

2018

Rooming-in and neonatal abstinence syndrome : a systematic review

Jacobs-Byrne, Tamara

<http://knowledgecommons.lakeheadu.ca/handle/2453/4303>

Downloaded from Lakehead University, Knowledge Commons

Rooming-in and Neonatal Abstinence Syndrome

A Systematic Review

by

Tamara Jacobs-Byrne

A Thesis

Presented to Lakehead University

in fulfillment of the thesis requirement for the degree of
Masters of Social Work

Thunder Bay, Ontario, Canada

August, 2018

© Tamara Jacobs-Byrne 2018

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, included final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public

Abstract

Aim: The purpose of this systematic review was to critically examine the literature about the effectiveness of rooming-in compared to traditional care settings such as the Neonatal Intensive Care Unit (NICU) for newborns with Neonatal Abstinence Syndrome (NAS).

Background: NAS is a multi-system disorder observed in newborns experiencing withdrawal following in-utero opioid exposure. Rooming-in may be beneficial to newborns with NAS as outcomes may reduce the need for pharmacologic treatment, the duration of pharmacologic treatment, and shorten length of stay (LOS). Although the studies support rooming-in, information in this area of research is limited. Based on the little evidence known, rooming-in may provide beneficial outcomes for newborns with NAS symptoms. Therefore examining the outcomes of NAS and rooming-in may be insightful to the contribution of research in this area of NAS.

Method: A systematic search exploring the effects of rooming-in and NAS in newborns was conducted using the following electronic databases: Pubmed, Proquest, PsychoInfo, OVID Joanna Briggs Institute of systematic reviews, CINAHL, Nursing and Allied Health, Evidence-Based Medicine, Web of Science, Cochrane Database of Systematic Review, DARE and Medline (EMBASE). Studies were eligible for inclusion in the review if they fulfilled the following criteria: (1) reported outcome data for newborns with NAS and rooming-in care, (2) primary studies, (3) quantitative studies with a comparison group, (4) peer-reviewed, and (5) were published in English. Selected studies were assessed by two appraisers using the JBI Standardized critical appraisal checklist for cohort studies.

Findings: The search identified two hundred sixteen (n = 216 studies). An additional two studies were retrieved through a forward citation search. Following removal of studies that did not meet the inclusion criteria, six studies remained for the systematic review. The results from this review suggest that rooming-in has the potential to improve NAS outcomes including: a decreased need for pharmacologic treatment, a shorter duration of pharmacologic treatment, a reduction in hospital stay, and healthcare cost savings. These findings support the need for rooming-in to care for newborn with NAS symptoms.

Conclusion: The findings from this systematic review suggest that rooming-in for newborns with NAS was effective in reducing the duration of pharmacologic treatment, need for pharmacologic treatment, and length of hospital stay compared to traditional care settings. Rooming-in should be explored as a care model for select newborns however further investigation is required with larger sample sizes and a more detailed description of rooming-in in order to gain further insight.

Acknowledgements

I would like to take the opportunity to thank several important people that contributed to helping me make this thesis possible.

Jodie and Karen –your continuous mentorship, suggestions and encouragement has helped me to prepare a thesis that I am proud of. The knowledge and research I have learned from both of you is greatly appreciated. Without your encouragement, I could have not prepared this thesis. Thank you to my supervisor, Jodie Murphy-Oikonen, for being my supervisor. You had faith in me always and pushed me to challenge myself in ways I cannot imagine. I have learned so much from you and I cannot imagine having anyone else as a mentor.

Carleigh –Thank you for pushing me and motivating me when times got tough. Your encouragement is appreciated.

To my family and friends – especially my husband, Dwayne and three children: Finleigh, Gabriele and Jackson. Your patience, understanding, love, encouragement and support helped me to push through and complete my MSW. I love you all and appreciate all of your support during the school year.

Lakehead University – Thank you for the opportunity to be a student at your institution, your flexibility and support is appreciated.

Rooming-in and Neonatal Abstinence Syndrome

A Systematic Review

The rise in opioid substance use has led to a high prevalence of Neonatal Abstinence Syndrome (NAS) in Canada, United States, Europe and Australia (Davies, Gilbert, Johnson, Petersen, Nazareth, O'Donnell, Guttman, & Gonzalez-Izquierdo, 2016) thereby identifying a global concern. Newborns of mothers who utilize opioid substances may develop NAS and typically require prolonged care in the Neonatal Intensive Care Unit (NICU) (Saiki, Lee, Hannam & Greenough, 2009). While NICU care is common, emerging evidence supporting rooming-in has been noted as an effective care approach to caring for this population of newborns resulting in shorter hospital admissions, reduced duration of pharmacologic treatment (Hunseler, Bruckle, Roth & Kribs, 2013), a decreased need for pharmacologic treatment and less interference between maternal-newborn bonding (Saiki et al., 2009).

NAS is a multi-system disorder observed in newborns experiencing withdrawal following in-utero opioid exposure (Dow, Ordean, Murphy-Oikonen, Pereira, Koren, Roukema, & Turner, 2012; McQueen & Murphy-Oikonen, 2016). Exposure to opiates may result in poor neonatal outcomes such as low birth weight (Dow et al., 2012), preterm birth, congenital malformations, small for gestational age, and stillbirths (Norgaard, Neilsson, & Heide-Jorgensen, 2015).

NAS is characterized by dysregulation in the neurologic, autonomic, and gastrointestinal systems (Patrick, Kaplan, Passarella, Davis, & Lorch, 2014). Neurologic irritability includes tremors, irritability, high-pitched crying, reduced quality and length of sleep, increased muscle tone, seizures, hyperactive deep tendon reflexes and exaggerated moro reflex (Hudak & Tan, 2012). Autonomic dysregulation includes sweating, frequent yawning, sneezing, and increased respiration (Jansson, Velez, & Harlow, 2009). Gastrointestinal dysfunction includes difficulties

in feeding, loose stools, excessive sucking, regurgitation or projectile vomiting (McQueen, Murphy-Oikonen & Desaulniers, 2015).

The onset of NAS is likely observed within 24-72 hours (Hudak & Tan, 2012). However, a recent study reported the onset of NAS symptoms might appear as early as 8.3 hours after birth (McQueen, Murphy-Oikonen, & Desaulniers, 2015). Delayed onset of NAS may occur later depending on the half-life of the opioid substance (Kocherlakota, 2014). The symptoms of NAS varies with the opioid, maternal drug history, maternal metabolism, net transfer of the substance across the placenta, placental metabolism, and newborn metabolism and excretion (Hudak & Tan, 2012).

Typically newborns with NAS are cared for in the NICU where they are monitored by nursing staff and often placed on a treatment protocol which may include pharmacologic treatment (Brown, Hayes, & LaBrie, 2011). The NICU is often noisy, bright, and isolating which may be counterproductive to caring for this population of newborns, therefore rooming-in has been encouraged (McKnight, Coe, Davies, Holmes, Newman, Newton, & Dow, 2015) in some healthcare institutions. Caring for newborns in NICU may be necessary for newborns with severe NAS symptoms (Hunseler et al., 2013) but presents barriers for mothers to bond with their newborns as separation typically occurs (Abrahams, MackKay-Dunn, Nevmerjitskaia, MacRae, Payne, & Hodgson, 2010). Maternal-newborn separation has led to concerns regarding bonding and long-term neurodevelopmental impacts on the newborn (Haabrekke, Slinning, Walhovd, Wentzel-Larsen, & Moe, 2014; Kocherlakota, 2014). Other barriers such as weaning can prolong pharmacologic treatment, hospital admissions and contribute to greater healthcare costs (Boucher, 2017; Patrick, Kaplan Passarella, Davis, & Lorch, 2014). As evidence suggests, the

median length of stay (LOS) for newborns being treated for NAS can range from 8 to 28 days and costs a median of \$26 438 to \$155 386 USD (Patrick et al., 2014).

Rooming-in is an alternative care approach whereby newborn and mother remain together in one room with support and observation from the healthcare team (Abrahams, Kelly, Payne, Thiessen, Mackintosh, & Janssen, 2007; Grossman, Berkwitt, Osborn, Shapiro, Bizzaro, Xu, & Esserman, 2017; Holmes, Atwood, Whalen, Beliveau, Jarvis, Matulis, & Ralston, 2016; Hunseler et al., 2013; McKnight et al., 2015; Saiki et al., 2009). One of the benefits of rooming-in is that it may facilitate breastfeeding (McKnight et al., 2015). Evidence in the literature also suggests higher instances of breastfeeding in rooming-in have been associated with delayed onset of NAS, reduced severity, and decreased need for pharmacologic treatment (Abdel-Latif, Pinner, Clews, Cooke, Lui, & Oei, 2006; Saiki et al., 2009). Another potential benefit of rooming-in is the decreased utilization of healthcare resources (McKnight et al., 2015).

While the NICU is a traditional care setting for newborns with NAS, there is evidence that treatment in the NICU may prolong the need and duration of pharmacologic treatment and lengthen hospital admissions compared to rooming-in (Newman, Davies, Dow, Holmes, MacDonald, McKnight, & Newton, 2015; Abrahams et al., 2007; Boucher, 2017). Thus, evaluating the effects of rooming-in over traditional NAS care settings for the treatment of NAS is needed. Currently, there are no systematic reviews that analyze the effects of rooming-in for NAS. Thus, the purpose of this systematic review was to critically examine the literature about the effectiveness of rooming-in compared to traditional care settings such as the Neonatal Intensive Care Unit (NICU) for newborns with Neonatal Abstinence Syndrome (NAS).

Methods

Search Strategy

The electronic databases Pubmed, Proquest, PsychoInfo, OVID Joanna Briggs Institute of systematic reviews, CINAHL, Nursing and Allied Health, Evidence-Based Medicine, Web of Science, Cochrane Database of Systematic Review, DARE and Medline (EMBASE) were searched between December 2017 and January 2018. Subject terms used included "neonatal abstinence syndrome" (MeSH) or Neonate* AND Opiate* and one of the following additional terms, "rooming-in" or "rooming in", OR "non-separation" OR "non separation", OR "maternal presence". To ensure relevant studies had not been missed, the reference lists of included studies were reviewed for additional studies meeting the inclusion criteria.

Study Selection

The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009). Studies examining rooming-in for this review met the following inclusion criteria: 1) reported outcome data for newborns with NAS and rooming-in care, 2) primary studies, 3) quantitative studies with a comparison group, 4) peer-reviewed, and 5) were published in English. For this review, NAS was defined as a postnatal withdrawal syndrome in newborns that were exposed to opioids in utero (McQueen & Murphy-Oikonen, 2016). Thus, NAS in newborns exclusively from substances other than opioids were excluded. Studies exclusion criteria included 1) newborns re-admitted to the hospital for NAS post-discharge and 2) qualitative or quantitative studies of maternal experience, 3) not a primary study or no comparison group, 4) outcomes were based on pharmacologic treatment interventions for newborns and 5) no outcome data for rooming-in.

Student (TJB) entered all studies from the search criteria into the Zotero Reference Manager. Duplicates were removed, and remaining studies were screened for inclusion based on the title and abstract and full-text by the student (TJB) (see Appendix A – Diagram 1. PRISMA Flow Diagram). Studies that did not meet the inclusion criteria were eliminated for further review. Twenty full-text studies were assessed for eligibility based on the inclusion criteria by the student (TJB). Supervisor 1 (JMO) independently screened all the potential studies for inclusion based on the study title, abstract, and if necessary, the full text. Student (TJB) and supervisor 1 (JMO) collectively discussed the remaining studies (n = 20) and reviewed them together. Fourteen additional studies were removed as they did not meet the inclusion criteria. Both came to a consensus that six studies (n = 6) were eligible for this review.

Data Extraction

Data from full-text studies were extracted by student (TJB). A data extraction template was developed for the systematic review to capture all relevant details (see Appendix B, Table 1- Characteristics of Included Studies). The template included the authors' names, date of publication, research design and setting, purpose of study, population and sample size and quality appraisal risk of bias. Supervisor 1 (JMO) also independently extracted data onto a template. The extracted data were then compared and differences were discussed, referring back to the study until agreement was obtained. A secondary table was developed to capture the quantitative outcomes of rooming-in and NAS (see Appendix C, Table 2- Outcomes of Rooming-in). Data from the studies were also independently extracted by student (TJB) and supervisor 2 (KM) and placed into a data extraction template. The template captures the authors' names, date of publication as well as the following outcomes of rooming-in and NAS: pharmacologic treatment, duration of pharmacologic treatment, length of stay, breastfeeding,

healthcare costs, and discharge to maternal custody. The extracted data were then compared and differences were discussed in collaboration with supervisor 1 (JMO). All parties referred back to the studies until an agreement was obtained. The data on rooming-in and Neonatal Abstinence Syndrome was synthesized narratively as meta-analysis was not possible due to the heterogeneity of the included study samples and outcomes evaluated.

Assessment of Methodological Quality

The studies selected for the systematic review was assessed for methodological quality using the Joanna Briggs Institute (JBI) Standardized Critical Appraisal Checklist for Cohort Studies (Joanna Briggs Institute, 2014) (see Appendix D-JBI Critical Appraisal Checklist for Cohort Studies). The selected studies for inclusion were independently reviewed by student (TJB) and supervisor 2 (KM). Studies were evaluated based on low, moderate or high risk of bias. Ratings to determine level of risk were based on: sample selection bias, confounding factors, strategies to deal with confounding factors, validity and reliability of NAS outcomes, and follow-up. Any discrepancies between raters' scores were discussed and resolved with supervisor 1 (JMO) until a consensus was reached. Based on the evaluation of critical appraisal, none of the studies were eliminated from this review.

Results

The search identified two hundred sixteen studies (n = 216). An additional two studies were retrieved through a forward citation search. Following removal of duplicates, a total of one hundred eighteen studies (n = 118) studies remained for review. An initial title and abstract search eliminated ninety eight (n = 98) studies with twenty (n = 20) studies remaining for full-text search resulting in six (n = 6) studies that met the inclusion criteria for the systematic review. Fourteen full-text studies were eliminated from inclusion based on the following: 1) not

a primary study or no comparison group (n = 6); 2) outcomes were based on pharmacologic treatment interventions for newborns (n=4); and 3) no outcome data for rooming-in (n=4) (see Appendix A – Diagram 1. PRISMA Flow Diagram).

Rooming-in and NAS Outcomes

Study Characteristics

The characteristics of the six included studies are provided in Appendix C Table 1. Of the six studies, four explored the effects of rooming-in (Abrahams et al.,2007; Hunseler et al.,2013; McKnight et al. 2016; Saiki et al.,2009) and two studies were quality improvement initiatives for NAS (Grossman et al., 2017; Holmes et al.,2016), which included rooming-in. Studies were conducted in Canada (n = 2), United Kingdom (n = 1), Germany (n = 1), and in the United States (n = 2) between the years of 2001-2016. The selected studies were comprised of retrospective cohort designs (n = 3) and cohort studies (n = 3). Sample size for studies evaluating newborns with NAS ranged from 44 to 287 and the single study with a sample of women using heroin or methadone had a sample size of one hundred six (n = 106). Studies explored various NAS outcomes associated with rooming-in including 1) pharmacologic treatment, 2) duration of pharmacologic treatment, 3) LOS in hospital, 4) healthcare cost, 5) breastfeeding and 6) discharge to maternal custody.

Methodological Quality

Among the studies, three were identified as a low risk of bias (Abrahams et al., 2007; McKnight et al., 2015; Saiki et al., 2009) and three studies were identified as a moderate risk of bias (Grossman et al., 2017; Holmes et al., 2016; Hunseler et al., 2013). Selection bias for rooming-in was present in two studies (Abrahams et al., 2007; Hunseler et al., 2013) as between-group differences were identified. For example in the study by Hunseler et al., (2013)

participants self-selected traditional care or rooming-in. It is unclear if those who selected the rooming-in cohort were more stable or more motivated than the traditional care cohort (Hunseler et al., 2013). Two studies did not have selection bias as the intervention and control groups had similar maternal and newborn characteristics such as maternal age, substance use, gestational age, and birth weight and between-group differences were not statistically significant (McKnight et al., 2015; Saiki et al., 2009). It was unclear if there was selection bias present in two studies (Grossman et al., 2017; Holmes et al., 2016) as both studies examined quality improvement and did not have a clear rooming-in cohort (Grossman et al., 2017; Holmes et al., 2016).

Potential confounding factors such as training for staff, the encouragement of breastfeeding, cuddling and swaddling were present in a few of the studies (Abrahams et al., 2007; Hunseler et al., 2013; McKnight et al., 2015 & Saiki et al., 2009). Some of these confounding variables were adjusted and subsequently accounted for in the final analysis (Grossman et al., 2017; Holmes et al., 2016). All studies used scoring tools as a guide to treat symptoms of NAS (Abrahams et al., 2007; Grossman et al., 2017; Holmes et al., 2016; Hunseler et al., 2013; McKnight et al., 2015 & Saiki et al., 2009). However, the specific scoring tools, who administered the assessments and their protocols varied; thus, making between-study comparisons difficult. Lastly, it is difficult to ascertain whether any of the studies lost any of their participants during the course of examination as this is not addressed in the final outcome of the studies.

Rooming-in and NAS Outcome: Pharmacologic Treatment

All six studies examined pharmacologic treatment as an outcome of rooming-in. All of studies found a reduced need for pharmacologic treatment among newborns rooming-in with their mothers. Four studies reported a statistically significant difference between groups

(Abrahams et al., 2007; Grossman et al., 2017; McKnight et al., 2016; Saiki et al., 2009), while one study did not report a *p* value (Holmes et al., 2016) and one study reported no statistical significance (Hunseler et al., 2013). The percentage of newborns receiving pharmacologic treatment varied among the groups. Among those receiving rooming-in the percentage requiring pharmacologic treatment varied from 11% (Saiki et al., 2009) to 79.2% (Hunseler et al., 2013). Rates of pharmacologic treatment among controlled group participants were much higher, ranging from 45% (Saiki et al., 2009) to 98% (Grossman et al., 2017).

Rooming-in and NAS Outcome: Duration of Pharmacologic Treatment

Among the six studies included in this review, four of the studies measured the duration of pharmacologic treatment (Abrahams et al., 2007; Hunseler et al., 2013; McKnight et al., 2015; Saiki et al., 2009). Two of the studies evaluated the mean duration of treatment, which ranged from 5.9 days to 7.3 days for the rooming-in cohorts and 12.7 days to 18.6 days for the traditional care setting cohorts (Abrahams et al., 2007; Saiki et al., 2009). Two studies evaluated the (median) and (maximum – minimum values, Interquartile Range (IQR)) which ranged from 24.0 days to 27 days for rooming-in cohorts compared to traditional care setting cohorts which ranged from 29.5-32.5 days (Hunseler et al., 2013; McKnight et al., 2015). Abrahams et al. (2007) was the only study to find statistically significant results concerning the duration of pharmacologic treatment ($p=0.003$) and concluded that the rooming-in cohort had shorter durations of pharmacologic treatment.

Rooming-in and NAS Outcome: Length of Stay

All of the studies found a decrease in the average LOS for newborns with NAS that roomed-in with their mothers when compared to traditional care setting. Average length of stay for newborns rooming-in ranged from 5 days (McKnight et al., 2015) to 15.9 days (Saiki et al.,

2009). Among controls, average length of stay was higher, ranging from 19.8 days (Saiki et al., 2009) – 41.5 days (Hunseler et al., 2013). While all six studies found shorter LOS among those rooming-in, only four studies found a statistically significant reduction in LOS (Abrahams et al., 2007; Grossman et al., 2017; McKnight et al., 2015; Saiki et al., 2009). One study did not report a *p* value (Holmes et al., 2016) and another found no significant difference (Hunseler et al., 2013).

Rooming-in and NAS Outcome: Healthcare Costs

Healthcare costs were evaluated among three out of six included studies. All three studies found considerable financial savings for newborns who roomed-in with their mothers (Grossman et al., 2017; Holmes et al., 2016; Hunseler et al., 2013). The evaluation criteria for healthcare costs was diverse as each study was conducted in a different country with varying healthcare systems and different currency (Grossman et al., 2017; Holmes et al., 2016; Hunseler et al., 2013). Hunseler et al. (2013) noted a mean cost of 9547 € amongst the rooming-in cohort in comparison to the traditional care setting cohorts 14 486 € per admission ($p<0.014$) representing a cost savings of 66 %. Similarly, in a US study, Holmes et al. (2016) found a statistically significant decrease in healthcare costs associated with rooming-in for NAS. The average costs of hospitalization for a newborn with NAS decreased from the baseline year cohort (\$11,000 USD) to the second year intervention cohort (\$5300 USD) ($p<0.01$) for a cost saving of 48%. Finally, in another US based study, Grossman et al. (2017) identified significant cost savings and noted the average cost of hospitalization for the rooming-in cohort was \$10,289 vs. \$44,824 for traditional care resulting in a cost savings of 77%.

Rooming-in and NAS Outcome: Breastfeeding

Breastfeeding was evaluated in five of the six studies. While each study reported a higher number of breastfeeding mothers in the rooming-in cohorts compared to traditional care settings, only Grossman et al., 2017 found this to be statistically significant ($p=.01$). Rates of breastfeeding within the rooming-in cohort were ($n=20$) or 44% of the sample size while the rates of breastfeeding in the traditional care cohort were ($n=11$) or 20% of the sample size. Two studies reported additional findings that among newborns who were breastfed, there was less of a need for pharmacologic treatment (Holmes et al., 2016; McKnight et al., 2015). McKnight et al. (2015) evaluated any form of breastfeeding and reported that newborns in the NICU cohort ($n = 9$, 75%) that were formula fed, required more pharmacologic treatment than the breastfed newborns in the rooming-in cohort ($n=1$) or 16.7% ($p=0.04$). Similarly, formula fed newborns remained in hospital an average of 19.5 days compared to newborns that were breastfed and remained an average of 4.5 days in hospital (McKnight et al., 2015).

Rooming-in and NAS Outcome: Discharged to Maternal Custody

Among the 4 studies evaluating discharge to maternal custody, mothers who roomed in with their newborns had higher rates of custody over their newborn at discharge (Abrahams et al., 2007; Holmes et al., 2016; Hunseler et al., 2013; Saiki et al., 2009). In particular, the study by Abrahams et al. (2007), the relative risk (RR) of newborns discharged home was 2.23 (95% CI 1.43 to 3.98); concluding that mothers who roomed in at British Columbia Women's Hospital (BCWH) with their newborns were 2.2 times more likely to be discharged home. Likewise, when compared with the Surrey Cohort control group, the RR was 1.52 (95% CI 1.15 to 2.53) resulting in a 1.5 times greater likelihood that mothers who roomed in with their newborns had custody upon discharge from the hospital. While the other three studies had higher rates of discharge

home, the differences between rooming-in and controls groups were not statistically significant (Holmes et al., 2016; Hunseler et al., 2013; Saiki et al., 2009).

Discussion

This is the first systematic review to assess the effects of rooming-in for newborns with NAS. The most frequently evaluated outcomes of included studies were the average length of stay in hospital, the need for pharmacologic intervention and duration of treatment. Overall, all studies consistently identified that the average LOS was reduced when newborns roomed-in with their mothers. Similarly, newborns that roomed-in required pharmacologic treatment less frequently and had shorter duration of treatment in comparison to traditional care setting cohorts. While the trend was positive for rooming in, not all studies had statistically significant findings. This review also found a positive association between rooming-in and lower health care costs, increased rates of breastfeeding and discharge home with mothers. However, these outcomes were evaluated less frequently within the studies.

Reducing length of stay is important as in 2004, the average length of stay for newborns with NAS in NICU was 13 days. Subsequently, this increased to 19 days by 2013. (Tolia, Patrick, Bennett, Murphy, Sousa, & Smith, 2015). Given the long length of hospital stays for newborns with NAS receiving traditional care, rooming in may be a viable intervention to decrease length of stay.

Prolonged admissions in NICU can create difficulties for maternal-newborn bonding (Boucher, 2017; Newman et al., 2015; Saiki et al., 2009), given that maternal and newborn separation precludes consistent care from the mother. Newborns that remain with their mothers benefit from one on one care, frequent healthcare supervision, and remain in a more natural environment than the NICU (Saiki et al., 2009).

Another concern for mothers attending the NICU to care for their newborns is the existence of stigma from healthcare providers. Stigma may have a profound impact on the mother's ability to be present at the hospital and bond with their newborn (Murphy-Oikonen, Montelpare, Southon, Bertoldo, Persichino, 2010) as it may increase feelings of guilt and shame related to their use of opioids. Mothers with a substance use history may have more difficulty interacting with nurses in traditional care settings as evidence suggests that some nurses are judgemental towards women who have used opiates during pregnancy (Cleveland & Bonugli, 2014; Murphy-Oikonen et al., 2010). Mothers' experiences with stigma from healthcare providers may impact lower attendance while the newborn is in hospital, thereby further limiting opportunities for bonding (Johnson, 2017).

Reducing the need for pharmacologic treatment is another important outcome that warrants attention. Approximately 60-80% of newborns with NAS require pharmacologic treatment (Tolia et al., 2015). Our systematic review found that newborns that roomed-in with mothers received less pharmacologic treatment than newborns that remained in traditional care settings (Abrahams et al., 2007; Grossman et al., 2017; Holmes et al., 2016; Hunseler et al., 2013; McKnight et al., 2015 & Saiki et al., 2009). A decreased need for pharmacologic treatment is important given that research is limited on the neurodevelopment of newborns and postnatal (opioids) pharmacologic treatment (Devlin, Lau & Radmacher, 2017). Thus, utilizing rooming-in reduces the need for pharmacologic treatment in newborns with NAS, and may reduce the risk of possible long-term effects.

Pharmacologic treatment may prolong hospital admission and healthcare costs (Holmes et al., 2016). The systematic review findings suggest that rooming in is associated with decreased healthcare costs for newborns with NAS (Holmes et al., 2016; Hunseler et al., 2013;

Saiki et al., 2009). In the United States, the cost for a newborn being pharmacologically treated can be anywhere from 2 to 12 weeks and reported costs of approximately \$90 000 per admission (Holmes et al., 2016). Correspondingly, the mean cost in 2009 to treat a newborn with NAS exceeded \$53 000 (Patrick, Schumacher, Benneyworth, Krans, McAllister, & Davis, 2012). Although rooming-in is associated with cost-savings, the lack of clarity on how healthcare costs are evaluated in each of the included studies requires caution in the interpretation of this outcome. While the overall cost of healthcare savings may be a positive outcome, Holmes et al. (2016) argue that a reduction in hospital revenue in fee-for-service environments may lead to closure of some necessary services within the hospital. Similarly, while there is evidence of in-patient cost savings, there is uncertainty regarding the cost to primary care providers in the community.

Our findings regarding increased rates of breastfeeding are consistent with other studies that identified rooming-in may enhance maternal ability to initiate breastfeeding. Additionally, breastfeeding can provide emotional stability to the newborn and increase mother's confidence in caring for her newborn (Shrivastava, Shrivastava, & Ramasamy, 2013). There are also many associated benefits to breastfeeding newborns with NAS such as improved health, alleviating severity of NAS symptoms, optimal nutrition, mother-newborn bonding and the opportunity for mothers to enhance their parenting skills by reducing separation (MacVicar, Humphrey, & Forbes-McKay, 2017; Shrivastava et al., 2013; Welle-Strand, Skurtveit, Jansson, Bakstad, Bjarko, & Ravndal, 2013). Breastfeeding should be recommended as a non-pharmacologic intervention among mothers that are stabilized on Opioid Replacement Therapy (ORT) (Abdel-Latif, Pinner, Clews, Cooke, Lui & Oei. 2006; O'Connor, Collett, Alto, & O'Brien, 2013) as there are positive outcomes for newborns with NAS. In particular, the literature on breastfeeding

and NAS suggests that mothers who breastfeed their newborns are more likely to have a delayed or reduced onset of NAS (Saiki et al., 2009), reduce severity (Saiki et al., 2009), reduced LOS, and reduced need for pharmacologic treatment (Abdel-Latif et al., 2006; O'Connor et al., 2013; Saiki et al., 2009; Welle-Strand et al., 2013). As such, improving breastfeeding rates with rooming-in could also assist in mitigating NAS symptoms. However, historically breastfeeding among this population of mothers and newborns was not encouraged (O'Connor et al., 2013). As such, mothers of newborns with NAS have been less likely to initiate or sustain breastfeeding (Holmes, Schmidlin, & Kurzum, 2017).

Newborns that are exposed to substances in utero are at greater risk for involvement with child protection agencies, with North American studies finding that 1 in 3 children end up in out-of-home care (O'Donnell, Nassar, Leonard, Hagan, Matthews, Patterson, & Stanley, 2009). Among the studies that evaluated discharge to maternal custody (Abrahams et al., 2007; Grossman et al., 2017) rooming in was associated with an increased number of newborns discharged to mother's custody when compared to newborns receiving traditional care although this was not statistically significant. There are a number of potential reasons that newborns who roomed-in with their mothers had higher rates of returning home with their primary caregiver. According to Abrahams et al. (2007) the rooming-in cohorts had increased access to resources pre and postnatal including access to housing which may also increase the success rates of newborns being discharged to maternal care. In addition, mothers who roomed in with their newborns presumably received increased supervision and supports from healthcare staff. Despite this positive outcome, it is unclear if newborns that roomed in with their mothers represented a more socially stable cohort, thus resulting in the increased discharge to maternal care. The participants in most of the studies were selected by the researcher (Abrahams et al., 2007;

Grossman et al., 2017; Holmes et al., 2016; Mcknight et al., Saiki et al., 2009) with the exception of Hunseler et al. (2013) whereby participants had the opportunity to choose rooming in over traditional care. Thus, given the inconsistency in the inclusion criteria and support services rendered for the rooming-in cohorts, caution is required in the interpretation of this outcome.

Hidayati (2017) conducted a study on effects of bonding and concluded that hospitals that promoted bonding with the guidance and support from healthcare professionals instilled confidence within parents to care for their newborns after discharge from hospital. Increasing opportunities for mother and newborn to bond through rooming-in may increase the likelihood of maternal presence and in turn, increase the success of newborns remaining in maternal custody upon discharge (Newman et al., 2015). Rooming in also provides an opportunity for healthcare professionals to observe mother-newborn interactions which may also address or alleviate any child protection concerns prior to discharge (Abrahams et al., 2010; Cleveland et al., 2014). The safety of newborns must be carefully assessed prior to implementation of rooming in (O'Connor, Vietze, Sherrod, Sandler, & Altemeier III, 1980) and of subsequent discharge to the maternal care provider given that NAS has been associated with social instability in the home (O'Donnell et al., 2009).

Overall, the findings from this review suggest that rooming-in was associated with improved outcomes for newborns with NAS. However, as rooming-in varied between studies, it is unclear what the effective mechanism of rooming-in entails. For example, among the included studies rooming-in may have included psycho-education, breastfeeding support, specialized training of staff, cuddling, swaddling, and increased use of staff and resources. More research into the effective component of rooming-in is warranted.

Limitations

While the studies offer a variety of strengths pertaining to the effectiveness of rooming-in for newborns with NAS, some limitations were observed during this systematic review. The majority of included studies were retrospective, before and after studies, with small sample sizes, which limit the ability to determine causal relationships. Additionally, all of the studies used diverse scoring tools to assess and treat symptoms of NAS (Abrahams et al., 2007; Grossman et al., 2017; Holmes et al., 2016; Hunseler et al., 2013; McKnight et al., 2015 & Saiki et al., 2009). However, scoring tools ranged from the original Finnegan's scoring tool (Grossman et al., 2017; Hunseler et al., 2013) to a modified version of the Finnegan's scoring tool (Abrahams et al., 2007; Holmes et al., 2016; McKnight et al., 2015) to the River Scoring system (Saiki et al., 2009). Modified versions of the Finnegan did not include the number of items or specifics of how the tool was modified thereby putting the studies at-risk for measurement bias. Moreover, many studies did not provide detail whether the healthcare professionals who administered the assessment had adequate training or if scoring times were consistent among the samples. Another consideration for bias could be the times of when scoring occurred. For instance, in some studies newborns were scored after infant-feeding compared to newborns that may have been hungry or tired. In addition to the diversity of scoring, there were additional variations between studies in regards to pharmacologic and non-pharmacologic treatment. Some studies imposed pharmacologic interventions after two scores of 8 or greater while others studies intervened at three consecutive scores of 8 or greater, therefore, implementing pharmacologic intervention at different levels.

Implications for Practice

The results of this systematic review suggest that rooming-in should be considered a viable non-pharmacologic intervention for newborns with NAS. Rooming-in between mother and newborn should be encouraged when feasible and symptoms can be treated outside of the NICU. However, it is important to note that rooming-in may not be suitable for all mothers and newborns as some newborns may require additional treatment in the NICU. Therefore healthcare professionals should be aware of the potential risks involved and evaluate suitable candidates. Hospitals considering rooming-in should develop adequate policies and protocols which can decipher when a newborn will benefit by being in the NICU or rooming-in. A current gap identified in the literature is the lack of explicit eligibility criteria for rooming-in. As such, the findings of this review are limited to a select group.

Implications for Future Research

There is a need for future studies to continue to examine the associated benefits of rooming in. Consideration should be given to increasing utilizing prospective or randomized designs as they may mitigate selection bias. In addition, using a valid and reliable scoring tool with consistent scoring protocols and training of staff to administer the scoring tools will aid in having a homogenous sample to evaluate the effectiveness of the rooming-in intervention. Further exploration is required to assess the association and anticipated outcomes of breastfeeding, discharge to maternal custody, and safety of infants with NAS and rooming-in. Finally, detailed description of rooming-in interventions is required so that evaluation may be conducted to determine the effective component(s) of rooming-in.

Conclusion

The findings from this systematic review suggest that rooming-in for newborns with NAS was effective in reducing the duration of pharmacologic treatment, need for pharmacologic treatment, and length of hospital stay compared to traditional care settings. Rooming-in should be explored as a care model for select newborns however further investigation is required with larger sample sizes and a more detailed description of rooming-in in order to gain further insight.

References

- 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 mother. *Pediatrics*, *117*(6). e1163-e1169.
- Abrahams, R. R., MackKay-Dunn, M. H., Nevmerjitskaia, V., MacRae, G. S., Payne, S. P., & Hodgson, Z.G. (2010). An evaluation of rooming-in among substance-exposed newborns in British Columbia. *Journal of Obstetrics and Gynaecology Canada*, *32*, 866-871. doi: 10.1016/s1701-2163(16)34659-X
- 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 using methadone or heroin. *Canadian Family Physician*, *53*(10), 1722-1730.
- Boucher, A. (2017). Nonopioid management of neonatal abstinence syndrome. *Advances In Neonatal Care*, *17*(2), 84-90. doi:10.1097/ANC.0000000000000371
- Brown, M. S., Hayes, M. J., & LaBrie, S. (2011). Breastfeeding is associated with decreased risk and length of treatment for neonatal abstinence syndrome in methadone and buprenorphine exposed infants. Presented at: *Pediatric Academic Societies*; May 1-4, 2011. Vancouver, BC, Canada. Abstract 2258.
- Cleveland, L.M., & Bonugli, R. (2014). Experiences of mothers of infants with neonatal abstinence syndrome in the neonatal intensive care unit. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, *43*(3), 318-329. doi:10.1111/1552-6909.12306
- Davies, H., Gilbert, R., Johnson, K., Petersen, I., Nazareth, I., O'Donnell, M., Guttmann, A., & Gonzalez-Izquierdo, A. (2016). Neonatal drug withdrawal syndrome: Cross-country comparison using hospital administrative data in England, the USA, Western Australia

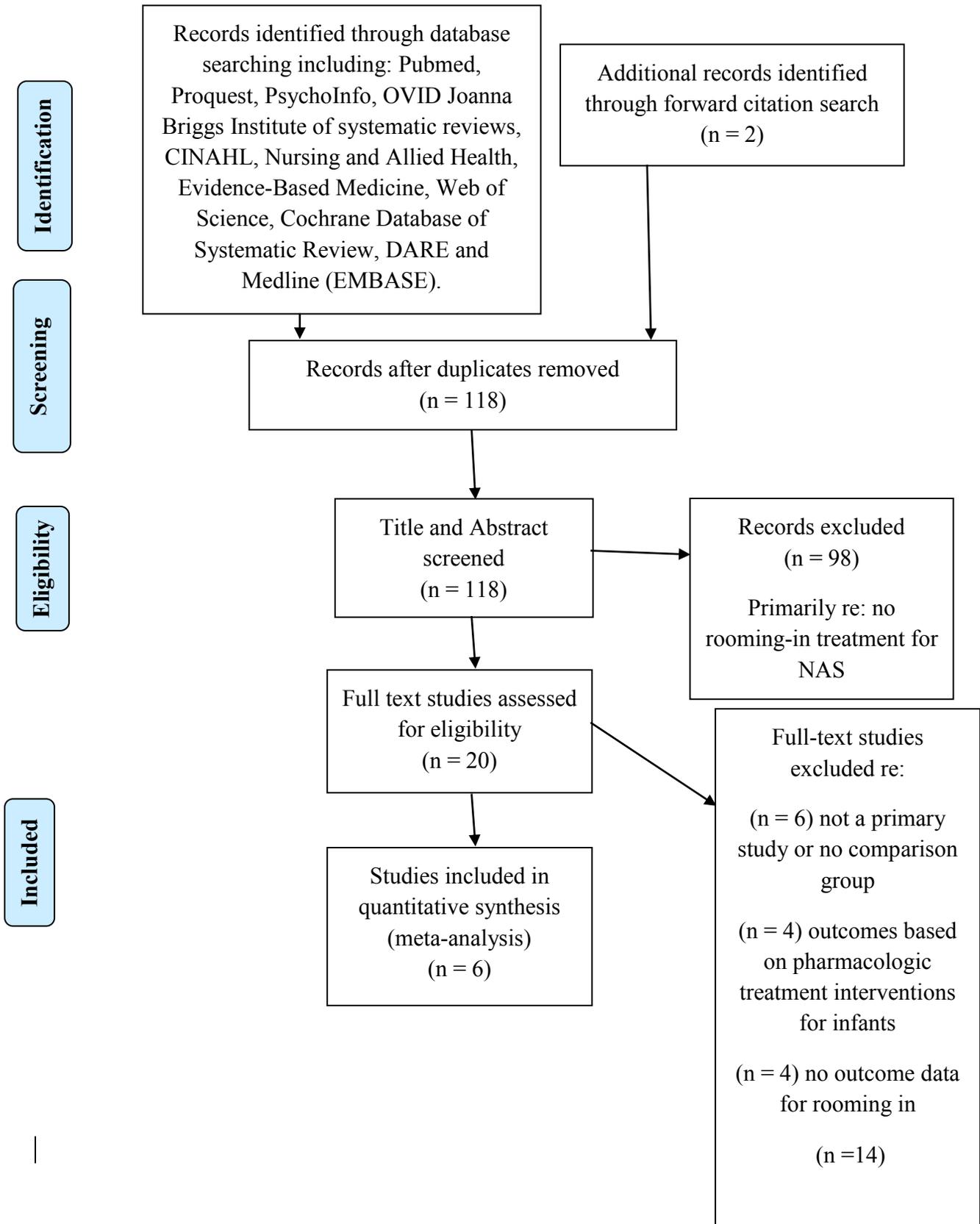
- and Ontario, Canada. *Archives of Disease in Childhood. Fetal and Neonatal Edition*, 101(1), F26-30. doi:10.1136/archdischild-2015-308948.
- Devlin, L. A., Lau, T., & Radmacher, P. G. (2017). Decreasing total medication exposure and length of stay while completing withdrawal for neonatal abstinence syndrome during the neonatal hospital stay. *Front Pediatr* 10(5), 216. Doi:10.3389/fped.2017.00216.
- Dow, K., Ordean, A., Murphy-Oikonen, J., Pereira, J., Koren, G., Roukema, H., & Turner, R. (2012). Neonatal abstinence syndrome clinical practice guidelines for Ontario. *Journal Of Population Therapeutics and Clinical Pharmacology*, 19(3), e488-e506.
- Grossman, M. R., Berkwitz, A. K., Osborn, R. R., Shapiro, E. D., Bizzarro, M. J., Xu, Y., & Esserman, D. A. (2017). An initiative to improve the quality of care of infants with neonatal syndrome. *Pediatrics*, 139(6).
- Haabrekke, K.J., Slinning, K., Walhovd, K.B., Wentzel-Larsen, T., & Moe, V. (2014). The perinatal outcomes of children born to women with substance dependence detoxified in residential treatment during pregnancy. *Journal of Addictive Diseases*, 33(2), 114-123. doi:10.1080/10550887.2014.909698.
- Hidayati, R. (2017). Bonding attachment enhances postpartum mother's confidence in caring for her baby. *Jurnal Ners*, 2(2), 107-110. doi:10.20473/jn.v2i2.4965
- Holmes, A. V., Atwood, E. C., Whalen, B., Beliveau, J., Jarvis, J. D., Matulis, J. C., & Ralston, S. L. (2016). Rooming-in to treat neonatal abstinence syndrome: Improved family centered care at lower cost. *Pediatrics*, 137(6), 2015-2929. doi:10.1542/peds.2015-2929
- Holmes, A. P., Schmidlin, H. N., & Kurzum, E. N. (2017). Breastfeeding considerations for mothers of infants with neonatal abstinence syndrome. *Pharmacotherapy*, 37(7), 861-869. doi: 10.1002/phar.1944.

- Hudak, M. L., Tan, R. C. (2012). The committee on drugs and the committee on fetus and newborn neonatal drug withdrawal. *Pediatrics*, 133(5), 937-938.
doi:10.1542/peds.2014-0557
- Hudak, M. L., & Tan, R. C. (2012). Neonatal drug withdrawal. *Pediatrics*, 129(2), e540-560.
<https://doi.org/10.1542/peds.2011-3212>
- Hunseler, C., Bruckle, M., Roth, B., & Kribs, A. (2013). Neonatal opiate withdrawal and rooming-in: A retrospective analysis of a single center experience. *Klin Padiatr*, 225(5), 247-51. doi:10.1055/s-0033-1347190
- Jansson, L. M., Velez, M., & Harlow, C. (2009). The opioid exposed newborn: Assessment and pharmacologic management. *J Opioid Manag*, 5(1), 47-55.
- Joanna Briggs Institute. (2014). Reviewers manual. Adelaide: Author.
- Johnson, B. (2017). Neonatal abstinence syndrome. *Pediatric Nursing*, 43(4), 206-207.
- Kocherlakota, P. (2014). Neonatal abstinence syndrome. *Pediatrics*, 134(2), e547-561.
<https://doi.org/10.1542/peds.2013-3524>
- MacVicar, P.S., Humphrey, P.T., & Forbes-McKay, P. E. (2017). Breastfeeding support and opiate dependence: A think aloud study. *Midwifery*, 50, 239-245.
doi:10.1016/j.midw.2017.04.013
- 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. *Am J Perinatol*, 33(5), 495-501. doi: 10.1055/s-0035-1566295
- McQueen, K., & Murphy-Oikonen, J. (2016). Neonatal Abstinence Syndrome. *The New England Journal of Medicine*, 375(25), 2468-2479. doi:10.1056/NWJMra1600879

- McQueen, K. A., Murphy-Oikonen, J., & Desaulniers, L. (2015). Maternal substance use and neonatal abstinence syndrome: A descriptive study. *Maternal and Child Health Journal*, (8), 1756. Doi:10. 1007/s10995-015-1689-y
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., & PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, 6(7), e1000097. <https://doi.org/10.1371/journal.pmed.1000097>
- Murphy-Oikonen, J., Montelpare, W. J., Southon, S., Bertoldo, L., Persichino, N. (2010). Identifying infants at risk for neonatal abstinence syndrome: a retrospective cohort comparison study of 3 screening approaches. *J Perinat Neonatal Nurs*, 24, 366-72.
- 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.
- Norgaard, M., Nielsson, M.S., & Heide-Jorgensen, U. (2015). Birth and neonatal outcomes following opioid use in pregnancy: A Danish population-based study. *Substance Abuse: Research and Treatment*, (5), 1178-2218.
- 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 Womens Health*, 58(4). 383-388. <http://dx.doi.org/10.1111/jmwh.12009>
- O'Connor, S., Vietze, P. M., Sherrod, K. B., Sandler, H. M., & Altemeier III, W. A. (1980). Reduced incidence of parenting inadequacy following rooming-in. *Pediatrics*, 66(2), 176-182.

- O'Donnell, M., Nassar, N., Leonard, H., Hagan, R., Mathews, R., Patterson, Y., & Stanley, F. (2009). Increasing prevalence of neonatal withdrawal syndrome: Population study of maternal factors and child protection involvement. *Pediatrics*, *123*(4), e614-621. <https://doi.org/10.1542/peds.2008-2888>
- Patrick, S., Davis, M., Lehman, C., & Cooper, W. (2015). Increasing incidence and geographic distribution of neonatal abstinence syndrome. *Journal of Perinatology*, *35*(8), 650. doi:10.1038/jp.2015.36
- Patrick, S., Kaplan H., Passarella, M., Davis, M., & Lorch, S. (2014). Variation in treatment of neonatal abstinence syndrome in US children's hospitals, 2004-2011. *J Perinatol*. *34*(11), 867-72. doi:10.1038/jp.2014.114
- Patrick, S. W., Schumacher, R. E., Benneyworth, B. D., Krans, E. E., McAllister, J. M., & Davis, M. M. (2012). Neonatal abstinence syndrome and associated health care expenditures: United States, 2000-2009. *JAMA*, *307*(18), 1934-1940. doi:10.1001/jama.2012.3951
- Saiki, T., Lee, S., Hannam, S., & Greenough, A. (2009). Neonatal abstinence syndrome: Postnatal ward versus neonatal unit management. *Eur J Pediatr*, *169*(1), 95-8. doi: 10.1007/s00431-009-0994-0
- Shrivastava, S, R., Shrivastava, P, S., Ramasamy, J. (2013). Fostering the practice of rooming-in in newborn care. *Journal of Health Sciences* *3*(2): 177-178.
- Tolia, V.N., Patrick, S.W., Bennett, M.M., Murphy K., Sousa, J., & Smith, P.B. (2015). Increasing incidence of the neonatal abstinence syndrome in U.S. neonatal ICUs. *New England Journal of Medicine*, *372*(22):2118-26.
- Welle-Strand, G. K., Skurtveit, S., Jansson, L. M., Bakstad, B., Bjarko, L., Ravndal, E. (2013). Breastfeeding reduces the need for withdrawal treatment in opioid-exposed infants. *ACTA Paediatrica Nurturing the Child*, *102*(11), 1060-1066. doi:10.1111/apa.12378

Appendix A
Diagram 1. PRISMA Flow Diagram



Appendix B

Table 1. Characteristics of Included Studies

Author	Research Design & Setting	Purpose of Study	Population and Sample Details	Quality Appraisal Risk of Bias
Abrahams et al.,(2007).	Retrospective Cohort Study British Columbia Women's Hospital and Surrey Hospital, British Columbia, Canada	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 the proportion of mothers who retain custody of their babies at hospital discharge.	Total sample (n = 106) methadone or heroin using women: Rooming in cohort BCWH (RI): (n=32) methadone or heroin using women); Pre-rooming in cohort BCWH (C1) (n=38) Observation nursery cohort level II at Surrey Hospital (C2): (n=36)	LOW
Grossman et al., (2017).	Cohort Study Yale New Haven Children's Hospital, United States	The aim is to reduce the average LOS for newborns with NAS by 50%	Total sample (n=287) newborns with symptoms of NAS Intervention Cohort (I1): (n=188) Post-implementation Cohort (I2): (n=44) Baseline Cohort (C1): (n=55)	MODERATE
Holmes et al., (2016).	Cohort Study Children's Hospital at Dartmouth-Hitchcock (CHaD), United States	To examine the impact of a rooming-in program for infants at risk of neonatal abstinence syndrome (NAS) on the need for pharmacologic treatment and length of hospitalization.	Total sample (n=163) newborns with symptoms of NAS Intervention year 1 Cohort (I1): (n=61) Intervention year 2 Cohort (I2): (n=48) Baseline Cohort (C1): (n=54)	MODERATE
Hunseler et al., (2013).	Retrospective Cohort Study University of Cologne, Germany	To evaluate the treatment of neonatal abstinence syndrome, the experience with rooming-in of opiate-dependent mothers and to examine the influence of rooming in on short-term outcome of infants exposed to opiates in utero	Total sample (n=77) newborns with NAS symptoms Rooming in cohort (RI): (n=24) Neonatal Unit Cohort (C1): (n=53)	MODERATE
McKnight et al., (2015).	Retrospective Cohort Study Kingston General Hospital, Ontario, Canada	To examine the impact of a rooming-in program for infants at risk of neonatal abstinence syndrome on the need for pharmacologic treatment and length of hospitalization	Total sample (n=44) newborns with symptoms of NAS Rooming-in cohort (RI): (n=20) NICU cohort (C1): (n=24)	LOW
Saiki et al., (2009).	Cohort Study Kings College Hospital, United Kingdom	To test the hypothesis that caring for infants with neonatal abstinence syndrome with their mothers on the postnatal ward rather than admit them to the neonatal unit would reduce treatment duration and length of stay.	Total sample (n = 60) newborns with symptoms of NAS Rooming-in cohort (RI): (n=18) newborns Neonatal Unit Cohort (C1): (n=42)	LOW

Appendix C
Table 2. Outcomes of Rooming-in

Study	Duration of Pharmacologic Treatment*					Pharmacologic Treatment*					Length of Stay				
	Mean (SD)					N(%)					Mean (SD) Days (%)				
Abrahams et al., (2007)	R1 5.9 (14.2)	C1 18.6 (23.4)	<i>p</i> .007	C2 18.6 (20.1)	<i>p</i> 0.003	R1 8 (25)	C1 21(55.3)	RR/95% CI 0.40(0.20-0.78)	C2 19(52.8)	RR/95% CI 0.39(0.20-0.75)	R1 11.8 (9.1)	C1 23.5 (24.6)	<i>p</i> .014	C2 25.9 (19.7)	<i>p</i> <0.001
Grossman et al., 2017						I1 NR	I2 6(14)	C1 54(98)	<i>p</i> <.001		I1 NR	I2 5.9(1.9)	C1 22.4 (10.8)	<i>p</i> <.001	I1 NR
Holmes et al., (2016)						I1 31(51%)	I2 13(27%)	Baseline (C1) 25(46%)	<i>p</i> NR		I1* NR	I2* 12.3	C1* 16.9	<i>p</i> NR	
Hunseler et al., (2013)	R1 (Median) 27(24.0-38.5)	C1 (Median) 32.5(25.0-48.5)	<i>p</i> 0.043	R1 (79.2)		C1 (88.7)		<i>p</i> 0.14			R1 33		C1 41.5		<i>p</i> 0.077
McKnight et al., (2015)	R1(media n) (min- max values: IQR) 24.0 (23- 29)	C1 (median) (min-max values: IQR) 29.5(8- 73;23)	<i>p</i> 0.83	R1 3(15.0)		C1 20(83.3)		<i>p</i> <0.001			R1(median) (min-max values: IQR) 5		C1(median) (min-max values: IQR) 24		<i>p</i> <0.001
Saiki et al., (2009)	R1 7.3	C1 12.7	<i>p</i> 0.05	R1 2(11)		C1 19(45)		<i>p</i> 0.012			R1 15.9		C1 19.8		<i>p</i> 0.012

RI & RI2 = Rooming-in Cohorts (Intervention group) RR = Relative Risk C1 = Not rooming-in Cohort (control group)

p = Probability Value of Statistical Significance

I1 & I2 = Intervention groups

Appendix C
Table 2. Outcomes of Rooming-in

Study	Breastfeeding N(%)				Healthcare Costs Median (\$)				Discharged to Maternal Custody N(%)				
	R1	C1	C2	<i>p</i>	I1	I2	C1	<i>p</i>	R1	C1	RR/95% CI	C2	RR/95% CI
Abrahams et al., (2007)	R1 20(62.5)	C1 3(7.9)	C2 4(11.1)	<i>p</i> NR					R1 23(71.9)	C1 12(31.6)	RR/95% CI 2.23(1.43-3.98)	C2 17(42.5)	RR/95% CI 1.52, 95% CI 1.15 to 2.53
Grossman et al., 2017	I1 NR	I2 20(45%)	C1 11(20%)	<i>p</i> .01	I1 NR	I2 10289	C1 44824	<i>p</i> <.001					
Holmes et al., (2016)	R1	R12	C1	<i>p</i>	I1 NR	I2 5300	C1 11000	<i>p</i> <.01	R1 NR	R12 43(90)	C1 50(93)	<i>p</i> .73	
Hunseler et al., (2013)					R1 9547€	C1 14486€	<i>p</i> 0.014		R1 (79.2)	C1 (69.8)	<i>p</i> 0.046		
McKnight et al., (2015)	R1 14(70)	C1 12(50)		<i>p</i> 0.18									
Saiki et al., (2009)	R1 4(22)	C1 12(29)		<i>p</i> 0.647					R1 13(67)	C1 25(60)	<i>p</i> 0.264		

RI & R12 = Rooming-in Cohorts (Intervention group) RR = Relative Risk C1 = Not rooming-in Cohort (control group)

P = Probability Value of Statistical Significance

I1 & I2 = Intervention groups

Appendix D JBI Critical Appraisal Checklist for Cohort Studies



JBI Critical Appraisal Checklist for Cohort Studies

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not applicable
1. Were the two groups similar and recruited from the same population?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the exposure measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were confounding factors identified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were strategies to deal with confounding factors stated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Were strategies to address incomplete follow up utilized?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)
