Biobanking, Pandemics & The Future of Sample Handling

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The central tenets of biobanking - data/sample collection, processing, storage, and providing access for researchers - have proven indispensable throughout the COVID-19 pandemic. Even before the virus was properly characterised and defined as a coronavirus with a similar morphology to MERS and SARS, biobanks were leveraged for the storage of bronchoalveolar lavage fluids from patients with the as-yet unknown strain of viral pneumonia.

Researchers across the globe accelerated their efforts to decode the genome of the novel coronavirus and to make data available to the global scientific community. Thanks to the availability of a limited number of high-quality specimens and the tireless work of a small group of researchers, many of them in the UK, the viral genome was quickly sequenced and the virus characterised as SARS-CoV-2. Thereafter, the World Health Organisation (WHO) declared the outbreak a pandemic.

Over a year later we can begin to reflect on lessons learned, including the importance of effective biobanking and sample handling in any future pandemic.

Figure 1: Effective COVID-19 sample tracking

The rapid sequencing of SARS-CoV-2 was accomplished using a relatively restricted number of samples and therefore only characterised a small subset of the viral strains in circulation. The quality and traceability of samples was thus of the utmost importance, and though sample quality should already be a hallmark of biobanks, without having that principle ingrained in the sample handling workflow, COVID-19 research would have been hindered significantly with potentially fatal consequences.

The size of the pandemic presented a unique issue to biobanking in that, after the initial outbreak phase, vast quantities of sample material were anticipated. At a point where the number of confirmed cases passed 2 million in mid-April 2020, academic and biopharmaceutical biobanks alike were inundated with samples involved in the development of new diagnostic test kits and potential vaccines. A hurdle to the success of these initiatives was that few biobanks were experienced in the handling of highly pathogenic viruses, often lacking the necessary containment. In future, the receiving biobanks will be much better positioned to deal with samples emanating from a potential pandemic virus.

International cooperation and transparency were key to overcoming these obstacles, with the Centre for Disease Control (CDC) in Atlanta, USA, the International Atomic Energy Authority in Vienna (on behalf of the United Nations), and Public Health England at Colindale, UK, quickly publishing guidelines for handling and testing COVID-19 samples. Additionally, scientific publications were quick to disseminate articles relating to SARS-CoV-2 and biobanking, putting extremely valuable information in the hands of biobankers.

Some biobanks have been forced to reduce existing activities as many clinical efforts have stuttered to a halt while the scientific community rallies to defeat COVID-19. One key question that remains is which biobanks will return to pre-COVID levels of activity once the overwhelming demand for SARS-CoV-2 samples eventually reduces?

Figure 2: Laboratory scientist handling Biobank samples

Many areas of human genetics research that rely heavily on biobanking for sample storage retain biological specimens from hundreds of thousands of participants. The UK Biobank project exploring the link between major disease development and various genetic, environmental, and lifestyle factors involves extensive data and sample collection from as many as 500,000 participants. Shanghai's Zhangjian Biobank has reportedly reached a storage capacity of 10 million samples. Although the pandemic may have slowed the rate of their growth, these larger biobanks will certainly pick up the pace again post-pandemic.

The need for efficient and ethical storage protocols when dealing with human-derived samples takes on a new meaning at such enormous scales. Yet it is not simply these vast biobanks that need to implement smart biorepository storage protocols. Poor sample documentation and data loss can be devastating to research initiatives, forcing biobank researchers to repeat experiments which can significantly drain time and resources. It is absolutely crucial therefore that biobanking information is appropriately controlled and managed.

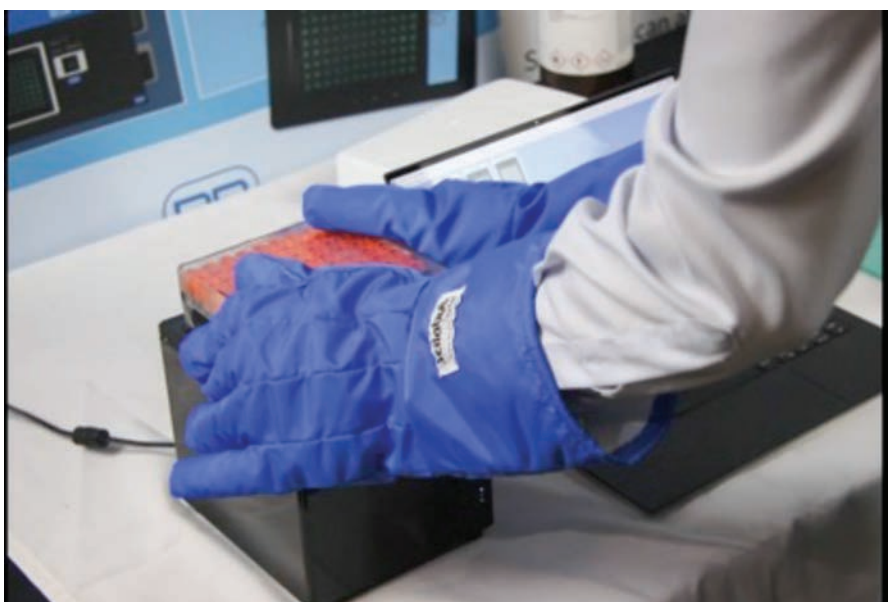

Figure 3: Scanning 2D-coded tubes direct from low temperature storage

Ziath has always recommended using 2D-barcoded sample tubes for information management and instrumentation control. Global biobanks support a wide range of specimen types including biopsies, body fluids (plasma, serum, urine, extracted DNA, etc.), and more. The viability of these samples is usually preserved at cryogenic temperatures using sterile tubes with high-integrity closures. Full traceability is guaranteed by 2D barcoding each individual sample tube, alongside the manufactured linear barcode printed onto the side of each tube.

The absolute integrity of these storage protocols ensures that all sample information can be quickly recalled whenever necessary. Coupling 2D barcoded cryotubes and readers with proprietary information management software, such as the Samples programme from Ziath allows researchers to store all relevant data easily and accessibly. This can streamline workflows and maximise the scientific return for biobank researchers, helping accelerate times to market for novel therapeutics, or assisting with individual diagnoses in emerging areas of personalised medicine or epidemiological studies of emerging pandemics.

Many commentators think that it is now inevitable that another viral pandemic will arise in the next 10 years and in that situation, biobanks will be much better prepared to cope with the bio-sampling necessary to support the development of new vaccines and treatments. Access to the genomes of many individuals from different geographies, races and socio-economic backgrounds will allow us to more fully understand the impact of future viral diseases on closely targeted segments of the population much more quickly than before. By making this data available to epidemiologists more quickly and precisely, we will be able to track the spread of the disease more efficiently and through that, to control it more effectively. In this, the role of biobanks will be key to success.

In summary, biobanking is a mainstay in drug discovery, pathology, and personalised medicine. It enables researchers to effectively manage biological sample collections in an easily accessible repository. The benefits of a centralised biobank for studies focused on particular conditions or for wider, more general research, cannot be overlooked.

About the Author

Steve Knight has more than 30 years' experience in the design & marketing of laboratory instrumentation & robotics. He holds a BSc in Biochemistry and an MA in Marketing and has specialised in developing small to medium sized robotic-compatible instrumentation for drug discovery for the past 15 years.