

Comparative Analysis of Universal Newborn Hearing Screening Programs in Malaysia, China and Philippines

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ABSTRACT

Universal Newborn Hearing Screening Program (UNHS) has developed rapidly and tremendously in the world, but developing countries need contextual models for UNHS to optimize screening outcomes and cost-effectiveness. Therefore, this study aims to document current UNHS practices in three developing countries; Malaysia, Philippines and China with the aim of comparing the reported practices to bring about some recommendations. Based on the comprehensive review of reports, published research, and other relevant materials, it is found that UNHS practices in the selected countries (Philippine, Malaysia, and China) have commonalities and differences. Newborn hearing screening is made binding on all caregivers in Philippine, whereas it is just recommended in Malaysia and China. Nevertheless, the protocols of UNHS program applied in the selected countries are similar. In the selected countries, the protocol involves OAE and AABR. Also, UNHS has been well instituted in the selected countries, but certain challenges (e.g. poor follow-up) are debilitating the effectiveness of the screening in the selected countries, and the challenges should be well addressed and empirically studied. Furthermore, stakeholders could possibly benefit from the findings of this study and recognize the need to optimize the UNHS program through suggested factors. This study has hopefully contributed towards the enrichment of the relevant literature, and it could serve as a useful guide for stakeholders with regards to improvement of UNHS program in their respective countries.

Keywords: *Universal Newborn Hearing Screening, UNHS, Malaysia, Philippine China, OAE, AABR.*

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INTRODUCTION

Universal newborn hearing screening (UNHS) program has become a vital channel for timely diagnosis and treatment of hearing problems in the newborns, and numerous countries of the world have adopted it. UNHS is carried out based on capability of the country concerned. Continuous assessment of UNHS practices is needed to ensure the objectives of the program are achieved successfully, and any evolving problem is dealt with effectively.

According to World Health Organization's (WHO) report, two thirds of the people with simple to extreme hearing impairment live in developing nations (Kumar 2001). Contextual models for UNHS to optimize screening outcomes and cost-effectiveness are needed in developing nations (De Kock, 2016). Thus, this study aims to document current UNHS practices in three developing countries; Malaysia, Philippines and China with the aim of comparing the reported practices to bring about some recommendations regarding the factors that could lead to further refinement of the program.

Overview of UNHS

Reports from various countries have indicated the predominance of hereditary and initial-on-set deafness or acute-to-extreme hearing damage ranged from 0.5 to 5 per 1000 toddlers or newborns (Olusanya, 2011). Although inborn hearing impairment has widely spread across the world, half of all cases of hearing impairment are avoidable using primary prevention (WHO, 2015), and timely discovery and intervention can mitigate the growing trends of hearing impairment (Mincarone, et al., 2015; Olusanya, 2012).

Given this, UNHS was introduced to serve as a measure of early discovery and intervention. The purpose for which UNHS was introduced was to make a perfect distinction between the newborns with good hearing from those suffer from hearing impairment. In addition, UNHS denotes a screening that focuses on abating and/or averting hearing loss connected with impediments in language, social, emotional, and cognitive growth of newborns, irrespective of the existence of risk pointers (Kemp *et al.*, 2015). The advent of newborn hearing screening dated back to drafting of deaf education report which was done by the advisory committee on the education of the deaf, the United States Secretary of Health, Education, and Welfare in

1965. Newborn hearing screening was then endorsed for the development and nationwide application of collectively applied measures for early detection and assessment of hearing loss.

In 1967, the national advisory committee on the deaf education in the United States Secretariat of Health, Education, and Welfare drafted the challenge and the charge report and proposed a public information campaign for high-risk register to enable detection. Testing of infants and children 5-12 months of age was also proposed by the committee. Subsequently, screening of high-risk infants before leaving the hospital within a period no later than 3 months after the newborns are delivered was recommended by the joint committee on Infant hearing (JCIH) Position Statement (1990).

In the same vein, screening of newborns for hearing loss before they are discharged from the hospital was suggested, as contained in the consensus development conference statement (1993), via the report on early detection of hearing loss in infants and young children which was drafted by national institutes of health (NIH). This was supported by JCIH Position statement in (1994), given its recommendation which indicated diagnosis of infants with hearing loss prior to 3 months of age and intervention by 6 months of age. Then, report prepared by the American academy of pediatrics in 1999 summed up and indicated the group's support for UNHS which ensure diagnosis of hearing loss. In the year 2000, the JCIH's position statement involved the principles and guidelines for early hearing diagnosis and intervention programs report.

Originally, UNHS focused on newborn that suffer from hearing impairment, and subsequently its coverage transcended to all newborns (Piza, 2014; The Joint Committee on Infant Hearing (JCIH), 2007). The most important international guidelines proposed application of a universal screening program on all neonates including the newborns with increased risk factors (Lasisi, Onakoya, Lasisi, Akinola, & Tongo, 2014).

Afterwards, different countries adopted the UNHS programs (Vos, Lagasse, & Leveque, 2014). The astonishing and successful spread of UNHS programs at global level indicate that the program is really a revolution in health care. The main objective of UNHS is early discovery and intervention of hearing loss. The program aims at assessing and diagnosing hearing capability of children with and without risk factors for congenital hearing loss (Clemens *et al.*, 2000; Kemp *et al.*, 2015; National Institutes of Health (NIH), 1993; The Joint Committee on Infant Hearing (JCIH), 2007).

Moreover, UNHS involves what is known as *Transient Evoked Oto-Acoustic Emissions* (TEOAE) or *Automated Auditory Brainstem Response* (AABR) or both (Olusanya, Luxon & Wirz, 2004). The TEOAE entails low strength echoes produced by the external hair cells in the cochlear which can be provoked in reaction to beep (sound type) accessible to the ear via a light

weight probe. With this process, the means through which the integrity of the middle and inner ear is ensured. Conversely, The AABR refers to an electrical reaction to aural inducements to measure the role of the eighth cranial nerve and the aural route. The automated version is simply for the production of screening results indicating 'pass' or 'fail'. With the adoption of only TEOAE, the newborns that suffer from aural neuropathy will be missed. Similarly, newborns that suffer from slight sensorineural or hearing impairment may also be missed if AABR is solely adopted. Hence, the adoption of both TEOAE and AABR is preferred (Johnson et al., 2005; Olusanya, Luxon & Wirz, 2004). More so, TEOAE can be substituted by the *Distortion Product Oto-Acoustic Emissions* (DPOAE). DPOAE's edge over TEOAE lies in its capability to identify releases at rates over 5 kHz. However, this is considered as trivial to UNHS. In some schemes, a conventional diagnostic ABR is used to confirm diagnosis (Olusanya, Luxon & Wirz, 2004).

Owing to logistics-related factors and economies of scale, majority of UNHS schemes are hospital-based. The implication would be that newborns that were discharged few hours after birth or born outside the hospital would be missed. Thus, the coverage is harmfully affected, most especially, the community with substantial home deliveries will not be adequately covered (Olusanya, Luxon & Wirz, 2004).

Brief Account of UNHS Program in the Selected Countries Philippine:

Following the introduction of UNHS in 1996 in Philippine, a task force on newborn hearing screening was convened in 2007 by PSO-HNS together with the PNEI working group, which meticulously researched, analyzed and considered the benefits of the UNHPS for further recommendation and implementation (Marquez, 2015). Later on, the Universal Newborn Hearing Screening and Intervention Act of 2008, which is also known as Senate Bill No. 2390, was formally filed and submitted by Senators Miraim Defensor Santiago, Loren B. Legarda and Pia S. Cayetano on June 10, 2008, but the Act was approved and signed into the law by the President of the country in June 2009. Thereafter, IRR of RA 9709 was approved, signed and disseminated as Administrative Order 2010-0020 in June 2009 (Marquez, 2015).

The approved Universal Newborn Hearing Screening and Intervention Act of 2008 makes UNHS becomes mandatory for Filipino newborns, as it would serve as prevention, prompt discovery, and intervention of hearing impairment. The Act specifies that the newborn below one month of age would be repeatedly screened before s/he reaches three months of age if the first test is unsuccessful for accurate uncovering of hearing loss. If the result of the screening is positive, the amplification device or hearing aid will be applied before the child reaches six months of age. This would increase the likelihood of the kids developing some language skills regardless of the presence of severe hearing impairment (Laguyo, 2013).

Filipinos' UNHS protocols was adapted from developed countries, but it was designed with some modification. The modification was justified on the premise that home deliveries is larger and this pose challenges to Philippines as a developing country. Philippine's population of 95 million grows at 1.87%, and the infant mortality rate is 18.75 per 100 live births. Starting from 1996, targeted OAE screening began with few tertiary hospitals. Due to the unavailability of tools and trained personnel, the government hospitals could not offer targeted OAE screening. (Philippines Fact Sheet, 2012).

Discerned from Marquez's (2015) study, the Filipinos' UNHS aims to guarantee hearing screening for all newborns prior to hospital discharge of within three months if born outside the hospitals; implement time-bound intervention, involving hearing screening within the first month and hearing appraisal by the sixth month; provide an accessible, effective and efficient system of services and critical services for hearing habilitation/rehabilitation; monitor the occurrence and spread of hearing loss in the Philippines; and enhance awareness and information campaign to the public about hearing impairment. With these aims, UNHS in Philippine would upturn the numbers of newborns vetted for hearing impairment within their first month of life. It would also recognize hearing impairment via audiological evaluation among newborns within three months of age, and then implement early intervention services among infants diagnosed with hearing impairment within six months of age.

Malaysia:

UNHS program, which was initiated in 2003 and 2009 in Malaysian non-public and public hospitals respectively, is still in the early phase. Malaysian Ministry of Health Specifically Audiology services have made an attempt to implement the UNHS program since 2002. Nevertheless, given numerous reasons and challenges, UNHS program could not be introduced. Public hospitals were unable to utilize UNHS, because some challenges must be addressed before implementation of the program. This was revealed by the summary of the study on implementation of UNHS program in Malaysia in 2008.

Dated in 2009, there are only four hospitals in Malaysia that have been implementing the UNHS program, all of them were 2 university hospitals; Hospital Universiti Sains Malaysia (HUSM), Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM) and 2 private hospitals; Sime Darby Medical Center (SDMC) and Sunway Medical Centre (SMC). However, in the Ministry of Health, the majority of the hospitals with Audiology services (19 hospitals) have been implementing the High-Risk Newborn Hearing Screening (HRNHS) program. The UNHS program involves both OAE and AABR in Malaysia.

Since 2011, only 3 government hospitals including Hospital Sultanah Bahiyah, Hospital Kuala Lumpur and Hospital Putrajaya started to implement UNHS program. In 2014, the number of hospital implementing the program was increasing. Currently, there are 4 hospitals (Hospital Kuala Lumpur, Hospital Putrajaya, Hospital Sultanah Bahiyah & Hospital Taiping) able to start the program. However, based on the report on meeting of JKTA (Audiologist Technical Committee) in 12th June 2013 and 24th June 2014, the coverage rate for these four hospitals still inadequate (not achieved the international guidelines by JCIH 2007 more than 95%).

Moreover, Hospital Alor Setar (Hospital Sultanah Bahiyah) in 2007 and Hospital Raja Perempuan Zainab II, Kota Bharu in 2009 were the two hospitals upon which the pilot study was conducted. Findings of the study identified some problems facing the implementation of UNHS program. These problems include dearth of equipment and staff, less-efficient baby management system, and shortage of awareness regarding the value of UNHS among the hospital staffs and caregivers.

China:

UNHS was originally initiated in 1999 in China. Prior to 2009, newborn hearing screening was conducted only in the designated urban hospitals in China. Then, the country's Ministry of Health recommended, in 2009, widen the repetitive newborn hearing screening all over the country. Few hospitals in the cities adopted the screening in the 1990s. General hospitals and maternal and child hospitals (MCH) in the cities then adopted the screening program (Tobe, et al., 2013).

Chinese UNHS, like that of Filipinos' model of UNHS, involves two-stage screening via OAE) or OAE-AABR. The two-stage screening method is a highly widespread screening method. The result of OAE divulges the role of cochlea, which can be swayed by the situation of outer and middle ear, generating the false positive. Above and beyond, there can be some situations, in which aural neuropathy and the impairment in cochlear inner cells might not be detected by OAE, and in turn generate the false negative, but merging OAE with AABR constitutes a perfect and fitting tool to evaluate the entire aural passageway, including the condition of outer, middle, and inner ear (Tobe, et al., 2013).

Going by earlier experience in European countries, it could be asserted that the two-stage OAE-AABR approach forms a likely solution to high false positive, because REFER level at the time of hospital discharge from the schemes were found to be really lesser than those in schemes that adopted just OAE screening (Johnson et al., 2005). Hence, the two-stage OAE-AABR approach becomes the best exercise and suitable way of discovering aural nerve diseases.

In the regions with inadequate financial and technical capability, targeted screening or OAE screening is recommended as an alternative the two-stage OAE-AABR approach. In the year 2009, Ministry of Health (MOH) in China decided to augment the NHS scheme by introducing a new national program to consolidate the scheme into the maternal and child health services package as a part of hereditary disease screening. The two-stage OAE-AABR approach was then recommended as the protocol of the screening (Tobe, et al., 2013).

Comparison of UNHS Practices in the Selected Countries

Table 1

Comparison Between Philippine's UNHS, China's UNHS, and Malaysia's UNHS

Criteria	Philippine	China	Malaysia
Prevalence (per 1000 live birth)	(3/1000-Philippine - WHO) 1.38 per 1000 births. Note: In every 3 hours in the Philippines, one deaf newborn is given birth to.	1-3/1000 (China, bilateral) and ~5/1000 (China, unilateral). Note: Almost 0.8 Million Chinese newborns below 7 years of age suffer from hearing damage.	Total number of screening – 58,000 for 2013 – 2014. 78 out of 58,000 detected with hearing loss.
Year Introduced	1996 (with OAE screening being carried out in few tertiary hospitals).	1999 after some pilot studies were conducted by Chinese government.	2003 in non-public hospital. 2009 in public hospital.
Protocol applied	Philippine employs OAE and AABR in the implementation of the UNHS. 1. OAE 2. AABR 3 every baby, who does not pass the hearing screening for treatment at the provincial hospital of the local government unit concerned or Department of Health Tertiary Hospital, will be referred, if the treatment is beyond the clinical capability.	Chinese UNHS involves two-stage OAE-AABR approach. newborns within two to seven days after birth before hospital discharge are screened. 3 models: 1. hospital-based UNHS; OAE in the well-baby nurseries. 2. AABR in NICUs (Neonatal Intensive Care Units). 3. Re-screening of infants who do not pass is done within 42 days at ENT/Audiology departments in the tertiary hospitals of each province when babies are 3-6 months of age.	AABR in HKL, Putrajaya Hospital OAE – Bukit Mertajam Hospital, Miri Hospital OAE & AABR – 1. Sultanah Bahiyah Hospital, Taiping Hospital, Raja Perempuan Zainab 2. Hospital, Sungai Buloh Hospital.

(continued)

Criteria	Philippine	China	Malaysia
Enforcement for Coverage	Legally mandated via Republic Act. 9709/ Universal Hearing Screening and Intervention Act (2009).	Not legally mandated.	Not legally mandated.
Personnel (HR)	Health workers	Nurses/audiologists/ technicians	Nurses/audiologists/technicians
Finance	Philippine Health Insurance Corporation	Parents	Non-public hospitals – Caregivers bears the cost Public hospital – Free
Follow-up Interval	Within 3 months	Within 42 days	Within 42 days

DISCUSSION

It has become common knowledge that numerous countries, including Malaysia, have adopted the UNHS programs (Vos, Lagasse, & Leveque, 2014), and the amazing level of prevalence of UNHS programs in the world indicates that the program is really a revolution in health care. Malaysia, China and Philippine are among the developing nations that adopt UNHS, but Table1 provided above depicts some kind variances in the practice of UNHS in the three selected countries.

From Table1 above, it can be discerned that that Philippine's approach to UNHS program is different to some extent from that of Malaysia's and China's approach. For example, newborn hearing screening is made binding on all caregivers in Philippine, whereas it is just recommended in the context of Malaysia and China. UNHS was introduced in 1996 in Philippine, 1999 in China, and 2003 and 2009 in Malaysian non-public and public hospitals respectively. Another fact that substantiates the position is that the cost of the hearing screening is shouldered by Health Insurance Corporation in Philippine while caregivers bear the cost of the screening in China and in Malaysian non-public hospitals, whereas in Malaysian public hospitals, the screening is free of charge. In addition, the workers responsible for carrying out the screening in Philippine are health workers, but in the case of Malaysia and China, Nurses/audiologists/technicians are in charge of conducting the screening. The follow-up interval in Malaysia and China, which is 42 days, is different from that of follow-up interval in Philippine.

Nevertheless, the protocols of UNHS program applied in the selected countries are similar. In Philippine and Malaysia, UNHS program involves two-stage OAE-AABR approach. Filipinos' babies who do not pass the hearing screening would be treated at the clinic, but If this cannot be handled by the clinic, it would be referred to the provincial hospital of the local government unit concerned or Department of Health Tertiary Hospital

for further treatment. Similarly, Chinese UNHS program involves three models comprising OAE in the well-baby nurseries, AABR in NICUs, and re-screening of infants who do not pass is done within 42 days at ENT/Audiology departments in the tertiary hospitals of each province when babies are 3–6 months of age.

CONCLUSION

UNHS practices in the selected countries are designed to develop the process of early diagnosis of possible hearing impairment. By going through the screening there will be benefits not only to caregivers but also to the newly born babies. Going by the comparative analysis conducted in this paper, UNHS practices in the selected countries have commonalities and differences. Nevertheless, certain challenges are debilitating the effectiveness of the screening in the selected countries. Based on the results in Table 1 and findings of some UNHS studies (e.g. Olusanya, Luxon, & Wirz, 2004; de Kock, Swanepoel, & Hall, 2016; Olusanya, Emokpae, Renner, & Wirz, 2009), low level of public awareness, limited funding, shortage of manpower, inadequate support services, dearth of equipment and workers, less efficient baby management system, poor follow-up, and dearth of awareness about the importance of the program among the hospital workers and caregivers constitute the challenges facing UNHS in the selected countries.

The current development indicates several initiatives are discernible and it (the initiatives) attempts to address some of the above-mentioned challenges. For example, WHO provided the procedures for the development of audiological services to magnify capacity building at diverse stages of healthcare delivery. This was done with the aim to tackle the current resource gap (WHO, 2004). Having identified the limitations relating to high costs of hearing aids, WHO took many steps to encourage production of affordable hearing aids. In addition, private sector has initiated manufacturing of solar powered hearing aids at reasonable running costs (McPherson & Brouillette, 2004).

In short, there is need that the discernible issues in UNHS practices in the selected countries be well addressed and empirically studied. Some of the possible solutions to overcome those issues and challenges could be: to increase the public awareness regarding the value of UNHS and its impacts; to hire dedicated related medical workers who would later provide continuing training; and to compel pediatricians to monitor the

implementation and effects of newborns screening and to communicate with caregivers. Stakeholders could possibly benefit from the findings, and recognize the need to optimize the UNHS program through the suggested factors in the researched studies. It is hopeful that this study contributes towards the enrichment of the relevant literature and serve as a useful guide for stakeholders with regards to improvement of UNHS program in their respective countries.

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