**NJ Guidance for Implementation and Reporting of Critical Congenital Heart Defects Screening in the NICU/SCN**

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**Background**

- In the U.S., about 7,200 (or 2 per 1,000) infants annually have a critical congenital heart defect (CCHD).
- Delayed detection of CCHD may result in significant morbidity or mortality.
- Screening for early detection of CCHD using pulse oximetry is near universal in the U.S.
- Most states requiring screening of all infants irrespective of clinical status or setting.
- Unique challenges in the NICU setting, yet limited evidence to guide implementation.

**Evolution of NICU Evaluation: New Jersey CCHD Screening NICU Working Group**

New Jersey CCHD Screening Legislation:

"The Commissioner of Health and Senior Services shall require each birthing facility licensed by the Department of Health and Senior Services to perform a pulse oximetry screening, a minimum of 24 hours after birth, on every newborn in its care." P.L.2011, Chapter 74, approved June 1, 2011

Recommendation from NJ Recommended Screening Protocol:

"In the NICU, screening should be performed at 24-48 hours of age or as soon as medically appropriate after 24 hours of age. Screening must be performed prior to transfer out of the hospital at 24 hours of age. In all cases, screening should be performed prior to discharge to home."

**New Jersey CCHD Screening Findings August 31, 2011–March 31, 2017**

- 338 Fails reported to the NJ Birth Defects Registry (BDR)
  - 39.1% (n=132) in Well-Baby Nursery
  - 60.9% (n=206) in NICU

<table>
<thead>
<tr>
<th>Gestational Age</th>
<th>Overall</th>
<th>NICU</th>
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</thead>
<tbody>
<tr>
<td>N=338 (%)</td>
<td>N=206 (%)</td>
<td></td>
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<tr>
<td>Extreme preterm</td>
<td>32 (9.5)</td>
<td>32 (15.5)</td>
</tr>
<tr>
<td>Preterm</td>
<td>50 (14.8)</td>
<td>47 (22.8)</td>
</tr>
<tr>
<td>Term</td>
<td>256 (75.7)</td>
<td>127 (61.7)</td>
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**Failed Screens in the NICU Registered to NJ BDR August 31, 2011–March 31, 2017**

- Pre-identified N=165 (88.1%)
  - Prenatal diagnosis of CHD
  - Signs or symptoms at or before the time of the screen
  - Cardiac consult or echocardiogram prior to the screen
- Total Fails in NJ N=206
  - Evaluation due to Screen N=41 (15.9%)

- CHD
  - N=5
  - CCHD
  - N=9

- 5 of 41 infants with an evaluation performed in response to the failed screen had an echo with normal findings

**Conditions of NICU Infants Identified Due to Screening**

- CCHD (1):
  - Coarctation of aorta
- CHDs (9):
  - VSD (3)
  - ASD (2)
  - Peripheral pulmonary artery stenosis (3)
  - Atrial septal aneurysm (1)
- PFO/PDA (15)
- Incomplete screens (16)
New Jersey CCHD Screening NICU Working Group Recommendations

- Continue current protocol
- Limited research on NICU screening
- Empiric evidence needed to guide recommendations
- Further study warranted

Objectives

To evaluate the feasibility and burden associated with

1) early timing options for screening and

2) exclusion of infants from universal CCHD screening in the NICU with
   a) prenatal CHD diagnosis,
   b) echocardiography conducted before screening, or
   c) those born extremely premature.

Methods

- Prospective evaluation of a multi-stage modified CCHD screening algorithm and implementation survey conducted in 21 NICUs: CA (1), IL (1), NJ (9), NY (5), and MN (5).
- Infants born February 1, 2015-September 30, 2015 with NICU stay of >23 hours (n=4,556).
- N=4120 infants with a complete set of appropriately timed screening results.

Methods: Evaluation Algorithm

Multi-stage algorithm modified for infants receiving oxygen

- Stage 1 targeted for 24-48 hours after admission
- Modification for infants on oxygen at Stage 1:
  - Re-screening only required for >3% pre and post-ductal differential.
  - Saturations <95% consistent with clinical profile considered conditional passes.
  - Saturations <95% inconsistent with clinical profile regarded as fails.
- Stage 2 conducted optimally within 24-48 hours of weaning from oxygen
- Pre-discharge screen done only if Stages 1 or 2 were not completed

Results: Characteristics and Outcomes

- The majority of NICU infants were
  - >2500 grams (56%)
  - not on oxygen at 24-48 hours (72%)
  - did not have a pre-identifying factor (92%)
- 68% had neither pre-identifying factor and were not on oxygen comprising subgroup who may benefit.
- Overall fail rates for Stage 1 (0.9%) and Stage 2 (0.6%) were low.
**Results: Supplemental Oxygen & Gestational Age**

- Despite the modification, Stage 1 fail rates were significantly higher for infants on oxygen (2.1%) than on room air (0.7%).
- Increased to 25.9% for infants on oxygen when conditional passes are considered fails.
- Stage 1 fail rates were highest among infants:
  - Born <1000 grams and/or < 28 weeks not on oxygen (7.4% & 9.5%)
  - Notably higher for these groups when conditional passes are considered fails (35.4% & 43.6%)

**Results: Characteristics of Failed Screens**

- Of the 32 infants that failed Stage 1
  - 63% were not on oxygen
  - 66% did not have a pre-identifying factor
  - One infant with previously unrecognized CHD was detected by screening
- Of the 5 infants that failed Stage 2
  - 40% did not have a pre-identifying factor
  - No infants with CCHD identified by screening

**Results: Feasibility and Burden**

**False Positive Rates**

- Overall for both Stages = 0.8%
  - 0.6% for non-identified infants overall
  - Compared with 0.2% for well-infants screened using upper and lower extremities at > 24 hours without a prenatal diagnosis (de Wahl Granelli et al, 2009).
- Highest among infants screened on oxygen (2.1%) and born extremely preterm (3.8%).
- Significantly lower for infants screened at Stage 1 not on oxygen (0.5%) and Stage 2 (0.6%).

**Results: Feasibility and Burden**

**Unnecessary Echocardiography**

- Approximately 13% of infants had an echocardiogram during hospitalization.
  - 0.2% (n=7) were performed in response to failed screens at any Stage; one identified a VSD.

**Results: Feasibility and Burden**

**Implementation Survey (n=258)**

- Nursing staff reported low burden during the evaluation (mean = 3.5)
  - Likert scale 0 = no burden to 10 = extremely burdensome.
- 80% reported a NICU specific CCHD screening protocol facilitated differentiation between screening and routine monitoring with pulse oximetry.
- 81% responded that utilization of the evaluation protocol increased awareness of unsuspected CHD in the NICU.
- Tracking screening & results from multi-stage algorithm quite challenging.

**Conclusions**

- Given the NICU population consists largely of normal birthweight infants not receiving oxygen, screening at 24-48 hours may provide benefit for early detection of CCHD.
- Exclusion of sub-populations introduces practice variation potentially leading to missed screens.
- Challenges when early screening infants born extremely premature and/or those receiving supplemental oxygen.
- Systematic, early screening does not incur significant burden.
Recommendations for Implementation and Reporting in New Jersey

Who to Screen

Infants admitted to the NICU are not exempt from CCHD screening including those:
- with a prenatal diagnosis of CHD
- with an echocardiogram performed before the screening
- being transferred at ≥ 24 hours after birth

When to Screen

Screen as early as possible at ≥ 24 hours
- Optimally screen at 24-48 hours, if medically appropriate
- If not screened at 24-48 hours, screen as soon as possible when medically appropriate
  - Screen as soon as possible after weaning from respiratory support including
    - Supplemental oxygen
    - Room air CPAP

What to Report

- Screening results (up to 3 attempts) are entered into VIP
- For failed screens, report all fail results to NJBDR
  - Complete Pulse Ox module in NJBDR
- CCHD confirmed with echocardiogram
  - At least 1 set of measurements entered into VIP and failing results reported to NJBDR
  - No repeat screen needed

What to Report: Transfers

Transfers ≥ 24 hours
- At least 1 set of measurements entered into VIP and failing results reported to NJBDR
  - No repeat screen needed if not feasible
  - VIP record should be transferred to receiving hospital so that additional screening results can be added to the record
What to Report: Transfers

Transfers < 24 hours

- While not mandated, screening is recommended shortly before discharge or transfer

If done, results entered into VIP and failing results reported to NJBDR
- VIP record should be transferred to receiving hospital so that additional screening results can be added to the record

Education & Resources

- NJ DOH
  www.nj.gov/health/fhs/tdu/critical-congenital-heart-defects

- NJ AAP
  www.njaap.org/programs/critical-congenital-heart-defects/

- Free online course for nurses
  - New revised edition with CNE through April 30, 2019
  - https://trainingcourses.rutgers.edu/online/cchd/story.html

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  - Santa Clara Valley Medical Center
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  - Saint Peter’s University Hospital
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Questions & Thank You

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