Implementation of a Care Bundle to Prevent Severe Intraventricular Hemorrhage in Extremely Premature Infants

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BACKGROUND

Severe intraventricular hemorrhage (IVH) :

- Bleeding involving more than 50% of lateral ventricles or extension into dilated ventricle (grade 3), or intraparenchymal extension (grade 4)
- Common in extremely preterm infants and may be associated with lifelong neurodevelopmental impairments
- Prevention of severe IVH is of high priority

OBJECTIVE

To develop and implement a standardized bundle of practices to prevent severe IVH in infants born < 28 weeks gestational age (GA), with the specific aim of reducing our pre-bundle baseline incidence from 20% in 2020 to 15% within one-year post-bundle implementation (May 2021- May 2022).

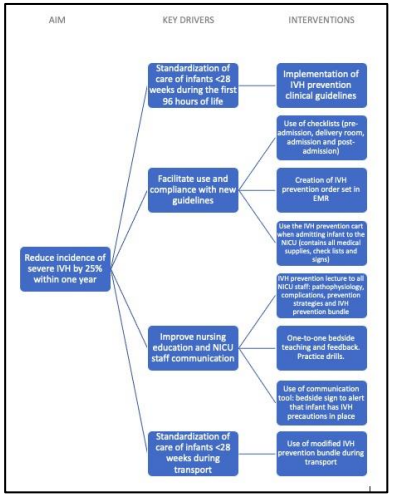
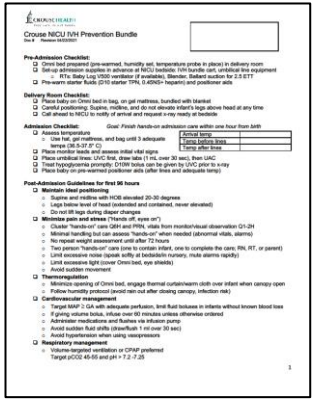


Figure 1. Key Drivers Diagram.

METHODS

- Key drivers and interventions were identified (Figure 1).
- New clinical guidelines were created (Figure 2) to address pre-delivery preparation, delivery room interventions, and post-admission practices within the first 4 days of life.
- Focus points:
  - position supine and midline
  - strict thermoregulation monitoring
  - minimize pain and stress
  - avoid rapid intravascular fluid shifts
  - volume ventilation with targeted ranges of pCO2 and pH levels.
- Bedside nursing checklists and electronic order sets were developed.
- Education: lectures, one-on-one bedside teaching and feedback, and practice drills.
- Plan-Do-Study-Act (PDSA) cycles were performed with process modifications introduced in subsequent cycles.
- Assessment of IVH: head sonograms on day of life 4 and 14
- Outcomes:
  - Primary outcome : incidence of SIVH.
  - Secondary outcomes: all grades of IVH, periventricular leukomalacia (PVL) assessed at 35 weeks corrected age, and mortality.


Crouse NICU IVH Prevention Bundle

Pre-Admission Checklist:
- Omni bed prepared (pre-warmed, humidity set, temperature probe in place) in delivery room
- Set-up admission supplies in advance at NICU bedside. IVH bundle cart, umbilical line equipment
  - RTs: Baby Log V500 ventilator (if available), Blender, Ballard suction for 2.5 ETT
- Pre-warm starter fluids (D10 starter TPN, 0.45NS+ heparin) and positioner aids

Delivery Room Checklist:
- Place baby on Omni bed in bag, on gel mattress, bundled with blanket
- Careful positioning: Supine, midline, and do not elevate infant's legs above head at any time
- Call ahead to NICU to notify of arrival and request x-ray ready at bedside

Admission Checklist: *Goal: Finish hands-on admission care within one hour from birth*
- Assess temperature
  - Use hat, gel mattress, and bag until 3 adequate temps (36.5-37.5° C)

Arrival temp	
Temp before lines	
Temp after lines	

- Place monitor leads and assess initial vital signs
- Place umbilicals: UVC first, draw labs (1 mL over 30 sec), then UAC
- Treat hypoglycemia promptly: D10W bolus can be given by UVC prior to x-ray
- Place baby on pre-warmed positioner aids (after lines and adequate temp)

Post-Admission Guidelines for first 96 hours

Maintain ideal positioning
- Supine and midline with HOB elevated 20-30 degrees
- Legs below level of head (extended and contained, never elevated)
- Do not lift legs during diaper changes

Minimize pain and stress ("Hands off, eyes on")
- Cluster "hands-on" care QAM and PRN, vitals from monitor/visual observation Q1-2H
- Minimal handling but can assess "hands-on" when needed (abnormal vitals, alarms)
- No repeat weight assessment until after 72 hours
- Two person "hands-on" care (one to contain infant, one to complete the care: RN, RT, or parent)
- Limit excessive noise (speak softly at bedside/in nursery, mute alarms rapidly)
- Limit excessive light (cover Omni bed, eye shields)
- Avoid sudden movement

Thermoregulation
- Minimize opening of Omni bed, engage thermal curtain/warm cloth over infant when canopy open
- Follow humidity protocol (avoid rain out after closing canopy, infection risk)

Cardiovascular management
- Target MAP ≥ GA with adequate perfusion, limit fluid boluses in infants without known blood loss
- If giving volume bolus, infuse over 60 minutes unless otherwise ordered
- Administer medications and flushes via infusion pump
- Avoid sudden fluid shifts (dose/flush 1 ml over 30 sec)
- Avoid hypertension when using vasopressors

Respiratory management
- Volume-targeted ventilation or CPAP preferred
  Target pCO2 45-55 and pH > 7.2 -7.35

Figure 2. IVH Prevention Bundle Guidelines.

RESULTS

- A total of 75 infants < 28 weeks GA born in 2020 comprised the pre-bundle group and 74 infants born from May 2021 to May 2022 the post-bundle group.
- The groups were similar for GA (25.3 ± 1 and 25.2 ± 1 weeks, respectively), birth weight (816 ± 211 and 760 ± 195 g) and Apgar <5 at 5 minutes.
- The incidence of severe IVH decreased from 20% to 11.4% (p=0.19) (Figure 3).
- There were no differences in incidence of other grades of IVH or PVL.
- Mortality decreased from 20% to 5.4% (p=0.012).

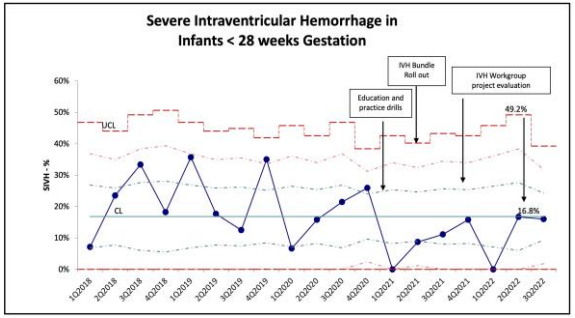


Figure 3. P-chart.

CONCLUSION

Standardization of care for the first 4 days of life with a bundle of potentially better practices focused on pre-delivery, delivery and post-delivery interventions was associated with a greater than 25% reduction of severe IVH in infants < 28 weeks' gestation, surpassing our goal.