Future proof your lab

February 2023

How to Choose the Best Digital Platform for Your Biobank

A Complete Guide to Avoiding Digital Chaos and Streamlining Your Operations

eLabJournal eLabInventory

eLabNext
EPPENDORF GROUP

Table of contents

- Biobanking has become an integral part of basic scientific research and developing solutions to global problems.
- Biobanks face many operational challenges, such as managing diverse sample types, ensuring data security, maintaining sample integrity, and more, making it difficult to function effectively and guarantee that samples are stored, tracked, and used in a compliant and ethical manner.
- Digital biobanking platforms provide many benefits to biobanks and help solve these operational challenges by providing a centralised location for all biospecimen-relevant data, full traceability, and the ability to expand functionality to meet specific needs.
- eLabNext provides an open and intuitive digital biobanking platform, eLabInventory, that significantly streamlines biospecimen tracking and maximises operational efficiency.

The importance of Biobanks

Biobanks, also known as biorepositories, collect, store, use, and distribute biological samples.[1] In the beginning, biobanks were small, often hastily constructed collections of leftover biological samples or waste from diagnostic or medical procedures.

Today, however, biobanking has expanded significantly and become a pillar of the biological, biomedical, and clinical research community, supporting current efforts in genomics, proteomics, precision medicine, conservation, immunology, oncology, infectious disease, and more.

As biobanking has become more integral to understanding and treating human diseases, operations have become more sophisticated. Automation, digitization, and strict regulations have modernised biobanking procedures and infrastructure. These adaptions have enabled the current breakneck pace at which biological research and drug development are progressing. Researchers have come to rely on high-quality biospecimens and secure, reliable data to advance academic, industry, and government research.

What is a Biobank?

Biobanks are like “libraries’ where biospecimens – often tissue or biofluid samples taken from humans and other organisms – are stored. Biospecimens can be further processed to extract specific biomolecules, such as DNA, RNA, or proteins, or used to develop model systems for pre-clinical drug efficacy and safety testing.

Biobanks also manage a significant amount of biospecimen-associated documentation and metadata, such as demographic, medical, and patient information, as part of their everyday operations. An important feature of many biobanks is that they are dynamic and always shifting: Biospecimens are being collected, added, or removed as part of a current or future research project and, therefore, may be collecting and managing samples over long periods.

The Broad Scope of Biobanking: Different Sample Types and Examples

Biobanking isn't limited to just human biospecimens. It can also include sample types from animals, plants, microbes, or the environment.

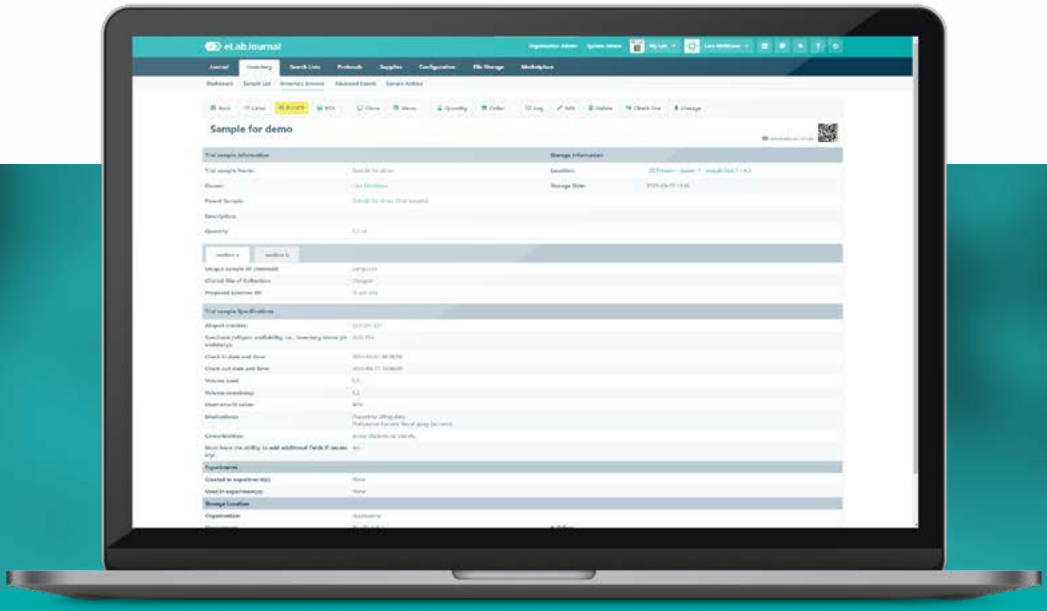
For example, the National Institute of Standards and Technology (NIST) has been archiving biological and environmental specimens since 1979 consisting of human livers, marine sediments, fish tissues, mussels, oysters, and more to support long-term environmental research and monitoring.[2] The Antibacterial Resistance Leadership Group (ARLG) Biorepository manages clinical isolates of gram-positive and gram-negative bacteria to develop diagnostic tests and novel antimicrobial compounds.[3]

Many biobanks can be divided into two categories for human biospecimens: disease-specific or population-based biobanks.

Population-based biobanks collect, store, and provide biospecimens from people in a specific population to understand their evolution or association with particular traits, such as disease resistance or susceptibility.[4] Examples include the UK Biobank, which contains 10 million samples from ½ million UK participants, and the Danish National Biobank, which has over 27 million samples from nearly 6 million members of the Danish population.[5,6] The enormous scope of these sampling efforts gives researchers statistical power to link specific biomarkers with a range of common or rare diseases. This information can help countries improve their current and future health.

Disease-oriented biobanks collect, store, and provide biospecimens (typically a single type of tissue) from people living with a specific disease.[4] The Cancer Moonshot Biobank, for instance, is run by the National Cancer Institute and supports " ...cancer research by establishing an infrastructure for longitudinal biospecimen collections from a diverse patient population receiving standard of care cancer treatment at multiple medical institutions."[7]

The internet and the birth of software platforms for data storage have also enabled the growth of virtual biobanking. This type of biobank is more of a digital biorepository of associated metadata, regardless of the physical location of a specific biological sample.



Biobank Classification Systems

Biobanks come in all shapes and sizes, with variations on the types of biospecimens collected and procedures for sample collection, processing, and storage. While there are no recognized guidelines for biobank classification, the three categories above are a common way of classifying the different biobanks.

Alternatively, biobanks can also be labelled according to the type of research they intend to support: population study biobank, basic research biobank, translational study biobank, clinical trial biobank, and pathology archive biobank.[8] Another method of classification considers the type of samples collected, such as frozen tissues, formalin-fixed paraffin-embedded (FFPE) tissues, cells, whole blood, urine, buccal cells and saliva, bone marrow aspirate, semen, hair, nails and nucleic acids (e.g., DNA, RNA, cDNA/mRNA, etc.).

The Canadian Tumour Repository Network (CTRNet) uses a categorization system following four functional elements:

- the type of donor/participant
- the collection methods and design
- the features of the biospecimens
- the nature of the brand and intended users.

Key Challenges in Biobanking

As biobanks have become more central to research progress, the questions scientists can ask using unique biospecimens have ballooned, deepening our understanding of biology and the world. With it, the logistical, ethical, and regulatory challenges of operating a biobank continue to grow and shift.

Let's look at some of the common hurdles modern biobanks face.

Challenge #1: Managing Diverse Sample Types and Complex Metadata

Many biobanks store several different types and subtypes of biospecimens: The storage and use of one primary cell type may lead to subsequent passages being stored, immortalised, or engineered versions of the cells developed, or DNA, RNA, or protein extracted from cells anywhere along this continuum. Each sample type may have different documentation, names, identifiers, or properties that need to remain associated with the biospecimen. Because they differ across sample types, it can be challenging to recognize which samples require which properties.

With human samples, in particular, informed consent records and intended use must be stored along with the samples to ensure ethical and regulatory compliance. To safeguard the naming and identity of biospecimens and secure any associated data, a comprehensive trail of what happens to a specimen from submission to storage must be tracked.

Challenge #2: Ensuring Data Security

Several regulatory mandates and guidelines dictate how biobanking operations are run. 21 CFR Part 11 lays out specific electronic data management regulations to ensure data remains secure.[9] Other notable regulations, such as Health Insurance Portability and Accountability Act (HIPAA), ISO 20387:2018, and others, regulate how data security and quality are maintained.[10,11]

Managing this data across its entire lifecycle creates logistical challenges. Compliance with the above regulatory standards means keeping data secure against unauthorised users and fully traceable so that data is fully auditable and any changes are recorded.

Challenge #3: Maintaining Sample Integrity and Quality

The day-to-day operations of large biobanks mean a steady flow of new samples being deposited and filling sample requests. The quality and integrity of many biospecimens are sensitive to the temperature at which they are stored. Accordingly, repeated freeze-thaw cycles, which can occur if samples are not organised and time is needed to locate and check out samples, can reduce the integrity of samples.[12] When a biobank has limited aliquots of a given sample, freeze-thaw cycles may be an inevitable part of the sample lifecycle. Managing location information for all biological samples, monitoring freezer temperatures, and tracking samples' freeze-thaw cycles is critical – and a major challenge – to guaranteeing the quality and integrity of a biospecimen and managing the expectations of those requesting samples.

Challenge #4: Planning for the Future

There has been an increased focus on strategic planning for the growth and scope of public and private biobanking. Tracking trends in activity is a critical part of planning for the future of operations. It enables a biobank to make informed and insightful decisions about the future, investing in capital equipment purchases (e.g., new -20 or -80 freezer or liquid nitrogen storage) only when necessary. Yet, monitoring operations and projecting into the future remains a significant challenge for biobanks. Consequently, making these purchasing decisions in an informed and strategic manner takes time.

Challenge #5: Disorganised or Clunky Information Management Systems

Early in operations, a biobank may often establish a laboratory information management system (LIMS) that fits its current needs or a simple Excel spreadsheet that captures sample information and any associated data. But, as operations and storage scale, these systems can become unwieldy, inflexible, and unsuited for the growing needs of an expanding organisation.

Migrating data from a legacy system, whether a commercially available system or a series of spreadsheets, can feel incredibly daunting, and many personnel may resist change. As a result, ineffective and inefficient information management systems persist. Operating with such inefficiencies can lead to an unhappy working environment and customers, ultimately limiting the potential for further growth.

Challenge #6: Prioritising Environmental Sustainability

Biobank operations require sample storage materials and significant energy for freezer and data storage. Maintaining the temperature of one ultra-low freezer has been estimated to consume as much energy as an average American household.[13]

Large biobanks can have hundreds to thousands of ultra-low temperature (ULT) freezers creating an operation with a substantial environmental footprint. Ensuring that all freezer space is efficiently managed, energy isn't lost through excessive opening and closing while adding or removing samples, and scaling up or down is done according to trends in activity is critical for keeping the environmental impact as small as possible.

Biobanking Challenges and the Emergence of SARS-CoV-2

As the spread of SARS-CoV-2 occurred globally, researchers began searching for treatments, cures, and vaccines to protect vulnerable populations. To support these efforts, biobanks played a vital role in the efficient and high-quality storage of samples from infected and healthy individuals.[14]

To do so, many biobanks nimbly shifted their focus away from other research projects to prioritise the safe collection of COVID-19 biospecimens. Two large global biobanks, the International Society for Biological and Environmental Repositories (ISBER) and the European Biobanking and BioMolecular Resources Research Infrastructure (BBMRI-ERIC), created a virtual catalogue of COVID-19 samples.[14]

Critical to this effort were digital platforms for the secure storage of sample metadata. The platform had to be accessible to all participants within ISBER and BBMRI-ERIC and researchers searching for relevant biospecimens. In addition, a standardised method for data harmonisation was needed as biobanks from around the world contributed to the BBMRI-ERIC collection. While there were challenges in addressing this immediate need for specific biospecimens, the ability to connect virtually using powerful digital tools enabled biobanks to play a crucial role in short- and long-term COVID-19 research. Moving forward, biobanks are well-positioned to continue aiding researchers in solving global infectious disease challenges.

Overcoming Barriers in Biobanking: The Benefits of using a Digital Lab Platform

Many of the challenges above come down to establishing a comprehensive, consistent, and secure system for managing, processing, and tracking samples and associated metadata. Gone are the days when these systems relied on paper or repurposed, clunky software and manual processes.

Now, digital software platforms built exclusively for efficient biobanking can help address many operational barriers and streamline sample management workflows. The platforms provide a "single source of truth" concerning a biospecimen and its associated metadata.

Digital lab platforms also enable biobanks to:

- Maximise operational efficiency: Information management systems can save personnel time and money with one-click transitions from legacy systems, trend tracking, and rapid data transfer.
- Locate any sample: Easy-to-use software and full traceability make it simple for anyone on the team to find a sample, fulfil a sample request, or identify empty box space with the click of a button or search functions
- Expand functionality to meet specific needs: With a collection of equipment and supplies associated with biobanking, many digital platforms are integrated directly with your new equipment for easy barcode automation and full sample traceability.

5 Steps for Choosing the Right Digital Lab Platform for Your Biobank

There are several factors to consider when picking from the many digital platforms available. Chief among these is cost and what specific functionality you need to pay for. Other factors include how the platform scales, integrates with other hardware and software, and technical support provided.

To navigate this multifaceted decision, follow the steps below to evaluate your options.

Step #1: Make a List of Short- and Long-Term Needs

In the short term, you'll need a software platform that handles your current operations, integrates with all equipment and pre-existing software, and meets your regulatory and security requirements. But your operations won't remain static: You'll need to ensure the platform has the flexibility to scale and expand functions appropriately with your operations. Remember that your personnel may also turn over, so choosing a vendor that can support onboarding and ongoing training is a major benefit.

With all this in mind, create a well-defined list of short- and long-term platform requirements to evaluate the options you'll be considering.

Step #2: Get a Personal Demo

Once you've defined what your organisation is looking for, schedule a demonstration to evaluate if a specific platform fits your organisation's needs. A demonstration can provide a hands-on, in-depth look at the features and capabilities of each system. Confirm all relevant stakeholders can attend the demonstration, as they can provide different perspectives and valuable feedback.

During the demonstration, ask questions and provide detailed information about your current processes and workflow so that you and your team can understand how the platform will fit into your day-to-day operations and allow the vendor to tailor the demonstration to your specific requirements.

After the initial demonstration, schedule a follow-up meeting or call to discuss any remaining questions or concerns and to review the system's pricing, implementation, and support options.

Step #3: Evaluate the Transition Process

Transitioning from a legacy information management system (or lack thereof) to a new platform can be a complex and challenging task.

To ensure the process goes smoothly, evaluate how a new vendor and system can help support that transition. Assess your current system and identify all essential data that needs to be migrated to the new system. Next, ask support staff how the new system can accommodate this data and how it can be imported in a format that the new system can understand.

Step #4: Test Technical Support

Technical support is critical to using a digital platform for data management. Bugs in software and technical complications are an inevitable part of software use and updates, so evaluate the ability of a customer support team to assist users with any questions related to the systems you're considering. This can include testing the support team's responsiveness, knowledge, and effectiveness in resolving issues related to software installation, system configuration, data management, and system troubleshooting. You can do this evaluation while participating in a trial, usually offered for 30 days by most vendors. The trial period is an excellent time to evaluate the data transition process as well (as described in Step #3 above).

Also, ensure that technical support teams can provide clear and accurate information to your team and that dedicated support is available 24/7 (not just advertised that way). Gather feedback from real system users to assess their experience with technical support.

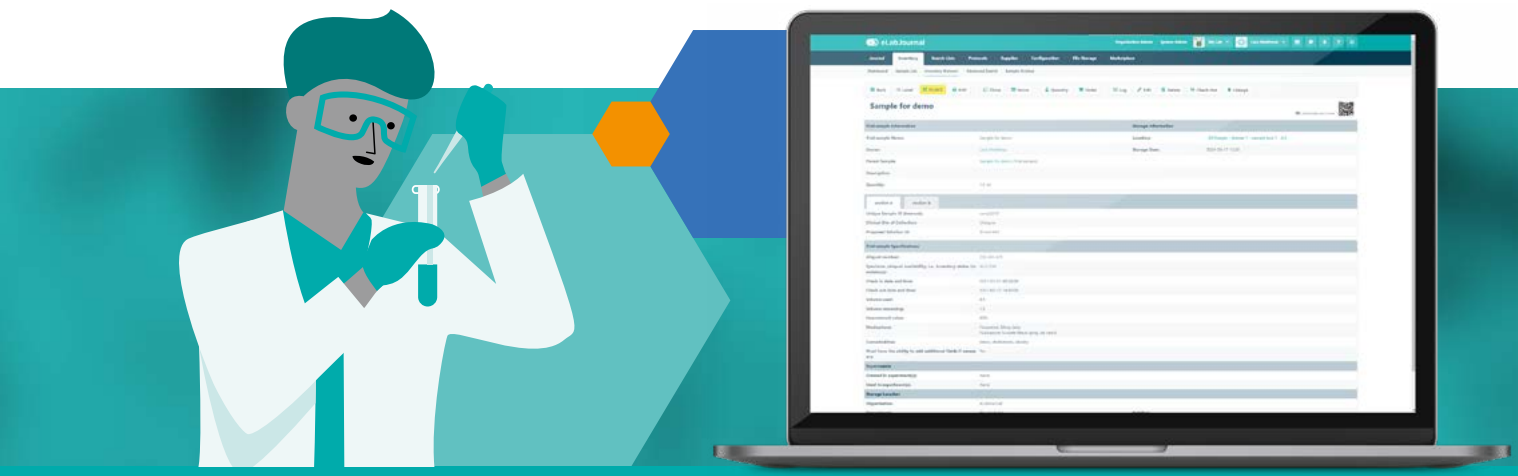
You can also browse a vendor's online resources, such as online tutorials, webinars, user forums, and FAQs, to evaluate the quality and completeness of the information provided.

Step #5: Assess Security and Accessibility

For biobanks operating in regulated environments, complying with HIPAA guidelines or 21 CFR Part 11, any information management system needs to meet regulatory requirements. That means role-based access to specific information, restricted access to certain data types, and maintaining the integrity or confidentiality of sensitive biospecimens and associated metadata.

Any platform should have full traceability so that there is a clear audit trail to track user activity and any changes to information.

Another critical aspect of accessibility is the platform's user experience: Are navigation and collaboration simple, intuitive, and user-friendly? Can personnel access the platform remotely in the cloud? The answers to these questions can be essential in adaption across your organisation.



A Biobanking Digital Lab Platform in Action

Managing Large Volumes of Time-Stamped Patient Data from the Musculoskeletal Oncology Lab at the University of Pittsburgh

The Musculoskeletal Oncology Lab (MOL) at the University of Pittsburgh established a musculoskeletal oncology tumour registry and tissue bank in 2010, which collects and stores patient clinical data and tissue samples over the entire course of disease and treatment. The MOL's tissue bank is a unique and valuable resource for translational research, providing powerful biospecimens for studying the progression of and treatment effects on primary and metastatic musculoskeletal tumours.

The Challenges

The MOL had created a biobank of over 40 subtypes of sarcoma and needed an efficient, simple, and secure way to track biospecimen inventory and link it with patient clinical data.

The eLabNext Solution

Using eLabInventory and eLabJournal, the MOL could flexibly tailor the software to their specific biobanking requirements. The cloud-based hosting was also a crucial feature due to the onset of the COVID-19 pandemic.

The MOL uses eLabNext's platform to manage biospecimens and clinical data collected from patients diagnosed with sarcoma at the University of Pittsburgh Medical Center (UPMC). The system allows them to store and track their inventory of biospecimens and associated clinical data in one integrated application.

The Results

The MOL has built the most diverse sarcoma biobank in the United States. With the help of eLabJournal, they can efficiently share biospecimens and data amongst lab members and external collaborators. The eLabInventory module allows them to quickly and efficiently track the whereabouts of all their biospecimens and link them directly to the associated clinical data, providing information on the patients and their treatments.

About eLabNext's Digital Biobanking Solution

eLabNext provides an open biobanking platform, eLabInventory, that significantly simplifies biospecimen tracking and expands functionality as your operations grow. The intuitive software helps you visualise your collection of biospecimens and associated metadata digitally, as you would in any of your storage units.

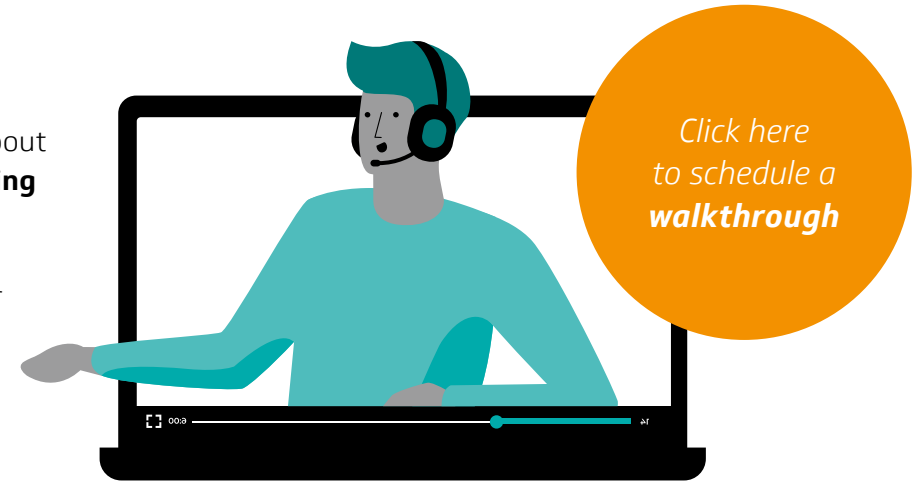
Here's what sets eLabInventory apart from other biobanking digital platforms:

- Improved traceability with sample barcoding: For maximum traceability, you can print identification labels with a unique barcode, assign it to a biospecimen, and store it in eLabInventory.
- Flexible add-ons with eLabSDK + eLabAPI: eLabInventory is not just another LIMS. We can develop custom applications and integrate third-party integrations to build functionalities for your unique needs.
- At a glance visualisation of your biobank: Easily browse different specimen types across your entire biobank with a colour-coded sample legend.
- State-of-the-art, compliant data security: All changes to biospecimen entries are logged, creating a full audit trail following GxP guidelines. You can also remotely access your data securely, preventing data breaches.

Get started

Do you want to learn more about **eLabNext's Digital Biobanking Solution?**

Schedule a personal demo for a free, no obligation product demonstration.



Reference:

1. Caenazzo L, Tozzo P. The Future of Biobanking: What Is Next?. BioTech (Basel). 2020;9(4):23.
2. The NIST Biorepository. NIST website: https://www.nist.gov/programs-projects/nist-biorepository. Accessed November 22, 2022. Published April 8, 2021.
3. ARLG Biorepository. ARLG website: https://arlg.org/laboratory-center-strain-access/. Accessed November 22, 2022. Published July 8, 2022.
4. Annaratone L, De Palma G, Bonizzi G, et al. Basic principles of biobanking: from biological samples to precision medicine for patients. Virchows Arch. 2021;479(2):233-246. doi:10.1007/s00428-021-03151-0
5. UK Biobank. UK Biobank website: https://www.ukbiobank.ac.uk/. Accessed December 1st, 2022.
6. Danish National Biobank.Danish National Biobank website: https://www.danishnationalbiobank.com/. Accessed December 1st, 2022. Published December 3, 2021.
7. Cancer Moonshot Biobank. Cancer Moonshot Biobank website: https://biospecimens.cancer.gov/programs/cancermoonshot/biobank/default.asp. Accessed December 1st, 2022.
8. Annaratone L, De Palma G, Bonizzi G, et al. Basic principles of biobanking: from biological samples to precision medicine for patients. Virchows Arch. 2021;479(2):233-246. doi:10.1007/s00428-021-03151-0
9. Part 11, Electronic Records; Electronic Signatures - Scope and Application. FDA website: https://www.fda.gov/regulatory-information/search-fda-guidance-documents/part-11-electronic-records-electronic-signatures-scope-and-application#iiia. Accessed December 15, 2022. Published September 2003.
10. Health Insurance Portability and Accountability Act of 1996 (HIPAA). CDC website: https://www.cdc.gov/phlp/publications/topic/hipaa.html. Accessed December 15, 2022. Published August 2018.
11. ISO 20387:2018. ISO website: https://www.iso.org/standard/67888.html. Accessed December 15, 2022. Published June 27, 2022.
12. Chaigneau C, Cabioch T, Beaumont K, Betsou F. Serum biobank certification and the establishment of quality controls for biological fluids: examples of serum biomarker stability after temperature variation. Clin Chem Lab Med. 2007;45(10):1390-1395. doi:10.1515/CCLM.2007.160
13. Purchasing Energy-Efficient Laboratory-Grade Refrigerators and Freezers. Energy.gov website: https://www.energy.gov/eere/femp/purchasing-energy-efficient-laboratory-grade-refrigerators-and-freezer. Accessed January 9, 2023.
14. The Hidden Role of Biobanks in Covid-19 Research. LabBioTech website: https://www.labiotech.eu/in-depth/biobanks-covid-19-research/. Accessed January 9, 2023. Published July 12, 2021.

Author: Zareh Zurabyan

eLabJournal eLabInventory

About eLabJournal

eLabJournal offers an intuitive and flexible solution to manage information in your lab. The all-in-one Electronic Lab Notebook also includes modules for sample tracking and protocol management. eLabJournal improves efficiency when documenting, organizing, searching and archiving data, samples and protocols. The software is suitable for any lab ranging from small academic laboratories and strart-up companies to large academic institutes and globally operating companies.

eLabNext
EPPENDORF GROUP

enquiries@elabnext.com
+31 50 720 00 55

All of our product specialists have a scientific background and are happy to discuss your needs. Schedule a demo for a free, no-obligation product demonstration.

CONTACT US

www.elabnext.com