Review Article



# The Chinese Neonatal Network: a new platform of national collaboration on quality improvement for preterm infants

**Mingyan Hei[1], Yun Cao[2], Jianhua Sun[3], Huayan Zhang[4,5], Xiaolu Ma[6], Hui Wu[7], Xiaoying Li[8], Siyuan Jiang[2], Huiqing Sun[9], Wei Zhou[4], Yuan Shi[10], Lizhong Du[6], Chao Chen[2], Shoo K. Lee[11,12,13], Wenhao Zhou[2]; the Chinese Neonatal Network***

[1]Neonatal Center, Beijing Children's Hospital, Capital Medical University, Beijing, China; [2]Division of Neonatology, Children's Hospital of Fudan University, Shanghai, China; [3]Division of Neonatology, Shanghai Children's Medical Center, Shanghai Jiao Tong University School of Medicine, Shanghai, China; [4]Division of Neonatology, Division of Neonatology and Center for Newborn Care, Guangzhou Women and Children's Medical Center, Guangzhou, China; [5]Department of Pediatrics, Children's Hospital of Philadelphia and University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, USA; [6]Division of Neonatology, The Children's Hospital Zhejiang University School of Medicine, Hangzhou, China; [7]Division of Neonatology, The First Hospital of Jilin University, Changchun, China; [8]Division of Neonatology, Children's Hospital Affiliated to Shandong University, Jinan, China; [9]Division of Neonatology, Children's Hospital Affiliated to Zhengzhou University, Children's Hospital of Henan Zhengzhou, Zhengzhou, China; [10]Department of Neonatology, Children's Hospital of Chongqing Medical University, Chongqing, China; [11]Maternal-Infant Care Research Centre and Department of Pediatrics Mount Sinai Hospital, Toronto, ON, Canada; [12]Department of Pediatrics, University of Toronto, Toronto, ON, Canada; [13]Department of Obstetrics and Gynecology and Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada

*Contributions:* (I) Conception and design: M Hei, SK Lee, W Zhou; (II) Administrative support: None; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: None; (V) Data analysis and interpretation: None; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

*Correspondence to:* Wenhao Zhou, MD, PhD. Department of Neonatology, Children's Hospital of Fudan University, 399 Wanyuan Road, Minhang District, Shanghai 201102, China. Email: zhouwenhao@fudan.edu.cn.

**Background:** The population of China represents about one sixth of the global population. It is important to create a national database with a large sample size and a sustained collaborative platform. The objective of this study was to introduce the Chinese Neonatal Network (CHNN), a new platform of national collaboration on quality improvement (QI) for short and long-term health outcomes of preterm infants.

**Methods:** The background, participating centers, data collection, and objectives are described. Specific objectives are to: (I) Establish a standardized database of very preterm infants (VPI) with gestational age <32 weeks or birth weight (BW) <1,500 grams. (II) Assess, benchmark and monitor major outcomes of VPI and their risk determinants, as well as inter-institutional variations. (III) Implement the Evidence-based Practice for Improving Quality (EPIQ) program to improve quality of care and outcomes. (IV) Conduct collaborative research, including epidemiologic, clinical and health services studies and randomized controlled trials. This study is collaboratively funded by Canadian Institute of Health Research and the Children's Hospital of Fudan University.

**Results:** The CHNN collaboration acts as a platform that member neonatal intensive care units (NICUs) can access for evidence on implementing practice improvements, learning activities, and research collaborations. There were 58 participating centers in 2018, which was expanded to be 79 in 2021. CHNN has published 2 annual reports to describe the outcomes and care practices of VPI in 2019 and 2020, and conducted an internal audit of data quality.

**Conclusions:** The knowledge generated will be available nationally and worldwide with a definite national impact and a likely global impact.

**Keywords:** Introduction; Chinese Neonatal Network (CHNN); collaboration; quality improvement (QI); preterm

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## Introduction

The population of China represents about one sixth of the global population. Of the 16 million infants born in China each year, 7.3% are preterm and the incidence has been rising steadily (1,2). Although preterm infant survival in China has significantly improved in recent years, mortality and major morbidity remains higher than in developed countries (3). There is significant variation among provinces, regions and hospitals. This variation might be due to differences in populations and socio-

*Group Information:

Chairmen: Shoo K. Lee, MBBS, Mount Sinai Hospital, University of Toronto; Chao Chen, MD, Children's Hospital of Fudan University.

Vice-Chairmen: Lizhong Du, MD, Children›s Hospital of Zhejiang University School of Medicine; Wenhao Zhou, Children's Hospital of Fudan University.

Site investigators of the CHNN: Children›s Hospital of Fudan University: Yun Cao, MD; The Third Affiliated Hospital of Zhengzhou University: Falin Xu, MD; Tianjin Obstetrics & Gynecology Hospital: Xiuying Tian, MD; Guangzhou Women and Children's Medical Center: Huayan Zhang, MD; Children's Hospital of Shanxi: Yong Ji, MD; Northwest Women›s and Children›s Hospital: Zhankui Li, MD; Gansu Provincial Maternity and Child Care Hospital: Bin Yi, MD; Shengjing Hospital of China Medical University: Xindong Xue, MD; Shenzhen Maternity and Child Health Care Hospital: Chuanzhong Yang, MD; Quanzhou Women and Children's Hospital: Dongmei Chen, MD; Suzhou Municipal Hospital affiliated to Nanjing Medical University: Sannan Wang, MD; Guizhou Women and Children's Hospital/ Guiyang Children's Hospital: Ling Liu, MD; Hunan Children's Hospital: Xirong Gao, MD; The First Hospital of Jilin University: Hui Wu, MD; Fujian Maternity and Child Health Hospital Affiliated Hospital of Fujian Medical University: Changyi Yang, MD; Nanjing Maternity and Child Health Care Hospital: Shuping Han, MD; Qingdao Women and Children's Hospital: Ruobing Shan, MD; The Affiliated Hospital of Qingdao University: Hong Jiang, MD; Children's Hospital of Shanghai: Gang Qiu, MD; Women and Children›s Hospital of Guangxi Zhuang Autonomous Region: Xinnian Pan, MD; Children's Hospital of Nanjing Medical University: Youyan Zhao, MD; Henan Children's Hospital: Wenqing Kang, MD; The First Affiliated Hospital of Xinjiang Medical University: Mingxia Li, MD; Foshan Women and Children's Hospital: Xuqiang Ye, MD; The First Affiliated Hospital of Anhui Medical University: Lili Wang, MD; Shanghai First Maternity and Infant Hospital: Jiangqin Liu MD; Yuying Children›s Hospital Affiliated to Wenzhou Medical University: Zhenlang Lin, MD; Children's Hospital of Chongqing Medical University: Yuan Shi, MD; The First Affiliated Hospital of Zhengzhou University: Xiuyong Cheng, MD; The First Affiliated Hospital of USTC, Division of Life Sciences and Medicine, University of Science and Technology of China: Jiahua Pan, MD; Shaanxi Provincial People's Hospital: Qin Zhang, MD; Children›s Hospital of Soochow University: Xing Feng, MD; Wuxi Maternity and Child Healthcare Hospital: Qin Zhou, MD; People›s Hospital of Xinjiang Uygur Autonomous Region: Long Li, MD; The Second Xiangya Hospital of Central South University: Pingyang Chen, MD; Children's Hospital Affiliated to Shandong University: Xiaoying Li, MD; Hainan Women and Children's Hospital: Ling Yang, MD; Xiamen Children's Hospital: Deyi Zhuang, MD; Xinhua Hospital affiliated to Shanghai Jiao Tong University School of Medicine: Yongjun Zhang, MD; Shanghai Children's Medical Center Shanghai Jiao Tong University School of Medicine: Jianhua Sun, MD; Shenzhen Children's Hospital: Jinxing Feng, MD; Children›s Hospital Affiliated to Capital Institute of Pediatrics: Li Li, MD; Women and Children's Hospital, School of Medicine, Xiamen university: Xinzhu Lin, MD; General Hospital of Ningxia Medical University: Yinping Qiu, MD; First Affiliated Hospital of Kunming Medical University: Kun Liang, MD; Hebei Provincial Children›s Hospital: Li Ma, MD; Jiangxi Provincial Children's Hospital: Liping Chen, MD; Fuzhou Children's Hospital of Fujian Province: Liyan Zhang, MD; First Affiliated Hospital of Xian Jiao Tong University: Hongxia Song, MD; Dehong people›s Hospital of Yunnan Province: Zhaoqing Yin, MD; Beijing Children›s Hospital Capital Medical University: Mingyan Hei, MD; Zhuhai Center for Maternal and Child Health Care: Huiwen Huang, MD; Guangdong Women and Children›s Hospital: Jie Yang, MD; Dalian Municipal Women and Children's Medical Center: Dong Li, MD; Peking Union Medical College Hospital: Guofang Ding, MD; Obstetrics & Gynecology Hospital of Fudan University: Jimei Wang, MD; Shenzhen Hospital of Hongkong University: Qianshen Zhang, MD; Children›s Hospital of Zhejiang University School of Medicine: Xiaolu Ma, MD.

economic status, training and expertise of health care personnel, availability and access to health care services and facilities, and even health insurance plans. To address these challenges, the Chinese Neonatal Network (CHNN) was established in 2018 as a national collaboration of neonatal intensive care units (NICU), neonatologists and nurses to improve training, research, clinical care and outcomes of newborn infants in China (4). CHNN is the first national neonatal network in China, and was started as a collaboration of 58 tertiary level NICUs in 25 provinces, but has since expanded to 79 NICUs in 30 provinces across China. There are many precedents for neonatal networks, including the Vermont-Oxford Neonatal Network, the Canadian Neonatal Network, and many national networks such as those participating in the International Network for Evaluation of Outcomes (iNEO) (5-7). All have in common, a standardized national database to monitor neonatal outcomes and a collaborative quality improvement (QI) initiative to improve neonatal outcomes. In addition to these, the CHNN is also implementing a national Chinese Neonatal Development Strategy 2030 (CNDS 2030) aimed at bringing neonatal care in China to international standards by 2030. The objective of this manuscript is to introduce the CHNN and to describe the platforms and activities that are being mobilized to achieve these goals.

## Objectives

The specific objectives of CHNN are to: (I) Establish an ongoing prospectively collected standardized database of very preterm infants (VPI) with gestational age (GA) <32 weeks or with birth weight (BW) <1,500 grams (the latter permits capture of small for gestational age (SGA) infants who may be >32 weeks GA but <1,500 grams BW) among NICUs in China, as a platform for surveillance, QI and research. (II) Assess, benchmark and monitor major outcomes of VPI and their risk determinants, as well as inter-institutional variations in care practices and outcomes to identify clinical practices associated with good or poor outcomes, and annual reports will be published and provided to participating institutions (4). (III) Implement the Evidence-based Practice for Improving Quality (EPIQ) program to improve quality of care and outcomes. (IV) Conduct collaborative research, including epidemiologic, clinical and health services studies and randomized controlled trials (8,9). In addition, CNDS 2030 is being implemented in 3 stages to improve training, clinical care, organizational infrastructure and research for neonatal care in China.

## Methods and organization

### *Network coordination and participating centers*

The CHNN Governance includes an Executive Committee comprising 2 chairmen, 2 vice-chairmen, 3 secretary generals and 8 committee members representing different regions of China. The CHNN Coordinating Centre is located at the Children's Hospital of Fudan University in Shanghai. Participating NICUs are accredited Grade A level III NICUs authorized by the Health Administration of China. The 79 participating NICUs include all government-designated neonatal centers of excellence in China, including 4 national children's medical centers, 5 regional children's medical centers, and 30 provincial perinatal or children's medical centers. Other hospitals comprise major referral centers in large cities across China.

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional ethics board of Children's Hospital of Fudan University (#CHFU 2018-296) and all participating sites. All participating sites have signed data transfer agreements with the CHNN Coordinating Centre in accordance with national and local regulations for protecting patients' personal privacy and confidentiality. Waiver of consent were granted at all sites.

### *Database, data management, and reporting*

Data variables for inclusion in the database were developed by consensus and modelled after the Canadian Neonatal Network database. Data definitions were standardized and mapped to the ICD-10 and SNOMED dictionaries where possible, and a standard data dictionary and manual of operations was provided to all sites (10-11). Data are prospectively collected by trained site data abstractors into a computerized data entry program with built-in error checking. Encrypted data are electronically transferred regularly to the Coordinating Center, where data are checked and potential errors fed back to sites for rechecking and correction. An annual data quality audit using re-abstraction of randomly selected charts reported high quality of data collected (12). Publications include an annual report of network outcomes as well as research projects utilizing network data.

### *Statistical methods*

Data analysis is performed by a team of statisticians at the

CHNN Coordinating Center. Statistical methods will depend on the questions asked and analyses required.

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## Chinese Neonatal Development Strategy 2030 (CNDS 2030)

China has made remarkable progress in neonatal care in recent years. However, there is still a gap between China and developed countries (13). Specifically, neonatology training remains fragmented and unstructured, nurse expertise is lacking, research capabilities lag, and organization and regionalization are variable. To address these issues, the Chinese Neonatal Development Strategy (CDNS2030) was launched in 2020 with the aim of bringing neonatology in China to international standards by 2030. CNDS 2030 is being implemented in 3 stages, focusing on training, clinical care, and organizational infrastructure and research.

### *Stage 1—Training*

**1. Advanced Neonatal Fellowship Enrichment Program (Lead—Children's Hospital Affiliated to Shandong University and Canadian Neonatal Network)**

Between 2004 and 2019, the International Training Program in Neonatal-Perinatal Medicine, which is a collaboration between the Canadian Neonatal Network and the Children's Hospital of Fudan University, trained over 100 Chinese neonatologists from over 30 provinces across China, in a 2-year clinical fellowship program with one year each in Shanghai and Canada. Many graduates are now in leadership positions at major institutions across China. The Advanced Neonatal Fellowship Enrichment Program builds upon this legacy by offering a 2-year academic enrichment program to current fellows at selected Chinese NICUs. The virtual program is taught by Chinese and international faculty from Canada, USA and Hongkong, and comprises a structured teaching program of developmental physiology, clinical neonatology, and research, teaching and management skills. It includes weekly lectures, clinical rounds, case discussions, seminars, journal clubs, research projects and structured oral examinations, and assigned mentorship.

**2. Neonatal Nurse Training Program (Lead—Shenzhen Hospital of Hongkong University, Hongkong University and Canadian Neonatal Network)**

This is a 3-month structured training program designed to upgrade neonatal nursing skills in China to international standards using a train the trainer model. Hands-on training is provided at designated training centers in China by instructors from China, Hongkong and Canada. Using a fan out strategy, graduates will train other nurses at their own NICUs and establish regional training centers for nurses from other hospitals in their region.

**3. Regional Scholars Clinical Research Program (Lead—Children's Hospital of Fudan University)**

Since research expertise in China is concentrated at large metropolitan hospitals, this program in intended to train regional leaders in clinical research so that they can actively engage in research and lead local participation in high quality research in a national network. Trainees attend a month-long residential course at the Children's Hospital of Fudan University that provides structured intensive instruction in clinical research methods, completion of a research project and publication in a peer reviewed journal.

**4. Clinician-Scientist Scholars/Leaders Program (Lead—TBD)**

The objective is to develop selected young and mid-career neonatology faculty into world class clinician-scientists and leaders. The 3-year program is currently in planning and will provide structured training in research methods, leadership, management and communication, combined with in-depth training in a focused area of research under senior Chinese and international mentorship, and may lead to a graduate degree.

*Stage 2—Clinical care*

**5. QI (Lead—Children's Hospital of Fudan University)**
The objective is to establish an on-going Evidence-based Program for Improving Quality (EPIQ) in CHNN to make China a world leader in neonatal outcomes within 10 years. The program will establish a database to facilitate QI, training in QI methods, coordinate collaborative QI initiatives and meetings, develop best practice guidelines and facilitate their implementation in Chinese NICUs.

**6. Family Integrated Care (Lead—Beijing Children's Hospital & Shenzhen Hospital of Hongkong University)**
Most hospitals in China do not allow parents in the NICU and family centered care is usually absent. The objective of this program is to promote and develop standards for family centered care, facilitate their implementation in Chinese NICUs and conduct research on integrating families into care of infants in the NICU.

**7. Human Milk Group (Lead—Nanjing Maternity and Child Health Care Hospital)**
Human milk feeding is one of the most effective interventions available for improving infant outcomes but its use in Chinese NICUs is variable, particularly because parents are not allowed into the NICU. Breast milk banks are frequently not available. The objective of this program is to promote and develop standards of practice for breast milk feeding and breast milk banks in China, conduct research into human milk feeding, and facilitate wide use of human milk in Chinese NICUs.

**8. Point of Care Technologies Group (Lead—The First Hospital of Jilin University)**
This program will develop and promote standards for use of point of care technologies in NICUs, including ultrasound (head, lung, heart, abdomen), NIRS, MRI and blood tests. It will also standardize training, establish a database to monitor use and outcomes of these technologies, and conduct research into their use and impact on outcomes.

**9. Respiratory Group (Lead—Guangzhou Women and Children's Medical Center & Children's Hospital of Zhejiang University School of Medicine)**
The objective of this program is to improve respiratory care and outcomes of neonates. The program will include structured training in respiratory physiology and respiratory management including assisted ventilation, as well as regular rounds, seminars and case discussions designed to improve collaboration and mutual learning. A database will be established for monitoring respiratory care and outcomes and research will be conducted to improve our knowledge of respiratory physiology, care and outcomes.

**10. Brain Group (Lead—Children's Hospital of Fudan University)**
The objective of this program is to improve brain care for neonates. This bench to bedside program will include basic and clinical research designed to further our knowledge and understanding of the nervous system and its impact on human development, as well as to develop and evaluate strategies for neuroprotection, therapy and early intervention to optimize neurodevelopment. Biobanking and genomic and phenotypic databases will be established to facilitate the research.

**11. Neonatal Follow-Up Group (Lead—Children's Hospital of Fudan University)**
Neonatal follow-up is fragmented and variable across China and there is lack of training and standardization of follow-up protocols. The objective of this program is to establish a standardized protocol and database for neonatal follow-up in China, provide standardized training in neurodevelopmental assessment, and to conduct research and implement early intervention programs to optimize long term outcomes.

*Stage 3—Organizational Infrastructure and Research*

**12. Neonatal Transport Group (Lead—TBD)**
Neonatal transport is unevenly developed in China. There is no training program or standards for transport and outcomes are uncertain. The objective of this program is to promote and develop training programs, standards and research for neonatal transport in China, progressing towards a fully regionalized system of neonatal-perinatal care.

**13. Antenatal Consultation/Care Clinic Group (Lead — TBD)**
Perinatal and neonatal care are not fully integrated across China. The objective of this program is to promote and develop standards for full integration of perinatal and neonatal care, including antenatal consultations and referral of mothers with at-risk pregnancies, and establishment of a database to monitor and evaluate antenatal care and

outcomes improvement, and to conduct research to improve antenatal care.

**14. Clinical Trials Group (Lead—TBD)**

China has one-sixth of the world population and 3 million births a year. The objective of this group is to establish a well organized NICU clinical trials network in CHNN with infrastructure that can efficiently and rapidly conduct multi-centered studies to answer important clinical questions, including prospective randomized controlled trials, comparative effectiveness studies and other quantitative and qualitative studies in newborn infants.

**15. Centers of Excellence (Lead—TBD)**

China already has some well developed academic and clinical neonatal centers in major metropolitan centers. The objective of this program is to develop them into world class neonatal centers of excellence in neonatal care, training and research, that will set the standard for China and internationally.

## Challenges

As with all networks, sustained reliable funding will be a challenge, particularly as the network grows to a truly national scale in such a large country like China. However, that is also its strength as the large sample size enables it to conduct research efficiently and quickly. CHNN has a broader mandate than most existing networks because it has taken on the role of developing neonatology in the country to international standards. This comes with opportunities and challenges, especially considering that the specialty has evolved very rapidly only in recent years along with the rapid economic and social developments in the country. Ensuring high quality of data will be a priority as the network expands quickly. Fortunately, a system for ensuring high data quality is now in place and bodes well for the future (12).

## Discussion and conclusions

Data from CHNN will provide robust estimates that will allow development of unified recommendations regarding the optimal design, staffing and organization of NICUs and the perinatal care system. With its large sample size, nationally-representative, multicentre membership, and collaborative approach, the CHNN is well-equipped to identify and evaluate risk factors influencing the outcomes of preterm neonates in China and engage in QI, best practice guidelines development and implementation, monitoring of outcomes, and mutual learning. The CHNN collaboration provides a convenient and efficient platform for member NICUs to engage in collaborative research. The knowledge generated will be available nationally and worldwide with a definite national impact and a likely global impact.

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## Footnote

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