Reduction in Severe Intraventricular Hemorrhage (SIVH) Following Implementation of a Small Baby Program: A Tertiary NICU Quality Improvement Study

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Background and SMART Aim

- Germinal matrix-intraventricular hemorrhage (GM/IVH) is a common acute brain injury in extremely preterm infants typically occurring within the first 24 to 72 hours of life which can lead to neurodevelopmental delays and 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.**

Methods

- Population: 266 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 2025.
  - Primary Outcome Measure: SIVH rate reduction in infants <28 weeks GA.
  - Secondary Outcome Measure: Survival without SIVH rate; any IVH rate.

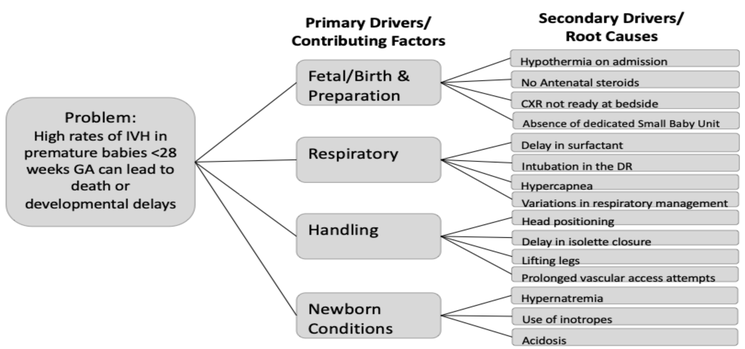
IVH Reduction Task Force: Multidisciplinary team launched five sequential neuroprotective care bundles targeting known IVH risk factors.

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

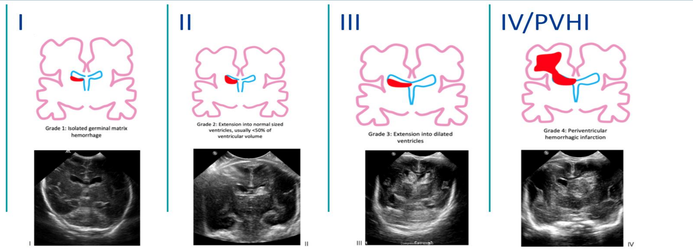
Small Baby Program:

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

Figure 1: Driver Diagram

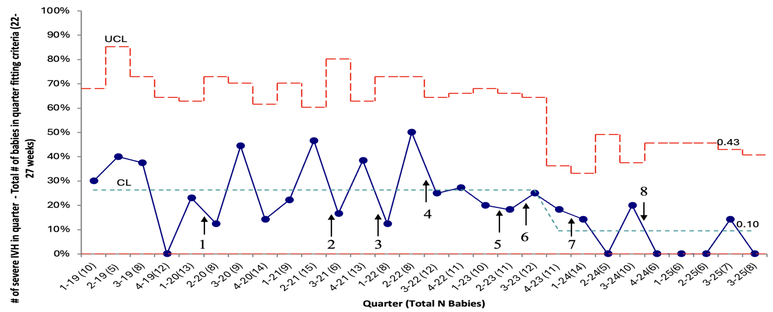


Grades of IVH



Inspired Pencil. (2023). *Intraventricular hemorrhage grades*. Inspired Pencil. https://ar.inspiredpencil.com/pictures-2023/intraventricular-hemorrhage-grades
El-Dib, et al., Am J Perinatol, 2010

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).

Results

Study Population

- 157 infants <28 weeks GA born during intervention period (October 2021-December 2025).
- Demographic and clinical characteristics compared between baseline and intervention groups Table 1. *Table 1 analysis includes 2019-2024 data.
- **Primary Outcome:**
- **SIVH mean decreased from baseline 26% to an overall mean of 10% from 2019-2025. SIVH rate in 2025: 4%**
- **>60% reduction in SIVH achieved, exceeding our 30% reduction SMART aim goal.**
- **Control Chart (Figure 2) demonstrates the QI special cause variation detected.**

Secondary Outcomes:

- Any grade IVH rate remained stable, with the overall mean consistent with the baseline at 46% from 2019-2025. Any IVH rate in 2025: 37%
- Survival without SIVH mean increased from baseline 60% to an overall mean of 67% from 2019-2025. Survival rate without SIVH in 2025: 81%
- Mortality mean decreased from baseline 26% to 21 from 2019-2025%. Mortality in 2025: 19%

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 $p < 0.05$.

Discussion and Conclusions

Achievement of >60% SIVH reduction (26% to 10%) suggests targeted bundle interventions can effectively address SIVH risk factors.

- A structured Small Baby Program initiative with multidisciplinary collaboration was integral to sustained neuroprotective efforts to reduce the risk of SIVH.
- Special cause variation detection confirms that observed improvements reflect true practice change, strengthening the case for continuous bundle adherence.
- SIVH reduction can be associated with a decrease in mortality.
- Increased incidence of NEC needs further investigation.

References

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