



CSIR THEME DIRECTORATES

Towards Healthcare For All

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THE vision of CSIR's Healthcare Theme is "Invent, adapt and deploy the latest bio-innovations, tapping into modern technology and traditional knowledge to make healthcare in India affordable and accessible, ensuring physical and mental wellness."

Some of the Grand Challenges identified under this theme are:

- (i) **Genomic Route to Preventive Healthcare (GRouP-Health):** Design diagnostics based on genomic information unique to the Indian population and carry out extensive analysis, preferable in the regions where there is evidence for high genetic disease burden.
- (ii) **Medicines of Tomorrow (MeT):** The challenge lies in integrating existing cutting-edge technologies and creating exponentially greater capacity to provide precision medicine that addresses currently intractable problems in human health.
- (iii) **Pushback Infections (PIIn):** Despite the tremendous gains made through vaccines and drugs, people around the world find themselves still fighting some of the same old diseases: tuberculosis, malaria, viral infections (flu, dengue, encephalitis), etc. CSIR's Healthcare Theme has identified the need to draw new strategies and new approaches if we are to make any further progress, leave alone win the battle.
- (iv) **Nutritional India [NuIndia]:** The role of micronutrients in health and disease is getting realised. Several forgotten micronutrients having small daily requirement present risk for common diseases. This extremely important challenge can be addressed by multiple CSIR labs. Capability exists to take indigenised approach – to do what is needed for our population and from our natural means.
- (v) **Knowledge Integration with Translation [KIT]:** This is a big impact making activity of connecting our knowledge to societal needs, hand holding industry and entrepreneurs to rise to the needs of the society, being the prime goal of it.

CSIR Strength in Healthcare

CSIR has a legacy of some major laboratories that have been working in the area of Healthcare leading to generation of knowledge, technologies, and products. These laboratories have been playing critical roles at different junctures of the country's independent journey by tackling seemingly intractable national health problems.

The laboratories playing a major role in the CSIR Healthcare Theme Directorate include:

- CSIR-Central Drug Research Institute (CSIR-CDRI), Lucknow
- CSIR-Indian Institute of Integrative Medicine (CSIR-IIIM), Jammu
- CSIR-Indian Institute of Chemical Biology (CSIR-IICB), Kolkata
- CSIR-Centre for Cellular & Molecular Biology (CSIR-CCMB), Hyderabad

- CSIR-Institute of Microbial Technology (CSIR-IMTech), Chandigarh

Healthcare – Major Highlights

Some of the significant developments in the Healthcare Theme Directorate of CSIR with major impact on the health scenario in the country include:

CSIR-CDRI

- Has developed a unique model for modernised drug research in India – having everything under one roof, from synthesis, screening, development studies, process up-scaling to clinical studies.
- Developed 12 new drugs, of which, Arteether (Brand Name: E-mal), BESEB (Brand Name: Memory Sure), Centchroman (Brand Name: Saheli) are currently in the market.
- Transferred more than 130 indigenous technologies to the pharmaceutical companies, a significant contribution in the metamorphosis of the Indian Pharma Industry.



CSIR-IIIM

- Core mandate to discover new drugs and therapeutic approaches from Natural Products, both of plant and microbial origin.
- Has discovered novel pharmacologically active natural products from plants and microbial species and translated them into drug leads and candidates by medicinal chemistry, preclinical pharmacology and clinical development.
- Carries out preclinical and clinical validation and establishment of mechanism of action of drugs used in various Indian systems of Medicines (Ayurveda, Unani, Siddha and other Indigenous systems of medicine).
- Developed agro-technologies for commercial cultivation of high value medicinal and aromatic plants from Western Himalayas including Kashmir Valley and Ladakh for national and international markets.



CSIR-IICB

- Conducted basic research on infectious diseases, specifically leishmaniasis and cholera, along with the development of technologies for the diagnosis, immunoprophylaxis, and chemotherapy of diseases.
- A neurobiology group is involved in research on the development of the vertebrate brain and also the genesis of human movement disorders.
- Bioactive substances from natural sources and chemically synthesised new molecules are being explored as potential drugs.
- Other areas being actively pursued are gastric hyperacidity and ulcer, muscular dystrophy and related disorders, macromolecular structure function analysis, development of targeted drug delivery systems, sperm biology and protein chemistry and enzymology.
- Developed an oral vaccine for cholera, herbal products for controlling gastric ulcer, empirical treatment for vitiligo, diagnostic kits for malignancy and hormonal disorders, fungal enzymes of industrial importance, radiopharmaceuticals for evaluation of the functional status of renal and hepatobiliary systems and a device for early detection of Parkinson's disease.

CSIR-CCMB

The mandate of the institute is to

- Provide integrated R&D and design base for microbial technology
- Develop and maintain gene pool resources and genetic stocks of microbial cultures and other cell lines
- Establish facilities for design of process equipment and bioreactors
- Impart training in microbiology, microbial technology and biochemical engineering
- Develop capabilities for producing design and engineering packages for industrial plants.

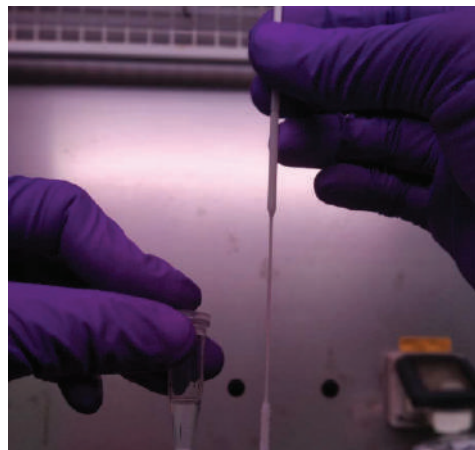
Healthcare - Significant Current Achievements

- **Genomic Sequencing (INSACOG):** CSIR labs have been at the forefront of the sequencing of the SARS-CoV-2 viral genomes since the beginning of the COVID-19 pandemic. Currently, they are active contributors to the Indian SARS-CoV-2 Genomics Consortium (INSACOG) that has been put in place for genomic surveillance in the country. CSIR has been instrumental in deciphering and identifying the variants of concern in the country and identification of the 'Indian variant' identified in Maharashtra. CSIR labs have the capacity and capability to scale up the sequencing with industry partners such as Syngene and Illumina.

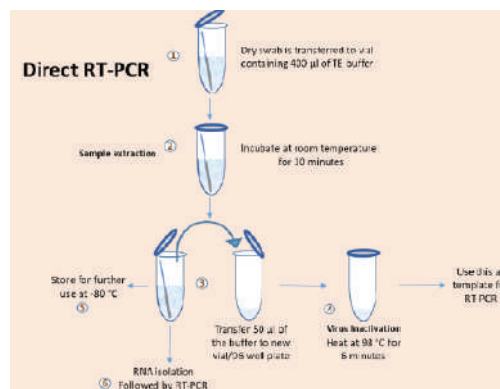
CSIR-IGIB in collaboration with the Cambridge Institute of Therapeutic Immunology & Infectious Disease (CITIID), Cambridge, UK; Department of Medicine, University of Cambridge, Cambridge, UK; University College London, London, UK; National Centre for

Disease Control, Delhi, India; MRC-Laboratory of Molecular Biology, Cambridge, UK and many others have done pioneering work on SARS-CoV-2 B.1.617.2 Delta variant replication and immune evasion.

- **Dry Swab-RNA Extraction Free-Direct RT-PCR:** A diagnostic method has been developed by CSIR of collecting nasal swab in dry mode (Dry Swab) and direct RT-PCR without the step of RNA isolation. The RNA isolation is the most cumbersome, expensive and lengthy step of the diagnostic. Omission of RNA isolation and proceeding directly to RT-PCR gives comparable results to routine RT-PCR and this method has been approved by ICMR. The later step of the diagnostic uses ICMR approved kit. This method developed by CSIR particularly helps in transportation and sample handling and cuts down the time and cost significantly, also eliminating inventory requirements related to RNA isolation and Viral Transport Media while enhancing the safety of testing personnel from infected samples that might have leaked in transit. It is being implemented routinely in CSIR-National Environmental Engineering Research Institute based in Nagpur, which has tested thousands of samples using this method. Currently, unlike many others it is able to perform RT-PCR with a short turnaround time. It has also been developed into a complete kit with Apollo Hospitals.

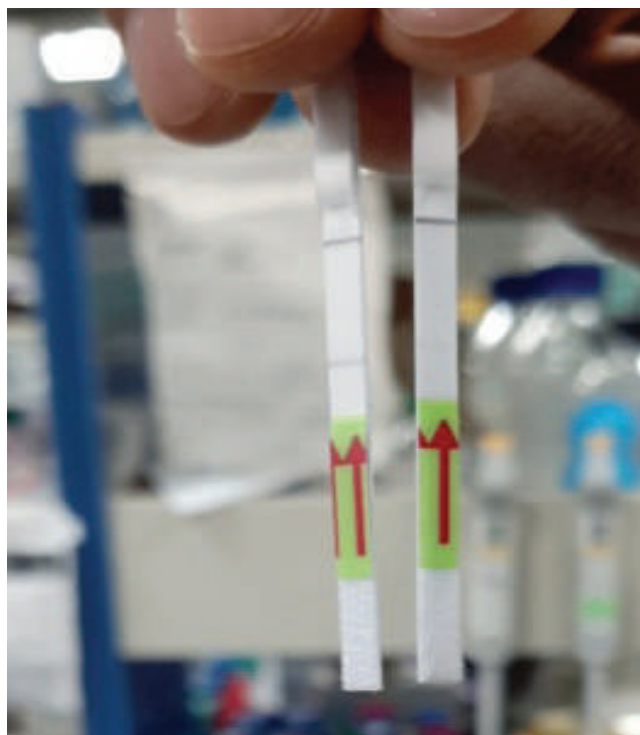


Dry swab and reagents for carrying out the test in a tube



Schematic for dry swab RNA extraction free coronavirus

- **FELUDA:** FnCas9 Editor Linked Uniform Detection Assay. The CSIR FELUDA indigenous CRISPR diagnostic technology is a novel paper based visual detection with broad reach, simpler and with less set up cost. It has been developed approved by the ICMR. This technology has been licensed to TATA Medical and Diagnostics and is now available in the market. It has accuracy similar to real time PCR and is as fast as cartridge-based tests (CBNAAT), and does not require quantitative (q) PCR machines. It has manual versions requiring minimum infrastructure capable of hundreds of tests per day, as well as an automated robotic line that costs less than a qPCR machine but can do thousands of tests per day. These have been deployed in vans. States can take advantage of such high throughput automated testing vans to rapidly increase capacity where needed during outbreaks and there is no other comparable solution currently.



- **Ready to Eat Food:** CSIR labs have developed many nutritious and ready-to-eat food that are rich in micro nutrients and protein to overcome deficiencies. These range from *dal khichdi* to rusks to spirulina chikkis, Iron and Zinc Enriched Spirulina (nut and chocolate bars), Multigrain Protein Mix, etc. These are chemical and preservative free and remain preserved for 12 months. Most importantly the ready-to-eat food reduces the manpower and minimises the inventory requirements at hospitals. During the pandemic, several tons of ready-to-eat food was provided to migrants, patients in hospitals and other places. The technologies have been licensed to many MSMEs and industries.



Launch of ready to eat food products made by CSIR labs

- **Sewage Surveillance:** A method of surveillance of sewage samples for the presence of SARS-CoV-2 has been established by CSIR-CCMB. This is based on the fact the SARS-CoV-2 infected persons (both symptomatic and asymptomatic) shed the virus in stools which can be detected in the sewage. This has been successfully tested at Hyderabad and many other cities in India and correlates well with the serological survey conducted in cities. CSIR along with DST and the Ministry of Housing and Urban Affairs has developed a National Plan for sewage surveillance across the country.
- **Aarogyapath National Healthcare Supply Chain Portal:** “Aarogyapath” has been developed by CSIR to fill the critical gaps in last-mile delivery of patient care within India via improved availability and affordability of healthcare supplies. It aims to provide real-time availability of critical healthcare supplies and serves manufacturers, suppliers and customers. The integrated public platform that provides single-point availability of key healthcare goods can be helpful to customers in tackling a number of routinely experienced issues. It also helps manufacturers and suppliers to reach a wide network of customers efficiently, overcoming gaps in connectivity between them and potential demand centres like nearby pathological laboratories, medical stores, hospitals, etc. It is now hosted on the National Health Portal of the Ministry of Health and Family Welfare.



- **Truenat (MicroPCR):** CSIR-NMITLI supported the development of the Truenat (MicroPCR) device for the diagnosis of many diseases. The device now tests the presence of corona infection. A multiplex assay combining E-gene screening and Orf1a-gene confirmatory assay has been developed. A total of 3000 devices are currently operational in 530 districts of India. More than 3 million

tests have been run on Truelab workstations so far. This innovative affordable COVID-19 testing platform has been a game-changer for testing in primary healthcare facilities of the country and quick testing in emergency departments of healthcare facilities in India.

- **Antiviral Mission:** The primary objective of the CSIR-Antiviral drug development initiative is to develop safe and effective antivirals (small molecules as well as biological i.e. therapeutic antibodies) to combat emerging variants of SARS-CoV-2, and to build sustainable platforms for targeted drug discovery and development creating a robust pipeline of active molecules against other viruses with pandemic potential. The key USPs of these antivirals will be their efficacy through oral/intranasal or IV routes; can be taken preferably at home early in the course of infection and would prevent transmission of the virus during infection surges in hospitals and communities. The consortium will support the most promising antiviral candidates and support their preclinical and clinical development & production to accelerate drug development for COVID-19 and related viruses with pandemic potential, such as the viruses from paramyxoviridae, bunyavirales, picornaviridae, filoviridae, togaviridae, and flaviviridae families. CSIR has signed an agreement with a leading pharmaceutical company, Mylan Labs Ltd, Hyderabad, which has provided a fund of Rs. 15.00 Cr for this programme.
- **CSIR-NMITLI supported clinical trials of Sepisvac:** CSIR has supported Cadila Pharmaceuticals under CSIR-NMITLI for conducting clinical trials to evaluate the efficacy of an existing gram-negative sepsis drug, called Sepisvac for COVID-19 patients. The drug now is being tested in Phase-III Clinical Trials for three different categories of COVID-19.
- **Alhydroxiqum-II adjuvant system:** Bharat Biotech International Limited (BBIL), Hyderabad is using adjuvant system called “Alhydroxiqum-II” to boost the immune response of Covaxin under a licensing agreement. In order to produce the vaccine in bulk scale, BBIL required imidazoquinoline molecule in larger quantities as part of the adjuvant component. BBIL approached CSIR-IICT to develop a scalable and cost-effective process to make this molecule in the desired quantities. The molecule (IMDG) is a heterocyclic, complex molecule and has critical synthetic transformations to achieve purity and manufacture the molecule on the required scale. CSIR-IICT took the challenge and successfully delivered the molecule using indigenous chemicals. The same is being used in the production of Covaxin.
- **mRNA-based platform for vaccines and therapeutics:** Considering the success of mRNA Vaccine for prevention of COVID, CSIR-CCMB along with CSIR-IICT, CSIR-IICB, CSIR-IMTech, CSIR-NIIST, CSIR-IGIB and CSIR-IIIM is working on mRNA-based platform for vaccines and therapeutics. The aim of the project is to develop an In Vitro Translation (IVT) platform to produce mRNA and formulate lipid nanoparticles for

vaccine purposes. The platform focuses on spike protein of delta variant of COVID and explores the suitability of the platforms for other bio-therapeutics.

- **Spike Protein-based Vaccine:** CSIR-IMTech, Chandigarh is working on Stabilised Prefusion Spike Protein-based Vaccine Design for COVID-19. Aurobindo Pharma is interested to take the project forward once the stable cell line-based expression process is ready (ongoing work), along with preclinical immunogenicity and efficacy (Viral neutralisation, Transgenic Mice/ Hamster or other suitable model) data.
- **API Mission:** Under the COVID API Mission, CSIR has developed technology for Remdesivir and Favipiravir which have been transferred to industry. The CSIR intervention in the area has made these drugs accessible and affordable to common people.
- **Drug Discovery:** Orally active fracture-healing molecule CDRI S007-1500, Novel anti-osteoporosis candidate CDRI-99/373, CDK9 inhibitor for metastatic pancreatic cancer-IIIM290 are ready for the clinical trials. IIIM-160, a dual IL-6/anti-nociceptive, an IND application to DCGI has been filed under phytopharmaceutical mode.
- **Medical-grade Oxygen (MO₂):** The COVID-19 pandemic has highlighted the need of distributed Medical-grade Oxygen (MO₂) generation capability for the Indian market. Typical demand is 5-20 Litre per Minute (LPM) per patient, depending upon the severity of the respiratory distress. Given the large requirements in hospitals, in-house generation of medical grade Oxygen offers independence from external parties and eliminates the risk and difficulty of handling bulky cylinders. CSIR-IIP has developed the technology for Medical Grade Oxygen device. The design is scalable and process packages are ready for 100-500 LPM plants. Currently, 120 units are being supplied across the country with funding from PMCare. In addition, 35 units are being supplied to different agencies.
- **Air Duct Disinfection System:** CSIR-CSIO has designed the UV-C Air Duct Disinfection System as a retrofittable unit into existing HVAC Air Ducts using customisable sliding mechanisms. The system has been installed in Parliament. The technology has been licensed to 32 industries. CSIR-CSIO has also developed indigenous air sampler, which can detect the presence of virus in the air samples. It is used for sampling air from large volume of space like hospital OPD, shopping malls, and bus stand terminal, where there is possibility of virus & bacteria infection.

Acknowledgement

The information provided by Scientists of Technology Management Directorate and Innovation Management Directorate of CSIR Headquarters and Directors of CSIR laboratories and their colleagues are gratefully acknowledged.

