



Quality improvement initiative to improve infant safe sleep practices in the newborn nursery

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To cite: Shaikh SK, Chamberlain L, Nazareth-Pidgeon KM, *et al.* Quality improvement initiative to improve infant safe sleep practices in the newborn nursery. *BMJ Open Quality* 2022;**11**:e001834. doi:10.1136/bmjopen-2022-001834

Received 28 January 2022
Accepted 26 July 2022

ABSTRACT

The American Academy of Pediatrics recommends that healthcare professionals model their safe infant sleeping environment recommendations, yet adherence to safe sleep practices within our community hospital mother–baby unit was low. We used quality improvement (QI) methodology to increase adherence to infant safe sleep practices, with a goal to improve the proportion of infants sleeping in an environment that would be considered ‘perfect sleep’ to 70% within a 1-year period. The project occurred while the hospital was preparing for Baby Friendly certification, with increased emphasis on rooming in and skin to skin at the same time. Multiple Plan–Do–Study–Act cycles were performed. Initial cycles targeted nurse and parental education, while later cycles focused on providing sleep sacks/wearable blankets for the infants.

While we did not meet our goal, the percentage of infants with ‘perfect sleep’ increased from a baseline of 41.9% to 67.3%, and we also saw improvement in each of the individual components that contribute to this composite measure. Improvements were sustained over 12 months later, suggesting that QI interventions targeting infant safe sleep in this inpatient setting can have long-lasting results. This project also suggests that infant safe sleep QI initiatives and preparation towards Baby Friendly Hospital Certification can be complementary.

PROBLEM

Although the American Academy of Pediatrics (AAP) safe sleep recommendations in 1992 and the initiation of the Back to Sleep campaign in 1994 led to a reduction in sudden infant death syndrome (SIDS), approximately 3400 infants die annually in the US from sudden unexpected infant death (SUID). SUID includes SIDS and other sleep-related deaths, such as accidental suffocation or strangulation in bed (ASSB), which may be attributable to unsafe sleep environments.¹

This project sought to improve the adherence to safe sleep practices (SSP) within the mother–baby unit of a suburban community hospital in North Carolina that delivers approximately 2400 infants annually. The mother–baby unit and a level 2 special care nursery are the only paediatric units within

WHAT IS ALREADY KNOWN ON THIS TOPIC

Quality improvement (QI) methodology can be used to improve infant safe sleep practices in an inpatient setting.

WHAT THIS STUDY ADDS

Safe sleep practices were improved in a sustainable way in the setting of a hospital seeking Baby Friendly Hospital Certification with the associated emphasis on rooming in and skin-to-skin care.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

Safe sleep QI initiatives may be complimentary to Baby Friendly Hospital Certification, and other hospitals may consider addressing safe sleep practices as part of their journey towards Baby Friendly certification.

the hospital, and the mother–baby unit is staffed mainly by providers who are faculty at an associated academic medical centre, plus two community practices also round on a limited number of infants. Baseline adherence to SSP within the mother–baby unit was noted to be low. This low adherence was observed anecdotally, but then confirmed with an informal survey of infant sleep environments conducted by a nursery attending while rounding in the newborn nursery on a single day. In particular, infant sleep areas were commonly found to have the head of the bassinet elevated and to contain extra items (defined as items other than a mattress and fitted sheet). Although we had moved to a rooming-in model where infants remain in the mother’s hospital room for the overlapping hospitalisation period several years prior to this project’s start, the hospital had recently begun the certification process for the Baby Friendly Hospital Initiative. With an increased emphasis on rooming in, it was imperative to ensure that infants were in a safe sleep environment within the mother’s room. Additionally, it was felt nurses would be receptive to safe sleep education, as they received



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increasingly frequent education on Baby Friendly topics. Our specific goal was to improve the percentage of infants with a composite measure of ‘perfect sleep’ (sleeping on their backs in an empty bassinet without any additional items, appropriately bundled and with the head of the bassinet flat) from a baseline of 41.9% to 70% within a year of project start.

BACKGROUND

The initial decline in rates of SIDS and SUID seen in the 1990s within the USA as a result of the Back to Sleep and, later, Safe to Sleep campaigns has slowed and over the past two decades the rates of infants dying due to ASSB has risen.¹ While many families have heard of and adhere to the recommendation to place an infant on their back to sleep, several other elements of SSP may be less well adhered to by parents and caregivers,² placing infants at risk for sleep-related death.³

The modelling of SSP within a hospital setting has been shown to improve SSP adherence at home.^{4,5} In 2016, the AAP developed guidelines that healthcare professionals should endorse and model their safe infant sleeping environments.³ Despite this recommendation, many institutions have reported a low baseline rate of compliance with AAP SSP⁶ and as such, this has become a common target for quality improvement (QI) projects within different types of paediatric units, including the NICU,⁷ general paediatric floors^{6,8} and mother–baby units.⁹ The majority of projects include some element of nursing education, including correcting common misconceptions about the guidelines,¹⁰ along with interventions to improve parental knowledge of SSP. Some QI projects have also taken into account the physical environment provided for infant sleep, including addressing space for storage of infant care items and altering what coverings are provided for infant swaddling.⁸

A qualitative study by Colson *et al*¹⁰ examined barriers to adherence to SSP in the inpatient setting, with the findings informing design of a successful multisite QI project. In this nurse-focused project that targeted both nurse and parent education, they were able to show improvement in each of eight mother–baby units, with improvement sustained for 12 months postintervention.⁹ This project was also instructive in showing that sites with both low and high baseline compliance with SSP could show improvement using a QI approach.

MEASUREMENT

We created an audit tool to record infants’ sleeping environments within the nursery. The tool was modelled on the tool used by Shadman *et al*.⁸ Our tool recorded whether an infant was sleeping and, if so, in what location and in what position, whether the head of the bassinet was flat or raised, presence of any additional items in the infant’s sleeping location, and whether the infant was appropriately bundled. We used the audit tool to record the sleeping environment of a convenient sample

of every infant rounded on by any attending involved in the QI project (which was performed by academic faculty providers only, not the community providers), with audits grouped by week for analysis. A given infant may have been sampled on more than 1 day if the attending rounded on them on consecutive days. ‘Perfect sleep’ is a composite measure that captures multiple elements of the AAP Infant Safe Sleep Guidelines, with an infant deemed to have ‘perfect sleep’ if they were sleeping on their backs in an empty bassinet without any additional items, they were appropriately bundled, and the head of the bassinet was flat. Head of bassinet status and the presence of extra items in the sleep area were recorded even if the infant was not in the bassinet or not sleeping at the time of the audit, but sleep location and sleeping position were only included if the infant was sleeping and was not being held by an awake adult. The infant’s bundling was included for any sleeping infant. Infants who were being treated with phototherapy, were under a warmer or where the bassinet was being prepared for a procedure or a photography session were excluded.

Baseline measurements were collected over an 8-week period with a total of 186 observations using the audit tool. During this period, 38.0% of sleep areas audited contained extra items, and 3.8% of observations had raised heads of bassinets. The percentage of infants sleeping in a safe location was 87.0% and the percentage of infants sleeping on their backs was 90.3%. In 15.3% of observations, sleeping infants were bundled inappropriately (which was considered as anything other than clothes alone, a tight swaddle or sleep sack/wearable blanket). Overall, 41.9% of sleeping infants met our criteria for ‘perfect sleep’. After the initial data collection and education, the frequency of raised heads of bassinets decreased, so we pivoted to studying the interval between elevated head of bed events.

DESIGN

We hypothesised that the main barrier to achieving infant perfect sleep was a lack of knowledge by both nursing and parents as to the AAP recommendations, and so our early interventions aimed to increase nurse and parent education. This project coincided with our hospital preparing to apply for Baby Friendly Hospital certification with increased emphasis on rooming in and skin-to-skin contact for staff and families. Thus, we were mindful to ensure that these emphases were done safely with the AAP Infant Safe Sleep guidelines in mind.

As we examined our baseline data, we discovered that inappropriate bundling of the infant and the presence of extra blankets and linens in the bassinets were common errors that prevented an infant from meeting criteria for ‘perfect sleep’. We had secured a small grant for a limited supply of sleep sacks/wearable blankets and saw a decrease in inappropriate bundling after that intervention, so we shifted the attention of later Plan–Do–Study–Act (PDSA) cycles to securing a permanent supply of

wearable blankets for infants instead of swaddling them in receiving blankets.

The QI team initially consisted of the physician medical director of the newborn nursery, an additional newborn nursery attending and the nurse manager with input from the mother–baby unit nurses, plus a QI project mentor. The nursing input was invaluable, as insight from them about both the nursing barriers to compliance and the parental barriers to compliance helped direct future PDSA cycles. In mid-2019 (around the time of PDSA cycle 6), the QI team joined forces with a ‘Safe Sleep Task Force’ at a sister hospital also aiming to improve infant SSPs, with the QI team growing to include physicians in different units, nurses, a nurse clinician, a speech therapist and a paediatric resident. Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research. We used Statistical Process Control charts for analysis, plus a two-sided Fisher’s exact test to analyse the head of the bed data. Data collection began mid-August 2018 and continued until the end of January 2021. Over 3100 individual observations were recorded.

STRATEGY

We performed seven PDSA cycles.

PDSA cycle 1 (week 9): We developed a PowerPoint nursing education module explaining the details of the AAP Infant Safe Sleep guidelines, which include commentary on sleep positioning and avoidance of infant exposure to smoking and illicit drugs, among other topics. We emailed this module to all mother–baby unit nurses and nursing assistants and encouraged them to complete the module and a before-and-after knowledge assessment quiz. Those who completed it were entered into a raffle to win a gift card. Thirty-five out of 54 (65%) nurses and nursing assistants completed the module. The results of the knowledge assessment quizzes showed nursing staff had a good knowledge of most of the AAP recommendations for infant safe sleep (>85% of nurses answered correctly for 7 of 10 answers) but we made an improvement in knowledge from 82% to 97% that the head of bed should be flat, from 62% to 94% that prone positioning did not help with clearance of amniotic fluid and from 70% to 86% that commercial products designed to allow infants and parents to bed-share should not be recommended.

PDSA cycle 2 (week 16): To improve parent education, the newborn attendings gave and discussed with each family a paper door hanger that explained the main tenets of the AAP Infant Safe Sleep guidelines. This was performed on the first day that the attending rounded on an infant. We used premade door hangers provided by a charitable organisation for the purpose of educating families on safe sleep, but we found that the hanger design was inconvenient as there was nowhere in the patient room to hang it. Additionally, the door hanger contained an advertisement from a company that partners with the

charitable organisation. Ultimately, hospital administration asked us to change format given the presence of this advertisement.

PDSA cycle 3 (week 22): We replaced the educational door hanger with a 3×5 inch ‘crib card’ that we designed, and again this was given by and discussed with families by the newborn attendings during the initial visit. This was displayed at the edge of the bassinette so it remained visible to parents throughout their stay.

PDSA cycle 4 (week 26): Through the aid of a grant, we were temporarily able to provide sleep sacks/wearable blankets to families in the nursery. Each family was gifted with a new, packaged wearable blanket that they were able to use in the hospital and also take home with them at discharge. The wearable blankets could not be laundered in the hospital and so families were encouraged to use them after the infant has received their bath at 24 hours of life. Some families chose to take the packages home unopened. There was a statistically significant decrease in the percentage of infants inappropriately bundled around this time, beginning week 23 and reaching statistical significance on SPC chart at week 28.

PDSA cycle 5 (week 38): An email reminder was sent to labour and delivery nurses (who set up the bassinets for the newborns) to ensure that the bassinets were given to the family empty, as we had noticed that a common extra item within the bassinets was an additional infant hat (sometimes still in its plastic packet). At this same time, our supply of wearable blankets ran out, corresponding to a non-statistically significant increase in the percentage of infants inappropriately bundled.

PDSA cycle 6 (week 47): We secured the ability to permanently provide sleep sacks/wearable blankets for use in the nursery starting at week 47 through the participation in an In-Hospital Modelling Programme by a popular wearable blanket manufacturer that provides a free supply of wearable blankets for in-hospital use. We were also able to launder them in the hospital, so they were used for the entire stay, rather than just after the bath at 24 hours of life. With this intervention, we saw statistically significant improvements in safe sleep location, sleeping on the back, sleep areas containing additional items, infant bundling and also in our composite metric ‘perfect sleep’.

PDSA cycle 7 (week 63): Additional funding was secured to allow us to gift families a sleep sack/wearable blanket to take home, in addition to being able to provide the wearable blankets for use in the nursery. This was deemed an important intervention because we discovered that over time a large number of the hospital’s wearable blankets went missing (presumably taken home by families), which left us with a low supply for in-hospital use. We were unfortunately without wearable blankets completely during week 53 due to delays with our laundry service and dwindling supplies. Simultaneously, many of the nurses had gone back to recommending using the wearable blankets only after the infants had been bathed so that the wearable blanket did not need to be changed during the

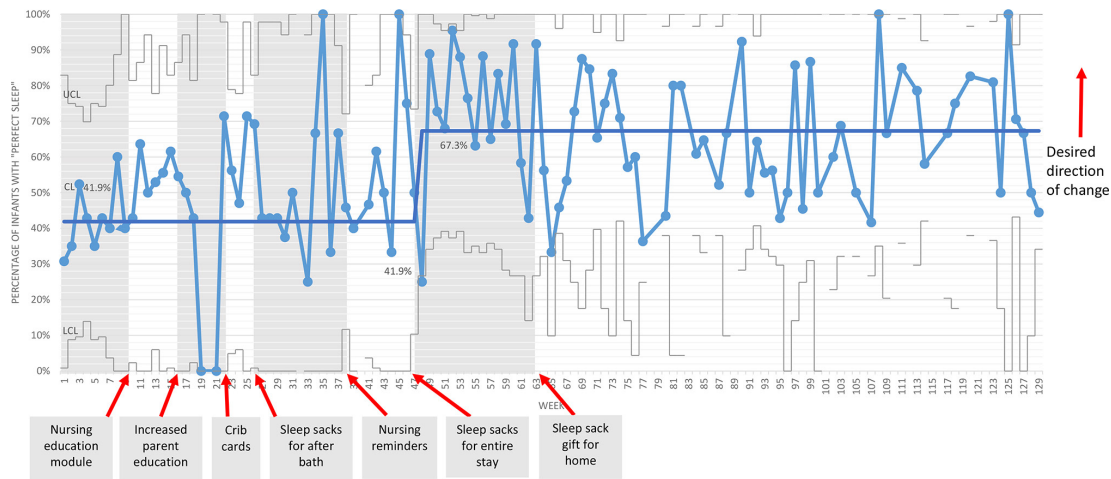


Figure 1 'Perfect sleep'.

infant’s admission. We saw a small but statistically significant improvement in the percentage of infants sleeping on their back after introducing the gifting programme.

RESULTS

Across the project, we saw a statistically significant improvement in the percentage of infants with ‘perfect sleep’, increasing from a baseline of 41.9%–67.3% around week 47, but this was below our project goal of 70%. However, this increase was sustained after the last PDSA cycle at week 63 until the end of data collect at week 129, over a year later (figure 1). Additionally, we saw statistically significant improvements in each of the individual components of SSP that we recorded, namely safe sleep location (increased from a baseline of 87.0%–92.0%), infants sleeping on their back (two statistically significant increases, once from the baseline of 90.3%–96.5% at week 48 and then to 98.1% at week 65), sleep areas with extra items (decreased from baseline of 38.0%–20.2%, as shown in figure 2), and a decrease in the number of infants that were inappropriately bundled (two statistically significant decreases, once from the baseline of 15.3%–7.7% around week 24 and again to 3.8% at

week 50). These changes were also sustained through the end of data collection over a year later. As we found the elevated head of bassinettes to be infrequent, we created a g-chart to study the interval in between occurrences (figure 3). Although we were unable to show a statistically significant change in the interval between observations where the head of the bassinette was raised, there was a statistically significant difference in the number of observations with raised head of bassinette in our baseline period vs after the start of our PDSA cycles (7 out of 186 observations in baseline period vs 18 out of 3190 observations after start of first PDSA cycle, $p < 0.001$ from a two-sided Fisher’s exact test).

Due to the variable census in the nursery and the inconsistency in the number of infants sleeping when the audits were performed on any given day, there are some weeks where no data were available for some of the components of the SSP measures. Additionally, due to some attending turnover during the project, there were some weeks when the attending in the nursery was not involved in this QI project and hence no cribs were audited, particularly towards the end of the project. This did not materially affect our ability to analyse included data, but this did

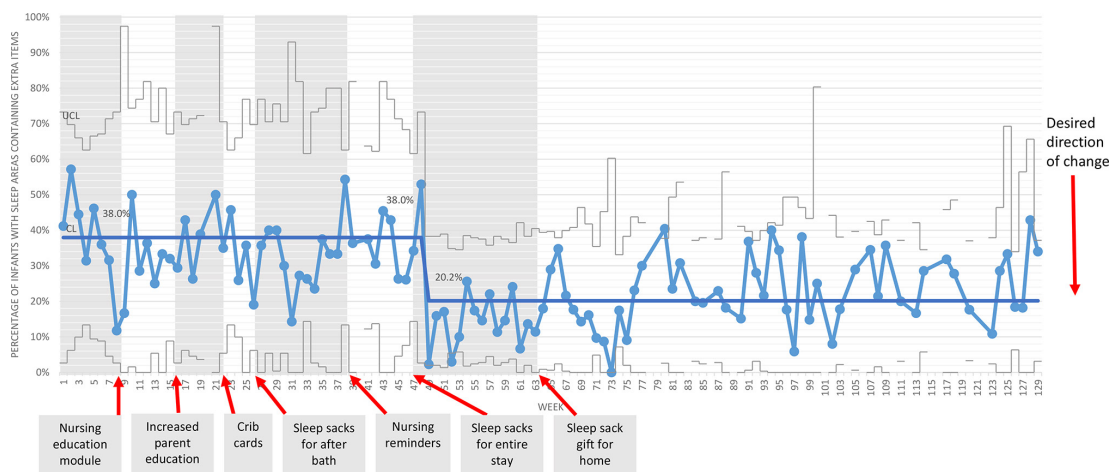


Figure 2 Sleep areas containing extra items.

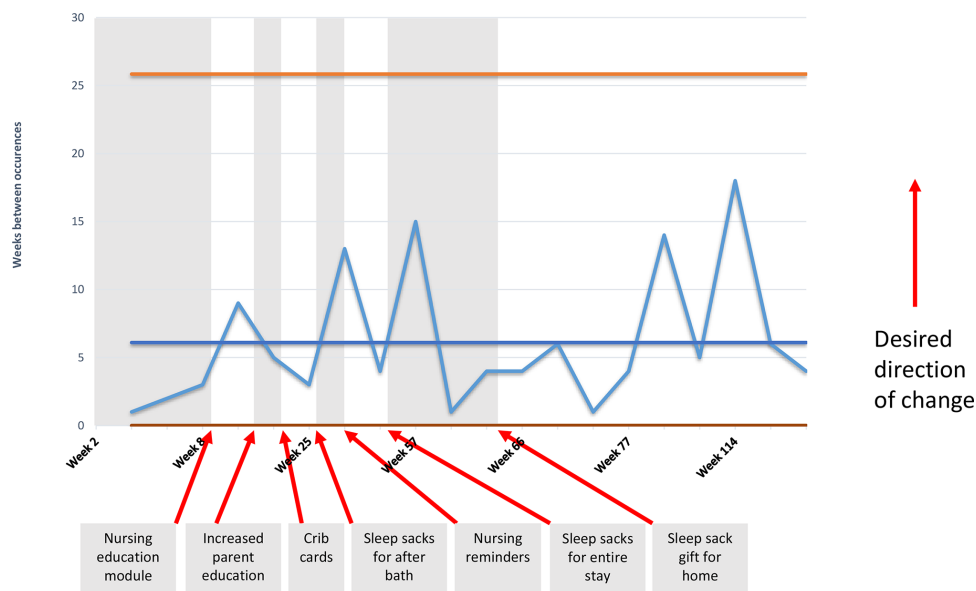


Figure 3 Weeks between elevated head of bed occurrences-g chart.

contribute to the decision to stop data collection at week 129.

A simultaneous project in the nursery was to encourage skin-to-skin care, as part of the hospital's journey towards Baby Friendly certification. We initially found some misconceptions from the nurses that skin-to-skin care and SSP were incompatible because they felt that this would count as the infants sleeping prone and bedsharing. We had not specifically addressed this in our nursing module for PDSA cycle 1, but we found after discussing the AAP recommendations on components of safe skin-to-skin care with nurses that there were fewer objections voiced and our skin-to-skin care increased.

Lessons and limitations

The study baseline data demonstrated that some unsafe sleep environments existed within our nursery. While other studies were able to meet their goal within 1 year, we did not meet our aim of 70% of infants having 'perfect sleep' within 1 year. Although there were improvements in each of the individual components of a safe sleep environment the most frequent cause of failure for 'perfect sleep' was due to extra items within the sleep environment. While some of the extra items were additional blankets, one of the barriers that was faced in the study was that the sleep area was frequently being used as a storage areas in the rooms, specifically for extra items for the infant such as diaper supplies or extra clothes within the context of the small hospital rooms. During our QI project we were not able to address the provision of storage space for infant care items as some other projects were specifically able to do,⁸ and this may have contributed to us being unable to meet our goal. We also found there were multiple groups of people who were placing these extra items into the sleep area, including patient caregivers, nurses and nursing assistants, and ensuring we hit each of these populations with our education on

removing extra items proved challenging. A limitation of our project was that we did not include patient families in our QI team, which may have been revealing of the barriers to parental compliance with SSP within the nursery, and we suggest that others looking to work on a similar project consider engaging patient families during the project planning stages.

One of the other lessons we learnt was that there exists a culture of unsafe practices and myths about sleep for both the staff and the caregivers. For example, some staff believed newborns that are 'spitty' needed to be elevated to sleep despite lack of evidence and direct contradiction of the AAP recommendations for safe sleep. While turnover of staff was low in general, we found that we had to address this concern with many new team members, despite it being included in the mandatory nursing education module.

We saw several statistically significant improvements associated with PDSA cycles involving the sleep sacks/wearable blankets. The In-Hospital Modelling Programme mentioned in PDSA cycle 6 may be a low cost option for other hospitals also looking to implement sleep sacks/wearable blankets within their own nurseries. However, there were some difficulties with the sleep sacks/wearable blankets. Many of them went missing, which was likely due to families taking them home, adding to the costs of maintaining a sufficient supply. While our losses did decrease when we were able to gift families a wearable blanket to take home, the gifting programme was an additional cost that may be prohibitive to other hospitals wishing to copy this. If in the future, we are unable to continue gifting them at our hospital it is possible that we may lose some of the improvements we saw in this project. We also discovered that the sleep sacks/wearable blankets could not be laundered with our regular hospital laundry and needed to be laundered in a different way, which

added an additional layer of difficulty in implementing their use within our hospital.

This project took place in a smaller community hospital where there is a specific pool of paediatrics nurses that rarely includes float nurses from outside of the mother-baby unit and, although we did have some nurse turnover, the number of new nursing staff members during the course of this project was low. This allowed focus on a discrete group of permanent staff for the various educational interventions. This directed type of education may have to be adjusted for a larger academic centre with multiple paediatric units or in areas where there is frequent staff turnover or float staff. Additionally, the hospital's emphasis on nurse education in order to prepare for the Baby Friendly Hospital Initiative likely made staff more receptive to our teaching and suggestions, as nurses were also receiving updated education on some other topics that represented changes in practice for some nurses.

It appears that the PDSA cycles providing sleep sacks/wearable blankets had the largest impact on 'perfect sleep' within the nursery. There was improvement in the number of bassinets with head of bed raised beginning after the nursing education module of PDSA cycle 1, suggesting that lack of compliance with this component of 'perfect sleep' may have been a nursing knowledge deficit. However, for the other components it appeared that nurses already knew the correct information but had difficulty actually implementing the correct practices within the nursery. Therefore, it is logical that the PDSA cycles that provided process change, in this instance physically changing the item available for bundling the infant and removing the option to add additional loose blankets or use rolled up blankets to create bumpers or a 'nest' for the infant, had the largest effect on outcome.

There were some weeks for which data was not collected due to both infants not meeting the inclusion criteria and extraneous circumstances unrelated to the project. In order for patients to meet the inclusion criteria, they had to be sleeping on the auditor entering the room and thus due to an inconsistent census, it was not possible to audit these cribs. As all of the data for this study was collected manually, changes in personnel and individual work schedules played a role in the ability to collect the crib audits each week; however, missing data did not affect the ability to analyse the data nor to obtain an objective look at the SSP within the nursery.

Our baseline data collection period was relatively short, at just 8 weeks. However, it took several weeks after our first PDSA cycle to show any improvements, so we do feel that the system was in steady-state before we began our project. This project showed sustained improvement in all of our measured individual elements of SSP for over a year after our last PDSA cycle. Although our formal PDSA cycles ended after week 63, an institution-wide Infant Safe Sleep Policy was approved at Week 102 that mandated that infants within our hospital should sleep within an AAP-compliant sleep environment unless there was a

medical reason for them not to. Additionally, the nurses continued to receive reinforcement of SSPs in combination with the emphasis on rooming in as part of their education for the Baby Friendly Hospital Initiative, so the sustained improvement in SSP within the nursery may not have been due to our QI project and PDSA cycles alone.

CONCLUSION

We were able to use QI methodologies to improve adherence to AAP SSP within our newborn nursery. While we did not meet our specific goal of 70% of infants achieving 'perfect sleep' (sleeping on their backs in an empty bassinet without any additional items, appropriately bundled and with the head of the bassinet flat), we were able to show statistically significant improvement from 41.9% to 67.3%, as well as improvement in each of the individual components of this composite measure. Importantly, the improvements in both the composite measure and the individual components were sustained over 12 months after the last PDSA cycle. This is similar to the project by Kellams *et al.*,⁹ who also found that changes were sustained for up to 12 months and suggests that QI interventions targeting infant safe sleep in the newborn nursery can have long-lasting results. An additional important lesson from our project is that infant safe sleep QI initiatives and preparation towards Baby Friendly Hospital Certification can be complementary, and we would encourage other hospitals working towards Baby Friendly Hospital Certification to specifically address the AAP's recommendations for SSP¹¹ in their nursing education to help prevent misconceptions, specifically in the setting of skin to skin. Although our interventions demonstrated improvement in SSP within the newborn nursery, translation of these practices to the home environment could be considered as a future project.

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Acknowledgements We wish to acknowledge Dr Kristin Shadman for her help with this project, and thank Meghann McCoy and the other members of the Safe Sleep Task Force.

Contributors LC participated in the design of the project, and drafted and revised the manuscript. KMN-P participated in the design of the project, and drafted and revised the manuscript. JCB participated in conception and design of the project and revised the draft manuscript critically for important intellectual content. SKS participated in the conception and design of the project; acquired, analysed and interpreted data; and drafted and revised the manuscript. SKS is guarantor for this work.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This project was reviewed by our institutional (Duke) IRB and was deemed Quality Improvement that was exempt from IRB oversight (Protocol ID Pro00100095).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

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