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How India is training next-generation human-centric scientists

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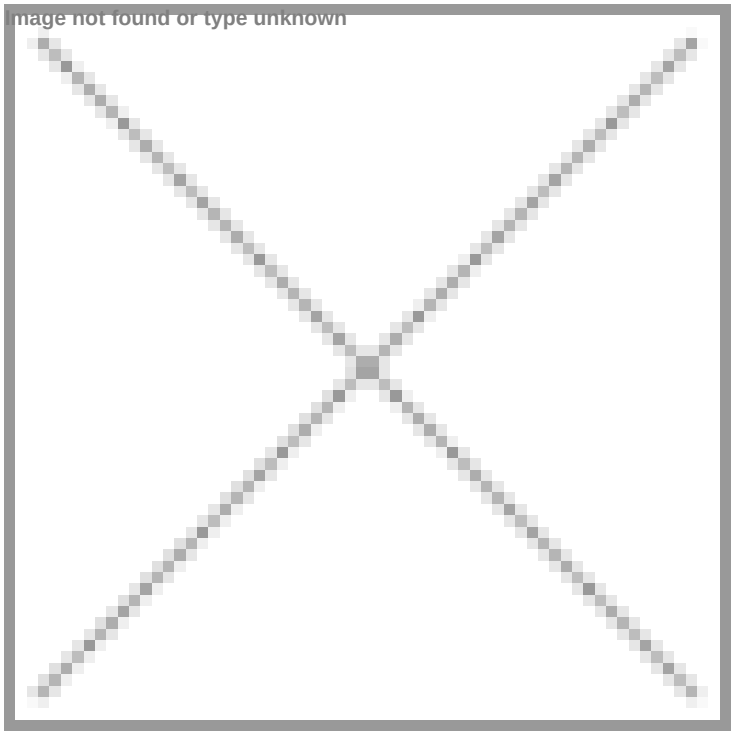
Deep-rooted, activity-based and hands-on workshops accelerate the adoption of human-relevant technologies inthe country



Umar Sheikh, a PhD student at the All India Institute of Medical Sciences (AIIMS) in New Delhi, is dedicated to unraveling the intricacies of cancer metabolism. Traditionally, he utilized cancerous cell lines to explore the nuances of aggressive and difficult-to-treat triple-negative breast cancer. However, he sensed a gap in evidence when working with cells grown on flat surfaces, considering tumors are three-dimensional (3D) entities after all.

The prospect of cultivating these cells in 3D environments to mimic disease conditions excited him. What was even more promising was the idea of bypassing cell lines entirely and utilizing patient-derived tumor biopsies to construct 3D tumor-like structures in a dish! Eager to translate these experiments into reality, he sought out hands-on workshops to acquire the necessary skills and bridge the gap.

Adding Human-ness to the Lab

Inefficient disease models limit biomedical research. Conventional research models like monolayer cell cultures display altered morphological and metabolic characteristics limiting their biological relevance. Animal models have also been used to understand pathology and progression of a disorder. However, studies consistently reveal that animal models frequently fall

short in predicting human responses, often leading to the failure of drugs in clinical trials owing to efficacy and toxicity issues.

Emerging human-relevant models such as the organoids, organ-on-chips, 3D bioprinted tissues, and spheroids show promise by capturing snapshots of human physiology including personalized genetic variations. Often, they leverage patient-derived cells to offer an accurate understanding of diseases and drug responses.

While there is a global effort to advance these technologies for translational research, in India, a major challenge is the scarcity of highly skilled professionals. Elite scientists across the country, with established labs, are typically trained abroad gaining interdisciplinary expertise. Consequently, there is a dire need for indigenous skill development programs to train next-generation scientists, leaders, and entrepreneurs in human-relevant technologies.

'*Playgrounds of Eton*'-on-a-Chip

"The battle of Waterloo was won on the playing fields of Eton"

- Arthur Wellesley (Duke of Wellington)

Similar to how the strategies and values instilled in students of Eton College were credited with aiding Britain's victory in the historic battle against Napoleon Bonaparte, consistent, incremental training efforts in human-centric disease solving can enable future researchers to defeat humanity's greatest ailments.

For Umar Sheikh to utilise cutting-edge technologies to develop novel cancer therapies, he would require not only the infrastructure to conduct experiments but also the guidance of a resourceful network of fellow scientists working on similar models throughout the country. It is here that training programmes such as the Microphysiological Systems Bootcamp organised by the Centre for Predictive Human Model Systems (CPHMS) at AIC-CCMB, Hyderabad bridge the gap.

A science & policy think-tank, CPHMS conducted a 10-day residential boot camp last year, of which Umar Sheikh was also a part. The training provided practical exposure to participants in 3D bioprinting, organoids, spheroids, and microfluidic systems. With 11 instructors, including professors, startup founders, and industry professionals, the workshop covered the fundamentals of these techniques to help participants apply them to their research. Catering to participants from diverse backgrounds such as engineering, nanotechnology, cancer biology, and biotechnology, the experience provided everyone with a network for troubleshooting and materialising their research ideas through experimentation, discussion and guidance.

"Most participants of the workshop had a theoretical grasp of human-relevant technologies but lacked the practical expertise. By the end of the 10-day program, we were pleased to know that over 80% of the participants demonstrated confidence in transitioning from routine to 3D experimentation. This marked a significant achievement", said Dr Kasturi Mahadik, Chief Manager, CPHMS.

Deep-rooted, activity-based and hands-on workshops accelerate the adoption of human-relevant technologies in the country. Recently, the Nanomedicine Research Group at the Institute of Chemical Technology (ICT), Mumbai organised a 3D cell culture workshop and conference. The four-day workshop covered emerging technologies such as organs-on-chip, and 3D bioprinting mimicking organ function. It featured industry collaborations, senior scientists, and sessions on Good Laboratory Practice (GLP) compliance, catering to a wide audience ranging from PhD candidates to industry personnel and startups.

"Interaction with participants enabled us to understand the growing interest of the country's pharmaceutical sector and Contract Research Organisations (CROs) to explore suitable non-animal models. Participant's interest in organ-on-chip, other 3D culture methods, and also their demand for continued skill development opportunities and networking platforms where Indian and international academicians, industries and regulators could regularly interact… is in line with the Government's recent interest in this field", said Prajakta Dandekar, Assistant Professor, ICT Mumbai.

International conferences that are informing the larger scientific community of the latest developments in 3D biology and providing a platform for Indian scientists to share their findings are becoming increasingly popular and paving the way to establishing collaborations.

In November 2022, CPHMS and the Centre for Cellular and Molecular Biology (CCMB, Hyderabad) organized an India | EMBO Lecture Course centred on microphysiological systems (MPS). The four-day event convened researchers to explore how advancements in human-relevant models are shaping new approaches in fundamental and translational research. Additionally, it featured demonstrations of the techniques discussed throughout the day.

In the following year, the Institute for Stem Cell Science and Regenerative Medicine (InStem), Bangalore hosted the India | EMBO lecture course 2023, which centered on human tissue organoids and their potential for modeling development and disease.

Skill-up and scale-up in human-relevant technologies

“Keeping the quality of research intact in the field of drug discovery, we are aiming at translating by reducing and refining the usage of animal models and finding the potential alternative in-vitro models as a replacement for animals in the research", said Dr Suresh Poosala, Founder, Oncoseek Bio.

Beyond fundamental research, numerous startups in the country are working to bridge the gap between bench to bedside by overcoming cultural and infrastructural barriers to translate their research. These companies are contributing to expanding India’s role in the global human-relevant research landscape and creating employment opportunities for entrepreneurial individuals.

For instance, Pandorum Technologies, a tissue engineering and regenerative medicine company, utilises foundational and translational principles of biology and engineering to design therapeutic products for conditions such as corneal dystrophies, lung-related disorders, and liver diseases. Oncoseek Bio, is a translational biotechnology company innovating in Organoid and Spheroid-based *in vitro* models to expedite the drug discovery process. One of their initiatives is the International Conference on 3R’s Research and Progress, an annual congregation of global researchers from academia and industry communicating the latest research in non-animal alternatives.

Some of these companies also organize training programs to provide in-depth knowledge and skills in these cutting-edge techniques, often in the form of certification courses. A few emerging startups like Next Big Innovation Labs and Avay Biosciences offer hands-on and foundational courses on 3D bioprinting. Courses like these help students to supplement their text-book knowledge and add job-relevant skills to their portfolio which can help them land research positions in their chosen industry.

In an effort to document the growing community of human-relevant researchers, CPHMS has curated a database of Indian scientists working in the fields of organoids, organ-on-chips and computational modeling. The open-access database enables students and scientists to access experts working in the field and also serves as a critical resource for public, private investors as well as policymakers.

While all this may sound substantial, we are merely scratching the surface. In future, innovative training programs are required to enable transdisciplinary research in human-relevant technologies. Initiatives such as joint thesis projects that run as collaborations between universities/ institutes and pharma companies can be an effective way to train students, translate technologies and bring innovation. It is imperative to channel young India’s energy to drive the development and adoption of new approach methodologies, pioneer human-relevant science in the country and poise it as the next superpower accelerating towards one health.

About the Author-

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