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COSTS AND LENGTH OF STAY ASSOCIATED WITH TREATING NEONATAL ABSTINENCE SYNDROME

ABSTRACT

Introduction: Neonatal Abstinence Syndrome has been costly for the healthcare system, for every 19 minutes a baby was diagnosed in 2021. Costs and Length of Stay both had been increased for newborns diagnosed. Medically Assisted Treatment for expecting mothers has shown to decrease costs and length of stay for newborns with neonatal abstinence syndrome.

Methodology: This study utilized a literature review and a semi-structured interview. Three databases were used to collect 126 total sources. These sources were reviewed and reduced to 30 total sources that were used in the written research. Of these, 14 sources were used in the results section.

Purpose of the Study: The purpose of this research was 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.

Results: The research showed that medically assisted treatment with methadone or buprenorphine during pregnancy decreased costs, length of stay, and severity of symptoms for newborns diagnosed with NAS. Barriers are still present for expectant mothers wanting to receive MAT intervention.

Discussion/Conclusion: Medication Assisted Treatment (MAT) during pregnancy has been shown to have a positive correlation with a shorter initial length of stay for infants with Neonatal Abstinence Syndrome (NAS). The findings show a positive correlation with lower costs for the initial stay of infants whose mother received MAT.

Key Words: 'Cost', 'Medically Assisted Treatment', 'MAT Intervention', 'Neonatal Abstinence Syndrome', 'Substance Use Disorder'.

INTRODUCTION

Neonatal Abstinence Syndrome (NAS) has been costly for the healthcare system, as in 2021 alone, every 19 minutes a baby was diagnosed (CDC, 2021b). NAS occurs when mothers used or were 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 the use of 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, 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 in place that required public health monitoring for NAS (Jilani et al., 2019). Quantitative data on occurrence and cost has been shown to be 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 county 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 the percentage of women with opioid-related diagnoses at time of delivery increased by 131% from 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, where average LOS for newborns with NAS was 11 days at an increase of nearly 6-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 and have been shown to require care in the Neonatal Intensive Care Unit (NICU) for tremors, poor feeding and sucking, seizures, hyperactive reflexes, vomiting, dehydration, irritability, and respiratory stress which have often led to longer 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 health care 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 10 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 has dependent on the type of substance, the amount used and usage occurrences of the substance, and whether the newborn was full term or premature born (CDC, 2021a). The Eat, Sleep, Console method has been developed to accompany the slow weaning of pharmaceuticals, and 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 the cost for other newborns at \$1,000 for the year of 2019 (HCUP, 2021).

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

Medically Assisted Treatment (MAT), having been known as a whole patient approach, was shown to decrease the severity of NAS in newborns and decrease the chances of miscarrying while pregnant (Ko et al., 2017). MAT practices for pregnant women have used medications known as methadone or buprenorphine that have a longer-acting cycle but are a less euphoric opioid (ASTHO, 2020). Buprenorphine has been known as the first medication used for 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 (ASTHO) have shown that 14% of pregnant women received a prescription for an opioid during their pregnancy, 65.8% of women with substance use disorder (SUD) reported that being pregnant was a barrier to entering MAT, and 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).

The purpose of this research was 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.

METHODOLOGY

The hypothesis was: 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 with a semi structured interview. IRB approval and verbal consent was obtained, and 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. A conceptual framework (Levine et. al., 2021) was adopted from a study that examined developmental outcomes of infants and children that were born to mothers with SUD, specifically opioid dependency, that were participating in methadone MAT. The researchers identified factors that placed the infants and children at risk developmentally, both during pregnancy and after the infant was born. This conceptual framework was adopted to identify the different areas related to this research and its connection to the flow of the purpose of this research (See Figure 1). The framework shows the relationship between prenatal exposure to substances, intervening factors, and outcomes.

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, Centers for Disease Control and Prevention, was utilized. These searches were limited to articles and other material, written in the English language, that were published from 2010 to 2022 to have the most recent data included. Searches were limited to critical key 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 webpages (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 (See Figure 2, PRISMA, 2020). The literature search was conducted by KD, and KS and validated by AC who acted as a second reviewer and determined if the references met inclusion criteria.

RESULTS

Length of Initial Infant Hospital Stay

The more frequently used method of MAT for women with prenatal NAS education was buprenorphine, although, in total of all the participants the frequency methadone use was similar to 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 that buprenorphine was a promising alternative to other MAT methods and abstinence due to the reduced LOS in days for those who received this form of 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 6 born required NAS treatment for

approximately 5.3 days, while the other 8 women were exposed to buprenorphine and 5 of the 8 born 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 implementation of a specialized care and education protocol for clinical treatment staff, the average LOS decreased to 9.71 days which was a reduction of more than 6 days LOS. A 2018 study (Freidman, et. al.), reported a significantly higher overall average LOS for infants being treated with NAS at 23 days.

Flannery, et. al. 2020, supported the correlation of LOS and severity, where the longer the LOS was associated with a greater severity of NAS symptoms that had required more intensive treatment. Average LOS for infants in the higher severity cluster was 27.33 days, where those in the lower severity cluster was 14.87 days, a difference of more than 13 days LOS in the severity range. NAS severity was determined by multiple factors, including the amount and intensity of prenatal ingestion of substances. 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, 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 may include differential placental transport in pre-term placenta or developmental immaturity of opiate receptors. It was acknowledged that there was a relationship between MAT pre-term and length of stay where severity was impacted by how developed the infant was at birth. Average LOS for a late pre-term was 14 days, where early term, full term, and late term were all average of 11 days for infants with NAS born of mothers with MAT treatment. The severity, LOS, and complexity of the NAS was determined by maternal severity of poly-substance use (Freidman, et. al., 2018).

In the Hall et. al. (2018) study, researchers found that infants with NAS who were 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 the 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, which was 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 and accounted for an estimated \$449.1 million for the year, with most of the costs funded by Medicaid. With a one day increase of stay, the total cost for a hospital stay 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 the cost 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 hospitals 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 form of 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.

Avoiding prenatal care with active substance use disorder was described in qualitative study that focused on pregnant women and the fear, stigma, and barriers to care (Stone, 2015). 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 withdraw symptoms were, as suspectedly due to the MAT administered. Stone (2015) also reported that while 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 for pregnant women to seek treatment to avoid costly medical bills for treatment.

DISCUSSION

The purpose of this research was 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 not substantial research available pertaining to costs nor did the Expert interviewed have an informed observation of the cost of treatment although 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 observation of infants whose mother 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 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 as a result of the mother not receiving treatment. The Expert suggested that the mother receiving treatment during pregnancy and being involved in the treatment of NAS during the initial length of stay yields positive outcomes for the infant.

This research was not without its limitations. The literature review was limited to the majority of available research found with keywords used focused on infant length of stay. Costs associated with NAS and prenatal MAT was not abundant in the databases searched. Other limitations included lack of research available for the mothers who did not receive prenatal treatment or whos' infant did not display NAS symptoms requiring treatment until after the initial hospital stay. There was also the possibility of bias within the publishers of the articles utilized. 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 shown to have a positive correlation 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 mother received MAT, as well. Therefore, the hypothesis of this research has been supported by this literature review.

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Table 1

| Researcher | Average LOS (with MAT) |
|-------------------------------|---|
| Brocato et. al., 2022 | 9.5 days |
| Wachman et. al., 2019 | 10.9 days |
| Tran et. al., 2015 | 5.05 days |
| Cree et. al., 2019 | 15.8 days (9.71 days with specialized care) |
| Gibson, Star, and Kumar, 2017 | 11 Days |
| Hall et. al., 2018 | 12.4 days |

Figure 1

Conceptual Framework
(Levine, et. al., 2021)

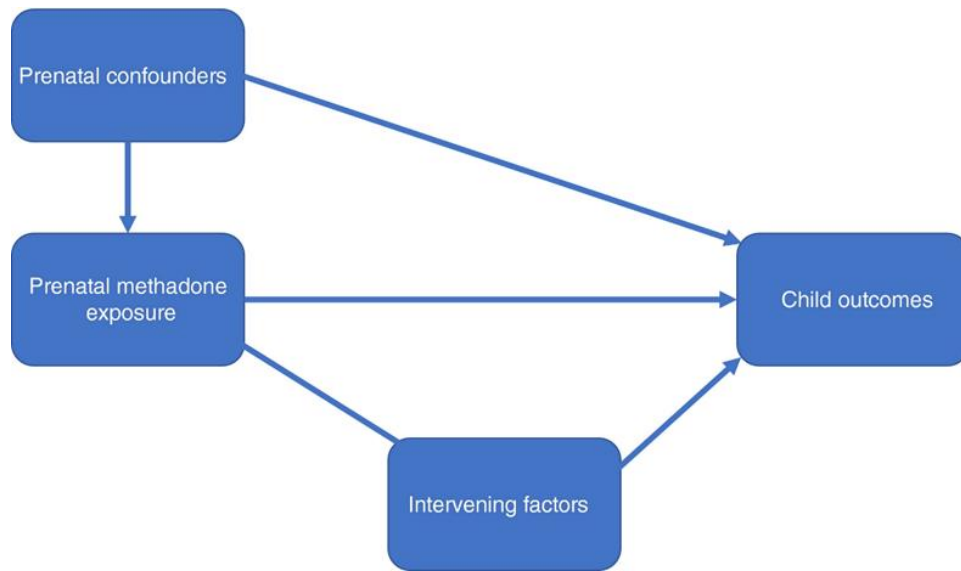
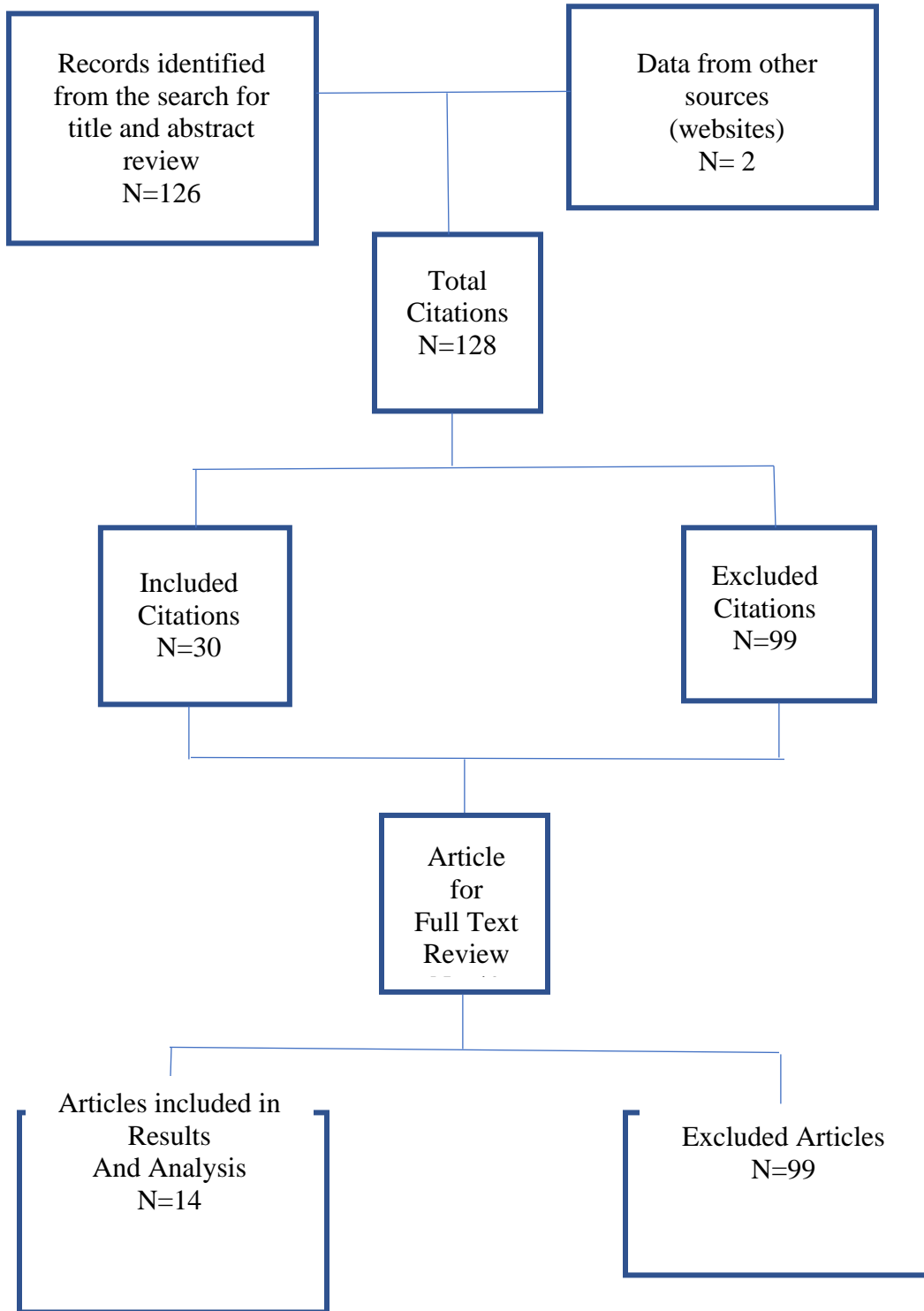


Figure 2

Overview of Literature Evaluation (PRISMA, 2020)



Interview Questions

1. As a NICU nurse, what types of admissions have you cared for with regard to 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? Why and why not? How does it do so?
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 greatest impact on health outcomes for infants with NAS? Why?
5. What are the greatest 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 in comparison with mothers who are actively using substances up until time of birth, if any? Why?
7. Do you think MAT programs play a crucial role 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 in between mothers with MAT intervention in comparison with mothers who are actively using substances up until time of birth, if any? Why?
9. What variance in services billed and costs have you observed between mothers with MAT intervention in comparison with mothers who are actively using substances up until time of birth, if any? Why and why not?
10. Why are there controversies surrounding MAT for pregnant individuals with SUD?