A Pillar of Precision Medicine: How Biobanks Are Transforming Life Sciences

We recently got together with Dr Neeta Bhatia, Global Portfolio Lead (Precision Medicine) at Atos Digital Health Solutions. The discussion of the day? Biobanks. From the basics of what they are, to the challenges of making them work, and the value they bring to the life sciences sector.

Biobanks. Back in 2009, Time Magazine called them one of the top-10 ideas that will change the world – so there's considerable hype to live up to. But we need to start from the beginning. As the global portfolio lead for precision medicine at Atos, Dr Bhatia is here to take us through what biobanks are and what role they play in the life sciences sector.

"We can look at biobanks simply as safe repositories of biological samples. But they are rather more than that" she says. "In fact, they are extended sample collection, processing, and storage infrastructures. Historically, most of these banks have focused on managing tumor tissue – largely due to the huge amount of research in the oncology field. This has evolved and now these infrastructures manage a vast range of bio-samples including blood, saliva samples, DNA Arrays, cell tissue from tumors, cord blood, spinal fluid."

According to Dr Bhatia, the spotlight has fallen on biobanks over the past 18 months. "Biobanks have been critical to increasing our understanding of, and response to, COVID-19. This is ongoing. Across the world, multiple biobanks are continuing to collect and store COVID test samples for future research."

"This is not just important in terms of developing appropriate vaccines," says Dr Bhatia. "The samples and data are also vital to determine the length of time when immunity starts to wane and the potential need for a booster vaccination."

Broadly speaking, there are two types of biobanks, Dr Bhatia goes on to explain. Disease-oriented biobanks, which collect disease-specific biospecimens, and are sometimes focused on specific tissues. Population-based biobanks, on the other hand, collect samples from across a generic population. Biobanks themselves can be part of hospitals, research centers, pharmaceutical companies, and also patient advocacy organizations, such as those in the cancer field.

The beauty of the biobank is that the biospecimens they contain don't just exist in isolation. They're all linked to personal data. "Health records, family history, genetic disorders, lifestyle – all the social determinants of health relevant to the individual are linked to the biospecimens [and vice-versa]," says Dr Bhatia. "This comprehensive patient profile then becomes the foundation of truly personalized, precision medicine."

It makes biobanks an incredibly useful resource for application in precision medicine, with a significant part to play in improving treatments and outcomes for individuals. "The important bit of the process is linking these two types of data," says Dr Bhatia, "We have the biospecimen information and then this wealth of other data that's related to it that tells us about the individual's lifestyle, medical history, DNA make-up. This allows us to correlate and find patterns – and then apply this to diagnosis and treatment."

Dr Bhatia stresses that the power of the biobank lies not just in its role within individual hospitals or institutions. There's much larger potential with biobanks providing important infrastructures for a wide range of basic, preclinical, translational, and clinical research.

"The scale and impact of biobanks are immense. They don't just have a healthcare context – they have a social context. When you look at the pandemic, for instance, the implications are widespread."

"It's a long-term, continuous program," she says. "Data has been collected over time, analyzed and added to. Take a cancer patient. You follow their entire lifecycle: you have samples at each stage of treatment, multiple interventions. You see what's happening at each stage, and all this research then informs the next interventions and treatment pathways. Then, you consider the links that can be made not just for this individual but for others – comparing, contrasting and linking all the aspects of data around the person, their background and family history, personal attributes, disease progression, treatment efficacy and so forth."

Bringing this information together and making it accessible and usable – not to mention, transformative – doesn't come without challenges though, as Dr Bhatia points out.

"The first process requirement is managing the sample and patient data. It needs to be anonymised, of course – data confidentiality and security are paramount. And then we need to assign role-based access to authorized users only. Removing silos is another challenge. End-to-end, the task is to generate unified personalized reports for each patient, while maintaining the integrity and security of the data."

The issue of non-standardized data offers challenges too – particularly when researchers want to compare data. "Coming back to the fight against COVID-19, we've seen [and are seeing] data collected and documented from all over the world, in many different ways. This fragmentation can make it difficult to answer questions that need large sample and data sets."

Add to this the lack of following appropriate standards during collection, processing or storage and, Dr Bhatia believes, there are important questions to be looked at around sample quality.

"Biobanks are one of the key pillars for precision – or personalized – medicine. We talk about the four Ps: personalized, preventative, predictive, participatory. Biobanks contribute to all of these four areas."

Another critical part is the processing of this data. "So, for instance, applying machine learning to harmonize big data, which will enable you to run algorithms and create models. And all this relies on high performance compute and storage – leveraging the cloud to automate and accelerate the time it takes to make those links and find connections in the mass of clinical, molecular, genetic, pathological and treatment data," says Dr Bhatia.

So, are biobanks living up to their immense potential – are they changing the world?

"As we've discussed, there are obvious challenges. However, the significance of biobanks in the life sciences field can't be underestimated," says, Dr Bhatia. "A lot of research is just impossible unless you have access to these clinical biospecimens. Biobanks help identification of new biomarkers – so we can figure out the causation or aetiology of complex diseases like cancer. If we can understand those causation factors more clearly, then we'll get to a point when cancer becomes just like any other lifestyle disease. It will be manageable rather than life threatening."

It's not simply in oncology where developing biobank infrastructures is making a difference. There is potential across the condition spectrum – including, as we have seen with the COVID-19 outbreak, in infectious diseases and beyond. Indeed, for all the potential issues, efforts in fighting the virus over the past 24 months has been something of a showcase for the potential of connected and accessible biobank infrastructure.

"Ultimately, it all comes back to the ability to prevent and predict," Dr Bhatia concludes. "Identifying key risk factors, diagnosing earlier, and diagnosing more accurately. Biobanks make this possible. They're transforming life sciences and helping us move towards the Holy Grail of personalized medicine."