INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Technologies and Expertise available at IITB w.r.t COVID-19

Various groups of researchers at Indian Institute of Technology Bombay have initiated projects both short term and long term, to work on areas for COVID-19 mitigation. Some of these have been funded internally to work towards seeking immediate solutions and / or proof of concept and some have already been funded by Government of India towards addressing COVID-19 related issues.

Given below is a list of our faculty and their expertise / projects initiated in various areas of research towards mitigation of COVID-19. We look forward to collaborating with other researchers across the country for addressing the urgent needs of mitigation of the current pandemic.

We hope to update this page with more information regarding areas of interest, capabilities and projects initiated.

Visit the IIT Council website for information on project initiated by IIT Bombay
https://www.iitsystem.ac.in/?q=covid19/publicview&ctnm=Personal

Areas of expertise

1. **Antiviral drug/molecule synthesis**

a. Prof. S. Kotha:

- Interested in preparing cage amines and test for covid-19 as potential antivirals, since adamentane amine is known as anti-viral.

b. Prof. Suvarn S. Kulkarni:

- Lab is specialized in chemical synthesis of complex glycans which are present on the surfaces of bacteria and viruses. These glycans can be conjugated with proteins for vaccine development.
- For this approach, one needs to know the specific structures of the glycans. Small sugar based molecules can be synthesised, to be tested as virus entry inhibitors, if the details about the nature of host-virus interaction at molecular level are available.

c. Prof. Santosh J. Gharpure:

- His research expertise is related to synthesis and such expertise can be extended for addressing various needs.

d. Prof. Ravindra Gudi

- Look at standardizing and developing a chemical synthesis protocol for the anti-viral drug (Prof. Gudi ravigudi@iitb.ac.in, Prof. Mahajani sanjaym@che.iitb.ac.in, Prof. Wangikar wangikar@iitb.ac.in)

e. Prof. Santosh Noronha

- Analyze effective downstream processing for drug isolation, design formulations.(Prof. Noronha noronha@iitb.ac.in)

f. Prof. I. N. N. Namboothiri:

- We can participate in the synthesis of anti-viral agents. Also we can provide structures of large number of compounds which can be subjected to virtual screening by computational methods to identify the lead compounds (I had a joint MSc project with Prof Prasenjit Bhowmik of BSBE) on similar approach.
- We can also supply available compounds in good quantities if someone is interested in screening directly by experimental methods.

g. Prof. Ruchi Anand:

- Our lab can help with diagnostic as well as drug development 3D structure and drug pocket evolution as well as assay development.

h. Prof. Debabrata Maiti:

- We are interested in synthesising anti-viral agents. New chemicals can be prepared by our methods and known anti-viral agents can be prepared in large scale. We can design and synthesize new anti-viral agents.
- In collaboration with other research groups, we are interested in contributing generation and testing of various anti-viral agents which will be effective against COVID-19.
- Our strength is to prepare new chemical entities in large numbers and quantities. We will be happy to write a proposal or can be part of a larger mission.

i. Prof. Rodney A. Fernandes:

- We can join with expertise in organic synthesis of compounds that can be tested. We have some compounds that worked well as anti-bacterials but not tested for antiviral. These can be tried for antiviral activity.

j. Prof. Rahul Purwar:

- Handles many types of virus including HIV (of course mutated ones).
- The main research interest in quantifying the immune response in population to understand the responders and non-responders.
- This expertise can help industry, academia and government in multiple ways. For example:

i) The team will be identifying the people, who have developed immunity after infection or vaccine candidates,
ii) The team can help diagnostic companies and can them developing ELiSa assays for antibody/ antigen quantification.

k. Prof Kiran Kondabagil:

- Have experience in all aspects of virology, from culture to cultivation to understanding their biology/evolution, detection of viruses, and therapy development.

2. <u>Drug discovery / delivery / scale up</u>

a. <u>Prof. J.Bellare</u>

- Nanoparticle based drug delivery and formulation (Prof. Bellare; jb@iitb.ac.in)
- Cryo-Electron microscopy to determine the structure of SARS-CoV-2 spike protein and its cellular receptor during infection. This could be helpful for design of new molecules or in decision on repurposing existing molecules.(Prof. Bellare; jb@iitb.ac.in)

b. <u>Prof. K.V.Venkatesh</u>

- Perform drug release studies and determine optimal drug dosage (Prof Venkatesh (venks@iitb.ac.in, Prof. Bellare jb@iitb.ac.in)
- Analyze and monitor clinical study through systems biology (Prof. Venkatesh; venks@iitb.ac.in)

c. <u>Prof. Ravindra Gudi</u>

- Assist in scale up through models and also data driven models (Prof. Venkatesh venks@iitb.ac.in, Prof. Gudi ravigudi@iitb.ac.in)

d. <u>Pradeep Kumar P.I.</u>

- Targeting non-canonical structures of COVID-19 genomic RNA by small-molecule ligands;
- Developing functional nucleic acids like aptamers/siRNAs /antisense oligos against COVID-19 proteins

e. <u>Prof. Sanjeeva Srivastava</u>

- **P**lasma Proteomic Analysis of COVID-19 patients to identify the potential biomarkers and therapeutic targets
- Identification of global metabolite biomarkers in COVID-19 infected patients for targeted therapy

f. <u>Prof. Rinti Banerjee</u>

- Development of drug delivery platforms for sustained delivery of antiviral drugs for

oral, buccal, nasal, aerosol routes

- Development of nanoparticle adjuvants for vaccine delivery
- Development of high absorption nutraceutical formulations including solubilisation of water insoluble bioactives
- Development of dissolvable microneedle platforms for vaccine delivery
- Development of oral and dermal formulations for delivery of nutrients for enhanced immunity

3. Diagnostics kits and related approaches

a. Prof. Ruchi Anand:

- Our lab can help with diagnostic as well as drug development 3D structure and drug pocket evolution as well as assay development.

b. Prof. Amit Agarwal

- Four microdevices have been developed which can potentially be integrated with an appropriate point-of-care or diagnostic device. These are:

  - Blood plasma separation microdevice
  - 3d-Hydrodynamic Focusing
  - Constant temperature microdevice
  - Platelet-rich-plasma separation microdevice

There is great value in selectively isolating and enriching platelets in plasma from whole blood with application in biomedical research and transfusion purposes.

c. Prof Rahul Purwar:

- Handles many types of virus including HIV (of course mutated ones).
- The main research interest in quantifying the immune response in population to understand the responders and non-responders.
- This expertise can help industry, academia and government in multiple ways. For example:
  i) The team will be identifying the people, who have developed immunity after infection or vaccine candidates,
  ii) The team can help diagnostic companies and can them developing ELiSa assays for antibody/ antigen quantification.

d. Prof Soumyo Mukherji:

- Has worked on technology to differentiate virus and bacteria. Rapid confirmative categorization of infections in clinical settings as bacterial or viral is frequently challenging due to the vague presentations of diseases and symptomatic similarities.
- Many earlier studies have shown the bactericidal effect of silver nanoparticles which, in the current study has been enhanced by synergistic action of polycationic chitosan stabilizers.
- An impedimetric electro-active polymer (polyaniline) modified paper substrate has been developed for generic differentiation of bacteria and virus based on their interaction with chitosan stabilized silver nanoparticles.

- These characteristic electrical impedance signatures of bacteria and virus, established here, have promising prospects in inexpensive and scalable bedside diagnostic development.

e. Prof Ambarish Kunwar:

- Coronavirus has become major global threat as it is rapidly spreading across the world originating from China. There is no treatment exists which effectively control the viral spread.
- Considering the severity of the novel coronavirus there is an urgent need to identify potent analogue / inhibitors which targets and controls the viral replication. Coronavirus proteases are considered as attractive targets for the design of antiviral drugs.
- The high-resolution crystal structure of main protease with its inhibitor has been very recently determined using x-ray crystallography. Therefore, we used this structure (PDB ID: 6LU7.pdb) to investigate atomic level interactions between main protease of corona virus and existing protease inhibitors using molecular modeling approach.

f. Prof. Sarika Mehra

- Development of an alternate assay for detection of virus; Alternate way of PCR based assay for the detection of virus

g. Prof. Mahesh Tirumkudulu

- Currently an ongoing projects to build blood cell counters, a diagnostic tool. These measure the complete blood count (CBC) - RBC, WBC and platelets. The number of WBC increases with a bacterial infection and hence is used to differentiate a bacterial infection from a viral infection. Further, the device can also detect virus infected cells, if one can synthesise fluorescent antibodies that will bind to virus infected cells. The latter is of course a challenge for COVID-19 and is a project in itself. Note that such blood cell counters are available in India but all of them are imported. The IMPRINT, GoI project was to develop indigenous technology.

h. Prof. Pradeep Kumar P.I.

- Diagnostic tools for the detection of Virus:
- Developing nucleic aptamers against viral antigens/proteins

i. Prof. Rinti Banerjee

- Development of nanocomposite coatings for antiviral effects

4. <u>AI/ML based approaches</u>

a. Prof. R. B. Sunoj:

- Our recent efforts in the use of machine learning is applicable to drug discovery and process (such as catalytic reactions) related to efficient generation of such potentially active compounds.
- We would like to use a combination of density functional theory computations to accelerate the process of identifying lead compounds.

5. Sanitisation approaches

a. Prof. Sanjay Mahajani:

- Incinerator for waste disposal

b. Prof. Ambarish Kunwar

- Portable UVC Germicidal Unit
-

c. Prof. Suparna Mukherji

- Surface spray for decontamination and antiviral action

d. Prof. P. Kumaresan

- Product design for UVC Germicidal Unit / station for Disinfection

e. Prof. Purba Joshi

- Product design for UVC Germicidal Unit / station for Disinfection

f. Prof. Soumyo Mukherji

- Has worked on technology to differentiate virus and bacteria. Rapid confirmative categorization of infections in clinical settings as bacterial or viral is frequently challenging due to the vague presentations of diseases and symptomatic similarities.
- Many earlier studies have shown the bactericidal effect of silver nanoparticles which, in the current study has been enhanced by synergistic action of polycationic chitosan stabilizers.
- An impedimetric electro-active polymer (polyaniline) modified paper substrate has been developed for generic differentiation of bacteria and virus based on their interaction with chitosan stabilized silver nanoparticles.
- These characteristic electrical impedance signatures of bacteria and virus, established here, have promising prospects in inexpensive and scalable bedside diagnostic development.

g. Prof. Sandeep Kumar

- Incinerator for waste disposal

h. Prof. Rinti Banerjee

- Development of nanocomposite coatings for antiviral effects

6. Medical Devices

a. Prof. Bellare

- Low-cost ventilator for emergency use [already in progress with collaboration with HN Hospital]

b. Prof. Sohum Mujumdar
Low cost ventilator

c. Prof. Ashutosh Gupta

- Low cost ventilator

7. <u>Surveillance</u>

a. Prof. Bhaskar Raman

- Use of "SAFE" app for Quarantine Adherence, http://safe.cse.iitb.ac.in/

b. Prof. Kameshwari Chebrolu

- Use of "SAFE" app for Quarantine Adherence, http://safe.cse.iitb.ac.in/

c. Prof. Ganesh Ramakrishnan

- CORONTINE: Tracking and Tracing of Asymptotic Carriers During Pandemic

d. Prof. Manjesh K Hanawal, IE OR

- CORONTINE: Tracking and Tracing of Asymptotic Carriers During Pandemic

8. <u>IT Solutions</u>

a. Prof. Kameshwari Chebrolu

- 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