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CHINA'S SHIFT FROM POPULATION CONTROL TO POPULATION QUALITY: IMPLICATIONS FOR NEUROLOGY

China's population restriction, known across the globe as the 1-child policy, has been in place since 1981, with variations to allow some couples a second child.^{1,2} In response to social challenges arising from this policy, the Chinese government announced in 2015 that it would transition to a new 2-child policy, encouraging couples since January 1, 2016, to have 2 children.³ This transition accompanies a focus on population quality (i.e., improvements in health, education, and social welfare) in newborns to the large Chinese elderly population, with an initiative to reform the Chinese health care system and increase disease screening and prevention. These changes provide an opportunity to improve the treatment of neurologic disease in China, specifically identification of disease through newborn screening (NBS) and disease treatment/prevention through education, patient registries, and improvement in primary care access.

History of family planning and population control in China. At the founding of the People's Republic of China in 1949, the population of China was an estimated 541 million, doubling to 830 million by the end of the 1970s.⁴ Facing such rapid population growth, China feared insufficient economic, social, and natural resources. To prevent this, in 1973, the Chinese government launched the family planning campaign, issuing voluntary guidelines on fertility control with a slogan "late, long, and few;" later marriage, longer spacing between births, and fewer births overall.¹ The birth rate (live births per 1,000 population per year) dropped from 33.59 in 1970 to 17.90 in 1979, and the total fertility rate (average number of live births per woman, at current age-specific rates) decreased from 5.81 to 2.75 (average level for the world).⁴ Despite this improvement, China anticipated continued population pressure on resources and in 1981, China's National Family Planning Commission proposed a population control policy advocating 1 child per couple (the policy moderated in

1984, allowing most rural families a second child, although in some provinces the first child had to be a girl).^{1,5} In 2002, the policy was enacted as law, the Population and Family Planning Law, penalizing couples with excess children (economic and administrative sanctions).¹ An exception was made at this time to allow a second child in some provinces if both husband and wife were from single-child families.¹ In 2013, if either spouse was from a single-child family, they were allowed a second child.² According to China's National Bureau, by 2013, the total fertility rate dropped to 1.55, below the world average.⁴

Coinciding with controlled population growth, the 1-child policy led to challenging new social problems: sex imbalance among newborns (117.7 boys for every 100 girls in 2012—the highest male/female ratio in the world), financial strain on those having more than 1 child, and an aging population with lack of offspring to care for them, termed the 4:2:1 phenomenon (1 child caring for 4 grandparents).^{4,6–8} China is the only country in the world with an elderly population of over 100 million (expected to double by 2016).¹ To address these issues, the Chinese government announced on December 21, 2015, a universal 2-child policy.³ In addition to easing of population restrictions, the government is focused on population quality, including investments in perinatal and newborn screening, disease prevention in its large aging population, and improvements to the Chinese health care system. Over the past 2 decades, the health care system has been modified, but major reform was initiated in 2009, to include a goal of affordable universal healthcare coverage by 2020 and increased access to primary care providers in rural areas; specialty care centers have been providing over 80% of initial patient evaluations.^{9,10} There are currently 3 basic Chinese health care schemes: (1) Urban Employee Basic Medical Insurance, mandatory for urban employed residents and funded by employees; (2) Urban Resident Basic Medical Insurance, funded by government and individuals, providing voluntary

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coverage to unemployed urban residents (i.e., children, elderly without pensions, unemployed); and (3) New Rural Cooperative Medical System, funded by government and individuals, providing basic voluntary medical benefits to rural residents. Additionally, the Medical Financial Assistance program has been established to assist the poor (those who receive the minimum living allowance) with costs from catastrophic health expenses.^{10,11} In 2010, >90% of the total Chinese population was covered under one of these schemes; however, despite this coverage, Chinese residents have significant out-of-pocket expenses for health care due to low government subsidies and thus affordability of health care is a significant ongoing issue.¹⁰

Implications of Chinese population policies and health care reform for neurologic diseases. *Prevention of disease: Stroke.* Cerebrovascular disease is the leading cause of death in China. Annually, China has 2.5 million new-onset stroke patients, of whom 1.6 million die, exceeding ischemic heart disease as the leading cause of death and adult disability in China.¹² China also has a high rate of stroke recurrence (11.2% in the first year), due to poor adoption of modifiable risk factors, lack of primary care physicians, and overreliance on alternative medicine.^{12,13} Screening and intervention for high-risk stroke populations were implemented as major Chinese medical reform projects in 2011, to include promoting healthy lifestyles (diet, physical activity, diabetes management, and smoking cessation, including public smoking bans) with government-funded education programs and materials directed at the public, establishment of wider coverage of primary care in rural areas, and disease screening programs, such as the Carotid Disease Screen and Intervention Project, screening patients for carotid disease with subsequent surgical or medical intervention.¹² In addition, as of 2104, 311 hospitals have been designated Stroke Intervention Base Hospitals (up from 34 in 2010) with evidence-based standardized therapy, stroke training/education, administrative support, and collaboration among departments.^{12,14} A stroke registry is under development.¹²

Prevention of disease: Dementia. With an aging population and restricted offspring to care for them, degenerative neurologic diseases such as dementia are becoming an enormous challenge for China. Dementia is the most common disease in China, with a prevalence in 2010 of 9.19 million; 2.6% at age 65–69 years and 60.5% at 95–99 years.¹⁵ The incidence of dementia (Alzheimer disease, vascular dementia, and other dementia meeting criteria defined by international organizations) in Chinese age ≥ 65 years is overall equal to that of Western countries, with higher incidence with age (doubling every 10 years) and in those with lower

education, who are more likely to be in the rural areas. Additionally, the high incidence of vascular dementia has been linked to poor risk factor modification (i.e., hypertension, diabetes, hyperlipidemia, and prior stroke).¹⁶ Reducing the incidence of dementia is a priority for the Chinese government with a focus on rural regions where there is lack of awareness and support for cognitive impairment; memory loss in China has been considered part of the normal aging process.¹⁵ Chinese studies on dementia have recommended implementation of resources at the local level for prevention, diagnosis, and treatment of dementia by improving education, increasing engagement in social activities, and planning for long-term care by focusing on government-funded programs, rather than relying on a free market system.^{15,17} Public awareness campaigns and screening for cognitive dysfunction have been initiated throughout the country. Professor Jia from Beijing Xuanwu Hospital leads dementia research and prevention in China, establishing a Chinese registry of patients with Alzheimer disease (China Registry Network), and implementing guidelines for treatment of dementia and cognitive impairment, along with training of more than 5,000 cognitive specialists.¹⁸ This group is also studying epidemiology, genetics, early biomarkers, and dementia treatments; 2 new treatment drugs, 参乌胶囊 (Shenwu capsule) and 泰思胶囊 (Taisi capsule), are compounded preparations of traditional Chinese medicine and await international patents. Shenwu capsule has completed a phase III clinical trial for mild to moderate Alzheimer disease and Taisi capsule has completed a phase II trial.¹⁹ In addition to research, The China Population Welfare Foundation initiated an awareness program in 2012 titled “Yellow bracelet.” This campaign provides yellow ID bracelets to patients with dementia at high risk of getting lost, while also providing professional training for community physicians and information to the public to improve early identification of patients with cognitive impairment.²⁰

Earlier diagnosis: Duchenne muscular dystrophy. China has outstanding capability for molecular diagnosis of genetic diseases but has not yet developed systems for the widespread application of this technology throughout the country. In 2013, the national neonatal screening rate (phenylketonuria and congenital hypothyroidism with some regions also screening for glucose-6-phosphate dehydrogenase deficiency and congenital adrenal hyperplasia) was just 87%.²¹ As China works on improving screening coverage in rural areas, it is also planning to increase the number of diseases screened. In the Disease Prevention Program in Hangzhou City, Zhejiang Province, NBS for Duchenne muscular dystrophy (DMD) is being initiated, with consideration to extend DMD screening throughout China. A recent publication documented that DMD diagnosis in East China is

usually delayed until boys are wheelchair-bound, later in the course of the disease, and corticosteroids are given to only 25% of diagnosed patients.²² NBS for DMD will be performed on dried blood spots and patients with 10-fold elevations in creatine kinase (CK) will receive follow-up genetic testing.²³ Screening CK on dried blood spots will also lead to diagnosis of other muscular dystrophies: limb-girdle and congenital muscular dystrophies.²⁴ NBS, in combination with establishing patient registries and protocols for patient follow-up, will revolutionize DMD care in China. Other neuromuscular diseases also being considered for routine NBS include spinal muscular atrophy (SMA) and Pompe disease. In the United States, screening for Pompe disease has been initiated while DMD and SMA are under consideration.²⁵ Implementation of NBS for these and other neurologic diseases provides opportunities for earlier treatment, avoids unnecessary diagnostic studies, and permits prevention of complications. Additionally, earlier diagnosis will enable parental genetic counseling.²⁶ As China reforms its health care system to include universal, more affordable coverage, and improved access to local health care providers, platforms for initiating patient registries and specialty care referrals based on positive NBS will ensure that patients diagnosed with these diseases receive published, standardized care.²⁷

Discussion. The Chinese government has recently announced that it will universally allow couples to have 2 children, abolishing previous 1-child restrictions in place for over 30 years. In combination with relaxing the population restriction, the government is focused on investing in population quality, including health care reform and disease detection, prevention, and treatment. Although China has extra challenges compared to other developed countries, especially access to care for its extensive rural population, changes and expansion of the NBS program, and education and prevention for diseases such as dementia and cerebrovascular disease, have the potential to improve the care and treatment of patients with these diseases.

AUTHOR CONTRIBUTIONS

Qing Ke: drafting/revising the manuscript for content, including medical writing for content, acquisition of data, conceptualization of the study. Li Zhang: drafting/revising the manuscript for content, including medical writing for content, acquisition of data. Chaying He: drafting/revising the manuscript for content, including medical writing for content, acquisition of data. Zhengyan Zhao: drafting/revising the manuscript for content, including medical writing for content, acquisition of data. Ming Qi: drafting/revising the manuscript for content, including medical writing for content, acquisition of data. Robert C. Griggs: drafting/revising the manuscript for content, including medical writing for content, acquisition of data, conceptualization of the study. Michele A. Gatheridge: drafting/revising the manuscript for content, including medical writing for content, acquisition of data.

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