

BEST NURSING PRACTICES IN TREATING NEONATAL ABSTINENCE  
SYNDROME

By

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### Abstract

This paper reviews the current research on best nursing practices for infants with neonatal abstinence syndrome (NAS). Women who use substances while pregnant put their babies at an increased risk for getting NAS. At delivery, the maternal drug supply is cut, which can cause a range of withdrawal symptoms. Evidence-based articles published within five years were found on Pubmed, Google Scholar, and CINHALL. The articles focus on nonpharmacologic interventions that can be used to reduce the need for pharmacologic treatment.

Nonpharmacologic interventions include swaddling, vibrotactile stimulation, laser acupuncture, rooming-in, breastfeeding, kangaroo care, reiki therapy, and a quiet, dark environment. If these methods do not relieve symptoms, pharmacologic treatment may be necessary.

Traditional pharmacologic therapy is oral morphine; however, methadone is an alternative. Buprenorphine is a promising new option due to a shorter length of stay in the hospital. Other articles discuss the implementation of a clinical practice guideline, the safety of breastfeeding while the mother is on a drug maintenance plan, and the characteristics of maternal-infant dyad interactions. Based on the review of current literature, this paper will identify the best nursing practice recommendations for nurses, a proposed implementation plan for the recommendations, and an evaluation of the implementation process.

## CHAPTER 1

### Introduction

#### **Statement of Purpose**

The purpose of this thesis is to develop evidence-based recommendations for the best nursing practice of neonatal abstinence syndrome (NAS). Both nonpharmacologic and pharmacologic methods will be discussed to focus on what practices are most beneficial for these infants including development later in life, the length of hospital stays (LOS), the length of treatment required (LOT), and the cost to the families and hospitals. The background of NAS will be discussed including its correlation to the rise in opioid use and abuse, which have a significant impact on nursing. The evidence behind each proposed intervention will be reviewed, guiding the formation of proposed best practice recommendations for the nursing care and treatment interventions of infants with NAS. The objective of these recommendations is to improve the short and long-term outcomes of the infants and families affected by NAS. The question that this paper will aim to answer is: What are the best evidence-based nonpharmacologic and pharmacologic nursing practices in the treatment of neonatal abstinence syndrome, given available and reliable research from the past five years?

#### **Background on the Issue**

NAS can occur when a woman uses either licit or illicit substances during her pregnancy. NAS causes major physiological changes in the infant, some of which include heightened senses, difficulty gaining weight, episodes of high-pitched crying, and reduced quantity and quality of sleep (Maguire et al., 2016). A complete list of symptoms can be viewed on the Finnegan scoring sheet found in appendix A. These infants thrive in quiet and dark environments, specifically with extended contact with their mothers via rooming-in, breastfeeding, and skin-to-skin contact

(MacMullen, Dulski, & Blobaum, 2014). While nonpharmacologic interventions like non-nutritive sucking, swaddling, and frequent small feeds are crucial to care, many infants require pharmacologic regimens to wean off substances they were exposed to in utero (MacMullen et al., 2014). Weaning is recommended to be done with the same drug class as the substance used; however, the choice of medication is decided by the hospital or provider. Traditionally oral morphine or methadone have been used, but it is now recommended that buprenorphine may be superior (Hall et al., 2016). Some expectant mothers may join drug maintenance programs to protect their baby from her own possible withdrawal. If the mother were to cut herself off from her substance ‘cold-turkey’ she could go into life-threatening withdrawal, which would severely harm the fetus and could even cause death. These maintenance programs exchange the drug of choice, often opioids or heroin, for methadone or buprenorphine. Methadone is an opioid that provides pain relief and diminishes withdrawal symptoms, without providing the high of most other opioids. Buprenorphine is an opioid partial agonist that has less euphoria and physical dependence with the addition of a ceiling effect; it is used to suppress withdrawal symptoms and decrease cravings for opioids. Most methadone or buprenorphine clinics require daily visits to dispense their dosage for that day, but only if the patient, or expectant mother, passes her daily urine drug screening.

NAS occurs in 50-95% of infants who are exposed to substances during pregnancy (Cook, Dahms, & Meiers, 2017). Substances more commonly used include opioids, but can also include illicit drugs, like heroin or cocaine, or prescribed mental health drugs like antidepressants or antianxiety medication. These substances can cross the placenta causing the fetus to become dependent on the drug, just like the mother. Infants with NAS have a longer average LOS at the hospital than healthy neonates, which affects the cost of care. The national mean average for a

neonate with NAS is \$66,700, compared to \$3,500 for an uncomplicated newborn (Cook et al., 2017).

In the United States there is currently an ongoing and increasingly dangerous opioid crisis, which has caused substantially increased rates of NAS. The opioid crisis not only causes increases in the cost of health care, but it also exposes how far behind health care policy and provider education truly are (Hall et al., 2016). As of March 2018, 115 Americans die every day from opioid overdoses, which has ended up costing approximately \$78.5 billion a year, which includes the cost of health care, the loss of productivity in society, addiction treatment, criminal justice involvement, and more (National Institute on Drug Abuse, 2018). 21-29% of all patients prescribed opioids for pain misuse the drugs and 8-12% of those will develop an opioid use disorder (National Institute on Drug Abuse, 2018). Based on the increase of opioid use, the number of infants with NAS has also increased. The number of infants covered by Medicaid who have NAS has increased fivefold from 2004-2014. In 2004, 2.8 per 1000 births resulted in NAS, whereas in 2014, 14.4 per 1000 births resulted in an NAS diagnosis (Winkelman, Villapiano, Kozhimannil, Davis, & Patrick, 2018).

Infants who are born with a risk of NAS are scored on a specific NAS scale to monitor signs and symptoms of withdrawal. The Finnegan scale, seen in appendix A, is one of the most commonly used scales after its publication in 1975. When the scale was initially developed it had a high inter-rater reliability coefficient of 0.82 (Bagley, Wachman, Holland, & Brogly, 2014). The baby will be scored starting two hours after birth and will be re-scored every four hours from then on. If an infant has a score above 8, or their score continues to increase, the baby has traditionally been brought to the Neonatal Intensive Care Unit (NICU) for more specialized care and monitoring (Bagley et al., 2014). However, this action separates the child and mother and it

opens the infant up to an environment that often has significant noxious stimuli. Department of Child Safety (DCS) is always involved in cases that involve maternal drug use, but as opioid abuse affects a greater diversity of the community, and research has supported keeping the infant-mother dyad together, more mothers are able to care for their baby after birth and discharge from the hospital (McKnight et al., 2015). There is very little conclusive research that shows if keeping the infant with their biological mother, rather than a foster or adoptive family, is more beneficial to later growth and development, but there is strong research concluding that their immediate recovery from NAS is faster and less severe with the care and feeding from their biological mother primarily due to the use of breastfeeding and rooming-in.

### **Significance to Nursing**

NAS has caused significant changes to how NICUs are run and the role of nursing in postpartum care. This condition has caused significantly longer LOS and LOT than healthy term neonates. Although many infants with NAS are born full-term, they require advanced and extensive nursing care almost continuously. These infants are extremely irritable, hyperactive, and inconsolable due to the increased sensitivity of the nervous systems; the best environment is a dark and quiet space; however, some NICUs still have florescent lighting and significant noise from beeping machines, people talking, and other infants crying. These infants often require a 1:1 nursing ratio, but this is commonly not possible given high censuses in NICUs and the nationwide nursing shortage. NAS has increased the cost of care for both hospitals and families. In 2004, Medicaid covered costs of \$65.4 million just for NAS, whereas in 2014, it covered \$462 million (Winkelman et al., 2018). Some hospitals have adjusted to the opioid crisis and increase in NAS by creating a separate section of the NICU specifically for infants with NAS. With resources available, hospitals have been able to create individualized rooms for the mother and

infant, which is ideal. Other hospitals have described utilizing postpartum or pediatric units for the extra space instead. The nurses who work in the specialized area are specifically trained in scoring NAS and caring for the significant and intrusive symptoms that may be present.

Given the nursing shortage and increase in infants with NAS in NICUs, nurses are under increased stress in providing care for inconsolable babies. Many nurses are not trained in treating NAS, nor do they have the time to provide the best care these infants need. The increased stress on nurses could lead to an increased rate of nursing burnout or dissatisfaction with their job. For these infants to succeed in their treatment, they require extensive attention and care, which may not be possible in the NICU. This is one reason why rooming-in with the mother can be so important. Not only does it increase the bonding between mother and baby, but it requires the mother to start caring for her child early on, which normalizes the post-birth situation.

### **Summary**

The purpose of this thesis is to provide best practice recommendations on the nursing care of NAS to offer improved outcomes for the infants, decreased costs to families and hospitals, and decreased stress on nurses. Often families that are affected by NAS are consumed by stressful situations and decisions, separation from their child, and the challenges of dealing with their own addiction. On top of that, many mothers of infants with NAS report feeling judged and treated poorly by nurses and other hospital staff (Cleveland & Bonugli, 2014). With increased nurse education and reinforcement of protocols, infants can be diagnosed and treated earlier and with the most appropriate evidence-based interventions. This thesis will explore what nursing interventions have been the most effective in treating NAS infants and identify what practices still require more supportive research to be considered reliable. Based on this information, recommendations will be made to improve the care of those with NAS.

## CHAPTER 2

## Review of Literature

The research literature search for this thesis was conducted through online searches using PubMed, Google Scholar, and CINAHL. The parameters used were: “less than 5 years” or “since 2013”, “nursing journal”, “full free text”, and “peer-reviewed”. All studies were published within the last five years and were from peer-reviewed journals. Search keywords included: “neonatal abstinence syndrome”, “breastfeeding”, “nonpharmacologic”, “buprenorphine”, and “rooming in”. Seventeen journal articles were selected for use and one reputable website source was also utilized. These research articles were chosen for the variety of nursing interventions that were studied, the clear and easily-implementable recommendations given, and the quality of research shown through publication in a peer-reviewed journal, having nurses as authors, and use of a specific, strong study design. The level of evidence ranges from level VI to level I with most articles falling under the level IV category due to their use of a cohort study design.

Unfortunately, owing to the nature of the subject being researched, randomized control trials are very difficult to perform while maintaining safety and appropriate treatment of all participants. The results from these evidence-based sources will be used to formulate best practice interventions that can be implemented to improve the care and outcomes of infants with NAS.

**Nonpharmacological Interventions**

Nonpharmacologic interventions are always the first line of treatment because medication comes with increased risks due to polypharmacy and side effects, which can significantly harm the functioning and development of the child. Current nursing practice is to move from least to most invasive interventions. The first, and most simple, intervention is to adjust the environment to provide supportive care. This can include turning off the lights, maintaining a quiet

environment, limited handling and stimulation, swaddling, and music therapy (MacMullen, Dulski & Blobaum, 2014). These are all simple interventions that do not require significant training or time commitment of the nurses. In a systematic review done by MacMullen, Dulski, and Blobaum, nine out of twenty-seven articles recommended decreased auditory, visual, and tactile stimulation for these infants to diminish the stress on their hyperactive and sensitive neurological systems. A quiet environment could include turning the volume on machines to the lowest level, silencing them once they are being attended to, and speaking in soft tones. Low visual stimulation primarily includes turning the lights off. Decreased tactile stimulation can include doing dressing changes only when necessary, having soft cotton or wool fabric, and minimizing the handling of the child for non-productive activities, which would exclude breastfeeding, kangaroo care, or necessary medical procedures (MacMullen, Dulski & Blobaum, 2014).

Soft music and white noise have been shown to calm infants with NAS (Radziewicz, Wright-Esber, Zupancic, Gargiulo, & Woodall, 2018). In one randomized controlled trial, both NAS and non-NAS infants were used to determine if two 15-minute interventions of “infant-directed talk, light stroking/infant massage, eye-to-eye contact, and vertical rocking when swaddled” were effective in positively changing the babies’ behavior. The intervention showed strong evidence towards its effectiveness in both population groups (Radzeiwicz et al., 2018). Swaddling may not always be recommended for newborns, especially those in the NICU, but infants with NAS have heightened nervous systems, which causes hyperirritability and hypersensitivity. Swaddling has been shown to be effective in NAS because it “lessens stimulation, decreases crying times, and promotes sleep that is more sustained” (Kocherlakota, 2014).

Infants with NAS have extensive digestive difficulties which can be seen through frequent difficulty feeding, vomiting, diarrhea, bloating, a lack of weight gain, and frequent skin breakdown under and around the diaper (MacMullen, Dulski, & Blobaum, 2014). There are many nonpharmacologic methods that can be implemented to treat these challenges and ensure that the baby is getting enough nutrients to grow and heal through the withdrawing process. Many of these infants have trouble focusing for feeds due to hyperirritability. This can cause challenges in forming and maintaining a successful latch. In order to calm the infant and strengthen the ability to suck and latch, it is important to provide an increased number of opportunities for non-nutritive sucking, which is often facilitated with a pacifier (MacMullen, Dulski, & Blobaum, 2014). Due to the infant's poorly functioning digestive tract, they are at an increased risk for vomiting up their meals. In order to prevent this, frequent smaller feeds can be effective, and it will assist in the efforts of weight gain and growth (Jansson et al., 2016). These infants also typically have severe diarrhea while they are withdrawing, which not only dehydrates the infant, but it can also lead to decreased nutritive absorption and skin breakdown. Barrier cream is highly suggested to prevent and treat diaper rash, raw, or fragile skin (MacMullen, Dulski, & Blobaum, 2014). The Western Australian Centre for Evidence-Based Nursing and Midwifery recommends the prevention of skin breakdown by using mittens, cotton sheets for the crib or isolette, and frequent diaper changes to ensure the skin is dry as often as possible (MacMullen, Dulski, & Blobaum, 2014).

An important way to care for these infants' digestive tracts and their future growth is through breastfeeding. Although there used to be controversy about the safety of breastfeeding these infants, research has now been able to show conclusively that breastfeeding benefits children with NAS. Not only has breastfeeding been shown to decrease LOS and LOT, but it also

“provides optimal nutrition, promotes bonding, and empowers babies’ mothers to be effective parents” (MacMullen, Dulski, & Blobaum, 2014). It was originally thought that if the mother was on a methadone or buprenorphine maintenance plan there would be significant levels of the drug in the breastmilk, but in a study of ten buprenorphine-maintained women, their milk samples from peak buprenorphine concentrations at 2-30 days postdelivery showed very low levels (Jansson et al., 2016). Buprenorphine was found in low concentrations in four of the nine infants’ plasma samples drawn for routine pediatric testing completed at day 14 of life. Undetectable levels were found in the remaining five infants’ blood samples (Jansson et al., 2016). This study found that their results were similar to other studies that measured methadone in the mothers’ breastmilk. The only time that breastmilk would not be appropriate would be if the “mother is taking street drugs, is involved in polydrug abuse, or is infected with HIV” (Kocherlakota, 2014).

Breastfeeding education is important in this population due to increased intricacies of the birth. These babies benefit significantly from the breastmilk, but many mothers do not breastfeed due to “frustration with lack of effective breastfeeding, separation of mother and child for infant admission to the neonatal intensive care unit, and a lack of education regarding established guidelines for breastfeeding with maternal methadone use” (Crook & Brandon, 2017). In one study, mothers with infants at risk for NAS were given a three-class curriculum to increase education on breastfeeding. The results showed that the education cohort had the largest percentage of exclusively breastfed infants during hospitalization and at discharge. There was also a significant decrease in LOS for those infants (Crook & Brandon, 2017).

One of the most promising interventions for these infants is rooming-in, which is where the infant stays in the same room as their mother instead of being transferred to the NICU. When

infants are brought to the NICU the relationship between the mother and baby can be severely affected; there will be detrimental effects to mother-infant attachment from less bonding time and fewer opportunities to breastfeed. Also, the NICU may be counterproductive to the care of these infants due to the bright and noisy environment. “Rooming-in may facilitate breastfeeding, which has been associated with a reduced need for pharmacologic treatment and shorter hospital stays” (McKnight et al., 2016).

At Kingston General Hospital a rooming-in program was introduced and studied for positive and negative effects. The mother and infant were admitted to a private room in the pediatric floor where the two would stay together, even after the mother was discharged (McKnight et al., 2016). The mother was responsible for providing all nonmedical care for the infant and the child would be assessed for signs of withdrawal by the nursing staff. Some institutions have termed the tasks the mother should perform as ‘ESC’, which stands for eat, sleep, and console. If the child were taken into the custody of DCS or if they required high acuity care, like significant pharmacologic treatment, the infant would be transferred to the NICU (McKnight et al., 2016). However, once the medication dose was stabilized, or starting to be weaned, the infant would be returned to the rooming-in program. There were 24 infants who were treated in the NICU and 20 were a part of the rooming-in program. The results showed that only three of the rooming-in group required pharmacologic treatment, while 20 of the NICU group required pharmaceuticals. Adjunct medication was needed in six infants in the NICU but was not needed for any of the infants in the rooming-in group (McKnight et al., 2016). The average LOS was five days in the rooming-in group, versus twenty-four days in the NICU group. All these results are statistically significant, and are similar to results from other studies, which is very telling of the success of this intervention (McKnight et al., 2016). One major factor is that

70% of the rooming-in group was breastfed, whereas only 50% were in the NICU. This intervention not only supports a shorter LOS and LOT for these infants, but it reduces costs for the hospital and the families, while reducing the health care and nursing resources required (McKnight et al., 2016).

It is well known that infants are easily comforted by being held, consoled, and cuddled. Kangaroo care, also called skin-to-skin contact, is an evidence-based intervention for infants, with and without NAS. The infant, without clothes on, is placed on the bare skin of someone's chest with a blanket over them both. Skin-to-skin contact is encouraged to be completed immediately after birth for a minimum of one hour and as often as possible afterwards (Ludington-Hoe & Abouelfetoh, 2015). Kangaroo care has been effective in infants with NAS due to its "physiologically-stabilizing, behaviorally-calming, and sleep-inducing effects" (Ludington-Hoe & Abouelfetoh, 2015). Previous research has shown that mothers of infants with NAS who are on maintenance programs "may be reluctant to visit or hold their newborns skin-to-skin," but with appropriate education of the mothers and encouragement by the nurses, more frequent and longer periods of kangaroo care can occur (Ludington-Hoe & Abouelfetoh, 2015). In one study, two mothers on maintenance programs were observed for how long they provided skin-to-skin contact and how the NAS scores of their infants changed. In the first infant, the scores decreased from 12 to 3 during the first session of kangaroo care and the score remained low for the rest of the day. In the second infant the scores ranged from 2-3 during kangaroo care, but without kangaroo care 6-9. This shows that skin-to-skin contact can provide calming measures to the infant and it can foster bonding and attachment between the mother and child (Ludington-Hoe & Abouelfetoh, 2015).

Nonpharmacological neuromuscular treatments are also available to help provide calming treatment to infants with NAS. These treatments include: laser acupuncture, vibrotactile stimulation, reiki, and infant massage. These treatments all require specialized training, but an increasing number of nurses are becoming certified in alternative treatments, like these. In one randomized and blinded control trial, infants were put into an acupuncture group where they also received their pharmacologic treatment and the other infants were placed in an only-pharmacologic care group (Raith et al., 2015). Laser acupuncture was performed with a specialized pen in five ear and four body points bilaterally. Sessions were repeated every day and the duration and amount of oral morphine therapy, Finnegan scores, and the length of hospital stay were measured closely (Raith et al., 2015). The results showed that the duration of morphine therapy and LOS in the hospital were significantly reduced with acupuncture compared to the control group. The LOT was an average of 28 days with acupuncture compared to 39 days without, and the average LOS in the hospital was 35 days compared with 50 days (Raith et al., 2015).

Stochastic vibrotactile stimulation is a nonpharmacologic method that uses a specialized mattress to deliver 30-60 Hz of vibrations with the goal of decreasing the infant's movement activity, heart rate, respiratory rate, axillary temperature, and increase blood-oxygen saturation. One study used these mattresses in 30-minute intervals for a session of 6-8 hours on 26 opioid-exposed newborns with NAS (Zuzarte et al., 2017). This study found that there was a 35% reduction in movement activity with the mattress on, which is an important feature for infants with NAS due to their hyperactivity and hyperirritability. There was a relative decrease of 36.6% in tachycardia, which came out to a statistically significant average of a drop of ~3bpm. The average respiratory rate dropped by 6 breaths/min, but neither the temperature nor the oxygen

saturation was significantly affected positively or negatively (Zuzarte et al., 2017). Vibrotactile stimulation has also been administered through vibrating swings as an alternative to a mattress. There is still a need for increased research on the physiology of how vibrotactile stimulation can relax these infants, but it is thought that it “may help regulate autonomic function by stimulating pressure receptors, specifically slowly-adapting pulmonary stretch receptors, to increase vagal tone (e.g., reduced tachypnea and tachycardia)” (Zuzarte et al., 2017).

Reiki is defined by the National Center for Complimentary and Integrative Health as “a health practice in which practitioners place their hands lightly on or just above the person, with the goal of facilitating the person’s own healing response” (Radziewicz et al., 2018). Reiki is administered by a trained practitioner to channel universal energy and help support the “body’s innate or natural healing abilities” with the hopes of relaxing the patient and making them more comfortable (Radziewicz et al., 2018). Reiki has been shown to assist adult patients, but very few studies have observed the effects on infants, let alone those with NAS. In one study a group of 30 infants with NAS received one 30-minute session of Reiki therapy. Heart rate, oxygen saturation, and NAS scores were observed before, during, and after the session. There was a statistically significant decreases in heart rate, but non-significant decreases in oxygen saturation or NAS scores (Radziewicz et al., 2018). The average drop in heart rate during and after the session could be indicative of increased relaxation in the infants. Infant massage, which is different than Reiki therapy, can also be used as a simple touch therapy that has “been shown to improve sympathovagal responses,” which can be seen in changes in vital signs like heart rate (Radziewicz et al., 2018). Infant massage is a simple and quick intervention that can provide comfort and relaxation to infants. Nurses can be trained in how to administer appropriate massage, but simple touch can be done by the mother and other family members too.

### **Pharmacological Interventions**

Although nonpharmacologic methods are always initiated first, about two thirds of infants with NAS require pharmacologic treatment due to severe withdrawal symptoms or a lack of improvement with only nonpharmacologic interventions (Kraft et al., 2017). One of the current barriers of appropriate treatment of NAS is that “there are currently no uniformly accepted pharmacological interventions or standardized regimens for the management of NAS” (Kocherlakota, 2014). Oral morphine has traditionally been used and as of 2017, about 80% of infants with NAS in the US who required pharmacologic treatment received morphine as the choice drug (Kraft et al., 2017). Pharmacologic treatment is initiated based on Finnegan scoring, seen in appendix A. Typically, medication is begun when the infant receives three consecutive scores that are greater than or equal to eight or when the average of two scores or two consecutive scores are greater than or equal to a score of twelve (Bagley et al., 2014).

Morphine is often chosen because it can easily control severe symptoms like seizures, difficulty feeding, diarrhea, and agitation. However, it prolongs the length of the infant’s hospital stay, which increases the risk for infections, is not cost effective, and can cause added stress to the infant and family (Kocherlakota, 2014). Morphine has a short pharmacological half-life, which means that it must be administered more often, sometimes even every 2-3 hours. If an infant has a rapid increase in their NAS scores the dose can be increased quickly also, but it must be weaned slowly (Kocherlakota, 2014).

Methadone is an alternative to morphine; the use of methadone is much higher in the US than in other countries (Kocherlakota, 2014). Methadone can be administered less frequently than morphine, sometimes only twice a day, but it has a long half-life, which means it is more difficult to adjust the dosing (Kocherlakota, 2014). Buprenorphine is the newest drug used for

infants with NAS. There is promising research showing its benefits compared to morphine and methadone. Buprenorphine has a ceiling effect for respiratory depression and fewer cardiovascular effects than the other two drugs. It has a longer half-life, which means fewer doses, and infant interruptions, per day (Hall et al., 2016). The longer half-life of buprenorphine is also helpful because it can “smooth out peaks and troughs that are seen with morphine” (Kraft et al., 2017). However, buprenorphine is not yet a standard practice in hospitals.

In order to use the smallest opioid dose necessary, sometimes adjunct medications are added to the patient’s regimen; this is often initiated when the maximum opioid dose still does not establish stability in the infant (Kocherlakota, 2014). The most common adjunct medications are phenobarbital and clonidine. Phenobarbital is used more often with the use of morphine or methadone. Although it does not assist with seizures or gastrointestinal symptoms, it is extremely successful in infants withdrawing from polydrug use. Clonidine, a centrally acting alpha adrenergic receptor agonist, can be helpful in curtailing the need for high doses of methadone or morphine (Kocherlakota, 2014).

Methadone and buprenorphine maternal maintenance programs are commonly used with the mothers in this population. Current health practitioners prefer if the infant is treated with the same substance as the offending substance used during pregnancy because it is thought to help mitigate withdrawal symptoms (Hall et al., 2016). For example, if an infant were exposed to methadone in utero, they would be treated with methadone after birth, even if buprenorphine has shown more success with shorter LOS and LOT (Hall et al., 2016). This topic, however, still requires increased data to evaluate whether this is the best treatment decision for the infant.

There is currently not enough research, or randomized control trials, to prove the superiority of buprenorphine, but initial studies are able to show its promise in the treatment of

NAS. One study utilized a cohort comparison method to look at the use of buprenorphine and methadone in order to determine the differences in average LOT, LOS, and need for adjunct therapy (Hall et al., 2016). In this study, all infants who were exposed to methadone in utero were given methadone after birth, which may have skewed the results. There was a total of 201 infants: 38 received buprenorphine and 163 received methadone (Hall et al., 2016). Those in the buprenorphine treatment group had shorter durations of pharmacologic treatment with an average of 9.4 days compared to 14 days in the methadone group. The buprenorphine group also had a shorter LOS at the hospital with an average of 16.3 days to 20.7 days in the methadone group. There were no significant differences in the need for adjunct therapies (Hall et al., 2016).

A second study focused on comparing buprenorphine to morphine, while assessing the same outcomes as the previous study: LOT, LOS, and need for adjunct therapy. This was a double-blind randomized control trial completed in the U.S., which holds a higher level of evidence. However, it was only done at one site, which means there were fewer participants (Kraft et al., 2017). Both groups of infants were perceived by family and staff to be given both buprenorphine and morphine, but if the infant was in the buprenorphine group the morphine was a placebo and vice versa for the morphine group; this was done to ensure blinding. There were 63 infants total with 33 in the buprenorphine group and 30 in the morphine group. The results showed that the median LOT was 15 days in the buprenorphine group and 28 days in the morphine group (Kraft et al., 2017). The median LOS was 21 days for buprenorphine compared to 33 days for morphine. The use of supplemental phenobarbital as an adjunct medication was needed in five infants in the buprenorphine group and seven in the morphine group; however, these results are insignificant (Kraft et al., 2017). This study also focused on the safety of the two drugs by looking at the infants' mean respiratory rates, weight gain or loss, and number of

serious adverse events. There was no difference in adverse events between the two groups, but the morphine group had an average respiratory rate of 4.4 fewer breaths per minute compared to the buprenorphine group (Kraft et al., 2017). While both respiratory rate means were within the normal range, it does show that respiratory depression is an increased risk factor with the use of morphine. At seven days of age the mean reduction in weight from birth was less in the morphine group than in the buprenorphine group. There were no significant differences in the weight changes at 14, 21, or 28 days of life (Kraft et al., 2017).

### **Barriers to Care**

Unfortunately, the population affected by NAS faces significant challenges in addition to their already difficult, painful, and disruptive start to life. The rates of NAS rose so quickly with the opioid epidemic that the health care system could not catch up fast enough in research, clinical policy, and nursing care education. These are all barriers to providing the most efficient, effective, and positive experiences for mothers and infants dealing with NAS in hospitals. One challenge that occurs for the mother-infant dyad is learning to read each other's cues and respond to them appropriately. As mentioned earlier, DCS is always involved in maternal drug use cases, even if the mother plans to stop using substances after the birth of the child. This can add tension and stress to the mother's situation because she feels she must impress the case worker and 'prove' her ability to be a mother. This, in addition to current or past substance abuse, places the interactions of the maternal-infant dyad in an unusually stressful situation. It was hypothesized that mothers in drug maintenance programs innately have a harder time reading infant cues. It was also thought that infants diagnosed with NAS innately cannot show clear cues to the mother due to neurological irritability and concurrent dampening from medication, which can increase the difficulty of forming an effective bond (Maguire et al., 2016).

A comparative-descriptive study was done to describe the interactions between mothers in a methadone treatment program and their newborns with NAS during bottle feeding sessions, compared with normed data. If the mothers can succeed at regularly feeding their child, they can become more “sensitive to infant cues with fewer distractions, and [they are] able to establish a framework for all future productive interactions” (Maguire et al., 2016). Twelve dyads were observed via video and were scored by two trained coders independently to accurately assess six different classification criteria: clarity of cues, responsiveness to caregiver, total score, parent sensitivity to infant cues, parent contingency, and cognitive growth fostering.

The results showed that the NAS dyad scores were significantly lower than the normed data in all categories except cognitive growth fostering, which was significantly higher in the NAS group compared to normed data (Maguire et al., 2016). Examples of cognitive growth fostering seen in these mothers included caregiver encouragement of the infant or allowing the child to explore the breast or bottle. “These mothers may feel a lot of pressure to be ‘good’ mothers, because they are under the scrutiny of health care providers” and DCS who could remove the child from the mother’s care (Maguire et al., 2016). This is termed the “Hawthorne” effect, which is when people act differently than they normally would because they know they are being observed. The reason this is a barrier to care is because the dyad is already at a disadvantaged state in terms of their ability to interact with each other. The challenges, including a lack in clarity of cues, may be due to the effects of maternal drug use, the infant’s withdrawal symptoms, and medication side effects (Maguire et al., 2016).

Mothers of infants with NAS have an atypical experience in the hospital when they go to give birth. The experiences of these mothers were investigated during a qualitative descriptive study. The intention was to gain data to assist in identifying areas that need improvement within

the hospital (Cleveland & Bonugli, 2014). One major conclusion that became clear was that nurses require additional education about NAS and substance use in order to provide more customized and appropriate care. Fifteen mothers' experiences were analyzed, and four common themes were created: understanding addiction, watching the infant withdraw, judging, and trusting the nurses (Cleveland & Bonugli, 2014). The mothers participated in semi-structured, individual interviews where they discussed their own experiences in the hospital, which could include anything from their emotions toward their infant to how the hospital staff treated them.

The study also spoke of the nurses' experiences caring for these mothers and infants (Cleveland & Bonugli, 2014). Some NICU nurses felt that they often had a difficult time caring for infants with NAS due to their inconsolability, while others felt that these infants often did not require the specialized care of an intensive care setting. One common theme with NICU nurses, though, was that there was overall concern about the mother's ability to care for, and cope with, the challenges of an infant with NAS (Cleveland & Bonugli, 2014). Nurses of the mothers "claimed that interacting with families with addicted members was stressful for them and [they] acknowledged negatively judging mothers because they used illicit drugs" (Cleveland & Bonugli, 2014). Many nurses reported being "verbally attacked" by the mother and her family, possibly because the mother felt she needed to be on the defensive due to nursing judgment and the presence of DCS. Other nurses described feeling like they did not have the necessary education in mental health or substance use to provide the best care (Cleveland & Bonugli, 2014).

The four themes of the study were derived from the mothers' responses, not the nurses, during interviews. Understanding addiction was a key aspect because many women discussed "their lack of understanding related to the process of addiction even after having become

addicted” (Cleveland & Bonugli, 2014). This included how quickly addiction manifests, the impact it can have on everyday life, and the ignorance or immaturity in ignoring previous drug use prevention education they had received in school. Watching the infant withdraw was a common topic of discussion; many women talked about the “shame and guilt” they experienced when watching their infant suffer with inconsolable crying and tremors (Cleveland & Bonugli, 2014). The mothers described the NICU as a scary and busy place where they felt they did not want to bother the nurses for assistance with seemingly simple tasks. Judging was commonly associated with the nursing staff. The mothers described feeling ridiculed due to their previous drug use (Cleveland & Bonugli, 2014). However, other mothers described gratitude towards the nurses and noticed the extreme efforts taken to make the mothers comfortable and involved in the infant’s care. The final category was trusting the nurses; many of the mothers reported that trust was challenging for them. There did seem to be, however, a positive correlation between the amount of time the mother spent in the NICU with the nurses and the extent of the mother’s ability to trust them (Cleveland & Bonugli, 2014).

Unfortunately, there is a significant lack of research in the future development of children that are born with NAS. These studies are required to ensure that the treatments performed on them at a young age are not negatively impacting them. Some researchers have hypothesized that children that were “treated for NAS would score lower than the normative sample on the Bayley Scale of Infant Development (BSID)” (Merhar et al., 2018). As of September 2018, there were only five articles in the literature evaluating long term outcomes of opioid-exposed infants (Merhar et al., 2018). In the coming years, it will be crucial to increase efforts on studying these children from a young age through development.

One retrospective cohort study looked at 87 two-year-old children who were treated for NAS at birth. Electronic medical records were drawn for the subjects and were followed up with at the two-year check-up visit at the clinic (Merhar et al., 2018). The BSID was performed by a single non-blinded examiner. The results showed significantly lower scores in NAS children compared to the norm on all three subscales. The norm for all scales was considered 100, but the children treated for NAS had a mean of 96.5 for cognition, 93.8 for language, and 94 for motor skills (Merhar et al., 2018). A quarter of the guardians reported “significant behavioral or sleep issues, most commonly tantrums, hyperactivity, sensory issues, and difficulty falling/staying asleep”. A significant result was that 8% of the children were receiving treatment for strabismus (Merhar et al., 2018). The type of pharmacologic treatment for NAS, between methadone, morphine, and buprenorphine, was shown to have no effects on the BSID scores (Merhar et al., 2018).

Early intervention services and therapies are encouraged for any child showing difficulties with appropriate development. 40% of the subject population in this study received early intervention services prior to age two. 22% received speech/language therapy, 7% occupational therapy, and 16% physical therapy (Merhar et al., 2018). This shows how the withdrawal and its treatment at such a young age can have significant impacts on every day life functioning. Although this study did provide valuable information in the developmental difficulties of these infants at around two years of age, there is still no concrete knowledge on the influential factors of the neurodevelopment of infants treated pharmacologically for NAS at birth.

Given the vastness of interventions for NAS, the complexity of the disorder itself, and the lack of education of practitioners, there is a great need for a comprehensive guideline that can be

easily followed by practitioners hospital-, state-, and nation-wide. The implementation of a clinical practice guideline (CPG) has been used for many other conditions in order to provide a standard of care within and between hospitals. In a study done by Cook, Dahms, and Meiers, a CPG project was implemented at a facility in the rural Midwest. Pre- and post-test evaluations were done with the Nurses' Knowledge and Confidence Survey (NKCS). The study sought to determine if a CPG for NAS, compared to current treatment, would affect neonatal outcomes, LOT, LOS, neonate assessment scores, and "nurses' knowledge and confidence in caring for neonates with NAS" (Cook, Dahms, & Meiers, 2017).

Three months prior to the implementation of the CPG, education about the NAS CPG was provided via educational handouts and pocket guides. Hard copies of the CPG were given to all nurses and electronic versions were added to the electronic health record (EHR) with troubleshooting guides (Cook, Dahms, & Meiers, 2017). Other, non-CPG related educational documents about NAS were also provided in the EHR. Although there were no statistically significant changes in LOT, LOS, and NAS assessment scores in the pre- and post-tests, there was a statistically significant increase in the nurses' scores on the NKCS from pretest to post-test (Cook, Dahms, & Meiers, 2017). "Nurses agreed that education on NAS assessment improved their ability to identify and accurately assess NAS symptoms in neonates". The nurses described that they were better able to provide breastfeeding education, identify early symptoms of NAS, and they could better assess when they needed to call the provider (Cook, Dahms, & Meiers, 2017).

Although CPGs can be helpful in creating a standard of practice for reliable evidence-based care, without consistent assessment of these infants across health care providers, the appropriate treatments may not be provided. A significant challenge that has arisen in the course

of the opioid epidemic is the lack of reliability in the use of assessment tools like the Finnegan scale, seen in appendix A. Not only are there a vast number of modified versions of the Finnegan scale, but there are multiple other commonly used tools as well (Bagley et al., 2014). With the significant variations between hospitals, the reliability and consistency of NAS assessments are brought into question. A systematic review of the published literature on infant assessment of NAS found that there was “limited data on the inter-observer reliability of NAS assessment tools due to a lack of standardized approach” (Bagley et al., 2014). This study also focused on the troubling fact that most of the popular scales were developed before prenatal maintenance medication programs were standard practice for mothers, which can complicate NAS assessments. Some institutions have required nurses and doctors to take specific intensive courses on accurate NAS assessment to ensure that there is standardization across health care professionals’ assessments. However, there is still a lack of consistency across hospitals. It is hypothesized that “this standardization may lead to a decrease in the extent of pharmacotherapy used and length of hospitalization needed” (Bagley et al., 2014).

### **Conclusions**

The articles reviewed in this chapter addressed multiple nonpharmacologic interventions, the strengths and weaknesses of different pharmacologic treatment options, and barriers to the care of infants with NAS. The eighteen sources utilized vary in method from qualitative descriptive studies to double-blinded randomized control trials. A common weakness in almost all articles was a small sample size and a lack of ability to include randomization due to the nature of the study topic. The literature showed that there is significant hope for the success in treatment with nonpharmacologic methods, especially with decreasing environmental stimuli, breastfeeding, and rooming-in. Breastfeeding itself, which is a safe practice even for mothers on

opioid maintenance plans, can reduce NAS severity through “smaller, more frequent feeding of digestible milk, maternal attention to more frequent infant cues,” and increased bonding with the mother (Jansson et al., 2016). Although morphine is still a valid choice for pharmacologic interventions, methadone and buprenorphine have shown decreased LOS and LOT. These interventions not only decrease the stress on the hospital staff, the family, and finances, but they also allow for a quicker treatment period of the illness and a chance for the infant to get back to acting like a typical newborn.

It is essential that future research focuses on performing more randomized control trials so that there is strong evidence backing NAS treatments that should be implemented into hospitals. There needs to be an increased rate of change in hospital policy and nurse education because as more rooming-in initiatives are implemented, as well as other treatments, postpartum mom-baby nurses and/or pediatric nurses are going to have to be educated on caring for these mother-infant dyads, instead of NICU nurses. An alternative is that hospitals need to implement special areas of the NICU that allow for an appropriate quiet and dark environment for the infants as well as increased accessibility for the mother, so she can provide active parenting and breastfeeding. As infants who are treated for NAS grow up, they need to be monitored and assessed throughout their lifetime for developmental changes. Some current treatments may be causing damage to these newborns that cannot currently be seen or measured, but long-term studies can help determine how current actions affect these infants later in life. Based on this review of existing literature, evidence-based recommendations are required to assist nurses and providers in effectively treating NAS and supporting the infants and mothers in coping with a challenging disorder.

## CHAPTER 3

## Best Practice Recommendations: Neonatal Abstinence Syndrome

The purpose of this thesis was to build informed best practice recommendations to better support and provide care for infants with NAS. This chapter lays out proposed best practice recommendations, seen in Table 1, that can be used to assist nurses and other health care professionals in assessing and caring for babies with NAS in order to create more favorable outcomes for the child and family. The literature that was reviewed in chapter two provided a thorough analysis of symptoms, assessment, treatment interventions, and barriers to care that the infants, and the mothers, may deal with during the hospitalization.

Much of the literature reviewed in chapter two focused on environmental adjustments that can significantly improve the process of the infant's withdrawal. Some of the most promising interventions include diminishing auditory, visual, and tactile stimulation, soft music, white noise, and aromatherapy (Kocherlakota, 2014; MacMullen, Dulski, & Blobaum, 2014; Radziewicz et al., 2018). Other more intricate treatments include vibrating mattresses or swings, laser acupuncture, and infant touch and massage (Radziewicz et al., 2018; Raith et al., 2015; Zuzarte et al., 2017). However, two of the most successful interventions were simply breastfeeding and non-separation of the mother and child (Crook & Brandon, 2017; Jansson et al., 2016; MacMullen, Dulski, & Blobaum, 2014). The research has shown that infants with NAS are able to have a shorter LOS and LOT in the hospital just by being in the care of their mother, otherwise known as rooming-in (McKnight et al., 2015). This practice not only encourages breastfeeding, but it reinforces bonding where the mother and baby are better able to read and send cues to each other (Maguire et al., 2016). If these nonpharmacologic interventions are unsuccessful in treating the withdrawal symptoms, the infant may require pharmacologic

treatment. Although oral morphine and methadone are most commonly used as a standard of practice, buprenorphine has shown promising results in lowering the LOS and LOT (Hall et al., 2016; Kraft et al., 2017; Kocherlakota, 2014). The literature described common challenges between the mothers of NAS babies and the nursing staff; these often had to do with judgement and a lack of trust in one another (Cleveland & Bonugli, 2014). Healthcare workers require an increased level of education on opioid maintenance programs for the mother, addiction as a disease, and common stressors that these mothers face. This can include the mother's challenges with DCS and the feeling that they must prove their ability to be a mother (Cleveland & Bonugli, 2014). The more that healthcare providers support these infants and mothers through positive interactions and interventions, the better the outcomes can be.

Table 1:

*Best Practice Recommendations for the Treatment of Neonatal Abstinence Syndrome*

<b>Recommendation</b>	<b>Rationale</b>	<b>References</b>	<b>Level of Evidence</b>
Environmental Adjustments: <ul style="list-style-type: none"> <li>• Turn the lights off</li> <li>• Remain quiet</li> <li>• Limit handling and stimulation</li> <li>• Use soft cotton linen</li> <li>• Play soft music/white noise</li> <li>• Swaddle</li> <li>• Use aromatherapy</li> </ul>	Infants with NAS are hypersensitive to external stimuli. These interventions aid in keeping the infant relaxed. Some have been associated with a decreased need for pharmacologic care.	Kocherlakota, P. (2014). Neonatal abstinence syndrome. <i>Pediatrics</i> , 134(2), 547-561. doi: 10.1542/peds.2013-3524. MacMullen N.J., Dulski L.A., & Blobaum P. (2014). Evidence-based intervention for neonatal abstinence syndrome. <i>Pediatric Nursing</i> , 40(4), 165-203. Retrieved from <a href="http://www.pediatricnursing.net/">http://www.pediatricnursing.net/</a> . Radziewicz, R.M., Wright-Esber, S., Zupancic, J., Gargiulo, D., & Woodall, P. (2018). Safety of reiki therapy for newborns at risk for neonatal abstinence syndrome. <i>Holistic Nursing Practice</i> , 32(2), 63-70. doi: 10.1097/HNP.000000000000251.	Level V  Level I  Level IV
Gastrointestinal Treatments:	NAS causes significant gastrointestinal distress including diarrhea,	Jansson, L.M., Spencer, N., McConnell, K., Velez, M., Tuten, M., Harrow, C.A., Jones, H.E., ... Huestis, M.A. (2016).	Level IV

<ul style="list-style-type: none"> <li>• Non-nutritive sucking</li> <li>• Frequent and smaller feeds</li> <li>• The use of barrier cream</li> <li>• Change diapers frequently</li> </ul>	<p>vomiting, and non-synchronous sucking. Providing these interventions can assist with forming a latch for breastfeeding and preventing skin breakdown around the diaper.</p>	<p>Maternal buprenorphine maintenance and lactation. <i>Journal of Human Lactation</i>, 32(4), 675-681. doi: 10.1177/0890334416663198.</p> <p>MacMullen N.J., Dulski L.A., &amp; Blobaum P. (2014). Evidence-based intervention for neonatal abstinence syndrome. <i>Pediatric Nursing</i>, 40(4), 165-203. Retrieved from <a href="http://www.pediatricnursing.net/">http://www.pediatricnursing.net/</a>.</p>	Level I
Encourage breastfeeding	<p>Breastfeeding is a safe practice for mothers in methadone or buprenorphine maintenance programs. Breastfeeding provides more digestible milk in smaller and more frequent feeds on a demand basis. Breastmilk also contains rich nutrients and antibody properties that are not found in formula. Breastfeeding has been associated with a decreased need for pharmacologic care and shorter LOS and LOT.</p>	<p>Crook, K. &amp; Brandon, D. (2017). Prenatal breastfeeding education impact on infants with neonatal abstinence syndrome. <i>National Association of Neonatal Nurses</i>, 17(4), 299-305. doi: 10.1097/ANC.0000000000000392.</p> <p>Jansson, L.M., Spencer, N., McConnell, K., Velez, M., Tuten, M., Harrow, C.A., Jones, H.E., ... Huestis, M.A. (2016). Maternal buprenorphine maintenance and lactation. <i>Journal of Human Lactation</i>, 32(4), 675-681. doi: 10.1177/0890334416663198.</p> <p>MacMullen N.J., Dulski L.A., &amp; Blobaum P. (2014). Evidence-based intervention for neonatal abstinence syndrome. <i>Pediatric Nursing</i>, 40(4), 165-203. Retrieved from <a href="http://www.pediatricnursing.net/">http://www.pediatricnursing.net/</a>.</p>	Level III
<p>Neuromuscular treatments:</p> <ul style="list-style-type: none"> <li>• Laser acupuncture</li> <li>• Vibrotactile stimulation</li> <li>• Reiki</li> <li>• Infant massage</li> </ul>	<p>Common symptoms of infant withdrawal are shaking, myoclonic jerks, excess movement, and neurologic hypersensitivity. These treatments aid in relaxing the infant and decreasing the requirement of pharmacologic treatment.</p>	<p>Radziewicz, R.M., Wright-Esber, S., Zupancic, J., Gargiulo, D., &amp; Woodall, P. (2018). Safety of reiki therapy for newborns at risk for neonatal abstinence syndrome. <i>Holistic Nursing Practice</i>, 32(2), 63-70. doi: 10.1097/HNP.0000000000000251.</p> <p>Raith, W., Schmolzer, G.M., Resch, B., Reiterer, F., Avian, A., Koestenberger, M., Urlseberger, B. (2015). Laser acupuncture for neonatal abstinence syndrome: A randomized controlled trial. <i>American Academy of Pediatrics</i>, 136 (5), 876-884. doi: 10.1542/peds.2015-0676.</p>	Level IV
			Level IV

Zuzarte, I., Indic, P., Barton, B., Paydarfar, D., Bednarek, F., & Bloch-Salisbury, E. (2017). Vibrotactile stimulation. A non-pharmacological intervention for opioid-exposed newborns. *PLoS ONE* 12(4), 1-15. Retrieved from <https://doi.org/10.1371/journal.pone.0175981>.

Perform kangaroo care	Kangaroo care can be used to keep the infant relaxed as well as help regulate their temperature, oxygenation, heart rate, and respiration rate. It aids in the bonding process as well.	Ludington-Hoe, S.M. & Abouelfetoh, A.M. (2015). Can kangaroo care help newborns with neonatal abstinence syndrome? Case report. <i>Clinical Nursing Studies</i> , 3(4), 44-52. doi: 10.5430/cns.v3n4p44.	Level IV
Set up spaces to allow for rooming-in and educate nurses in what tasks the mother should be performing instead of the nurses (eat, sleep, console)	Rooming-in not only removes the infant from the NICU, which often has noxious stimuli, but it encourages mothers to be more active in the care of their baby. This has been shown to significantly reduce the LOS and LOT for the infant.	McKnight, S., Coo, H., Davies, G., Holmes, B., Newman, A., Newton, L., ... Dow, K. (2015). Rooming-in for infants at risk of neonatal abstinence syndrome. <i>American Journal of Perinatology</i> , 33(5), 495-501. doi: 10.1055/s-0035-1566295.	Level IV
Use methadone, or possibly buprenorphine, as a preferred alternative to oral morphine for the infant	Methadone has shown significant reductions in LOS and LOT compared to oral morphine, which has been the standard of treatment in the past. Buprenorphine is still being investigated as a comparable or superior alternative to methadone; initial studies are showing promising results.	Hall, E.S., Isemann, B.T., Wexelblatt, S.L., Meizen-Derr, J., Wiles, J.R., Harvey, S. ... Akinbi, H.T. (2016). A cohort comparison of buprenorphine versus methadone treatment for neonatal abstinence syndrome. <i>The Journal of Pediatrics</i> , 170, 39-44. doi: 10.1016/j.jpeds.2015.11.039. Kraft, W.K., Adeniyi-Jones, S.C., Chervoneva, I., Greenspan, J.S., Abatamarco, D., Kaltenbach, K., & Ehrlich, M.E. (2017). Buprenorphine for the treatment of the neonatal abstinence syndrome. <i>The New England Journal of Medicine</i> , 376(24), 2341-2348. doi:10.1056/NEJMoa1614835.	Level IV  Level II
		Kocherlakota, P. (2014). Neonatal abstinence syndrome. <i>Pediatrics</i> , 134(2), 547-561. doi: 10.1542/peds.2013-3524.	Level V

Provide early intervention to PT/OT/speech, language, and hearing therapy (SLH), etc. and increase access to these resources after discharge	Services like PT/OT/SLH are important to start as early as possible, including in the hospital setting. Many children by age 2 had lower scores for cognition, language, and motor skills. Many of them reported significant behavioral challenges, sleep problems, and sensory issues.	Merhar, S.L., McAllister, J.M., Wedig-Stevie, K.E., Klein, A.C., Meinzen-Derr, J., & Poindexter, B.B. (2018). Retrospective review of neurodevelopmental outcomes in infants treated for neonatal abstinence syndrome. <i>Journal of Perinatology</i> , 38(5), 587-592. doi: 10.1038/s41372-018-0088-9.	Level IV
Improve nurse education of addiction and NAS to better the interactions between mothers and nurses.	Mothers of infants with NAS often feel as if they must prove their ability to be a mother due to the involvement of DCS and the judgement of nurses. With increased education on addiction and NAS, nurses can become more sensitive and aware to this population of mothers. This will help foster trusting relationships with the nursing staff.	Cleveland, L.M. & Bonugli, R. (2014). Experiences of Mothers of Infants with Neonatal Abstinence Syndrome in the Neonatal Intensive Care Unit. <i>Journal of Obstetric, Gynecologic, &amp; Neonatal Nursing</i> , 43, 318-329. doi: 10.1111/1552-6909.12306. Maguire, D.J, Taylor, S., Armstrong, K., Shaffer-Hudkins, E., DeBate, R., Germain, A.M., ... Brooks, S.S. (2016). Characteristics of maternal-infant interaction during treatment for opioid withdrawal. <i>Neonatal Network</i> , 35(5), 297-304. doi: 10.1891/0730-0832.35.5.297.	Level VI  Level VI
Improve nurse education on accurate assessment, possibly with the Finnegan Scale, and infant care by using a clinical practice guideline	With an increased knowledge in appropriate and accurate assessment, nurses can better determine symptoms, which can lead to an earlier diagnosis and treatment. A formal guideline can help nurses ensure treatments are being performed correctly, and on an appropriate timeline, based on evidence-based research.	Cook C.L., Dahms S.K., & Meiers S.J. (2017). Enhancing care for infants with neonatal abstinence syndrome: an evidence-based practice approach in rural midwestern region. <i>Worldviews on Evidence Based Nursing</i> , 14(5), 422-423. doi: 10.1111/wvn.12217. Bagley, S.M., Wachman, E.M., Holland, E., & Brogly, S.B. (2014). Review of the assessment and management of neonatal abstinence syndrome. <i>Addiction Science &amp; Clinical Practice Journal</i> , 9(19), 1-10. <a href="https://doi.org/10.1186/1940-0640-9-19">https://doi.org/10.1186/1940-0640-9-19</a> .	Level I  Level I

### **Summary of Best Practice Recommendations**

A significant number of possible treatments were reviewed in the previous chapter; the recommendations pulled from this literature were organized in Table 1 to show the progression from the least invasive interventions to the most invasive, which follows best nursing practice. The simplest, and least invasive, recommendations included environmental adjustments, like minimizing sensory stimuli and performing swaddling as a comfort measure (MacMullen, Dulski, & Blobaum, 2014). The next level of treatment would include increasing the frequency and attention to GI disruptions. This can be paired along with encouraging the mother to breastfeed and spend time with her baby. The above-mentioned interventions can typically be completed without any provider orders, which increases the need for nurses to assume responsibility for initiating these actions. Neuromuscular treatments, like reiki, laser acupuncture, or infant massage, can be effective for these infants, but they must be performed by a trained professional. The next most invasive intervention, rooming-in, can be challenging for hospitals logistically. If there is not the physical space to allow parents to sleep in NICU rooms, alternatives might be investigated (McKnight et al., 2015). Some hospitals have started designating parts of post-partum mom/baby floors to rooming-in spaces, while other hospitals have instead turned to the pediatric unit for added rooms. Rooming-in is one of the most crucial nonpharmacologic interventions for lessening the infant's LOS and LOT at the hospital (McKnight et al., 2015).

If none of these nonpharmacologic treatments have been successful enough in curbing the infant's withdrawal symptoms, which should be scored accurately on the Finnegan scale, pharmacologic treatment will be necessary. Although oral morphine has been the traditional medication of choice for treating NAS, methadone has proven to be a more successful drug due

to decreased LOS and LOT (Hall et al., 2016). Buprenorphine, which is a promising new option, is not yet integrated into the standard of care, but if more studies, with larger sample sizes, can continue to show its success, it may start to be used in treating these infants as well (Hall et al., 2016). Finally, there are significant barriers to care that occur for both the infants and mothers in this population including judgement by nurses, a lack of access for early PT/OT/SLH, and a lack of awareness and accuracy when assessing and treating these infants. These can be changed through increased education, awareness, and early planning.

## CHAPTER 4

**Implementation and Evaluation**

This chapter will focus on the implementation and evaluation of an evidence-based hospital protocol for the care of infants identified with NAS. This protocol, which will be based on the strongest, and most recent evidence, will be utilized by health care providers to guide a more standardized delivery of nonpharmacologic and pharmacologic care to NAS babies. The protocol will be integrated into the electronic medical record (EMR) to ensure comprehensive adoption by all health care providers. When an NAS diagnosis is made, a new task bar will appear in the EMR guiding the health care providers through appropriate scoring of NAS symptoms, which evidence-based intervention to initiate, and when to do them. It will indicate which nonpharmacologic interventions can be implemented by the nurse without physician orders to emphasize and promote the initiation of these treatments. This EMR task bar will create a single place for all NAS charting for ease of reading as well as for highlighting the need for interdisciplinary groupwork. Throughout the EMR there will be links to the hospital protocol and evidence-based research that supports each intervention that will be easily printable for reference by health care professionals. These can also be utilized as teaching materials for explanations of NAS and its treatments to hospital personnel, the mother, or other family members.

The protocol will be a clear and concise document that moves from least to most invasive interventions for the treatment of NAS. Information that will be integrated into the protocol includes recommended nonpharmacologic interventions like environmental adjustments, gastrointestinal treatments, breastfeeding recommendations, neuromuscular treatments, kangaroo care support, and rooming-in guidelines. It will also include pharmacologic treatment procedures for when to initiate medications, which drug to use, and what dose is appropriate based on NAS

scoring. Initiation of the use of supportive staff including PT, OT, and SLH therapy will be done early in the diagnosis with guidance from the EMR via ‘suggested task’ pop-up windows. Based on the recommendations from the previous chapter, health care professionals will require increased education on NAS and maternal drug maintenance programs in order to work with these couples.

An educational program for staff will be initiated with the release of the protocol. This will include specific NAS scoring classes for nurses as well as general NAS informational courses with education on the new protocol, integration into the EMR, and a specific focus on the importance of rooming-in. All staff must take these courses prior to working with NAS infants and all nurses will have to take an annual online continuing education course on NAS scoring to ensure continued competency of this vital skill. The primary objective of this required education is to give health care providers the appropriate and necessary tools to effectively treat and support both the infants with NAS and the families at the bedside. By implementing educational programs, a clear hospital protocol, and an integrative area of the EMR, health care providers will feel more informed and confident in their knowledge of this complex condition, which will allow them to provide more evidence-based, supportive, and appropriate care.

In order to implement the hospital protocol along with the supportive educational program, and integration into the EMR, the Plan-Do-Study-Act (PDSA) cycle will be utilized. The hospital protocol will follow a simple listed format of interventions from least to most invasive, which aligns with best nursing practice. This will allow for pertinent information to be delivered to the target audience in an efficient and effective manner. The PDSA cycle will provide a framework for the implementation of the protocol into a single local facility. The

PDSA cycle is commonly used as a method to guide the implementation of evidence-based research into the clinical practice setting (Institute for Healthcare Improvement, 2017).

This chapter will also focus on the evaluation of the evidence-based hospital protocol implementation. The PDSA cycle will be used for a framework of both the implementation of the protocol, where the ‘plan’ and ‘do’ sections will be utilized, as well as the evaluation of the protocol, which is done through the ‘study’ and ‘act’ portions. The ‘study’ stage of the PDSA cycle will help to identify the precise evaluation process of the evidence-based hospital protocol, for example, chart auditing or pre- and post- tests. The ‘act’ stage will allow for adjustments to be made to the implementation process based on what was learned from the previous ‘plan’, ‘do’, and ‘study’ stages. Evaluating the success of the hospital protocol, staff education, and EMR integration will be done through multiple PDSA cycles on a smaller scale to provide more frequent feedback that can help guide future changes. However, there will also be one larger over-arching PDSA cycle that will look at the implementation and evaluation as a whole; this is what will be discussed throughout the remainder of this chapter. After the implementation has been completed at one hospital facility successfully, it could have the capability to be implemented on a broader scale to include entire hospital systems, specifically those that see the most cases of NAS annually. Finally, the strengths and limitations of the hospital protocol, staff education, and EMR integration will be discussed in addition to any additional recommendations for future research related to the best nursing practices for NAS.

## **Implementation**

### **Implementing an Effective Hospital Protocol**

Effectively implementing evidence-based interventions has always been a challenge in healthcare due to a “lack of health care provider awareness or difficult clinical algorithms in

medical institutions” (The American College of Obstetricians and Gynecologists [ACOG], 2015). However, research has shown that protocols and checklists, like what will be implemented for NAS from this paper, “have been shown to reduce patient harm through improved standardization and communication” (ACOG, 2015). Utilizing a hospital protocol is just one approach to implementing evidence-based practices for this target demographic. By utilizing the framework of a protocol, it allows for easy refinements and modifications for different facilities. The protocol will be theoretically implemented using the PDSA cycle on multiple hospital units including the NICU, pediatric intensive care unit (PICU), maternal/newborn unit, labor/delivery unit, and general pediatric unit within a single local hospital. After successful implementation of this intervention, the protocol and adjoining education and EMR integration can then be implemented in other hospitals and health systems.

**Plan.** Planning is the first stage of the PDSA cycle that will help guide the implementation of an evidence-based hospital protocol, education requirement, and EMR integration. The planning step involves creating an objective for the intervention, making predictions about what will happen and why, as well as developing a plan to test the change through data collection (Institute for Healthcare Improvement, 2017). Implementing a three-tiered intervention can become increasingly challenging due to how many parties are involved and how much prior organization must occur. It is important to complete as much planning, with effective and thorough communication, early in the process to eliminate as many miscommunications and bumps in the road as possible.

The planning for this intervention would begin about a year in advance of the actual implementation in the hospital. The organization of the planning is made up of three different pathways that would all be occurring at similar times to ensure a timely and efficient release of

the protocol. The initial pathway would be creating a committee of nurses, physicians, nurse practitioners, PT/OT/SLH therapists, clinical nurse educators, nursing managers, as well as any other primary stakeholders in this intervention. This committee will assist in editing the hospital protocol and aligning it to the specific institution it will be eventually implemented. The protocol must then be approved by the hospital board and dispersed to all unit managers that it will affect.

While this is being done, the second pathway, the EMR integration, will also be completed. The technological side of the EMR integration will be created and fine-tuned by Information Technology (IT) technicians for user-friendliness, appropriate suggested task pop-up windows, and easy-to-use imbedded links to the protocol and evidence-based articles supporting each intervention. It will be important to ensure that as soon as an NAS diagnosis is made, a dedicated NAS charting bar appears on the charting system. This area of the EMR will prompt the user to chart timely NAS scores as well as suggest interventions that could be appropriate. An IT support team will also be created and trained specifically on the new NAS charting changes to help guide health care professionals on its use and assist with any technological issues in the future. The IT technicians will also be responsible for loading the NAS online continuing education course material into the electronic system that is already established within the hospital. Nurses will be required to take the continuing education online course annually to ensure continued competency of the skill.

The third pathway, healthcare provider education, will also be completed during this same time frame. Clinical nurse educators will be leaders of the creation of an in-person educational course for all health care providers that have the possibility of interacting with NAS infants. After the course is created, registered nurse NAS super users will be appointed and trained to instruct the course. The course will go over the new protocol, appropriate scoring, new

charting requirements, and what resources are available. The nurse managers of the previously described affected units will inform the nursing staff that they must take the in-person course in the following six months; emailed reminders of the deadline will be crucial in ensuring staff compliance. The nurse managers will also find appropriate areas to hang posters and flowcharts of the new protocol for easy reference on each unit. The staff will be required to take the in-person course within four months of the protocol being released. Charge nurses will be informed to try and assign NAS infants to nurses who have already completed the course. A large section of the in-person class will be focused on accurate knowledge and scoring of NAS based on the most recent evidence. All nurses must take a pre-test and a post-test, which will need to be passed in order to gain the certification at the end of the class. These tests will be used to help measure the intervention's success. Again, all nurses will be also be required to perform an annual competency on NAS scoring.

The final part of the planning stage in the PDSA cycle is to find ways to accurately evaluate and test the future intervention (Institute for Healthcare Improvement, 2017). This will initially be done with pre- and post-testing of nurses from the in-person course. However, the more important evaluation comes from the results of the infants. The over-arching goal for the hospital protocol intervention is to decrease the average LOS and LOT for the infants with NAS. The evaluation for this will begin during the planning stage by auditing the charting completed by health care professionals caring for infants with NAS. Prior to the implementation of the intervention the average LOS, LOT, and required use of adjunct medications will be measured. The key outcome is to decrease these statistics by consistently using the evidence-based interventions presented in this paper and the hospital protocol. Once the objective of the protocol is established, predictions about the outcome of the intervention are made, and methods to test

the success of the protocol are determined, the planning stage can transition into the stage of implementation (Institute for Healthcare Improvement, 2017).

**Do.** The implementation stage of the PDSA, or the ‘do’ stage, is where the intervention is tested on a small scale. Any problems or unexpected observations are noted, and the data collection that was mentioned in the planning stage will start to be analyzed (Institute for Healthcare Improvement, 2017). The hospital protocol for the theoretical implementation of this best practice thesis will be created to improve the use of evidence-based interventions in the treatment of NAS. This implementation will be done in a single facility as a pilot of the hospital protocol, educational services, and EMR integration. Once the protocol is written, it will be edited multiple times by the committee, and eventually approved by the hospital board. This protocol will provide a clear instruction to healthcare providers on evidenced-based treatments for NAS. It will include a step-by-step explanation of nonpharmacologic interventions, like environmental adjustments, gastrointestinal treatments, breastfeeding recommendations, neuromuscular treatments, kangaroo care support, and rooming-in guidelines. It will also include procedures for when providers need to initiate pharmacologic treatment, which drug to select, and what dose is appropriate based on NAS scoring.

The educational programs for healthcare providers will be initiated and nurses will perform pre- and post-testing on their NAS knowledge and accurate NAS scoring via skills testing. Once the healthcare providers have passed the in-person course they will begin working with NAS infants with the new NAS protocol and charting guidelines. Each healthcare provider will be sent an online survey three months after the completion of the in-person class asking follow-up questions about the quality of the course, NAS charting through the EMR integration, and the initiation of more nonpharmacologic interventions, focusing on rooming-in.

The EMR changes will be released following multiple notices to nursing staff that the change will occur. The EMR will automatically create an NAS charting bar after the provider notes an NAS diagnosis. This adaptive charting allows for more organized and comprehensive documentation of assessments. It will provide suggested tasks for nurses and providers including referrals to PT/OT/SLH therapy and nonpharmacologic interventions that can be done without any orders. The EMR will be audited to observe any changes in LOS, LOT, or adjunct medication requirements. These audits will be compared with the ones completed prior to the implementation of the hospital protocol. However, these initial statistical results will likely not show the degree of change in behavior until the protocol has been adopted for at least six months. It will be important to receive feedback from nurses, charge nurses, nurse managers, teachers of the in-person course, providers, IT support, and any other assistive staff on any problems or unexpected observations that were made (Institute of Healthcare Improvement, 2017). The committee will reconvene to discuss the initial outcomes of the implementation focusing on the degree of behavior change from staff, what problems arose, and how they can be fixed for continued implementation.

### **Summary**

The implementation process for best practice recommendations to improve the use of evidenced-based interventions for the treatment of NAS was developed from research on the effectiveness of hospital protocols and the PDSA cycle for improvement. Utilizing a hospital protocol, educational training, and EMR integration that is geared towards promoting the use of more nonpharmacologic interventions and accurate NAS scoring by nurses ensures that the target audience, nurses caring for infants with NAS, can receive the information in a clear, concise, and informative manner. The PDSA cycle for improvement is a model that adapts the scientific

method and applies it to a health care environment utilizing action-oriented learning (Institute for Healthcare Improvement, 2017). The ‘plan’ and ‘do’ steps of the PDSA cycle were covered earlier in this chapter. In the next section, the ‘study’ and ‘act’ stages of the PDSA cycle will be discussed, focusing on the evaluation of the implementation of the NAS best-practices hospital protocol.

### **Evaluation**

The ‘study’ and ‘act’ stages of the PDSA cycle are the final portions that will be discussed with respect to the integration of this best-practices thesis into practice. The ‘study’ stage of the PDSA cycle is when most of the collected data is studied and analyzed. The data will be compared to the predictions made in the planning stage and the creators of the intervention will reflect on what has been learned about the intervention and its implementation (Institute for Healthcare Improvement, 2017). The ‘act’ stage is when the intervention is modified based on what was learned. The next step is to start planning for another PDSA cycle with the refinements made (Institute for Healthcare Improvement, 2017).

**Study.** During the ‘study’ stage, the committee members will gather all the data from the nursing pre- and post-testing, health care providers’ three-month survey responses, and all EMR auditing data from before and after the implementation of the hospital protocol. The leaders of the committee will analyze the data in depth focusing on what was predicted to be effective, but was not, and vice versa. This will allow for learning based on what was useful to those who took the educational course, started utilizing a new area of the EMR, and provided new and more integrative nonpharmacologic care.

A complete data analysis of the EMR audits will be performed at three months, six months, and one year after implementation. The analysis will focus on the core objective of

decreasing LOS, LOT, and the need for adjunct medication. If there has been no change or a decrease in LOS and LOT at the six-month mark, the protocol will be maintained as initially written and it will be reassessed six months later at the one-year mark. However, if there was an increase in LOS or LOT or there was significant negative feedback from nurses or providers at the six-month mark, necessary changes would need to be implemented prior to the one-year mark. The committee members will meet with the IT department to determine what technological issues were the most common to guide in adjusting the EMR for future use. The final step of the ‘study’ section is to create a summary of what was learned from the data analysis and to reflect on what was learned through the initial implementation of the evidence-based NAS hospital protocol (Institute for Healthcare Improvement, 2017).

**Act.** The last stage of the PDSA cycle is the ‘act’ stage. During this stage any necessary changes are made to the hospital protocol and the adjoining educational procedures and EMR integration based on what was learned during the ‘study’ stage (Institute for Healthcare Improvement, 2017). Items that may be discussed are increasing or decreasing the length of the in-person educational course, the frequency of pop-up task suggestions in the EMR, or the amount of training that occurred prior to the full integration of the protocol. This final stage is when conclusions are drawn about the successes and drawbacks of the entire PDSA cycle, specifically identifying if the overall objective was met: did the intervention decrease LOS and LOT for infants with NAS (Institute for Healthcare Improvement, 2017)? Based on these conclusions, future PDSA cycles may be initiated to refine the intervention and implementation in this facility, or to start planning the protocol’s implementation in other hospitals or health systems.

### **Strengths and Limitations of Thesis Project**

The primary strength of this best practice recommendation thesis is that it included an in-depth and broad review of literature that resulted in an immense number of possible nonpharmacologic interventions that can be used to help to provide more supportive, integrative, and shorter stays in the hospital for infants suffering with NAS. This thesis incorporates many interventions, some of which are commonly practiced, and others that are newer to even those who work in the neonatal nursing field. The vast amount of research that was found during the literature review provides hope for more evidence-based care of infants with NAS in the future, providing them with shorter LOS and LOT in the hospital, which reduces the likelihood for hospital-acquired complications. The theoretical implementation of the hospital protocol, educational guidelines, and EMR integration encompasses many aspects of a realistic intervention that can not only be utilized by larger and more advanced medical centers, but also by smaller and more rural facilities with adjustments to the intervention. This protocol has the ability to provide standardization of care for infants with NAS within a single facility, or even across the country with active support from national governing bodies. The improved education and implementation of evidence-based interventions increases the knowledge base of healthcare providers, which can in turn improve the outcomes of infants with NAS.

This thesis project is limited by the level of evidence of the research that is available; due to the nature of the topic, randomized control trials are rare to come by. This means that much of the evidence supporting interventions is not as reputable or generalizable. Another limitation to this thesis is the fact that maternal maintenance programs are becoming more common due to the opioid crisis, but research studying the best pharmacologic treatments after birth are lagging and are not necessarily aligned with the newer practice of drug maintenance during pregnancy.

Furthermore, the proposed hospital protocol, educational support, and EMR integration would likely be a costly and lengthy process that may prove challenging when trying to propose it for funding as well as when the committee is trying to promote interdisciplinary teamwork.

### Summary

The purpose of this thesis was to develop best nursing practice recommendations to better provide evidence-based interventions to infants with NAS in order to improve their health outcomes. Current research indicated a large increase in infants diagnosed and treated pharmacologically for NAS in the past few decades due to the national opioid crisis. Although there is significant evidence showing a quiet and dark environment is best for infants with NAS, there appears to be a lag in adoption of these practices within hospitals; many infants are still treated in the NICU, instead of in the direct care of the mother in a private room. The most recent evidence-based research has supported the use of more nonpharmacologic interventions in order to decrease the need for pharmacologic treatment. Some of these nonpharmacologic interventions include: a dark and quiet environment with limited handling and stimulation, swaddling, aromatherapy, non-nutritive sucking, more frequent and smaller feeds, breastfeeding, laser acupuncture, vibrotactile stimulation, reiki, kangaroo care, and rooming in. If these interventions are not successful in subduing withdrawal symptoms, pharmacologic therapy may be necessary. Research has shown that methadone is superior to oral morphine. However, a newer drug that is still undergoing further testing, buprenorphine, has shown promising results at providing shorter LOS and LOT than both methadone and morphine. One key takeaway is that nurses require further education on maternal maintenance programs as well as NAS in order to provide more culturally competent and sensitive care.

Current literature supports the implementation of the hospital protocol, educational training, and EMR integration in order to increase awareness and implementation of evidence-based interventions in the treatment of NAS. This intervention can be implemented and evaluated through the PDSA cycle framework, which provides direct opportunities for feedback

from all parties involved. This creates a positive learning environment that allows for changes to be made to the intervention to improve it within a facility or expand it to other hospitals too.

Overall, implementation of this hospital protocol, which encompasses the best nursing practices for the treatment of NAS, will better prepare and support health care providers in the delivery of the evidence-based interventions that can offer better health outcomes for the infants, their mothers, and society.

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Appendix A

Modified Finnegan Neonatal Abstinence Score Sheet <sup>1</sup>												
System	Signs and Symptoms	Score	AM				PM				Comments	
Central Nervous System Disturbances	Excessive high-pitched (or other) cry < 5 mins	2										
	Continuous high-pitched (or other) cry > 5 mins	3										
	Sleeps < 1 hour after feeding	3										
	Sleeps < 2 hours after feeding	2										
	Sleeps < 3 hours after feeding	1										
	Hyperactive Moro reflex	2										
	Markedly hyperactive Moro reflex	3										
	Mild tremors when disturbed	1										
	Moderate-severe tremors when disturbed	2										
	Mild tremors when undisturbed	3										
	Moderate-severe tremors when undisturbed	4										
	Increased muscle tone	1										
	Excoriation (chin, knees, elbow, toes, nose)	1										
	Myoclonic jerks (twitching/jerking of limbs)	3										
Generalised convulsions	5											
Metabolic/ Vasomotor/ Respiratory Disturbances	Sweating	1										
	Hyperthermia 37.2-38.3C	1										
	Hyperthermia > 38.4C	2										
	Frequent yawning (> 3-4 times/ scoring interval)	1										
	Mottling	1										
	Nasal stuffiness	1										
	Sneezing (> 3-4 times/scoring interval)	1										
	Nasal flaring	2										
	Respiratory rate > 60/min	1										
	Respiratory rate > 60/min with retractions	2										
Gastrointestinal Disturbances	Excessive sucking	1										
	Poor feeding (infrequent/uncoordinated suck)	2										
	Regurgitation (≥ 2 times during/post feeding)	2										
	Projectile vomiting	3										
	Loose stools (curds/seedy appearance)	2										
	Watery stools (water ring on nappy around stool)	3										
	<b>Total Score</b>											
	<b>Date/Time</b>											
<b>Initials of Scorer</b>												

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