

Coming Together to Save Babies: Our Institution's Quality Improvement Collaborative to Improve Infant Safe Sleep Practices

Jamie R. Macklin, MD*; Gail Bagwell, DNP†; Sarah A. Denny, MD‡; Jane Goleman, MD‡; Julia Lloyd, MD§; Kris Reber, MD†; Linda Stoverock, DNP¶; and Richard E. McClead, MD, MHA¶¶

Abstract

Introduction: Many hospitalized infants are not observed in an American Academy of Pediatrics-recommended safe sleep environment, which can translate to unsafe sleep practices at home. We implemented this collaborative to reduce our county's sleep-related death rate by improving infant safe sleep practices in the freestanding children's hospital setting and increasing safe sleep screening and education in our clinics and emergency departments (EDs). **Methods:** Physicians from our institution's primary care clinics, EDs, neonatal intensive care units, and general inpatient units created and led multidisciplinary safe sleep teams. Teams have used standardized data tools to collect information on infant patient ages and sleep position and environment, both in the hospital and at home. Based on audit data, teams have implemented multiple Plan-Do-Study-Act cycles during this collaborative. We have calculated changes in safe sleep practices in the hospital and changes in screening and education on safe sleep behaviors over time. **Results:** Our teams have significantly increased compliance with safe sleep practices in the inpatient and neonatal intensive care unit settings ($P < 0.01$). We have also increased screening and education on appropriate safe sleep behaviors by ED and primary care providers ($P < 0.01$). Our county's sleep-related death rate has not significantly decreased during the collaborative. **Conclusions:** Our collaborative has increased American Academy of Pediatrics-recommended safe sleep practices in our institution, and we decreased sleep-related deaths in our primary care network. We have created stronger ties to our community partners working to decrease infant mortality rates. More efforts will be needed, both within and outside of our institution, to lower our community's sleep-related death rate. (*Pediatr Qual Saf* 2020;6:e339; doi: 10.1097/pq9.0000000000000339; Published online October 23, 2020.)

INTRODUCTION

Despite American Academy of Pediatrics (AAP) recommendations highlighting the

From the *Division of Hospital Pediatrics, Nationwide Children's Hospital, Columbus, Ohio; †Division of Neonatology, Nationwide Children's Hospital, Columbus, Ohio; ‡Division of Primary Care Pediatrics, Nationwide Children's Hospital, Columbus, Ohio; §Division of Emergency Medicine, Nationwide Children's Hospital, Columbus, Ohio; and ¶¶Nationwide Children's Hospital, Columbus, Ohio.

Poster presented at the IHI National Forum on Quality Improvement in Health Care, December 4, 2016, Orlando, Fla.

Supplemental digital content is available for this article. Clickable URL citations appear in the text.

*Corresponding author. Address: Jamie R. Macklin, MD, Division of Hospital Pediatrics, Nationwide Children's Hospital, FOB, Ste. 3A.4, 700 Children's Drive, Columbus, OH 43205

PH: 614-722-0479; Fax: 614-722-5115

Email: jamie.macklin@nationwidechildrens.org

Copyright © 2020 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

To cite: Macklin JR, Bagwell G, Denny SA, Goleman J, Lloyd J, Reber K, Stoverock L, McClead RE. Coming Together to Save Babies: Our Institution's Quality Improvement Collaborative to Improve Infant Safe Sleep Practices. *Pediatr Qual Saf* 2020;6:e339.

Received for publication December 17, 2019; Accepted July 1, 2020.

Published online October 23, 2020

DOI: 10.1097/pq9.0000000000000339



importance of supine sleeping and a safe sleep environment for every sleep occurrence, infants continue to die from Sudden Infant Death Syndrome and other sleep-related deaths.¹⁻⁶ These recommendations are particularly important given Ohio's dire infant mortality rate (IMR).² Ohio ranks among the states with the highest IMR in the country, at 7.2 per 1,000 live births, and significant disparities in rates between white and black babies.³ Locally, Franklin County's IMR is 7.4 per 1,000 live births, one of the highest in the state.⁴ Sleep-related deaths account for one of the largest percentages of these deaths, following prematurity and congenital anomalies.³

Healthcare providers are uniquely positioned to model safe sleep behaviors in the hospital setting and to counsel parents and caregivers on the importance of continuing these behaviors in the home. A previous study showed that parents were more likely to place their baby supine at home when witnessing this practice in the newborn nursery.⁵ Unfortunately, multiple recent studies have shown that $\leq 25\%$ of infants in newborn nurseries or general pediatric units are found in appropriate safe sleep environments.⁶⁻⁸ Similar research indicates identical findings in the medically stable, neonatal intensive care unit (NICU) population.⁹ Additionally, further data suggest that primary care physicians often provide incorrect

information and guidance on safe sleep behaviors, which could lead to unsafe sleep in the home.¹⁰

Eight years ago, random audits revealed that our hospital did not consistently role model safe sleep practices to families of infants admitted to our facility. A small committee, comprising a physician, nursing staff, physical and occupational therapists, and social workers, was created to align our safe sleep practices with AAP recommendations. In 2014, Ohio passed Senate Bill 276 (SB276), requiring all birthing and children's hospitals to screen all newborns for an appropriate home safe sleep environment before first discharge. Soon after, the Central Ohio Hospital Council launched a multi-institutional initiative to improve infant safe sleep practices within all area birthing hospitals.¹¹ This legislation and the initiative amplified our hospital's efforts to improve the sleep environment for all hospitalized infants and to screen and provide cribs to those infants in need being discharged from the NICU.¹²

In 2015, given our local and state's continued high IMRs, members of our institution, along with many other organizations, joined to implement several concurrent but related initiatives related to the promotion of infant safe sleep practices. Our safe sleep committee transitioned from a small committee to a larger interdisciplinary team with 4 distinct "subteams," representing the inpatient medical/surgical units, the NICUs, the emergency department (ED), and the primary care network (PCN). The 4 teams launched a multidisciplinary quality improvement (QI) collaborative geared to enhance the behavioral modeling, screening, and educational processes provided to our patients and families on safe sleep. Though improving our institutional practices was a high priority for this project, our global goal was to lower the sleep-related death rate in our county (Franklin County) by 25%, from 1.174 to 0.880 per 1,000 live births, by June 30, 2019.

METHODS

Context

The collaborative has taken place at Nationwide Children's Hospital (NCH), which is located in Columbus, Ohio, and is a quaternary referral center for central and southeastern Ohio. The institution cares for more than 1.5 million children every year from all 50 states and around the world through its inpatient units, emergency department, urgent care units, outpatient clinics, and surgery centers. It also boasts the country's largest neonatal network, consisting of 274 beds located in 9 NICUs and 1 special care unit.¹³ The units are located at NCH, as well as in delivery hospitals throughout the city, and care for over 3,000 babies per year. Our institution does not contain a delivery ward or a well-newborn unit, and so these services were not included in this QI collaborative.

The hospital administration asked the physician, nurse, and QI champions in each of the 4 areas to form and lead multidisciplinary groups comprising of other physicians

and trainees, nursing staff, and other healthcare providers. All physicians are eligible to receive Part IV maintenance of certification credit for active participation in the program.

Interventions

The administration held an on-site kick-off meeting in October 2015 to motivate and educate the hospital's healthcare providers on local infant mortality and sleep-related death rates and the new multiteam approach. Safe sleep champions from the 4 teams were then encouraged to work with their teams to tailor interventions, both specific to the needs of their areas and to address the global aim of county-wide sleep-related death reduction. Teams collaborated to produce a hospital-wide key driver diagram (Fig. 1) and several subteam key driver diagrams (Figures 7–10, Supplemental Digital Content, which shows further detail on interventions completed by each subteam, <http://links.lww.com/PQ9/A206>). Teams were encouraged to complete as many Plan-Do-Study-Act (PDSA) cycles as necessary to improve their safe sleep practices.

Data Collection

Before PDSA cycle initiation, the hospital administration instructed the teams to collect baseline data for 4–6 months on their chosen metrics by conducting random audits. Following baseline data collection, teams were allowed to initiate PDSA cycles. The NICU and inpatient teams have utilized a standardized tool for patients 1 year of age or younger admitted to the general medical/surgical units and those infants in both the main campus and affiliated offsite NICUs who are medically stable and 35 weeks or more gestational age. The audit tool asks questions regarding infants' sleep location and position, head of the bed elevation, loose items found in the sleep environment, inappropriate developmental tool use (such as the use of a positioner to prop a pacifier or using devices when no longer needed), and family education on safe sleep (available by request). Exclusion criteria for any infants, regardless of their location in the hospital, are patients with tracheostomies; ventilator dependence; use of noninvasive pressure support, such as nasal continuous positive airway pressure support; recent spinal surgeries; upper airway anatomic abnormalities; or initial escalation of neonatal abstinence syndrome treatment. The NICUs also utilize a new safe sleep screening tool in the electronic medical record (EMR) to satisfy the requirements of SB276.

Teams from the PCN and the ED collaborated with EMR representatives to create electronic screening tools to document safe sleep environments in the home. The teams also audit the infants' charts as to whether education on safe sleep is provided to the parent/caregiver during an encounter, as well as what education modalities are utilized. The ED audits all discharged infants younger than 7 months of age who present to both the main campus and offsite departments. Patients who leave without being seen

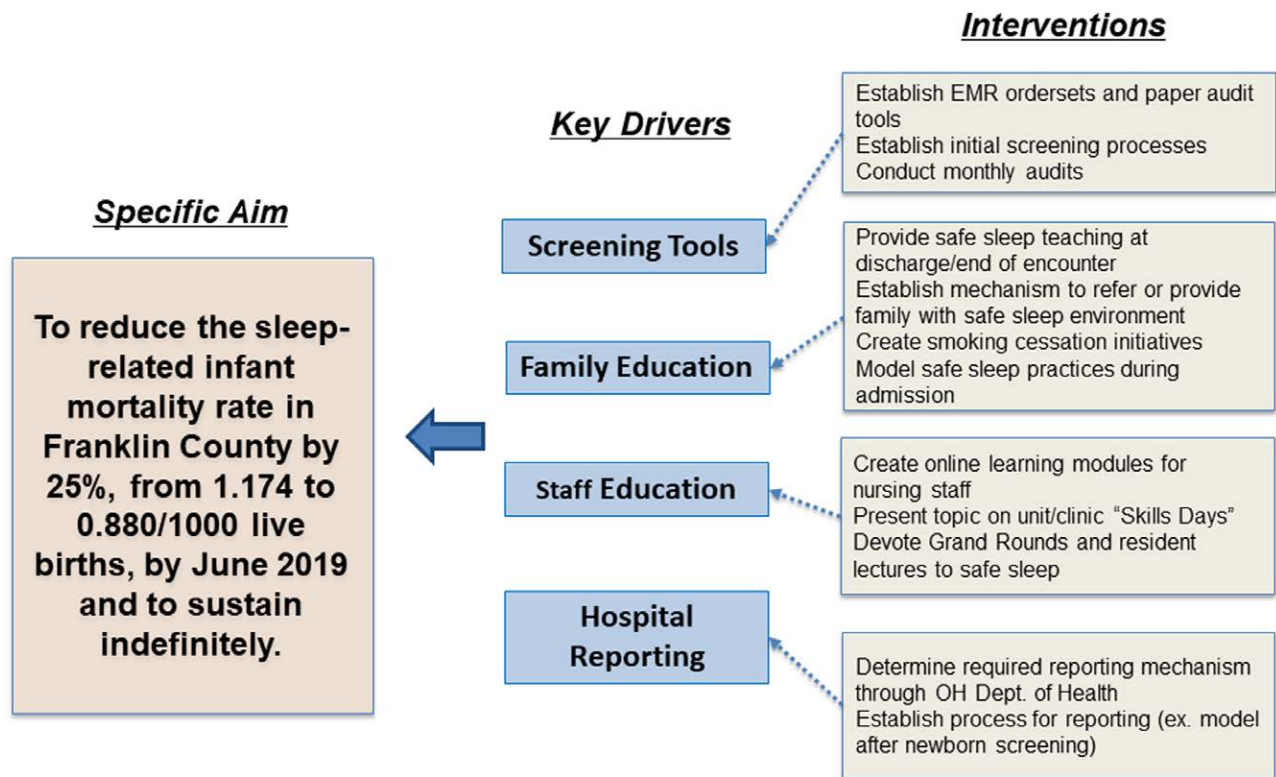


Fig. 1. NCH safe sleep hospital-wide key driver diagram. Dept. indicates department; OH, Ohio.

or against medical advice are excluded. The PCN audits all infants who present to their 13 clinics for their newborn visits through 9-month well-child visits. Through the Franklin County Coroner's office, the PCN also collects data on the number of infant sleep-related deaths each month. Safe sleep education in both the ED and PCN is provided via patient handouts, provider teaching, or videos.

Measures

The primary objective for both the NICU and the inpatient teams was to show that >80% of infants not meeting exclusion criteria were in a "safe sleep environment" on random audits during the duration of the project. We calculated this measure by taking the number of audited infants found in appropriate sleep environments divided by the total number of audited infants. We defined a safe sleep audit as one where the infant is alone in the crib, on his/her back, in a crib empty of blankets, toys, or other extraneous items, and the head of the bed flat.

The primary measure by ED was to increase the number of infants who were provided education on safe sleep to >90% by the project's completion. This measure was calculated by taking the number of audited infants who had EMR documentation of safe sleep education during

the ED encounter divided by the total number of audited infants. The primary measure by PCN was to decrease infant sleep-related deaths within PCN patients in Franklin County, from 1.2 to <0.84 per 1,000 live births, through educational efforts. The goal was calculated based on the Healthy People 2020 goal of reducing sudden unexpected infant deaths to <0.84 infant deaths per 1,000 live births.¹⁴ We created all of these measures in efforts to address our global aim of reducing county-wide sleep-related deaths.

Analysis

All objectives have been tracked over time, utilizing statistical process control charts for each subteam and the global aim. For these analyses, we defined a shift as 6 consecutive data points above the baseline. We performed 2-proportion Z tests and CIs comparing the proportions of infants in a safe sleeping environment in the inpatient and NICU populations and the proportions of infants who received safe sleep education in the ED and PCN groups at the start of the collaborative and currently. We also utilized these tests to determine changes in infant mortality and sleep-related death rates at the beginning and end of our collaborative. We performed statistical analyses using Stata (StataCorp, College Station, Tex.).

Human Subjects Review

This project was QI and not human subjects research; therefore, the NCH Institutional Review Board’s review and approval were not required.

RESULTS

Inpatient

The inpatient units submitted 5,072 audits on hospitalized infants in general medical/surgical units meeting inclusion criteria for our project since September 2012. Since the start of the project, there has been a 77% increase of infants observed to be in a safe sleep environment [baseline, 4/165 (2.4%) to current, 69/87 (79.3%)] (95% CI, 68.1–85.7; $P < 0.01$) (Fig. 2). We noted the most significant behavioral change in the removal of excess items in the crib, with an 82% increase in empty cribs [4.2% (7/165) to 86.2% (75/87)] (95% CI, 74.1–89.8; $P < 0.01$). There has been a significant increase in the presence of blanket-free cribs during the project, from 9.1% (15/165) to 89.6% (78/87) (95% CI, 72.8–88.3; $P < 0.01$).

Neonatal Intensive Care Unit

Since December 2015, the NICUs have submitted 3,690 audits of neonates meeting inclusion criteria in the 4 main campus and 6 affiliated offsite NICUs. The percentage of infants in a safe sleep environment has significantly increased from 35% (baseline, 7/20) to 75.4% (46/61), a 40.4% increase (95% CI, 16.9–63.9; $P < 0.01$) (Fig. 3). Babies found in the correct sleep location have

significantly increased from 80% (16/20) to 100% (66/66) (95% CI, 2.5–37.5; $P < 0.01$). The largest improvement was demonstrated in the number of babies with an empty crib, which significantly improved from 50% (10/20) to 83.3% (55/66) (95% CI, 9.6–57.0; $P < 0.01$).

Per state legislation mentioned above, NCH began questioning parents about the presence of a safe sleep environment in the home in August 2016, with over 7,575 parents/caregivers screened to date. Screening rates have significantly increased from 61.7% (121/196) to 93.4% (197/211) over the past 3 years (95% CI, 24.0–39.2; $P < 0.01$). Families or caregivers that indicate that they do not have access to a safe sleep surface have a consult to social work placed. Those who are unable to afford or obtain a safe sleep surface are provided a play yard. Less than 5% of screened families have needed a play yard.

Emergency Department

The main campus emergency department has audited 15,470 patients who meet inclusion criteria. The majority of caregivers report placing their babies in a safe sleep environment most of the time (bassinet 26%; crib 59%; and portable crib/play yard 9%). Most babies (97%) are placed to sleep on their backs, with few being placed on their sides (2%) and stomach (1%). Few families (3%) reported bedsharing with their infants. There has been an improvement in documented safe sleep education by staff to families, from 48% (200/413) to 80.5% (286/355) (95% CI, 25.8–38.5; $P < 0.01$) (Fig. 4).



Figure 2: Inpatient Med/Surg Unit Safe Sleep Audit Compliance, September 2012-June 2019

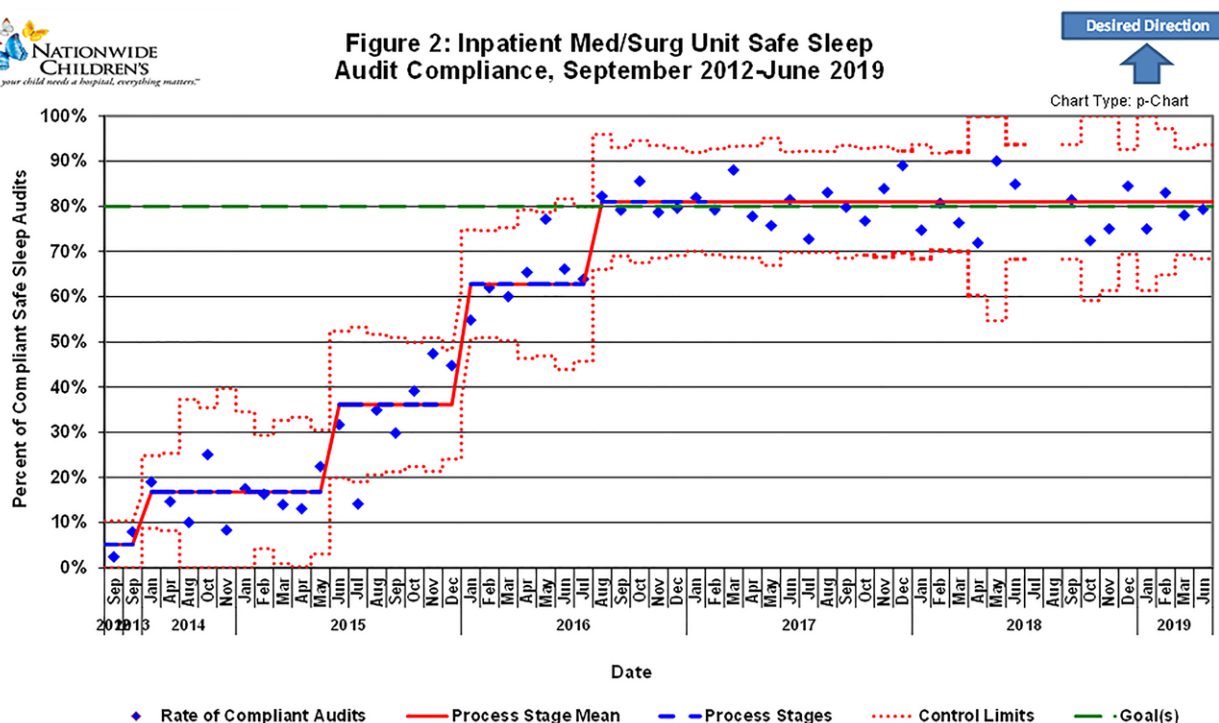


Fig. 2. Inpatient medical/surgical unit safe sleep audit compliance, September 2012 to June 2019.

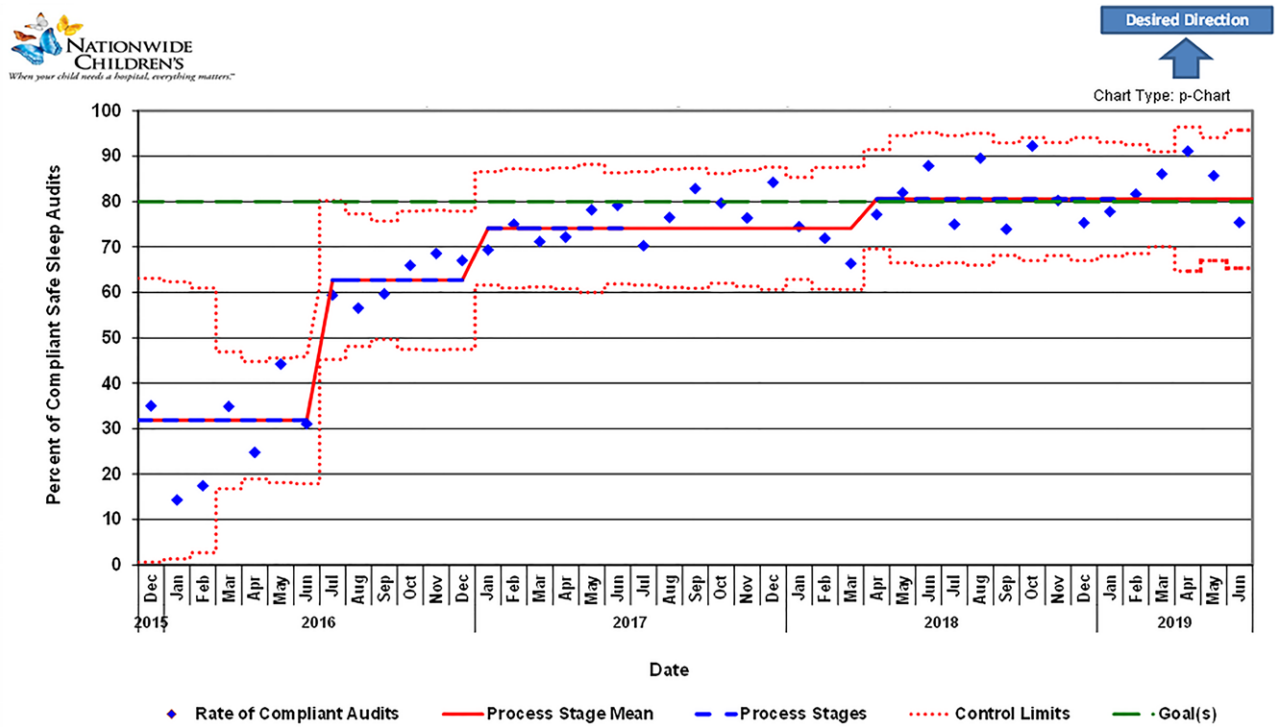


Fig. 3. NICU safe sleep audit compliance, December 2015 to June 2019 (excludes CNS and Resp modality infants). CNS indicates central nervous system; Resp, respiratory.

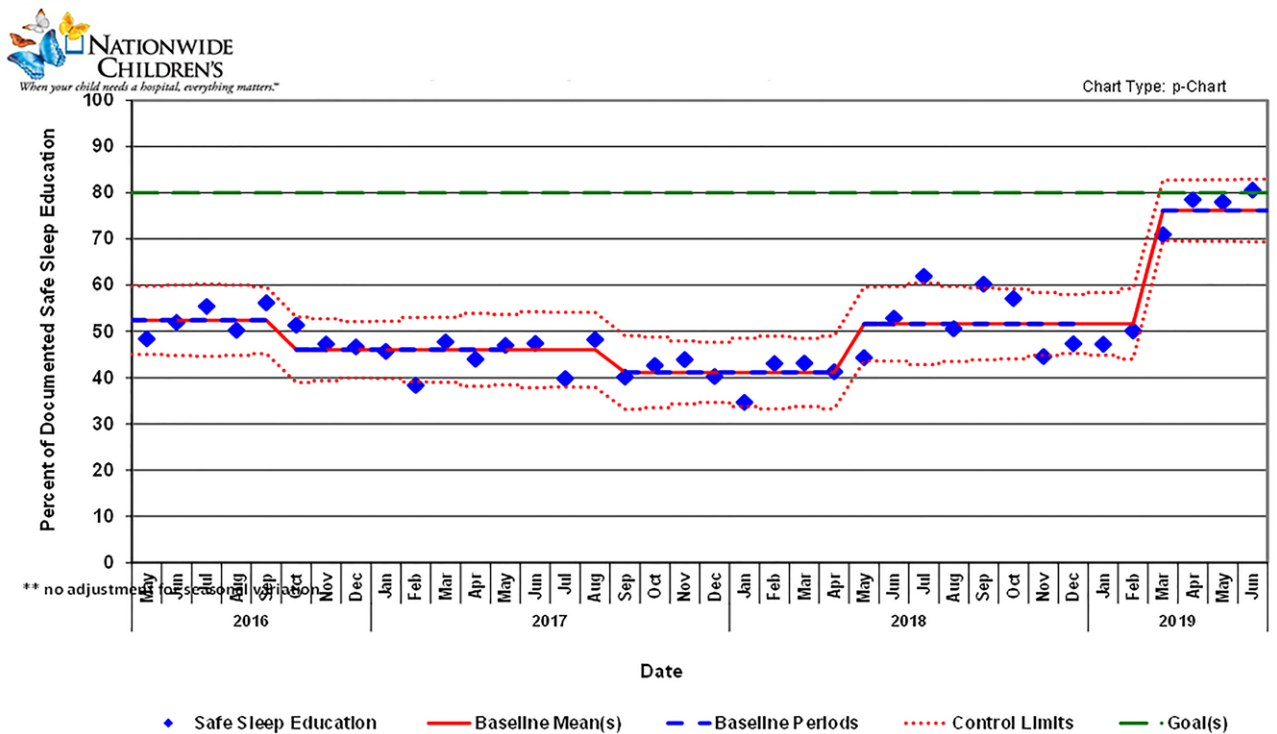


Fig. 4. ED (main campus) patients (<6 mo) receiving safe sleep education, May 2016 to June 2019.

Primary Care

In 2015, 63% (12/19) of infant sleep-related deaths in Franklin County were patients of the PCN.¹⁵ Since this project began, infant sleep-related deaths among PCN

patients have significantly decreased from 1.75 per 1,000 (2015–2017) to 0.20 per 1,000 (August 2018 till current) (95% CI, 0.9–2.2; $P < 0.01$) (Fig. 5). There has also been a 43% increase in infant well-child visits where the nurses

or physicians provided safe sleep education to families [baseline, 12,299 of 23,608 (52%) to current, 19,607 of 19,698 (95%)] (95% CI, 0.44–0.46; $P < 0.01$) (Figure 11, Supplemental Digital Content, which shows the control chart for trends on safe sleep education provided to families in the PCN, <http://links.lww.com/PQ9/A207>).

Franklin County

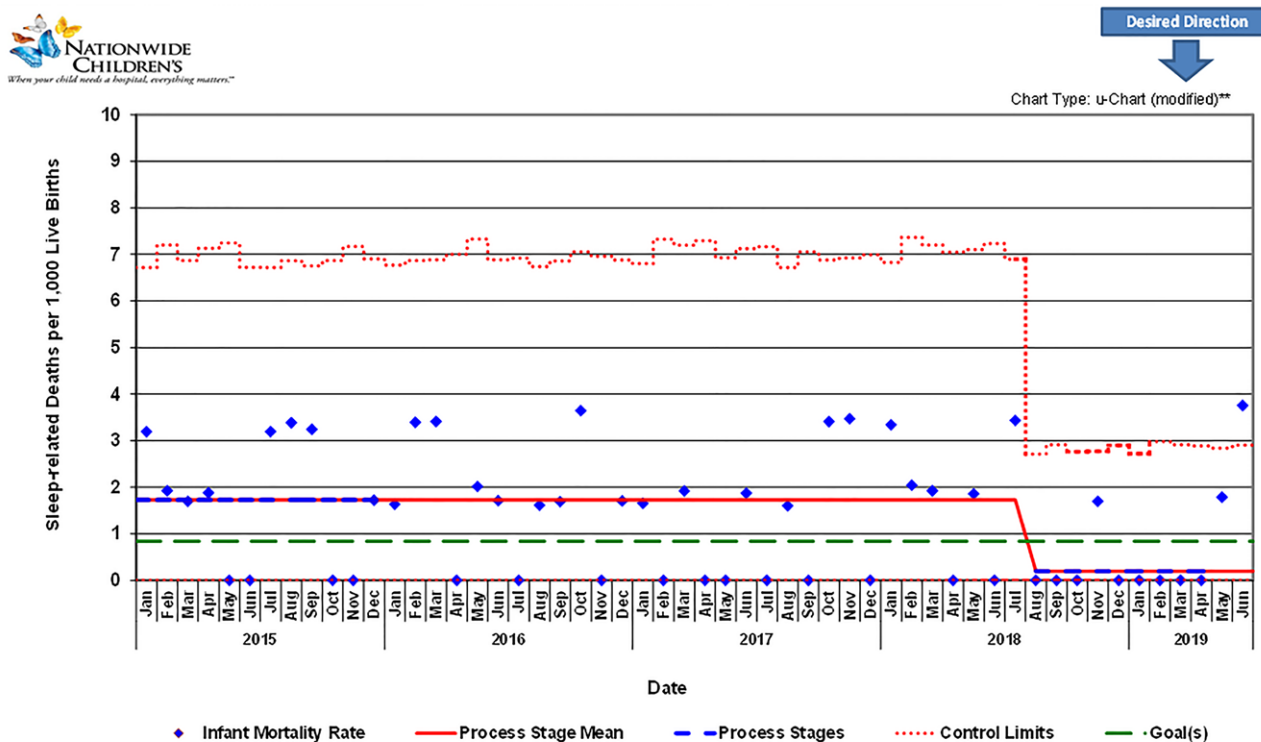
At the start of our collaborative, Franklin County’s sleep-related death rate was 1.174 deaths per 1,000 live births; the current sleep-related death rate is 1.283 deaths per 1,000 live births. Although we have seen several months recently where this rate is below our goal of 0.88 deaths, we have not observed a statistically significant change in this mortality rate over the past 4 years (95% CI, -0.32 to 0.34; $P = 0.94$) (Fig. 6).¹⁶

DISCUSSION

Overall, each of our teams has improved the processes within our divisions and the institution. Our rates of compliance in providing safe sleep environments for infants across the hospital have increased in both the inpatient and NICU settings; subsequently, we have been able to model these behaviors and educate parents and caregivers on these practices in the home. We have also significantly increased the amount and frequency of education provided to families in both our PCN and EDs. Our PCN has

also significantly decreased the amount of sleep-related deaths within their patient population. We attribute this decrease to consistent and sustained education, starting with birthing hospitals and continuing in the PCN, the EDs, and inpatient units, and through public messaging. The efforts of the teams in our multidisciplinary collaborative have not significantly decreased our county’s sleep-related mortality rate.

We suspect that there are many reasons for this sustained lack of improvement at the county-wide level. Although education and demonstration are essential tools to prompt caregivers to place infants in a safe sleep environment, our efforts in the hospital and clinics do not guarantee that parents will always adopt these practices in their homes. According to a recent county Child Fatality Review Board brief, 50% of infants who died from a sleep-related death were found sharing a sleeping surface with another person or animal. Nearly 66% of the infants were found sleeping in an adult bed, couch, or a surface other than a crib, bassinet, or play yard. Only 21% of these infants were found alone, on their backs, and in a crib. All had blankets, pillows, or other suffocation hazards in their sleep environments with them.¹⁶ In short, despite previous studies, we found that appropriate modeling and counseling on AAP-recommended safe sleep practices may not consistently ensure these safe behaviors outside of the healthcare setting. However, our PCN efforts did



**Control Limits are wider than standard because the number of zeros is sufficient to skew probabilities. Standard limits would yield false special cause flags.

Fig. 5. Sleep-related infant mortality rate in primary care network, January 2015 to June 2019.

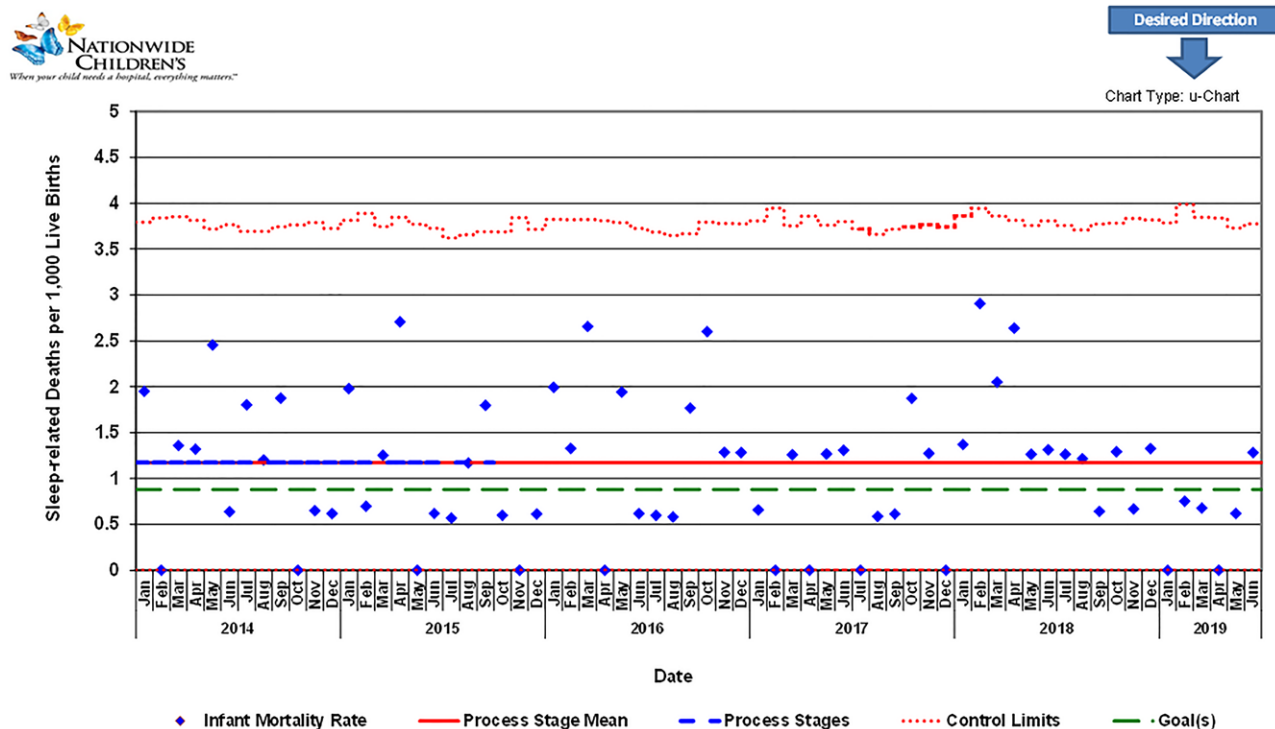


Fig. 6. Sleep-related infant mortality rate in Franklin County, January 2014 to June 2019.

result in a decrease in sleep-related deaths in the network’s patients.

We also acknowledge that factors other than those involving the sleep environment, such as tobacco use, are influencers in sleep-related deaths. In Franklin County, approximately 11% of infants are born to mothers who smoke during pregnancy. However, among sleep-related deaths, almost 60% of infants’ mothers smoked during their pregnancies.¹⁶ Nearly 60% of infants who died a sleep-related death in Franklin County were also born to mothers living in the county’s “urban core” zip codes—areas of low income, increased crime rates, lack of stable housing, and low education rates—lending credence to the idea that socioeconomic status is a significant factor in many sleep-related deaths.^{17,18}

Nevertheless, we feel that our project has brought value to our institution, and, most importantly, our patients and caregivers. Given that we have educated and demonstrated safe sleep behaviors to thousands of families over the past 8 years, we know that our efforts have saved some lives, even if not enough to decrease the county’s sleep-related death rate. We have also aligned our processes with AAP recommendations and now counsel and assist families beyond what our state laws dictate. Lastly, we now have strong relationships with many of our local community organizations to decrease infant mortality further.

Limitations

Our study had a few limitations. Except for the PCN, all of our interventions targeted ill or premature neonates and hospitalized infants. Staff from each team self-reported their audit results, which may have led to a bias in reporting. We have also experienced a high turnover of auditors and QI staff on some of our units and teams, resulting in the potential for inaccurate auditing.

Concluding Summary

We have successfully led teams in a multidisciplinary collaboration to improve infant safe sleep practices and education in our institution, aligned with AAP recommendations and our state’s laws. Although we have significantly decreased the sleep-related mortality rate in our PCN, we have not yet seen a significant decrease in our county’s sleep-related mortality rate. In the future, we will continue to role model safe sleep practices in the hospital, educate caregivers, and work with the local delivery hospitals in providing consistent messaging to families. Further efforts will likely need to involve increased engagement with community organizations, such as CelebrateOne,¹⁹ and other like-minded groups, to bring education, funding, and other resources to our high-risk communities.

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article. We would like to

thank the Child Injury Action Group of Ohio, who provided us with grant funding to purchase multilingual patient education tools, sleep sacks, and other necessary materials.

ACKNOWLEDGMENTS

The authors wish to thank our nursing champions, Jen Pauken, Lynette Starner, Katie King, and neonatal intensive care unit (NICU) occupational therapy specialist Jen Hofherr for their assistance with the study. We would also like to thank our Quality Improvement Services (QIS) Department collaborative members, including Jim Dail, Jenah Eastep, Nathaniel Gallup, Jim Gallup, Charlie Macias, Brockton Mitchell, Venita Robinson, Greg Ryshen, and Christina Toth, for their assistance in project design and statistical analyses.

REFERENCES

1. American Academy of Pediatrics. Task force on sudden infant death syndrome. SIDS and other sleep-related deaths: updated 2016 recommendations for a safe infant sleeping environment. *Pediatrics*. 2016;138:1.
2. Centers for Disease Control and Prevention (CDC). Infant Mortality. 2017. Available at: <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/infantmortality.htm>. Accessed November 18, 2019.
3. Ohio Department of Health (ODH). 2017 Ohio Infant Mortality Data: General Findings. 2017. Available at: https://odh.ohio.gov/wps/wcm/connect/gov/5b43b42b-0733-42cd-8a01-063f831ec53f/2017+Ohio+Infant+Mortality+Report.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=ROOTWORKSPACE.Z18_M1HGGIK0N0JO00QO9DDDDM3000-5b43b42b-0733-42cd-8a01-063f831ec53f-mLmEAnU. Accessed November 18, 2019.
4. Franklin County Public Health. Infant Mortality. 2016. Available at: <https://myfcph.org/health-wellness-maternal-and-child-health/infant-mortality/>. Accessed November 18, 2019.
5. Colson ER, Joslin SC. Changing nursery practice gets inner-city infants in the supine position for sleep. *Arch Pediatr Adolesc Med*. 2002;156:717–720.
6. Shadman KA, Wald ER, Smith W, et al. Improving safe sleep practices for hospitalized infants. *Pediatrics*. 2016;138:e20154441.
7. Macklin JR, Gittelman MA, Denny SA, et al. The EASE quality improvement project: improving safe sleep practices in Ohio Children's Hospitals. *Pediatrics*. 2016;138:e20154267.
8. Mason B, Ahlers-Schmidt CR, Schunn C. Improving safe sleep environments for well newborns in the hospital setting. *Clin Pediatr (Phila)*. 2013;52:969–975.
9. Gelfer P, Cameron R, Masters K, et al. Integrating “Back to Sleep” recommendations into neonatal ICU practice. *Pediatrics*. 2013;131:e1264–e1270.
10. Schaeffer P, Asnes AG. What do pediatricians tell parents about bed-sharing? *Matern Child Health J*. 2018;22:51–58.
11. Central Ohio Hospital Council. Infant Mortality. 2020. Available at: <https://centralohiohospitals.org/infant-mortality/>. Accessed June 12, 2020.
12. Ohio General Assembly Archives. SB 276. 2014. Available at: http://archives.legislature.state.oh.us/bills.cfm?ID=130_SB_276. Accessed November 18, 2019.
13. Nationwide Children's Hospital. Fast Facts, 2018. 2019. Available at: <https://www.nationwidechildrens.org/about-us/our-story/fast-facts>. Accessed November 18, 2019.
14. Healthy People.gov. Maternal, Infant, and Child Health: Morbidity and Mortality. 2020. Available at: <https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives#4825>. Accessed December 5, 2019.
15. Columbus Public Health. *Franklin County Health Indicator Brief: 2015-2016. Sleep-Related Infant Deaths*. 2017. Available at: <https://www.columbus.gov/publichealth/programs/Office-of-Epidemiology/Infant-Mortality-Reports/>. Accessed: November 18, 2019.
16. Office of Epidemiology, Columbus Public Health. Sleep-Related Infant Deaths by Month & Year, 2011-2019. Ohio Department of Health Vital Statistics. Accessed December 5, 2019.
17. Spencer N, Logan S. Sudden unexpected death in infancy and socioeconomic status: a systematic review. *J Epidemiol Community Health*. 2004;58:366–373.
18. Blair PS, Sidebotham P, Berry PJ, et al. Major epidemiological changes in sudden infant death syndrome: a 20-year population-based study in the UK. *Lancet*. 2006;367:314–319.
19. The City of Columbus. CelebrateOne. 2020. Available at: <https://www.columbus.gov/celebrate-one/>. Accessed on: June 12, 2020.