COMPENDIUM OF INDIAN TECHNOLOGIES FOR COMBATING COVID-19

(Tracing, Testing and Treating)

April-2020

Compiled by:
National Research Development Corporation
(An Enterprise of DSIR, Ministry of Science and Technology, Govt. of India)
20-22, Zamroodpur Community Centre, Kailash Colony Extn., New Delhi-110048
Tel: +91-11-29240401-07, 29241212, Email: cmdnrdc@nrdc.in
Website: www.nrdcindia.com

CALL FOR PROPOSALS FOR MATURING LAB SCALE COVID-19 TECHNOLOGIES

NRDC grants :

To fight against COVID-19 combindly in the country, NRDC invites proposals from the innovators under its two Promotional Schemes i.e. (i) Techno Commercial Support (ii) Priority Projects

Who can apply :

R&D Institutions/Universities/Start-ups/ MSMEs /Industries

Support for :

Development of COVID-19 technologies in the area of tracking, testing & treatment covering process scale up, pilot plant studies, validation /authentication of the product, registration of the product with regulatory authorities. Conducting field trials, generation of toxicology data, bridging the gap between the lab scale development and industrial requirement, so that commercial production and marketing of product become successful.

Amount of grant :

- Rs. 2.00 Lakh under techno-commercial support
- Rs. 10.00 lakh under priority projects
- In deserving cases the amount of grant assistance may be enhanced subject to the recommendation of the Technical Evaluation Committee (TEC) and availability of budget, on mutually agreed conditions.
- One company can apply only for one grant

How to apply :

- Please visit our website www.nrdcindia.com for details of the scheme and application forms
- The duly filled in application with necessary supporting documents to be sent to amishra@nrdc.in

Last date :

Though the applications may be submitted throughout the financial year but for this COVID-19 technology call the last date for submission of the applications is 15.05.2020

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Website: wwwnrdcindia.com

FOREWORD

COVID-19 (coronavirus disease 2019) is a public health emergency of international concern. WHO declared COVID-19 as a global pandemic On 11 March 2020. COVID-19 is acknowledged as illness caused by a novel coronavirus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; formerly called 2019-nCoV), which was first identified in Wuhan City, Hubei Province, China. Global researchers are working round-the-clock to find possible treatments to save lives and develop vaccine for future prevention.

India reported first case of COVID-19 on 30 January 2020. India's proactive, preventive and productive approach to fight COVID-19 pandemic started under the eminent leadership of Hon'ble Prime Minister of India, Shri Narendra Modi. At present there is no known specific, effective and proven treatment and vaccine for the disease available worldwide. In this critical situation, Government of India has dynamically activated programs like "Make in India", "COVID-19 Task Force" and geared up various Science Ministries, Departments and Funding organisations to battle this pandemic with all its might. Government of India is not leaving any stones unturned in facilitating its complete and committed support to the community, academia, researchers, private and public research labs, startups, SME's, incubators, entrepreneurs and industries. Hon'ble Union Minister for Health & Family Welfare, Science & Technology and Earth Sciences, Dr Harsh Vardhan, took initiative to activate all the research and scientific community to gather them all onto one common platform, to share their need-driven innovations and technologies to tackle COVID-19, like protective equipment, tracking and tracing techniques, testing kits, etc., and also to avoid repetitive research work.

National Research Development Corporation (NRDC), a Govt. of India Enterprise was established in 1953 for the development, promotion and transfer of technologies emanating from R&D organisations and academic institution in India and abroad. It is functioning under the Department of Scientific and Industrial Research, Ministry of Science & Technology, Government of India. Over six decades of its existence, NRDC has developed a wide network with R&D organisations, viz., CSIR (Council of Scientific and Industrial Research), DRDO (Defence Research and Development Organisation), ICMR (Indian Council of Medical Research), ICAR (Indian Council of Agricultural Research), universities and industries, industry associations, NGO's, etc. NRDC nurtures new ideas and inventions by providing support and rewards; ensuring intellectual property protection; effective transfer of know-how from laboratories to industry; providing access to new technologies from India and abroad; exporting Indian technological expertise and offering an array of technology consultancy services.

In this compendium, NRDC has made an attempt to summarise the emerging technology landscaping in this frontier area. The report comprises information about the latest significant scientific advancements and innovative research in progress in India sourced from the details published in public domain and from all laboratories, premier academic institutions and patented technologies developed to combat this COVID-19 pandemic. NRDC has compiled the list of technologies available for commercialisation, on-going potential projects and various R&D programs being initiated across the country in scientific researchers, startups, private and government sectors including initiatives and activities being undertaken by Government of India. This 'Compendium of Indian Technologies for Combating COVID-19' has compiled COVID-19-related technologies classified under the value chain of **3Ts** of **T**racking, **T**esting and **T**reating SARS-CoV-2 disease. The compendium shall serve as a ready reference for policy makers, industries, entrepreneurs, startups, MSMEs, research scholars, scientists and other stakeholders. Anyone interested to know the further detailed information or to commercialise any technologies may reach NRDC at cmdnrdc@nrdc.in

Dr. H. Purushotham
Chairman and Managing Director
NRDC, New Delhi

CONTRIBUTORS FOR COMPILING THE COMPENDIUM

Dr. Bhavya Manjeera Patruni

R. K. Anthwal

Dr. Naresh Kumar

Srisudha Senathi

Ashwani Kumar

Neetu

Shilpi Srivastava

Neeta Rai

Aditya Sharma

K. Preethi Niharika

Varsha Padhi

Dipanithya Banerjee

Fatema Motiwala

Kaustubh Singh

NATIONAL RESEARCH DEVELOPMENT CORPORATION

[An Enterprise of DSIR, Min. of Science & Technology, Govt. of India]

20-22, Zamroodpur Community Centre

Kailash Colony Extension, New Delhi-110 048, India.

Phone: +91 11 2924 0401-07, 29241212

E-mail: cmdnrdc@nrdc.in; Website: www.nrdcindia.com

INDEX

EXECUTIVE SUMMARY

The recently emerged SARS-CoV-2 has become a major global health problem. SARS-CoV-2 infections are accelerating exponentially across the world and the COVID-19 pandemic is continuing to create a challenging test for humanity. The outbreak of COVID-19 and the ensuing crisis has brought together the community of scientists, researchers, academicians, health professionals, inventors, innovators, technologists, policy makers and so on of India on a single platform to pursue solutions for challenges thrown by the COVID-19. Government of India is taking all necessary steps and launching various funding schemes to support R&D laboratories, private and public research labs, universities and educational institutes, students, startups, SME's, incubators, entrepreneurs, businesses, industries to focus on the development of COVID-19 solutions. Government of India, through its various ministries, departments, and funding organizations, has invited Calls for Proposals (CFPs) and Expression of Interests (EoIs) to augment the research and development-related activities.

Government of India actively launched and implemented multiple initiatives through its various ministries, departments, and funding organizations aimed at screening and early detection of SARS-CoV-2 infections accurately, and rapid drug repurposing, providing training to young microbiologists on COVID-19 diagnostics and developing drugs and vaccines. Many creative, low-cost and hi-tech innovative solutions and technologies have been developed and a number of projects are at research and validation stage.

National Research Development Corporation (NRDC) has made an attempt to compile most relevant and emerging indigenously developed technological innovations, including those which are at research stage, to fight COVID-19 for the benefit of the stakeholders. The document comprises information about 200 various COVID-19-related technologies, ongoing research activities, technologies available for commercialisation, initiatives and efforts taken by the Government of India categorized under **3Ts** of **T**racking, **T**esting and **T**reating. The information is sourced from various government bodies and premier academic institutions including Department of Science and Technology (DST), Department of Biotechnology (DBT), Indian Council for Medical Research (ICMR), Ministry of Electronics and Information Technology (MeitY), Council of Scientific and Industrial Research (CSIR), Defence Research and Development Organisation (DRDO), Ministry of AYUSH, Indian Institute(s) of Technology (IITs), Science and Engineering Research Board (SERB), Technology Development Board (TDB), National Innovation Foundation (NIF), Ordnance Factory Board (OFB), Startup India and All India Council for Technical Education (AICTE), Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST),and Indian Institute of Science (IISc). This **Compendium of Indian Technologies for Combating COVID-19** shall serve as a ready reference for policy makers, industries, entrepreneurs, startups, MSMEs, research scholars, scientists and other stakeholders. For more information, including Transfer of Technology, one may reach NRDC at cmdnrdc@nrdc.in

TRACKING & SURVEILLANCE

DIGITAL IR THERMOMETER
NRDC (01)-T&S-COVID-19

Introduction: Researchers of Government of India have developed a Digital IR Thermometer, which is an important component of measures to mitigate COVID-19. This is an effort to enable a large number of manufacturers to manufacture the thermometers and cater to their local demands.

Salient Features:

1. A handheld Digital IR Thermometer which is an important component of measures to mitigate COVID-9 outbreak.
2. The Design of IR Thermometers is available open source where in the complete know-how with mass manufacturing ready hardware and software design will be available to manufacturers across India for free to allow the manufacturing of these thermometers in large scale to cater to their local demands.
3. Mobile phone or power banks can be used as a power source.

Stage of Development: The project developed at pilot scale and is being scaled up in partnership with industries. About 100 prototype units will be made for pilot distribution and testing in Bengaluru.

DIGITAL AND MOLECULAR SURVEILLANCE
NRDC (02)-T&S-COVID-19

Introduction: Digital and Molecular Surveillance are crucial to detect the genetic sequencing of the virus which can be used to develop the vaccine to treat and possibly mitigate COVID-19. Country needs digital surveillance data to help trace the recent movements of coronavirus patients and establish virus transmission chains. Molecular SARS-CoV-2 surveillance is the collection, reporting, and analysis of SARS-CoV-2 genetic sequences. As soon as database of affected individuals is made available, biological R&D laboratories in collaboration with industries geared up to implement digital surveillance of the virus and also to do molecular surveillance of corona virus.

Outcome Driven Progress under Technology Verticals – Strategic & Synergetic steps proposed and being undertaken by Government of India towards digital and molecular surveillance:

1. Digital Surveillance Platform is a platform for surveillance is being developed in partnership with private organizations. The database will be managed in a dynamic mode for feeding the R&D channels.
2. For sample collection, agreements were signed with hospitals and started receiving samples of the patients from them from different states. Sequencing of SARS-CoV-2, about 25 viral samples have been put up for sequencing which will help in understanding how mutations are taking place in virus. Further, it will indicate whether one or more viral strains are prevalent in India.
3. About 500 sequences will be done from clinical samples in the next 2-4 weeks.
4. Based on sequencing, strategy for mitigation of virus can be devised. Both host and virus RNA sequencing are being done which will be linked to digital data.
5. Efforts are under progress to generate data on Hydroxychloroquine and Azithromycin as prophylactic agent to prevent SARS-CoV-2 infection.

GOCORONAGO
NRDC (03)-T&S-COVID-19

Introduction: This is an app to help identify people who may have crossed paths with COVID-19 positive subjects by tracking their interactions in the past using Bluetooth and GPS. It also provides alerts on isolation and proximity scores, and helps enhance social distancing.

Salient Features:

1. It uses temporal network analytics in the backend to understand the risk propensity even for distant contacts, understand disease spread and identify high-risk people who are likely to contract and spread the virus.
2. The app generates a 'risk score' after considering various factors and can alert people to take precautionary measures including self-isolate or consulting a doctor. The app would facilitate users to estimate corona sampark risk rating.
3. It has a geo-fencing feature for those who are under quarantine, and has the ability to provide their symptoms which is used in the risk evaluation.

Stage of Development: Version v0.2 is currently deployed to use. This is expected to be installed by 100-1000 users. The contact graph is being constructed and the proximity and isolation scores are being reported. Geo-fencing is available and integrated with the local COVID-19 control centre.

Ongoing Additional Research: Researchers are proposing to include news alerts, integrating with the health centres and related networks, providing more detailed visual analytics, and offering predictive analytics. The app will soon be hosted on the Google Playstore. An iPhone version is also being considered.

MODELING OF EPIDEMIC SPREAD IN INDIAN URBAN CONDITIONS

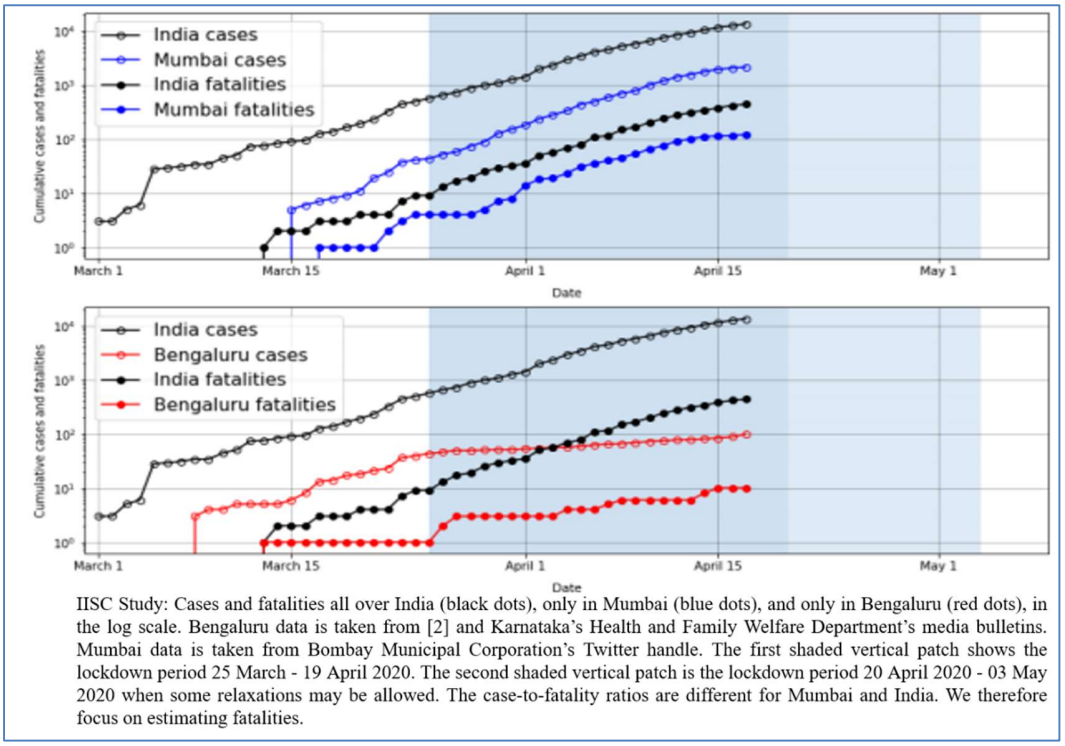
NRDC (04)-T&S-COVID-19

Introduction: This project aims at modelling the epidemic spread taking Indian urban conditions into account.

Salient Features: This project intends to assist epidemiologists and decision makers with (a) understanding the effectiveness of imposing and lifting various kinds of restrictions (b) anticipating hospital needs (c) devising testing strategies.

Stage of Development: Agent-based simulator with several interventions has already been implemented at the level of 200,000 residents in 1/50 version of Bengaluru. Scaling up, connecting multiple cities, testing strategies and assessment of hospital needs, are in progress.

Support Anticipated: People with experience in visualization, user interface development; Epidemiologists and social scientists who can suggest novel strategies for lifting of interventions; Coders familiar with Python scripting and Java scripting.



IISC Study: Cases and fatalities all over India (black dots), only in Mumbai (blue dots), and only in Bengaluru (red dots), in the log scale. Bengaluru data is taken from [2] and Karnataka's Health and Family Welfare Department's media bulletins. Mumbai data is taken from Bombay Municipal Corporation's Twitter handle. The first shaded vertical patch shows the lockdown period 25 March - 19 April 2020. The second shaded vertical patch is the lockdown period 20 April 2020 - 03 May 2020 when some relaxations may be allowed. The case-to-fatality ratios are different for Mumbai and India. We therefore focus on estimating fatalities.

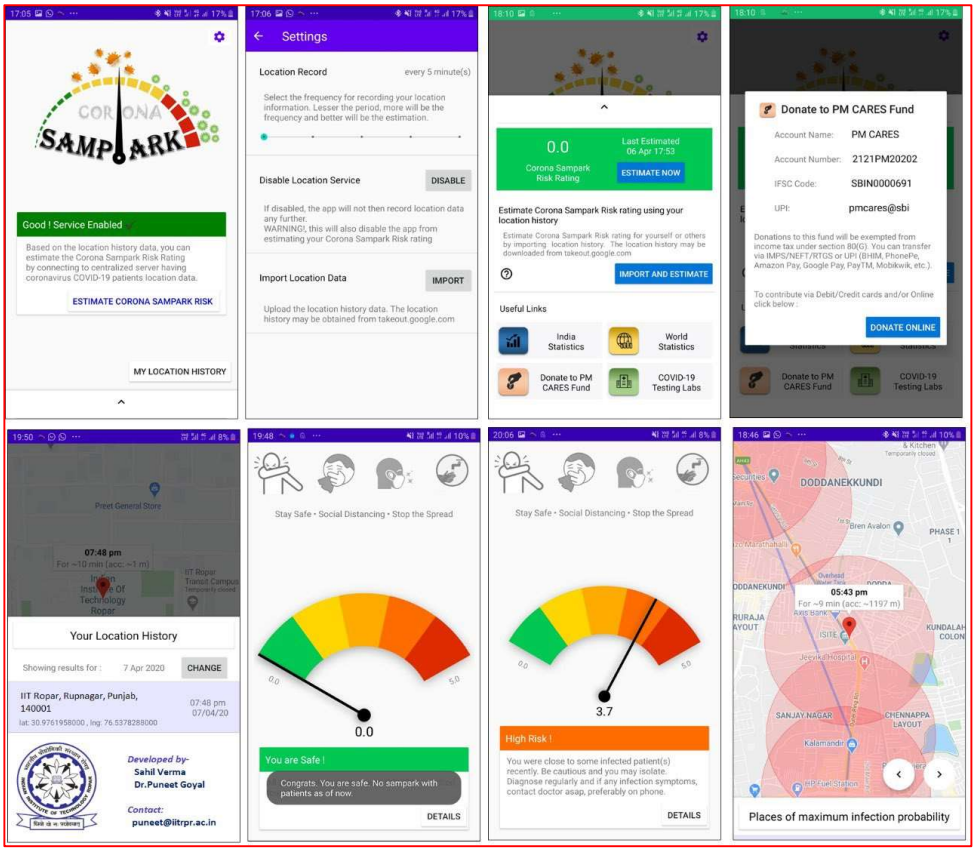
SAMPARK-O-METER
NRDC (05)-T&S-COVID-19

Introduction: This app can indicate areas on maps with maximum coronavirus infection possibility. The existing approaches used for contact tracing and alerting or isolating the potential suspects are subjected to delays because of which, in most cases, the suspect has further spread the virus to many others before being caught. This app, if implemented successfully, can timely alert and more efficiently control the spread.

Salient Features:

1. The app id user-centric and will help people to estimate risk of coming into contact with any COVID-19 positive/highly suspected cases in the last 14 days.
2. The app generates a 'risk score' after considering various factors and can alert people to take precautionary measures including self-isolate or consulting a doctor.
3. The app would facilitate users to estimate the corona sampark risk rating.

Stage of Development: App has been developed and at implementation stage.



SAFE
NRDC (06)-T&S-COVID-19

Introduction: This APP has three dimensions of verification: Location, identity and time. The SAFE (Smart, Authenticated, Fast Exams) app is time-tested as it has been in use since the last five years and has been used for classroom attendance by thousands of students in various courses. The app can check the adherence to quarantine of a large group of people and also track the trajectory of any person moving out of it.

Salient Features:

1. It is capable of detecting cases where the person may leave the phone and go outside quarantine himself/herself.
2. It is customizable app and can be applied during this COVID-19 combat which can be used by officials for checking quarantine adherence.
3. It is based on a BYOD (bring your own device) model that leverages student smart-phones. SAFE has 3 components: a smart-n phone app, a web server and Wi-Fi infrastructure to enable app-server communication. It needs GPS monitoring.
4. SAFE works like class attendance. Authorities can track it every five minutes. If a building has a thousand people in it then, any person leaving the group can be easily tracked. If the person is SARS-CoV-2 infected, he/she might be carrying the infection and may infect other people.
5. Similar way authorities can find out other hot spots whichever places the person visits and whomever he/she meets.

Stage of Development: App has been developed and launched earlier for the purpose of exams and is ow being upgraded for the purpose of tracking the quarantined people. The developed app is at implementation stage.

CORONAVIRUS SUSPECT SURVEILLANCE SYSTEM

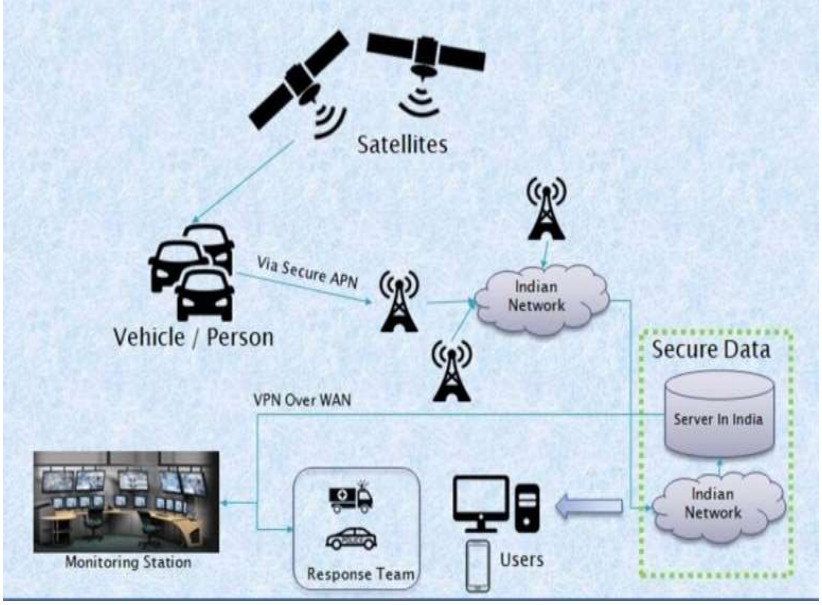
NRDC (07)-T&S-COVID-19

Introduction: Developed a surveillance system to fight COVID-19 through a unique tracking mobile application which is endowed with state-of-the-art Features and it cannot be tampered. The mobile app can track individuals and also do geofencing around him/her. The system will get an alert if the geofencing is violated by the quarantined person.

Salient Features:

1. The tracking system allows for state-of-the-art surveillance during SARS-CoV-2/COVID-19.
2. Besides facilitating quarantine management, it helps to overcome overcrowding at any location by issuing an alert to the predefined agency.
3. The surveillance system is a plug and play device and allows tracking with an accuracy of give-or-take 5 meters through notifications at 2, 10 or 20 seconds.
4. Besides live tracking, the administrator can view the entire movement history of an individual.
5. In case of loss of data, the device sends an alert to the concerned team.
6. Other Features of the app include multi-camera support, surveillance magnetic device, halt time and auto camera click on preset time.
7. In case GPS data is not received, the location will be obtained automatically through the triangulation of mobile towers.
8. If the internet is not working in a certain area, the location will be received through SMS.
9. If the application gets off, an alert will be received immediately.

Stage of Development: The system has been developed and is at implementation stage.



MANU

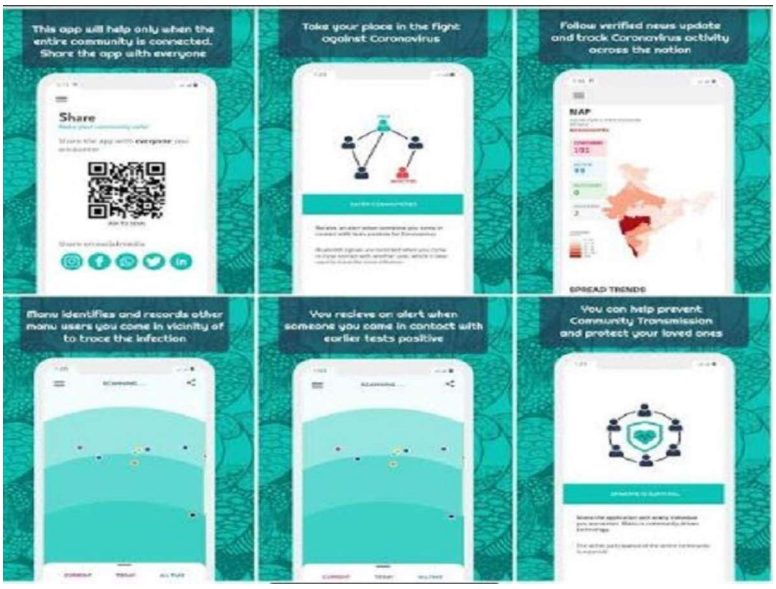
NRDC (08)-T&S-COVID-19

Introduction: The app 'MANU' works when the smartphones have installed this app and runs by using Bluetooth to measure distance between the smartphones. MANU app is developed apprehending the commencement of Stage-3 of the COVID-19 pandemic, which involves community transmission. The app is titled MANU, nickname of *manushay* and symbolises the Indian mythical progenitor of humanity who saved the world by building a boat during the great flood.

Salient Features:

1. The application works by maintaining a record of all those with whom an individual has been in close contact.
2. A unique numerical ID is generated after the app is downloaded in the smartphone of the user.
3. An alarm will be raised on user's smartphone when the SARS-CoV-2 suspect or COVID-19 patient is around them within a distance of 2-3 metres.
4. In case, the medical reports of the suspect have turned negative, the history of his/her ID will be deleted after 14 days.
5. For the application to work successfully, every individual in the community requires to download it, and the developers will require access to official records on number of cases and it will need to be updated in real time through government sources.

Stage of Development: The app has been developed. The inventors have received government approval for the initial trial in West Bengal.



MACHINE LEARNING MODEL

NRDC (09)-T&S-COVID-19

Introduction: The model aims at identifying the risk factors associated with mortality of SARS-CoV-2 infected persons using a supervised machine learning approach. The model reveals the key predictors of mortality in patients with COVID-19.

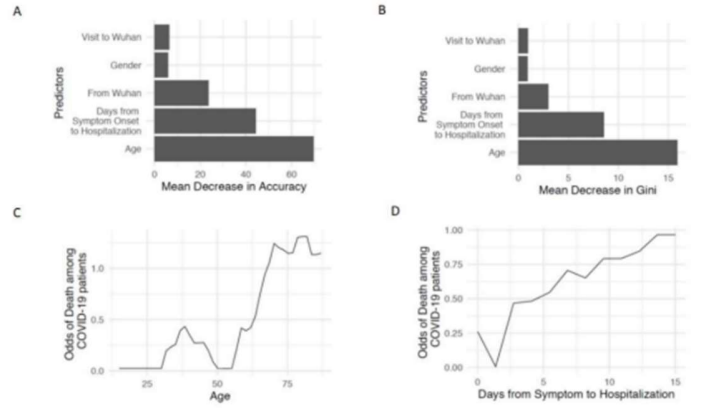
Research Design and Methods adopted:

1. Clinical data of 1085 cases of COVID-19 from 13th January to 28th February, 2020 was obtained from an online community of Data scientists.
2. 430 cases were selected for the final analysis. Random Forest Classification (ROC) algorithm was implemented on the dataset to identify the important predictors and their effects on mortality.
3. Results: The area under the ROC curve obtained during model validation on the test dataset was 0.97.
4. Age was the most important variable in predicting mortality followed by the time gap between onset of onset symptoms hospitalization.

Salient Features of Methodology:

1. Patients aged above 62 years are at higher risk of fatality whereas hospitalization within 2 days of the onset of symptoms could reduce mortality in COVID-19 patients.

Declaration: Researchers have followed all relevant ethical guidelines; any necessary Institutional Review Board (IRB) or Independent Ethics committee approvals have been obtained and details of the IRB/oversight body are included in the manuscript. All the necessary patient/participant consent have been obtained and the appropriate institutional forms have been archived.



Variable Importance Plot and Partial Dependency Plot from the Random Forest model. (A, B) Variable Importance Plot showing the contribution of the predictors on the Random Forest model according to Mean Decrease in Accuracy (A) and Mean Decrease in Gini (B), Partial Dependency Plot showing the marginal effect of Age (C) and Days from Symptom to Hospitalization (D) on the odds of Death among COVID-19 patients.

MONITORING SYSTEM APP

NRDC (10)-T&S-COVID-19

Introduction: COVID-19 Monitoring System App is developed in a record time to deal with the pandemic. It is applied to identify, undertake live surveillance, track, monitor, and provide realtime analytics. COVID Monitoring System is a timely technological innovation, which has potential to ease the pain off by effective surveillance, and deploy a meticulous tech-enabled method to collate vital data, at the click of a button empowering active associates across any state, from the hierarchical polity to bureaucracy to the front line ASHA & ANM workers. This technology is based on IoT, Smart devices, GPS and Geotag via a super lite centralized App -COVID-19 Monitoring System, which will be installed in the smartphones of all associates from the ground level to the Chief Minister's Office in a state.

Salient Features:

1. The app enables live surveillance, monitoring, tracking, reporting, and major bulletins. The analytics by the app also facilitate assurance to the stakeholders by providing the facts and figures in their fingertips.
2. The system empowers each health-caller to handle 1500+ calls, and simple chatbot interaction every day with a patient, to ensure that the symptomatic or confirmed 'positive', quarantined and is under treatment, helping to strengthen the COVID contacts outreach significantly.
3. The callers will also persuade and remind the patient to self-administer the prescribed treatment, to maintain social distancing, as well as give a reminder to stay home and stay safe.
4. This Monitoring System which is built on a digital platform, erases human errors, and provides accurate information. The quick turnaround, and the innovative psyche will initiate improved surveillance, tracking-effective monitoring, and supervision
5. Among the vital Features of the app is Geotagging and GPS tracking of the home quarantined person, to ensure that he/she is not breaching the law of quarantine. With instant trace and trackability, accurate information is pushed to the authorities even if there is a breach. Every detail reported –reaches the Chief Minister's office through various updaters like the ASHA worker, doctor, police, concerned bureaucrat.

Stage of Development: This application has been launched and proven to create detailed health profiles for more than 50,000 people across these 3 states in a record number of days.

JARVIS THERMAL CAMERA

NRDC (11)-T&S-COVID-19

Introduction: Driven by a vision to solve real-world problems by integrating advanced technologies like AI, a new Thermal Camera has been developed under video analytics platform, JARVIS. The technology is functional and effective in scanning crowded places. From airports to railway stations, the AI-powered Thermal Cameras can be installed at various hotspots of consequence for the purpose of early detection and prevention of the spread. With the growing scare around novel Coronavirus and the possibility of our health infrastructure getting overwhelmed, the implementation of these cameras becomes pertinent and urgent. By reducing both the time and human effort required in identification, agencies can get ahead of the curve in controlling the spread of this pandemic.

Salient Features:

1. This technology removes the human intervention in early stages of detection; through heat wave analysis and more, the technology helps in proactively taking preventive efforts to reduce the risk of the spreading the virus.
2. The latest technology will alert the system of anyone with a body temperature of above 37°C and examines heat signatures directly through the cameras, enabling authorities to identify and further inspect suspected virus carriers.
3. The camera has a range of up to 100 meters and can identify multiple people at the same time.
4. The AI-powered system is enabled with a Sensitivity ranging from High sensitivity range of -40 to 160C or -40 to 320F, whereas the low sensitivity of -40 to 550C and -40 to 1022F.

Stage of Development: The inventors have developed and launched the product, which is being used by many law enforcement agencies in India.

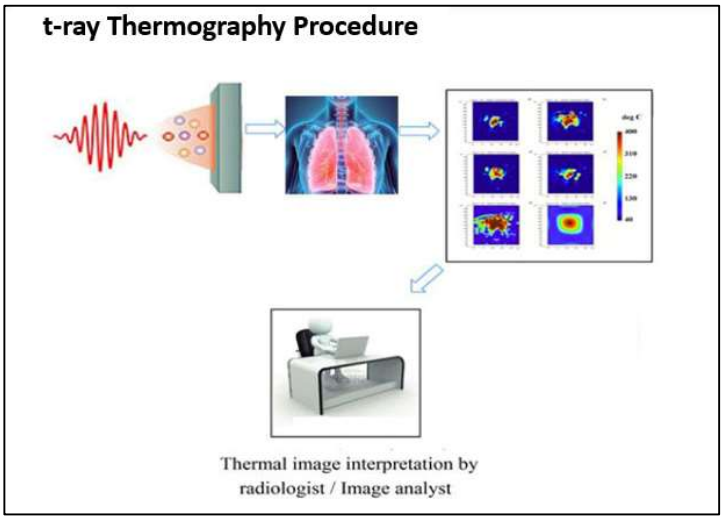
t-ray THERMOGRAPHY DEVICE
NRDC (12)-T&S-COVID-19

Introduction: Thermal screening or infrared-based devices has major limitations in accurately identifying asymptomatic individuals carrying the virus and such cases go undetected. A team of researchers are working on developing this artificial intelligence-based terahertz radiation (t-ray) scanning unit to address the limitation of infrared thermal scanner in accurate and early detection of coronavirus patients. The device will be cost-effective, which will allow quick diagnosis with accurate screening and monitoring of mass population.

Salient Features:

1. Device with t-ray depends on the distribution of water content in cell and biomolecules, which could be employed for screening of body organs such as lungs for diagnosing respiratory infections.
2. The unique absorption fingerprint of t-ray radiation in lungs and the contrast thermal image of affected and healthy lungs will help doctors and paramedical staff identify such cases at an early stage when the patient is apparently asymptomatic and not showing any virus symptoms.
3. t-ray thermography is a potential alternative to thermal infrared scanners and CT imaging for early detection and safe monitoring of COVID-19 patients.
4. The fundamental physics behind the biomedical diagnosis with t-ray depends on the distribution of water content in cell and biomolecules, which could be employed for screening of body organs such as lungs for diagnosing respiratory infections.

Stage of Development: The invention is currently at the developmental stage and awaiting approval from different regulatory agencies.



FEVER DETECTION SYSTEM

NRDC (13)-T&S-COVID-19

Introduction: The researchers have proposed to developed a technology for a fever detection system to help contain the epidemic as the demand for abnormal body temperature sensing camera systems has increased.

Salient Features:

1. The Fever Screening System uses face detection technology and the infrared energy that a body emits, which is invisible to the human eye. The software constructs a heat map of the exposed skin and calculates the temperature.
2. Person has to face the camera and stand still, allowing a clear view of the corners of the eyes, the tear ducts where the skin temperature comes closest to that of the body's core. Anyone flagged with an elevated skin temperature can be taken aside for further examination.
3. When the system detects someone with abnormal body temperature, it generates an alert and opens a ticket in the ticket management system, which has that person's photograph and temperature details.
4. The researchers have developed an algorithm and device that checks for the body's temperatures by checking the tear ducts.

Stage of Development: Product has been developed at pilot scale and the company is in talk with investors and camera manufacturers to scale up the product.

DRONE THERMAL SCREENING

NRDC (14)-T&S-COVID-19

Introduction: Once the lockdown is eased, and people start gathering it will be difficult to ensure social distancing and hence enhanced risk of virus spread till the time situation is completely in control. To address the issue, researchers have developed a drone equipped with infrared camera which can help in thermal screening of groups without human intervention and identify suspected COVID-19 cases at an early stage. Drones are being made for lot of other activities including delivery of foods and medicines and spraying disinfectants, in similar way to limit the risk of the personnel getting infected while conducting temperature checks, drones equipped with infrared cameras to test temperature measurements can be used.

Salient Features:

1. Results showed that by installing a cotton swab within the field of view of the thermal camera, the camera can get an accurate reading. The calibrated drone camera can then be used to measure body temperatures while the officer remains at a safe distance away. While the results are encouraging, it is essential to mention this solution is not designed to be used for standard medical procedures.
2. Any abnormalities can be marked as suspects for COVID-19. This information can be used by health workers and officials to take further measures. This will help in the identification of infection in a person at a much early stage and can prove to be vital in the present scenario.
3. The drone also has a loudspeaker which can be used by personnel to monitor places especially with high disease prevalence and give appropriate instructions.

Stage of Development: Product has been developed and in trail run stage in co-ordination with few states of India

qXR TOOL

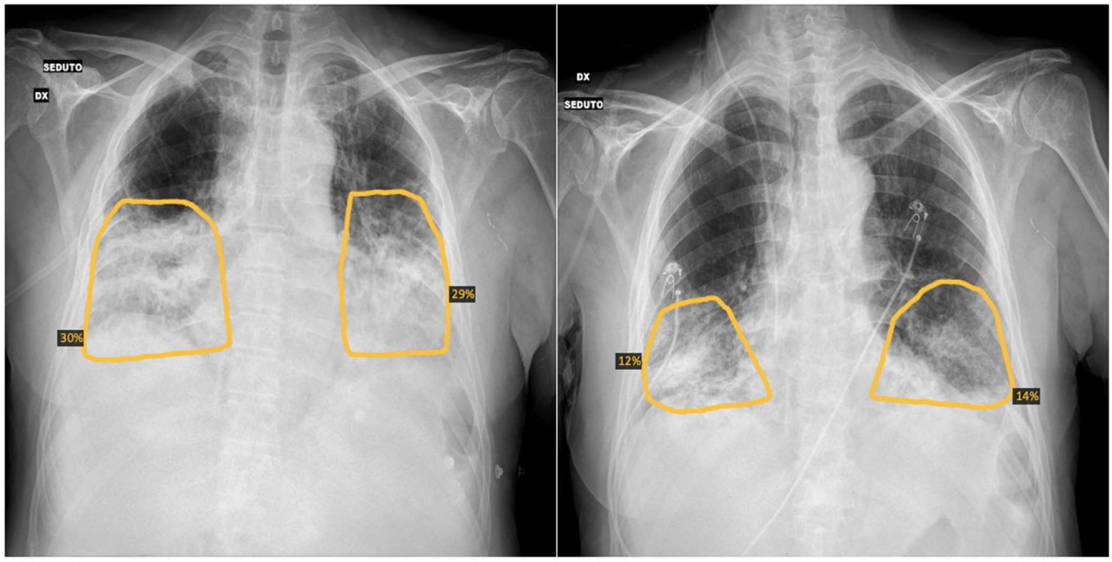
NRDC (15)-T&S-COVID-19

Introduction: To enable high quality and affordable diagnoses for COVID-19, researchers have developed progression monitoring tool "qXR".

Salient Features:

1. Screen chest X-rays for COVID-19 signs, detects ground glass opacities and consolidation indicative of COVID-19 and Lesion localisation in lung parenchyma with COVID-19 risk and affected area estimate. The monitoring involves in 3 steps as indicated below:
    - Monitor progression of infected patients via daily bedside chest x-rays
    - Automated overread in seconds without burdening the radiology team
    - Estimates percentage area of the lung and tracks change with each chest X-ray

Stage of Development: Product has been developed and at implementation stage.



qScout PLATFORM

NRDC (16)-T&S-COVID-19

Introduction: Pandemic Response Care Platform. qScout-EMR is used for contact registration and tracing.

Salient Features:

1. Platform agnostic: Can be accessed from any mobile or laptop.
2. Register confirmed cases of COVID-193.
3. Add linked contacts who might be at risk
4. Connects with qScout-Monitor for daily symptom check of contacts
5. Alerts about contacts converting to COVID-19 presumptive.

Stage of Development: Product has been developed and at implementation stage.

QUARANTINE APP

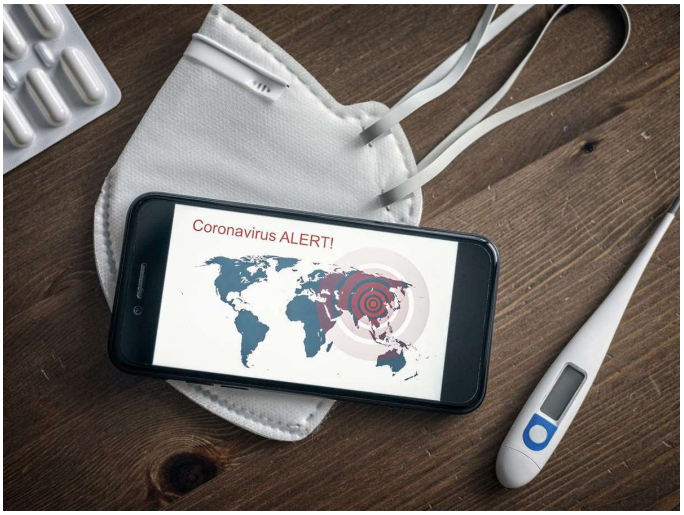
NRDC (17)-T&S-COVID-19

Introduction: The startups ecosystem is collaborating and in process of developing an app called Quarantine app, which will live track the patients who are in home quarantine and those who have tested positive. The app will have self-reporting option where individuals who are feeling the symptoms can report themselves to authorities. This will be available to both the authorities and the public to track.

Salient Features:

1. The idea proposed of opening up a map view of where one can identify the location of the affected patients so that the locations can be marked as unsafe or risky. This way, citizens will know that these are risky spots and will start with avoiding these areas.
2. The researchers are trying to create a tool which will give the authorities the ability to track the patients. If they are supposed to be quarantined, they can upload pictures in the app on a regular basis so that the authorities have the ability to keep track of a patient and whether he's following rules or not.
3. Discussions are in progress to include a feature that enables users to identify locations in the map where the patients are admitted. It also offers a whole database of the dates when the cases were confirmed, the names of the hospitals and the patients' travel route i.e., the places they visited before testing positive.

Stage of Development: the app is still a work in progress and developers are in the early stages of discussion with the government.



NO QUE NOW

NRDC (18)-T&S-COVID-19

Introduction: "No Que Now" is a specially developed social distancing app. This mobile application is made to help people maintain social distance, while they purchase essential groceries.

Salient Features:

1. According to this application, no need to stand in the 'Que' while going for bank works or groceries. One can book the slots according to the time and then step out exactly at that time to get essential needs.
2. This way the rush near the shops will be reduced and all the people will be able to purchase the needed items.

Stage of Development: The app is in usage, but this app is not available on play stores, customer needs to go with the URL NoQueNow.com and then enter your area.

TRACECOVID-19

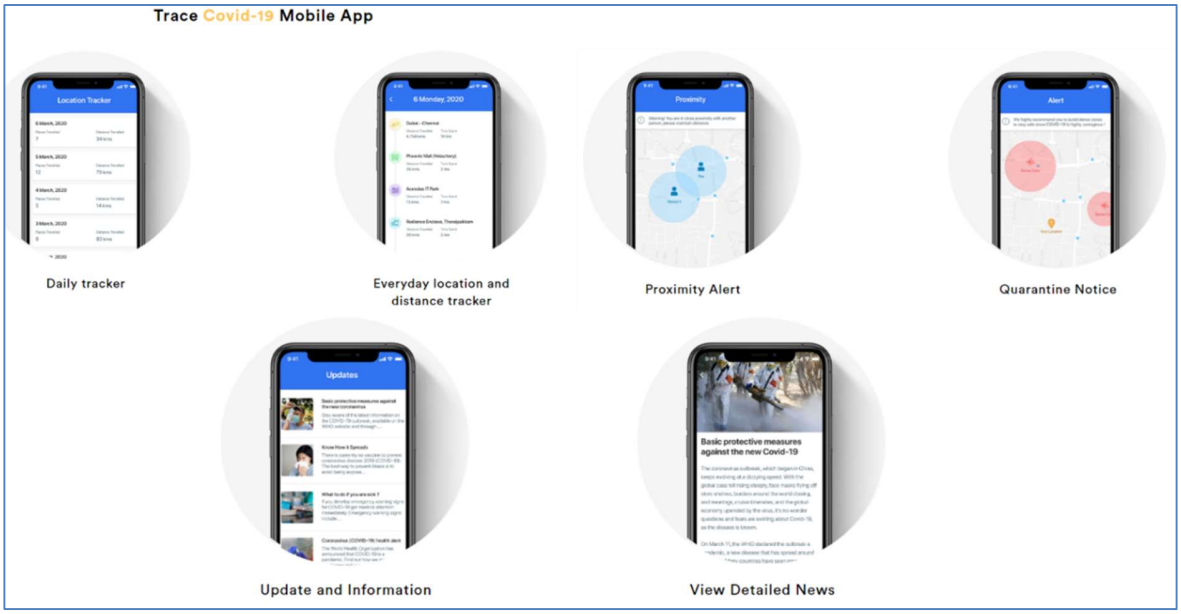
NRDC (19)-T&S-COVID-19

Introduction: Health workers all over the world are working round the clock, risking their lives and being away from their families. They are seriously over-burdened. This app is developed to help reduce the burden by helping trace contacts and automatically intimating them and authorities which otherwise have to be done by the health workers and authorities manually.

Salient Features: The app has been developed with the below core and salient features

1. Automated Tracking: Contact tracking and proximity alert is done automatically in realtime.
2. Accurate Data: The data is collected using accurate location information on smart phones.
3. No Manual Intervention: There is no need to manually interview affected individuals by health officials.
4. Instant Intimation to Contacts: Upon confirmation of a case, instant notification is sent to all contacts.
5. Quarantine an Area: Mark an area as quarantined for visitors or people living nearby.
6. Information and Updates: Give realtime updates and important information about Covid-19 via the app.

Stage of Development: The app has been developed and at implementation stage.



KAWACH

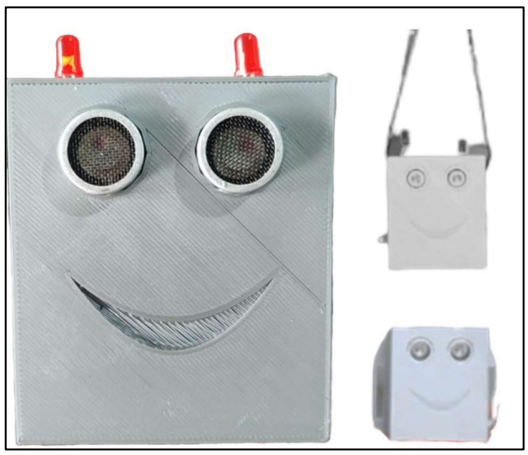
NRDC (20)-T&S-COVID-19

Introduction: This KAWACH app ensures social distancing and reminds one timely sanitization terms. According to the Ministry of Health and Family Welfare, Govt., of India social distancing is a non-pharmaceutical infection prevention and control intervention implemented to avoid or decrease contact between those who are infected with a disease-causing pathogen and those who are not, so as to stop or slow down the rate and extent of disease transmission in a community. If user needs any aid to develop habits which will help in dealing with coronavirus, the time is now.

Salient Features:

1. 'KAWACH' (shield) which vibrates and glows in case someone breaches the user's safe space of one metre.
2. The device which can be worn as a pendant comes equipped with a 'hand wash reminder' feature that beeps every 30 minutes to remind the user to wash his/her hands.
3. It also has a temperature sensor that sends an alert to the user through SMS in case his/her body temperature crosses the prescribed limit.
4. Kawach is a low-cost and easy to carry device that comprises of an LED, vibrator, controller, battery, human body temperature sensor, ultrasonic sensor, switch and a storage card.
5. The device can be of good help to those who are involved in essential services as they also need to maintain adequate distance which is generally not happening because there are too many customers and they often forget.

Stage of Development: The device has been developed and tested internally. The technology is ready for commercialization for mass production.



TRACKING APP

NRDC (21)-T&S-COVID-19

Introduction: While the epi-centre of the SARS-CoV-2 infection was quick to identify, and people travelling from abroad are thoroughly checked, the initial symptoms take between two to 14 days to show up. During such times, it is difficult to track everyone who has come in close proximity with those who might be infected. Research team has come up with solutions for this crisis with new Covid-19 tracking app. The application provides precise, secure, and reliable tracking techniques. Additionally, it will help in spreading self-awareness among patients and encourage more to get tested for the infection. The application is a voluntarily effort of the students involved. It is an open-source project.

Salient Features:

1. A team of students have developed an application to help trace individuals who come in close contact with COVID-19 positive cases. The team has developed a mobile application that can identify people who have been near, that is, within two meters of an infected person. The application uses Bluetooth technology and enables tracking of the population who have been in close contact with any infected coronavirus positive cases.
2. The application requires Bluetooth permission and does not involve a GPS tracking or sharing of personal data and information. Once the users complete the one-time registration using their name, phone number, and age, the app records the encrypted information of individuals interacting with each other or within two meters of distance. This information is then uploaded to a secured server.
3. The application has three major verticals:
    - Spreading awareness: It provides live verified statistics through credible sources like that provided by the World Health Organisation (WHO).
    - Detection: Using Bluetooth, the application will backtrack and alert all the linked people – individuals who have been in close vicinity of positive coronavirus cases in the past days. The date and region of interaction within the Bluetooth radius are also provided through the application.
    - If and when an individual does come in close contact with a COVID-19 positive patient, the app will connect the user with the nearest healthcare facility. Additionally, it will provide guidelines for self-quarantine and supportive care guidelines.
4. A user will get the following updates on downloading the app: Statistics of his social distancing, Regular updates and notifications about COVID-19, Statistics of how many people (known and unknown) the user was in close contact with, In case of any contact with a suspected or confirmed case, a preventive advisory from healthcare service providers, Self-quarantining guidelines to be followed and action to be taken, in case of a potential suspect, Alarm about maintaining social distancing
5. Healthcare providers or state governments downloading the app will get the following benefits: Easy and hassle-free backtracking of COVID-19 positive individuals and Rapid reach and alarming to all suspected and infected population to take preventive measures

Stage of Development: The app has been developed and tested internally among the team. Developers are looking forward to collaborating with government bodies and agencies to work with and deploy the application as soon as possible. Team has not spent any money in developing the application, but if the government wants, they would require to host in a separate server, as the scale of usage will increase.

UNMAZE

NRDC (22)-T&S-COVID-19

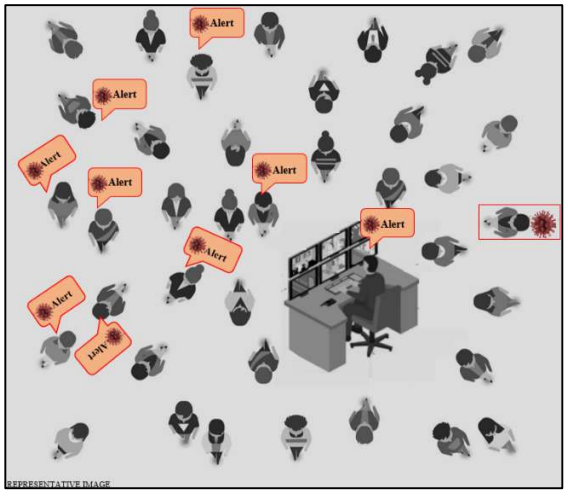
Introduction: The massive surge in cases of SARS-CoV-2 has created a situation where governments across the world are forced to adopt a complete lockdown approach. In many cases, due to absence of actionable information and unawareness about movement of people who are quarantined in home, there is a huge risk of a rise in infection. To resolve this, research team has come up with an application which can keep people informed when they are near someone who is infected with COVID-19 or have been advised to be in quarantine 'unmaze'.

Salient Features:

1. The app works on the basis of GPS, and gives error free data of accurate movement. App users can get informed whenever they're near an infected person who has been advised to be in quarantine. All data remains encrypted to ensure privacy.
2. The application is mapped with the mobile phone number of the user. It picks up the geo-location of the user and the details of the devices which came in the vicinity of the device (5 – 10 meters).
3. In case a person is identified to be infected with corona, the administrator will enter the details on the server. The solution will subsequently pick up data from those devices and identify all the locations they went to and the other devices they came in contact with. Automatically, a notification is sent to users requesting them for self-quarantine.
4. Subsequently, the devices are regularly monitored to ensure that they are not violating the quarantine. A separate alert is sent to the administrator informing him of the areas which need to be disinfected.
5. This application can be used to identify contact tracing. However, it has not been made mandatory for all users. As a result, the effectiveness may be reduced.

Stage of Development: The application model has been designed and developed. Some of the state police departments have approached the team to use the solution and implementing this surveillance-based containment techniques. There isn't much investment to be made and hence these apps can be rolled out soon.

Limitations: However, for these applications to work at full capacity, the location of the user needs to be tracked in realtime which is a challenge. There is another concern, despite other countries employing similar techniques, there hasn't been evidence of a significant contribution of these applications in containing the outbreak.



COVID-19 RELATED FEW INDIAN APPS FOR FREE DOWNLOAD

AAROGYA SETU
NRDC (23)-T&S-COVID-19

Introduction: The ministry of electronics and IT launched this mobile app. This app is in implementation and is rolled out on Google and Apple app stores. The app is loosely based on Singapore's tried and tested community tracing app called 'TraceTogether'. The unique features in the app will help identify if a person put under quarantine has come into close contact with another person. It's a technical equivalence of one phone shaking hands with another while remembering the time and location of the meet up. The app is likely to be used in contact tracing of the suspect coronavirus cases, reducing time and error in manual identification. e App will help the Government take necessary timely steps for assessing risk of spread of COVID-19 infection, and ensuring isolation where required.

Salient Features:

1. The app built through public private partnership "assesses themselves the risk for their catching the Corona Virus infection.
2. The app is available in 11 languages and is expected to go through a number of updates as the pandemic progresses.
3. It will calculate this based on their interaction with others, using cutting edge Bluetooth technology, algorithms and artificial intelligence.
4. The app will have permission to use the phone's Bluetooth and once it comes within close proximity with another phone, it will identify the other device with its Bluetooth prints.
5. User's privacy will not be compromised.

Stage of Development: Developed by eGov Mobile Apps division of NIC and at implementation by Indian Government. The app has been launched on both Andriod and ioS.

Ongoing additional Research: The future versions of the app are likely to offer additional features.

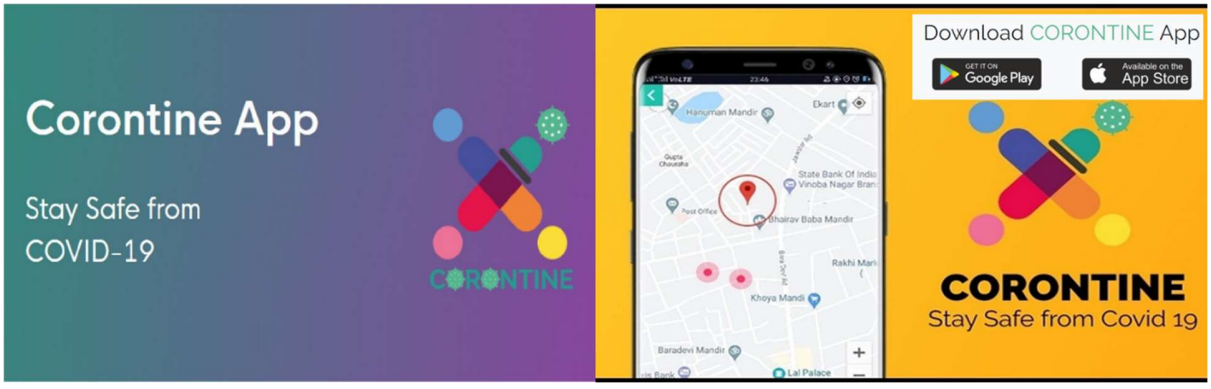
CORONTINE
NRDC (24)-T&S-COVID-19

Introduction: CORONTINE app is used to track people escaping quarantine. Asymptomatic carriers of SARS-CoV-2 have been a cause of concern for the medical community globally. These individuals may be positive asymptomatic carriers of SARS-CoV-2. There have been several cases in India where such people escaped quarantine and mingled with the general public, increasing the potential risk of community transmission of SARS-CoV-2. If a user leaves a specified quarantined zone marked by a geo-fence, it will be auto-detected. The purpose of the app is to help authorities track the asymptomatic carriers and prevent the spread of the disease.

Salient Features:

1. This platform can help authorities to register and track the individuals to check if they confine to their quarantined zones.
2. The app is meant to be installed on the mobile of asymptomatic carriers (AC) by an authorized agency (AA). The app will send GPS coordinates of the mobiles periodically to a server under the supervision of AA.
3. CORONTINE allows to geo-fence and automatically generate alerts including text messages and e-mails if users move out of the quarantined zone. The CORONTINE platform provisions for organizing zones into regions and several other such features.
4. Once this application is installed on the mobile phone of a suspected person by an authorized person, if he/she leaves the designated home and moves outside alerts are sent. Live tracking with the help of GPS is possible.
5. The platform is extremely customizable to the needs of the agencies and will be very useful for contact tracking by the authorities.

Stage of Development: App has been developed and launched.



NATIONAL AGRICULTURE MARKET (E-NAM) PLATFORM
NRDC (25)-T&S-COVID-19

Introduction: E-NAM is a web-based platform of Ministry of Agriculture, Government of India. New features were launched in E-Nam to strengthen agriculture marketing by farmers which will reduce their need to physically come to wholesale mandis for selling their harvested produce, at a time when there is critical need to decongest mandis to effectively fight against COVID-19. In addition to facilitate inter-mandi and inter-state trade at this juncture, enhanced version of logistic module has been released whereby aggregators of transport logistic platform have on boarded which helps users to avail trackable transport facilities for transporting their produce.

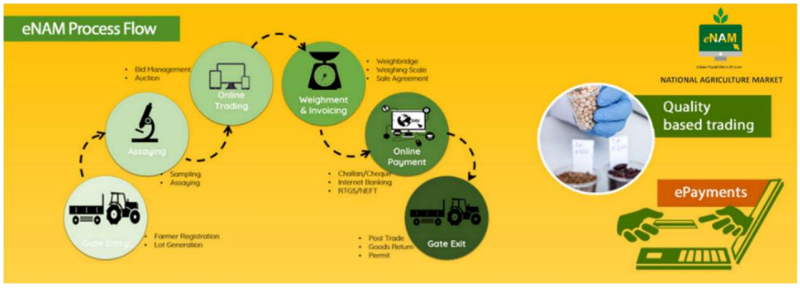
Salient Features:

1. The software modules are namely (i) Warehouse based trading module in e-NAM software to facilitate trade from warehouses based on e-NWR (ii) FPO trading module in e-NAM whereby FPOs can trade their produce from their collection centre without bringing the produce to APMC and (iii) Launch of Logistics module.
2. With the new features, e-NAM provides for contactless remote bidding and mobile-based any time payment for which traders do not need to either visit mandis or banks for the same. This helps improve social distancing and safety in the APMC markets to fight against COVID-19.
3. These features will help farmers at this juncture to effectively sell their produce at better prices from near their farm gate thus helping them at this time.

Advantages:

1. Depositor can save the Logistics expenses and will have better income. Farmers can sell the produce across the nation to get better price and at the same time can save oneself from hassle of mandi.
2. Farmers will be able to place their produce in WDRA accredited warehouses avail the benefit of pledge loan if required.
3. Price stabilization by matching supply and demand through time and place utility. This will not only decongest the mandis but also reduce the hassle of FPOs to deal with mandis.
4. This will help FPOs by reducing transaction costs (Transportation) and enhancing their bargaining power. Facilitates FPOs to avail online payment facility with ease of doing business.
5. This will help in seamless transportation of agri-produce. This will promote inter-state trade under e-NAM by providing online transport facilities for distant buyers.

Stage of Development: App has been developed and launched.



CORONA KAVACH

NRDC (26)-T&S-COVID-19

Introduction: Government of India has launched a COVID-19 risk-tracking Android application. The application christened 'CORONA KAVACH' uses a person's location to assess whether they are in a high-risk geographical zone or not.

Salient Features:

1. The CORONA KAVACH user's location is mapped through GPS on the app to assess whether he/she is at a high-risk geographical zone or not.
2. The application shall use the data to conduct analysis and provide the public information about active COVID-19 cases in India.
3. The application also facilitates a survey to keep a self-check, while featuring the capability to help individuals track their breathing capacity.
4. Additionally, the app will track the data of the users every hour and inform the user if they come within the infection range of a host or carrier of the SARS-CoV-2.
5. This will enable identifying the chain of contact. Moreover, the app will also alert the user whether they have crossed paths with any person who has tested positive for the infection.

Stage of Development: Government of India has launched CORONA KAVACH which can be downloaded from the Google Play Store. Application floated at the moment is in the beta stage.

COVA APP

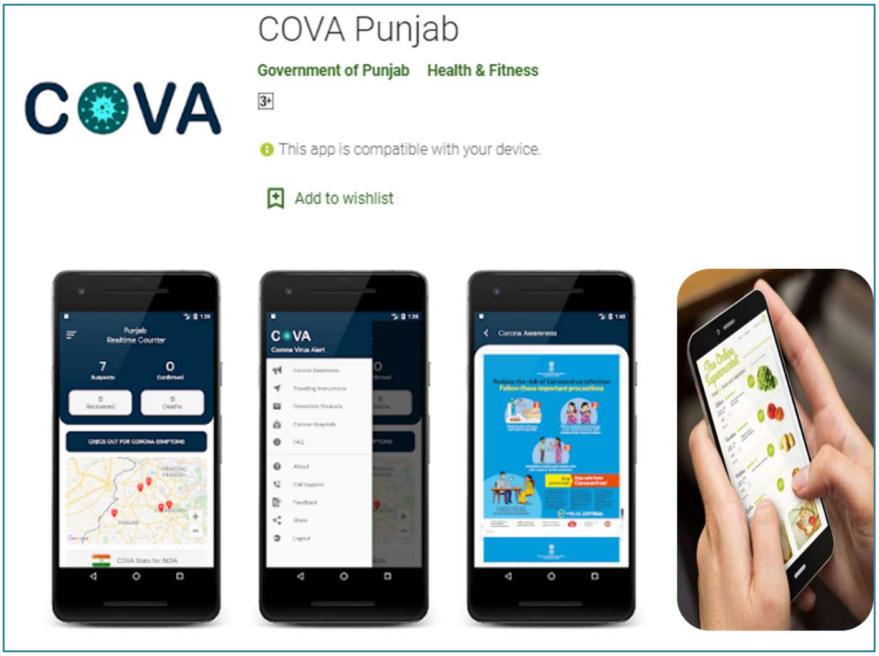
NRDC (27)-T&S-COVID-19

Introduction: The government of Punjab has launched an on-demand delivery of essential goods and groceries through its COVA app. Initially, the services were available on calls, but the state government decided to expand it to a mobile app to reach a much wider audience.

Salient Features:

1. The app will not only allow users to place orders for food and other necessities but will also provide authentic and important information to the users. This includes report gathering, access to medical advice from doctors and other authentic information.
2. The added feature in the app will enable vendors to register themselves as suppliers and enlist their delivery executives for curfew passes. This shall also empower the district administration to approve or reject a vendor, and also act as a monitoring authority if a complaint is registered with regard to overpricing or adulteration.
3. Aside from accepting and delivering groceries and food, the app also contains vital information like the statistics of COVID-19, medical advice from the doctors, and other essential information.
4. The app also has features like Contact Tracing (GPS, Bluetooth) Hotspots (Containment Zones), Real time dashboard for Punjab, India and global stats, To check for symptoms of Corona and have a quick self-screening, Traveling instructions, Corona Awareness, Prevention Products, information about Corona Hospitals, Punjab and many more.
5. The development and maintenance of the COVA delivery app are taken care of by the Punjab Government digital team.

Stage of Development: The app has been launched and available in Google Play.



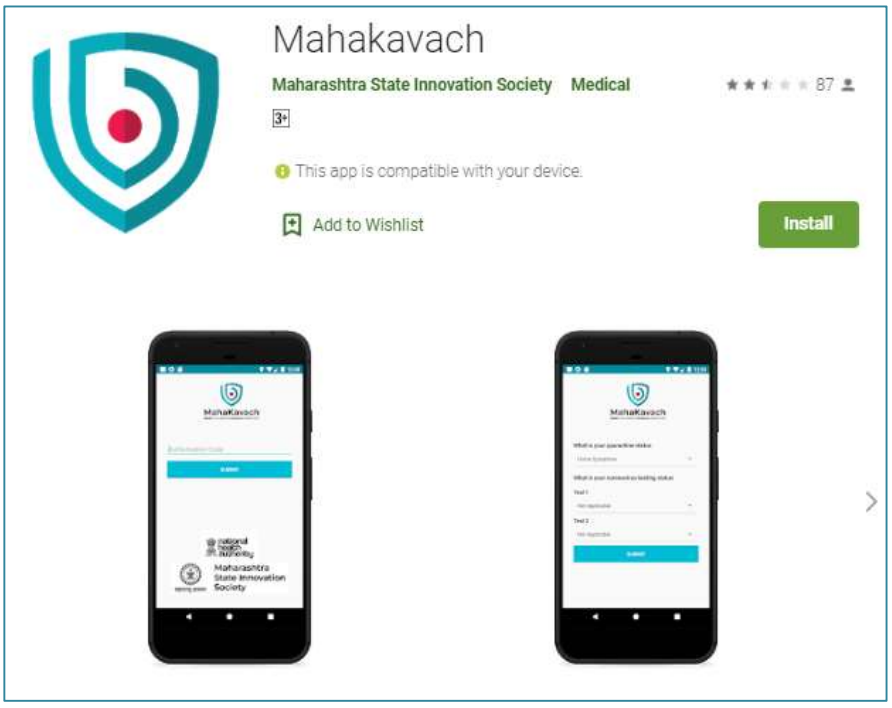
MAHAKAVACH

NRDC (28)-T&S-COVID-19

Introduction: India presently stands on the brink of the community transmission stage of COVID-19, smartphone apps such as these are becoming increasingly commonplace. Mahakavach is a digital contact tracing app for Covid-19. The state government of Maharashtra launched MahaKavach, a smartphone app that will help government officials to track suspected COVID-19 cases in the state Since the governing body wants to use it only for specific cases, sources in the Maharashtra state government have clarified that it will only available for download via a link or QR code that will be provided to specific individuals personally.

Salient Features: The app will use smartphone-based location services, and will be used to geo-fence the individuals as India fights to prevent the COVID-19 pandemic from reaching a community transmission stage.

Stage of Development: The app has been launched and available in Google Play. The app is not being openly listed on Android or iOS app stores, and according to internal sources, will only be used by the government to track specific, suspected COVID-19 cases, or those who have already been put in quarantine by health officials in the state.



TEST YOURSELF

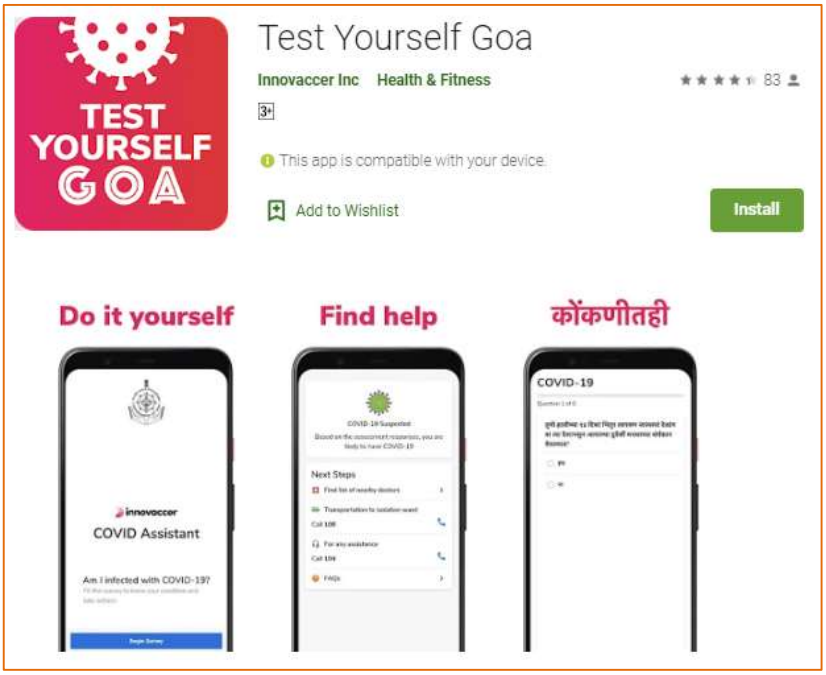
NRDC (29)-T&S-COVID-19

Introduction: Goa becomes the first State in India to adopt an automated technological solution for the citizens to carry out a self-assessment test for COVID-19 with their launched app "Test Yourself Goa". It is a self-evaluation app to identify at-risk patients for coronavirus. The application assists users to take the next step accordingly without having to physically visit a healthcare facility. he application will help the government to curb the coronavirus panic in the state as people will first test themselves with this before queuing up at already overburdened hospitals.

Salient Features:

1. The App provides information on Self Quarantine, Helpline numbers to reach out to, and other such information.
2. The person fills a survey based on the symptoms and the solution will assist them to take the next step accordingly without having to physically visit a healthcare facility.
3. The application automatically sends the educational materials on prevention guidelines, steps to take in quarantine, and other relevant information from the Directorate of Health.
4. The solution automates the identification processes by sending self-evaluation assessments as patients book appointments.

Stage of Development: The app has been launched and available in Google Play.



QUARANTINE MONITOR

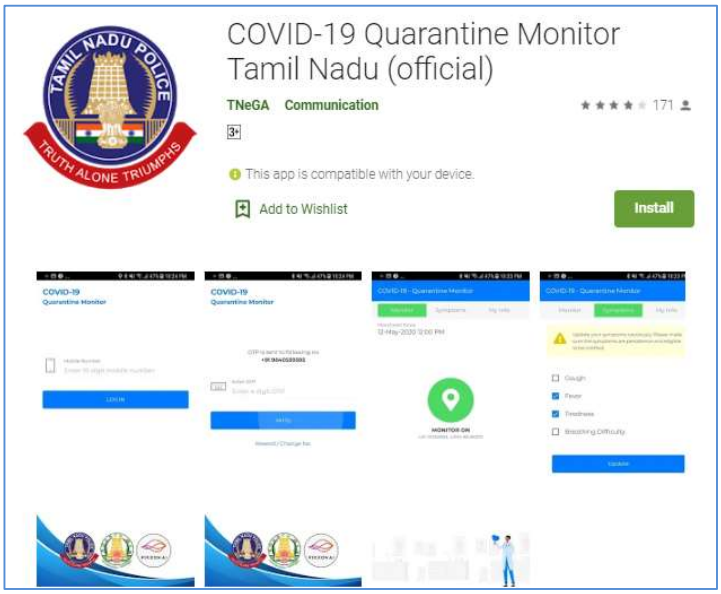
NRDC (30)-T&S-COVID-19

Introduction: With people who are violating home quarantine rules, police department has come out with a novel idea to track them using a mobile application. The app will track people with history of foreign travel in the past two months. This Application is ONLY for people who are quarantined as per the official database.

Salient Features:

1. The COVID 19 Quarantine Monitor will create and maintain records of quarantined and infected persons, track all quarantined people on a realtime basis and will have updates on people quarantined.
2. It will work as a geo fence. If the quarantined person goes out beyond a certain perimeter, the authorities will be alerted. It will also keep the local police updated on the status and location of the person.
3. The app will start working once the person under home quarantine downloads the app as per the instructions from the police and the health department authorities and feeds his or her details.
4. The details of the quarantined persons will be collected from the health department and messages will be sent to each of them asking them to download the mobile application.
5. Once the application is downloaded, the exact location of the person can be tracked as it is GPS-enabled.

Stage of Development: The app has been launched and available in Google Play.

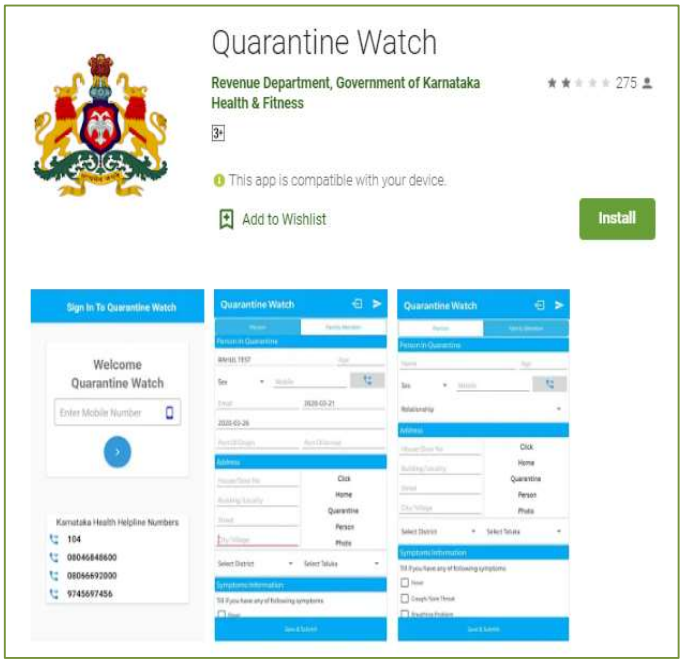


QUARANTINE WATCH
NRDC (31)-T&S-COVID-19

Introduction: Quarantine Watch is just one of several apps and other digital surveillance measures that states and the central government have launched to curb the spread of the novel coronavirus. to ensure that people remain under quarantine, the government has issued new surveillance measures, and they're monitoring them closely using mobile phone apps and other methods. One of these surveillance strategies in India is to publicly release the addresses of people who have been potentially exposed to the virus — a tactic successfully deployed in places like Hong Kong. Citizens are encouraged to confront and report violators to the authorities.

Salient Features:

1. All persons under order of Home Quarantine shall send their selfie to government every one hour from home.
2. The selfie sent from the Quarantine Watch contains GSP coordinates, which makes the location of the person known.
3. If the home quarantine person fails to send selfie every one hour (except sleeping time from 10 pm to 7 am) or who are sending wrong selfie Even those sending wrong pictures to mislead, then government team will reach such defaulters and they are liable to be shifted to the government created mass quarantine.
4. The government quarantine check team during house-to- house visits will use the application and click photo of home quarantined persons and send it to the government.
5. This app shall be used by quarantined persons only. This app will track quarantined people in GOK. After Home Quarantine Completed, no need to send selfie. After Home Quarantine Completed. User Need to send daily health status for 14-days.



Stage of Development: The app has been launched and available in Google Play.

GoK APP

NRDC (32)-T&S-COVID-19

Introduction: The app offers exclusive updates from GoK - Direct Kerala, where a user can download and install the app for free to use the service. Sign-up and registration are not required for the user to use this app.

Salient Features:

1. The information regarding COVID-19 and the virus outbreak can be obtained through this app.
2. the app named GoK Direct is developed to check fake information on coronavirus being spread.
3. This facility would be available on ordinary mobile phones through SMS alerts.
4. News, government notices, helpline numbers and other details would be available on the app. Quarantine protocol, advice to visitors and awareness to travelers are some of the categories included in the app.

Stage of Development: The app has been launched and available in Google Play.

FEEDBACK OF QUARANTINE PATIENTS

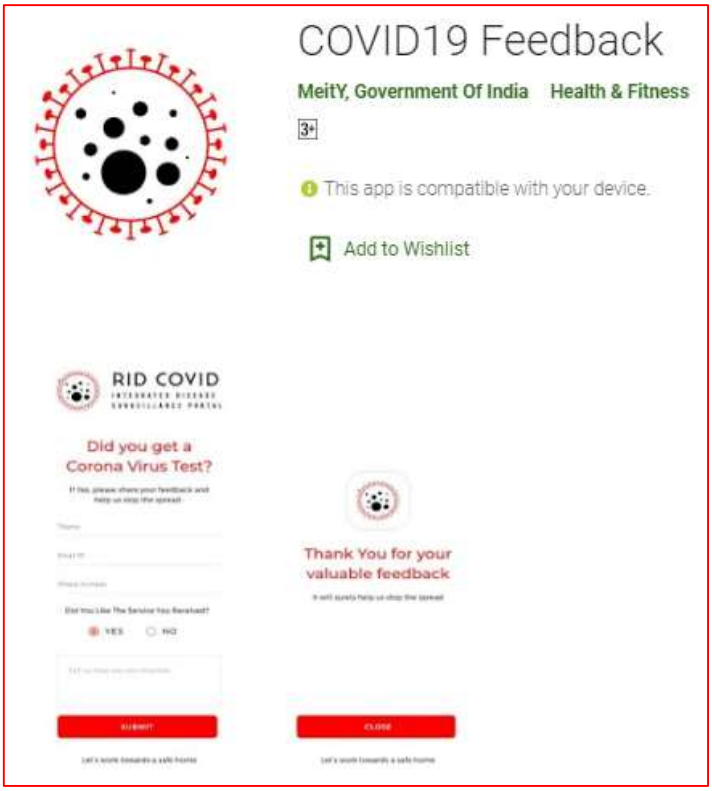
NRDC (33)-T&S-COVID-19

Introduction: The app can track suspected patients who have been quarantined by setting up a geo-fence around them. If they move out of that radius, the app will alert authorities.

Salient Features:

1. Developed mobile application can track the movement of people with the disease and also can do geofencing around him or her. The system will get an alert if geofencing is violated by the quarantined person.
2. Besides live tracking, the administrator can view the entire movement history of an individual, it said, adding that in case GPS data is not received, the location will be obtained automatically through the triangulation of mobile towers. If the internet is not working in a certain area, the location will be received through SMS.

Stage of Development: The app has been launched and available in Google Play.



CAWACH PROGRAM - GOI SCHEME
NRDC (34)-T&S-COVID-19

Introduction: Department of Science & Technology, Government of India in a quick response to combat COVID-19 global pandemic approved setting up of a Centre for Augmenting WAR with COVID-19 Health Crisis (CAWACH) to scout, evaluate and support the innovations and start-ups that address COVID-19 challenges. The implementation agency of the CAWACH was set up in the Society for Innovation and Entrepreneurship (SINE), a technology business incubator at IIT supported by DST, Govt. of India.

Salient Features:

1. CAWACH will identify upto 50 innovations and startups that are in the area of novel, low cost, safe and effective ventilators, respiratory aids, protective gears, novel solutions for sanitizers, disinfectants, diagnostics, therapeutics, informatics and any effective interventions to control COVID-19.
2. CAWACH will provide timely support at different stages for fast-tracking the commercialization process and scale-up of technologies across the country.
3. It will provide access to pan India networks for testing, trial and market deployment of these products and solutions in the identified areas of priority COVID-19 solutions.

Stage of Development: CAWACH program of DST, Govt. of India is focused on leveraging the youthful energy, intelligence and extraordinary innovative potential of our technology incubators and startups and empowering them for scale-up to speedily address the multi-dimensional challenges of COVID-19 across respiratory aids, disinfection systems, protective gear and coatings, information and monitoring assists, diagnostics, and plethora of other relevant materials, devices and solutions.

COVID INDIA SEVA

NRDC (35)-T&S-COVID-19

Introduction: Union Minister of Health & Family Welfare, Science & Technology, and Earth Sciences, Govt. of India, launched an interactive platform, COVID INDIA SEVA. This initiative is aimed at enabling transparent e-governance delivery at large scale, especially in crises, like the ongoing outbreak of COVID-19 pandemic.

Salient Features:

1. COVID INDIA SEVA is aimed at providing real-time solutions to COVID-19 related queries. People can post their queries and requests to the COVID INDIA SEVA and COVID INDIA SEVA twitter will handle to give the swift replies from the team of trained experts.
2. Through this platform, trained experts would be able to share authoritative public health information swiftly at scale, helping to build a direct channel for communication with citizens.
3. Twitter has proved to be an essential service for both the government and citizens to interact and exchange information, especially in times of need.
4. The responses by the experts will be available for everyone and users will not be required to share any personal details or health records on this account.
5. The dedicated account will be accessible to people be it local or national in their scope.

Stage of Development: COVID INDIA SEVA interactive platform has been developed and launched. COVID INDIA SEVA is a twitter seva solution which will help government to build a direct channel for communication with citizens.

TESTING/ DIAGNOSTIC KITS

RAPID TESTING KIT
NRDC (01)-T&D-COVID-19

Introduction: COVID-19 Rapid Testing Kits are indigenously developed ICMR-approved diagnostic kits. DNA, RNA, PCR tests could also be performed using these kits. This fully automatic device is portable and works on 'proprietary matrix-based extraction'.

Salient Features:

1. These unique kits can reveal the results within 55 minutes (less than an hour).
2. The key Features include fully automatic device, cartridge based and battery operated, works with multiple sample types, DNA/RNA extraction in ~20 minutes, exhibits high purity and efficiency, assures point-of-care portable.
3. These cartridges are PCR – Polymerase Chain Reaction – based into which nasal or throat swab samples are taken and assessment is carried utilizing the existing tuberculosis-test machines.
4. Fully automatic sample prep device works in tandem with auto cartridge and auto Reagent Kits for extraction and purification of nucleic acids from clinical specimen.
5. Operating temperature is between 15- 45°C, RH: 10 -90%.
6. It costs only ₹ 1,200 per person, while the present expense is ₹ 4,500.
7. About 20 tests can be performed using one machine, with one disposable cartridge per person.
8. The present scale of development of the research is that any firm can manufacture 2,000 such testing cartridges per day.

Stage of Development: Product has been developed and launched in Andhra Pradesh with the first set of 1,000 rapid testing kits. Researchers are planning g to scale up the cartridges supply so that 4,000 tests can be conducted a day in the state. Product Batch No: 603041001.

Ongoing Research Development: Government of Andhra Pradesh is planning for scaling up to manufacture 25,000 Kits per week.

RT-PCR DETECTION KIT
NRDC (02)-T&D-COVID-19

Introduction: Government of India is sourcing millions of testing kits from Germany to facilitate testing to diagnose COVID-19 patients across the India. However, the dependency on foreign kits has been troublesome and supply is getting blocked due to variable reasons. This can change with the approval for made in India kits. **PATHODETECT COVID-19 DETECTION KIT** is an Indigenously manufactured kit and one kit can test about 100 patients per day. An average lab with automated PCR can test more than 1,000 patients per day.

Salient Features:

1. Detects the infection within 2.5 hours against the prevalent 6-8 hours.
2. Manufacturing capacity can be 15,000 kits /day.
3. It works on Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) tests.
4. RT-PCR is a laboratory technique that combines the reverse transcription of RNA into DNA using a polymerase chain reaction (PCR) and is primarily used to measure the amount of specific RNA in a cell.
5. The kit has a capability to quantify viral RNA which is why the technique is one of the most common ways of identifying viral strains.
6. The test kit cost nearly one-fourth of the currently procured kits, uses advanced protocols which can reduce testing time by 65%.
7. Even early stage infection can be detected with highest accuracy, as has been seen during testing at ICMR.
8. Achieved 100% sensitivity and 100% specificity in the ICMR evaluation. The kit is approved by Central Drugs Standard Control Organization (CDSCO)/US-Food and Drugs Administration (USFDA).

Stage of Development: Product has been developed and being marketed. Product Batch No: PP00005-C-032001.

REAL-TIME TESTING KIT

NRDC (03)-T&D-COVID-19

Introduction: Real-time RT-PCR Kit is a unique diagnostic kit that helps diagnose SARS-CoV-2 infection. It is used to detect SARS-CoV-2 RNA from suspected persons samples through Real-Time Polymerase chain reaction (PCR). The kit is recommended by ICMR, approved by NIV and IVD license issued by CDSCO. Assay design based on WHO recommended primers and probes.

Salient Features:

1. Single step detection from RNA sample. Results are revealed in 2.5 hour.
2. Kit is a reagent system, based on real-time PCR technology, for the qualitative detection of SARS-CoV-2 specific RNA.
3. The assay includes an Internal Control (RNase P) to identify possible RT-PCR inhibition and to confirm the integrity of the reagents of the kit.
4. The probes are labelled with fluorescent reporter and quencher dyes. The probe specific for SARS-CoV-2 RNA (target E, RdRP, and N) are labelled with the fluorophore FAM, whereas the probe specific for internal control RNA (RNase P gene) is labelled with the HEX.
5. Technology utilizes reverse-transcriptase (RT) reaction to convert RNA into complementary DNA (cDNA), polymerase chain reaction (PCR) for the amplification of specific target sequences and target specific probes for the detection of the amplified DNA.
6. No cross- reactivity with other pathogenic virus, bacteria or fungi.
7. Endogenous internal control RNase P is included in both the tube to avoid false negativity.

Stage of Development: Product has been developed and is at marketing stage. IVD Lic No: MFG/IVD/2020/000024. The kit gives 100 per cent concordance among true positive and 75 per cent concordance among true negative. Product Batch No: COV-19/V2/2020/01

PAPER STRIP BASED TESTING ASSAY

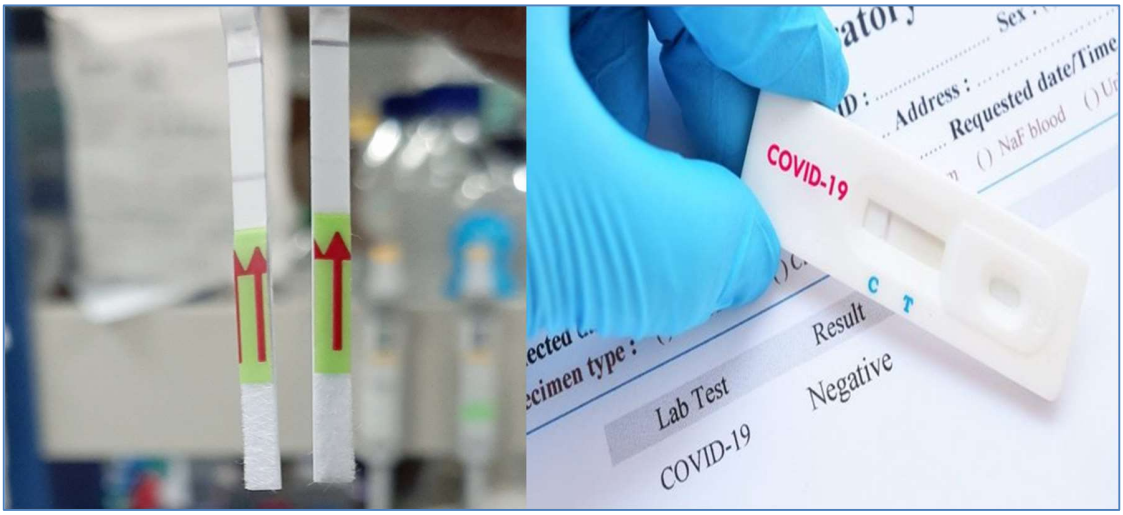
NRDC (04)-T&D-COVID-19

Introduction: With the country reaching the stage in the course of the coronavirus pandemic where rapid testing has become essential. Researchers have come up with an indigenous testing kit based on CRISPR technology. Designed a paper strip-based testing assay and is very low cost, can detect the viral RNA of the SARS-Cov-2 which can detect the virus within an hour. The method is very adaptable and cost effective. The test does not need dedicated machinery or specialised skill. Rapid-testing would be the key strategy to ensure timely isolation of the positive cases to contain the virus from spreading fast.

Salient Features:

1. Virus detection can be revealed in 1 hour
2. Expensive real-time PCR machine use to test for the virus can be completely done away with, making any lab with a thermal cycler capable of performing this test.
3. The paper strip test uses the cutting-edge gene-editing tool CRISPR-Cas9 technology.
4. The assay works by converting the viral RNA into DNA, amplifying it, and deploying the Cas9 complex to detect any genetic material of the virus.
5. It can work with very low RNA copies in the sample.
6. Kit would cost less than ₹ 500/-
7. Paper-strip test can be performed using equipment available in pathological labs. And this is the USP of the test. As infections shoot up the test can be employed in local clinics to test larger numbers in lesser time.

Stage of Development: The team led is currently testing the kit in a patient cohort for its accuracy and sensitivity and are in process to seek validation from a regulatory body of the Indian Council of Medical Research (ICMR).



ELISA TEST

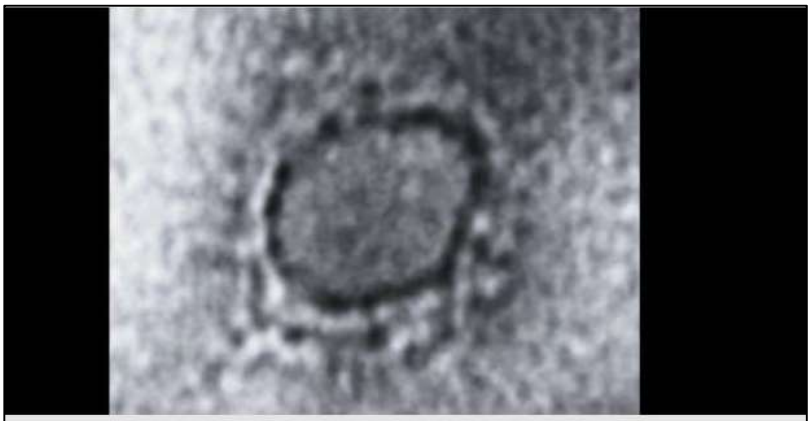
NRDC (05)-T&D-COVID-19

Introduction: The Indian population is dense, and there are so many poor people. Social distancing, therefore, may be a tricky proposition. Finding rapid solutions to protect a dense population will be crucial. Therefore, in contrast to current diagnostic tests for COVID-19, which detect genetic material from the virus in respiratory secretions, the ELISA test looks for antibodies to the virus in plasma, the liquid in blood, to provide information about a person's immune response to an infection.

Salient Features:

1. ELISA test for serological studies across the country which will essentially help to understand the extent of disease spread in India.
2. The epidemiology research should take center stage at this point in the life of the pandemic in India.
3. Elisa test is capable of Recognizing and binding to COVID-19 IgG/IgM antibodies. COVID-19 antibodies can be produced by a host immune system following exposure to SARS-CoV-2. IgG and IgM antibodies are also known as immunoglobulins IgG and IgM, respectively, and are among the antibody isotypes produced by vertebrate immune systems.

Stage of Development: Research is under progress. The research team is working as a first task to boost public health research to help control the spread. The next step should be supplementary research for developing additional diagnostic tools, drugs and vaccines.



The first transmission electron microscope image of SARS-CoV-2 from a COVID-19 patient in India.

RT-PCR DIAGNOSTIC TEST

NRDC (06)-T&D-COVID-19

Introduction: It is a reagent system, based on real-time PCR technology, for the qualitative detection and differentiation of lineage B-betacoronavirus (B-βCoV) and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) specific RNA. SARS-CoV-2 is the causative agent of the coronavirus disease 2019 (COVID-19).

Salient Features:

1. The kit a reagent system, based on real-time PCR technology, for the qualitative detection and differentiation of lineage B-betacoronavirus (B-βCoV) and severe acute respiratory syndrome SARS-CoV-2 specific RNA.
2. The assay includes a heterologous amplification system (Internal Control) to identify possible RT-PCR inhibition and to confirm the integrity of the reagents of the kit.
3. All components of the kit should be stored between -25°C and -15°C.
4. The test consists of three processes in a single tube assay:
    - Reverse transcription of target and Internal Control RNA to cDNA.
    - PCR amplification of target and Internal Control cDNA.
    - Simultaneous detection of PCR amplicons by fluorescent dye labelled probes.
5. Provide PCR quantification with standard curve analysis.
6. Sensitive detection for up to five targets.
7. Time-saving management via data import through use of handheld barcode scanner or via LIMS and export of results.
8. Automatic programming of real-time PCR instruments.
9. Streamline data analysis with built-in analysis modules.

Stage of Development: Product has been developed and received ICMR approval for 100% concordance among true positive and 80% concordance among true negative. Started manufacturing and testing. It saves time and test in parallel. Product Batch No: 023005

CHIP BASED RTPCR TEST

NRDC (07)-T&D-COVID-19

Introduction: A unique chip based real-time PCR test has been developed and is recommended for use as a first line screening test for COVID-19. Samples testing positive by this Beta CoV method may be confirmed using confirmatory tests for SARS CoV-2. The results of the stability of viral RNA after neutralization of SARS-CoV-2 by virus lysis buffer are awaited from ICMR-NIV, Pune. Until then, this beta CoV test can be performed with all biosafety precautions in BSL-2 or BSL-3 setups at laboratories.

Salient Features:

1. The test results can be revealed within just 1 hour.
2. The micro PCR Chips are pre-loaded, ready-to-use and disposable. These are disease-specific and can be run on the device to get a quantitative real-time PCR result.
3. This RT-PCR test is designed for semi quantitative detection of Beta Coronavirus (Sarbeco) RNA in human oropharyngeal and nasopharyngeal swab specimen. The developed machine is an instrument the size of a domestic telephone in which we load a sample into a cartridge that looks like a pen drive.
4. Under the test, the throat/nasal swabs will be collected in the viral transport medium (VTM – a liquid that helps preserve the virus) with virus lysis buffer (a solution that neutralizes some viruses) provided along with the kit.
5. A portion of the VTM is added to the chip, which is put into the machine. It extracts genetic material and then it does the PCR. All the reagents are in the form of a gel and put on a small strip. So, when it is put into the machine, the reagents l melt and the PC reaction starts and one can read the result in an hour.
6. If the machine is a four-bay one, in one hour, four samples can be tested. The advantage is that it can be run several times continuously. The big technology difference here is the underlying principle of both the traditional PCR machine technology has been miniaturised in a small box.
7. Achieved 100% sensitivity and 100% specificity in the ICMR evaluation. Even early stage infection can be detected, with highest accuracy as has been seen during tests at ICMR

Stage of Development: Product has been developed and is in marketing stage. ICMR validated beta CoV test for COVID-19 screening tests.

Ongoing additional development: The machine can test for 18 other viruses including KFD with its upcoming PCR tests which are under development.

REAL-TIME PCR TEST

NRDC (08)-T&D-COVID-19

Introduction: The real-time PCR kit developed is based on the published protocol of Centers for Disease Control and Prevention (CDC) – the national public health agency of the USA. All high-quality reagents required for the test, including enzymes of IVD quality, are made in-house. This kit is a one-stop solution for detection, extraction, molecular transport medium and swabs for sample collection.

Salient Features:

1. A test using Quantiplus COV kit costs ₹ 1,000-1300 and the result will be available in two hours.
2. The testing kit includes a detection kit, extraction kit, molecular transport medium and swabs for sample collection.
3. It uses a single formulation where one doesn't need to add separate components while setting up reactions. It's easy to set up and also avoids contamination and reduces the time of reaction.
4. It has been designed exclusively to detect COVID-19 but also helps detect other diseases caused by the coronavirus family.
5. The kit has synthetic gene cloned in a plasmid as a positive control. The primers set is cross-verified for specificity with several RNA and DNA viruses and bacteria.
6. It's scalable; quality can be controlled and consistency can be maintained.
7. Manufacturing capacity is about 3000 to 4000 kits per day.

Stage of Development: Product has been developed and at manufacturing stage. Received ICMR approval for providing 100% concordance among true positive and 40% concordance among true negative. Started manufacturing and testing. It saves time and test in parallel. Product Batch No: QLCNV0620.

QUICK REAL-TIME PCR TEST

NRDC (09)-T&D-COVID-19

Introduction: The real-time PCR kit developed is an innovative and affordable product which gives the fastest test kit making molecular detection fast, sensitive, and truly portable based on MBC method and this MBC COVID-19 could be the fastest test kit in the world.

Salient Features:

1. The test kit uses a novel enzyme which can overcut and bring down the test time drastically.
2. Uses loop-mediated isothermal amplification and promises results in 30 minutes. Needs to be qualified by the Drug Control General of India.
3. These kits can test 150 samples whereas a PCR-based test kit can test only 25 samples in the same time frame.
4. Easily adaptable to any kind of the existing PCS system.

Stage of Development: Product has been developed and validated in-house. Test kits were only optimised for small portable devices. The research team is now sending the kit to National Institute of Virology for further validation and parallelly approaching to many stakeholders to scale-up the operations.

RAPID ANTIBODY TEST

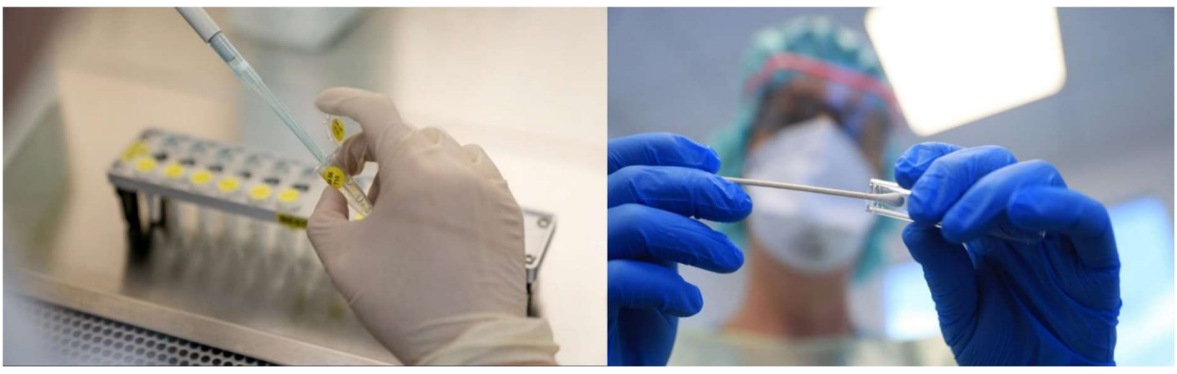
NRDC (10)-T&D-COVID-19

Introduction: The rapid antibody test is IgM and IgG based test, it involves one-step novel coronavirus (COVID-19) IgM/IgG antibody detection from the human serum, plasma or whole blood obtained from the patient with signs and symptoms of respiratory infection.

Salient Features:

1. The test kit is novel and very cost effective. It will be priced between ₹ 350-400 per kit.
2. Rapid antibody tests are prick-based tests that can detect the presence of coronavirus antibodies.
3. They provide quick results and don't need to be conducted in laboratories. They use blood samples of suspected patients and typically takes around 15-30 minutes to provide the result. Under this, one has to clean their finger with an alcohol swab and use the lancet provided for finger-pricks.
4. The body produces two types of antibodies – IgM and IgG. IgM is detected from the seventh day from the onset of symptoms or the entry of the virus in the body. If used with the PCR test, it helps in increasing the detection rate. IgG is detected from the fourteenth day onwards. If IgG comes positive, it indicates immunity or a natural vaccination.
5. Unlike a throat or nasal swab, a rapid test is a blood test and the results can be obtained in few hours.

Stage of Development: The product has been developed in collaboration with Ministry of Health and Family Welfare, Govt of India. The manufacturing of the kits has been started. India's apex medical research body, ICMR, had approved the use of these tests in areas with a high number of Covid-19 cases (clusters), as well as those with large migration and a high number of evacuees.



IgM/IgG LATERAL FLOW ASSAY KIT

NRDC (11)-T&D-COVID-19

Introduction: The rapid spread of COVID-19 across the world has exposed major gaps in the abilities of most countries to respond to a virulent new pathogen. The assay kit conducts rapid antibody test which is an IgM and IgG based test. Two drops of blood from a pinprick is enough to detect a virus.

Salient Features:

1. The lateral flow assay format – essentially a dipstick encased in a cassette – contains the capture reagents (either an mAb directed at a viral antigen or a viral antigen that is recognized by antibodies of the patients) immobilized at defined locations on a nitrocellulose membrane, as well as labelled detector mAbs that recognize the same target.
2. A positive result, which is triggered by binding between the analyte and capture mAb and binding by the detector mAb, is visible as a colored line.
3. Lateral flow assay kit consists of NS1 antigen along with IgM and IgG antibodies to completely diagnose the immune profile of viral infection using the lateral flow assay method.
4. All the accessories needed for the sampling and testing will be included in the kit.
5. Works on serum/plasma and whole blood.
6. A lateral flow assay usually takes 20 minutes to 45 minutes including an RNA extraction step.

Stage of Development: Product has been developed and at manufacturing stage. Received ICMR/NIV approval with Product Batch No: CVC 200401.

IgM/IgG ANTIBODY DETECTION CARD

NRDC (12)-T&D-COVID-19

Introduction: The kit is a rapid antibody-based blood test based on IgM and IgG. It involves one-step novel coronavirus (COVID-19) IgM/IgG antibody detection from the human serum, plasma or whole blood obtained from the patient with signs and symptoms of respiratory infection.

Salient Features:

1. Rapid antibody tests are prick-based tests that can detect the presence of coronavirus antibodies. The results will be provided in 30 minutes.
2. They provide quick results and don't need to be conducted in laboratories. Antibody test kits can be used for screening in the areas declared as COVID-19 hotspots in India.
3. The body produces two types of antibodies – IgM and IgG. IgM is detected from the seventh day from the onset of symptoms or the entry of the virus in the body. If used with the PCR test, it helps in increasing the detection rate. IgG is detected from the fourteenth day onwards. If IgG comes positive, it indicates immunity or a natural vaccination.
4. It is a qualitative lateral flow immunoassay for the simultaneous detection of IgM and IgG antibodies to SARS-CoV-2 in whole blood, serum or plasma specimens, which looks for antibodies in the blood, it is different from the current, diagnostic tests that determine active infection through nasal or throat swabs.
5. These tests will allow doctors to determine if a person previously had a viral infection, based on the presence of antibodies in the blood, possibly even if they were asymptomatic.

Stage of Development: Product has been developed and manufacturing kits being started. Received ICMR/NIV approval with Product Batch No: RCOVID200301T.

RAPID ANTIBODY TEST KITS

NRDC (13)-T&D-COVID-19

Introduction: Research team has developed antibody-immunoglobulin M(IgM) and immunoglobulin G(IgG)-based rapid test kits. As per the advisory from government of India, if the antibody tests are negative, when warranted, a real-time RT-PCR using throat/nasal swab can be done to reconfirm or home quarantine and repeat antibody testing after 10 days of the last rapid antibody test. And, if the antibody test is positive, then the clinical assessment is to be done, following which treatment in hospital or isolation as per the protocol.

Salient Features:

1. All the raw materials used in the kit are indigenously procured, assuring the supply of product citing no issues for raw material or packaging material supplies.
2. Serology kits are better known as rapid testing kits. Rapid IgM-IgG combined antibody test for COVID-19 is used to qualitatively detect IgM and IgG antibodies of the novel coronavirus in human serum, plasma or whole blood in vitro.
3. Steps for the test involve: collecting blood sample, adding blood sample to sample well, placing 2-3 drops of buffer in sample well, results can be revealed within 20-30 minutes.
4. Suitable for Point of Care Testing. No need for extra equipment.

Stage of Development: Product has been developed and manufacturing kits being started. Received ICMR/NIV approval with Product Batch No: PCCV200301S.

AUTOMATED CLIA TESTING

NRDC (14)-T&D-COVID-19

Introduction: Research team has introduced an effective automated CLIA testing for SARS CoV-2 IgG/IgM facilitating the fastest screening for SARS CoV-2. This testing can satisfy the clinical needs to detect antibodies for SARS CoV-2 and offer differential diagnosis to doctors.

Salient Features:

1. It confirms fast reporting in just 27 minutes.
2. Offers comprehensive CLIA solutions up to 180 T/H for detecting SARS CoV-2.
3. Ease of sample collection: Serum or EDTA plasma.
4. Automated Assay: CLIA platform- 180 test/hr and 300 tests /hr.
5. Test Pack: 2 x 50 tests with built-in calibrators.
6. On board and calibration stability: 28 days after opening.
7. Initial evaluation of these assays was carried out and results showed that these assays have strong anti-interference ability to other respiratory pathogens (e.g. *Legionella pneumophila, Mycoplasma pneumonia, Chlamydia pneumonia*, Q Fever from *Rickettsia,* Adenovirus, RSV-Respiratory Syncytial Virus, Influenza A, Influenza B, Parainfluenza 1, 2, 3, etc.)

Stage of Development: Product has been developed and are starting manufacturing of kits. Received ICMR/NIV approval with batch no: 20200206. Developed the AntiSARS-CoV-2 ELISAs for IgG and IgA. The diagnostic test has higher sensitivity (up to 100%) and specificity (up to 97.5%).

LOW-COST RAPID DIAGNOSTIC KIT

NRDC (15)-T&D-COVID-19

Introduction: The new kit is based on antigen-antibody reactions. There are two ways of making such kits. The most commonly-used technique requires a number of samples available to the developers and the other method is the knowledge about viral genome, if the structure of the virus is known, the proteins can be identified that have the ability to elicit immune response in the host, in this case, human beings. The second method of genome-based analysis is applied to develop this low cost rapid diagnostic kit. With the World Health Organisation and open access National Centre for Biotechnology Information, maintained by the US National Institutes of Health, publishing the genome of the virus, the research team looked for the sections of the genome that code for these proteins. Using their expertise in genome-based analysis, they identified genes for two such proteins and synthesised them to create the proteins and developed this unique probe.

Salient Features:

1. The advantage of the rapid antibody kits is that it can give the result in 30-45 minutes, its processing time is a lot faster than the RT-PCR, which can take 24 hours for a report.
2. The kit will be able to detect two types of antibodies – Immunoglobulin M (IgM) and Immunoglobulin G (IgG). IgM is the first antibody that appears in human body when it is exposed to a virus or any other antigen. Presence of IgG antibody in the body, in contrast, is indicative of an individual's immune status to particular pathogens.
3. The kit is expected to cost around ₹ 380-500/- The kit is hardly the size of a pregnancy testing kit.

Stage of Development: The preliminary testing has been done and it is to be validated by ICMR/NIV.

GUT MICROBIOME

NRDC (16)-T&D-COVID-19

Introduction: Analysis of Gut Microbiome can show how strong you are to fight infections like SARS CoV-2. Gut Microbiome test is the only way to know when the virus is no longer in your system. Microbiome test kit is simply used to check gut dysbiosis and genetic tests to predict susceptibility to contagious diseases such as COVID-19, based on their genetic make-up.

Salient Features:

1. Genetic Susceptibility Test is a breakthrough product, which discovers specific gene variants that are responsible for an individual's susceptibility to SARS-CoV-2.
2. Microbial imbalance in gut can be identified which can affect one's immunity against viruses. It can help to understand body's DNA Gene Variants which are responsible for making one more prone to virus infection.
3. Based on reports, Genetic Counseling can be provided to make positive lifestyle changes for a healthier and happier life.
4. The kit is highly recommended for the elderly and people suffering from health conditions like diabetes, obesity, hypertension, heart disease, etc. as they are prone to SARS-CoV-2

Stage of Development: The product is at manufacturing stage.

MOBILE DIAGNOSTICS MODEL

NRDC (17)-T&D-COVID-19

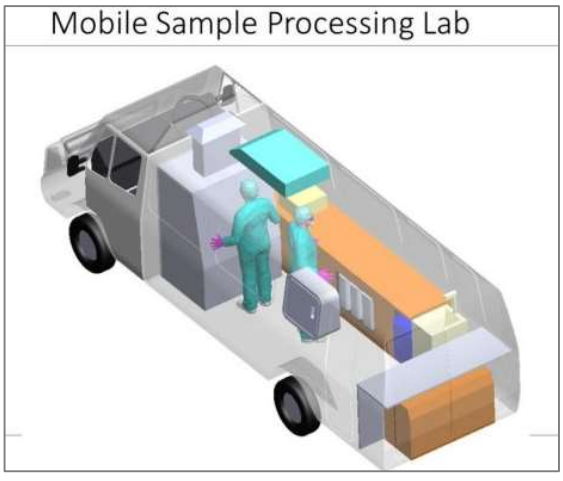
Introduction: The goal of the research team is to scale up diagnostic testing capabilities and cut down turnaround times from sample collection to test results from 1-3 days, as India is preparing to deal with a spike in the number of cases across the country. Proposed to develop Mobile diagnostic testing lab for SARS CoV-2/COVID-19. As processing and testing of the samples cannot be done in the same room, since the RNA of SARS CoV-2 needs to be isolated and this must be done in a biosafety environment. The research team is planning to undertake sample pool testing in a few of the vans., but not exclusively. Some van labs will be dedicated for individual sample testing also and they are making multiple pairs of van labs.

Salient Features:

1. With one unit, turnaround time: 45 minutes/sample.
2. With one lab technician batch processing 12 samples: turnaround time of 3 hours.
3. Throughput of one mobile sample processing lab: 100 samples/day
4. Throughput of one mobile molecular testing lab: 800 samples/day.
5. Each van costs between ₹ 40 lakh to ₹ 50 lakh.
6. With this model on implementation would lead in saving a lot of time on shipping the samples from collection centres to PCR testing labs, which are fewer in the country.

Stage of Development: Mobile van model has been designed, lab protos & testing done for instruments and waiting for ICMR approvals for validating and scaling-up the instruments and idea.

Support Anticipated: Funding, connections with kit manufacturers, clinical samples access, access to approved kits, manufacturing scale-up etc. Developing the product in collaboration with government organisations and Tata motors.



PROBE FREE DETECTION ASSAY

NRDC (18)-T&D-COVID-19

Introduction: Considering the scale of the ongoing pandemic, development of indigenous kits is the need of the hour. With the proposed kit the test can be performed at a much cheaper cost and hence will be affordable for general public. The team has identified alternative methodology at second and third stage of testing. They are using comparative sequence analysis.

Salient Features:

1. With this probe-free detection method, COVID-19 diagnosis gets done at significantly reduced test cost making it affordable for large sections.
2. Using comparative sequence analysis, research team have identified unique regions in COVID-19. These unique regions are not present in other human coronaviruses providing an opportunity to specifically detect SARS-CoV-2.
3. The COVID-19 test is a three-step process. In this alternative methodology, they are using fluorescent labels combined with different chemical techniques at the second stage of testing itself to get easy results.
4. At the third stage, amplification is needed, for which, a probe is supposed to be used. The team has developed new method where they are not using a probe, and this would potentially save cost.
5. Probe is a DNA sequence which has fluorescent labels, which signal the presence of the coronavirus in humans. The probe is manufactured by private companies and is supposed to be obtained for the purpose of these tests.
6. Most of the test kits currently available in the market are using a probe, which is the most expensive element. In this test method probe is not used for the test.
7. The results obtained are successful at the laboratory level.

Stage of Development: The methodology has been optimised and tested for sensitivity at the research laboratories of the Institute. It has obtained ICMR approval for a real-time PCR-based diagnostic assay with a sensitivity and specificity of 100%.

NANO BASED DIAGNOSTIC TEST

NRDC (19)-T&D-COVID-19

Introduction: Considering the severity of the SARS-CoV-2, there is an urgent need to identify potent analogue/inhibitors which targets and controls the viral replication. Coronavirus proteases are considered as attractive targets for the design of antiviral drugs. Research on efficient microdevice for blood plasma separation and silver nano-particle based sensor for pathogen detection is under progress.

Salient Features:

1. Proposed to develop silver nano-particle based sensor for pathogen detection, diagnostic as well as drug development 3-D structure and drug pocket evolution as well as assay development.
2. An impedimetric electro-active polymer (polyaniline) modified paper substrate has been developed for generic differentiation of bacteria and virus based on their interaction with chitosan stabilized silver nano-particles. These characteristic electrical impedance signatures of bacteria and virus, established here, have promising prospects in an inexpensive and scalable bedside diagnostic development.
3. The high-resolution crystal structure of main protease with its inhibitor has been very recently determined using x-ray crystallography. Therefore, team used this structure (PDBID: 6LU7.pdb) to investigate atomic level interactions between main protease of SARS CoV-2 and existing protease inhibitors using molecular modeling approach.

Stage of Development: Research is under progress at laboratory level.

REVERSE TRANSCRIPTASE LOOP DETECTION

NRDC (20)-T&D-COVID-19

Introduction: Research team has developed a novel, inexpensive, rapid confirmatory for the diagnosis of COVID-19. The test kit is highly specific for SARS-CoV-2 N-gene and is designed to give accurate results even after viral gene undergoes mutation during its spread.

Salient Features:

1. The test is said to give accurate results even after viral gene undergoes mutation during the spread. Developers have described the testing kit's detection time as 10 minutes and the time of 'sample to result' (from RNA extraction in swab to RT-LAMP detection time) is said to take less than two hours.
2. The confirmatory diagnostic test, which detects the N-gene of SARS-CoV-2 using reverse transcriptase loop-mediated amplification of viral nucleic acid.
3. Diagnostic kit is cost-effective as each test will cost the lab ₹1,000, which is less than the minimum cost of COVID-19 tests being carried out at present.
4. The test kit is highly specific for SARS-CoV-2 N-gene and can detect two regions of the gene, which will ensure that the test does not fail even if one region of the viral gene undergoes mutation during its current spread.
5. GeneLAMP-N gene testing will allow confirmation in one test without the need for a screening test and at much lower costs, the department said.
6. A total of 30 samples can be tested in a single batch and the machines are estimated to cost ₹ 2.5 lakh.
7. Current PCR kits in India enable detection of E-gene for screening and RdRp (RNA-dependent RNA polymerase) gene for confirmation. GeneLAMP-N gene testing will allow confirmation in one test without the need for a screening test and at much lower costs.

Stage of Development: Regulatory validation is under progress. The tests performed at National Institute of Virology, Alappuzha show that GeneLAMP-N has 100% accuracy and match with test results using RT-PCR. Once the ICMR approves the tests, the license needs to be obtained from CDSCO for manufacturing.

DETERMINATION OF BIOMARKERS

NRDC (21)-T&D-COVID-19

Introduction: Department of Science and Technology, Govt. of India initiated an approach to differentiate between the mild and severe cases of COVID-19 based on the determination of biomarkers from detailed metabolome or proteome investigations. This is a very interesting approach to differentiate between the mild and severe cases of COVID-19 based on the determination of biomarkers from detailed metabolome or proteome investigations. The study will include COVID-19 confirmed patients with mild and typical respiratory tract symptoms as non-severe group and patients with respiratory distress or multi-organ failure as severe groups. Patients with flu symptoms and RT-PCR negative will serve as controls. The comparison of metabolomics between these groups in terms of severity with the help of the patient's plasma and swab samples will be a novel approach to understand the progression of infection and also assess changes in the metabolite profile of the host.

Salient Features:

1. The study will identify potential biomarker candidates to predict progression from non-severe to severe COVID-19 conditions.
2. Search for potential diagnostic candidates will involve metabolite profiling of different patient groups with various complications. Metabolites are small biomolecules, capable of regulating various pathways in all the living-organisms.
3. By identifying potential markers to distinguish the patients based on severity, the study can help find novel targets for therapy.
4. Detailed metabolome or proteome investigation of COVID-19+ patient clinical samples need to be done to provide novel cues of COVID-19 severity.

Stage of Development: Research is under progress. After completion, it could help both in advanced diagnostic and therapeutic strategies.

RAPID POINT-OF CARE DETECTION

NRDC (22)-T&D-COVID-19

Introduction: The major challenges of testing for SARS-CoV-2/ COVID-19 are speed, cost, accuracy and accessibility at the point-of-care or use. Several startups have developed rather creative and innovative ways to address these needs. Research team funded by Department of Science and Technology, Govt. of India are developing the product in line of OmniSens.

Salient Features:

1. The proposed kit can be utilized for early detection and screening of complex diseases, i.e. cancers, liver ailments and neonatal sepsis, the company has proposed a technology CovE-Sens specifically for COVID-19. The results will be revealed in less than 1 hour.
2. The team plans to roll out two products – a modified polymerase chain reaction (PCR) based detection kit for confirmatory analysis in lesser time compared to existing detection methods (approximately 50 samples can be tested in an hour) and a portable chip-based module for rapid screening of target population based on the on-chip sensing technology that would provide on the spot results in less than 15 minutes per sample. The sample size for confirmatory tests can also be increased in the future to 100 samples/ hour.
3. The two proposed modules can be deployed at any real locations and hotspots like airports, densely populated areas, hospitals, where screening of population can be done to prevent SARS-CoV-2/ COVID-19 spread to healthy individuals and data can be generated with ease in less than an hour.
4. Besides, preventing further spread of the disease during the current pandemic, the portable rapid diagnostic kit can also prevent future relapse by regular monitoring.

Stage of Development: Research is under progress. A patent has been filed for CovE-Sens which would provide a rapid, point-of-care detection along with screening and confirmatory test as well with ease of operation. The team is also planning to collaborate with the National Institute of Virology (NIV), Pune for which formal approval is under process for performance evaluation. They are also in touch with existing market players for scaling- up and large-scale deployment of device.

DISINFECTANT, EXAMINATION & SAMPLE COLLECTION BOOTH

NRDC (23)-T&D-COVID-19 (Technology available for free of cost)

Introduction: Research team under Ministry of Health and Family Welfare, Govt. of India has developed disinfection gateway, examination booth and sample collection booth. Disposal of infected secretions from patients poses a great challenge to every hospital. This is particularly so in the case of secretions of patients with highly contagious diseases such as COVID-19.

Salient Features:

1. Like a telephone booth, it is a closed booth for examining the patient without direct contact with the doctor to prevent transmission of infection.
2. Examination booth is equipped with lamp, table fan, rack and UV light. The UV light is used to disinfect the chamber after each patient leaves. The installed UV light has wavelength of 254nm with 15 watts rating, which effectively removes the most of viral-load within 3 minutes of exposure.
3. There is a pair of gloves in examination booth which allows person's physical examination. Additionally, there is an entry tunnel on the side frame to pass a stethoscope within the chamber. This feature helps doctor to place stethoscope on the person and listen to heart and breath sounds. After examination, person is asked to vacate the chamber and UV light is turned on for 3 minutes.
4. When UV-exposure in chamber is completed, the next person is examined, and the sequence is repeated. The examination booth has dimensions of 210 cm(H) X 150cm(D) X 120cm(W) which provides enough space for the person.
5. The collection and disposal of such wastes put the nursing and cleaning staff at high risk. This is the reason why we have come up with canisters to collect body fluids and dispose of it safely
6. The isolation pod can be used to shift the COVID-19 patient from one place to another. It comprises of a sterilised tent cover, which can be equipped with a light bed.

Stage of Development: The examination booth has been developed and are constructed with designed equipment and are also in operation. Researchers plan to supply the disinfection gateway to public institutions, hospitals all across the nation to effectively combat COVID-19 pandemic. Government of India has decided to transfer technology (design of the product) free of cost to companies of various equipment it developed to aid health workers in the country.

KIOSK FOR SAMPLE COLLECTION

NRDC (24)-T&D-COVID-19

Introduction: The research team of Government of India has designed and developed a kiosk for SARS-CoV-2 sample collection. The kiosk is designed through which healthcare workers can take samples from suspected infected persons.

Salient Features:

1. The person walks into the kiosk and a nasal/oral swab is taken by healthcare professional from outside through the built-in gloves, according to a statement.
2. The kiosk is automatically disinfected without the need for human involvement, making the process free of infection-spread.
3. The shielding screen of the kiosk cabin protects the healthcare worker from the aerosols/droplet transmission while taking the sample. This reduces the need of frequent PPE change by healthcare workers.
4. After the person leaves the kiosk, four nozzle sprayers mounted in the cabin disinfect the empty chamber by spraying disinfectant mist for a period of 70 seconds. It is further flushed with water and UV light disinfection.
5. The system is ready for next use in less than two minutes. Voice commands can be given via a two-way communication system integrated with the kiosk.
6. It is possible to configure the kiosk to be used either from inside or outside, as required by the medical professionals.
7. The kiosk costs nearly ₹1 lakh, and the present manufacturing capacity can support 10 units per day.

Stage of Development: The product has been designed and developed in two units and handed over to Hospital Hyderabad after successful testing.

DIAGNOSIS KIT

NRDC (25)-T&D-COVID-19

Introduction: Research team has made preparations for synthesis of reagents that are required in large quantities for bulk RT-PCR diagnosis.

Salient Features:

Recombinant enzymes (Reverse transcriptase and DNA polymerase and two other proteins) that are used in RT-PCR reaction has been developed. Also, enzymes are available for distribution to anybody who would like to make RT-PCR kits. 80% of the material which goes into making the kit has been developed in-house by the institute.

Stage of Development: At present supplies sufficient for more than 5 lakh reactions are made ready. Also, enzymes are available for distribution to anybody who would like to make RT-PCR kits.

RAPID & ECONOMICAL DIAGNOSIS KIT

NRDC (26)-T&D-COVID-19

Introduction: COVID-19 has posed several challenges to the healthcare sector. The limited number of test kits for COVID-19 is one such challenge. The research team has developed Rapid and Economical diagnostic kits.

Salient Features:

RT-PCR based technologies are also being implemented for use. Antibody based detection for the presence of the virus is being designed for serological applications. This is a one step RT-PCR testing method.

Stage of Development: The Kits have been developed. Testing and manufacturing procedures are under progress.

LOW COST ULTRA-PORTABLE THERMAL SCANNER

NRDC (27)-T&D-COVID-19

Introduction: Research team has developed an Ultra-portable Thermal Scanner which is of low-cost and affordable.

Salient Features:

1. Measures body temperature (using non-contact IR temperature sensor) in real-time.
2. Plug and play feature.
3. Connectivity to smartphone based android app.
4. Automatic database maintenance feature for COVID-19 suspects with date, time, name, address and location information.
5. Connectivity with third party cloud services.
6. Low cost, rapid and ultra-portable in nature.
7. Provides high fever indication with alarm.
8. Approximate BOM = 2000 INR.

Stage of Development: The product has been developed and technology is ready for commercialisation

Pocket size Thermal Scanner Device (First Level Prototype)

Smartphone based android app

Pocket size IoT enabled thermal scanner

PORTABLE AND RAPID DETECTION DEVICE

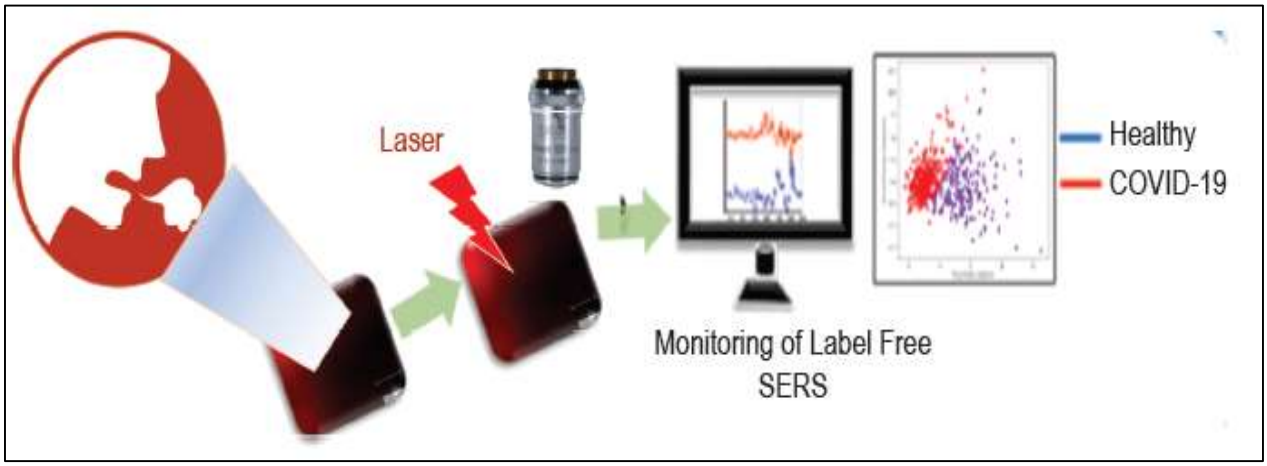
NRDC (28)-T&D-COVID-19

Introduction: Research team has developed a portable rapid detection device which is of low cost and affordable.

Salient Features: The lab has developed a detection device in collaboration with other labs having two-way approach:

1. First, detection device will be based on antibody-antigen reaction; and
2. Second, detection device will be based on Surface Enhanced Raman Spectroscopy (SERS) active chip and Artificial Intelligence based handheld Raman spectrometer

Stage of Development: The product has been developed.



ACCURATE DIAGNOSTIC KIT

NRDC (29)-T&D-COVID-19

Introduction: Research organization is working on developing cost-effective and accurate diagnostic kits, to combat COVID-19 pandemic.

Salient Features: Low- cost and affordable kits are being developed. Their estimate is that the cost of test should be less than ₹ 1,000. They are proposing to develop much cheaper kits costing about ₹400-500 with more standardization techniques.

Stage of Development: Diagnostic kits have been developed. Testing and validating procedures for the diagnostic kits are under progress.

IgM/IgG RAPID TESTING KIT

NRDC (30)-T&D-COVID-19

Introduction: Researchers have developed Covid-19 IgM and IgG which is an effective method for the rapid detection of COVID-19 antibodies.

Salient Features:

1. Presence of COVID-19 IgM antibodies indicates a recent exposure to COVID-19, whereas detection of COVID-19 IgG antibodies indicates a later stage of infection. Thus, this combined antibody test could also provide information on the stage of infection.
2. Their estimate is that the cost of test should be less than ₹ 900.
3. The testing results will be revealed within 15 minutes.
4. Achieved 100% sensitivity and 100% specificity in the ICMR evaluation.

Stage of Development: Product has been developed and being marketed. Product Batch No: COV-002.

ONGOING DEVELOPMENTS TOWARDS DETECTION & DIAGNOSIS of COVID-19

NRDC (31)-T&D-COVID-19

Introduction: The significant ongoing research works towards detection and diagnosis of COVID-19 are compiled.

Salient Features:

1. Researchers at Thiruvananthapuram, are in the final stages of developing a kit that promises to detect SARS-CoV-2 infection as early as four days post-infection of the virus. The kit will be able to detect two types of antibodies – Immunoglobulin M (IgM) and Immunoglobulin G (IgG). IgM is the first antibody that appears in the human body when exposed to a virus or any other antigen. The presence of IgG antibody in the body, in contrast, is indicative of an individual's immune status to particular pathogen.
2. Academic researchers supported by the Department of Biotechnology (DBT), is conducting research on isolating genes encoding antibodies, which can neutralize the SARS-CoV-2 using an extensive antibody library already available in-house as well as a library made from cells of patients who have recovered from COVID-19 disease.
3. DST, Govt. of India supported healthcare startup developing rapid test for detection of COVID-19. This technology aimed for rapid diagnosis of diseases to develop a product for detecting COVID-19 with a 10 to 15 minutes test. Using the proven concept from its flagship product USense, the startup is now developing nCoVSENSEs (TM) which is a rapid test device for detection of antibodies that have been generated against the COVID-19 in the human body. The startup is planning to deploy the test in a time of 2-3 months after due validation with national agencies. This in future will also help determine people who have recovered and assign them front line jobs.
4. CSIR will work on RT-PCR based, RNA sequence-based, Crispr/Cas9 based paper diagnostic and sero diagnosis. CSIR in collaboration with an IIT is proposing to develop a portable and instant COVID-19 detection device which will be based on Surface Enhanced Raman Spectroscopy (SERS) active chip and Artificial Intelligence based handheld Raman spectrometer. It is also developing a portable and rapid COVID-19 detection device which will be based on antibody-antigen reaction.
5. The CSIR laboratories have been able to develop recombinant enzymes (Reverse Transcriptase and DNA polymerase and two other proteins) that are used in RT-PCR reaction.
6. CSIR-Central Food Technological Research Institute (CSIR-CFTRI), Mysuru, joined hands with the district administration by making available equipment needed for testing of samples. The institute is providing two PCR machines and one RNA extraction unit along with necessary chemicals to the district administration for coping with the large number of samples to be tested in the district. The machines will help by tripling the number of tests conducted per day.

TREATMENT & PREVENTION

IDENTIFICATION OF DRUGS BY COMPUTATION
NRDC (01)-T&P-COVID-19

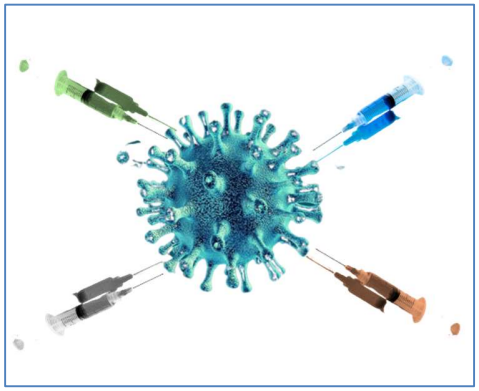
Introduction: The DBT (Department of Biotechnology, a department within the DST, Ministry of Science & Technology, Govt. of India), along with Drug Controller General of India, has developed and notified a Rapid Response Regulatory Framework to provide expedited regulatory approvals for all diagnostics drugs and vaccines. The scientific research team has deployed Computational Technology for identifying existing drugs against coronavirus (COVID-19). Use of existing drugs already approved by the regulators can offer a huge relief in the short to medium term, if found effective against COVID-19.

Salient Features:

1. Computational technology has been organized to identify the probable medicines from exiting drugs for minimizing its impact on human body.
2. Through a complex and extensive computational study involving 2,100 approved drugs and 30 potential viral and human targets, team has identified 42 existing drugs which may be helpful to patients at different stages of SARS-CoV-2 infection.
3. This method employs computational infrastructure and technology platform armed with Artificial Intelligence (AI) and uses Machine Learning (ML) techniques, along with intensive statistical modeling and simulations.
4. The major advantage with this approach is that the drugs being approved are already proved to be safe for humans and are being actively manufactured and therefore can be immediately put to use in a very short time.
5. They are following multi-pronged strategy involving multiple scientific computational approaches. The team has completed three phases of rational computational screenings and its discoveries so far include drugs that show promise as effective treatment either by directly attacking the virus proteins or by empowering the human proteins to minimise its spread.

Stage of Development: Technology has been developed and implemented. This is a proven technology and it has helped in developing drugs for diabetes and psoriasis previously.

Ongoing Research Development: The research efforts will continue to shortlist candidates who are at different stages of SARS-CoV-2 infection, including those suffering from Acute Respiratory Distress Syndrome (ARDS) stage.



ANTIMICROBIAL FABRIC

NRDC (02)-T&P-COVID-19

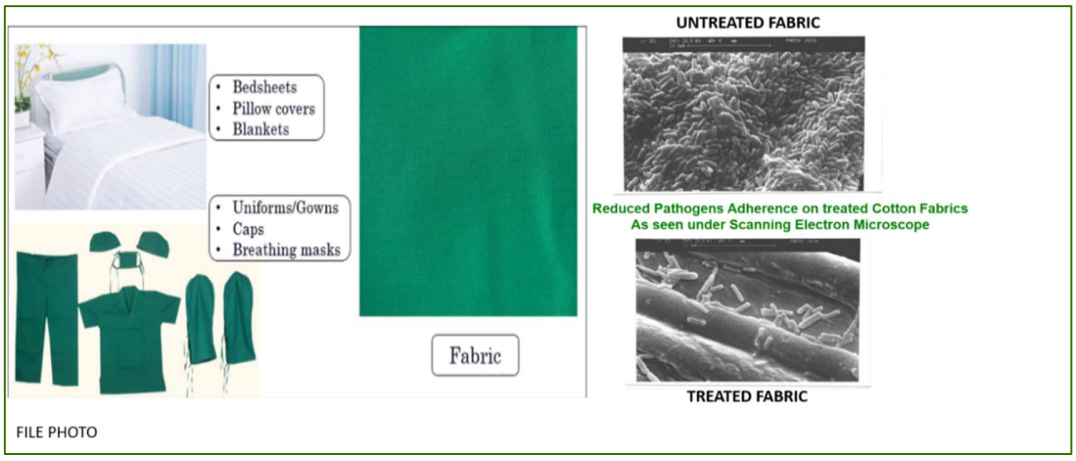
Introduction: The team created fabric that acquires a non-microbial functionality through a series of chemical processing activities. The developed fabric is affordable, novel textile-processing technology, which converts regular cotton fabric into infection-proof fabric. The fabric has been developed keeping into context the analytics from the Ministry of Health and Family Welfare, Govt. of India which states that almost 10 out of every 100 patients in the hospital gain hospital-acquired infections. The fabric satisfies the Indian washing standards in terms of number of washing.

Salient Features:

1. Research team has developed an infection-proof fabric. The fabric has been developed to prevent hospital-acquired infections, namely the nosocomial infections.
2. The fabric can be used in hospitals to prevent hospital-acquired infections (HAIs). This fabric can be stitched into various articles such as bedsheets, the uniforms for patients, doctors and nurses and even curtains. It is also completely non-toxic and affordable.
3. The created fabric acquires a non-microbial functionality through a series of chemical processing activities. The best thing about the fabric is that even after multiple washing, the fabric doesn't lose its antimicrobial functionality.
4. The fabric can be stitched into various elements at the hospital such as bedsheets, curtains, uniforms for officials and patients, etc.
5. The fabric is said to kill 99.9% of pathogens in 1-2 hours.

Stage of Development: Product has been developed. Rolls of cotton fabric are taken and treated with a set of proprietary-developed chemicals under a set of particular reaction conditions, using the machinery already commonly available in textile industries. The fabric, after undergoing these processes, gains the powerful antimicrobial functionality.

Additional Information: The project has been funded by DST, Govt. of India and being collaborated with the All India Institute of Medical Sciences (AIIMS) for a pilot run of the product and also large-scale manufacturing trials.



MINUS CORONA UV BOT TEST

NRDC (03)-T&P-COVID-19

Introduction: As a preventive measure against SARS-CoV-2, the research team has developed a device titled Minus Corona UV Bot to disinfect hospitals. Inspired by 'UVD Robots' of a Denmark based company, this indigenous product will be available at very low cost. Ultraviolet (UV) sterilization technology has been proven to be extremely effective in killing viruses and micro-organisms of any kind which may remain on surfaces even after the minimum number of standard cleaning.

Salient Features:

1. This device is an ultraviolet light (UV-C-254nm) based robot that will enable sterilization of hospital corridors, wards, Intensive Care Unit (ICUs) and patient rooms without exposing anybody to the contaminated environment.
2. It comprises a UV-C lamp mounted on a wheeled robotic platform that is operated (front-back, left-right) with a remote control which is also equipped with a camera that gives the perspective from the driver's seat onto a digital screen to remotely control the UV robot and avoid any obstacles.

Stage of Development: Product has been developed and at implementation stage. In the coming days affordable and accessible automation is clearly going to play an important role in healthcare.

REPRESENTATIVE IMAGE

LOW-COST 3-D FACE SHIELD

NRDC (04)-T&P-COVID-19

Introduction: Research team has developed face shields for the protection of frontline healthcare workers. They are confident that these face shields will be of utmost use not only for medical health workers of our Institute but for the whole country.

Salient Features:

1. The spectacle-type design of the protection shield provides the ease of replacement as the transparent sheet is not bound to a reusable frame.
2. The frame of face shield is 3-D printed and the shield can be used along with the protective gear by healthcare personnel while entering wards housing COVID-19 patients.
3. These face shields will help in minimizing the transmission risk of the SARS-CoV-2 disease.
4. It costs as little as ₹ 45 to make. The cost of each sheet is just ₹ 5 and mass manufacturing the face shields will come at ₹ 25 each.

Stage of Development: Product has been developed and tested in campus. Research team will be sending the first batch of 100 face shields to All India Institute of Medical Science (AIIMS).

UV-TECH FITTED SANITIZING TRUNK

NRDC (05)-T&P-COVID-19

Introduction: The fight against the COVID-19 epidemic will not end just with social distancing and not stepping out. In the coming days and it will be extremely important to be cautious to avoid infection. All items coming from outside including currency notes, vegetables, milk packets, any items ordered through delivery, wrist watch, wallets, mobile phones or any documents can be placed inside the sanitizing trunk. Currently there are many people who wash vegetables with warm water before using but the same cannot be done with currency notes or wallets. So, team have developed a common sanitizing solution for everything.

Salient Features:

1. Research team has developed a trunk-shaped device fitted with ultraviolet germicidal irradiation technology used in water purifiers., which they claimed that it could be placed at doorsteps and all items brought from outside, including grocery and currency notes be put in it to sanitize.
2. The device, when commercialized, can be available at less than ₹ 500. It will take 30 minutes to sanitize the items and a 10-minute cooling-off period before one takes the items out. It is strongly advised not to look directly at the light inside the trunk as it can be harmful.
3. It is recommended to place the truck at doorsteps or may be somewhere closer to the entry. The sanitizing tool makes it super easy to make sure that none of the products one receives from outside home is in any way contaminated. The infection-causing droplets will remain on vegetable, paper and plastic skins for a long time. Therefore, all external objects need to be sanitized. Now there is no need to be immersed for 20 seconds in soapy water, which was an issue with market-bought vegetables and paper-made currency notes, and even wallets.

Stage of Development: Product has been developed and launched. Technology is ready for commercialization.

CORONA OVEN

NRDC (06)-T&P-COVID-19

Introduction: As worldwide, nations are putting all their efforts to contain the spread of COVID-19, people have become extra cautious about hygiene and careful towards encountering the virus on packages and surfaces around them. To prevent surface-to-human transmission of SARS-CoV-2, Corona Oven has been invented.

Salient Features:

1. Corona Oven is a quick, reliable, safe and effective sanitization system, especially designed for combating coronavirus.
2. Makes use of UV-C light in combination with significant design parameters in order to effectively sanitize the surfaces of various products/objects of regular use in healthcare and household settings.
3. It's a patent-protected technology can focus on the necessary energy on the entire surface of an object that is kept inside the box to kill viruses and even bacteria.
4. The Corona Oven is also designed in a way that every square centimetre of an object, placed inside, is completely sanitized, helping it to stand out from standard UV technologies deployed in other countries.

Stage of Development: Product has been developed and listed the Corona Oven on the government's e-marketplace, and is in touch with the authorities to help supply it to hospitals. They have now secured the complete supply chain to build the product and have tied up with the vendors for manufacturing.

NASAL GEL

NRDC (07)-T&P-COVID-19

Introduction: The team is planning a two-pronged approach to limit transmission of the SARS-CoV-2. The first component of the strategy will be to inhibit the binding of viruses to host cells. Secondly, biological molecules would be incorporated, which would inactivate the trapped viruses in a manner similar to that of detergents. This approach will lead to development of gels that can be locally applied in the nasal cavity.

Salient Features:

1. The research team aims to prevent it from actually entering the body itself, as in most cases viral infection happens through the nasal passage. So, the team has proposed a gel that could be applied in the nasal cavity or applied on the masks.
2. The nasal gel, being developed in conjunction with other protective measures, will provide a strong extra layer of defence. This gel is not only expected to protect the safety of health workers, but can also lead to reduction in community transmission of SARS-CoV-2, thereby helping disease management.
3. Healthcare workers and others working in the frontline of fight against the COVID-19 deserve a fool-proof complete protection. The nasal gel being developed in conjunction with other protective measures, will provide a strong extra layer of defence.
4. The first objective for the gel, under development, will be to inhibit the binding of the viral component with the host cells of the infected person's lungs. This, however, will only limit the replication of virus but the threat of it will still persist.
5. The second goal of the gel will serve that purpose to eradicate the threat of the completely SARS-CoV-2 by inactivating or killing the virus. The gel will trap the viral component and will inactivate its working by competitive inhibition.

Stage of Development: Research is under development. The Science and Engineering Research Board (SERB), a statutory body of the DST, Govt. of India is supporting this project. The team has expertise in areas encompassing virology, structural biology, biophysics, biomaterials and drug delivery. This technology is expected to be ready in about 9 months.

REPRESENTATIVE IMAGE

PORTABLE UV SANITIZERS

NRDC (08)-T&P-COVID-19

Introduction: This new portable UV sanitizer will help in disinfecting the currency notes, wallets and mobile phones that can be detrimental in tackling the SARS-CoV-2 in the country. Sanitizer gel cannot be used to disinfect papers, files, currency notes and mobile phones which can endanger our fight against Coronavirus. The sanitizer was designed on the basis of a study published in a journal called *Pubmed* by the U.S National Library of Medicine. According to the study, ultraviolet- C light can render SARS-CoV-2 ineffective.

Salient Features:

1. This sanitizer can be used in disinfecting currency notes, masks, wallets and mobile phones. It can also be used against the spread of Crimean-Congo Haemorrhagic fever and the Nipah virus.
2. The prototype of the portable UV sanitizer was built using a germicidal UV lamp that is used in water purifiers, stainless-steel kitchen containers and aluminium mesh.
3. The portable sanitizer is prepared in 4 hours. The large-scale production of the sanitizer, however, will be possible by involvement of the industry since its production will need material from outside.

Stage of Development: Device has been designed and developed at laboratory scale. Team is conducting trials inside the labs. There are currently two prototypes of the device and the innovators are working to scale it up to the possible extent.

SOURCE IMAGE

UV-C LED DISINFECTING SYSTEM

NRDC (09)-T&P-COVID-19

Introduction: In a bid to help the nation fight the SARS-CoV-2 menace, the research team has developed a disinfecting system that can be used to sanitize large areas and even metro-trains, buses, etc. UV-C system is a proven technology to sanitize the microorganism infected non-porous surface.

Salient Features:

1. The system is low-cost and based on UV-C LED technology and can be used to sanitize large areas and even metro-trains and buses.
2. By using UV-C 90% killing rate can be achieved for one of the highly stable virus MS-2 Coliphase with 186 J dose, whereas 36 J dose is needed for influenza virus, which is similar to SARS-CoV-2. In this project, the team has developed a UV-C LED system capable of providing 400 J dose in 30 seconds, such that virus-infected surface will be sanitized.
3. The unique design of this UV-C system will ensure uniform UV-C exposure in the virus-infected non-porous area.
4. Another critical aspect of the technology is the safe usage of UV-C system while sanitizing. The system is equipped with an object movement identification feature so that UV-C exposure to human skin is avoided during the operation.
5. Currently the team has developed three models for household sanitisation and one for bigger spaces like hospital wards, buses, metros, et cetera including those transformed for COVID-19 care.

Stage of Development: UV-C LED system is under design and prototype development. The industrial partner was able to source required raw material to produce 5000 number of floor sanitization UV-C system. The industrial partners are in the process of getting special approval from the government agencies to start production during the lockdown period.

Ongoing Research Development: Further to adopt this technology to porous surfaces, the team is improving the design by integrating UV-C with Ozone system such that porous surfaces can also be sanitized. The main purpose of the team is to develop the UV-C system design, prototype (using 3-D technology), and testing it in its laboratory.

3D-PRINTED HANDS-FREE OBJECT

NRDC (10)-T&P-COVID-19

Introduction: To help in the fight against the COVID-19, the researchers came up with the design for the fabrication of the 3D-printed object after detailed analyses of several resources for risk measurement and on how viruses spread through bare hands. In the current situation of COVID-19 pandemic, these surfaces may play a key role in transmitting infection from one person to another as these surfaces are the most germ-infested objects in our surrounding. The 3D-printed hands-free object can be utilized (both vertical & horizontal) to minimize this risk.

Salient Features:

1. The product is easy to design and amenable to rapid development of prototypes. It was also handy, user friendly, non-fragile and easy to clean with the existing sanitizers or any alcoholic disinfectant.
2. The 3D-printed hands-free object can be used to open or close windows, drawers (both vertical and horizontal), doors, computer keyboard, and refrigerator handle, or to press elevator- buttons, and laptop/desktop keyboards, including turning the switch buttons on/off.

Stage of Development: Product has been designed and developed. The technology is ready for commercialisation.

3D-PRINTED ANTIMICROBIAL FACE-SHIELD

NRDC (11)-T&P-COVID-19

Introduction: The 3D-printed antimicrobial face-shield has been designed after a thorough study to understand the spread of the SARS-CoV-2 through oral, ophthalmic, olfactory and other body cavities. It is also low cost, easy to wear, having good chemical stability, non-fragile and is easy to clean with the existing sanitizers or any alcoholic disinfectant.

Salient Features:

1. The face shield is an easy design and open to rapid development of prototypes.
2. It is low cost, easy to wear, has good chemical stability, non-fragile and maintenance is easy, like the 3D-printed hands-free object.
3. This 3D-printed antimicrobial face-shield can effectively control the spread of SARS-CoV-2. It was designed after studying how viruses spread through mouth, eyes, nose and other body cavities.

Stage of Development: Product has been designed and developed and ready for commercialization.

UV-BASED DISINFECTING DEVICE

NRDC (12)-T&P-COVID-19

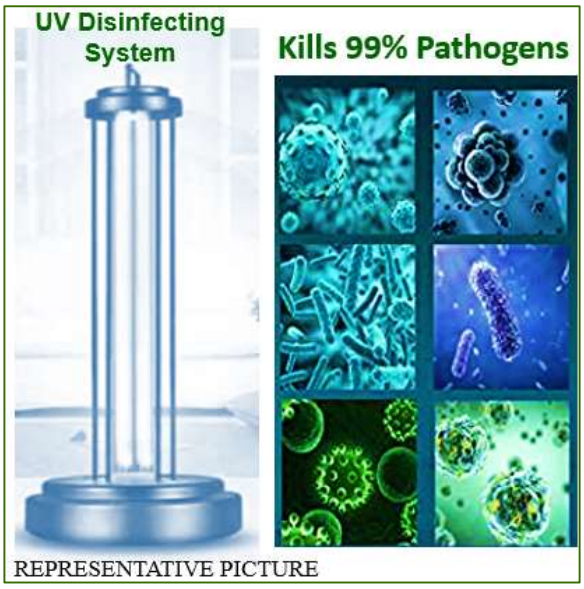
Introduction: At present, public spaces and hospital environment are cleaned by spraying disinfectants in the air, or on a surface followed by wiping. This requires a lot of manual effort and time. Public places like railway platforms, railway coaches have large areas which require longer time to disinfect. Critical spaces like isolation wards and hospital corridors cannot afford to have long cleaning cycle time. This innovation is for quick disinfection procedures at public spaces and hospital environment as spraying disinfectants in the air, or on a surface followed by wiping requires lot of manual effort and time.

Salient Features:

1. A UV-based disinfection system would be efficient in killing the SARS-CoV-2 as well as faster the cleaning cycle time.
2. This can also be used to decontaminate reusable personal protective equipment in times of extreme scarcity which presently is for single use.

Stage of Development: The project is still at research stage

Support anticipated: At prototyping facility, production facility, sourcing UV lamps. Factories open to supporting this project with production of UV lamps can reach out to us. The help of suppliers of UV lamps with stock is being sort. Assembly facility for the product and packaging facility contacts are also being sort.



REPRESENTATIVE PICTURE

DISINFECTION DRONES

NRDC (13)-T&P-COVID-19

Introduction: As people are confined to their homes, they are primarily responsible for their personal hygiene and care to prevent the spread of SARS-CoV-2/COVID-19. However, central/state governments and various civic bodies are undertaking ample measures to disinfect outdoor spaces and public infrastructure, which is a massive resource-intensive task. Research team is proposing in accelerating the process by using drones to disinfect hard-to-reach areas.

Salient Features: The research team are proposing to develop drone to disinfect outdoor spaces and public infrastructure which is currently a massive resource-intensive task.

Stage of Development: The project is still at research stage. Team is working to get clarity on use of specific disinfectant in a particular scenario.

Support Anticipated: Financial support to scale up the activity. Help in evaluating efficacy of spray using drone using different disinfectants

REPRESENTATIVE PICTURE

SUBUNIT VACCINE FOR SARS-CoV-2

NRDC (14)-T&P-COVID-19

Introduction: Several research and technology development projects have been initiated to address problems arising from the current COVID-19 pandemic. The goal of this research is to develop a rapidly producible vaccine for protection to front-line health workers, senior citizens and individuals with co-morbidities such as cardiovascular disease and diabetes.

Salient Features:

1. Immunization with a vaccine should provide significant protection to individuals at high risk of aggravated illness upon infection. Previous studies have shown that antibodies against the spike glycoprotein found on the surface of the earlier 2003 SARS-CoV-2 inhibit viral infection in cell culture, and confer protection against infection in animal models.
2. Hence, the research team is attempting to design and test variants of the spike glycoprotein of SARS-CoV-2 as vaccine candidates.
3. With critical, catalytic funding and support from one of the prominent American foundations, a number of spike protein derivatives have been designed and characterized.
4. These are being tested in animal models through the incubated startups in the presence of experts.
5. Research team estimates that minimum 100 million doses will be required to meet India's requirement if the SARS-CoV-2 infection persists for the medium to long-term.

Stage of Development: Spike protein design has been developed. The design which shows the best results in animals will be advanced to development of production technology, safety and toxicity testing, followed by GMP manufacturing for use in Phase-1 clinical trials. Tentative Timelines framework is below:

- First generation vaccine candidate: 4 months
- Production technology: 8 months
- Initiate Phase-1 human clinical trial: 12 months

Support Anticipated: Research team are sending proposals for funding. The team need funding of about ₹ 15 crores.

REPRESENTATIVE PICTURE

SMART STETHOSCOPE

NRDC (15)-T&P-COVID-19

Introduction: Patients diagnosed with COVID-19 often experience shortness of breath, leading to acute respiratory distress syndrome. Doctors use traditional stethoscope to listen to chest sounds such as wheezing and crackles that appear with the progress of the disease. This however, poses a risk to doctors, as evident from the rising infections reported among healthcare professionals handling COVID-19 patients. The research team has developed a "Smart Stethoscope" that can listen to heartbeats from a distance and record them, minimising the risk of healthcare professionals contracting the novel coronavirus from patients. The basic version of the digital stethoscope developed can be connected to mobile or laptop through a wire. The advanced version developed can transmit data from the stethoscope to mobile or laptop via Bluetooth. The device allows any healthcare professional with protective suit to approach a patient, capture lung sounds and send them for analysis to experienced doctors, thereby distributing the workload. It can help in monitoring and characterising lung infections in severe patients of COVID-19.

Salient Features:

1. Smart Stethoscope can listen to heartbeats from a distance and record them. It consists of a tube connected to two earpieces. The tube transmits sounds from the body while eliminating background noise that might interfere with diagnosis
2. The second advantage is that the stethoscope it amplifies and filter several sounds and translate them into an electronic signal, which can be further amplified for optimal listening. The data or the auscultated sound from a patient's chest is wirelessly sent to the doctor using Bluetooth, doing away with the need to go near to the patient to take readings, according to members of the team.
3. The signal can then be displayed as a phonocardiogram on a smartphone or laptop. In contrast, a regular stethoscope which is limited, when it comes to amplifying sounds and there is no way of recording those sounds and sharing from one place to another. Even visualisation is not possible, which means one cannot see the graph and identify abnormalities with regular stethoscope.
4. The researchers received patent for the device that records the auscultated sound and stores it as part of a patient's health record. This can be shared with other doctors for analysis as well as follow ups.
5. This digital stethoscope is a unique device used for remote auscultation (listening to chest sounds). The device allows storing the auscultated sound as part of the health record of the patient and sharing with other doctors for confirmatory opinion. The digital device can be attached to any conventional stethoscope, to amplify chest sounds and send them wirelessly from patients to doctors without physical tubing.

Stage of Development: Product has been developed and patented. Operating a startup, the research team has manufactured and sent 1,000 stethoscopes to different hospitals and healthcare centers across the country. The product has been developed with clinical inputs from doctors at Reliance Hospital and PD Hinduja Hospital.

NEGATIVE PRESSURE ROOMS

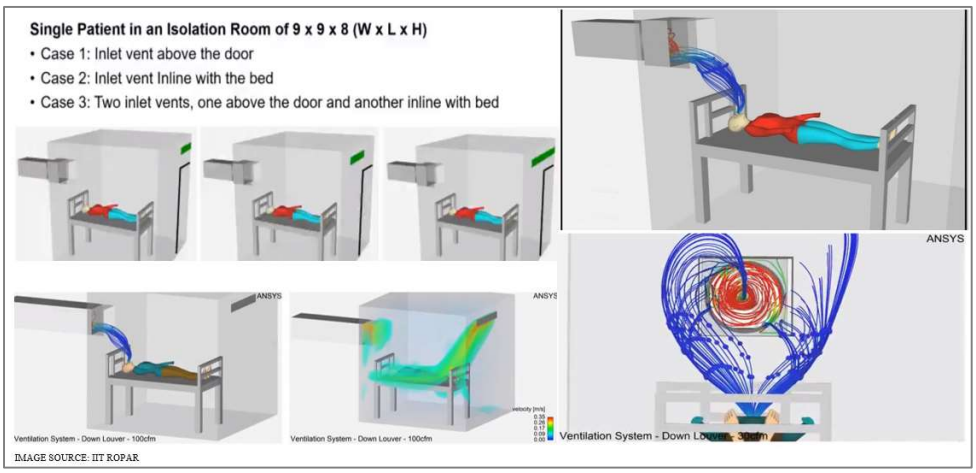
NRDC (16)-T&P-COVID-19

Introduction: In order to shield the medical staff from coronavirus and ensure that the COVID-19 patients are in proper isolation, a team of researchers has come up with a solution after studying the South Korea-model for creating portable negative pressure rooms for the patients. The negative pressure room ensures that released droplets of the infected person do not stay suspended and is sucked out through the ventilation.

Salient Features:

1. The invention prevents room-to-room cross-contamination in hospitals.
2. These negative pressure rooms are specifically designed isolation rooms in hospitals and medical centres to prevent transmission of virus through air by patients.
3. The design includes a ventilation system that generates negative pressure in the room which allows the air to flow into the isolation room and to escape from the room carrying away the viruses along. The negative pressure prevents any airborne pathogen out of isolation wards. The continuous filtration of virus infected air reduces the potential risk of infections on doctors and other healthcare staff.
4. The team is proposing that testing labs and isolation rooms (which have one or more COVID-19 patient) need to be converted into negative pressure rooms for the safety of health workers.
5. These negative pressure rooms will use fabricated plastic sheets as suction system to filter out the air in the room. Each room will be 9X9X8 (WXLXH). After procuring the material, can be complete the task in a few days at a cost of ₹ 9,000 per room.
6. A sealed plastic canopy and a removable door around the bed of the patient will be installed in the room and the suction system will be appropriately placed to suck the oral discharge from the patient. It will ensure that the healthcare professionals will not come in the contact of the air borne virus. The suction system, developed by the research team, will automatically purify the air before discharging it into the environment.

Stage of Development: The design of the model has been developed and research team has sent their proposal to the Ministry of Human Resource Development (MHRD), Govt. of India and Principal Scientific Advisor, Govt. of India for creating negative pressure isolation rooms on a mass scale to prevent room-to-room cross-contamination in hospitals.



ELECTROSTATIC FACE MASKS

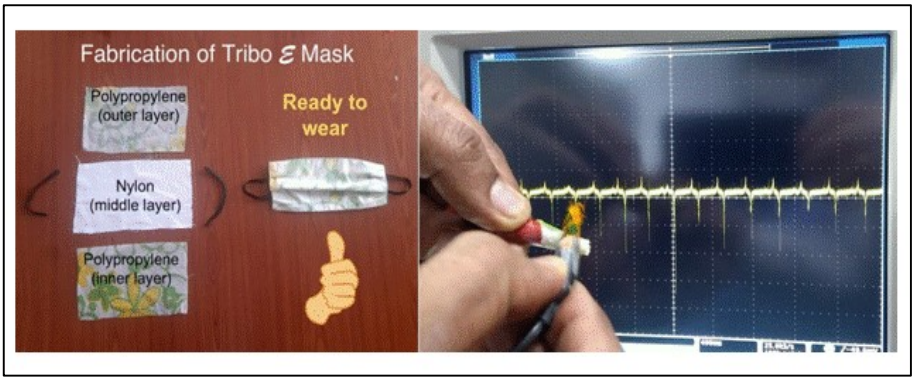
NRDC (17)-T&P-COVID-19 (Technology available for free of cost)

Introduction: In the present scenario, interestingly several new and useful COVID-19 solutions have emerged by creative applications of basic principles of chemistry, physics, materials, and bio-sciences, often by stitching together of simple insights to provide an interdisciplinary solution. The mask proposed here is a good example of such a creative process that adds huge value by a simple design. A team of researchers have come up with a solution for making face masks, termed as TriboE Mask. It can hold electric charges to restrict the entry of infections, but interestingly, without any external power. The invention relies on electrostatics. When two non-conducting layers are rubbed against each other the layers develop positive and negative charges instantly and continue to hold the charges for some time. The idea has been taken from physics textbooks on triboelectricity; something kids enjoy playing with. When used in the context of a face mask, the idea can translate into a product, realizable by the end-user without the need of industry developing or manufacturing it.

Salient Features:

1. The mask is three-layered – a layer of nylon cloth sandwiched between polypropylene layers, the latter sourced from commonly used non-woven grocery bags.
2. In place of nylon, silk fabric from an old saree or shawl may also be cut and used. When layers are rubbed against each other, the outer layers develop negative charges, while nylon will hold the positive charges. This will act as double electric wall protection against the infectious entities crossing. This type of charging is known as static electricity.
3. This electric field has been used which is quite strong at proximity, to deactivate or possibly even kill the germs.
4. As the mask is made out of commonly available fabrics, it can be washed just like any other cloth and can be reused. At this stage, the mask is, however, not recommended to healthcare professionals and patients.

Stage of Development: Tests on these masks are being performed, particularly in the context of COVID 19 to be used by health professionals. It's a simple home-made mask. At this stage, the mask is, however, not recommended to healthcare professionals and patients. The instructions are provided in the link: https://www.youtube.com/watch?v=IlOKwnVlYXw&feature=youtu.be



ROBOT FOR ISOLATION WARD

NRDC (18)-T&P-COVID-19

Introduction: The World Health Organisation has advised physical distancing for people around the world to prevent community level transmission of SARS-CoV-2. As health workers, researchers and governments struggle to contain the spread of the SARS-CoV-2, robots are also being deployed for administering treatment and providing support to quarantined patients. Stepping in where humans should not, robots are being used for jobs such as sanitizing hospitals and delivering food and medicines in many parts of the world and perhaps soon in India where experiments are underway to increase their role in combating COVID-19.

Salient Features:

1. It is a Three-wheeled robot and can be used to assist patients in isolation wards. This will include helping with things like food and medication, something that nurses and doctors have been doing so far, putting them at larger risk of contracting the virus.
2. This robot can help reduce both the burden on healthcare professionals as well as the risk of them being exposed to SARS-CoV-2.
3. The robot known as "KARMIbot" is cost effective, light weight, easy to handle and can be transported in a hatchback vehicle.
4. It has Features like self-charging, has both Features of autonomous and remote control. It has detachable container with self-disinfection facility between visits.
5. The robot also comes enabled with a video conferencing facility, which is expected to aid healthcare workers in keeping tabs on patients remotely. The patient will also be able to interact with attendants without coming in contact with them physically.

Stage of Development: Prototype of the robot has been developed. It does not have arms but has a detachable container that self-disinfects the items it uses. Since it is removable, it can be periodically sterilized too. The robot is expected to be cost-effective. Once the mould is completed and spares made available, the company will be able to manufacture one robot a day. Talks are going on with the district health authorities for approval to roll out the robot at the earliest.

IMAGE SOURCE: ASIMOV ROBOTICS

MIST SANITIZER SYSTEM

NRDC (19)-T&P-COVID-19

Introduction: The research team has developed Mist Sanitizer System which is a transportable system and is developed for quick sanitization.

Salient Features:

1. It is a transportable system to enable quick sanitization of personnel – one person at a time – at a designated site/premises.
2. The system includes Mist Generation System, Pumping assembly, Mist generation Nozzles, Piping Assembly, and Sanitizing Fluid Storage Tank.
3. The person walking through the system is subjected to the mist for 10-15 seconds.
4. The mist is generated through 24 nozzles placed at two different heights for maximum exposure and across the 12 feet length of the tunnel to ensure full body coverage.
5. Sodium hypochlorite solution of suitable concentration as suggested by WHO (0.5% in water equivalent to 5,000 ppm) is used to create the disinfection mist in the chamber.
6. The hypo mist smells like chlorinated water in a swimming pool. The ten-second exposure to hypo mist is similar to swimming in a pool for about 10 minutes.

Stage of Development: Technology has been developed and tested. This unit is under testing for next few days and will be installed.

ANTI-MICROBIAL COATING

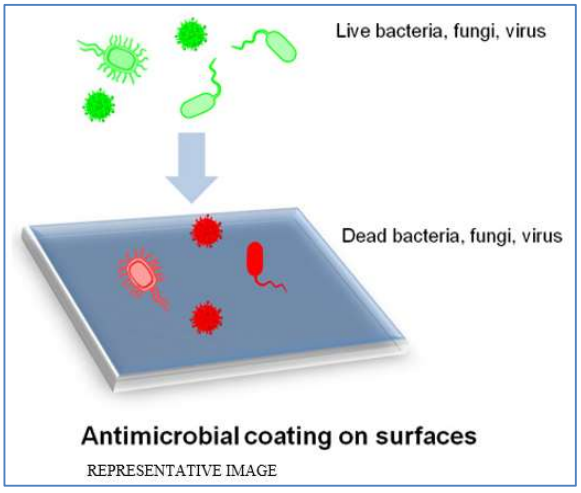
NRDC (20)-T&P-COVID-19

Introduction: Research team has developed a one-step curable anti-microbial coating which, after applied on different surfaces such as textile, plastic and so on could kill a range of virus types including SARS-CoV-2. Microbial attachment and their colony formation on different surfaces play a major role in the transmission of deadly infections in the community as well as healthcare settings. Considering this, an easy approach was developed to coat a wide range of substrates used in daily life as well as in clinical settings. It is anticipated that the coating will not allow microorganisms to become active on coated surfaces. During the COVID-19 outbreak, the coating may be used to protect personal protective tools, clothes and equipment of health workers.

Salient Features:

1. This covalent coating has been found to completely kill influenza virus as well as resistant pathogenic bacteria and fungi, including methicillin-resistant *Staphylococcus aureus* and fluconazole-resistant *C. albicans* spp.
2. The recent outbreak of SARS-CoV-2 has created an unprecedented stir in the global public health. Coronavirus, like influenza, is also an enveloped virus. Therefore, it is anticipated that the coating may inactivate SARS-CoV-2 upon contact and can help prevent contamination if coated on various surfaces.
3. The molecules developed have an ability to chemically cross-link with different surfaces upon UV irradiation. Upon the formation of the coating, it has been shown to permeabilize the membranes of pathogens (i.e. bacteria) leading to their inactivation.
4. Molecules were designed, keeping in mind their optimum solubility in a wide range of solvents (such as water, ethanol, chloroform, etc.) and a cost-effective three to four-step synthetic strategy with easy purification and high yield.
5. The molecules were then immobilized on different substrates such as cotton, polyurethane, polypropylene, polystyrene, etc., which construct majority of the objects we see around us.
6. In brief, for coating on cotton, the sheets were dipped in a water solution of the compounds whereas, for other cases, ethanolic substrates were drop-casted on them followed by UV irradiation. After coating, the surfaces were evaluated for their antibacterial, antifungal, and antiviral activity.

Stage of Development: Research proposal has been developed. Considering the current SARS-CoV-2 outbreak, if shown to be active, the molecule can be synthesized in large scale through a CRO (Contract Research Organization) and can be coated on various personal protective tools, such as masks, gloves, gowns, etc. in collaboration with the private organizations. The molecules can also be coated on other medical devices and tools to avoid hospital-acquired or nosocomial infections.



FOOT CONTROLLED WATER TAP

NRDC (21)-T&P-COVID-19

Introduction: Recommended precautionary measures against the SARS-CoV-2 include washing hands regularly with soap or alcohol-based rub to kill the pathogen which spreads through respiratory droplets and avoiding hand-face contact to prevent its transfer to person's eyes, nose or mouth. In an effort to implement the precautionary measure, the research team has developed foot operated water dispensing faucet as a part of efforts to mitigate the spread of SARS-CoV-2.

Salient Features:

1. The device ensures hands-free delivery of water from a plumbing system. foot-operated tap designed to both save water and protect users from germs like the SARS-CoV-2.
2. The uniqueness of this device is to control the water outflow with the help of foot actuation instead of hand.
3. It helps in regulating water usage and address hygiene issues. The use of foot for the said operation avoids secondary transfer of germs/microbes of contagious nature through common usage of faucet.
4. Also, the tap will not use any external power requirement for driving the mechanism. This tap can be installed in existing faucet systems for multi-level flow regulation.
5. This tap is environment friendly and this foot-operated tap costs ₹ 2,000.

Stage of Development: Technology has been developed and filed for Patent (Application Number: 2684DEL2015). Technology has been transferred and been installed in various government hospitals and will soon be available at some railway stations. Technology is ready for commercialization.

FACE SHIELDS

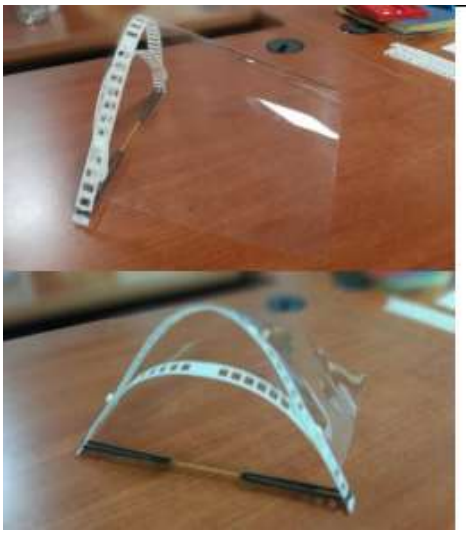
NRDC (22)-T&P-COVID-19

Introduction: Research team has designed and developed low cost and effective face shields.

Salient Features:

1. The design uses easily available materials for production in volumes with minimum investment in materials and machines.
2. The design is ergonomic with universal head size adaptability, does not let fogging to happen, ultralight weight and provides ample room for wearing eye glasses.
3. The design can be fabricated using various materials viz. plastic, cardboard and fabrication methods such as 3-D printing, laser cutting, die cutting.
4. The design is transportation friendly and can be assembled by the user in few easy steps. The estimated production cost per piece is not more than ₹ 15 depending upon fabrication material and method.
5. Although, the Face Shield has been designed as disposable after use, however, the same can be reused after sanitization.

Stage of Development: Face Shield has been designed and few prototypes are handed over to the doctors for testing.



DRONE DISINFECTANT

NRDC (23)-T&P-COVID-19

Introduction: It is a challenging task to regularly disinfect the entire city in the wake of the COVID-19 pandemic. The team has developed a drone to spray disinfectant near the coronavirus specialty wings as a measure to control the spread of COVID-19 pandemic. The drone will be useful as it will help in reducing the burden of workers

Salient Features:

1. Specially design model for the disinfection of public place has wider nozzle in order to cover large area. One battery can power a drone for 25 mins. The drone covers an area of about 6 m/s
2. The hexacopter with six propellers can carry 15 liters of disinfectant and fly upto 20 to 25 feet. The team has deployed six drones which can operate for about 6-7 hours a day.
3. The Bengaluru-based startup has designed and developed the drones in-house with the battery too has been sourced indigenously.

Stage of Development: Technology has been developed and at implementation stage by the government bodies.

IMAGE SOURCE: ALPHA DRONE TECHNOLOGY

BIO BODY SUITS

NRDC (24)-T&P-COVID-19

Introduction: Earlier, the research team had developed this body suit for medical and paramedical staff to manage and evacuate the casualties in the event of radiological emergencies, which right now is converted as a full body suit to stop contamination during this COVID-19 pandemic.

Salient Features:

1. Research team has developed a suit for protection against liquid radionuclide which has been tested to be effective as a Bio-suit. These are being produced through industry partner.
2. Each suit costs ₹ 7,000.
3. These PPEs are tested and certified, synthetic blood penetration test of government defence laboratories is facilitating the testing and certifying facility for PPEs
4. 20,000 suits are likely can be manufactured in a week time. Production capability will be ramped up to 15-20,000 PPEs per day in a week.

Stage of Development: Technology of bio-suits has been developed and manufacturing is being started through industrial partners and are being supplied to MOH&FW, Govt. of India.

3D BASED FACE SHIELD

NRDC (25)-T&P-COVID-19

Introduction: 3D-printed face shield is made by research team to help doctors and nurses (treating COVID-19 patients), by guarding their eyes and face against potential infection from the cough and sneeze of the patients.

Salient Features: A 3D-printed face shield with reusable options has been designed and developed

Stage of Development: Few pieces were presented to doctors and other paramedical staff working in laboratory dispensary. Taking it further with a private partner for mass production with synergistically improved design aspects and printing of antimicrobial coated face shields has been planned.

DISINFECTION WALK WAY

NRDC (26)-T&P-COVID-19

Introduction: Research team has developed technologies and products, which can help in countering the menacing SARS-CoV-2. In a view to disinfect people two variants of the Disinfection Walkway has been developed known as Pneumatic Variant Disinfection Walkway and Hydraulic Variant Disinfection Walkway. The Disinfection Walkways can be deployed at multiple critical locations such as isolation/quarantine facilities, mass transit system entry points, medical centres and any other location with a considerable number of footfalls.

Salient Features:

1. The Disinfection Walkway can be considered to be one of the most comprehensive Disinfectant Delivery Systems available.
2. The Walkway ensures maximum target coverage with minimum shadow area of an individual.
3. Pneumatic Variant Disinfection Walkway: This variant of Disinfection Walkway deploys Six Bar pressure Air Compressor to ensure optimum mist formation. The embedded sensors of the Walkway ensure that the operational time of the system can be varied within a range of 20 seconds to 40 seconds. Though the initial cost of this variant is relatively higher, the operating cost of this system is much less, owing to optimum usage of disinfectant in this system. This has been installed with the dimensions of the Walkway as 2 metre height by 2.1 metre length and 1 metre width.
4. Hydraulic Variant Disinfection Walkway: It deploys 1 hp pressurised motor High Velocity pump with necessary set up nozzles to ensure optimum mist formation. The initial cost of this variant is relatively lower. The embedded sensors of the Walkway ensure that the operational time of the system is just within a range of 20 seconds to 40 seconds. This variant of Disinfection Walkway has been installed.

Stage of Development: The product has been designed, developed and installed.

ROAD SANITIZATION UNIT

NRDC (27)-T&P-COVID-19

Introduction: Research team has developed Road Sanitization unit which can be effectively deployed in long stretches of highways, vicinity of toll plazas etc., where there is a massive volume of traffic and higher chances of infection spreading. It can also be deployed in housing complexes, office complexes, sports arenas, apartment buildings, etc.

Salient Features:

1. Road Sanitizer Unit is a tractor-mounted Road Sanitizing System.
2. The Road Sanitizer has a span of 16 feet, which uses 15 to 35 bars of pressure to ensure effective delivery of the sanitizer. 12 nozzles are used to ensure optimum radial coverage of sanitizer. The system utilizes a 2,000 to 5,000 litres tank with a pump of 22 LMP which can be used to sanitize a road stretch of up to 75 kms.

Stage of Development: The product has been designed and developed. The first developed prototype is under trial run at the laboratory. Many district municipal corporations, MSMEs and small business clusters have also expressed interest for the unit and interactions are under progress.

MASK WITH REPLACEABLE FILTERS

NRDC (28)-T&P-COVID-19

Introduction: Research team has come up with a two-layered filter mask to ensure considerable facial area coverage. Keeping in mind the mass requirements in the present context, the cost of an individual mask is developed with a very low price.

Salient Features:

1. The two-layered filter mask ensure considerable facial area coverage. The dual layered filters ensure maximum protection against external infection.
2. The replaceable filters are hydrophobic (water resistant) and ensure perpetual use of the filter-support, which can be sterilized utilizing commonly used procedures. The filters can resist upto 90% of contaminated aerosols.
3. The cost of an individual unit has been restricted to ₹ 5.

Stage of Development: The product has been designed and developed. Soon the product will be available to laboratory employees for testing purpose.

HANDS FREE HAND SANITIZING AND WASHING SYSTEM

NRDC (29)-T&P-COVID-19

Introduction: The laboratory research team has designed and developed a compact hand sanitizing and washing system to ensure hands-free sanitization of both hands without touching the water source and the liquid dispenser.

Salient Features:

1. The system is mechanically operated by foot for dispensing liquid soap for hand sanitization and water flow for washing.
2. It can be utilised either as a standalone compact unit with water source or can be attached to any existing wash basin.
3. The operation doesn't require electricity.

Stage of Development: The product has been designed, developed and proposed to be installed at strategic locations in and around Bhubaneswar city.

ANTI-MICROBIAL SOAP BARS

NRDC (30)-T&P-COVID-19

Introduction: The laboratory research team has started working on various types of sanitizers and sanitizing systems.

Salient Features:

1. Affordable soap bars with anti-infective property by using cold process of soap making. The method utilizes approved chemical ingredients along with metallic substances exhibiting antimicrobial activity.
2. Further, the technology will be handy for providing an opportunity of livelihood to many migrant workers who lost their jobs recently.

Stage of Development: The process will be scaled-up and brought under usage through community participation to combat COVID-19 related spread through hands and clothes after its scientific evaluation.

REPRESENTATIVE IMAGE

FACE SHIELD WITH 3D-PRINT TECHNOLOGY

NRDC (31)-T&P-COVID-19

Introduction: Using 3D-printing technology, scientists have made protective face shields for the doctors and paramedics attending to COVID-19 patients.

Salient Features: In these cost-effective shields the frame is made of poly lactic acetate (PLA) and the front transparent portion is made of cellulose acetate (OHP sheets). These shields have been sent to Bhavnagar Medical College and been greatly appreciated by the medical fraternity.

Stage of Development: Shields have been designed and developed.

HERBAL SOAP

NRDC (32)-T&P-COVID-19

Introduction: Presently, the demand of soap is rising day by day for preventive measures against the contagious SARS-CoV-2. Research team has developed herbal soap with natural saponins.

Salient Features: The composition does not contain any mineral oil, SLES (Sodium laureth sulphate) and SDS (Sodium dodecyl sulphate) and provides effective antifungal, antibacterial, cleansing and moisturizing benefits. The technology has been transferred to two companies for its commercial production and is made available in major cities across the country.

Stage of Development: Product formulation has been developed and technology transferred to two firms for commercial production. The technology is ready for commercialization.

FULL FACE MASK

NRDC (33)-T&P-COVID-19

Introduction: Research team has developed face protection mask for health care professionals handling COVID-19 patients. It's a light weight construction makes it convenient for comfortable wear for long duration.

Salient Features:

1. This design uses commonly available A4 size Over-Head Projection (OHP) film for face protection.
2. The holding frame is manufactured using Fused Deposition Modeling (3D- printing). Polylactic Acid filament is used for 3D-printing of the frame. This thermoplastic is derived from renewable resources such as corn starch or sugarcane and is biodegradable.
3. The face mask will be mass produced using injection moulding technique for volume production.

Stage of Development: Product has been designed and developed. 200 face shields are being produced daily and provided to the dispensaries and to health professionals at PGIMER, Chandigarh and ESIC, Hyderabad as 100 to each for trials. A demand of 10,000 face shields has been received from PGIMER and ESIC Hospitals based on successful user trials.

D-NANO SILVER DISINFACTANTS

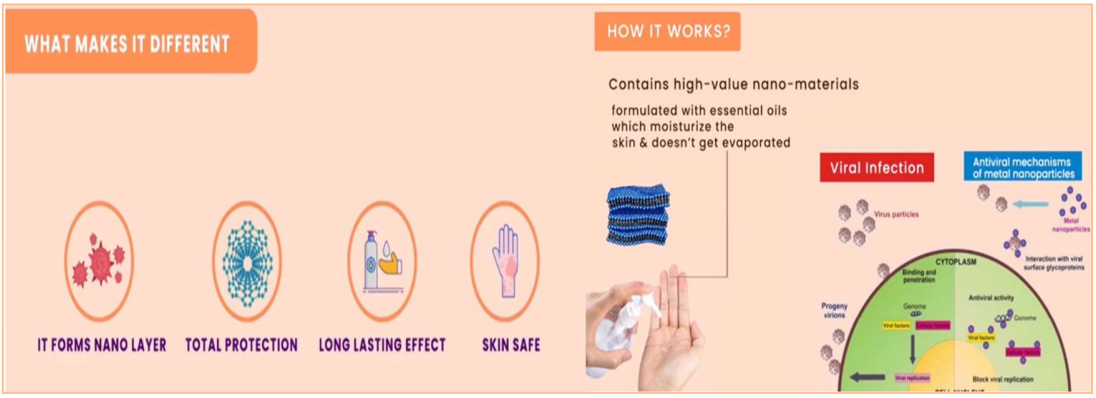
NRDC (34)-T&P-COVID-19

Introduction: Worldwide COVID-19 is threatening the public health, economy as well as destabilizing the functioning of the society. While there is no single solution to contain and eradicate this disease in the absence of a known cure nor a preventive vaccine, the best available solution is to keep the living, working and commercial areas free from bacteria, viruses etc., in order to prevent sustenance and transmission of the pathogen and at the same time to manage the health condition of the infected persons through isolation and treatment to the effect of system management. In this background, effective face masks and disinfectants in general and specialized anti-viral disinfectants in particular play a key role.

Salient Features:

1. The research team of startup has developed a solution based on nanotechnology principles in the form of a surface coat to eliminate harmful germs like bacteria, virus, fungus, mold etc., and VOC's and odor as well, with the combination of TiO_2, silver, zinc and copper in nano form. For example: with the combination of our nano-formulation a simple 3 % H_2O_2 can be made 15 to 20 times more effective and long lasting.
2. The products developed are D-Nano Silcuz Sani spray, D-Nano Silver protection Sprays for Cars and other vehicles; D-Nano Silver protection sprays for Masks and gowns.
3. Houses, offices, shopping malls, markets, vehicles, around toilet areas, pet places, schools, hotels etc., any place that needs disinfection, sanitizing and freshness. These D-Nano products can effectively eliminate virus, bacteria and other microbes and keep the vehicles disinfected and safe to travel.
4. These sprays when used on any mask or gown will kill the germs that come in touch with the coated surface making them safe to use and dispose since they eliminate the problems related to improper use and disposal of masks and gowns.

Stage of Development: Product prototypes are designed and developed. The sprays and sanitizers are tested by JNTU Hyderabad India. centre for Nano technology for its effectiveness they said that it is very effective but the tests were done only on bacteria since they don't have virus testing facility. The team is approaching statutory bodies for virus testing formalities.



D-NANO TIO_2 SURFACE COAT TECHNOLOGY

NRDC (35)-T&P-COVID-19

Introduction: The research team has developed D-Nano TiO_2 Photocatalytic Advanced Surface Coat Technology.

Salient Features:

1. This contains Nano TiO_2 Photocatalytic particles which when applied can Continuously.
2. eliminate bacteria, virus (earlier researches show that they can inhibit SARS, CORONA too); kill and suppress microbial and virus growth; remove air and water contaminates; degrade hazardous organic pollutants into harmless substance, non-toxic, affordable.
3. The product is eco-friendly & Long-lasting effect one coat will last for more than a year.
4. Disinfecting by D-Nano TiO_2 Photocatalytic Advanced Surface Coat Technology contains is many times stronger and safe than regular disinfectants.
5. Also available in spray which is a combination of highly efficient photocatalytic nano TiO_2 and nano Ag which is anti-viral and anti-microbial that can eliminate virus, bacteria, fungus, mold etc., from the treated area 24/7 in the with or without light.

Stage of Development: Product prototypes are designed and developed. The Sprays and sanitizers are tested by JNTU Hyderabad India. center for Nano technology for its effectiveness they said that it is very effective but the tests were done only on bacteria since they don't have Virus testing facility. The team are approaching statutory bodies for virus testing formalities.

N-95 MAKS

NRDC (36)-T&P-COVID-19

Introduction: In the event of a shortfall of N-95 masks, the research proposes devising a method to clean them without affecting their specifications.

Salient Features: The team aims to renew the N-95 Masks for multiple uses and also with more protective Features.

Stage of Development: The research is under progress. The team is being assembled and the problem statement is being defined.

Support Anticipated: Experts who can outline methods of cleaning the masks and those who can come up with methods of testing them post-cleaning to ensure that specifications are still met.

REPRESENTATIVE IMAGE of N95 MASK

BIO-PROTECTIVE FACE MASK

NRDC (37)-T&P-COVID-19

SN	Parameters	Test Method/ Standard	Specified Value	Remarks/Test Places
1.	**Design Features**	□ Design of the mask – Flat & fold with exhalation valve □ No interference with mask while wearing goggles. □ One-way exhalation valve to facilitate longer wearing with low exhalation resistance. □ Provision of aluminium nose clip for snug fit. □ The elastic head band with adjustable fittings should be attached (adhesive/ultrasonic/RF welding/stitching) with the mask		
2	**Size**	□ Free Size		
3	**Filtration Medium**	□ The mask material is required to be multilayered nonwoven fabric(max. 121 gsm) □ Silver impregnated nylon nano -web of 0.35-0.40 gsm to be deposited on polypropylene melt blown nonwoven fabric (max 20 gsm): **Certificate required from supplier/ATIRA, Ahmedabad.** □ Two such nano-deposited layers are to be sandwitched between two layers of polypropylene melt blown nonwoven fabric (max. 40 gsm)		**NABL accredited/Govt. Approved lab**
4	Biological Filtration efficiency, % Min	**ASTM F 2101**	**99.7**	**NABL accredited/Govt. Approved lab/ SITRA**
5	Breathing (inhalation) Resistance, Max a. Inhalation (@30 lpm) b. Inhalation (@95 lpm)	Using DOP for 0.3 micron (µm) size particulate matter	**100Pa** **300 Pa**	**DRDE/NABL accredited/Govt. Approved lab**
6	Exhalation valve leakage test	As per NIOSH procedure :TEB-APR- STP-004 or Equivalent	**Leakage shall not exceed 30 ml per minute**	**NABL accredited/Govt. approved lab**

7	Mass (With fitted Accessories & without packing), grams, Max		12.0 g	**NABL accredited/Govt. Approved lab**
8	Life	Shelf life Usage Life	12 months Single use	**Certificate from Industry**
9	Packing	Mask is required to be packed in polyethylene pouch along with moisture adsorbent (silica gel pouch) and user instructions and month and year of manufacturing. Finally 12 such packed masks are to be packed in a card board box.		

Note: Industry has to submit the compliance certificate/reports to the above specification.

Configuration – Suggested, only for reference

LIGHT WEIGHT STRUCTURES FOR QUARANTINE HOSPITALS

NRDC (38)-T&P-COVID-19

Introduction: The Research team has proposed fast, lightweight and prefabricated structure for quarantine hospitals/structures.

Salient Features:

1. The Lab proposed a design of large structures with innovative concepts, a fast, lightweight and prefabricated unit.
2. The design of structures will be made by utilizing light weight material by ensuring safety and stability such that structures can be constructed in couple of days.
3. For the construction, it is proposed to employ precast units to reduce labour and time.
4. The approximate cost for setting up the proposed structure is ₹ 25000-28000/- per sq.m and the erection time at site will be less than 7 days (time requirement for fabrication of truss elements at factory and the foundation at site will be 10-14 days). Additional cost of ₹ 3000-5000/- per sq.m may be required for mobility, toilet and other functional and specific requirements.
5. The air filtration system, AC system and doctors' rooms, anti-viral painting etc., if required, will have to be added appropriately.

Stage of Development: Research is under progress. Scientists are gearing up to contribute towards design of the proposed structures.

PERSONAL PROTECTIVE COVERALL SUIT

NRDC (39)-T&P-COVID-19

Introduction: The research team has developed and got certified for the overall protective coverall suit. The suit has been developed by identifying suitable indigenous materials and innovative manufacturing processes.

Salient Features:

1. The polyproplylene spun laminated multi-layered non-woven fabric-based coverall can be used to ensure the safety of Doctors, Nurses, Paramedical staff and Health Care workers working round the clock on COVID-19 mitigation.
2. These Coveralls are highly competitive in price as compared to other manufacturers and the import content is negligible.

Stage of Development: Product has been developed and has gone through stringent testing at SITRA, Coimbatore and it has qualified for use. The team has plans to augment the production capacity to about 30,000 units per day within four weeks' time.

AIRON IONISER MACHINES

NRDC (40)-T&P-COVID-19

Introduction: A technology has been developed by startup inventors which offers an effective solution for India's fight against COVID-19 by reducing the viral load of infected areas within a room significantly within an hour. The efficacy of the ion generator has also been observed on different types of pathogens like the Influenza virus, Coxsackie virus, Polio virus, SARS-CoV-2 a range of allergens, bacteria, and fungi. It could also be useful against floating viruses in the air on public transport, train stations or airports, or especially within a confined space like a plane cabin, house, hospital ward, and so on. The technology has been developed under the NIDHI PRAYAS program initiated by the Department of Science and Technology (DST), Govt. of India.

Salient Features:

1. The negative ion generator titled Airon, which helps to control the virus, bacteria, and fungal infections in a closed environment, could clean up the air and disinfect areas which are exposed to the infection through COVID-19 positive cases and suspects.
2. Hence it could ensure the wellbeing of the staff, doctors and nurses who are working round the clock in the quarantine facilities by enhancing their disease- resistance power and ability to fight the.
3. It could ensure wellbeing of the staff, doctors, and nurses working in the quarantine facilities by enhancing their disease resistance power and ability to fight the SARS-CoV-2.
4. Its usefulness in killing disease-causing viruses and bacteria has been scientifically tested by various globally renowned labs in different types of closed environments like houses, hospitals, schools, farms, industries, and so on. One hour of operation of ion generator machine reduces viral load within a room by 99.7% depending on room size.
5. The Scitech Airon ionizer machine generates negatively charged ions at approx hundred million per 8 seconds (10 ions per sec.). The negative ions generated by the ionizer form clusters around microparticles such as airborne mold, corona or influenza viruses, mite allergens, bacteria, pollens, dust and so on and render them inactive through a chemical reaction by creating highly reactive OH groups called hydroxyl radicals and HO which are highly reactive and known as atmospheric detergents.
6. The detergent property generated by the ion generator helps in the breakdown of the outer protein of the allergens, viruses and bacteria, which helps in controlling airborne diseases. It increases the body's resistance to infections and harmful environmental factors. This resistance could be helpful for the next 20-30 days outside the ion atmosphere. It also decomposes gaseous pollutants like carbon monoxide (1,000 times more harmful than carbon dioxide), nitrogen dioxide, and volatile organic compounds.

Stage of Development: DST, Govt. of India has released ₹ 1 crore to manufacture and scale up the product, and 1000 of them will soon be ready for installation in various hospitals in Maharashtra.

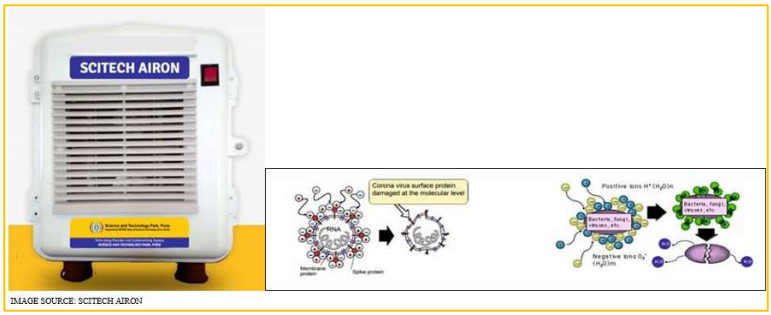


IMAGE SOURCE: SCITECH AIRON

ROBOT ZAFI

NRDC (41)-T&P-COVID-19

Introduction: Researchers have developed a robot known as ZAFI which can be deployed in isolation wards for SARS-CoV-2 infected cases for delivery of food and medicine to patients, which can be customized as per the needs of the hospital. They are working on another robot will be specifically for toxic and contagious waste collection from isolation wards.

Salient Features:

1. The ZAFI robot which is 4 f.t tall, has the capacity to carry a load up to 8kg. with a connection range (using Wi-Fi) of 250m.
2. The robot can reach patients in the isolation wards with anyone operating it using the mobile app. It is equipped with voice interaction also.
3. The other robot, 'ZAFI med' can be operated from a distance of 1.5 km with a load of 20 Kgs. and can be used to deliver essential to people who are home-quarantined.
4. The district administration tested it and it'll be in the hospital soon

Stage of Development: The robot has been developed and tested. Robot is deployed for demo in isolation ward of Stanley Medical Hospital, Chennai in view of COVID-19.

STERILISATION SYSTEM FOR MEDICAL ACCESSORIES

NRDC (42)-T&P-COVID-19

Introduction: Researchers have developed an Advanced Photocatalytic Oxidation Sterilization System based on UV-light and metal oxide nano-particles catalyst panels. This can be used for sterilization of medical accessories being used by doctors and COVID-19 patient handlers. The current system facilitates the reuse of N-95 Filtering Face-mask Respirators.

Salient Features:

1. This system has two indigenous assemblies of UV-light sterilization systems housed in a portable biological safety environment to kill the bacteria and viruses in a protective environment.
2. Metal oxide nano-particles catalyst plates are synergistically used in the system in combination with UV-lamps.
3. The process eliminates microorganisms including viruses and any other suspended particles including volatile organic compounds (VOCs).
4. It also has an advanced control system and is enabled with semi-automated operation.

Stage of Development: The system has been tested at AIIMS and got confirmation for its effectiveness. This in-house project was completed within 15 days. Research team is ready to transfer the technology at zero cost to MSME for mass production. Also, the research team is willing to work with such industries for derivate products development on this technology at zero cost.

IMAGE SOURCE: IIT JODHPUR

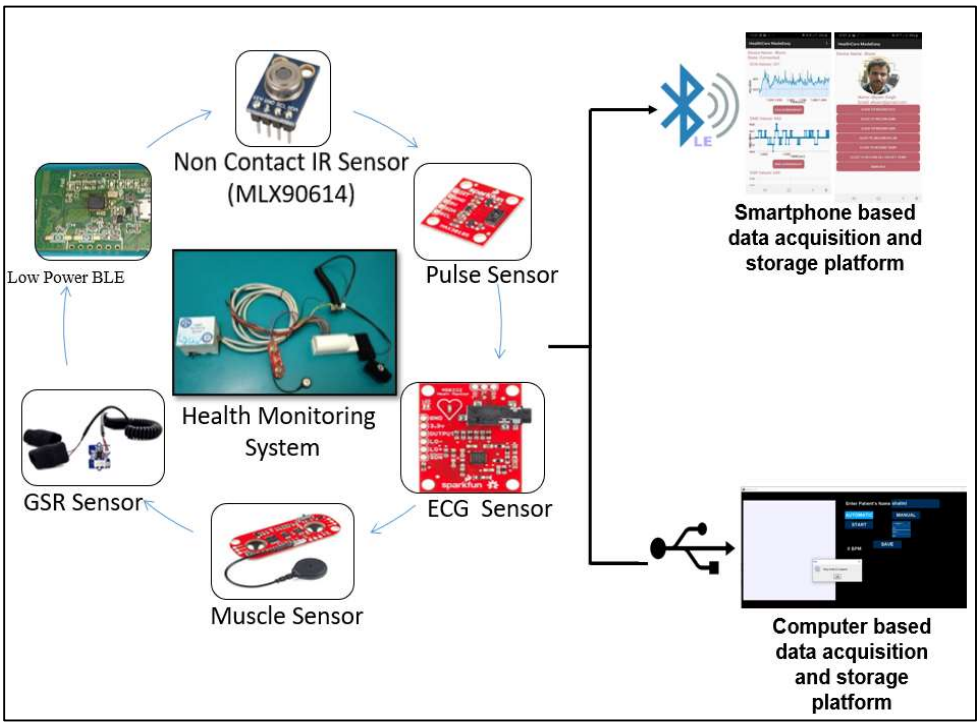
HANDHELD HEALTH MONITORING SYSTEM

NRDC (43)-T&P-COVID-19

Introduction: A remote patient health monitoring system that can be installed at homes or hospitals handling isolated COVID-19 cases, which promises to spare healthcare workers from exposure to suspected or quarantined cases, has been developed. When the health parameters exceed the threshold, an alert is sent to medical officers and healthcare workers. It will also show the severity of the patient's condition using colour codes.

Salient Features:

1. Measures body temperature (using non-contact IR temperature sensor (MLX90614) in real-time.
2. Also measures ECG, EMG, GSR, pulse in real-time.
3. Connectivity to smartphone and computer.
4. Battery operated with charging facility.
5. Low cost, rapid and ultra-portable in nature.
6. Provides various data sharing options.
7. Supports bi-directional communication between doctors and patients from remote locations
8. Approximate BOM= ₹ 15000



N-99 MASK

NRDC (44)-T&P-COVID-19

Introduction: Researchers have developed five layered N-99 masks using a nano web filter layer which is being produced by two of the industry partners.

Salient Features:

1. Five-layer N-99 masks with two layers of nano-mesh are very advanced. The mask costs ₹ 70 per piece.
2. The inventors have designed 3-ply surgical masks and producing through industry partner. 40,000 3-ply surgical masks have been supplied to Delhi Police and other agencies

Stage of Development: The masks are developed and tested. Manufacturing of masks is in progress with an aim to produce 1 lakh masks over next 5/6 days. Production will be ramped up to 2 lakh N-99 masks per week through the industry partners.

BUBBLE HELMET FOR VENTILATION

NRDC (45)-T&P-COVID-19 (Technology available for free of cost)

Introduction: Researchers have developed a new equipment named Bubble Helmet for ventilation to ensure better treatment and the safety of health workers.

Salient Features:

1. Bubble helmet is the equipment which will be revolutionary in the treatment of COVID-19.
2. Bubble helmet is an alternative option for the traditional oxygen mask.
3. Bubble helmet completely covers the head of the patient and it will be connected through a special collar on it.
4. This device will help the patient to overcome breathing problems and avoid using a ventilator facility.
5. The helmet is most suitable for patients suffering from acute respiratory distress syndrome caused by COVID-19.

Stage of Development: The system has been developed and tested. For mass production of the team is ready to transfer this technology to manufacturers free of cost.

IMAGE SOURCE: SCTIMST, KERALA

CHITHRA ACRYLOSORB

NRDC (46)-T&P-COVID-19 (Technology available for free of cost)

Introduction: Researchers have developed Chithra Acrylosorb suction canisters for collecting liquid respiratory secretions from patients. Chithra Acrylosorb suction canisters are spill-proof and can be sealed after use. There is no risk of re-contamination as the waste is absorbed by the equipment itself and also it can handle more liquid waste at a time.

Salient Features:

1. It is a new equipment developed for the treatment of COVID-19.
2. It is used to collect body fluids of patients and dispose of the liquid waste safely.
3. Under the system, spill-proof suction canisters can be sealed after being used for collecting liquid respiratory secretions from patients.
4. There is no risk of re-contamination as the waste is absorbed by the equipment itself and also it can handle comparatively more liquid waste at a time.

Stage of Development: The product has been developed and tested. For mass production of the product the team is ready to transfer this technology to manufacturers free of cost.

IMAGE SOURCE: SCTIMST, KERALA

REMOTE MINI ICU (INTENSIVE CARE UNIT)

NRDC (47)-T&P-COVID-19

Introduction: At present, the availability of sufficient numbers of fully trained critical care unit (CCU) and ICU staff may become a significant constraint. The data from China suggest that 15–20% of COVID-19 cases require hospitalization, with around 15% of cases presenting with severe symptoms and 5% requiring intensive care. Patients in intensive care units (ICUs) require approximately 13 days of respiratory support. In the case of highly contagious virus SARS-CoV-2 which aggressively attacks the respiratory tract, it is clear that a remote vital tracking system is the need of the hour and a Mini ICU Unit is built to monitor COVID-19 patients for quarantine facilities.

Salient Features:

1. An AI-powered, wi-fi enabled product with a highly accurate respiration monitoring system.
2. The product has a capability to check on patients in quarantine and ensure their monitoring.
3. A low-cost solution that could monitor the vitals of 100s of patients checked by doctors from anywhere, anytime.
4. This product connects to doctors through video when the patients are moving into severe or critical stage.
5. It is set up at a distance of 3 feet from the patient, the device can track breathing rate and send the data to the app. Then the app will give notifications of drastic fluctuations in breathing rate and doctors can use this information to establish what next steps should be.
6. The device is also capable of audio and video streaming which will be especially useful for monitoring critically ill patients.

Stage of Development: Product has been developed and at marketing stage. 5,000 readily deployable devices are available which can cover 25% of the infected population over this period.

LOGIX SMART CORONAVIRUS DISASE 2019 (COVID19) KIT

NRDC (48)-T&P-COVID-19

Introduction: The Logix Smart™ Coronavirus Disease 2019 (COVID-19) Test kit is an *In Vitro Diagnostic* test that uses CoPrimer™ technology for the qualitative detection of the RNA from SARS-CoV-2. The test operates using a single step real-time reverse transcriptase polymerase chain reaction (RT-PCR) process in lower respiratory tract fluids (e.g. bronchoalveolar lavage, sputum, tracheal aspirate), and upper respiratory tract fluids (e.g. nasopharyngeal and oropharyngeal swabs) from patients who meet the clinical criteria for coronavirus disease 2019 (COVID-19).

Salient Features:

1. Ready-to-use Master Mix, complete with RNaseP internal positive control to verify sample quality.
2. Positive Control (PC), to verify the performance of the master mix.
3. Nuclease-Free Water as a negative control, to verify master mix is free from contamination.
4. Designed a reverse transcription polymerase chain reaction screening test for COVID-19 for use on its Co-primer platform.

Stage of Development: Product has been developed and at marketing stage. Received a licence from the Central Drugs Standards Control Organization to manufacture reverse transcription polymerase chain reaction COVID-19 test kits.

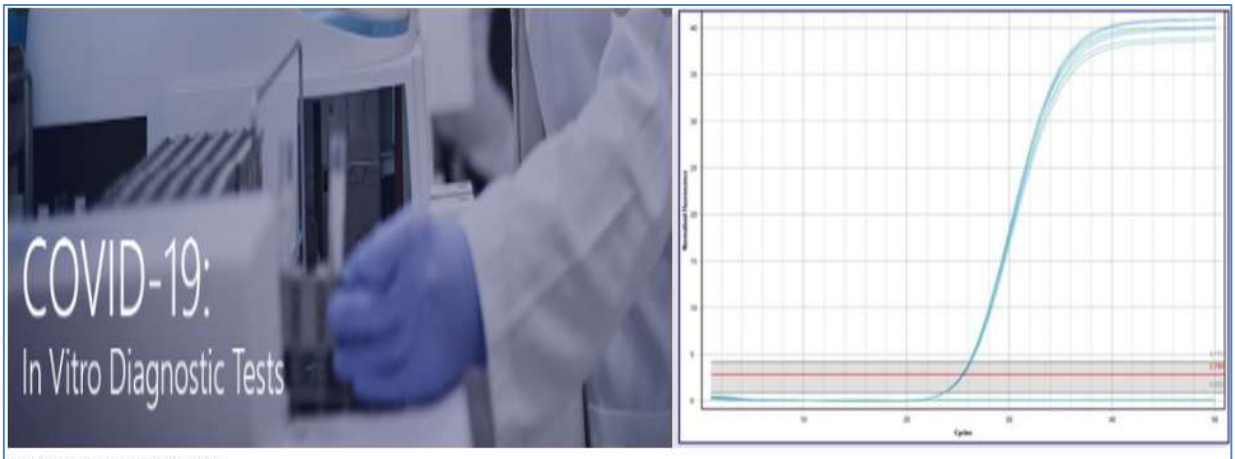


IMAGE SOURCE: LOGIX SMART

TELE-ICU PLATFORM

NRDC (49)-T&P-COVID-19

Introduction: The COVID-19 pandemic has further strained India's preexisting shortage of intensivists (less than 5,000). With the Tele-ICU platform, RADAR, it is possible for 1 intensivist to cater to the needs of 60-80 sick patients in multiple locations as compared with the current ratio of 1:15, where an intensivist is at the bedside. Intensivists use RADAR's real-time video communication platform to coordinate with bedside providers at a moment's notice.

Salient Features:

1. Integrative Smart ICU System.
2. Centralized command centre with 24X7 trained intensivist.
3. Automated early warnings.
4. Actionable decision support.
5. Diagnostic assistance.
6. Preventing ICU infections: such as central line infections and catheter infections.
7. Appropriate ICU prophylaxis.
8. Utilization of lung protective ventilation strategies.
9. RADAR's monitoring technology to reduce utilization of personal protective equipment.

Stage of Development: The team led is currently democratizing quality healthcare to small and medium sized hospital ICUs with its smart-ICU solution for their network hospitals for COVID-19.

ELECTROSTATIC DISINFECTION MACHINE

NRDC (50)-T&P-COVID-19

Introduction: Electrostatic Disinfection Machine is developed based on the electrostatic principle. This disinfection machine is a very efficient and effective technology to stop the spread of coronavirus and pathogens. Researchers have come up with this innovative concept of electrostatic spraying for disinfection and sanitization of public places especially hospitals, poultry, trains and buses, airports and airplanes, offices, classrooms and hotels to contribute healthy lifestyle and healthcare of masses and directly linked to Swasth Bharat Mission of Government of India.

Salient Features:

1. The machine produces uniform and fine spray droplets of disinfectants in the size range of 10-20 micrometre to kill microorganisms and viruses. Due to the small size of droplets, the surface area of spray droplets increases thereby enhancing the interaction with harmful microorganisms and coronavirus.
2. The machine uses very less disinfection material as compared to conventional methods, which helps to save natural resources with negligible increase of chemical waste in the environment.
3. Charged droplets emitted from the disinfection machine will cover the directly exposed and obscured surfaces uniformly with increased efficiency and efficacy and the disinfectant reaches to any hidden areas of the target, where there is a maximum possibility to find the viruses. Therefore, it kills or inhibits the growth of pathogens very effectively.

Stage of Development: Technology has been developed and commercialized. Technology is ready for commercialization.

HCARD

NRDC (51)-T&P-COVID-19

Introduction: Healthcare workers at hospitals are taking care of COVID-19 infected patients 24/7 and risking their lives. Researchers have developed HCARD to reduce the level of the risk faced by healthcare workers. The robotic device HCARD, in short for Hospital Care Assistive Robotic Device, can help frontline healthcare workers in maintaining physical distance from those infected by SARS-CoV-2.

Salient Features: The chamber comprises following Features:

1. The device is equipped with various state-of-the-art technologies and works both in automatic as well as manual modes of navigation.
2. This robot can be controlled and monitored by a nursing booth with a control station. HCARD is having features such as navigation, drawer activation for providing medicines and food to patients, sample collection and audio-visual communication.
3. The robot works in automatic as well as manual modes of navigation.
4. The cost of this device is less than ₹ 5 lakh and the weight of the device is less than 80 kilograms.
5. The robot disinfects everything it handles.

Stage of Development: The product has been developed and ready for commercialization.

UV DISINFECTION GATEWAY

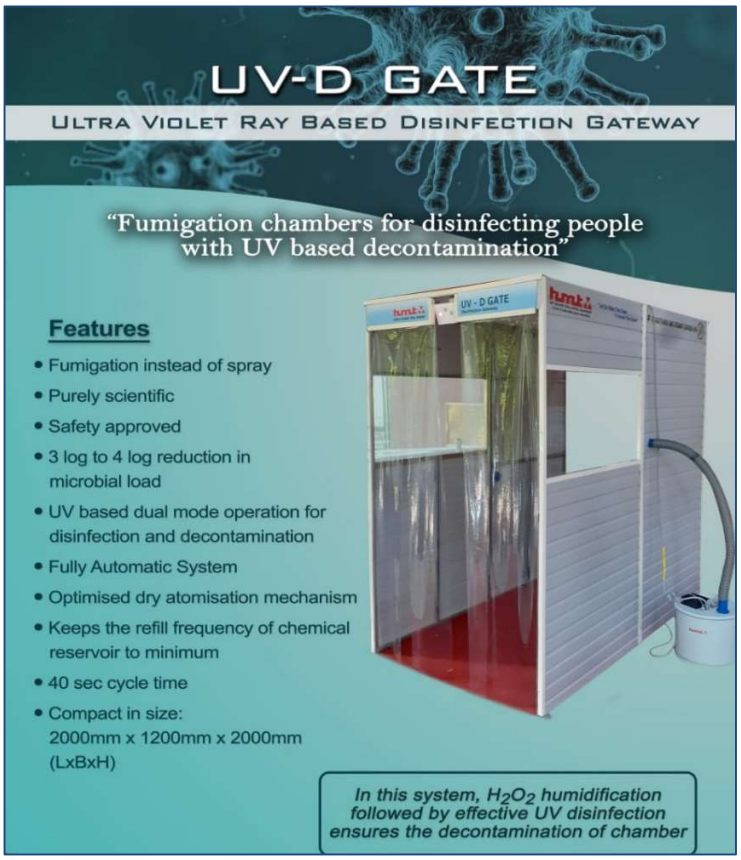
NRDC (52)-T&P-COVID-19

Introduction: Researchers have developed fumigation chambers for disinfecting people with UV based decontamination.

Salient Features: The chamber comprises following Features:

6. Fumigation instead of spray.
7. Purely scientific.
8. 3 log to 4 log reduction in microbial load.
9. UV-based dual mode operation for disinfection and decontamination.
10. Fully automatic system.
11. Optimized dry atomization mechanism.
12. Keeps the refill frequency of chemical reservoir to minimum.
13. 40 second cycle time.
14. Compact in size (2000mmX1200mmX2000mm).

Stage of Development: The product has been developed and got safety approvals. At production stage.



HAND SANITIZERS, SPRAYS AND GELS

NRDC (53)-T&P-COVID-19

Introduction: The compilation of significant Hand Sanitizers Developed for protection and prevention against SARS-CoV-2/COVID-19 is compiled.

Title	Salient Features and application of the technology	Stage of Development
Hand Sanitizer- 01	Specification: (As per WHO Guideline) **Formulation - 1** Content (v/v) 2-Propanol :75.15%, 3% H_2O_2 :4.17% 98% Glycerol :1.45% DI Water :19.23% **Formulation - 2** Content (v/v) 96% Ethanol :83.33%, 3% H_2O_2, :4.17% 98% Glycerol :1.45% DI Water :11.05%	Sanitizer is developed and tested. Testing procedures: • The sanitizers are tested for antimicrobial activity based on contact time with sanitizer and reduction in log count of both gram positive and gram-negative bacteria and Bacteriophage (virus stimulant) lysis. • The alcohol percentage is estimated based on alcoholmeter/hydrometer. • H_2O_2 % is estimated based on volumetric titration.
Hand Sanitizer- 02	Research team has standardized the process for the preparation of alcohol-based hand sanitizing gel. 250 L of hand sanitizing gel were prepared in the laboratory for internal and sister laboratories consumption. The process technology was transferred to a Rajasthan based MSME on non-exclusive basis. 800 L of hand sanitizing gel prepared within lab with a batch capacity of 100 L per day. The hand sanitizing gel were distributed to Telangana Police and GHMC workers.	The process technology is developed and product has been tested. The technology is ready for transfer to any firms. To government organization, free of cost technology can be transferred provided they have sufficient raw materials.
Hand Sanitizer- 03	The Hand Sanitizer, has following specifications: Iso proponal 75%, Glycerol 1.45%, Hydrogen peroxide 0.125% plus lemongrass oil for fragrance. The sanitizer is developed as per WHO Guidelines.	This economical and effective hand sanitiser formulation has been developed and tested. Research team handed over handwash and hand sanitisers, hand sanitiser sprayers, and hypo-disinfectants to corporation.
Liquid Hand Rub - 04	Liquid hand-rub is an alcohol-based hand sanitizer with plant extracts exhibiting aromatic and anti-infective activity. The preparation follows established SOPs.	The product has been developed and is being validated by Bhubaneswar RMRC for its use as a disinfectant against Corona virus after which bulk production will start.
Alcohol-Based Hand Sanitizer Containing Natural Aromatic Oils- 05	The formulation contains active tea constituents & natural oils, and is free from parabens, triclosan, phthalates & synthetic fragrance.	The developed alcohol-based formulation of hand sanitiser with alcohol content as per the World Health Organization (WHO) guidelines. The technology is transferred on non-exclusive basis. Technology is ready for transfer.
Sanitizer & Disinfectant- 06	Developed a non-alcoholic aqueous-based colloidal silver solution uniquely made from its NanoAgCide technology for disinfecting hands and environmental surfaces.	Product is developed.

Title	Salient Features and application of the technology	Stage of Development
D-Nano Silver Protection Hand Sanitizer- 07	Effective hand sanitizers prepared with Nano technology Nano Ag, Heavy on germs soft on hands, D-Nano Silver protection Hand Wash, eliminates germs and soft on hands. Effective hand wash with Nano silver protection	Effective nano hand sanitizer product is developed and ready for mass deployment.
Herbal Hand Sanitizer- 08	Used for hand sanitization with herbal based formula	Herbal sanitizer developed in the lab itself and distributed more than 2500 liters of it, free of cost within IIT campus.
Hand Sanitizer- 09	Developed two types based on WHO guidelines amid the coronavirus outbreak: 1.) Hand sanitiser comprises isopropyl alcohol, hydrogen peroxide, glycerol and water. 2.) The sanitizer comprises 70 percent ethanol and 30 percent aloe vera gel.	Product developed and Utilized in campus. Ready to produce at commercial scale.
Hand and Surface Sanitizer- 10	1. Sanitizer based on ethyl alcohol base formulation and process is shared with industries and production in bulk has been initiated. 2. Cost- Approx. ₹ 120/-per liter including GST	Product developed and ready for transfer.
Hand Sanitizer- 11	The formulation contains three chemicals along with Aloe Vera and the major component is isopropyl alcohol (around 75%).	Researchers has developed alcohol-based hand sanitizer, which has been prescribed by WHO for destroying coronavirus and its spores from surfaces and hand for use by the campus community.
Hand Sanitizer- 12	The 'in-house prepared hand sanitizer' contains an oxidizing agent which is usually absent in most of the commercialized hand sanitizers. The alcohol-based hand sanitizer prepared contain at least 70% alcohol can efficiently disinfect microorganisms and viruses on hands within 30 seconds or so after application.	Research team has prepared alcohol-based hand sanitizer, which has been prescribed by World Health Organization (WHO) for preventing the spread of coronavirus and its spores from small surfaces and hand for use by the campus community. Team has also started distributing the same sanitizer to the medical unit, security unit(s) as well as among the staff and faculty members residing within the campus.
Hand Sanitizer- 13	The researchers had the required raw material in lab, developed the following the WHO guidelines and the sanitizers produced contain more than 70 % isopropyl alcohol, 20 % distilled water and 2% hydrogen peroxide. We have used glycerol to moisturize the skin and added jasmine fragrance	Following the pandemic COVID-19 pandemic, there has been a sudden rise in the demand for hand sanitizers and non-availability in stores has led to illegal manufacture of adulterated sanitizers. Therefore, the researchers developed this product. The first batch of 390 bottles (each about 70 ml) was released and distributed

Title	Salient Features and application of the technology	Stage of Development
Hand Sanitizer- 14	Laboratory prepared hand sanitizer in its pilot facility and handed over 1000 bottles of its hand sanitiser (Hankool), 1000 bottles of floor disinfectant (Swabee) and 50 litres of floor cleaner (Clean germ) to the Lucknow Nagar Nigam and District Magistrate for distribution.	Product prepared and tested.
Hand Sanitizer- 15	Team prepared hand sanitiser, hand wash, liquid disinfectant, sanitized paper towel and anti-septic soap in large quantities. These were distributed in banks, hospitals, Universities, district municipality, etc.	The hand sanitizers were also distributed to various sections of the society including the institute's staff and family members, local communities, various nearby establishments like airport, district administration including police station and different essential service-related establishments
Herbal Hand Sanitizer- 16	Two types of sanitizers: 1) Team prepared herbal alcohol-based hand sanitiser technologies. Commercial production has already started. The Institute also developed a disinfectant and circulated the formula among the villagers for use in washing clothes and masks 2) Team have also made large quantities of alcohol-based hand sanitiser that complies with WHO standards. This has been supplied to Bhavnagar Medical College (BMC).	The technology developed and transferred to two entrepreneurs for large-scale production. The technology is readily available for transfer.
Hand Sanitizer- 17	Two types of sanitizers: 1.) Team has developed 1000 bottles of hand sanitisers for use in the Chennai Corporation. These hand sanitisers were handed over to the Assistant Commissioner, Greater Chennai Corporation 2) Hand sanitisers manufactured by it among people in essential services. The Institute handed over 10,000 sanitiser units to the district administration and provided hand-rub sanitiser to the office of State Mission of Clean Ganga.	The sanitizers were developed tested and deployed for utilization.
Mist Based Hand Sanitizer- 18	Researcher team has developed automatic mist-based sanitizer dispensing unit. It is a contactless sanitizer dispenser which sprays alcohol-based hand rub sanitizer solution for sanitising hands while entering the buildings/office complexes, etc.	It is based on water mist aerator technology, which was developed for water conservation.

VENTILATORS AND RELATED EQUIPMENTS

NRDC (54)-T&P-COVID-19

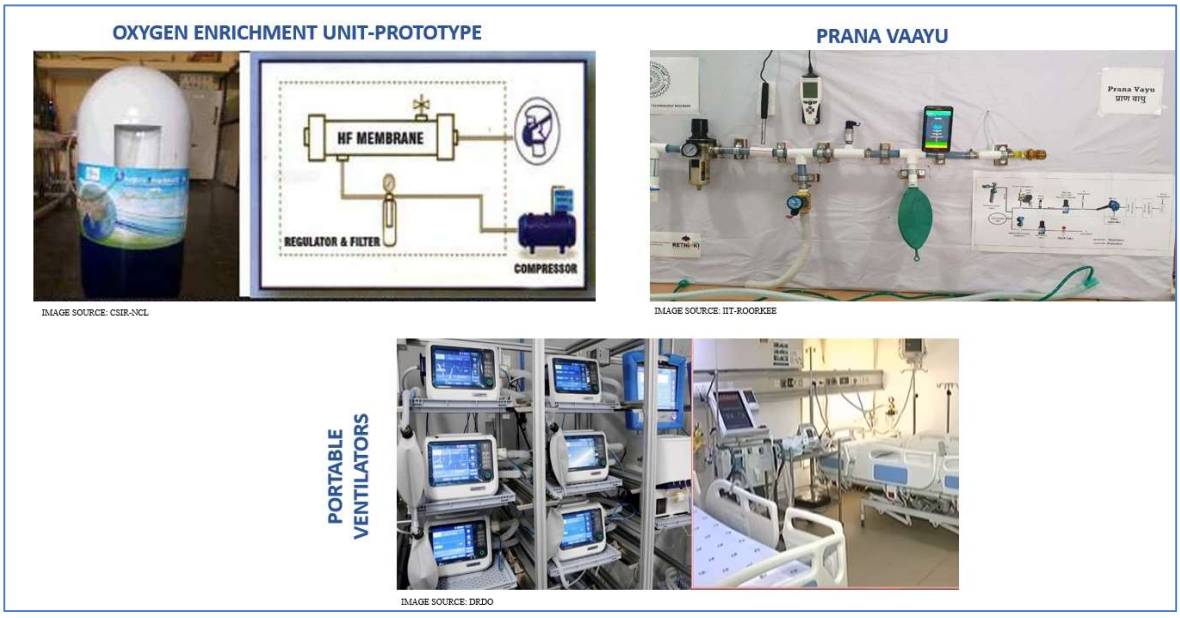
Introduction: The availability of ventilators in hospitals for critically ill COVID-19 patients has emerged as a major challenge. A ventilator is a mechanical breathing device that blows air and oxygen into the lungs and is critical for people with lung failure–a potentially fatal complication in patients with severe COVID-19.

Title	Salient Features and application of the technology	Stage of Development
Prana Vayu-portable ventilator – 01	The closed-loop ventilator does not require compressed air and is useful when wards are converted to ICUs. Low-cost portable ventilator. The ventilator is based on the controlled operation of the prime mover to deliver the required amount of air to the patient. The automated process controls the pressure and flow rates in the inhalation and exhalation lines. Even this ventilator has feedback that can control tidal volume and breathe per minute. Commercial product will be of approximate dimensions of 1.5 feet × 1.5 feet for effective portability It can automatically limit high pressure with an alarm system. In case of a failure, the circuit opens to the atmosphere which prevents choking. Some additional Features are remote monitoring by health professionals, touch screen control of all operating parameters, moister, and temperature control for inhaled air.	The prototype has been tested successfully for normal and patient-specific breathing conditions. The manufacturing cost per ventilator is estimated to be Rs 25000.
Low cost portable ventilators- 02	Invasive ventilators are available at around ₹ 4 lakh per unit in the market, this ventilator will be made at a cost of ₹ 70,000 per unit as all the components have been sourced from India only. The ventilator will be permanently connected to a mobile phone which will be used to control the device and display critical information. There will also be a provision for attaching oxygen cylinder, when required. The device will not require any form of medical air and will be capable of operating on its own in ambient air.	The prototype has been developed. Research team & doctors from Narayana Institute of Cardiac Sciences (NICS), Bengaluru will be evaluating the prototype following which the start-up will get around 1000 portable ventilators ready within a month.
3D printed valves for split use of ventilators to serve multiple patients- 03	The main purpose has been to demonstrate that this design has been fabricated and demonstrated in a hospital setting.	The first of these splitter valves has been delivered to Manipal Hospital and tested there. Future Development: The team is keen on discussing further details and other aspects with interested people.

Title	Salient Features and application of the technology	Stage of Development
Mechanical Ventilator-04	The prototype has been equipped with multiple life-saving control Features such as Tidal Volume, Breaths per Minute and Inspiratory/Expiratory ratios. Portability and cost effectiveness are two of the most primary elements of the product.	Prototype is developed and planning for mass production.
Low Cost Automation for Ventilators / Touch free operation-04	The Device can be used to control the ventilators which uses automobile wiper motors. The frequency can be customised according to the requirement of the patient. Our device can be connected to the wiper motors easily since it uses relays. The operation can be done from a smartphone and controlled even by medical persons who don't have technical knowledge. Customised operation of wiper motors. Approximate cost of making device will be around ₹ 500/- to 1000/- approximately depending on functionalities (excluding wiper motor cost)	Low Cost Ventilator Controlling Device without App. DTMF Control Logic for Windshield Wipers (Patents Pending Application no. 1.) 1215/CHE/2014, 2.) 201643022735). Technology proven in real automobile wiper motors. Real Working Prototype Ready. PoC funded and approved by PRSIM of DSIR, Ministry of Science and Technology, Govt., of India.
Low cost ventilator (for 2 patients) - 06	Low cost and portable ventilators that can be easily and quickly manufactured as per the requirement. These ventilators can provide oxygen to two patients at a time. The researchers have developed this low-cost set-up (ventilators) for automatic compression of Ambu bag used in manual ventilators The cost of the complete setup will get drastically reduced when there will be mass production. Team said that the total cost of setup including the bags is ₹ 5000 rupees means cost per person would be ₹ 2500.	The team completely developed the entire setup out from scrap and that too in merely two days. the development of automated resuscitator for automatic compression of Ambu bag is under progress.
Membrane oxygenator equipment (MOE) -07	MOE enriches in the air upto 35%. The device is safe, needs minimum maintenance, portable, compact and with plug and play facility provides on-site, quick start oxygen enriches air.	Technology has been developed and licensed. Technology available for transfer.
Ventilator-08	It has been created by using existing technologies like breath regulators, pressure/flow sensors, etc, industrial partners tied up to manufacture the product and research team is giving all assistance, including developing some critical equipment not available in the open market.	Designed portable ventilators and transferred for commercial production. The innovation is on to create 'Multi patient ventilator' wherein several patients can be supported by a single ventilator.

Title	Salient Features and application of the technology	Stage of Development
Cyclone separator design for compressor exit flow oil and dust particle cleanup-09	To develop a cyclone-based oil droplet separator system as part of the ongoing ventilator development effort, which can be used to reduce the oil droplet and dust particle load on standard filters, thereby prolonging their life and reducing the requirement for frequent maintenance intervals. The device will work by spinning the droplet and dust-laden air in a tube, causing the suspended matter to move outwards towards the wall, while leaving the air in the core of the tube free of suspended matter. This clean air can then be passed through a final filtration step to render the air quality consistent with medical requirements.	The team has come up with a preliminary design in collaboration with a local company. Team may require help with machining components and are in discussions about the same. This innovation is proposed to improve access to key medical equipment such as ventilators in order to offset reduced lung function in symptomatic COVID-19 patients. The use of lubricating oil, which is essential for the smooth and reliable operation of air compressors, results in oil droplets in the compressor exit flow that must be removed completely and requires frequent system shutdown and maintenance cycles that can hamper medical care.
Open source aerosol shield for incubation and anaesthesia-10	The virus causing COVID-19 can be transmitted through droplets of different size (less than 10 micrometres) which get airborne in vicinity of an infected patient. The medical team which comes in proximity needs to be protected from this undesirable exposure to the virus. During a crisis, when shortage of personal protective equipment is expected, alternative solutions will be needed to protect the medical team. While placing a patient on a ventilator or anaesthesia, a tube is inserted into the patients' airways through his/her mouth.	Design files were already made available under creative commons share alike license. Upon review, it was decided that the design should be modified according to the bed size in the operating theatre (OT) and the intensive care unit (ICU). Sample product was designed and Doctors of NIMHANS were able to conduct the intubation procedure with the box and found it suitable for the purpose.
Oxygen Concentrator-11	Oxygen concentrators provide a sustainable and cost-effective source of medical oxygen for medical facilities. The advantages of oxygen concentrators are high reliability and low cost compared with oxygen cylinders and piped oxygen supply systems. Challenges with oxygen concentrators include the need for regular, although minimal, maintenance and a reliable power supply.	The model was developed targeting the concentrating oxygen from ambient air of 20% to 95%. But with current invention 20% to >70% was achieved. The upgradation of the system is under progress. Support Anticipated: Zeolite sources (powder and pellets); Valves used in water purifiers; Oxygen sensors which can measure between 21-95% oxygen; Flow sensors in the range of 0.5 ltr/min-20 ltr/min
Project Praana: Open Source Ventilator Development -12	In the COVID-19 crisis, if a worst-case scenario is assumed, about 0.006% (for 130 crores population about 70,000 patients) of the cases will require critical care needing access to ventilators. The main aspects of the design are: easy sourcing of components in India, quick manufacturability and simple user interface.	The prototype is designed, scaling up of the project is under progress. Project aims to use components available in India to build a mechanical ventilator, whose production can be rapidly scaled up.

Title	Salient Features and application of the technology	Stage of Development
Cost effective ventilator-13	The designed ventilation mechanisms are cost effective methods to easily interface with existing infrastructure in hospitals. This is an open source design. Project aims to create a ventilator or a ventilation mechanism with minimum of electronics that can easily interface with existing hospital infrastructure or hospital like infrastructure for less than ₹ 50,000.	Prototypes are ready. Team has the design 1 (D1) ready and is sourcing components for D2. D1 is a ventilator that can work in pure pressure control mode by providing a pressure pulse, it uses a solenoid. D2 will do both pressure control and volume control mode which is under progress
Oxygen enrichment unit -14	The eco-friendly technology uses hollow fibre polymeric membranes packed in a unit. The equipment is different from the currently available oxygen cylinders as they have ~99% oxygen concentration, which is not required for early-stage patients.	The prototype has already been tested and a start-up has agreed to manufacture the unit on large scale for use in hospitals.
Artificial manual breathing unit (AMBU)-15	Institute has developed a ventilator system based on an artificial manual breathing unit (AMBU). The institute's automated AMBU ventilator with inputs from clinical faculty will assist in the breathing of the critical patients who have no access to ICU ventilators. Apart from this emergency ventilator, efforts in developing low-cost AI-enabled digital X-ray detectors for screening COVID-19 patients are in progress.	The technology has been developed and has rapidly moved into clinical trials and manufacturing through Wipro3D, Bengaluru.
Isolation Beds ventilators and other medical equipments for isolation and quarantine- 16	Research team has designed and manufactured two-bed tents with medical equipment for screening, isolation and quarantine that can be set up in any place. These tents with a floor area of 9.55 square metre are made up of waterproof fabric, mild steel and aluminium alloy. The tents can be set up in any place and terrain and help in creating additional facilities, other than those in conventional hospitals, within a short period of time.	The technology has been developed and implemented. Team has manufactured and dispatched 50 specialised tents for COVID-19 patients to the Arunachal Pradesh government. Proposal has been planned for 280 isolation beds across 10 hospitals spread over six states in the country.



HERBAL PRODUCTS TO BOOST IMMUNE SYSTEM

NRDC (55)-T&P-COVID-19

Introduction: The Research team has developed scientifically proven two herbal products, which can boost the immunity of the persons as well as help in alleviating the dry cough symptom, generally associated with the SARS-CoV-2/COVID-19.

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Salient Features:

1. According to health experts, coronavirus reduces the immune response of the infected person and it has been observed that this pandemic has mostly affected people with low immune system. The experts feel that improvement of the immune system helps in reducing the effects of the infection from SARS-CoV-2 and also fight the COVID-19.
2. CIMAP-Paushak and Herbal Cough Syrup are two herbal products which were found to be effective in boosting the immunity of a person.
3. Twelve valuable herbs including Puranva, Ashwagandha, Mulethi, Harad, Baheda and Sataver compounds have been used in both these products.
4. Scientific studies have shown that 'CIMAP-Puashak' has performed better than other available immunity booster products in the market. It has also been found to be cheap, safe and effective in the animal trials conducted in the institute.
5. Herbal Cough Syrup is developed based on latest guidelines of the AYUSH ministry, and it has been prepared on the basis of the 'Tridosha' principle of Ayurveda.

Stage of Development: The Institute would provide its pilot facility for manufacturing these herbal products 'CIMAP-Paushak' and 'Herbal Cough Syrup' to entrepreneurs and startups after signing of the MoU and transfer of technology. This pilot plant is equipped with state-of-the-art facilities and a quality control cell.

SPIRULINA CHIKKI TO BOOST IMMUNE SYSTEM

NRDC (56)-T&P-COVID-19

Introduction: Chikki is a ready- to-eat traditional sweet snack consumed by all sections of population in India. The product can be utilized under the label ready-to-eat sweet snack or enriched snacks and supplied to school children or pre-school children or any other specific target group as a ready-to-eat food and a concentrated source of energy and Spirulina protein. The research team claim that this product is the immunity-boosting food which provide one or other supplement needed to maintain the immune system in times of distress.

Salient Features:

1. Spirulina, a blue-green alga (cyanobacterium) has been extensively studied and is now in widespread usage throughout the world as a health food and a dietary supplement. It is a concentrated source of protein; vitamins, especially B120, Provitamin A (β carotene) and vitamin E; and minerals, especially iron. It is also rich in gamma linolenic acid (GLA), an omega 3 fatty acid.
2. Spirulina chikki is a snack that provides good micronutrients from spirulina as well as the tasty, nourishing groundnut proteins, provides the bio-available micronutrients, such as Vitamin A, Beta Carotene and easily digestible algal proteins.
3. The product has shelf life of 3 months.
4. Raw Materials: Peanuts, Jaggery, Spirulina, etc.
5. Equipments Required: drum roaster, splitting machine, stainless steel trays, candy cooker cum mixer, sheeting and cutting machines, etc.
6. Suggested plant capacity is 100 kg/day.

Stage of Development: The product has been developed and technology is ready for commercialization. Additional Information: The institute has informed that as many as 15,000 chikki bars (500 kg of spirulina chikki) have been distributed so far, as a part of relief food preparation to feed nearly 10,000 migrant workers daily in Bengaluru and surrounding areas. This has been achieved by the collaboration of private-public enterprise where the institute used its knowledge to formulate foods and some of its licensees provided their facilities for manufacturing the food in a short time. In times of lockdown when manpower and movement are curtailed, this model is providing a workable solution. The food items supplied sustain for a longer time as these are long shelf-life foods supplemented with some essential nutrition.

FORTIFIED MANGO BAR TO STRENGTHEN IMMUNITY

NRDC (57)-T&P-COVID-19

Introduction: Mango varieties totapuri and alphonso are processed into pulp and concentrate. Mango is a good source of natural plant pigments carbohydrates, carotenoids, polyphenols and soluble and insoluble dietary fiber. Mango bar is a popular confectionary product widely accepted by the consumers for its texture, color and overall quality. Fortified mango bar also contains natural carbohydrates, pectin, dietary fiber, and other micronutrients, such as calcium and zinc.

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Salient Features:

1. The bar can be consumed as confectionary product and can be used as a concentrated source of energy in special rations designed for mid-day meal, expeditions and defense-forces. It is suitable for consumption by children, adults, teenagers and aged people.
2. Fortified mango bar is developed to contain betacarotene supplemented from carrots which is known to contain a very high carotene and betacarotene content and minerals, such as calcium and zinc. Bioavailability of carotenoids and polyphenols from plant sources is reportedly higher which would render the fortified bar as an important food vehicle for the fortification of these important nutrients and minerals.
3. Nutri-mango fruit bars contain essential nutrients like carbohydrates, carotenes and also added vitamin C and zinc which are known to improve the immunity. The mango bars provide nearly 75 % of vitamin C and 30% of zinc required by a person daily.
4. The product has shelf- life of 6 Months.
5. Raw materials: Mature ripe mango pulp, dehydrated carrot powder, canesugar, etc.
6. Equipments required: Fruit washer, stirrer, fruit pulper, SS preparation tables, boiler, SS blending tank with agitator and pump, SS steam jacketed kettles, hot air drier.
7. Suggested plant capacity is 200 kg/day.
8. Total cost of the project is approximately around ₹ 68 lakh.

Stage of Development: The product has been developed and technology is ready for commercialization.

Additional Information: The institute informed that as many as 5 tons of fruit bars have been distributed so far, as a part of relief food preparation to feed nearly 10,000 migrant workers daily in Bengaluru and surrounding areas. This was achieved by the collaboration of private-public enterprise where the institute used its knowledge to formulate foods and some of its licensees provided their facilities for manufacturing the food in a short time. In this pandemic situation, foods taken need to provide micro-nutrients that aid in boosting immunity. This bar provides supplements with essential nutrients along with taste.

GINGER BEVERAGE TO ENHANCE HEALTHY IMMUNE SYSTEM

NRDC (58)-T&P-COVID-19

Introduction: Natural ginger beverage/concentrate is a good product, which possesses several combined qualities of refreshing, thirst quenching, nutritious as well as carminative and tonic beverage. It has become very popular in almost every part of the country. Ginger candy-cubes, Ginger candy-tit-bits and Ginger powder are other products that can be made from fresh ginger during the process.

Salient Features:

1. This beverage can serve as an immune enhancing drink. The ingredients present in the drink generate a pleasant taste and fresh feeling and stimulate the saliva glands
2. The product has shelf-life of 4 months.
3. Raw materials: Fresh ginger
4. Equipments required: Canning retorts, tilting kettles, stationery kettle SS, pump roto, syrup tanks, tray drier, mono rail with hoist, SS vessels, brix refractometer, sugar grinder, boiler etc.
5. Plant capacity suggested is 1200 kg/day (200 working days per year).
6. Total cost of the project is approximately around ₹ 60 lakh

Stage of Development: The product has been developed and technology is ready for commercialization. In this COVID-19 pandemic situation, foods being consumed needs to provide healthy immune system and this drink serves as a simple and healthy beverage.

AMLA PRODUCTS TO ENHANCE IMMUNE SYSTEM

NRDC (59)-T&P-COVID-19

Introduction: Amla (*Emblica officinalis*) or Indian gooseberry is a minor subtropical deciduous tree. The important varieties of Amla are: banarsi, bansi red, chkiya, desi, hathi fool and pink-tinged. Amla varieties, though have not been classified according to their size, colours are named after the places of growing. Amla is highly valued for its medicinal properties and as a health immunity enhancer. Being rich in poly-phenols it is popularly used as an astringent or mouth freshener. The fruit is known to have cooling properties and is used in several other preparations like chutneys, pickle, spread, etc., inheriting the properties of amla increases all-round immunity in the body against heart and nervous disorders. Technology is available to process amla into products like Osmo Dried Amla, Amla Spread and Amla Paste.

Salient Features:

1. Amla fruit is rich in vitamin C and pectin and is an important constituent of 'Triphala', a popular ayurvedic preparation.
2. Amla paste is a rich source of vitamin C including ascorbic acid, minerals, organic acids, polyphenols, crude fibre, etc. Amla paste, also known as amla pulp, is an intermediate product which can be used for the preparations of chavanpras, jam, spread and other preparations. It can also be used in different culinary preparations where sour taste is desired.
3. Amla spread can be used in bread for sandwitching. This product can also be taken along with chapthi, dosa or similar breakfast foods to make it more appealing. It can be consumed as jam for bread spread. It can serve the dual purpose as breakfast meal and health booster to strengthen immune system to fight against any infections.
4. Osmo air-dried amla is a ready-to-eat product wherein salt/sugar is incorporated into the amla pieces which makes the subsequent drying process less energy intensive and gives a good taste and texture to the finished product. This product has shelf-life up to 8-10 months at ambient temperature and finds varied application as it can be used in place of fresh fruits. It is a concentrated fruit product with a good nutritive value.

Stage of Development: The products have been developed and technology is ready for commercialization.

KOKUM JELLY TO IMPROVE IMMUNE SYSTEM

NRDC (60)-T&P-COVID-19

Introduction: Kokum (*Garcinia indica*) is used in many culinary processes in India. Kokum kadi is a famous delicacy in Goa-Konkan region of India. It is used as a home remedy for urinary infections. Kokum has a prominent role in traditional medicines and cuisines. Kokum jelly candy is prepared from the extract of the dried kokum rind. The extract has a distinctive acidic flavour, stable colour and is strongly acidic. Using this characteristic property of the fruit rind extracts, a jelly has been developed. The product is consumed as a confectionary and is a concentrated source of energy. The kokum jellies are safe for all groups of people as it has many health benefits and naturally made.

Salient Features:

1. With increasing demand for more natural products, kokum jelly candy has been developed and free of synthetic colour and synthetic acid would have an added advantage.
2. Raw materials: Dried kokum rind, sugar, liquid glucose, pectin and sodium benzoate.
3. Equipments required: Coolers, filtration unit, stainless steel preparation tables, SS blending tank with agitator, SS steam jacketed kettles, boiler (steam generator), jelly cutting and packing machine.
4. Production capacity: Fruit jelly candy – 500 kg /day (100 working days).
5. The plant can also alternatively run for the preparation of kokum RTS beverage and squash.
6. Total cost of the project approximately around ₹ 30 lakh.

Stage of Development: The product has been developed and technology is ready for commercialization.

FIFATROL TO INCREASE IMMUNE BUILDING EFFICIENCY

NRDC (61)-T&P-COVID-19

Introduction: Health experts have suggested boosting the body's immune system may help minimize the affects and hasten the recovery from the disease. Hon'ble Prime Minister of India, Shri Narendra Modi, too, recently highlighted the benefits of ayurveda and urged people to "have a look" at Ayush Ministry's protocol to stay fit, saying "good health is the harbinger of happiness". Fifatrol acts as an immunity enhancer which is a multi-drug combination of ayurvedic classical medicines and herbs. Researchers have suggested that Fifatrol acts a natural antibiotic and fights infection, flu and ache.

Salient Features:

1. Fifatrol comprises 5 polyphyto-minerals active compounds and 6 herbal extracts. It is a natural formulation providing fast relief from nasal congestion, sore throat, body ache & headache.
2. It is enriched with scientifically validated botanical extracts and micro-nutrients.
3. It is a rationale combination of vital phytoconstituents, immunomodulators and antioxidants which justifies its beneficial effect for the treatment of viral upper respiratory infections.
4. It offers improved immune system in top notch form to fight off viral, bacterial and other infections, normalizes the raised body temperature, fastens recovery and eases the associated symptoms like flu, cold and congestion.
5. It is an effective remedy to fight pyrexia of unknown origin.
6. The key ingredients of Fifatrol includes Guduchi (*Tinospora cardifolia (Willd.) Miers*), Daruharidra (*Berberis aristata DC.*), Apamarga (*Achyranthes aspera L.*), Chirayata (*Swertia chirata Buch.*), Karanja (*Pongamia pinnata (L.) Pierre*), Kutaki (*Picrorhiza kurroa Royle ex Benth*), Tulsi (*Ocimum sanctum*), Motha (*Cyperus rotandus*), Godanti (Bhasam) (*Selenite ($CaSO_4$. $2H_2O$)*), Mrtyunjaya rasa, Tribhuvana kriti rasa, Sanjivani Vati.

Stage of Development: The product has been developed.

ONGOING RESEARCH DEVELOPMENTS
TOWARDS TREATMENT AND PREVENTION TECHNOLOGIES
NRDC (62)-T&P-COVID-19

Introduction: The Government of India has set up a **'COVID-19 Task Force'** for mapping the COVID-19 related technology capabilities in start-ups, academia, research and development labs and industry. The capacity mapping group consists of representatives from Department of Science and Technology (DST), Department of Biotechnology (DBT), Indian Council for Medical Research (ICMR), Ministry of Electronics and Information Technology (MeitY), Council for Scientific and Industrial Research (CSIR), Atal Innovation Mission (AIM), Ministry of Micro, Small and Medium Enterprises (MSME), Startup India and All India Council for Technical Education (AICTE).

Treatment Technologies	Description & Stage of development	Name of the Institution/ Organization
Raw material for Drug -01	NCL will be ready with 1st level chemicals synthesis of drug intermediates report soon to hand over to Dept. Chem. Pharma and industry bodies for tie ups on manufacturing	CSIR-NCL
Hybrid membrane-adsorption process -02	Hybrid membrane- adsorption process for the enrichment of medical grade oxygen from air.	CSIR-IIP in collaboration with CSIR-NCL
Medicinal Chemistry/ synthesis of APIs/ and repurposing of drugs -03	The Lab has synthesised Niclosamide analogues for evaluation against Papain-like proteinase (PL-Pro) from Covid sars-2 and also other selected molecules for testing their inhibitory efficacy.	CSIR-CDRI
Andrographis paniculata (kala megh) -04	*Andrographis paniculata* (Kal megh) is an important plant reported in traditional medicine, both as an immune booster and also for antiviral activities	CSIR-CDRI
Andrographolide, Neoandrographolides and Graphisides -05	The Lab has isolated important andrographolide, neo-andrographolides and graphisides from the plant for testing their efficacy against SARS-CoV-2/ COVID-19. In silico target-based screening studies suggests that some of these can inhibit critical proteins like the CL-proteinase of the pathogen	CSIR-CDRI
Polyalthia longifolia (isolated compound from Ashoka tree) -06	The Lab has identified that some isolated compounds from Polyalthia longifolia, commonly known as the 'Ashoka tree' have striking similarity to some of isolated compounds from Andrographis Paniculata. These are also being evaluated against the COVID-19 infection targets and models	CSIR-CDRI

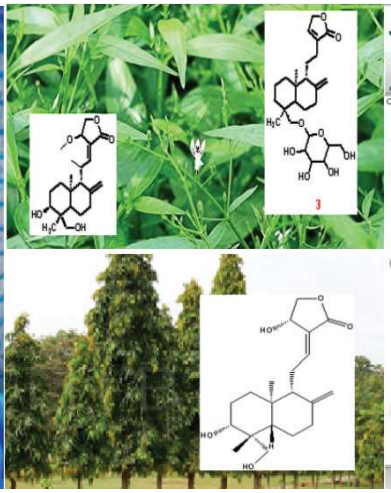
Treatment Technologies	Description & Stage of development	Name of the Institution/ Organization
Antiviral drug/molecule synthesis -07	Working on Structures of compounds for virtual screening for lead compounds. Drug Development stage, standardizing and developing a chemical synthesis protocol for the anti-viral drug. COVID-19 Drug development is under progress	Indian Institute of Technology Bombay, Mumbai
Deployable Isolation Hospitals -08	Deployable or mobile hospitals proposed for disaster management and to fight the Covid-19. The project is in development stage. Modulus a start up in IITM research park signed an MoU with Sree Chitra Tirunal Institute for Medical sciences and Technology, Trivandrum for developing the technology.	MODULUS Housing Solutions – IIT Madras, Madras
Vaccine for the novel coronavirus, 2019-nCoV (COVID-19) based on two approaches -09	The first approach deals with development of a DNA vaccine against the major viral membrane protein responsible for the cell entry of the novel coronavirus, now called COVID-19. The second approach deals with development of a live attenuated recombinant measles virus vectored vaccine against COVID-19	Zydus Cadila research team in India and Europe
Peptide Compound -10	Use of bioinformatic tools to design a novel peptide for blocking Coronavirus	IIT Delhi
Personal Sanitization Tunnel -11	Designed a full-body disinfection chamber called Personnel Sanitization Enclosure. This walkthrough enclosure is designed for personnel decontamination, one person at a time. This is a portable system equipped with sanitizers and soap dispenser. The model is in prototype stage and	Vehicle Research and Development Establishment (VRDE), Ahmednagar, a DRDO laboratory. Manufactured by M/s Dass Hitachi Ltd, Ghaziabad
Identification of global metabolite biomarkers in CoVID-19 infected patients for targeted therapy-12	The project is aimed to identify the global metabolite biomarkers in COVID-19 infected patients. It will help in search of potential biomarker signature for COVID infection and recognition of novel targets for therapy. Metabolites are small molecules that get formed during the cellular processes, which can act as unique biomarkers for a disease. This will help scientists in search for molecular signs of the infection. These molecules can then be targeted with novel therapies.	Department of Biosciences and Bioengineering, IIT Bombay. The project is supported by DST-SERB, for further development into implementable technologies. Rs. 25 lakhs fund provided by DST, Govt. of India.

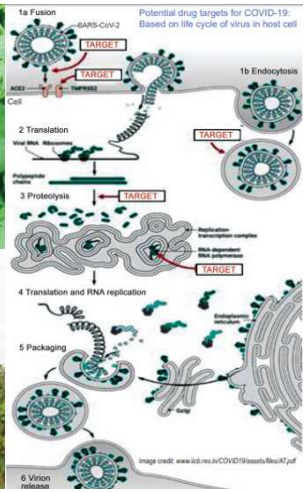
Treatment Technologies	Description & Stage of development	Name of the Institution/ Organization
Development of functionalized inanimate surfaces with repurposable multi-targeted viricidal agents/drugs for preventive and cost-effective antiviral applications -13	This project will help develop viricidal coatings for inanimate surfaces used in healthcare settings such as surgical masks for the prevention of infectious diseases caused by highly contagious pathogens such as severe acute respiratory syndrome-related novel coronavirus, SARS-CoV-2. Materials with coatings can effectively destroy viruses. These materials will be cost-effective, can be repurposed and will be used in various healthcare settings, such as surgical masks to prevent the spread of highly contagious infections like COVID-19.	Department of Chemistry, IIT Kanpur, Kanpur. The project is supported by DST-SERB, for further development into implementable technologies. ₹ 25 lakhs fund provided by DST, Govt. of India
Development of antiviral surface coatings to prevent the spread of infections caused by influenza virus -14	As the attachment of viruses onto surfaces leads to the spread of deadly infections, the objective of the proposal is to develop small molecular and polymeric compounds which will be coated, both covalently as well as non-covalently, on various surfaces and kill respiratory viruses completely upon contact.	JNCASR, Bengaluru. The project is supported by DST-SERB, for further development into implementable technologies. ₹ 25 lakhs fund provided by DST, Govt. of India.
Development of formulations for viral decontamination of inanimate surfaces -15	This will help develop material which may be used as a virus tactic and be applied to mops to disinfect the surfaces to remove any adhering viruses or bacteria. Project aims to develop a material that attracts the virus and kills it. This can be effective in any setting as regular mops can be fitted with the material and used to disinfect surfaces.	IIT Delhi. The project is supported by DST-SERB, for further development into implementable technologies. ₹ 25 lakhs fund provided by DST, Govt. of India.
Antibody-based capture of SARS-CoV-2 and its inactivation using lipid-based in situ gel -16	This project will help develop antibodies against the receptor-binding domain of the spike glycoprotein of SARS-CoV-2 involved in recognizing a host cell-surface receptor, namely, zinc peptidase angiotensin-converting enzyme 2. Another objective is to develop unsaturated free fatty acid-based emulsion loaded in-situ gels to inactivate the virus at the point of entry.	IIT Bombay. The project is supported by DST-SERB, for further development into implementable technologies. ₹ 25 lakhs fund provided by DST, Govt. of India.
One drop nasal vaccine based on flu vaccine candidate M2SR [CoroFlu] -17	Unique intranasal vaccine for Coronavirus 'CoroFlu' is under development. Bharat Biotech will manufacture the vaccine, conduct clinical trials, and prepare to produce almost 300 million doses of vaccine for global distribution.	Bharat Biotech (International collaboration), University of Wisconsin, FluGen Inc.
WardBot -18	Researchers are aiming to develop a wardbot that will deliver food and medicine to COVID-19 patients in their isolation wards. The conceptual design is of a bot that can be instructed to receive and deliver food and medicines and the necessary equipment to every room from a remotely-located control room.	IIT Ropar, Research is at development stage.

Treatment Technologies	Description & Stage of development	Name of the Institution/ Organization
Vaccine based on vaccine train similar to original virus -19	Research team are developing COVID-19 vaccine candidate, being developed is now in pre-clinical / animal testing phase. Preclinical data from mice and primates should be available by the end of August, with these results submitted to regulatory authorities. The inventors are partnered to develop a live-attenuated vaccine using Codagenix's deoptimisation technology. The vaccine-virus strain developed by the companies is identical to the original virus, expected to be the fastest such India-made vaccine to advance into human trials within six months.	Serum Institute of India in collaboration with US-based Codagenix has announced that its new COVID-19 vaccine candidate. While several efforts have been made to finding a cure as well as in controlling the outbreak, this is the first vaccine-virus strain to progress to the pre-clinical trial phase."
COVID-19 therapeutics and diagnostics -20	The research team will sequence the virus to see whether the virus infecting travellers from different parts of the world is the same or has undergone changes. That can happen through ribonucleic acid (RNA) sequencing. We saw such mutations during the H1N1 outbreak.	Anti-COVID Consortium NII, Gennova Biopharmaceuticals, UDSC-CIIDRET University of Delhi
Isolation pod used to shift the COVID-19 patient from one place to another -21	It is a special module that can be used to shift the COVID-19 patient safely from one place to another. A tend cover is attached with a pod that restricts the patient from having contact with others. The tend cover will be completely sterilized. A light bed is also arranged on the isolation pod. The technology is developed and ready for technology transfer and manufacturing. The hospital staff will sign the contract with the manufactures to develop sufficient equipment for the treatment of coronavirus patients and overcome the pandemic. They will provide the technology for free of cost.	Sree Chitra Tirunal Institute of Medical Sciences and Technology (SCTIMST) in Thiruvananthapuram
T cell epitopes – vaccination to COVID -22	A quick response to developing an effective immunotherapy regimen is sorely needed in order to prevent further infections due to Covid-19. In this study, immunoinformatics approaches have been used to provide putative promiscuous epitopes using genome-wide screening of novel coronavirus genome. Theoretically speaking, the ideal scenario would be to use all the protein targets available to identify potent immunogens as data is scarce on the identity of virulent proteins of the nCoV genome. These results have been disseminated to the scientific community using ChemRxiv preprint platform for urgent experimental assays.	The team of University of Hyderabad has designed potential vaccine candidates, called T cell epitopes, against all the structural and non-structural proteins of SARS-CoV-2 for experimental testing.

Treatment Technologies	Description & Stage of development	Name of the Institution/ Organization
Computer-aided designs for a mechanical ventilator-23	IISER Pune and IUCAA, Pune teamed up to create the designs using a model lent by Capt. Bharucha. The need of the hour is to find a ventilator with a proven design, which has already been used in hospitals and mass produced locally.	IISER Pune
Anti-viral Drug -24	It has been identified that WHO approved drugs such as Paracetamol, Remdesivir, Hydroxychloroquine, Azithromycin, Flaviparavir, Lupinivir, etc. can be helpful for coronavirus treatment in India. IICT are fully equipped and will be carrying out repurposing of such drugs to COVID-19 treatment as per WHO norms. Research team has also been able to source about 200 Favipiravir tablets from Japan for comparative studies. The research is under progress.	CSIR-Indian Institute of Chemical Technology (CSIR-IICT), Hyderabad. Pharmaceutical company Cipla has already announced that it is fast-tracking repurposing of its wide variety of respiratory, asthma, anti-virals and HIV drugs to meet challenges arising from coronavirus in collaboration with scientists from the CSIR-IICT.
Live Attenuated SARS – CoV-2 vaccine -25	A Live Attenuated Severe Acute Respiratory Syndrome Coronavirus Is Immunogenic and Efficacious in Golden Syrian Hamsters. The technology looks promising for developing a vaccine for prophylactic, active, single dose immunization against coronavirus in humans, with an enhanced safety profile. The vaccine is expected to provide long-lasting protection with a single dose administration with an anticipated safety profile similar to other licensed vaccines for active immunization. On completion of the research, the vaccine strain will be transferred to IIL and the vaccine maker will work accordingly with the country's regulator CDSCO (The Central Drugs Standard Control Organisation) to further conduct clinical trials which will be taken up in a phased manner. IIL intends to use its existing Vero cell platform technology for mass production of the vaccine.	Vaccine manufacturer Indian Immunologicals Ltd (IIL) has entered into a research collaboration agreement with Australia's Griffith University to develop a lead vaccine candidate for SARS-CoV-2.
Zn-Gluconate and amino acid complex for COVID19 -26	Research team is exploring Zinc Gluconate and Proline as nutraceuticals and Unilever has agreed to partner with it to develop Zn-Gluconate and amino acid complex.	CSIR-IIIM

Treatment Technologies	Description & Stage of development	Name of the Institution/ Organization
Ayurveda based natural formulations -27	Research team is working on developing natural products/ Ayurveda based sanitizers, inhalers and immunity boosters. The Institute is also screening selected Ayurvedic formulations, medicinal plants used in classical formulations or folklore medicines, and molecules from CSIRNIIST natural products repository for treatment of viral diseases	CSIR-NIIST
Viral Transport Medium -28	Viral Transport Medium (VTM) is a serious limitation in collecting and transporting COVID-19 samples. One component of VTM (veal infusion broth) is imported which is the reason for the limitation. Therefore, CSIRIICT developed two saline-based solutions which are under evaluation at Gandhi Hospital, Hyderabad.	CSIR-IICT.
Antisera Bank -29	CSIR-IICB has initiated a programme for the development of an anti- COVID-19 antisera bank (biobanking of plasma from convalescent donors). Besides, to understand the COVID-19 receptor recognition causing infectivity and pathogenesis, CSIR-IICB compiled a list of 20 probable drug targets on host and virus based on viral life cycle for the rational development of future antivirals. They prepared nine homology models for vital proteins for which no crystal structure is reported, which includes protein from the host, viral membrane proteins and essential Non-structural Proteins (NSPs) of the virus. The information can be used for the discovery effort towards new antivirals as well as repurposing FDA approved drugs against COVID-19	CSIR-IICB





PROPOSALS BY GOVERNMENT OF INDIA/ R&D AND ACADEMIC INSTITUTIONS

NRDC (63)-T&P-COVID-19

Introduction: Department of Science and Technology (DST), Govt. of India is India's apex science and technology (S&T) agency. With the help of institutions under DST and sister ministries, DST is taking the lead in coordinating the effort to map and upscale appropriate technologies in India for addressing a plethora of issues related to COVID-19. It is also scouting for solutions that are more relevant to the country and also to help prepare the country for exigencies arising out of COVID-19 pandemic.

Name of the Proposal	Name of the Organisation	Description of the program & Eligibility Criteria and additional information
Intensification of Research in High Priority Area (IRPHA) scheme- 01	Science and Engineering Research Board (SERB), an autonomous body under Department of Science & Technology (DST)	Focused on: epidemiological studies, studies on immune response and immunity during respiratory viral infections, new anti-virals, vaccines, and affordable diagnostic against COVID-19 and related respiratory viral infections. http://www.serb.gov.in/home.php
Core Research Grant Special Call on COVID-19-02	Science and Engineering Research Board (SERB), an autonomous body under Department of Science & Technology (DST)	Focused on 5 projects: Antiviral nanomaterials and bionano antiviral systems, Drug repurposing against key COVID-19 targets, Affordable, portable rapid diagnostic kits / tools, Computational identification and validation of COVID-19 molecular targets and In-vitro / clinical dose testing of nutritional supplements for immunity. http://www.serb.gov.in/home.php
Mathematical Modelling of COVID-19 Spread - 03	Science and Engineering Research Board (SERB), an autonomous body under Department of Science & Technology (DST).	Focused on: Mathematical Modeling of COVID-19 Spread, Statistical Machine Learning, Forecasting and Inferences from Pandemic Data, Focused Algorithms for Infectious Disease Modeling, Quantitative Social Science Approaches for Epidemiological Models. http://www.serb.gov.in/home.php
Proposals for Fighting COVID-19-04	The Technology Development Board (TDB), a statutory body under Department of Science & Technology (DST)	Technology innovative solutions on: Low-cost masks which can capture virus from the air and absorb respiratory droplets Cost-effective Thermal Scanning Large area sanitization and sterilization (including electrostatic spray and Ultra Violet treatment for various available surfaces like glass, ceramic, wood, textile, etc.)Bioinformatics and Surveillance Rapid and Accurate Diagnosis kit (paper-based and other point of care devices)AI and IoT based solution for contact-less entry Oxygenators and ventilators (Low cost and portable)Or any other related technology **Eligibility:** Indian Companies and Enterprises are eligible to apply. Will provide financial assistance by means of soft loans (up to 50% of project cost @ 5% simple interest per annum), Equity participation (up to a maximum of 25% of the project cost) or grants in exceptional cases, for encouraging the commercial application of indigenously developed technology. http://tdb.gov.in/fighting-covid-19-proposal-submission-process/

Name of the Proposal	Name of the Organisation	Description of the program & Eligibility Criteria and additional information
COVID-19 Research Consortium Program - 05	Department of Biotechnology (DBT) and the Biotechnology Industry Research Assistance Council (BIRAC), a sister department of DST	Developing Diagnostics, Vaccines, novel Therapeutics, repurposing of drugs and any other intervention for control of COVID-19 outbreak. **Eligibility:** Industry, Academia, Industry-Academia Partnership. The Developed process should be sustainable from an economic and environmental point of view. The technology should be scalable. https://birac.nic.in/cfp_view.php?id=45&scheme_type=32
New Millennium Indian Technology Leadership Initiative (NMITLI) - 06	The Council of Scientific and Industrial Research (CSIR)	Assistive devices such as affordable ventilators, innovative diagnostics (rapid, affordable, cutting edge), novel drugs or repurposed drugs, new vaccines or repurposed vaccine, and track-and-trace technologies. **Eligibility:** Industries and startups/ Public- private. The companies registered in India with more than 50 percent Indian shareholding or with manufacturing facilities in India are eligible partnerships. https://www.csir.res.in/collaborations/nmitli
Challenge COVID-19 Competition (C3) -07	National Innovation Foundation (NIF)	Focused on issues: (a) healthy food for nutrition and boosting immunity; (b) reducing transmission of coronavirus; (c) sanitising one's hands, body, home items and home, public places wherever required; (d) supply and distribution of essential items to people, especially the elderly living alone; (e) gainful engagement of people at home; (f) PPEs and rapid diagnostic testing facilities for capacity building of healthcare; and (g) rethinking "contactless" devices for post-corona implementation needs and varying needs of the different segment of the population during COVID-19. Eligibility: Specially for grassroot innovators. In case of technological ideas worthy for prototyping, NIF will provide requisite financial help. Those ideas which may be implemented or disseminated, NIF will engage with relevant District/ State/ National authorities for their implementation. http://nif.org.in/challenge-covid-19-competition
Molecular and rapid diagnostic tests -08	Union Ministry of Science and Technology's Department of Biotechnology (DBT) and its public sector undertaking Biotechnology Industry Research Assistance Council (BIRAC) have called for project proposals under their COVID-19 Research Consortium.	Following companies got approval for financial support to scale-up the production of molecular and rapid diagnostic tests: Mylab Discovery Solutions Pvt Ltd, Huwel Lifesciences, Ubio Biotechnology Systems Pvt Ltd, Dhiti Life Sciences Pvt Ltd, MagGenome Technologies Pvt Ltd, Bigtec Pvt Ltd and Yaathum Biotech Pvt Ltd. http://dbtindia.gov.in/

Name of the Proposal	Name of the Organisation	Description of the program & Eligibility Criteria and additional information
Proposal for COVID-19 Research at IIT Delhi Super computer – 09	IIT, Delhi	IIT Delhi is committing a total of INR 1 crore worth of High-Performance Computing (HPC) Resource for COVID-19 research to merit based proposals selected from a nationwide call of proposals. **Eligibility:** Researchers affiliated to the government or private institutions are all welcome to apply to this call. Researchers from private companies may also apply in association with an academic partner. http://www.iitd.ac.in/content/call-proposal-covid-19-research-iit-delhi-supercomputer
C-CAMP COVID-19 Innovations Deployment Accelerator or C-CIDA – 10	C-CAMP along with UNHIE, Social Alpha, XYNTEO India2022, MedTechConnect, India Health Fund, AIC CCMB and CCMB	Innovations can be under following categories: screening, diagnostics, therapeutics, vaccines, containment strategies, public health & other categories including but not limited to focussed technologies in mobile health technologies for screening and homecare, diagnostic kits and Point of Care tests, protective gear and sterilization innovations for care providers, digital triaging tools and risk stratifying systems, low cost ventilators and oxygen therapy units, AI systems to assist critical care, supply chain innovations, volunteerism and service innovations and scalable plug and play isolation units, treatment tents. **Eligibility:** selected proposals will be helped for fast-tracking promising innovations for pilot deployment, scaling through industry partnership, navigating regulatory pathway and connecting with investors http://www.ccamp.res.in/covid-19-innovations-deployment-accelerator
Project proposals on COVID-19 -11	Centre for Innovation and Bio-Design (CIBiOD), ICMR	Preventive, diagnostic and curative ideas for the prevention and treatment of COVID-19. **Eligibility:** CIBioD provides a platform for fusion of the best Indian medical & technical experts to work jointly on cutting edge technologies for the development of sustainable, disruptive, frugal & robust Healthcare equipment & devices. https://docs.google.com/forms/d/e/1FAIpQLSeDAvovZxDVLx9w7y-ogd8yUNRUTcyaSvUOD0wXeIlS3qyytQ/viewform
Solutions to combat COVID-19-12	Startup India	The innovation which can plug the gap between the demand and supply of essential medical items to fight the COVID-19 outbreak as well as an innovative tech for applications such as motion tracking, geofencing, fake news detection, etc. **Eligibility:** Startups, Companies, Innovators etc. are eligible to apply. https://www.startupindia.gov.in/content/sih/en/ams-application/challenge.html?applicationId=5e79126ee4b055bfaea9ef66

Name of the Proposal	Name of the Organisation	Description of the program & Eligibility Criteria and additional information
COVID-19 Solution Challenge – 13	Government of India	Technologies and innovative solutions, Bioinformatics, datasets, Apps for diagnosis etc that can be leveraged for strengthening the fight against Corona. **Eligibility:** 1.Applicants who want to participate in COVID-19 Solution Challenge can be individuals or Startups that comply with the definition of startup as notified by DPIIT vide order no G.S.R. 127(E) dated 19th February 2019.2.For the product to be developed as part of COVID-19 Solution Challenge, if any IPR/Patent is being used, contesting entity must possess the legitimate rights to use the IPR/Patents. https://innovate.mygov.in/covid19/
Samadhaan -14	Ministry of Human Resource Development	The mega online challenge "SAMADHAN" has been launched by MIC and AICTE in collaboration with Forge and InnovatioCuris to test the ability of students and Educators to innovate. **Eligibility:** Students innovators, researchers, educators, and startups to share their ideas (design/simulation mandatory) to solve the challenges posed by the pandemic or working prototype of technologically advanced solutions that can be validated and deployed immediately to support the fight against the pandemic. mic-mhrd@gov.in
COVID-19 Grand Challenge – 15	IIT, Guwahati	Solutions on: Detection of infected persons, Precautions to halt its spread, Newer treatment approaches, Society impact, Behavior changes, Disease outbreak pattern etc. **Eligibility:** UG, PG, PhD Research Scholars & Project staff of IIT Guwahati http://www.iitg.ac.in/upload/17004822395e8608c700915.pdf
Develop antiviral Nano-coating and Nano based material – 16	DST invites short-term proposals for developing antiviral Nano-coating and Nano based material for scale up by industry and start-ups to combat COVID-19	Portal invites ideas in the form of short-term proposals for developing Antiviral Nanocoating and new nano-based material for use in Personal Protective Equipment (PPE). Such Nano coatings could contribute immensely in the emerging health care requirements in India's fight against the COVID-19 pandemic Science and Engineering Board (SERB): http://www.serb.gov.in/home.php
DST sets up Task Force for mapping of technologies by Start Ups on COVID-19- 17	DST sets up task force for funding technologies related to health and sanitation	DST has set up a COVID 19 Task Force for mapping of technologies from R&D labs, academic institutions, start-ups, and MSMEs to fund nearly market-ready solutions in the area of diagnostics, testing, health care delivery solutions, equipment supplies. Some of these solutions include masks and other protective gear, sanitizers, affordable kits for screening, ventilators and oxygenators, data analytics for tracking, monitoring, and controlling the spread of outbreak through AI and IOT based solutions, to name a few DST: https://dst.gov.in/call-for-proposals

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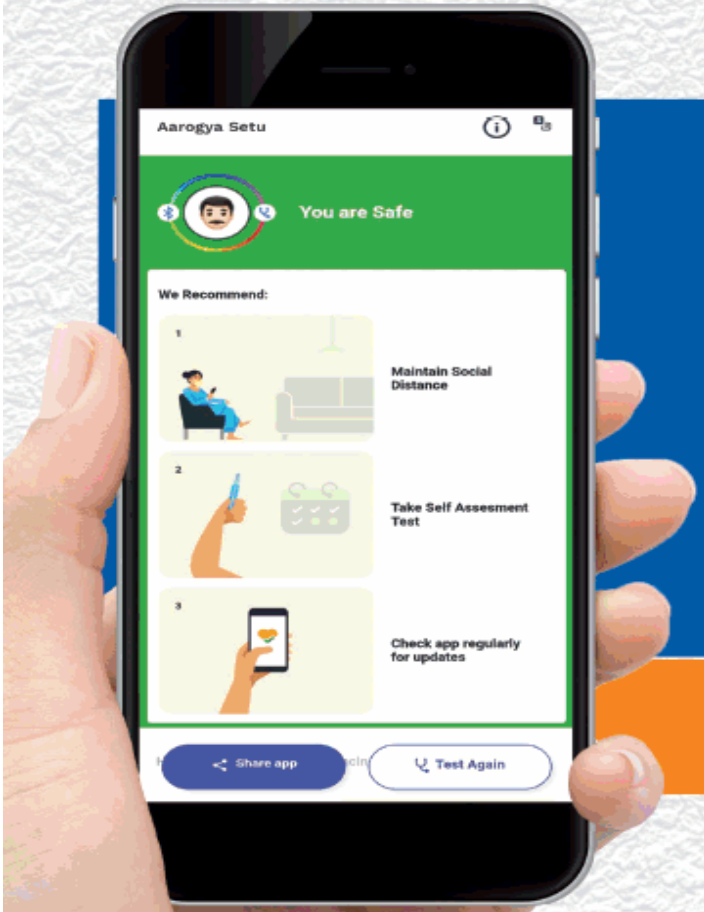

- All information regarding COVID-19 available
- Proper evaluation of threat and risks of Corona Virus infection
- Facility for self-evaluation on the basis of Corona infection symptoms
- Help desk numbers of all state governments available

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नेशनल रिसर्च डिवेलपमेंट कारपोरेशन

(वै. औ. अनु. वि., विज्ञान और प्रौद्योगिकी मंत्रालय, भारत सरकार का उद्यम)

NATIONAL RESEARCH DEVELOPMENT CORPORATION

(An Enterprise of DSIR, Ministry of Science and Technology, Govt. of India)

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20-22, जमरूदपुर सामुदायिक केन्द्र,
कैलाश कालोनी विस्तार,
नई दिल्ली-110048
दूरभाषः 011-29240401-07
फैक्सः 011-29240409-10
वेबसाइटः www.nrdcindia.com
ईमेलः write2@nrdc.in

Registered Office:
'Anusandhan Vikas'
20-22, Zamroodpur Community Centre,
Kailash Colony Extension
New Delhi-110048
Tel: 011-29240401-07
Fax: 011-29240409-10
Website: www.nrdcindia.com
Email: write2@nrdc.in