

Navigating care pathways to 1-3-6 goals in the NICU

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Background

- Newborn hearing screening program guidance has long maintained a 1-3-6 goal.

Figure 1. Goal to screen by 1 month of age, have a diagnosis by 3 months of age, and implement early intervention no later than 6 months of age.



- Individual hospitals and statewide EHDI programs have improved approaches over the years.
 - Focus on attainable goals for most newborns/infants and families.
- Challenges persist in the neonatal intensive care unit (NICU) setting:
 - Higher incidence of hearing loss in NICU graduates 9.4 to 9.7 per 1000 neonates (Vohr et al., 2002).
 - Separate protocols and techniques from the well-baby nursery are recommended with no consensus guideline available NICU (George et al., 2019).
 - Due to multiple risk factors and comorbidities, may not be medically feasible to screen hearing by 1 month of age (reviewed by George et al., 2019).
 - In 2018 in Minnesota, 98% of babies with normal birth weight were screened by one month versus 47% of babies with low birth weight (largely NICU patients).
- For the Mayo Clinic NICU hearing screening program, the criteria for determining babies ready to be screened has evolved over 25+ years of NICU screening.
- As we review the NICU patient population's journey through hearing screening, diagnosis and intervention, we often find traditional 1-3-6 targets are not met.
 - Some states use corrected age when looking at benchmarks, but the Centers for Disease Control and Minnesota Department of Health (MDH) do not.
- This poster reviews the improvements we have made to conduct screening, diagnosis, and intervention in a timely manner for our NICU population. It highlights different care pathways that necessitate variability for individual patients and their unique situations.

Challenges to Meeting 1-3-6 Goals in the NICU

- Patient factors**
 - Tiny ears and underdeveloped auditory systems
 - Other equipment present that impacts testing
 - Babies who are very sick and complex care needs are prioritized
- Environmental factors**
 - Electrical and acoustical noise present in the room
 - Timing newborn hearing screening prior to discharge
 - Coordination of logistics and follow-up with care team for those needing inpatient evaluation and intervention
- Family factors**
 - Availability of family and community resources/support (also, distance between home and NICU, balancing needs of other children/family members, etc.)
 - Financial resources
 - Linguistic and cultural differences between families and hospital staff

Ongoing "gaps" and challenges: missed or delayed discharge due to emergent requests for screening, limited inpatient time to complete re-screen and/or bedside diagnostic evaluation prior to discharge, optimize provider time, significant administrative time for "manual" data tracking, phone calls, etc.

Mayo Clinic NICU Hearing Screening Program

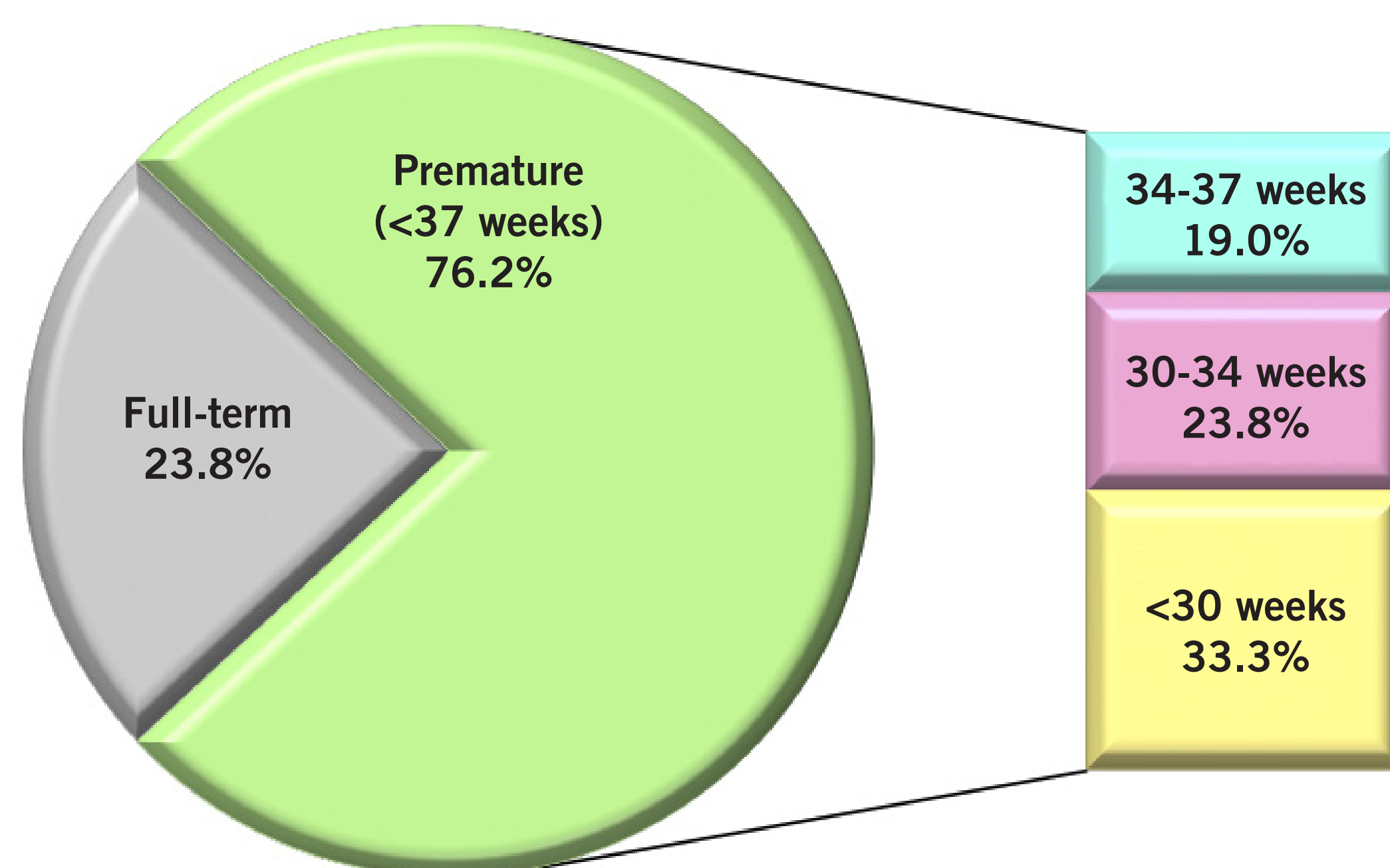
- Mayo Clinic Hospital includes a well-baby nursery, level III NICU and level IV NICU (data presented in this poster).
 - Mayo Clinic Hospital level IV NICU is a 26 bed family centered nursery that accepts patients from the Southeast Minnesota region, as well as transfer patients from Western Wisconsin, Northern Iowa, and less frequently includes transfer patients from farther distances.
 - Length of stay ranges from 2-3 days to many months; the level of care needed varies widely.
- More than 200 patients per year spend time in this NICU. Most will be discharged to home while some will be transferred back to a local hospital.
 - Programmatic data tracking for this population began in 2013 (141 babies screened in 2013).
 - Currently, the number and percentage of the patients that have screening and evaluation completed is tracked and reviewed on an ongoing basis.
 - A Mayo Clinic-developed database is used to track individual and population EHDI data.
- Annually, 10 – 15% of NICU babies have a refer result on their initial newborn hearing screening.
- Approximately 5 % of all babies screened in the NICU are ultimately identified with hearing loss each year.
- In 2019, 178 babies were referred for hearing screening in the NICU.
 - 1 baby's parents refused screening and 2 skipped hearing screening in favor of diagnostic ABR (due to needing a baseline for hearing monitoring).
 - Of the remaining 175 babies, 127 (72.6%) had at least one hearing screening by 1 month of age.
 - Of the 32 babies who needed audiologic evaluation, 20 (62.5%) had that evaluation by 3 months of age.

A Day in the Life of the NICU

To better understand the medical challenges faced by babies in the NICU, a snapshot was created on a single day in January 2020.

- 21 babies were in the NICU
- 7/21 (33.3%) had cardiac concerns, including atrial septal defect and ECMO
- 7/21 (33.3%) had neurological concerns
- 3/21 (14.3%) had other risk factors of hearing loss
- Prematurity was also very common among NICU babies included in the snapshot, which can contribute to the challenge of meeting 1-3-6 goals

Figure 2. Postmenstrual age at birth



Acknowledgements

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Case Illustrations

CASE 1 Do what you can when you can	CASE 2 Sometimes you have to wait for babies to grow	CASE 3 Meeting the family where they are	CASE 4 How high of a priority is hearing screening?
<ul style="list-style-type: none"> Born at 23 weeks GA Risk factors: <ul style="list-style-type: none"> NICU stay >5 days Postnatal symptomatic CMV infection Low birthweight Mechanical ventilation Ototoxic meds exposure 8 wks old (31 wks PMA) Diagnosed with CMV Attempted ABR, OAE, tympanometry, but unable to obtain reliable responses due to ventilation noise and patient's small ear size 4 mos old (39 wks PMA) - diagnostic ABR and present OA Since then, ABR continues to indicate normal hearing sensitivity in both ears 	<ul style="list-style-type: none"> Born at 38 wks GA Risk factors: <ul style="list-style-type: none"> NICU stay >5 days Craniofacial findings Heart defect Genetic syndrome Ototoxic meds exposure 3 days old - referred ABR in 1 ear 7 days old - 1st diagnostic ABR shows no clear waveforms in either ear 5 weeks old - 2nd diagnostic ABR indicates normal hearing in one ear and mild hearing loss in other ear 12 weeks old - 3rd diagnostic ABR shows normal hearing sensitivity in both ears Since then, behavioral testing has reliably shown normal hearing in both ears 	<ul style="list-style-type: none"> Born at 34 wks GA Risk Factors: <ul style="list-style-type: none"> NICU stay >5 days raniofacial findings Heart defect Mechanical ventilation Ototoxic meds exposure 31 days and 7 wks old Refer ABR both ears x2 3 mos old - atypical diagnostic ABR 4, 6, and 9 mos old <ul style="list-style-type: none"> Improvement in ABR waveform morphology Mild to moderate SNHL 12 mos old <ul style="list-style-type: none"> Confirmed seizures and developmental delays 2 yrs old <ul style="list-style-type: none"> Behavioral audiogram results similar to ABR findings 2.5 yrs old <ul style="list-style-type: none"> Hearing aid consult/fit 	<ul style="list-style-type: none"> 8 wks old - NHS requested Multiple risk factors/ challenges to AABR <ul style="list-style-type: none"> Acoustic noise from high-volume oxygen Electrical noise from feeding pump Patient neurological status (encephalopathy) Abnormal outer ears Neonatology team confirmed diagnostic ABR was needed for care plan No clear waveforms on ABR, unable to get OAEs due to noise, recommended repeating testing when child is a few weeks older 2 days later - met with palliative care team to discuss invasive ventilation. Decided on comfort measures for peaceful end of life

[^]GA=gestational age; PMA=postmenstrual age; Risk factors per JCIH, 2007; ABR=Auditory Brainstem Response; AABR= Automated ABR; OAE=Otoacoustic Emission; SNHL= sensorineural hearing loss

Current State of Screening

Mayo Clinic NICU Hearing Screening Program has evolved over time to meet the needs of the patient. Currently, the Audiology team provides order-based inpatient services with ongoing programmatic data tracking and management by a program coordinator and Audiology liaison to the NICU. A clinical assistant maintains a spreadsheet monitoring many aspects of a baby's progress. This person is the contact to help audiology identify which babies are ready to be screened.

The neonatology service uses a set of criteria to determine which patients are ready for hearing screening:

- Respiratory:** On room air or low flow nasal cannula (<1 LPM flow)
- Oral:** Working on oral feedings
- Age:** 34 weeks postmenstrual age or greater
- Discharge:** discharge to home anticipated within 1 to 2 weeks

A care team-based approach from inpatient screening to outpatient follow-up is used. This may involve Neonatology, Audiology, Pediatric Otorhinolaryngology, Otolaryngology, Infectious Disease, Primary Care, and many more to promote family-centered comprehensive care.

Future Considerations

- Hospital-based Audiological Interventions**
 - Development of protocols for additional inpatient audiologic intervention, such as use of personal amplification systems and/or assistive listening devices. This is done on a case-by case basis at this time.
 - Streamlining logistics for NICU staff and audiologists. Any interventions must be done in coordination with parent preferences.
- Referral Criteria and Clinical Practice Approaches**
 - Ongoing evaluation and consider additional criteria beyond ROAD to help determine candidacy for timely screening.
 - Utilize the electronic medical record report feature to generate a list of babies meeting specific criteria. This could help facilitate care team discussions of any new patients meeting the criteria and improve Audiology coordination with nursing.
- Risk Factor Monitoring**
 - Earlier return recommendations for proactive monitoring per JCIH (2019)
 - This means that some of these babies will still be inpatients when it is time for 3 and 6 month follow-up evaluations. Refinement of protocols for proactive, inpatient monitoring ongoing.
- Programmatic Data Tracking Tools**
 - Improvements in data tracking systems may help evaluate meeting goals as well as assist with quality metrics.
 - Development of new tools to evaluate clinical significance of EHDI for the inpatient NICU population needed.
- Care Team Management**
 - Efforts to provide in-service and specialized training for care team members working with patients with hearing loss are ongoing.
 - Improved approach to the promotion of intentional speech/language exposure for long term inpatients. Improved communication strategies, care team awareness, and hearing loss prevention strategies also under consideration.