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## The Chinese National Stem Cell Resource Center

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### ABSTRACT

The Chinese National Stem Cell Resource Center was first established in 2007 and has progressed to produce and prepare stocks of more than 400 human embryonic stem cell lines. Its facilities are accredited to international standards and it has accreditation as a supplier of cells for research and therapy. The NSCRC also has an active program of translational research and strong collaborations with the Institute of Zoology and the Academy for Stem Cells and Regeneration of the Chinese Academy of Sciences. Its translational research extends to early stage clinical studies and it also has a strong training and public education program.

### 1. Introduction

The Chinese Academy of Sciences (CAS) is the linchpin of China's drive to explore and harness high technology and the natural sciences. The Institute of Zoology (IOZ) at the CAS established the Beijing Stem Cell Bank in 2007 which is now known as the National Stem Cell Resource Center (NSCRC). The mission of NSCRC is to provide resources and support for basic research and future clinical applications of human stem cells. This is implemented through key NSCRC objectives to establish, improve and develop relevant technical resources, create and collect a variety of stem cells, conduct stem cell-related preclinical animal experiments, and address key scientific questions emerging during the clinical translation of stem cells. NSCRC closely follows the development of international standards and in addition, implements national evaluation criteria of clinical-grade stem cells with a focus on safety and adherence to scientific best practice.

Based on the development of high quality pluripotent stem cell lines, NSCRC has actively engaged in collaborations with major stem cell research institutions in China, to develop or improve relevant technologies, which can then be used to benefit the entire stem cell research community. NSCRC serves as a hub to set up networks of national stem cell resources and preclinical research. To promote clinical application of stem cells in the near future, NSCRC is also working hard to provide high-level resources, services and support for worldwide stem cell researchers and institutions.

The NSCRC has an internal program of work delivering cell banks and differentiation protocols as part of a clinical translation effort to treat age-related macular degeneration (Liu et al., 2018), recurrent uterine adhesion (Cao et al., 2018), Parkinson's disease

(NCT03119636), moderate and severe intrauterine adhesions (NCT04232592), retinitis pigmentosa (NCT03944239), and severe COVID-19 associated with/without ARDS (NCT04331613).

A new goal of NSCRC is to establish a pluripotent stem cell registry in China that will expand the international reach of the hPSCreg project ([www.hpscereg.eu/](http://www.hpscereg.eu/)) share cell line data with other registries, harmonize procedures and enable communication. NSCRC is an international partner in the hPSCreg project for which its tasks include definition of new information fields to add to the database, acquisition and registration of Chinese cell line information according to the defined requirements agreed in cooperation with other national registries and banks.

### 2. Cell lines distributed and conditions of supply

The Bank currently holds multiple clinical-grade human embryonic stem cells (Gu et al., 2017) and induced pluripotent stem cells (Wang et al., 2015; Li et al., 2018) which provides an important resource for both basic and clinically oriented research. Furthermore, NSCRC has also developed a range functional differentiated products from human embryonic stem cells. These include neural progenitor cells and neurons (Wang et al., 2018), retinal pigment epithelial cells (Wang et al., 2019), cardiomyocytes (Tan et al., 2018), hepatocytes (Li et al., 2020) and tissue-specific progenitor cells (Ma et al., 2018). These cell types have been supplied as part of formal collaborations, to numerous hospitals and research departments who have performed a range of basic and clinical research projects with these cell resources. Transfers include a no-cost, non-transferable license, for a specific project in accordance with all relevant laws and regulations, industry practices and academic

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norms. Ownership, intellectual property and other rights in the research materials remain with the provider, however, the results obtained from such research are typically shared by both parties. The cell information that we provide to users includes, the name of the cell line, its passage number and the number of cells per vial (or the recovery ratio), cell characterization data and cell quality reports. Cell quality reports include cell microbial detection test results, viability assessment and cell characterisation data. NSCRC is also now the hub for development of a Chinese National Stem Cell Innovation Alliance of major stem cell resource centers. In this program NSCRC will have a broader and more diverse range of service activities and an expanded scope providing the lead in China for the quality and safety of stem cells used in research and clinical applications. This project will include an online public information platform by which researchers can access cell lines in the future.

NSCRC has established a Quality Management System based on ISO 20387 which defines the competence of personnel, facility requirements, documentation and control of equipment, process requirements and quality management requirements. The current NSCRC facilities include several separated areas for different banking and differentiation activities. All personnel training and performance is managed under the NSCRC Quality Management System (QMS) and all activities under this system are subject to internal and external review including inspections by the Chinese regulators, the SFDA.

Quality control activities cover all the biobanking processes, and QC procedures are maintained and documented under the NSCRC QMS. All cell lines are subject to safety testing with samples from each individual cell bank tested by standard operating procedures for mycoplasma, bacterial endotoxins, bacteria and viruses (Gu et al., 2017). In addition, cells from each cell bank are subjected to a characterization regime including cell viability, morphology, cell markers and assays of pluripotency. In addition to regulatory review by the SFDA, the NSCRC also uses internal quality control and external quality assessment programs to demonstrate the competence and the accuracy of testing.

The China National Accreditation Service for Conformity Assessment (CNAS) conducted an on-site assessment of NSCRC on May 2019, which was the first time that China has carried out an assessment using the ISO 20387 for biobanking [ISO 20387 \(2018\)](https://www.iso.org/standard/68411.html) (<https://accreditation.news-weaver.co.uk/ilac/1dr3bw5vg94tny0fn3gsmg?a=1&p=55809193&t=28643616>). This marks a landmark step for NSCRC in the promotion of quality and competence of biobanking.

### 3. Other services and training provided to the outside community

In addition to providing cell resources, NSCRC also provides services to the outside community, such as stem cell technology training, organization of a national science forum on stem cells and public outreach activities on stem cell research.

### 4. Training

So far, NSCRC has organized 30 training courses and hundreds of students have been trained. The training has covered many aspects of

stem cell science, from basic to clinical research. Training formats have included experimental operation and theoretical knowledge, focused on the isolation and culture of hESC and tissue-specific progenitor/stem cells (MSCs).

Several sessions of the National Science Forum on Stem Cells have also been held, with thousands of participants mainly from universities, research institutes and hospitals.

### 5. Public science outreach

In order to communicate stem cell technology and science to the public, we welcome high school and primary school students to come into the NSCRC laboratories, including high school students for laboratory practice. NSCRC also formed the 'popular science group' delivering popular science exhibitions and held numerous popular science report meetings open to the public (more than 300 reports up to 2018).

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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