Report of The
Evaluation of the Implementation of the High Risk Neonatal Hearing Screening in the
Ministry of Health, Malaysia for the year of
2013-2014

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EXECUTIVE SUMMARY

INTRODUCTION:

Despite recommendations by the Joint Committee of Infant Hearing, universal newborn hearing screening program is still not available in majority of the Ministry of Health Malaysia hospitals due to the limitation of the manpower, equipment and proper facility. To comply with the international standard, this report evaluates the outcome of the high risk newborn hearing screening (HRHS) program in 26 Ministry of Health Malaysia Hospital for the year of 2013 and 2014.

OBJECTIVE:

To assess the coverage rate, the coverage of the babies screened before 1 month of age, initial refer rate, loss to follow up rate, mean age of hearing detection and the prevalence of hearing impairment.

METHODS:

Data from 26 participating hospitals were hand collected and submitted to the Audiology Technical Committee of MOH. The data from this source reported here refers to high risk babies whose reports were created during the period from 1st January 2013 to 31st December 2014. The technology used in the high risk hearing screening program in the majority of the hospitals for first and second stage screening was OAE-AABR (in twelve hospitals), followed by OAE-OAE in nine other hospitals and only five hospitals used AABR-AABR. Due to limited support staff, HRHS was done by Audiologist alone in 16 hospitals while in other 10 hospitals, the program was done by Audiologist and the nurses.

RESULTS:

In 2014, 65 % of high risk newborns (58, 845) were screened from the total of NICU population. The coverage rate for the babies that were screened before the age of one month was 61.2% in 2013 and increased to 74.7% in 2014. The initial refer rate was 22.4% in 2013 and 24.2% in 2014 while the loss to follow up rate was 34.9% in 2013 and decreased to 31.7% in 2014. The average age of diagnosis was 5.3 month in 2013 and reduced to 4.5 month in 2014. While the prevalence of hearing impairment in 2013 was 16: 1000 out of NICU population and the prevalence of hearing impairment in 2014 was 9: 1000 out of NICU population. For two years duration (2013-2014), 680 babies were detected with hearing loss which contributes to the hearing impairment prevalence of 11 babies over 1000 out of NICU population.

CONCLUSION:

This study showed significant improvement between two years data (2013, 2014) in term of total babies screened, loss to follow up rate, coverage rate for the babies screened below the age of 1 month and the age of diagnosis.

However, the comparison between these quality indicators (the coverage of the babies screened before 1 month of age, initial refer rate, loss to follow up rate, mean age of hearing detection) with the Joint Committee of Infant Hearing (JCIH) recommendation (Year 2007 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs, Pediatrics 2007; 120; 898-921) revealed that the performance of HRHS program was unsatisfactory.

The implementation of the current high risk screening program needs to be reviewed. Factors contributing to its unsatisfactory performance must be identified and steps must be taken to resolve them so that early identification and intervention of permanent congenital hearing loss can become a reality. The use of HRHS would have missed neonates from the well-baby group who actually had permanent congenital hearing loss. By implementing UNHS all cases with permanent congenital hearing loss will be identified thus allowing for early intervention and follow-up.

Background of Neonatal Hearing Screening program in Ministry of Health (MOH)

The High-risk Neonatal Hearing Screening Program (HRHNS) has been introduced into the Ministry of Health, Malaysia (MOH) hospitals since 2001. To date, 26 hospitals have implemented HRHNS and 7 hospitals have progressed to Universal Neonatal Hearing Screening Program (UNHS). To monitor progress toward national goals, the Audiology Technical Committee of MOH collects data from state and district hospitals. This article summarizes findings from the MOH Neonatal Hearing Screening Program in 2013 to 2014 and provides a summary of recent efforts to identify infants with hearing loss in Malaysia.

Introduction of High Risk Neonatal Hearing Screening (HRNHS) program

The implementation of the high risk neonatal hearing screening program (HRHNS) in the Ministry of Health (MOH) hospitals began in 2001. The ultimate objective of HRNHS is to prevent significant language, cognitive, and social delays among hearing impaired babies. Hence, the program strives to ensure that:

- All high risk newborns are screened for hearing loss **before three (3) month** of age, preferably before hospital discharge.

- All high risk infants who failed hearing screening should receive diagnostic audiologic evaluation **before six (6) months** of age.

- All infants identified with a hearing loss receive appropriate early intervention services **before six (6) months** of age.

To date, 26 hospitals have implemented the HRNHS programs. Generally there are two approaches of implementing the HRNHS program in MOH. These approaches are dependent on the site of testing; at the neonatal intensive care unit (NICU) and/or the special care nursery (SCN) or at the Otorhinolaryngology (ORL) clinic. Table 1 shows list of participating hospitals according to the aforementioned approaches.

Table 1: List of participating hospitals according to the site of testing

At the NICU/SCN	At the ORL Clinic
i. Hospital Selayang, Selangor ii. Hospital Tengku Ampuan Rahimah, Selangor iii. Hospital Sungai Buloh, Selangor iv. Hospital Serdang, Selangor v. Hospital Sultan Abdul Halim, Kedah vi. Hospital Sultanah Nora Ismail, Johor	i. Hospital Ampang, Selangor ii. Hospital Raja Permaisuri Bainun, Perak iii. Hospital Teluk Intan, Perak iv. Hospital Pulau Pinang v. Hospital Tuanku Fauziah, Perlis vi. Hospital Sultanah Nur Zahirah, Terengganu

vii. Hospital Umum Kuching, Sarawak viii. Hospital Tengku Ampuan Afzan, Pahang ix. Hospital Sultan Ahmad Shah	vii. Hospital Kemaman, Terengganu viii. Hospital Sibu, Sarawak ix. Hospital Tuanku Ampuan Najihah, Negeri Sembilan x. Hospital Tuanku Jaafar, Negeri Sembilan xi. Hospital Melaka xii. Hospital Pakar Sultanah Fatimah, Muar Johor xiii. Hospital Sultanah Aminah, Johor Bharu xiv. Hospital Queen Elizabeth, Sabah xv. Hospital Dutchess of Kent, Sabah xvi. Hospital Sultan Ismail xvii. Hospital Tawau

Test Protocol for High Risk Neonatal Hearing Screening

All high risk babies should be screened before age of 3 months old. Those who failed initial stage of hearing screening must return to hospital for second hearing screening within 4 weeks after first stage screening.

Currently there are two neonatal hearing screening techniques widely used namely the automated auditory brain-stem response (AABR) and otoacoustic emissions (OAE) (Finitzo T, 2000). Both OAE and AABR are non-invasive, quick and easy to perform on newborns. OAE measures emissions generated by the motion of the outer hair cells in the cochlear while AABR measures the hearing pathway along the auditory nerve (A.Asma et al 2008).

In this HRNHS program, the protocol uses OAE or AABR depending to the technology available in that hospital. The diagnostic assessments need to be carried out before babies reached 6 months of age upon failing second hearing screening.
For the initial screening, the protocols used are:

- 1 stage protocol: OAE - OAE or AABR-AABR.

- 2 stage protocol: OAE – AABR

Table 2 shows list of participating hospitals according to the technology used for the HRNHS program.

OAE-OAE	AABR-AABR	OAE-AABR
i. H. Selayang ii. H.Tengku Ampuan Afzan iii. H.Raja Permaisuri Bainun iv. H. Pulau Pinang v. H. Kemaman vi. H. Duchess of Kent vii. H. Sultanah Aminah viii. H. Ampang ix. H. Tawau	i. H.Tuanku Jaafar ii. H.Sultan Ismail iii. H.Sultan Abdul Halim iv. H.Tuanku Ampuan Najihah v. H.Teluk Intan	i. H.Tengku Ampuan Rahimah, Klang ii. H.Sungai Buloh iii. H.Sultanah Nora Ismail iv. H.Serdang v. H.Umum Sarawak vi. H.Sultanah Nur Zahirah vii. H.Sibu viii. H.Queen Elizabeth ix. H.Pakar Sultanah Fatimah x. H.Melaka xi. H.Tuanku Fauziah, Perlis xii. H.Haji Sultan Ahmad Shah

Table 2: List of participating hospitals according to the technology used for the HRNHS program

Manpower for the screener

The support for the manpower to perform high risk newborn hearing screening is very critical in order to ensure the continuity of optimum quality services offered to the patients. In majority of the MOH hospital that implemented HRNHS program in 2013-2014, the hearing screening was performed by the Audiologist alone (16 hospitals). Only 10 hospitals had the hearing screening team consist of Audiologist and nurses.

Table 3: Manpower for the screener

Audiologist	Audiologist and nurses
i. H.Sultanah Aminah, Johor ii. H.Pakar Sultanah Fatimah, Johor iii. H.Melaka iv. H. Tuanku Jaafar v. H.Sultan Ismail, Johor Bharu vi. H.Tuanku Ampuan Najihah vii. H.Ampang viii. H.Tuanku Fauziah, Perlis ix. H. Tawau	i. H.Tengku Ampuan Rahimah, Klang ii. H.Sungai Buloh iii. H.Serdang iv. H.Umum Sarawak v. H.Sultanah Nur Zahirah vi. H.Sibu vii. H.Queen Elizabeth viii. H. Selayang ix. H.Pakar Sultanah Fatimah

x. Kemaman	x. H.Raja Permaisuri Bainun
xi. Teluk Intan	
xii. Pulau Pinang	
xiii. Tengku Ampuan Afzan, Kuantan	
xiv. Sultanah Nora Ismail, Johor	

Quality Indicators for Screening & Confirmation of Hearing Loss

The quality indicators used in this program are as below:

1.   Coverage rate

Definition: Percentage of babies screened referred from NICU

Formula: Number of babies screened / total babies referred from NICU

The recommended benchmark is ≥ 95% (Guidelines For High Risk Neonatal Hearing Screening, Ministry of Health Malaysia, August 2009)

2.   Coverage rate screened at less than 1 month of age

Definition: Percentage of neonates who complete screening by 1 month of age

Formula: Number of babies screened by 1 month of age / total babies referred from NICU

The recommended benchmark is ≥ 95% (JCIH 2007)

3.   Refer rate

Definition: Percentage of screened neonates who failed initial screening.

Formula: Number of babies who failed (1st screening)/ number of babies screened

The recommended benchmark is ≤4 % (JCIH 2007)

4.   Loss to follow up

Definition: Babies who failed to turn up for subsequent assessment.

Formula:

a) 2nd Screening = number of babies defaulted second screening / number of babies failed first screening

b) Diagnostic = Number of babies defaulted diagnostic appointment/ number of babies failed second screening

5.   Return for follow up rate
Definition: Percentage of neonates who return for follow up services;
a) For second screening
Formula:
Second screening = number of babies return for follow up / number of babies failed from first screening
Recommended benchmark is ≥ 70% (JCIH 2007)

b) Diagnostic of babies who failed hearing screening and complete comprehensive audiological evaluation by 3 month of age

Formula:
Diagnostic = number of babies return for diagnostic f/up / number of babies failed from 2nd screening
Recommended benchmark is ≥90% (JCIH 2007)

Target population

As recommended by the JCIH in 2007, all neonates with high risk factors (as shown in Table 3) will be screened in the HRNHS program.

Table 3: High risk factors

Family history	Parental Concern
In-utero Infection (CMV)	Mechanical ventilation > 5days
Craniofacial disorder	NICU stay > 2 days
Associated syndrome	Neurodegenerative Disorders
Very low birth weight (<1500gm)	Head Trauma
Hyperbilirubinemia (>300 mmol/l or need exchange transfusion)	Low APGAR Score (0-4 at 1 min. or 0-6 at 5 min.)
Ototoxic Medication	Bacterial meningitis

Results

Table 5 shows the findings of HRNHS program the Ministry of Health Malaysia in year 2013 and 2014. In 2014, 65 % of high risk newborns (58, 845) were screened from the total of NICU population. The coverage rate for the babies that were screened before the age of one month was 61.2% in 2013 and increased to 74.7% in 2014. The initial refer rate was 22.4% in 2013 and 24.2% in 2014 while the loss to follow up rate was 34.9% in 2013 and decreased to 31.7% in 2014. The average age of diagnosis was 5.3 month in 2013 and reduced to 4.5 month in 2014. While the prevalence of hearing impairment in 2013 was 4: 1000 out of NICU population and the prevalence of hearing impairment in 2014 was 2: 1000 out of NICU population. For two years duration (2013-2014), 680 babies were detected with hearing loss which contributes to the hearing impairment prevalence of 11 babies over 1000 out of NICU population.

For the year of 2013 and 2014, 149 babies were diagnosed with sensorineural hearing loss, 515 babies with conductive hearing loss and 17 babies with mixed hearing loss (Table 5).

Table 5: Number of babies with hearing loss according to type of hearing loss.

Type of Hearing Loss	Number of babies 2013	Number of babies 2014	Total babies with diagnosed with hearing loss
SNHL	69	80	149
CHL	250	265	515
MHL	8	9	17
Total	**327**	**352**	**680**

Conclusion

This study showed significant improvement between two years data (2013, 2014) in term of total babies screened, loss to follow up rate, coverage rate for the babies screened below the age of 1 month and the age of diagnosis.

However, the comparison between these quality indicators (the coverage of the babies screened before 1 month of age, initial refer rate, loss to follow up rate, mean age of hearing detection) to the Joint Committee of Infant Hearing recommendation [Year 2007 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs, Pediatrics 2007; 120; 898-921] revealed unsatisfactory performance of HRHS programme. For 2 years data (2013-2014) : the coverage of the babies screened before 1 month of age, initial refer rate, loss to follow up rate, mean age of hearing detection were 68%, 24.15%, 33.3% and 4.9 months respectively.

The coverage of the babies screened from total NICU population in 2014 (65%) and the coverage of the babies screened before 1 month of age for the year of 2013 and 2014 (68%) was low might be due to the inadequate manpower and the availability of the hearing screening devices. In majority of the hospital that implemented HRHS in 2013 and 2014, the neonatal hearing screening was carried out by Audiologist alone without supporting paramedic staff (16 hospitals) with limited screening devices (maximum 2 unit of per hospital). The screening program was run usually at the afternoon session after hectic Audiology clinic schedule in the morning and limited on the working days only. Hearing screening was not done on the weekend and public holidays which also contributed to the low coverage rate of the screening done to the neonates. Another factor which caused low coverage of the babies screened before 1 month of age for the HRHS was the baby unhealthy condition with multiple complications which prevent the hearing screening procedure to take place prior the age of one month.

The high initial rate for the year of 2013 and 2014 (24.15%) compared to the JCIH (<4%) mainly due to technology of screening device (OAE) used in majority of the hospital that implemented HRHS (22 hospitals). OAE has been reported to have a high false-positive rate (about 15% at the first screen on day one and then reduces by about 50% with each retest). Screening using automated auditory brainstem response (AABR) technique is associated with a much lower false-positive rate (about 5% on day one and reduces to about one percent by the second retest). The failure in the first hearing screening using OAE might be secondary to external ear obstruction and/or middle ear effusion. In other study, Clarke et al. (2003) suggested that screening for hearing loss in neonates using OAE should be performed 4 days after birth.

The high percentage of loss to follow up rate for the year of 2013 and 2014 (33.3%) might caused lower number of hearing loss detected in the high risk neonates. Thus the prevalence of hearing loss of 11 babies over 1000 out of NICU population for two years duration (2013-2014) is lower if compared with other study data, (Erenberg et al 1999 and Nelson et al 2008) which indicates the prevalence of hearing impairment for 20 to 40 of every 1000 neonates in the neonatal intensive care unit (NICU) population.

The implementation of the current high risk screening program needs to be reviewed. Factors contributing to its unsatisfactory performance must be identified and steps must be taken to resolve them so that early identification and intervention of permanent congenital hearing loss can become a reality.

The implementation of HRHS would have missed neonates from the well-baby group who actually had permanent congenital hearing loss. Hence, UNHS program would identify all cases with permanent congenital hearing loss, allowing for early intervention and follow-up.

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