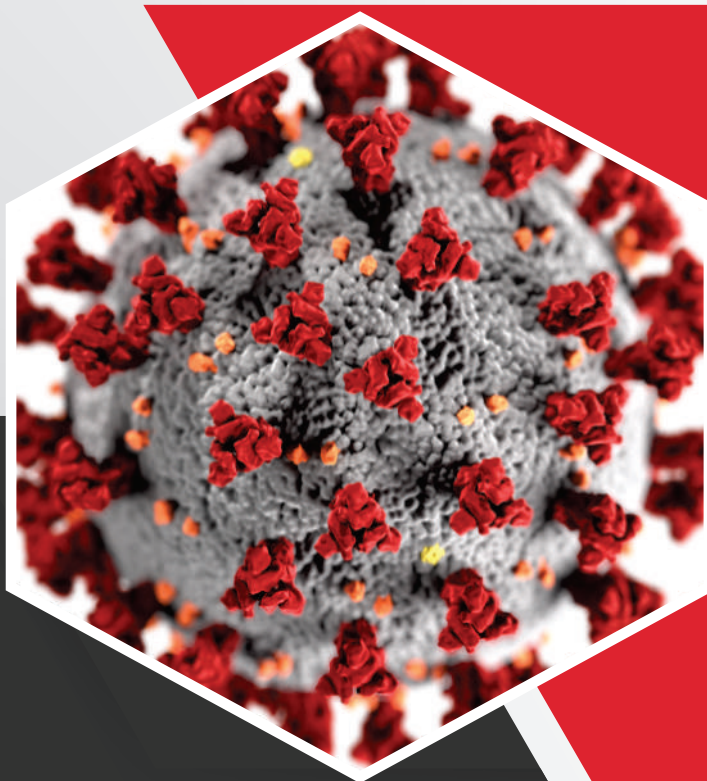# COVID-19 RELATED INITIATIVES AND ACTIVITIES OF DST AND ITS AUTONOMOUS INSTITUTIONS

A BRIEF REPORT

July 2020

Department of Science and Technology
Ministry of Science & Technology

COVID-19 RELATED INITIATIVES AND ACTIVITIES OF DST AND ITS AUTONOMOUS INSTITUTIONS

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MESSAGE

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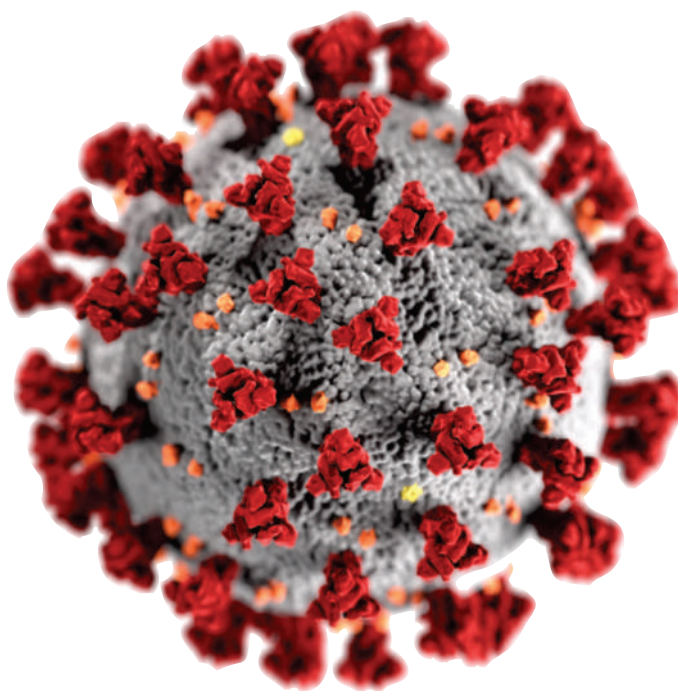# Major COVID-19 Related Initiatives and Activities of DST and its Autonomous Institutions

1.   Background

The COVID-19 pandemic in India is part of the worldwide pandemic of coronavirus disease (COVID-19) caused by severe acute respiratory syndromecoronavirus 2 (SARS-CoV-2). The transmission dynamics of SARS-CoV-2 have allowed it to spread rapidly across the world bringing an epidemic-like situation. Given the lack of availability of suitable chemotherapeutic interventions and an efficacious vaccine, the global population has been hit hard with utmost vulnerability to the coronavirus infections. The World Health Organization (WHO) has designated the existing crisis as a pandemic on 11th March 2020. Since then, the Indian Government and Ministries through its various Science and Technology based organisations and Institutes, undertook fast track programmes to identify the gaps in the diagnosis, treatment, prevention and other aspects of disease etiology and transmission of COVID-19 through various stakeholders across the country to enhance research and development related activities to battle the pandemic out.

The United Nations (UN) and the World Health Organization (WHO) have praised India's response to the pandemic as 'Comprehensive and robust,' terming the Lockdown restrictions as aggressive but vital for containing the spread and building necessary healthcare infrastructure. The Oxford COVID-19 Government Response Tracker (OxCGRT) noted the government's swift and stringent actions, emergency policy making, emergency investment in healthcare, fiscal stimulus, investment in vaccine and drug R&D. It gave India a score of 100 for its strict response. In June, India was ranked 56th of 200 countries in COVID 19 safety assessment report by Deep Knowledge Group.

2.   Initiatives taken up by DST and its institutions

The Department of Science & Technology and its various Autonomous Institutions made some significant efforts to address R&D and innovation related challenges arising out of COVID-19 pandemic. Based on rapid planning, the first sets of concrete actions were underway starting from March 19, 2020.

The actions were seeded with speed and scale at several fronts, which included:

i.   A comprehensive mapping of our entire startup ecosystem to identify and support the relevant technology solutions ready for scaleup; over 600 relevant startups mapped; around 60 startups being supported.

ii.   A special call to support industries that have an appropriate and proven product or technology to commercialize or scaleup further;

iii. A call to support projects from academia and R&D labs on the basic science of COVID-2 including modelling, properties of the virus and its impact, novel solutions, etc;

iv. A special call on scientifically identifying relevant yoga and meditation practices for immunity boosting, respiratory toning and stress reduction;

v. Support for a network of over 30 mid and large size NGOs for dissemination of information, training and mask/disinfectantdistribution;

vi. Activation of Survey of India in relevant digital mapping solutions;

vii. Formation and support to a group across several IITs and AI startups to find Artificial Intelligence solutions to COVID-19 diagnostics and predictions.

viii. Linked with technology industry such as IBM, NVIDIA etc who have agreed to provide resources such as supercomputing time and software stacks pro bono for COVID research;

ix. Communication: Made several dozens of programs on COVID-19 for India Science Internet TV channel; and widely disseminated weekly reports on all the initiatives of MoST on COVID-19.

x. Activation of relevant DST autonomous institutions in providing solutions-- a particularly successful institute has been Sree Chitra Tirunal Institute of Medical Science and Technology which has already come up with over 10 effective products, several of which are of a breakthrough nature and are being commercialized rapidly.

xi. Formation of a National Task Force with over 20 leading scientists of the area for formulating a Super Model for predicting the spread of pandemic. The model should be robust and trustworthy to allow confidence in its predictions for decision making. Timeline is end of July.

xii. RT-PCR Testing Centers operational in over 10 scientific institutions based on the research facilities established there previously by DST, including 5 autonomous institutions of DST. A comprehensive one week course on molecular diagnostics for scientists and technicians is being offered at JNCASR, Bangalore (a DST institution).

Various initiatives of DST and its institutions are broad divided into following categories-

I. Various divisions of DST (NEB, International, SEED, NCSTC, Nano,)

II. Statutory bodies (SERB and TDB)

III. Autonomous Institutions (SCTIMST, JNCASR, RRI, ARCI, CENS, TIFAC, Vigyan Prasar, Agarkar Res Inst., WIHG, BSIP, and other AIs)

IV. Subordinate organizations (SoI)

3. Major initiatives of DST and its institutions on developing Technological Solutions to address COVID-19 challenges

As part of initiatives of some of DST's Divisions and Autonmous instititions, a number of activities and actions were initiated on developing technological solutions to address COVID-19 challenges. These include; Diagnostics, Ventilators, PPE, disinfectants, plasma therapy & vaccine development, etc. Several R&D projects were also launched. A summary of these initatives are are enumerated in the following paragraphs.

DIAGNOSTIC KITS RELATED

A. SCTIMST develops a diagnostic test kit that confirms COVID19 in 10 min

❖ Confirmatory diagnostic test detects the N Gene of SARS- COV2 using reverse transcriptase loop-mediated amplification of viral nucleic acid (RT-LAMP) - one of world's first few

❖ One step detection in10 minutes and the sample to result time (from RNA extraction in swab to RT LAMP detection time) is less than 2 hours.

❖ A total of 30 samples can be tested in a single batch in a single machine

❖ Testing facility can be easily set up even in the laboratories of district hospitals with limited facilities and trained laboratory technicians

• The cost of testing is less than Rs 1000/test

B. Sree Chitra Tirunal Institute develops magnetic nanoparticle-based RNA extraction kit for PCR and LAMP tests for COVID-19

❖ Chitra Magna, an innovative RNA extraction kit, has been developed by Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), as an innovative technology for isolating RNA from swabs for COVID 19 tests.

❖ SARS-COV-2, the causative virus of COVID-19 pandemic, is an RNA virus-- a long single-stranded polymeric substance present in all living cells that carries the genetic information of the organism necessary for life.

❖ One of the critical steps in detecting this virus is by confirming the presence of the RNA of the virus in the sample taken from the throat or nose. The sample collected is transported under specified conditions in a viral transport medium to the testing laboratory.

C. JNCASR launched indigenous fluorescence probes and PCR

❖ Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) in partnership with VNIR Biotechnologies Private Limited, a startup incubated by JNCASR, launched indigenous fluorescence probes and PCR (Polymerase Chain Reaction) mix for RT-

PCR (Reverse transcription polymerase chain reaction) detection which are molecular probes used in COVID-19 test kits.

D. DST funded startup develops kits for testing asymptomatic COVID-19 infections & gears up for vaccine production

- ❖ DST provided support to Seagull BioSolutions, Pune, a startup working on new biological technologies To undertake the development of Active Virosome (AV)-Vaccine and Immunodiagnostic kits for tackling COVID-19 emergency

- ❖ Active Virosome Technology (AVT) is useful for the production of vaccines & immunotherapeutic agents. The AVT platform helps will be used to develop a novel vaccine for the prevention of COVID-19 infection and also immunodiagnostic ELISA kits for COVID-19.

E. DST funds Pune healthcare startup for rapid detection of COVID-19

- ❖ DST has funded Module Innovations, a Pune-based healthcare startup working on the point-of-care diagnostics to develop a test kit for detecting COVID-19 within 10 to 15 minutes.

- ❖ 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

F. Rapid diagnostic kit being developed by Pune based startup for COVID 19 screening

- ❖ DST has funded FastSense Diagnostics, a start-up to develop a rapid diagnostic kit for the screening of COVID-19.

- ❖ The company plans to roll out 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)

- ❖ 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 min per sample.

G. TDB approves support for indigenous company for ramping up production of COVID-19 diagnostic kits

- ❖ TDB has approved financial support to MyLab Discovery Solutions, Pune, for ramping up production of COVID-19 diagnostic kits

- ❖ Mylab Discovery Solutions is the first indigenous company to develop real-time PCR based molecular diagnostic kit that screens and detects COVID 19 from samples of people who display flu-like symptoms

- ❖ The company will ramp up the production of the kits through automation of the facility from current manual process, thereby increasing its current capacity from 30000 tests per day to one lakh test per day

H. Birbal Sahni Institute of Palaeosciences (BSIP) set ups a COVID-19 Testing Lab

- ❖ Birbal Sahni Institute of Palaeosciences (BSIP) joined hands with the Government of Uttar Pradesh to set up laboratory testing of COVID-19 using ancient DNA BSL-2A laboratory of the Institute. More than 12000 samples have been tested, out of which about 400+ samples have been reported positive for SARS-CoV-2.

I. Institute of Advanced Study in Science and Technology (IASST), Guwahati sets up a COVID-19 testing and research laboratory

- ❖ Institute of Advanced Study in Science and Technology (IASST), Guwahati, in coordination with Guwahati Medical College & Hospital (GMCH) and National Health Mission has set up a COVID-19 testing and research laboratory. Most of the equipment, including RT-PCR, biosafety cabinets, deep refrigerators, refrigerated centrifuge, laminar flow, autoclave, etc. are arranged from IASST. Another RT-PCR has also been provided by the IIT, Guwahati, for the laboratory.

J. Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), sets up a state-of-the-art COVID Diagnostic Training Centre

- ❖ Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), established a state-of-the-art COVID Diagnostic Training Centre at its Jakkur campus to help build capacity for the national fight against COVID 19 pandemic. The first batch has undergone training from June 16 to 22, 2020, at COVID Training Facility, JNCASR.

VENTILATORS RELATED

A. DST funded company to scale up device to enrich oxygen supply in air for the treatment of COVID-19 patients

- ❖ DST is scaling up membrane oxygenator equipment (MOE) that was developed to treat COVID-19 patients.

- ❖ It is supporting to Genrich Membranes, a spin-off company, based on proprietary technology licensed from CSIR-NCL, Pune. Based on innovative, indigenous hollow-fibre membrane technology, the MOE enriches oxygen in the air up to 35% under pressure (4-7 bar, using oil-free compressor).

- ❖ The equipment consists of membrane cartridge, oil-free compressor, output flowmeter, humidifier bottle, nasal-cannula, and tubing & fittings

- ❖ The device is safe, does not require trained human resources for its operation, needs minimum maintenance, is portable, compact, and with plug-and-play facility provides on-site, quick-start oxygen-enriched air.

B. **SCTIMST ties up with Wipro 3D to manufacture automated ventilators to meet COVID-19 related crisis**

- ❖ SCTIMST, an institute of National Importance of the DST, tied up with Wipro 3D, Bengaluru to jointly build up on a prototype of an emergency ventilator system based on Artificial Manual Breathing Unit (AMBU)

- ❖ The ventilators can help meet urgent requirements arising out of the COVID-19 related crisis that the country is facing.

- ❖ AMBU bag or a bag-valve-mask (BVM) is a hand-held device used to provide positive pressure ventilation to a patient who is either not breathing or who is breathing inadequately.

DISINFECTANTS RELATED

A. **SCTIMST scientists develop disinfected barrier-examination booth for examining COVID-19 patients**

- ❖ Scientists at SCTIMST, Trivandrum an autonomous institute of the DST have designed and developed a disinfected barrier-examination booth for examining COVID-19 patients

- ❖ The innovative booth is closed like a telephone booth for examining and reviewing the patient without direct contact with the doctor to prevent transmission of infection

- ❖ It is equipped with a lamp, table fan, rack, and Ultraviolet (UV) light.

B. **SCTIMST scientists develop disinfection gateway & facemask disposal bin to fight COVID-19**

- ❖ Scientists at Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum, Kerala, an autonomous institute under the Department of Science and Technology (DST), Government of India, have designed two technologies to fight COVID-19 pandemic.

- ❖ Chitra Disinfection Gateway is one of the two technology designed by SCTIMST scientists Jithin Krishan and Subash VV from the Division of Medical Instrumentation for the decontamination of people, one at a time. It is a portable system equipped with a system for generating Hydrogen peroxide mist and UV based decontamination facility.

C. Tech by Pune based Startup incubatee of Scitech Park to disinfect Maharashtra hospitals in COVID-19 fight

❖ A technology developed under the NIDHI PRAYAS program DST by an incubatee company of Scitech Park, Pune has emerged as 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.

❖ Various globally renowned labs have scientifically tested its usefulness in killing disease-causing viruses and bacteria 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.

D. DST and DBT funded startup develops silver-based disinfectant to fight COVID-19 pandemic

❖ DST & DBT have jointly supported and funded Weinnovate Biosolutions, a Pune based startup, to develop a non-alcoholic aqueous-based colloidal silver solution uniquely made from its NanoAgCide technology for disinfecting hands and environmental surfaces.

❖ The newly developed disinfectant is non-inflammable and free of hazardous chemicals.

❖ It can pose as an effective sanitizer to prevent the spread of the infection through contact, the prime method of transmission of the pandemic, thereby protecting health professionals and infected people.

E. UV disinfection trolley can effectively clean up hospital spaces to combat COVID-19

❖ International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), an autonomous R&D Centre of Department of DST and University of Hyderabad (UoH) together with the help of Mekins Industries Ltd. (MIL), have developed a UVC based disinfection trolley to fight against COVID-19 by rapid cleaning of hospital environment.

❖ UV light in the range of wavelengths between 200 and 300 nm is capable of inactivating microorganisms, such as bacteria and viruses, thus disinfecting both air and solid surfaces. Often, chemical disinfectants are not enough to remove the bacteria and viruses found in hospitals and other contamination prone environment. Rapid decontamination of the used patient-care beds and hospital rooms before admission of subsequent occupants is a major requirement in hospitals in view of the limited availability of beds. Coronavirus is sensitive to UVC light, as in the case of other viruses and bacteria.

F. **ARCI develops UV based Bagage disinfection system**

❖ Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad, in partnership with Vehant Technologies, Noida developed KritiScan® UV Baggage Disinfection System. This a compact UVC conveyor system which can efficiently disinfect the baggage passing through the conveyor within a few seconds and is suitable for use in airports, railway and bus stations, hotels, commercial and private establishments for rapid disinfection of baggage. The disinfection process is dry and chemical-free.

G. **SCTIMST develps UV based face mask disposal BIN technology**

A Chitra UV based face mask disposal bin technology, named BIN-19, was developed jointly by the Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum and VST Mobility Solutions, a Startup based at Cochin. The IoT based BIN-19 used for collecting and disinfecting used Face-Mask, was formally launched by Ernakulam District Collector S. Suhas by installing a unit at his office, the administrative headquarters of the district.

PPE- MASKS, SANITIZERS, ETC RELATED

A. **Hand sanitizer prepared by ARCI provided to police personnel on duty during COVID-19 crisis**

❖ ARCI, Hyderabad, an autonomous R&D Centre of Department of Science and Technology (DST), has produced hand sanitizer as per the WHO standards and distributed it among police personnel in Hyderabad, students, and staff of the institution.

❖ A team of scientists, students, and staff voluntarily came forward and produced about 40 litres of sanitizer.

B. **DST supported startup to make natural, alcohol-free sanitizer to combat COVID 19**

❖ DST provided support and funds to Green Pyramid Biotech (GPB), Pune, a company working on Food, Agriculture, and Bio-Technology for making sanitizer formulation developed by it.

❖ The Active Pharmaceutical Ingredient (API) is a biosurfactant that provides long-lasting protection against bacteria and viruses and can be an alternative to reduce the risk of infection significantly.

❖ The formulation can provide a convenient and effective way to clean hands and surfaces and is biodegradable, natural, and alcohol-free. In addition to sanitization it can be used to clean the wounds and prevents dryness and skin irritation.

C. **Antiviral nano-coatings to be upscaled for making triple layer medical masks & N-95 respirator receives to combat COVD 19**

❖ As part of Nano Mission programme, the DST approved support for upscaling an antiviral nano-coatings developed by IIT Delhi researchers for use as appropriate material for producing anti-COVID-19 Triple Layer Medical masks and N-95 respirator in large quantities.

❖ They will carry out the upscaling work in association with two industrial partners Resil Chemicals Pvt Ltd. Bangalore and Nanoclean Global Pvt Ltd., New Delhi.

❖ Resil chemicals will provide N9 blue nanosilver. Nanoclean Global will provide face masks and PPE materials for the application of nanocoating and will help in the design and fabrication of samples at their facilities.

D. **CeNS uses electrostatics of materials to develop Tribo E mask to protect healthy individuals from COVID 19**

❖ A team of researchers at the Centre for Nano and Soft Matter Sciences (CeNS), Bangalore, an autonomous institute of the Department of Science and Technology (DST), have come up with a recipe for making face masks, termed as Tribo E Mask, that can hold electric charges to restrict the entry of infections but interestingly, without any external power.

PLASMA THERAPY AND VACCINE DEVELOPMENT RELATED

A. **India To Deploy COVID-recovered Patients' Antibodies In Plasma Therapy Trial**

❖ India will soon start clinical trials of a plasma treatment for critical COVID-19 patients, according to ICMR.

❖ Convalescent plasma therapy is a process in which blood plasma from a patient who has recovered from COVID-19 is infused into a critically ill patient so that specific antibodies present in the blood of recovered person can help fight the infection.

❖ Researchers called it a "promising rescue option" for severe COVID-19 patients, but added that large randomised control trials are needed.

❖ The study appeared on Tuesday in the American journal, Proceedings of the National Academy of Sciences (PNAS). The trails become important as there is no tried and tested anti-viral drug or vaccine against the novel Coronavirus yet.

B. **DST funded startup develops kits for testing asymptomatic COVID-19 infections & gears up for vaccine production**

❖ DST provided support to Seagull BioSolutions, Pune, a startup working on new

biological technologies To undertake the development of Active Virosome (AV)-Vaccine and Immunodiagnostic kits for tackling COVID-19 emergency.

❖ Active Virosome Technology (AVT) is useful for the production of vaccines & immunotherapeutic agents. The AVT platform helps will be used to develop a novel vaccine for the prevention of COVID-19 infection and also immunodiagnostic ELISA kits for COVID-19.

R&D & INNOVATION INITIATIVES ON COVID-19

A. Study to identify biomarkers to predict progression from non-severe to severe COVID 19 cases can help interventions

❖ SERB a statutory body under DST, will support the exploration of metabolomics alteration in COVID-19 infected patients by IIT Bombay in collaboration with some hospitals in Mumbai.

❖ The study will identify potential biomarker candidates to predict progression from non-severe to severe COVID-19 conditions.

B. Book chapter on the structure of the coronavirus by RRI

❖ The chapter includes general morphological features as well as ultrastructural details with references to structure-function correlation and drug targeting aspects.

❖ It will be part of a book on the coronavirus pandemic, its control and treatment as well as its social, political and economic effects on India and the world.

C. Mathematical models for spread of COVID-19: an explanation for non-scientists

❖ COVID 19 pandemic has exposed us to the necessity of predictions through mathematical models.

❖ The predictions from these models sometimes differ widely, and it may be confusing to citizens &political leaders, who make important decisions based on predictions.

❖ Theorists at RRI are writing a popular article titled: "MATHEMATICAL MODELS FOR SPREAD OF COVID-19: an explanation for non-scientists" to help clear the confusion and be socially useful.

D. A predictive model by JNCASR can help prepare for medical needs for COVID 19

❖ A team of researchers from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) an autonomous institute under DST along with collaborator from IISc Bengaluru have developed a heuristic predictive model for COVID-19 that provides

short-term predictions about the evolution of the disease and the medical needs that are generated as a consequence.

E. DST approves funding for developing a gel for nasal passage as prevention for COVID-19

- ❖ DST has taken the initiative to develop a gel that can be applied to the nasal passage, which is a significant entry point of the coronavirus.

- ❖ Department of Biosciences and Bioengineering, IIT Bombay, has been selected to develop the solution

- ❖ This solution is not only expected to protect the safety of healthcare professionals but also can lead to a reduction in community transmission of COVID-19

F. DST sets up Task Force for mapping of technologies by Start-Ups on COVID-19

- ❖ 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 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, & controlling the spread of outbreak through AI and IOT based solutions

G. DST launches nationwide exercise to map & boost COVID-19 solutions with R&D, SEED & scale-up support

- ❖ DST has set up a 'COVID-19 Task Force' for mapping of technologies from R&D labs, academic institutions, start-ups and MSMEs.

- ❖ The capacity mapping group has representatives from DST, DBT, ICMR, MeitY, CSIR, AIM, MSME, Start-up India and AICTE.

- ❖ The aim is to identify the most promising start-ups that are close to scaleup, who may need financial or other help or connects based on its projected demand to rapidly scaleup.

H. Coating developed by JNCASR may prevent transmission of infection

- ❖ JNCASR, Bengaluru an autonomous institution under the DST, developed a one-step curable anti-microbial coating which, when coated on different surfaces such as textile, plastic and so on could kill range of virus types including COVID 19.

- ❖ The molecules developed can 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.

I. DST-SERB announces first set of approved projects to combat COVID-19 & related respiratory infections

❖ DST-SERB announced several special research project calls to ramp up national R&D efforts against the epidemic.

❖ The first 5 projects has been selected by DST-SERB, for support for further development into implementable technologies.

❖ Three of these projects concern the highly important issue of antiviral and virustatic surface coating of inanimate surfaces, such as PPE.

❖ One project deals with the identification of metabolite biomarkers in COVID-19 infected patients enabling therapeutic target identification.

❖ Another project concerns with the development of antibodies against the receptor-binding domain of the spike glycoprotein of coronavirus.

J. DST sets up rapid response centre at SINE, IIT Bombay to combat COVID-19

❖ DST 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) at total cost of Rs 56 Cr to scout, evaluate and support the innovations and start-ups that address COVID-19 challenges.

❖ The Society for Innovation and Entrepreneurship (SINE), a technology business incubator at IIT Bombay supported by DST has been identified as the Implementing Agency of the CAWACH.

❖ CAWACH will identify up to 50 innovations and startups for 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.

K. Challenge COVID-19 Competition (C3)

❖ National Innovation Foundation – India (NIF), an autonomous institute under the Department of Science and Technology, Govt. of India has come up with a call inviting innovative citizens to participate in its Challenge COVID-19 Competition (C3).

❖ Interested innovators are welcome to participate with their creative ideas and innovations for problems or issues like reducing transmission of Coronavirus through original creative ideas, innovations, which can supplement the efforts of the

government in slowing or eliminating the spread further, innovative ideas which can make activities like sanitizing one's hands, body, and home items etc.

❖ Ideas are also invited for gainful engagement of people at home, healthy food for nutrition and boosting immunity especially at the time of lockdown when raw materials are limited, (Personal Protective Equipment) PPE's and rapid diagnostic testing facilities for capacity building of healthcare and other areas.

L.   Integrated geospatial platform to help area-specific strategies & decisions in COVID-19 outbreak

❖ DST has created an Integrated Geospatial Platform out of available geospatial datasets, standards-based services, and analytic tools to help decision making during the current COVID-19 outbreak and aid devising area-specific strategies to handle the socio-economic impact in the recovery phase.

❖ The platform is initially expected to strengthen the public health delivery system of the State and Central Governments and subsequently provide the necessary geospatial information support to citizens and agencies dealing with the challenges related to health, socio-economic distress, and livelihood challenges.

❖ The mobile application SAHYOG as well as the web portal (https://indiamaps.gov. in/soiapp/) prepared and managed by the Survey of India (SoI) has been customized to collect COVID-19-specific geospatial datasets through community engagement to augment the response activities by Government of India to the pandemic.

M.   TIFAC releases a white paper on COVID-19 interventions

❖ The Technology Information, Forecasting and Assessment Council (TIFAC), released a White paper on 'Focused Interventions for 'Make in India': Post COVID 19' . The White Paper captures sector-specific strengths, market trends, and opportunities in five sectors, critical from the country's perspective that include, healthcare, machinery, ICT, agriculture, manufacturing, and electronics with reference to supply and demand, self-sufficiency and mass-scale production capacity.

❖ It has identified policy options primarily in the areas of Public health system, MSME sector, Global relations: FDI, recalibrated trade alignments, new-age technologies, etc.

❖ This is important for the development of technology clusters in champion segments, creating Technology Start-up Exchange, identifying, supporting, and piloting ten blockbuster technologies and collaborating with new dynamics with incubators of Israel, Germany, towards promoting import substitution as well as evolving technology platforms in sunrise technologies.

❖ The recommendations are directed towards giving immediate technology and policy

impetus to make India "ATMANIRBHAR". Based on the linkages and interdependencies between the outputs of different sectors, output multiplier and income multiplier for various sectors have been presented in the paper.

N. DST supported startup offers digital platform to monitor ground level situations by integrating with drones for COVID-19

❖ FlyBase, an enterprise Incubated at the Bhau Institute's Incubation Centre, Government College of Engineering, Pune, Technology Business Incubator (TBI), under a DST NIDHI TBI Scheme is offering a digital platform that can monitor ground level situations by integrating with drones.

❖ The platform called FlyNow allows drones—increasingly being used for aerial monitoring, emergency response, or urgent delivery of blood samples, medicines as well as lockdown surveillance, to be operated remotely for managing different aspects of COVID-19.

❖ Via FlytNow, police authorities are now carrying out live, remote drone operations to monitor the overall social situation through an operator-friendly dashboard and take measures to monitor crowds and maintain public safety.

4. Initiatives by different Divisions of DST

A. *National Science & Technology Entrepreneurship Development Board (NSTEDB Division)*

The National Science & Technology Entrepreneurship Development Board, Department of Science & Technology, Government of India has supported various startups providing CoVID 19 related solutions under Seed Support Program and has also set up the Centre for Augmenting WAR with COVID-19 Health Crisis (CAWACH) to scout, evaluate and support the innovations and startups that address COVID-19 challenges faced by the society.

(i) Centre for Augmenting WAR with COVID-19 (CAWACH) Program

The funding support is aimed at helping the start-ups with funding to meet capital expenditure and recurring expenditure for producing quantities to meet market needs. This program is meant to support product, solutions and innovations in the areas of diagnostics, therapeutics (drugs, vaccines, devices, ventilators & PPEs, informatics including bio-informatics & information management systems, any intervention) for the control of COVID-19 and/or startup ideas to address/mitigate various challenges faced by country/society due to severe impact of COVID-19.

a. Implementation Stakeholders of CAWACH Program

The Society for Innovation and Entrepreneurship (SINE) the TBI (Technology Business Incubator) supported by DST at Indian Institute of Technology, Bombay was identified as

the Implementing Agency of the Centre for Augmenting WARwith COVID-19 Health Crisis (CAWACH). SINE IIT B has implemented CAWACH under the guidance of Department of Science and Technology (DST) and startup incubation and eco-system.

The CAWACH program has been implemented in partnership with associations with Satellite Centres, Ancillary Centres and partners who are having expertise and track record of supporting startups in healthcare areas.

b. Satellite Centres of CAWACH Program

SINE, IIT Bombay
Foundation for Innovation and Technology Transfer (FITT), IIT Delhi
Foundation for Innovation and Research in Science and Technology (F.I.R.S.T), IIT Kanpur
Healthcare Technology Innovation Centre (HTIC), IIT Madras
Venture Centre, NCL Pune
IKP Knowledge Park, Hyderabad
KIIT Technology Business Incubator, KIIT Bhubaneswar
PSG-STEP, Coimbatore -Ancillary Centre of CAWACH Program
VIT-TBI, Vellore - Ancillary Centre of CAWACH Program

c. Implementation Partner of CAWACH Program

Indian STEPS and Business Incubator Association (ISBA)

SINE, IIT B the CAWACH Monitoring Centre (CMC) is responsible for the overall implementation and monitoring of the CAWACH program with the help of Satellite centre, Ancillary Centre and ISBA. The roles and responsibilities have been duly documented amongst all the stakeholders of the CAWACH program.

d. Implementation Status

A nationwide call for applications was opened on April 6, 2020 and was closed on April 20, 2020. The entire process of sourcing application and first level screening was conducted on the the portal developed by ISBA https://isba.in/cawach/. The response to the call was encouraging; a total number of 826 applications were received during the call period. The process of evaluation and screening has commenced with the help of satellite centre, ancillary centre and ISBA. A snap shot of the status of application is given under:

Total Applications received: 826

Bifurcation of total application Thrust Area-wise

Thrust Area	Total applications (No)
Informatics	264
Sterilizers & Disinfectants	203
PPE	100
Ventilator &respiratory care devices	73
Diagnostics:	64
Others	54
Other Medical Equipment	51
Drugs and Vaccines	17
Total	**826**

e. First level screening

Out of 826 applications, total eligible 641 applications were evaluated for First level of screening by a group of experts from various thrust areas at the respective Satellite and Ancillary centres. The scrutiny of 641 applications was conducted from April 27 to April 30, 2020. Pursuant to the scrutiny of 641 applications, a total of 105 eligible applications were shortlisted and recommended by the satellite centre to the CAWACH Empowered Committee.

f. Second level screening

This stage comprised of allocating specific thrust area to the respective satellite centre based on the domain expertise available, online presentation by the applicant to the empowered committee comprising of experts and officials from DST and TDB. This process was conducted between 18th May to 21st May 2020.

Out of the total 105 applications, 54 applications have been shortlisted (provisionally) for support under the CAWACH program. The selected solution comprises of High sensitivity rapid Antigen-antibody COVID diagnostic kits, PCR based testing kits, X-ray based COVID diagnostic and disease monitoring, Contactless digital stethoshope, Mask manufacturing machine, Mask integrity test setup, Nanomaterial coated antiviral, re-usable PPEs, Screening and remote monitoring telemedicine platform, Wearables to track and ensure social distancing, Oxygenerator, Ventilator, Microplasma oxidation based sterilization, Silver nanoparticle based alcohol free sanitizer. The total amount recommended by the empowered committee is Rs 4091.34 lacs. The financial due-diligence is underway of these provisionally selected startups.

g. Thrust area-wise breakup

Thrust Area wise	No. of companies	Amount(Rs in lacs)
PPE	13	720.29
Diagnostics and Drugs & Vaccines	10	1,150.00
Informatics	16	1,030.00
Disinfectants and Sterilizers	10	725.75
Ventilator and Other Medical Equipment	5	465.30
Total	**54**	**4,091.34**

The CAWACH centre is in the process of completing the modalities with regards documentation and finalising the agreements with reference to deliverables, milestones, utilisation of funds etc.

(ii) Seed Support System

The NSTEDB, DST supported Seed Support System (SSS) is to ensure timely availability of the seed support to the deserving incubatee startups within an incubator, thereby enabling them to take their venture to next level and facilitate towards their success in the market place. The scheme also enables the incubator to widen their pipeline of startups and also share the success of their startups which would also result in ensuring their long term operational sustainability.

DST has extended directives to the TBIs to utilise seed fund on priority basis for supporting startups working solutions for CoVID 19 related challenges. The incubators have also initiated specific calls on this and funded startups providing solutions for CoVID 19 related challenges.

B. International Cooperation Division

International cooperation division is working proactively to support the nation's R & D efforts to fight against COVID-19 by negotiating with other countries to work together for solution oriented research. We have received several encouraging responses from many countries like Denmark, Australia, Egypt, Israel, Japan, Portugal, Korea, Norway, Serbia, Singapore, Slovenia, South Africa, United Kingdom, and United States. Some of the actions taken so far and received proposals are as follows:

i. Keeping in mind the current covid-19 crisis, IC division has announced Indo-US (15th April 2020) and Indo-Australia joint Call (05th June 2020) to support the research projects which aims to find out the effective solutions against the pandemic and also to prepare the tools to upgrade the present healthcare system.

ii. Included 'S&T Solutions against COVID-19/ Pandemic' as one of the research area for joint R&D collaboration and to develop a new product /including trying for

re-purposing of existing equipment under ongoing calls of India-Portugal (01 May 2020), India-Slovenia (10 Mar 2020) and India-Serbia joint call 2020 (24 Feb 2020).

iii. A joint R & D call for diagnostics, vaccines and therapies and repurposing of drugs on COVID-19 with BRICS countries is planned to launch in 01 July 2020

iv. A joint R & Call is under discussion with European Commission and UK in the areas like therapeutics, advanced modelling and computer techniques, improved epidemiology and public health.

v. All the approved projects by DST are shared with our International partners to explore the possibilities of cooperation.

vi. Research projects initiated by Denmark on COVID 19 has been shared with Indian research community through SERB to explore possibility of cooperation

vii. To connect Indian industry R & D efforts on COVID internationally, proposal is under discussion for Industrial R & D projects with VINNOVA (Sweden) and Israel Innovation Authority (Israel) for researchers, start-ups and companies.

viii. A technology transfer Call is under discussion with Ethiopia and Rwanda. Zambia has requested for Hydrogen peroxide chamber developed by SCIMS.

ix. Technology offers received from UK, Norway, Singapore, Japan and Portugalare shared with DST technology groups (NEB, Nano mission and TDB) to analyse the national needs to take them forward. Based on technology groups feedback technology adoption can be facilitated.

x. Efforts have been made to connect Indian and Italian researchers working on specific problem of COVID. Initial discussion took place on sharing strategy implemented by Italy and India to tackle COVID19. Both sides have been discussing possibilities of taking advantage of the "use" of a broader epidemiological basis and to explore possible interactions also in the context of emergency management models (management in hospitals and society). A webinar on connecting Indian and Italian laboratories working on Genetics of Disease Outcome; Basic Research for Therapy & Prevention; and Artificial Intelligence for Surveillance and Prediction is proposed to be organised on 14th July 2020.

xi. Due to the lock down, many researchers were stranded abroad. Division has contacted the each every individual and connected them to respective Indian embassy. Based on the need and requirement, about 50 researchers were evacuated safely to India from countries like Italy, France, UK ,USA etc in coordination with MEA.

xii. All the research scientists/student working in Indian research laboratories in various fellowship programmes were provided upto 3 month extension of the fellowship as they were not able to fly back to their own country due to flight restrictions after

completion of the fellowship period. Efforts were also made to send about 10 of them back to their country via special flights in coordination with their country embassy and MEA.

C.   *Initiatives of SEED Division :* COVID-19 Containment & Resilience of Communities at Grassroots

The COVID-19 Pandemic has created a public health disruption, swiftly developing into a major global crisis impacting social, health and economic systems. The resilience of communities at grassroots level, especially the most vulnerable sections of the society like the Scheduled Caste (SC) and Scheduled Tribe (ST) Communities, Women and Children, Divyangjan and Elderly are closely coupled to pre-existing health challenges or difficulties in accessing care, compromised dietary practices, poor affordability, low educational levels, lack of awareness etc. The local dynamics of livelihoods, health and socioeconomic conditions thus calls for better healthcare, social services, planned relief and rehabilitation measures to best share during the current pandemic. DST through its huge network of Knowledge Institutions (KIs) and Science and Technology (S&T) based Non-Government Organizations (NGOs) spread across the length and breadth of the Country has fostered several S&T interventions since the lockdown to mitigate the impact of COVID-19 in rural and peri-urban areas.

During the Lockdown 1.0, DST had initiated an action plan for immediate interventions for containment of COVID-19 at community level through creation of awareness in the communities on critical issues including social distancing, use of masks, recommended practices, quarantine and psycho-social issues of migrants, mental health and wellbeing etc. The Organisations supported by the DST had demonstrated capabilities in building resilience against COVID-19 through various S&T interventions in the States of Andhra Pradesh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Rajasthan, Tamil Nadu, Tripura, Telangana, Uttarakhand, Uttar Pradesh and West Bengal by tweaking the objectives of the ongoing projects wherever possible for improving the livelihoods of the communities.

Hand sanitizers and Hand wash as per recommended guidelines, sanitizers/hand wash with locally available materials as per USFDA guidelines has been prepared. Protocols were developed for manufacturing 100% natural liquid hand wash with anti-viral properties using Sapindus mukorossi and hand sanitizers with ethanol, hydrogen peroxide, glycerol and extract of *Artemisia nilagirica* and citrinolla. 3D printed face shields (visors) were manufactured using Fused Deposition Modelling. low cost hand sanitizer dispensers, sanitization booths, wireless UVC solutions for large area sanitization, drones for disinfestation were some of the technologies developed for containment of COVID-19. These interventions, apart from providing health benefits are also providing alternate source of livelihoods for women SHGs.

3D printed face shields (visors)

Hand Sanitizers

The network has approximately reached 3,00,000 people in the above States. Relief material (ration items and food) was provided more than 1,00,000 people. 700 awareness and training programmes covering approximately 50,000 people were conducted and masks and sanitizers were provided to over 1,00,000 people. 20,000 litres of sanitizer and 20,000 face shields were distributed among the police personnel and frontline health workers. These operations are being scaled up wherever and whenever necessary for meeting the needs of the people.

Distribution of facemask to Police in Lathur, Mask and Sanitizer to Tribal in Purulia

The NGOs and KIs supported by DST has responded aptly in time to ground reality and has taken utmost care of the SC and ST communities by creating awareness, supply of relief materials and containment of communal spread of COVID-19. During Lockdown 3.0, these organizations designed approaches tailored to the unique needs of these communities and framework for protecting the existing livelihoods and creating alternate livelihood options. A unique concept of Immune Villages for boosting the immunity of the people hailing from the tribal belt in Purulia is being promoted to prevent the spread of COVID-19. Several immune villages were established in collaboration with the AYUSH Department of Government of West Bengal. The livelihood activities were rejuvenated during the lockdown 4.0 by following social distancing norms in collection of Minor Forest Produce and during implementation of

works related to MGNREGA. The livelihoods of 15,000 SC and ST households were protected with various S&T interventions in the fields of agriculture, aquaculture and other non-farm activities like pottery, manufacturing of Geopolymer based floor tiles and roof tiles etc.

Artisans working from home with face masks and diary workers with face shields

The organizations supported by DST have been instrumental in developing various assistive tools, technologies and techniques, that are affordable and adaptable to Indian milieu for creating inclusiveness and universal accessibility for Divyangjan and Elderly during the current pandemic. An e-Tool to create awareness and impart health and hygiene related information along with education and entertainment to overcome loneliness of the persons with intellectual disabilities due to COVID-19 pandemic have been developed. The Beta Version of the e-tool is used by 200 specially-abled children.A wearable sensor device is developed to remotely monitor the activities of Elderly and Divyangjan staying alone or who happen to be under quarantine or isolation wards. A wearable rehabilitation band with real time monitoring and feedback of recovery process through guided rehabilitation protocols is developed for elderly with motor function disabilities that will eliminate the physical presence of physiotherapist. These devices are tailor-made for the current COVID-19 situations.

Screenshot of Web based E-tool

Wearable Sensor Device

In response to the advisory issued by DST, the KIs as part of their Scientific Social Responsibility (SSR), has created scientific awareness on COVID-19 using social, print and electronic media for building resilience at community level during and post lockdown period. Scientists at DST/CSIR/ICAR funded labs, Chandigarh University, Manipur University, SKAUST Srinagar, KAHE, Baba Farid University etc has voluntarily contributed their knowledge and resources for developing various S&T interventions for containment of COVID-19 during the Lockdown 1.0 and for creation resilience during the post COVID period.

Multi Drive Mechanical Ventilator and Face shield developed by KAHE

A Mobile App based regular advisory to pregnant women (AIIMS New Delhi), telemedicine facility for monitoring the health of farm animals (SKAUST, Srinagar), Psychological First Aid-Epidemic (PFA-E) for COVID-19, ready-to-use bio-surfactant-based formulation for hands and surface sanitization, a nontoxic biocompatible cost-effective body wipes, prototype for sterilization using ozone Micro-Nano-Bubbles (MNBs), herbal decongestion spray etc are some of the technologies currently under development by the KIs for creating resilience. Chandigarh University had developed hand sanitizer with 50% Ethyl Alcohol and 25% Isopropyl Alcohol and more than 5000 litres has been distributed among migrant population, AIIMS New Delhi, Safdurjung Hospital New Delhi, Police Department of Haryana, Punjab, Uttar Pradesh and to DST as a part of SSR.

D. *Initiatives of NRDMS Division : Geospatial based solutions to address the challenges in COVID-19 crisis*

In a response to combat COVID-19 pandemic related challenges, National Geospatial Programme Division (*erstwhile NRDMS*) of Department of Science & Technology (DST), Government of India (GoI), has made efforts to integrate available geospatial datasets, standards-based services, products, applications; and analytic tools from its attached offices and programme divisions. The attached offices, such as, Survey of India (SoI), National Atlas & Thematic Mapping Organisation (NATMO), and the DST's programme division, National Spatial Data Infrastructure (NSDI), have pulled together their resources to provide the integrated geospatial platform for not only addressing the present geospatial needs of the decision-makers but also devising area-specific strategies for socio-economic development in the post-COVID-19 mitigation scenarios.

Survey of India (SOI) portal www.indiamaps.gov.in/soiapp/ is available as the core of the integrated geospatial platform to address COVID 19 outbreak and its socioeconomic impact. For required data collection pertinent to COVID emergency management, the Sahyog mobile App of SOI has been customized. The App contains interface in local language viz. hindi to capture data on the problems of reversed migrants (Fig. 1). The collected data is hosted on the above platform and for that a POI (point of interest) has been also created.
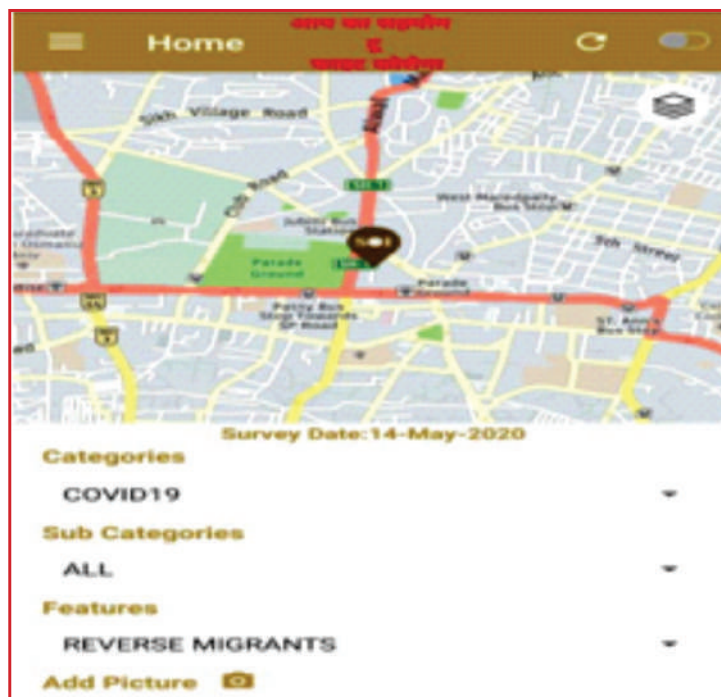

Figure. 1.Screen shot of Sahyog mobile App of Survey of India depicting the added feature of reversed migrants.

Under NSDI, many State Spatial Data Infrastructure (SSDI) teams have utilized the Sahyog mobile App of SoI for collecting data for Covid-19. In Karnataka state, 100 sample points for testing/training on Sahyog app from all 30 districts have been uploaded to the SoI Geoportal. Similarly, the GIS cells in all 13 districts of Uttarakhand State are sensitized for using Sahyog app. In the State of Uttarakhand, geotagging of dedicated Covid-19 Centres/ isolated Covid Centers institutional quarantine centres with their attributes has been done. Data of the reversed migrants such as travel history of reversed migrants, place of migration, cause of migration, education level, technical skill, marital status, income at migrated place, income at home, what want to do now, expectation from government etc. have also been collected in the State.

The functioning of NGOs of Science for Equity, Empowerment & Development (*SEED*) *division of DST has been* strengthened with basic geospatial tools & techniques so the outputs could be scaled up as per the current needs of the stakeholders in the COVID-19 scenario.

NATMO is in the process of launching a web-based thematic map service by combining its authoritative and reliable Atlas-based boundary data sets from its geoportal (http://geoportal.natmo.gov.in) with the health related data sets from the Central and State level health authorities. The thematic maps provided at different levels of the governmental hierarchy (National, State, and District levels) will help provide the details of the unfolding geospatial patterns of Covid-19 occurrence.

In order to strengthen the Geospatial analytics capabilities of the integrated platform, a Call for proposals (short-term) to address the COVID-19 crisis has been initiatedin Collaboration with AGNIi (Accelerating Growth of New India's Innovations) initiative of office of the Principal Scientific Adviser to the Government of India. Spatial analytics will be used to address issues pertinent to migratory workers viz. employment generation, strengthening of livelihood, community resilience etc

These key geospatial inputs with integrated geospatial information content are expected to be useful for the decision makers and local authorities in preparing operational strategies in the present and future outbreak scenarios.

E. Initiatives of NCSTC Division

In order to facilitate necessary actions and to ensure preparedness of the society well to face the challenge & threat posed by the growing pandemic of COVID 19 –the Corona Virus, NCSTC conducted a divisional meeting of its scientists on 07th April, 2020 through Video Conferencing. Various strategies about involving Academic Institutions and S&T based Voluntary organizations supported through NCSTC were discussed during this meeting.

In the current scenario, where there is lot of anxiety, depression and challenges vis a vis translation and usage of common minimum science and authentic information to communicate the risks and facilitate risk management, an immediate and effective science communication for promoting community level response was desired. Here are some important initiatives of NCSTC:

- ❖ Online call for proposals has been made on e PMS portal for Year of Awareness on Science & Health (YASH)

- ❖ COVID Katha, an interactive, online multimedia guide was developed and it's was released by Honble Minister of Science & Technology and Earth Sciences on 03rd May 2020, at the start of Golden Jubilee celebrations of the Department of Science & Technology.

- ❖ Illustrative brochure was brought out for YASH initiative.

- ❖ Webinar series, "Science Communication in the time of COVID 19" was with implementation by Gujarat Council of Science & Technology organised every day during 10 May - 16 May 2020.

5. Initiatives by different Autonomous Institutions of DST

a. Initiatives by SERB

Considering the emerging health care requirements to combat the COVID-19 epidemic, Science & Engineering Research Board (SERB) announced rapid/short-term projects of one year duration in the various thrust areas, preferably with multidisciplinary efforts under Core Research Grant (CRG) to urgently ramp up national R&D efforts against the epidemic. The first call was announced on 16th March. The final recommendations of of the first set of 5 projects after peer-review and assessment by a Special Expert Committee for COVID-19 projects was done within a fortnight by DST-SERB. Three of these projects concern highly important issue of antiviral and virustatic surface coating of inanimate surfaces, such as personal protection equipment (PPE); while another one deals with the identification of metabolite biomarkers in COVID-19 infected patients enabling therapeutic target identification; and the last one concerns with the development of antibodies against the receptor binding domain of the spike glycoprotein of coronavirus.

The second call by DST-SERB on CRG was announced on 18th March with following thrust areas :

- 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
- In-vitro / clinical dose testing of nutritional supplements for immunity

As a response to this call for proposals, a total of 768 proposals under Life Sciences (LS) and 172 under Chemical Sciences (CS) were received from the researchers throughout the country till the last date of submission, 30th April 2020. To gear up the research activities, a mid-term screening and review of 94 projects under LS received till 15th of April by Programme Advisory committee (PAC) experts and further assessed by the Task Force on COVID-19 for their suitability for funding was done in 2-3rd week of April and the following six proposals were recommended for funding:

a) 10-minute paper-based test kit to detect SARS-CoV-2

b) Rapid, affordable, portable SARS-CoV-2 screening kit for resource-limited settings

c) Re-purposing of approved drugs from DrugBank database for possible treatment for COVID-19 by targeting SARS-CoV-2 main protease

d) Molecular Beacons-based detection of novel SARS coronavirus-19 (CoV-2)

e) Single ventilator design modification for optimal multi-patient use - A CFD study

f) Development of host-directed anti-coronavirus agents

Similarly, the CRG proposals under Chemical sciences were also assessed during the mid-term with a screening and review of 17 projects received till 21st of April by Programme Advisory committee (PAC) experts constituted as Special Task Force committee on COVID 19 for their suitability for funding in 4th week of April and the following five proposals were recommended for funding:

a) In silico screening for repurposing known drugs for SARS-CoV-2 using AI and molecular simulations.

b) Extremely Water Repellent Coating for Anti-Viral Application.

c) Cost-effective, Antiviral and Antibacterial textile based face mask using facile and industrially scalable air-brush technology.

d) Bioinspired copper coordination polymers as filter for COVID-19: targeting catalytic site of virus.

e) Evaluating the potential antiviral efficacy of functional carbon quantum dots loaded with Ketorolac salt against SARS-CoV-2.

Till now, few of these research-driven and technology-based interventions have been initiated on war footing to fight out the outburst of the pandemic. Among the remaining proposals, screening and shortlisting has been completed and the proposals are submitted for further review by subject experts. The next meeting of both (LS and CS) the committees is scheduled in the 2nd and 3rd week of June 2020 to take final decision on these proposals for funding. The

details of sub-area wise proposals received under CRG scheme Life Sciences Programme is shown in Table 1.

Table 1: CRG proposals received under various sub-areas

S. No.	Sub area	Proposals received
1	Antiviral nanomaterials and bionano antiviral systems	172
2	Affordable, portable rapid diagnostic kits / tools	250
3	Computational identification and validation of COVID-19 molecular targets	212
4	Drug repurposing against key COVID-19 targets	214
5.	In-vitro / clinical dose testing of nutritional supplements for immunity	92
		940

The officials across the funding agencies and the Scientific community at the other end geared up their efforts and worked tirelessly since the outbreak to combat the epidemic of COVID-19. Another Special IRHPA Call (Intensification of Research in High Priority Area) for a 3-year duration specifically designed for COVID-19 and related respiratory viral infections was announced on 23rd March with the last date of 30th April for the receipt of full proposals. The preference to multi-institutional network with industrial partnership to assist teams, preferably with multidisciplinary efforts in the area was encouraged in the IRHPA call.

The thrust areas for IRHPA call specifically designed for COVID-19 and related respiratory viral infections were as follows:

- ❖ New or repurposed antivirals against valid viral targets; viricidal coatings; etc.
- ❖ Affordable diagnostics for symptomatic and asymptomatic respiratory viral infections
- ❖ Investigational vaccines against respiratory viruses
- ❖ Development of disease models for respiratory viral infections
- ❖ Studies on immune response and immunity during respiratory viral infections
- ❖ Epidemiology of COVID and other respiratory viral infections

Multiple virtual meetings were held in succession to screen and review by subject experts for the 310 proposals received till 30th April 2020. The sub-area wise details of the **IRPHA** recommended projects is shown in Figure 2.
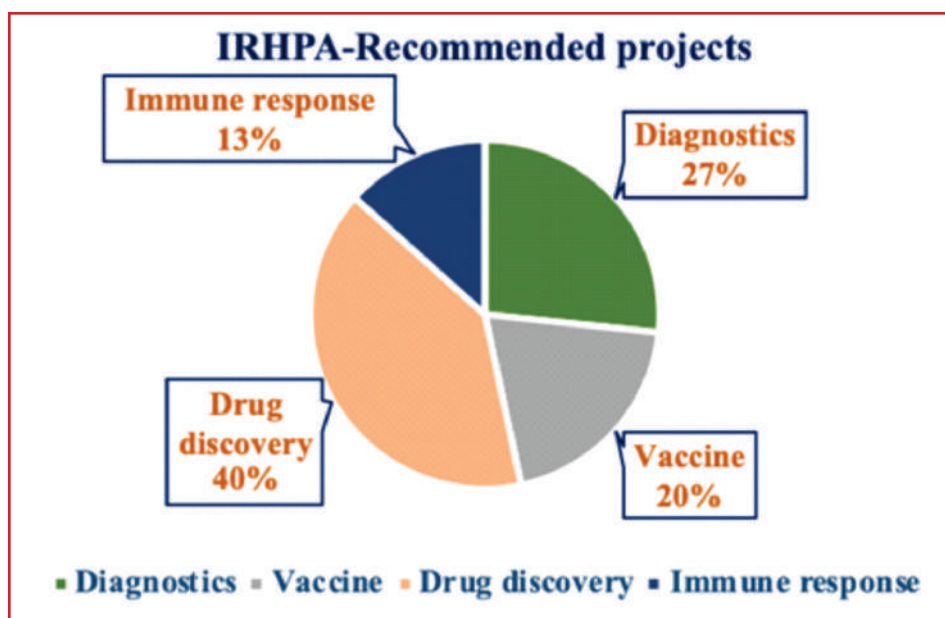
Fig 2: Details of IRHPA recommended projects

Considering the importance to develop mathematical models to study the rate of spread of COVID-19 among the population and also the criticality of data driven inference for forecasting of coronavirus infections, SERB announced a special call for short-term projects under its MATRICS program, preferably with multidisciplinary efforts in the following thrust areas:

- ❖ 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

The call was open from March 31 to April 30, 2020.

The number of proposals received were 624. First meeting of the MATRICS Special Call Task Force Committee was held virtually on April 23, 2020 to evaluate 68 proposals received till April 14, 2020. The committee recommended 11 proposals for support. The remaining proposals will be evaluated in the 2-3rd week of June 2020.

The list of approved proposals under MATRICS scheme are as follows:

a) Modelling and Forecasting of COVID-19 pandemic

b) Mathematical Modelling of Transmission Dynamics of COVID-19 and its Control

c) Mathematical and Statistical Modeling of COVID-19 Outbreak in India

d) Modelling, Analysis and Prediction for SARS-CoV-2 Infections

e) Bayesian Individual-level modeling of the spread of COVID-19 Pandemic.

f) Anatomy of COVID-19 transmission dynamics: A modelling and computational approach from Indian perspective

g) Effects of Nonpharmaceutical Measures on COVID-19 Pandemic in India and Network-based Forecast Beyond Relaxation of Lockdown

h) A network optimization based prediction model for COVID 19 outbreak tree

i) Optimization of lockdown, testing and isolating strategies to contain COVID-19 in India

j) Identification of possible cure of COVID-19 through study of DNA structures through Iterated Function Systems

k) Multi-cluster models for epidemic spread and evaluation based on data-driven parameterization

The grants for the projects recommended under the first phase of PAC meetings are released/ under release and the monthly progress reports are being requested from the Principal Investigators for monitoring purposes.

Till now, the country has been able to contain the spread of the virus with the active participation of the population across various states through best practices of hygiene, hand washing, social distancing etc. However, immediate as well as long lasting interventions/ strategies are needed, for which various ministries under GOI took forward steps.

As a premiere R&D funding agency, DST-SERB initiated the promotional R & D activities for proving various solutions for containment and prevention of COVID-19. With the initial in-house meetings and announcing the call for proposals by the middle of the March 2020, in multiples thrust areas across short (one-year duration) and long (three-year duration) calls. SERB will closely monitor the progress of the COVID-19 funded projects and endeavour to find S&T solutions to the alleviate this epidemic.

b. Initiatives by TDB

The Technology Development Board (TDB), a statutory body under DST, invited proposals/ applications from Indian companies and enterprises on 20th March, 2020, to address protection and home-based respiratory intervention for COVID-19 patients. The areas in which technologically innovative solutions were invited include the following:

❖ 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

The Indian industry and the start-up ecosystem responded enthusiastically to the invitation by the Technology Development Board (TDB). The last date of submission for proposals was initially 30 Mar 20 which was later extended to 30 Apr 20 considering the response and requirement.

Nearly 350 companies registered themselves with TDB through online process and a total of 228 applications were received through online mode.

The received applications were processed phase wise based on the technical and financial details provided in the proposal, without waiting for the last date for submission of applications.

The project evaluation at TDB is quite exhaustive. Prior to the project proposal being approved for financial assistance by the Board, the proposal is evaluated by two separate committees. These committees consists of technical experts who are shortlisted from government/ academic institutions like IITs, IISc, NIV, AIIMS, ICMR, DST, DBT etc and financial experts with over 15 years of experience in project finance.

TDB, through its evaluation process, has processed 194 applications under various domains and another 34 applications are in the final stages of evaluation. TDB has approved six projects towards commercialization, with a total commitment of Rs.924 lakhs which include thermal scanners, medical devices, masks, and diagnostic kits.

Thermal Scanners

Hand-held thermometers, used in checking temperature, a common test for screening symptoms of virus infection, exposes security personnel and health workers to infection. Removal of current restrictions after lockdowns will further increase this risk.

Therefore, it becomes imperative to have non-intrusive technologies for monitoring body temperature from a distance and in the crowd. TDB has approved financial assistance to two Bangalore based companies, Cocoslabs Innovation Solutions Private Limited, & Advance Mechanical Services Private limited, which are poised to provide these solutions.

i. **Cocoslabs Innovation Solutions Private Limited** plans to commercialize a low-cost solution to identify persons with abnormal body temperature in a crowd and, at the same time, provide an alert system to notify about identified persons to authorities on their phones and laptops. An artificial intelligence software solution for real-time detection using video analytics platform

for real-time alerts combined with a low-cost thermal camera (basic camera with only thermal image capture capability), & GPU servers are used for real-time abnormal temperature detection, of multiple people at a given time in crowded public places.

The product includes features such as detection & tracking a person with and without mask, prediction of age, gender, race, temperature readings (fever detection), and facial recognition in a single product that can track multiple people in a real-time environment.

ii. **Advance Mechanical Services Private limited** plans to commercialize Infrared Thermography-based Temperature Scanner for Rapid Measurement and Real-Time Decision Making using an uncooled microbolometer and video analytics platform. This has been indigenously developed, providing real-time alerts and analytics using AI and IIOT (Industrial Internet of Things). The product design, imaging processing software, AI protocols development, and configuring of IIOT solutions has been developed in-house with due considerations for ruggedness, reliability & affordability. The company has also developed server technology, which is value-added feature for the IIOT systems.

Medical devices

iii. **Iatome Electric India Pvt. Ltd., Coimbatore** envisages commercialization of battery-powered portable X-ray machines with digital display as standalone medical radiography equipment suitable for ICU & Isolation Wards. The device is portable and can be taken to the patient's bedside, thereby reducing the exposure of infection to the medical staff involved in the process. The battery back-up option is useful for a wireless workflow and continuous operation without power mains. Portable X-Rays with Digital Imaging and Battery Back-Up can be used in the isolation wards and Intensive Care Units of the COVID19 management set-up.

Masks

iv. **Thincr Technologies India Pvt. Ltd, Pune** is providing coating and 3D printing of anti-viral agents on the masks as a preventive measure against COVID-19. Sodium Olefin Sulfonate based mixture is used for coating on the mask. It is a soap forming agent with hydrophilic and hydrophobic properties. In contact with enveloped viruses, it disrupts the outer membrane of the latter. The ingredients used are stable at room temperature and are widely used in cosmetics.

Diagnostic Kits

v. **Mylab Discovery Solutions, Pune**, the first indigenous company to develop real-time RT-PCR based molecular diagnostic kit that screens and detects samples of people who display flu-like symptoms that screens and detect samples of people, who display flu-like symptom. This kit has been approved by ICMR and CDSCO. The company approached TDB with the project proposal for automation of their facility under the TDB's call for proposals for Fighting Covid 19. The proposal stipulated automation of the facility from

current manual process, resulting in increase in its current capacity from 30000 tests per day to one lakh tests per day. The company is expected to complete the project in a two months.

vi. **Medzome Life Sciencez, New Delhi** currently manufactures rapid diagnostic kits for Malaria, Dengue, Pregnancy, Typhoid, etc. and intends to manufacture fluorescence-based Rapid COVID-19 Antibody based Detection Kit. It targets to deploy them commercially in 2-3 months. The fluorescence-based diagnostic kits are reported to be several-fold sensitive and shall be able to provide quantitative results. This test does not require well-established laboratory facilities or technical person and therefore is expected to be cost effective. The company is expected to develop a capacity of nearly 50000 kits per day.

TDB is proactively supporting the efforts of the scientists, technologists, entrepreneurs, and industrialists towards preventing and containing the spread of the COVID 19 pandemic by providing financial support for commercialization of these technologies. In addition, TDB is also scouting for novel solutions for supporting the country's efforts in tackling the health care emergency that the world is facing.

c. **Initiatives by Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST)**

In the wake of the crisis situation during the COVID -19 pandemic, the three wings of Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) namely the Biomedical Technology Wing (BMT), Achutha Menon Centre for Health Science Studies (AMCHSS) and the Hospital Wing have tried their best to face the unprecedented emergency situation.

A number of measures are taken for mitigating the effects of the COVID 19 pandemic not only for the institute but also for the entire country with the full utilization of resources and best of its capabilities. Though the institute had to quarantine a number of staff when a foreign returned doctor was detected with COVID 19 much before the nationwide lockdown, SCTIMST rose up to the occasion to bring out several technologies, products, patient management guidelines that could be crucial to combat the disease not only for the institute, but for the state and entire country. Furthermore, SCTIMST has evolved a fast track method to come out with the biomedical devices, technologies and guidelines useful for the management of Covid-19 in the country, in addition to streamlining the management of patients with cardiac and neuro illnesses in the hospital wing.

a. **BIOMEDICAL TECHNOLOGY WING**

The BMT wing stood out with its research, technologies and innovations to meet the need of the hour in India's fight against Covid 19. Under the leadership of Director of the institute, it evolved a fast track method coordinating the all-round efforts of scientists, engineers and doctors on to develop the following technologies:

SNo	Devices	Features	Status
In Vitro Diagnostics Devices			
1	Chitra Magna RNA Isolation Kit	• Uses innovative technology for isolating RNA using magnetic nanoparticles • Enhances the chances of identifying positive cases. • Can help increase number of tests and bring down its costs	Technology transferred to M/s. Agappe Diagnostics Ltd, Kochi; Commercial launch over. Relicensed to M/s. Tata Sons Pvt. Ltd, Mumbai
2	Chitra Rapid Ab Antibody Test Kit	• Immunochromatographic test kit method is used for detecting the presence of antibodies (IgG/IgM) against corona virus in serum, plasma or whole blood. • Will help to identify infection and isolate people without symptoms and suspected SARS-CoV-2	Technology transferred to M/s. Origin Diagnostics and Research, Kollam, Kerala; Internal validation in progress.
3	Chitra LAMP-N Covid test kit	• Confirm SARS- COV2 using (RT-LAMP) • Point of care diagnostic test which detects the N Gene • Validation in progress	Technology transferred to M/s. Agappe Diagnostics, Kochi & M/s. Tata Sons Pvt. Ltd Internal validation in progress.
4	Chitra Embed Nylon Flocked Swab	• Individually wrapped Nylon flocked swabs • Sterile, ready-to-use devices for the collection of clinical samples • Nasopharyngeal and oropharyngeal models available	Technology trasnfered to M/s. Mallelil Industries Pvt. Ltd, Kochi; Ready for large scale manufacture.
5	Chitra ENMesh Swabs and VTM Kit	• Swab made from polyurethane foam • Viral Transport Medium (VTM): Specifically designed to retain the virus in its active form during transportation	Technology transferred to M/s. Origin Diagnostics and Research, Kerala and M/s. Levram Life sciences Pvt. Ltd., Mumbai Ready for commercial launch
Devices for Therapeutic Support			
6	Automated AMBU ventilator/ respirator	• Automated AMBU based ventilator for emergency respiratory support. • Mild to moderate respiratory function • Made with locally available material • Portable & cost effective	Technology transferred to M/s. Wipro 3D, Bangalore; Ready for manufacturing in large scale.
7	MediCAB deployable isolation wards, hospitals, ICUs	• Deployable isolation hospitals to combat Covid19 with four zone strategy. • Co-developed with M/s. Modulus Housing, Chennai.	Technology transferred to M/s. Debrique Creative Labs Pvt. Ltd, Chennai; First unit deployed in Chennai; Ready for large scale manufacture.

SNo	Devices	Features	Status
Devices for Isolation /Barrier Creation			
8	Chitra Isolation Pods	• Isolation pod device is an enclosure for carrying the COVID-19 infectious patients from one place to another.	Technology transferred to M/s. HMT Ltd, Kochi Ready for manufacture Relicense to M/s. Kerala State Drugs and Pharmaceuticals being taken up
9	Chitra Clinical Examination Booth	Technology transferred to: • M/s. HLL Lifecare, Trivandrum • M/s. Shivapriya Exim, Chennai • M/s. HMG India, Mumbai • M/s. TVS Supply Chain, Bangalore • JADRO Steel, Kolkata	M/s. HLL Lifecare and M/s. TVS Supply Chain Solutions started marketing the product.
10	Chitra Single Chamber Swab Collection Booth	Technology transferred to: • M/s. HLL Lifecare, Trivandrum • M/s. Shivapriya Exim, Chennai • M/s. HMT, Kochi • M/s. TVS Supply Chain, Bangalore • JADRO Steel, Kolkata	M/s. HLL Lifecare, M/s. HMT and M/s. TVS Supply Chain started marketing the product.
11	Chitra Single Chamber Swab Collection Booth	• The dual-chamber swab collection booth is designed to have one chamber for the health worker and the second chamber for the suspected case of an infectious disease such as COVID-19.	Technology transferred M/s. HLL Lifecare, Shivapriya Exim, HMT, TVS and JADRO Steel Ready for manufacture.
Devices for Disnfection			
12	UV based face mask disinfection bin	• Ultraviolet (UV) based facemask disinfection bin indicated for disinfecting used facemasks prior to disposal. • Reduces the risk waste collectors being exposed to hazardous waste.	Licensed to M/s. VST Mobility Solutions, Kochi Commercially launched Relicensed to M/s. PMG Equipment, Hyderabad and M/s. Vivesty Green Recyclers, Kozhikode
13	UV based multipurpose disinfector	• UV-C based disinfection system • Multi-purpose design • Applications in shops, public places	Licensed to M/s. VST Mobility Solutions, Kochi. Commercially launched
14	Chitra Disinfection Gateway	• System for generating Hydrogen peroxide mist and UV based decontamination facility. • Hydrogen Peroxide fumes will decontaminate the body, hands, and clothes of a person. • The UV rays will decontaminate the chamber.	Technology licensed to eight companies spread across the country. Started deployment at various locations.

SNo	Devices	Features	Status
15	Acrylosorb Advanced super absorbent	• Solidifies the secretary fluids from infected personnel and disinfects the fluid • Reduces the risk to personnel carrying out waste disposal process.	Technology Licensed to M/s. Kerala State Drugs and Pharmaceuticals, Alappuzha

Patent Applications

SNo	Application No	Filing Date	Title of Invention
1.	202041013409	27/03/2020	Developing point of care testing protocol based on RT-LAMP for rapid detection of coronavirus SARS-COV-2
2.	202041014164	31/03/2020	Deployable field units for emergency response.
3.	202041014183	31/03/2020	Deployable hospitalised partitions
4.	202041014200	31/03/2020	Face masks sanitization bin
5.	202041014210	31/03/2020	Cough and sneeze mask with specimen collector for respiratory droplet specimen collection.
6.	202041014221	31/03/2020	Automated artificial manual breathing unit ventilator
7.	202041014548	01/04/2020	Isolation pod for the isolation / transportation of infected patients.
8.	202041015253	07/04/2020	Digital sanitation mobile app
9.	202041014706	02/04/2020	Ventilating patients for emergency care
10.	202041014851	03/04/2020	Battery operated assistive breathing unit
11.	202041014965	04/04/2020	Disposable safety face shield
12.	202041015213	07/04/2020	Surface modification of masks and gloves for viral inactivation
13.	202041015783	11/04/2020	Oropharyngeal swab
14.	202041015199	07/04/2020	Rapid detection of Covid 19 antigens using immunochromatorgraphic techniques
15.	202041015212	07/04/2020	Rapid detection of Covid-19 IgG/IgM antibodies using immunochromatographic techniques.
16.	202041015384	08/04/2020	Development of remote controlled non touch opening dustbin wit integrated disinfection mechanism base on uv light for infection control in Covid-19 outbreak
17.	202041015131	06/04/2020	A formulation dispensing system worn as a hand bracelet.
18.	202041015399	08/04/2020	Disposable disinfectant absorbent sponge.
19.	202041015441	08/04/2020	Disinfection walk-through /gateway
20.	202041015611	09/04/2020	Examination booth
21.	202041015925	13/04/2020	Swab collection booth

SNo	Application No	Filing Date	Title of Invention
22.	202041016055	14/04/2020	Level A personal protective equipment with continuous air supply for medical/ surgical use.
23.	202041016519	16/04/2020	Rapid viral RNA isolation protocol
24.	202041016758	18/04/2020	Automatic smart-bin with combined UV enabled microwave based disinfection of hospital waste

COVID-19 MANGEMENT – INCUBATION ACTIVITIES (SCTIMST TIMed)

SCTIMST-TIMed is a Technology Business Incubator for Medical Devices and Biomaterials funded by Department of Science & Technology, Govt. Of India. In the Covid-19 crisis situation, TIMed has been working on fast track mode to reach out to the innovators or companies and to support them. Brainstorming sessions were held with existing start-ups and Prayasees of TIMed to come up with quick to market interventions, that could be manufactured even in the lockdown situation.

SNo	Device	Features	Status
1	Medical Grade Thermal Scanner	• For airports, malls, large offices etc. • Thermal Eye Body Temperature IR Scanner to get an accurate body temperature of a person on an automated platform. • CDSCO registration, production planning and marketing activities in progress.	Incubatee: M/s. Avatar Renewables Pvt Ltd, Kochi (Nidhi Prayas Scheme)
2	Face Barrier and Shields	Three variants of face shields namely, • Modified scuba diving mask with Virus filter • Full covered non permeable Head hood with air exchange • Face shield barrier.	Incubatee: Dr. Praveen Pai (Nidhi Prayas Scheme)
3	Face Shields	• Safety face shields • Reusable shields • Already started marketing	Incubatee: M/s. Creativity Council (Nidhi Prayas Scheme)

b. ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES (AMCHSS)

The Achutha Menon Centre at the Institute is actively involved in supporting the Hospital Wing and the State in the containment of COVID-19 through the COVID Cell constituted by the Director at the Institute. Further it is helping the State Health Department also by preparing a number of new initiatives and proposals.

Involvement in the support to Covid-19 related activities of the Institute.

1. February 1st – Sensitisation on COVID-19 for staff of SCTIMST – staff from all three wings joined. BMT wing staff and field staff from Wayanad joined over zoom (Dr. Biju took the lead in arranging).

2. February onwards AMC staff interacted with various staff of SCT individually and in small groups to clear doubts and raise awareness on COVID.

3. Three members of AMCHSS are members of the COVID Cell of the institute – Dr. Sankara Sarma, Dr. Biju Soman and Dr. Rakhal Gaitonde. This cell coordinates and makes decision regarding all COVID related decisions in the institute.

4. The AMC team contributed to coordinating the public health and other aspects of the institute's response to one of our staff member testing COVID-19 positive. This included the following:

    a. a.   Coordination of contact tracing activities and decision – Dr. Biju Soman was part the team of faculty that did this activity.

    b. Re-classification of contacts into high risk and low risk – Dr. Biju Soman lead the team.

    c. Development of Rapid Survey tool to survey the whole of the institute – Dr. Biju Soman, Dr. Rakhal Gaitonde contributed to development of the tool.

    d. Designing the Campus Cohort study protocol – which follows those who were in quarantine as contacts of our positive faculty. Dr. Biju Soman and Dr. Rakhal Gaitonde in association with Team from NIE, Chennai

    e. Formation and initial support of nearly 700 members whatsapp support group for staff – Dr. Rakhal Gaitonde and MPH students of Batch of 2019. Later support was taken over by other faculty and staff.

    f. Intensive telephone counselling and support to those in quarantine – team led by Dr. Ravi Prasad Varma and PhD and MPH students of 2019 batch.

    g. Development of material for support of those in quarantine – Dr. Jeemon, Dr. Manju and Dr. Ravi Prasad Varma.

    h. Dr. Ravi Prasad Varma has joined the Institute Infection Control Team (ICT) and is providing public health inputs. He is supporting the Social Work Department in daily screening of patients, developing protocols and monitoring implementation of these in the Hospital and AMC campus.

    i. Developed an English (Dr. Ravi Prasad Varma, Dr. Srikanth, Dr. Manju Nair, Dr. Jissa VT) and Malayalam (by Ravi Prasad Varma, Jissa, Rajalakshmi (MPH student)) webinar on epidemiological basis of COVID-19 in Malayalam for ICT.

j. Dr. Mala Ramanathan as member secretary of Institutional Ethics Committee (IEC) – April 1, 2020: Developed two SOPs for dealing with the COVID-19 pandemic situation and implemented them for the IEC functioning. Put in place expedited IEC review protocols. IEC reviews are now being processed in 72 hours. These protocols were developed based on the ICMR guidelines (Of 2017) section on Ethics in Humanitarian / Disaster situations. Proposals received under the COVID-19 protocol of IEC: 7. Number of proposals approved: 6.

k. Dr. Ravi Prasad Varma - Preparing COVID-19 high-risk district list every alternate day to facilitate patient triaging.

l. Dr. Ravi Prasad Varma - Contributed to the SCTIMST-Infection Control Manual for COVID-19 (dated 22-04-2020)

Involvement in supporting Government of Kerala

1. Dr. Rakhal Gaitonde, Professor, AMC was appointed on to the State Government Expert Committee on COVID-19. This committee is chaired by Dr. Ekbal, Member State Planning Commission.

2. AMC team consisting of Dr. Rakhal Gaitonde, Dr. Sankara Sarma, Dr. Biju Soman and Dr. Jissa VT helped develop three proposal submitted to Government of Kerala as Technical support, these are protocols for epidemiological and sero-prevalence surveys. These proposals include:

   a. Epidemiological studies on COVID-19 in Kerala, India SCT COVID STUDY GROUP 001.

   b. Sero-epidemiological study of COVID-19 in State/Union Territory, India: Among community members, contacts and health care workers. SCT COVID STUDY GROUP 002

   c. An exploration of sero-prevalence of COVID-19 in Kerala using facility-based samples. SCT COVID STUDY GROUP 002a

3. Dr. Manju Nair developed and submitted a comprehensive sentinel surveillance programme for the Trivandrum District Disaster Management Authority.

Involvement in support to Central Government

1. Dr. Rakhal Gaitonde, Professor, AMC was appointed to the National Task Force on COVID by ICMR. He was appointed as a member of the Operations Research / Implementation Research Group.

2. Dr. Rakhal Gaitonde, Professor, AMC was appointed as convenor of the Health Systems Working sub-group of the OR/IR Task force of the ICMR.

Academics, Research and Publications

1. Publications from AMCHSS:

    a. Varma RP. Alcohol withdrawal management during the Covid-19 lockdown in Kerala. *Indian J Med Ethics*. 2020;V(2):105-106. doi:10.20529/IJME.2020.042

    b. Singh G, Srinivas G, Jyothi EK, Gayatri LK, Gaitonde R, Soman **B**. The Sree Chitra experience in containing the first outbreak of COVID19 in a healthcare setting in India. Indian J Public Health 2020;64:S1-S4.

2. Publications being prepared as part of COVID activities –

    a. Support to faculty member who was infected with COVID to write a first person case report for publication.

    b. Completing a manuscript on the Campus Cohort investigation for submission – it will be the first report of an outbreak investigation of COVID in a health care institution in India. (Team leading first drafting – Dr. Biju Soman, Dr. Gurpreet Singh (PhD student), Dr. Rakhal Gaitonde.

    c. Dr. Rakhal Gaitonde is part of team writing a conceptual framework of COVID control activities to be submitted for upcoming COVID special issue of IJPH.

3. Projects initiated related to COVID 19 by AMCHSS:

    a. Dr. Mala Ramanathan - 'Primary Health Care Preparedness and LSGI reponse in the context of COVID-19 in Kerala'. This study is being undertaken with the collaboration of the Director, Kerala Institute for Local Adminstration, Trissur

    b. Dr. Rakhal Gaitonde. Innovations during COVID-19 pandemic in India: A repository. Project submitted to ICMR. Status – Approved by National Task Force.

c. HOSPITAL WING

The faculty of hospital wing and AMCHSS under the leadership of Director swung to action mode needed for patient and staff protection as soon as the crisis of Covid set in with the diagnosis of Covid in a member of the faculty. The communications between the staff was done mainly via digital conferencing since a sizeable number of the personnel in different departments were sent to home quarantine. The remaining nonquarantined staff was in duty duly following the guidelines regularly updated by the government and the Covid cell headed by the director.

Orders and advisories issued & Various response actions

Manuals & practice guidelines were prepared by all departments for the management of outpatients, emergencies and inpatient care to tackle Covid-19 pandemic. Furthermore

specific guidelines for triaging patients into high, intermediate and low risk or no risk categories were also prepared using MOHFW, WHO and various international professional societies' recommendations to guide the institute's admission policy, transport of patients and treatment. Doctors and Nurses of all the departments participated and prepared the Covid specific Infection Control Manual of SCTIMST under the guidance of department of Microbiology. This manual has protocols and guidelines for:

The Basic Sciences and Para Clinical Departments such as Biochemistry, Microbiology, Pathology and Cellular Molecular Cardiology chipped in with various activities to control Covid 19 on the timelines mentioned. The computer division gave invaluable support with prompt organization of multiple video conferencing, creation of covid specific web pages, updating the softwares for teleconsultations and online examinations. Further, it created new modules for covid specific purchases & store items and SMS services to inform the staff and students on quarantine.

Measures and Safety Precautions in the OPD

- Queuing at entrance area is discouraged and token numbers are issued to patients by security personnel. They are advised to be seated at the waiting areas maintaining social distancing until their turn comes (Figure 3).

Figure 3: Social distancing by patients.

- Entry of the patients is regularized and a staggered system is followed.
- Facility for hand washing with soap and hand sanitizers are provided at the entrance to the OPD (Figure 4).

Figure 4: Hand washing facilities with soap and hand sanitizers at hospital entrance.

- Patients and bystanders are advised to wash their hands and wear facemask properly before entering the hospital. Mask are provided if required.

- All staff at OPD area is wearing required preventive equipments like mask, gloves and also to use hand sanitizers or wash with soap frequently. In addition facial visors are used by doctors and nurses during patient interactions.

- Security personnel conduct temperature screening with thermal scanner, at the entrance. All patients, bystanders, visitors to various departments and staff members are screened.

- Next level of screening is done using a proforma for Covid 19 screening by the Medical Social worker in the Patient Management Services

- If any of the checklist question is positive, the patient is directed to triage area and will be communicated to concerned OPD (Figure 4). The concerned doctor will examine the patient at triage area with all preventive precautions like PPE. Hotspot notifications in the intranet were reviewed on a daily basis and the patients from these areas were also triaged.

Figure 5: Triage aream

- Sick / Ambulance patients are also attended as per protocol.

- Disposal / admission of the patient is done fast.

- Structural modification has been done at Information Centers and OPD Nursing station by fixing glass partitions.

- Chairs are rearranged near OPD and outside waiting areas to ensure social distancing.

- Only one bystander is permitted to visit the patient during visiting hours.

Measures and safety precautions in the Inpatient Department

Separate area have been demarcated in all inpatient areas for Covid-suspected patients in all admitting departments. Furthermore, special Covid Isolation facilities have been created in one block of the hospital to take care of critically ill Covid patients:

- Converted the existing Neuro-medical Ward to COVID 19 Isolation ward by providing additional medical gas outlets including oxygen, air and vacuum ports, Electrical work done for accommodating additional patient monitors, ventilators, etc., Air-conditioned the entire area and provided exhaust outlet for increasing the air changes to reduce the risk of Covid spread through aerosols by the Division of Clinical Engineering.

- Converted the Neuro Medical ICU into a negative pressure isolation ICU by re-designing and installing suitable exhaust blowers with filters.

- Separate entrance/exit and areas were made for donning and doffing of PPE for managing sick COVID-19 patients.

- Conversion of Congenital Heart ICU into a negative pressure isolation room by re-designing and installing suitable exhaust blowers with filters.

- Additional options were installed in selected Adult Cardiac surgical and Neuro surgical OTs for switching between positive and negative pressure to meet the infection control requirements to reduce the impact of aerosol generating procedures induced Covid transmission.

- Most of the critical equipments were serviced and repaired to meet the COVD 19 emergencies. Extra preventive maintenance was done for making the equipment ready to meet the emergencies, since most of the equipment were idle during the lockdown period.

- Critical Air Handling Units rooms and CT room were installed with UVC germicidal UV tubes for reducing the aerosol infections (Figure 6).

Figure 6: CT room with installed UV lights

- Disinfectant, face mask, N 95 masks, COVID guard face shield, gloves, and PPE kits were made available for all staff according to guidelines.

- Standard operating procedures (SOP) were placed in SCTIMST intranet after approval by Covid cell for everybody's information.

- New protocols for periodic checking of critical care equipment during lockdown period were developed by the Division of Clinical Engineering.

- Procurement of essential spares and consumables were done in order to manage the epidemic/pandemic outbreaks and lockdown conditions.

Furthermore, we formulated focussed guidelines and protocols for the safety of our staff and patients undergoing diagnostic procedures such as echo, ultrasound, CT, X-ray, DSA, MRI, ECG, EEG, EMG etc. For example, Echo was modified in two ways:

(i) Plastic sheet screens were kept between patient and operator with transparent plastic covers. Holes in the proper places ensured access to patient with probe (Figure 7).

(ii) Sono Box: Developed by the Department of Clinical Engineering, of the Hospital Block, is an enclosure inside air-conditioned echo rooms to prevent aerosols. It has UV sterilisation which is done after each patient. It is equipped with HEPA filter with negative suction which will prevent aerosol spread (Figure 8).

Figure 7: Modification in echo lab

Figure 8: Sono Box

Training programs and Communication materials

All the departments made sure that all members attended the training program arranged by the infection control team for donning and doffing of PPE and other standard hygiene precautions.

The academic programs were continued via digital mode using multiple apps like Zoom, Microsoft teams, Big-Blue button, Google meeting etc.

Furthermore, Dr. Kavita Raja published a COVID related article in Malayalam in Shastra Gathi, for public awareness.

Successes, Best practices

- All the departments started working during lockdown to manage the emergencies initially and then the elective work also started.
- Tele-consultation services and counselling over phone was offered during this period to reduce the stress and strain of the patients and to prevent travel.
- In quick time, two ICMR approved Covid test laboratories have been set up to test people or patients suspected to have contracted the infection. This facility was mainly used by the state government.
- The departments has succeeded in keeping down the stress and anxiety levels of all staff, students and patients to a minimum during the COVID19 period by counselling and regular training classes.
- Nursing department has actively involved with the establishment of the COVID testing lab in the institute. Further, it gave training to all the staff in donning & doffing of PPE, management of Covid patients on ventilators and cleaning & waste management.
- Classes were given to relatives of patients on hand washing and use of face masks by the nursing department.
- Four hourly cleaning in all units and 2 hourly surface cleaning for frequently touching areas such as OPDs were ensured.
- Regular rounds by infection control team and nursing officers.
- Accommodation was arranged for staff in nursing hostels, and a nearby hotel during the lock down period.
- The morale among staff and students remained high.
- Online teaching was ensured to the Resident who was on quarantine due to the stipulated regulation.
- A patient from adjacent medical college COVID ward was transported by the red protocol recommended by the ICT of medical college Trivandrum and SCTIMST

and the necessary interventional procedure was performed on 19th May 2020 which highlights the coordination with other departments in other institutions.

Shortcomings, Deficiencies, and Mistakes

- Lack of co-ordination and lack of proper communication between departments have resulted in unnecessary mental tension for the staff on duty during the initial days. This problem was solved by more inter-departmental discussion meetings.

- Clinical discussion for students suffers a lot as direct contact with patients is reduced and much of the discussion happens over video conferencing.

- Service support of many companies were not available during the lockdown period for the equipments.

d. Initiatives by Raman Research Institute, Bangalore

The Institute took proactive steps to respond to the emerging situations on account of COVID 19 from time to time.

1 March 2020 – The Institute stopped visits by students from schools and colleges in an around Bengaluru and elsewhere who usually visit as part of the Institute's science outreach efforts.

15th March 2020 – The Institute went into 'Work from Home' mode as per the State Government orders, which was followed by nationwide lockdown. During the lockdown, the Institute ensured that full wages were paid to the casual labour on time to provide them with financial stability. Students were advised before the nationwide lockdown to decide on their stay in hostels. Accordingly, one half of the students went home. For the remaining students who were residing at the hostels, all necessary arrangements were made to ensure their safety.

27th April, 2020 – The Institute started working with minimal staff as per the government orders. All the government orders with reference to the attendance of staff were adhered to. Necessary safety precautions like Thermal scanning, Sanitizers, Hand wash, cleaning the surfaces with disinfectants were taken up as per the guidelines issued by the government.

3rd June, 2020 – Home quarantine facility for returning students along with detailed guidelines based on government quarantine norms. The guidelines also included safety procedures upon arrival, food arrangements and emergency contacts.

Initiatives – The Institute is putting in place foot operated sanitizer dispensers, foot operated door knobs and water taps to reduce the human touch points across the campus. To continue the academic traditions of the Institute during the lockdown virtual platforms were used to hold research discussion meetings, seminars etc.

Science Communication – Theoreticians at the Institute wrote a popular article titled "Mathematical models for the spread of CoVID 19: an explanation for non-scientists. This

was widely shared on the Institute's social media platforms. The Institute has been sharing DST's e-newsletters - a compilation of the most relevant initiatives and efforts taken by the Government of India on COVID-19. The Institute has also been posting and retweeting COVID 19 related posts and tweets of the Honourable Minister of Science and Technology and the Department of Science and Technology.

(e) Initiatives by Wadia Institute of Himalayan Geology, Dehradun

Wadia Institute of Himalayan Geology (WIHG), Dehradun has reacted immediately after the spread of the pandemic Covid-19. Following are some of the WIHG responses in relation to the spread of the disease.

a) Institute was to organise an International workshop on the 'Assessment and Mitigation of landslides in the Himalaya' during March 13-14, 2020. The response to this workshop from across the country and also from abroad was very good, and ~80 researchers from India and ~ 7 from abroad were expected to participate. However with the spread of the Covid-19, Institute took an apt decision to postpone the said workshop.

b) During the early days of lockdown, the employees of the institute along with its alumni and the retirees, contributed a respected sum and donated 100 PPE kits for the doctors and 100 Ration kits for the needy to the state government official. This gesture was greatly appreciated and thus the state government conferred the title of 'Corrona Warriar' to the Director, WIHG, Dr Kalachand Sain. This event was widely covered in the local media.

c) The employees of the Institute contributed a part of their salary to the PM Cares fund

d) In order to maintain the proper hygiene at low cost, the scientists and laboratory staff of the institute have prepared indigenous sanitizer that are being used by its employees.

e) The lockdown is first of its kind in the human civilised history, therefore in order to understand its effect on the geological system of the Himalaya, particularly on the fluvial systems in the Ganga and Yamuna rivers, Institute has initiated a study towards this. For this, samples of the river water and sediments covering the Ganga and Yamuna valleys of the Garhwal region has been collected during May 04-05, 2020. The collected water samples were analysed in the laboratory. The preliminary measurements on stable isotope composition ($\delta^{18}O$ & δD) indicate towards a dilution effect as they fall close to Global Meteoric Water Line (GMWL). Subsequent fieldwork from June 11-14, 2020 after the release of the lockdown will be undertaken to testify any compositional change in the fluvial systems.

f) Institute has a network of automated weather stations (AWS) in the vicinity of the Gangotri, Dokriani, Chorabari and Pindari glaciers in the Upper Ganga basin and a black carbon (BC) monitoring system near the Gangotri Glacier. Institute is eager to assess any change in the atmospheric concentration of BC during the lockdown period

and the anthropogenic activities, and this will be assessed in the high altitude field season that will start soon.

g) In addition, the Institute honestly followed all the advisory and guidelines of the state government and the Ministry of Health & Family Welfare and the Ministry of Home Affairs, issued from time to time.

f. Initiatives by National Innovation Foundation

1. National Innovation Foundation – India (NIF), an autonomous institute under the Department of Science and Technology, Govt. of India has come up with a call inviting innovative citizens to participate in its Challenge COVID-19 Competition (C3).

2. Interested innovators are welcome to participate with their creative ideas and innovations for problems or issues like reducing transmission of Coronavirus through original creative ideas, innovations, which can supplement the efforts of the government in slowing or eliminating the spread further, innovative ideas which can make activities like sanitizing one's hands, body, and home items etc.

3. Ideas are also invited for gainful engagement of people at home, healthy food for nutrition and boosting immunity especially at the time of lockdown when raw materials are limited, (Personal Protective Equipment) PPE's and rapid diagnostic testing facilities for capacity building of healthcare and other areas.

g. Initiatives by Survey of India

1. DST has created an Integrated Geospatial Platform out of available geospatial datasets, standards-based services, and analytic tools to help decision making during the current COVID-19 outbreak and aid devising area-specific strategies to handle the socio-economic impact in the recovery phase.

2. The platform is initially expected to strengthen the public health delivery system of the State and Central Governments and subsequently provide the necessary geospatial information support to citizens and agencies dealing with the challenges related to health, socio-economic distress, and livelihood challenges.

3. The mobile application SAHYOG as well as the web portal (https://indiamaps.gov. in/soiapp/) prepared and managed by the Survey of India (SoI) has been customized to collect COVID-19-specific geospatial datasets through community engagement to augment the response activities by Government of India to the pandemic.

h. Initiatives by TIFAC

❖ The Technology Information, Forecasting and Assessment Council (TIFAC), released a White paper on 'Focused Interventions for 'Make in India': Post COVID 19' . The White Paper captures sector-specific strengths, market trends, and opportunities in

five sectors, critical from the country's perspective that include, healthcare, machinery, ICT, agriculture, manufacturing, and electronics with reference to supply and demand, self-sufficiency and mass-scale production capacity.

❖ It has identified policy options primarily in the areas of Public health system, MSME sector, Global relations: FDI, recalibrated trade alignments, new-age technologies, etc.

❖ This is important for the development of technology clusters in champion segments, creating Technology Start-up Exchange, identifying, supporting, and piloting ten blockbuster technologies and collaborating with new dynamics with incubators of Israel, Germany, towards promoting import substitution as well as evolving technology platforms in sunrise technologies.

❖ The recommendations are directed towards giving immediate technology and policy impetus to make India "ATMANIRBHAR". Based on the linkages and interdependencies between the outputs of different sectors, output multiplier and income multiplier for various sectors have been presented in the paper.

i.   Initiatives by CeNS

a. Comfortable face mask designed by CeNS could encourage public to use it for long hours

A team of researchers at Centre for Nano and Soft Matter Sciences (CeNS), Bangalore, an autonomous institute of the Department of Science and Technology, have developed a cup-shaped design (patent filed) of the mask that helps to create enough space in front of the mouth while speaking. It has been transferred to a Bangalore based company for mass production.

This snug fit mask causes no speech distortion, no fogging on glasses, and indeed, packs well all around, leaving practically no room for leakage while breathing. Another important advantage is its high breathability allowing one to wear it without any discomfort. Further, the researchers have chosen the fabric layers such that there is a possibility of deactivating pathogens sheerly by the electric charges that may prevail under mild friction due to the triboelectric nature of the fabric. These advanced-level tests are being carried out.

With the increase of active COVID cases in India and other countries, usage of face masks has been advised for the general public. While the healthcare professionals can use the special and high technical quality medical masks, for the general public, a mask with moderate filtering efficiency should suffice. It should be comfortable to wear to encourage public to wear it for long hours.

CeNS has transferred this technology to Camellia Clothing Ltd., a Bangalore based garment company, established a couple of decades ago. The company wishes to produce and sell around one lakh mask per day through different distribution channels throughout India.

b. CeNS uses electrostatics of materials to develop Tribo E mask to protect healthy individuals from COVID 19

Face masks used by frontline healthcare professionals, which are of high technical quality, need special expertise for production, while a simple face mask that can contain the spread of the Corona virus is advised for the general public.

Such a mask, though rudimentary in its action for containing the viral diffusion across the fabric layer, is expected to reduce the transmission of micro-droplets that linger in the air even during a simple conversation, let alone sneezing. Simple, often, homemade ones are advised for healthy individuals rather than those meant for health workers as there is limited supply of the latter. If only the choice of the fabric can be made intelligently, the mask can serve the purpose more efficiently.

A team of researchers at the Centre for Nano and Soft Matter Sciences (CeNS), Bangalore, an autonomous institute of the Department of Science and Technology (DST), have come up with a recipe for making face masks, termed as Tribo E Mask, that can hold electric charges to restrict the entry of infections but interestingly, without any external power.

The innovation by Dr. Pralay Santra, Dr. Ashutosh Singh, and Prof. Giridhar U. Kulkarni 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. They have used this electric field, quite strong at proximity, to deactivate or possibly even kill the germs.

The mask is three-layered –a layer of nylon cloth sandwiched between polypropylene layers, the latter sourced from commonly used non woven grocery bags. 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. 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.

Tribo E mask comprising of polypropylene layers on the outside and nylon layer in between. When the layers are rubbed against each other, static electricity is produced, which is expected to restrict the possible transmission of infections.

j. Initiatives by JNCASR

a. JNCASR develops versatile coating to stop spread of viruses like influenza and COVID 19

An antimicrobial coating, developed by Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, an autonomous institute under Department of Science & Technology (DST), has shown excellent results in tackling the spread of deadly influenza virus, the root cause of severe respiratory infections, by inactivating large loads of influenza virus. The Science and Engineering Research Board, a unit of the DST is supporting the further development of this coating for the country's war against COVID-19.

The proven efficiency of the coating in 100% destruction of influenza virus (an enveloped virus) shows that the coating may be effective in destroying COVID 19 – another enveloped virus upon contact. The technology which is simple and hence do not require skilled personnel for its development is already set to be tested against COVD 19. If found to be active, a number of PPEs, such as masks, gowns, gloves, face shields, used by doctors and nurses can be coated with it, imparting enhanced protection and safety to them. This will aid them to fight the battle against COVID 19 more effectively.

The technology has been developed by Prof. Jayanta Haldar's group at JNCASR including Mr. Sreyan Ghosh, Dr. Riya Mukherjee and Dr. Debajyoti Basak. The compound that the

scientists have synthesized for the coating is soluble in a range of solvents such as water, ethanol, methanol and chloroform. Aqueous or organic solutions of this compound can be used to coat different daily life and medically important materials, such as textiles, plastic, PVC, polyurethane, polystyrene, in a single step. The coating displays excellent antiviral activity against influenza virus completely killing them within 30 minutes of contact. It disrupts the membranes of pathogens (i.e. bacteria) leading to their death.
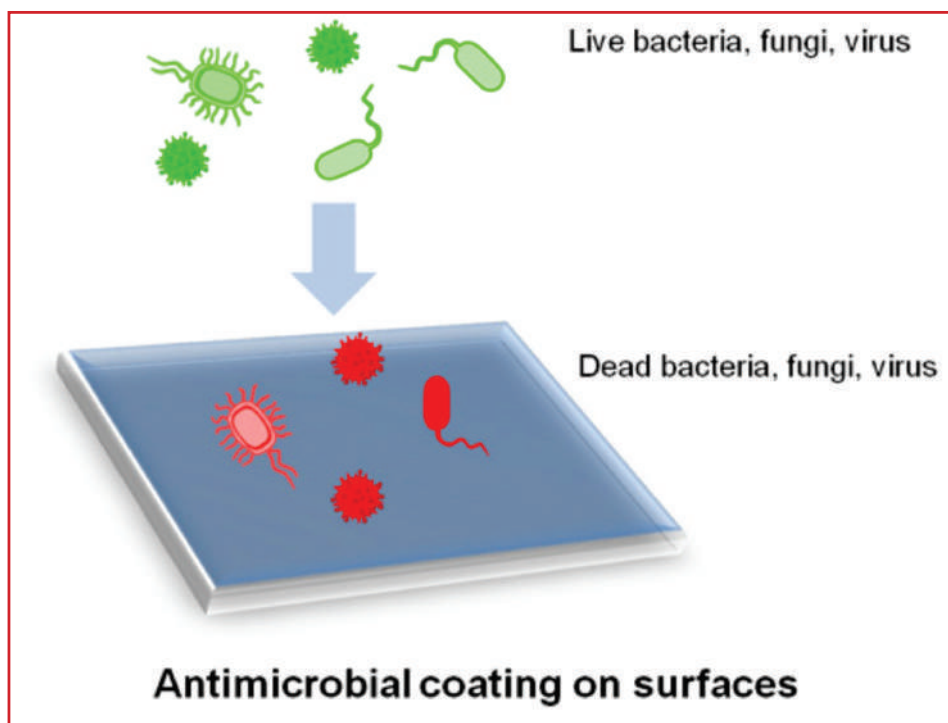
During the research, the coated surfaces also completely killed different drug-resistant bacteria and fungi such as methicillin resistant *S. aureus* (MRSA) and fluconazole resistant *C. albicans* spp, respectively, most of them with 30 to 45 minutes, thus displaying rapid microbicidal activity. The cotton sheets coated with the compound showed complete killing of more than a million bacterial cells.

Molecules have been designed to achieve optimum solubility in a wide range of solvents using a cost-effective three to four step synthetic approach with easy purification and high yield. Besides, the coating can be fabricated on a variety of surfaces with ease and simplicity of the technology eliminates the necessity of skilled personnel for its development.

b. Launch of a COVID Diagnostic Training Centre at JNCASR

Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), has established a state-of-the-art COVID Diagnostic Training Centre at its Jakkur campus to help build capacity for the national fight against COVID 19 pandemic.

Molecular diagnostic techniques, such as the real-time PCR, play a crucial role in the diagnosis and tracking of epidemics, including COVID-19. Unfortunately, India lacks personnel skilled in and adept at performing a real-time PCR in clinical diagnostics. Appreciating the crucial and unmet needs of the nation, JNCASR has embarked upon a campaign by establishing a state-of-the-art diagnostic training facility to train personnel in a real-time PCR for COVID-19. The primary objective of the program is to train multiple batches of trainees, 6-10 trainees per batch, in real-time PCR.

The program envisages training people in multiple and sequential batches over the coming months through crash course spanning over a week. The first batch has undergone training from June 16 to 22, 2020, at COVID Training Facility, JNCASR.

The comprehensive crash-course spanning over a week comprises of both classroom lectures and laboratory experiments. The course is designed to impart theoretical knowledge as well as hands-on training. The practical laboratory sessions have taught the participants the processing of infectious samples, nucleic acid extraction and preservation, real-time PCR and other molecular techniques, data analysis, and, importantly, standard operating protocols (SOP) of a clinical diagnostic facility. Only simulated samples, not containing an infectious virus, has been used for training. Following the course, the trainees will be well-positioned to join a clinical diagnostic facility and handle samples in a clinical setup and perform a real-time PCR for not only COVID but any infectious organism.

The program is open for young candidates with a graduate or post-graduate degree in medical laboratory testing (MLT degree) offered by any medical institute in India. Personnel currently engaged in clinical service, and diagnostic laboratories are especially encouraged to apply for the training. Registered personnel are offered a suitable remuneration in addition to free boarding and lodging by the institute.

c. A predictive model by JNCASR can help prepare for medical needs for COVID 19

A team of researchers from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) an autonomous institute under the Department of Science &Technology (DST), Government of India along with collaborator from IISc Bengaluru have developed a heuristic predictive model for COVID-19 that provides short-term predictions about the evolution of the disease and the medical needs that are generated as a consequence.

The model focuses on the 'Achilles' heel' of COVID-19 response – medical inventory management. By providing key figures for medical inventories such as PPEs and ventilators, this model can greatly aid a systematic and meticulously planned response to the pandemic. It will provide a full layout of the medical inventory needs, including intensive care, acute care, and medical supplies requirements, district-wise, for the coming weeks. It will also provide a pan-India overview of the development of the pandemic, but also a state and district-level insight into its progress.

This research is under review, and a version is available in the public domain at medRxiv. The work was carried out by Prof. Santosh Ansumali and Dr Meher Prakash from JNCASR along with Prof. Aloke Kumar from IISC as an initiative of the office of the Principal Scientific Advisor to Government of India along with Prof P. Sunthar IIT Mumbai and a team from AFMC Pune led by Lieutenant General (Dr) Madhuri Kanitkar. The initial motivation for the work was a request from the Caring Indians team, which is a crowd-sourced response to the pandemic. When this crowd-sourced project started, a key question was what will be India's projected need for critical medical supplies such as PPEs, ventilators, and so on.

Responding to the question, the team assessed that most modeling and forecasting work for COVID-19, focusing on India, was clustered around the popular epidemiological models like Susceptible-Infected-Recovered (SIR) model. These models have a serious shortcoming because many aspects of the disease are yet unknown, and models were proceeding with 'educated guesses' on key parameters. However, they realized that in many nations, COVID-19 evolution had key similarities, and as these nations were ahead in the curve, these key similarities could be exploited for predictive heuristics -- allowing rapid calculation of disease evolution.

Prof. K.R. Sreenivas, Chairman, Engineering Mechanics Unit, JNCASR, says that the adoptive model is successful in monitoring the progression of the disease and is handy for planers to mitigated Covid19 crisis in India.

According to Dr. M. Vidyasagar, FRS, National Science Chair and Distinguished Professor: The predictive model for the progress of COVID-19 developed by Profs. Ansumali and Kumar is quite novel and has wider applicability than almost any other existing model. The model can help Indian authorities to get accurate projections of the requirements for critical resources such as ICU beds, ventilators, and the like.

k. Initiatives by ARCI

a. ARCI develops UVC-based multipurpose disinfection cabinet for containing surface contamination of COVID 19

International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), an autonomous R&D Centre of Department of Science and Technology (DST), Govt. of India and MEKINS Industries have co-developed a UVC-based Cabinet for disinfecting non-critical hospital items, laboratory wear, and PPEs in the research laboratories to prevent surface contamination of COVID 19.

It can also be used to disinfect items exhibited to customers in commercial establishments and several domestic items.

India was successful in controlling the spread of COVID 19 caused by the SARS COV2 virus during the first few phases of lockdown due to strict implementation of COVID 19 guidelines. But, with relaxation of the lockdown, there is a chance of slow spread of disease due to the movement of people across the country, and this is predicted to continue for some time. Transmission through surface contamination is an unpredictable risk in which common utilities play a key role.

The best way to deal with this transmission is by a dry and chemical-free rapid disinfection through exposure to UVC light. UVC irradiation with 254 nm is strongly absorbed by RNA part of COVID-19, leading to molecular structural damage via a photodimerization process and thus inactivating it. UVC exposure is the best known among the methods to disinfect virus-prone objects, including stethoscopes, blood pressure measuring equipment, patient care items, mobile phones, wallets, laptops, reusable laboratory gloves, lab coats, micropipettes, smaller measurement equipment, papers and so on. As the extent of disinfection is proportional to the UVC dose received by a contaminated surface, designing a UVC system with proper engineering is very critical to get the best results.

A compact UVC disinfection cabinet co-developed by ARCI and MEKINS, a Hyderabad based company, consists of 4 UVC lamps of 30W (on sides) and 2 lamps of 15 W (top and bottom). It gives a flux sufficient to disinfect articles of various dimensions placed in shelves separated by metal grilled frames to allow sufficient light from all sides. For the safety consideration and to avoid direct exposure of UVC light to the user, the lamps switch on only when the door is locked. The irradiance intensity is measured at various points within the box to assure sufficient radiation to disinfect all the placed articles within 10minutes. The partition frames in the cabinet are removable so that even bigger objects like lab coats, blazers, suits can be disinfected when required. The UVC cabinet is multifunctional and very promising for establishments including research and academic institutes, corporate offices, hospitals, clinics, nursing homes, hotels, restaurants and other commercial establishments, including domestic usage for fighting COVID 19.

b. Hand sanitizer prepared by ARCI provided to police personnel on duty during COVID 19 crisis

Considering the scarcity of hand sanitizers in the market, International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI), Hyderabad, an autonomous R&D Centre of Department of Science and Technology (DST), Govt. of India, has produced hand sanitizer as per the WHO standards and distributed it among police personnel in Hyderabad, students, and staff of the institution. A team of scientists, students, and staff voluntarily came forward and produced about 40 liters of sanitizer.

The complete Idea of production, packaging, and distribution was completed in just 6 hours. Meanwhile, the order of lockdown was announced, and many of the students were leaving for their home towns. For their safety, a bottle of hand sanitizer and a face mask was given to most of them who were traveling. The sanitizer was also distributed to all the security staff, people working in the canteen, scientists, and also placed at common areas and entry gates. Team spirit, desire to contribute in disaster management, care, and concern about the ARCI family made this possible within a very short time.

Subsequently, given the risk being taken by the police personnel who are working relentlessly to enforce the social distancing, ARCI Director Dr. G Padmanabham directed the team to increase the preparation of sanitizer so that it can be distributed among them. Accordingly, a substantial quantity of sanitizer was prepared and handed over to Shri Sunpreet Singh, DCP, Rachakonda Commissionerate by ARCI's Senior Scientist Dr. R Vijay.

The Deputy Commissioner of Police, while appreciating the support extended by the scientists, requested for more quantity to provide for as many personnel as to possible. ARCI has made all arrangements to produce large quantities of sanitizer and provide it in easy to dispense 100 ml bottles, which the police personnel can easily carry with them in their pockets. Each bottle could last more than a week for each police personnel.

Dr. Padmanabham conveyed his appreciation to all the team members who contributed to this effort and encouraged them and other scientists to come up with more ideas to fight COVID 19.

In order to stop the spreading of dangerous corona virus, it is recommended that hands, staircase railings, door handles, "IRIS" biometric machine keys, common equipment, office vehicles are to be cleaned by sanitizer.

The team who had made 40 liters hand sanitizer within a few hours

Dr. R. Vijay handing over the hand sanitizer bottles made at ARCI to Shri Sunpreet Singh, DCP, Rachakonda Commissionerate

CALL FOR PROPOSALS AND EXPRESSIONS OF INTEREST

DST invites short-term proposals for developing antiviral Nano-coating and Nano based material for scale-up by industry and startups to combat COVID-19

- DST using the SERB 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).

- The technology then can be transferred to a partnering industry or start-up for scale-up. Such Nanocoatings could contribute immensely in the emerging health care requirements in India's fight against the COVID-19 pandemic.

- This call is for bringing the Academic groups and relevant Industrial Groups together for submitting proposals to DST's Nano Mission. It encourages multidisciplinary efforts and collaboration with industrial partners for scaling up production within a year.

Special Call under SATYAM to fight against COVID-19

- DST invites concept note under 'Science and Technology of Yoga and Meditation (SATYAM)' for the appropriate intervention of yoga and meditation to fight against COVID-19 and other similar kinds of viruses. This special call aims to provide assistance to our society in today's critical condition arises due to pandemic COVID-19. The project may address on Improving immunity, Improving respiratory system, Stress, anxiety, depression and others.

- The concept note may be submitted at e-PMS (onlinedst.gov.in) till 30 April 2020.

Call for Expression of Interest - 2nd Set of Products

- SCTIMST, Trivandrum an Institute of National Importance under DST has developed designs and know-how for several products to combat the COVID 19 pandemic crisis.

- Sree Chitra is interested in transferring these designs and know-how to entities that can manufacture and make it available to users. Expression of Interest (EoI) is invited from interested entities for this purpose.

Expression of Interest for Developing and manufacturing Devices for the fast track Programme for COVID-19 Pandemic

- SCTIMST, Trivandrum invites manufacturers/startups/social groups who are interested to co-develop and manufacture medical devices on a fast track mode to support the distressing situation the epidemic COVID 19 has created for the development of Ambu bag based Ventilator, Ventilator Sharing Kit, Battery Operated Assistive Breathing Unit, Isolation Pods, Disposable Safety Face Shield and Deployable Field Units.

SERB invites proposals on COVID-19 & related respiratory viral infections

- SERB a statutory body of the DST invites proposals as part of special call under IRHPA (Intensification of Research in High Priority Area) scheme designed explicitly for COVID-19 and related respiratory viral infections to ramp up national R&D efforts for new antivirals, vaccines, and affordable diagnostics.

TDB invites technology proposals for fighting COVID 19

- TDB a statutory body of DST invites proposal applications from Indian companies and enterprises to address protection and home-based respiratory intervention for COVID-19 patients.

- The proposal may include technologically innovative solutions like low-cost masks, cost-effective scanning devices, technologies for sanitization of large areas as well as for contactless entry, rapid diagnostic kits and oxygenators, and ventilators.

CALL FOR PROPOSALS UNDER BI-LATERAL INTERNATIONAL COLLABORATIONS

Call for Proposals: Indo-U.S. Virtual Networks for COVID-19

- The Indo-U.S. Science and Technology Forum (IUSSTF) announces a Call for Proposals for COVID-19 Indo-U.S. Virtual Networks allowing Indian and U.S. scientists and engineers currently engaged in COVID-related research to carry out joint research activities

- IUSSTF encourages proposals that convincingly demonstrate the benefits and value of the Indo-U.S. partnership to advance research and address critical challenges related to COVID-19.

- These network projects could be of two types: Knowledge R&D Networks and Public-Private Virtual Networks.

- Last date of submission: 15 May 2020

United States - India Science and Technology Endowment Fund COVID-19 Ignition Grants

- IUSSTEF would select and support promising joint U.S.-India S&T based entrepreneurial initiatives that address the "development and implementation of new technologies, tools, and systems to address COVID-19 related challenges including monitoring, diagnosis, health and safety, public outreach, information and communication".

- USISTEF would also consider proposals related to technologies/products that can be re-purposed to address COVID-19 in the current scenario. USISTEF encourages projects that demonstrate a high degree of innovation leveraging advances in science and technology.

- Last date of submission: 15 May 2020

6.   Media Coverage of DST initiatives on COVID-19

There have been widespread coverage of initiatives launched by DST and its institutions both in national and local media. There has also been considerable media coverage in digital and print media. There was some good coverage in electronic media too.

The Vigyan prasar, an autonomous institution of DST has been bringing out a weekly bulletin on *"Science and Technology Efforts in India on COVID-19"* since 5th April,2020.

India Science Channel/OTT, a dedicated science channel run by Vigyan Prasar, an autonomous institution of DST, has been covering COVID-19 related activities and news since March,2020.

7.   Research papers published and submitted

COVID-19 has impacted almost every sector. R&D is no exception. India made some outstanding progress in R&D in last few months. These success stories have unfolded due to an exceptionalsharing of purpose, synergy, collaboration and cooperation that R&D institutions, Academia and industry have demonstrated in these months. There have also been severalcompelling lessons from COVID-19 in relation to our R&D.

8.   R&D in India in post COVID-19 era: Major Lessons

Based on the experience and learning of last 3-4 months since the COVID-19 was around, following are a few important observations and likely impact of COVID-19 on R&D –

a.   Need for having short-duration projects to address immediate challenges and deliver results in shortest possible time. Generally, most of the R&D projects are supported by government agencies for a period of 3 to 5 years. The COVID posed a new challenge to evolve quick solutions in shortest possible time, more so in case of development of COVID related technologies that need to be delivered to industries for production.

b.   The boundariesamong private, public, national laboratories, academic institutions are to be dissolvedin the cases where a strong collaboration is required for problem solving. In the last few months it has been amply demonstrated that R&D institutions, labs, academia, startups and industry when they work together, can come up with solutions in a rapid mode to meet the challenges posed by COVID-19.

c.   COVID-19 is likely to have major impact on Domestic and International Travel not just in short term but also in medium terms say for a period of another 2-3 years. On the positive side, this will conserve resources and time especially on international R&D collaborations. SOPs and new normal for the efficient conduct of remote meetings will be fully evolved.

d.   COVID-19 has already impacted the way we used to have meetings and conferences. Having virtual meetings in the form of webinars may become a new normal even after COVID-19

has gone. This is considered as one of the biggest gain to R&D as such virtual meetings help save time, money and most importantly, ensure greater attendance and participation reaching to much larger audiences that will be a vital factor in democratization of science.

e.   COVID-19 may have some impact on field and institutional visits by students, experts and professionals that might become little restrictive in short term, but will improve with time. Infrastructure and processes for remote carrying out of experiments and instructions need to be evolved.

f.   COVID-19 may promote more "Profound" research than "Incremental" to achieve multi-fold jump in R&D. That would entail a more risk taking research.

g.   There may be greater alignment with national priorities and programmes for R&D to focus on "Quality" and "Relevance"

h.   COVID-19 has impacted science and scientists world over. A large number of People of Indian Origin and NRIs have already expressing their interest to help India in R&D, many of them may also like to return to India. This may be a big "Brain Gain" for Indian R&D.

9. Concluding Remarks and Way forward

We will retain and institutionalize the best of lessons learned during the time of virus as presented above to accelerate the growth and translation of relevant S&T with speed and scale by an early participation of industry/stratups for an Atmanirbhar Bharat.

Plus the nation will be fully ready to meet any new pandemic of the future much faster and with enhanced effectiveness.

The overarching factors which need to be addressed are:

- Defining clear and present objectives for product and technology needs in different sectors with industry and line ministries.

- Structures and processes for coordination and cooperation among academia, labs, startups, line ministries and industry.

- Flexibilities in the structures and processes needed for problem solving with speed and scale.

The interventions needed are:

❖ Creating a seamless end-to-end knowledge generation/consumption chain from relevant, early direction R&D to translation to design and prototyping to startups/industry/market/ society by directed partnerships.

❖ Identification of products/technologies to be developed in health, agriculture, transport, energy, water, environment, digital mapping, education, etc for their time-bound

development with industry partnership.

❖ Be fully future ready in strong partnership with industry with flexibility required in the emerging areas of Artificial Intelligence and applications; Clean Fuels and energy; Quantum Technologies; and other hybrid Digital-physical Technologies for manufacturing and services, etc.

❖ Direct and incentivize collaborative approach to problem solving rather than fragmentation of the problem attempted by different scientists/groups.

❖ Create network of institutions (R&D labs, universities, IITs, industry, startups) for developing technologies and products based on national priorities in models such as a tertiary web of Hub, Spokes and Spikes (individual projects that assemble to the big picture).

❖ Processes for efficient review, monitoring and evaluation of projects that brings in transparency and accountability together with a way forward for the outcomes to reach industry/society.

❖ Projects/centers/schemes/missions supported shouldall embed the above elements.

❖ Incentivize industry R&D participation and facilities for developing critical needs with or without public sector partnership. This includes not only tax breaks, soft loans, interest subvention and grant support for the high risk products, but also preferred market access and conveying a clear intent of the products required by the government.

❖ A map of technologies and capabilities available with industry, startups and academia/labs need creation and constant updating to be able to engage, leverage and activate latent capacity at a short notice.

❖ The concept of L1 in the government purchases needs to be replaced by the concept of 'Cost to the Nation'. This for example takes into account the jobs created and the money retained here versus outside of India.

❖ Continuation of standing groups of scientists in two critical areas: (1) Modeling and analysis group that will refine their tools to have a robust National Supermodel in readiness so as to make prediction based decisions; (2) Artificial Intelligence based hubs for rapid response on diagnostics and planning.

❖ Continuous mapping of relevant startup and industry for their capability and capacity, which could be activated at a short notice.

❖ An extraordinary 10x push to innovation and startup ecosystem within the next 4 years at 4x of investment by a new scheme on distributed startups.

- ❖ Creation of an army of highly accomplished startup mentors who are dedicated to the cause, not necessarily looking for their own financial profit. This plan on a pilot scale is already seeded to help the startups that were chosen for funding.

- ❖ Digital push in all technologies including effective remote access to R&D infrastructure and human resources.

- ❖ Creation of technologies for an independent electronic backbone ecosystem.

- ❖ Reorientation of PhD research, which is the backbone of R&D and creation of human resources, by training and mentoring and appropriate orientation to make some of them relevant for industry.

- ❖ Need far more extensive and strong science communication which reaches and appeals various segments of society.

- ❖ Seeking continuous feedback of stakeholders such as scientists, external committees etc on the effectiveness and functioning of officials and schemes for course corrections.

- ❖ Many of the above tasks are not done in an efficient and effective manner by ministry officials and external expert committees and consultants as these tasks require vision and continuous engagement that is full time. MoST needs to engage over 200 young professionals and scientists from academia and industry on deputation for a period of about 1-3 years to formulate, drive, monitor projects/schemes and advance the outcomes.

Department of Science and Technology
Ministry of Science & Technology
Govt. of India