“Golden Hour” Thermoregulation of Extremely Low Birth Weight Infants
Amaris Keiser MD, Angela Montgomery MD, Matthew Bizzarro MD, Yeisid Gozzo MD
and the Delivery Room Initiative Committee
Yale University School of Medicine, New Haven, CT, USA
Primary author: Amaris Keiser, MD amaris.keiser@yale.edu (203) 688-2320

KEYWORDS: Thermoregulation, hypothermia, ELBW

Background: Effective stabilization and management of the extremely low birth weight (ELBW) infant during the hour immediately following delivery room (DR) resuscitation – termed the “Golden Hour” – is known to have an impact on short and long-term outcomes. Compared to VON published data, we noted elevated rates of hypothermia (temperature <36.5°C) on admission to the neonatal intensive care unit (NICU) at our institution. We felt this to be secondary to a lack of standardized thermoregulatory measures and lack of emphasis on preventing heat loss during the DR resuscitation and transition to the NICU.

Aims: To decrease the incidence of ELBW hypothermia (skin temperature <36.5°C) on admission from 69% to no more than 47% to align with the 2013 VON annual incidence. We will achieve this within 1 year, and strive to maintain and improve upon this rate over time. Ultimately, our goal is for all ELBW infants to have an admission temperature between 36.5°C and 37.5°C, in the optimal physiologic range.

Setting: A Level IV, 54 bed NICU (Type C) at an urban academic medical center with approximately 800 admissions per year (88% inborn). ELBW infants account for approximately 9% of annual admissions.

Mechanistically, the initial management of ELBW infants at our institution was provider-dependent, without consensus or evidence-based guidelines to inform medical management or insure consistency. The multidisciplinary Delivery Room Initiative Committee identified the absence of clearly-defined and standardized thermoregulatory measures and lack of emphasis on maneuvers to establish normothermia and prevent hypothermia during the DR resuscitation and initial NICU stabilization as potential drivers of current undesirable outcomes (Figure 1).

Methods: We created formal thermoregulation management guidelines, including setting the DR ambient temperature to 78°F, setting the radiant warmer to 100% heat, consistent and appropriate use of a chemical warming mattress for all deliveries at <30 weeks, placement of a warmed hat immediately after drying, placing sides of the radiant warmer up and nesting the infant with warm blankets promptly after resuscitation, and keeping the infant on the warming mattress during the transition to the NICU and umbilical line placement.

Measures: Measures were collected via chart review, analyzed quarterly and presented at committee meetings biannually.
Outcome measures:
- Average ELBW admission temperature
- Percent of ELBW with admission body temperature <36.5°C
- Percent of ELBW with admission body temperature > 37.5°C
- Percent of ELBW with admission body temperature 36.5°C – 37.5°C

Data/Results: Our data demonstrate an overall decrease in the incidence of ELBW infants with admission temperatures <36.5°C (57% vs 69%), an increase in the percent of admission temperatures within the goal range (37% vs 31%), and a trend towards overall higher admission temperatures (Figures 2-3). However, we were unable to decrease rates of hypothermia to below the 2013 VON incidence of 47.7%, and our data are highly variable (Figures 4-6).

Discussion: Our data demonstrate initial success in decreasing the absolute rate of ELBW admission hypothermia by 12% following project implementation, though we did not reach our goal rate of 47.7%. We were unable to sustain this initial improvement in admission temperatures, which indicates the need to critically review our processes and chosen measures through additional PDSA cycles and determine how best to refine our intervention to yield lasting results.
Team Acknowledgement:

- Amaris Keiser, MD: prepared abstract, involved in identification of potential drivers, development of educational materials, development of implementation strategies, responsible for data collection, collation and analysis
- Angela Montgomery, MD: involved in identification of potential drivers, development of educational materials, development of implementation strategies, responsible for data collection and analysis
- Yeisid Gozzo, MD: senior leader, head of Delivery Room Initiative Committee (DRIC), provided structure and oversight for all aspects of this project, provided ongoing support for this project
- Matthew Bizzarro, MD: senior leader, identified need to address poorly performing outcome measures, created DRIC, provided ongoing support for this project
- Delivery Room Initiative Committee members: involved in the identification of potential drivers of change, creation of interventions, implementation of initiative, and ongoing education/training of staff members
  - Angela Craft, APRN, NNP-BC
  - Nancy Koval, APRN, NNP-BC
  - Tracy Gambardella, PA-C
  - Megan Luizzi, PA-C
  - Timothy Mack, RT
  - Steven Nivison, RT
  - Louise Dunphy, RN
  - Michele Faust, RN
  - Erica Leighton, RN
Figure 1: Key Driver Diagram demonstrating the mechanisms we believe account for the pre-intervention elevated rates of ELBW hypothermia.

Distribution of ELBW Admission Temperatures, Pre- and Post-Intervention

Figure 2: Bar graph demonstrating overall decrease in incidence of hypothermia before and after implementation (69% vs 57%).
Figure 3: Run chart demonstrating average ELBW admission temperatures over time. While not yet achieving the goal of all admission temperatures between 36.5°C and 37.5°C, the trend over time has been an overall increase in average admission temperatures.
Incidence of ELBW Hypothermia on Admission (<36.5°C)

Figure 4: Run chart demonstrating initial decrease in incidence of admission hypothermia, though the decreased rate was not sustained over time.
Incidence of ELBW Normothermia on Admission (36.5°C - 37.5°C)

Figure 5: Run chart demonstrating initial increase in incidence of admission temperatures to within goal range; however, this trend was not sustained.

Incidence of ELBW Hyperthermia on Admission (>37.5°C)

Figure 6: Run chart demonstrating the infrequent, but measurable, occurrence of infant hyperthermia following implementation of this QI project. Of note, none of the infants had admission temperatures >38°C (febrile).
“Golden Hour” Thermoregulation of ELBW Infants

AIMS

Primary Drivers

- Lack of standardized interventions to prevent heat loss and maintain normothermia in the DR
- Lack of standardized interventions to prevent heat loss and maintain normothermia upon admission to the NICU
- No standardized provider education addressing how to establish and maintain normothermia/prevent heat loss in ELBWs

Secondary Drivers

- Failure to perform routine maneuvers to conserve and preserve heat in the DR
- Failure to perform routine maneuvers to conserve and preserve heat in the NICU
- No specific focus on thermoregulatory measures during the DR resuscitation and transition to NICU

Potential Change Concepts

1) Modification of “Roles and Responsibilities” chart
2) Review of the NRP algorithm with all NICU providers with a specific focus on preventing infant heat loss
3) Targeted provider educational sessions addressing temperature management in the ELBW

Balancing Measures

- Incorrect use of the chemical warming mattress
- Inconsistent use of the chemical warming mattress
- Inconsistent/delayed placement of hat, removal of infant from wet blankets

Outcome Measures:

- Lack of awareness of prevalence and implications of hypothermia
- Inconsistent use of the chemical warming mattress
- Incorrect use of the chemical warming mattress
- Inconsistent/delayed placement of hat, removal of infant from wet blankets

Overall Project Goal

To improve the delivery room management of ELBW infants to optimize infant outcomes

Primary Aim:

- Decrease the incidence of hypothermia on admission (skin temperature <36.5°C) to at or below the VON 50th percentile within 1 year of implementation

Secondary Aim:

- Decrease the incidence of normothermia on admission (skin temperature 36.5°C – 37.5°C) to at or below the VON 50th percentile within 1 year of implementation

Outcome Measures:

- % of inborn ELBW infants with admission temperature <36.5°C, >37.5°C, and 36.5-37.5°C
- No specific focus on thermoregulatory measures during the DR resuscitation and transition to NICU

Balancing Measures

- Hyperthermia on admission (skin temperature >37.5°C)
- Incidence of IVH
- Incidence of DR chest compressions or epinephrine administration
- Incidence of Apgar score <4 at 5 minutes
- Incidence of Pneumothorax

1) Universal staff education regarding prevalence and potential consequences of hypothermia
2) Reinforcement of effective chemical warming mattress use during biannual skills validation sessions for ALL medical providers
3) Quarterly newsletter updates reporting progress/compliance