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Original Article

Reducing mother-infant separation through early skin-to-skin care in a neonatal intensive care unit setting

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ABSTRACT

INTRODUCTION. In neonatal care, mother–infant separation is common even when infants are stable or require only short-term support. Early skin-to-skin (ESTS) care may reduce separation and improve stability, bonding and breastfeeding. We aimed at implementing the practice as a protective quality improvement project.

METHODS. The study was conducted in a level-2 neonatal intensive care unit (NICU) in Denmark, embedded in routine practice. ESTS was offered whenever feasible to preterm infants, GA ≥ 30 weeks or term infants with low birth weight or respiratory symptoms. ESTS was initiated immediately after birth or when admission was indicated. A neonatal nurse stayed with the infant continuously, providing monitoring, continuous positive airway pressure (CPAP) if needed, and early feeding. Predefined safety and quality measures were recorded.

RESULTS. A total of 65 infants were included (37 preterm/low birth weight; 28 ≥ 35 weeks with respiratory symptoms). Among preterm/low birth weight infants, 32% received CPAP, none developed respiratory distress syndrome and all received ESTS for at least two hours. In the ≥ 35 weeks group, 71% received CPAP, and 36% avoided NICU transfer after short-term support. Overall, 87% were normothermic, 96% had normal glucose and no severe hypoglycaemia occurred. Latching within two hours succeeded in 29%.

CONCLUSIONS. In this real-world NICU setting, ESTS proved to be feasible and safe for selected infants. The approach reduced early separation and prevented some admissions without extra resources, supporting family-centred neonatal practice in high-income care.

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Neonatology has been a subspeciality of paediatrics for over 50 years, with notable advances in treatment and outcomes. Survival rates have increased in all high-income countries, with 97% of very preterm infants (gestational age (GA) 28-31+6) and 99.4% of moderately and late preterm infants (GA 32+0-36+0) surviving in Denmark [1]. This underscores the need to assess treatment quality beyond survival rates. In recent decades, parents have become more involved in caregiving, which has promoted the well-being of both infants and families. The World Health Organization (WHO) now advocates for increased support for parents, which has led to the emergence of new concepts [2]. Rooming-in allows parents to stay close to their baby in the neonatal intensive care unit (NICU), whereas couplet care ensures that the mother and infants are cared for in the same unit. Additionally, Kangaroo care, which promotes skin-to-skin contact, has gained prominence and is now a

priority of the WHO and national organisations [2]. Despite these changes in practice, the routine separation of infants from their mothers upon admission to the NICU remains common. Evidence increasingly suggests that early separation can cause stress for both parents and infants and may negatively affect breastfeeding and postnatal cardiorespiratory adaptation [3-5].

Approximately 10% of newborns are admitted to the neonatal unit within their first 24 hours, most immediately after delivery [1]. Infants with GA < 35 or with low birth weight are routinely admitted due to increased risk of temperature instability, feeding difficulties, hypoglycaemia and respiratory distress. Most of these infants are stable and require no intensive care after birth. Term infants are typically admitted unexpectedly, typically with respiratory distress requiring short-term support [6, 7].

In neonatology, the early skin-to-skin (ESTS) approach is a practice in which the mother and infant remain together after birth, with no or minimal physical separation, even if the newborn requires specialised care [8]. In many cases, care and treatment can be provided without separating the infant from the mother in the labour ward or operating room. Treatment and care are initiated while the newborn is lying on the mother's chest or on a resuscitation table near the mother's bed.

Recognising the numerous benefits of ESTS, we introduced this approach in our NICU while carefully monitoring safety. Before this project, infants meeting NICU admission criteria were routinely separated from mothers and transferred to the NICU shortly after birth. Whenever possible, ESTS was offered to all stable infants with a GA ≥ 30 requiring admission to the NICU. In our project, ESTS was initiated immediately after birth or as soon as the child had been stabilised. The intended duration was at least two hours or until transfer to the NICU or maternity ward. This study aimed to present data from our initial experiences, based on the hypothesis that ESTS is safe for both preterm and term infants and may reduce admissions in infants with GA ≥ 35 presenting with respiratory symptoms.

Methods

This prospective quality improvement project, conducted from 1 December 2023 to 30 June 2024, systematically evaluated the practice of ESTS in newborns requiring NICU admission.

To introduce ESTS, the plan-do-check-act (PDCA) process was used to structure the project and ensure a systematic approach. The PDCA process is a four-step cycle that serves as a tool for structuring continuous improvement processes [9]. The cycle involves identifying an opportunity for change (plan), implementing a plan to evaluate its effectiveness (do), verifying implementation (check) and taking further action based on the review to ensure implementation (act), and thus the cycle begins again. After the initial cycle in our project, infants delivered by Caesarean section (CS) were included. A project protocol was developed involving the paediatric, anaesthesiology and obstetrics departments across the hospital.

Our department is a level 2 NICU providing care for infants with GA ≥ 28 in the Capital Region of Denmark and covers approximately 4,000 births annually. The unit already practices rooming-in and couplet care, and it is a priority to support parents in bonding and caring for their infants. All preterm infants with a GA < 35, and all infants with a birth weight (BW) of less than 2,300 g are routinely admitted to the NICU. Paediatric attendance is standard for all preterm deliveries at GA < 35. In emergency situations or when symptoms arise, paediatric support is available to all newborns. In case of respiratory symptoms, the newborn typically receives continuous positive airway pressure (CPAP) via mask at the resuscitation table. If symptoms persist beyond 20-30 minutes, the standard practice before this project was to admit the infant to the NICU for further treatment, with the attending physician determining whether admission was needed. Eligible newborns were those deemed to require NICU admission due to GA, BW or respiratory support. The limited availability of nursing resources in

the NICU, compounded by the lack of additional resources allocated for implementation of ESTS practice, restricted inclusion at any given time. For infants admitted due to GA or BW, ESTS was initiated immediately after birth or following stabilisation with a target duration of at least two hours or before transfer to the NICU. For newborns with GA ≥ 35 who presented with respiratory symptoms, ESTS was initiated once NICU admission was confirmed, typically 20-30 minutes after delivery. Infants delivered via CS received treatment either while positioned on the mother's chest using portable equipment or on a resuscitation table adjacent to the mother if direct contact was not feasible. All infants subsequently received skin-to-skin care upon arrival in the recovery room.

Whenever an infant was eligible for inclusion, the attending physician contacted the neonatal nurse, who initiated observation and treatment in the delivery or operating room. Observation included continuous pulse oximetry, blood pressure, respiration rate and temperature measurement. Nasal CPAP (NCPAP) treatment was used when indicated, and a nasogastric tube was inserted for early feeding. The neonatal nurse stayed with the infant continuously, ideally until both mother and infant could be transferred either to the NICU or the maternity ward together. In the group of infants GA ≥ 35 with transient respiratory symptoms, the attending physician assessed the infant's need for further NCPAP or whether treatment could be discontinued when the mother was ready to be transferred from the delivery or recovery ward to the maternity ward. We predefined safety parameters (infants requiring more than 30% inspired oxygen or circulatory instability) and early care quality parameters (temperature stability, normoglycaemia, successful latching, avoidance of NICU transfer). Failing safety parameters prompted NICU transfer.

Predefined quality data were collected prospectively (**Table 1**).

TABLE 1 Cohort description divided into unexpected admissions and infants who are routinely admitted to the neonatal intensive care unit.

Cohort	GA ≥ 35 wks and BW ≥ 2,300 g	GA 30-35 wks or BW < 2,300 g
Infants, N	28	37
GA, mean (min.-max), wks	38+5 (35+1-42+0)	35+0 (31+4-39+3)
BW, mean (min.-max), g	3,274 (2,315-4,350)	2,048 (1,650-2,535)
Mode of delivery		
Vaginal	12/28 (43)	30/37 (81)
Caesarean section	16/28 (57)	7/37 (19)
Gastric tube	22/28 (79)	37/37 (100)
NCPAP, n/N (%)	20/28 (71)	12/37 (32)
Time min. 2 h, n/N (%)	28/28 (100)	37/37 (100)
Skin-to-skin contact, n/N (%)	28/28 (100)	37/37 (100)
Temperature at admission: 36.5-37.5 °C, n/N (%)	26/28 (93)	32/37 (86)
Hypoglycaemia, n/N (%)	1/28 (4)	2/37 (5)
Admission, n/N (%)	18/28 (64)	37/37 (100)

BW = birth weight; GA = gestational age; NCPAP = nasal continuous positive airway pressure.

Trial registration: not relevant.

Statistics

Categorical variables are presented as frequencies in counts with corresponding percentages.

Results

A total of 65 infants were included in the study, representing approximately 28% of all infants admitted to the NICU after delivery during the study period. All families who were offered inclusion in the study accepted. None of the included infants were transferred to the NICU before a minimum of two hours had passed. Two infants, one preterm and one term, failed safety parameters due to progression of respiratory symptoms that required more than 30% inspired oxygen. Both infants were treated for suspected early-onset infection, and the ESTS strategy did not delay treatment initiation. The characteristics of the cohort and the prospectively collected quality data are shown in Table 1, divided into two groups.

Among infants with GA < 35 or BW < 2,300 g, who were routinely admitted to the NICU, 37 infants were included, of whom seven (19%) were delivered via CS. Twelve (32%) of these infants received NCPAP, and none developed respiratory distress syndrome.

Among infants with GA ≥ 35 who were admitted to the NICU based on clinical indication, 28 infants were included, of whom 16 (57%) were delivered via CS. Twenty received (71%) NCPAP treatment, and 18 (64%) were admitted to the NICU following ESTS.

Nasogastric feeding tubes were inserted in 22 (79%) of the term infants, and early feeding was started according to established guidelines for all preterm infants. Among all infants included, 58 (87%) had a temperature within the target range (36.5-37.5 °C) at admission to the NICU, with the lowest being 36.1 °C. Successful latching was observed in 19 infants (29%) within the first two hours of ESTS.

No cases of severe hypoglycaemia occurred, and 96% had normal blood glucose on admission.

Discussion

This study found that ESTS was possible in our setting without jeopardising the safety or quality of initial infant care and treatment.

All infants with GA < 35 or BW < 2,300 g, who, according to local practice, were routinely transferred to the NICU, were able to remain with their parents during treatment without any compromise in care quality. In infants with GA ≥ 35, who were only admitted to the NICU when symptomatic, treatment could be initiated close to the mother, thereby avoiding early separation. Furthermore, it seemed that a substantial part of the NICU transfers was preventable following short-term NCPAP treatment.

A 2016 Cochrane review supports skin-to-skin contact as a safe and effective alternative to standard care, particularly in resource-limited settings [3].

A large randomised controlled trial involving over 3,000 infants with BW 1.0 and 1.8 kg, conducted in sub-Saharan Africa and India, showed a 25% reduction in mortality when skin-to-skin between the mother and infant was initiated shortly after birth [10]. In a high-income setting like ours, two randomised studies have found that skin-to-skin may result in a more stable cardiorespiratory transition in very preterm infants [11, 12]. Furthermore, a four-month follow-up of one of these studies revealed that the approach had a positive effect on the mother-infant relationship [13].

In our real-world clinical setting, ESTS was feasible in a substantial number of infants without dedicating additional resources to its implementation. Early measures of care quality were reassuring. Temperature at

admission revealed a significantly higher proportion of infants with normothermia compared with data of 65% reported in the Danish National Quality Register and nearly all had normal blood sugar upon admission [1]. ESTS could also be beneficial for establishing breastfeeding, and we found that latching within the first two hours was successful in many infants [8, 14-16].

Respiratory problems are the most common reason for admission to the NICU. In our setting, 3-4% of all term infants are admitted to the NICU due to respiratory symptoms. Many of these admissions are short-term, with infants requiring respiratory support for only a median of five hours [17]. In Denmark, early NCPAP is the first-line treatment for newborns with respiratory symptoms, and our study indicates that this can be provided without separating the infants from the mother. Furthermore, some early admissions could potentially be avoided. Similar findings have also been reported in other studies using a transitional unit providing short-term supportive care to term infants, including research from Aalborg University Hospital, Denmark [18, 19].

Despite mounting evidence that non-separation of the mother-infant dyad has positive effects, there are likely many barriers to ESTS practice [12]. The need for additional resources is often the limiting factor. The availability of NICU nurses when providing initial care outside the NICU was our primary challenge. Yet, in our setting, ESTS was feasible without additional resources in approximately 30% of all admissions during the study period, which we attribute to the PDCA process and the nurses' dedication. However, implementing the practice as a standard seems not possible within existing resources.

Our study aimed to challenge routine practices in modern neonatology by highlighting the initial management of most infants admitted to the NICU for whom intensive care is not the primary focus. The study design was informed by existing literature and clinical experience. Future research on ESTS should examine multiple dimensions, including clinical outcomes such as those evaluated in our study, as well as admission duration and breastfeeding rates at discharge, alongside psychosocial outcomes (e.g., reduced parental stress and improved bonding) and socioeconomic factors.

The strengths of our study include the prospective collection of data using predefined care quality markers and its conduct in a real-world clinical setting involving collaboration among the obstetric, anesthesiology, surgical and perioperative teams.

This study also has several limitations. Infants eligible for inclusion were not systematically registered, which limits our understanding of the reasons for non-inclusion. Only initial quality data were collected, so information on admission duration, the subsequent clinical course, and important outcomes such as breastfeeding at discharge was unavailable. Additionally, the experiences of family members and caregivers were not systematically assessed, and data on nursing resource utilisation were not recorded.

Conclusions

In our study, ESTS practice appeared feasible without compromising safety or the initial quality of care in selected preterm and term infants. The ESTS was possible in many infants without extra resources. Furthermore, it seemed that brief admissions to the neonatal unit for transient respiratory symptoms were avoided in some of the infants with GA ≥ 35 weeks.

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REFERENCES

1. Dansk Kvalitetsdatabase for Nyfødte (DKN). RKKP, 2024. www.sundk.dk/media/rls53e1q/c12916065318474c956cd376ce5b700d.pdf (Nov 2025)
2. World Health Organization. WHO recommendations for care of the preterm or low-birth-weight infant: web supplement. Evidence base. World Health Organization, 2022. https://iris.who.int/server/api/core/bitstreams/707c8feb-e4e4-4e5c-b029-b78202c67cc7/content (Nov 2025)
3. Moore ER, Bergman N, Anderson GC, Medley N. Early skin-to-skin contact for mothers and their healthy newborn infants. Cochrane Database Syst Rev. 2016;(11):CD003519. https://doi.org/10.1002/14651858.CD003519.pub4
4. van Veenendaal NR, van Kempen AAMW, Broekman BFP, et al. Association of a zero-separation neonatal care model with stress in mothers of preterm infants. JAMA Netw Open. 2022;5(3):e224514. https://doi.org/10.1001/jamanetworkopen.2022.4514
5. van Veenendaal NR, Labrie NHM, Mader S, et al. An international study on implementation and facilitators and barriers for parent-infant closeness in neonatal units. Pediatr Investig. 2022;6(3):179-188. https://doi.org/10.1002/ped4.12339
6. Leone TA, Abreu WJ. The term newborn: delivery room triage and transitions of care. Clin Perinatol. 2021;48(3):431-445. https://doi.org/10.1016/j.clp.2021.05.001
7. Bedwell S, Leasure AR, Gibson TL. Interventions for the management of respiratory distress in late preterm and term infants experiencing delayed respiratory transition: a systematic review. Dimens Crit Care Nurs. 2019;38(4):192-200. https://doi.org/10.1097/DCC.0000000000000365
8. Patriksson K, Selin L. Parents and newborn “togetherness” after birth. Int J Qual Stud Health Well-being. 2022;17(1):2026281. https://doi.org/10.1080/17482631.2022.2026281
9. Patel PM, Deshpande VA. Application of plan-do-check-act cycle for quality and productivity improvement - a review. Int J Res Appl Sci Eng Technol. 2017;5:197-201
10. Arya S, Naburi H, Kawaza K, et al. Immediate “kangaroo mother care” and survival of infants with low birth weight. N Engl J Med. 2021;384(21):2028-2038. https://doi.org/10.1056/NEJMoa2026486
11. Linnér A, Kolz KL, Klemming S, et al. Immediate skin-to-skin contact may have beneficial effects on the cardiorespiratory stabilisation in very preterm infants. Acta Paediatr. 2022;111(8):1507-1514. https://doi.org/10.1111/apa.16371
12. Kristoffersen L, Bergseng H, Engesland H, et al. Skin-to-skin contact in the delivery room for very preterm infants: a randomised clinical trial. BMJ Paediatr Open. 2023;7(1):e001831. https://doi.org/10.1136/bmjpo-2022-001831
13. Lilliesköld S, Lode-Kolz K, Rettedal S, et al. Skin-to-skin contact at birth for very preterm infants and mother-infant interaction quality at 4 months: a secondary analysis of the IPISTOSS randomized clinical trial. JAMA Netw Open. 2023;6(11):e2344469. https://doi.org/10.1001/jamanetworkopen.2023.44469
14. Stelwagen MA, van Kempen AAMW, Westmaas A, et al. Integration of maternity and neonatal care to empower parents. J Obstet Gynecol Neonatal Nurs. 2020;49(1):65-77. https://doi.org/10.1016/j.jogn.2019.11.003
15. Hucklenbruch-Rother E, Vohlen C, Mehdiani N, et al. Delivery room skin-to-skin contact in preterm infants affects long-term expression of stress response genes. Psychoneuroendocrinology. 2020;122:104883. https://doi.org/10.1016/j.psyneuen.2020.104883
16. Bergman NJ. Birth practices: maternal-neonate separation as a source of toxic stress. Birth Defects Res. 2019;111(15):1087-1109. https://doi.org/10.1002/bdr2.1530

17. Larsen MP, Lewis AE, Plomgaard AM, Hansen BM. Respiratory morbidity in newborns with a gestational age at or above 32 weeks. Dan Med J. 2025:72(2):A03240200. https://doi.org/10.61409/A03240200
18. Granger CL, Okpapi A, Peters C, Campbell M. G578(P) potentially preventable unexpected term admissions to neonatal intensive care (NICU). Arch Dis Child. 2015;100:A263. https://doi.org/10.1136/archdischild-2015-308599.527
19. Andersen SB, Eriksen J, Viuff ACF, et al. Portable bedside nasal continuous positive airway pressure in the delivery room reduces length of stay. Acta Paed. 2025;114(8):1945-1952. https://doi.org/10.1111/apa.70062

