



BRIAN CARE BUNDLE IN PRETERM INFANTS

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Abstract

BACKGROUND: Intraventricular hemorrhage (IVH) is a frequent cause of death and morbidity among preterm infants. Few studies have addressed the use of bundles for preventing IVH.

OBJECTIVE: To evaluate the efficacy of a bundle of interventions designed to decrease the incidence of intraventricular hemorrhage at hospital discharge among preterm infants.

DESIGN AND SETTING: Pre-post interventional with retrospective and prospective data collection performed before and after bundle implementation in the Neonatal Intensive Care unit of KFAFH JEDDAH.

METHODS: Infants with gestational age < 30 weeks without malformations, who survived > 6 days were included. The bundle consisted of the following actions during the first 72 hours of life: maintenance of head in neutral position with the body in supine position, minimal handling, including delay of lumbar puncture until after 72 hours and absence of respiratory therapy maneuvers. Cranial ultrasound was performed on days 3, 7 and 28, or later if needed. The effect of the bundle was analyzed through logistic regression and results were adjusted for confounding variables.

RESULTS: In this project, 168 infants met the inclusion criteria, with 157 (94%) analyzed. The implementation of a care bundle was associated with a reduction of over 50% in the incidence of Grade 3-4 intraventricular hemorrhage (IVH) during the first week of life across all gestational age groups. Additionally, the need for ventricular-peritoneal (V-P) shunt placement was eliminated. The brain care bundle also contributed to a decrease in the incidence of Grade 1-2 IVH, maintaining rates below 20% compared to international benchmarks, particularly in infants born at extremely low gestational ages (23 weeks and above). A significant limitation encountered in this project was the lack of antenatal steroid administration.

Introduction

• IVH stems from intrinsic weakness in germinal matrix vasculature and fluctuations in cerebral blood flow, posing a major risk for premature infants who often develop neurological sequelae.

• Out-born infants are at higher risk for severe IVH.

• Early interventions (first minutes, hours, days) impact survival and long-term morbidity, especially crucial in the first 3-4 days when most IVH cases occur.

• IVH is a key prematurity complication; quality improvement methods can reduce IVH incidence at KFAFH NICU.

• We developed a care bundle that promotes a multidisciplinary, collaborative approach, aiming for neuroprotection and reducing IVH, ischemic brain injury, and poor neurodevelopmental outcomes in <30-week infants admitted within 48 hours.

• Immature neo-vasculature stabilizes within days after premature delivery, aiding germinal matrix microvasculature.

SMART AIM:

• A care bundle promoting a multidisciplinary, collaborative approach will be consistently applied to infants <30 weeks' gestation admitted to KFAFH NICU within 48 hours, within the first 4 days of life.

• Aim: Reduce incidence of grade 3 IVH (intraventricular hemorrhage with ventricular enlargement) or grade 4 IVH (IVH with persistent parenchymal echogenicity after 21 days) by 10%.

• Population: Infants born <30 weeks' gestation, admitted to KFAFH NICU within 48 hours of birth.

Methods

- Literature review and consensus determined final bundle recommendations, focusing on measures to reduce IVH risk.
- Bundle components aim to:
 - Maintain hemodynamic stability and prevent cerebral blood flow disruptions
 - Strengthen fragile germinal matrix vasculature
 - Data collection and bundle adherence monitoring conducted monthly based was discussed by using PDSA cycle, in each cycle we are looking for the main challenges we face during bundle implementation

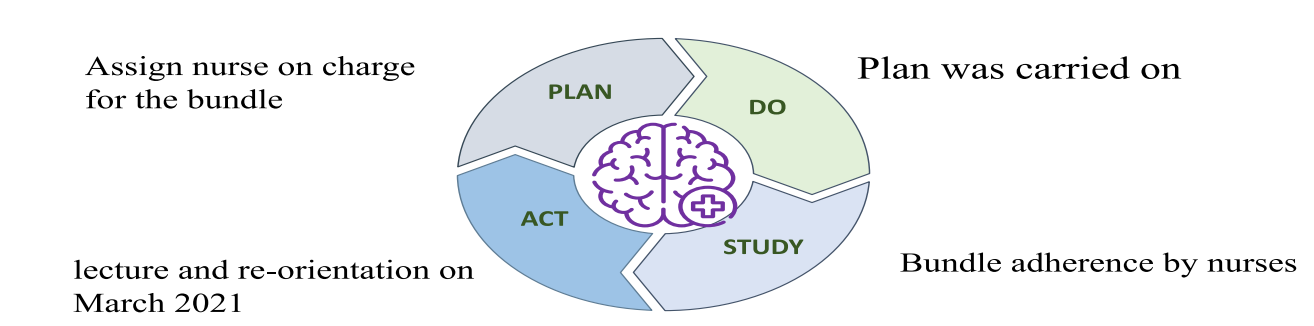
• Project plan and timeline as explained in Gantt Chart below:

Gantt Chart

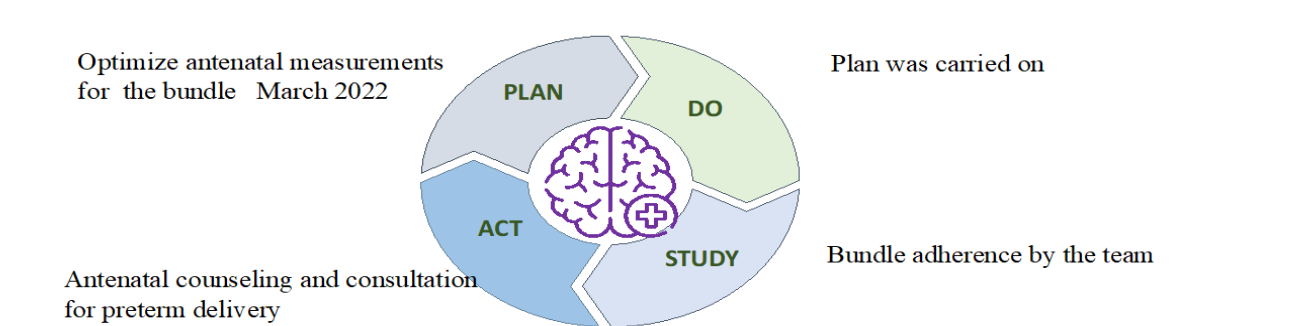
Intervention	Q1 2021	Q2 2021-2022	Q3 2023-2024
	JAN 2021	FAB 2021	March21-Dec 2022
Planning			Jan 2-23-s Dec 2023
Quality project proposal			
Design project team members/meeting			
Implementation of Bundle and project			
Team orientation about bundle			
Staff Education every 3 months			
Bedside checklist -card			
Follow-up			

PDSA CYCLES

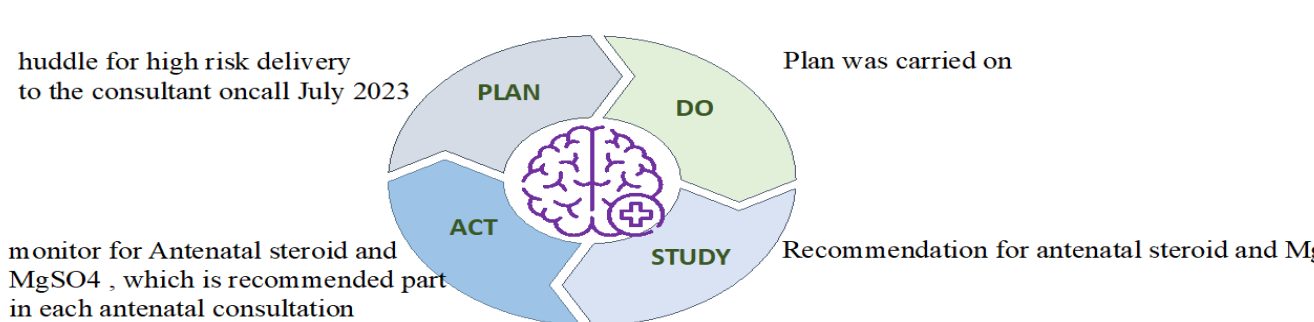
First PDSA cycle (Nurses compliance)



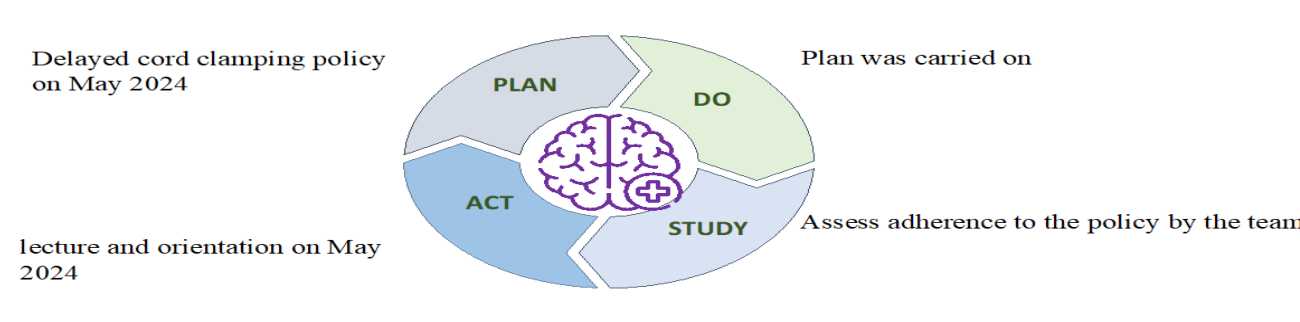
Second PDSA cycle (Antenatal measurements)



Third PDSA cycle



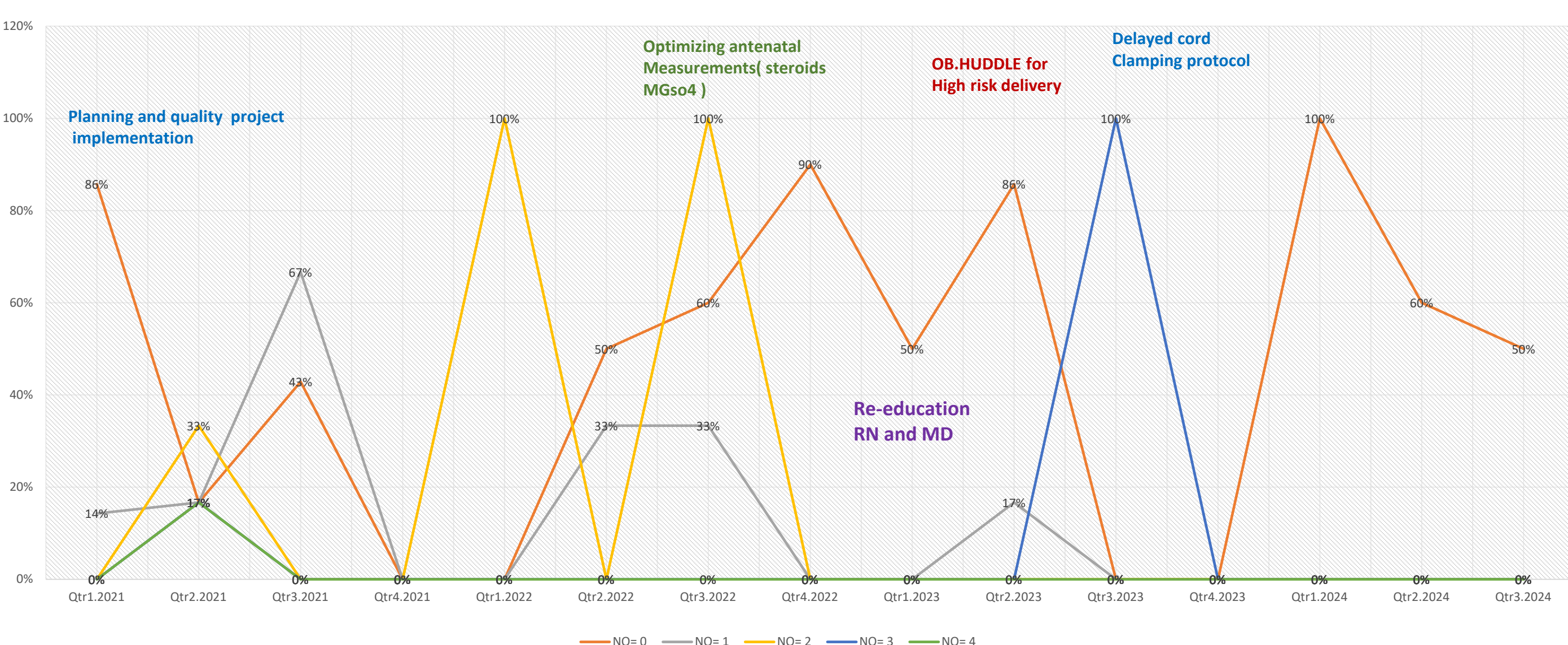
Fourth PDSA cycle



INTERVENTIONS

- Focus on the first days of life when IVH risk and PVL events are highest.
- Optimize antenatal management (antenatal steroids, MgSO₄) and ensure delivery at a tertiary center for optimal infant condition.
- Smooth, gentle transition at birth.
- Post-stabilization goal: "HANDS OFF AND EYES ON."
- Support adequate circulation, oxygenation, and ventilation.
- Practice minimal handling; minimize and defer disruptive or painful interventions.

Run Chart



Outcome measures

- Incidence of severe IVH defined as grade 3 or 4 IVH as definition (grade3 IVH (intraventricular hemorrhage with ventricular enlargement) or grade 4 IVH (IVH and persistent parenchymal echogenicity detected after 21 days of age).
- Incidence of post-hemorrhagic hydrocephalus requiring shunt placement

Process Measures

- IVH card at bedside for 72 hours
- Gel rolls used for 72 hours
- Temperature >36C
- Blood gas CO₂ measurements > 35 mmHg <55 mmHg
- Blood gas pH measurements >7.20 <7.40
- Highest mean arterial pressure (MAP) via manual or arterial catheter
- Blood sugar > 2.6 mmol/L
- No PICC or LP x 72 hours unless rationale provided

Balancing Measures

- These will measure system performance difference after implementation and any unexpected unwanted outcomes. rates for infants <30 weeks' gestation 2020 data compared to (2021-2024) data, BPD rates, NEC rates, ROP rates.

Results

168 infants met the inclusion criteria; 157 (94%) were analyzed. Bundle implementation was associated with decreased Incidence of Grade 3-4 IVH at the first week of life By >50% in all aspect of gestational age and the need for V-P shunt placement was also decreased by 100%. Figure (1,2,3)

By brain care bundle we were also be able to reduced our rate of grade 1-2 IVH within the international incidence rate less then 20% although when we are use it in extremely low gestational 23wks and above.

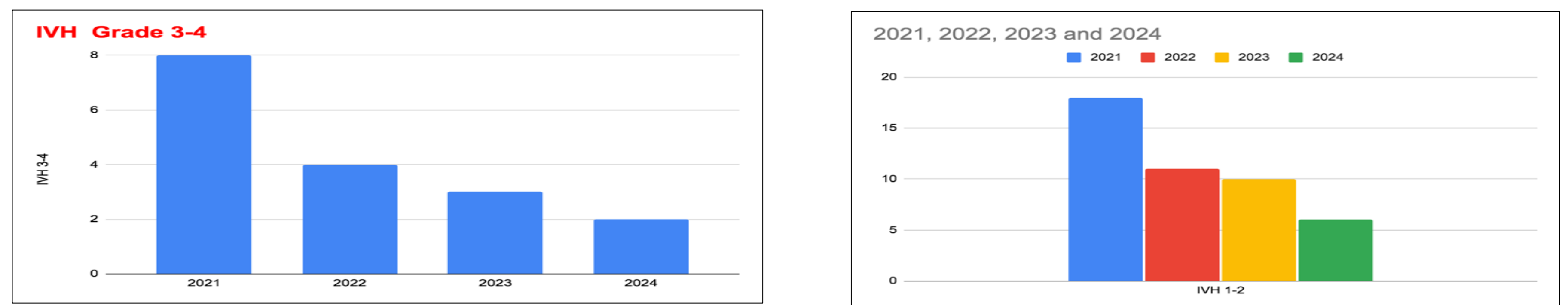


FIGURE 1: The right-side figure shows the number of severe intraventricular hemorrhage (IVH) cases, while the left side displays the Grade 1-2 diagnoses, categorized by birth year for patients under 30 weeks of gestational age who were admitted to the NICU from January 2021 to August 2024. The median number of severe IVH cases was 8 in 2021, prior to implementation, while the median for Grade 1-2 cases was 18. These numbers were reduced to 2 patients

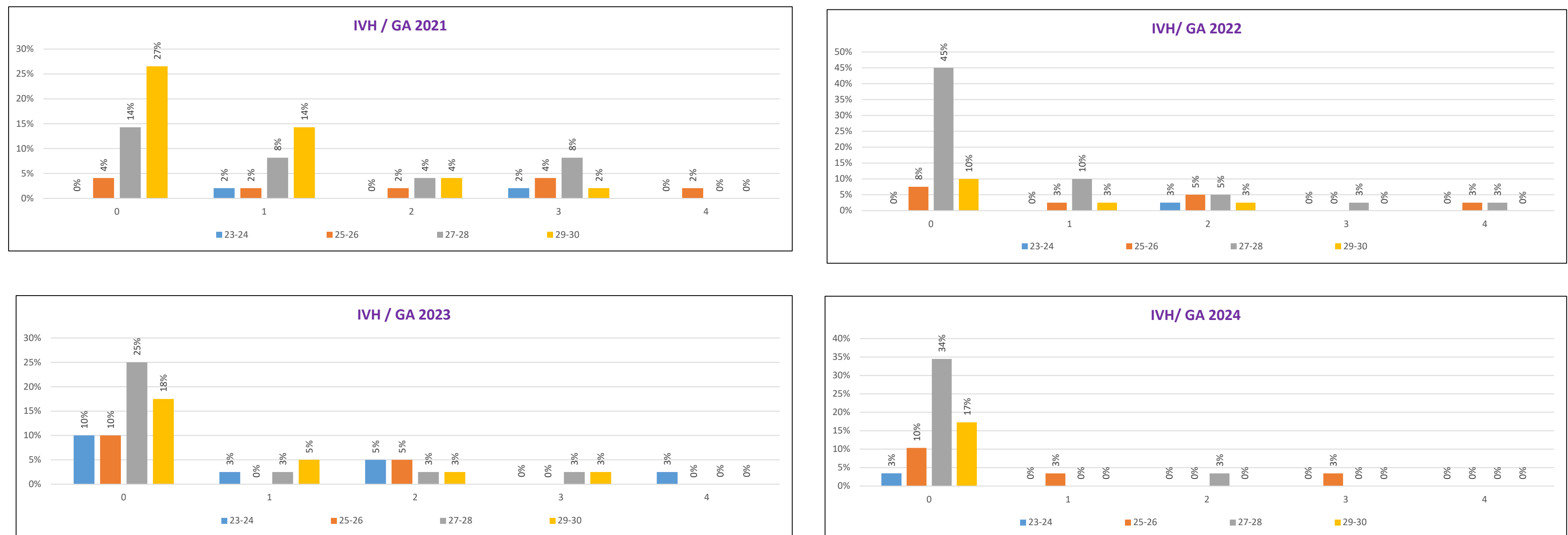


FIGURE 2: IVH incidence by Gestational Age. This figure illustrates the incidence of IVH by gestational age. There was a significant reduction in all IVH grades across all gestational ages; however, the number of infants born at 23 weeks of gestational age increased in 2023-2024 compared to 2021 and 2022."

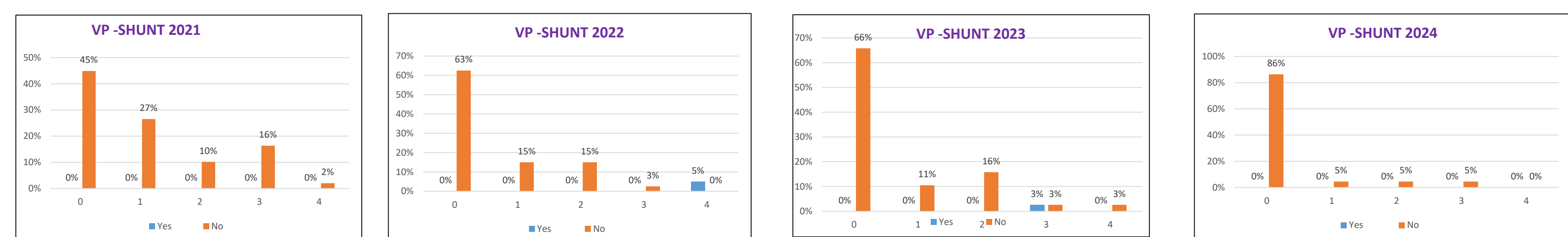


FIGURE 3: Need for Ventriculoperitoneal shunt. "This figure illustrates that the need for a ventriculoperitoneal shunt (V-P shunt) was significantly reduced following the implementation of a brain care bundle. This reduction was a result of decreased severity of intraventricular hemorrhage (IVH), as well as reduced post-hemorrhagic ventricular dilatation and hydrocephalus."

Discussion

•The Brain Care Bundle for preterm infants was implemented successfully by a multidisciplinary team, each member contributing specialized expertise:

- Obstetricians manage high-risk pregnancies and collaborate with neonatologists for maternal care and optimal delivery settings.
- Nurses provide hands-on care, monitor vital signs, minimize handling, and ensure environmental stability.
- Respiratory therapists optimize oxygenation through ventilator setup and non-invasive support.
- Social workers support family well-being, positively impacting infant recovery.
- Dietitians promote nutrition for healthy development and reduced growth complications.

- The bundle reduced all grades of IVH; Grade 3-4 IVH incidence dropped by >50%, with a 100% decrease in V-P shunt placement. Grade 1-2 IVH rates were reduced to below 20% internationally, even in extremely low gestational ages (e.g., 23 weeks).
- Standardized protocols in the Brain Care Bundle enable replication across healthcare facilities, supported by bedside IVH cards for provider education, enhancing scalability and evidence-based care.
- The Brain Care Bundle empowers providers with tools and training for a proactive, standardized approach, emphasizing patient safety by minimizing stress and invasive procedures, such as reducing unnecessary handling and controlling environmental factors.
- A significant limitation encountered in this project was the lack of antenatal steroid administration due to unbooked mothers presenting in preterm labor, as well as the absence of delayed cord clamping at the time of delivery. To address these challenges, guidelines and policies have been developed and initiated for future application.
- Further work is needed to evaluate the long-term neurodevelopmental outcomes following the implementation of this care bundle.

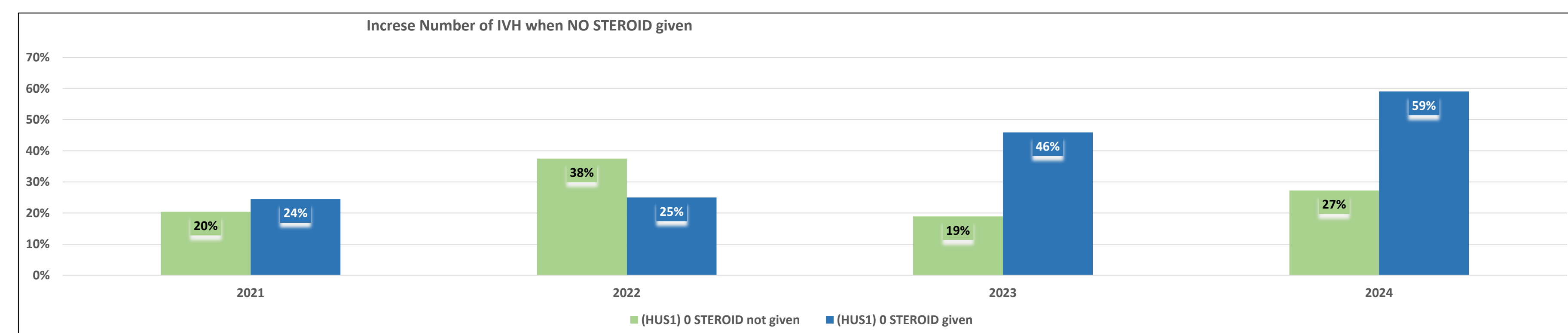


FIGURE 4: This figure denotes the role of antenatal steroids in reducing the incidence of intraventricular hemorrhage when the mother received antenatal steroids compared with infants born to mother didn't receive antenatal steroids

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Acknowledgments: To all NICU team at King Fahad Armed Forces Hospital , Jeddah , Saudi Arabia

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