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Neonatal Abstinence Syndrome (NAS) in Neonatal Intensive Care: Breastfeeding May Be Beneficial for Decreasing NAS Severity for Infants

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NEONATAL ABSTINENCE SYNDROME (NAS) IN NEONATAL INTENSIVE CARE: BREASTFEEDING MAY BE BENEFICAL FOR DECREASING NAS SEVERITY FOR INFANTS

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I dedicate this project to infants with NAS and their families.

Abstract

Background: Neonatal abstinence syndrome (NAS) is defined as hyperactivity of the central and autonomic nervous symptoms in infants from intrauterine exposure to drugs of addiction. There is variability in how NAS is managed in the neonatal intensive care unit (NICU) for infants with NAS, more research should be conducted to discover how breastfeeding may benefit NAS infants in the NICU.

Purpose: The purpose of this critical review of the literature is to determine whether neonatal abstinence symptoms of infants diagnosed with neonatal abstinence syndrome (NAS) in the neonatal intensive care (NICU) differed if they were breastfed.

Results: Using Meleis's Transition Theory as the theoretical framework, 15 studies were reviewed and analyzed. The central concept of transitions closely aligns with the experiences of opioid-dependent women and their NAS infants in various types of transitions. The literature reveals that there are statistically significantly differences between formula-fed and breastfed infants in relation to the NAS scores done, length of hospital stay, and initiation of pharmacological treatment for NAS.

Conclusion: The evidence from the research shows that breastfeeding may decrease NAS symptoms among infants in the NICU.

Implications for Research and Practice: Further research is needed to examine tailored breastfeeding support for the substance-exposed mother and baby in randomized controlled trials to evaluate clinical benefits for breastfed infants. In the absence of breastfeeding contraindications, mothers should be encouraged and supported to breastfeed their infants by the nurses who care for them.

Key Words: Opioids, Finnegan Score, Transitions

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Chapter One: Introduction

Breastfeeding is associated with many health benefits both for the mother and infant. The World Health Organization (WHO) recommends infants should be exclusively breastfed for the first six months of life to achieve optimum health and development (WHO, n.d.). Breastfeeding also contributes to the health of the mother by decreasing the risk of breast cancer and ovarian cancer (WHO, n.d.). However, in some rare circumstances breastfeeding is contraindicated in the United States (i.e. human immunodeficiency virus (HIV) infection). Previously, breastfeeding was discouraged for opioid-dependent women due to the concern that breast milk may lead to neonatal sedation and other adverse consequences (Wachmann, Byun, & Philipp, 2010). The Academy of Breastfeeding Medicine (ABM) strongly recommends breastfeeding for mothers of infants with neonatal abstinence syndrome (NAS) (Reece-Stremtan, Marinelli, & ABM, 2015). A research study conducted by Jansson et al. (2007) demonstrated that concentrations of methadone in breast milk were small in infants breastfed by mothers on methadone maintenance therapy. Ideally, opioid dependent women in pregnancy are receiving comprehensive health care and are in a continuous methadone treatment during pregnancy (Reece-Stremtan, Marinelli, & ABM, 2015).

Extent of the Problem

Neonatal abstinence syndrome is a public health problem. In the United States within the last decade, the incidence of infants born with NAS has increased due to an increase in opioid use during pregnancy (Tolia et al., 2015). The incidence of NAS nearly doubled nationally from 3.4% to 5.8% per 1000 hospital births between 2009 and 2012 (Patrick, Davis, Lehman, & Cooper, 2015). NAS is withdrawal symptoms an infant may experience if the mother abused opioids during pregnancy.

NAS is a broad array of neurological, respiratory, and developmental symptoms that an infant diagnosed with NAS displays that result from withdrawal due to a sudden cessation of illegal drugs following birth (Wu & Carre, 2018). Infants born with NAS results in more costly, longer, and complicated hospital stays compared with other hospital births (Patrick et al., 2015). An infant born with NAS is commonly admitted to a neonatal intensive care/pediatric unit for specialized care. A study conducted by Patrick et al., (2015) found "infants with NAS had an overall mean length of stay (LOS) of 16 days and those requiring pharmacological treatment had a mean LOS of 23 days" (p. 653). Data from a retrospective review found infants diagnosed with NAS have more complications than hospital births, including feeding difficulties, respiratory distress syndrome, transient tachypnea of the newborn, meconium aspiration, low birth weight, jaundice, seizures, and possible sepsis (Patrick et al., 2015).

Need for Critical Review

Infants admitted to NICUs with NAS utilize a large amount of resources (Tolia et al., 2015). Tolia et al. (2015) found among 674,845 infants admitted to NICUs, from 2004 through 2013, there were 10,327 admitted with NAS. In addition, from 2004 through 2013 NAS increased from 0.6% to 4.0% of the total percentage of NICU days nationwide that was attributed to the care of these infants (Tolia et al., 2015). According to Tolia et al. (2015) it is important for NICUs to understand "clinical treatment of these infants is critical for defining research priorities and aiding in the design of public health programs to improve health care delivery for the infants and their mothers" (p. 2119). In addition, to the increases in the health burden of infants with NAS, it also has an emotional cost to the maternal-infant dyad. When infants are admitted to NICUs for NAS assessment and care it affects maternal infant bonding.

As the incidence of NAS increases, it is important to examine nonpharmacological strategies to improve neonatal outcomes, such as swaddling, quiet environment, frequent feeding, and a decrease in environmental lighting. However, pharmacological intervention is recommended if supportive therapy fails and in cases of severe withdrawal. Wu and Carre (2018) recommended breastfeeding should be used as a first-line intervention for the early management of NAS. In addition, emotional and physical bonding occurs between the mother and the breastfeeding infant when they are together and mothering skills are enhanced (Abrahams et al., 2007).

This literature review investigated if breastfeeding among infants with NAS in NICUs can provide an effective nonpharmacological method for decreasing NAS symptoms for infants. The goal of breastfeeding among opioid-exposed infants in NICUs might be a delayed onset of NAS (Abrahams et al., 2007). Drug-exposed infants are at risk for multiple health and developmental issues that may stand to benefit substantially from breastfeeding and human milk (Reece-Stremtan, Marinelli, & ABM, 2015).

Research Question

Breastfeeding an infant exhibiting NAS symptoms can be challenging for mothers with a history of drug abuse while pregnant. The infant who is experiencing withdrawal symptoms is excessively irritable and difficult to soothe, and this may interfere with breastfeeding rate and duration. The research question to be addressed in this review: among infants in the NICU with NAS is there a difference between the neonatal abstinence symptoms who are breastfed and those who are not breastfed?

Theoretical Framework

The nursing phenomena of changes in health and illness of human beings' can be examined through Afaf Meleis's (2010) Transition Theory (TT). The opioid dependent mother and her newborn exhibiting multiple NAS symptoms will be in various types of transitions. According to Meleis (2010) transitions types are complex processes and may overlap or occur simultaneously. For example, an opioid dependent mother who has given birth is going through a developmental transition and also going through a health and illness transition due to the goal of breastfeeding her newborn with NAS. Human beings' sometimes go through transitions easily and successfully, but often they have difficulty due to the disequilibrium caused by changes (Meleis, 2010). TT will be used to implement the recommendations of the findings in this review of the literature. The concepts from TT will be a useful basis for nurses to assess and support healthy transitions for this unique mother-infant dyad.

The major concepts of this theoretical framework by Meleis, Sawyer, Im, Messias, & Schumacher (2000) include the following: "types and patterns of transitions, properties of transitions experience, transition conditions (facilitators and inhibitors), patterns of response (process indicators and outcome indicators), and nursing therapeutics" (p. 16). Nursing therapeutics include assessment of readiness, preparation of transition, and role supplementation (Schumacher & Meleis, 1994). Nursing therapeutics are nursing interventions that nurses may utilize to support a healthy transition, which include nursing education and practice to facilitate healthy outcome behaviors (McEwen & Wills, 2014). The major concept of nursing therapeutics and areas for intervention refers to educating the mothers on breastfeeding to produce the best condition for enabling transitions (Schumacher & Meleis, 1994).

Meleis's theory is widely used as a model to identify a large spectrum of life transitions. In addition, the theory is often used in nursing research for situation-specific types of transitions, nursing education, and nursing practice (Im, 2018). In this literature review, there was no situation-specific transitions of breastfeeding and NAS studies identified based on the middle range TT. However, there has been an increasing number of situation-specific theories that have been derived from the TT (Im, 2018). Furthermore, Meleis (2010) supports the claim that transitions are central to the mission of nursing.

Significance to Nursing

Nurses are concerned with providing care for their patients experiencing transitions. Meleis's theory (2010) provides a framework for nurses to provide interventions to enable transitions to promote well-being and mastery of the changes that result from the transitions. Nurses can facilitate well-being by assessing for process indicators that move patients in the direction of health or toward vulnerability and risk (Meleis et al., 2000). For example, patients negotiating successful transitions is dependent on the development of an effective relationship between the nurse and the patient (Meleis, 2010). Nursing is concerned with patients feeling connected, interacting, being situated, and developing confidence and coping while experiencing transitions (Meleis et al., 2000). Outcome indicators can be used by nurses to assess if a transition is healthy or not. For example, nurses can assess patients demonstrating new skills and behaviors needed to manage their new situation or environments (Meleis et al., 2000).

Nurses play an important role educating and promoting all breastfeeding efforts and assessment of the infant for symptoms of withdrawal. Nurses are obligated to promote all breastfeeding efforts as determined by current evidenced-based practice guidelines (Busch & Flagg, 2018). Nurses utilize the Finnegan scoring system as a tool for the assessment of NAS to

monitor the severity of the symptoms. However, breastfeeding an infant with NAS symptoms may be more difficult and nurses can provide reassurance that breastfeeding can still be achievable in spite of the obstacles and that it is the best option for mother and baby. In addition, nurses can guide the mother with nonpharmacological strategies to empower mothers to continue breastfeeding such as rooming in and skin to skin contact. With the increase of infants born to mothers with opioid dependency, and subsequent increase of infants born with NAS, it is important to understand the needs of the unique mother-infant dyad and to provide strategies to support breastfeeding as an early intervention for NAS.

Summary

In this chapter, the health benefits of breastfeeding were introduced and the promotion of breastfeeding for the mother who desires to breastfeed her infant was discussed. In addition, NAS was introduced and discussed as well as the management of NAS in NICUs. Finally, Transitions Theory was introduced, and the concepts of this theoretical framework were discussed. Substance abuse mothers and their infants with NAS will benefit from nurses who apply the key concepts of the TT to support them during these transitions.

Chapter Two: Methods

The purpose of this chapter is to describe the concepts used to identify and appraise a review of the literature relating to the impact of breastfeeding on NAS symptoms among infants diagnosed with NAS in NICUs. This chapter will begin with definitions of major concepts, the search strategy used to identify scientific materials, inclusion and exclusion criteria, and criteria for evaluating the research studies.

Definitions

For the purpose of this project, major concepts used throughout this literature review are defined as the following:

Opioids.

> The term opioid refers to natural and synthetic substances with morphine-like activities that activate mu-opioid receptors in the central nervous system and gastrointestinal tract. Opiate refers to a subclass of opioids consisting of alkaloid compounds extracted or derived from opium that include morphine, codeine, and semisynthetic derivatives such as heroin, methadone, fentanyl, hydromorphone, and buprenorphine (Jansson, 2018, p. 1).

Finnegan Score. The Finnegan score is an assessment tool used by nurses to assess twenty-one symptoms that are most commonly observed in opiate-exposed infants. The diagnostic tool is divided into three systems to assess central nervous disturbances, metabolic, vasomotor, and respiratory disturbances, and gastrointestinal disturbances. The scoring interval is every four hours after birth (Jansson, Velez, & Harrow, 2009).

Transitions. Meleis (2010) defined transitions as "a passage from one fairly stable to another fairly stable state, and it is a process triggered by a change" (p. 11).

Search Strategy

A critical review of the literature began with conducting a search in PubMed Medline, CINHAHL, CINHAHL Plus, Google Scholar, UpToDate, Science Direct, and Cochrane Database of Systematic Reviews. Search words included a combination of the following terms in the databases including neonatal abstinence syndrome, drug withdrawal, lactation, breastfeeding, opioid, and methadone. The abstract section of the studies were reviewed for the highest level of evidence and relevance to the research question. This search resulted in eleven relevant studies from 2006 to 2018.

Inclusion/Exclusion Criteria

The articles selected for this review of the literature were included based on the purpose of the studies, design, and the research methodology. The purpose of the majority of the studies included in this review were opioid dependent women who chose to breastfeed and the effect on neonatal outcomes, whether results determined length of hospital stay for NAS, or if breastfeeding effected NAS symptoms. The design of the studies included in this review were selected based on applicability to the research question. Exclusion criteria were studies that had a narrow focus, such as those that did not look at the impact of breastfeeding on the severity of NAS and health outcomes, and if the studies were not about abuse of illicit drugs in pregnant mothers. Lastly, literature was excluded if they were published prior to 2002.

Evaluation Criteria

Johns Hopkins Nursing Evidence-Based Practice: Model and Guidelines by Dang and Dearholt (2018) was used to determine evidence levels. Each article was critically appraised for the quality of evidence and to determine if the results were clinically significant using the

individual appraisal tool for research and non-research evidence. Both level of evidence and quality of evidence for each article were placed in Table 1.

Studies Selected for Review

After each article was systematically appraised using the Johns Hopkins Research Evidence Appraisal Tools, a total of fifteen articles were selected for review. All fifteen articles were Level III studies. Ten articles were appraised with good quality and one article was low quality. No randomized studies of promoting breastfeeding were found; only a case series, retrospective studies, one prospective, and a single time-dimensional design.

Summary

This chapter included the discussion of conducting a systematic review of the literature, including a description of the search strategies using key words, journal articles chosen for inclusion and exclusion criteria, and the number and types of studies selected for review. In addition, the articles were appraised to identify the evidence level and quality level of each article using the tools from the Johns Hopkins Research Evidence Appraisal Tools.

Chapter 3: Literature Review and Analysis

The objective of this critical literature review is to determine if breastfeeding NAS infants improve NAS outcomes (e.g. length of hospitalization). A synthesis of the major findings of the literature is presented in this chapter and is organized by the level of evidence. Also, a critique of the strengths and weaknesses of the most salient studies is provided. The literature review was organized by using the Matrix Method by Garrard (2017).

Major Findings

NAS infants that receive supportive care of breastfeeding have improved health outcomes (MacVicar, Humphrey, & Forbes-McKay, 2017). Despite promoting breastfeeding for methadone-exposed infants, barriers exist that prevent mothers from breastfeeding, including lack of consistency from health care providers, unclear guidelines, feeding problems due to methadone exposure, and separation of mothers and infants due to hospitalization (McQueen et al., 2011). Controversy exists among the mothers themselves regarding breastfeeding and methadone treatment such as low self-esteem, lack of knowledge, or feelings of quilt (McQueen et al., 2011). A case series study by O'Connor et al. (2009) indicated opioid-dependent mothers is a vulnerable population, and who have a history of low breastfeeding rates while maintained on assisted-opioid therapy. O'Connor et al. (2009) indicated factors contributing to the higher rates of breastfeeding in the case series was the less stringent eligibility criteria, including a unique geographic location, and the medical and behavioral model of care provided. Breastfeeding rates are below the national average among NAS infants due to the higher rates of NICU admission and the physical symptoms for NAS infants, which could make breastfeeding difficult (Short, Gannon, & Abatemarco, 2016).

Short, Gannon, & Abatemarco (2016) indicated "designing and implementing targeted breastfeeding promotion activities to increase the overall breastfeeding rate among women at risk" for having an NAS infant is valuable (p. 347.) Health care providers need to provide appropriate education and support in a caring environment to women who are breastfeeding while on opioid substitution therapy (OST) and their NAS infants (McQueen, Taylor, & Murphy-Oikonen, 2019).

Level I evidence. There is only one investigation as identified as Level 1 evidence of good quality. The mixed-methods feasibility study conducted by MacVicar, Humphrey, & Forbes-McKay (2018), included a randomized control trial (RCT) and maternal questionnaire. The study evaluated substance-exposed mother and baby who either received standard Baby-Friendly Initiative care or tailored breastfeeding support for five days. The results of this RCT and questionnaire, good quality investigation found that the integrated support including breastfeeding advice, promotion of maternal self-efficacy, and neonatal self-consolation techniques within a low-stimuli environment endorse the promotion and support for this group (MacVicar, Humphrey, & Forbes-McKay, 2018). The study findings displayed a milder course of neonatal withdrawal for breastfed infants by incorporating breastfeeding, a supportive environment, and through encouragement that fostered maternal capacity building (MacVicar, Humphrey, & Forbes-McKay, 2018).

Level III evidence. There are fourteen articles in this level, thirteen of good quality and one of low quality. Five articles were related to methadone maintenance therapy in pregnancy and effect on neonatal outcomes. One good quality article reported neonates with prenatal exposure to buprenorphine maintenance therapy (BMT) spent less days in the hospital for treatment of NAS than infants with prenatal exposure to methadone maintenance therapy (MMT)

(Pritham, Paul, & Hayes, 2012). This investigation found that breastfed neonates than formula-fed neonates or neonates who received breast milk and formula had a shorter hospitalization (Pritham, Paul, & Hayes, 2012).

One article reported an investigation that examined the effect of different feeding modalities on the onset of NAS in the first two days. This investigation explored three feeding categories, predominantly breastfed, expressed breast milk fed, or formula fed, and then analyzed the onset of NAS using the Finnegan objective scoring system (Liu, Juarez, Nair, & Nanan, 2015). Results indicated the feeding modality did not significantly impact the possibility of developing NAS. The study concluded neonates exposed to methadone in utero have the similar possibility of developing NAS compared to formula fed infants, and have a delayed onset (Liu, Juarez, Nair, & Nanan, 2015).

In 2006, Abdel-Latif et al. examined the relationship of the effects of breast milk feeding on the severity of NAS in infants of drug-dependent women. This investigation explored two categories of the predominant type of milk consumed on the fifth day of life and classified either the formula fed group or the breast milk group. The study concluded that infants fed predominantly breast milk had a reduced mean NAS scores, delayed onset of withdrawal, a decreased need for drug therapy, and shorter length of stay than formula-fed infants (Abdel et al., 2006).

Short, Gannon, and Abatemarco (2016) study examined the association between breastfeeding and infant length of hospitalization among NAS infants. Infant and maternal characteristics were compared by breastfeeding status in this good quality investigation. Considerable differences in infant and maternal characteristics were found between breastfed infants and those infants who were not breastfed. The researchers found the infants who were

breastfed were significantly more likely to have a normal birth weight and born full term than infants who were not breastfed. The article reported infants who were breastfed were likely to have mothers who were married, had a greater than a high school education, and had prenatal care than infants who were not breastfed (Short, Gannon, & Abatemarco, 2016). The authors concluded that NAS infants who were breastfed have a significantly shorter length of hospital stay than nonbreastfed infants, even with significant differences in infant and maternal characteristics (Short, Gannon, & Abatemarco, 2016).

One retrospective chart review is categorized as low quality and is focused on infants born with a diagnosis of NAS. This six-year investigation was to determine breastfeeding rates among drug-dependent women giving birth at Boston Medical Center, a Baby-Friendly Hospital. The authors determined the following eligibility criteria: breastfeeding, breastfeeding initiation, and continuation rates. The researchers concluded the rates among the drug-dependent women were low, a variety of reasons why three-quarters of those eligible chose not to breastfeed. Of the small number who did choose to breastfeed, over fifty percent stopped within seven days (Wachman, Byun, & Philipp, 2010).

Strengths and Weakness of the Research Studies

All of the articles included in the matrix are of good or low quality according to the Johns Hopkins Nursing Guidelines Evidence-Based Practice: Model and Guidelines which is "used to appraise both individual quality and overall quality of evidence" (Dang & Dearholt, p. 303, 2018). The majority of the studies evaluated whether nonpharmacological interventions, particularly breastfeeding rates, and infant feeding method, reduces the severity of NAS among infants of drug-dependent mothers. These studies provide some evidence that may guide

practice recommendations based on the synthesis of the findings and to make recommendations on what further research is needed.

The weakness of the reviewed study by McQueen, Murphy-Oikonen, Gerlach, & Montelpare (2011) included limited generalizability. First, group allocation was divided by self-selected feeding method, which limited the ability to control for confounding variables. McQueen et al., (2011) identified other likely confounding variables, including maternal education, socioeconomic status, and culture were not assessed, as these statistics were not documented in the hospital records. Therefore, carefulness must be taken in inferring causality of the research results. Second, the researchers had a small group size of twenty-eight term infants that were exposed to methadone in utero (McQueen et al., 2011). A large sample size was found in Level III evidence in Abdel-Latif et al. (2006), where one hundred and ninety infants of drug-dependent mothers comparison outcomes were studied. Small group sizes in this matrix have been identified as a common feature regarding breastfeeding and methadone maintenance (McQueen et al., 2011).

A major strength of Short, Gannon, and Abatemarco (2016) study is the use of a large, population database from in-hospital births for a three-year period to examine NAS of three thousand seven hundred and twenty-five neonates. Another strength the authors reported is the use of a standardized data collection tool and discharge diagnosis codes to identify NAS infants, which will allow for validation of the research findings (Short, Gannon, & Abatemarco, 2016).

Similar generalizability of the findings from previous studies outside of the United States have been reported for an inverse relationship between breastfeeding and length of hospital stay. In London, Abdel et al. (2006) conducted a study among one hundred and ninety infants born to drug-dependent women found breast milk reduced the NAS symptoms and decreased the length

of hospital stay. Welle-Strand, Skurtveit, and Jansson (2013) found duration of NAS was shorter for one hundred and twenty-four breastfed than nonbreastfed infants in Norway.

A weakness may exist of the reviewed studies included instrument bias. Hospital nurses need to be trained in utilizing the Modified Finnegan Scoring Tool according to the hospital's policy to assess for neonatal withdrawal. Interrater reliability and validity of the Modified Finnegan Scoring Tool has not been verified (McQueen et al., 2011). One limitation identified by Isemann, Meinzen, and Akini (2011) in the use of the Finnegan Scoring Tool is it is designed for term infants and is a subjective assessment.

An additional weakness of several studies in this review is the voluntary maternal disclosure as the eligibility criteria of drug use. Self-reporting of maternal drug use makes these studies vulnerable to trustworthiness in reporting (McQueen et al., 2011).

A strength of MacVicar, Humphrey, and Forbes (2018) was the research design, which included an RCT and maternal questionnaire. The intervention group received tailored breastfeeding support. The authors concluded the intervention participants reported breastfed infants were less likely to need pharmacotherapy for neonatal withdrawal and had a shorter length of hospital stay (MacVicar, Humphrey, & Forbes, 2018). None of these studies included in this review, used an RCT emphasizing the need for robust evaluation of infant feeding and the substance-use of the mother.

Summary

As illustrated by the evidence, breastfeeding infants with NAS may be the best practice for nonpharmacological management to improve neonatal outcomes. The major weaknesses were the small sample sizes in several studies. In addition, assessing for NAS utilizing the Modified Finnegan Assessment Tool without proper tool instruction among drug-exposed infants

and existing guidelines varies among hospitals. In the studies included in this systematic review, the infant-mother dyad may benefit most from breastfeeding, and this may assure the best care for NAS infants.

Chapter 4: Discussion, Implications, and Conclusions

This critical review of the literature demonstrated that breastfeeding may offer enhanced benefits for drug-exposed infants experiencing NAS. This chapter includes a synthesis of the literature that encourages breastfeeding management and the potential to improve health outcomes for NAS infants. Trends and gaps in the literature are discussed, including nursing practice implications and recommendations where future research is needed. Lastly, Meleis's Transition Theory is applied to the practice question.

Answer to Practice Question

The research question that guided this appraisal is as follows: among infants in the NICU with NAS is there a difference between the neonatal abstinence symptoms who are breastfed and those who are not breastfed? This appraisal was important because neonates who are exposed to opioids in utero experience NAS symptoms. In addition, neonates with NAS symptoms may spend more days in the hospital for treatment of NAS, including pharmacological treatment and drawing heavily on health care resources (Dryden, Young, Hepburn, & Mactier, 2009). Severity of NAS may be mitigated by encouraging mother's breast milk feedings as the neonate's primary nutrition (Isemann, Meinzen-Derr, & Akinbi, 2010).

Outcome measurement of NAS were NAS scores using the objective Modified Finnegan Scoring Tool. The tool is widely used according to the hospital's protocol; however, validity and reliability for the Modified Finnegan Scoring Tool are lacking (McQueen, Murphy-Oikonen, Gerlach, & Montelpare, 2011). Majority of the studies in this review have reported the use of the Modified Finnegan Scoring Tool to guide treatment (Abdel-Latif et al, 2006; Isemann, Meinzen-

Derr, & Akinbi, 2011; Lui, Juarez, Nair, & Nanan, 2015; Jansson et al., 2008; O'Connor, Collett, Alto, & O'Brien, 2013; Welle-Strand et al., 2013; Ordean et al., 2015).

Most investigations included in this review suggest opioid-dependent women in methadone maintenance programs should be encouraged and supported to breastfeed their infants with NAS. For example, McQueen et al. (2011) found infants who predominantly breastfed had significantly fewer NAS scores recorded, and the breastfed group had a lower mean number of recorded NAS scores. Overall, this demonstrated the breastfed group had a decreased severity and duration of NAS symptoms when compared with the combination and formula-fed groups.

Trends and Gaps in the Literature

Trends.

All investigations characterized NAS as a group of symptoms observed in infants experiencing withdrawal from intrauterine exposure to drugs and found breastfeeding may have a positive impact on infants. A major trend discovered in the literature are the strategies to optimize therapy for opioid-dependent women to lessen NAS and to improve neonatal outcomes. Pritham et al. (2012) indicated the standards of care for opioid-dependent pregnant women have been treated with methadone maintenance therapy (MMT) or the use of buprenorphine maintenance therapy (BMT). However, the concentrations of methadone and buprenorphine found in breast milk are low; therefore, opioid-dependent women on substance abuse treatment should be encouraged to breastfeed. This is a major strength as it was the purpose of this critical review of the literature. This critical review identified that breastfeeding may be protective for neonates withdrawing from opioids (Pritham et al., 2012).

Infant feeding was negatively related to length of stay. Another trend of the critical review is that infants with prenatal exposure to methadone who were breastfed had a shorter hospitalization than those infants who were formula fed. This is a positive outcome for the relationship of breastfeeding to length of stay for NAS.

Conversations about recommendations to breastfeed should happen early. Abdel-Latif et al. (2006) found that breastfeeding mothers were more likely to have antenatal care, and more capable of calming and soothing an irritable NAS infant and thus reducing the infant's NAS scores. When encouragement of breastfeeding begins at the appropriate time, whether during the prenatal or postnatal period, successful breastfeeding is more likely to occur and reduce the severity of NAS.

Tailored breastfeeding support by health care professionals is more effective. When substance-dependent women receive education from a health care professional with tailored instruction in facilitating breastfeeding in the context of neonatal withdrawal, they reported a greater degree of confidence in their breastfeeding ability (MacVicar et al., 2017). Organizations and facilities caring for mothers with infants experiencing NAS should integrate evidence-based strategies from the general literature to promote breastfeeding success (McQueen et al., 2011).

Gaps.

There is limited high-quality evidence indicating how breastfeeding may benefit infants with NAS. Individual studies found data suggesting that breastfeeding may have assisted to lessen NAS symptomatology, including duration and intensity (McQueen et al., 2011). One of the fourteen Level III studies was limited to the study of a sample of methadone-maintained breastfeeding women and a matched group of formula-feeding women (Jansson et al., 2007). The purpose of this study was to explain the "concentrations of methadone in breastmilk among

breastfeeding women and concentrations of methadone in maternal and infant plasma in both groups" (Jansson et al., 2007, p. 106). This is a gap in the critical review based on the small group sizes of a total of sixteen study participants and the limited generalizability regarding breastfeeding and methadone maintenance. McQueen et al. (2011) conducted a study on a small group size of twenty-eight term infants, which affect the generalizability regarding breastfeeding and methadone-maintained women.

Another gap in this research was the level of bias present in a few studies. Jansson et al. (2007) reported a high level of bias in measurements of a few of the infant plasma specimens, and the plasma concentrated values of methadone may be overestimated. In addition, instrument bias may occur as the interrater reliability of the Modified Finnegan Scoring Tool has not been proven. Also, McQueen et al. (2011) and Pritham et al. (2012) identified the possibility of confounding variables such as maternal education, socioeconomic status, history of substance abuse, and culture were not evaluated, and indicating the possibility for inferring causality of the findings.

Implications for Nursing

The literature demonstrated that there are specific interventions to support breastfeeding mothers with infants experiencing NAS from methadone exposure (McQueen et al., 2011). Implications for nurses include the need to provide improved education addressing the benefits of breastfeeding, addressing the barriers, and implementing evidence-based strategies for breastfeeding.

Provide education on the benefits of breastfeeding. This critical review identified mothers should be educated during pregnancy regarding the benefits of breastfeeding for both methadone-exposed infants and mothers on methadone maintenance programs (McQueen et al.,

2011). Nurses need to educate mothers in the prenatal period addressing the benefits of breastfeeding and provide practical advice on how to breastfeed so that women on methadone are encouraged to breastfeed for a longer duration (McQueen et al., 2011).

Understand the barriers to breastfeeding for methadone-maintained mothers. McQueen et al. (2011) indicated a barrier that exists is the inconsistent advice from health care providers in the recommendations regarding methadone and breastfeeding for mothers in methadone maintenance programs. It is important for all health care professionals to be knowledgeable about the American Academy of Pediatrics policy on the recommendation of endorsing methadone for use in breastfeeding, so nurses can provide consistent advice on encouraging breastfeeding in their practice (American Academy of Pediatrics Committee on Drugs, 2001, as cited in McQueen et al., 2011).

Evidence-based strategies to support breastfeeding mothers. Nurses should be knowledgeable about evidence-based strategies from the general breastfeeding studies to promote breastfeeding success such as the *Breastfeeding Best Practice Guideline, Baby-Friendly Hospital Initiative 10 Steps* (Registered Nurses Association of Ontario [RNAO], 2007, as cited in McQueen et al., 2011). Training and skill development for nurses who support breastfeeding are also important to promote breastfeeding success. In addition, nurses can implement evidence-based interventions to promote breastfeeding success including, skin-to-skin contact, practice rooming-in, and provision of additional support from nurses (McQueen et al., 2011).

Recommendations for nursing research.

Nurses need to consider further research on the impact of breastfeeding as to the enhanced benefits it may offer for methadone-exposed infants. The effect of breastfeeding on neonatal abstinence scores is an important issue to explore, and high-quality investigations of

large group sizes so as not to affect the generalizability of the findings. In addition, research is needed to control for potential confounding variables that may affect the findings.

A barrier that puts potential limitations on future studies is the Modified Finnegan Scoring Tool that is used to monitor opiate withdrawal. It is important nurses are skilled in obtaining NAS scores to prevent instrument bias when using the Modified Finnegan Scoring Tool (McQueen et al., 2011).

Lastly, research is needed to understand nurses' perceptions regarding breastfeeding and methadone to deliver quality care for both mothers and infants. Current research has identified barriers to successful breastfeeding rates such as drug-dependent mothers choosing not to breastfeed do so as a result of social prejudice (Dryden et al., 2008). Additional research is needed on understanding nurses' perceptions on maternal methadone use in pregnancy and their infants treated for NAS.

Integration of Theoretical Framework

Meleis's Transitions Theory was the theoretical framework utilized in this literature review because its central concept of transitions closely aligns with the experiences of opioid-dependent women and their NAS infants in various types of transitions. The basic assumption of the Transitions Theory is that nursing should play an essential role in facilitating successful transitions for opioid-dependent women and their NAS infants experiencing changes. Also, all nursing phenomena involve a type of transition such as various developmental transitions, situational, and health-illness transitions (Im, 2014). A transition resulting from an opioid-dependent mother successfully breastfeeding her NAS infant reflect a movement toward a health-illness continuum.

Transitions Theory, a middle range nursing theory, is defined as "a passage from one fairly stable state to another fairly stable state, and it is a process triggered by a change" (Meleis, 2010, p. 10). Meleis (2010) identified four major categories that nurses tend to be engaged in, which are developmental, situational, health-illness, and organizational. Meleis posits that the nurse should be concerned about the "facilitators and "inhibitors" of the transitions the patient is experiencing, and the goal of nursing care is to encourage health outcomes (McEwen & Wills, 2014). When Transitions Theory is applied to tailored breastfeeding support for the opioid-dependent mother and baby, it provides a guide to promote well-being.

This literature reviewed identified challenges exist to achieving improved breastfeeding results for opioid-dependent women because of socioeconomic deprivation and low self-efficacy in breastfeeding ability and an anticipation of failure (McVicar et al., 2017). Also, an infant experiencing withdrawal symptoms when breastfeeding presents a further challenge (McVicar et al., 2017). The framework provided from the Transitions Theory is an opportunity for nurses to use "nursing therapeutics" to address opioid-dependent mothers concerns of breastfeeding their NAS infant. It is important for nurses to integrate the Transitions Theory when supporting breastfeeding, so the opioid-dependent mother is developing confidence breastfeeding her NAS infant.

Summary

This critical review of the literature includes evidence that breastfeeding may decrease NAS symptoms among infants who are breastfed. Also, trends and gaps were identified in the literature as well as nursing implications and future research. As the use and misuse of substances is an ongoing problem in pregnancy, it places the newborn at risk of developing NAS. It is important that nurses provide consistent breastfeeding support to opioid-dependent women,

so that breastfed infants may display less NAS symptoms. Transitions Theory provides a comprehensive approach that helps nurses give attention to the process and consequences of transitions in the opioid-dependent mother and infant (Schumacher & Meleis, 1994).

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Table 1

Quality Rating and Level of Evidence of Articles in this Review

Level of Evidence	Number of Articles	Quality Good	Quality Low
I	1	0	0
II	0	0	0
III	14	14	1
IV	0	0	0

Table 2

Evidence Synthesis Matrix

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
McQueen, K. A., Murphy-Oikonen, J., Gerlach, K., & Montelpare, W. (2011). The impact of infant feeding method on neonatal abstinence scores of methadone-exposed infants. *Advances in neonatal care, 11*(4), 282-290. doi: 10.1098/ANC.0b013e318225a30c **Level of Evidence – III** **Quality of Evidence - Good**	To evaluate whether the feeding methods of infants exposed to methadone in utero had a difference in their neonatal abstinence scores.	28 term infants that were exposed to methadone in utero & exhibited symptoms of neonatal abstinence syndrome (NAS) prior to hospital discharge at a tertiary care center located in Ontario between 3/2007 & 3/2008. The sample was further divided by self-selected infant feeding method including 1) predominately breastfed (n = 8) 2) combination fed (n = 11) or 3) predominantly formula fed (n = 9)	Retrospective chart review	Data extracted by 2 independent researchers from mother's & infant's chart. This included variables: 1) NAS scores 2) NAS treatment 3) Infant feeding method 4) baseline demographic information NAS scores assessed by a Modified Finnegan Scoring Tool by trained nurses & according to the policy.	Mean Finnegan score was lower in predominantly breastfed group (M = 4.9, SD = 2.9) in comparison combination-fed (M = 6.5, SD = 3.7) & formula-fed groups (M = 6.9, SD = 4.2). Breastfed group had a lower magnitude score indicating on average lower severity of symptoms. Area scores for breastfed group (M = 7.7, SD = 3.5), combination (M = 12.4, SD = 4.2), formula-fed (M =11.4, SD = 2.9).	1) In the absence of contradictions, mothers in methadone maintenance programs should be educated, encouraged & supported to breastfeed their infants. 2) Breastfeeding may help decrease severity of NAS, shorter duration of symptoms, & less pharmacologic treatment. 3) Further research regarding breastfeeding among methadone-maintained women. 4) Skill development & education for providers concerning breastfeeding promotion. **Limitations:** 1) Small sample size

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
Pritham, U. A., Paul, J. A., & Hayes, M. J. (2012). Opioid dependency in pregnancy and length of stay for neonatal abstinence syndrome. *Journal Obstetrical Gynecological Neonatal Nursing*, 41, 180-190. doi: 10.1111/j.1552-6909.2011.01330.x **Level of Evidence – III** **Quality of Evidence - Good**	"To examine opioid replacement therapy in pregnancy and effect on neonatal outcomes, including length of hospital stay for neonatal abstinence syndrome (NAS)" (Pritham, Paul, & Hayes, 2012, p. 1).	152 opioid-dependent pregnant women on methadone maintenance therapy (MMT) (*n* = 136) or buprenorphine maintenance therapy (BMT) (*n* = 16) during pregnancy & their neonates. The neonates were born between 1/1/2005 & 12/31/2007. Setting: Labor & delivery unit and neonatal intensive care unit (NICU), Eastern Maine Medical Center (EMMC), Bangor, Maine.	Retrospective chart review, descriptive study	Electronic medical record was queried at EMMC & a list of women on prescribed MMT or BMT when admitted for labor & delivery was generated. A list of neonates diagnosed with NAS was generated. Data collection worksheet as a tool for the nurse researcher to document demographic data mother/ neonate dyad & variables of interest.	Breastfeeding was associated with a decrease rate of infant treatment for withdrawal from prenatal methadone or buprenorphine exposure. Women on MMT who breastfed their neonates shortened their infants' length of stay as compared to formula-fed neonates or neonates who received formula & breast milk.	Opioid-dependent women on MMT or BMT should be encouraged to breastfeed. Breastfeeding may be protective for neonates withdrawing from opioids, this finding might have been statistically significant with a larger sample. **Limitations:** 1) Documentation may be inaccurate 2) Unequal BMT sample 3) Multiple confounding variables not measured

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
Abdel-Latif, M.E., Pinner, J., Clews, S., Cooke, F., Lui, K., & Oei, J. (2006). Effects of breast milk on the severity and outcome of neonatal abstinence syndrome among infants of drug-dependent mothers. *Pediatrics*, 111, 1163-1169. doi: 10.1542/peds.2005-1561 **Level of Evidence – III** **Quality of Evidence – Good**	To "assess the effects of breast milk feeding on the severity of neonatal abstinence syndrome (NAS) in a population of infants of drug-dependent mothers who were at risk of NAS" (Abdel-Latif et al., 2006, p. 1164).	Infants of drug-dependent mothers admitted to a postnatal ward in New South Wales between 1998 & 2004. Infants were categorized according to the predominant type of milk consumed by the infant on the fifth day of life Formula group (n = 105) Breast milk group (n = 85)	Retrospective chart review	190 charts reviewed for maternal & infant data >2 feeds/day of formula during the fifth day were classified as "formula" group whereas others classified as the "breast milk" group Each infant exposed to drugs monitored by the Finnegan scoring system before first feed and was performed before every feed for the duration of admission Sporadic toxicology performed on infant urine & meconium for illicit drug use	1) Mean duration of hospitalization 5 days longer in formula group than breast milk group 2) Mean Finnegan scores for first 9 days of life lower in breast milk infants 3) Median time withdrawal occurred later in breast milk group compared to formula group (10 vs 3 days; $P <$ .001) 4) Breast milk group less pharmacological treatment (52.9% vs 79%, $P <$ .001) 5) Treatment duration 20 days < in breast milk group	1) Mothers advised to continue to breastfeed for a few months or a year. 2) They are taught the possibilities of withdrawal should an abrupt reduction or cessation of breastfeeding or breast milk supply 3) Gradually wean breastfeeding over a week if the mothers chose to stop 4) Unless there are medical contradictions (HIV) to breastfeeding the study suggests that women of all infants at risk of NAS be encouraged to breastfeed. **Limitations:** 1) Self-reporting for drug disclosure 2) Finnegan's scoring system validated only for opiate withdrawal

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
Dryden, C., Young, D., Hepburn, M., & Mactier H. (2009). Maternal methadone use in pregnancy: factors associated with the development of neonatal abstinence syndrome and implications for healthcare resources. *International Journal of Obstetrics and Gynecology*, 111, 665-671. doi: 10.1111/j.1471-0528.2008.02073.x **Level of Evidence – III** **Quality of Evidence - Good**	To "investigate factors associated with the development of neonatal abstinence syndrome (NAS) and to assess the implications for healthcare resources of infants born to drug-misusing women" (Dryden et al., 2009, p. 665).	Drug-misusing women on methadone maintenance therapy (MMT) and their infants (n = 450) from 1/1/2004 to 12/31/2006. The setting was an inner-city maternity hospital providing multidisciplinary care to drug-misusing women located in Glasgow, United Kingdom.	Retrospective cohort study	Case note review. Mothers identified on admission to postnatal ward & information extracted from case notes after discharge. Completeness of data was ensured by cross-checking. NAS managed by protocol and Lipsitz scores. Data were complete for 437 infants & 440 mothers.	Breastfeeding for > = 72 hours significantly reduced the likelihood of NAS treatment (P = 0.013) 11.3% total cohort breastfeeding, at least in part, at discharge	Pregnant drug-misusing women should be encouraged and supported to breastfeed their infants Facilitate rooming-in to encourage breastfeeding A prolonged hospital stay is important to observe for NAS symptoms and also to support breastfeeding **Limitations:** 1) Missing postnatal data could not be located on 7 infants and 4 mothers

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
Isemann, B., Meinzen-Derr, J., & Akinbi, H. (2011). Maternal and neonatal factors impacting response to methadone therapy in infants treated for neonatal abstinence syndrome. *Journal of Perinatology*, 31, 25-29. doi: 10.1038/jp.2010.66 **Level of Evidence – III** **Quality of Evidence - Good**	The aim of this study is to identify maternal and neonatal factors that impact response to methadone therapy for neonatal abstinence syndrome.	Infants (*n* =128) that received pharmacotherapy for opiate withdrawal (one dose of methadone per treatment protocol) in the newborn intensive care unit. The setting is a University Hospital in Cincinnati, Ohio between January 2002 and December 2007.	Retrospective chart review	Medical records for maternal urine drug screens & self-reported history for drugs Infants identified through the pharmacy database that was cross-referenced to the 'electronic medication administration' & nursing flow sheets (for breastmilk intake). Finnegan scoring method	1) No significance noted ingestion of breast milk & initiation of methadone treatment 2) Breast milk feedings associated with shorter median duration of methadone therapy in infants 3) Compared with formula feedings, breast milk feedings shorter length of hospital stay ($P = 0.01$)	The study identified that breast milk feedings are an independent predictor of response to pharmacotherapy for NAS Further studies needed to identify infants for risk for rebound NAS (abrupt cessation of breast milk feedings & rapid weaning) Providers should aim for breast milk as primary nutrition Care plan early in pregnancy emphasizing the benefits of providing breast milk to infants & against weaning **Limitations:** 1) Incomplete data collection 2) Finnegan abstinence scoring method

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
Liu, A., Juarez, J., Nair, A., & Nanan, R. (2015). Feeding modalities and the onset of the neonatal abstinence syndrome. *Frontiers in Pediatrics, 3*(14), 1-4. doi: 10.3389/fped.2015.00014 **Level of Evidence – III** **Quality of Evidence - Good**	To compare the effect of different feeding modalities on onset of neonatal abstinence syndrome (NAS).	Methadone-maintained mother/infant dyads (n = 194) at 2 birthing centers in Western Sydney between 2000 and 2006. Formula group (n = 150) Breast fed group (n = 32) Expressed breast milk (EBM) group (n = 12)	Retrospective chart review	Medical record review. Infants categorized on first 2 days of life as breastfed > = 50%, fed EBM > = 15ml and breastfed <3 times per day, or formula fed > = 50% and EBM < 15ml/day. The feeding categories analyzed by onset of NAS. Finnegan objective scoring system	No significant effect of the modality of feeding on rates of NAS needing treatment (p = 0.11) Breastfeeding delayed the onset of NAS (p = 0.04) Act of breastfeeding in the first 2 days of life had no effect whether an infant needed NAS treatment compared to formula fed or EBM.	This study suggests encouraging breastfeeding for all methadone-maintained women with infants at risk for NAS. Breastfeeding has other benefits associated with the act of breastfeeding that should further encourage breastfeeding to comfort NAS infants.

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
Jansson L. M., Choo, R., Velez, M. L., Schroeder, J. R., Shakleya, D. M., & Huestus, M.A. (2008). Methadone maintenance and breastfeeding in the neonatal period. *Pediatrics*, 106-114. doi: 10.1542/peds.2007-1182 **Level of Evidence – III** **Quality of Evidence - Good**	To evaluate the methadone concentration in plasma & breast milk of breastfeeding women, and to compare outcomes & concentrations of methadone in the plasma in formula-fed infants versus breastfed infants.	8 breastfeeding subjects and 8 formula-fed subjects. The women were in a "comprehensive abuse substance treatment program for pregnant and postpartum drug-dependent women" in Baltimore, MD. (Jansson et al., 2008, p. 107).	Prospective	Methadone confirmed by study staff Plasma samples obtained at times of trough and peak for all women Breastfeeding women submitted paired samples of breast milk daily on days 1, 2, 3, 4, 14 & 30 after birth. Infant plasma specimens on day 14 after birth Neonatal abstinence syndrome scoring & drug treatment per protocol NICU its Neonatal Neurobehavioral Scale assessments by study staff	Formula-fed group required more pharmacological treatment for NAS ($n = 4$, compared to $n = 1$ breastfed) was not significant ($p = 0.28$) No significant group differences in maternal plasma methadone concentrations Significant increase in breast milk methadone concentrations over time for 4 samplings (troughs) No significant associations between infant plasma methadone & breastfeeding	Encourage breastfeeding for methadone-maintained women. According to Jansson et al. (2008) more research is needed to "determine the effects of small amounts of methadone on developing children" among methadone-maintained women who breastfeed their infants for a longer period of time. (p. 113). **Limitations:** 1) Small sample size 2) Researcher reports that some infant plasma dried when frozen during storage, & needed dilution in water, which overestimated methadone levels in the samples

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
O'Connor, A. B., Collett, A., Alto, W. A., & O'Brien, L. M. (2013). Breastfeeding rates and the relationship between breastfeeding and neonatal abstinence syndrome in women-maintained buprenorphine during pregnancy. *Journal of Midwifery & Women's Health, 58* (4), 383-388. doi: 10.1111/jmwh.12009 **Level of Evidence – III** **Quality of Evidence – Good**	1) Describe BF rates of women maintained on buprenorphine in an integrated med & behavioral health program & whether they continued to BF 6-8 wks. postpartum and compared these rates with previously reported data. 2) Determine whether BF is related to duration, severity, & frequency of pharmacologic al Tx for neonatal abstinence syndrome (NAS).	All infants born to opioid-dependent pregnant women in the integrated buprenorphine program between December 2007 and August 2012. 1) Initially identified 88 maternal- infant pairs 2) 3 pairs excluded due to transfer to tertiary-care 3) 20 pairs non-BF	Case study series	Retrospective office and charts reviewed from a maternal-infant opioid Tx program within a family medicine residency 1) Infants observed for NAS in hospital for 5d 2) Finnegan score for NAS by experienced staff 3) Hospital policy for pharmacological Tx for NAS	1) 65 women (76%) BF in hospital, 66% still BF 6-8 wks. postpartum 2) BF may attenuate NAS mean peak 3) NAS score BF lower than non-BF (8.83 vs 9.65) 4) BF less likely to require pharmacological Tx for NAS (15 of 65, or 23.1% vs 6 of 20, 30%) 5) NAS symptoms resolved earlier in the BF cohort (76.1 vs 78.3 hrs.) 6) Results reported not statistically significant ($P > 0.05$) 7) Not possible to distinguish impact of BF from nonpharmacologic al NAS therapies	1) Further research is needed to elucidate the decision making about BF in this vulnerable population 2) Research to study the effect of BF reducing the severity of NAS & the requirement of pharmacological Tx for NAS. 3) Further research with a larger cohort 4) Care model: Integrated Tx program in a single setting may have enhanced BF knowledge and decreased some of the barriers to BF.

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
Welle-Strand, G. K., Skurtveit, S., Jansson, L. M., Bakstad, B., Bjarko, L., & Ravndal, E. (2013). Breastfeeding reduces the need for withdrawal treatment in opioid-exposed infants. *Acta Paediatrica: Nurturing the Child, 102*, (11), 1060-1066. doi: 10.1111/apa.12378 **Level of Evidence – III** **Quality of Evidence –** **Good**	To examine rate and duration of breastfeeding in women in opioid maintenance treatment (OMT), and the effect of breastfeeding (BF) on the incidence and duration of neonatal abstinence syndrome (NAS).	A national cohort of 124 women in Norway treated with either methadone (MMT) or buprenorphine (BMT) during pregnancy, who gave birth between 1999-2009 and their newborns. • 78 neonates exposed to methadone • 46 neonates exposed to buprenorphine • only 1st child woman delivered in OMT included	Non-Experimental research, Time-dimensional designs in 3 study parts 1)1st study part Retrospective (1999-2003) 2) 2nd study part Prospective (2005-2007) 3) 3rd study part Retrospective (2004-2009)	1) Standardized questionnaire based on variables used in international literature on methadone-exposed pregnancies 2) Coordinated health care services for substance use & maintenance on MMT or BMT for high level of control 3) Tx guidelines for MMT & BMT 4) Regular urine screening for illicit drug use/licit drug use (Confirmed by medical records) 5) Finnegan score for NAS 6) Occurrence of NAS whether drug Tx for	1) Rates of BF at 4, 8, 12, 26, 52 weeks of infant age were 58/56%, 53/39%, 46/34%, 21/15%, & 7/5% for women in MMT & BMT 2) Median length of BF 12 weeks MMT & 7 weeks for women in BMT 3) BF neonates of women MMT had ⬇ incidence of NAS than those not BF ($p < 0.05$) 4) ⬇ duration of drug NAS Tx for neonates of women in OMT & MMT who BF compared to those who were not ($p < 0.05$) 5) For BMT exposed neonates, no differences in the incidence of drug Tx needed &	1) Research to study the effect of BF on NAS for neonates of women in BMT 2) The variables in the sample represented the national sample 3) ⬆proportion of BF women is easier to study effect of BF on NAS incidence and duration 4) MMT & BMT making a comparison easier 5) Mothers need education & support of advantages of BF to initiation & duration of BF 6) ⬆Education early in pregnancy, consistent, & continuous from health team

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
		• 1st study part (n=36) • 2nd study part (n=36) • 3rd study part (n= 52)		NAS or not (yes/no) 7) Data collected for the study parts from medical records, personal & telephone interviews.	duration of NAS Tx linked to BF	

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
			Methodology	Instruments		
Short, V. L., Gannon, M., & Abatemarco, D. J. (2016). The association between breastfeeding and length of hospital stay among infants diagnosed with neonatal abstinence syndrome: A population-based study of in-hospital births. *Breastfeeding Medicine, 11*(7), 343-349. doi: 10.1089/bfm.2016.0084 **Level of Evidence – III** **Quality of Evidence – Good**	Population-based study to examine the association between BF & length of hospital stay in a large sample among infants diagnosed with neonatal abstinence syndrome (NAS).	A cohort study of singleton in-hospital births to resident mothers in PA. occurring between 1/1/2012-12/31/2014. 1) restricted to infants with discharge diagnosis code to identify NAS neonates (N = 3,725)	Retrospective study using state-based registry data.	Standardized data collection tool & ICD-9 codes. DC data from in-hospital births linked with corresponding birth certificate data using multiple fields with similar characteristics. 1) Infant & maternal characteristics were compared by BF status & association between BF & infant length of hospital stay 2) 20 matching iterations were performed using variables (gender, race, etc.) only one-to-one matches deemed successful for	1) Less than ½ of all infants with NAS BF @ DC (n = 1,576) or 44.5%. 2) Length of hospital stay was reduced by 9.4% in BF group compared to non-BF group (median length of stay 10 days for BF group) 3) Significant inverse relationship between BF and length of stay (B = 0.085. P = 0.008) 4) Significant differences in infant birth wt., GA, maternal ed., marital status, prenatal care, smoking, insurance status was found by BF status, showing shorter hospitalization for	1) Prospective research into the development & eval of BF interventions targeting infants & their mothers that address other related outcomes (disease severity) 2) Individual, clinical, & hospital environmental determinants can influence BF intention & initiation, so identifying these would be key in planning such interventions 3) Identify determinants in planning other nonpharmacological interventions in NAS infants. 4) BF may be beneficial for NAS infants by shortening length of hospital stay 5) Designing and implementing targeted BF promotion activities to increase BF rate for women at risk for having an infant with NAS

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				the final dataset aggregate 3) Assessment of NAS 4) ICD-9 codes acceptable method for identifying NAS cases 5) Birth certificate - is infant BF? (Yes/No)	BF group. 5) Findings consistent with smaller studies & outside the U.S. 6) Lack of specific data about BF practices	

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
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Wachman, E. M., Byun, J., & Philipp, B. L. (2010). Breastfeeding rates among mothers of infants with neonatal abstinence syndrome. *Breastfeeding Medicine, 5*(4), 159-164. doi: 10.1089/bfm.2009.0079 **Level of Evidence – III** **Quality of Evidence - Low**	Evaluate rates of breastfeeding among women who are opioid-dependent giving birth in a Baby-Friendly Hospital.	All infants born between July 2003 and January 2009 with a diagnosis of neonatal abstinence syndrome (NAS). Mother-infant dyads identified (n = 267). The hospital was Boston Medical Center (BMC) in Boston, MA.	Retrospective chart review	Feeding information & baseline medical information about the mother-infant pairs obtained from the chart review. Breastfeeding eligibility determined by: 1) negative urine toxicology on admission 2) no illicit drug use in 3rd trimester 3) Negative human immuno-deficiency status	68% of mothers were eligible to breastfeed, of those 24% breastfed some during infant's hospital stay. 60% of those who initiated stopped breastfeeding after an average of 5.88 days (SD 6.51) Breastfeeding and continuation rates low.	In July of 2008, BMC created Breastfeeding and Illicit Drug Use Guidelines because of the confusion surrounding breastfeeding in this population. It is important for eligible mothers with drug addiction who are willing to breastfeed receive all possible support. **Limitations:** retrospective chart review; "definite reasons as to why these women chose not to breastfeed and why they stopped breastfeeding were unable to be fully explore" (Wachman, Byun, & Philipp, 2010, p 162).

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
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McQueen, K., Taylor, C., & Murphy-Oikonen, J. (2019). Systematic review of newborn feeding method and outcomes related to neonatal abstinence syndrome. *Journal of Obstetric, Gynecologic, & Neonatal Nursing, 42*(5), 398-526. Retrieved from https:////doi.org/10.1016/j.jogn.2019.03.004 **Level of Evidence – III** **Quality of Evidence – Good**	Combine existing studies on the relationship between newborn feeding methods and neonatal outcomes related to neonatal abstinence syndrome (NAS).	Identified 8 studies by a conducted systematic search of the literature	Following criteria were met by a systematic review: 1) data on outcomes related to feeding method & NAS 2) any quantitative design that compared breastfed & formula-fed newborns with NAS 3) published in English in peer-reviewed journals 4) published from 1990 to February 2018	1) 2 authors independently extracted data from the articles 2) Entered data into an extraction template developed for the systematic review 3) data synthesized narratively	Newborns exposed to methadone: 1) Breastfeeding showed decreased incidence & duration of pharmacological treatment 2) Shorter hospital length of stay 3) Decreased severity of NAS	1) Breastfeeding may lessen poor outcomes related to NAS among newborns exposed to methadone in utero. 2) Women who are stable on opioid treatment should have breastfeeding support and education **Limitations:** 1) Newborns exposed to buprenorphine, the association between newborn feeding method and NAS among newborns the results were unclear. 2) Barriers to breastfeeding need to be addressed

Citation/Level & Quality	Purpose of Study	Sample/Setting	Design		Results	Authors' Recommendations
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Dryden, C., Young, D., Campbell, N., & Mactier, H. (2010). Postnatal weight loss in substitute methadone-exposed infants: implication for the management of breast feeding. *Archives of Disease in Childhood - Fetal and Neonatal Condition*, 97, F214-F 216. doi: 10.1136/adc.2009.178723 **Level of Evidence – III** **Quality of Evidence – Good**	Quantify postnatal weight loss of maternal drug-exposed infants.	354 term infants born to drug-misusing women prescribed substitute methadone occurring over a 3-year period January 1, 2004 to December 31, 2006. The setting was at the princess Royal Maternity in Glasgow.	Retrospective cohort study	Information extracted from case noted after discharge 1) Infants weighed at birth & daily until discharge 2) Self-reports & urine toxicology tests during pregnancy & after delivery for maternal polydrug misuse (n=297) 3) Prior to drug treatment for NAS blood sampling was undertaken in all infants with weight loss > 15%, majority >12%, & most commonly associated with calcium & magnesium 4) data anonymized	Weight loss > in breast- than formula fed infants (p=0.003) and this effect continued when infants admitted to the Neonatal Unit or treatment for NAS. 1) Weight loss in > 95th centile, by 23% non-admitted exclusively breastfed infants & 48% of non-admitted formula-fed infants	Authors' data confirm increased neonatal weight loss in maternal drug-exposed infants. Breast feeding protects against the development of severe NAS and should be encouraged that requires lots of support and encouragement. Dryden, Young, Campbell and Mactier (2010) indicated "Careful supervision, greater tolerance of early weight loss in breastfed infants of methadone-prescribed drug-misusing mothers may be appropriate" (p. F216). **Limitations:** 1) Authors' chose not to further subdivide cohort to maintain group sizes, and to reflect clinical practice regardless of intrauterine growth.

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Ordean, A., Kahan, M., Graves, L. E., Abrahams, R., & Kim, T. (2014). Obstetrical and neonatal outcomes of methadone-maintained pregnant women: A Canadian multisite cohort study. *Journal of Obstetric Gynecology Canada, 37*(3), 252-257. Retrieved from https://doi.org/10.1016/S1701-2163(15)30311-X **Level of Evidence – III** **Quality of Evidence - Good**	1) To explain obstetrical and neonatal effects including NAS outcomes in a Canadian cohort of methadone-maintained pregnant women.	1) 94 pregnant women on methadone maintenance treatment (MMT) who attended care between 1997 and 2009 2) 3 integrated care programs in Vancouver (n = 36), Toronto (n = 36), & Montreal (n = 22)	Retrospective chart review	prior to analysis 1) Medical records 2) Spreadsheet of maternal demographics, obstetrical & neonatal outcomes, including NAS & management 3) Data entry by researchers (inter-rater reliability reviewed by researchers) 4) Data summarized by descriptive statistics	1) Breastfeeding reported by 17% of the total cohort 2) Breastfeeding rates were not significantly different among the 3 programs 3) Breastfeeding *P* = 0.767 4) 27% of neonates required pharmacological treatment for NAS, "which is lower than the MOTHER study and a national cohort study in Norway" (Ordean, Kahan, Graves, Abrahams, & Kim, 2014, p. 256).	1) Emphasis on mother-infant dyad care through non-pharmacological interventions such as breastfeeding 2) Policies promoting breastfeeding may decrease the severity of NAS and the need for pharmacological treatment **Limitations:** 1) 3 sites varied in the management of NAS for rates of NICU admission 2) Protocols for management of NAS vary geographically 3) Documentation was inconsistent 4) Omissions frequent in patient charts
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Humphrey, T., & Forbes-McKay, K. E. (2018). Breastfeeding and the substance-exposed mother and baby, 45, 450-458. doi: 10.1111/birt.12338 **Level of Evidence - I** **Quality of Evidence - Good**	Explore the feasibility of in-hospital, tailored breastfeeding support for the substance-exposed mother & baby	1) 14 mother-infant dyads in a tertiary hospital 2)Scotland from April 2014 to May 2015 3) Women with a substance-use disorder	Mixed-methods feasibility, including a randomized controlled trial 1) Control group either received standard Baby-Friendly Initiative care only 2) Intervention group received additional support (a dedicated breastfeeding support worker, personalized capacity-building approach, and a low-stimuli environment	Feasibility outcome measures 1) Maternal recruitment 2) Satisfaction & acceptability of support by a questionnaire 3) Breastfeeding on 5th postnatal day 4) Severity of neonatal abstinence syndrome (NAS)	Collectively breastfed infants less likely required pharmacology for NAS (3 of 11 breastfeeding versus 3 of 3 formula feeding) & had a shorter hospital stay than formula-fed infants	A model including family focused care which collaboratively fosters a therapeutic mother-child relationship and places breastfeeding at its center improves clinical outcomes. **Strengths:** The evaluation & the use of an RCT trial design **Limitations:** 1) Single site 2) Homogeneity of the population 3) May not be representative of other geographic settings or where health service provision differs

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