Intraprofessional Excellence in Nursing: Collaborative Strategies for Neonatal Abstinence Syndrome

Amanda H. Teague, MSN, NNP-BC
Amy J. Jnah, APRN, DNP, NNP-BC
Desi Newberry DNP, NNP-BC

Disclosure
The authors have no relevant financial interest or affiliations with any commercial interests related to the subjects discussed within this article. No commercial support or sponsorship was provided for this educational activity.

Abstract

Neonatal abstinence syndrome (NAS) is a growing public health concern, one that costs the health care system $190–$720 million each year. Recently, state-level perinatal quality collaborative groups have disseminated NAS action plans: customizable frameworks aimed to assist health care systems in identifying, evaluating, treating, and coordinating discharge services for neonates with NAS. Hospital-based neonatal nursing quality improvement teams, including neonatal nurse practitioners (NNPs), neonatal clinical nurse specialists (CNSs), and clinical neonatal nurses, by virtue of their collective academic, administrative, and practical years of experience, are ideally positioned to develop, implement, and evaluate NAS care bundles. The article's purpose is to discuss key elements of an NAS care bundle using the framework of the Perinatal Quality Collaborative of North Carolina NAS action plan as an exemplar. Discussion of evidence-based and nursing-driven metrics will be followed by a discussion of the emerging concept of an inpatient-to-outpatient transitional care NAS management model.

Keywords: neonatal abstinence syndrome; standardization of care; clinical practice guidelines; intraprofessional collaboration; care bundles

Reducing neonatal/infant mortality rates is a topic of national significance because it is a gauge of maternal, neonatal, infant, and societal health.[1] Investigations into underlying etiologies that contribute to neonatal mortality and morbidity must be undertaken to develop interventions aimed at protecting this vulnerable population. According to the U.S. Department of Health and Human Services, women who do not seek prenatal care deliver neonates who are five times more likely to die soon after birth, making lack of prenatal care a leading cause of untoward outcomes for neonates.[2] Unintended pregnancies are linked to absent or inadequate prenatal care as well as alcohol and licit or illicit drug abuse.[3] The abuse of these licit or illicit drugs is reported as a perceived barrier for pregnant women to seeking adequate prenatal care.[4] These addictive behaviors impose morbidity risks for the vulnerable neonate because neonatal withdrawal is a likely consequence of the routine consumption of controlled substances by a pregnant female.

Efforts focused on the identification, diagnosis, and provision of safe, quality, cost-conscious care for these at-risk families are under way in many states across the United States. Some states are attempting to enact legislative packages, a compilation of multiple state and interstate level laws, imposing regimented reporting structures for prescribing and dispensing practices, limitations to pharmacy access by patients, and appropriate ongoing medical education

Accepted for publication
April 2015.

for clinicians.[5] Other states, such as Tennessee, are calling for the incarceration of mothers who consume illicit drugs during pregnancy and deliver addicted neonates.[6,7] States to include North Carolina, Ohio, Tennessee, and California have started up state-level perinatal quality collaborative (PQC) groups to address the inpatient management of neonatal abstinence syndrome (NAS). These PQC groups are composed of multidisciplinary experts who develop standardized, evidence-based action plans, or frameworks for clinical practice. PQC experts hope that these frameworks will assist individual hospitals in developing NAS care bundles and achieve the outcomes of earlier identification, evaluation, treatment, and discharge of at-risk or addicted mothers and neonates. Proper understanding of NAS, associated morbidity statistics, impacts on all stakeholders, and methods by which neonatal nurses can optimize the delivery of best practices for the care of neonates with NAS is indicated.

BACKGROUND/SIGNIFICANCE

The NAS is defined as a constellation of clinical manifestations consistent with drug withdrawal in a fetus exposed in utero to opioids or other licit or illicit drugs.[8] Neonates diagnosed with NAS amass one of the highest mortality and morbidity statistics afflicting term newborns as compared to their healthy term newborn counterparts.[9] Neurologic, respiratory, and gastrointestinal disturbances may be displayed at varying intensities depending on the severity of withdrawal.[8] Observable clinical manifestations may include a high-pitched cry, increased muscle tone, aberrations with sleep-wake patterns, poor feeding, poor linear growth, seizures, and tremors (Table 1).[8] The severity of the withdrawal symptoms, as documented by an NAS scoring tool, determines the need for pharmacologic and/or nonpharmacologic management strategies.

The NAS is a psychosocial and economic enemy to the health care system, pregnant females, voiceless neonates, and families. Both the censuses in the NICU and newborn nursery as well as the demand for ongoing outpatient pediatric continuing care continue to rise as a result of NAS. The NAS is clearly imposing a substantial economic and psychosocial burden on the U.S. health care system.[1] The average inpatient length of stay (LOS) for neonates with NAS across the United States averages 16.4 days, compared to 2–3 days for the healthy term newborn.[10] Mean U.S. hospital costs for neonates diagnosed and treated for NAS in 2009 was $720 million, averaging per person to be $43,000 more expensive than a healthy term neonatal inpatient hospitalization.[11,12] These numbers reflect a growing public health issue and a critical issue for health care systems that risk operating at a loss by retaining these neonates on census for prolonged periods of time. Interventions aimed at reducing hospital stay while ensuring that no compromises in quality or safety emerge are clearly indicated.

TABLE 1 ■ Symptoms of Neonatal Abstinence Syndrome by System[8]

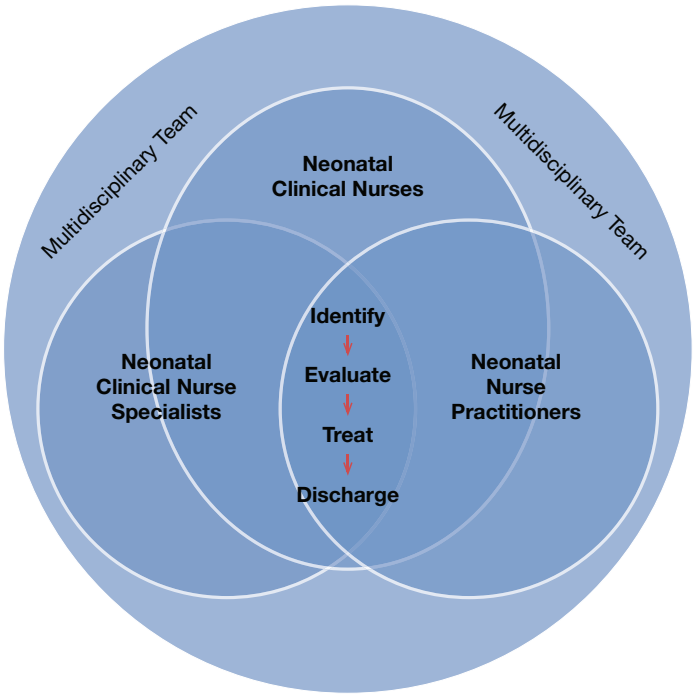
System	Symptoms
Central nervous system	Excessive, high-pitched cry Sleep aberrations Hyperactive Moro reflex Tremors Increased tone Skin excoriation Myoclonic jerks Seizures
Metabolic/respiratory	Sweating Hyperthermia Frequent yawning Mottling Nasal stuffiness Sneezing Nasal flaring Tachypnea
Gastrointestinal	Excessive sucking Poor feeding Projectile vomiting Regurgitation Loose stools Watery stools

The morbidity risks associated with NAS extend well beyond the immediate neonatal period, requiring ongoing observation and management by clinicians in the outpatient sector. Experts have associated NAS with neurodevelopmental impairments, including hyperactivity, attention deficits, memory, and perceptual difficulties in children across the life span.[13–16] Reports of below average performance on developmental tests[14] and poor ophthalmologic outcomes[17] have also been correlated with the fetus's exposure to controlled substances, specifically opioids, in utero and the subsequent diagnosis of NAS.

NEONATAL NURSES AND QUALITY IMPROVEMENT

Neonatal nurse practitioners (NNPs), clinical neonatal nurses, and neonatal clinical nurse specialists (CNSs) comprise the aggregate majority of the neonatal intensive care workforce. Collectively, these experts bring forth vast theoretical and practical knowledge, experience, innovative ideas, and culturally sensitive approaches to the care of neonates and families. A collective, overlapping, and collaborative approach (Figure 1) to NAS care is indicated to optimize expertise and create intraprofessional synergy within neonatal nursing. Planned, purposeful activities with shared onus over the planning, implementation, and evaluation phases of quality improvement, while optimizing each participant based on his or her education, training, and scope of practice,

FIGURE 1 ■ Neonatal nursing collaborative framework for action.



can yield high-fidelity, quality solutions. Understanding the unique level of expertise and scholarship that each neonatal nurse brings to the team is essential.

The neonatal clinical nurse plays an equally important role in the management of infants with NAS and their families. Neonatal clinical nurses range in experience from novice to expert, providing tireless continuous care to neonates and families. As the frontline clinical provider in the NICU, these clinical nurses possess the ability to assess and appraise the subtlest of clinical status changes of the voiceless neonate. Clinical nurses assess the severity of abstinence signs exhibited by the neonate with NAS, provide nonpharmacologic and ordered prescribed therapies, and provide supportive care to the infant and family. Through participation in the development and implementation of NAS care bundles, clinical nurses across the spectrum of experience can better understand and contribute to the complex constructs of quality improvement. Employer commitment, both administratively and financially, to the ongoing population-specific continuing education for neonatal clinical nurses is indicated. This may be achieved through attendance at state or national conferences, membership in neonatal-specific organizations, or the provision of resources to encourage scholarly contributions such as publications or presentations. These strategies encourage clinical excellence and the pursuit of lifelong learning, thereby benefitting all stakeholders.

The neonatal CNS is equipped with scientific knowledge and practice expertise specific to the neonatal arena. These highly trained nurses bring forth years of clinical practice experience which provides a strong foundation for leadership with evidence-based practice inquiries and projects. CNSs exert influence on neonatal nursing colleagues, the NNP, and the clinical neonatal nurse and systems at the organizational, state, and national levels. Through the use of interpersonal communication, mentoring, and role modeling, CNSs encourage and facilitate the advancement of neonatal clinical practices in cadence with the ever-changing health care system. A paucity of neonatal CNSs exists within today's NICUs because of a troubling shortage of neonatal CNS graduate nursing education programs. As a result, NNPs are forced to absorb additional responsibility for evidence-based teaching, research, and quality improvement and often serve as role models for clinical nurses in the NICU.

The NNP brings unparalleled advanced practice expertise specific to neonates, infants, and children up to two years of age in both inpatient and primary care settings.[18] NNPs are equipped to lead, collaborate, and participate in neonatal clinical care, research, and scholarship activities. NNPs have independent prescriptive authority in 18 states; other states require a supervising/collaborative relationship with a physician for the prescription of Schedule II–V drugs.[19] NNPs consistently coordinate and implement care regimens for neonates with NAS and do so in a collaborative, family-focused manner. Having proven their worth to the inpatient acute care arena since the early 1970s, now may be the time for NNPs to expand to the outpatient sector and continue to positively impact their patients into the toddler years. A remarkable opportunity for continuity of care is at the fingertips of the health care system should a practice model be developed and tested. As stated in the Institute of Medicine's (IOM) report, *The Future of Nursing: Leading Change, Advancing Health*, the removal of scope of practice barriers such that advanced practice nurses (APNs) could practice to the maximum extent to which their certification and scope of practice allows is desired.[20] As NNPs and other APNs gain the opportunity for independent practice with billing authority and reimbursement potential, the feasibility for this type of model will increase. With the steady infiltration of doctoral-prepared NNPs keenly trained to identify quality improvement initiatives with NAS as well as other clinical problems, the potential for the emergence of new best practices is right around the corner. These initiatives will underpin the aim woven into the constructs of the Affordable Care Act—to improve quality of health care and lower costs.[21]

Reorganization of the operational structure within NICUs such that clinical nurses, CNSs, and NNPs consistently work in collaboration with evidence-based practice, leadership agendas, or quality improvement initiatives, such as NAS, is needed. This will allow all neonatal nursing experts to practice to the full extent of their education and training, in collaboration with each other, strengthening professional bonds and helping to maintain nursing's respected presence in the NICU.[20]

PROPOSED SOLUTION

The implementation of NAS care bundles affords health care systems an attainable solution to mitigating the NAS epidemic. The NAS care bundles are composed of high-fidelity identification, evaluation, management, and treatment strategies that the multidisciplinary team adopts as its standard of excellence in practice. Multidisciplinary team members include neonatologists, NNPs, CNSs, clinical nurses, and allied health professionals. Thoughtful, planned, and purposeful collaborations between all perinatal-neonatal team members can optimize the successful and consistent implementation of a care bundle for NAS.[22]

The Perinatal Quality Collaborative of North Carolina (PQCNC) NAS initiative provides readers with an exemplar of a model framework to guide hospitals in the development of a care bundle specific to NAS. The PQCNC's action plan is composed of a list of several outcome measures focused on the identification, evaluation, treatment, and discharge of neonates afflicted with NAS (Table 2).[23] Hospitals are thereby encouraged to enact policies and standardized operating procedures that facilitate the achievement of each outcome measure. This underpins the PQCNC's global aim to standardize approaches to the care of neonates while obtaining maximum outreach on a statewide level. Neonatal nurses across the spectrum of academic preparation, including the clinical nurse, CNS, and NNP, bring valuable expertise and can contribute unique practical perspectives to this process, which cannot be duplicated by any other subspecialty.

STRATEGIES FOR DEVELOPMENT OF A NAS CARE BUNDLE

Identification

Each maternal-child division within each health care system should have a standardized approach for identifying neonates at risk for NAS.[22] A thorough review of the prenatal history and admitting interview with the mother (with emphasis on dialogue between the nurse and patient) can yield beneficial information. Data that warrant toxicology testing include a documented maternal drug history, fewer than six prenatal visits, or a positive drug screen at any point during the pregnancy.[22] NNPs have to be keen to identifying these risk factors and order appropriate testing for eligible neonates, including testing of urine and meconium. Neonatal nurses should initiate a social work consult to ensure that a referral to child protective services (CPS) is filed in the event of a positive infant toxicology test. Social workers may provide the family with information on community resources, monitor the CPS investigation, and communicate the findings of CPS to caregivers. Revolving continuing education for all members of the multidisciplinary neonatal team, managed by neonatal CNSs, is critical to measure knowledge retention and ensure competency.

Evaluation

Each nursery should have a standardized approach to evaluating high-risk infants through the implementation of the Finnegan, or modified Finnegan, scoring tool.[22] The Finnegan tool is the most comprehensive, validated tool available for neonatal clinicians.[24] Neonatal CNSs can lead the development of an evidence-based protocol for NAS scoring as well as an interrater reliability program to ensure competency with NAS scoring among clinical nurses. NNPs and CNSs can serve as expert educators to medical and nursing staff on the use of the Finnegan tool. The CNSs' efforts to institute frequent interobserver reliability testing for appropriate team members must be supported by all team members.[22] The Finnegan score directs treatment, and, therefore, the clinical nurse's assessment of the infant and corresponding Finnegan withdrawal score must be accurate and reliable. After interobserver reliability testing has

TABLE 2 ■ Perinatal Quality Collaborative of North Carolina Neonatal Abstinence Syndrome (NAS) Action Plan: Outcomes & Key Metrics[23]

Outcome Measure	Key Metrics
Provide a standardized approach to the **identification** of the at-risk infant and family	Neonatal team protocols will establish a standardized plan that defines indications, criteria, and procedures for screening at-risk infants, toxicology testing regimens, procedures for ongoing staff education, and barriers to discharge.
Provide a standardized approach to the **evaluation** of the at-risk infant and family	Neonatal teams will establish a standardized plan for evaluating at-risk infants or those displaying signs of withdrawal. Neonatal teams will establish a standardized plan to ensure consistent and accurate scoring of neonatal withdrawal. Neonatal teams will establish a core team responsible for the NAS initiative from implementation to evaluation and ongoing education related to evaluation regimens.
Provide a standardized approach to the **treatment** of the at-risk infant and family	Neonatal teams will provide nonpharmacologic therapies prior to the initiation of pharmacologic treatment. Neonatal teams will establish a standardized plan for pharmacotherapy. Neonatal teams will establish procedures for ongoing staff education related to treatment regimens.
Provide a standardized approach to the **discharge** of the at-risk infant and family	Neonatal teams will require a standardized length of stay for any at-risk infant. Neonatal teams will provide a standardized plan for the discharge of neonates/families. Neonatal teams will establish procedures for ongoing staff education related to discharge regimens.

been completed, clinical nurses can share their new or reinforced knowledge with family members to ensure their understanding of evaluation methods used for their neonate.

Consistency with caregivers is essential to providing a standardized approach to the care of the neonate and family.[23] The benefits to primary nursing in the NICU has been well-documented in the literature and should be considered with the care of the neonate with NAS, regardless of the unit to which the neonate and family are assigned.[25] Neonatal nurses can advocate for primary nursing and contribute to the success of this element of a care bundle.

Treatment

There are few evidence-based publications specific to the treatment of NAS; however, treatment should be based on valid, reliable, and current evidence. Equally important, treatment should be standardized and consistently implemented.[23] Each member of the interprofessional team plays a valuable role in the treatment of NAS and can directly contribute to a positive outcome for the neonate. Nursing interventions, medical regimens, pharmacotherapies, and parental involvement comprise the essential core treatment pathways for these neonates.[23]

Nonpharmacologic Treatment Options. Each nursery should have a standardized treatment plan that includes nonpharmacologic and pharmacologic management guidelines.[23] Nonpharmacologic interventions consist of supportive measures such as minimizing environmental stimulation, promoting rest, providing sufficient calories to promote weight gain, swaddling, holding, and skin-to-skin contact.[22] CNSs can lead policy and procedure development, as well as educational inservices, to ensure all nonpharmacologic treatment options are considered with each neonatal admission for NAS. Clinical nurses can lead the nonpharmacologic provision of care at the bedside and provide teaching and coaching to parents or other caregivers. For parents, rooming-in is an excellent way to achieve these nonpharmacologic methods of treatment and promote parental involvement. NNPs can encourage rooming-in by engaging in routine dialogue with the parents during care updates. All team members must understand that nonpharmacologic methods of treatment can decrease the need for medication management.[22]

Pharmacologic Treatment Options. Initiation and weaning of medications should follow a protocol based on withdrawal scores obtained through the use of a standardized scoring tool, such as the Finnegan scoring tool.[22,23] An average score of ≥8 for three consecutive scores or ≥12 for two consecutive scores signals the need to initiate pharmacologic management.[22] Each nursery must thereby identify a first-line medication and second-line (adjunct) therapy with indications for use based on the measured severity of withdrawal (Table 3).[22,26]

Opioid dependence should be treated with an opioid. Morphine and methadone are the drugs of choice for opioid-specific withdrawal.[26] To a lesser degree, tincture of opium and buprenorphine have also been used as first-line agents.[27] Tincture of opium has the drawback of containing alcohol, and buprenorphine is less studied in neonates.[27] Phenobarbital and clonidine are useful as adjunct medications in the therapy of NAS or with the treatment of polydrug withdrawal.[26] Limited research has shown dexmedetomidine to also be effective as an adjunct therapy for NAS, but more studies are needed in neonates.[27] NNPs are perfectly positioned to initiate pharmacotherapy as needed based on documented nursing assessments and through purposeful dialogue with clinical nurses. Clinical nurses should be afforded the opportunity to share these findings during daily patient rounds and at any time that deviations from the patient's typical behavior is observed. CNSs can effectively contribute through the provision of educational units for their nursing colleagues and by sharing current research or other literature that can enhance the delivery of quality neonatal nursing care.

TABLE 3 ■ Medications and Dosages for Pharmacologic Treatment of NAS[22]

Medication	Dosage
Morphine preparations	0.03–0.2 mg of morphine per kg per dose every 3–4 h
Methadone	Initial: 0.05–0.1 mg/kg/dose every 6 h; increase by 0.05 mg/kg until NAS score stabilizes Maintenance: total daily dose divided into twice daily or daily dosing
Buprenorphine	4.4–5.3 mcg/kg/dose every 8 h sublingual
Phenobarbital	Load: 16 mg/kg Daily dose: 2–8 mg/kg/dose daily
Clonidine	Load: 0.5–1 mcg/kg Maintenance: 0.5–1.25 mcg/kg/dose every 4–6 h

Abbreviation: NAS = neonatal abstinence syndrome.

Adapted by permission from Macmillan Publishers Ltd: Bio LL, Siu A, Poon CY. Update on the pharmacologic management of neonatal abstinence syndrome. *J Perinatol.* 2011;31(11):692-701. Copyright 2011.

Parental Involvement

Parent–infant bonding is necessary to encourage healthy social, emotional, and intellectual growth for the neonate across its life span.[28] Evaluating the parent's initial interest in their neonate's medical plan of care and encouraging involvement can provide opportunities to assess parenting skills and identify potential child safety concerns.[10] The inclusion of parents during daily NICU rounds has been reported to facilitate engagement, reduce anxiety, and increase confidence levels in parents of hospitalized neonates.[29] The multidisciplinary team must recognize that the unpredictable workflow and acuity in an intensive care unit and timing of daily patient rounds can unintentionally exclude parents who otherwise desire or should be included in daily care planning for their neonate. Simple strategies such as scheduling daily rounds with parents could mitigate this barrier.[29]

Rooming-In. Evaluation of a NICU's readiness or capability to accommodate parental rooming-in is essential. The provision of rooming-in, a 24-hour parent-focused care cycle, encourages parental involvement, promotes bonding, and eases the transition to home.[30] Rooming-in is considered the standard of care in the postpartum setting but is often not offered to opioid-using mothers.[30] Abrahams and colleagues[30] reported a statistically significant decrease in the need for treatment of NAS, subsequent need for admission to the NICU, and cumulative LOS in a group of opioid-dependent women who were allowed to room-in with their neonates ($p = .014$, 95% CI). Those neonates were 48.2 percent more likely to breastfeed and to be discharged in the custody of their mothers (RR 2.23, 95% CI 1.43–3.98), and no hospital readmissions for withdrawal symptoms were reported among the rooming-in cohort.[30]

Neonatal nurses can facilitate the rooming-in process through education of the parents, colleagues, and senior hospital management officials. Hospital-specific quality improvement efforts are indicated to investigate best practices for prioritizing rooming-in eligibility or the use of alternative hospital units with private rooms to facilitate this beneficial intervention.

The Provision of Maternal Milk. Evaluation of the mother's willingness to breastfeed her neonate, in conjunction with her willingness to remain actively involved and/or room-in with her neonate, is key to a successful evaluation phase. Many benefits to breastfeeding and NAS have been documented in the literature. Pritham investigated correlations between method of feeding, NAS symptoms, and LOS.[31] Onset of withdrawal symptoms was delayed, and LOS decreased by 9.4 days with the provision of breastfeeding ($p = .016$) compared to the formula-fed neonates.[31]

Furthermore, McQueen and colleagues concluded breastfed neonates required less NAS scoring, experienced less severe symptoms, and did not require pharmacologic interventions as often as formula-fed or combination formula-breastfed neonates ($p = .04$).[32]

These data support the priority status for breastfeeding with neonates, in particular those diagnosed with NAS. This further underpins the American Academy of Pediatrics position statement on breastfeeding and encourages a healthy, cost-conscious dietary regimen for neonates and their families.[33] Breastfeeding rates tend to be lower among addicted mothers when compared to the general population.[34] Through a proactive team approach, including consistent reciprocal communication between all neonatal nurses and the family as well as consistent use of certified lactation specialists (IBCLC), this negative statistic can be reduced.

Health care worker bias can also confound breastfeeding rates among addicted mothers. Balain and Johnson reported that many health care workers perceive breastfeeding as harmful for neonates with NAS, when in fact, the literature describes polydrug abuse and positive HIV as the two contraindicating factors to the provision of maternal breast milk from an addicted mother.[34] Neonatal nurses as well as all members of the interdisciplinary team must be aware of personal or group biases toward breastfeeding, use IBCLC support to verify any medication contraindications, and ensure a neutral, supportive care environment for NAS neonates and their families.

Discharge

Each nursery should have a standardized discharge process for high-risk families.[23] The American Academy of Pediatrics recommends a minimum of three to seven days of inpatient evaluation for neonates at risk for NAS.[22,23] Clinical nurses play a critical role in this process through the documentation of routine (often every three hours) Finnegan scores. NNPs are expected to analyze weaning scores and correlate them with recommended criteria for eligibility for discharge. A checklist of criteria that qualify for a safe discharge is provided in Table 4.[22,23]

TABLE 4 ■ Discharge Checklist for Infant with Neonatal Abstinence Syndrome (NAS)[23]

All NAS Infants	NAS Infants on Medications (Previous List Plus)
Identified caregiver	Home assessment
Medically stable with adequate weight nutrition	Two successful weans prior to discharge
Clearance from all hospital or outside agencies (social worker, CPS)	PCP agrees to accept infant
Identified PCP	Withdrawal symptoms controlled
Follow-up appointments made or caregiver aware of need for follow-up appointments	Successful feeding with weight gain
Outpatient resources identified including referral for high-risk follow-up	Caregiver provides return demonstration of medication administration
Caregiver demonstrates ability to provide infant care and adequately feed infant	Caregiver recognizes symptoms of withdrawal
Caregiver demonstrates nonpharmacologic treatments	Caregiver aware of when to notify PCP

Abbreviations: CPS = child protective services; PCP = primary care physician.

The NNP's expertise in the care of infants, in collaboration with an interprofessional team, makes her ideally suited to provide care in an outpatient clinic to follow these high-risk families as they transition to home. The neonatal CNS can lead policy and procedure development through a rigorous investigation of the literature and published PQC guidelines as well as educate team members on criteria for discharge. As is the case with any inpatient neonate, planning for discharge begins on the date of admission. Therefore, clinical nurses are encouraged to actively participate in discharge planning through parental education, advocacy, and collaboration with their nursing and medical teammates.

Inpatient-to-Outpatient NAS Transitional Care Concept

Outpatient treatment options should be explored to decrease costly inpatient weaning[35] while providing safe, quality continuing care to these vulnerable neonates. Neonates who require pharmacologic treatment for withdrawal first require inpatient monitoring of withdrawal symptoms to achieve an optimal dosing regimen that will moderate withdrawal symptoms and place the infant on a trajectory toward recovery. Earlier discharge to home once a neonate tolerates interval decreases in pharmacologic support may be beneficial to all stakeholders. Backes and colleagues recognized a decrease in LOS and reduction in hospital charges of $13,387 with the use of a transitional inpatient-to-outpatient NAS management program.[35] No statistically significant differences in hospital readmission rates or emergency room visits for withdrawal symptoms were reported. Backes and colleagues recommended a minimum seven-day inpatient hospitalization prior to discharge to outpatient management to allow time to assess the home environment and the mother's willingness and ability to provide care in an outpatient setting.[35] The best practice for an inpatient-to-outpatient discharge program, as a means to establish a best practice for the transition to outpatient management, requires further investigation.

The successful implementation of an inpatient-to-outpatient NAS program requires much interdisciplinary coordination and communication. In-home assessments, as suggested by Backes and colleagues, would require home health or other ancillary resources, thereby imposing fee-based services.[35] Investigation into the feasibility of in-home assessments as a standard of practice for this type of program is indicated. Furthermore, earlier transition to home imposes increased demands on outpatient pediatric providers. Continuity of care is essential to facilitate a continued successful pharmacologic wean for the affected neonate, thereby requiring care providers to be specifically trained in the assessment of neonatal withdrawal, demonstrate ongoing continuing competence, and incorporate current best practices for pharmacologic weaning parameters into their practices policies and procedural guidelines. Furthermore, this type of program requires commitment among family members to comply with outpatient follow-up appointments as scheduled. Any breakdown in these processes could prove devastating to the neonate and increase the risk for hospital readmissions, thereby eroding the efficacy of the intervention.

The use of the NNP in the primary care environment, as a coordinator of care services for an outpatient NAS clinic, may serve as the vector for continuity of care after discharge. Further investigation into the initial and continuing education requirements for professionals providing outpatient care to neonates with NAS should include, but not be limited to, addiction and mental health, trauma, and violence, as well as available community resources.

CONCLUSION

The literature supports the use of quality improvement initiatives in the neonatal population to improve care and decrease costs. Neonatal nurses are properly positioned to identify, develop, and implement these quality initiatives.[36] Collectively, the NNP, CNS, and clinical neonatal nurse's education and experience can exert a synergistic effect on the identification of clinical problems, synthesis of available data, investigation, and implementation of evidence-based solution(s). Through participation in multidisciplinary quality improvement teams, neonatal nurses can effectively contribute to translational research and should place priority on this agenda.

Neonatal mortality and morbidity has a long-lasting effect on society and the health care system because the consequences of illness and injury in the neonatal period can be long-term medical needs.[1] Improving the health of this most vulnerable population is a goal of *Healthy People 2020* and should be a goal for all members of the neonatal-perinatal health care team.[1] Term newborns who normally represent a group with low mortalities and morbidities experience increased mortalities and morbidities when their mothers abuse drugs.[9] NAS results from maternal drug abuse/use during pregnancy. A growing public health concern is the population of neonates suffering from NAS.[13] Goals of the PQCs for neonates with NAS is to streamline care, decrease institutional costs, and promote parent-focused caregiving practices.[22]

The initiation of standardized NAS care bundles is a proposed solution to the NAS epidemic. Standardized care, when grounded in evidence-based practices, improves outcomes and provides consistency in practices from larger, better-equipped tertiary medical centers to smaller rural health care facilities.[22] Proposed best practices to the inpatient management of NAS include encouraging parental engagement through rooming-in and a parent-first priority during the infant's hospitalization and encouraging breastfeeding unless otherwise contraindicated.

Future investigation of the risks and benefits to outpatient management of NAS, including investigation into licit or illicit drug consumption patterns and practices of postpartum females, is indicated to evaluate the safety and efficacy of this

proposed solution. Nurses across the spectrum of academic preparation and expertise are encouraged to collaborate and fill this critical knowledge–practice gap.

REFERENCES

1. Centers for Disease Control and Prevention. CDC grand rounds: public health approaches to reducing US infant mortality. *MMWR Morb Mortal Wkly Rep*. 2013;62(31):625-628. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6231a3.htm. Published August 9, 2013. Accessed September 3, 2014.
2. U.S. Department of Health and Human Services. Preventing infant mortality. U.S. Department of Health and Human Services Web site. http://www.hhs.gov/news/factsheet/infant.html. Published January 13, 2006. Updated June 6, 2006. Accessed October 25, 2014.
3. Gipson JD, Koenig MA, Hindin MJ. The effects of unintended pregnancies on infant, child and parental health: a review of the literature. *Stud Fam Plann*. 2008;39(1):18-38. http://dx.doi.org/10.1111/j.1728-4465.2008.00148.x
4. Friedman SH, Heneghan H, Rosenthal M. Characteristics of women who do not seek prenatal care and implications for prevention. *J Obstet Gynecol Neonatal Nurs*. 2009;38(2):174-181. http://dx.doi.org/10.1111/j.1552-6909.2009.01004.x.
5. National Alliance for Model State Drug Laws. Mission. National Alliance for Model State Drug Laws Web site. http://www.namsdl.org/about.cfm. Accessed January 25, 2015.
6. McInerny C. Lawmaker wants to reduce neonatal abstinence syndrome cases. Indiana Public Media Website. http://indianapublicmedia.org/news/lawm-59206/. Published November 29, 2013. Accessed September 10, 2014.
7. Smith P. Tennessee's scary new law criminalizing drug-using pregnant women. *Drug War Chronicle*. (834). http://stopthedrugwar.org/chronicle/2014/may/09/tennessee_criminalizes_pregnancy_and_drug_use. Accessed September 10, 2014.
8. Dow K, Ordean A, Murphy-Oikonen J, et al. Neonatal abstinence syndrome clinical practice guidelines for Ontario. *J Popul Ther Clin Pharmacol*. 2012;19(3):e488-e506.
9. Thomas DB. Cleft palate, mortality and morbidity in infants of substance abusing mothers. *J Paediatr Child Health*. 1995;31(5):457-460.
10. Patrick S. Neonatal abstinence syndrome: scope and evolving issues. In: Proceedings from the Perinatal Quality Collaborative of North Carolina Neonatal Abstinence Syndrome Symposium; January 23, 2014; Durham, NC.
11. Patrick SW, Schumacher RE, Benneyworth BD, et al. Neonatal abstinence syndrome and associated health care expenditures: United States, 2000-2009. *JAMA*. 2012;307(18):1934-1940. http://dx.doi.org/10.1001/jama.2012.3951
12. Sarkar S, Donn SM. Management of neonatal abstinence syndrome in neonatal intensive care units: a national survey. *J Perinatol*. 2006;26:15-17. http://dx.doi.org/10.1038/sj.jp.7211427
13. Behnke M, Smith VC. Prenatal substance abuse: short- and long-term effects on the exposed fetus. *Pediatrics*. 2013;131(3):e1009-e1024. http://dx.doi.org/10.1542/peds.2012-3931
14. Hunt RW, Tzioumi D, Collins E, Jeffery HE. Adverse neurodevelopmental outcome of infants exposed to opiate in-utero. *Early Hum Dev*. 2008;84(1):29-35. http://dx.doi.org/10.1016/j.earlhumdev.2007.01.013
15. McGlone L, Mactier H. Infants of opioid-dependent mothers: neurodevelopment at six months. *Early Hum Dev*. 2015;91(1):19-21. http://dx.doi.org/10.1016/j.earlhumdev.2014.10.006
16. Bunikowski R, Grimmer I, Heiser A, Metze B, Schäfer A, Obladen M. Neurodevelopmental outcome after prenatal exposure to opiates. *Eur J Pediatr*. 1998;157(9):724-730.
17. Hamilton R, McGlone L, MacKinnon JR, Russell HC, Bradnam MS, Mactier H. Ophthalmic, clinical and visual electrophysiological findings in children born to mothers prescribed substitute methadone in pregnancy. *Br J Ophthalmol*. 2010;94(6):696-700. http://dx.doi.org/10.1136/bjo.2009.169284
18. National Association of Neonatal Nurses. *Advanced Practice Registered Nurse: Role, Preparation, and Scope of Practice*. Chicago, IL: National Association of Neonatal Nurses; 2013. http://www.nannp.org/uploads/files/APRN_Role_Preparation_position_statement_FINAL.pdf. Accessed September 10, 2014.
19. Bosque E. Collaboration, not competition: cost analysis of neonatal nurse practitioner plus neonatologist versus neonatologist-only care models. *Adv Neonatal Care*. 2015;15:112-117. http://dx.doi.org/10.1097/ANC.0000000000000161
20. Institute of Medicine. *The Future of Nursing: Leading Change, Advancing Health*. Washington, DC: National Academies Press; 2011. http://books.nap.edu/openbook.php?record_id=12956. Accessed September 8, 2014.
21. U.S. Department of Health and Human Services. Key features of the Affordable Care Act. U.S. Department of Health and Human Services Web site. http://www.hhs.gov/healthcare/facts/timeline/index.html. Updated November 18, 2014. Accessed October 8, 2015.
22. Perinatal Quality Collaborative of North Carolina. PQCNC NAS action plan final. Perinatal Quality Collaborative of North Carolina Web site. http://www.scribd.com/doc/181411113/PQCNC-NAS-Action-Plan-Final. Accessed October 14, 2014.
23. Perinatal Quality Collaborative of North Carolina. Neonatal abstinence syndrome. Perinatal Quality Collaborative of North Carolina Web site. http://pqcnc.org/node/13348. Accessed October 14, 2014.
24. Provincial Council for Maternal and Child Health. Neonatal abstinence syndrome (NAS) clinical practice guidelines. Perinatal Quality Collaborative of North Carolina Web site. http://www.pqcnc.org/documents/nas/nasresources/NASGuidelines.pdf. Updated March 30, 2012. Accessed October 24, 2014.
25. Korhonen A, Kangasniemi M. Nurses' narratives on termination of primary nursing relationship with parents in neonatal intensive care. *Scand J Caring Sci*. 2014;28(4):716-723. http://dx.doi.org/10.1111/scs.12101
26. Bio LL, Siu A, Poon CY. Update on the pharmacologic management of neonatal abstinence syndrome. *J Perinatol*. 2011;31(11):692-701. http://dx.doi.org/10.1038/jp.2011.116
27. Grim K, Harrison TE, Wilder RT. Management of neonatal abstinence syndrome from opioids. *Clin Perinatol*. 2013;40:509-524.
28. American Psychological Association. Parents and caregivers are essential for children's healthy development. American Psychological Association Web site. http://www.apa.org/pi/families/resources/parents-caregivers.aspx# item=8. Accessed September 29, 2014.
29. Grzyb MJ, Coo H, Rühland L, Dow K. Views of parents and health-care providers regarding parental presence at bedside rounds in a neonatal intensive care unit. *J Perinatol*. 2014;34:143-148. http://dx.doi.org/10.1038/jp.2013.144
30. Abrahams RR, Kelly SA, Payne S, Thiessen PN, Mackintosh J, Janssen PA. Rooming-in compared with standard care for newborns of mothers using methadone or heroin. *Can Fam Physician*. 2007;53:1722-1730.
31. Pritham UA. Effects of breast and formula feedings on neonatal abstinence syndrome. Poster presented at: Meeting of the Association of Women's Health, Obstetric, and Neonatal Nurses; June 2012; Orlando, FL.
32. McQueen KA, Murphy-Oikonen J, Gerlach K, Montelpare W. The impact of infant feeding method on neonatal abstinence scores of methadone-exposed infants. *Adv Neonatal Care*. 2011;11(4):282-290. http://dx.doi.org/10.1097/ANC.0b013e318225a30c

33. American Academy of Pediatrics. Breastfeeding and the use of human milk. *Pediatrics.* 2012;129(3):e827-e841. http://dx.doi.org/10.1542/peds.2011-3552
34. Balain M, Johnson K. Neonatal abstinence syndrome: the role of breastfeeding. *Infant.* 2014;10(1):9-13. http://www.infantgrapevine.co.uk/pdf/inf_055_nen.pdf. Accessed September 5, 2014.
35. Backes CH, Backes CR, Gardner D, Nankervis CA, Giannone PJ, Cordero L. Neonatal abstinence syndrome: transitioning methadone-treated infants from an inpatient to an outpatient setting. *J Perinatol.* 2012;32(6):425-430. http://dx.doi.org/10.1038/jp.2011.114
36. Bakerjian D. Advanced practice nurses leadership opportunities in quality assurance and performance improvement. *Geriatr Nurs.* 2012;33(6):499-500. http://dx.doi.org/10.1016/j.gerinurse.2012.09.003

About the Authors

Amanda H. Teague, MSN, NNP-BC, performed focus research on the topic of neonatal abstinence syndrome during completion of her master's degree in nursing from East Carolina University. She is employed as a neonatal nurse practitioner with Novant Health, Charlotte, North Carolina.

Amy J. Jnah, APRN, DNP, NNP-BC, is the director of the neonatal nurse practitioner program at East Carolina University in Greenville, North Carolina. She also serves as an adjunct faculty member for residents at the University of North Carolina at Chapel Hill School of Medicine.

Desi Newberry DNP, NNP-BC, is an neonatal nurse practitioner at Wake Medical Center in Raleigh, North Carolina, as well as a clinical instructor at East Carolina University in Greenville, North Carolina. She has published articles in Neonatal Network, Advances in Neonatal Care, *and the* Journal of Perinatology.

For further information, please contact:
Amanda H. Teague, MSN, NNP-BC
Novant Health Presbyterian Medical Center
NICU
200 Hawthorne Lane
Charlotte, NC 28204
E-mail: ahteague@yahoo.com