RESEARCH ARTICLE

Successful Implementation of the Eat Sleep Console Model of Care for Infants With NAS in a Community Hospital

Douglas Dodds, MD, Kayla Koch, MD, Talia Buitrago-Mogollon, MHA, CPHQ, Sara Horstmann, MD

ABSTRACT

BACKGROUND: Opioid use across the United States is increasing. The concomitant rise in the incidence of neonatal abstinence syndrome (NAS) has made care of infants with this disease process a top priority for pediatric centers across the country. There is growing evidence that the Eat Sleep Console (ESC) model of care is superior to the established Finnegan Neonatal Abstinence Scoring System model.

OBJECTIVES: We aimed to improve the care of infants with NAS by transitioning from the Finnegan Neonatal Abstinence Scoring System model to the ESC model of care. Our goal was to decrease the average length of stay from 11.77 to 5.94 days without having an increase in readmissions.

METHODS: A multidisciplinary team was created. Education about NAS and ESC was created and distributed. Patients were admitted to the inpatient unit, and outcomes were observed. Standard quality improvement methodology was used for this intervention.

RESULTS: After implementation of the ESC care model, average length of stay decreased to 5.94 days, with 0 patients readmitted or transferred for NAS-related complications. We saw a 48% reduction in average variable cost per patient. In addition to these reductions and savings, total per patient morphine exposure was reduced from 2.25 to 0.45 mg/kg, a 79% reduction in use.

CONCLUSIONS: The ESC model of care was successfully implemented at our institution with resultant cost savings, decreased length of stay, and decreased medication use. Our work further supports the adoption of this new model of care for infants with NAS.

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Drs Dodds, Koch, and Horstmann conceptualized and designed the study and drafted the initial manuscript; Mrs Buitrago-Mogollon created run and control charts, provided initial analyses, and reviewed and revised the manuscript; and all authors approved the final manuscript as submitted.

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The incidence of neonatal abstinence syndrome (NAS) has quintupled over the last decade.[1,2] NAS results from the rapid discontinuation of opioids, which causes disturbances in neurologic, autonomic, gastrointestinal, and musculoskeletal system function.[3] Treatment of NAS varies considerably across the country.[4,5] The most used care model is the Finnegan Neonatal Abstinence Scoring System (FNASS). The FNASS is a scoring tool based largely on subjective clinical criteria. Patients often require prolonged hospital stays, pharmacologic interventions, and have high health care costs.[1,6,7] These factors, when joined with increasing numbers of patients with NAS, stretch the care limits of NICUs, special care nurseries, and newborn nurseries across the United States, producing upward inflection on the value curve of national and local health care systems.

Recent care improvements generated compelling data suggesting that using a model of care that is more functional in its assessment and treatment of infants with NAS improves quality of care and positively affects the average length of stay (ALOS), medication use, breastfeeding, and cost per stay. Authors of several studies report reduced ALOS, cost, and NICU admission rates after adopting a rooming-in model of care.[8–10] Howard et al[11] reported similar decreases in length of stay (LOS), withdrawal severity, and need for pharmacologic intervention with increased parental presence and involvement. Authors of other studies report breastfeeding's association with decreased need for pharmacologic treatment and reduced LOS.[12] In 2014–2015, Grossman et al[13–15] developed and introduced the Eat Sleep Console (ESC) model of care with significant reductions in ALOS, pharmacologic intervention, and average cost of hospitalization. In their work, Grossman et al[13–15] also described increases in breastfeeding rates in the intervention cohort. This model relies less on subjective assessments and provides a simplified approach to assessing and caring for infants and families coping with NAS. The focus with the ESC model is the functional well-being of the child, and it enhances the care of the patient by using nonpharmacological treatment, improved breastfeeding support, and caregiver-centered education and social support.

With >700 at-risk deliveries each year within our health care system and an ALOS for NAS of 11.77 days, the need for improvement was evident. We sought to find an improved model of care and a more appropriate setting for care. For our study, the ESC care model was adopted and adapted to the pediatric hospital medicine inpatient service at a 28-bed community children's hospital with 3286 yearly admissions located within a 457-bed general hospital that is part of a large multisite health care system. We chose this setting to provide a less stimulating, more holistic, and caregiver-centered environment where caregivers can stay and provide continuous care at the newborn's bedside. This site also provided access to vital collaborative services of the NICU, maternal fetal medicine, psychiatry, and case management. With these benefits in mind, our aim was to transition care of infants with NAS from an FNASS model to the ESC

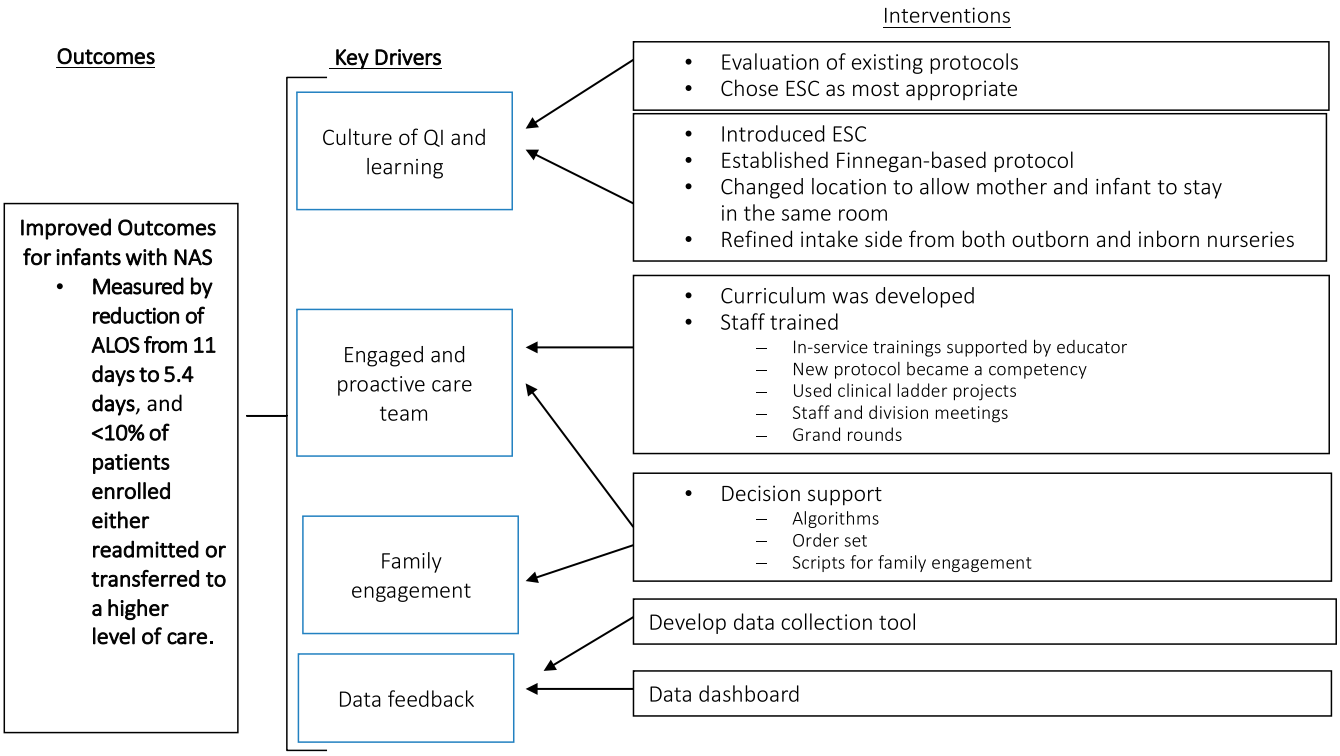

FIGURE 1 Key driver diagram. The aim was to improve the care for children with NAS within Atrium Health.

model of care and to follow our progress using the Model for Improvement as our quality improvement (QI) methodology.[16] Our outcome measures were to reduce ALOS by 50% and decrease cost per stay by 15%. Our process measures were a 90% use rate of the ESC assessment tool and increase in breastfeeding rate of 30%. Our balancing measure was a readmission rate of <10%.

METHODS

This intervention was conducted at a children's hospital within a hospital that is part of a major health care system. The hospital has a busy newborn service, NICU, and inpatient service and is a regional referral base. The practice at the time of the study was for infants born exposed to opioids, either through prenatal identification or at delivery, to be observed for 5 days in the newborn nursery and scored by using the FNASS. Infants with 2 FNASS scores ≥8 or 1 score ≥12 were then moved from the newborn nursery to the NICU where an FNASS-based protocol was followed. After implementation, the 5-day observation period and assessment of severity remained the same. However, infants were screened by medical social work for inclusion and then transferred to either the inpatient ward or the NICU for treatment on the basis of the screening results. Our inclusion criteria for the ESC group were as follows: gestational age ≥37 weeks, availability of bedside caretaker, and no comorbid illnesses requiring specialized care. Infants not meeting ≥1 of these criteria were transferred to the NICU for treatment.

For this planned intervention, a multidisciplinary team was created. This team included representatives from pediatric hospital medicine, the Center for Advancing Pediatric Excellence (QI Center), neonatology, nursing (pediatrics, NICU, newborn nursery), administration, case management, volunteer services, child life, obstetrics, behavioral health, family medicine, and the local health department. Monthly meetings were held to sustain engagement and assess progress. Institutional review board oversight was applied for, and the project received exempt status as a quality initiative. The Model for Improvement and rapid plan-do-study-act cycles were used to drive change. A key driver diagram was created (Fig 1). Data were collected on infants admitted to the hospital in the year (January 2017 to March 2018) before project initiation for

ESC Assessment

Give 1 point for each "yes" answer

Date											
Time											
Eating effectively (breastfeeds with effective suck, swallow, and/or latch and minimal regurgitation or able to eat the amount of prescribed formula)											
Sleeping effectively (able to sleep for 60 consecutive minutes)											
Console (able to console in 10 minutes or less)											
Total score											
RN initials											

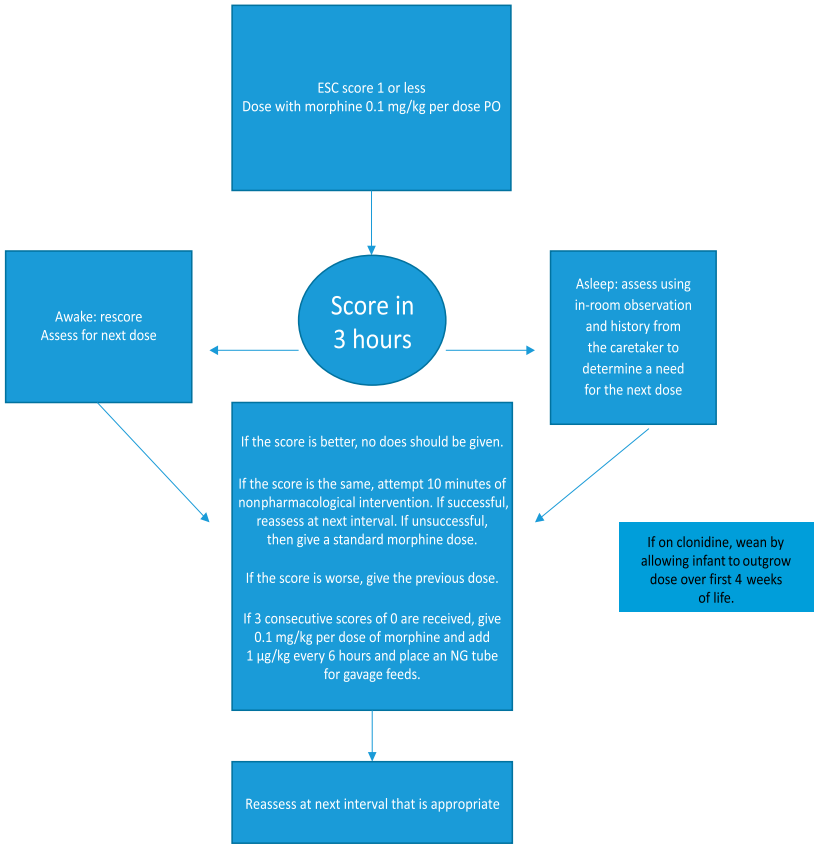

FIGURE 2 ESC scoring form and treatment pathway. NG, Nasogastric; PO, Per Os; RN, registered nurse.

comparison. These data included detailed demographic information, in utero drug exposure, individual hospital course, LOS, allocated variable cost per stay, need for medication, frequency of medication administered, and any associated complications. We analyzed all infants who were transferred to the NICU for NAS care in the preimplementation phase. Postimplementation analysis was performed on infants admitted to the inpatient pediatric unit for treatment of NAS. Infants exposed to various illicit drugs as well as prescription opioids, selective serotonin reuptake inhibitors, alcohol, and nicotine were included.

Our first intervention was changing the location of care for qualifying infants identified to have symptoms of NAS from any nursery to the inpatient unit. This allowed for rooming-in and increased caregiver involvement at the bedside. A package of tools was created to streamline the process of caring for these infants. This included a social work screening tool, admission checklist, discharge checklist, inborn transfer checklist, and outborn transfer checklist. We also developed a process for outpatient developmental follow-up and continued behavioral health intervention for the family. Inpatient floor nursing staff were educated on the FNASS. Initially this system was followed, and treatment was based on the preexisting NAS protocol.

The second intervention was to change from the FNASS model to the ESC model of care. Educational materials were created on the ESC model, and nursing and providers were educated. A flow map for treatment was created with the scoring system (Fig 2). The ESC scoring tool was created and approved by the hospital system forms committee (Fig 2). For the first month of implementation, FNASS and ESC scoring were done concurrently for every patient. This allowed familiarity with each tool to develop for each scorer. After the first month, the ESC scoring tool was used exclusively. In accordance with the ESC model, infants were assessed on their ability to breastfeed or bottle-feed effectively, to sleep undisturbed for >1 hour in between feeds, and to console within 10 minutes if distressed. A score of ≥2 was considered effectively managed withdrawal. A score of ≤1 was indicative of withdrawal requiring medication. Nonpharmacological treatment was administered, and if ineffective, morphine 0.1 mg/kg per dose was administered. Each score was independent and drove treatment decisions only for that given time of evaluation. Three consecutive scores of 0 triggered consideration of nasogastric tube placement for feeds and addition of clonidine 1 μg/kg per dose every 6 hours. During this time, extensive education on nonpharmacological interventions such as vertical rocking, swaddling, singing, cooing as well as mamaRoo swings and the Pacifier-Activated Lullaby System were made available to nursing staff and caregivers (Fig 2). Parental (or identified caregiver) presence was strongly encouraged, and volunteers were used when caregivers were unavailable.

Monthly data collection occurred for infants admitted for NAS through manual chart audits from April 2018 to February 2019. Outcome measures included ALOS, allocated variable cost per stay, and total morphine use. These measures were evaluated by using statistical process control (SPC) charts. Change concepts were annotated on SPC charts, and results were analyzed by using standard SPC rules to identify the presence of special cause variation and 2-sample *t* test with unequal variance to attain significance of improvement. The process measures were use of the ESC assessment tool, which was a proxy for adherence to the ESC method, and breastfeeding rates. Our balancing measure was readmission rate.

RESULTS

There were 82 infants included in this study, with 49 from the baseline period (January 2017–March 2018) and 33 from the postimplementation period (April 2018–February 2019). Eight patients were excluded from the postimplementation period analysis, with 5 excluded because of caregiver unavailability, 2 because of prematurity, and 1 because of comorbid disease requiring specialized care. Demographic characteristics of the included infants are presented in Table 1. There was no significant difference between the 2 groups. Several patients were missing data on race and ethnicity and thus could not be included in this statistical comparison.

The ESC model was followed for 90% of the postimplementation patients. The remaining 10% were scored with the FNASS, which occurred in the first month of data collection posttransition after an

TABLE 1 Characteristics and Outcomes of Newborns

Newborn Characteristics	Baseline ($N = 49$)	Postimplementation ($N = 33$)	*P*
Excluded	0	8	
Boys, *n* (%)	21 (44)	10 (29)	.17
Race, *n* (%)			.15
White	43 (90)	13 (76)	
Person of color	5 (10)	4 (24)	
Birth wt, kg	2.91 ± 0.48	2.84 ± 0.48	.52
Polypharmacy, *n* (%)	26 (54)	17 (50)	.72
Exposed to opioids, *n*	48	31	
Outcomes			
Use of ESC scoring tool, *n* (%)	0 (0)	12, $n = 13$ (92%)	<.0001
ALOS, d	11.77 ± 9.62	5.94 ± 2.98	.0003
Morphine use	2.25 mg/kg ± 3.45	0.45 mg/kg ± 0.78	.001
Required morphine, *n* (%)	23 (48)	8 (24)	.03
Total dose, mg/kg	2	0.45	
Breastfeeding rate, %	45	45	0.99

educational communication breakdown occurred causing this break in protocol. None of these infants required initiation of morphine therapy. These infants were included in our analysis. Our measures of ALOS, average variable cost per patient, and morphine use revealed special cause variation (8 data points below the mean) resulting in a downward shift of the mean after the main 2 interventions (mother and infant rooming-in and starting ESC protocol) (Fig 3). The 2-sample *t* test with unequal variance revealed a decreased ALOS from 11.77 to 5.94 days, a 50% reduction ($P = .0003$). Average variable cost per stay decreased by 48%, and the cumulative amount of morphine used per stay (total amount of morphine given during the

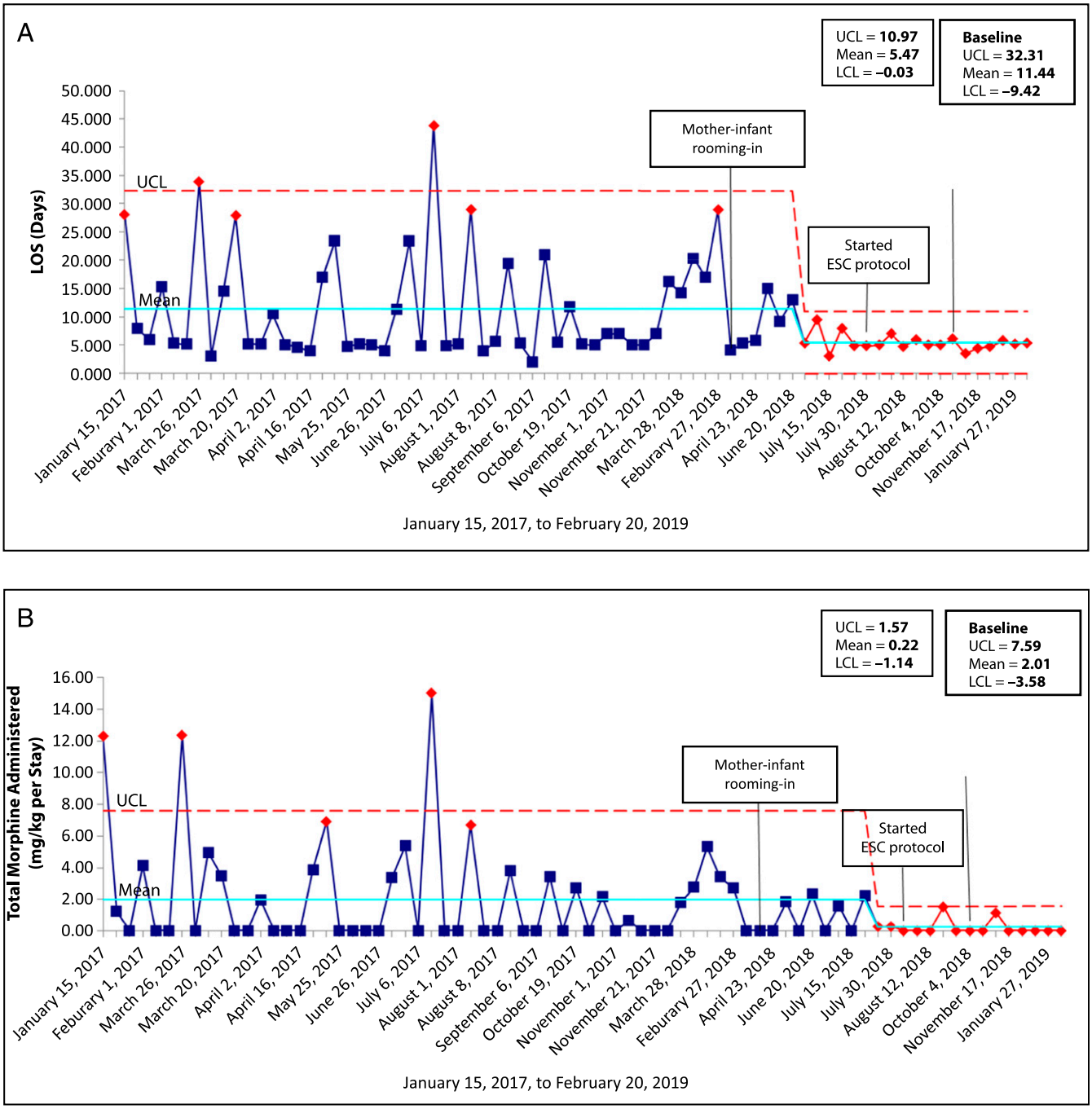

FIGURE 3 X-bar charts. Means differ between *t* test and SPC charts because of different data groups. Means in SPC charts represent normal versus special cause variation and means on *t* test represent pre- and postintervention periods. A, LOS per patient (days). B, Total morphine administered per patient (mg/kg). LCL, lower control limit; UCL, upper control limit.

hospital stay divided by birth weight) decreased from 2.25 to 0.45 mg/kg, a 79% reduction ($P = .001$) (Table 1). Breastfeeding rates were not impacted. No adverse events were reported in study participants. Two infants required readmission for non–NAS-related illnesses.

All 8 excluded infants were scored and treated with the FNASS-based protocol in the NICU. For the 5 infants who were excluded because of caregiver unavailability, the ALOS was 22 days. The average cumulative amount of morphine per kilograms used for these 5 infants was 3.1 mg/kg.

DISCUSSION

Transition from the FNASS to the ESC model of care at our institution was successful. While achieving these successes, quality and safety of care was maintained. There were no other efforts aimed at decreasing the LOS for patients with NAS at the time of this study, and we are confident that our interventions gave rise to the changes observed. Grossman et al[13–15] described similar results at their institution when developing the ESC model. Our study was implemented at a smaller, nonacademic community-based children's hospital within a larger health care system.

The major strength of this QI initiative was the adoption of an interdisciplinary collaborative view of the disease process. Viewing the mother-infant dyad as a single entity allowed a shift in care from a patient-centered to a caregiver-centered care model. Allowing caregivers to room in with infants and providing a quiet and nurturing environment are major reasons for the project's success. Opioid use disorder stigma softened as the caregiver became the primary care provider for the infant and a therapeutic, trustful relationship developed between the hospital staff and the caregiver. Another strength was the regularity with which the multidisciplinary team met to discuss the study and interventions. We were able to address concerns and unexpected barriers quickly and effectively, thus maintaining a treatment environment conducive to positive results throughout the study period. Strengthening of the local care system occurred as community, government, and health system programs were identified to generate a continuum of care beginning at the first prenatal visit and extending to the entry of the dyad into primary care. Financial support of the program by the hospital foundation solidified its commitment to the community to find creative and effective ways to stem the effects of opioid use disorder. This early and dramatic success led to expansion of the program to other system sites. The success has also led to strengthening of interdepartmental collaborative efforts and exploration of other novel strategies for care delivery.

Limitations of the study include the fact that we did not control for exposure to any substances, including nicotine. We chose not to limit our patient population to those exposed only to opioids so as not to markedly limit the number of patients who could be included. Also, our ESC screening tool is not validated. A final limitation is that we only included patients enrolled in our program in the postimplementation evaluation. We believe our poor improvement in breastfeeding rate was influenced by not recommending breastfeeding to mothers expressing a desire to actively use marijuana in the postpartum time period. This was in accordance with the current approach proposed by the American Academy of Pediatrics in 2018.

With the initial program success, implementation of the ESC model of care across our health care system has begun. We expect to have full implementation across all sites caring for newborns by 2020. We continue to monitor for changes in ALOS, average variable cost per patient, and morphine use.

Plans include the development of a prenatal education package for expectant mothers to better prepare them for the postpartum hospital experience. Targeted interventions to increase breastfeeding rates and skin-to-skin time for infants are planned. Long-term goals include strengthening the collaborative efforts between key stakeholders to improve access to maternal medication-assisted treatment using buprenorphine, to improve infant developmental follow-up, and to begin longitudinal well care for the infant-caretaker dyad.

CONCLUSIONS

The ESC model of care for children with NAS was successfully implemented at a community, nonacademic children's hospital within a larger health care system with a reduced LOS of 5.94 days (a 50% reduction), reduced morphine use per stay to 0.45 mg/kg (a 79% reduction), and average variable cost savings of 48% per case. We believe these results support adopting the ESC model of care for infants and caretakers to improve their care quality and experience while favorably bending the health care value curve.

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