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Amir Lahav is an Assistant Professor of Pediatrics at Harvard Medical School with faculty appointments at Mass General Hospital for Children and Harvard School of Public Health. He is currently a Visiting Professor in the Department of Pediatrics at Women & Infants Hospital at Brown University. Dr. Lahav received his Doctor of Science degree in Health & Rehabilitation Sciences from Boston University. Dr. Lahav’s work is focused on the effects of hospital noise and womb-like sounds on the developing brain, with a special interest in the acoustic design of the neonatal intensive care unit. Dr. Lahav’s research aims to determine the impact of early exposure to mother’s voice on brain mechanisms that support stress, language, cognition, and attention.

Annual Quality Congress Breakout Session, Sunday, October 4, 2015
Balancing Noise and Language Exposure for Premature Infants in the NICU
Objectives: Compare and contrast the uterine auditory environment versus the NICU and discuss potential impacts on brain mechanisms that support hearing, language, cognition, and attention.
Balancing Noise and Language Exposure for Premature Infants in the NICU

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DISCLOSURE

The speaker cannot identify any potential conflict of interests or financial relationships that should be disclosed.

Background

• Hearing begins in utero at ~25 wks gestation.
• In the NICU:
  ➢ dB levels are typically too high.
  ➢ Quality language stimulation is often insufficient.
  ➢ Multi-talkers babble is masked by environmental noise.
• In the womb:
  ➢ External noise is attenuated by maternal tissue and fluids.
  ➢ Constant auditory stimulation of maternal voice + heartbeat.
• There seems to be a concerning gap between the sensory demands of the auditory brain system and the sound exposure in the NICU environment.
• How do we find the right balance?

Exposure to high-frequency noise in the NICU

Tonotopic development of sound frequencies in the cochlea

October 4, 2015
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An acoustic gap between the NICU and the womb

<table>
<thead>
<tr>
<th>Womb</th>
<th>NICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of hearing</td>
<td>Bone conduction</td>
</tr>
<tr>
<td>Sound transmission medium</td>
<td>Fluid</td>
</tr>
<tr>
<td>Sound attenuation</td>
<td>Attenuation provided by maternal tissue and fluids</td>
</tr>
<tr>
<td>Sound attenuation</td>
<td>Primarily low frequency (&lt; 500 Hz)</td>
</tr>
<tr>
<td>Ambient noise dosage</td>
<td>Restricted daily exposure to noise</td>
</tr>
<tr>
<td>Most prevalent sounds</td>
<td>Maternal vocalizations, maternal biological sounds</td>
</tr>
<tr>
<td>Exposure to language</td>
<td>High-quality stimuli, primarily from mother</td>
</tr>
<tr>
<td>Complexity of prevalent sounds in environment</td>
<td>Organized, rhythmic/periodic, predictable</td>
</tr>
</tbody>
</table>

Problems with the environment in the NICU

1. Too much noise: overstimulation
   Noise exposure during critical periods deviates from the sound exposure of a normally developing newborn, which can negatively affect physiological stability and compromise brain development.

2. Too little maternal sounds: deprivation
   Auditory and language deprivation during critical periods can result in abnormal wiring of the auditory brain system, leading to hearing and language deficits, ADHD, and learning disabilities.

Wachman & Lahav, 2010; McMahon, Wintermark, & Lahav, 2012; Lahav & Skoe, 2014; Rand & Lahav, 2014

What sound environment is better for the babies?

Multi-bed units

Single family rooms

What knowledge are we still missing in order to improve the AAP recommended standards regarding sound exposure in the NICU?
What is the best audio track NICU babies should listen to?

Thank you!