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NYSCF Global Stem Cell Array brings precision medicine one step closer to the clinic

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Scientists at The New York Stem Cell Foundation (NYSCF) Research Institute successfully designed a revolutionary, high-throughput, robotic platform that automates and standardizes the process of transforming patient samples into stem cells. This unique platform, the NYSCF Global Stem Cell Array, for the first time gives researchers the scale to look at diverse populations to better understand the underlying causes of disease and create new individually tailored treatments, enabling precision medicine in patient care.

A paper published in *Nature Methods* demonstrates how this novel,

highly efficient technology automates the entire process of generating patient-specific stem cells while reducing variability resulting from manual manipulations. The system takes patient samples and turns them into cells that have the ability to become any other cell type in the body, induced pluripotent stem (iPS) cells. The Array can then turn these iPS cells into adult cell types in the body such as heart cells, neurons, and liver cells. NYSCF scientists built the Array to be highly modular enabling customized cell production to best approach unaddressed research questions.

"Our goal is to understand and treat diseases. This is not an artisanal pursuit. Researchers need to look at genetically diverse populations at scale, which means creating large numbers of standardized, human pluripotent stem cells. The NYSCF Global Stem Cell Array's massive parallel processing capabilities make this research possible," said NYSCF Research Institute CEO and Founder Susan L. Solomon, an author of the paper.

The Array will allow researchers to anticipate how people from genetically diverse backgrounds respond to new drugs - conducting 'clinical trials in a dish.' This pioneering technology will allow researchers to identify potential drug metabolism and toxicity issues in human cells, rather than in animals, in advance of bringing drugs to patients. Ms. Solomon explained, "This has the potential to save billions of dollars in drug development and limit the dangers to people participating in those clinical trials; dramatically reducing the amount of time currently spent on human clinical trials."

"The capacity to test drugs on thousands of patients in a dish will change how we cure disease. We will be more informed about how drug candidates will behave in patients before the clinical trial phase accelerating the discovery process. This technology will enable us to bring precision medicine treatments and personalized pharmaceuticals to

more patients," noted Dr. Thomas Singer, Senior Vice President, F. Hoffmann-La Roche Ltd, Pharmaceuticals Division.

The industry norm used to turn adult cells into iPS cells is time consuming, laborious, and produces variable results. Currently, scientists take skin cells and, by hand, expose them to a mixture of molecules that make them look and act like embryonic stem cells. This handmade process of creating iPS cells introduces human error and variability between resulting cell lines, in addition to requiring months of hands-on time and attention. This automated, robotic platform graduates stem cell production from a classical, hands-on approach to twenty-first century high-throughput standards. The Array fuses the power of patient-specific research made possible by iPS cells with the scale to look at macroscopic, population patterns in a lab.

"This is a great example of how non-profit organizations can work together to make important advances in technology. The ability to achieve scale and reproducibility vastly increases the utility of stem cells for therapeutics," said Dr. Steven Hyman, Director of the Stanley Center for Psychiatric Research at the Broad Institute of MIT and Harvard and Harvard University Distinguished Service Professor of Stem Cell and Regenerative Biology, in regard to the collaboration between NYSCF and the Broad Institute to demonstrate the reduced variance of stem cell lines made with NYSCF automated technology.

The over 600 skin samples used in this particular study represent patients with undiagnosed diseases, mental health conditions, neurodegenerative diseases like Parkinson's and Alzheimer's disease, individuals with other diseases, and those with no known diseases. The creation of specific cell types from these patients allows scientists to, for the first time, merge data from the human genome with global genetically diverse populations supplying insights as to how unlucky genetics and environmental factors might promote disease onset. Moreover, the sheer quantity of cells to

study generated by the Array provides researchers the power to draw broader conclusions and work with statistically significant data.

"The cell lines generated by The New York Stem Cell Foundation using the NYSCF Array are an important tool to help us better understand and develop new treatments to prevent or slow the progression of Parkinson's disease, especially in combination with emerging comprehensive biomarker data," said Dr. Todd Sherer, Chief Executive Officer of The Michael J. Fox Foundation, which was not involved in the Array development, commenting on the NYSCF innovation. "The ability to quickly test hypotheses in human cells on a large scale will be of great benefit to our research pursuit."

After patients' cells are reprogrammed to iPS cells, the Array selects cells with similar growth characteristics to further study. The research demonstrates that, when done manually, this step in generating patient-specific stem cells introduces significant variation between cell lines. This variation derived from techniques can hide important genetic differences between patients. The Array reduces the noise between resulting pluripotent cell lines allowing genetic-based differences to be detectable, and scientists to move forward to draw real and applicable solutions from their research. Additionally, the Array increases the efficiency of turning adult cells into iPS cells.

"For many common diseases such as diabetes and Alzheimer's, using stem cell models to understand these diseases has relied on a few rare genetic mutations affecting only a small percentage of all sufferers. However, it has been difficult to study the more common genetic risk factors that affect the majority of patients with these diseases using stem cell models. Our automated system will enable large-scale stem cell experiments needed to understand how these risk factors directly contribute to disease," Dr. Scott Noggle, NYSCF Vice President of Stem Cell Research and senior author of the paper, explained.

The Array provides the necessary power to understand development and disease in populations, test treatments, and conduct clinical trials in a dish. This system also makes the generation of stem cell lines for conducting future cell replacement therapies possible. The NYSCF Global Stem Cell ArrayTM pushes biological research into the future, meeting the demands required to perform population-wide studies while enhancing experimental and statistical power.

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Provided by New York Stem Cell Foundation