Impact of Small Baby Program on the Incidence of Severe IVH- A Tertiary Level NICU Quality Improvement Project

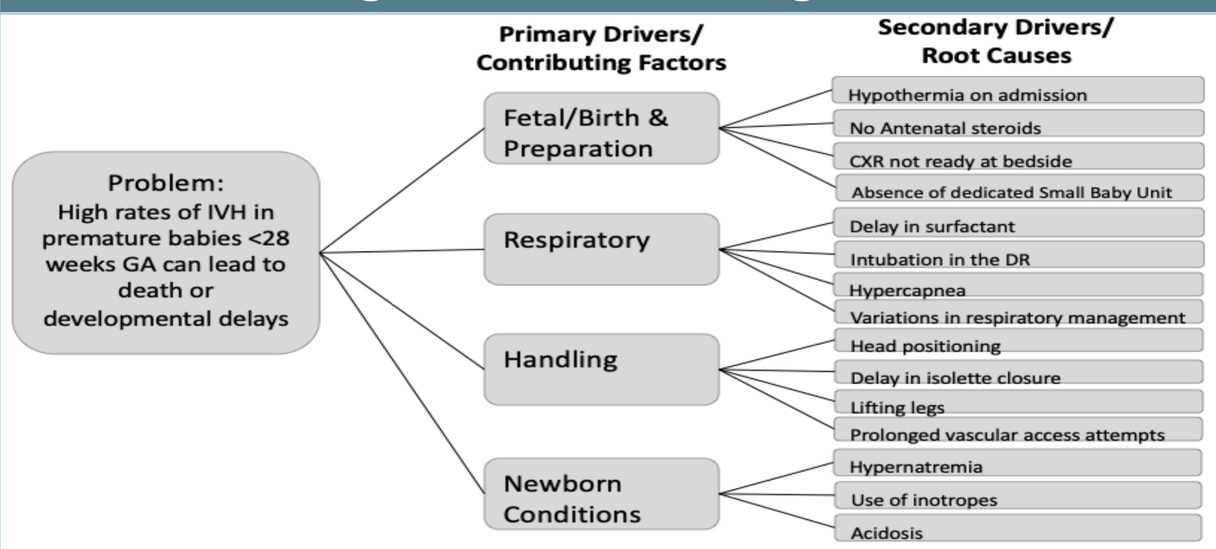
Alence Zion[1,2]; Margaret Everett [1,3]; Channing Pooley [1, 4]; Ceilidh Smith [1]; Hoda Elshibiny[1]; Danielle Ben-David [1]; Laura Bernardini[1,3]; Elizabeth Brennick[1]; Elisabeth Kaza[1,3]; Stephanie Neville[1], Kendra Woo[1]; Jullie Cadogan[1]; Elisa Abdulhayoglu[1,3]; Elizabeth Flanigan[1,3]; Mohamed El-Dib [1,3]

[1] Division of Newborn Medicine, Department of Pediatrics, Mass General Brigham for Children, Boston, MA, USA; [2] College of Science, Northeastern University, Boston, MA, USA; [3] Harvard Medical School, Boston, MA, USA; [4] Tufts University School of Medicine, Boston, MA, USA

Background

- Germinal matrix-intraventricular hemorrhage (GM/IVH) is a common acute brain injury in extremely preterm infants.
- IVH typically occurs within the first 24 to 72 hours of life and can lead to neurodevelopmental delays and increase mortality.
- IVH Grade classification: Grades I-II (mild), Grades III-IV (severe IVH/ SIVH).
- Risk of developing IVH increases with lower gestational age, especially in infants born <28 weeks gestation
- **Problem Statement: At BWH from 2019 to September of 2021, of 109 babies born at gestation less than 28 weeks, 50 (46%) babies developed IVH; 22 (20%) grades I-II and 28 (26%) grades III-IV.**
- **SMART AIM: To reduce the rate of SIVH in infants born less than 28 weeks' gestation at Brigham and Women's Hospital (BWH) by 30% over 3 years starting October 2021, using targeted neuroprotective strategies.**

Figure 1: Driver Diagram



Results

Study Population

- 132 infants <28 weeks GA born during intervention period (October 2021-December 2024).
- Demographic and clinical characteristics compared between baseline and intervention groups Table 1.

Primary Outcome: SIVH rate reduction

Baseline SIVH rate: 26% **2024 SIVH rate: 11%**

- 50% reduction in SIVH achieved, exceeding our 30% reduction SMART aim goal.
- Control Chart (Figure 2) demonstrates decrease trend of IVH over study period, no QI special cause variation or phase shift detected.

Secondary Outcomes

- Any IVH rate in 2024: 57%.
- Survival without SIVH increased from baseline 60% to 71%.
- Mortality decreased from baseline 23.1% to 14.4%.

Methods:

- Population: 241 preterm infants <28 weeks GA.
- Baseline Period: January 2019–September 2021 from BWH NICU Vermont Oxford Network (VON) and Electronic Medical Record (EMR).
- Intervention Period: Multiple Plan-Do-Study-Act (PDSA) cycles implemented October 2021-December 2024.
  - Primary Outcome Measure: SIVH rate reduction in infants <28 weeks GA.
  - Secondary Outcome Measure: Survival without SIVH rate; any IVH rate.

IVH Reduction Task Force: Multidisciplinary team launched five sequential neuroprotective care bundles targeting known IVH risk factors.

- 1) Low Sodium Intake Initiative (November 2021)
- 2) IVH Prevention Clinical Practice Guideline (May 2022)

Small Baby Program:

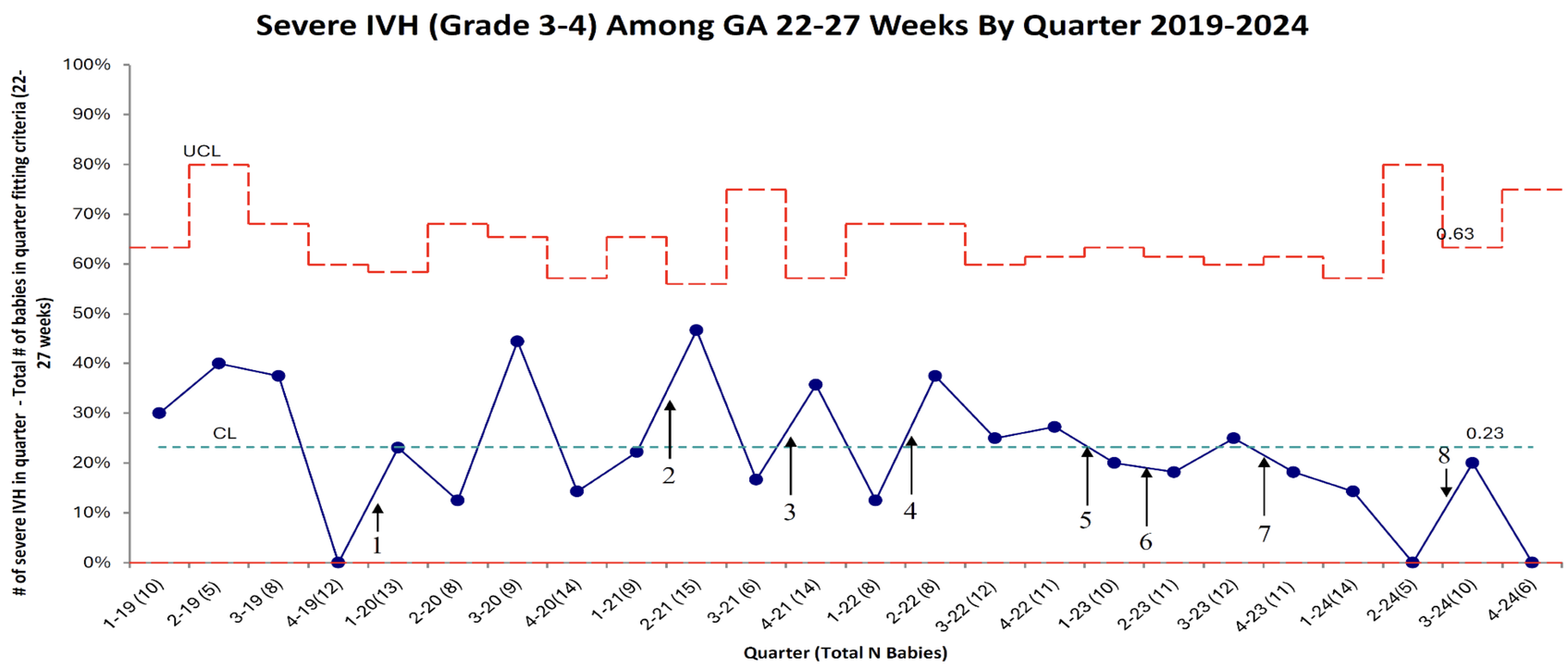
- 1) First Intention Jet Ventilation Guidelines (May 2023)
- 2) Fluid Management Guidelines (November 2023)
- 3) Vascular Access Guidelines (July 2024)

Table 1: Demographic and Clinical Data

Table 1: Demographic and Clinical Data of the Study Cohort			
	Baseline Cohort (n=109) (Mean ± SD)	**Intervention Cohort (n=132)(Mean ± SD)**	**p-value**
GA(weeks)	25.75 ± 1.68	25.45 ± 1.65	0.135
Birth weight (g)	798.4 ± 226.8	747.1 ± 207.8	0.084
Apgar 1 Minute: Median (IQR)	3 (3)	3 (3)	0.615
Apgar 5 Minute: Median (IQR)	6 (4)	6 (4)	0.687
	Baseline Cohort (n=109) (n,%)	**Intervention Cohort (n=132) (n,%)**	**p-value**
Infants 22 weeks GA	7 (6.5%)	15 (11.4%)	0.073
Multiple Births	29 (26.9%)	38 (28.8%)	0.739
Sex (male=1)	58.1 (53.7%)	80 (60.6%)	0.282
Chorioamnionitis	18 (16.7%)	25 (18.9%)	0.648
Cesarean Section	74 (68.5%)	94 (71.2%)	0.651
Chest compressions in DR	9 (8.3%)	8 (6.1%)	0.495
Intubated in DR	93 (90.3%)	117 (88.6%)	0.683
PDA	57 (54.8%)	77 (60.2%)	0.412
Acetaminophen for PDA	41 (39.4%)	64 (50%)	0.107
Surgery or Interventional Catheterization for Closure of PDA	11 (10.6%)	15 (11.7%)	0.784
Sepsis	11 (10.6%)	22 (17.2%)	0.152
Necrotizing Enterocolitis	6 (5.8%)	19 (14.8%)	0.027
ROP	77 (74.0%)	97 (75.8%)	0.76
Treatment of ROP with Anti-VEGF Drug	6 (5.8%)	17 (13.3%)	0.057
ROP Surgery	5 (4.8%)	0(0)	0.012
Death	25 (23.1%)	19 (14.4%)	<0.001

Abbreviations: GA: gestational age, PDA: Patent Ductus Arteriosus, ROP: Retinopathy of Prematurity Categorical and binary data presented as n (%), continuous data as medians (Interquartile range (IQR)). Differences among categories were assessed using the chi-square test (or Fisher's exact test for small expected cell counts, n < 5) and the Wilcoxon rank-sum test for continuous variables. Statistical significance was defined as $p < 0.05$.

Figure 2: Control Chart



Interventions: **1**) Establishing the IVH Prevention Group and Working Groups (January 2020). **2**) End of Chart Review and Comparison of IVH and No IVH (April 2021). **3**) Low Sodium Intake Initiative First PDSA Cycle (November 2021). **4**) The IVH Prevention CPG and Education (May 2022). **5**) Launch of the Small Baby Program (January 2023). **6**) First Intention Jet Guidelines (May 2023). **7**) Fluid Management Guidelines (November 2023). **8**) Vascular Access Guidelines (July 2024).

Discussion and Conclusions

- Achievement of >50% SIVH reduction (26% to 11%) suggests targeted bundle interventions can effectively address SIVH risk factors.
- A Small Baby Program initiative with multidisciplinary collaboration demonstrates potential to assist neuroprotective efforts and has the potential to reduce the risk of SIVH.
- Early trends show promise for sustained reduction over time.
- No QI special cause variation detected in SIVH rates.
- Reduction of SIVH was associated with a reduction in mortality.
- Increased incidence of NEC needs further investigation.

References

1. Volpe, J. J., Kinney, H. C., Jensen, F. E., et al. (2011). The developing oligodendrocyte: Key cellular target in brain injury in the premature infant. International Journal of Developmental Neuroscience, 29(4), 423–440.
2. Inder, T. E., Perlman, J. M., & Volpe, J. J. (2018). Preterm intraventricular hemorrhage/posthemorrhagic hydrocephalus. In J. J. Volpe, T. E. Inder, B. S. Darras, L. S. de Vries, A. J. du Plessis, J. J. Neil, & J. M. Perlman (Eds.), Volpe's neurology of the newborn (6th ed., pp. 637–698).
3. Murthy, P., Zein, H., Thomas, S., Scott, J. N., Abou Mehrem, A., Esser, M. J., Lodha, A., Metcalfe, C., Kowal, D., Irvine, L., Scotland, J., Leijser, L., & Mohammad, K. (2020). Neuroprotection care bundle implementation to decrease acute brain injury in preterm infants. Pediatric Neurology, 110, 42–48.