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An Ounce of Prevention for Mothers and Newborns: Reducing In-Utero Opioid Exposure in Missouri

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Executive Summary

Infants born with severe opioid withdrawal resulting from maternal use during pregnancy often suffer from Neonatal Abstinence Syndrome. NAS is estimated to occur in 55 to 94 percent of neonates among mothers who either misused or were prescribed opioids to manage pain during pregnancy.¹ Harm to the infant can occur during the pregnancy and following delivery. Prior to birth, fetuses with opioid exposure are more likely to experience structural growth abnormalities and miscarriage. Infants with NAS experience higher neonatal intensive care unit admission rates and an average hospital stay of 17 days at birth.¹ In addition, depending on the severity of the mother's opioid use, 60 to 80 percent of newborns with NAS require pharmacological treatment to physically support the infant through the withdrawal until opioids are out of the system.¹

The Medicaid program pays for more than eight out of every 10 newborns with NAS in Missouri. **It is estimated that the additional hospital costs associated with NAS for labor, delivery and neonatal care amounted to \$10 million in additional spending by Missouri's Medicaid program in 2016 alone.** New data and surveillance techniques designed to detect the actual prevalence of NAS in Missouri suggest this figure could be underestimated by a factor of as much as four.

During its 2018 regular session, the Missouri General Assembly enacted legislation that provides Medicaid coverage up to 12 months of additional postpartum substance abuse and related mental health treatment to new mothers. To qualify, the mother must receive substance abuse treatment within 60 days after giving birth and must adhere to the treatment. The coverage is subject to state appropriations and federal authorization. This approach to treating the growing epidemic of substance use disorder in Missouri

The Missouri Medicaid program pays for more than eight out of every 10 newborns with NAS.



Executive Summary continued ▼

will positively impact outcomes for thousands of families across the state while saving the health care system long-term, downstream costs. However, similar legislative action could be targeted upstream, to prevent the increasing incidence of Missouri infants exposed to opioids before birth.

Taking steps to ensure potential, expectant and new mothers have the resources needed to overcome substance use disorder is a critical step to reducing health care and societal costs associated with NAS. Providing low-income, uninsured women with substance use recovery resources before pregnancy occurs, or as early in the pregnancy as possible, **would prevent NAS from occurring — dramatically improving outcomes for these children and potentially saving the system millions** in downstream medical, social services, foster care, law enforcement and educational spending.

In this policy brief, we seek to quantify the incidence of NAS in Missouri using both conventional and novel surveillance techniques, and propose a Medicaid policy-centered interventional approach aimed at reducing the number of infants born with opioid withdrawal in Missouri.

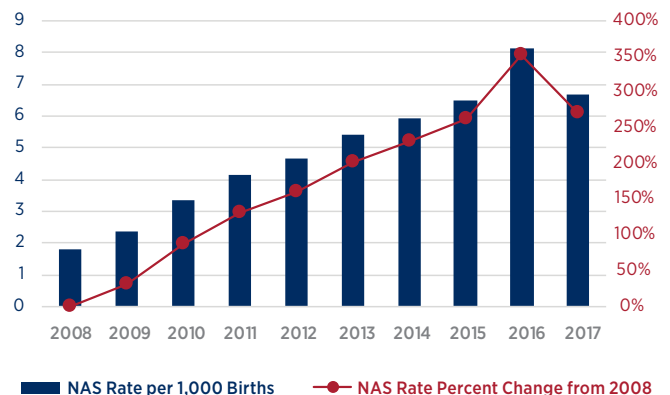
Measuring the Impact of NAS in Missouri

The incidence of NAS has grown dramatically in the U.S. with the proliferation of opioid use disorder — both through prescribed and nonprescribed usage. A review of national data sources on the opioid epidemic suggests that the NAS crisis is rapidly outpacing other measures of the adverse consequences of the larger opioid crisis in the U.S.

- Between 2005 and 2014, the opioid-related overdose mortality rate in the U.S. increased from 4.5 to 8.8 per 100,000 — a 10-year increase of 95.6 percent.ⁱ
- During the same period, the rate of opioid-related hospital emergency department utilization in the U.S. increased from 89.1 to 177.7 per 100,000 — a 10-year increase of 99.4 percent.ⁱⁱⁱ
- Between 2004 and 2013, the rate of NAS increased from seven to 27 per 1,000 admissions to a NICU in the U.S. — a 10-year increase of 286 percent.^{iv}

Using traditional methods of detection, which identify NAS cases by the presence of certain diagnosis codes on neonatal hospital discharge records,^{vi} the incidence of NAS among Missouri newborns increased 353 percent between 2008 and 2016 and then receded between 2016 and 2017. However the 10-year increase remained significantly higher than other indicators of the opioid crisis in the state at 270 percent growth between 2008 and 2017 (Figure 1).

Figure 1: Missouri NAS Rate Identified with Conventional Hospital Discharge Coding Surveillance: 2008-2017



Clinical Care Perspective

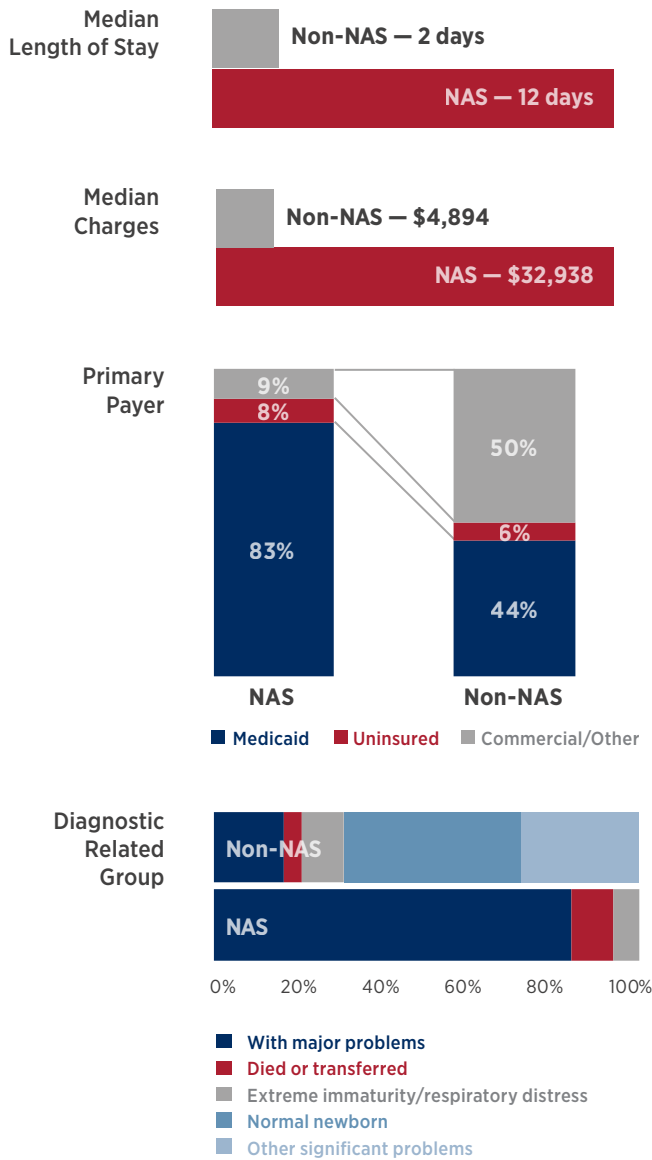
The clinical care of a woman experiencing opioid use disorder during pregnancy focuses on the use of medication substitution therapy, such as with buprenorphine, behavioral therapy and social support services to best manage and control the potential for ongoing abuse and to support recovery. Weaning maternal patients off opioids is not currently recommended by several leading professional organizations, including the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics, due to the potential for severe withdrawal effects and unknown long-term health outcomes. Clinicians should perform early and ongoing

assessment and interviews of all maternal patients for the risk of OUD. Opioids should be prescribed sparingly during and after pregnancy for pain. As noted in studies of the general population, nonpharmacologic methods of pain control can be just as or more effective than opioids. Maternal patients are somewhat limited pharmacologically, as taking nonsteroidal anti-inflammatories, such as ibuprofen, during pregnancy is contraindicated.

A complicating factor with maternal substance abuse is the high rate of polysubstance abuse, increasing the negative impact to

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Figure 2: Differences in NAS and Non-NAS Births for Missouri Newborns Between 2016 and 2017 (N=145,168 without NAS and 1,083 with NAS)



Hospital discharge records also show significant differences in resources required for newborns with NAS compared to other neonates. The median length of stay for newborns with NAS is 10 days longer, or six times the average hospital stay of two days for other neonates in Missouri. Average hospital charges for NAS births are nearly \$33,000 compared to less than \$5,000 for other births in Missouri — a difference of 570 percent (Figure 2).

In addition, hospital records indicate that Medicaid paid for more than eight out of every 10 NAS births in Missouri during 2016 and 2017 (Figure 2). Previous research found that NAS costs the Missouri Medicaid program an additional \$20,000 per birth, for a **total of \$10 million in additional costs associated with NAS during 2016.**^{vii} Importantly, this estimate only includes additional hospital costs associated with NAS during and immediately following the delivery, and does not factor significant downstream costs associated with additional health care needs or added strain on social services, foster care, education and law enforcement.

Nationally, the percent of NAS births covered by Medicaid increased from 74 percent in 2004 to 82 percent in 2014, which is estimated to have cost an additional \$462 million in hospital-based spending during that year alone.^{viii}

The observed reduction in the rate of NAS in Missouri, from 8.1 per 1,000 births in 2016 to 6.7 in 2017, contradicts anecdotal and empirical experience of hospital-based obstetric health care providers from across the state. This causes concern around potential under-coding of NAS in hospital data used by conventional surveillance methods. Understanding the true scale of the NAS crisis in Missouri is critical to targeting primary prevention strategies and resources toward populations most impacted by NAS.

Clinical Care Perspective continued ▼

both the mother and the unborn fetus. It is important to note that while not all substance-exposed newborns will trigger a NAS diagnosis, those newborns can exhibit signs and symptoms of withdrawal for as many as four to six months post-birth, and the aggregate extent of physical, mental and behavioral effects is not currently realized in the medical literature. What is verified is that substance-exposed newborns have higher rates of premature birth, low birth weight, neuro-behavioral symptoms, sudden infant death syndrome, NAS, congenital malformations, and child abuse and neglect.^v

Addressing OUD risk should be a primary assessment and intervention by all clinicians. For the female patient, special consideration and counseling is warranted regarding family planning, use of contraceptives, and risk factors of OUD and subsequent NAS if a pregnancy were to occur. Prescribers can access further resources through ACOG, AAP and the Council on Patient Safety in Women's Care, which produced a patient care bundle on maternal opioid use and management.

To evaluate potential gaps between conventional surveillance of NAS in Missouri and the actual number of infants born with opioid withdrawal, we conducted two analyses drawing from alternative sources of data. First, we used hospital discharge data for new and expectant mothers during 2016 and 2017 to evaluate the potential for NAS among their newborns by linking their delivery dates to opioid-related hospital inpatient and ED encounters during the nine months before and after the date of birth. Second, we conducted a survey of Missouri’s birthing hospitals that was designed to capture observational data from obstetric health care providers on the prevalence and severity of NAS among infants delivered in their hospitals. The full results for each surveillance approach are available at <http://bit.ly/NASinMO>.

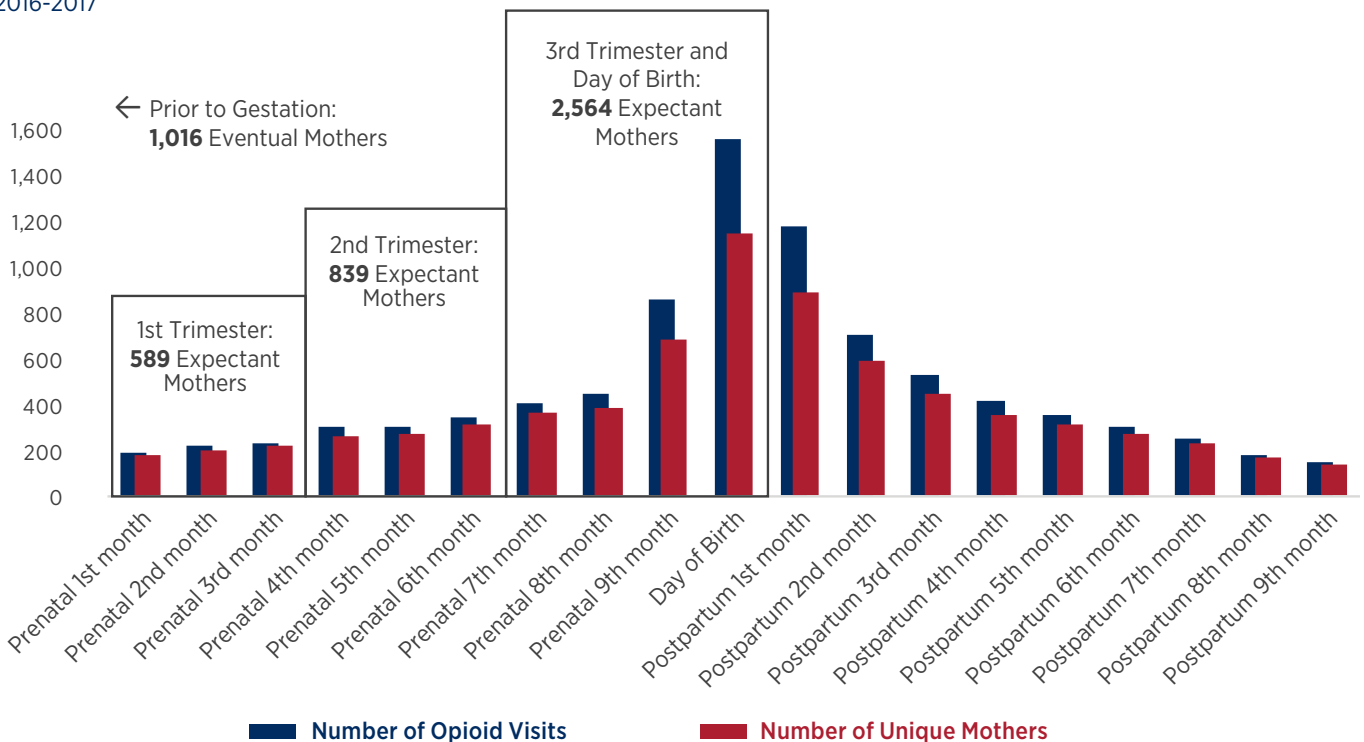
During 2016 and 2017, conventional surveillance identified 1,083 newborns in Missouri diagnosed with NAS on the hospital discharge record. However, unique patient identification codes linking hospital claims for new and expectant mothers in Missouri revealed 3,714 individual women with at least one hospital visit for opioid misuse during, or immediately following, pregnancy. On average, they had 5.5 hospital inpatient or ED encounters related to opioids during the two-year period, and 73 percent were diagnosed with opioid dependence, long-term use, suspected abuse or opioid withdrawal. For women who gave birth during the study period, 56 percent had an opioid-related hospital encounter during gestation, and among those, 62 percent occurred during the third trimester of pregnancy, including 25.6 percent on the day of birth. Figure 3 shows the distribution of new and expectant mothers in Missouri during 2016 and 2017 with an opioid-related hospital visit, as well as the total number of opioid-related visits in temporal proximity to their delivery dates.^{ix}

“Primary-prevention strategies are needed to address the epidemic of opioid use and the associated development of the neonatal abstinence syndrome. Ongoing surveillance is essential to inform public health-related efforts aimed at prevention. Evidence suggests that in the United States, states with the highest rates of prescription opioid use also have the highest rates of the neonatal abstinence syndrome. Therefore, targeted initiatives to address prescribing practices may help to reduce opioid use in women of childbearing age and prevent the subsequent development of the neonatal abstinence syndrome.”ⁱ

Queen and Murphy-Oikonen, NEJM 2016.

The survey of hospital obstetric staff on perceptions of the incidence and severity of NAS was administered during April 2018 to 70 hospitals providing labor and delivery services in Missouri. The questionnaire was completed by 38 hospitals for a response rate of 54 percent. During 2017, responding hospitals accounted for 45 percent of all Missouri births and 50 percent of all births with a NAS diagnosis on the discharge record. The reported perception of the severity of NAS at responding hospitals (as measured by a 10-point scale with 10 being most severe) reflected the incidence of NAS at those hospitals as detected by conventional surveillance methods. For example, 0.4 percent of newborns were diagnosed with NAS at the seven hospitals reporting the least severity, compared to 1.2 percent of newborns at the five hospitals reporting the highest severity—a three-fold difference (Figure 4). However, a large

Figure 3: Number of Opioid-Related Hospital Visits by Unique New and Expectant Mothers in Missouri in Relation to Date of Birth: 2016-2017



disagreement was detected between the actual rate of NAS conventionally identified through diagnosis codes on hospital discharge records and the survey-reported prevalence of NAS across all perceived severity groups. The difference between diagnosed and perceived percentages of newborns with NAS ranged from a perceived rate that was 2.8 times higher than the diagnosed rate at hospitals reporting low NAS severity, to a perceived rate that was 20 times higher than diagnosed NAS at 11 hospitals reporting a severity level of two or three (6.2 versus 0.3 percent, Figure 4).

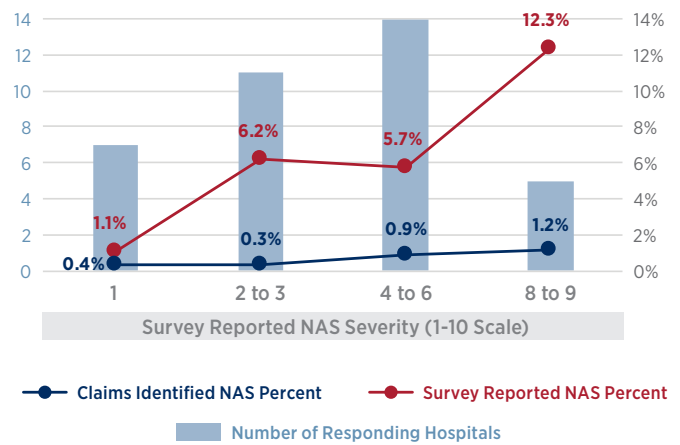
Taken as a whole, there were 257 newborns diagnosed with NAS on discharge records from the 38 responding hospitals during 2017. This was a rate of 7.6 newborns with NAS per 1,000 births. Applying the survey-reported rates of NAS to actual births at these hospitals during the same period suggests the number of NAS births might have been closer to 2,369 for a rate of 70 per 1,000 births.

We detected a wide range in both the number and incidence of newborns with NAS in Missouri across the three surveillance techniques evaluated. Conventional detection methods suggested that 6.7 out of 1,000 infants in Missouri were born with NAS during 2017. Pairing new and expectant mothers with hospital encounters for opioid misuse suggest that the incidence of NAS in Missouri may have been as high as 25.4 per 1,000 births between 2016 and 2017. The highest estimated rate of NAS was generated by combining the survey-reported percentage of NAS births with the conventional rates for nonresponding hospitals. This approach suggested that the incidence in 2017 may have been as high as 35 per 1,000 births, or 413 percent higher than indicated by conventional approaches to the identification of NAS in Missouri (Table 1).

Table 1: Competing Estimates of the Incidence of NAS Among Missouri Newborns

Surveillance Method	Number of Cases	Rate per 1,000 Births	Percent Difference
Claims-based by identifying neonates with ICD-10 codes P961 or P962 on discharge record (2017)	484	6.7	-
Claims-based by linking new and expectant mothers to hospital utilization for opioid misuse (2016-2017)	3,714	25.4	272%
Survey-reported and claims-based for nonresponding hospitals (2017)	2,624	35.0	413%

Figure 4: Distribution of Survey Respondents by Reported NAS Severity, Estimated NAS Percentage and Actual NAS Percentage Identified by Hospital Claims During 2017



Policy Considerations to Curb the Incidence and Burden of NAS in Missouri: Medicaid Coverage Waiver – Low-Income Women with Opioid Use Disorder

Providing evidence-based opioid use disorder treatment to low-income, uninsured women of childbearing age with substance use disorder, prior to becoming pregnant, would reduce two costly negative outcomes associated with infants born drug-exposed: Medical costs associated with NAS and costs incurred by the Family Court and supporting agencies when intervening on behalf of the child (i.e. protective custody). **The cost to care for an infant born with NAS can be more than 10 times the birth cost of a typical, healthy child.** The mother’s SUD often necessitates intervention of the Children’s Division, and subsequent foster care placement may be required to ensure the infant’s well-being.

A Section 1115 Medicaid waiver could be used to make the standard regimen of opioid use disorder treatments available under the existing Missouri Medicaid program accessible to uninsured women of childbearing age, with income below 185 percent of the federal poverty limit and with SUD. The 185 percent FPL is recommended because pregnant women in this income range and their infants, once born, would be Medicaid eligible. Coverage would be the same as the state’s existing Comprehensive Substance Treatment and Rehabilitation opioid treatment program. Waiver cost neutrality standards would be met for program participants below 138 percent FPL because this group currently is eligible for Medicaid coverage at the state’s option, and the services provided are the same as those provided under the existing Medicaid state plan. For participants between 138 and 185 percent FPL, the standard federal Medicaid cost effectiveness requirement would apply.

Program Costs

During 2016, it is estimated that 3,395 women in Missouri would have met the criteria to be eligible for SUD treatment coverage under this program. This estimate is based on uninsured females between the ages of 18 and 39, with income below 185 percent FPL, and with prescription or illicit opioid use during the previous year.^x Treatment costs are summarized in Table 2 and are based on the following factors.

- **Per Member Per Month cost:** \$250
- **Participation rate:** 70%
- **Title XIX match rate:** 65.203%
- **Phase-in:** 12 months
- **Assumed length of treatment (10.5 month average length of stay):**
 - 6 months – 20% of participants;
 - 9 months – 60% of participants;
 - 12 months – 15% of participants;
 - 30 months – 3% of participants; and
 - 60 months – 2% of participants
- **Recidivism rate:** 15%

Table 2: Program Costs

	TOTAL FUNDS	GR	FEDERAL
10-YEAR TOTAL	\$19,780,750	\$6,883,131	\$12,897,619
Year 1	\$3,431,000	\$1,193,886	\$2,237,114
Year 2	\$2,815,000	\$979,536	\$1,835,464
Year 3	\$1,647,250	\$573,195	\$1,074,055
Year 4	\$1,684,500	\$586,158	\$1,098,342
Year 5	\$1,720,500	\$598,686	\$1,121,814
Year 6	\$1,672,750	\$582,069	\$1,090,681
Year 7	\$1,648,250	\$573,543	\$1,074,707
Year 8	\$1,684,500	\$586,158	\$1,098,342
Year 9	\$1,720,500	\$598,686	\$1,121,814
Year 10	\$1,756,500	\$611,214	\$1,145,286

Program Savings – Avoided Costs Associated with NAS Births

Infants born to women with income below 185 percent FPL will be paid for by Medicaid under Missouri's existing eligibility standards. Making SUD treatment available to uninsured women of this income range prior to becoming pregnant carries the potential to greatly reduce the likelihood of their children being born with NAS, resulting in avoided Medicaid costs associated with labor, delivery and neonatal care. Projected cost savings of avoided NAS births are summarized in Table 3 and are based on the following assumptions.

- **Birth rate:** 64 per 1,000
- **Marginal Medicaid hospital costs of a NAS birth:** \$20,000
- **NAS births avoided:** 85%

Table 3: Avoided NAS Birth Costs

	TOTAL FUNDS	GR	FEDERAL
10-YEAR TOTAL	(\$22,295,205)	(\$7,758,063)	(\$14,537,142)
Year 1	(\$155,947)	(\$54,266)	(\$101,681)
Year 2	(\$1,627,829)	(\$566,436)	(\$1,061,393)
Year 3	(\$2,168,837)	(\$754,691)	(\$1,414,146)
Year 4	(\$2,272,832)	(\$790,876)	(\$1,481,956)
Year 5	(\$2,377,280)	(\$827,222)	(\$1,550,058)
Year 6	(\$2,512,101)	(\$874,135)	(\$1,637,966)
Year 7	(\$2,638,491)	(\$918,117)	(\$1,720,374)
Year 8	(\$2,742,848)	(\$954,429)	(\$1,788,419)
Year 9	(\$2,847,296)	(\$990,773)	(\$1,856,523)
Year 10	(\$2,951,744)	(\$1,027,118)	(\$1,924,626)

Program Savings – Avoided Foster Care Maintenance

Decreasing the number of infants born with NAS will mean fewer children will require protective child welfare services. The projected avoided costs of foster care maintenance payments are summarized in Table 4 based on the following assumptions.

- **NAS births avoiding foster care placement:** 50%
- **Monthly foster care maintenance cost per child:** \$700
- **Foster care length of stay:**
 - 1 year: 10% of children entering foster care
 - 2.5 years: 15% of children entering foster care
 - 5 years: 60% of children entering foster care
- **Title IV-E penetration rate:** 60%
- **Title IV-E match rate:** 65.203%

Table 4: Avoided Foster Care Maintenance Costs

	TOTAL FUNDS	GR	FEDERAL
10-YEAR TOTAL	(\$15,252,719)	(\$9,285,582)	(\$5,967,137)
Year 1	(\$6,842)	(\$4,166)	(\$2,676)
Year 2	(\$192,041)	(\$116,912)	(\$75,129)
Year 3	(\$619,527)	(\$377,158)	(\$242,369)
Year 4	(\$1,086,768)	(\$661,606)	(\$425,162)
Year 5	(\$1,515,667)	(\$922,709)	(\$592,958)
Year 6	(\$1,907,904)	(\$1,161,498)	(\$746,406)
Year 7	(\$2,216,532)	(\$1,349,384)	(\$867,148)
Year 8	(\$2,396,618)	(\$1,459,018)	(\$937,600)
Year 9	(\$2,568,269)	(\$1,563,517)	(\$1,004,752)
Year 10	(\$2,742,553)	(\$1,669,616)	(\$1,072,937)

Program Savings – Avoided Foster Care Medicaid Costs

Children in foster care have more complex health care needs than other children. Avoiding NAS births and foster care placements will result in a lower projected cost of health care for the children born to mothers treated through this program. Because children born to women in this income range would otherwise be covered by Medicaid, the avoided costs are the difference between the \$262 PMPM cost of a child under MO HealthNet for Kids and \$839 PMPM cost of a foster child. Avoided foster care costs are summarized in Table 5.

Table 5: Avoided Foster Care Medicaid Costs

	TOTAL FUNDS	GR	FEDERAL
10-YEAR TOTAL	(\$12,572,599)	(\$4,374,888)	(\$8,197,711)
Year 1	(\$5,640)	(\$1,962)	(\$3,678)
Year 2	(\$158,296)	(\$55,082)	(\$103,214)
Year 3	(\$510,667)	(\$177,697)	(\$332,970)
Year 4	(\$895,808)	(\$311,714)	(\$584,094)
Year 5	(\$1,249,342)	(\$434,734)	(\$814,608)
Year 6	(\$1,572,658)	(\$547,239)	(\$1,025,419)
Year 7	(\$1,827,056)	(\$635,762)	(\$1,191,294)
Year 8	(\$1,975,498)	(\$687,413)	(\$1,288,085)
Year 9	(\$2,116,987)	(\$736,647)	(\$1,380,340)
Year 10	(\$2,260,647)	(\$786,638)	(\$1,474,009)

Program Net Savings and State General Revenue Cost Effectiveness

Providing coverage for women suffering from opioid use disorders is a cost-effective policy objective. **The modest program previously described has a 10-year projection to prevent 1,115 infants from being born with NAS and 557 children from entering foster care.** With regard to state general revenue spending, the program described is projected to break even in the third year and result in cumulative net savings to the state in the fourth year. Total general revenue savings throughout the first 10 years of the program is projected to be \$14.5 million. Projected net annual and cumulative costs or savings are summarized in Tables 6 and 7 respectively.

Table 6: Net Program Costs/(Savings)

	TOTAL FUNDS	GR	FEDERAL
Year 1	\$3,262,572	\$1,133,493	\$2,129,079
Year 2	\$836,834	\$241,106	\$595,728
Year 3	(\$1,651,781)	(\$736,351)	(\$915,430)
Year 4	(\$2,570,908)	(\$1,178,038)	(\$1,392,870)
Year 5	(\$3,421,789)	(\$1,585,979)	(\$1,835,810)
Year 6	(\$4,319,914)	(\$2,000,804)	(\$2,319,110)
Year 7	(\$5,033,828)	(\$2,329,719)	(\$2,704,109)
Year 8	(\$5,430,463)	(\$2,514,701)	(\$2,915,762)
Year 9	(\$5,812,052)	(\$2,692,251)	(\$3,119,801)
Year 10	(\$6,198,443)	(\$2,872,157)	(\$3,326,286)

Table 7: Net Cumulative Costs/(Savings)

	TOTAL	GR	FEDERAL
Year 1	\$3,262,572	\$1,133,493	\$2,129,079
Year 2	\$4,099,406	\$1,374,599	\$2,724,807
Year 3	\$2,447,625	\$638,248	\$1,809,377
Year 4	(\$123,283)	(\$539,790)	\$416,507
Year 5	(\$3,545,072)	(\$2,125,769)	(\$1,419,303)
Year 6	(\$7,864,986)	(\$4,126,573)	(\$3,738,413)
Year 7	(\$12,898,814)	(\$6,456,292)	(\$6,442,522)
Year 8	(\$18,329,277)	(\$8,970,993)	(\$9,358,284)
Year 9	(\$24,141,330)	(\$11,663,245)	(\$12,478,085)
Year 10	(\$30,339,773)	(\$14,535,402)	(\$15,804,371)

Federal Cost Neutrality

Federal cost neutrality is required for women between 138 and 185 percent FPL to be covered because individuals in this income group would not otherwise be eligible for Medicaid coverage. For the purposes of calculating federal cost neutrality, the savings of foster care maintenance are excluded since these are savings that would not accrue to the federal Medicaid program. Only avoided costs of NAS births and the additional Medicaid costs of foster children are counted against the treatment costs of the waiver program to determine federal waiver cost neutrality.

Tables 8 and 9 show the net costs and savings estimated for women with incomes between 138 and 185 percent FPL. Extending opioid treatment coverage to uninsured women between this income range is projected to save the federal Medicaid program \$109.213 throughout the first five years of the program, and thus should satisfy federal cost neutrality requirements for Section 1115 waivers.

Table 8: Waiver Cost Neutrality Annual Net Medicaid Costs/(Savings)

	TOTAL	GR	FEDERAL
Year 1	\$1,138,444	\$396,144	\$742,300
Year 2	\$346,302	\$120,504	\$225,798
Year 3	(\$380,258)	(\$132,313)	(\$247,945)
Year 4	(\$553,779)	(\$192,691)	(\$361,088)
Year 5	(\$716,741)	(\$249,400)	(\$467,341)
Year 6	(\$903,954)	(\$314,546)	(\$589,408)
Year 7	(\$1,047,364)	(\$364,446)	(\$682,918)
Year 8	(\$1,138,515)	(\$396,163)	(\$742,352)
Year 9	(\$1,227,785)	(\$427,229)	(\$800,556)
Year 10	(\$1,318,057)	(\$458,640)	(\$859,417)

Table 9: Waiver Cost Neutrality Cumulative Net Medicaid Costs/(Savings)

	TOTAL	GR	FEDERAL
Year 1	\$1,136,048	\$394,685	\$741,363
Year 2	\$1,482,350	\$515,189	\$967,161
Year 3	\$1,102,093	\$382,877	\$719,216
Year 4	\$548,313	\$190,185	\$358,128
Year 5	(\$168,428)	(\$59,215)	(\$109,213)
Year 6	(\$1,072,382)	(\$373,761)	(\$698,621)
Year 7	(\$2,119,746)	(\$738,207)	(\$1,381,539)
Year 8	(\$3,258,261)	(\$1,134,370)	(\$2,123,891)
Year 9	(\$4,486,046)	(\$1,561,599)	(\$2,924,447)
Year 10	(\$5,804,104)	(\$2,020,240)	(\$3,783,864)

Conclusion

The rate of newborns exposed to opioids in Missouri is growing at an alarming rate. In addition, novel surveillance techniques suggest that the true scale of the crisis may be significantly underreported by conventional surveillance methods. The direct and societal costs of NAS are expansive and are borne primarily by Medicaid, which paid for more than eight out of 10 births for newborns with opioid exposure in Missouri during 2017. During its 2018 regular session, the Missouri General Assembly passed critical legislation to ensure new mothers with Medicaid have access to treatment for substance use disorder. Similar resources are needed for low-income uninsured women prior to pregnancy to prevent NAS in Missouri. This analysis shows that a policy-driven preventive approach to reversing the trend of NAS in Missouri would meet federal requirements to obtain a Medicaid 1115 waiver and be cost-effective by yielding returns on the investment of general revenue beginning in the third year of the program.

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- vi Prior to Oct. 1, 2015, neonates with NAS were identified with the presence of ICD-9 CM code 7795 at any position on the discharge record. On and after Oct. 1, 2015, neonates with NAS were identified with the presence of ICD-10 CM codes P961 or P962 at any position on the discharge record.
- vii Reidhead, M. (2017). Trends in Hospital Utilization for Opioid Overuse and Drug-Dependent Newborns in Missouri. Missouri Hospital Association. Available at https://web.mhanet.com/SQI/opioid/NAS_Research.pdf
- viii Winkelman, T.N.A., Villapiano, N., Kozhimannil, K.B., Davis, M.M. & Patrick, S.W. (2018). Incidence and Costs of Neonatal Abstinence Syndrome Among Infants With Medicaid: 2004-2014. *Pediatrics*. 141(4). Retrieved from <http://pediatrics.aappublications.org/content/early/2018/03/21/peds.2017-3520>
- ix Note the number of expectant mothers reported in Figure 3 by trimester do not sum to the total due to overlap by those with visits in multiple trimesters.
- x The number of women qualifying for the proposed program was estimated using data from the Small Area Health Insurance Estimates Program of the U.S. Census Bureau in combination with prevalence of prescription drug and heroin use estimates from the U.S. Substance Abuse and Mental Health Services Administration.