

Impact of the National Hearing Screening Programme in China

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Abstract

China has a large population with different levels of medical care among the eastern, central and western areas. The national universal newborn hearing screening (UNHS) programme was initiated in 1999 and then progressively implemented nationwide. A “National UNHS Experts Group” was set up, formulating the national UNHS administration rules and technological specifications. 3 March had been named as national “ear-care day” since 2000 and such social activities help make deafness prevention work more widely accepted. UNHS in China presently has 3 phases due to disparities in economic development. 1) Implementation in stages: in economically under-developed areas. 2) Implementation completed: in the coastal cities. 3) Beyond basic UNHS: i) Development of a completed UNHS system including follow-up and quality control based on the neonatal disease screening system, ii) Exploration of a new public health care programme: simultaneous screening of newborn hearing and ocular disease, iii) Carrying out of a multi-centre study on high-risk factors and GJB2 gene mutations in newborn with non-syndromic hearing impairment. The incidence of newborn bilateral hearing loss was 2.22 per 1000, and 2.74 per 1000 for unilateral hearing loss. Though UNHS have been carried out widely in the eastern parts of China, there are difficulties for its implementation in the western regions. Economic development and technical expertise are the main restricting factors.

Ann Acad Med Singapore 2008;37(Suppl 3):52-4

Key words: Hearing, Newborn, Screening

Introduction

China has a large population, with great differences in economic development and levels of medical care within the eastern, central and western areas. There are 1.3 billion people or 25% of the world’s population, of whom almost 40% are urban and 60% rural. There are about 16 million babies born every year, with 88.4% of babies being delivered in hospitals in 2006.¹ The eastern, central and western areas respectively contributed 72.5%, 16.8% and 10.7% to industry revenue.² The hearing impaired population was 20.57 million in 2007. The number of children with hearing impairment increased by 20,000 to 30,000 per year.³ The incidence of newborn bilateral hearing loss was 2.22 per 1000, and 2.74 per 1000 for unilateral hearing loss.⁴

Development of UNHS Programme in China

i) Promotion of Newborn Hearing Loss (NHL) Services as National Policy

Neonatal hearing screening began in 1999. Demanded as a routine service in the national maternal and child health

care system in 2001, the government issued a new management guideline in 2003, organised a “National UNHS Experts Group”, compiled the national unified training book and formulated the national neonatal hearing screening administration rules and technological specifications in 2004. March 3rd has been named as national “ear-care day” since 2000. Local health service organisations are encouraged to offer service models and framework tailored to different local conditions. NHS programmes in rural areas were also emphasised at the same time.

ii) UNHS Technology and Clinical Programmes

The national UNHS programme was established according to the situation in China and the Year 2000 Position Statement by the Joint Committee on Infant Hearing (JCIH) included 2 aspects: i) hospital-based UNHS,⁴ ii) community and children healthcare system-based inspection programme (0 to 6 years).⁶

iii) UNHS Technologies

OAE and AABR are common technologies for UNHS

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which can be combined in different ways. Screening protocols in China are as follows: (i) two-stage OAE/AABR programme: OAE is used first, and if the baby fails, AABR was used before discharge; (ii) AABR screening alone; (iii) OAE is used in the well-baby nurseries alone, and both OAE and AABR are used in neonatal intensive care units (NICU). The third is the most frequently used protocol.^{4,6}

iv) Diagnosis, Follow-up and Intervention after Screening

This is the protocol created for early hearing loss intervention and treatment

- Severe to profound sensorineural hearing loss (SNHL): Fit hearing aids at 4 months. Suggest a cochlear implant at 1 year of age if necessary.
- Moderate SNHL: Fit hearing aids at 6 months of age.
- Mild and some moderate SNHL: Follow-up till 8 to 10 months of age, fit hearing aids if permanent SNHL was diagnosed. Family-based rehabilitation: speaking in a louder voice.
- Conducted HL: follow-up, medical or surgical treatment if necessary.

Continued Surveillance for Children

The follow-up rate for hearing impaired children is a hot topic in many countries.^{4,7} The follow-up rate was about 40% to 80% in eastern coastal cities and 30% to 50% in western cities.⁴ Follow-up centres were set up in many hospitals as part of the UNHS programmes.

Impact of the National Hearing Programme

There are 3 stages in the national UNHS programme due to different local situations.

First stage: hospital-based implementation in mid-western underdeveloped areas. OAE or AABR was used for screening in obstetric wards, with diagnosis in the ENT department. Initiation of UNHS programme is easy in this stage, but the follow-up rate is low and screening in NICU is difficult.

Second stage: completed implementation of integrated programmes. The UNHS programme was run with the support of the national maternal and childcare systems. This system included 3 grades: province, district and county. From the upper to the basic level, technological support was provided gradually. Generally there is 1 diagnostic and rehabilitation centre in each city, which is also charged with staff training and quality control. The health bureau of the city coordinated the UNHS programme. Screening was conducted in different hospitals, diagnosis made in approved centres, and rehabilitation carried out in appointed organisations.

Third stage: beyond newborn hearing screening

- Periodic hearing screenings for 0 to 6 year old children: In Beijing, there are 54 hospitals and 237 community service centres which carry out UNHS programmes (2007), and the coverage rate was 63.2%.⁸
- Hearing screening synchronised with newborn screening programme: Developing follow-up and quality controls in conjunction with newborn disease screening programmes. Hearing screening can be conducted by newborn disease screening staff.
- Simultaneous screening programmes for hearing and ocular diseases:⁹ The UNHS was simultaneously conducted with newborn ocular disease screening programme. Well newborns were screened 2 to 7 days after birth (this included testing reaction to light, red reflex and external ocular examination). Those with abnormalities were subjected to a diagnostic examination (external ocular examination with a hand-held slit-lamp, red reflex and mydriatic examination). Newborns in NICU were subjected to screening 5 to 14 days after birth and they, together with those with high risk factors, received a comprehensive examination for screening and diagnostic purpose. In 15,398 cases who underwent simultaneous screening, the incidence was 3.11 per 1000 (48/15,398) for bilateral congenital SNHL and 2.27 per 1000 (35/15,398) for unilateral SNHL. Four cases of congenital SNHL were complicated with newborn eye diseases, including 1 case of profound SNHL (bilateral) and auditory neuropathy accompanied by congenital cataract (bilateral), 1 case of mild SNHL (bilateral) complicated with membrana pupillaris perseverans (left), 1 case of mild SNHL (bilateral) with retina vein dilatation (bilateral), and 1 case of mild SNHL (right) with accompanying bilateral persistent hyaloid artery. In all the 15,398 newborns, 12 different eye diseases were detected (involving 1266 cases) with a prevalence of 82.2 per 1000 newborns.
- A case-control multi-centre study on high-risk factors for NHL in 7 cities of Shandong Province.¹⁰ Three hundred and thirty one cases (including 177 cases of bilateral HL and 154 cases of unilateral HL) that fully satisfied the matching requirements were included as subjects. Among 39 factors studied, bilateral NHL had 3 independent risk factors: parity (OR = 16.29), neonatal diseases (OR = 34.97), family history of congenital hearing loss (OR = 69.49) and 1 protective factor, birth weight (OR = 0.24). Unilateral NHL had 2 independent risk factors: parity (OR = 9.789) and a family history of congenital hearing loss (OR = 4.234).
- Mutations of GJB2 gene in infants with non-syndromic hearing impairment.¹¹ In 20 infants with severe to profound bilateral SNHL confirmed by UNHS, PCR and sequencing technique were used to analyse the

coding region of the GJB2 gene. Three infants (15%) were identified as 235delC 235delC homozygotes, 1 infant was identified as 235delC 299-300delAT compound heterozygote, 1 as 235delC heterozygote, 1 as 235delC 605ins46 compound heterozygote with 605ins46 mutation. 605ins46 is a novel mutation reported in Chinese for the first time.

Challenge and Opportunity

- i) Interdisciplinary collaboration needs to be improved: The UNHS programme has 3 phases: screening, diagnosis and long-term hearing rehabilitation which involve different academic branches and different administrative areas. The development of these 3 phases was not balanced among different areas.
- ii) Specialty education and professional training need to be reinforced. At present, audiology clinics are commonly conducted in ENT departments. Speech pathology clinics are common conducted in paediatric departments or rehabilitation centres.
- iii) The National UNHS information system need to be further improved.

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Financial disclosure: The author/s declare that they have no relevant financial interest in this manuscript.