

Neonatal respiratory and intensive care in emerging regions of China: learning curve, cost-effectiveness, quality and standard of care

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From the womb to the adult

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Abstract

The article presents informations on birth population and policy change in China, along with data on neonatal and perinatal morbidity and mortality, covering four decades. Care standard and cost-effectiveness are also analyzed, highlighting the measures that significantly improved general and specified maternal and infant care, and established modern perinatal care system. Moreover, results from multicenter studies – through nation-wide or province-wide collaborative NICU network for respiratory diseases – are reported.

Development of neonatal-perinatal care in China is representative in its transition over more than 3 decades from a poor condition into a modernized one. Public health care policy and professionally integrated service mode played pivotal roles, whereas social economic and cultural factors play either synergistic or detrimental roles for such a transition. The progress in Chinese neonatal-perinatal care is also influenced by international collaboration and exchange, and in a sense followed right the foot-print of international pioneers and their colleagues. In foreseeable future, many Chinese perinatal and neonatal centers would actively participate in international collaborations aiming at improving not only domestic but developing country neonatal-perinatal care as a whole.

Keywords

Birth population, policy change, perinatal morbidity, perinatal mortality, neonatal respiratory diseases, care standards.

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Birth population and policy change

Among the most populous countries in the world, China is the only one executing a nationwide birth control through legislation, with policy adjustment over four decades. This so-called "One-child" policy for family planning resulted in a significant reduction of total birth rate from more than 5% in 70's to 2.75% in early 90's, and further to below 1.2% in 2010 [1]. Meanwhile, the average national gross domestic product (GDP) rose from below 500 USD to higher than 6,000 USD in 2014. Since 2010, several events remarkably influenced birth population control. Firstly, New Rural Co-operative Medical Scheme (NRCMS), a nation-wide universal health insurance, has been introduced to most of the population living in rural areas [2]. After 5 years of implement and regulation, it has shown stability and covered more than 99% of the rural birth population by providing financial reimbursement up to 50-70% of the total hospital medical care costs for neonates and infants. For rural pregnant women, NRCMS has also provided free hospital delivery to effectively limit pregnancy and delivery associated complications and death risks, such as preterm birth, birth asphyxia, infection and maternal death. This health care policy significantly impacted on low level maternal-infant health care standard. Secondly, from 2008 to 2013, a policy adjustment gradually come into effect which directed for couples with both partners from a single-child family to have a second child. In 2014, the "second child policy" was extended

to couples with only one partner coming from a single-child family. These adjustment aimed at counterbalancing the aging speed of Chinese society and gender bias in young generation, while avoiding to be overpopulated in the long run. Thirdly, with an urbanization of nearly 50% after 2010, most coastal regions and most provincial capital city metropolis will achieve industrialization, and more than 40% of the total population (1.34 billion in 2010) live on modernized life style, intention for more children in a family declines [3]. However, in many rural and less developed urban regions, there is still gender related birth selection for a boy, mainly in the second or higher order of pregnancy. The male-to-female ratio was 105 in early 70's, which was increase to > 110 in 90's, and further up to > 115 in 2005-2010, presumably associated with the promotion of sonographic technique in rural health care service. In very recent years, the gender difference rose to alarmingly 116-120. It may decline to 115 should effective measures be implemented to control gender selected fertilization and pregnancy.

Neonatal and perinatal morbidity and mortality

There are substantial changes in neonatal and perinatal morbidity and mortality in 1970's up to now. In 70's and 80's, neonatal mortality in most rural areas was more than 60 per 1,000 births. It was reduced to below 40 per 1,000 in 90's when perinatal care system was established, and further to < 20 per 1,000 in 2000 when delivery room resuscitation, sterilization, neonatal special care and transport were widely organised. During the first decade of this century, neonatal tetanus was completely eliminated, maternal death reduced to lower than 25 per 100,000 delivery, and neonatal mortality down to 8 per 1,000 births, adequately meeting the millennium developmental goal 4 and 5 of World Health Organization target for developing countries. According to a nation-wide sampling system for surveillance of neonatal birth defects and death causes, birth defects and prematurity became the two leading cause of death, whereas birth asphyxia, infection were no longer dominant but still common in under-developed regions in the country. Most subprovincial (prefectural) cities established regional perinatal care system providing advanced maternal, obstetric and neonatal special care for those pregnancy-related complications and high risk delivery. In a well organised region with intermediate GDP and

health care resource, perinatal mortality has been reduced to < 10 per 1,000 births, with half (4-5 per 1,000) as fetal death and stillbirths. Neonatal special care at regional level III and II hospitals is provided to more than 10% of annual total births, with wide geographic variations in care standard. Two to five folds of difference in neonatal and infant mortality has been shown between urban and rural areas, and among coastal, inland and western (remote) provinces.

The total births in China since 2010 has been estimated to be around 16 million annually (from 16.3 million in 2013 to 16.7 million in 2014, an increase due to the second baby policy adjustment), corresponding to a rate of 1-1.2% of total population in different provinces. Preterm birth rate is about 4-5%, with a mortality around 9-10%, although domestic data from level III hospital delivery reported that preterm birth rate was 8-13%. The very preterm birth rate (< 32 weeks of gestation) is about 1% in a regional complete birth population, and at most regional tertiary maternal care center, the delivery of very preterm births, especially those with very (VLBW) and extremely low birth weight (ELBW), increased steadily due to centralized and effective care of high risk pregnancy. Current national and provincial perinatal vital statistics does not include those born below 28 weeks of gestation, and the data comparison with those of international resource is thus difficult. However, based on our complete regional birth population survey data file which included all VLBW below 28 weeks, current birth rate of ELBW and VLBW is estimated to be 1 and 3 per 1,000 live births, respectively, and the presumed nation-wide annual births should be 16,000 and 48,000, respectively. In the tertiary centers and regions with best perinatal and neonatal special care service and standard, 50% survival rate may be achieved for 27-28 weeks of gestation, mainly attributable to surfactant and non-invasive and invasive ventilation and treatment bundles for prematurity and infection. A very recent multicenter retrospective survey in south China revealed a 45% survival for NICU admitted 888 ELBW. This trend shall continue in 2015-2020, to achieve a goal of more than 70% survival of VLBW and 50% of ELBW births with further improved care standard and dimension.

Care standard and cost-effectiveness

Infrastructure for perinatal care is generally centralized at regional subprovincial women

and children's hospital, outreaching regional county and township health care services. This systematic structure and mechanism ensure close surveillance of maternal-infant health care policy implementation and effectiveness. This has been for many years and in most regions by regularly checking causes of maternal and infant deaths, adjustment of health care staffs availability and competence as well as insurance coverage efficiency, and providing continuing education for forefront professionals. Funds from public health are provided continuously for the infrastructure build-up, and have been scaled up dramatically in recent five years in most provinces and regions of western China, aiming at narrowing the regional gap with reference to the coastal provinces and regions. Among these efforts are programs and projects of antenatal care, hospital delivery, delivery room resuscitation, maternal and neonatal transportation, neonatal intensive care, nutrition, nosocomial infection control, hospital service standardization, among other things. These measures significantly improved general and specified maternal and infant care, and established modern perinatal care system relevant for medium-to-high income developing country in contrast to newly industrialized regions. The equity of maternal and infant welfare is balanced and ensured by public health policy, professional network construction and management, and regional economic development. Thus current cost-effectiveness of perinatal and neonatal special care requires in-depth investigation for its advantages and disadvantages.

Collaborative network of neonatal respiratory diseases

In the past 15 years, we conducted more than 10 multicenter studies through nation-wide or province-wide collaborative NICU network for respiratory diseases, which reflected difference in respiratory and intensive care standard among hospitals as well as advances in specific treatment modalities over time [4-7]. The general achievements are that non-invasive ventilation and surfactant use for premature infants with hypoxemic respiratory failure increased, and composite survival rate rose from below 70% up to more than 85%. The causes of neonatal respiratory failure are mainly respiratory distress syndrome, meconium aspiration syndrome and pneumonia in late preterm and full term infants. For very preterm infants, the lowest gestational

age with more than 50% survival was 28-29 weeks, either from NICU network admission data or from a complete birth population data. Similar trend was shown for very preterm population by domestic population data. Prospective study targeting reduction of mortality of ELBW is still lacking, but treatment of this population increases steadily in most tertiary NICUs. With regard to the incidence of major neonatal respiratory diseases, we estimate that approximately 100,000 cases with hypoxemic respiratory failure require non-invasive and invasive ventilation care, and 50,000 as RDS requiring surfactant therapy, based on the evidence from either provincial NICU admission data or regional complete birth based NICU admission data in 2008-2010. Inhaled nitric oxide (iNO) is introduced as investigational respiratory therapy in more than 50 NICUs, and multicenter studies revealed that it may alleviate hypoxemic pulmonary hypertension in term and near-term infants, but may not reduce the mortality. NO is now used for selected term and preterm infants with persistent pulmonary hypertension. There are very few neonatal cases who presented cardiopulmonary failure due to congenital defects and sepsis, have been treated with extracorporeal life support, and overall survival rate is 50-60%.

Challenges and perspectives

The experience over the past three or more decades reveals that the most remarkable achievements are the significant reduction of maternal and infants deaths in 70's to 80's, when China was in the category of low-income developing country. The second most important achievement is well established regional perinatal care system for sustainable development. However, disadvantages and challenges remain [8, 9]. As there always is shortage of skilled medical professionals, efforts are made to ensure maternal and neonatal care at different levels be more efficient. Priority is given to those at risk of pregnant complications by hospital delivery, as mentioned above, implementation of measures to prevent preterm birth, intrauterine growth retardation and nosocomial infection, standardized delivery and early management of high risk newborns, surgery for birth defects, intensive care. It also adds to daily workload for forefront caregivers, resulting in increased tensions between doctors and patients due to inadequate communication, malpractice and patient (parent) rage. Family centered maternal and neonatal care

are common practice through room-in care, and with more high-risk maternal and infant care it requires incorporating contemporary concept and technology into a more modernized environment. Many newly built or refurbished maternity hospitals have special ward for high risk pregnant women and family members to stay together during delivery, and for parents and guardians to be involved in neonatal special care, whereby partly reducing the tension between doctors and patients and facilitating smooth transition for the newborn.

There is a high proportion of Cesarean delivery, averaged at 35-40% nationwide, with 20-25% in the western provinces vs. 35-55% in the coastal and mid-land provinces, and a very high proportion not related to medical indication has been observed. It leads to reduced birth asphyxia while increasing invasive ventilation requirement for later preterm and full term neonates after birth. In general, pregnant complications account for approximately 10% of total births in a regional complete birth population. In vitro fertilization has been widely established in provincial and sub-provincial maternity hospitals, accounting for 2-5% of the total births or around 10% of neonatal intensive care admissions, of which many were due to preterm birth related disorders.

In summary, development of neonatal-perinatal care in China is representative in its transition over more than 3 decades from a poor condition into a modernized one. Public health care policy and professionally integrated service mode played pivotal roles, whereas social economic and cultural factors play either synergistic or detrimental roles for such a transition. The progress in Chinese neonatal-perinatal care is also influenced by international collaboration and exchange, and in a sense followed right the footprint of international pioneers and their colleagues. In foreseeable future, many Chinese perinatal and neonatal centers would actively participate in international collaborations aiming at improving not only domestic but developing country neonatal-perinatal care as a whole.

Declaration of interest

The Author declares that there is no conflict of interest.

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