Fall 2018

The Effect of Breastfeeding and Rooming-In Care on Neonatal Abstinence Syndrome

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Abstract

Concurrent with a rise in opioid abuse during pregnancy is an increase in the number of babies born with Neonatal Abstinence Syndrome (NAS). Despite this crisis, no single treatment has been identified for NAS. This paper sought to analyze and synthesize research evaluating the effectiveness of breastfeeding and rooming-in care on the need and length of pharmacologic treatment and length of hospital stay for neonates with NAS. Twenty-six peer reviewed research articles published between 2006 and 2017 were selected from PubMed and CINAHL for analysis. The studies focused on neonates with NAS born to mothers addicted to opioids or undergoing opioid maintenance treatment (OMT). The studies reviewed included systematic reviews and research studies utilizing control and intervention groups in various countries with sample sizes ranging from 16 to 952 neonates. Findings indicate that breastfeeding and rooming-in are effective for mild-moderate NAS whereas pharmacologic treatments are recommended for moderate-severe NAS. In addition to these findings, this paper will discuss limitations faced while compiling research and the possibility for future research and implementation into practice.

Keywords: *neonatal abstinence syndrome, pregnancy, post-natal care, breastfeeding, rooming-in care, length of stay, substance abuse, opioids*

The Effect of Breastfeeding and Rooming-In Care on Neonatal Abstinence Syndrome

Over the last twenty years, there has been a significant rise in the number of pregnant women who are addicted to drugs, specifically opioids, during their pregnancy. Concurrent with an escalation in opiate prescription abuse, there has been a five-fold increase in the occurrence of pregnant women using opiates from 2000 to 2009 (Forray, 2016). As of 2012, a national survey found that illicit drugs were used by 5.9% of pregnant women in the United States (Forray, 2016). This has resulted in an equally significant rise in the number of neonates born with Neonatal Abstinence Syndrome (NAS), which is the result of the sudden cessation of fetal exposure to any substance abused by the mother during pregnancy (Kocherlakota, 2014). Because opioids mainly affect the central nervous system and gastrointestinal tract, common signs and symptoms of NAS in neonates include: irritability, increased wakefulness, high-pitched crying, repeated yawning and sneezing, exaggerated deep tendon reflexes, increased muscle tone, tremors, seizures, inadequate feeding and weight gain, uncoordinated continuous sucking, and temperature instability (Hudak et al., 2012). Between 2009 and 2012, the occurrence of NAS jumped from 3.4 to 5.8 per 1,000 hospital births in the United States (Patrick, Davis, Lehman, & Cooper, 2015). Between 2004 and 2013, the incidence of NAS soared from 7 to 27 out of every 1,000 Neonatal Intensive Care Unit (NICU) admissions (Raffaeli et al., 2017). According to Centers for Disease Control and Prevention (CDC), the rate of NAS increased five-fold from 2000 to 2013 (Barfield, Broussard, Yonkers, & Patrick, 2016). In 2012, the CDC stated that every 25 minutes a neonate was born with NAS in the United States (Barfield et al., 2016). There were approximately 21,732 neonates identified with NAS in 2012 in the United States alone (Patrick et al., 2015).

Mothers suffering from drug addiction during pregnancy generally live high risk lifestyles that lead to a variety of social, nutritional, physical, and mental health problems (Kocherlakota, 2014). Social issues of pregnant addicts include participation in illegal activities, inability to access appropriate birth control, decreased likelihood of attending prenatal care visits, and an increased likelihood of smoking and drinking alcohol (Ashraf, Ashraf, Asif, & Basri, 2016). A nutritional issue common to pregnant addicts is malnourishment (Ashraf et al., 2016). Physical issues that are common among pregnant addicts include irregular menstruation, amenorrhea, anemia, hypertension, diabetes mellitus, heart disease, increased risk of infection, and inadequate oral hygiene (Ashraf et al., 2016). Mental health issues among pregnant addicts include postpartum mood disorders and depression (Pritham, 2013). Due to these issues, women addicted to opioids during their pregnancy have six times the risk of developing obstetric complications, including abruptio placenta, premature rupture of membranes, preterm delivery, preeclampsia, and postpartum hemorrhage (Ashraf et al., 2016). Additionally, maternal drug addiction puts the neonate at risk for intrauterine growth restriction, congenital anomalies, cognitive defects, prematurity, low birth weight, respiratory distress syndrome, and NAS (Ashraf et al., 2016; Raffaeli et al., 2017). These complications of maternal and neonatal lifestyle result in an increased need for pharmacologic treatment, increased length of hospital stay (LOS), and increased medical costs (Raffaeli et al., 2017). Due to increased cost of care and increased LOS, it was estimated that hospital charges for NAS care in 2012 was $1.5 billion (Crook & Brandon, 2017).

With a rise in neonates born with NAS, it is important for nurses to be prepared to use evidence-based practice to effectively care for neonates born with NAS. The current issue nurses are facing is that there are heterogeneous standards of care across hospitals globally for

treating neonates with NAS. According to Kocherlakota (2014), there is no single standard treatment regimen accepted for NAS due to the complicated and indistinct nature of withdrawal in neonates and the effects of illicit drugs. Because thorough research has not been performed to determine the most effective treatment for NAS, nurses are left to treat neonates based on individual hospital policy rather than on what is best for the neonate. By initiating a standard plan of care founded on evidence-based practice across hospitals globally, there is potential to improve patient outcomes and decrease healthcare costs.

In order to establish a foundation for evidence-based practice, it is important to identify which treatments are currently in practice, including pharmacologic and nonpharmacologic interventions. Three common pharmacologic interventions used to treat NAS are morphine, methadone, and buprenorphine. These substances are all opioids, which consist of endogenous and synthetic drugs that mainly act on opioid receptors in the central nervous system to elicit analgesia (Hudak et al., 2012). Both morphine and methadone are opioid agonists and buprenorphine is an opioid mixed agonist-antagonist (Hudak et al., 2012). These opioids have each been used to treat NAS in neonates, but morphine is currently the preferred treatment (Kocherlakota, 2014). Neonates who receive pharmacologic treatment have an average LOS of 23 days (Patrick et al., 2015). Two common nonpharmacologic interventions used to treat NAS are breastfeeding and rooming-in care. Breastfeeding (the feeding of milk produced by the mother to her neonate) and rooming-in care (the method of tending to both mother and baby in the same room beginning directly after birth) have both been identified as treatments that decrease the severity of NAS symptoms in neonates (Abrahams, MacKay-Dunn, Nevmerjitskaia, MacRae, Payne & Hodgson, 2010; Kocherlakota, 2014).

The aim of this systematic review is to clarify what is known about the effect of breastfeeding and rooming-in care on the need for pharmacologic treatment, length of pharmacologic treatment, and length of hospital stay with neonates suffering from NAS. This systematic review is guided by the following question: In neonates with NAS, what is the effectiveness of nonpharmacologic interventions (including breastfeeding and rooming-in care) instead of or in addition to pharmacologic interventions such as opioid maintenance treatment (OMT) compared to exclusive OMT on decreasing the need for pharmacologic treatment, length of pharmacologic treatment, and length of hospital stay?

Methods

The search focused on research studies about neonates with NAS. The mothers described in these studies were either currently addicted to opioids and other addictive substances or undergoing OMT. The studies included both pharmacologic and non-pharmacologic interventions, including morphine maintenance treatment, buprenorphine maintenance treatment, methadone maintenance treatment, breastfeeding, and/or rooming-in care. The timeline observed in these studies included the treatment of NAS in neonates from time of birth to discharge from a healthcare facility. The studies were published in peer reviewed medical journals published between 2006 and 2017 found through CINAHL and PubMED databases.

When searching the CINAHL and PubMED databases for research studies, the following keywords were used in a variety of combinations: neonatal abstinence syndrome, breastfeeding, rooming-in care, drug therapy, opioid maintenance treatment, methadone maintenance treatment, methadone, buprenorphine, and nonpharmacologic treatment. Seventeen results were found when the keywords neonatal abstinence syndrome, breastfeeding, and opioid maintenance treatment were collectively searched on PubMed. Fifty-two results were found when neonatal

abstinence syndrome, breastfeeding, and drug therapy were collectively searched on PubMed. Two results were found when neonatal abstinence syndrome, rooming-in care, and opioid maintenance treatment were collectively searched on PubMed. Eight results were found when neonatal abstinence syndrome and rooming-in care were collectively searched on PubMed. One hundred and one results were found when neonatal abstinence syndrome and buprenorphine were collectively searched on CINAHL. Six results were found when neonatal abstinence syndrome and rooming-in care were collectively searched on CINAHL.

After each initial keyword search brought back a list of search results, studies from that results list were first eliminated if the title of the study was irrelevant to the treatment of neonates with NAS. If the studies were still relevant, their abstracts were examined to determine if the content of the study was relevant to the treatment of neonates with NAS. If the studies were irrelevant, they were discarded; if the studies were relevant, their entire contents were thoroughly read to determine if the studies examined how each NAS treatment affected the outcomes described in the research question. The outcomes described in the research question include the need for pharmacologic treatment, length of pharmacologic treatment, and length of hospital stay for neonates suffering from NAS. If one or all of these outcomes were measured, the study was included in this systematic review. In total, twenty-six research studies met the criteria previously stated and were included in this systematic review.

The journals used in this review were selected based on their relevance to the keywords and if they met the criteria established before conducting the research. The use of the two databases CINAHL and PubMed ensured a comprehensive review of available studies related to the topic at hand. This review sought to avoid bias by including studies with multiple points of

view about the effectiveness of nonpharmacologic and pharmacologic treatments used to treat NAS.

Results

There were twenty-six research studies included in this systematic review. This section will provide detailed information on the sample setting, sampling method, sample size, study design, level of evidence, and specific findings of the research studies included in this systematic review. The specific findings will describe the conclusions reached regarding the need for pharmacologic treatment, length of pharmacologic treatment, and length of hospital stay.

Sample Setting

An extensive review of the literature revealed that studies about nonpharmacologic treatments for neonates with NAS have been conducted across the globe. Included within this systematic review are two studies from Australia, two from the United Kingdom, six from Canada, six from the United States, and one from Norway. Considering the worldwide interest in this neonatal health problem, nurses should seek out research that supports effective evidence-based practices to care for neonates born with NAS.

Two studies were performed at hospitals in Australia, with one study located in Randwich, New South Wales and one study located in Western Sydney (Abdel-Latif et al., 2006; Liu, Juarez, Nair, & Nanan, 2015). Two studies were performed at hospitals in the United Kingdom, with one performed in London and the other in Glasgow (Dryden, Young, Hepburn & Mactier, 2009; Saiki, Lee, Hannam & Greenough, 2010). One study looked at 18 different hospitals in Norway (Welle-Strand, Skurtveit, Jansson, Bakstad, Bjarkø & Ravndal, 2013).

Six studies were performed at hospitals in Canada. Three of the six studies were performed in Vancouver, one of which was specifically performed at the Fir Square Unit of BC

Women's Hospital (Abrahams, Kelly, Payne, Thiessen, Mackintosh & Janssen, 2007; Abrahams et al., 2010; Hodgson & Abrahams, 2012). One of the six studies was performed at hospitals in Vancouver, Toronto, and Montreal (Ordean, Kahan, Graves, Abrahams & Kim, 2015). Two of the six studies were specifically performed at Kingston General Hospital in Ontario (McKnight et al., 2015; Newman et al., 2015).

Five studies were performed at hospitals in the United States. Four of the five studies were located in the northeastern states, including Pennsylvania, New York, New Hampshire, and Maine (Brown, Hayes & Thornton, 2015; Holmes et al., 2016; Kraft et al., 2008; Kraft et al., 2017). The two studies located in Pennsylvania were both conducted at the Thomas Jefferson University Hospital (Kraft et al., 2008; Kraft et al., 2017). One of the five studies was located in the Midwest state of Ohio (Isemann, Meinzen-Derr & Akinbi, 2011).

Five studies were systematic reviews that pulled the research necessary for their reviews from several online databases, including PubMed, Ovid Medline, Embase, CINAHL, Medline, and Cochrane (Bagley, Wachman, Holland, & Brogly, 2014; Boucher, 2017; Holmes, Schmidlin & Kurzum, 2017; Kocherlakota, 2014; Pritham, 2013). Four studies were performed at unspecified hospitals, clinics, or treatment programs (Crook & Brandon, 2017; Hudak et al., 2012; Jansson et al., 2008; O'Connor, Collett, Alto & O'Brien, 2013). One study was a compilation of current medical research and expert opinion discussing NAS (Raffaeli et al., 2017). Given the national and international interest in this topic at prestigious institutions, synthesis of study results and further research is certainly warranted.

Sampling Method

Among the 26 studies included in this systematic review, a common methodology is evident with noticeable similarities and differences. The overwhelming majority of studies

utilized a control group compared with one or more intervention groups. The minority of studies used databases to synthesize evidence from research studies to draw a conclusion about the effectiveness of one or more interventions.

Fourteen studies followed two comparison groups during a specific length of time. However, these 14 studies did not use the same type of comparison groups or conduct research during the same time periods. Seven of the 14 studies used a comparison group of formula-fed neonates with a comparison group of breastfed neonates suffering from NAS (Abdel-Latif et al., 2006; Dryden et al., 2009; Isemann et al., 2011; Jansson et al., 2008; Liu et al., 2015; O'Connor et al., 2013; Welle-Strand et al., 2013). Three of the 14 studies used a comparison group of neonates with NAS rooming-in with their mothers and a comparison group of neonates with NAS admitted to the NICU (Abrahams et al., 2010; Newman et al., 2015; Ordean et al., 2015). One of the 14 studies specifically used a comparison group with and a control group without prenatal family education, increased family involvement in symptom monitoring as well as in nonpharmacologic treatment, and rooming-in care (Holmes et al., 2016). One of the 14 studies used a comparison group of neonates with NAS who received buprenorphine and a comparison group of neonates with NAS who received morphine (Kraft et al., 2017). One of the 14 studies used a comparison group of neonates with NAS who received methadone and a comparison group of neonates with NAS who received morphine (Brown et al., 2015). One of the 14 studies used a comparison group of neonates with NAS who received buprenorphine and a comparison group of neonates with NAS who received neonatal opium solution (NOS) (Kraft et al., 2008).

Three research studies used two comparison groups in which both groups collected data at different periods of time. These three studies used the same type of control and comparison groups, but did not conduct the research over the same time periods. The control group consisted

of a group of neonates suffering from NAS who were admitted to the NICU, while the comparison group consisted of neonates with NAS that practiced rooming-in with their mothers (Abrahams et al., 2007; McKnight et al., 2015; Saiki et al., 2010).

One research study looked at one cohort over a specific length of time (Hodgson & Abrahams, 2012). The cohort was made up of mother-neonate dyads who were cared for through a rooming-in care program. The medical charts of these dyads were reviewed and data was collected regarding the type of drug used by the mother, maternal methadone dose at the time of delivery, and whether or not the neonate required morphine treatment.

One research study used three comparison groups in which each comparison group had data collected at different periods of time. This study used a comparison group of neonates with NAS before specific changes in interventions occurred, a comparison group after Baby Friendly Status (BFS) was implemented, and a comparison group after BFS plus breastfeeding education was implemented (Crook & Brandon, 2017). Baby Friendly Status in this particular study is defined as a quality improvement program which promotes breastfeeding through the healthcare structure and practices (Crook & Brandon, 2017). There are ten steps involved in achieving BFS, some of these include: allowing mothers and neonates to remain together 24 hours a day, training the staff how to implement this policy, encouraging breastfeeding on neonate command, and giving neonates no drinks other than breast milk (Crook & Brandon, 2017).

Five of the studies were systematic reviews. These studies used databases to find research articles relating to the topic at hand. The keywords used to find the studies for these five studies included, but were not limited to, LOS, breastfeeding, nonpharmacologic treatment, rooming in, swaddling, and NAS (Bagley et al., 2014; Boucher, 2017; Holmes et al., 2017; Kocherlakota, 2014; Pritham, 2013).

Two of the studies simply compiled current scientific literature on the subject of NAS (Hudak et al., 2012; Raffaeli et al., 2017). Topics described in these studies included clinical presentation, diagnostic strategies, and types of nonpharmacologic and pharmacologic therapy. Most importantly, these studies weighed current evidence to determine when treating NAS with pharmacologic therapies is necessary. The current work in this area is based on research using strong methodology. Therefore, the studies provide a good basis for developing policy and interventions.

Sample Size

Fourteen studies followed two comparison groups during a specific length of time. For seven of the 14 studies, which used a group of formula-fed neonates and a group of breastfed neonates, the sample size ranged from 16 to 437 neonates (Abdel-Latif et al., 2006; Dryden et al., 2009; Isemann et al., 2011; Jansson et al., 2008; Liu et al., 2015; O'Connor et al., 2013; Welle-Strand et al., 2013). For three of the 14 studies, which used a group of neonates who roomed-in with their mothers and a group of neonates who were admitted to the NICU, the sample size ranged from 45 to 952 neonates (Abrahams et al., 2010; Newman et al., 2015; Ordean et al., 2015). For one of the 14 studies, which used a group with neonates that received pharmacologic treatment and a group with neonates that received nonpharmacologic treatment, the total sample size was 163 neonates with 69 receiving pharmacologic treatment and 94 receiving nonpharmacologic treatment (Holmes et al., 2016). For one of the 14 studies, which used a group of neonates who received buprenorphine and a group of neonates who received morphine, the total sample size was 63 neonates with 33 receiving buprenorphine and 30 receiving morphine (Kraft et al., 2017). For one of the 14 studies, which used a group of neonates who received methadone and a group of neonates who received morphine, the total

sample size was 31 neonates with 15 receiving methadone and 16 receiving morphine (Brown et al., 2015). For one of the 14 studies, which used a group of neonates who received buprenorphine and a group of neonates who received neonatal opium solution (NOS), the total sample size was 26 neonates with 13 receiving buprenorphine and 13 receiving NOS (Kraft et al., 2008).

Three research studies used two comparison groups in which both groups collected data at different periods of time. The control group consisted of a group of neonates suffering from NAS who were admitted to the NICU, while the comparison group consisted of neonates with NAS that practiced rooming-in with their mothers. The sample size ranged from 44 to 96 neonates (Abrahams et al., 2007; McKnight et al., 2015; Saiki et al., 2010).

One research study looked at one cohort over a specific length of time (Hodgson & Abrahams, 2012). The cohort was made up of mother-neonate dyads who were cared for through a rooming-in care program. The total sample size for this study was 295 neonates.

One research study used three comparison groups in which each comparison group had data collected at different periods of time. This study used a comparison group of neonates with NAS before specific changes in interventions occurred, a comparison group after Baby Friendly Status (BFS) was implemented, and a comparison group after BFS plus breastfeeding education was implemented (Crook & Brandon, 2017). The total sample size of this study was 200 neonates.

Five of the studies used databases to find research articles relating to the topic at hand (Bagley et al., 2014; Boucher, 2017; Holmes et al., 2017; Kocherlakota, 2014; Pritham, 2013). The sample size ranged from 5 to 13 articles included within each systematic review. Two of the

five studies stated that many articles were included within each systematic review, but failed to state a specific sample size.

Two of the studies simply compiled current scientific literature on the subject of NAS (Hudak et al., 2012; Raffaeli et al., 2017). The first study cited a total of 165 journal articles (Hudak et al., 2012). The second study cited a total of 64 journal articles (Raffaeli et al., 2017). These studies utilized a range of sample sizes to create a strong foundation upon which future research can be conducted.

Design and Level of Evidence

While conducting a systematic review, it is important that well designed studies are used in the analyses. Five types of designs were identified after reviewing the studies included in this review: systematic reviews, randomized controlled trials, controlled trials without randomization, retrospective cohort studies, and expert opinions. These designs are ranked on predetermined scales and the strength of the evidence is graded using three areas of expertise: quality, quantity, and consistency (Schmidt & Brown, 2015).

Systematic reviews are marked as a level one evidence because they combine the results of studies and statistically determine the effects of the interventions used (Schmidt & Brown, 2015). These types of studies often use both published and unpublished studies (Schmidt & Brown, 2015). Five of the studies were systematic reviews (Bagley et al., 2014; Boucher, 2017; Holmes et al., 2017; Kocherlakota et al., 2014; Pritham, 2013).

Randomized controlled trials are marked as a level two evidence. Three of the studies included in this systematic review were randomized controlled trials (Brown et al., 2015; Kraft et al., 2008; Kraft et al., 2017). Controlled trials without randomization are marked as a level three evidence. Four of the studies were controlled trials without randomization (Crook & Brandon,

2017; Holmes et al., 2016; Jansson et al., 2008; Newman et al., 2015). Both of these types of trials can be found in nursing literature and help with the promotion of evidence-based practice (Schmidt & Brown, 2015).

Retrospective cohort studies are marked as a level four evidence. They look at changes in characteristics of a large sample over time (Schmidt & Brown, 2015). Twelve of the studies were retrospective cohort studies (Abdel-Latif et al., 2006; Abrahams et al., 2007; Abrahams et al., 2010; Dryden et al., 2009; Hodgson & Abrahams, 2012; Isemann et al., 2011; Liu et al., 2015; McKnight et al., 2015; O'Connor et al., 2013; Ordean et al., 2015; Saiki et al., 2010; Welle-Strand et al., 2013). Expert opinions are marked as a level seven evidence. Two of the studies were considered expert opinions (Hudak et al., 2012; Raffaeli et al., 2017). Although these studies range from strongly designed randomized controlled trials to expert opinion, each study adds to the knowledge amassed in this systematic review and helps researchers better understand NAS.

Findings

This section will describe the specific findings related to the effectiveness of treatments for NAS. Both nonpharmacologic and pharmacologic treatments will be discussed, including breastfeeding, rooming-in care, morphine, methadone, and buprenorphine. Each of these treatments will be examined to determine how they affect the need for pharmacologic treatment, length of pharmacologic treatment, and length of hospital stay.

Breastfeeding.

Of the 28 studies examined in this systematic review, similar findings related to breastfeeding neonates suffering from NAS were identified. A correlation between breastfeeding and a decrease in the severity of NAS in neonates was found in seven of the studies reviewed

(Abdel-Latif et al., 2006; Bagley et al., 2014; Dryden et al., 2009; Hudak et al., 2012; Isemann et al., 2011; O'Connor et al., 2013; Pritham, 2013). Two of these seven studies found that breastfeeding decreased Finnegan scores, one specifying that the mean score peak decreased from 9.65 to 8.8 (Bagley et al., 2014; O'Connor et al., 2013). The Finnegan scoring system was created in 1975 as a neonatal narcotic withdrawal scoring system (Bagley et al., 2014). It includes 20 items, such as high pitched cries, feeding habits, stools, and is weighted on pathologic severity (Bagley et al., 2014). The higher the score, the more severe the NAS is considered.

One study that showed a correlation between breastfeeding and the severity of NAS in neonates was a systematic review with an objective to provide findings related to the assessment and management of neonates with NAS (Bagley et al., 2014). A total of 13 studies regarding nonpharmacologic interventions were included in the review with seven studies specifically examining the relationship between the neonate feeding method and NAS outcomes (Bagley et al., 2014). The articles were found on PubMed and Cochrane Databases and were published between 1975 and 2013 (Bagley et al., 2014). Since the transfer of methadone and buprenorphine through breastmilk is minimal, breastfeeding is recommended for mothers on opioid maintenance therapy, but it is not recommended for mothers using illicit drugs (Bagley et al., 2014). The review shared how breastfeeding is found to act as an analgesic for neonates (Bagley et al., 2014). Throughout examination of the studies, it was concluded that predominantly breastfed neonates showed a decrease in Finnegan scores as early as the first nine days of life when compared to formula fed neonates (Bagley et al., 2014). The average Finnegan scores in breastfed neonates compared to formula fed neonates was not calculated in this study. LOS was shown to decrease by up to 19 days in breastfed neonates, and breastfed neonates had a

30% decreased need for pharmacologic treatment (Bagley et al., 2014). The correlation of breastfeeding and the decreased need for pharmacologic treatment and LOS will be discussed in further detail in this section.

Eleven studies found that breastfeeding decreases the neonate's need for pharmacologic treatment (Abdel-Latif et al., 2006; Bagley et al., 2014; Dryden et al., 2009; Holmes et al., 2017; Hudak et al., 2012; Jansson et al., 2008; Kocherlakota, 2014; Liu et al., 2015; O'Connor et al., 2013; Pritham, 2013; Welle-Strand et al., 2013). The result of one of those studies was not statistically significant due to a small sample size. Of these 11 studies, seven stated that there was a decrease in the need for pharmacological treatment in breastfed neonates ranging from 6.9% to 50% compared to formula fed neonates (Abdel-Latif et al., 2006; Bagley et al., 2014; Dryden et al., 2009; Holmes et al., 2017; Liu et al., 2015; O'Connor et al., 2013; Welle-Strand et al., 2013).

Three studies found that breastfeeding decreased the length of pharmacologic treatment in neonates with NAS (Abdel-Latif et al., 2006; Isemann et al., 2011; Welle-Strand et al., 2013). One of these three studies stated that the length of methadone maintenance therapy in a neonate would decrease from 15 to 8 days if that neonate was breastfed (Isemann et al., 2011). Another of the three studies stated that the length of pharmacologic treatment in neonates who were breastfed was 28.6 days compared to 46.7 days in neonates who were formula fed (Welle-Strand et al., 2013).

If the need for and length of pharmacologic treatment both decreased, LOS would also decrease. This finding was shown by eight studies which indicated that breastfeeding reduces the neonate's LOS (Abdel-Latif et al., 2006; Bagley et al., 2014; Crook & Brandon, 2017; Dryden et al., 2009; Holmes et al., 2017; Isemann et al., 2011; Kocherlakota, 2014; Pritham,

2013). Of these eight studies, five stated that the LOS for breastfed neonates with NAS compared to formula fed neonates with NAS decreased between 2.3 days and 19 days (Abdel-Latif et al., 2006; Bagley et al., 2014; Crook & Brandon, 2017; Holmes et al., 2017; Isemann et al., 2011).

One study included a quality improvement project to see whether prenatal breastfeeding initiatives would increase breastfeeding rates and decrease LOS in neonates with NAS (Crook & Brandon, 2017). The study included three groups: a traditional care group that included births from February 2014 to August 2014; a baby friendly status (BFS) group that included births from September 2014 to January 2015; and a BFS plus breastfeeding education group that included births from February 2015 to July 2015. Hospital achieved BFS means that the facility provides great care for neonate feeding as well as mother-neonate bonding. LOS was 18.8 days in the traditional care group, 13.14 days in the BFS group, and 10.41 days in the BFS plus breastfeeding education group. Breastfeeding initiation rates were higher in women who were part of group care as opposed to traditional prenatal care. Sixty-seven point three percent of neonates in the traditional care group needed pharmacologic treatment, 53.9% of neonates in the BFS group needed pharmacologic treatment, and 34.8% of neonates in the BFS plus breastfeeding education group needed pharmacologic treatment (Crook & Brandon, 2017). These results demonstrate that detailed breastfeeding education should be provided to all mothers with neonates suffering from NAS (Crook & Brandon, 2017).

In opposition to all previous findings, one study stated there is no benefit to breastfeeding neonates with NAS in regards to NAS scores and the need for pharmacologic treatment (Liu et al., 2015). The study stated that breastfed neonates were found to have an average NAS score of 1.3 compared to formula fed neonates who had an average NAS score of 1.1 (Liu et al., 2015).

The study also found that the max dose of morphine required was the same for breastfed neonates as formula fed neonates, which was 0.5-0.7 milligrams per kilogram per day (Liu et al., 2015). This study had a small sample size as well as other limitations that could have affected its results. While it is possible the findings of this study could be supported by future research, this study alone should not lead to the conclusion that breastfeeding is a poor treatment option for neonates with NAS.

Overall, these studies indicate that breastfeeding decreases NAS severity, decreases the need and length of pharmacologic treatment, and decreases LOS. Due to these positive findings, it was also determined that breastfeeding education should be provided to all mothers with neonates suffering from NAS.

Rooming-in care.

Out of the 26 studies used in this systematic review, several of the studies provided findings related to rooming-in care and how it affects neonates with NAS. Seven studies found that rooming-in care decreases the need for pharmacologic treatment (Abrahams et al., 2007; Boucher, 2017; Hodgson & Abrahams, 2012; McKnight et al., 2015; Newman et al., 2015; Ordean et al., 2015; Saiki et al., 2010), with one study specifying that rooming-in care decreases the need for oral morphine therapy (Abrahams et al., 2007). These seven studies examined how the need for pharmacologic treatment differed between neonates who roomed-in with their mothers or were cared for in the NICU. The percentage of neonates who needed pharmacologic treatment in rooming-in ranged from 11% to 79.2%, whereas the percentage of neonates who needed pharmacologic treatment who were cared for in the NICU ranged from 45% to 88.7% (Abrahams et al., 2007; Boucher, 2017; Hodgson & Abrahams, 2012; McKnight et al., 2015; Newman et al., 2015; Ordean et al., 2015; Saiki et al., 2010). Overall, the percentage of neonates

who needed pharmacologic treatment was lower by a statistically significant number for those who roomed-in with their mothers.

Four studies found that rooming-in care decreases the length of pharmacologic treatment in neonates with NAS (Abrahams et al., 2007; Bagley et al., 2014; Boucher, 2017; Saiki et al., 2010). These four studies examined the length of pharmacologic treatment in neonates who roomed-in with their mothers compared to those cared for in the NICU. The length of pharmacologic treatment for neonates who roomed-in with their mothers ranged from 5.9 to 27 days, whereas the length of pharmacologic treatment for neonates cared for in the NICU ranged from 18.6 to 32.5 days (Abrahams et al., 2007; Bagley et al., 2014; Boucher, 2017; Saiki et al., 2010). Overall, the length of pharmacologic treatment was lower by a statistically significant number for neonates who roomed-in with their mothers.

When the length of pharmacologic treatment decreases for a neonate with NAS, the length of hospital stay has also been shown to decrease. Seven studies found that rooming-in care reduces the neonate's LOS (Abrahams et al., 2007; Bagley et al., 2014; Boucher, 2017; Holmes et al., 2016; McKnight et al., 2015; Newman et al., 2015; Saiki et al., 2010). Six of the seven studies compared the LOS in neonates who roomed-in with their mothers and those who were cared for in the NICU. Between these specific six studies, the mean LOS for neonates who roomed-in with their mothers was 12.6 days, whereas the mean LOS for neonates cared for in the NICU was 25 days (Abrahams et al., 2007; Boucher, 2017; Holmes et al., 2016; McKnight et al., 2015; Newman et al., 2015; Saiki et al., 2010).

In contrast, two studies found that rooming-in care increases the neonate's LOS (Abrahams et al., 2010; Ordean et al., 2015). One of these two studies stated that LOS for neonates who roomed-in with their mothers was 21 days, whereas LOS for neonates who were

cared for in the NICU was 11 days (Abrahams et al., 2010). The other study found that LOS for neonates who roomed-in with their mothers was 26 days, whereas LOS for neonates who did not room-in with their mothers was between 14 and 16 days (Ordean et al., 2015).

One specific retrospective cohort study examined rooming-in for neonates with NAS across three comparison groups (Abrahams et al., 2007). The first group consisted of 32 neonates who roomed-in with their mothers at Vancouver General Hospital during October 2001 and December 2002 (Abrahams et al., 2007). The second group consisted of 28 neonates who were admitted to a level two nursery at B. C. Women's Hospital between January 1999 and September 2001 (Abrahams et al., 2007). The third group consisted of 36 neonates who were admitted to a level two nursery at Surrey Memorial Hospital between January 1999 and December 2002 (Abrahams et al., 2007). Results from this study showed that rooming-in care was associated with decreased need for pharmacologic treatment with morphine, length of pharmacologic treatment, and LOS. Only 25% of the neonates that roomed-in needed pharmacologic treatment, whereas between 52.8% and 55.3% of neonates admitted to a level two nursery needed pharmacologic treatment (Abrahams et al., 2007). The length of pharmacologic treatment with morphine for neonates who roomed-in with their mothers was 5.9 days compared to 18.6 days for neonates admitted to a level two nursery (Abrahams et al., 2007). The LOS for neonates who roomed-in with their mothers was 11.8 days compared to an average of 24.7 days for neonates admitted to a level two nursery (Abrahams et al., 2007). Besides two outlying studies that found rooming-in care increased LOS, the majority of studies indicate that rooming-in care decreases the need for pharmacologic treatment, decreases the length of pharmacologic treatment, and decreases LOS.

Pharmacologic treatments.

Four studies regarding pharmacologic treatments for NAS were included in this systematic review (Brown et al., 2015; Kraft et al., 2008; Kraft et al., 2017; Raffaeli et al., 2017). It is crucial to examine the effects of pharmacologic treatments on neonates with NAS because 50-80% of opiate-exposed neonates require some form of pharmacologic treatment (Raffaeli et al., 2017). For example, the average LOS for neonates with NAS increases from 17 to 23 days when the neonate has to receive pharmacologic treatment (Raffaeli et al., 2017). Therefore, it is important to examine each type of pharmacologic treatment in order to know how each of them affects a neonate's LOS. These four studies focus on three main pharmacologic treatments: buprenorphine, methadone, and morphine.

Of the four studies regarding pharmacological, three of them focused on comparing buprenorphine treatments to other pharmacological agents, such as morphine and methadone (Kraft et al., 2008; Kraft et al., 2017; Raffaeli et al., 2017). One of the three studies discussed the nature of the medications themselves, including the pros and cons of buprenorphine, methadone, and morphine (Raffaeli et al., 2017). The study found that treating neonates with buprenorphine decreased the need for pharmacologic treatment, decreased the length of pharmacologic treatment by 40%, and decreased LOS by 24% when compared to treating neonates with morphine (Raffaeli et al., 2017). The study also found that evidence regarding how methadone compared to morphine was conflicting and inconclusive (Raffaeli et al., 2017). Another one of the three studies showed that the length of pharmacologic treatment with buprenorphine is 13 days shorter than treatment with morphine (Kraft et al., 2017). In addition, the same study found that the LOS for neonates receiving buprenorphine is 12 days shorter than for neonates receiving morphine (Kraft et al., 2017). The last of the three studies compared 26 term neonates with NAS who were randomly assigned to receive buprenorphine or neonatal

opium solution (NOS) (Kraft et al., 2008). The results showed that the mean length of pharmacologic treatment in the morphine group was 32 days, whereas the mean length of pharmacologic treatment in the buprenorphine group was 22 days (Kraft et al., 2008). Additionally, the mean LOS for neonates treated with morphine was 38 days, whereas the mean LOS for neonates treated with buprenorphine was 27 days (Kraft et al., 2008). Overall, these findings point to the conclusion that buprenorphine is a more effective pharmacologic treatment compared to methadone and morphine.

One study compared methadone and morphine pharmacologic treatment in neonates with NAS (Brown et al., 2015). A total of 31 neonates were randomly selected to receive either methadone or morphine (Brown et al., 2015). The results showed that the length of pharmacologic treatment for neonates treated with methadone was 14 days, whereas the length of pharmacologic treatment for neonates treated with morphine was 21 days (Brown et al., 2015). Overall, the evidence points towards methadone being a more effective pharmacologic treatment than morphine. However, more research should be done to compare buprenorphine to methadone.

Critical Appraisal of the Evidence

The following sections will examine the limitations of findings, the validity and reliability of the methods and findings, and the limitations across the studies included in this systematic review.

Limitations of Findings

There are several notable limitations to the findings of this systematic review. Due to the recent rise in illicit drug use and relative newness of NAS, only a small amount of research has been performed on NAS in general. As a result, this systematic review was first limited by the

lack of general research on NAS and further limited by the small number of studies directly relevant to the aim of this systematic review. Another limitation was only two databases were searched for relevant studies to include in the systematic review. It is possible that more studies could have been found if databases in addition to PubMed and CINHAL were searched. The findings of this systematic review were limited by the keywords chosen to search PubMed and CINHAL. It is possible that using additional keywords and combinations of keywords that more studies could have been found. Additionally, the studies selected were free to access by downloading and reading online PDF versions of the studies. More studies could have potentially been included if interlibrary loan, paid sources of research, and physical forms of research were investigated.

Validity and Reliability of the Methods and Findings

Across the studies included in this systematic review, issues have been discovered with the validity and reliability of the methods and findings. In three studies, the Finnegan scoring tool was either used incorrectly or subjectively depending on which healthcare professional was using the scoring tool (Abdel-Latif et al., 2006; Kraft et al., 2008; Newman et al., 2015). In one study, there were a high number of premature neonates included in the study population, which could have skewed the reliability of the study (Abdel-Latif et al., 2006). Three studies noted that not all of the hospitals they gathered data from used the same list of signs and symptoms to diagnose a neonate with NAS (Abrahams et al., 2010; Newman et al., 2015; Welle-Strand et al., 2013). Thus, the validity of the methods of these studies is decreased because there could have been more or less neonates diagnosed with NAS depending on which list of signs and symptoms were used. Two studies stated they did not know which types of illicit drugs the mothers took during pregnancy and how those different drugs could have affected the severity of NAS in the

neonates as a result (Abrahams et al., 2010; McKnight et al., 2015). Therefore, the validity of the findings of these studies is decreased because it is possible that breastfeeding and rooming-in were more successful in treating NAS since the illicit drugs the mothers were on had less severe effects on the neonates. Two studies noted that the validity of their methods was compromised because there were inconsistencies and/or omissions in their data collection due to documentation issues in patient charts (Isemann et al., 2011; Ordean et al., 2015). One study stated their results may not be universally applicable to pregnant women because the effectiveness of rooming-in may have been affected by whether or not pregnant women received prenatal care (Ordean et al., 2015). One study stated the validity of their methods may have been affected because they used a limited number of attending pediatricians to care for their patients (Holmes et al., 2016). This means that the methods these pediatricians used to care for neonates with NAS could have negatively affected the outcomes examined in the study. One study noted the validity of their findings could have been affected because the use of methadone or buprenorphine maintenance treatments on top of rooming-in care could have masked the true effects rooming-in care has on neonates with NAS when used on its own (Holmes et al., 2016). One study stated the reliability of their methods could have been affected because they compared sample groups of different sizes (Abrahams et al., 2007). The same study noted the reliability of their findings could have been affected because they were unable to separate out the specific effects of breastfeeding from the effects of rooming-in care (Abrahams et al., 2007).

Limitations across Studies

Upon reviewing the studies included in this systematic review, several limitations were found to be issues across the studies. Three major limitations found across the studies included no randomized group assignment (Abdel-Latif et al., 2006; Abrahams et al., 2007; Boucher,

2017; McKnight et al., 2015; O'Connor et al., 2013; Ordean et al., 2015; Saiki et al., 2010), no use of control over the study (Boucher, 2017; Kraft et al., 2008; McKnight et al., 2015; O'Connor et al., 2013; Ordean et al., 2015), and small study population (Brown et al., 2015; Crook & Brandon, 2017; Jansson et al., 2008; Kraft et al., 2017; Liu et al., 2015; McKnight et al., 2015; O'Connor et al., 2013). Other limitations found across the studies include not accounting for outside variables (Abrahams et al., 2010; O'Connor et al., 2013), not being able to differentiate between the positive effects of breastfeeding and the effects of skin-to-skin contact during breastfeeding (O'Connor et al., 2013), not knowing how long mothers breastfed their neonates with NAS (Bagley et al., 2014; Welle-Strand et al., 2013), only gathering data from one hospital (Brown et al., 2015; Kraft et al., 2008; Kraft et al., 2017), and not using an ethnically diverse sample population (Brown et al., 2015). These limitations represent areas where those conducting the studies failed to ensure the validity and reliability of their study. These areas of failure should be improved upon with research conducted on NAS in the future.

Recommendations

After an extensive review of twenty-six studies, potential practice and research implications were determined for future studies that may be conducted. Research findings support breastfeeding and rooming-in care as effective treatments for mild to moderate cases of NAS. Results of the studies show that breastfeeding and rooming-in care decrease the need for pharmacologic treatment, length of pharmacologic treatment, and length of hospital stay. In moderate to severe cases, it is recommended that nonpharmacologic treatments be used in combination with pharmacologic treatments. Combining these two treatments will provide the most effective care in treating NAS symptoms. Three studies showed that methadone is more effective than morphine as a pharmacologic treatment for NAS, however more research should

be done to compare buprenorphine to methadone (Kraft et al., 2008; Kraft et al., 2017; Raffaeli et al., 2017).

As previously noted, an issue facing nurses today is the heterogeneous standards of care across hospitals globally for treating neonates with NAS. It is recommended that hospitals and healthcare facilities look further into case studies and the possibility of implementing a standard treatment protocol for opioid-dependent neonates with NAS derived from evidence-based practice. Once a standard treatment for NAS is created, it is important to first implement the standard care locally before advancing to a regional or statewide practice. At a local level, it would be easier to implement any changes needed to be done to the standard treatment for NAS before it becomes a regional or statewide practice. In addition, it is recommended that doctors, nurses, and other healthcare professionals be further educated about the treatment and care of neonates with NAS. It is important to have well-informed staff members that use evidence-based practice to effectively care for their patients.

Next, it is recommended that research be done to develop a standard screening process for neonates who are at risk for developing NAS and expecting mothers who have a history or high risk of substance abuse. Along with this new standard of care and screening process, it is recommended that the mothers of opioid-dependent neonates be encouraged to take part in an educational program to teach them the importance of nonpharmacologic practices such as breastfeeding and rooming-in care and the positive impact they have on their child's health outcomes. These educational programs should also teach mothers who still struggle with substance abuse and addiction how important it is to stop breastfeeding. The transfer of methadone and buprenorphine through breast milk is minimal. Therefore, breastfeeding is recommended for mothers on opioid maintenance therapy, but it is not recommended for mothers

using illicit drugs (Bagley et al., 2014). These educational programs could be offered in local hospitals as well as in the community. It is recommended that medical treatment, resources, and teaching are made available for mothers to stop abuse of illicit substances.

Finally, it is recommended that further research be done on treatment for NAS to advance future practice. Larger, more inclusive studies would be beneficial to determine the trends and common practices for dealing with cases of NAS. One option would be to conduct more randomized controlled clinical trials as opposed to retrospective studies in order to obtain a more accurate comparison of effective treatment plans. Another option would be to conduct a comprehensive focused review concerning the current standards of care for NAS patients at various local and state institutions to determine which treatments prove to be most effective for relieving symptoms of withdrawal with the least negative consequences. This review could include current as well as previous patient charts and their treatment plans. Further systematic reviews would also be beneficial to accumulate data that is currently available for both pharmacologic and nonpharmacologic treatment of NAS. Other systematic reviews could be more expansive than this systematic review by including data on other pharmacologic and nonpharmacologic treatments not previously covered. Further studies also need to address long-term morbidity related to neonatal drug withdrawal and whether it is increased or decreased by pharmacologic treatment. Future studies should also include whether continuing postnatal drug exposure creates risk of neurobehavioral damage and other morbidities.

Conclusion

Breastfeeding and rooming-in care are effective as stand-alone treatments for most NAS cases with mild to moderate symptoms. Breastfeeding and rooming-in care should also be used in congruence with pharmacologic agents to treat moderate to severe symptoms of NAS unless

otherwise contraindicated. Buprenorphine and methadone have been shown to be more effective at treating the symptoms of NAS than morphine while further research must be conducted to compare the effectiveness of buprenorphine to methadone. Further research still needs to be conducted on the treatment of NAS to determine long-term effects of drug exposure and advance further practice.

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Appendix

Systematic Review Table of Evidence (TOE)

APA Formatted Reference	Purpose Statement and Research Question	Setting, Sampling Methods, and Sample Size	Design and Level of Evidence	Findings / Conclusion	Practice & Research Implications	Limitations of Findings
1: 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, 117*(6), e1163–e1169. doi: 10.1542/peds.2005-1561	**Purpose Statement:** To assess the effects of breast milk feeding on the severity of NAS in a population of infants of drug-dependent mothers who are at risk of NAS. **Research Question:** Is there a difference in the severity of NAS and the need for pharmacologic treatment of NAS in infants of drug-dependent mothers who consumed breast milk as opposed to formula?	**Setting:** Royal Hospital for Women in Randwick, New South Wales, Australia. **Sampling Method:** Reviewed data from all of the infants of drug-dependent mothers admitted to the Royal Hospital for Women between 1998 and 2004. **Sample Size:** A total of 190 consecutive charts were reviewed for maternal and neonatal data with 105 formula-fed infants and 85 breast milk-fed infants.	**Design:** Retrospective cohort study **Level of Evidence:** 4	Infants in the breast milk group had lower Finnegan scores, shorter LOS, delayed onset of withdrawal symptoms, and had a decreased need for pharmacologic treatment than infants in the formula group. Overall, breast milk intake significantly reduces the severity of NAS.	Unless there are medical contraindications to breastfeeding, women of all infants at risk of NAS should be encouraged to breastfeed.	The Finnegan scoring system was used to monitor withdrawal from all types of drugs although it is only validated to evaluate opiate withdrawal symptoms. There could be a threat to validity due to the higher number of premature infants in the formula group. There was no randomized group assignment.
2: Abrahams, R. R., Kelly, S. A., Payne, S., Thiessen, P. N., Mackintosh, J., & Janssen, P. A. (2007). Rooming-in compared with standard care for newborns of mothers	**Purpose Statement:** "To evaluate the effect of rooming in (rather than standard nursery care) on the incidence and severity of neonatal abstinence syndrome among opioid exposed newborns and on	**Setting:** One group was from Vancouver General Hospital (VGH). The first comparison group was from B. C. Women's Hospital (BCWH). The second comparison cohort was from Surrey Memorial	**Design:** Retrospective Cohort Study **Level of Evidence:** 4	**Findings:** Rooming in was found to be associated with a significant decrease in need for treatment for the newborn,	**Practice & Research Implications:** Through the conclusion, we learned that treatment for NAS can't be universally one particular treatment, due to the	**Limitations of Findings:** Non-random allocation of subjects for study groups could be a limiting factor in the study design. I

using methadone or heroin. *Canadian Family Physician*, *53*(10), 1722–1730. http://cfp.ca/content/53/10/1722.long	the proportion of mothers who retain custody of their babies at hospital discharge" (p. 1723). **Research Question:** Is there a decrease on the incidence and severity of NAS seeing among opioid exposed newborns and on the number of mothers who retain custody of their babies with the intervention of rooming, compared to a historical cohort and a concurrent cohort.	Hospital (Surrey). **Sampling Method:** The study used women who during pregnancy used heroin or methadone between October 2001 and December 2002. The first comparison group included a historical cohort of every third woman who gave birth between January 1999 and September 2001 who used heroin or methadone or whose babies had NAS symptoms. The second comparison group included all women who were under the same category as above, between January 1999 and December 2002. Both comparison groups, had babies separated from their mothers during the first week of life. **Sample Size:** A total of 96 women were in the study, 32 from VGH, 28 from BCWH, and a 36 from Surrey. .		shorter hospital stay, and more likely to be discharged in their mother's custody. Lifestyle related factors significantly impacted the outcomes of the study. When the study restricted their analysis to non-breastfeeding women, significantly fewer of the rooming in newborns required admission to a level 2 or 3 nursery. It was stated that breastfeeding in this population might be delayed onset of NAS.	impact of lifestyle related factors. The article states, "These results should encourage further study in the context of a randomized design with prognostic stratification on breastfeeding" (p. 1730). Along with this, under care of nursing and medical staff, rooming in should be implemented more for a safe intervention for NAS.	also noticed the sample sizes for the different groups were not the same, which could have possibly skewed the results. The study could not separate the effects of rooming in from those of breastfeeding, so they should replicate the study in a large sample of women not breastfeeding to explore outcomes independently linked with rooming in. .
3: Abrahams, R. R., MacKay-Dunn, M. H., Nevmerjitskaia, V., MacRae, G. S., Payne, S. P., & Hodgson, Z.	**Purpose Statement:** To determine if an interdisciplinary rooming-in model of care affects clinical and psychosocial	**Setting:** Fir Square unit of BC Women's Hospital, Royal Columbian, Victoria General, Surrey Memorial, Matsqui-Sumas-	**Design:** Retrospective cohort study **Level of Evidence:** 4	The rooming-in group had a significant decrease in admission and length of stay in the	Rooming-in is valuable to the care of substance-exposed infants. Future areas of study include	The study could not report how morphine administration changed neonatal

G. (2010). An evaluation of rooming-in among substance-exposed newborns in british columbia. *Journal of Obstetrics and Gynaecology Canada*, *32*(9), 866–871. doi: 10.1016/S1701-2163(16)34659-X	outcomes in substance-exposed newborns. **Research Question:** Is there a difference in clinical and psychosocial outcomes between substance-exposed newborns whose care follows a traditional standard care model as compared to an interdisciplinary rooming-in model of care?	Abbotsford General, Burnaby General, St. Paul's, Richmond General, Lion's Gate, Royal Inland, Kelowna General, Nanaimo Regional General, and Prince George Regional. **Sampling Method:** Reviewed data from all neonates of women who used substances during pregnancy that delivered in British Columbia between October 1, 2003 and December 31, 2006. Neonates and their mothers were put into two groups based on whether they gave birth at BC Women's Hospital (where rooming-in care was received) or elsewhere in British Columbia (where standard care was received). **Sample Size:** There were a total of 952 substance-exposed neonates with 355 in the rooming-in group and 597 in the standard care group.		NICU, an increased chance of receiving breast milk during their hospital stay, and an increased chance of being discharged home with their mothers. The standard care group was found to have a significantly shorter length of stay on average (11 days compared to 21 days in the rooming-in group).There was no significant difference between the two groups with respect to neonatal withdrawal symptoms.	performing an economic evaluation for providing appropriate care to substance-using women and examining whether rooming-in influences morphine administration for neonatal withdrawal.	outcomes because this variable wasn't recorded. The presence or absence of neonatal withdrawal symptoms is considered unreliable because institutions vary on their reporting method. The study was unable to report which types of substances were used during pregnancy, which could affect the comparability of the two groups.
4: Bagley, S. M., Wachman, E. M., Holland, E., & Brogly, S. B. (2014). Review	**Purpose Statement:** **"**The objective of this review is to summarize available	**Setting:** Articles that were used in this systematic search were found on PubMed and the Cochrane	**Design:** Systematic Review **Level of**	**Findings:** Four of the studies showed length of hospital stay three to	**Practice & Research Implications:** This systematic review clearly showed through	**Limitations of Findings:** Studies often didn't differentiate

of the assessment and management of neonatal abstinence syndrome. *Addiction Science & Clinical Practice*, *9*(19), 1-10. doi: 10.1186/1940-0640-9-19	evidence on the assessment and management of infants exposed to opioids in utero, including assessment tools used for NAS scoring, nonpharmacologic interventions, and pharmacologic management of NAS" (p. 2). **Research Question:** What does published English-language literature have to say about assessment of NAS, as well as nonpharmacologic interventions and pharmacologic treatments for NAS?	Database. The articles were published between 1975 and November 15, 2013. **Sampling Method:** Finding articles using specific keywords. For nonpharmacologic treatment, they included studies composed of cohort, case series, case control, and randomized controlled trials. **Sample Size:** 13 of the 879 articles pertaining to nonpharmacologic interventions were included in this review.	**Evidence:** 1	nineteen days shorter in breastfed infants. Four of the studies showed 30 percent decrease in pharmacologic treatment for NAS. One study found breastfed infants showed signs of withdrawal significantly later than formula fed infants. In regards to rooming in, two studies showed overall decreased length of hospital stay and duration of therapy. These interventions increase bonding and help normalize the postpartum process for women with opioid history who may feel vulnerable and stigmatized.	multiple articles that breastfeeding and rooming in help neonates with NAS. Due to these findings, it is crucial for hospitals to all start implementing these interventions by teaching their staff on how to implement them. The article stated that low breastfeeding rates in this population are likely due to feeding difficulties in these infants. This may open up a window for learning how to help these neonates with feeding difficulties. Further studies should also focus on how to increase rates of rooming in and breastfeeding.	between expressed breast milk and breastfeeding, they did not compare exclusive breastfeeding versus combination feeding and neonates fed with formula only. Duration of breastfeeding was also not defined. Bias was also introduced due to the fact that criteria for permitting breastfeeding were not described in every study.
5: Boucher, A. (2017). Nonopioid management of neonatal abstinence	**Purpose Statement:** To examine the effectiveness of rooming-in care and acupuncture as	**Setting:** PubMed, Ovid Medline, Embase, and CINAHL **Sampling Method:** The	**Design:** Systematic Review **Level of**	Several studies concluded that infants with NAS who receive	Randomized controlled trials should be performed in the future in order to determine	This study is nonrandomized and uncontrolled.

syndrome. *Advances in Neonatal Care*, *17*(2), 84–90. doi: 10.1097/ANC.0000000000000371	nonpharmacologic treatments to decrease the amount of postpartum neonatal opioid exposure and length of hospital stay. **Research Question:** Is there a difference in amount of postpartum neonatal opioid exposure and length of hospital stay in neonates who receive rooming-in care and acupuncture?	above databases were searched for primary sources on rooming-in care and acupuncture as treatments for NAS **Sample Size:** Eight research studies were chosen to be examined in this systematic review.	**Evidence:** 1	rooming-in care have a decreased likelihood of needing pharmacologic treatment; even when pharmacologic treatment is needed, length of hospital stay and opioid exposure is decreased.	the necessary components of a rooming-in care model for NAS treatment. In the present, healthcare providers should be encouraged to offer rooming-in care to postpartum mothers with infants at risk for NAS.	
6: Brown, M. S., Hayes, M. J., & Thornton, L. M. (2015). Methadone versus morphine for treatment of neonatal abstinence syndrome: a prospective randomized clinical trial. *Journal of Perinatology*, *35*(4), 278–283. https://doi.org/10.1038/jp.2014.194	**Purpose Statement:** To compare the length of methadone and morphine treatment for Neonatal Abstinence Syndrome. **Research Question:** Is there a difference in the length of treatment for Neonatal Abstinence Syndrome between methadone and morphine?	**Setting:** The Neonatal Intensive Care and Pediatric Inpatient units at Eastern Maine Medical Center. **Sampling Method:** Mothers in labor who were admitted between January 2011 and October 2012 were included in the study if they met the following criteria: "(i) prenatal exposure to prescribed methadone or buprenorphine, (ii) meeting our NAS treatment criteria, (iii) adjusted gestational age of > 350/7 weeks assessed from best menstrual, obstetrical and physical	**Design:** Randomized Controlled Trial **Level of Evidence:** 2	**Findings:** Length of treatment was significantly reduced for neonates treated with methadone (14 days) compared to neonates treated with morphine (21 days). Neonates treated with methadone had a reduced need for a rescue drug compared to neonates treated with morphine; however, this finding wasn't statistically	**Practice & Research Implications:** A multicenter trial should be performed to enable the findings of the study to be generalized to the neonate population.	**Limitations of Findings:** This study was a single site pilot and was unable to include as many neonates in the study as previously hoped. The small sample size means that findings cannot be generalized to the population. Findings could have been affected by the fact that maternal methadone doses at birth were lower in the neonates treated

		exam criteria, and (iv) otherwise medically stable in the opinion of the attending neonatologist" (p. 279). Mothers and their infants who qualified were then randomly assigned to receive treatment with either morphine or methadone. **Sample Size:** 198 mother-infants pairs were screened for inclusion in the study. Only 31 neonates met the inclusion criteria.		significant.		with methadone. Additionally, the sample population was mostly European American and therefore not ethnically diverse.
7: Crook, K., & Brandon, D. (2017). Prenatal breastfeeding education: Impact on infants with neonatal abstinence syndrome. *Lippincott Williams & Wilkins, 14*(4), 299-305. doi: 10.1097/ANC.0000000000000392	**Purpose Statement:** "To increase breastfeeding rates and decrease hospital length of stay for infants with NAS through prenatal breastfeeding initiatives" (p. 299). **Research Question:** Would prenatal breastfeeding initiatives for mothers with infants suffering from NAS increase breastfeeding rates and decrease length?	**Setting:** An outpatient OB clinic. **Sampling Method:** Infants in the study were divided into three groups; baseline status was births from February 2014 to August 2014, baby friendly status (BFS) was births from September 2014 to January 2015, then BFS plus breastfeeding education initiative were births from February 2015 to July 2015. **Sample Size:** A total of 200 infants were included in the study.	**Design:** Controlled Trials without Randomization **Level of Evidence:** 3	**Findings:** Average LOS for infants decreased from 18.8 days in the baseline group, to 13.1 days in the BFS group, to 10.4 days in the BFS with additional breastfeeding education group. Additionally, infants who received more than 50 percent human milk predicted to have a LOS that was 2.78 days shorter than infants who received all	**Practice & Research Implications:** Due to results suggest that prenatal education may contribute to an increase in infants with NAS receiving breast milk, which results in a decrease in hospital length of stay, prenatal education needs to be more stressed about in the community.	**Limitations of Findings:** The small sample cannot make it possible to infer direct impact of the intervention.

				formula.		
8: Dryden, C., Young, D., Hepburn, M. and Mactier, H. (2009). Maternal methadone use in pregnancy: Factors associated with the development of neonatal abstinence syndrome and implications for health care resources. *British Journal of Obstetrics & Gynaecology*, *116*, 665–671. doi:10.1111/j.1471-0528.2008.02073.x	**Purpose Statement:** "To investigate factors associated with the development of NAS and to assess the implications for health care resources of infants born to drug misusing women" (p. 665). **Research Question:** Is the implications provided by healthcare resources helping infants born to drug misusing women?	**Setting:** An inner city maternity hospital, Princess Royal Maternity in Glasgow, United Kingdom. **Sampling Method:** The article presents data over a 3 year period, from January 2004 to December 2006 to a large cohort of drug misusing mothers. **Sample Size:** This article collected data for 437 infants and 440 mothers.	**Design:** Retrospective Cohort Study **Level of Evidence:** 4	**Findings:** Breastfeeding for greater than or equal to 72 hours was associated with decreasing the odds of the neonate needing treatment for NAS by 50 percent, which decreases their hospital stay. The article states breastfeeding soothes agitated infants, and the drugs taken by the mom are excreted in the milk, decreasing the effects of withdrawal. Postnatal stay was recommended for intensive parenting support.	**Practice & Research Implications:** Learning preterm infants have a hard time suckling, and many drug misusing mothers choose not to breastfeed due to social prejudice, we need to increase programs to help these causes. The public needs to learn the importance of this intervention. We need appropriate support services in the community as well, because 50 percent neonates failed to attend outpatient appointments.	**Limitations of Findings:** The article could have compared health care resources now provided for NAS, compared to those provided in the past, to have a comparison group.
9: Hodgson, Z. G., & Abrahams, R. R. (2012). A Rooming-in Program to Mitigate the Need to Treat for Opiate Withdrawal in the Newborn. *Journal of Obstetrics and*	**Purpose Statement:** "...to explore the effect of our rooming-in protocol on the need to treat withdrawal in the opiate-exposed newborn" (p. 475). **Research Question:**	**Setting:** Fir Square, a combined care unit within BC Women's Hospital, mother-child dyads between 10/01/2003-12/31/2006. **Sample Method:** Mothers selected during a certain	**Design:** Retrospective cohort study **Level of Evidence:** 4	**Findings:** "...significant positive relationship between maternal methadone dose at delivery, 'other opiate' use, and	**Practice & Research Implications**: Rooming-in is a safer and more beneficial alternative to the current standard practice of separating mother and opioid-	**Limitations of Findings:** Recommends looking into illicit drug use and methadone relationship over the course of the

Gynaecology Canada, *34*(5), 475–481. doi:10.1016/S1701-2163(16)35245-8	Does this rooming-in program help reduce the amount of maternal methadone required to treat opiate withdrawal in newborns?	study period. **Sample Size:** 295 women between the age of 27.5 +/- 6.2 years, 295 neonates.		breastfeeding and the need to treat the neonate for withdrawal...maternal methadone dose at delivery...related to the duration of pharmacological treatment of the neonate" (p. 475).	dependent infant. "The current study suggests a useful role for rooming-in in mitigating the relationship between maternal methadone dose and the need to treat the newborn for opiate withdrawal" (p. 480).	pregnancy to treat infant opioid withdrawal.
10: Holmes, A., Atwood, E., Whalen, B., Beliveau, J., Jarvis, D., Matulis, J., Ralston, S. (2016). Rooming-in to treat neonatal abstinence syndrome: Improved family-centered care at lower cost. *American Academy of Pediatrics*, *137*(6), e1-e9. doi:10.1542/peds.2015-2929	**Purpose Statement:** "To determine how to improve the care of opioid-exposed newborns by involving families, standardizing assessment and treatment, and transitioning to rooming-in for the full hospital stay" (p. e2). **Research Question:** Is there a difference in length of stay and hospital costs when a coordinated program for NAS is implemented, which includes standardized scoring, weaning of medications,, and a calm rooming in environment, compared to infants treated without	**Setting:** Dartmouth-Hitchcock, a Children's Hospital, which provides inpatient, critical care, and pediatric specialty services to most of New Hampshire and a portion of Vermont. **Sampling Method:** The research included all birth hospitalizations between March 2012 and February 2015, using patients with reported or laboratory confirmed maternal opioid use. **Sample Size:** Began with a pilot group of 10 opioid dependent women, then expanded it for all infants. 163 newborns treated for NAS was used in the study. 69 newborns	**Design:** Controlled Trials without Randomization **Level of Evidence:** 3	**Findings:** For infants with NAS treated with the new implementations, LOS was reduced from 23 days to 12 days, system costs decreased by more than half. Costs are decreased not only because the LOS is decreased, but due to the rooming in model. Critical care beds no longer have to be used for this condition, which greatly decreases care costs.	**Practice & Research Implications:** While achieving the outcomes they have hoped for, they also saw positive family engagement, increased family preparation and involvement, and trained clinical teams better on how to take care of these patient situations. These outcomes are major findings in the nursing realm, and shows that involving families, standardizing assessment and treatment, and rooming in for a full hospital stay should be	**Limitations of Findings:** The same six pediatricians were attending to the patients. Mother's in the hospital service area are maintained on buprenorphine more commonly than methadone, which is seen with a shorter length of treatment. Rooming-in program socially acceptable in Hampshire and Vermont because they do not

	this program being implemented?	received pharmacologic treatment, while 94 newborns did not require pharmacological treatment and just focused on the interventions of the study. These included standardize scoring, rooming in, prenatal family education, and environmental management.			seen in more hospitals in the future.	impose mandatory foster care placement for opioid exposed newborns, unlike other states.
11: Holmes, A. P., Schmidlin, H. N., & Kurzum, E. N. (2017). Breastfeeding considerations for mothers of infants with neonatal abstinence syndrome. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, *37*(7), 861–869. doi:10.1002/phar.1944	**Purpose Statement:** To identify different benefits of breastfeeding infants with NAS to reduce withdrawal syndromes and determine the clinician's role in promoting, identifying, and counseling the mothers. **Research Question:** What role does the clinician have in advocating for mothers to breastfeed the infants born with NAS?	**Setting:** Retrieved from databases. **Sample Method:** Multiple studies where some infants are breastfed and some are formula fed. Each article has its own requirements to determine which infants were formula fed and which were breastfed. **Sample Size:** Reviewed five studies with a focus on breastfeeding compared to formula feeding.	**Design:** Systematic review **Level of Evidence:** 1	**Findings:** Breastfeeding promotes weight gain, skin-to-skin contact, and the mother-infant bond. "…infants with NAS who were fed primarily breast milk compared with those fed formula had a later onset of NAS (10 vs 3 days, $p<0.001$), required pharmacologic treatment less often (52.9% vs 79%, $p<0.001$), and had a shorter length of stay (LOS) (15 vs 19 days, $p=0.049$)" (p. 862).	**Practice & Research Implications**: "Clinicians can play an important role in identifying, promoting, and counseling mothers of infants with NAS regarding breastfeeding" (p. 868). Monitor for rebound NAS and mothers continuing to abuse substances.	**Limitations of Findings:** Barriers to study include inconsistent and inaccurate data that causes healthcare providers to continue to discourage drug-dependent mothers from breastfeeding. Social prejudice against the mothers is also another barrier to treatment.

12: Hudak, M. L., Tan, R. C., Drugs, T. C. O., & Newborn, T. C. on F. A. (2012). Neonatal drug withdrawal. *Pediatrics*, *129*(2), e540–e560. doi:10.1542/peds.2011-3212	**Purpose Statement:** To explore "therapeutic options for treatment of withdrawal" and determine evidence-based management practices of the infant with NAS (p. 1). **Research Question:** What are the current evidence-based practices for treatment and management of NAS?	**Setting:** Multiple hospitals and healthcare clinics **Sample Method:** Reviewing scientific research on the subject of NAS **Sample Size:** N/A	**Design:** Expert Opinion **Level of Evidence:** 7	**Findings:** "Drug therapy is indicated to relieve moderate to severe signs of NAS and to prevent complications such as fever, weight loss, and seizures if an infant does not respond to a committed program of nonpharmacologic support" (p. e548). "When possible, and if not otherwise contraindicated, mothers who adhere to a supervised drug treatment program should be encouraged to breastfeed so long as the infant continues to gain weight. Breastfeeding or the feeding of human milk has been associated with less severe NAS that presents	**Practice & Research Implications**: Each clinic should establish a threshold level for total opioid exposure, have weaning protocol for infants exposed to opioids, and monitor for S/S of withdrawal 24 hours after discontinuing an opioid. Have protocol and screening in place at nurseries for S/S of NAS or risk of developing withdrawal.	**Limitations of Findings:** "Studies have not addressed whether long-term morbidity related to neonatal drug withdrawal is decreased by pharmacologic management of affected infants, or whether continued postnatal drug exposure augments the risk of neurobehavioral and other morbidities. It is possible that pharmacologic therapy of the infant may introduce or reinforce a maternal disposition to rely on drugs for the treatment of infant discomfort or annoying behavior" (p. e548).

				later and less frequently requires pharmacologic intervention" (p. e548).		
13: 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	**Purpose Statement:** To coordinate a managed care plan for opiate dependent women that reduces the public health burden posed by NAS, by outlining the risks of fetal drug exposure, emphasizes the benefits of providing mother breast milk to infants, and cautions against rapidly weaning infants from mother breast milk. **Research Question:** Is there a reduced public health burden posed by NAS when opiate dependent women are treated through a managed care plan?	**Setting:** In the newborn intensive care unit at The University Hospital in Cincinnati, Ohio. **Sampling Method:** All newborns that received methadone therapy for NAS at The University Hospital between January 2002 and December 2007. **Sample Size:** 128 infants, with a total of 1528 methadone treatment days were included in the analyses. Of the 128 infants, 56 of the term infants had breast milk available to them.	**Design:** Retrospective Cohort Study **Level of Evidence:** 4	**Findings:** Shorter median duration of methadone therapy in both preterm and term infants were found with infants feed breast milk. Breast milk feed infants had a shorter hospital stay, 3 to 51 days, compared to formula fed infants hospital stay ranging from 9 to 43 days. Through the study they estimated that the intake of methadone from breast milk could be as high as 0.05mg kg daily, which may help prevent or decrease the severity of NAS.	**Practice & Research Implications:** Through the study, they taught the women not to abruptly stop infant's ingestion of breast milk, for it could precipitate rebound withdrawal. I would like to see more future studies identifying infants at risk for rebound NAS. The article states providers should aim for a individualized approach to initial methadone dosing, which takes into consideration the gestational age and the availability of breast milk as a primary nutrition. Due to this finding, I think it is important for more physicians taught on proper methadone dosing.	**Limitations of Findings:** The retrospective study had incomplete data collection from the medical records, and stated that infants rehospitalized for withdrawal symptoms may have been underestimated. Also, since the article was about benefits of breastfeeding to help with NAS, the article stated they may have possibly contributed to decreased length of hospital stay due to bias in initiating therapy.
14: Jansson, L. M.,	**Purpose Statement:** To	**Setting:** N/A	**Design:**	"More infants in the	While it appears that	The study's results

Choo, R., Velez, M. L., Harrow, C., Schroeder, J. R., Shakleya, D. M., & Huestis, M. A. (2008). Methadone maintenance and breastfeeding in the neonatal period. *Pediatrics*, *121*(1), 106–114. doi:10.1542/peds.2007-1182	evaluate concentrations of methadone in breast milk as well as maternal and infant plasma among methadone-maintained breastfeeding women compared to formula-feeding women. **Research Question:** Is there a difference in concentrations of methadone in breast milk as well as maternal and infant plasma among methadone-maintained breastfeeding women compared to formula-feeding women?	**Sampling Method:** Subjects enrolled in a substance abuse treatment program for pregnant and postpartum drug-dependent women between January 2001 and September 2005. Subjects were included in the study if they met the following criteria: "Single daily dose of methadone, absence of significant fetal or maternal complications, singleton pregnancies, expressing a desire to breastfeed at routine obstetric care visits, abstinence from licit/illicit substance use after 32 weeks gestation, and compliance with program standards" (p. 107). **Sample Size:** Eight women met the criteria and were called the breastfeeding group. These women were compared to eight control subjects who were called the formula-feeding group.	Controlled Trial without Randomization **Level of Evidence:** 3	control (formula-fed) group required pharmacologic treatment for NAS (4 infants, compared with 1 breastfed infant), but this association was not statistically significant" (p. 110). A substantial increase in methadone concentrations in breast milk was noted over time. "There was no significant correlation between maternal methadone doses and infant plasma methadone concentrations" (p.112). There was no association between neonatal methadone concentrations and breastfeeding or receiving pharmacologic treatment for NAS.	the benefits of breastfeeding outweigh the effect a small concentration of methadone found in breast milk might have, more research should be performed to determine the long-term effects of methadone on developing infants. Overall, the study recommends breastfeeding among pregnant women maintained on methadone.	are based on very small group sizes. The results exhibit bias due to the need for reconstitution of several infant plasma specimens that dried out while in storage. This caused those concentration values to be overestimated.
15: Kocherlakota, P. (2014). Neonatal abstinence syndrome.	**Purpose Statement:** To explain NAS, its history, clinical	**Setting:** Children's Hospital at New York Medical College, Valhalla,	**Design:** Systematic Review	**Findings:** "Breastfeeding may decrease the	**Practice & Research Implications**: Assess neurological and	**Limitations of Findings:** Healthcare bias

Pediatrics, *134*(2), e547–e561. doi:10.1542/peds.2013-3524	presentations, treatments, and discharge/follow-up. **Research Question:** What is Neonatal Abstinence Syndrome?	New York. **Sample Method:** Complication of multiple journal articles. **Sample Size:** 187 journal articles.	**Level of Evidence:** 1	incidence of NAS, the need for pharmacological treatment, and the length of the hospital stay" (p. e555). "Nonpharmacological therapy is the first option in all cases, and may suffice in cases of mild withdrawal. Nonpharmacological therapy is easily acceptable, less expensive, and less controversial" (p. e553).	motor function, psycho-behavioral behavior, growth and nutrition for abnormalities and setbacks.	against mothers who breastfeed while on opioid agonist treatment. Mothers don't continue breastfeeding after they leave the hospital.
16: Kraft, W. K., Gibson, E., Dysart, K., Damle, V. S., LaRusso, J. L., Greenspan, J. S., … Ehrlich, M. E. (2008). Sublingual buprenorphine for treatment of neonatal abstinence syndrome: a randomized trial. *Pediatrics*, *122*(3), e601–e607. https://doi.org/10.1542/peds.2008-0571	**Purpose Statement:** To determine the viability, safety, and effectiveness of treating neonates with Neonatal Abstinence Syndrome with sublingual buprenorphine compared to the standard care neonatal opium solution (NOS). **Research Question:** Is there a difference in viability, safety, and effectiveness of treating neonates with Neonatal Abstinence Syndrome	**Setting:** Thomas Jefferson University Hospital in Philadelphia. **Sampling Method:** Mothers in labor who were admitted between April 2005 and January 2008 were included in the study if they met the following criteria: ">37 weeks' gestation, exposure to opioids in utero, and demonstration of signs and symptoms of NAS that required treatment" (p. e602). Mothers and their	**Design:** Randomized Controlled Trial **Level of Evidence:** 2	**Findings:** The average length of treatment for neonates treated with buprenorphine was 22 days compared to 32 days for neonates treated with NOS. The average length of hospital stay was 27 days for neonates treated with buprenorphine	**Practice & Research Implications:** Although the findings of this study suggest that buprenorphine is viable, safe, and effective treatment, a double-blind clinical trial with a larger sample size should be conducted in order for findings to be found statistically significant.	**Limitations of Findings:** This study was a single site pilot study, which means that findings cannot be generalized to the neonate population as a whole. Additionally, bias couldn't be completely eliminated during scoring of symptom severity.

	with sublingual buprenorphine compared to neonatal opium solution (NOS)?	infants who qualified were then randomly assigned to receive either sublingual buprenorphine or NOS. **Sample Size:** 26 neonates met the inclusion criteria. 13 neonates were treated with buprenorphine and 13 were treated with NOS.		compared to 38 days for neonates treated with NOS. Unfortunately, neither of these findings was statistically significant.		
17: Kraft, W. K., Adeniyi-Jones, S. C., Chervoneva, I., Greenspan, J. S., Abatemarco, D., Kaltenbach, K., Ehrlich, M. E. (2017). Buprenorphine for the treatment of the neonatal abstinence syndrome. *New England Journal of Medicine 376*(24), 2341-2348. doi:10.1056/NEJMoa1614835	**Purpose Statement:** "In the single-site, randomized, double-blind, double-dummy Blinded Buprenorphine or Neonatal Morphine Solution (BBORN) trial, we compared sublingual buprenorphine with oral morphine with respect to the duration of treatment in infants with the neonatal abstinence syndrome" (p. 2342). **Research Question:** Which pharmacologic treatment decreases the duration of treatment in infants with NAS, buprenorphine or morphine?	**Setting:** Thomas Jefferson University Hospital in Philadelphia **Sampling Method:** Mothers in this study were enrolled in an outpatient methadone treatment program from October 31, 2011 and May 29, 2016. 30 infants were randomly assigned to receive buprenorphine, while 28 were randomly assigned to receive morphine. **Sample Size:** 63 infants	**Design:** Randomized Controlled Trial **Level of Evidence:** 2	**Findings:** Buprenorphine is useful for treatment of neonatal abstinence syndrome due to its large therapeutic index for respiratory depression, along with having a long half-life. Primary outcomes included a decrease of duration of treatment with buprenorphine, with the mean number of days 13 days decrease compared to those treated with morphine. A decrease LOS of a mean of 12 days	**Practice & Research Implications:** This studies results shares the benefits of buprenorphine over morphine drug, showing the buprenorphine is beneficial to the treatment of NAS. With these results, buprenorphine should be used more often in these cases, and more research should be involved in this topic.	**Limitations of Findings**: Some limitations of this study include the small sample size and the single center design. The study also excluded preterm infants and those with benzodiazepine exposure in utero, causing the results to be invalid to this population.

				was found with buprenorphine.		
18: 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	**Purpose Statement:** "...to compare the impact of different feeding modalities on the onset of NAS" (p. 1). **Research Question:** What is the mechanism behind the beneficial effect of breast milk?	**Setting:** Two birthing units in Western Sydney from 2000 to 2006. **Sample Method:** Researchers looked at the medical records of 194 cases and organized the infants within the first 2 days of life. One group was mainly breastfed while the other was mainly formula fed. **Sample Size:** "…194 methadone-maintained mother/infant dyads" (p. 1).	**Design:** Retrospective Cohort Study **Level of Evidence:** 4	**Findings:** "After adjusting for confounders, there was no significant effect of the modality of feeding on the rates of NAS requiring treatment ($p = 0.11$). Breastfeeding significantly delayed the onset of NAS ($p = 0.04$). The act of breastfeeding in the first 2 days of life had no effect on whether an infant required treatment for NAS when compared to those fed EBM or formula" (p. 1).	**Practice & Research Implications**: Breastfed infants reacted to NAS the same as those who were formula fed. They encourage breastfeeding unless contraindicated in the mother. Breastfeeding isn't negative concerning NAS treatment and has other positive benefits.	**Limitations of Findings:** The small sample size of the sample groups made it difficult to prove the advantages of breastfeeding for infants with NAS.
19: 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. *American*	**Purpose Statement:** To determine the impact of rooming-in care for infants at risk of NAS on the necessity for pharmacologic treatment and length of hospital stay. **Research Question:** Is	**Setting:** Kingston General Hospital in Ontario, Canada **Sampling Method:** The study population was all infants considered at risk of developing NAS. The population was split into two groups. The first group	**Design:** Retrospective cohort study **Level of Evidence:** 4	The need for pharmacologic treatment has a strong association with the length of hospital stay. Rooming-in was found to decrease the need for	Future studies should examine the cost differences between rooming-in and admission to the NICU. More research should be done to test the relationship between breastfeeding and	The study was nonrandomized and uncontrolled. The study's small population numbers could have made it difficult to statistically detect

Journal of Perinatology, 33(5), 495-501. doi:10.1055/s-0035-1566295	there a difference in the need for pharmacologic treatment and length of hospitalization for infants at risk of neonatal abstinence syndrome (NAS) who take part in a rooming-in program compared to those who receive standard care?	of infants was born between May 1, 2012 and May 31, 2013 as these infants were admitted to the NICU. Infants born between June and August of 2013 were excluded. The second group of infants was born between September 1, 2013 and September 30, 2014 as these infants roomed-in with their mothers. **Sample Size:** There were a total of 44 infants with 24 in the NICU group and 20 in the rooming-in group.		pharmacologic treatment, decrease length of hospital stay, and is independent of breastfeeding.	rooming-in. Futures research should evaluate the possible barriers to employing rooming-in for pregnant substance users and their neonates.	differences between the two groups that could have affected the study's results. The study did not compare the types of drugs used by the mothers in the two groups.
20: Newman, A., Davies, G. A., Dow, K., Holmes, B., Macdonald, J., McKnight, S., & Newton, L. (2015). Rooming-in care for infants of opioid-dependent mothers: Implementation and evaluation at a tertiary care hospital. *Canadian Family Physician*, *61*(12), e555–e561. Retrieved from http://web.a.ebscohost.com.ezproxy.uakron.e	**Purpose Statement:** "To implement a rooming-in program to support close uninterrupted contact between opioid-dependent women and their infants in order to decrease the severity of NAS scores, lessen the need for pharmacotherapy, and shorten hospital stays" (p. e555). **Research Question:** Is there a difference in severity of NAS scores, the need for pharmacotherapy, or length of hospital stay	**Setting:** Kingston General Hospital located in Ontario. A tertiary care referral centre with a level 3 NICU. **Sampling Method:** All known opioid dependent mothers attending the multidisciplinary antenatal clinics by September 30th, 2014. Exclusion criteria if had planned apprehension by child protection services or existence of another neonatal condition that would require admission to the NICU. **Sample Size:** 21 women	**Design:** Controlled Trials without Randomization **Level of Evidence:** 3	**Findings:** The neonates in the rooming in cohort had significantly lower oral morphine therapy (14.3%) compared to those admitted directly to the NICU (83.3%). The LOS for those rooming in was 7.9 days, compared to 24.8 days seen in those directly admitted to the NICU.	**Practice & Research Implications:** Due to the significant findings in this research article, it is important for more hospitals to implement neonates rooming in rather than admitting them to the NICU.	**Limitations of Findings:** There might be a possible source of bias regarding the NAS scoring tool, for to quantify withdrawal severity, subjective judgment is used to some degree. Future research also has to be done to look at neonatal and childhood outcomes in the

du	with opioid dependent mothers and their neonates cared for with the new rooming in program, compared to those not rooming in?	were admitted to a private room in the pediatrics unit with their full term infants. 24 women whose babies were directly admitted to the NICU for direct observation.				long run.
21: 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 on buprenorphine during pregnancy. *Journal of Midwifery & Women's Health*, *58*(4), 383–388. doi:10.1111/jmwh.12009	**Purpose Statement:** To examine breastfeeding rates among opioid-dependent pregnant women on buprenorphine maintenance treatment and to determine the effects of breastfeeding on length, intensity, and frequency of pharmacologic treatment for neonates with NAS. **Research Question:** Is there a difference in length, intensity, and frequency of pharmacologic treatment for neonates with NAS who receive breast milk compared to non-breastfed neonates?	**Setting:** "An integrated medical and behavioral health program for opioid-dependent women…" (p. 384). **Sampling Method:** The charts of all opioid-dependent pregnant women on buprenorphine maintenance treatment who were in the integrated program from December 2007 to August 2012 were reviewed. **Sample Size:** 85 mother-infant pairs were examined in this study.	**Design:** Retrospective cohort study **Level of Evidence:** 4	"Although not statistically significant, preliminary results suggest that breastfeeding may attenuate NAS" (p. 385). The average NAS score and likelihood of pharmacologic treatment were lower in breastfed neonates. NAS symptoms resolved approximately 2 hours earlier in breastfed neonates than in non-breastfed neonates.	Although initial findings are positive, more research should be done with larger sample sizes to determine if breastfeeding causes a statistically significant difference in NAS severity and need for pharmacologic treatment.	This study could not measure the effects of breastfeeding on length of hospital stay because other variables (such as pregnancy complications other than NAS) were present in the study's sample. Because this study is nonrandomized and uncontrolled, it cannot be used to determine cause and effect. There was information missing regarding why the women in this study chose to begin and/or stop breastfeeding. Additionally, it is hard to differentiate the positive effects of

						breastfeeding from other nonpharmacologic treatments, such as skin-to-skin contact that occurs during breastfeeding. The small sample size, especially regarding the number of neonates in the non-breastfed group, diminished the study's ability to show statistical significance.

22: Ordean, A., Kahan, M., Graves, L., Abrahams, R., & Kim, T. (2015). Obstetrical and neonatal outcomes of methadone-maintained pregnant women: A canadian multisite cohort study. *Journal of Obstetrics and Gynaecology Canada*, *37*(3), 252–257. doi:10.1016/S1701-2163(15)30311-X	**Purpose Statement:** To compare obstetrical and neonatal outcomes, including NAS, among methadone-maintained pregnant women across three Canadian metropolitan cities. **Research Question:** Is there a difference in obstetrical and neonatal outcomes, including NAS, among methadone-maintained pregnant women across three Canadian metropolitan cities?	**Setting:** The Sheway Clinic in Vancouver (which uses rooming-in care for infants with NAS), the Toronto Centre for Substance Use in Pregnancy, and the Herzl Family Practice Centre in Montreal (both of which admit infants with NAS to the NICU). **Sampling Method:** Reviewed the medical records of pregnant women with a history of opioid use that were eligible for or already receiving methadone-maintenance treatment (MMT) at integrated care programs in three Canadian cities from 1997 to 2009. **Sample Size:** There were a total of 94 women in the study with 36 from Toronto, 36 from Vancouver, and 22 from Montreal.	**Design:** Retrospective cohort study **Level of Evidence:** 4	In the Vancouver site where rooming-in care was used, there was a reduced rate of NICU admission, an increased length of hospital stay, and a shorter duration of NAS treatment. These findings are all consistent with the hypothesis that rooming-in decreases the need for treatment of newborns with NAS.	Policies should promote maternal-newborn contact, rooming-in care, and breastfeeding as methods to decrease NAS symptoms and the need for pharmacologic treatment.	This study is nonrandomized and uncontrolled. There are inconsistencies and omissions in the data due to frequent documentation issues in patient charts. Additionally, the results of this study may not be universally applicable to methadone-maintained pregnant women who have not received prenatal care.
23: Pritham, U. A. (2013). Breastfeeding promotion for management of neonatal abstinence syndrome. *Journal of Obstetric, Gynecologic*	**Purpose Statement:** "...to educate perinatal clinicians and substance abuse treatment specialists about NAS and the interplay of breastfeeding, skin-to-	**Setting:** PubMed, CINAHL, and Medline **Sample Method:** In the databases mentioned above, the keywords used were: "…opioid dependency in pregnancy, neonatal	**Design:** Systematic Review **Level of Evidence:** 1	**Findings:** Breastfeeding is shown to decrease need of treatment, LOS, severity, and duration of NAS. It is also shown to	**Practice & Research Implications**: This study encourages healthcare workers to reassure and educate the mothers of opioid-dependent infants about	**Limitations of Findings:** "Further research is needed to determine differences in NAS between

& Neonatal Nursing, *42*(5), 517–526. doi:10.1111/1552-6909.12242	skin contact, and swaddling on NAS symptom management" (p. 517). **Research Question:** Should breastfeeding be recommended as a long-term health treatment for high risk mothers and their newborn infants with NAS?	abstinence syndrome, methadone, buprenorphine, neonatal length of stay, breastfeeding, methadone in breast milk, buprenorphine in breast milk, swaddling, and rooming-in" (p. 517). **Sample Size:** Articles published between January 1990 and April 2013.		promote bonding and infant attachment between the mother and child.	the benefits of breastfeeding, both for the mother and infant.	neonates who were breastfed and those who were fed pumped breast milk or donor milk. The safety of breastfeeding while on psychotropic medications with opioid replacement therapy also needs further exploration" (p. 524).
24: Raffaeli, G., Cavallaro, G., Allegaert, K., Wildschut, E. D., Fumagalli, M., Agosti, M., Tibboel, D., Mosca, F. (2017). Neonatal abstinence syndrome: Update on diagnostic and therapeutic strategies. *Pharmacotherapy Publications 37*(7), 814-823. doi:10.1002/phar.1954	**Purpose Statement:** "The aim of this review is to examine recent and relevant scientific literature on NAS, to increase awareness of the severe potential impact of in utero drug exposure on the developing child, and to highlight preventive strategies, early diagnosis, educational programs, evidence based standardized management, and research agendas as priority	**Setting:** Medical journals. **Sampling Method:** Reviewing recent and relevant scientific literature on NAS. **Sample Size:** N/A	**Design:** Expert Opinion **Level of Evidence:** 7	**Findings:** Morphine is often the first line agent to treat NAS with methadone being another alternative, but its safety profile is not totally known. 50-80% of opiate exposed neonates require pharmacologic management. Compared with methadone, buprenorphine-exposed neonates	**Practice & Research Implications:** More tailored therapy regarding pharmacologic management should be done to better understand the risks associated with them. Community awareness of the impact of NAS on health care will maybe generate supportive policies to expand on research related to this topic. Implementation of standard weaning	**Limitations of Findings**: Limitations of this study involve no specifically stating how many articles were reviewed, where they were found, and the time period these articles were published.

	issues" (p. 815). **Research Question:** What does recent and relevant scientific literature have to say regarding NAS, and evidence based standardized management?			have a milder NAS course.	protocols is also important to research more on, for it has a positive impact on length of pharmacologic therapy.	
25: Saiki, T., Lee, S., Hannam, S., & Greenough, A. (2010). Neonatal abstinence syndrome—postnatal ward versus neonatal unit management. *European Journal of Pediatrics*, *169*(1), 95. doi:10.1007/s00431-009-0994-0	**Purpose Statement:** To determine if caring for infants with NAS on the postpartum unit with their mothers will reduce treatment duration and length of hospital stay when compared to infants admitted to the NICU or neonatal unit. **Research Question:** Is there a difference in treatment duration and length of hospital stay in infants with NAS when they are cared for on the postpartum unit compared to in the NICU or neonatal unit?	**Setting:** King's College Hospital (KCH) in Denmark Hill, London, UK **Sampling Method:** Two groups of infants with NAS were examined. The first group was comprised of all infants with NAS cared for between 2002 and 2005 who were admitted to the neonatal unit. The second group was comprised of all infants with NAS cared for between 2006 and 2007 who remained on the postpartum unit with their mother. **Sample Size:** There were 42 infants in the neonatal unit group and 18 infants in the postpartum unit group.	**Design:** Retrospective cohort study **Level of Evidence:** 4	Infants who were cared for on the postpartum unit with their mother required less treatment, a decreased length of treatment, and a decreased length of hospital stay.	Further studies, particularly randomized trials, should be performed to examine postpartum unit management of infants with NAS.	The largest limitation to this study was that it was not a randomized trial.
26: Welle-Strand, G. K., Skurtveit, S., Jansson, L. M.,	**Purpose Statement:** "To examine the rate and duration of breastfeeding	**Setting:** Regional treatment centres for OMT in Norway, 18 different	**Design:** Retrospective Cohort Study	**Findings:** 77 percent of the women in OMT	**Practice & Research Implications:** Since breastfeeding benefits	**Limitations of Findings:** Only one part of the

Bakstad, B., Bjarkø, L., & Ravndal, E. (2013). Breastfeeding reduces the need for withdrawal treatment in opioid exposed infants. *Acta Paediatrica, 102*(11), 1060-1066. doi:10.1111/APA.12378	in a cohort of women in opioid maintenance treatment (OMT) in Norwary, as well as the effect of breastfeeding on the incidence and duration of NAS" (p. 1060). **Research Question:** Is there a difference in the duration or incidence of NAS as a result of breastfeeding in a cohort of women in OMT?	hospitals were used. **Sampling Method:** "A national cohort of women treated with either methadone or buprenorphine during pregnancy, and their neonates born between 1999 and 2009" (p. 1060). A standard questionnaire was passed out and medical information was collected to confirm self-reported data. **Sample Size:** A total of 124 women and children were included in this study.	**Level of Evidence:** 4	breastfed. Breastfed neonates who prenatally were exposed to methadone required less pharmacotherapy for NAS. All breastfed neonates needed less pharmacological treatment for NAS compared to those who were not breastfed.	both the mother and child, we need to increase the rates among women in OMT. We need to increase support for these women. It may already be harder for them due to lactation difficulty found in OMT women and Nas associated behaviours make breastfeeding more difficult.	study consisted of a prospective design, and the retrospectively designed study maybe have less accurate data due to relying on recall. Also, the children were born in 18 different hospitals with different assessment skills of NAS at each. Lastly, the questionnaire did not cover breastfeeding that in depth, so we don't know how long the women exclusively breastfed for.