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Evaluation of the Newborn Hearing Screening Program in the University of Santo Tomas Hospital Based on the Joint Committee on Infant Hearing 2019 Position Statement on Quality Indicators for Screening and Confirmation of Hearing Loss

ABSTRACT

Objective: To evaluate the newborn hearing screening program in the University of Santo Tomas Hospital based on the quality indicators set by the Joint Committee on Infant Hearing (JCIH) 2019 position statement.

Methods:

Design: Cross-sectional study

Setting: Tertiary Private Training Hospital

Participants: All newborns delivered in 2019 at the University of Santo Tomas (UST) Hospital were considered for inclusion

Results: The UST Hospital had 778 newborns in 2019, of which 687 (88.3%) completed newborn hearing screening by 1 month of age. There were 81 (10.4%) who failed initial hospital-based screening and required outpatient re-screening while 11 (1.4%) of those who failed initial screening also failed subsequent rescreening. Forty-five (5.7%) newborns failed initial screening and subsequently passed re-screening. None of the eleven (0/11) patients completed comprehensive audiologic evaluation thus, patients necessitating referral for intervention were not identified. There were a total of 67 (8.6%) dropouts throughout the hearing evaluation process. Fifteen (15) infants were not screened due to unavailability of trained personnel at time of referral, four (4) infants were advised third screening while two (2) were advised observation instead of proceeding to confirmatory test.

Conclusion: The University of Santo Tomas Hospital newborn hearing screening program has yet to reach the quality indicators set by the Joint Committee on Infant Hearing 2019 for screening and confirmation of hearing loss. Among identified areas for improvement are the availability of trained personnel, insufficient means to ensure compliance, reluctance to pursue further testing and practices among healthcare providers.

Keywords: *Newborn hearing screening; otoacoustic emission; congenital hearing loss; diagnostics; quality indicators*

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Congenital hearing loss is a debilitating condition if not identified and managed in a timely manner.¹ Without intervention, it impairs one's capacity to communicate, predisposes to discrimination and provides restricted access to social services.¹ It is one of the most common disabilities in newborns with a worldwide prevalence of ~1-4 infants per 1,000 live births.² In the Philippines, the prevalence of bilateral congenital profound hearing loss is at 1.3 per 1,000 live births.³ Because of this, newborn hearing screening became an integral part of the healthcare system in most countries.² In the Philippines, the Universal Newborn Hearing Screening and Intervention Act (RA 9709) was put into law in 2009 which aims to prevent congenital hearing loss, provide early diagnosis and early intervention of hearing loss.² The University of Santo Tomas Hospital, a tertiary hospital in the capital of the Philippines, has since offered newborn hearing screening to all newborns.

As with any other program, implementation is always a critical aspect to evaluate success by. The Joint Committee on Infant Hearing (JCIH) in 2007 published guidelines in hearing evaluation and intervention.⁴ Within the publication are set quality indicators and benchmarks for newborn hearing screening, confirmation of hearing loss and intervention. For the screening, the recommended benchmark is >95% of all newborns completely screened within 1 month of age.⁴ While for confirmation of hearing loss, the recommendation with regards to the percentage of infants who completed comprehensive audiologic evaluation is at 90%.⁴ Lastly, the recommendation for receiving amplification devices within 1 month of confirmation of hearing loss is 95%.⁴ It was further adapted and updated in JCIH 2019 Position Statement with additional quality indicators to further assess the efficacy of newborn hearing programs.⁵ The following are the additional quality indicators: 1. Failed initial hospital-based screening and required out-patient re-screening; 2. Failed initial screening and subsequent re-screening; and 3. Failed initial birth screening and subsequent rescreening.⁵ However, no nominal benchmarks were set. While the guidelines on the Universal Newborn Hearing Screening Program are being implemented by the institution and services are available from screening, confirmation and intervention within the institution, there has been no data regarding patients' compliance and adherence by the audiologists and concerned clinicians to the guidelines.

The objective of this study is to identify how the newborn hearing screening program of the University of Santo Tomas Hospital measures up to the 2019 JCIH Quality Indicators for screening and confirmation of congenital hearing loss. It will also identify areas that need further investigation and improvement to maximize the program's efficacy.

METHODS

This cross-sectional study was approved by the UST Hospital – Research Ethics Committee (Reference # REC-2021-06-073-TR-FR). A retrospective review of records of all newborns delivered in 2019 in the UST Hospital was carried out. Newborns with congenital otologic anomalies and malformations not amenable to Otoacoustic Emission (OAE), those born outside the facility and those with incomplete records were excluded from the study.

From the total number of deliveries and newborns, the number of those referred for and who underwent hearing screening and its interval from birth were identified. The number of dropouts, and the number of infants who obtained 'pass' and 'refer' scores on newborn hearing screening using an Otoacoustic Emission Machine (Otoread Portable OAE Screener – Interacoustic, A/S, Denmark), were noted. For those who were advised rescreening by the audiologists, records were reviewed at the Hearing and Dizziness center and the number of dropouts, the number of infants who obtained 'pass' and 'refer' scores and the interval between first and second screening were listed.

For those who had persistent 'refer' results on repeat hearing screening whose parents or guardians had been advised by the audiologist and/or physician for their child to undergo confirmatory testing using Auditory Brainstem Response (ABR) and/or Auditory Steady State Response (ASSR), the number of dropouts, number of those with normal hearing threshold and the number of those with confirmed congenital hearing loss via ABR and/or ASSR were tabulated. The Bio-Logic Navigator Pro Natus Hearing Diagnostics Systems 580-NAVPRO (Natus, CA, USA) and Bio-Logic MASTER II Ver 1.2.0.0 (Natus, CA, USA) were used at the center for ABR and ASSR testing, respectively. Out of those with confirmed congenital hearing loss, the number of those who were referred for fitting of amplification devices were listed. Newborns who had their tests done or completed elsewhere were also considered as dropouts.

Statistical analyses were performed using STATA Statistical Software Version 13 (College Station, TX: StataCorp LP). A p-value of .05 was considered statistically significant. Percentages were used to identify the proportion of newborns screened within 1 month of age, the proportion of newborns who had 'pass' or 'refer' results on screening and results on subsequent rescreening, who underwent confirmatory tests within 3 months of age and were fitted with amplifying devices within 1 month of confirmation of hearing loss. Median and interquartile range were used to describe the interval between birth and first screening and interval between first and second screening, using Microsoft Excel for Mac Version 16.47.1, (Microsoft Corp., Redmond, WA, USA). One-sample



test of proportion was utilized to compare the achieved proportion of the different quality indicators for screening and confirmation of hearing loss with the standard quality indicators of the JCIH.

RESULTS

The UST Hospital recorded 772 deliveries with 779 live births (766 singleton, 5 twins and 1 triplets) in 2019. One of the newborns had microtia of the left ear and was excluded from the study. Of the 778 newborns, 758 (97.4%) were referred and subsequently screened for newborn hearing screening. The remaining 20, which comprised 2.59%, were not screened due to various reasons: three (0.39%) newborns expired prior to initiation of newborn hearing screening, while the remaining 17 were not screened – 15 due to unavailability of trained personnel at time of referral, one was discharged against medical advice, and one opted to have the newborn hearing screening done as outpatient elsewhere.

Of the 758 newborns who were screened, 677 (89.3%) had results of 'pass' while 81 (10.7%) had results of 'refer', and were advised re-screening. Of the 81 patients who were advised rescreening, 45 (55.6%) underwent second screening, while 36 (44.4%) either had their re-screening done at another institution or had no subsequent re-screening at all and were listed among study drop-outs. Among those screened, the interval between birth and initial screening ranged from one to 49 days (median 2 days; interquartile range 3 days) because some patients were only able to undergo initial screening after one month.

Of the 45 who underwent second screening, 32 (71.1%) had results of 'pass' while 13 (28.9%) had results of 'refer'. Of the 13 patients, four (30.8%) were advised by their pediatrician to undergo third screening where 2 (50%) had 'pass' results while 2 (50%) had persistently refer results. The 2 patients who had persistent refer results were advised by the audiologist to undergo confirmatory testing but advised by their pediatrician to observe behaviorally for response to sounds before proceeding with the confirmatory hearing test, hence, they did not proceed with the confirmatory test. Among those who proceeded with second screening, the interval between first and second screening ranged from one to 210 days (median 15 days; interquartile range 58 days) because some patients had their second screening done seven months after the first screening.

Of the 13 patients, there were 9 (69.2%) who either had their re-screening done at another institution or had no subsequent re-screening at all and were listed among the study drop-outs. Because confirmatory tests (such as ASSR, ABR and/or behavioral test) were not done, the institution was not able to identify patients who would need to be fitted with amplification devices or undergo further intervention.

Of the 778 newborns, there were 711 (91.4%) who completed the newborn hearing screening. However, based on the parameters by the JCIH 2019 Quality Indicators, hearing screening must be completed by 1 month of age. There were 687 (88.3%) who completed their newborn hearing screening by 1 month of age while 24 (3.1%) had their screening completed beyond 1 month of age. Analysis using one-sample test of proportion and results indicated that the newborns who completed screening by the first month of age in the UST Hospital in 2019 was 88.30%, which was significantly lower ($z = 8.57, p = .001$) than the target indicator of more than 95%.

There were 81 (10.4%) who had 'refer' results on initial hospital-based screening and required subsequent outpatient re-screening. With 36 dropouts, 45 (55.6%) underwent re-screening where 34 (75.6%) subsequently had 'pass' results on re-screening, noting that 2 of the 34 patients 'passed' after a third screening, while 11 (1.4%) had persistent 'refer' results on all screenings. Results indicated that the proportion of newborns who failed initial screening and subsequent rescreening was 1.40%, which was significantly lower ($z = 3.70, p = .001$) than the target indicator of less than 4.0%.

There were 11 (1.4%) newborns who failed initial screening and subsequent re-screening prior to comprehensive evaluation. However, it should be noted that there were 67 (8.6%) dropouts throughout the screening process. The 11 newborns who had persistently 'refer' results on hearing screenings (OAE) were advised by the audiologist to undergo a comprehensive audiologic evaluation through auditory brainstem response (ABR) however, they were not able to comply and were considered dropouts as seen in *Figure 1* and *Table 1*. Using one-sample test of proportion, with 90% of the null proportion, results indicated that the UST Hospital had a significantly lower proportion of newborns who completed comprehensive audiologic evaluation at 3 months ($z = -9.95, p = .001$). Because of incomplete confirmatory evaluation, infants necessitating intervention were not identified.

DISCUSSION

The UST Hospital was not able to reach the first quality indicator for screening and indicators for confirmation of hearing loss based on the JCIH 2019 Position Statement. Quality indicators are tools in order to monitor and improve the quality and efficiency of a program by recognizing problems and more importantly, taking necessary actions towards it. Although the institution has satisfied the benchmark for having < 4% failed initial screening and subsequent re-screening, it has unsatisfactorily met the benchmarks for complete screening by 1 month of age and complete comprehensive audiologic evaluation by 3 months of age. Our intervals between birth and first screening and

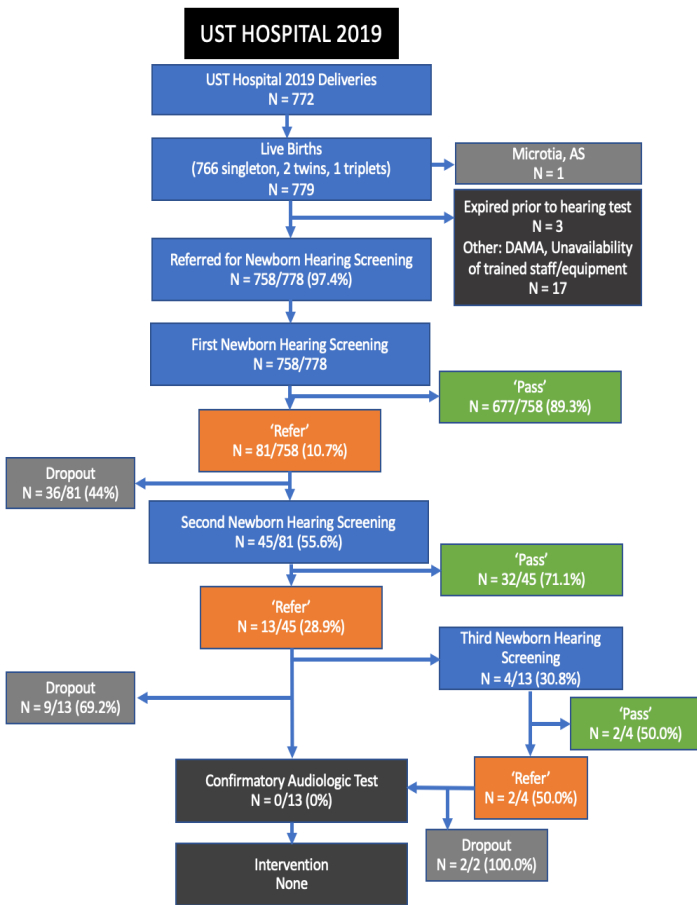


Figure 1. Flowchart of Newborn Hearing Screening Program in UST Hospital (2019)

between first and second screening were also prolonged in comparison to the Universal Newborn Hearing Screening Program recommendation of completing screenings within 1-3 months.²

The institution has a lower screening rate in comparison to The Medical City (98.8%)⁶ but higher than the Philippine General Hospital (75%; one quarter),³ although these studies did not mention whether screenings were completed within 1 month of age. Both the UST Hospital and The Medical City satisfied the benchmark for having a referral rate of < 4% at 1.40% and 0.75%⁶ respectively, while the Philippine General Hospital had a higher referral rate at 10.6% (one quarter).³ Neither the UST Hospital or The Medical City were able to satisfy the criteria for confirmation of hearing loss.⁶

With 8.6% (67/778) of newborns with incomplete hearing screening, the reasons for dropouts in initial screening and subsequent re-screening should be reviewed and addressed. Factors that lead to increased lost to follow-up rates and incomplete hearing evaluation include lack of parental involvement, reluctance for evaluations and

Table 1. Comparison of the Newborn Hearing Screening Program in Tertiary Hospital with the JCIH 2007 Quality Indicators for Screening and Confirmation of Hearing Loss

Quality Indicators	JCIH 2019 Quality Indicators	UST Hospital (2019)	Test Statistic	p-value (Two-Tailed)
SCREENING				
1. Complete screening by 1 month of age	>95% (JCIH, 2007)	88.30% (687/778)	-8.57	.001
2. Failed initial hospital-based screening and required outpatient re-screening	-	10.40% (81/778)	-	-
3. Failed initial screening and subsequent re-screening	<4% (JCIH, 2007)	1.4% (11/778)	-3.70	.001
4. Failed initial screening and subsequently pass a re-screening	-	55.60% (45/81)	-	-
CONFIRMATION OF HEARING LOSS				
5. Complete comprehensive audiologic evaluation (3 months)	90% (JCIH, 2007)	0.00% (0/11)	-9.95	.001
6. Failed initial birth screening and subsequent rescreening	-	1.4% (11/778)	-	-
7. Received amplification devices within 1 month of confirmation of hearing loss	95% (JCIH, 2007)	-	-	-

interventions and socioeconomic factors.¹ Identified problems at The Medical City were: 1. Availability of parent to bring patient for repeat OAE; 2. Patient having more pressing medical problems; 3. Advised by the pediatrician to observe; 4. OAE machine malfunction at time of schedule; and 5. Reluctance to pursue repeat OAE because of clinically assessed normal hearing.⁶ At the UST Hospital, identified points for improvement were the availability of trained personnel to perform the initial newborn hearing screening, insufficient means to ensure compliance, and reluctance to pursue further testing and practices among healthcare providers.

The availability of trained personnel to perform initial newborn hearing screening at time of referral was one of the identified problems. Fifteen (15) infants were discharged on a weekend or a holiday, hence no audiologist was on duty to perform the initial hospital-based hearing screening. According to the Universal Newborn Hearing Screening Act of 2009 (RA 9709), newborn hearing screening tests may be performed by qualified adult (≥ 19 years old) personnel, including audiometrists,



audiologists, licensed health professionals and trained health workers certified in a DOH-NIH training program.² As of the writing, this has been addressed by training resident physicians to perform the newborn hearing screening at any time, in the absence of an audiologist.

Although the follow-up schedule is indicated in the institution's results form and proper counselling with the results were done, the institution did not have other means of ensuring follow-up. At The Medical City, other measures taken were contacting parents of newborns for their scheduled rescreening in order to ensure compliance.⁶

Physicians and other healthcare providers play an important role in promoting follow-up, ensuring proper management and in educating with regards to the impact of a timely and proper management. In 4 cases, patients were advised by their pediatrician to undergo third screening (OAE) instead of proceeding with the confirmatory test (ABR/ASSR), which is the recommendation. In 2 cases with persistently refer results, instead of proceeding with the confirmatory test, they were advised by their pediatrician to observe. These may cause reluctance to pursue the diagnostic hearing protocol due to cost, and deviation from the recommendations may cause delay in the diagnosis and management of these patients. In the previous study at The Medical City, the practice to observe behaviorally as advised by the pediatrician was also cited.⁶ Knowledge, attitudes and practices among concerned personnel and clinicians should be reviewed in future studies as conflicting advice from audiologists and clinicians may result in delays in the diagnosis and management of congenital hearing loss.

There were no nominal benchmarks set by the JCIH 2019 Position Statement for the following indicators: 1. Failed initial hospital-based screening and required outpatient re-screening; 2. Failed initial screening and subsequently pass a re-screening; and 3. Failed initial birth screening and subsequent rescreening.⁵ However, values identified in this study for the previously mentioned indicators may be a reference to the goal that the institution will set for the next years.

There are several limitations to our study. Our study population was limited to newborns from UST Hospital in the year 2019 only. Increasing the coverage years and/or additional studies may better identify areas that need improvement and evaluation after application of necessary interventions. Hearing tests not done within the institution were not identified either and while these may contribute to the dropout rates, they may not necessarily imply incomplete hearing evaluation. Reasons for dropouts should also be investigated further. As what was done in previous studies, the institution may consider reminding patients regarding their scheduled follow-up and asking for reasons if they are unable to follow-up. Inclusion of other institutions may be considered as well, in order to assess the country's implementation of the universal newborn hearing screening program. With the conflicting advice from

clinicians, guidelines should be reiterated to different departments, which can be done through seminars and conferences. Communications between audiologists, clinicians and primary care givers should be improved in order to avoid delay in the diagnosis and management of patients with congenital hearing loss. Another limitation is the absence of data regarding causes of prolonged interval between screenings. In future studies, the interval between screenings, confirmatory tests and intervention may be investigated along with reasons for any delay.

Our study showed that the UST Hospital has yet to reach the benchmarks for quality indicators set by the JCIH in 2019. Initial hospital-based newborn screening should be ensured prior to discharge. Lost-to-follow up rates should substantially be reduced. The interval between screenings should be decreased as well. Among identified problems were availability of trained personnel, insufficient means to ensure compliance, reluctance to pursue further testing and practices among healthcare providers. The institution would benefit from routine monitoring of these measures in order to continuously improve the implementation of the program.

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