PRESS RELEASE

NUS Medicine researchers can now reprogramme cells to revert to original state for regenerative medicine

*Inducing totipotency into stem cells outside of embryos will allow maximal cell engineering for therapeutic purposes*

*Singapore, January 2020 —* Early mammalian development is a highly complex process involving elaborate and highly coordinated biological processes. One such process is zygotic genome activation (ZGA) which occurs following the union of the sperm and egg, marking the beginning of life. The resultant early embryos, termed ‘zygotes’ are capable of generating the entire organism, a property known as totipotency.

Totipotent cells sit atop the developmental hierarchy and have the greatest potency of all cell types, giving it limitless therapeutic potential. Surpassing pluripotent embryonic stem cells, which are only able to differentiate into all cell types within the embryo, the totipotent zygote loses its totipotency as it matures into pluripotency.

Scientists at the National University of Singapore’s Yong Loo Lin School of Medicine have now found a way to manipulate pluripotent cells into acquiring the totipotent capacity previously thought to exist only in the zygote. This not only provides key insights into how totipotency is formed and the earliest events in mammalian development, but opens new doors for potential cell therapies that were previously unexplored.

The study identified a totipotency-inducing factor – Negative Elongation Factor A (NELFA), which is capable of driving pluripotent embryonic stem cells into totipotency in a petri dish. NELFA achieves this feat by causing specific changes in the gene regulatory and metabolic networks of the cell. Specifically, NELFA has the ability to reactivate certain genes that are only active in the zygote but otherwise silent in embryonic stem cells. NELFA is also able to alter the energy using pathways in the pluripotent stem cells. All these changes will result in pluripotent stem cells reverting into a totipotent-like state.

Discovering this method of inducing totipotency in cells outside of the embryo also provides a means to engineer cells with maximum cell plasticity for therapeutic purposes. This increases the potential applications of regenerative medicine, especially in cell replacement therapies.

According to Assistant Professor Tee Wee Wei, the lead investigator in this study, the eventual goal of this research is to translate the findings into the development of rapid and efficient cellular reprogramming strategies for clinical application, such as in the treatment of debilitating diseases and developmental disorders.
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About the National University of Singapore (NUS)

The National University of Singapore (NUS) is Singapore’s flagship university, which offers a global approach to education, research and entrepreneurship, with a focus on Asian perspectives and expertise. We have 17 faculties across three campuses in Singapore, as well as 12 NUS Overseas Colleges across the world. Close to 40,000 students from 100 countries enrich our vibrant and diverse campus community.

Our multidisciplinary and real-world approach to education, research and entrepreneurship enables us to work closely with industry, governments and academia to address crucial and complex issues relevant to Asia and the world. Researchers in our faculties, 29 university-level research institutes, research centres of excellence and corporate labs focus on themes that include energy, environmental and urban sustainability; treatment and prevention of diseases common among Asians; active ageing; advanced materials; as well as risk management and resilience of financial systems. Our latest research focus is on the use of data science, operations research and cybersecurity to support Singapore’s Smart Nation initiative.

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About the NUS Yong Loo Lin School of Medicine (NUS Medicine)

Established in 1905, the NUS Yong Loo Lin School of Medicine is the first institution of higher learning in Singapore and the genesis of the National University of Singapore.

The School offers one of the finest undergraduate medical programmes in the Asia Pacific region and enjoys international recognition and respect. The Times Higher Education World University Rankings 2019 by subject and Quacquarelli Symonds (QS) World University Rankings by Subject 2019 list NUS Medicine as the leading medical school in Asia.

It admits 300 students to the MBBS degree programme annually and its principal missions are to educate and train the next generation of healthcare professionals, and foster research that will help to advance the practice of medicine.

The 18 NUS Medicine departments in the basic sciences and clinical specialties work closely with the Centre for Medical Education, the Centre for Biomedical Ethics, the Centre for Healthcare Simulation as well as the restructured public hospitals to ensure that teaching and research are aligned and relevant to Singapore’s healthcare needs. The School is a founding institutional member of the National University Health System.

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