Kliiniline küsimus nr 13

Kas kõikidel enneaegsetel vastsündinutel mõjutab ravitulemusi normotermia tagamine võrreldes hüpotermiaga ja iatrogeense hüpertermiaga?

Kriitilised tulemusnäitajad: lapse peamised tulemusnäitajad

Ravijuhendid

Kokkuvõte ravijuhendites leiduvast

Sekretariaadi poolt eelnevalt hinnatud ravijuhenditest käsitlevad antud teemat 4 ravijuhendit:

1) European Resuscitation Council Guidelines for Resuscitation 2010 ja 2015

Naked, wet, newborn babies cannot maintain their body temperature in a room that feels comfortably warm for adults. Compromised babies are particularly vulnerable. Exposure of the newborn to cold stress will lower arterial oxygen tension and increase metabolic acidosis. Preterm infants are especially vulnerable and hypothermia is also associated with serious morbidities such as intraventricular haemorrhage, need for respiratory support, hypoglycaemia and in some studies late onset sepsis.

Prevent heat loss:

• Keep the delivery room warm. For babies less than 28 weeks gestation the delivery room temperature should be >25 ◦C.

• In very preterm babies (especially below 28 weeks) drying and wrapping may not be sufficient. A more effective method of keeping these babies warm is to cover the head and body of the baby (apart from the face) with plastic wrapping, without drying the baby beforehand, and then to place the baby so covered under radiant heat.

Dahm LS, James LS. Newborn temperature and calculated heat loss in the delivery room. Pediatrics 1972;49:504–13.

Stephenson J, Du JTKO. The effect if cooling on blood gas tensions in newborn infants. J Pediatr 1970;76:848–52.

Gandy GM, Adamsons Jr K, Cunningham N, Silverman WA, James LS. Thermal environment and acid-base homeostasis in human infants during the first few hours of life. J Clin Invest 1964;43:751–8.

Kent AL, Williams J. Increasing ambient operating theatre temperature and wrapping in polyethylene improves admission temperature in premature infants. J Paediatr Child Health 2008;44:325–31.

Knobel RB, Wimmer Jr JE, Holbert D. Heat loss prevention for preterm infants in the delivery room. J Perinatol 2005;25:304–8.

2) European Consensus Guidelines on the Management of Neonatal Respiratory Distress Syndrome (RDS) in Preterm Infants 2013

Plastic bags or occlusive wrapping under radiant warmers should be used during stabilization in the delivery suite for babies <28 weeks' gestation to reduce the risk of hypothermia (A).

Babies stabilized under a radiant warmer should be servocontrolled within 10 min to avoid overheating (B).

Body temperature should be maintained at 36.5–37.5 ° C at all times (C).

In preterm babies in incubators the use of a servo-controlled skin temperature at 36.5 ° C decreases neonatal mortality.

Sinclair JC: Servo-control for maintaining abdominal skin temperature at 36 ° C in low birth weight infants. Cochrane Database Syst Rev 2002:CD001074.

McCall EM, Alderdice F, Halliday HL, Jenkins JG, Vohra S: Interventions to prevent hypothermia at birth in preterm and/or low birthweight infants. Cochrane Database Syst Rev 2010:CD004210.

Table 1. Levels of evidence and grades of recommendation

Levels of evidence	
1++	High-quality meta-analyses, systematic reviews of RCTs or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews or RCTs with a low risk of bias
1–	Meta-analyses, systematic reviews or RCTs with a high risk of bias
2++	High-quality systematic reviews of case control or cohort studies High-quality case control or cohort studies with a very low risk of confounding bias
2+	High quality case control or cohort studies with a low risk of confounding bias
2–	Well-conducted case control or cohort studies with a high risk of confounding bias
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion
Grades of recommendation: GRADE	
A	At least one meta-analysis, systematic review or RCT rated as 1++ and directly applicable to the target population or A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population and demonstrating consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population and demonstrating consistency of results or Extrapolated evidence from studies such as 1++ or 1+
C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating consistency of results or Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4 or Extrapolated evidence from studies rated as 2+

GRADE = Grading of recommendations assessment, development and evaluation [5]; RCT = randomized controlled trial.

3) Care of extremely premature infants, The Swedish National Board of Health and Welfare, 2014

To avoid heat losses, the child ought to be wrapped in plastic as soon as possible after the birth and without being dried off beforehand.

Süstemaatilised ülevaated

Kokkuvõte süstemaatilistest ülevaadetest

Antud teema kohta ei leidunud ühtki kvaliteetset süstemaatilist ülevaadet ega metaanalüüsi (viimase kümnendi jooksul), mistõttu ülevaade on koostatud tuginedes randomiseeritud kontroll- ja vaatlusuuringutele.

For more than 40 years, hypothermia has been recognized as an independent risk factor for death in newborn infants. Despite modern resuscitation techniques, 40%-65% of premature newborns still experience hypothermia, and it remains an independent risk factor for death in this population. Very preterm infants are particularly vulnerable to heat loss because of immature, keratindeficient skin without subcutaneous fat, poor vasomotor control, and increased surface area to body weight ratio. Besides an increased risk of mortality, other complications associated with neonatal hypothermia include morbidity from acidosis, delayed transition from fetal to newborn circulation, abnormal coagulation, infection, and respiratory distress syndrome. /Reilly et al 2015

Minimizing heat loss in low birth weight and premature infants is difficult because of high evaporative heat loss exacerbated by a large temperature gradient from the skin to the ambient air and physical characteristics of the premature infant (increased surface area/weight ratio, immature epidermal barrier, limited vernix caseosa, and subcutaneous fat). /Laptook et al 2007.

2000. aastal avaldatud EPICure uuring Ühendkuningriikides ja Iirimaal leidis, et 40% hospitaliseeritud enneaegsetest vastsündinutest (< 26 GN) oli kehatemperatuur alla 35 kraadi ning see omakorda oli otseses seoses suremusega.

Laptook et al avaldasid 2007. aastal uuringu, milles hinnati suure kohordi (5277 LBWI) enneaegsete vastsündinute kehatemperatuure NICUsse hospitaliseerimisel ning selle mõju haigestumisele ja suremusele (kojukirjutamisel, 120 päeva peale sündi või surma puhuselt – olenevalt milline ajaliselt varem juhtus). Uuringus osales 15 keskust *Neonatal Research Network*'i haiglatest. Arvesse võeti ka emapoolseid (ema ravimid, AB-ravi, steroidid), sünnipuhuseid (PROM, sünnituse viis) asjaolusid jm. Kokkuvõtvalt leiti, et kehatemperatuur hospitaliseerimisel ei ole seotud NEKi, IVH, invasiivse hingamistoetuse kestusega. Küll aga leiti seoseid kehatemperatuuri ja hilise sepsise vahel ning seeläbi ilmnes seos ka suremusega. Põhjapanevamateks järeldusteks on vajalikud põhjalikumad uuringud.

Miller et al 2011 aastal avaldatud uuringus hinnati 8782 VLBW vastsündinu kehatemperatuure ja seost haigestumise ja suremusega, kasutades WHO temperatuuri kriteeriume (kerge hüpotermia =36.0–36.4^{0}C; mõõdukas hüpotermia = 32.0–35.9^{0}C; raske hüpotermia = <32^{0}C). Uuringu tulemusena on mõõduka hüpotermia puhuselt suurenenud risk IVH kujunemisele; mõõduka või raske hüpotermiaga suureneb risk suremusele.

Reilly et al 2015 aastal avaldatud uuringus kontrollisid juba avaldatud uuringute tulemusi ning analüüsisid ligi 800 enneaegse vastsündinu (24+0-27+6) ravitulemusi. Leiti, et enneaegse vastsündinu kinnikatmine küll tõstab kehatemperatuuri, kuid ei ole statistiliselt oluliselt seoses suremusega. Autorid leidsid, et lastel, kellel oli rektaalne temperatuur

<34,5^{0}C, oli suremus >40% ning lastel, kellel temperatuur oli >37,5^{0}C, oli suremus 10-15%. Statistiliselt küll mitteoluline, kuid autorid järeldasid: hüpotermia korral suureneb suremus, kuid vaid kinnikatmine ei ole efektiivne viis hüpotermiast põhjustatud surmade vähendamiseks. Statistiliselt oluliselt vähendab kinnikatmine DAPi sulgemise vajadust ja kopsu hemorraagia esinemissagedust 24.-25. GN-l sündinud laste hulgas.

Several studies and reviews have been carried out to evaluate interventions that may be valuable in decreasing post-birth heat loss in very preterm infants, and currently the latest guidelines for newborn resuscitation from the American Academy of Pediatrics emphasize the goal of preventing hypothermia in premature infants. Despite the emphasis placed on maintaining normothermia, no population-based investigation of the distribution and predictors of initial temperatures using WHO criteria in VLBW infants born in contemporary neonatal intensive care units and their relationship to morbidity and mortality has been published.

Palju erinevaid üksikuuringuid on avaldatud erinevate kinnikatmise meetodite kohta. Peamine probleem tänapäeval käigus olevate uuringute puhul on see, et vaatamata kinnikatmisele esineb suurel osal enneaegsetest vastsündinutest jätkuvalt hüpotermiat.
Several interventions, including plastic hats and wraps, warmer mattresses, and warm delivery rooms, have been shown to improve admission temperatures for preterm infants, but the majority of infants still become cold. /DeMauro et al 2013

McCarthy et al 2013 avaldatud uuringus hindasid polüetüleenkile ja eksotermaalse madratsi kasutamist. Leiti, et polüetüleenkile ja madratsi koos kasutamisel on suurem risk hüpertermia kujunemisele kui risk vaid polüetüleenkile kasutamisel tekkivale hüpotermiale. Vajalikud on edasised uuringud mööduva hüpertermia mõjude hindamiseks enneaegsel vastsündinul. Sama uuringu käigus hinnati ka kulusid ning leiti, et polüetüleenkile kasutamine on tunduvalt odavam ja kulutõhusam.

Arvestades kliinilist küsimust, ei ole antud dokumendis põhjalikumalt analüüsitud erinevaid kinnikatmise meetodeid.

Normotermia teemat on uuritud ja sellekohaseid artikleid avaldatud juba 1960ndatest. Erinevad uuringud väidavad, et normotermia tagamine vähendab suremust ja neonataalset haigetumust, eriti sügavalt enneaegsete laste hulgas. Viimase kümnendi jooksul ei ole aga antud teema kohta avaldatud ühtki väga hea kvaliteediga süstemaatilist ülevaadet ega metaanalüüsi (puudulik kvaliteet ja väike uuritavate arv).

Uuringute ja (enneaegse) vastsündinu füsioloogia analüüsimisel tuleb kindlasti arvestada ka asjaolu, et patsiendi seisukohast on soojendamine ja normotermia tagamine eluliselt vajalik, mistõttu tänapäevase kvaliteetse randomiseeritud uuringu teostamine on kindlasti ka eetiliselt problemaatiline. Vaatamata sellele, et lähikümnendil ei ole avaldatud uusi põhjapanevate tulemustega artikleid, jääb normotermia tagamine tugevaks soovituseks ka tänapäeval.

Viited

Kokkuvõtte (abstract või kokkuvõtlikum info)	Viide kirjandusallikale
OBJECTIVE: To evaluate the outcome for all infants born before 26 weeks of gestation in the United Kingdom and the Republic of Ireland. This report is of survival and complications up until discharge from hospital. **RESULTS:** A total of 4004 births were recorded, and 811 infants were admitted for intensive care. Overall survival was 39% (n = 314). Male sex, no reported chorioamnionitis, no antenatal steroids, persistent bradycardia at 5 minutes, hypothermia, and high Clinical Risk Index for Babies (CRIB) score were all independently associated with death. Of the survivors, 17% had parenchymal cysts and/or hydrocephalus, 14% received treatment for retinopathy of prematurity (ROP), and 51% needed supplementary oxygen at the expected date of delivery. Failure to administer antenatal steroids and postnatal transfer for intensive care within 24 hours of birth were predictive of major scan abnormality; lower gestation was predictive of severe ROP, while being born to a black mother was protective. Being of lower gestation, male sex, tocolysis, low maternal age, neonatal hypothermia, a high CRIB score, and surfactant therapy were all predictive of oxygen dependency. Intensive care was provided in 137 units, only 8 of which had >5 survivors. There was no difference in survival between institutions when divided into quintiles based on their numbers of extremely preterm births or admissions. **CONCLUSIONS:** This study provides outcome data for this geographically defined cohort; survival and neonatal morbidity are consistent with previous data from the United Kingdom and facilitate comparison with other geographically based data.	Costeloe K, Hennessy E, Gibson AT, Marlow N, Wilkinson AR**. The EPICure study: outcomes to discharge from hospital for infants born at the threshold of viability.** Pediatrics. 2000 Oct;106(4):659–71.
BACKGROUND. There is a paucity of information on the maintenance of body temperature at birth for low birth weight infants. **OBJECTIVES.**We examined the distribution of temperatures in low birth weight infants on admission to the NICUs in the Neonatal Research Network centers and determined whether admission temperature was associated with antepartum and birth variables and selected morbidities and mortality. **METHODS.** Infants without major congenital anomalies born during 2002 and 2003 with birth weights of 401 to 1499 g who were admitted directly from the delivery room to the NICU were included. Bivariate associations between antepartum/birth variables and admission temperature and selected morbidities/mortality and admission temperature were examined, followed by multivariable linear or logistic regressions to detect independent associations. **RESULTS.** There were 5277 study infants and the mean (±SD) birth weight and gestational age were 1036 ± 286 g and 28 ± 3 weeks, respectively. The	Laptook AR, Salhab W, Bhaskar B, Neonatal Research Network. **Admission temperature of low birth weight infants: predictors and associated morbidities.** Pediatrics. 2007 Mar;119(3):e643–9.

distribution of admission temperatures was 14.3% at <35°C, 32.6% between 35 and 35.9°C, 42.3% between 36 and 36.9°C, and 10.8% at ≥37°C. The estimate of birth weight on admission temperature with and without intubation was +0.13°C and +0.04°C per 100-g increase in birth weight, respectively. The mean admission temperature for each center varied from 1.5°C below to 0.3°C above a reference center. On adjusted analyses, admission temperature was inversely related to mortality (28% increase per 1°C decrease) and late-onset sepsis (11% increase per 1°C decrease) but not to intraventricular hemorrhage, necrotizing enterocolitis, or duration of conventional ventilation.
CONCLUSIONS. Preventing decreases in temperature at birth among low birth weight infants remains a challenge. Associations with intubation and center of birth suggest that assessment of temperature control for infants intubated in the delivery room may be beneficial. Whether the admission temperature is part of the casual path or a marker of mortality needs additional study.

TABLE 1 Descriptive Characteristics of the Study Cohort

Characteristic	Total
Maternal, %	
Medications received	
Antibiotics	69.9
Tocolytics	42.1
Antenatal steroids	82.6
Intrapartum, %	
Multiple births	28.0
Labor	63.9
Ruptured membranes >18 h	24.6
Cesarean section	63.1
Infant characteristics	
Birth weight, mean ± SD, g	1032 ± 288
Gestational age, mean ± SD, wk	28.0 ± 2.8
Male, %	51.2
Delivery room	
Apgar at 1 min <7, %	56.1
Apgar at 5 min <7, %	24.9
Umbilical artery pH, mean ± SD	7.26 ± 0.11
Umbilical artery base deficit, mean ± SD	−4.5 ± 4.3
Intubation, %	52.4
Chest compressions/medications, %	6.8

TABLE 2 Admission Temperature for Infants ≤28 Weeks' Gestation

Gestational Age, wk	*n*	Birth Weight, mean ± SD, g	Admission Temperature, %	
			<35°C	<36°C
28	643	1088 ± 201	9.6	38.3
27	609	977 ± 182	10.7	41.5
26	539	840 ± 163	13.2	44.2
25	468	751 ± 130	20.5	57.1
24	397	655 ± 100	33.8	64.2
<24	187	598 ± 118	43.9	71.1

Data are presented up to 28 weeks, because the registry is defined by birth weight, and infants >28 weeks' with a birth weight >1500 g will not be included.

Objective: The objective of this study was to study the epidemiology of neonatal hypothermia in preterm infants using World Health Organization (WHO) temperature criteria.
Study Design: A population-based cohort of 8782 very low birth weight (VLBW) infants born in California neonatal intensive care units in 2006 and 2007. Associations between admission hypothermia and maternal and neonatal characteristics and outcomes were determined using logistic regression.
Result: In all, 56.2% of infants were hypothermic. Low birth weight, cesarean

Miller SS, Lee HC, Gould JB. **Hypothermia in very low birth weight infants: distribution, risk factors and outcomes.** J Perinatol. 2011 Apr;31 Suppl 1:S49–56.

delivery and a low Apgar score were associated with hypothermia. Spontaneous labor, prolonged rupture of membranes and antenatal steroid administration were associated with decreased risk of hypothermia. Moderate hypothermia was associated with higher risk of intraventricular hemorrhage (IVH). Moderate and severe hypothermic conditions were associated with risk of death.

Conclusion: Hypothermia by WHO criteria is prevalent in VLBW infants and is associated with IVH and mortality. Use of WHO criteria could guide the need for quality improvement projects targeted toward the most vulnerable infants.

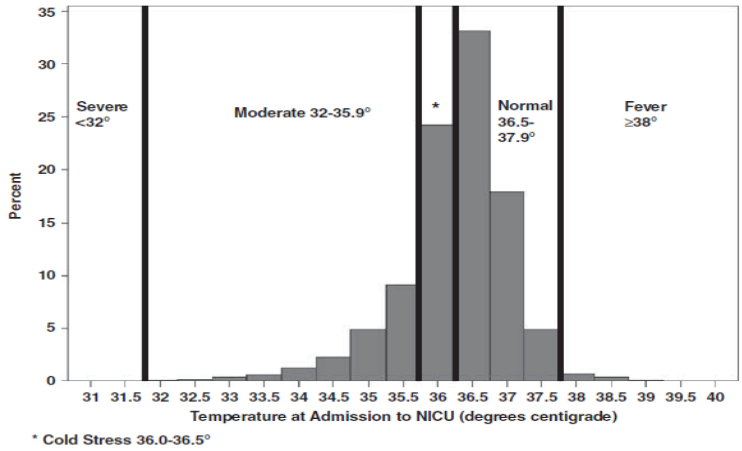

Table 2 Risk factors for WHO criteria of moderate/severe hypothermia, cold stress and any hypothermia as determined by logistic regression models

	Moderate/severe (95% CL)	*Cold stress (95% CL)*	*Any low temperature (95% CL)*
Birth weight (vs 1400–1499)			
1000–1099 g	NS	1.3 (1.0–1.6)	1.3 (1.0–1.5)
900–999 g	1.6 (1.3–2.0)	1.3 (1.1–1.6)	1.5 (1.2–1.8)
800–899 g	1.7 (1.3–2.1)	NS	1.4 (1.1–1.7)
700–799 g	2.2 (1.7–2.8)	1.3 (1.1–1.7)	1.7 (1.4–2.1)
600–699 g	3.8 (2.9–4.9)	1.6 (1.2–2.1)	2.5 (2.0–3.2)
500–599 g	4.2 (3.1–5.9)	1.8 (1.2–2.5)	2.9 (2.1–3.8)
400–499 g	8.0 (4.2–15.3)	2.6 (1.3–5.3)	5.0 (2.7–9.3)
Delivery mode (Cesarean vs vaginal)	1.2 (1.0–1.4)	1.3 (1.1–1.5)	1.2 (1.1–1.4)
Spontaneous labor	0.8 (0.7–0.9)[a]	0.9 (0.8–1.0)[a]	0.8 (0.8–0.9)[a]
Prolonged rupture of membranes	0.7 (0.6–0.9)[a]	0.8 (0.7–0.9)[a]	0.8 (0.7–0.9)[a]
Antenatal steroids	0.7 (0.6–0.8)[a]	0.9 (0.8–1.0)[a]	0.8 (0.7–0.9)[a]
Maternal hypertension	1.1 (1.0–1.1)	NS	NS
1 min Apgar (0–6 vs 7–10)	1.1 (1.0–1.3)	1.1 (1.0–1.3)	1.1 (1.0–1.3)
5 min Apgar (0–6 vs 7–10)	1.5 (1.3–1.7)	NS	1.3 (1.1–1.4)
Resuscitation (none vs any in delivery room)	NS	0.8 (0.7–0.9)[a]	0.8 (0.7–0.9)[a]
Multiple gestation	NS	0.8 (0.7–0.9)[a]	0.9 (0.8–1.0)[a]
Race			
Black	1.3 (1.1–1.5)	NS	1.2 (1.1–1.4)
Asian	NS	NS	1.2 (1.0–1.4)

Abbreviations: CL, confidence limits; NS, not statistically significant; WHO, World Health Organization.
[a]Represents factors associated with lower risk of hypothermia.
All odds ratios listed in the table have $P<0.05$.

Table 3 Neonatal outcomes evaluated according to WHO criteria for hypothermia using bivariate analyses

Morbidity	*Normal (%) (N = 2233)*[a]	*Cold stress (%) (N = 2639)*[a]	*Severe/moderate (%) (N = 3740)*[a]	P-*value*
Stage 3 or 4 ROP	6.5	6.5	11.2	<0.0001
NEC	7.3	7.2	8.8	0.11
Sepsis (early)	2.4	2.0	2.3	0.46
Sepsis (late)	11.4	10.9	15.0	<0.0002
Oxygen at 36 weeks	8.4	6.5	7.0	<0.0001
IVH	6.8	7.0	13.0	<0.0001
Death	6.7	8.5	17.0	<0.0001
Death + IVH 3–4	11.1	12.3	22.8	<0.0001

Abbreviations: IVH, intraventricular hemorrhage; NEC, necrotizing enterocolitis; ROP, retinopathy of prematurity; WHO, World Health Organization.
[a]Infants excluded if they died and did not have the condition.
The independent variable is hypothermia. The (%) is the percent of infants in each subcohort that have the condition.

We evaluated the relationship between hypothermia and stage 3 or 4 ROP, necrotizing enterocolitis, early-onset sepsis, late-onset sepsis, oxygen use at 36-week-corrected gestational age, IVH, death and the combined outcome of grades 3 to 4 IVH and death.
Table 3 shows the frequency of these morbidities across WHO temperature criteria. Although there were significant bivariate associations between hypothermia and ROP, late-onset sepsis, oxygen at 36 weeks, IVH and death, many of these relationships were not statistically significant after risk adjustment. After risk adjustment, we found no association between mild hypothermia and any of the morbidities or death. Moderate hypothermia was associated with higher odds of IVH (odds ratio 1.3, 95% confidence limit 1.1 to 1.6) and death (odds ratio 1.5, 95% confidence limit 1.3 to 1.9). Severe hypothermia, although seen in only nine infants, was also associated with higher odds of death (odds ratio 5.6, 95% confidence limit 1.1 to 28.1).

Objective To determine whether the application of occlusive wrap applied immediately after birth will reduce mortality in very preterm infants.
Study design This was a prospective randomized controlled trial of infants born 24 0/7 to 27 6/7 weeks' gestation who were assigned randomly to occlusive wrap or no wrap. The primary outcome was all cause mortality at discharge or 6 months' corrected age. Secondary outcomes included temperature, Apgar scores, pH, base deficit, blood pressure and glucose, respiratory distress syndrome, bronchopulmonary dysplasia, seizures, patent ductus arteriosus, necrotizing enterocolitis, gastrointestinal perforation, intraventricular hemorrhage, cystic periventricular leukomalacia, pulmonary hemorrhage, retinopathy of prematurity, sepsis, hearing screen, and pneumothorax.

Reilly, M.C., Vohra, S., Rac, V.E., Dunn, M., Ferrelli, K., Kiss, A., Vincer, M., Wimmer, J., Zayack, D., Soll, R.F., Vermont Oxford Network Heat Loss Prevention (HeLP) Trial Study Group, 2015. **Randomized trial of occlusive wrap for heat loss prevention in preterm infants.** J.

Results Eight hundred one infants were enrolled. There was no difference in baseline population characteristics. There were no significant differences in mortality (OR 1.0, 95% CI 0.7-1.5). Wrap infants had statistically significant greater baseline temperatures (36.3^{0}C wrap vs 35.7^{0}C no wrap, P < .0001) and poststabilization temperatures (36.6^{0}C vs 36.2^{0}C, P < .001) than nonwrap infants. For the secondary outcomes, there was a significant decrease in pulmonary hemorrhage (OR 0.6, 95% CI 0.3-0.9) in the wrap group and a significant lower mean one minute Apgar score (P = .007) in the wrap group. The study was stopped early because continued enrollment would not result in the attainment of a significant difference in the primary outcome.
Conclusion Application of occlusive wrap to very preterm infants immediately after birth results in greater mean body temperature but does not reduce mortality.

Table II. Primary outcome for infants assigned to the wrap and no wrap groups

Mortality	Wrap	No wrap	OR (95% CI)	*P* value
All infants	83/404 (20.5%)	79/395 (20.0%)	1.0 (0.7-1.5)	.85
Stratum 1: 24 0/7 to 25 6/7	49/188 (26.1%)	59/178 (33.2%)	0.7 (0.5-1.1)	.14
Stratum 2: 26 0/7 to 27 6/7	34/216 (15.7%)	20/217 (9.2%)	1.8 (1.0-3.3)	.04

Table III. Secondary outcomes of infants assigned to the wrap and no-wrap groups

Secondary outcomes	Wrap	No wrap	*P* value	OR (95% CI)
Apgar scores (mean)				
1 min	4.68 ± 2.3	5.12 ± 2.3	**.007**	
5 min	7.05 ± 2.0	7.30 ± 1.8	.11	
10 min	7.31 ± 2.3	7.33 ± 2.2	.67	
RDS	373/404 (92%)	363/396 (92%)	.73	1.09 (0.7-1.08)
Treated PDA	192/401 (48%)	209/394 (53%)	.14	0.8 (0.6-1.1)
IVH				
Any	143/378 (38%)	148/375 (40%)	.97	0.95 (0.6-1.45)
Severe (3 and 4)	45/378 (12%)	45/375 (12%)		0.97 (0.5-1.8)
Cystic PVL	17/376 (5%)	21/375 (6%)	.50	0.78 (0.41-1.50)
Pulmonary hemorrhage	27/403 (7%)	44/393 (11%*)	**.03**	0.6 (0.3-0.9)
GI perforation	23/402 (6%)	18/393 (5%)	.47	1.3 (0.7-2.4)
NEC (stage 2 or more)	34/403 (8%)	35/394 (9%)	.82	0.9 (0.6-1.5)
ROP, severe (stage 3 or greater)	58/305 (19%)	57/301 (19%)	.98	1.0 (0.7-1.5)
Bacterial sepsis (early)	16/401 (4%)	22/394 (6%)	.29	0.7 (0.4-1.4)
Sepsis and/or meningitis late (any bacterial)	78/373 (21%)	93/369 (25%)	.16	0.8 (0.5-1.1)
Sepsis and/or meningitis late (coagulase negative staphylococcus only)	86/373 (23%)	80/367 (22%)	.68	1.1 (0.8-1.5)
Sepsis and/or meningitis late (fungal)	25/372 (7%)	20/367 (6%)	.47	1.3 (0.7-2.3)
BPD (collapsed category analysis)	184/354 (52%)	182/348 (52%)	.93	1.0 (0.7-1.3)
Steroids for BPD	75/403 (19%)	78/393 (20%)	.66	0.9 (0.6-1.3)
Pneumothorax	24/403 (6%)	24/393 (6%)	.93	1.0 (0.5-1.7)

BPD, bronchopulmonary dysplasia; *GI*, gastrointestinal; *IVH*, intraventricular hemorrhage; *NEC*, necrotizing enterocolitis; *PVL*, periventricular leukomalacia; *RDS*, respiratory distress syndrome; *ROP*, retinopathy of prematurity.
Bolded values are statistically significant.

Pediatr. 166, 262–268.e2. doi:10.1016/j.jpeds.2014.09.068

BACKGROUND AND OBJECTIVES:
Events in the delivery room significantly impact the outcomes of preterm infants. We developed evidence-based guidelines to prevent heat loss, reduce exposure to supplemental oxygen, and increase use of noninvasive respiratory support to improve the care and outcomes of infants with birth weight ≤1250 g at our institution.
METHODS:
The guidelines were implemented through multidisciplinary conferences, routine use of a checklist, appointment of a dedicated resuscitation nurse, and frequent feedback to clinicians. This cohort study compares a historical group (n = 80) to a prospective group (n = 80, after guidelines were implemented). Primary outcome was axillary temperature at admission to the intensive care nursery. Secondary outcomes measured adherence to the guidelines and changes in clinically relevant patient outcomes.

DeMauro SB, Douglas E, Karp K, Schmidt B, Patel J, Kronberger A, et al. **Improving delivery room management for very preterm infants.** Pediatrics. 2013 Oct;132(4):e1018–25.

RESULTS: Baseline characteristics of the groups were similar. After introduction of the guidelines, average admission temperatures increased (36.4°C vs 36.7°C, P < .001) and the proportion of infants admitted with moderate/severe hypothermia fell (14% vs 1%, P = .003). Infants were exposed to less oxygen during the first 10 minutes (P < .001), with similar oxygen saturations. Although more patients were tried on continuous positive airway pressure (40% vs 61%, P = .007), the intubation rate was not significantly different (64% vs 54%, P = .20). Median durations of invasive ventilation and hospitalization decreased after the quality initiative (5 vs 1 days [P = .008] and 80 vs 60 days [P = .02], respectively). **CONCLUSIONS:** We have demonstrated significantly improved quality of delivery room care for very preterm infants after introduction of evidence-based delivery room guidelines. Multidisciplinary involvement and continuous education and reinforcement of the guidelines permitted sustained change.	
BACKGROUND AND OBJECTIVE: Hypothermia on admission to the NICU is associated with increased mortality in preterm infants. Many newborns are hypothermic on admission despite using polyethylene bags (PBs). Using exothermic mattresses (EMs) in addition to PBs may reduce hypothermia but increase hyperthermia. We wished to determine whether placing preterm newborns in PBs on EMs in the DR results in more infants with rectal temperature outside the range 36.5 to 37.5°C on NICU admission. **METHODS:** Infants ,31 weeks were randomly assigned before birth to treatment with or without an EM. All infants were placed in a PB and under radiant heat immediately after birth and brought to NICU in a transport incubator. Infants randomly assigned to EM were placed on a mattress immediately after delivery and remained on it until admission. Randomization was stratified by gestational age. Rectal temperature was measured with a digital thermometer on NICU admission. **RESULTS:** The data safety monitoring committee recommended stopping for efficacy after analyzing data from half the planned sample. We report data for 72 infants enrolled at this time. Fewer infants in PBs on EMs had temperatures within the target range (15/37 [41%] vs 27/35 [77%], P = .002) and more had temperatures .37.5°C (17/37 [46%] vs 6/35 [17%], P = .009). **CONCLUSIONS:** In very preterm newborns, using EMs in addition to PBs in the DR resulted in more infants with temperatures outside the normal range and more hyperthermia on NICU admission.	McCarthy LK, Molloy EJ, Twomey AR, Murphy JFA, O'Donnell CPF. **A randomized trial of exothermic mattresses for preterm newborns in polyethylene bags.** Pediatrics. 2013 Jul;132(1):e135–41.

TABLE 3 Demographics and Outcomes for Subgroups by Gestational Age

	PB + EM	PB	*P*
Infants <28 wk	*n* = 15	*n* = 14	
Gestational age (wk)[a]	25 (1.5)	26 (1.1)	.146
Birth wt (g)[a]	746 (150)	881 (216)	.059
Maternal fever	1 (7)	1 (7)	.997
Time to NICU admission (min)[a]	23 (7)	18 (4)	.021[c]
Admission rectal temperature 36.5–37.5(°C)[b]	7 (47)	13 (93)	.007[c]
Admission rectal temperature (°C)[a]	37.5 (0.9)	36.7 (0.4)	.008[c]
Admission rectal temperature >37.5°C[b]	7 (47)	0 (0)	.004[c]
Admission rectal temperature <36.5°C[b]	1 (7)	1 (7)	.960
Admission axillary temperature (°C)[a]	37.4 (0.8)	36.5 (0.5)	.002[c]
Infants ≥28 wk	*n* = 22	*n* = 21	
Gestational age (wk)[a]	29 (0.8)	29 (0.7)	.723[c]
Birth wt (g)[a]	1317 (262)	1402 (331)	.354[c]
Maternal fever	3 (14)	4 (19)	.631[c]
Time to NICU admission (min)[a]	24 (6)	20 (8)	.118[c]
Admission rectal temperature 36.5–37.5 (°C)[b]	8 (36)	14 (67)	.047[c]
Admission rectal temperature (°C)[a]	37.3 (0.9)	37.2 (0.6)	.398[c]
Admission rectal temperature >37.5°C[b]	10 (45)	6 (29)	.252[c]
Admission rectal temperature <36.5°C[b]	4 (18)	1 (5)	.170[c]
Admission axillary temperature (°C)[a]	37.3 (0.9)	37.1 (0.6)	.474[c]

[a] Data are mean (SD).
[b] Data are *n* (%).
[c] Significant *P* value.

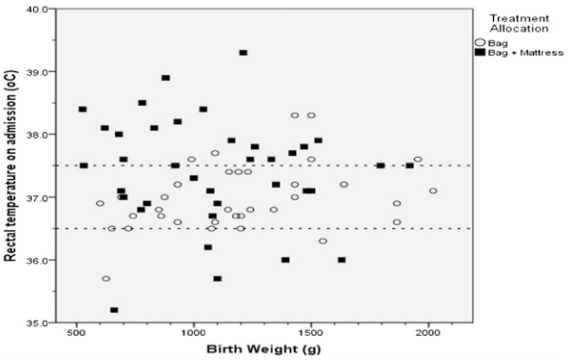

FIGURE 3
Rectal temperature versus birth weight on admission to the NICU.

OTSINGUD:

Search	Add to builder	Query	Items found	Time
#8	Add	Search ((((((((((("premature infant") OR "premature infants") OR "premature newborn") OR "premature newborns") OR "premature neonate") OR "premature neonates") OR "preterm infant") OR "preterm infants") OR "preterm newborn") OR "preterm newborns") OR "preterm neonate") OR "preterm neonates")) OR (("Infant, Premature"[Mesh]) OR "Infant, Low Birth Weight"[Mesh]))) AND ((((hypothermia) OR hyperthermia) OR thermoregulation) OR temperature)	1973	21:28:02
#28	Add	Search ((((((((((("premature infant") OR "premature infants") OR "premature newborn") OR "premature newborns") OR "premature neonate") OR "premature neonates") OR "preterm infant") OR "preterm infants") OR "preterm newborn") OR "preterm newborns") OR "preterm neonate") OR "preterm neonates")) OR (("Infant, Premature"[Mesh]) OR "Infant, Low Birth Weight"[Mesh]))) AND ((((hypothermia) OR hyperthermia) OR thermoregulation) OR temperature) Filters: Meta-Analysis; Systematic Reviews; Randomized Controlled Trial	185	21:28:02
#13	Add	Search ((((((((((("premature infant") OR "premature infants") OR "premature newborn") OR "premature newborns") OR "premature neonate") OR "premature neonates") OR "preterm infant") OR "preterm infants") OR "preterm newborn") OR "preterm newborns") OR "preterm neonate") OR "preterm neonates")) OR (("Infant, Premature"[Mesh]) OR "Infant, Low Birth Weight"[Mesh]))) AND ((((hypothermia) OR hyperthermia) OR thermoregulation) OR temperature) Filters: Meta-Analysis; Systematic Reviews; Randomized Controlled Trial; published in the last 5 years	64	21:24:14
#12	Add	Search ((((((((((("premature infant") OR "premature infants") OR "premature newborn") OR "premature newborns") OR "premature neonate") OR "premature neonates") OR "preterm infant") OR "preterm infants") OR "preterm newborn") OR "preterm newborns") OR "preterm neonate") OR "preterm neonates")) OR (("Infant, Premature"[Mesh]) OR "Infant, Low Birth Weight"[Mesh]))) AND ((((hypothermia) OR hyperthermia) OR thermoregulation) OR temperature) Filters: Meta-Analysis; Systematic Reviews; published in the last 5 years	24	21:20:24
#11	Add	Search ((((((((((("premature infant") OR "premature infants") OR "premature newborn") OR "premature newborns") OR "premature neonate") OR "premature neonates") OR "preterm infant") OR "preterm infants") OR "preterm newborn") OR "preterm newborns") OR "preterm neonate") OR "preterm neonates")) OR (("Infant, Premature"[Mesh]) OR "Infant, Low Birth Weight"[Mesh]))) AND ((((hypothermia) OR hyperthermia) OR thermoregulation) OR temperature) Filters: Meta-Analysis; published in the last 5 years	6	21:20:21

Search	Add to builder	Query	Items found	Time
#9	Add	Search ((((((((((("premature infant") OR "premature infants") OR "premature newborn") OR "premature newborns") OR "premature neonate") OR "premature neonates") OR "preterm infant") OR "preterm infants") OR "preterm newborn") OR "preterm newborns") OR "preterm neonate") OR "preterm neonates")) OR (("Infant, Premature"[Mesh]) OR "Infant, Low Birth Weight"[Mesh]))) AND ((((hypothermia) OR hyperthermia) OR thermoregulation) OR temperature) Filters: published in the last 5 years	413	21:20:17
#10	Add	Search ((((((((((("premature infant") OR "premature infants") OR "premature newborn") OR "premature newborns") OR "premature neonate") OR "premature neonates") OR "preterm infant") OR "preterm infants") OR "preterm newborn") OR "preterm newborns") OR "preterm neonate") OR "preterm neonates")) OR (("Infant, Premature"[Mesh]) OR "Infant, Low Birth Weight"[Mesh]))) AND ((((hypothermia) OR hyperthermia) OR thermoregulation) OR temperature) Filters: Guideline; published in the last 5 years	3	21:20:04
#7	Add	Search (((hypothermia) OR hyperthermia) OR thermoregulation) OR temperature	854170	21:18:19
#6	Add	Search hypothermia	38887	21:17:57
#5	Add	Search hyperthermia	193897	21:17:45
#4	Add	Search hypertermia	18	21:17:39
#3	Add	Search thermoregulation	37511	21:16:55
#2	Add	Search temperature	657585	21:16:43
#1	Add	Search ((((((((((("premature infant") OR "premature infants") OR "premature newborn") OR "premature newborns") OR "premature neonate") OR "premature neonates") OR "preterm infant") OR "preterm infants") OR "preterm newborn") OR "preterm newborns") OR "preterm neonate") OR "preterm neonates")) OR (("Infant, Premature"[Mesh]) OR "Infant, Low Birth Weight"[Mesh])		