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# **NEONATAL ABSTINENCE SYNDROME: AN UPDATE ON THE COST AND LENGTH OF STAY ASSOCIATED WITH TREATMENT DURING THE HOSPITAL STAY**

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# NEONATAL ABSTINENCE SYNDROME: AN UPDATE ON THE COST AND LENGTH OF STAY ASSOCIATED WITH TREATMENT DURING THE HOSPITAL STAY

## ABSTRACT

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*Neonatal Abstinence Syndrome (NAS) has been costly for the healthcare system; every 19 minutes, a newborn was diagnosed in 2021. Medically Assisted Treatment (MAT) for expecting mothers has been shown to decrease costs and length of stay for newborns NAS. This study utilized a literature review and a semi-structured interview. The research showed that medically assisted treatment with methadone or buprenorphine during pregnancy decreased costs, LOS, and severity of symptoms for newborns diagnosed with NAS. The findings showed a positive association between lower costs for the initial stay of infants whose mothers received MAT. MAT during pregnancy has been shown to correlate positively with a shorter initial LOS for infants with NAS.*

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## INTRODUCTION

Neonatal Abstinence Syndrome (NAS) has been costly for the healthcare system, as in 2021 alone, every 19 minutes, a newborn was diagnosed (CDC, 2021b). NAS occurs when mothers use or are exposed to certain substances and opioids during pregnancy causing newborns to go through withdrawal (CDC, 2021a). The use of opioids as prescribed, misuse of prescription opioids, and illicit opioids caused NAS in newborns (CDC, 2021a). Maternal opioid use and NAS have been found to impact low-income women and newborns (Toila et al., 2018). In 2016, rates were highest among American Indian/Alaska, Native individuals with 15.9 per 1000 births, and non-Hispanic white individuals with 10.5 per 1000 births (Strahan, 2020). Rates were also noted as the highest in rural areas, with 10.6 per 1000 births, and most of these infants were either covered under Medicaid or were without insurance (Strahan, 2020).

As of 2013, only six states had laws requiring public health monitoring for NAS (Jilani et al., 2019). Quantitative data on occurrence and cost is difficult to find per each state and has left states and federal health officials unable to improve efforts on delivery care, treatment options for mothers, and prevention of NAS (Toila et al., 2015). Research has shown throughout the country that pregnant women lack access to treatment and help with opioid use during pregnancy (Patrick et al., 2020). It has been observed that from 2010 to 2017, women with opioid-related diagnoses at the time of delivery increased by 131% since 2010 (Hirai et al., 2021). As of 2019, every 19 minutes, a baby was born with NAS. (CDC, 2021b).

The average length of stay (LOS) for newborns in 2017 was two days, whereas the average LOS for newborns with NAS was 11 days, an increase of six times the LOS (HCUP, 2021). Research has shown that NAS can affect a baby even after treatment after birth and cause developmental delays (sitting and walking), motor problems, behavioral and learning issues, social issues, speech problems, sleep problems, and vision problems (March of Dimes, 2019).

As of 2014, Medicaid covered 82% of NAS-related births, which resulted in \$462 million (Winkelman et al., 2018). Per every 1,000 births, 14.4 newborns were impacted by NAS. It has been shown that NAS requires care in the Neonatal Intensive Care Unit for tremors, poor feeding and sucking, seizures, hyperactive reflexes, vomiting, dehydration, irritability, and respiratory stress. Because of these conditions have often led to more extended stays and higher rates for readmissions increasing overall costs of care (Winkelman et al., 2018). As of 2016, newborns with NAS occupied 4% of NICU beds (Holmes et al., 2016). In the United States, only eight states require healthcare professionals to test for prenatal drug exposure if substance use was suspected; however, 19 states had targeted SUD treatment programs specifically for those who are pregnant that were funded or created by the state. Additionally, this report noted that ten states prohibited discrimination against pregnant people seeking treatment from publicly funded SUD treatment programs (Guttmacher Institute, 2022).

The extent to which newborns have these symptoms depends on the type of substance, the amount used and usage occurrences of the substance, and whether the newborn was full-term or premature (CDC, 2021a). The Eat, Sleep, Console method has been developed to accompany the slow weaning of pharmaceuticals. It has allowed more family involvement and morphine as needed instead of its typical strict schedule (Grisham et al., 2019). The cost for hospital stays for a newborn diagnosed with NAS at \$8,200 was more than eight times more than that for other newborns at \$1,000 for 2019 (HCUP, 2021).

Processes for identification and treatment of SUD during pregnancy were varied and inconsistent across the United States, according to the research on state policies on pregnancy completed by the Guttmacher Institute (2022).

Medically Assisted Treatment (MAT), known as a whole-patient approach, decreased the severity of NAS in newborns and decreased the chances of miscarrying while pregnant (Ko et al., 2017). MAT practices for pregnant women have used medications known as methadone or buprenorphine, which have a longer-acting cycle but are less euphoric opioids (ASTHO, 2020). Buprenorphine has been known as the first medication used for the treatment of opioid use disorders that in-office physician prescriptions can be made, which has resulted in greater access to treatment (SAMHSA, 2022). Reports from the Association of State and Territorial Health Officials have shown that 14% of pregnant women received a prescription for an opioid during their pregnancy, and 65.8% of women with substance use disorder (SUD) reported that being pregnant was a barrier to entering MAT. Additionally, 44.1% of pregnant women with SUD did not receive MAT (ASTHO, 2020). Other barriers have been reported, such as facility location (typically not at the same facility as their pre and postpartum care), insurance type (public, private, or no insurance), and their jurisdictions' child abuse and neglect laws (fear of being arrested or losing custody of their child) (Ko et al., 2017).

This research analyzed the difference between cost and length of stay for newborns with Neonatal Abstinence Syndrome between mothers who participated in Medication Assisted Treatment (MAT) and those who were in active substance use up to the time of birth with MAT.

## METHODOLOGY

The hypothesis was: that babies born with Neonatal Abstinence Syndrome of mothers who participated in Medically Assisted Treatment would have lower costs and length of stay than those who were in active substance use up to the time of birth.

The methodology for this qualitative study was a literature review following a systematic review approach complemented by a semi-structured interview. IRB approval and verbal consent were obtained. This interview was tape-recorded, and relevant answers that supported the information found in the literature reviews were used to support the information on NAS and MAT on costs and length of stay for newborns. The databases for this research included: PubMed, ProQuest, and Summon. When information could not be found using these databases, Google Scholar was utilized to find additional scholarly articles. An additional governmental website, the Centers for Disease Control and Prevention, was utilized. These searches were limited to articles and other material written in the English language that was published from 2010 to 2022 to have the most recent data included. Searches were limited to critical vital words including: 'Neonatal Abstinence Syndrome' OR 'NAS' AND 'length of stay' OR 'cost' AND 'Medically Assisted Treatment' OR 'MAT Intervention' AND 'substance use disorder' OR 'SUD.'

A total of 126 articles were identified through database searching and categorized using a PRISMA diagram. Articles were excluded when they did not meet the inclusion criteria (N=99). Articles were included if they described costs and length of stay for newborns with NAS. Articles from relevant government web pages (N=2) were included as well. These 30 articles were subject to full-text review, and these 30 references were included in the analysis. Of these 30 references, 14 were used in the results section.

## RESULTS

### *Length of Initial Infant Hospital Stay*

The more frequently used method of MAT for women with prenatal NAS education was buprenorphine. However, in all participants, the frequency of methadone use was like buprenorphine. Shorter LOS was observed in women who had participated in prenatal NAS education at an average of 9.5 days. (Brocato et. al, 2022).

Wachman et al., 2019 described the average LOS for infants born of women who participated in prenatal buprenorphine MAT at 10.9 days. These authors suggested buprenorphine was a promising alternative to other MAT methods and abstinence due to the reduced LOS in days for those who received this MAT intervention.

Tran et al., 2015, reported that MAT using either methadone or buprenorphine decreased the LOS to an average of 5.05 days. The participants in the trial were between 24 and 29 weeks of gestation; of the 18 original

participants, 14 women completed the trial. (Tran et al., 2015). Six women were exposed to methadone, and 3 of the six born required NAS treatment for approximately 5.3 days. The other 8 women were exposed to buprenorphine, and 5 of the 8 required NAS treatment for approximately 4.8 days (Tran et al., 2015).

The average LOS for infants with NAS to mothers who had received prenatal MAT treatment in a NICU study by Cree et al. (2019) was 15.68 days. After implementing a specialized care and education protocol for clinical treatment staff, the average LOS decreased to 9.71 days, a reduction of more than 6 days of LOS. A 2018 study (Freidman et al.) reported a significantly higher overall average LOS for infants treated with NAS at 23 days.

Flannery et al. 2020, supported the correlation between LOS and severity, where the longer LOS was associated with greater severity of NAS symptoms requiring more intensive treatment. The average LOS for infants in the higher severity cluster was 27.33 days. In contrast, those in the lower severity cluster were 14.87 days, a difference of more than 13 days LOS in the severity range. Multiple factors, including the amount and intensity of prenatal ingestion of substances, determined NAS severity. This study did not differentiate between MAT and non-MAT prenatal care.

Krans, Cochran, and Bogen (2015) suggested that MAT interventions which were medically monitored conversions of opioids from illicit to maintenance treatment therapy, reduced neonatal morbidity via opioid stability. It also minimized withdrawal, reduced risk-taking behavior, and was also associated with improved prenatal care. Complete opioid detoxification was not suggested during pregnancy, even when closely monitored because although it was possible, the risks included preterm labor, fetal distress, maternal SUD relapse, and even spontaneous abortion.

Gibson, Star, and Kumar (2017) reported that some indicators of NAS severity might include differential placental transport in the preterm placenta or developmental immaturity of opiate receptors. It was acknowledged that there was a relationship between MAT preterm and length of stay where severity was impacted by how developed the infant was at birth. The average LOS for late preterm was 14 days, while the early, complete, and late-term were 11 days for infants with NAS born of mothers with MAT treatment. Maternal severity of poly-substance use determined the severity, LOS, and complexity of the NAS (Freidman et al., 2018).

In the Hall et al. (2018) study, researchers found that infants with NAS exposed to prenatal MAT of buprenorphine yielded a shorter LOS at 12.4 days than those with other MAT and prenatal intervention methods at 15.2 days. Of 908 infants with NAS in this study, only 39.6% yielded a severity score high enough to require pharmacological treatment during the inpatient stay, where severity was associated with prenatal MAT intervention of treatment opioids being of lower severity than those treated with methadone of higher severity. [See Figure 1 for LOS summary] Devlin, Lau, and Radmacher (2017) observed that the average LOS for infants exposed to methadone MAT in utero was reduced by an average of one day. Through the implementation of a protocol, it was determined that average LOS could be reduced by decreasing the total medication exposure (pre and postnatal).

#### *Costs associated with initial NAS treatment.*

Devlin et al. (2017) suggested a reduction in cost through a LOS decrease, evidenced by an average reduction of \$27,090 in charges per patient.

Freidman et al. (2018) suggested that cost reductions could be made by treating infants with NAS in the community setting, where appropriate, for what researchers described as the less severe cases of NAS.

Bhatt et al., 2021 reported that in 2018, the average cost for a newborn diagnosed with NAS was \$17,590, accounting for an estimated \$449.1 million for the year, with most of the costs funded by Medicaid. With a one-day stay increase, the hospital stay cost increased by \$1,685 (Bhatt et al., 2021). The extent and symptoms that arose further increased the costs for NAS newborns. Seizures increased the cost to an average of \$71,380, sepsis increased by \$12,837, feeding complications increased by \$7,737, and respiratory complications increased the cost by \$8,268 on average (Bhatt et al., 2021). Treatment at urban teaching and large-bed hospitals also increased the costs by \$12,005 and \$5,243 (Bhatt et al., 2021).

#### *Evidence of Maternal MAT Intervention*

A study in Tennessee (Brennan et al., 2019) found that of 4070 women with a maternal SUD diagnosis, only 289 were not receiving any MAT intervention during pregnancy. Their findings implied that the substances more commonly associated with the NAS were the drugs that were used for the MAT intervention.

A qualitative study focused on pregnant women and the fear, stigma, and barriers to care (Stone, 2015) described avoiding prenatal care with active substance use disorder. This research observed that 54.5% resorted to avoiding prenatal care altogether to avoid detection, and of those that did receive MAT, it was reported that many of

these mothers were still surprised with how severe the infant's withdrawal symptoms were, as suspected, due to the MAT administered. Stone (2015) also reported that women were eligible for Medicaid due to pregnancy and, therefore, could receive MAT covered by Medicaid. Without Medicaid coverage, MAT was a costly treatment, and the fear of losing coverage after birth induced hesitation in pregnant women to seek treatment to avoid costly medical bills for treatment.

## DISCUSSION

This research aimed to analyze the difference between cost and length of stay for newborns with Neonatal Abstinence Syndrome between mothers who participated in Medication Assisted Treatment (MAT) and those who were in active substance use up to the time of birth with MAT. The results of the literature review and the interview with an expert in the field have demonstrated a positive correlation between MAT during pregnancy and a lower length of stay. There was no substantial research available about costs, nor did the Expert interviewed have an informed observation of the cost of treatment. However, the research that was obtained alluded to lower costs associated with MAT during pregnancy as opposed to not initiating MAT.

According to the Expert, the average length of stay in their hospital for initial NAS treatment was 2-3 weeks, but the treatment plan varied based on the Physician overseeing the treatment. Initial observations of infants whose mothers tested positive for illicit substances with a urine drug screen were automatically initiated with a length of stay of 5-7 days to assess any potential NAS symptoms. It was also disclosed that the length of stay for infants with NAS was, at times, due to Child Protective Services needing more time to place the infant if an investigation required displacing the infant from the mother because of the mother not receiving treatment. The Expert suggested that the mother receiving treatment during pregnancy and being involved in treating NAS during the initial length of stay yields positive outcomes for the infant.

This research had its limitations. The literature review was limited to the most available research with keywords focused on infant length of stay. Costs associated with NAS and prenatal MAT were limited in the databases searched. Other limitations included a lack of research for mothers who did not receive prenatal treatment or whose infant did not display NAS symptoms requiring treatment until after the initial hospital stay. There was also the possibility of bias among the articles' publishers. Moreover, researcher and Expert bias could have also played a role.

## CONCLUSION

As a result of this research, Medication Assisted Treatment (MAT) during pregnancy has been shown to positively correlate with a shorter initial length of stay for infants with Neonatal Abstinence Syndrome (NAS). Of the research available on costs associated, it could be inferred that there was also a positive correlation with lower costs for the initial stay of infants whose mothers received MAT. Therefore, the hypothesis of this research has been supported by this literature review.

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#### Interview Questions

1. As a NICU nurse, what types of admissions have you cared for regarding diagnosis and frequency of occurrence? Why and why not?
2. As an active healthcare provider, what types of treatment does the NICU provide infants with NAS? How does it do so? Why and why not?
3. Since the pandemic, have you seen an increase or decrease in infants admitted with NAS? Why and why not?
4. What types of treatment pathways have you observed have the most significant impact on health outcomes for infants with NAS? Why?
5. What are the most significant benefits of MAT intervention on the fetus while the mother is pregnant? Why?
6. What adverse effects of MAT intervention on a fetus have you observed compared to mothers who are actively using substances up until birth if any? Why?
7. Do you think MAT programs are crucial in improving health outcomes for infants born with NAS? If so, why and how?
8. What variance in length of stay for infants with NAS have you observed between mothers with MAT intervention compared to mothers who are actively using substances until birth, if any? Why?
9. What variance in services billed and costs have you observed between mothers with MAT intervention compared to mothers who are actively using substances up until birth, if any? Why and why not?



10. Why are there controversies surrounding MAT for pregnant individuals with SUD?