



Critical role of biobanks in COVID-19 pandemic

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Proper collection of infectious biosamples is critically important for better understanding of the disease pathogenesis and health. These precious samples are stored in biobanks. COVID-19 is an infectious disease caused by the recently discovered novel coronavirus named SARS-COV-2. Currently, specific drugs are not available against this virus though efforts on development of vaccines by various agencies have shown some positive results. Limited knowledge about the pathogenesis mechanism is a critical gap in developing intervention options. Access of COVID-19 biosamples for research could provide more insight into the disease. The Indian Council of Medical Research (ICMR) designated National Liver Disease Biobank (NLDB) as one of the dedicated facilities for collection and storage of COVID-19 biosamples for research purposes. Samples are collected, processed, and stored with proper security at NLDB. In this minireview, we have made an attempt to provide comprehensive coverage on the role of biobanking in Covid-19 pandemic.

Keywords: Biobanking, COVID-19 pandemic, SARS-COV-2

Biobanking

Biobanking is an important tool in biomedical research, which facilitates research in various fields by providing access of biological materials and associated clinical data¹. In ancient times, biobanks were the way of the collection of samples and associated information. Samples were collected, processed, stored, and shared in the beginning without any regulations and rules. However, as the research field advanced, scientists stressed the use of high-quality biological material. The requirement for the different type of samples (Oropharyngeal/nasopharyngeal swabs, bronchoalveolar lavage, sputum, blood, urine and stool) size, the procedure of sample collection, process, transportation, storage, and connected information became more specific and precise to study diseases and disorders. Biobanking represents a new and innovative field for development and discovery of new drugs².

Further, biobanks play a critical role in the diagnosis, classification of complex diseases, identification of new biomarkers, and development of treatments for a variety of diseases. International organizations like International Society for Biological and Environmental Repositories (ISBER), Biobanking and Bio-Molecular Resources Research Infrastructure

(BBMRI) and government agencies involved in shaping biobanking practices^{3,4}. These organizations are also engaged to provide scientific, ethical, and legal guidelines for pharmaceutical companies, the R&D sector, and healthcare. These units meet all requirements to regard them as one of the most innovative and up-to-date in the field of biomedical research. They enable conducting wide-scale research by the professional collection of biological specimens and correlated clinical data.

COVID-19

COVID-19 is an infectious disease caused by the most recently discovered SARS-CoV-2 (Severe Acute Respiratory Syndrome-Coronavirus-2). This new virus and conditions were unknown before the outbreak began in Wuhan, China, in December 2019. The World Health Organization (WHO) declared COVID-19 as a global pandemic on March 11, 2020. As of 29 December 2020, it has rapidly spread to more than 222 countries affecting 81,988,852 people and caused 1,787,759 deaths worldwide⁵. In India, there are 10,242,306 reported cases, with 148,423 deaths⁶. The COVID cases are rising at an exponential rate. Due to absence of specific medicine, an increasing number of cases and associated mortality forced lockdowns in various countries to break the chain of the virus. Worldwide, scientists are engaged in developing vaccines and therapeutics.

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Currently, more than 50 COVID-19 candidate vaccines are reported to be in trials⁷. Two vaccines, pfizer-biontech-covid-19-vaccine and moderna-covid-19-vaccine, declared safe and authorized by FDA for emergency use, have been released for prevention of COVID-19 caused by SARS-CoV-2 in ≥ 16 years and ≥ 18 years, respectively in the second week of December 2020⁸.

Biobanking in COVID Pandemic

Since, SARS-COV is an emerging pathogen of Risk Group 3 (RG3) category, the specimens collected from infected individuals should be handled carefully and follow standard guidelines of safety. For COVID-19 related research purposes, various types of samples should be collected including body fluids, epithelial tissues, secretions, and cells of the immune system. Precise collection of biosamples and its characterization with correlated data is important for the correct diagnosis, the origin of disease, epidemiological analyses, and understanding for the development of medicine/vaccine.

In the past, an ample number of samples were stored in biobanks during various disease outbreak periods. These valuable samples were utilized for finding the history of infections, disease characterization, and development of epidemiological tools, e.g. Spanish flu pandemic of 1918-1919 accounted somewhere between 20 to 40 million people, cited the worst infectious epidemic in world history. Preserved tissue from a victim of the 1918 epidemic was used to determine the origin of the virus and allowed to track major genetic events of change⁹. Similarly, the 2014-2016 Ebola outbreak in Sierra Leone precipitated largescale biobanking of diagnostic samples, the research done on these biosamples contributed substantially to the knowledge and control of Ebola disease. The Centers for Disease Control and Prevention (CDC), United States has maintained a biobank of epidemic diseases for decades and found the source of outbreaks of Hantavirus and Legionnaires Disease^{10,11}.

Collection of COVID-19 biosamples would create a precious resource and provide a unique opportunity to facilitate the rapid expansion of our knowledge about the virus and its pathogenesis. Many countries worldwide have started COVID biobank to facilitate COVID-19 vaccine and/or treatment. Biobanking and Bio-Molecular Resources Research Infrastructure-European Research Infrastructure Consortium (BBMRI-ERIC) is a European research infrastructure

Table 1 — List of COVID biobank across the world

Name of Biobank	Types of samples	Country
UK Biobank	Blood	UK
Biogen, Broad Institute of MIT and Harvard COVID-19 Biobank	Blood	USA
Indian Council of Medical Research (ICMR) COVID - Biorepositories	Oropharyngeal/nasopharyngeal swabs, bronchoalveolar lavage, sputum, blood, urine and stool	India
Joao Lobo Antunes Institute of Molecular Medicine Biobank	Blood	Portugal
NSW Health Pathology COVID-19 Biobank	blood, swabs	Australia
Biobank Graz	Blood	Austria

involved in facilitating quality defined COVID-19 biosamples from its network of more than 600 biobanks¹². Table 1 provides the list of COVID biobanks across the world.

SARS-COV-2 Biobanking at NLDB

National Liver Disease Biobank (NLDB) is an advanced open resource facility established by the Department of Biotechnology, Government of India in 2017 at the Institute of Liver and Biliary Sciences (ILBS) to accelerate research in liver associated diseases^{13,14}. Although, the NLDB is a liver disease biobank, the ICMR designated it as a centre for add-on COVID biobank permitting it for collection of COVID-19 biosamples for research, developing diagnostics, and support vaccine development activities. ILBS is a center for COVID-19 testing laboratory designated by ICMR, Government of India. COVID-19 samples from seven government run and nineteen privately run hospitals for are accepted for testing at ILBS. It handles approximately 300-400 tests per day. After collecting COVID samples from three hospitals, NLDB processes the samples in 'state-of-the-art' BSL 2 & 3 laboratories and stores them in ultra-freezer at -80°C and LN2 tanks, assigned for SARS-CoV-2. The process is explained in Fig. 1. The data is managed by Biobank Information Management System (BIMS), designed and developed by NLDB. At present, biobank have 21,183 biosamples from 16,534 COVID-19 patients with well annotated clinical and follow-up data.

NLDB is involved in multiple projects for collection of COVID biosamples in collaboration with different research institutes and hospitals. NLDB has a Biosample Release Committee (BRC) to review the scientific and ethical appropriateness of the proposed

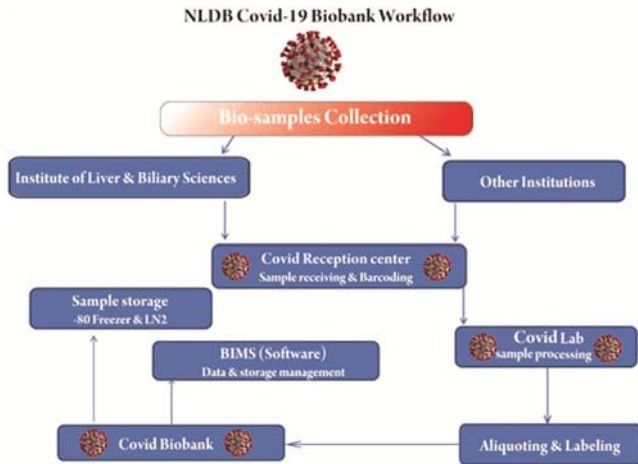


Fig. 1 — COVID-19 biobank work flow for collection, deidentification, processing and storage

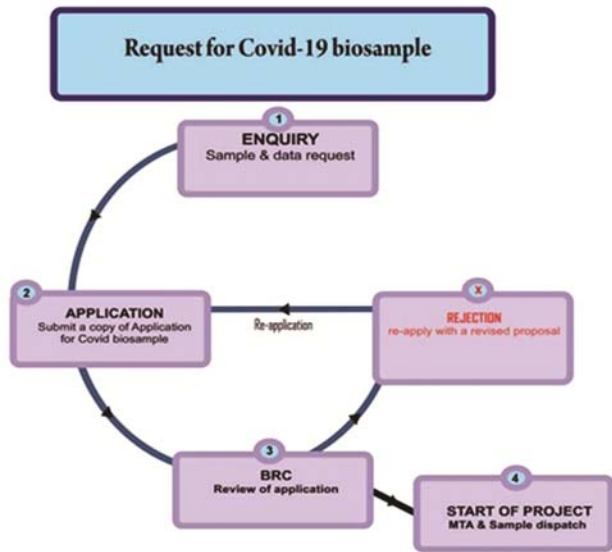


Fig. 2 — COVID-19 biobank work flow for sample request, review and release through Biosample Release Committee (BRC)

projects for requisition and release of the biosamples along with clinical information. The process is explained in Fig. 2. Research institutes and pharma industries require standard samples and phenotypic characterization of the disease because of the Government of India and funding agencies’ initiative to grants to organizations or individuals who are focused on developing diagnostics, vaccines, novel therapeutics including the repurposing of existing drugs, and any other intervention for the control of COVID-19¹⁵.

Challenges of COVID-19 Biobanking and Research

Handling of COVID-19 sample

Collection, transportation, processing, and storage of COVID-19 biospecimens, unlike other non-

infectious samples, biobanks must develop a separate SOP for COVID-19 biobanking. All biospecimens related to COVID-19 shall be collected and handled as per the ICMR guidelines for clinical samples under the strategy of COVID 19 testing in India¹⁶. Handling of COVID-19 samples are not possible for all biobanks and laboratories as it is necessary to have a BSL 2/3 laboratory due to the nature of work and samples. Biosamples must be handled by trained staff using the recommended Personal Protective Equipment (PPE) and waste management SOPs¹⁷. Personnel involved in COVID-19 biobanking should have a designated area for donning and doffing PPE. To minimize the risk of transmitting the virus and contaminating other samples, the workspace area should be away from the main lab. It is also essential that the transportation of biosamples should be under proper cold-chain conditions and with triple-layered packing.

Ethical challenges

During the infectious disease outbreak, it is incumbent that infected biosamples are stored and used for research. All research to be considered ethical with minimum risk and maximum benefit. Since the biosamples are property of patients, informed consent must be signed before storing the samples. At times, diagnostic leftover COVID-19 samples, stored without informed consent, matter in ethics. In such cases the Institutional Review Board (IRB) also known as Ethical Review Board (ERB) or Research Ethics Board (REB) take a call and decide the use of biosamples in research and waive off of the otherwise mandatory requirement of informed consent.

An effective digital meeting of the ethical committee is crucial for a rapid review of research proposals and protocols during the lockdown and to keep social distancing. IRB should make sure to maintain the quality of ethics committee decision-making by avoiding any superficial decision, approval of poor-quality or extraneous research.

Bioterrorism

Terrorists are doing intentional violence with a different type of weapon for political or religious purposes. Bioterrorism agents are a common choice for them because they are inexpensive and can cause extensive effects. The international community has experienced multiple acts of bioterrorism from world war I to till date. In an earlier incidence, anthrax

spores was used as a bioweapon in America¹⁸. Regulating the possession, use, and transfer of biological agents (COVID-19) from the government by making strict rules and regulations could save a severe threat to public health and safety.

Conclusion

Biobanks are structured systems for collecting and storing valuable clinical samples. Access to high-quality biosamples and data from COVID-19 infected patients is an essential requirement for the development and validation of new diagnostics, therapeutics, or vaccines. In this context, biobanks are a secure place for infectious biosamples and may play a critical crucial role in this pandemic.

Conflict of interest

The authors declare no conflict of interests.

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