Projects initiated by IIT Bombay for COVID-19 mitigation

Status updates

November 2020

Sr.	Project Title	Faculty	Status
Area of Work: Antiviral drug / molecule synthesis			
1	Antibody based capture of 2019-nCoV and its inactivation using lipid based in-situ gel	• Prof Kiran Kondabagil, BSBE • Prof. Rinti Banerjee, BSBE • Prof. Shamik Sen, BSBE • Prof. Ashutosh Kumar, BSBE	• DST approved 1-year project • Bioinformatic analysis completed; Polyclonal antibody that will be used is established to be effective against all the variants of SARS-CoV-2 strains • Gel formulation optimization completed • Successful entrapment of antibody in the gel has been shown • Proof of principle demonstration of capture of a surrogate virus by the gel entrapped viral antibodies is currently underway • Labelling of SARS-CoV-2 antibodies being carried out to optimize the antibody concentrations required for entrapment and develop capture assays using SARS-CoV-2 component/s

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Area of Work: Antiviral drug / molecule synthesis			
2	Identification of global metabolite biomarkers in COVID-19 infected patients for targeted therapy	• Prof. Sanjeeva Srivastava, BSBE	• DST approved 1 year project • Proteomics analysis carried out for 18 COVID +ve, 11 recovered and 7 true -ve swab samples • SARS-CoV-2 peptides detected and validated using MRM (multiple reaction monitoring); Significant proteins and pathways in host-response identified • Two patents filed and manuscript communicated • Untargeted metabolomics analysis carried out for 36 COVID –ve, 45 mild +ve and 34 severe +ve samples • Comparison of swab and plasma metabolomics revealed that plasma samples showed better results in terms of numbers of metabolites detected • Significant metabolite markers detected for analysis of disease progression; Plasma metabolomics manuscript under preparation

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Area of Work: Antiviral drug / molecule synthesis			
3	Plasma proteomic analysis of COVID-19 patients to identify the potential biomarkers and therapeutic targets: A pilot study	• Prof. Sanjeeva Srivastava, BSBE	• IITB approved project for preliminary studies • 20 COVID –ve, 18 non-severe +ve and 33 severe +ve plasma samples processed for proteomic analysis • Significant number of differentially expressed proteins obtained; Peptides for the sample has been validated using MRM (multiple reaction monitoring) • Plasma proteomics manuscript under preparation • One patent to be filed

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Area of Work: Antiviral drug / molecule synthesis			
4	PICOVRID: Prophylactic nutraceutical and ayurvedic therapeutic  	• Prof. Rinti Banerjee, BSBE	• Can be used as a prophylactic nutraceutical for those at risk of exposure to COVID patient; and potentially as a therapeutic for those who are suffering from COVID-19 • Spice based actives which have antiviral and anti-inflammatory properties • Directly inactivate SARS-CoV-2; Reduces IL6 levels in lungs since due to complications of COVID • Licensed to two partners Medilabs India and Jagran Pehel; GMP manufactured • Several product formats available • To be launched commercially soon

Sr.	Project Title	Faculty	Status
Area of Work: Antiviral drug / molecule synthesis			
5	NANOSURF: Aerosols for pneumonitis and ARDS complications of COVID-19 	• Prof. Rinti Banerjee, BSBE	• Potential novel life saving aerosol formulations developed to address the cytokine storm of ARDS (Adult Respiratory Distress Syndrome) • Works both as a pulmonary surfactant and an anti-inflammatory drug • US and Indian Patents granted • Regulatory toxicology and stability in accordance with industry standards has been established • Aerosol and oral formulations are available as liquid and lyophilised forms for licensing • Clinical trials for emergency use underway

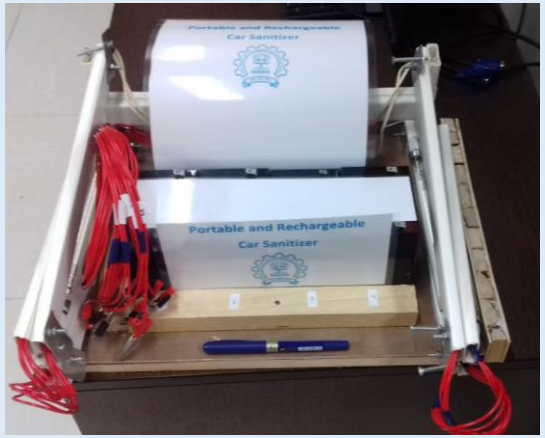
Sr.	Project Title	Faculty	Status
Area of Work: Antiviral drug / molecule synthesis			
6	TGuard: Antiviral nutraceutical and phytopharmaceutical	• Prof. Rinti Banerjee, BSBE	• Prototype of oral formulations developed on palm based constituents • Throat formulations for swish and ingest • Strong antiviral properties of actives • GRAS approved; stable and taste masked • Collaboration with Fine Organics • In vitro and in vivo evaluation planned • Clinical trial as prophylactic planned

Sr.	Project Title	Faculty	Status
Area of Work: Sanitization approaches			
7	ECORSANI: Phytoformulations for hand and body sanitizers, apparel spray, aerosols for room spray and surface disinfection sprays 	• Prof. Rinti Banerjee, BSBE	• Safe formulations developed for hand and body sanitizer, apparel spray, aerosols for room spray and surface disinfection sprays • Biodegradable, safe, GRAS (generally regarded as safe) formulations of biopolymers and essential oils which are alcohol-free and bleach free sanitizers and kill >99.9% viruses, bacteria and fungi • Directly inactivates the envelopes of viruses including SARS-CoV-2, inactivates bacteria by breakdown of their cell wall and also inactivates fungi • Non-irritant and safe for skin for extended use • Four products commercially available on Amazon, Flipkart and why2wait website: ➢ Ecorsani_H: Hand and body sanitizers ➢ Ecorsani_Apparel: Sprays for textiles, all cloth surfaces and clothes ➢ Ecorsani_S: Surface sprays ➢ Ecorsani_Aerosol: Aerosol sprays for room and public transport disinfection

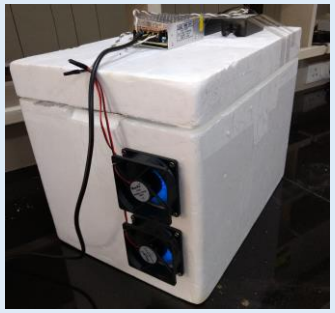
Sr.	Project Title	Faculty	Status
	Area of Work: Sanitization approaches (contd.)		
8	Portable UV sterilization unit  	• Prof. Ambarish Kunwar, BSBE • Prof. Kiran Kondabagil, BSBE • Prof. P. Kumaresan, IDC	• Portable cylindrical unit (approx. diameter 25 cm and length 36 cm); using one single germicidal UV tube for disinfection • Unit provides > 4 log inactivation of MS2 Phage for UV exposure of 90 seconds • Installed at IITB Hospital • Non-exclusive license given to one company so far • Product available for non-exclusive licensing

Sr.	Project Title	Faculty	Status
	Area of Work: Sanitization approaches (contd.)		
9	Portable Germicidal UV cabinet  	• Prof. Ambarish Kunwar, BSBE • Prof. Kiran Kondabagil, BSBE	• Cabinet with approx. volume of 45 cm x 45 cm x 35 cm for sterilization • Experiment conducted using MS2 Phage shows that 3 minutes exposure completely eliminates the virus (> log 7 inactivation) • Prototype being used by IITB Hospital • Non-exclusive license has been given to one company so far • Product available for non-exclusive licensing

Sr.	Project Title	Faculty	Status
	Area of Work: Sanitization approaches (contd.)		
10	Wheeled sterilization unit for large areas 	• Prof. Ambarish Kunwar, BSBE • Prof. Kiran Kondabagil, BSBE	• Wheeled unit for disinfection of empty rooms and/or large areas • Experiment conducted using the unit shows that 15 mins exposure completely eliminates MS2 Phage within 1 meter radius • Prototype being used by IITB Hospital • Non-exclusive license has been given to one company so far • Product available for non-exclusive licensing

Sr.	Project Title	Faculty	Status
	Area of Work: Sanitization approaches (contd.)		
11	Portable and rechargeable car sanitizer  	• Prof. Ambarish Kunwar, BSBE • Prof. Kiran Kondabagil, BSBE	• Car sanitizer unit which is portable and rechargeable • Unit can be kept in the trunk of the car when not in use • Currently the unit is powered via four 12V rechargeable batteries and total run-time depends on the battery's capacity • The prototype provides 9 log inactivation (99.9999999% inactivation) of MS2 Phage samples kept directly under illuminated zones inside the car for 35 mins • Product available for licensing

Sr.	Project Title	Faculty	Status
Area of Work: Sanitization approaches (contd.)			
12	Safe Biohazard Transporter  	• Prof. Ambarish Kunwar, BSBE • Prof. Kiran Kondabagil, BSBE	• Safe transporter used for inactivation, transport as well as safe disposal of solid and some liquid biohazards • Powered by single 12V rechargeable battery • Prototype currently being used by IITB • Proteomics Lab to bring inactivated COVID samples from hospitals • Product available for licensing

Sr.	Project Title	Faculty	Status
Area of Work: Sanitization approaches (contd.)			
13	Robotic disinfection unit 	• Prof. Ambarish Kunwar, BSBE • Prof. Kiran Kondabagil, BSBE • Prof. Leena Vachhani, SysCon • Prof. P. Kumaresan, IDC	• Robotic unit can be used for sterilization of public transport system and hospitals • Prototype is currently being tested for pathogen inactivation
14	Low-cost air disinfection unit 	• Prof. Ambarish Kunwar, BSBE • Prof. Kiran Kondabagil, BSBE	• Low cost air disinfection unit can be used to eliminate airborne pathogens using a combination of filtration and UV treatment • Prototype currently being tested for pathogen inactivation

Sr.	Project Title	Faculty	Status
Area of Work: Sanitization approaches (contd.)			
15	Surface spray for decontamination and antiviral action	• Prof. Soumyo Mukherji, BSBE • Prof. Suparna Mukherji, CESE	• Time dependent analysis of synthesized nanoparticles showed complete disinfection of MS2 Phage within 30-45 mins for 5 microlitre droplets with 5 million viral particles in each droplet • Funding of 25,000 USD sanctioned by Applied Materials • Successfully tested in clinical settings • Patent being filed
16	Sanitization solution for hands for Institute personnel	• Prof. Soumyo Mukherji, BSBE	• Hand sanitizers produced as per WHO protocol • Currently being carried out by IITB Public Health Office

Sr.	Project Title	Faculty	Status
Area of Work: Sanitization approaches (contd.)			
17	Development of incineration device for safe disposal of masks / gloves in hospitals and quarantine centres 	• Prof. Sandeep Kumar, ESE • Prof. Sanjay Mahajani, ChE	• Prototype fabrication completed • Successfully tested with N95/cloth mask and rubber gloves • Approvals not sanctioned by authorities of Dhule Municipal Corporation for testing in their quarantine center • Collaboration with Life Essentials and Metwiz Materials (a SINE incubated startup) • Testing to be carried at by these companies after product is ready

Sr.	Project Title	Faculty	Status
	Area of Work: Medical Devices		
18	CPAP Helmet: Respiratory support device for mildly distressed COVID-19 patients  	• Prof. Ramesh Singh, ME • Prof. Soham Mujumdar, ME	• Low cost ventilator for patients with mild distress level • Helmet-patient-interface has been engineered for optimal performance and has been manufactured to the design specifications • Tested comprehensively for mechanical integrity and flow performance at IITB • Stage I and II clinical studies are planned at IIT Bombay Hospital and Tata Memorial Hospital respectively. • Looking for partners with capability to manufacture and scale-up

Sr.	Project Title	Faculty	Status
Area of Work: Medical Devices			
19	Mechanized ambu-bag for COVID patients with moderate respiratory difficulties	• Prof. Ramesh Singh, ME • Prof. Soham Mujumdar, ME • Prof. Ankit Jain, ME	• Low cost ventilator for patients with moderate difficulties • Functional prototype ready; Its controls and sensors tested at Technocraft facility • Clinical trials to be conducted
20	Advanced ventilator for severely critical COVID-19 patients	• Prof. Ramesh Singh, ME • Prof. Soham Mujumdar, ME • Prof. Ankit Jain, ME	• Low cost ventilator for severely critical patients • Collaboration with Technocraft and Dr. Deopujari's team at Shree Clinics, Nagpur • Design iterations completed • First prototype developed using components of old ventilator • Fabrication of final prototype is awaited due to unavailability of indigenous components such as sensors and flow/pressure controllers

Sr.	Project Title	Faculty	Status
Area of Work: Medical Devices (contd.)			
21	Vi-SWAAS: ICU ventilator for COVID patients 	• Prof. B. Ravi, ME	• Full-featured ICU ventilator developed • Suitable for both adults and pediatric patients • Provides advanced modes of ventilation and automatic control needed in ICU • Technology licensed to Innvolution Healthcare, Bengaluru • Product testing carried out at Hinduja Hospital, Reliance Hospital, Kokilaben Dhirubhai Ambani Hospital, Sassoon General Hospital (Pune), Jehangir Hospital (Pune), … • Calibration training being provided to Innvolution Healthcare engineers at BETIC, IITB

Sr.	Project Title	Faculty	Status
	Area of Work: Personal protection		
22	DURAPROT: Reusable community masks with antiviral coating  	Prof. Rinti Banerjee, BSBE	• Wash resistant and safe antiviral coatings for reusable community masks • Easily gets crosslinked to fabrics, and inactivates SARS-CoV-2, other viruses and bacteria • Duraprot coated masks provide additional protection and are reusable • Indian Patents filed • Commercially available on Amazon India and on websites of Ants Innovation, Meemansa, and Jeevika Bihar along with Shilpygram. Also launched by SDM, Kerala

Sr.	Project Title	Faculty	Status
Area of Work: Personal protection (contd.)			
23	DURAPROT Plus: Reusable N95 plus masks with antiviral coating 	Prof. Rinti Banerjee, BSBE	• Safe antiviral coatings for reusable wash resistant N95 plus masks • Modification of cloth masks to provide N95 plus features along with self disinfecting nature • Easily gets crosslinked to fabrics, and cause wash-resistant hydrophobic coatings which inactivate >99.9% bacteria and viruses including SARS-CoV-2 • Superior N98 equivalent masks with >98% particle filtration for 0.1 to 0.3 micron particles, >98% viral filtration, hydrophobic surface with splash resistance with excellent breathability similar to cloth masks • Commercially available

Sr.	Project Title	Faculty	Status
Area of Work: Personal protection (contd.)			
24	Biodegradable antiviral plastic like films for face shields	• Prof. Rinti Banerjee, BSBE	• Environmentally friendly alternatives to plastic based PPE – face shields developed using biodegradable biopolymer composites • Indian Patent filed for biodegradable plastics for packaging • Prototypes of biodegradable films available • Antiviral properties of components ongoing • Scale up required through industry partner, Regulatory validation required • Can be used for face shields, PPE as ecofriendly alternatives

Sr.	Project Title	Faculty	Status
Area of Work: Personal protection (contd.)			
25	Design and development of PPE solutions: Face Masks	• Prof. P. Kumaresan, IDC • Prof. Purba Joshi, IDC • Prof. B. K. Chakravarthy, IDC	• Original design created, along with 9 DIY videos • Collaboration with Ecostyle, Padmavati Tapes & AS Industries • 50,000 pieces distributed to IITB community and NGOs
26	Design and development of PPE solutions: Low cost face shields	• Prof. P. Kumaresan, IDC • Prof. Purba Joshi, IDC • Prof. B. K. Chakravarthy, IDC	• Original design created • Collaboration with Ecostyle, Padmavati Tapes & AS Industries • 100 pieces distributed • Three more new designs created, which are easy to manufacture • Mask designs can be can be shared with interested industries

Sr.	Project Title	Faculty	Status
Area of Work: Personal protection			
27	Design and development of PPE solutions: Aerosol Box for hospitals	• Prof. P. Kumaresan, IDC • Prof. Purba Joshi, IDC • Prof. B. K. Chakravarthy, IDC	• Original design created • Collaboration with Ecostyle, Padmavati Tapes & AS Industries • Collapsible prototype developed • Seven boxes have been made and supplied to KEM hospital
28	Washable PPE coverall suit	• Prof. P. Kumaresan, IDC • Prof. Purba Joshi, IDC • Prof. B. K. Chakravarthy, IDC	• Original design created • Collaboration with Ecostyle, Padmavati Tapes & AS Industries • Prototype sent for certification was rejected • Working on new design currently

Sr.	Project Title	Faculty	Status
Area of Work: Personal protection (contd.)			
29	Urination attachment for PPE coverall suit	• Prof. P. Kumaresan, IDC • Prof. Purba Joshi, IDC • Prof. B. K. Chakravarthy, IDC	• Original design created • Product helps the healthcare professionals to urinate without removing the PPE coverall suit • Suitable for both male and female • Collaboration with Ecostyle, Padmavati Tapes & AS Industries • Prototype is being tested
30	Low cost temperature controller for PPE coverall suit	• Prof. P. Kumaresan, IDC • Prof. Purba Joshi, IDC • Prof. B. K. Chakravarthy, IDC	• Original design created • Product addresses the most pressing need of the healthcare professionals in terms of keeping the temperature inside the suit within a comfortable range • Collaboration with Ecostyle, Padmavati Tapes & AS Industries • Prototype under construction

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Area of Work: Diagnostics			
31	Tapestry Pooling	Prof. Manoj Gopalkrishnan, EE	• Algorithm developed that can provide guidance for pooling samples from patients using statistical modelling for COVID-19 detection • Samples from the same individual are tested in multiple pools at once • Based on all the results, the algorithm zeroes in on the individual who has tested positive across multiple tests as carrying the infection • This method makes the testing timeline shorter and provides a quicker screening platform

Sr.	Project Title	Faculty	Status
		Area of Work: Surveillance	
32	SAFE app for quarantine adherence	• Prof. Bhaskaran Raman, CSE • Prof. Kameswari Chebrolu, CSE	• App developed and shared with several agencies; awaiting response
33	CORONTINE: Tracking and tracing of asymptotic carriers during pandemic	• Prof. Ganesh Ramakrishnan, CSE • Prof. Manjesh K Hanawal, IEOR • Prof. Maryam Bhaghini, EE	• Tracking asymptomatic persons through GPS tracking systems • CORONTINE platform developed • Active integration in Orissa and Meghalaya • Partly used by BMC, Mumbai • In process of integrating with Arogya Setu • Complementing with telecom data for tracking / tracing • Currently, the app has been integrated with IoT as well

Sr.	Project Title	Faculty	Status
Area of Work: Surveillance (contd.)			
34	Privacy preserving contact tracing	• Prof. Bhaskaran Raman, CSE	• Software developed and released in open source domain
35	Contactless (video) surveillance at COVID-19 quarantine facilities	• Prof. Ganesh Ramakrishnan, CSE	• RTA (real-time application) solution deployed at different quarantine locations at IITB • Also used for crowd counting at select locations within the campus; and face recognition to ensure that people identified by the institute do not leave the premises • Collaboration with SrivisifAI Technologies

Sr.	Project Title	Faculty	Status
Area of Work: IT Solutions			
36	World Wide Help: IT solution for user-friendly, cost effective and customized information access on any topic and in any domain with humans-in-the-loop	• Prof. Kameswari Chebrolu, CSE	• App developed to connect people requiring help to those providing help via Phone calls or Whatsapp • Helpline operational at KEM Hospital: Medical advice to public by 40+ doctors across all specialities • Helpline set at IITB Hospital for telemedicine services • In process of setting up palliative care helpline for Kokilaben Hospital, with help of NGOs • Setting up of demand-supply hospital network (MIT, Stanford & Maharashtra Govt.)

Sr.	Project Title	Faculty	Status
Area of Work: IT Solutions (contd.)			
37	Small Bag App: e-token and online ordering system	• Prof. Bhaskaran Raman, CSE	• Implemented at IITB and local grocery stores • Requests from IIT Bhilai and IIT Bhubaneswar • Need help for outreach
38	Short-term projection of COVID-19 medical resources and inventory	• Prof. P. Sunthar, ChE	• Web application developed to provide a four-week projected requirement for various medical inventory across districts, states and at national level *https://covid19medinventory.in/*

Sr.	Project Title	Faculty	Status
Area of Work: IT Solutions (contd.)			
39	Lokacart: Platform for enabling MSMEs for e-commerce, inventory management and billing	• Prof. Ganesh Ramakrishnan, CSE	• Client & Admin apps, Admin web portal developed: - Lokacart App (B2C) - Lokacart Admin App - Lokacart Plus App (B2B) • Used by 15-20 farmer groups • Available in PlayStore • Tutorials in English, Hindi, Marathi • Taken up by several local grocery stores, farmer groups and BAIF (Bharat Agro Industrial Foundation) • Working out plans for more systematic and professional adoption; field level activities ongoing

Sr.	Project Title	Faculty	Status
Area of Work: IT Solutions (contd.)			
40	Lokavidya: Knowledge sharing platform for educational institutions	• Prof. Ganesh Ramakrishnan, CSE • Prof Preethi Jyothi, CSE	• Deployed at Ekal Vidyalaya, one of India's largest Educational NGOs to train their village level teachers (Link) • Investigating collaborations with larger school bodies like Kendriya Vidyalaya Sangathan, Zilla Parishad Schools, Navodaya Vidyalaya as well as private schools who do not have their own distance education infrastructure • Collaboration with Aify Innovation Labs, Lokavidya Technologies, SrivisifAI Technologies, and STARS Forum • Platform is actively being used by Ekal even during COVID-19 lockdown • Currently, this is being actively evolved for skill development organizations and farmer organizations such as BAIF (Bharat Agro Industrial Foundation)

Thank You