



While there is nearly 30 years of published research demonstrating the positive impact of music on preterm infants in the neonatal intensive care unit (NICU), including shorter hospital stays, a more positive behavior state, improved physiological status, better feeding skills and fewer re-hospitalizations (Standley, 2012), healthcare providers and parents of patients still have many questions about the why, what, when and how related to NICU music therapy interventions.

Milestones in Infant Auditory Development

In order for an infant's auditory system to properly develop, including fine-tuning of the cochlear hair cells and appropriate formation of neural pathways, he or she must be exposed to meaningful auditory stimuli either in utero, or in the NICU environment in the case of pre-term infants.

Infant Age	Milestones
24-25 Weeks	Begin to respond to vibroacoustic stimuli
28 Weeks	Hearing structures including appropriate neural pathways, in place and operational, allowing consistent response to vibroacoustic stimuli
29 Weeks	Has a moderate hearing range, including the natural singing range for most females
32 Weeks	In utero learning – thus memory - of sounds, such as music and the mother's voice, have been demonstrated.
40 Weeks	Discrimination for what they like to hear, with their mother's voice being the favorite, especially in a higher pitched, singsong style.

Infants that are deprived of meaningful sounds during auditory development are at risk for inhibited brain maturation, and ultimately inhibited speech and language acquisition.



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The Role of the NICU Music Therapist

Research has shown that age-appropriate sensory stimuli, such as carefully selected music, can significantly benefit the clinical and neurodevelopmental outcomes of premature infants in the NICU (Standley, 2012; Standley & Walworth, 2010). The role of a board-certified music therapist (MT-BC) with specialized NICU therapy (NICU-MT) training is to enhance these outcomes.

While over 50 percent of the top U.S. children's hospitals engage the services of board-certified music therapists with their NICU-MT specialization (Standley, 2014), there are many misconceptions about the field of music therapy – it is far more than a musician strumming a guitar or a nurse pressing “play” on a Pandora playlist.

In order for NICU music therapy to optimize the developmental outcomes of pre-term infants it must be delivered as an intentional, individualized intervention by a highly skilled, credentialed professional with extensive knowledge on the developmental care of these infants. Furthermore, music therapy should be utilized in close coordination with other members of the interdisciplinary team including speech language pathologists, occupational therapists, and physical therapists.

NICU music therapy uses specialized, research-based interventions that impact patient outcomes. Therefore a board-certified NICU music therapist with extensive experience working with pre-term infants must be the one to develop and manage the program. But that doesn't mean that other NICU staff and parents do not have a role. Rather, they can be invaluable in extending the benefits of music.

We know from the speech and language development literature that babies learn to speak sooner and have higher language development scores the more they are exposed to language and the more words they hear, particularly from the voice of a parent. Infants will attend longer to a parent's voice, especially singing, than a stranger's voice because it is familiar and more rewarding to them.

In my first interactions with parents, over 95 percent tell me they are not good singers and don't want to harm their babies by singing to them. But we know from research that it is less about the quality of the voice and more about the familiarity and exposure. I frequently have to remind parents of that – singing to your baby is critical for his/her language development and opportunities for bonding, and he/she will attend to you for longer periods of time and respond better to your voice than a stranger's voice. They not only like your voice, but they *require* it for optimal speech and language development.

Regardless of who is providing the music - a music therapist, nurse or parent - it must be infant-directed. The singer must be able to read the cues of the infant and respond in the moment to optimize the interaction and the infant's response. For example, if an infant becomes more interactive during music, the singer could raise his/her eyebrows or sing a little faster. On the other hand, if the infant shows signs of stress, the singer could reduce the complexity of the music by beginning humming the song rather than singing the words.

Music Therapy Protocols

There are two primary protocols that we use in the field of NICU music therapy. One called “multimodal neurologic enhancement,” is a 22-step progression that systematically introduces stimuli to the infant, first sound (i.e. live lullaby singing), then touch (i.e. stroking of the infant from the top of the body down and from the middle of the body out), and lastly rocking. The goal of the intervention is to help preterm babies, who have immature sensory systems, learn to tolerate layering of sound, touch and movement in an attempt to decrease stress, which impacts sleep and neurodevelopment. We have been performing this protocol for more than two decades and have seen remarkable results.

Among preterm infants receiving multimodal neurologic enhancement interventions for 15-20 minutes twice a week, baby girls went home 21.3 days sooner, and boys 16.8 days sooner, compared to those who did not receive the therapy. (Walworth, Standley, Robertson, Smith, Swedberg, & Peyton, 2012)

The other protocol uses the Pacifier Activated Lullaby® (PAL). This is an FDA-approved medical device featuring a pressure sensor that fits into the back of a pacifier. When the baby sucks on the pacifier the device plays lullaby music for 10 seconds. The music then stops unless the infant sucks on the pacifier again within the 10-second timeframe. The device allows the therapist to change the duration of the reinforcement (music) period, and the suck settings including the strength and the number of sucks per burst required by the infant to activate the music. We commonly use this intervention starting with infants around 34 weeks when they are just learning how, or preparing, to breast or bottle-feed. The pacifier can help them establish the strength, oral motor control, and suck-swallow-breathe coordination required for successful oral feeding.

The Pacifier Activated Lullaby® (PAL) intervention has resulted in shorter hospital stays, as well as increased volume intake, feeding rates, number of oral feeds per day, and shorter duration of gavage feedings (Chorna, Slaughter, Wang, Stark, & Maitre, 2014).

PAL® has also had an effect on infants admitted to the NICU for in-utero drug exposure including significantly decreased withdrawal symptoms as measured by the Finnegan Scoring Tool (Detmer, DeLoach, Forbes, & Gossom, 2017).

Evidence-Based Guidelines for Music Therapy in the NICU

In my role as a board-certified music therapist, NICU nurses and other therapists often ask me for guidelines on using music in the care of premature infants, including the contraindications. When I began pulling together all of the music therapy and developmental literature, I realized there was no one single set of step-by-step guidelines that can serve as a resource for clinicians. I decided to use the current literature to fill this void and developed a set of evidence-based guidelines for the use of music with premature infants. These guidelines were published in the July/August 2017 issue of the journal *Neonatal Network*.

In reviewing the guidelines (see sidebar) it becomes clear why music therapy is such a complex field. It is no simple task. It requires a keen eye for clinical decision-making and control over multiple elements of music, including tempo, rhythm, volume, harmony and style.

While infant-directed singing that is applied within established guidelines and protocols can improve outcomes for NICU babies, research and clinical observations have shown that misguided efforts on music or other sound in the NICU can cause more harm than good, including infant overstimulation, stress, increased heart and respiration rates and sleep disturbances.

In my research I found some clinicians make emotionally-based rather than evidence-based decisions on music for NICU patients. For example, one study found nearly half of NICU nurses said they prefer the use of classical music for their patients. As an adult that seems to make sense because we think of classical music as calming. But in reality, classical music is very inconsistent, with volume and tempo changes and multiple instruments, which research has shown can over stimulate preterm babies.

Other therapists have attempted to mimic womb sounds with instruments such as a whooshing drum or ocean disc (both which contain beads that roll around) in the belief that the preterm infant will be soothed by the familiar sounds of the womb. What they don't take into consideration is that while infants can hear at 26-27 weeks gestation, they don't remember sound before 32 weeks and it is likely not until 34-35 weeks that they remember sounds consistently. So a baby born at 30 weeks has no memory of womb sounds. Furthermore, research has shown that preterm infants prefer and are most stable with predictable, consistent and rhythmic auditory stimuli, and there is no way to create rhythm with a whooshing drum or ocean disc. Finally, this lacks language input, which we know is critical for development.

EVIDENCE-BASED RECORDED MUSIC GUIDELINES FOR PREMATURE INFANTS IN THE NICU*

Eligibility Criteria

- At least 28 postmenstrual weeks
- Daily nursing approval

Music Characteristics

- During initial presentation and for very premature infants, music should be as simple and non-alerting as possible.
- Soothing, constant, stable, and relatively unchanging:
 - Voice alone or voice with one instrument
 - Light rhythmic emphasis and slow tempo
 - Constant rhythm and volume
 - Melodies in a higher vocal range, which infants hear best
 - Female (mother preferred) or child vocalists
 - In the native language of the family
- Least alerting music for premature infants include:
 - Three chords or less
 - Major chords
 - Lullaby style (repetitious: no separate melody for chorus/bridge)
 - Played slowly and softly
- Various selections should be used to promote learning and avoid infant fatigue.
- Live, infant-directed singing (interactive and responsive to the infant) is recommended and more effective than recorded singing if it adheres to the characteristics mentioned earlier.

When to Play

- When awake or at the beginning of sleep
- During kangaroo care
- Immediately after painful/stressful procedures
- Audio recordings should not be left unattended in the high-risk infant.

When to Stop

- If infant exhibits frequent/continuous signs of overstimulation (e.g., squirming, arched back, grimacing, increased heart rate, irregular breathing patterns, change in skin color, crying, splay finger, hiccoughing)
- During painful/stressful procedures

*Detmer, M. R. & Whelan, M. L (2017) Music in the NICU: The role of nurses in neuroprotection. Neonatal Network, 36(4). 213-217.

**EVIDENCE-BASED RECORDED MUSIC
GUIDELINES FOR PREMATURE
INFANTS IN THE NICU – *continued****

Duration and Frequency

- Maximum of four hours per day, alternating between 30 minutes of music and 30 minutes of no music

Volume

- 65–75 dB, scale C (measured at ear, not source)
- Music should be played with background noise not exceeding 50 dB.

Presentation

- Place speakers on each side of infant's head or feet so sound stimuli are received binaurally. (NOTE: the speakers don't necessarily have to be independent speakers; the sound just needs to be presented binaurally).
- Music equipment must be tested to ensure it does not create electrical interference with medical equipment such as cardiac monitors and ventilators and is resistant (if used in the isolette) against high temperatures (36C) and humidity (75 percent) levels.

Contraindications

- Musical toys and mobiles because of the highly repetitive nature of the sole music selection usually available with these toys, the inability to adjust sound levels, and the lack of research on their use
- Radio, white noise, or nature sounds
- Earmuffs
- Headphones on the infant or directly on the mother's abdomen while pregnant
- Music played free field in an open bay because the volume is difficult to manage for each infant and it may not be appropriate because of the gestational age for those subjected

Least Alerting Songs

For a list of the least alerting songs for babies in the NICU, refer to *Detmer, M. R. & Whelan, M. L. (2017) Music in the NICU: The role of nurses in neuroprotection. Neonatal Network, 36(4). 213-217.

**Presenting the Case for a NICU Music
Therapy Program**

In today's healthcare environment, where health systems and hospitals are trying to deliver better patient outcomes at a lower cost, NICU music therapy is a natural fit. Studies have shown that NICU music therapy interventions facilitated by board-certified music therapists contribute to shorter hospital stays for premature infants among many other developmental and medical benefits (Standley, 2012). Shorter length of stay drives savings for healthcare organizations, and increases revenue generation since it frees up beds for additional patients.

With music therapy we are essentially wiring the brain of preterm infants so that they work more like a typically developing term infant's brain. As a result, we see acquisition of important developmental milestones sooner than those who did not receive the therapy. This has the potential to minimize the number of therapeutic interventions needed for the child long-term (e.g. speech therapy), further reducing healthcare costs.

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Additional Resources

Below are resources for healthcare staff and parents of preterm infants seeking additional information on music therapy in the NICU:

- *The National Institute for Infant & Child Medical Music Therapy*. Offers a registry of all trained NICU music therapists by city: <http://www.music.fsu.edu/NICU>
- *Music Therapy with Premature Infants: Research and Developmental Interventions, 2nd ed.*, by Jayne M. Standley and Darcy Walworth: This handbook discusses prematurity, medical/developmental assessments, NICU care procedures, and infant growth and maturation goals and the NICU music therapy procedures to facilitate these goals. While it is aimed toward medical professionals, it is valuable for parents as well.
- *Bright Start Music: A Developmental Program for Music Therapists, Parents, and Teachers of Young Children* by Darcy Walworth: This is a research- and developmentally-based music curriculum aligned with the Centers for Disease Control & Prevention (CDC) developmental milestones. This book and CD walks parents and therapists through age-based milestones in child development and presents musical activities designed to support developmental milestones.

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