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Parental Satisfaction and Objective Test Measurements Associated with Post-Partum versus Nursery Newborn Hearing Screening

Jennifer E. Bentley, AuD[1]
Wenyang Mao, MS[1]
Wendy L. Timpson, MD[1]
Jane E. Steward, MD[1]

[1]Beth Israel Deaconess Medical Center, Boston, MA

Abstract: Beth Israel Deaconess Medical Center (BIDMC; Boston, MA) initiated a change to the newborn hearing screening program in 2013 to encourage increased parental presence at the time of screening and support a more family-centered hospital environment. Newborn hearing screening program technicians were encouraged to conduct all hearing screens in the parent's post-partum rooms instead of in the nursery. To measure the effect of this change on the families' experience and screening measures, satisfaction surveys and retrospective data were collected over a 2-year period and compared. Newborn hearing screening program technicians and mother-baby nursing staff were surveyed to determine influence of this new process on their work flow. Results suggest post-partum room testing leads to an increase in family satisfaction without a resulting change in pass rates or decrease in the efficiency of screening activities or staff work flow.

Key Words: Parental satisfaction, hearing screening, auditory brainstem response, rooming-in, newborn

Acronyms: ABR = Auditory Brainstem Response; AABR = Automated Auditory Brainstem Response; BIDMC = Beth Israel Deaconess Medical Center; CCI = Committee on Clinical Investigations; NICU = Newborn Intensive Care Unit

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Correspondence concerning this article should be addressed to: Jennifer Bentley, AuD, Beth Israel Deaconess Medical Center, Department of Neonatology–RO, 330 Brookline Ave., Boston, MA 02215. Phone: 617-667-8643; Email: jbentle1@bidmc.harvard.edu

Background

Universal newborn hearing screening is performed in all 50 states as an effort to identify infants at risk for congenital hearing loss (Centers for Disease Control and Prevention, 2014). The recommendation from the Joint Committee on Infant Hearing (2007) to screen all infants prior to one month of age or before discharge is aimed at obtaining quicker diagnoses and earlier initiation of intervention. In the most recent CDC national data from 2014, over 97% of newborns are screened, with approximately 1.6% not passing their final screen. Although many infants who do not pass the hearing screening will go on to have a normal diagnostic test, approximately 1 to 2 per every 1000 babies are diagnosed with permanent hearing loss each year (CDC, 2014).

Many hospitals screen infants within a few hours or days of birth and past studies investigating parental feelings around the newborn hearing screening have highlighted the need to determine the best methods and practices to minimize worry and stress. Although most families express a positive view of the hearing screening process, those parents who express worry or skepticism often report feeling less informed (Vohr, Letourneau, & McDermott, 2001; Weichbold, Welzl-Mueller, & Mussbacher, 2001). To better educate families, many programs provide parents with written information regarding newborn hearing screening either on registration, with post-partum documentation, or at the time of testing. Weichbold et al. (2001) showed that parental presence at the time of hearing screening decreased skepticism and that mothers who attended the hearing screen had a more positive view of the program. A newborn hearing screening survey distributed to parents in Massachusetts regarding satisfaction with the Early Hearing Detection and Intervention program in 2007 highlighted parental presence at the time of the screening as the most frequent suggestion for program improvement (MacNeil, Liu, Stone, & Farrell, 2007).

Today, many birthing hospitals are moving toward increased direct parental care of the infant during hospitalization. Studies have shown that rooming-in, the practice of keeping newborns in the mother's post-partum room instead of in a nursery, provides numerous

benefits to families and babies, including improved sleep, better bonding, and more successful breastfeeding with increases in milk production and duration of nursing (Crenshaw, 2007). Svensson, Matthiesen, and Widstrom (2005) found that staff attitudes on rooming-in can subsequently influence the parent's attitude. In their study, mothers who did not room-in with their babies were more likely to feel that hospital staff believed the baby should stay in the nursery. Beth Israel Deaconess Medical Center (BIDMC), located in Massachusetts, increased efforts to promote a more family-centered environment in 2012 and to support family-centered initiatives, the BIDMC Newborn Hearing Screening Program started performing screenings in the post-partum rooms in May 2013.

The Massachusetts Universal Newborn Hearing Program Birth Facility Guidelines (2012) requires measures of quality assurance when evaluating and monitoring the success of a program. Satisfaction surveys are one of a variety of methods used in health care services to assist with the assessment of outcomes and provide information to plan quality improvement (Castle, Brown, Hepner, & Hayes, 2005). Parent surveys have proven to be a reliable and informative way to assess family satisfaction with newborn hearing screening and diagnostic follow-up programs (Mazlan, Hickson, & Driscoll, 2006). Mazlan et al.'s study of 80 families found high test–retest reliability with their survey suggesting parental feelings associated with the newborn hearing program did not vary significantly over time. The study also indicated that the majority of parents, when surveyed, expressed high levels of satisfaction with the quality of services they received.

This project was aimed at determining the effects of a change in hearing screening location on the satisfaction levels of families, staff workflow, and efficiency of the screening process and outcomes.

Method

This quality improvement project was presented to the Director of Operations for Committee on Clinical Investigations (CCI) at BIDMC in accordance with CCI policy and deemed not to constitute human subjects research.

Equipment

Newborn hearing screening program technicians conducted an automated auditory brainstem response (AABR) screening on all babies using the Natus Algo 5 Newborn Hearing Screener. Testing was conducted using automated parameters with a 35 dBnHL click stimulus, a 60 Hz Notch Filter, and a rate of 37 clicks/second. The screening protocol used was consistent with the Massachusetts Universal Newborn Hearing Screen Program (2012) guidelines. The ALGO 5 screening parameters are as follows: (a) Equipment produces a "passing" result when at a minimum of 1000 clicks, it establishes a > 99% statistical confidence that the auditory brainstem response (ABR) signal is present and matches the internal template. (b) A "refer" result is produced if the equipment reaches 15,000 clicks and has not established with a > 99% statistical confidence the presence of an ABR signal that matches the internal template (Natus Medical Incorporated, 2011). (c) Impedance levels of the electrodes must be below 12 kOhms individually and within 5 kOhms of each other for testing to commence. Natus Medical (2011) designates excessive myogenic interference at greater than 50% and excessive ambient noise at greater than 30%.

Protocol

Hearing screens were completed at least 12 hours after vaginal birth and 24 hours after cesarean birth. At the onset of the project, the technicians were educated about the benefits of rooming-in and were encouraged to begin screening all infants in the family's post-partum room. Screening in the nursery was discouraged unless the baby was not allowed to be in the post-partum room due to medical concern or family request. Babies who were in the nursery due to blood draw, circumcision check or due to family wishes had testing delayed until they were re-united with their parents. When a screening was conducted in the nursery, families were not present. Although initial post-partum room screening rates were low, these continued to rise throughout the project period. All other protocols regarding screening procedure remained unchanged. At the completion of the screenings in either setting, the technicians verbally shared the screening results with all parents, answered any questions, and provided them with written information on the final results, follow-up and hearing and language developmental milestones. All surveys were distributed to families after the infant received a final screen result (first screen pass; second screen pass; second screen refer).

Survey Data Collection Procedures and Parent Participants

Instrument. A five-item survey, developed by Beth Israel Deaconess Medical Center Newborn Hearing Screening Program, was used to obtain parental feedback about their satisfaction with the newborn hearing screening (see Appendix A). Responses to questions were anonymous, completed using paper and pencil, and satisfaction was rated using a 5-point Likert scale (1 = *not at all satisfied*; 5 = *extremely satisfied*). The survey queried parent perceptions of the information they received prior to testing, the test process, the results, information regarding follow-up, and the overall process.

Data collection. Surveys were collected over two time periods. The first data collection period was from September 2013 to December 2013. Surveys were distributed and collected daily during those months (*n* = 201; 103 nursery, 98 post-partum room). Due to time required to distribute and collect surveys and technician availability the collection of surveys was discontinued

for two months. The second data collection period was from March 2014 to December 2015. During this time, surveys were distributed and collected on the last day of each month (n = 164: 36 in nursery; 128 in post-partum room). A total of 365 completed surveys were obtained (n = 139 nursery; n = 226 post-partum room). There were a total of 9,861 infants screened during the two collection periods, indicating 4% of the population surveyed. Hospital demographic data revealed average maternal age of 32 and 45% of mothers reporting their race as White. Survey data were analyzed using Wilcoxon Rank Sum test.

From March 2014 to March 2015, the technicians tracked the number of surveys they distributed and collected. When comparing locations, there was a small difference in percentage of surveys returned (75% in nursery, n = 9/12; 79% post-partum room, n = 50/63). Return rate data was not analyzed for significance due to small sample size of nursery surveys.

Survey Data Collection Procedures and Staff Participants

Instrument. A five-item survey (nurses) and six-item survey (technicians), developed by Beth Israel Deaconess Medical Center Newborn Hearing Screening Program was used to obtain feedback from the mother-baby nursing staff and newborn hearing screening technicians in March 2015. Responses to the survey were obtained using Qualtrics, an online survey generator and rated using a 5-point Likert scale (1 = *not at all*; 5 = *extremely*). The survey queried staff perceptions about the effect of the post-partum room testing process on comfort level with the program and influences on work process (see Appendix B and C). Completion of the survey was voluntary.

Participants. BIDMC employs part-time technicians to perform hearing screenings on the well-baby units. Anywhere from two to five technicians are employed at one time and each work between two to four days per week. Technicians in the program are typically pursuing education in the healthcare field but may have limited occupational experience in the medical setting and with handling newborns. The survey was distributed to both current and previous employees. At the time of this project the technicians' average amount of time working with the program was 11 months (range 1–26 months). A total of eight hearing screening technicians were emailed the link to the survey with a 100% response rate (n = 8).

The mother-baby nursing staff does not perform hearing screenings, but are responsible for completing paperwork regarding risk factors for late onset hearing loss. Mother-baby nurses are in close contact with families and newborn hearing screening technicians and are usually the first to know when a family has a concern or question. A total of 120 mother-baby nurses were emailed the link to the survey with a 20% response rate (n = 24).

Objective Data Collection and Participants

Objective hearing screening outcome data were collected retrospectively. All infant hearing screenings between September 2013 and December 2015 with a final result of "pass both", "refer both", "refer right", or "refer left" were eligible for inclusion in the study. Per hospital policy, infants that did not pass the first screen received a second hearing screen prior to discharge. Eleven percent of infants required a second hearing screening. Infants were not screened more than twice and infants that did not pass the first screen had only their second (final) screen included in the data analysis. Screens completed on infants in the neonatal intensive care unit (NICU) were excluded due to inconsistencies in time of screening and parental presence. Total number of infant screens included in this measure was 10,538 (7,588 post-partum room; 2,950 nursery).

Objective data was downloaded biweekly from the ALGO 5 between September 2013 and December 2015 and was analyzed using the t-test procedure and Satterthwaite method for unequal variances. Test parameters such as duration of screen, myogenic interference (muscular or electrical interference), ambient noise, and screening results, were compared to determine if the change in location resulted in any objective differences. Screen duration (total time in seconds the ALGO device was actively screening) was assessed because significant increases would decrease technician efficiency and increase cost of program. Screening results were compared to determine consistency with national, state, and program pass rates.

Myogenic interference (time during the test that the equipment was not accumulating data due to myogenic interference) and ambient noise were reported by the equipment in percentages. Myogenic interference and ambient noise percentages were assessed because changes in either of these parameters may lead to changes in screen accuracy. Along with infant activity level, myogenic interference can also be created by electrical interference. It is possible that minimal electrical activity was present in both the post-partum room and in the nursery.

Results

Survey Data

A total of 365 family satisfaction surveys were collected which included 226 surveys from families with screening in the post-partum room and 139 surveys from families with screening in the nursery. Figure 1 shows an analysis of satisfaction measures that reveals parents report higher satisfaction levels for post-partum room screening compared to nursery screening for information prior to screen ($p < .0001$); testing process

($p < .0001$); information on results ($p < .01$); information on follow-up ($p < .01$); and overall program ($p < .0001$). Newborn hearing screening technician survey results indicated the technicians' comfort in screening was

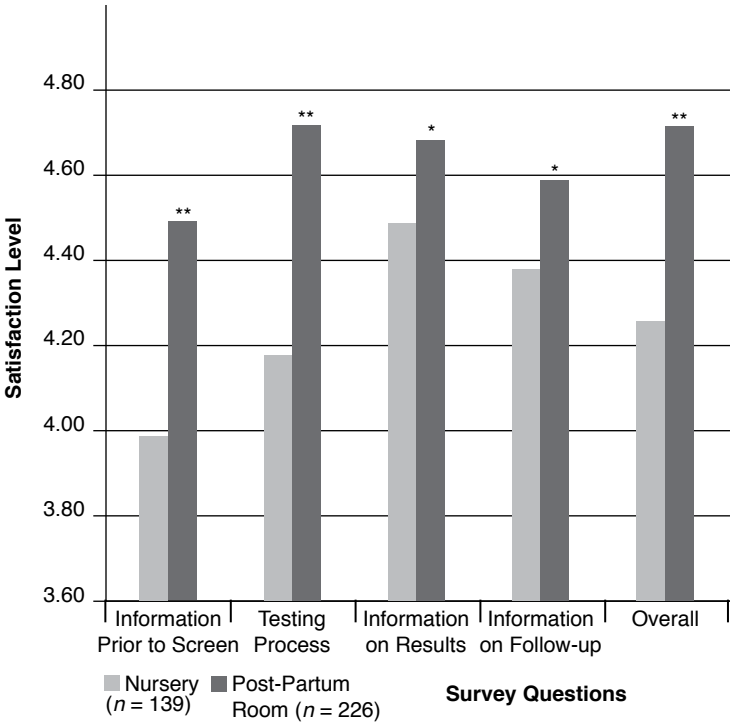

Figure 1. **Mean satisfication rating for families with post-partum room or nursery hearing screening**
***$p < .01$, **$p < .0001$**

higher when testing was completed in the nursery (5) compared to in the post-partum room (4.25). Five of the technicians were equally comfortable quieting the infant in both settings, but three were more comfortable quieting the infant in the nursery. Issues relating to hearing screens such as equipment handling, missing paperwork, parental involvement, and disruptions from other staff members or family did not appear to create problems in either setting for the technicians. Data were not analyzed for significance due to small sample size.

The mother-baby nurse survey results indicated they are very comfortable regarding the hearing screening process in both locations (4.3 in the post-partum room; 4 in the nursery). Some nurses reported disruption in their work flow when the hearing screens were done in the post-partum room (15%), but the majority (85%) felt the change in screen location caused either no issues or allowed the nurses to improve their work flow.

Objective Data

The objective measure analysis in Table 1 shows the comparison of percent of myogenic interference, percent of ambient noise, and screen duration between screens conducted in the post-partum room and screens conducted in the nursery. Analysis revealed the percent of myogenic interference present during screens was always slightly higher in the post-partum room. There were significantly higher rates of myogenic interference during post-partum room testing compared to nursery testing for 2013 ($p = .007$) and 2014 ($p < .0001$). In 2013 there was also a significant difference in both the percent of ambient noise and duration of the screen ($p = .03$ and $p = .005$ respectively). By 2015 no significant differences remained in any measure between the two locations.

Hearing screen results were similar in both locations. Post-partum room pass rates for 2013, 2014, and 2015 were 98.2%, 98.2% and 98.7% respectively. Nursery pass rates for 2013, 2014, and 2015 were 97.3%, 97.7% and 98.5% respectively.

Table 1
Average Myogenic and Duration Measures across Location and Year

	Post-Partum Room ($N = 7588$)	Nursery ($N = 2950$)
2013	$n = 508$	$n = 925$
Myogenic (%)	2.6**	22.4
Ambient (%)	2.2**	1.6
Duration (sec)	322.1*	284.7
2014	$n = 3176$	$n = 1287$
Myogenic (%)	27.5**	24.3
Ambient (%)	1.6	1.4
Duration (sec)	307.4	295.2
2015	$n = 3904$	$n = 738$
Myogenic (%)	27.6	26.9
Ambient (%)	1.7	1.9
Duration (sec)	307	302.4

*$p < .05$; **$p < .01$

Discussion

The primary purpose of the project was to determine if there was an increase in family satisfaction when screenings were moved from the nursery to the post-partum rooms without negatively impacting passing rates or markedly decreasing the efficiency of the screening.

Subjective satisfaction survey results indicated that families were satisfied with both post-partum room and nursery hearing screenings which is consistent with Mazlan et al. (2006), who showed that greater than 95% of parents are highly satisfied with hearing screening programs. This project determined that although both settings are highly rated, parents were significantly more satisfied with all measured aspects of the post-partum room hearing screening program including the information they received prior to testing, the test process, the results, information regarding follow-up, and the overall program. Parental presence, direct observation of the testing procedure and immediate access to technicians to answer questions, could

lead to an increased comfort level and understanding of information resulting in higher satisfaction levels. Weichbold et al. (2001) reported mothers who were present at the hearing screening gained some impressions from the situation and these impressions along with information received most likely added to their positive views of hearing screening.

Staff surveys suggest that the technicians have a slight preference for testing in the nursery. This is possibly influenced by their rating of comfort level in quieting the baby in parents' presence which was lower than comfort level in the nursery. Based on personal discussions with staff, comfort level has the potential to improve with increased length of employment and experience. Technicians were equally comfortable answering parent questions in both settings and although there was some reported increase in perceived complexity associated with testing in the post-partum rooms, it was not reported as problematic.

Mother-baby nurses were enthusiastic about the post-partum room hearing screening process and rated their feelings toward it slightly higher than nursery screenings. Nurses felt that the location of testing did not drastically affect their part of the hearing screening process and although there are some changes in work flow, the nurses felt that the change to post-partum room screening did not negatively impact their other work processes.

Objective data analyzed consisted of percent of myogenic interference, ambient noise, screen duration, and screen results. Screening results remained similar in both locations over the project period and was consistent with Massachusetts' pass rate of 98.2% (Massachusetts Universal Newborn Hearing Screening Program, 2014). Data analysis of myogenic interference, ambient noise, and screen duration, showed significant differences between post-partum room and nursery screenings in 2013, but by 2015 those differences no longer persisted and screenings from both locations demonstrated similar levels for each measure.

Limitations

Several limitations of the project were identified. Though our survey response rate was good (75–79% completion of parents offered survey), the responses reflect a sample of only 4% of our total population during the period assessed. Sample size was restricted by limitations on hearing screening technician time and resources. Non-English speaking families were not surveyed therefore the survey population may not be representative of the total family population (88% of BIDMC's maternal population is English speaking). Surveys were anonymous so obtaining demographic data to assist in comparing differences in who completed the survey (maternal vs. partner), ethnicity, or maternal age were unable to be evaluated.

Future directions

Future direction includes plans to determine if the location of the screening had any influence on follow-up rates for infants who do not pass the screening and those with identified risk factors for late onset hearing loss.

Conclusion

The purpose of the project was to examine the association between family satisfaction, objective test measurements, and location of newborn hearing screenings. After performing a survey of 365 families and reviewing objective test data from 10,538 infant screens, the project demonstrated that conducting hearing screenings in the post-partum room increased family satisfaction while not negatively influencing objective test measurements. Changes in program process may result in small impacts on staff work flow.

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Appendix A

BIDMC Newborn Hearing Screening Program Satisfaction Survey

Thank you for giving us the opportunity to find out more about the effectiveness of our hearing screening program. Your answers below will be kept confidential and we will not be collecting any patient information.

Where was your infant's hearing screened? ☐ In your room ☐ In the nursery

Thinking back on your baby's hearing screening at BIDMC, please circle the number that shows how satisfied you were with each part of the process.

1. How satisfied were you with the information you received about hearing screening **prior** to your infant's testing?	Not at all Satisfied 1	Slightly Satisfied 2	Moderately Satisfied 3	Very Satisfied 4	Extremely Satisfied 5
2. How satisfied were you with the **testing process**?	Not at all Satisfied 1	Slightly Satisfied 2	Moderately Satisfied 3	Very Satisfied 4	Extremely Satisfied 5
3. How satisfied were you with the information regarding the **results** of the hearing screening?	Not at all Satisfied 1	Slightly Satisfied 2	Moderately Satisfied 3	Very Satisfied 4	Extremely Satisfied 5
4. How satisfied were you with the information you received regarding **follow-up**?	Not at all Satisfied 1	Slightly Satisfied 2	Moderately Satisfied 3	Very Satisfied 4	Extremely Satisfied 5
5. **Overall**, how satisfied were you with the hearing screening services provided to your baby and family?	Not at all Satisfied 1	Slightly Satisfied 2	Moderately Satisfied 3	Very Satisfied 4	Extremely Satisfied 5

6. Comments: _____

_____

_____

_____

Please place the completed survey back in the envelope and seal closed. It will be collected by the hearing screening technician later today.

Thank you,
Beth Israel Deaconess Medical Center Newborn Hearing Screening Program

Appendix B

In Room Hearing Screenings: Mother-Baby Nurse Survey

In the past year we have transitioned to performing the majority of our hearing screenings in the parent's post-partum room as opposed to the nursery. While we are continuously assessing the satisfaction levels of our families, our program was interested in the opinions of our staff as well. Please take a few moments and complete the following survey. In order to keep this anonymous, please feel free to drop it in my mailbox or on my desk in a sealed envelope.

Thank you,

Newborn Hearing Screening Program

1) How comfortable are you with the hearing screening process when done in the...

nursery?	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5
post-partum room	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5

2) How problematic are these issues to the <u>in room</u> hearing screening process?

A - Finding out test results	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5
B - Contacting the technician	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5
C - Questions from parents regarding the test	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5
D - Completing hearing screening forms on test day	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5

3) How problematic are these issues to the <u>nursery</u> hearing screening process?

A - Finding out test results	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5
B - Contacting the technician	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5
C - Questions from parents regarding the test	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5
D - Completing hearing screening forms on test day	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5

4) Does having the hearing screening done in the room influence your work in the <u>nursery</u>?

A - Yes — Improves it

B - Yes — Hinders it

C - No — Neither improves nor hinders it

4) Does having the hearing screening done in the room influence your work in the <u>post-partum room</u>?

A - Yes — Improves it

B - Yes — Hinders it

C - No — Neither improves nor hinders it

Appendix C

In Room Hearing Screenings: Hearing Screening Technician Survey

In the past year we have transitioned to performing the majority of our hearing screenings in the parent's post-partum room as opposed to the nursery. While we are continuously assessing the satisfaction levels of our families, our program was interested in the opinions of our staff as well. Please take a few moments and complete the following survey

Thank you!

1) How comfortable are you...

screening babies in the nursery?	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
screening babies in the room?	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5

2) Do you feel comfortable taking the necessary steps to quiet/calm baby in both settings?

A - Yes, just as comfortable in room as in nursery

B - No, more comfortable in nursery

C - No, more comfortable in room

3) Is parental presence helpful in ensuring baby stayed quiet/calm during testing?

No, never	Rarely	Occasionally	Regularly	All the time
1	2	3	4	5

4) Do you feel as comfortable answering questions in both settings?

A - Yes, just as comfortable when baby tested in room as in nursery

B - No, more comfortable explaining when parents **have not** seen test (nursery)

C - No, more comfortable explaining after parents **have** seen test (room)

5) How problematic are these issues to the in room hearing screening process?

A - Equipment handling	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
B - Missing paperwork	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
C - Parental involvement	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
D - Disruptions from other hospital staff members	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
E - Disruptions from family (TV, other kids, talking)	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5

6) How problematic are these issues to the nursery hearing screening process?

A - Equipment handling	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
B - Missing paperwork	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
C - Parental involvement	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
D - Disruptions from other hospital staff members	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
E - Disruptions from family (TV, other kids, talking)	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5