

# The Result of Universal Newborn Hearing Screening, 4 Years of Experience in Trang

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**Objective:** 1) To share the experience in establishing the first province to set up the universal newborn hearing screening (UNHS) in Thailand. 2) To report the results of four consecutive years of UNHS in Trang.

**Materials and Methods:** All newborns in Trang province, between October 2013 and September 2017, who received UNHS, were included in this study. The present study was a descriptive study.

**Results:** There were three main obstacles to be solved to establish the program. There was no supported budget from the central government to run the UNHS. There was a lack of audiologists or trained personnel to run the UNHS. Finally, there was no province in Thailand that has done the project before. A budget for the Trang's UNHS project was allocated, which was 3,100,000 baht from the Trang provincial administrative organization, to purchase hearing screening machines for every community hospital. The personnel to run the UNHS, which were nurses, were trained in every hospital. The protocols, referral, and follow-up programs were newly designed to establish the hospital network for the program. There were 28,254 newborns in Trang and 27,983 (99.04%) were screened. The high-risk newborns were 1,415 (5.1%). The low-risk group was 26,568 (94.9%). The referral rate of transient evoked otoacoustic emission (TEOAE) was 5.9%. In the low-risk past screening group, there was one newborn (0.005%) that presented later with delayed speech and profound hearing loss after 1½ years and the MRI showed bilateral IAC stenosis. There were two newborns with severe hearing loss, one was Mondini dysplasia, and the other was normal on imaging, in 169 unpassed low-risk newborns. In the high-risk group, 73 (5.2%) were unpassed. After diagnostic tests, 71 (97.2%) were normal, one had severe hearing loss with normal imaging, and the other had bilateral microtia. The incidence of bilateral severe SNHL in high-risk newborn was (1/1,415) 0.71:1,000 births. The incidence of bilateral severe SNHL in low-risk newborn was (3/26,568) 0.11:1,000 births. After two years of follow-up, there was no delayed speech due to hearing loss in all the present study newborns.

**Conclusion:** The rate of congenital hearing loss is not as high as in the literature, but the UNHS is still important to the newborns and their parents.

**Keywords:** UNHS in Trang, Province-based UNHS, Incidence of hearing loss in newborn

Received 26 May 2020 | Revised 21 August 2020 | Accepted 21 August 2020

**J Med Assoc Thai 2021;104(1):95-9**

**Website:** <http://www.jmatonline.com>

Hearing loss is one of the most common congenital disorders, with an estimated incidence of one to three per thousand newborns<sup>(1-3)</sup>. The incidence of congenital hearing loss is more common than congenital hypothyroidism, phenylketonuria, and other inborn errors of metabolism, which are screened routinely<sup>(4,5)</sup>. In the past, the hearing was screened in only high-risk newborns. However, half of congenital hearing loss occurred in low-risk newborns<sup>(1,6)</sup>. Therefore, a universal newborn hearing

screening (UNHS) has been implemented especially in the developed countries for early detection within three months together with early intervention by six months of life to decrease the irreversible deficits in communication and psychosocial skills, cognition, and literacy<sup>(6-9)</sup>.

In Thailand, most of the university hospitals and some tertiary hospitals have the UNHS. However, it has not been implemented in provincial areas because of the scarcity of the budget and the lack of trained personnel or audiologists. The establishment of the UNHS in Trang province, nine district hospitals and one provincial hospital, had been done in October 2013, with the well-supported budget from the Trang provincial administrative organization and good cooperation of the hospital networks and the trained nurses.

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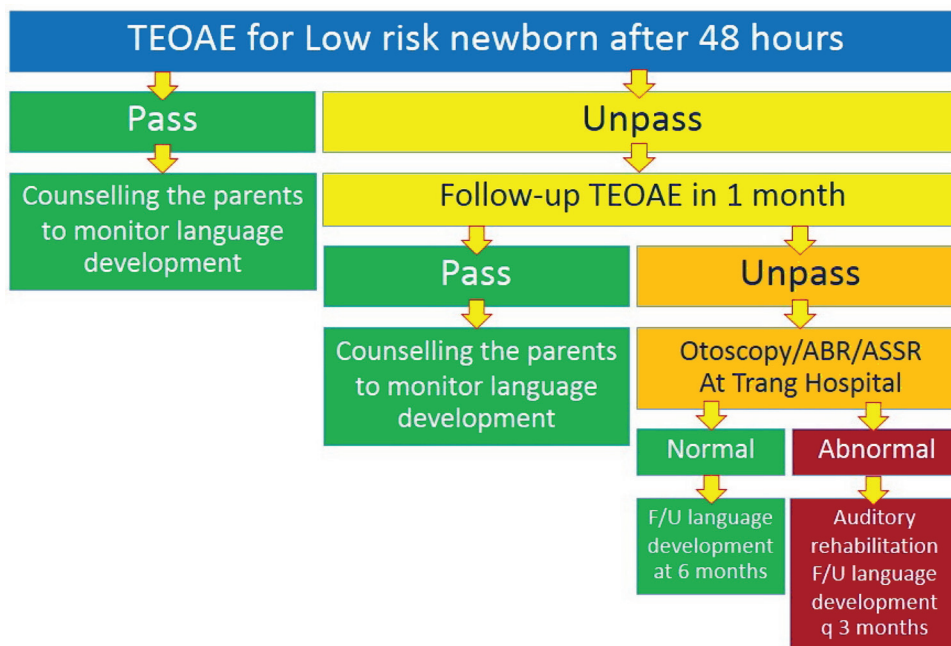
## How to cite this article:

Mukkun T. The Result of Universal Newborn Hearing Screening, 4 Years of Experience in Trang. *J Med Assoc Thai* 2021;104:95-9.

[doi.org/10.35755/jmedassocthai.2021.01.11432](https://doi.org/10.35755/jmedassocthai.2021.01.11432)

## Objective

To share the experience in establishing the first province to set up the UNHS in Thailand and to



**Figure 1.** The protocol for newborn hearing screening in the low-risk group.

report the results of four consecutive years of UNHS in Trang province.

## Materials and Methods

All newborns in Trang between October 2013 and September 2017, screened by UNHS were included in this descriptive observational study. They were followed for two years for any delayed speech due to hearing loss. The research was conducted under the approval of the ethic committee, the approval number was ID 029/09-2562.

### The protocol for the low-risk newborn

Forty-eight hours after birth, the low-risk newborn underwent testing using transient evoked otoacoustic emission (TEOAE). If the test result was pass, counseling was given to their parents on how to monitor language development (Figure 1). If the test failed, an appointment was made for repeated screening within one month.

If in the repeated screening, the test still failed, they would be sent to Trang Hospital for otoscopy, Auditory Brainstem Response (ABR), and Auditory Steady State Response (ASSR) for diagnosis. If the diagnostic tests were normal, they would be followed-up for language development at six months. If the diagnostic tests were abnormal, they would enter the auditory rehabilitation program with either

hearing aid fitting, aural rehabilitation, or cochlear implantation.

### The protocol for the high-risk newborn, according to JCIH 2007<sup>(5)</sup>

The double protocol, TEOAE and Automated Auditory Brainstem Response (AABR), was used for screening before discharge. If any tests were failed, they would be sent to perform diagnostic tests (Figure 2).

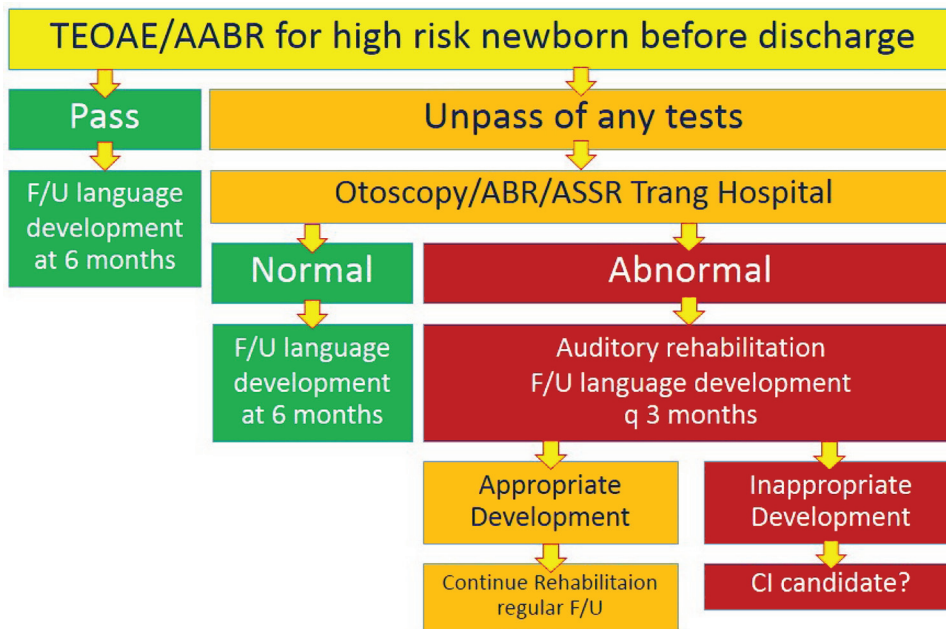
### Statistical analysis

The statistical analysis was performed by calculating percentages in screening rate, referral rate, pass rate and unpassed rate, and the incidence per 1,000 births, using 95% confidence interval with chi-square test in the IBM SPSS Statistics software, version 25.0 (IBM Corp., Armonk, NY, USA).

## Results

### Part 1: There were three main obstacles to be solved to establish the UNHS

*There was no supported budget from the central government to run the UNHS:* The UNHS project was presented to the administrators of Trang provincial public health office to recognize the importance of UNHS for early detection of the newborns with hearing problem, and for early rehabilitation. After



**Figure 2.** The protocol for newborn hearing screening in the high-risk group.

All newborns 28,254 (100%)			
Screened newborns 27,983 (99.04%)			
TEOAE in low-risk: 26,568 (94.9%)		TEOAE/AABR in high-risk: 1,415 (5.1%)	
Pass: 25,005 (94.1%)	Unpassed: 1,563 (5.9%) Repeat TEOAE 1 month		Pass: 1,342 (94.8%)
1 child delayed speech after 1 ½ year (bilateral IAC stenosis)	Pass: 1,394 (89.2%)	Unpassed 2 <sup>nd</sup> TAOAE: 169 (10.8%) Diagnostic test	Unpassed: 73 (5.2%) Diagnostic test
		Normal: 167 (98.8%)	Normal: 71 (97.2%)
		Abnormal: 2 (1.2%) Bilateral SNHL (CT-normal 1, Mondini 1)	Abnormal: 2 (2.8%) Bilateral SNHL (CT-normal 1, Bilateral microtia 1)
			Waardenberg syndrome: 1 Unilateral Microtia: 17 (good ear passed)

**Figure 3.** The results of Trang universal newborn hearing screening in 4 years.

that, the doctor-in-chief of Trang provincial public health office had signed the budget request to Trang provincial administrative organization. After discussion and debating for the budget in 2-year-process, a budget of 3,100,000 baht was allocated to purchase the hearing screening machines.

**The lack of audiologists and no trained personnel to run the UNHS:** The nurses from every hospital in Trang were trained to run the TEOAE and Automated ABR.

**No province in Thailand ran the project before:** The system of the UNHS was designed and discussed with the directors of every hospital in Trang to establish

the hospital network for the program.

### Part 2: The results of UNHS program between October 2013 and September 2017

As in Figure 3, there were 28,254 newborns in Trang and 27,983 (99.04%) were screened. Two hundred seventy-one newborns missed the UNHS because they were discharged when the trained nurses were not on duty or the newborns were relocated to other provinces with their mothers. Therefore, the missed newborns could not join the UNHS. There were 1,415 (5.1%) high-risk newborns and 26,568 (94.9%) low-

**Table 1.** The incidence of referred test, unpassed test and hearing loss in newborns

Incidence	Rate	95% CI
Bilateral severe SNHL in high-risk newborns	0.71:1,000	0.71±0.0024
Bilateral severe SNHL in screened infants	0.11:1,000	0.11±0.0036
Hearing loss in screened infants	0.79:1,000	0.79±0.002
Hearing loss in all newborns	0.78:1,000	0.78±0.001

SNHL=sensorineural hearing loss; CI=confidence interval

risk newborns. The referral rate of TEOAE was 5.9% (95% CI 5.9±0.002).

In the low-risk pass group, one newborn (0.005%) presented later with delayed speech and profound hearing loss after one and a half year. The MRI showed bilateral IAC stenosis. The parents decided to enter the school for the disables for total language.

In the low-risk fail group, 169 newborns failed the repeated TEOAE one month later. In this group, after diagnostic tests, 167 were normal and two had severe hearing loss, which one was Mondini dysplasia, and one was normal on imaging. There was no loss of follow-up in this group. The hearing aids were fitted together with aural rehabilitation program for the newborns.

In high-risk group, 73 (5.2%) failed the test (95% CI 5.2±0.001). After diagnostic tests, 71 (97.2%) were normal, one had severe hearing loss with normal imaging, the other had bilateral microtia. The hearing aids were fitted to the newborn with severe sensorineural hearing loss (SNHL), and the newborn with bilateral microtia was transferred for bone-anchoring hearing aids. There also was one newborn with Waardenberg syndrome with normal hearing. There also was no loss of follow-up in this group. The incidence of bilateral severe SNHL in high-risk newborn was 0.71 per 1,000 (95% CI 0.71±0.0024).

The incidence of the Trang UNHS program is shown in Table 1. The incidence of bilateral severe SNHL was 0.11:1,000 newborns (95% CI 0.11±0.0036). Additionally, there were 17 newborns with unilateral microtia and one bilateral microtia. All the newborns with unilateral microtia had normal hearing on the other ear and still had normal language development. The only one newborn with bilateral microtia was referred for bone conduction hearing aids. The incidence of hearing loss, which included bilateral severe SNHL, bilateral microtia, unilateral microtia, and bilateral IAC stenosis, of the newborn in Trang was 22 from 28,254 births. Therefore, the

incidence was 0.79 per 1,000 screened infants (95% CI 0.79±0.002) or 0.78 per 1,000 births (95% CI 0.78±0.001).

## Discussion

The UNHS is beneficial and is worldwide accepted. However, some problems remain to administer the UNHS system over Thailand<sup>(10,11)</sup>. In Trang, the author had solved the initial problems establishing UNHS by searching for the budget support from Trang provincial administrative office, encouraging the administrators to realize the importance of the UNHS, and training nurses to run the TEOAE. Early rehabilitation is also required for infants with either severe to profound or moderate hearing loss after diagnosis to gain normal language development<sup>(6-9)</sup>.

The UNHS screened 99.04% of newborn in Trang. Most of them were screened before discharge. The most common cause of lost to follow-up was the migration of the parent to other provinces, according to the call for follow-up. The successful rate of UNHS was determined to be at least 95% coverage by the Joint Committee on Infant Hearing (JCIH)<sup>(12)</sup>. All newborns with failed hearing screening were diagnosed before the age of three months. All newborns with hearing loss entered auditory rehabilitation program before the age of six months. As determined by JCIH 2007<sup>(12)</sup>, the successful diagnostic rate of UNHS was at least 90% coverage within three months of age and the successful rate of early intervention was at least 95% within six months of age.

The referral rate of TEOAE in low-risk UNHS was 5.9% while the referral rate of TEOAE in the literature was 3.9% to 8.9%<sup>(11-13)</sup>.

According to JCIH 2007, there were 1,415 (5.1%) high-risk newborns in Trang. All were screened with TEOAE and AABR before discharge. Five-point-two percent of high-risk newborns failed the screening. After diagnostic tests 98.6% was normal and one child had severe hearing loss with normal imaging. In literature, 6.76% to 20% of high-risk infants failed the screening<sup>(14-16)</sup>. The failed rate variation depends upon the protocol, which are TEOAE, AABR, or both, the age of screened infants, the underlying high-risk factors, and the definition of fail screening test.

According to the literature, the incidence of hearing loss in newborn ranges from 0.001% to 0.5%, and as high as 2% to 5% in the high-risk group<sup>(17)</sup>. In Trang, the incidence of hearing loss was 0.079% of all infant screened, or 0.078% of all births. Lévêque et al<sup>(18)</sup> has reported the same incidence in the French

region of Champagne-Ardenne, 0.08% of all screened newborns.

The limitation of the present study is the missing 271 newborns in the UNHS due to the relocation to other provinces with their mothers.

## Conclusion

The rate of congenital hearing loss is not as high as in most of the literature, but the UNHS is still important to the newborns and their parents.

## What is already known on this topic?

1. The role of trained nurse in UNHS among the scarcity of personnel.
2. The role of network hospital in UNHS.
3. The referral rate after UNHS in Thai newborn is 5.9%, which is equal to other countries.

## What this study adds?

1. The role of provincial administrative organization in UNHS.
2. The incidence of hearing loss in Thai newborn is 0.079% of all infant screened, which is lower than expected.
3. The incidence of bilateral hearing loss in high-risk is 1.4%, which is lower than expected.
4. The fail rate of double protocol high-risk newborn hearing screening (5.2%) is lower than in the literature (6.76% to 20%).
5. The screening rate of UNHS in Trang (99.04%) is higher than 95% according to JCIH Criterion.

## Conflicts of interest

The author declares no conflict of interest.

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