



Towards reducing percentage of hypothermia among newborn upon admission to NICU

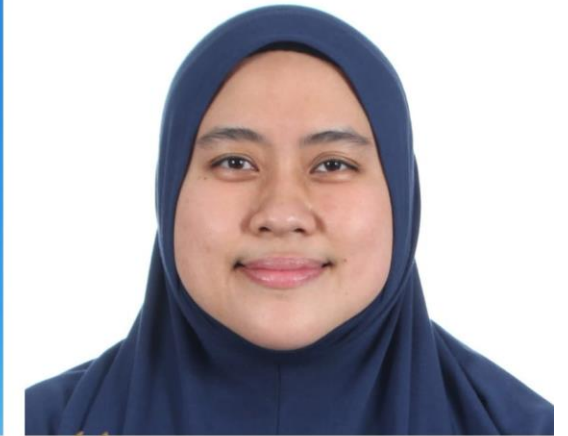
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Team Members

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See Jing Kai



Nurul Jannah



Siti Aisyah



Aimi

Problem Identification



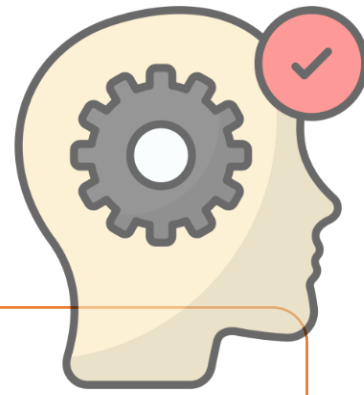
	Problems
1	High percentage of hypothermia among newborn upon admission to NICU
2	Poor reduction of serum bilirubin among jaundiced neonates admitted for phototherapy
3	High incidence of pressure sores among paediatric patients on non-invasive ventilation therapy
4	High incidence of peritonitis among paediatric patients on CAPD

Prioritisation of Problem Using **SMART** criteria

PROBLEMS	S	M	A	R	T	SCORE
1) High percentage of hypothermia among newborn upon admission to NICU	12	11	12	12	10	57
2) Poor reduction of serum bilirubin among jaundiced neonates admitted for phototherapy	7	10	10	10	11	48
3) High incidence of pressure sores among paediatric patients on non-invasive ventilation therapy	7	6	8	10	7	38
4) High rate of peritonitis among paediatric patients on CAPD	11	6	9	6	4	36

Weightage: 1=Low; 2=Medium; 3=High

Cumulative points of each problem for each criterion is calculated based on votes by 4 team members.



Rationale of Problem Selection

S

Neonatal hypothermia has potentially **life threatening effects** including cardiopulmonary, central nervous system, vascular system and metabolic disturbances, which may lead to **increased morbidity and length of stay**.

M

Axillary temperature of newborn babies can be measured during resuscitation and upon admission to NICU.

A

Optimum thermoregulation in neonate can **reduce morbidity and length of stay**.

R

Strategies to improve neonatal thermoregulation will be implemented on personnel involved in neonatal resuscitation through **training and establishing improved guidelines**.

T

Estimated time period for this project is within **12 months**

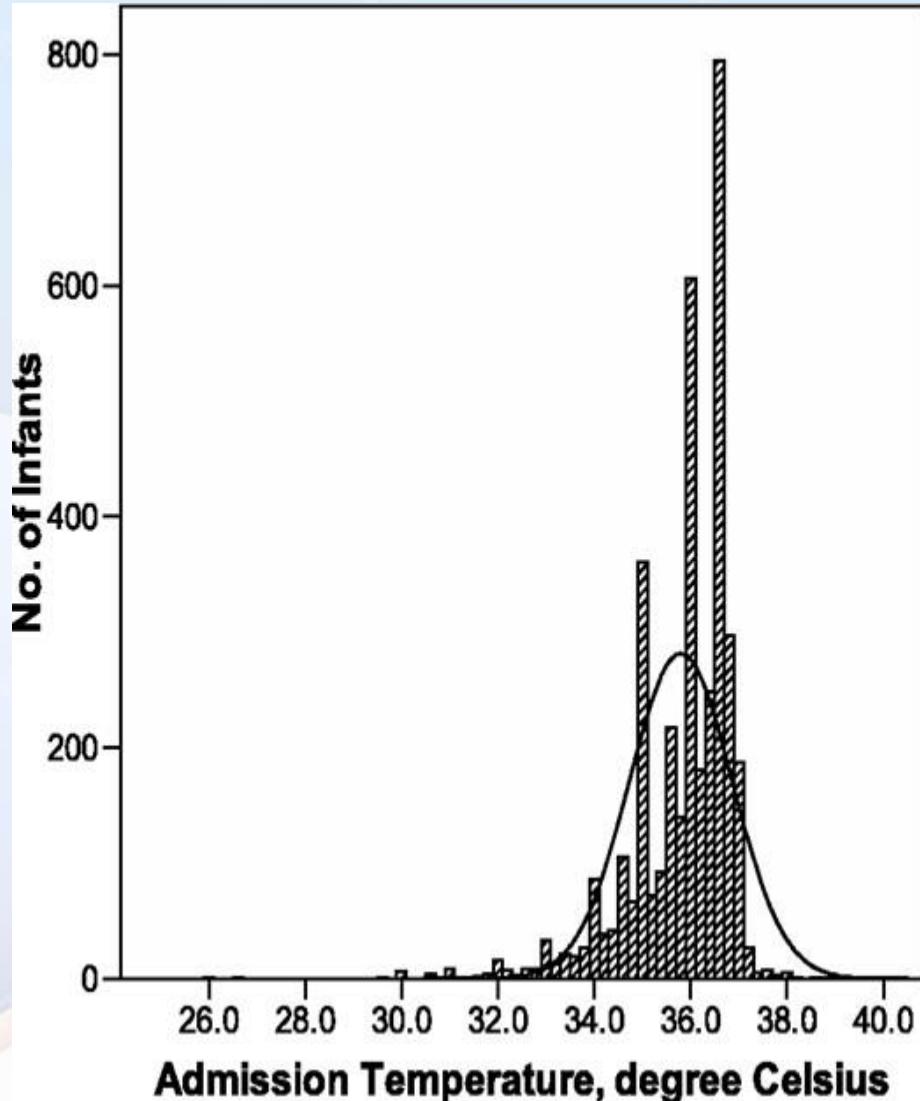


Literature Review

- According to the World Health Organization (*WHO, 1997*) a newborn is normothermic when its body temperature is between 36.5°C and 37.5°C.
- Hypothermia is defined as follows:
 - ❖ **Mild** : Core temperature between 36 – 36.4C
 - ❖ **Moderate** : Core temperature between 32 – 35.9C
 - ❖ **Severe** : Core temperature between < 32C
- For every decrease of 1°C , there is 28% increase in mortality (*Laptook etal, 2007*).
- Risk factors of hypothermia include **prematurity, low birth weight** and intrauterine growth restriction.
- Hypothermia has multiple effects include cardiopulmonary, central nervous system, vascular system and metabolic disturbances.

Admission Hypothermia among VLBW infants in Malaysian NICU

Nem-Yun Boo et al, 2013, Journal of Tropical Pediatrics



- Retrospective analysis of prospectively collected data from MNNR of 32 Malaysian government NICU
- Results:
 - Median temperature was 36°C
 - 64.8% of them were hypothermic on admission
 - Hypothermic infants had significantly lower birth weight and gestational age
 - A significant higher proportion of hypothermic infants developed RDS and/or IVH, died within 12h of admission and died before discharge
 - Although not statistically significant, data suggest that NICUs practicing more preventive measures had lower rates of admission hypothermia

Outcomes of neonatal hypothermia among very low birth weight infants: a Meta-analysis

Obeid Mohamed et al., 2021, Maternal Health, Neonatology and Perinatology

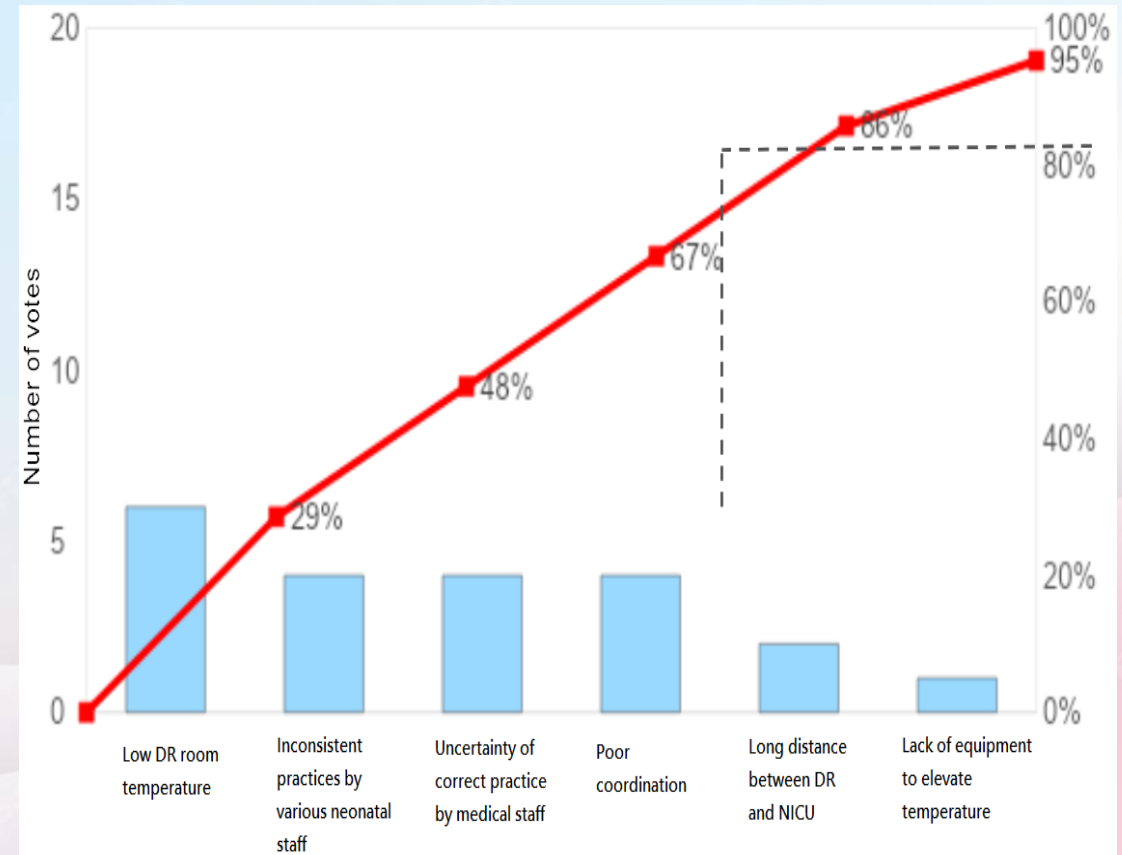
Adverse outcome	No. of studies	Pooled OR (95% CI)	p value for OR
Death	8	1.89 (95% CI, 1.72–2.09)	$P < .001$
NEC	4	1.04 (95% CI, 0.89–1.21)	$P = .594$
IVH	3	1.86 (95% CI, 1.09–3.14)	$P = .021$
BPD	4	1.28 (95% CI, 1.16–1.40)	$P < .001$
Sepsis	4	1.45 (95% CI, 1.22–1.49)	$P < .001$
ROP	4	1.46 (95% CI, 1.08–1.98)	$P = .013$

- The pooled prevalence of hypothermia was **48.3%**
- Results showed that **hypothermia was linked to increased adverse outcomes, indicating there were more than mere associations of prematurity.**
- The risk of mortality among hypothermic infants was reported highest within the first 7 days of life

Reducing IVH following implementation of a prevention bundle for neonatal hypothermia

Chiu et al., 2022, Journal Prone

- Quality improvement project, done in Taiwan
 - Two time periods: Pre-intervention and post-intervention
- 3 leading causes to hypothermia found;
 - Low delivery room temperature
 - Inconsistent practices by various neonatal staff
 - Uncertainty of correct practice by medical staff



Parameter		Pre-intervention	Post-intervention	P value
		N = 37	N = 58	
DRT, mean (SD)		20.56 (1.40)	21.45 (1.30)	0.002
DRT $\geq 21^{\circ}\text{C}$		12 (33.3)	39 (68.4)	<0.001
BT1, mean (SD) [†]		36.5 (0.35)	36.8 (0.40)	<0.001
BT2, mean (SD)		36.4 (0.38)	36.7 (0.39)	<0.001
BT1 <36.5 $^{\circ}\text{C}$ [†]		17 (45.9)	5 (8.6)	<0.001
BT2 <36.5 $^{\circ}\text{C}$		22 (59.5)	9 (15.5)	<0.001
BT1 $\geq 38^{\circ}\text{C}$ [†]		0 (0)	1 (1.8)	0.418
BT2 $\geq 38^{\circ}\text{C}$		0 (0)	1 (1.7)	0.422
Death	Yes	1 (2.7)	0 (0)	0.208
	No	36 (97.3)	58 (100)	
Survanta	Yes	4 (10.8)	8 (13.8)	0.670
	No	33 (89.2)	50 (86.2)	
IVH	Yes	8 (21.6)	3 (5.2)	0.015
	No	29 (78.4)	55 (94.8)	
Inotropic agent use	Yes	7 (18.9)	9 (15.5)	0.666
	No	30 (81.1)	49 (84.5)	
pH <7.2 [‡]	Yes	5 (16.7)	7 (13.7)	0.719
	No	25 (83.3)	44 (86.3)	
5-min Apgar <7	Yes	4 (10.8)	3 (5.2)	0.305
	No	33 (89.2)	55 (94.8)	

Abbreviations: DRT, delivery room temperature; BT1, body temperature before leaving the delivery room; BT2, body temperature at the NICU; IVH, intraventricular hemorrhage

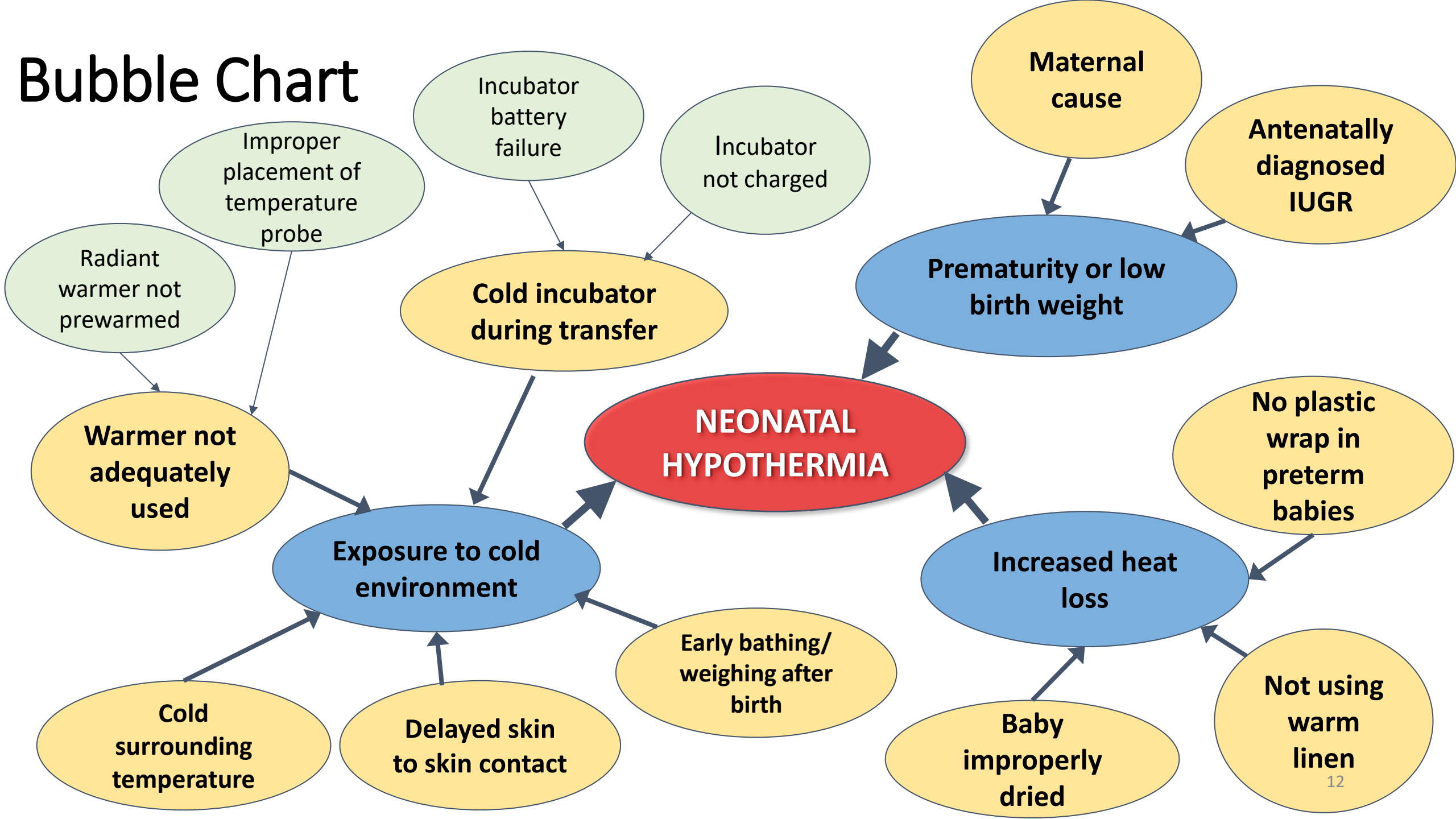
[†]Only 1 patient was missing this variable

[‡]A total of 14 patients were missing this variable

Problem Statement

- **Thermoregulation** is the ability to maintain a balance between heat production and heat loss.
- In the first half of 2023, the incidence of neonatal hypothermia in NICU HTAA is **60%**.
 - This is associated with **increased morbidity, length of stay and increases risk of mortality**
- Among the causes that contributes to hypothermia in newborns **include poor thermoregulatory control** during resuscitation, **environment and transportation** prior to admission to NICU.
- Hence, the aim of this study is to **reduce the rate of hypothermia** among newborn during admission.

Bubble Chart



Objectives

General Objectives	Specific Objectives
<p>To reduce the percentage of hypothermia among newborns admitted to NICU</p>	<ol style="list-style-type: none">1. To determine the percentage of hypothermia among newborn admitted to NICU.2. To identify factors causing neonatal hypothermia.3. To formulate remedial action to reduce hypothermia among newborn admitted to NICU4. To evaluate the effectiveness of remedial action taken to reduce percentage of neonatal hypothermia

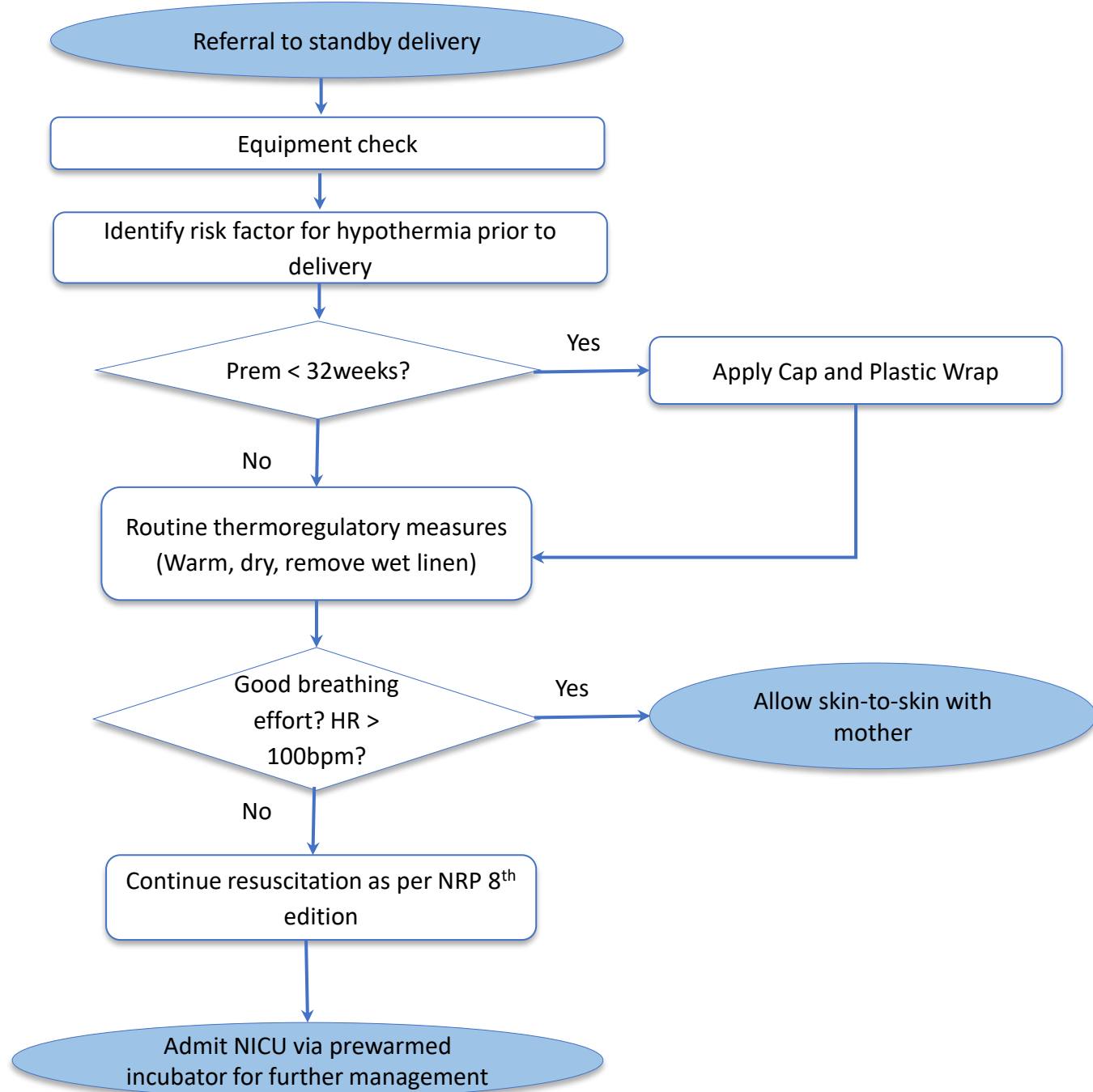
Indicators

Indicator	Formula	Standard
Percentage of newborn with hypothermia at the point of admission to NICU	$\frac{\text{Number of newborn with hypothermia on admission to NICU}}{\text{Total newborns admitted to NICU}} \times 100$	< 20%

PROCESS OF CARE

- Preheated warmer
- Warm towels or blankets
- Temperature sensor and sensor cover for prolonged resuscitation
- Hat
- Plastic bag or plastic wrap (< 32 weeks' gestation)
- Thermal mattress (< 32 weeks' gestation)

Adapted from NRP 8th edition - Quick Equipment checklist



Model of Good Care (1)

Step No.	Process of Care	Criteria	Standard	Pre-remedial (baseline)
1	Referral for standby during delivery	Obtain details of pregnancy, indication of standby and location of delivery.	100%	75%
2	Thermoregulatory device check	Radiant warmer in delivery room is preheated	100%	90%
		Ensure prewarmed linens/ towel available	100%	75%
		Ensure availability of temperature sensor and sensor cover for prolonged resuscitation	100%	80%
		Cap available for all preterm deliveries	100%	65%
		Plastic wrap available for preterm deliveries <32 week gestation	100%	90%
		Ensure transport incubator prewarmed	100%	75%

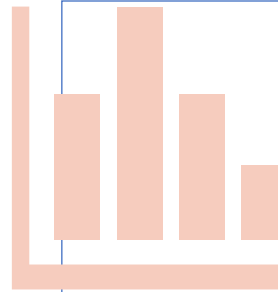
Model of Good Care (2)

Step No.	Process of Care	Criteria	Standard	Pre-remedial (baseline)
3	Identification of risk factors of hypothermia	Correct identification of fetal gestation at risk of of hypothermia (Very Preterm/ <32 weeks)	100%	90%
		Correct identification of estimated fetal weight at risk of of hypothermia (VLBW/ <1.5kg)	100%	95%
4	Routine thermoregulatory steps during resuscitation	All newborn babies put under preheated radiant warmer upon delivery	100%	90%
		All newborn babies are dried and stimulated (> 32 week)	100%	85%
		Removal of wet linens	100%	85%

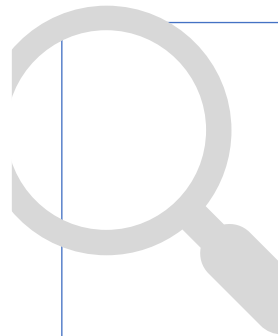
Model of Good Care (3)

Step No.	Process of Care	Criteria	Standard	Pre-remedial (baseline)
5	Additional thermoregulatory steps	For all preterm babies < 32 weeks, cap and plastic wrap is immediately applied	100%	75%
6	Thermoregulation during transfer of baby to NICU	Transport baby via prewarmed incubator	100%	80%

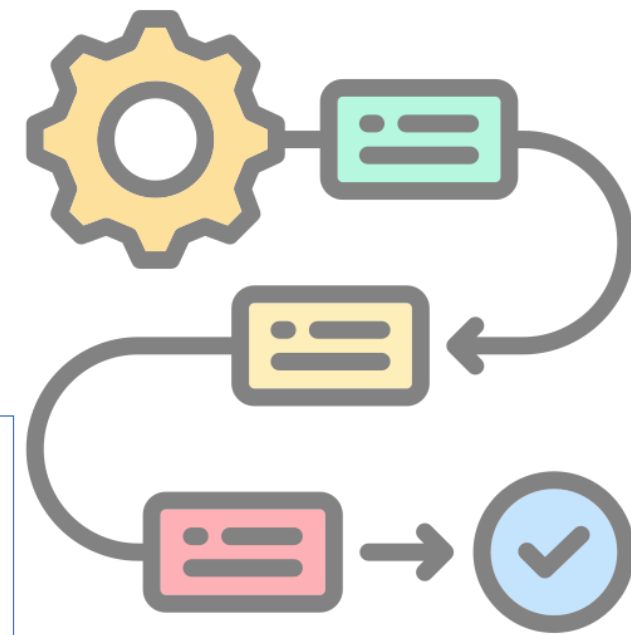
Methodology



Study to determine the **magnitude** of hypothermia among newborn.



Study to determine **contributing factors** of neonatal hypothermia.



Methodology

Type of Study	Quality Improvement study
Study population	All newborn attended by Paediatric team during delivery who are admitted to NICU
Sampling method	Universal sampling
Study period	January 2023 until February 2024
Data collection techniques	Axillary temperature of newborn upon admission to NICU

Inclusion Criteria	Exclusion Criteria
<p>All newborn attended by Paediatric team during delivery who are admitted to NICU</p>	<p>Newborn < 26 weeks of gestation</p> <p>Newborn with Lethal Congenital Malformation (LCM)</p> <p>Newborn with poor Apgar Score < 6 at 10 minutes or continued need for resuscitation</p> <p>Newborn required bedside invasive procedures during resuscitation</p> <p>All outborn newborns – eg BBA</p>

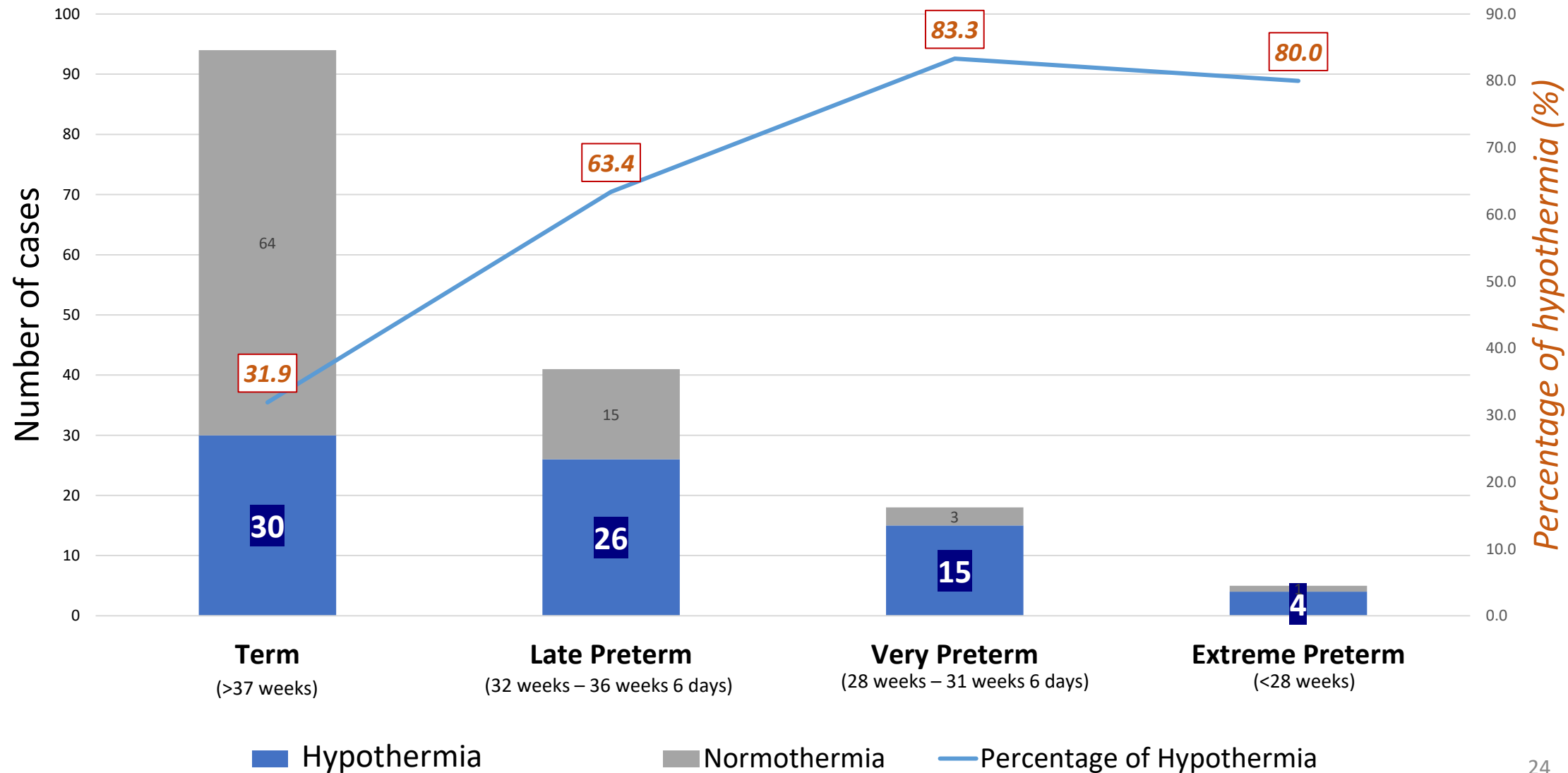
Result of Study: Magnitude

	Number of patients
Incidence of newborn with hypothermia at the point of admission to NICU (Temperature <36.5)	75
Total admission of newborn in NICU	158

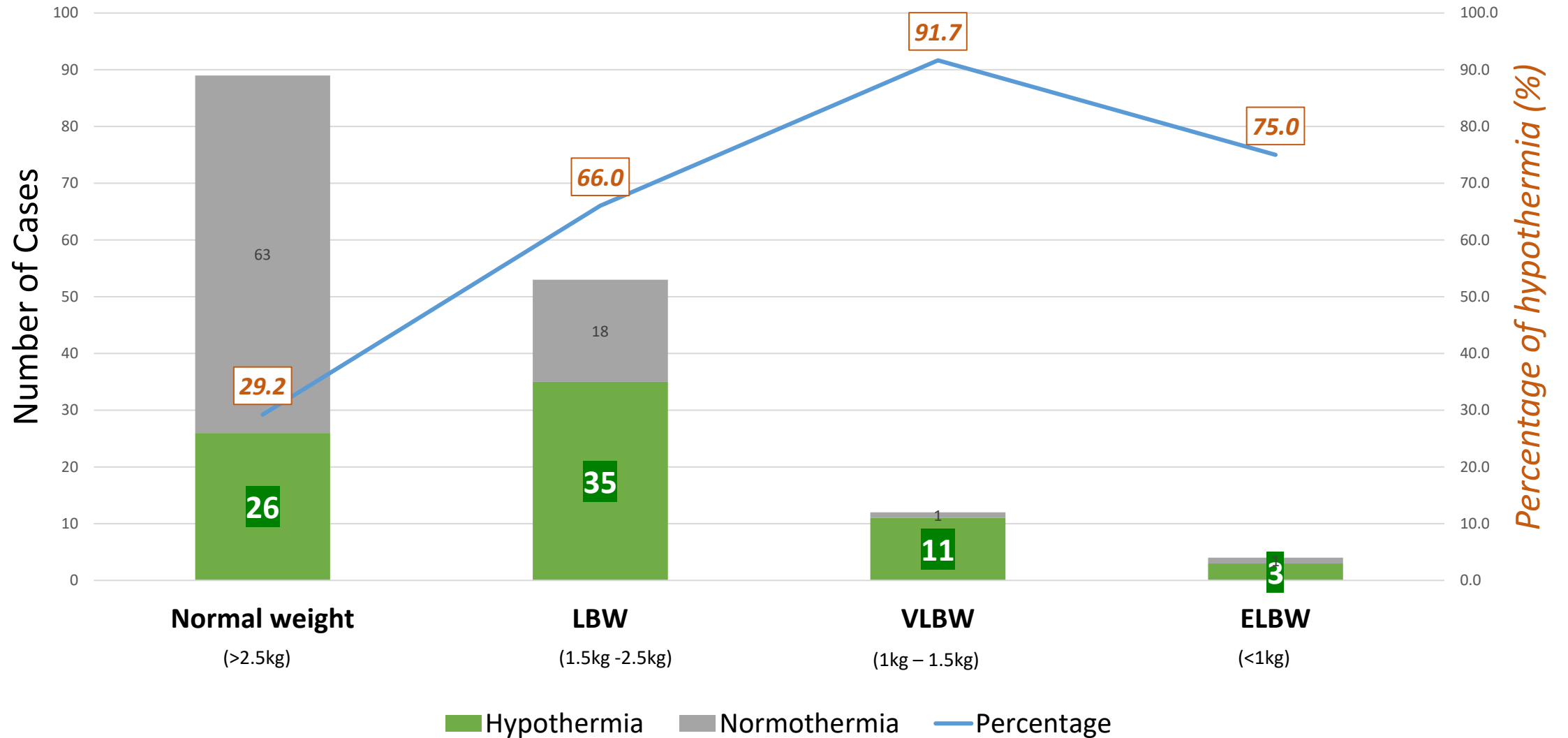
Indicators

Indicator	Formula	Achievement
Percentage of newborn with hypothermia at the point of admission to NICU	$\frac{75}{158} \times 100$	47.5%

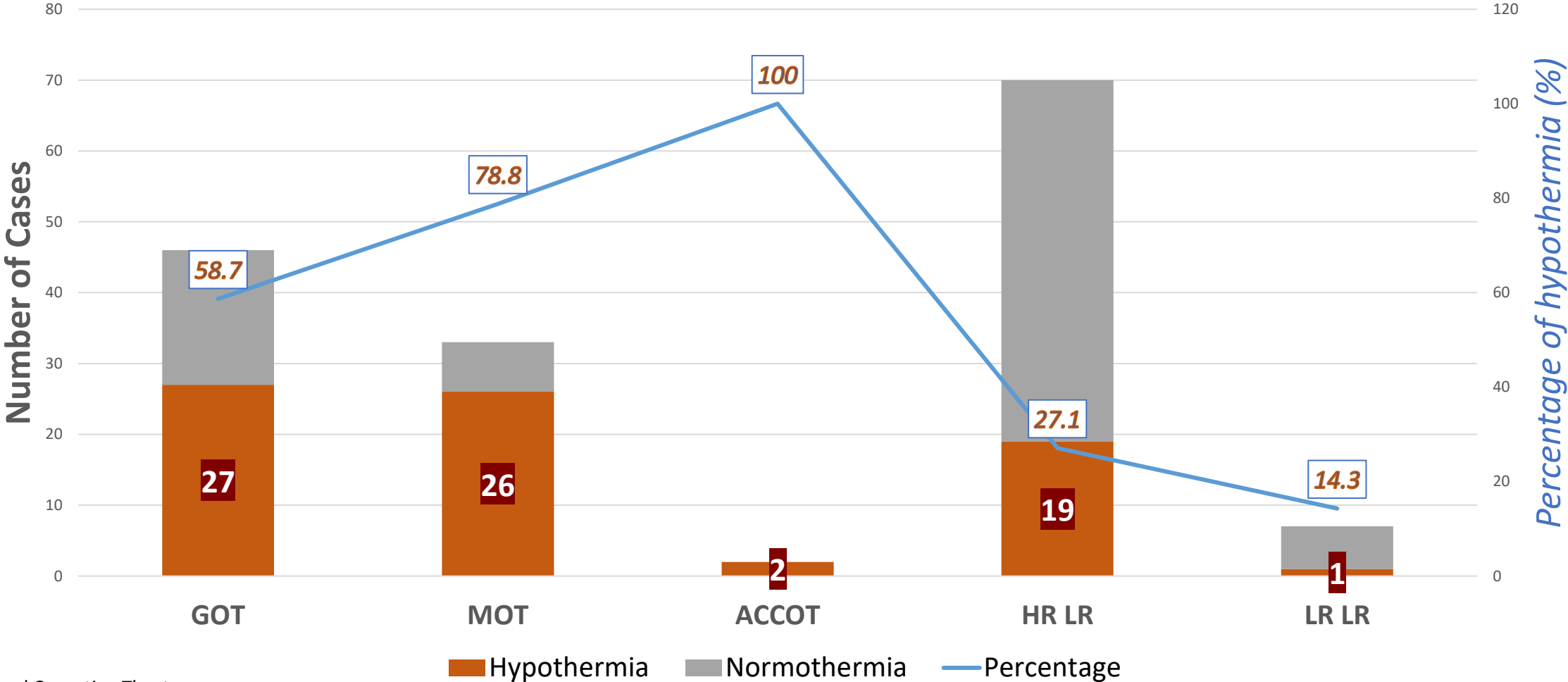
NUMBER AND PERCENTAGE OF HYPOTHERMIC NEWBORN ACCORDING TO GESTATION



NUMBER AND PERCENTAGE OF HYPOTHERMIC NEWBORN ACCORDING TO BIRTH WEIGHT



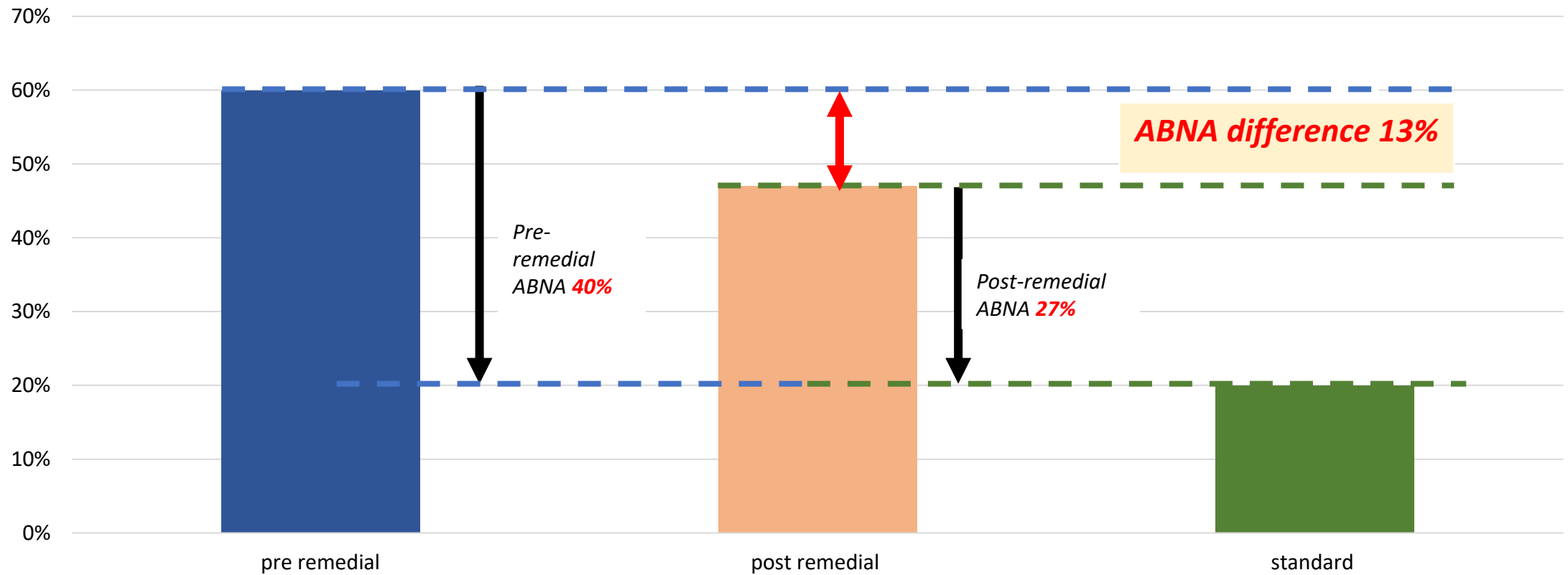
NUMBER AND PERCENTAGE OF HYPOTHERMIC NEWBORN ACCORDING TO PLACE OF DELIVERY



GOT – General Operating Theatre
 MOT – Maternity Operating Theatre
 ACC OT– Ambulatory Care Centre OT
 HR LR – High Risk Labour Room
 LR LR – Low Risk Labour Room

Achievable Benefit Not Achieved (ABNA)

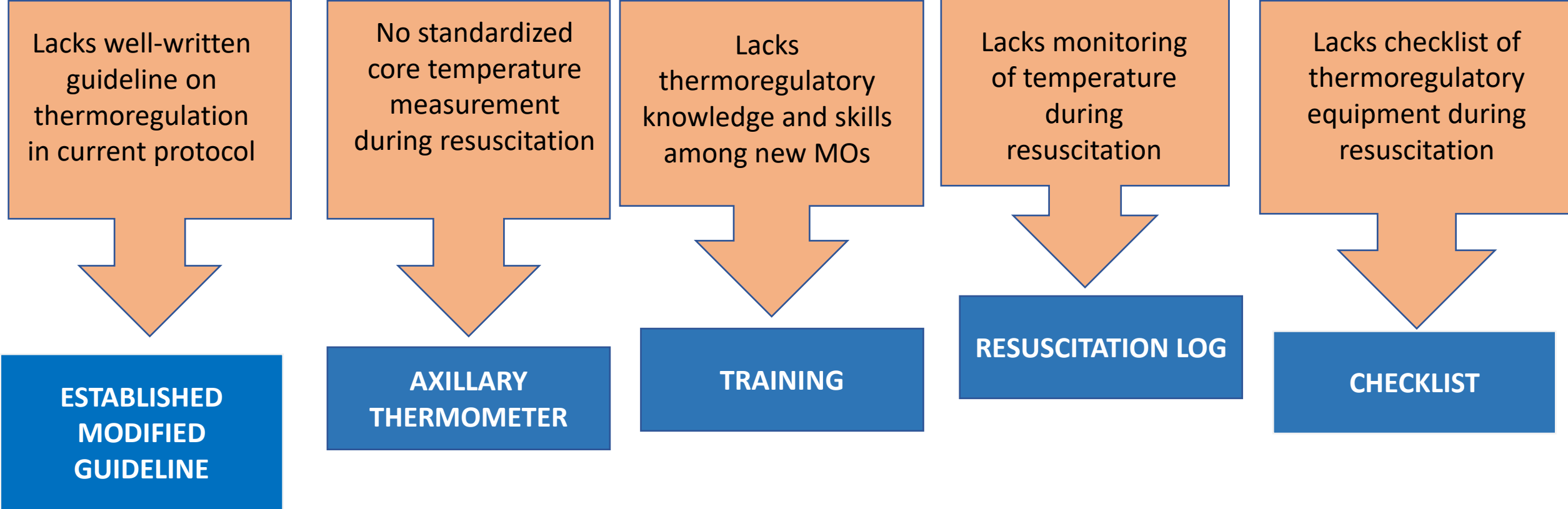
Percentage of Hypothermia in newborn on admission to NICU





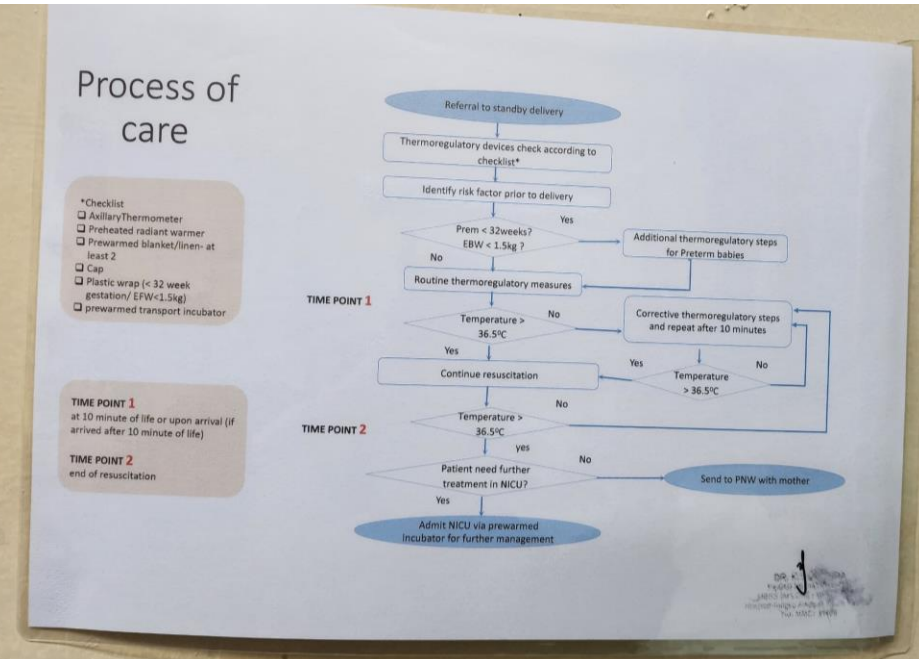
STRATEGY FOR CHANGE

Remedial Actions



FACTOR 1:

Lacks well-written guideline on thermoregulation in current neonatal resuscitation protocol



Previously:

NRP 8th edition lacks clear written steps on thermoregulation during neonatal resuscitation

Remedial action:

Thermoregulation steps was incorporated in resuscitation steps including corrective thermoregulatory measures

Process of care (Post remedial)

*Checklist

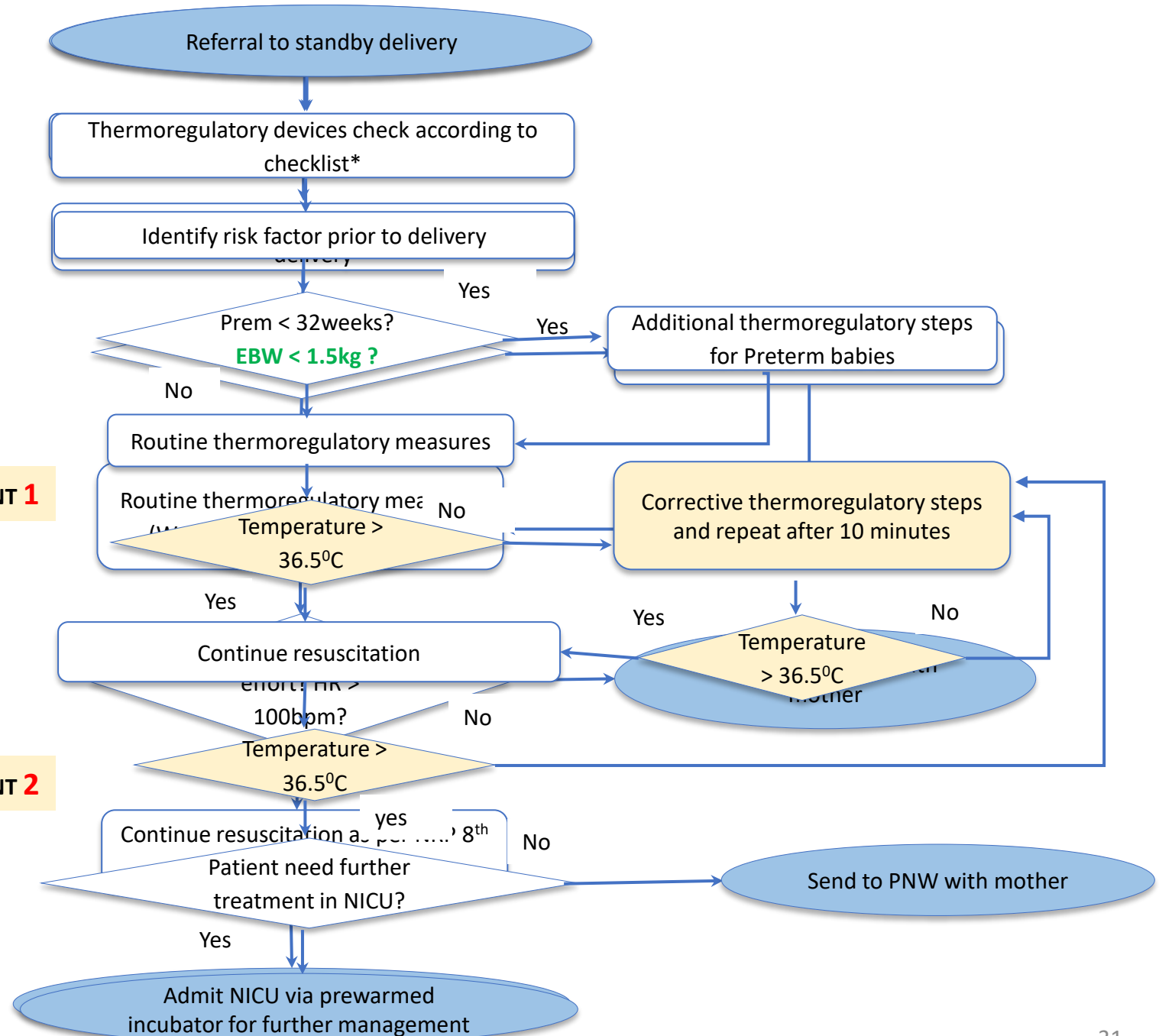
- Axillary Thermometer
- Preheated radiant warmer
- Prewarmed blanket/linen- at least 2
- Cap
- Plastic wrap (< 32 week gestation/ EFW<1.5kg)
- prewarmed transport incubator

TIME POINT 1

at 10 minute of life or upon arrival
(if arrived after 10 minute of life)

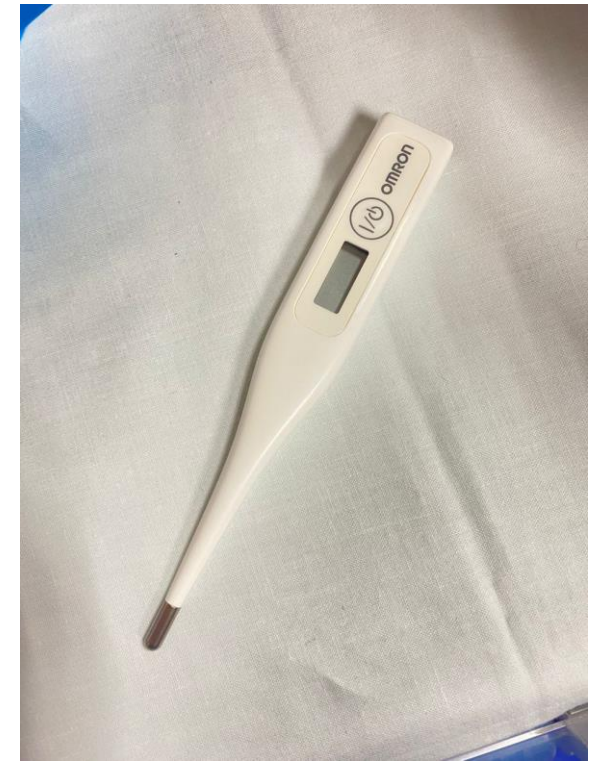
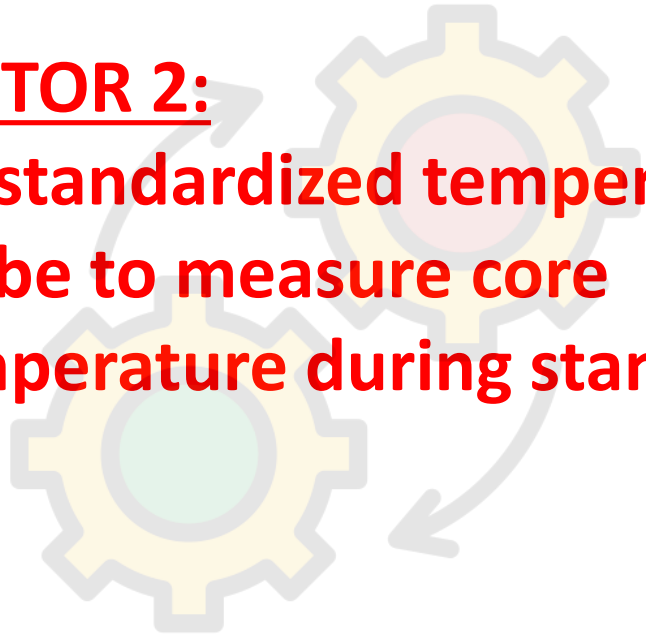
TIME POINT 2

end of resuscitation



FACTOR 2:

No standardized temperature probe to measure core temperature during standby



Previously :

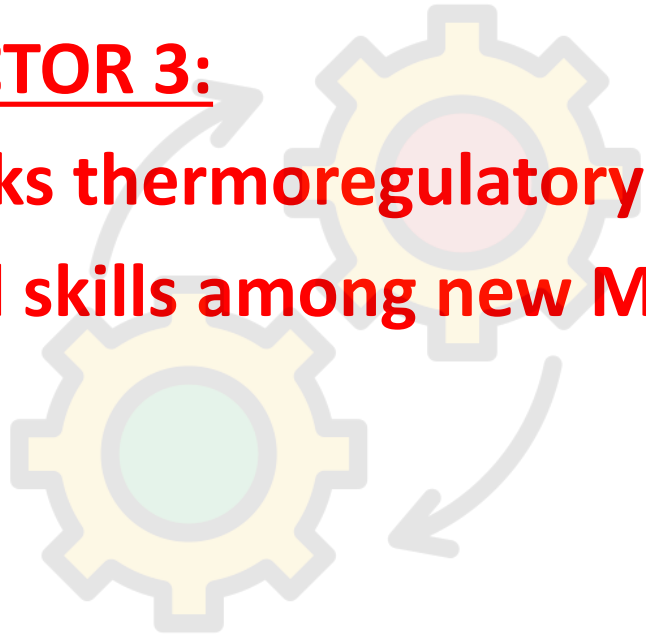
No standardised temperature probe used to measure temperature baby during delivery

Remedial action:

To establish axillary thermometers in resuscitation bag and use of probe to measure core temperature

FACTOR 3:

Lacks thermoregulatory knowledge and skills among new MOs



Previously:

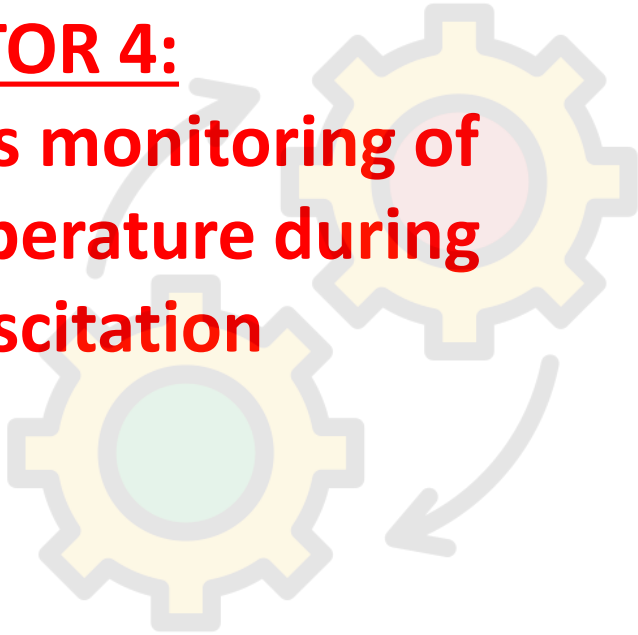
New MO unfamiliarized with thermoregulation steps during resuscitation

Remedial action:

Thermoregulation steps was incorporated in resuscitation steps and emphasized during NRP training of new MOs.

FACTOR 4:

Lacks monitoring of temperature during resuscitation



Resuscitation Log

Name: B/O
Standby/After
Date:
From: HRLR/OT/LRC/PNW

Refer for:
Liquor: Clear/Meconium

TIME	
COLOR	
BREATHING EFFORT	
MUSCLE TONE	
HR	
RR	
NASAL FLARRING	
GRUNTING	
CHEST RECESSION	
SUCTION	
TRACHEAL SUCTION	
FREE FLOW O2	
PPV	
CPAP	
SPO2	
INTUBATION	
CPR	
ADRENALINE	

Resuscitation Log

Name: B/O
Standby/after :
Date :
From : HRLR/OT/LRC/PNW

Refer for:
Liquor: clear/meconium

TIME	
COLOR	
BREATHING EFFORT	
MUSCLE TONE	
HR	
RR	
TEMPERATURE	
NASAL FLARRING	
GRUNTING	
CHEST RECESSION	
SUCTION	
TRACHEAL SUCTION	
FREE FLOW O2	
PPV	
CPAP	
SPO2	
INTUBATION	

Remedial action :

-Body temperature measurement is incorporated into resuscitation log at TWO different time points

-Allow Resuscitator to improve thermoregulatory measures in hypothermic babies

Previously :

Previous resuscitation log did not include measurement of body temperature during active resuscitation

FACTOR 5: **Lacks checklist of thermoregulatory equipment during resuscitation**

Previously :

No checklist to detail each thermoregulatory devices needed prior to stand-by

Remedial action :

Established a standardized thermoregulation checklist has on standby has been briefed to use the check list.

Name

Date of birth

Mother's IC

MRN

Gestational Age

Birth weight

Antenatal problem

Diagnosis

Apgar score

Place of delivery

HRLR Low ri M T
ACC OT

Room temperature : _____

Extensive resuscitation

Eg: Chest compression, Inotropes

Fluid resuscitation, chest tube
insertion, etc.

YES (specify)

NO

Thermoregulatory device
checklist before delivery

Axillary Thermometer
 Preheated radiant warmer
 Prewarmed linens/ towel (at least 2)
 Cap (for < 32 weeks/ EFW < 1.5kg)
 Plastic wrap (for < 32 weeks/ EFW < 1.5kg)
 Ensure transport incubator prewarmed








QUALITY ASSURANCE PROJECT
"TOWARDS REDUCING PERCENTAGE OF HYPOTHERMIA AMONG
NEWBORN UPON ADMISSION TO NICU"

DATA COLLECTION SHEET






Name	[REDACTED]
Date of birth	28/10/2023.
Mother's IC	021204060906.
MRN	134811.
Gestational Age	31w 4d.
Birth weight	1457g.
Antenatal problem	Antenataly / DM CRA this.
Diagnosis	1) Preterm 31w 2) Pre-eclampsia severe 3) Respiratory distress syndrome.
Apgar score	91.95.
Place of delivery	<input checked="" type="checkbox"/> HRLR <input type="checkbox"/> Low risk <input type="checkbox"/> MOT <input type="checkbox"/> GOT <input type="checkbox"/> ACC OT Room temperature: 24.6°C.
Extensive resuscitation Eg: Chest compression, inotropes, Fluid resuscitation, chest tube insertion etc.	<input type="checkbox"/> YES (specify) <input checked="" type="checkbox"/> NO
Thermoregulatory device checklist before delivery	<input checked="" type="checkbox"/> Axillary Thermometer <input checked="" type="checkbox"/> Preheated radiant warmer <input checked="" type="checkbox"/> Prewarmed linens/ towel (at least 2) <input checked="" type="checkbox"/> Cap (for < 32 weeks/ EFW < 1.5kg) <input checked="" type="checkbox"/> Plastic wrap (for < 32 weeks/ EFW < 1.5kg) <input checked="" type="checkbox"/> Ensure transport incubator prewarmed

Routine thermoregulatory steps	<input checked="" type="checkbox"/> Place baby under preheated radiant warmer <input checked="" type="checkbox"/> Place baby above prewarmed linen <input checked="" type="checkbox"/> Remove wet linen <input checked="" type="checkbox"/> Apply cap and plastic wrap to baby (if < 32 weeks OR estimated weight < 1.5kg)
TIME POINT 1 at 10 minute of life OR upon arrival (if arrived after 10 minute of life)	Temperature check? More than 36.5°C? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No, state temperature <u>34.8°C</u>
Corrective thermoregulatory steps (if temperature at timepoint 1 < 36.5°C)	<input checked="" type="checkbox"/> Addition of prewarmed linen <input checked="" type="checkbox"/> Ensure plastic wrap are of good seal (In < 32 weeks / EFW < 1.5kg) <input checked="" type="checkbox"/> Reassessment of axillary temperature at 10minutes interval till timepoint 2 10min interval x 1: <u>35.6</u> 10min interval x 2: <u>36.4</u> 10min interval x 3: <u>36.2</u> 10min interval x 4: <u>36.6</u>
TIME POINT 2 end of resuscitation	Temperature check? More than 36.5°C? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No, state temperature <u>36.5°C</u>
Temperature upon NICU admission	Temperature check? More than 36.5°C? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No, state temperature <u>35.5°C</u>
Sign and Chop	DR ERMA DHAILAH SINDU CHE DAUD PEGAWAI PERGASAL 1052 HOSPITAL TENGGALU, KEMAMAN AFZAN KUANTAN NO PENDAFTARAN RANC: 64538

Comparison of Pre-remedial and post-remedial actions

Step No.	Process of Care	Criteria	Standard	Pre-remedial (baseline)	Post-remedial
1	Referral for standby during delivery	Obtain details of pregnancy, indication of standby and location of delivery.	100%	75%	100% 
2	Thermoregulatory device check	Axillary Thermometer is available in resuscitation bag and is functioning	100%	NA	100%
		Radiant warmer in delivery room is preheated	100%	90%	100% 
		At least TWO prewarmed linens/ towel available	100%	75%	100% 
		Ensure availability of temperature sensor and sensor cover for prolonged resuscitation	100%	80%	100% 
		Cap available for all preterm deliveries	100%	65%	100% 
		Plastic wrap available for all preterm deliveries <32 week gestation	100%	90%	100% 
		Ensure transport incubator prewarmed	100%	75%	100% 

....Comparison of Pre-remedial and post-remedial actions *(cont)*

Step No.	Process of Care	criteria	Standard	Pre-remedial (baseline)	Post-remedial
3	Identification of risk factors of hypothermia	Correct identification of fetal gestation at risk of of hypothermia (Very Preterm/ <32 weeks)	100%	90%	100% 
		Correct identification of estimated fetal weight at risk of of hypothermia (VLBW/ <1.5kg)	100%	95%	100% 
4	Routine thermoregulatory steps during resuscitation	All newborn babies put under preheated radiant warmer	100%	90%	100% 
		All newborn babies are dried and stimulated (> 32 week)	100%	85%	100% 
		Removal of wet linens	100%	85%	100% 

....Comparison of Pre-remedial and post-remedial actions *(cont)*

Step No.	Process of Care	criteria	Standard	Pre-remedial (baseline)	Post-remedial
5	Additional thermoregulatory steps	For all preterm babies < 32 weeks, cap and plastic wrap is immediately applied	100%	75%	100%
		For babies < 1.5kg, cap and plastic wrap is immediately applied	100%	70%	100%



....Comparison of Pre-remedial and post-remedial actions *(cont)*

Step No.	Process of Care	criteria	Standard	Pre-remedial (baseline)	Post-remedial
6	Measurement of core temperature	Monitor axillary temperature at TWO time points	100%	NA	100%
7	Corrective thermoregulatory steps	Addition of prewarmed linen in hypothermic babies	100%	NA	100%
		Ensure plastic wrap are of good seal in hypothermic pre-term babies < 32 weeks / EFW < 1.5kg	100%	NA	100%
		Reassessment of axillary temperature at 10 minutes interval until normothermia/ end of resuscitation	100%	NA	100%
8	Thermoregulation during transfer of baby to NICU	Transport baby via prewarmed incubator	100%	80%	100%
		Ensure thermoregulatory measures are optimised and continued throughout transport	100%	NA	100%



Conclusion

- Neonatal hypothermia is a potentially life threatening condition that leads increment in morbidity and mortality.
- Effective thermoregulation and prompt corrective thermoregulatory measures are essential during neonatal resuscitation to reduce incidence of hypothermia in newborn.
- Clear and concise thermoregulatory guideline should be incorporated into the existing standard neonatal resuscitation guideline.
- Continuous training should be conducted among medical staff with emphasis of strict adherence to thermoregulation during resuscitation.

What's the next step?

- For continued implementation of thermoregulation bundle care in all neonatal resuscitation
- Continued emphasis of thermoregulatory measures during NRP training for all new staffs
- To follow-up on adherence of thermoregulation bundle care among all staff
- To involve hospital authorities in standardization of Operation theatre temperature
- To obtain other thermoregulatory equipment that may improve thermoregulation (thermal mattress, new radiant warmer with thermal probes etc.)

Gantt chart

	March 2023	April 2023	October 2023	Dec 2023	January 2024	Feb – March 2024	4th March 2024
Study proposal							
Proposal presentation							
Data collection							
Remedial Action							
Data analysis							
Write-up							



*The greatest gift you can give a newborn is the chance
to grow and thrive*

References

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