

Original Research Article

Hypothermia reduction during neonatal transport in a tertiary care center in South India: a quality improvement initiative

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ABSTRACT

Background: Each degree drop in target temperature at admission increases mortality by 28% in neonates. Maintenance of target temperature during neonatal transport and at admission will pose an enormous challenge in developing countries due to various factors. The objective of the study was to decrease the incidence of hypothermia in transported babies at admission by 50% from a baseline of 64% over 12 months period. Prospective cohort study by QI methodology.

Methods: Neonates transported to NICU from March 2019 – February 2020 were included. A baseline data was collected retrospectively to determine the incidence of existing hypothermic babies at admission. Problems were identified using Fishbone analysis. Evidence-based changes were implemented as per local needs in the Plan-Do Study cycle (PDSA) cycles.

Results: A total of 96 babies were transported (62 babies during implementation, 34 during the sustenance Phase) during the study period. The mean (SD) gestation and birthweight was similar in the two groups. The distance travelled in kilometres in the hypothermic group was significantly more 7.3 (5.5) compared to the normothermic group 4.1(3.8) (p,0.01). We reduced the incidence of hypothermia from 64% to 16% over 12 months from the time of implementation. There was no correlation seen noted between hypothermia at admission and gestational age (r, - 0.18), birthweight (r, 0.04), or distance travelled in kilometres (r, 0.02). However, there was a positive correlation seen between adherence to the '5 Point -protocol' and admission temperature (r, 0.86).

Conclusions: Thermoregulation during neonatal transport is a huge challenge especially in the Indian scenario due to multiple incorrigible factors contributing to its high incidence even in the best of the centres. QI initiatives is a way forward to deal with some of these aspects. Involving the nursing team who forms the core team of neonatal transport is imperative.

Keywords: Hypothermia, Neonatal transport, Quality improvement

INTRODUCTION

Neonatal transport organization is the need of the hour which brings an intensive care environment during interhospital transfer. Many neonates inevitably need transport from one center to the other for better care, subspecialty services, and due to regionalization of neonatal care in the western world.¹ Indian account for

23.6% of global prematurity and most of these babies are born in facilities not equipped to handle these babies. Hypoglycemia, hypothermia, cardiac arrest, tube displacement, apneic episodes are common complications encountered during transport at admission.³ Hypothermia a major problem noticed during transport increase mortality by 28% in these babies by each degree drop in temperature.⁴ Due to the lack of regionalization of neonatal

care in India in-utero transfer of preterm or high-risk deliveries to a level 2 or 3 center is not performed in all cases. In unavoidable circumstances, babies are delivered at primary health care and then either transported in a high-risk environment or requested to transport these babies to a level 2 or 3 care. The transport team has no choice but to perform ‘scoop and run transport’ due to a lack of stabilization services at parent health care. Maintenance of target temperature during neonatal transport and at admission in these conditions will pose an enormous challenge in developing countries due to various factors.⁵

With an increased number of neonatal transports done at our unit in such scenarios, we needed to focus on quality transport and admission temperature is one of the determinants. We aimed to reduce the incidence of hypothermia in these settings through the Quality improvement (QI) project.

METHODS

Setting and context

Ovum Women and Children’s Hospital is a level 3 NICU located in Bengaluru, Karnataka, India. It runs a 16 bed NICU with about 200 admissions per annum and is predominantly an outborn unit. Most of the admissions are high-risk babies retrieved from peripheral centers (example- nursing homes are hospitals that have level 1 neonatal care, public sector hospitals, primary health care centers, etc) with no or bare minimal facilities to handle high-risk deliveries. Due to a lack of regionalization of care in the Indian context, high-risk pregnancies are still delivered in centers not equipped enough to handle the complications and post-delivery babies are referred to level 2 or 3 neonatal units after discussing with parents. We retrieve an average of 8-10 extramural babies each month. For every transport, a doctor who is trained in neonatal care, and one nurse will accompany the baby. A

transport incubator with a ventilator, emergency transport kit (airway, breathing, circulation equipment), thermal care equipment, Masimo monitor, multichannel monitor, back up oxygen cylinder will be carried.

When we analyzed the data of these babies retrospectively for 6 months period it was noted that 64% of the babies were hypothermic at admission despite all the necessary steps taken. We aimed to fix this issue through a one-year QI project.

Ethical considerations

The current QI study involved the collection of anonymized data of patients and routine care was done as per protocol no parental consent was obtained. Internal board ethical approval was obtained for the study.

Interventions

The study was conducted over a period of 12 months from March 2019 to February 2020. Our overall goal was to reduce the incidence of hypothermia at the admission of transported babies Over 12 months of implementation, we aimed to increase the percentage of eligible infants whose temperature at admission will be normal (36.5-37.5) from a baseline of 36% to more than 80%. SQUIRE2.0 guidelines 6 were used as applicable when designing our study and drafting the manuscript. Baseline data (September 2018-February 2019) data was collected retrospectively from the patient records of admission temperature of all babies and it was noted that 64% of babies were hypothermic (all grades). The core committee for the QI was then formed including consultant (SD), nurse in charge (NS), nursing supervisor (PS), and mentor (PV). We did the flow chart for neonatal transport and Fish Bone Analysis (Figure 1) for the possible problems leading to Hypothermia at admission. Based on the issues we formulated our PDSA cycles. (Table 1)

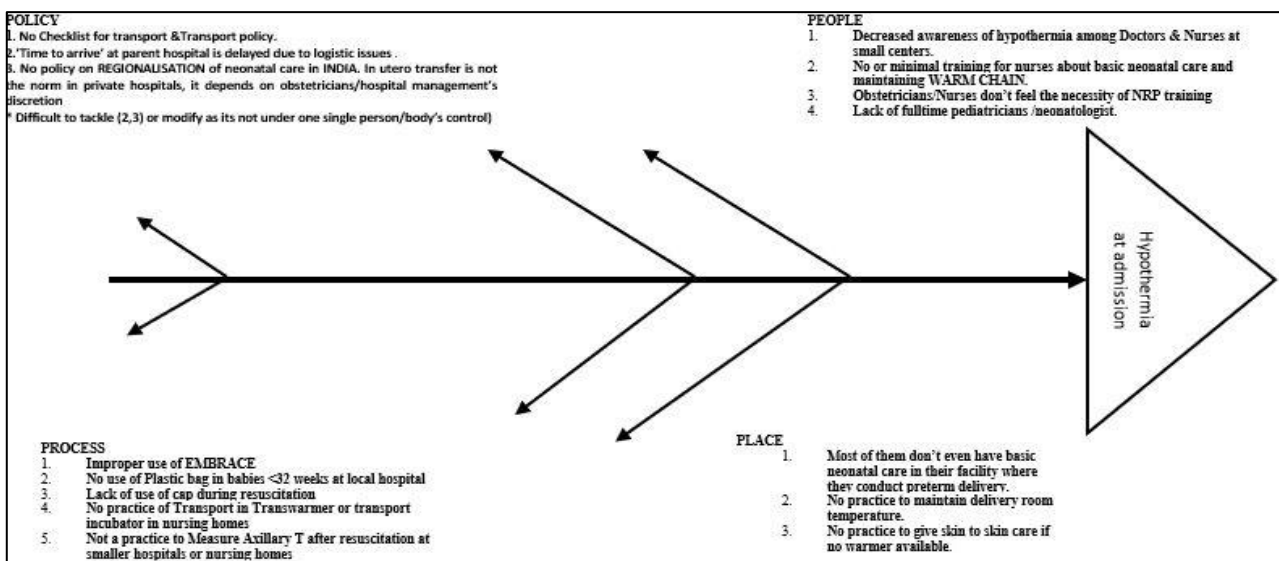


Figure 1: Fish bone analysis.

QI Phase 1

Training about the importance of normothermia, ‘warm chain’ maintenance (all the steps involved in maintaining normothermia for the babies), checking the temperature at admission, and documentation during transport by the lead

nurse in charge to all trainee doctors and nurses The training was held once a week for 4 weeks. The first training was led by a consultant (SD), subsequently, all training was done by the nurse in charge. Implementation was done from March 1st – 31st 2019. Data was reviewed at the end of the cycle.

Table 1: Implementation of test changes and the time period.

Test changes	Period of intervention 2019
PDSA 1 Training of all junior and senior nurses by the Nurse -in -charge about ‘Warm chain ‘in babies, measuring and recording axillary Temperature	March
PDSA 2 1. Replacement of Gel in 'Embrace' (Transwarmer) 2. Replacement of Transport Incubator back up battery	April
PDSA 3 (5 Point protocol framed– after discussion with Nurses and trainee doctors) This protocol was the necessary change to the existing practices wrong practices during transport was leading to hypothermia at admission 1.Switch ‘ON’ the Transport Incubator as soon as the call for transport is received which will give at least 15 minutes for the Incubator to get pre-warmed. 2.Strict use of Cap and Polythene cover in babies <32 weeks at parent hospital on arrival. 3.Avoid unnecessary opening Side ports of transport incubator during transport. 4. Strict Use of transport ‘CPAP kit’ which prevents opening side ports whilst giving CPAP. 5. Temperature check before leaving Parent hospital and on arrival at our center	May-June
PDSA 4 Reinforcement of ‘5-point protocol’ in the form of training every week by the -Nurse- incharge to all nurses	July- August
PDSA 5 Due to the influx of new junior doctors training them was the priority was they were responsible for most of the transports. The nurse incharge took the lead and sensitized about the QI every week for 8 weeks	Sept -October

Table 2: Comparison between hypothermic and normothermic neonates during the study period.

Measure	Hypothermia group N=20 Mean (SD)	Normothermia group N=42 Mean (SD)	P-value
Gestational age (weeks)	35 (3.7)	34 (3.4)	0.326
Birthweight (grams)	2261 (891)	2203 (864)	0.808
Admission Temperature (Celsius)	35.6 (0.6)	36.7 (0.20)	<0.001*

QI phase 2

After the second meeting, we went through Fishbone analysis again and found two important issues. Firstly, Embrace (Phoenix medical system, Ltd)7 commonly used in Low-Middle income countries for the transport of babies was not working to the optimal level. The gel mattress which keeps the temperature between 36.5-37.5

was past its expiry date by 3 months which could have been easily overlooked. Secondly, the back battery of the transport incubator which is supposed to maintain the temperature whilst disconnected from the main electrical input was at fault when we checked with the biomedical engineer and it was replaced on an urgent basis. This PDSA cycle was continued for 4 weeks (April 2019) and data were reviewed at the end.

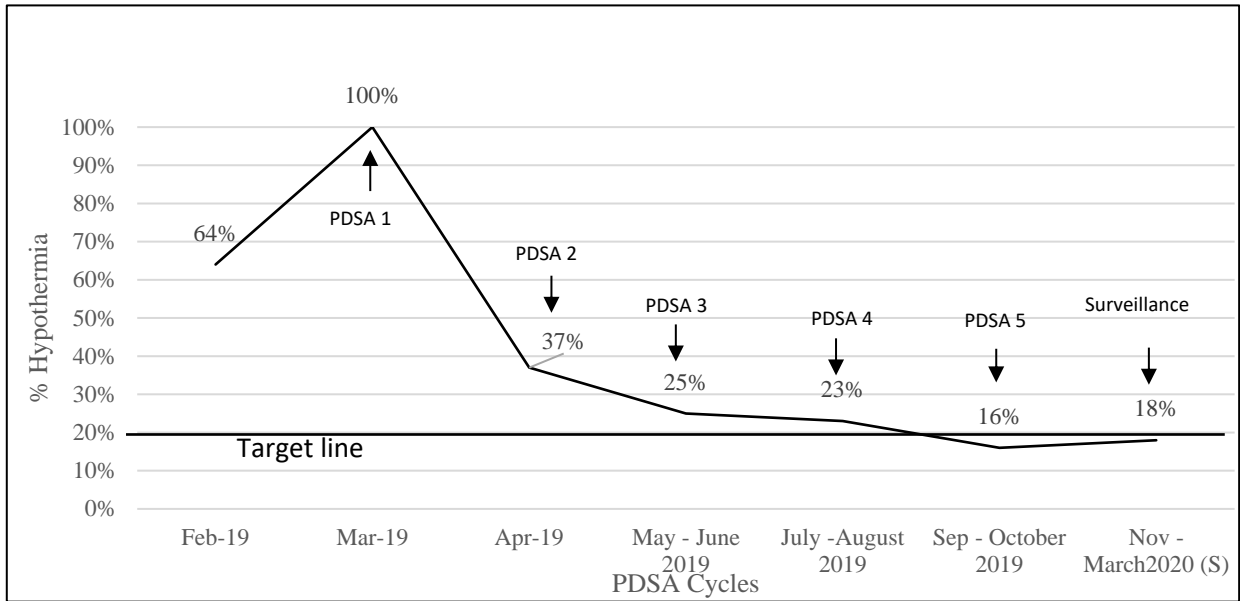


Figure 2: PDSA cycles and incidence of hypothermia.

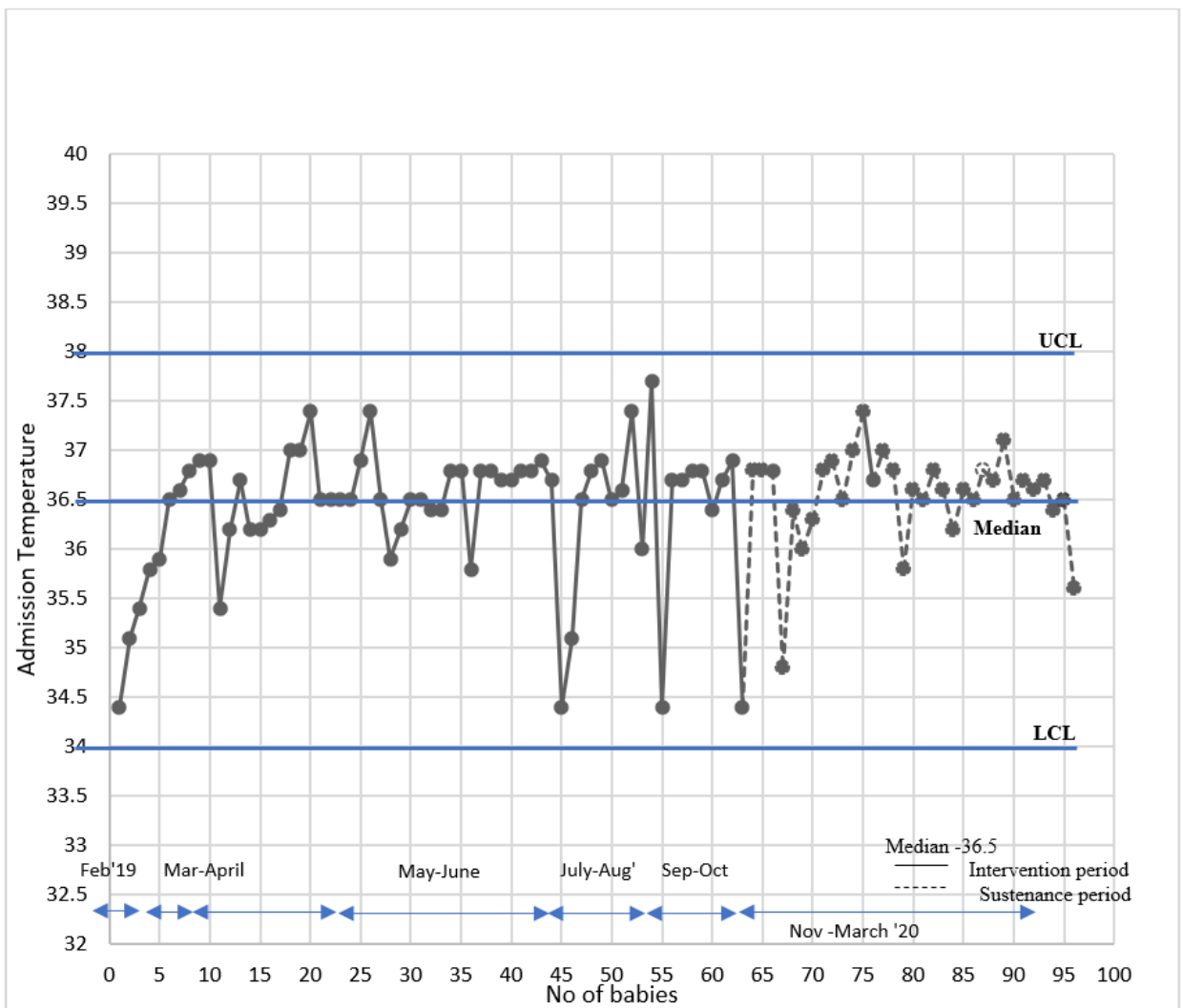


Figure 3: Admission temperature of all babies over complete QI period.

QI phase 3

The third meeting was called for on May 1st week 2019. After thorough discussion nurses had a very valid input. They felt that there need to be a transport policy which needs to be followed. Example- Trainee doctors were opening the side ports of the transport incubator to give IPPV via T-piece if the baby was desaturating during transport. So, we formulated a '5 Point protocol(5Pp)' as PDSA 3 (Table 1) which was implemented. This protocol was put up on the incubator and needs to be filled by the nurse during the transport. Compliance with the protocol was also stressed upon. This PDSA cycle was done for 8 weeks May- June 2019. Data were analyzed.

QI Phase 4

The fourth meeting was on July 1st, 2019. Poor adherence to 5Pp was the reason that some babies being hypothermic. There was an influx of new nurses whose training was imperative. The 4th PDSA involved reinforcement of 5Pp and training of all new nurses. It was conducted weekly for 8 weeks (July-August 2019) and data were reviewed at the end of August. The adherence to 5Pp was noted.

QI Phase 5

After our 5th meeting, we did training of new trainee doctors about 'warm chain maintenance' and '5Pp' as a part of the 5th PDSA. The training was done regularly by the Nurse in charge every week for 8 weeks (September - October 2019).

Surveillance Phase

This phase was from November 2019 – March 2020. Sharing and displaying the results of the intervention and 'top-up' education session to the teams was performed. The admission temperature was collected prospectively during this period and reviewed every month.

RESULTS

Outcome measures

The main outcome measure was admission temperature on arrival to Ovum Hospital before the baby was taken out of the incubator. Admission temperature was measured in the axilla using the digital thermometer (Omron MC 246 Digital). We collected the data for each baby on arrival and entered it into the QI proforma. Other outcome measures were a correlation between admission temperature and birthweight, gestational age, sex, and distance covered during transport. The consultant (SD) reviewed the data every week and entered the data into an electronic sheet (excel sheet) including patient demographics.

Analysis

Statistics are presented as a percentage or mean±standard deviation (SD). The run chart was performed for the

admission temperature of all babies and PDSA cycles. P-value <0.05 was taken as significant.

During the study period over 12 months total of 96 babies were transported (62 babies during implementation, 34 during the sustenance Phase). During the implementation phase total, five Plan-Do-Study-Act (PDSA) cycles were undertaken (Table 1). The data comparing the hypothermic and normothermic groups is shown in Table 2. The mean (SD) gestation in the hypothermic group was 35 (3.7) slightly higher than in the normothermic group 34(3.4) but it was not statistically significant. Birthweight was similar in the two groups. The distance travelled in kilometers in the hypothermic group was significantly more 7.3 (5.5) compared to the normothermic group 4.1(3.8) (p,0.01).

All PDSA cycles with the run chart are shown in Figure 2. During the first PDSA cycle, 5 babies were transported and all babies were hypothermic (Figure 2). During the second PDSA, the incidence of hypothermia drastically reduced from 100% to 37%. The incidence of hypothermia dropped from 37% to 25% after the third PDSA. Adherence to the '5-Point protocol'(5Pp) was 80%. During the fourth and fifth the incidence was 23% and 16% and adherence to 5Pp increased to 90% and 94% respectively. The target was reached after 5 PDSA cycles.

There was no correlation seen noted between hypothermia at admission and gestational age (r, - 0.18), birthweight (r, 0.04), or distance travelled in kilometers (r, 0.02). However, there was a positive correlation seen between adherence to the '5 Point -protocol' and admission temperature (r, 0.86). The process chart over the complete study period is represented in Figure 3.

Sustenance phase

During the sustenance phase, we shared the results of the intervention and provided a "brush up" education session to the teams. The admission temperatures were collected prospectively and reviewed every month. The incidence of hypothermia increased slightly from 16% to 18% and adherence to 5Pp decreased from 94% to 85%. The median (IQR)temperature at admission was 36.6 (36.4-36.8). Although the compliance to '5pp' reduced slightly the admission temperature did not change significantly.

Balancing measures

There was only 1 instance of hyperthermia noted during the intervention period which was not significant.

DISCUSSION

The existing health care in the Indian scenario for neonates especially for extremely preterm babies is still not streamlined and regionalization of care is still a way ahead. Neonatal transport needs an expert team to retrieve sick babies against all odds as it is a dynamic environment unlike in the delivery room or neonatal unit where the

environment is controlled.⁸ Transportation is a stressful event and maintaining normothermia during transport is a big challenge especially in the Indian context where dedicated ambulance for neonatal transport are very few. Most of the transportation happens in an unfavorable environment and it poses an enormous challenge to the team on the ground to maintain the standards while transportation.^{9,10} Deliveries occur in nursing homes, small private settings, and primary health care with varied facilities and once a baby is born, they are transferred to the nearest public teaching hospital or private hospital for advanced neonatal care. In the public sector, most of the transportation is done by '108 Emergency service' – a free service by GVK Emergency Management and Research Institute with state of art emergency call response centers. This service is available in most states and on average their ambulance reaches the client at 18-26 minutes but dedicated neonatal ambulances are not available.¹¹ The incidence of complications can be high in these settings ranging from mild hypothermia to life-threatening episodes however there are no published data on this.

Hypothermia is a frequent complication and is associated during transport with increased morbidity and mortality more so in preterm neonates.¹²⁻¹⁴ As most of the babies transported to our unit are preterm babies and in response to the high incidence of hypothermia at admission, we planned a standardized QI approach to develop an evidence-based thermoregulation protocol to reduce the incidence of hypothermia. In our settings, many incorrigible factors like variable ambient temperature, lack of stabilization facilities at the parent hospital, short transport times, and many other factors that are difficult to change and beyond the scope of our QI (fishbone analysis, figure 1) leads to hypothermia. We presumed that there will be few babies failing to achieve normothermia despite all measures. Therefore the primary outcome to reduce the incidence of hypothermia was set as 20% or less. Although we came across many babies with a 'scoop and run' approach the incidence of hypothermia was reduced to 16% from 64% after 5-PDSA cycles. After the first PDSA cycle, almost all our babies were hypothermic explained by the knowledge practice gap.¹⁵ In the second PDSA cycle equipment replacement did reduce the incidence of hypothermia to 37% as 'Embrace™, a transport warmer is of utmost importance in the Indian context as most of the hospital has not enough facilities to receive transport incubator till neonatal unit. Therefore, babies must be received at the entrance gates, Embrace helps to maintain normothermia from the neonatal unit/delivery room to transport ambulance. The EMBRACETM warmer 7 is a small sleeping bag-like apparatus that has in its back a reusable pouch of phase change material that can be heated to 37°C and can maintain that temperature for several hours. It is cheap, reusable, portable, and hygienic and does not require constant electricity ("Embrace Global - The center for Global Innovations", 2020) for maintaining normothermia. In the third PDSA cycle, we formulated an evidence-based '5 Point protocol' but customized it to our settings. The compliance to the protocol was thoroughly investigated and training was done for the same in the

fourth and fifth PDSA cycle. We took hyperthermia as balancing measures but only one baby was hyperthermic.¹⁶ Adhering to the '5Pp' strongly correlated with admission temperature. In the surveillance phase, the incidence of hypothermia did drop slightly from 16% to 18%, and the compliance by 9%, we attributed it to increased transportation of babies under highly unfavorable circumstances, shorter transport times where time is insufficient to achieve normothermia. The present QI gave us a learning point that the availability of equipment alone is not sufficient but its use in an 'evidence-based' approach is of utmost importance. Hypothermia one of the quality determinants of neonatal transport need to be tackled on an urgent basis especially in the Indian context where hypothermia is one of the leading causes of mortality.^{17,18}

The highlight of our QI is that it was led mostly by the staff nurse. Before the implementation of the QI, temperature maintenance during transport, and achieving normothermia at admission were low priorities attributed to a huge knowledge practice gap. After implementation the awareness of hypothermia, checking admission temperature, documentation of the temperature improved drastically. The salient feature although intangible was the maintenance of 'Warm chain' even in the worst of scenarios, despite short transport times and 'scoop and run' transport we were able to achieve normothermia in most of the babies.

Limitations

We did not measure 'travel time/ground time' which could be a balancing measure.

CONCLUSION

Thermoregulation during neonatal transport is a huge challenge especially in the Indian scenario due to multiple incorrigible factors contributing to its high incidence even in the best of the centers. Unless regionalization of care in public and private sectors is initiated achieving normothermia in babies will be a challenge. QI initiative is a way forward to deal with some of these aspects. Involving the nursing team who form the core team of neonatal transport is imperative.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Diehl B. Neonatal Transport. *Critical Care Nursing Clinics of North America.* 2018;30(4):597-606.
2. Blencowe H, Cousens S, Oestergaard M, Chou D, Moller A, Narwal R et al. National, Regional, and Worldwide Estimates of Preterm Birth Rates in the Year 2010 With Time Trends Since 1990 for Selected Countries. *Obstetric Anaesthesia Digest.* 2013;33(3):142.
3. Kumar PP, Kumar CD, Venkatlakshmi A. Long-distance neonatal transport-the need of the hour. *Indian Pediatr.* 2008;45:920-922.
4. Narang M, Kaushik JS, Sharma AK, Faridi MM. Predictors of mortality among the neonates transported to referral centre in Delhi, India. *Indian J Public Health.* 2013;57:100-104.
5. Verma A, Gaur A, Ambey R. Predictors in profile of referred newborns for their outcome in a tertiary newborn referral facility. *Int J Contemporary Pediatrics.* 2018;6(1):87.
6. Ogrinc G, Davies L, Goodman D, Batalden P, Davidoff F, Stevens D. Standards for QUality Improvement Reporting Excellence 2.0: revised publication guidelines from a detailed consensus process. *J Surg Res.* 2016;200:676-82.
7. EMBRACE, "EMBRACE Warmer,"2014. Available at: <http://EMBRACE-global.org/EMBRACE-warmer/>. Accessed on 20th December, 2020.
8. Chang A, Berry A, Jones L. Specialist teams for neonatal transport to neonatal intensive care units for prevention of morbidity and mortality. *Cochrane Database Syst Rev.* 2015;(10):CD007485.
9. Singh H, Singh D and Jain BK. Transport of referred sick neonates: how far from ideal? *Indian Pediatr.* 1996;33:851-853.
10. Adhisivam B. Transport of sick children – the Indian perspective. *Indian Journal of Emergency Pediatrics.* 2010;2:19-23.
11. Kumutha J, Rao G, Sridhar B, Vidyasagar D. The GVK EMRI maternal and neonatal transport system in India: a mega plan for a mammoth problem. *Seminars in Fetal and Neonatal Medicine.* 2015;20(5):326-334.
12. Chang H, Sung Y, Wang S, Lung H, Chang J, Hsu C et al. Short- and Long-Term Outcomes in Very Low Birth Weight Infants with Admission Hypothermia. *PLOS ONE.* 2015;10(7):e0131976.
13. Van den Berg J, Olsson L, Svensson A, Håkansson S. Adverse events during air and ground neonatal transport: 13 years' experience from a neonatal transport team in Northern Sweden. *J Maternal-Fetal Neonatal Med.* 2014;28(10):1231-1237.
14. Laptook A, Salhab W, Bhaskar B. Admission Temperature of Low Birth Weight Infants: Predictors and Associated Morbidities. *Pediatrics.* 2007;119(3):e643-e649.
15. Straus S, Tetroe J, Graham I. Knowledge translation is the use of knowledge in health care decision making. *J Clin Epidemiol.* 2011;64(1):6-10.
16. Impey L, Greenwood C, Black R, Yeh P, Sheil O, Doyle P. The relationship between intrapartum maternal fever and neonatal acidosis as risk factors for neonatal encephalopathy. *Am J Obstetr Gynecol.* 2008;198(1):49.e1-49.e6.
17. Bigham M, Schwartz H. Quality Metrics in Neonatal and Pediatric Critical Care Transport. *Pediatric Critical Care Med.* 2013;14(5):518-524.
18. Datta V, Saili A, Goel S, Sooden A, Singh M, Vaid S et al. Reducing hypothermia in newborns admitted to a neonatal care unit in a large academic hospital in New Delhi, India. *BMJ Open Quality.* 2017;6(2):e000183.

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