

ORIGINAL ARTICLE

Implementation of safe sleep practices in the neonatal intensive care unit

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OBJECTIVE: To increase the percentage of eligible infants engaging in safe sleep practices (SSP) in two level III neonatal intensive care units (NICUs) in the Boston, Massachusetts area.

STUDY DESIGN: On the basis of eligibility criteria (≥ 34 weeks or ≥ 1800 g without acute medical conditions), all infants were eligible for two sleep practices: SSP or NICU therapeutic positioning (NTP) depending on their gestational age, weight, clinical illness and need for therapeutic interventions. Compliance with SSP was defined as: (1) supine positioning, (2) in a flat crib with no incline, (3) without positioning devices and (4) without toys, comforters or fluffy blankets. NTP comprised usual NICU care. Nursing education was comprised of a web-based learning module and in-person teaching sessions with a study team member. Double-sided crib cards (SSP one side and NTP on the other) were attached to the bedside of every infant. Pre- and postintervention audits of all infants were carried out at both study sites. We compared compliance across all time points using generalized estimating equations to account for correlated data (SAS v9.3, Cary, NC, USA).

RESULT: Of 755 cases, 395 (52.3%) were assessed to be eligible for SSP. From the pre- to post-intervention period, there was a significant improvement in overall compliance with SSP (25.9 to 79.7%; P -value < 0.001). Adherence to each component of SSP also improved significantly following the intervention.

CONCLUSION: Safe infant sleep practices can be integrated into the routine care of preterm infants in the NICU. Modeling SSP to families far in advance of hospital discharge may improve adherence to SSP at home and reduce the risk of sleep-related morbidity and mortality in this vulnerable population of infants.

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INTRODUCTION

Each year, in the United States, ~4000 infants die suddenly and unexpectedly, and these deaths are referred to as sudden unexpected infant deaths (SUIDs).¹ The leading causes of SUIDs are sudden infant death syndrome (SIDS), unknown cause and accidental suffocation and strangulation in bed (ASSB) or unsafe sleep practices from mechanisms such as soft bedding, overlay from another individual or entrapment between objects like mattress and wall.¹ SIDS is defined as the sudden death of an infant < 1 year of age that cannot be explained after a thorough investigation is conducted, including a complete autopsy, examination of the death scene and a review of the clinical history.² Owing to the intra- and interstate variability in the investigation and categorization of the causes of SUIDs, it may be difficult to differentiate SIDS from ASSB or unknown cause. Thus regional and national estimates of SIDS or unknown cause likely encompass infant deaths due to ASSB or unsafe sleep practices.² In 2011, more than half of SUIDs was attributed to SIDS, whereas 18% of deaths was classified as ASSB and 26% as unknown.¹

The American Academy of Pediatrics defines safe infant sleep practices as supine positioning in a safety-approved crib (as outlined by the US Consumer Product Safety Commission) without positioning devices and free of quilts, comforters and other soft surfaces.² Although preterm infants are at higher risk for SIDS/SUIDs, with the association between prone sleep positioning and SIDS among low birth weight infants possibly even stronger than

for term infants,³ safe sleep practices (SSP) are rarely integrated into the routine clinical care of these infants.⁴ The American Academy of Pediatrics Task Force on SIDS recommends that preterm infants be placed in supine sleep position by 32 weeks postmenstrual age if they are clinically stable.² Despite these recommendations, preterm infants are less likely than term infants to be placed supine in the hospital, as well as after discharge to home.^{5,6} A prior quality improvement study from Houston, Texas demonstrated that SSPs such as supine positioning of preterm infants in the neonatal intensive care unit (NICU) can be integrated into routine clinical care.⁷ We sought to build upon this work and demonstrate that adherence to safe sleep recommendations could be integrated into the care of infants at two community-level NICUs in Massachusetts.

METHODS

The project was reviewed and approved by the institutional review board at Boston Children's Hospital, South Shore Hospital and St Elizabeth's Medical Center. The data were collected without any identifiers of patients or hospital staff.

The project took place in two level III NICUs at South Shore Hospital and St Elizabeth's Medical Center, community-affiliated units of Boston Children's Hospital, from November 2013 to June 2014. South Shore Hospital has ~3500 deliveries per year and the NICU has 30 beds with ~400 admissions per year. St Elizabeth's Medical Center has ~900 deliveries per year and the NICU has 18 beds with ~235 admissions per year. The majority of infants from both hospitals are inborn. In each of the

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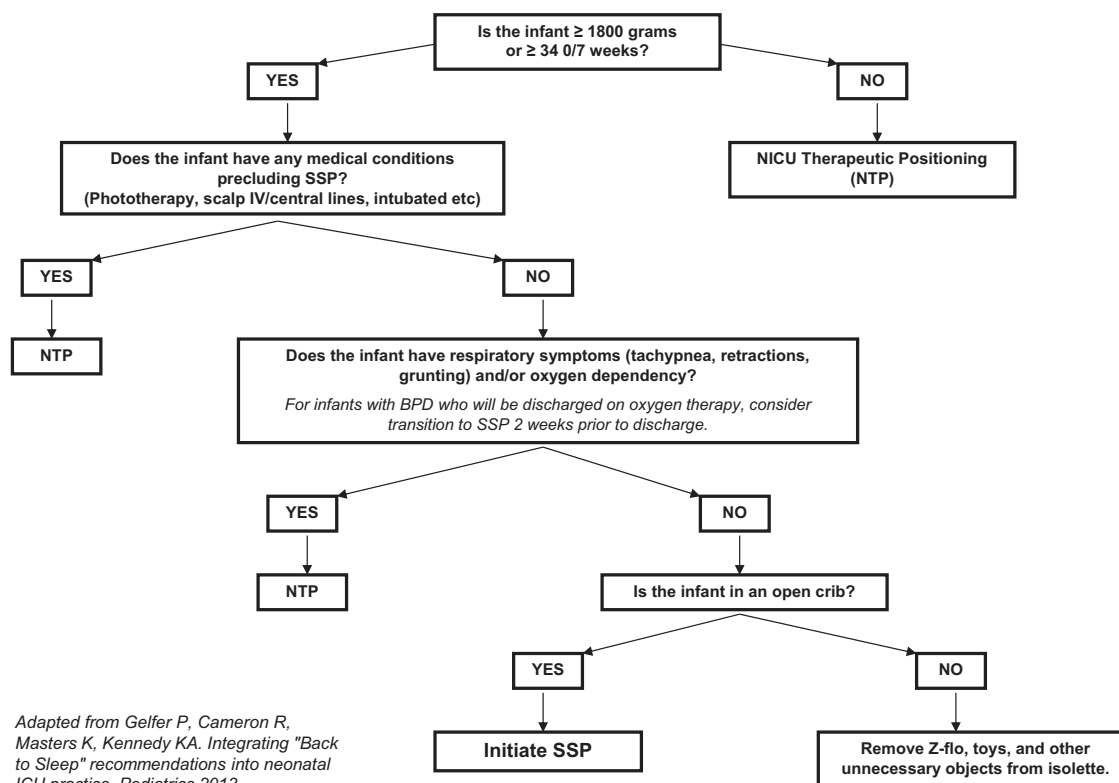


Figure 1. Initiating safe sleep practice (SSP) algorithm.


project sites, a team comprised of neonatologists, nurses/clinical nurse educators and occupational therapists/physical therapists provided input in the implementation of this initiative.

Before the initiation of our intervention, we carried out a baseline audit, ascertaining the percentage of eligible infants engaging in SSPs. All infants in the NICU were eligible for two sleep practices, SSP or NICU therapeutic positioning depending on their gestational age, weight, clinical illness and need for therapeutic interventions or medical equipment such as central lines and endotracheal tubes (Figure 1). SSP were defined as: (1) supine positioning, (2) in a flat crib without any incline, (3) no positioning devices and (4) no toys, comforters or quilts in the sleep environment. Overall compliance with SSP was defined as adherence to all four sleep practices. NICU therapeutic positioning comprised of usual NICU care that included positioning devices such as bendy bumpers and gel pillows, incline of the head of crib up and prone positioning. This algorithm was first developed by neonatal providers at The University of Texas at Houston Medical School. We adapted components of the algorithm to fit the needs of our smaller community units. As shown in Figure 1, entry criteria into the safe sleep algorithm began with a corrected gestational age of 34 0/7 weeks or a daily weight ≥ 1800 g. Although the American Academy of Pediatrics recommends supine positioning of NICU infants as early as 32 weeks, we selected 34 weeks as our entry criteria because in our baseline audit, we found that few infants younger than 34 weeks were eligible for SSP. Subsequent eligibility criteria were based on the clinical status of the infant.

Nursing education was comprised of a web-based learning module and in-person teaching sessions with a project team member. The web-based learning module is a continuing education program on SIDS risk reduction from the National Institute of Child Health and Development available at <http://www.nichd.nih.gov/SIDS/pages/sidsnursesce.aspx>.

During the intervention period, a project team member provided bedside education and assistance to the nurse by reviewing the algorithm and appropriate sleep practices.

Neonatologists and neonatal nurse practitioners who provided clinical care for infants in the project sites were responsible for determining the sleep status of the patients during daily medical rounds and then documenting the designated sleep position (SSP vs NICU therapeutic positioning) in their daily progress note. Deviations from the protocol with explanations were also documented in the daily progress note. Bedside




"Safe to Sleep" Practices

The American Academy of Pediatrics Safe Sleep Practices include:

- Back to Sleep
- Use a firm flat mattress in a crib or bassinet
- No sleeping in carseats, swings, or other positioning devices
- No loose bedding, blankets or soft objects in crib
- No bumpers, pillows, or stuffed toys in the crib
- Do not over heat infants
- No co-sleeping in bed, sofa, or other areas

For more information from the American Academy of Pediatrics on how parents can create a safe sleep environment for their infants, please read the provided pamphlet and attend the NICU/SCN Discharge Class.



Infant Therapeutic Positioning

- While your infant is hospitalized, he/she may be placed in positions other than the American Academy of Pediatrics "Safe to Sleep" Guidelines because of medical reasons. Sleep positions may include:
 - Stomach
 - Side-lying
 - Elevated head of bed
- Developmental positioning aids and/or blanket rolls may also be used for medical purposes.

Therapeutic positioning is NOT recommended or safe for your infant at home

** Your infant will be introduced to Safe Sleep Practices when it is medically appropriate**

Figure 2. Bedside crib cards.

nurses documented the infant's sleep status in their daily flow sheets, either electronically or on paper.

Double-sided crib cards were placed at the bedside for each infant (Figure 2). One side of the crib card described SSP while the other described NICU therapeutic positioning. The bedside nurse was responsible for maintaining or changing the appropriate crib card designation depending on the infant's status on the algorithm. Given that the crib cards were visible to parents, they assisted nurses in teaching parents about SSP. Large posters, placed strategically in the staff lounge, near the provider work area and entrance to units, also raised awareness about the safe sleep initiative.

Two weeks following the initiation of the intervention, we performed postintervention audits to assess percentage of eligible infants engaging in SSP, including overall compliance and adherence to each of the four SSPs. In addition, safe sleep refresher sessions were carried out by project coordinators to reinforce the guidelines.

Analysis

Descriptive analysis of project site, time of audit and use of crib cards were summarized using percentages for categorical variables. We compared overall compliance as well as adherence to each component of SSPs across the three time periods using logit link generalized linear models for binomial outcomes. *P*-value ≤ 0.05 was considered statistically significant. All analyses were performed using SAS version 9.3 (SAS Institute, Cary, NC, USA).

RESULTS

Of 755 cases, 395 (52.3%) were assessed to be eligible for SSP and 388 (98.2%) had completed bedside audit forms. The majority of cases was from South Shore Hospital given that this unit is much larger than St Elizabeth's Medical Center (333 cases, 85.8% vs 55 cases, 14.2%). The majority of crib audits occurred during the day shift and almost 80% of cribs were assessed to have crib cards in the mid- and postintervention periods (Table 1). For both units combined, from the pre- to postintervention period, there was significant improvement in overall compliance with SSP (25.9 to 79.7%; *P*-value < 0.001). Adherence to each component of SSP also improved significantly following the intervention (Figure 3). We observed the greatest magnitude of improvement in the removal of unsafe objects such as blankets and dolls from the crib (40.9 to 85.6%; *P* < 0.001), yet it remained the area of lowest compliance. The run chart of adherence to SSP for the NICU at South Shore Hospital, where mid-intervention data were collected, is shown in Figure 4. From the pre- to postintervention period, overall compliance with SSP as well as adherence to the four components of SSP improved significantly.

DISCUSSION

In this quality improvement initiative, we demonstrated that SSP can be integrated into the clinical care of infants in the NICU. Given that preterm infants are less likely to be placed in supine sleep position after hospital discharge and are at greater risk for SIDS,^{3,6} modeling the 'back-to-sleep' position as well as the safe sleep environment should be incorporated into the discharge education of families weeks or months before their infants' discharge from the NICU. Although we did not assess post-discharge adherence to SSP for our project, Gelfer *et al.*⁷ demonstrated that after the integration of SSP in the care of infants in their NICU in Houston, Texas, there was significant improvement in parental compliance with SSP after hospital discharge. The process of discharging high-risk infants from the hospital with adequate family engagement and teaching requires greater standardization as outlined by a recently published review of discharge from the NICU.⁸ In addition, the recently released Report of the Secretary's Advisory Committee on Infant Mortality highlights the importance of family education and engagement

Table 1. Descriptive analysis by intervention period 755 cases/395 eligible (52.3%)/388 completed surveys (98.2%)

	Overall		Pre-period		Mid-period		Post-period	
	N	%	N	%	N	%	N	%
Case volume	388		112		158		118	
Site ^a								
South Shore Hospital	333	85.8	71	63.4	158	100.0	104	88.1
St Elizabeth's Medical Center	55	14.2	41	36.6	0	0.0	14	11.9
Time of day								
Day	344	88.7	99	88.4	139	88.0	106	89.9
Night	44	11.3	13	11.6	19	12.0	12	10.2
Crib card								
No	61	22.1	-	-	36	22.8	25	21.2
Yes	215	77.9	-	-	122	77.2	93	78.8

^aNote: intervention time differs by site. South Shore Hospital: pre-period: 8/13–10/13, mid-period: 11/13–12/13, post-period: 1/14–6/14. St Elizabeth's Medical Center: pre-period: 12/13–1/14, mid-period: not available, post-period: 4/14.

efforts such as teaching safe infant sleep practices through collaborative multi-disciplinary efforts.⁹

The Health and Human Resources Administration, Maternal and Child Health Bureau launched the Collaboration Innovation and Improvement Network in 2012 to facilitate collaborative learning and adoption of quality improvement principles and practices across 13 southern states (Regions IV and VI) to reduce infant mortality.¹⁰ One of the five priority strategies was increasing safe infant sleep practices. Massachusetts is now part of the northeast (Region I) Collaboration Innovation and Improvement Network initiative and has been focusing on safe infant sleep practices along with a number of other maternal and infant health outcomes. Presently, all level III NICUs in Massachusetts are working toward developing a standardized approach to safe infant sleep practices.

Interestingly, our study demonstrated the greatest improvement in SSP compliance with the removal of soft items such as dolls and blankets. However, adherence to this element was still the lowest in the postintervention period compared with the other SSP components. Although data about the presence of unsafe objects in the crib for the preterm population are lacking, a recent study on mainly term infants demonstrated that bedding use (blankets, quilts, pillows and other similar materials) was common (54% from 2008 to 2010) despite recommendations against this practice.¹¹ Given the wide prevalence of this unsafe sleep practice after hospital discharge, knowledge about the hazards of such items may not be widespread and thus even the nursing staff in our NICUs may not have been aware of recommendations against their use. Moving forward, additional efforts to remove these unsafe items from cribs in the NICU will be required as it remained to be the practice with lowest adherence in the postintervention period.

There are several limitations to this study. Our intervention period of 2 weeks was brief and all NICU staff may not have been exposed to the initiative. However, for South Shore Hospital, where the majority of audits occurred, the intervention began on the annual nursing competency day when all NICU nurses are required to undergo education and re-credentialing for key neonatal care practices. The SSP guidelines were included as a module on this competency day and thus from the NICU staff, all

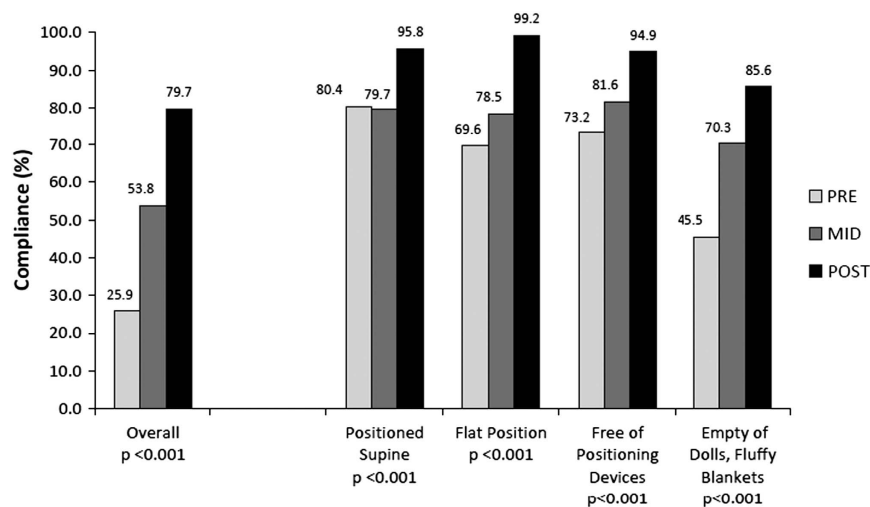


Figure 3. Adherence to safe sleep practices by intervention period.

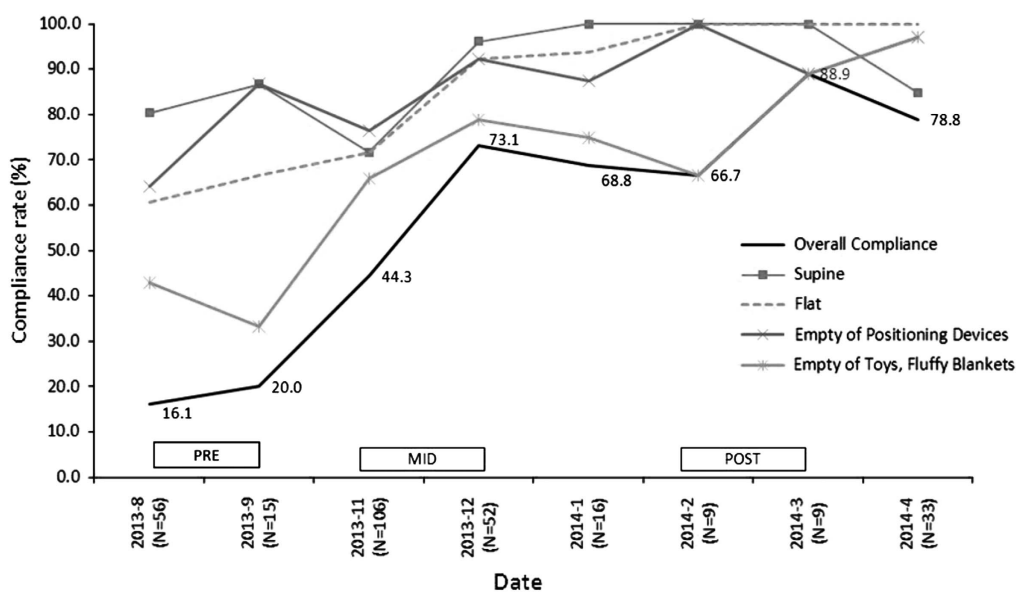


Figure 4. Adherence to safe sleep practices at South Shore Hospital.

nurses participated. Another limitation is that the majority of crib audits occurred during the day and thus may not have captured infant sleep practices during night shifts. However, on several occasions, audits did take place in the morning during nursing change-of-shift and thus sleep position and environment of infants was likely representative of care during the night. Finally, as previously mentioned, parental compliance with SSP after hospital discharge was not assessed and thus from this study, we are unable to measure whether our intervention led to improved adherence at home.

Despite these limitations, our quality improvement project demonstrated that SSP can be integrated into the routine care of infants in community-level NICUs. As the state-wide NICU safe sleep collaborative moves forward in Massachusetts, our work will include the assessment of continued adherence to SSP by families after hospital discharge, which is an important driver in efforts to reduce infant mortality in our state and in the United States.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

- Centers for Disease Control and Prevention. Sudden unexpected infant death and sudden infant death syndrome. Accessed on 31 March 2015. <http://www.cdc.gov/sids/data.htm#resources>.
- Task Force on Sudden Infant Death Syndrome: Moon RY. SIDS and other sleep-related infant deaths: expansion of recommendations for a safe infant sleeping environment. *Pediatrics* 2011; **128**(5): 1030–9.
- Malloy MH. Prematurity and sudden infant death syndrome: United States 2005–2007. *J Perinatol* 2013; **33**(6): 470–475.

- 4 Grazel R, Phalen AG, Polomano RC. Implementation of the American Academy of Pediatrics recommendations to reduce sudden infant death syndrome risk in neonatal intensive care units: an evaluation of nursing knowledge and practice. *Adv Neonatal Care* 2010; **10**(6): 332–342.
- 5 Vernacchio L, Corwin MJ, Lesko SM, Vezina RM, Hunt CE, Hoffman HJ *et al*. Sleep position of low birth weight infants. *Pediatrics* 2003; **111**(3): 633–640.
- 6 Hwang SS, Barfield WD, Smith RA, Morrow B, Shapiro-Mendoza CK, Prince CB *et al*. Discharge timing, outpatient follow-up, and home care of late-preterm and early-term infants. *Pediatrics* 2013; **132**(1): 101–108.
- 7 Gelfer P, Cameron R, Masters K, Kennedy KA. Integrating “Back to Sleep” recommendations into neonatal ICU practice. *Pediatrics* 2013; **131**(4): e1264–1270.
- 8 Smith VC, Hwang SS, Dukhovny D, Young S, Pursley DM. Neonatal intensive care unit discharge preparation, family readiness and infant outcomes: connecting the dots. *J Perinatol* 2013; **33**(6): 415–421.
- 9 *Report of the Secretary’s Advisory Committee on Infant Mortality (SACIM): Recommendations for Department of Health and Human Services (HHS) Action and Framework for a National Strategy*. January 2013. Available at <http://www.hrsa.gov/advisorycommittees/mchbadvisory/InfantMortality/About/natlstrategyrecommendations.pdf> (accessed on 9 July 2014).
- 10 *Collaborative Improvement and Innovation Network to Reduce Infant Mortality*. Available at <http://mchb.hrsa.gov/infantmortality/coiin/index.html> (accessed on 9 July 2014).
- 11 Shapiro-Mendoza CK, Colson ER, Willinger M, Rybin DV, Camperlengo L, Corwin MJ. Trends in infant bedding use: National Infant Sleep Position study, 1993–2010. *Pediatrics* 2015; **135**(1): 10–17.