of the week and one that garnered considerable attention and positive responses was the development of the BiPAP Ventilator by the CSIR-National Aerospace Laboratories. The ventilator is a microcontroller-based system with a HEPA filter (Highly Efficient Particulate Air Filter). These unique features help to alleviate the fear of the virus spread.

It is simple to use without any specialized nursing, cost effective, compact and configured with majority of indigenous components. It has features like Spontaneous, CPAP, Timed, AUTO BIPAP modes with provision to connect Oxygen concentrator or Enrichment unit externally.

The ventilator is ideal for treating COVID-19 patients in wards, make shift hospitals, dispensaries and home. It has been certified for safety and performance by NABL accredited agencies. The system has undergone stringent biomedical tests and beta clinical trials at NAL Health Centre. The entire process has been done in a record 36 days, competing with global standards for speed.

NDA has been signed with 6 MSMEs for commercialization of the technology – Cyient Technologies, Bengaluru; Datasol, Bengaluru; Apollo Computing, Hyderabad; Paras Defence, Mumbai; Redimo, Bangalore; and Kavitual, Gujarat.

Protective Coverall: CSIR-NAL Bengaluru developed a coverall protective suit for protection of healthcare workers attending to COVID-19 patients. The polypropylene spun laminated multi-layered non-woven fabric has been developed in collaboration with MAF Clothing and has undergone stringent testing. The production capacity of the coverall, initially pegged at 30,000 has now been enhanced to 50,000 units per day.

Respiratory Assistance Intervention Device by CSIR-CSIO: Functional testing of the developed prototype as per targeted specifications has been completed using a Ventilator calibrator and artificial test lung. Initial two rounds of validation have been completed in discussions with anaesthesiologist of GMCH, Chandigarh and the final round of validation in progress. Expected to be completed by May 16, 2020. ToT under process in discussions with M/s. Forbes (India), Mumbai, and M/s. LM Healthcare, Panchkula.

Oxygen Enrichment Unit by CSIR-NCL: OEU is one of the critical needs of COVID-19 patients is the need to meet the oxygen requirements due to their lungs being compromised. Oxygen enrichment unit (OEU) to increase the oxygen concentration from the ambient air of 21-22% to 38-40% has been developed by CSIR-NCL and Genrich Membranes, a start-up innovation venture. It produces enriched oxygen for patients in the home and hospital settings allowing enhancement of oxygen levels up-to 40%. It has passed all 11 tests at TUV Reinlands and is undergoing clinical trials

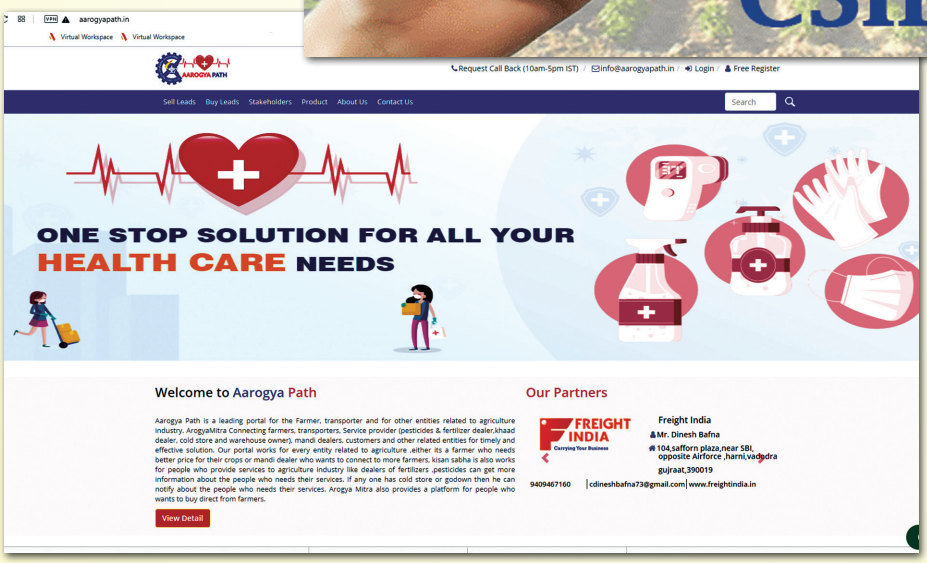
Face Shield by CSIR-CECRI: CSIR-CECRI has developed a 3-D printed face shield that has been certified by CIPET. The Institute has partnered with a company 3D Lycan, Bangalore which can make 500 pieces/ day (3D printed) and bulk orders can go up to 30,000/day based on the injection mold process.

Face Mask from CSIR-CMERI: The face masks developed by CSIR-CMERI have received certification from SITRA and scale-up is being explored with mechanization and MSMEs.

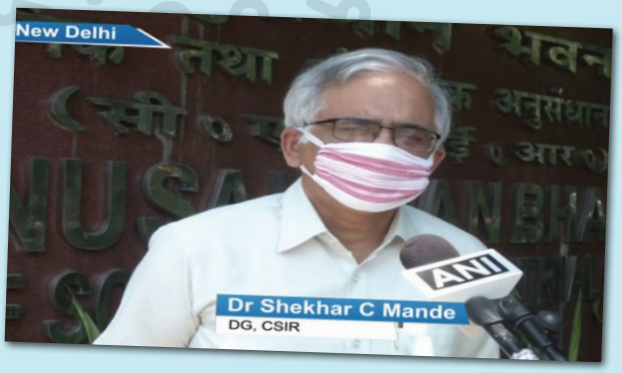
Supply Chain & Logistics

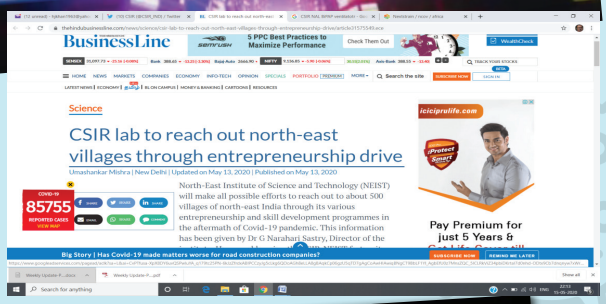
The success of development, deployment and operationalization depends on the entire supply chain being in place and functional, especially in the current lockdown scenario in the country and worldwide. CSIR labs are geared up to facilitate regional demands for materials and supplies for testing labs, PPEs, medical supplies, etc. The database of potential suppliers of quality products is under preparation. This platform will also showcase and make available the different CSIR products developed for the management of the COVID-19 pandemic.

- **AarogyaPath:** Following the successful launch of the Kisan Sabha App recently, steps have been initiated to develop Aarogyapath, a National Healthcare Supply Chain Management System to address COVID-19 and similar pandemics. This platform will act as a single stop solution for all the national healthcare needs. The domain http://aarogyapath.in/ has been registered. A knowhow management agreement entitled "Development of web application AarogyaPath: National Healthcare Supply Chain Management System" between CSIR and private partner Sarvodaya Infotech Private Limited was signed on 13 May 2020.

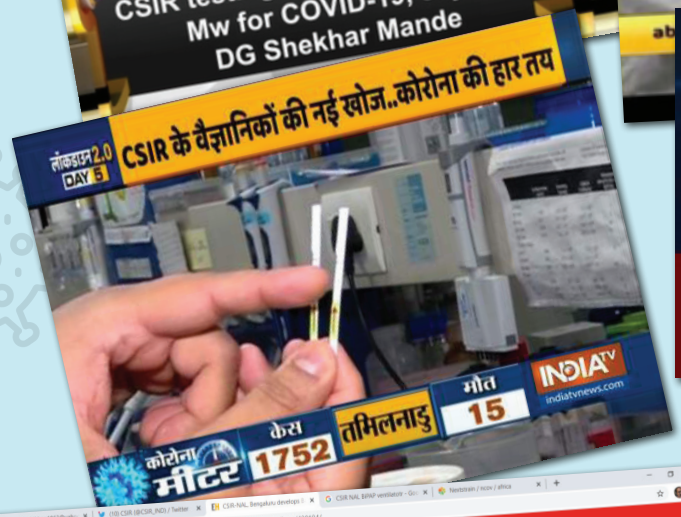


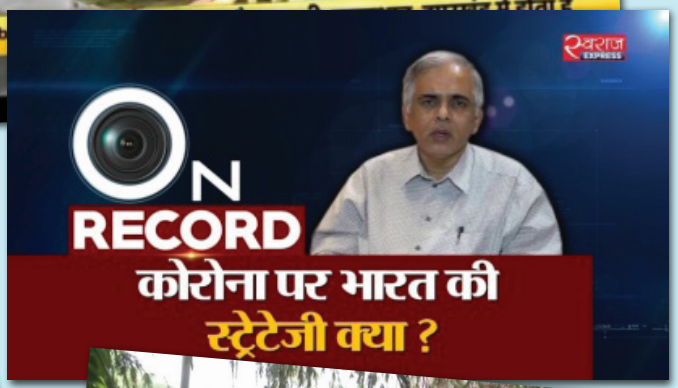
CSIR Media Coverage

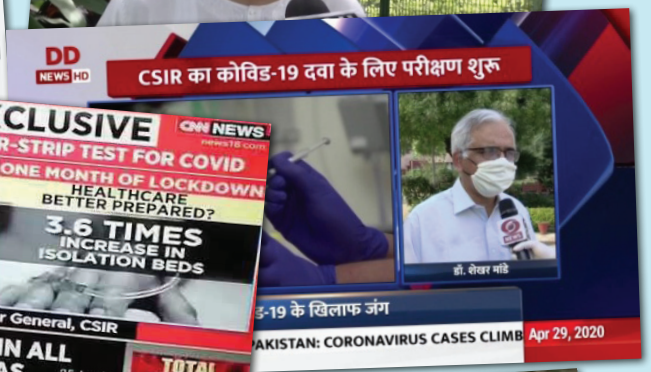


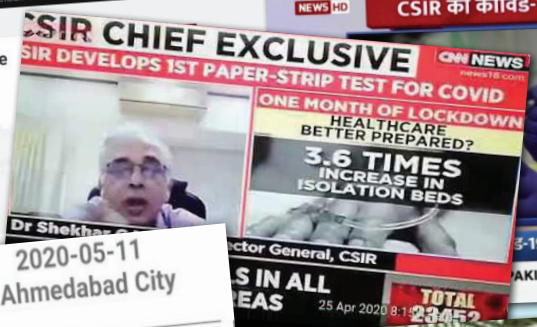


CSIR Media Coverage









CORONA RESEARCH SNAPSHOT

Probability of infants getting hospitalized higher

In a statistical study in Europe, it has been observed that 80% infants were hospitalized in Europe. Two thirds of the children had at least one infected parent with symptoms of COVID-19. However, 53% of the COVID-19 symptomatic children between the ages of 11 to 17 needed hospitalization. The study is published by the journal *Eurosurveillance* as preprint which is yet to be reviewed. (Source: *Nature News & Eurosurveillance;* http://doi.org/dvk8; 2020)

Human body generates huge amount of antibodies against COVID-19

The immune system of a human body generates a large amount of antibodies in response to coronavirus's proteins. Dr. Kavian and collaborators at University of Hong Kong were searching for the COVID-19 proteins which are targeted by human immune molecules called antibodies. This study is being considered as important in the process of making a vaccine. The researchers have found that people already infected with COVID-19 had more antibodies against 11 viral proteins in comparison to healthy people (never infected with COVID-19). Contrary to this, many of the current efforts to develop vaccines are focusing on a viral protein called spike protein. This study is published in medRxiv as a pre-print and yet to peer-reviewed. (Source: medRxiv; http://doi.org/ggtrxh; 2020)

One more study to confirm that COVID-19 is not lab born

RmYN02 Virus (Picture Courtesy: *Current Biology***)**

A close relative of SARS-CoV-2 *alias* COVID-19 has been found in some regions of the genome which suggests the natural evolution of COVID-19 virus. This close relative of the COVID-19 is named 'RmYN02' and is found in the bats' samples collected at time of the COVID-19 outbreak in Yunnan province of China. The researcher Weifeng Shi claims, "Our paper shows very clearly that these events occur naturally in wildlife. This provides strong evidence against SARS-CoV-2 being a laboratory escape." (Source: *Current Biology;* 10.1016/j.cub.2020.05.023; 2020)

RmYN02 Virus (Picture Courtesy: *Current Biology***)**

Smokers & chronic obstructive pulmonary disease patients under higher risk

Smokers and people with chronic obstructive pulmonary disease (COPD) are at higher risk of mortality in the case of COVID-19 infection, a new study published in *PLOS ONE* journal confirms. The researchers from University College, London found that smokers and COPD patients have

63% risk of severe disease and 60% risk of mortality, critically ill patients without COPD have only 33.4% risk of severe disease and 55% risk of mortality. The current smokers are 1.45 times more likely to have severe complications in comparison to never-smokers. (Source: *PLOS ONE*, 2020; 10.1371/journal.pone.0233147)

Kids with cancer not at higher risk for COVID-19 infection

Scientists at Memorial Sloan Kettering Cancer Centre, USA found in their studies that children with cancer are not at higher risk for COVID-19 infection. Dr. Andrew Kung and his team claimed that pediatric cancer patients are not more vulnerable in comparison to other healthy children to COVID-19 infection. These findings are important and will allow oncologists to perform cancer therapies to save lives in children without strict standard precautions and safety measures required during COVID-19 infection. (Source: *JAMA Oncology*, May 13, 2020; 10.1001/jamaoncol.2020.2028)

A pandemic of misinformation

The reach of public to accurate and good quality information is very crucial in the times of pandemics or emergency situations. A recently published research shows a huge amount of misleading, inaccurate and misinformation is being watched and read on internet and social media on COVID-19 by the common public. It is found that 1 out of 4 most watched videos on YouTube has misinformation on COVID-19. Videos by professionals and government agencies scored significantly higher for accuracy and quality but didn't feature prominently among the viewing figures. (Source: *BMJ Global Health*, 2020; 10.1136/bmjgh-2020-002604)

CORONA INNOVATIONS

COVID KAVACH ELISA

Scientists at ICMR-NIV, Pune, have developed and validated a completely indigenous IgG ELISA ("COVID KAVACH ELISA") test for antibody detection for SARS-CoV-2. On external validation, the IgG test kit produced by ICMR-NIV has been found to have sensitivity and specificity of 98.7% and 100% respectively. ELISA test has the advantage of processing 90 samples together in a single run of two-and-a-half hours.

(Source: *ICMR)*

Defence Research Ultraviolet Sanitiser — DRUVS

Hyderabad based Research Centre Imarat (RCI), DRDO has developed an automated contactless UVC sanitisation cabinet, called Defence Research Ultraviolet Sanitiser (DRUVS). It has been designed to sanitise mobile phones, iPads, laptops, currency notes, cheque leafs, challans, passbooks, paper, envelopes, etc. The DRUVS cabinet has a contactless operation with 360-degree exposure of UVC to sanitise objects placed inside the cabinet.

(Source: *PIB)*

Disinfection chamber

IIT Kanpur has successfully developed a low-cost rapid disinfectant process at the Health Centre for external disinfection. The process aims to achieve a high rate of personnel disinfection within 2 minutes.

(Source: *IIT-Kanpur*)

e-Tool to support intellectually disabled

Under DST's Technology Interventions for Disabled and Elderly (TIDE) programme, an e-Tool to create awareness and impart health and hygiene-related information along with education and entertainment to overcome the loneliness of persons with intellectual disabilities due to COVID-19 pandemic has been developed by Rajalakshmi Engineering College, Chennai. This will help persons with intellectual disability to learn with fun through tabs and mobiles. The e-Tool can also be converted to other vernacular languages. The Beta Version of the e-tool is being used by 200 specially-abled children.

(Source: *PIB)*

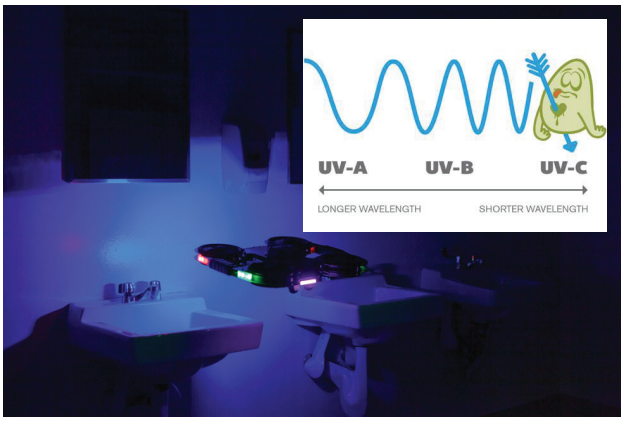
Innovative device to address ventilator shortage

In response to the growing need of medical equipment for treating COVID-19 patients, a group of doctors, engineers and medical researchers from UC Berkeley, UCSF has devised a creative solution to ventilator shortage. This group is called 'COVID-19 ventilator rapid response team' (CVRRT). They have figured out a way to modify existing CPAP machines which are used to treat sleep apnea. These machines will act as the kinds of ventilators needed to keep severe COVID-19 patients breathing in the ICU. The team has adapted the hardware by using a tube that can be used for intubation.

(Source: *https://techcrunch.com*)

Drones providing indoor disinfection

Digital Aerolus has tested the disinfection power of UV-C lights with its industrial drones. Ultra violet (UV) light has three wavelength categories UV-A, UV-B and UV-C. UV-A and UV-B light are not able to kill the



germs while UV-C light does so. UV-C light is a short-wavelength ultraviolet light that breaks apart the DNA of the germ, leaving it unable to function or reproduce.

(Source: *https://www.industryweek.com*)

Monitoring COVID patients remotely

Biovitals® Sentinel in Hong Kong monitors patients under quarantine or under medical care remotely. Because the technology is remote, it not only helps prevent the spread of the virus, it keeps the healthcare workers keep safe also.

(Source: *https://www.industryweek.com*)

COVID-19 Dashboard

COVID-19 Cases and Deaths in India

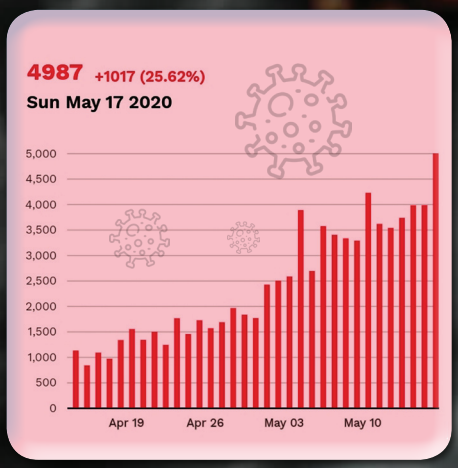
(Data as of 17 May 2020)

53946	34108	2872	1
Active Case	Cured/Discharged	Deaths	Migrated

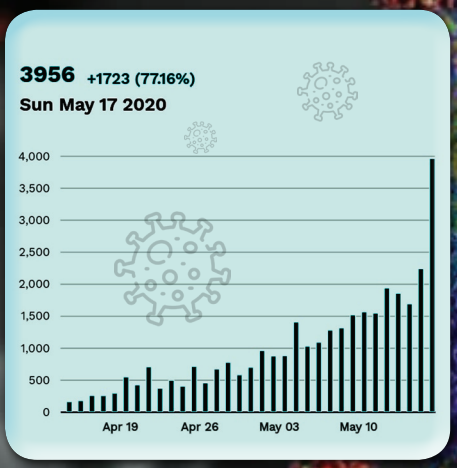
https://www.mygov.in/covid-19/

Graph
India

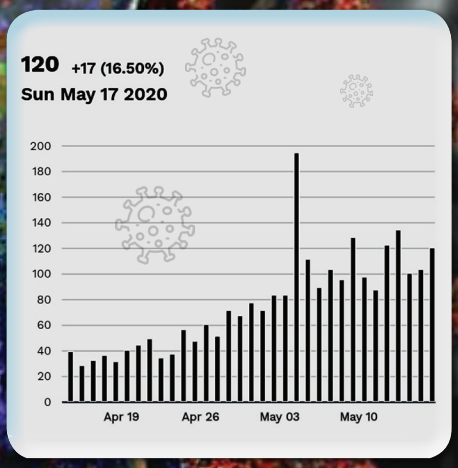
Confirmed Cases



Recovered Cases



Deceased Cases



Source: *Aarogya Setu App*

CORONA Q&A

Are people with high blood pressure (hypertension) at higher risk from COVID-19?

At this time, we do not think that people with high blood pressure and no other underlying health conditions are more likely than others to get severely ill from COVID-19. Although many people who have gotten severely ill from COVID-19 have high blood pressure, they are often older or have other medical conditions like obesity, diabetes, and serious heart conditions that place them at higher risk of severe illness from COVID-19.

If you have high blood pressure, it's critically important that you keep your blood pressure under control to lower your risk for heart disease and strokes. Take your blood pressure medications as directed, keep a log of your blood pressure every day if you are able to take your blood pressure at home, and work with your healthcare team to make sure your blood pressure is well controlled. Any changes to your medications should be made in consultation with your healthcare team.

(Courtesy: *cdc.gov*)

Why is the disease called COVID-19?

On February 11, the World Health Organization announced an official name for the disease that is causing the 2019 novel coronavirus outbreak, first identified in Wuhan China. In COVID-19, 'CO' stands for 'corona,' 'VI' for 'virus,' and 'D' for disease. Formerly, this disease was referred to as "2019 novel coronavirus" or "2019-nCoV".

(Courtesy: *cdc.gov*)

Should I cover my hair when I'm outside my home? Does the virus attach itself to hair?

The Centers for Disease Control and Prevention estimates the virus could be viable for "hours to days" depending on the surface and conditions. When it comes to stainless steel and plastic the coronavirus could live for a few days. However, experts agree it's unlikely the virus can stay on hair for any length of time. (Andrea Slaydon, Producer)

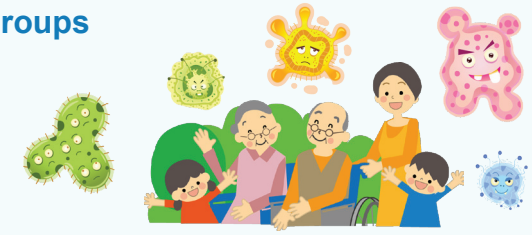
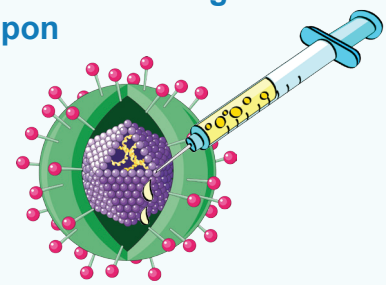
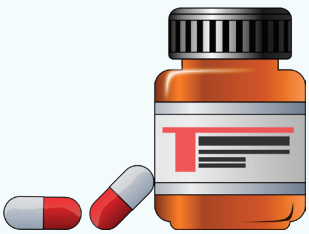
(Courtesy: *cdc.gov*)

What is a cytokine storm? And why is it killing some covid-19 patients?

Some COVID-19 deaths don't seem to be caused by the virus itself, but rather the immune system's overreaction to the infection. The immune system combats the invading pathogens through cytokines—small proteins that help coordinate the body's inflammatory response. Inflammation is the body's natural response against harm, where an army of white blood cells is dispatched to surround the area under attack. That's what causes the tissue to swell up. But when cytokines are released at excessive levels, they can activate too many white blood cells that threaten healthy cells and tissue in other parts of the body. The onset of this hyper-inflammation can be rapid and devastating. Even after the immune system has cleared out the disease, the body can continue to release cytokines, causing further damage to organs.

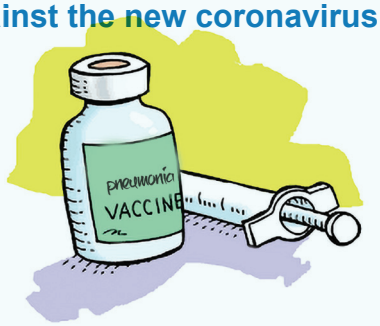
(Courtesy: *cdc.gov*)

COVID-19 MYTH BUSTERS

MYTH ✗	FACT ✓
Virus behaves differently in different age groups 	Virus does not behave differently in different age groups, it is the response of the host or the ability of the infected person to handle the virus which determines the severity of the infection. *THSTI Booklet*
Coronavirus is an engineered virus or a bioweapon 	The genome sequences of SARS-CoV-2 are obtained from credible virologists worldwide. They have found no evidence that this is an engineered virus or a bioweapon. *THSTI Booklet*
Hydroxychloroquine or any other drug can cure or prevent COVID-19 	While several drug trials are ongoing, there is currently no proof that hydroxychloroquine or any other drug can cure or prevent COVID-19. The misuse of hydroxychloroquine can cause serious side effects and illness and even lead to death. *www.who.int*
Regularly rinsing your nose with saline helps prevent infection with the new coronavirus 	No, there is no evidence that regularly rinsing the nose with saline has protected people from infection with the new coronavirus. *www.who.int*

MYTH ✗

Vaccines against pneumonia protect you against the new coronavirus

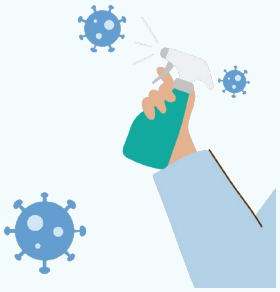


FACT ✓

No, vaccines against pneumonia, such as pneumococcal vaccine and Haemophilus influenza type B (Hib) vaccine, do not provide protection against the new coronavirus. The virus is so new and different that it needs its own vaccine.

www.who.int

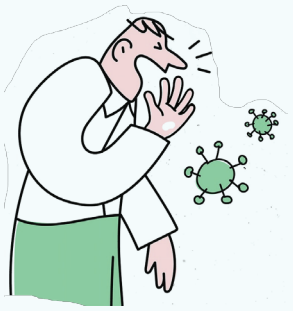
Spraying alcohol or chlorine all over your body can kill the new coronavirus



No, spraying alcohol or chlorine all over your body will not kill viruses that have already entered your body. Spraying such substances can be harmful to clothes or mucous membranes (i.e. eyes, mouth). Be aware that both alcohol and chlorine can be useful to disinfect surfaces, but they need to be used under appropriate recommendations.

www.hsph.harvard.edu

Coronavirus is spread only from coughing and sneezing



It can actually be spread three ways—from large droplets emitted through coughing and sneezing; contact with contaminated surfaces; and breathing in airborne virus (the small amount of aerosolized droplets that remain aloft after a cough or sneeze).

www.hsph.harvard.edu