Review Article

Scoring Tools Used to Assess and Treat Neonatal Abstinence Syndrome

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Abstract

This literature review was intended to evaluate the different scoring tools used to assess and treat term and preterm infants experiencing neonatal abstinence syndrome (NAS). This study also demonstrated the ways scoring tools and treatment can be improved. Many scoring tools for NAS are subjective and the validation of some of these tools used has not been proven yet. Scoring tools that aim to reduce the number of infants that require pharmacologic treatment and keep the mother and infant together are effective ways to care for NAS. Rural and economically disadvantaged areas and stigma are barriers to the assessment and treatment of NAS. These barriers can delay treatment and result in increased complications. Improvements in NAS scoring need to be made to better assess and treat withdrawal after delivery. A scoring tool designed specifically for preterm infants to guide treatment for NAS should be developed. Removing barriers to care can help improve the quality of care and treatment the infant receives and can aid in the early detection of NAS. Early detection is imperative because it allows treatment to be started sooner and can decrease the long-term outcomes of infants.

Background on the Opioid Epidemic and Pregnancy

The opioid epidemic continues to plague the United States, and its prevalence and the severity of impact on the population are typically increasing. While programs and resources have become more easily accessible in response to this public health issue, improvements are still needed to effectively address this epidemic. Of those who are 12 years and older, 10.1 million people abused opioids in 2019 [1]. Pregnant women often fail to be considered when addressing opioid use and abuse. It is especially important because the use of opioids not only affects the expecting mothers, but also the neonates during and following gestation. The number of pregnant women who abuse opioids during pregnancy continues to increase each year and results in more high-risk pregnancies and in-utero complications for the fetus [2]. In order to combat this public health crisis, it is imperative to look at all affected populations and the consequences.

Methodology

Articles were collected from the databases EBSCO and Web of Science. Inclusion criteria were articles published from 2009 to the present that discussed topics on NAS, preterm infants, scoring tools, NAS treatment, NAS care in rural vs urban areas, and stigma. Exclusion criteria were articles that were not published in a scientific peer-reviewed journal.

Neonatal Abstinence Syndrome

Effects and complications that opioids have on the fetus are often overlooked. Opioid misuse among expecting mothers during pregnancy influences many aspects of the unborn child's development and health. When the baby is born and no longer receives opiates via in-utero drug exposure, withdrawal may result and lead to a number of conditions and complications. This is referred to as neonatal abstinence syndrome (NAS) [3]. Oftentimes, infants diagnosed with NAS require intensive medical care and are admitted to the neonatal intensive care unit (NICU) following delivery (Figure 1) [2]. The length of NICU stay can vary depending on the health implications resulting from in-utero drug exposure and any other complications that may have occurred during gestation, during delivery, and within the first hours of the baby's life. With the increase in the number of pregnant women who abuse opioids, the number of babies that develop NAS and experience developmental problems and delays increases as well. The number of cases admitted into the NICU has increased from 7 per 1,000 cases to 27 per 1,000 during 2004 - 2013 [2, 4]. NAS is detected and evaluated through scoring tools. There are several scoring tools that can determine the severity of withdrawal the infant is experiencing (Table 1).

In order to properly treat NAS, its presence and severity have to be detected first. These scoring tools are helpful in the early identification of withdrawal. Infants experiencing severe withdrawal receive appropriate treatment early on which also proves the importance of these scoring tools. If treatment is delayed, this could lead to an increased length of stay (LOS) in the hospital [5]. Additionally, the effects that delaying treatment has on the long-term developmental outcomes of the neonate are not fully known [6]. Furthermore, the scoring tools developed are often used as a guide for treating NAS [7]. Some have certain setpoints that determine when the infant should be treated with pharmacologic intervention and how much. Treatment for NAS can vary, depending on the severity of opioid withdrawal. This can include pharmacologic or nonpharmacologic intervention. Breastfeeding,
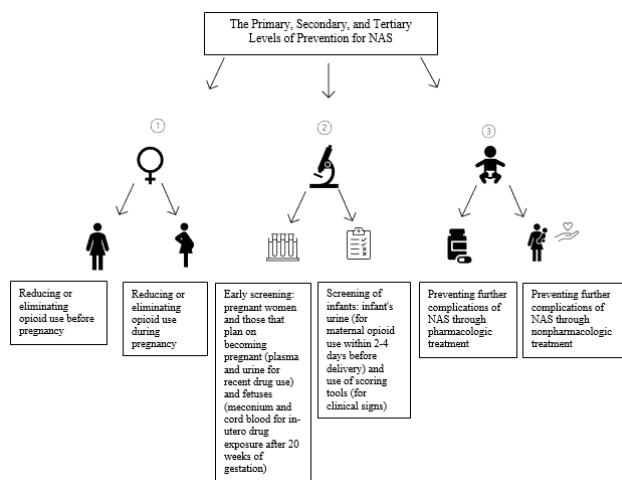
Figure 1: The Primary, secondary, and tertiary levels of prevention for NAS.

swaddling, and increasing skin-to-skin contact are some examples of nonpharmacologic methods for soothing the infant. Pharmacologic treatment includes administering one or more medications, which the infant will eventually be weaned off of [8]. The dose and number of medications depend on the severity of withdrawal.

While several scoring tools exist for NAS full-term infants, none have been designed to specifically assess and treat preterm infants [7]. Typically, premature infants have lower scores when evaluated by these tools which could be explained by less time exposed in utero or by their inability to display some signs of withdrawal [9]. Regardless, preterm infants display different symptoms than term infants do upon delivery. Besides, it is difficult to decipher whether some symptoms exhibited by the infant are caused by prematurity or withdrawal. Several items on scoring tools do not consider these differences, which will affect the neonates' scores and treatment they receive [10]. Just as preterm infants are cared for differently than term infants are, this distinction should also be made for infants exposed to opioids in utero.

Several scoring tools exist to diagnose NAS. While each tool has its own advantages and disadvantages, some have gained popularity over the years.

Existing Popular Scoring Tools

FNASS

FNASS is the most widely used scoring tool. This was the first

tool developed and is often considered the "gold standard" in assessing NAS [5]. Items on this tool are scored on a scale of 1 - 5 every 3 - 4 h. If an infant scores ≥8 three times or ≥12 two times, pharmacologic intervention is used [9]. While FNASS provides a complete examination of the infant, it is time-consuming, hard to use, and subjective. It is also unclear whether cutoff scores are appropriate or not [8]. Nurses usually are not trained on how to properly use this scoring tool and consistent training is not provided for this complex scale, although some research has demonstrated that such training can address this issue and improve reliability and accuracy in the use of this tool [3, 11]. FNASS also requires the infant to be disturbed and unswaddled in order to score them, which might increase withdrawal symptoms and affect the infant's score, resulting in false positive results, increasing the number of infants that unnecessarily receive pharmacologic treatment [5, 8].

M-FNASS

Due to the complexity of FNASS, modified versions of it have been created to simplify and shorten the scoring process of NAS infants. Typically, items that are not indicative of withdrawal signs or that are repetitive on the scoring tool are removed [12]. Examples of these shortened versions are the Maternal Opioid Treatment: Human Experimental Research NAS (MOTHER NAS), the simplified FNASS (sFNAS), the modified FNASS (M-FNASS), and the FNASS-Short Form, while several other variations exist [13]. These modified versions all consist of a different number of items as well. While there are 19 items on the MOTHER NAS, if the score is ≥ 9, the infant is reassessed before starting pharmacologic treatment [7]. Validation of this tool is still being studied [9, 14]. The sFNAS contains 10 items with the cut-off being 6 [15]. The most widely used version in the United States is the M-FNASS [16]. Since the M-FNASS and other similar modified versions of the FNASS are based off of the original FNASS, similar problems with the reliability and validity of these tools exist [7]. These tools are scored the same way and based off of the same criteria, just in a modified or simplified version, which still allows for subjectivity. There is also controversy of whether a certain cut-off score is appropriate or not to determine treatment, in addition to debate on whether these simplified versions assess all the criteria [8]. The FNASS-Short Form is a modified version of the M-FNASS and has 7 items with treatment being initiated after a score of ≥ 8. This tool is not appropriate for infants whose withdrawal symptoms rise rapidly, for whom a longer tool is required [17]. Although these modified versions of FNASS make the scoring process easier than before, there is uncertainty around which one to use and their validity.

ESC

ESC does not assign a score to the infant, instead it assesses the

Table 1: An overview of popular scoring tools.

Scoring tool	Validation	Average LOS [1]	Number of Items	Components
Finnegan Neonatal Abstinence Scoring System (FNASS)	Curran, 2020 [26] Chervoneva, 2020 [27]	19 days [5]	31 [4]	• Central nervous system disturbances • Metabolic, vasomotor, respiratory disturbances • Gastrointestinal disturbances [18]
Modified Finnegan Neonatal Abstinence Scoring Systems (M-FNASS)	Ryan, 2021 [28]	9.5 days [28]	21 (Varies among different versions) [29]	• Central nervous system disturbances • Metabolic, vasomotor, respiratory disturbances • Gastrointestinal disturbances (Also varies depending on the version) [30]
Eat, Sleep, Console (ESC)	Curran, 2020 [26]	5.9 days [5]	3 [8]	Ability to: Eat, Sleep, Be consoled [11]
NICU Network Neurobehavioral Scale (NNNS)	Foo, 2021 [18]	-	45 [31]	3 main parts: Neurological, behavioral, and stress/abstinence. 13 summary scores: Habituation, attention, arousal, regulation, number of handling procedures, quality of movement, excitability, lethargy, number of nonoptimal reflexes, number of asymmetric reflexes, hypertonicity, hypotonicity, and stress/abstinence [16]

infant's ability to eat, sleep without being disturbed for an hour, and be consoled within 10 min [3]. After birth, the newborn is evaluated every 2 - 3 h after being fed [18]. The infant is not disturbed during this process and ESC is one way to decrease the number of infants that receive medication as it focuses on utilizing nonpharmacologic strategies. This way, the mother is more involved and gains a better understanding of how to care for the infant during signs of withdrawal [8]. ESC also encourages the mother and infant to stay together, as oftentimes the mother and infant are separated [19]. If nonpharmacologic treatment is not effective, then medication is integrated into treatment. Medication is given to the infant as necessary, rather than administering scheduled doses. The ESC method has also been proven to decrease the LOS in the hospital [18]. This method has become popular; however, its validity has not been proven yet due to it being very new [20]. While ESC is shorter in duration for assessment time and easier to use than other scoring tools for NAS, there are disagreements on whether three items are sufficient to assess and determine treatment protocols for newborns experiencing withdrawal; this particularly applies when evaluating neurological development and functioning [21].

NNNS

NNNS assesses neurobehavioral functioning for infants at risk of developmental complications. This can be used on both term and preterm infants exposed to opioids [22]. Those using this tool should be trained and certified [23]. While this scale is not invasive, there are 13 summary scores with a "yes" or "no" marked for each area, rather than assigning a numerical score for the infant. Increased responses of "yes" lead to a higher score and indicate higher levels of stress [24]. There are several benefits to using NNNS, such as its ability to anticipate long-term developmental outcomes [23]. Although it includes several similar scoring areas to the FNASS, infants are evaluated in a different manner. This exam has more reliability, validity, and is less subjective [5]. A drawback to this method is that the NNNS is not designed to be used as a treatment guide for the infant but rather as an assessment of neurobehavioral performance [7, 23]. NNNS provides no guidance for treatment, although it includes aspects other tools are lacking.

Less Popular Scoring Tools

Neonatal Drug Withdrawal Scoring System (i.e., Lipsitz tool)

This tool is comprised of 11 items with 3 items having a value of 1, if they are present, while the others can score between 1 - 3. Intervention begins if the infant receives a score of 4 or higher [9]. However, studies have revealed that the reliability is low. To improve consistency in scoring and treatment for this tool, consecutive results are critical for this cut-off score [15].

Ostrea tool

This tool contains 6 items; however, it cannot include numerous signs of NAS and does not have a treatment guide [9].

Neonatal Withdrawal Inventory

This tool consists of 7 items, which are scored between 1 to 4. Pharmacologic treatment is initiated after the infant scores an 8 [9]. While this tool has high sensitivity and specificity, it has not been validated [15].

Neonatal Narcotic Withdrawal Index

This tool has 7 items, with 1 category being "other," and the other 6 assessing NAS symptoms. Each item is scored between 0 - 2, with pharmacologic treatment initiated after a score of 5 or greater [25]. This tool has been validated but is not widely used [15].

Assessment and treatment of NAS can also be affected by socioeconomic factors, such as residing in rural areas and being in a position of poverty.

Nonpharmacologic methods and maternal involvement are crucial in treatment, particularly in preterm infants [23]. However, some of these methods are hard to incorporate into infant care when the mother and infant are separated. In some instances, the infant is transferred to a different hospital to receive care. This is particularly true for families living in rural areas. Rural areas and areas of poverty have increased rates of opioid use disorder yet have fewer resources and care options available [26]. Oftentimes, infants born in rural hospitals are transferred to urban hospitals that are able to provide the level of care needed. When a baby is transferred to another hospital, it makes it difficult for the mother to stay as involved [27]. Such reasons prove the need for standardized care in both rural and urban areas in order to improve assessment and treatment of NAS overall [19]. Addressing opioid use in rural areas is especially important because of the higher prevalence and lack of available services and treatment options [28]. Hospitals in rural areas and poverty-stricken areas should have enough space and quality care available for pregnant women and NAS infants. This can help lower medical costs by reducing the number of infants that are transferred to another hospital. Medical costs are also reduced when nonpharmacologic treatment is used, as it decreases the LOS [29]. This treatment method over a medication and weaning approach is most effective when the infant is kept in a low-stimulus environment and the mother and infant stay together.

Stigma is another factor that affects care. Stigma from healthcare workers prevents women from revealing opioid use during pregnancy which delays the NAS assessment through scoring tools and treatment for withdrawal [30]. Some women distrust NAS assessments and believe they are biased [29]. Increasing maternal involvement in caring for the infant not only helps build a relationship between the mother and infant but also between the mother and healthcare workers. This allows the mother to feel more comfortable with the workers and can help to reduce preconceived beliefs workers may have. Additionally, a scoring tool that is objective is important in eliminating the workers' opinions and bias from affecting NAS assessment, which can help build trust between the mother and healthcare workers [18]. Finding ways to eliminate stigma is imperative so women can feel confident about the care their infant is receiving and understand the focus is on the treatment and health of the infant.

Opportunities for Improvement

While commonly used scoring tools for NAS have strengths, they are known to be time-consuming, complex, and subjective. Due to such reasons, these scoring tools may not be as practical as previously believed in assessing and treating NAS. Preventing pharmacologic treatment when possible, increasing the mother's involvement in caring for the infant, and reducing the frequency of mother-infant separation have shown several benefits. Not only does this decrease the average LOS in the hospital, but also the mother is better informed on how to respond to the infant [31, 32].

There is a need for a scoring tool that is specific to preterm infants with NAS, as preterm deliveries are common among mothers who are using opioids [10]. Using scoring tools that have not been validated for use on preterm infants could lead to misdiagnosing and mistreatment for NAS [33].

In addition, NAS scoring tools should assess the long-term neurobehavioral outcomes, be both reliable and valid, and be able

to help determine what treatment protocols should be followed. For example, the ESC has several strengths and reduces chances of subjectivity; however, its validity needs to be established, so it should be used in conjunction with another effective scoring tool in order to assess other aspects, such as neurobehavior, of the infant's development and functioning. Similarly, the NNNS is an effective tool to use in assessing long-term outcomes; however, no guide specific to treating NAS exists with this tool [34, 35].

Conclusion

Due to increasing rates of prenatal opioid use and the rising incidence of NAS, there is a critical need for improving its prevention, assessment, and treatment. Finding ways to improve and implement aspects of different scoring tools could help improve NAS scoring and treatment. Furthermore, there are several barriers to care and treatment, particularly stigma surrounding opioid use and lack of infrastructure and services in rural areas. Finding ways to address these barriers, along with preventative efforts taken earlier on, will reduce the severity of NAS.

Acknowledgements

Conflict of Interest

None.

References

1. U.S. Department of Health and Human Services (2022) Opioid crisis statistics. https://www.hhs.gov/opioids/about-the-epidemic/opioid-crisis-statistics/index.html#:~:text=In%202019%2C%20an%20estimated%2010.1,and%20745%2C000https://www.cdc.gov/pregnancy/opioids/basics.html%20people%20used%20heroin.&text=Appropriate%20prescribing%20of%20opioids%20is,and%20safety%20of%20Medicare%20beneficiaries

2. Anbalagan S, Mendez MD (2021) Neonatal Abstinence Syndrome. StatPearls Treasure Island.

3. Casavant SG, Meegan T, Fleming M, Hussain N, Gork S, et al. (2021) Integrated review of the assessment of newborns with neonatal abstinence syndrome. J Obstet Gynecol Neonatal Nurs 50(5): 539-548. https://doi.org/10.1016/j.jogn.2021.04.014

4. Tolia VN, Patrick SW, Bennett MM, Murthy K, Sousa J, et al. (2015) Increasing incidence of the neonatal abstinence syndrome in US neonatal ICUs. N Engl J Med 372(22): 2118-2126. https://doi.org/10.1056/NEJMsa1500439

5. Chin Foo CA, Dansereau LM, Hawes K, Oliveira EL, Lester BM (2021) Improving the assessment of neonatal abstinence syndrome (NAS). Children 8(8): 685. https://doi.org/10.3390/children8080685

6. Oei JL, Wouldes T (2020) Will Simplifying the Finnegan Neonatal Abstinence Scoring Tool Improve Outcomes for Infants With Opioid Exposure?. JAMA Netw Open 3(4): e202271-. https://doi.org/10.1001/jamanetworkopen.2020.2271

7. Orlando S (2014) An overview of clinical tools used to assess neonatal abstinence syndrome. J Perinat Neonatal Nurs 28(3): 212-219. https://doi.org/10.1097/JPN.0000000000000043

8. Schiff DM, Grossman MR (2019) Beyond the Finnegan scoring system: Novel assessment and diagnostic techniques for the opioid-exposed infant. Semin Fetal Neonatal Med 24(2) 115-120. https://doi.org/10.1016/j.siny.2019.01.003

9. Jansson LM, Velez M, Harrow C (2009) The opioid exposed newborn: Assessment and pharmacologic management. J Opioid Manag 5(1): 47. https://doi.org/10.5055/jom.2009.0006

10. Allocco E, Melker M, Rojas-Miguez F, Bradley C, Hahn KA, et al. (2016) Comparison of neonatal abstinence syndrome manifestations in preterm versus term opioid-exposed infants. Adv Nonatal Care 16(5): 329. https://doi.org/10.1097%2FANC.0000000000000320

11. Timpson W, Killoran C, Maranda L, Picarillo A, Bloch-Salisbury E (2018) A quality improvement initiative to increase scoring consistency and accuracy of the Finneg-

an tool: Challenges in obtaining reliable assessments of drug withdrawal in neonatal abstinence syndrome. Adv Neonatal Care 18(1): 70. https://doi.org/10.1097/ANC.0000000000000441

12. Ryan K, Moyer A, Glait M, Yan K, Dasgupta M, et al. (2021) Correlating scores but contrasting outcomes for eat sleep console versus modified finnegan. Hosp Pediatr 11(4): 350-357. https://doi.org/10.1542/hpeds.2020-003665

13. Isaac L, van den Hoogen NJ, Habib S, Trang T (2022) Maternal and iatrogenic neonatal opioid withdrawal syndrome: Differences and similarities in recognition, management, and consequences. J Neurosci Res 100(1): 373-395. https://doi.org/10.1002/jnr.24811

14. Jones HE, Fischer G, Heil SH, Kaltenbach K, Martin PR, et al. (2012) Maternal Opioid Treatment: Human Experimental Research (MOTHER)—approach, issues and lessons learned. Addiction 107: 28-35. https://doi.org/10.1111/j.1360-0443.2012.04036.x

15. Gomez-Pomar E, Finnegan LP (2018) The epidemic of neonatal abstinence syndrome, historical references of its' origins, assessment, and management. Front Pediatr 6: 33. https://doi.org/10.3389/fped.2018.00033

16. Armbruster D, Schwirian C, Mosier A, Tam WY, Prusakov P (2021) Neonatal abstinence syndrome and preterm infants: A look at current practice. Adv Neonatal Care 21(2): 107-114. https://doi.org/10.1097/ANC.0000000000000858

17. Maguire D, Cline GJ, Parnell L, Tai CY (2013) Validation of the Finnegan neonatal abstinence syndrome tool–short form. Adv Neonatal Care 13(6): 430-437. https://doi.org/10.1097/ANC.0000000000000033

18. Miller PA, Willier T (2021) Baby STRENGTH: Eat, sleep, console for infants with neonatal abstinence syndrome. Adv Neonatal Care 21(2): 99-106. https://doi.org/10.1097/ANC.0000000000000840

19. Sanlorenzo LA, Stark AR, Patrick SW (2018) Neonatal abstinence syndrome: An update. Curr Opin Pediatr 30(2): 182. https://doi.org/10.1097%2FMOP.0000000000000589

20. Minear S, Wachman EM (2019) Management of newborns with prenatal opioid exposure: One institution's journey. Clin Ther 41(9): 1663-1668. https://doi.org/10.1016/j.clinthera.2019.07.001

21. Jansson LM, Velez ML (2019) Optimal care for NAS: Are we moving in the wrong direction?. Hosp Pediatr 9(8): 655-658. https://doi.org/10.1542/hpeds.2019-0119

22. Sucharew H, Khoury JC, Xu Y, Succop P, Yolton K (2012) NICU Network Neurobehavioral Scale profiles predict developmental outcomes in a low risk sample. Paediatr Perinat Epidemiol 26(4): 344-352. https://doi.org/10.1111/j.1365-3016.2012.01288.x

23. Sullivan MC, Miller RJ, Fontaine LA, Lester B (2012) Refining Neurobehavioral Assessment of the High Risk Infant Using the NICU Network Neurobehavioral Scale. J Obstet Gynecol Neonatal Nurs 41(1): 17-23. https://doi.org/10.1111/j.1552-6909.2011.01322.x

24. Lester BM, Andreozzi-Fontaine L, Tronick E, Bigsby R (2014) Assessment and evaluation of the high-risk neonate: The NICU Network Neurobehavioral Scale. J Vis Exp 25(90): e3368. https://dx.doi.org/10.3791/3368

25. McQueen K, Murphy-Oikonen J (2016) Neonatal abstinence syndrome. N Eng J Med 375(25): 2468-2479. https://doi.org/10.1056/NEJMra1600879

26. Bryan MA, Smid MC, Cheng M, Fortenberry KT, Kenney A, et al. (2020) Addressing opioid use disorder among rural pregnant and postpartum women: A study protocol. Addict Sci Clin Pract 15(1): 1-4. https://doi.org/10.1186/s13722-020-00206-6

27. Syvertsen JL, Toneff H, Madden DR, Clapp JD (2018) Conceptualizing neonatal abstinence syndrome as a cascade of care: A qualitative study with healthcare providers in Ohio. Adv Neonatal Care 18(6): 488-499. https://doi.org/10.1097/ANC.0000000000000552

28. Weller AE, Crist RC, Reiner BC, Doyle GA, Berrettini WH (2021) Neonatal opioid withdrawal syndrome (NOWS): A transgenerational echo of the opioid crisis. Cold Spring Harb Perspect Med 11(3). https://doi.org/10.1101%2Fcshperspect.a039669

29. Goyal NK, McAllister J (2020) Hospital Care of Opioid Exposed Newborns: Clinical and Psychosocial Challenges. J Hosp Med 15(10): 613-618. https://doi.org/10.12788/jhm.3369

30. Blair LM, Ashford K, Gentry L, Bell S, Fallin-Bennett A (2021) Care experiences of persons with perinatal opioid use: A qualitative study. J Perinat Neonat Nurs 35(4): 320-329. https://doi.org/10.1097/JPN.0000000000000597

31. Curran M, Holt C, Arciero M, Quinlan J, Cox D, et al. (2020) Proxy finnegan component scores for Eat, Sleep, Console in a cohort of opioid-exposed neonates. Hosp Pediatr 10(12): 1053-1058. https://doi.org/10.1542/hpeds.2020-0190

32. Chervoneva I, Adeniyi-Jones SC, Blanco F, Kraft WK (2020) Development of an abbreviated symptom score for the neonatal abstinence syndrome. J Perinatol 40(7): 1031-1040. https://doi.org/10.1038/s41372-020-0606-4

33. Isemann BT, Stoeckle EC, Taleghani AA, Mueller EW (2017) Early prediction tool to identify the need for pharmacotherapy in infants at risk of neonatal abstinence syndrome. Pharmacotherapy 37(7): 840-848. https://doi.org/10.1002/phar.1948

34. Montirosso R, Del Prete A, Bellù R, Tronick E, Borgatti R (2012) Neonatal Adequate Care for Quality of Life (NEO-ACQUA) Study Group. Level of NICU quality of developmental care and neurobehavioral performance in very preterm infants. Pediatrics 129(5): e1129-e1137. https://doi.org/10.1542/peds.2011-0813

35. Jansson LM, Patrick SW (2019) Neonatal abstinence syndrome. Pediatr Clin North Am 66(2): 353-367. https://doi.org/10.1016/j.pcl.2018.12.006