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Every Degree Counts-A Quality Improvement Initiative to Reduce Neonatal Hypothermia during Transport

[1]Dr. Akshita Kansal, Department of Paediatrics, DVVPF Medical College, Ahilyanagar, Maharashtra, India
[2]Dr. Abhijit Shinde, Department of Paediatrics, DVVPF Medical College, Ahilyanagar, Maharashtra, India
[3]Dr. Sunil Natha Mhaske, Department of Paediatrics, DVVPF Medical College, Ahilyanagar, Maharashtra, India
[4]Dr. Suresh Nana Waydande, Department of Paediatrics, DVVPF Medical College, Ahilyanagar, Maharashtra, India
Corresponding Author: Dr. Akshita Kansal, Department of Paediatrics, DVVPF Medical College, Ahilyanagar, Maharashtra, India.

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Abstract

Background: Neonatal hypothermia is a frequent and preventable complication during transport, especially in low- and middle-income countries. It is associated with increased mortality and morbidity, particularly in preterm and low birth weight infants. At DVVPF Hospital, Ahilyanagar, the baseline incidence of admission hypothermia in transported neonates was alarmingly high at 62%. This Quality Improvement (QI) initiative aimed to reduce hypothermia through protocol-driven interventions.

Objectives:

- To reduce the incidence of admission hypothermia (<36.5°C) in transported neonates from 62% to below 20% over a 13-month period.
- To improve adherence to a 5-point thermal care protocol from baseline 60% to ≥90%.

Methods: This was a single-center, time-series QI study conducted from December 2023 to December 2024 in the NICU of DVVPF Hospital. Using root cause analysis (Fishbone diagram), key factors contributing to hypothermia were identified. Five Plan-Do-Study-Act (PDSA) cycles were implemented, focusing on equipment readiness, standardized thermal care protocol, and nurse-led training. Axillary temperature was measured upon arrival, and protocol adherence was documented for each transport.

Results: A total of 104 neonates were transported during the study period. The incidence of hypothermia reduced from 62% in December 2023 to 15% by December 2024. Protocol adherence improved from 60% to over 90%. A strong positive correlation (r = 0.84) was noted between adherence and normothermia. No serious adverse events or over-warming episodes were reported.

Conclusion: Simple, low-cost, and nurse-led QI interventions can significantly reduce hypothermia during neonatal transport. Sustained improvement was achieved through structured protocols, staff engagement, and regular monitoring. This model is replicable in resource-limited settings, reinforcing that every degree truly counts in neonatal survival.

Keywords: Adherence, Embrace™, Hypothermia, Neonatal transport, Newborn, NICU, Protocol, Quality improvement, Thermal care, Warm chain

Introduction

Neonatal hypothermia—defined as an axillary temperature below 36.5°C—is a widespread issue in low- and middle-income countries (LMICs), with hospital-based studies reporting prevalence rates between 32% and 85% [2], and is a well-established contributor to neonatal morbidity and mortality [1,3]. To address this, the World Health Organization (WHO) introduced the "warm chain," a series of ten integrated steps aimed at maintaining newborn thermal stability immediately after birth [1], including recommendations for maintaining delivery room temperatures between 25°C and 28°C. However, transport of neonates often represents a critical break in this warm chain, increasing the risk of hypothermia [3,4]. In contrast to high-income countries with robust thermal care systems [4,5], LMICs continue to face major obstacles such as the high cost of warming equipment, inadequate infrastructure, and unsafe clinical practices [2,4,6]. Evidence supports skin-to-skin contact (SSC) and kangaroo mother care (KMC) as effective means of preventing hypothermia in such settings [1,3,7]. KMC, in particular, has been proven to offer thermal and physiological stability during neonatal transport [9–11] and is promoted as a safe, cost-effective alternative to conventional incubator transport [9,10]. WHO [1,3] and the Government of India [12] strongly advocate continuous SSC and KMC [1,3,13] for maintaining temperature during transfer. The 12th International KMC Conference also supports KMC-based transport in stable neonates [14]. Despite these endorsements, wide-scale implementation remains limited due to systemic and logistical barriers [14]. Introducing affordable, simplified warming devices may improve adherence to WHO thermal care guidelines in LMICs [5]. Additionally, the WHO's Point-of-Care Quality Improvement (POCQI) model encourages identifying and resolving care quality gaps using team-based root cause analysis and the Plan-Do-Study-Act (PDSA) framework[15]. These cycles support iterative learning and targeted improvement. QI interventions for hospitalized neonates in LMICs have demonstrated benefits such as reduced neonatal mortality and morbidity[16]. Motivated by consistent audit findings of admission hypothermia, this study was undertaken at a public hospital in southern India with the aim of reducing the hypothermia rate at admission to below 20% over a one-year period through a structured QI approach.

Materials and Methods

Study Design and Setting: This was a single-center, time-series Quality Improvement (QI) interventional study conducted in the Neonatal Intensive Care Unit (NICU) of DVVPF Hospital, Ahilyanagar, over a 13-month period from December 2023 to December 2024. The study focused on reducing the incidence of hypothermia (axillary temperature <36.5°C) in neonates transported from outside facilities.

Study Population: All outborn neonates transported to the NICU during the study period were included.

Inclusion Criteria

- All outborn neonates transported by the hospital's neonatal ambulance or accompanied by healthcare personnel
- Transported within the study period

Exclusion Criteria

- Inborn neonates
- Neonates without recorded admission temperature
- Babies with congenital anomalies incompatible with life.

Baseline Data Collection

From December 1–15, 2023, a baseline audit was performed. It revealed a 62% incidence of hypothermia on arrival. Common gaps included non-pre warmed transport incubators, lack of thermal wraps, expired Embrace™ warmers, and untrained staff.

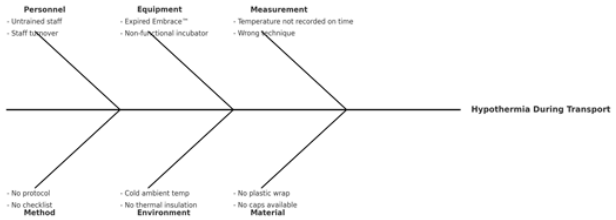
- Axillary temperature recorded within 15 minutes of arrival

Root Cause Analysis

A Fishbone analysis was conducted with a multidisciplinary team (residents, nurses, and consultants), identifying the following contributory factors:(Figure-1)

- **Personnel:** Lack of staff training, rotating teams
- **Methods:** Absence of standard thermal care protocol
- **Equipment:** Expired warmers, faulty transport incubator batteries
- **Environment:** Cold ambient temperature during winter months

Figure 1:



Intervention Strategy

The team implemented a structured 5-point thermal care protocol**,** focusing on:

1. Pre-warming of transport incubators for at least 15 minutes
2. Use of cap and plastic wrap for all babies <32 weeks or <1.5 kg
3. Avoiding opening ports or side doors of incubators during transport
4. Use of transport CPAP or Embrace™ warmers when appropriate
5. Temperature recording at departure and upon NICU arrival

Box 1 outlines the process improvement initiatives through PDSA cycles.

PDSA Cycle	Time Period	Plan	Do	Study (Observations)	Act (Next Steps)
Cycle 1	December 2023	Assess baseline incidence and increase staff awareness	- Conducted 15-day baseline audit- Found 62% hypothermia rate- Conducted staff sensitization sessions with posters and data	- Staff unaware of warm chain- No standard protocol or checklist- Pre-warming not routinely practiced	- Initiated regular training- Planned protocol creation and staff engagement for upcoming cycles
Cycle 2	Jan–Feb 2024	Review equipment and improve availability of thermal aids	- Replaced expired Embrace™ warmers- Repaired incubator battery backup- Stocked plastic wraps and caps in transport kits	- Increased use of warmers and wraps- Improved staff confidence in handling equipment	- Developed pre-transport checklist- Standardized equipment check protocol
Cycle 3	Mar–Apr 2024	Launch a formal thermal care protocol	- Introduced 5-point protocol- Printed laminated protocol	- Adherence rose to 78%- Hypothermia incidence	- Began correlating adherence with outcomes-

PDSA Cycle	Time Period	Plan	Do	Study (Observations)	Act (Next Steps)
		for transport	posters- Started adherence documentation using checklist	dropped to 34%	Reinforcement sessions planned weekly
Cycle 4	May–Jul 2024	Strengthen protocol implementation through reinforcement and monitoring	- Weekly bedside reinforcement by nurse-in-charge- Displayed data trends- Introduced colored checklists for easy tracking	- Adherence improved to 85%- Hypothermia reduced to 22%- Staff more consistent and confident	- Institutionalized protocol reminders in morning meetings and CMEs
Cycle 5	Aug–Dec 2024	Build sustainability and onboard new staff into thermal care practices	- Orientation module for new residents and nurses- Thermal care included in handover SOP- Monthly supply audits of thermal aids	- Maintained adherence >90%- Hypothermia incidence dropped to 15%- No major disruptions despite staff changes	- Protocol made part of unit SOP- Continued poster display and monthly bulletin updates

Conclusion

Results

Study Population

A total of 104 outborn neonates were transported to the NICU of DVVPF Hospital, Ahilyanagar, between December 2023 and December 2024 and were included in the analysis. The gestational age ranged from 28 to 41 weeks, and birth weight varied from 950g to 3.8 kg.

Male : Female ratio was approximately 1.2:1

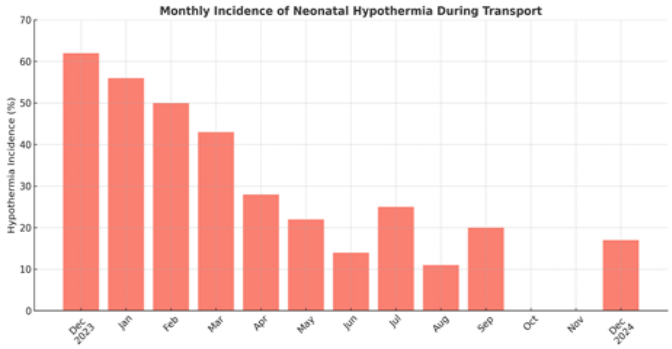
Preterm babies (<37 weeks): 41%

Low birth weight (<2.5 kg): 46%

Primary Outcome: Hypothermia Trend

The initial incidence of admission hypothermia in December 2023 was 62%, based on a baseline audit. With each subsequent PDSA cycle and implementation of the 5-point protocol, the proportion of hypothermic neonates steadily declined.

Graph 1:

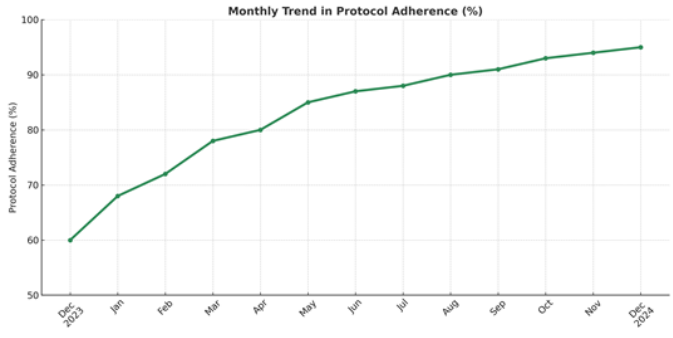


Overall hypothermia rate reduced from 62% to 15% by end of study.

Secondary Outcome: Protocol Adherence Trend

Adherence to the 5-point thermal care protocol was monitored using a checklist during every neonatal transport. Each criterion was awarded 1 point (max 5).

Graph 2:



Final protocol adherence reached 95%.

Correlation between Protocol Adherence and Normothermia

A strong positive Pearson correlation (r = 0.84) was observed between monthly protocol adherence rates and the proportion of neonates arriving with normal temperature. This indicates that better compliance with the thermal care protocol significantly contributed to the reduction in hypothermia.

Hyperthermia Incidence

Only one baby during the 13-month period had a recorded axillary temperature above 37.5°C, which was categorized as mild hyperthermia and resolved spontaneously. No cases of severe hyperthermia or thermal injury were reported.

Other Observations

- Time to temperature recording after arrival reduced from ~20 minutes (baseline) to <10 minutes' post-intervention.
- Staff satisfaction with transport process improved (informally assessed via feedback sessions).
- No adverse events linked to protocol use or Embrace™ warmers were reported.

Discussion

This quality improvement (QI) initiative at DVVPF Hospital, Ahilyanagar, aimed to reduce neonatal hypothermia during transport and successfully lowered the incidence from 62% to 15% over a 13-month period. This aligns with WHO's call for improving thermal protection as a critical component of neonatal care, particularly in low- and middle-income countries (LMICs) where transport systems and pre-referral care are often inadequate[17].

Neonatal hypothermia has been documented as a major contributor to morbidity and mortality in the early neonatal period, especially among preterm and low birth weight infants. According to Lunze and Hamer, hypothermia affects over 50% of newborns in LMICs and is strongly associated with poor outcomes including hypoglycemia, respiratory distress, metabolic acidosis, and death[18]. A study in Nepal found that every 1°C drop in admission temperature was associated with a 28% increase in mortality[19].

The marked improvement in this project was achieved through implementation of a 5-point thermal care protocol, PDSA cycles, and consistent staff education. These strategies are supported by similar QI initiatives globally. For example, a QI study by Kumar et al. in India achieved a reduction in NICU hypothermia from 74% to 21% using structured thermal care protocols and nursing-led interventions[20]. Our findings echo their success, showing that low-cost, process-based improvements can significantly affect clinical outcomes.

Importantly, the study also demonstrated a strong positive correlation (r = 0.84) between protocol adherence and normothermia. This supports previous findings that compliance with warm chain practices such as pre-warmed transport incubators, use of Embrace™ devices, and adequate documentation significantly improve thermal outcomes[21]. The use of real-time monitoring and bedside feedback helped reinforce behavior change and promote accountability.

One of the unique features of this project was sustainability planning—protocol reinforcement was incorporated into resident orientation and monthly nurse CMEs, ensuring continuity despite staff rotation. This approach aligns with recommendations from the Institute for Healthcare Improvement, which emphasizes embedding improvements into systems for long-term impact[22].

Limitations include the single-center nature of the study and absence of long-term clinical follow-up such as

neurodevelopmental outcomes. Moreover, self-reported adherence may introduce bias, although regular spot audits were conducted to minimize this.

Despite these limitations, this QI initiative contributes important evidence that even modest resource inputs, if strategically directed, can lead to substantial improvement in neonatal care. It reinforces that every degree matters—a warmer baby is a safer baby.

Conclusion

This quality improvement initiative titled “Every Degree Counts” successfully demonstrated that structured, protocol-based interventions can significantly reduce the incidence of neonatal hypothermia during transport. Through sequential PDSA cycles, training, equipment optimization, and robust staff engagement, the hypothermia rate declined from 62% to 15% while adherence to thermal care protocol rose to 95%. The project highlights the impact of low-cost, high-yield interventions and emphasizes that maintaining normothermia should be a non-negotiable component of neonatal care—especially during transport. These results are replicable and can serve as a model for similar low-resource settings.

Acknowledgment

We express our sincere gratitude to the NICU team at DVVPF Hospital, Ahilyanagar, including the residents, nursing staff, and transport personnel, for their continuous support and active participation in this quality improvement initiative. We also thank the hospital administration for facilitating training sessions and procurement of thermal care equipment.

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