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Part One: Prenatal Substance Use and Improving Family Health

Mother and infant risk and protective factors associated with child
welfare involvement in the first 60 days after a referral was made

REPORT HIGHLIGHTS:

Factors associated with an increased risk of
infant removal from their family by child welfare
due to prenatal substance use include:

- less than adequate prenatal care,
- lower household income,
- low participation in WIC, and
- greater medical fragility of the newborn.

For infants removed from the home, the rate of
placement with relatives while in foster care
decreased by 15% (2016-2019). This is a concern
as placing children with relatives has been shown
to promote healthy child development.

With additional authorizing legislation, future
phases of this study can increase understanding
of barriers to accessing adequate prenatal care,
promote more effective screenings and
treatments, and inform systems and policy
changes that can strengthen the health and life
path of Colorado families.

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Executive Summary

Comprehensively addressing perinatal substance use in Colorado requires robust data-informed policy and practice. The Colorado Legislature’s Study Committee on Opioid and Other Substance Use Disorders responded to this need with SB19-228, a data linkage project aimed at using administrative records to inform and advance state policies and programs that strengthen families impacted by perinatalⁱ substance use and substance use disorders.

This data linkage project is a first of its kind in Colorado because it considers the health and well-being of mothers and infants as a unit—even during times when they may be physically separated for medical care, safety, or permanency.ⁱⁱ

The goal of linking data across state administrative data systems is to advance lawmaker, practitioner, and advocates understanding of trends and outcomes of perinatal substance use for Colorado families. Multiple contextual factors influence substance use during pregnancy and national research has found that perinatal substance use variably impacts women of all races, incomes, education and employment levels, and geographic regions. Young women and those living in poverty experience the highest prevalence rates, often due to multiple social inequities and structural factors.^{1, 2, 3} In Colorado, the state health department reported a 98% increase in newborns exposed to opioids prenatally between 2012 to 2018.⁴ Beyond opioids, the Substance Abuse and Mental Health Services Administration estimates that prenatal exposure to alcohol or illicit drugs affects 10-11% of all births.⁵ Understanding the geographic and cultural variability associated with perinatal substance use in Colorado and how mother-infant dyads are engaging with public health care, prevention, and benefit systems can inform policies and practices aimed at improving family health and well-being.

This report communicates key findings from the first phase of the data linkage project, focused on mother-infant dyads who were referred to child welfare shortly after a birth event for substance exposure of a newborn. During child welfare involvement, an infant may be removed from the home when there is imminent concern for the child’s safety or health. Separating an infant from their mother can disrupt early bonding and healthy development, while also creating stress for the postpartum mother and entire family.^{6, 7} By focusing on the subset of child welfare-involved mother-infant dyads, this research offers unique insights into how health care, public assistance, and child welfare systems can coordinate efforts to strengthen families, prevent family separation, and decrease foster care placement for these Colorado babies.

“It is not possible to fully promote the health and well-being of a child without supporting their caregiver, particularly during the perinatal period. Integrated data on mothers and their children are needed to understand how to best support families in Colorado.”

- Kathryn (Kathi) Wells, M.D. Co-chair of SEN Steering Committee; Associate Professor, Department of Pediatrics, University of CO School of Medicine; Executive Director of the Kempe Center

ⁱ We use the term “perinatal” to refer to the time before (i.e., pregnancy) through the first year after the birth.

ⁱⁱ Permanency in this context is “a legally permanent nurturing family” consistent with the Child Welfare Family Services Review definition.



About the Data Linkage Project

To better understand perinatal substance use in Colorado, the legislature called for a statewide perinatal substance use data linkage project (SB19-228). The goal of this legislative mandate was to better use data to inform public health and human service actions and improve outcomes. Most existing research on perinatal substance use is focused on a singular system (e.g., health care or child welfare). The data linkage project creates a more robust understanding of perinatal substance use by focusing on the intersection of health, public assistance, and child welfare.

The data linkage project uses a mother-infant dyad approach, recognizing that infants and mothers are interconnected, their health and safety are intertwined and, therefore, engagement and outcomes are best understood when information is paired. During pregnancy, mother and infant are viewed and treated as one unit; however, following birth, the care, treatment, and support for mothers and infants are most often separated. A more holistic approach that centers the dyad after birth as well as during pregnancy can help to strengthen and coordinate early and ongoing care across systems.

Phase One of the Data Linkage Project: Phase One of the data linkage project (i.e., this report) focuses on mother-infant dyads involved in child welfare and opportunities to prevent the need for infant removal from the home for families impacted by prenatal substance use. Specifically, the study population includes mothers and infants who were Colorado residents at the time of the child's birth (2013-2019) and met the definition of substance exposure during the prenatal period as substantiated by a child welfare agency. As noted in the Methods section of the report, the sample consists primarily of births where the primary payment method for delivery was Medicaid. Part Two and beyond will expand the sample to include mother-infant dyads where substance use during pregnancy is evidenced in health care records.

Phase One Study Findings

Study findings show several factors associated with the risk of infant removal from their family by the child welfare system due to prenatal substance use, including:

- **Consistent participation in prenatal care** is associated with a lower risk of infant removal by child welfare. Less than one-third of mothers began prenatal care early in their pregnancy and participated in the recommended number of visits.
- **Higher household income levels** are associated with lower risk of infant removal by child welfare. The majority (72%) of mothers indicated their household income was less than \$25,000 a year.
- **Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) participation** is associated with lower risk of infant removal by child welfare. Household income data suggest there were more women eligible for WIC than engaged in these services.
- **Families involved in child welfare due to prenatal substance use care for infants that tend to be more medically fragile at the time of birth** and are admitted to the neonatal intensive care unit at

This is a correlational study that by design identifies associations between experiences and characteristics and the outcome of infant removal by child welfare.

The research does not mean that factors “cause” infant removal by child welfare.

Instead, the research offers insight into opportunities to wrap preventative services around families.



three times the rate of the general population. Infants who are medically fragile, which is characterized by conditions such as respiratory problems and/or being born preterm, are at higher risk of infant removal by child welfare.

- For infants removed from the home by child welfare, **the rate of placement with relatives while in foster care decreased by 15% from 2016 to 2019**. More infants being placed in non-relative foster care is concerning as placing children with kin is shown to promote healthy child development.^{8, 9}

Study Implications

Study findings inform prenatal opportunities for wrapping services around families impacted by prenatal substance use, beginning in the pregnancy and using [Plans of Safe Care](#), with the long-term goal of proactively preventing child welfare involvement and setting families who are involved in child welfare on a trajectory of safety and well-being. Prenatal opportunities for strengthening families include:

- **Prenatal care.** Prenatal care can provide guidance to mothers and other caregivers on infant health and care (e.g., breastfeeding, safe sleep, postpartum depression), what to expect in terms of caring for newborns with prenatal substance exposure, and referrals to specialists.
- **WIC participation.** WIC services can support prenatal food security and provide formula and breastfeeding support, while also creating vital parenting social support networks.
- **Family concrete support.** Child welfare services assess family needs and can offer referrals and service support for childcare and economic security.
- **Health and well-being support.** Health care providers can work together with pregnant people and their families during the prenatal period to create a Plan of Safe Care and introduce services that can support the health and well-being of mother-infant dyads over the long term (e.g., home-visiting programs, Maternal Opioid Misuse model, co-located services).

Putting policies and practices in place that incentivize care coordination across health care, public assistance, and child welfare systems can strengthen support networks for individuals experiencing perinatal substance use and substance use disorders. As a result, these changes can increase the opportunity for infants and mothers to remain together, giving them the consistency, predictability, and attachment they need to thrive.

Next Phases of Research

Legislation is needed to authorize access to additional data sources (i.e., Medicaid, prescription drug monitoring programs, and the Colorado Department of Human Services behavioral health data) and authorize connecting these data systems to non-state administrative data sources that can capture privately insured individual's health care utilization as well. With this authorization, future phases of the data linkage project will build the capacity to routinely monitor population-level incident rates of prenatal substance use and health outcomes for mother-infant dyads throughout the perinatal period (i.e., pregnancy through the first year after the birth). A companion qualitative study will engage mothers impacted by perinatal substance use, eliciting their lived experiences on processes, barriers, stigmas, and supports that influence access to and successful navigation of substance use disorder prevention and treatment, engagement with social services, and health care utilization. The goal is to better understand the risk and protective factors pregnant women impacted by substance use disorders experience in accessing adequate prenatal care; identify opportunities for more effective screening and treatment approaches; and inform systems and policy changes that can strengthen the health and life path of Colorado families.



Acknowledgements

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Study Partners

The Colorado Perinatal Substance Use Data Linkage Project was designed in partnership with the Center for Prescription Drug Abuse Prevention, Illuminate Colorado, the Substance Exposed Newborns Steering Committee, and experts from state agencies, non-profits, and the academic community. The project ensures decision-makers across sectors have access to routine and rigorous Colorado-specific data that can inform further advancements in policy and practice.

Center for Prescription Drug Abuse Prevention coordinates Colorado's response to the misuse of medications such as opioids, stimulants, and sedatives. They address this major public health crisis in partnership with many agencies, organizations, and community coalitions, working together to educate, conduct public outreach and research, and improve safe disposal and treatment.

Illuminate Colorado is dedicated to strengthening families, organizations, and communities to prevent child maltreatment in Colorado. Holding five national affiliations and serving as backbone support for four statewide coalitions, including the Substance Exposed Newborns Steering Committee, Illuminate leverages its cross-system connections to forward multi-level efforts aimed at increasing resources and support for families impacted by or at risk of perinatal substance use.

Substance Exposed Newborns Steering Committee is working to identify and implement strategies to reduce the number of families affected by perinatal substance use in Colorado and improve outcomes for impacted parents/caregivers, children, and families across the lifespan. As a committee of the Substance Abuse Trend and Response Task Force, the Committee is co-chaired by the executive directors of Illuminate Colorado and the Kempe Center for the Prevention & Treatment of Child Abuse and Neglect.



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Introduction

Comprehensively addressing perinatal substance use in Colorado requires robust data-informed policy and practice. The Colorado Legislature’s Study Committee on Opioid and Other Substance Use Disorders responded to this need with SB19-228, a data linkage project aimed at using administrative records to inform and advance state policies and programs that strengthen families impacted by perinatalⁱⁱⁱ¹⁰ substance use and substance use disorders.

This data linkage project is a first of its kind in Colorado because it considers the health and well-being of mothers and infants as a unit—even during times when they may be physically separated for medical care, safety, or permanency.^{iv}

The goal of linking data across state administrative data systems is to advance lawmaker, practitioner, and advocates understanding of trends and outcomes of perinatal substance use for Colorado families. Multiple contextual factors influence substance use during pregnancy and national research has found that perinatal substance use variably impacts women of all races, incomes, education and employment levels, and geographic regions. Young women and those living in poverty experience the highest prevalence rates, often due to multiple social inequities and structural factors.^{11, 12, 13} In Colorado, the state health department reported a 98% increase in newborns exposed to opioids prenatally between 2012 to 2018.¹⁴ Beyond opioids, the Substance Abuse and Mental Health Services Administration (SAMHSA) estimates that prenatal exposure to alcohol or illicit drugs affects 10-11% of all births.¹⁵ Understanding the geographic and cultural variability associated with perinatal substance use in Colorado and how mother-infant dyads are engaging with public health care, prevention, and benefit systems can inform policies and practices aimed at improving family health and well-being.

About Gender-Inclusive Language

Although we primarily use the term “mother” and/or “mother-infant dyad” and/or “pregnant women” in this report to refer to those experiencing pregnancy, birth, and the early postpartum period, we acknowledge and validate all gender identities that experience childbearing. Because data reported in this study use administrative datasets that only capture sex assigned at birth, we have no way of knowing the gender identities of participants. We honor that pregnancy, birth, and family formation are experienced by individuals across the gender continuum.

About the Data Linkage Project

To better understand perinatal substance use in Colorado, the legislature called for a statewide perinatal substance use data linkage project (SB19-228). The goal of this legislative mandate was to better use data to inform public health and human service actions and improve outcomes. Most existing research on perinatal substance use is focused on a singular system (e.g., health care or child welfare). The data linkage project creates a more robust understanding of perinatal substance use by focusing on the intersection of health, public assistance, and child welfare.

ⁱⁱⁱ We use the term “perinatal” to refer to the time before (i.e., pregnancy) through the first year after the birth.

^{iv} Permanency in this context is “a legally permanent nurturing family” consistent with the Child Welfare Family Services Review definition.



The mother-infant dyad approach used in this study recognizes that infants and mothers are interconnected, their health and safety are intertwined, and therefore engagement and outcomes are best understood when information is paired. During pregnancy, mother and infant are viewed and treated as one unit; however, following birth, the care, treatment, and support for mothers and infants are most often separated. A more holistic approach that centers the dyad after birth as well as during pregnancy can help to strengthen and coordinate early and ongoing care across systems.

Phase One of the Data Linkage Project (i.e., this report) focuses on mother-infant dyads who were referred to child welfare shortly after a birth event for substance exposure of a newborn and that referral was substantiated. During child welfare involvement, an infant may be removed from the home when there is imminent concern for the child's safety or health. Separating an infant from their mother can disrupt early bonding and healthy development, while also creating stress for the postpartum mother and entire family.^{16, 17} By focusing on the subset of child welfare-involved mother-infant dyads, this research offers unique insights into how health care, public assistance, and child welfare systems can coordinate efforts to strengthen families, prevent family separation, and decrease foster care placement for these Colorado babies. This is an important start to comprehensively understanding perinatal substance use among Colorado families. However, as noted in the [Methods section](#) of this report, the data in Phase One remain limited because the dataset only includes those dyads for whom a referral was made to child welfare and the referral was substantiated. Additionally, the [sample](#) consists primarily of births where the primary payment method for delivery was Medicaid. Part Two and beyond will expand the sample to include mother-infant dyads where substance use during pregnancy is evidenced in health care records.

“When families impacted by substance use disorders have information and access to resources without fear and stigma, we strengthen the foundation for families and communities to thrive.”

- Jade Woodard, Executive Director,
Illuminate Colorado

About the Study Sample

The mother-infant dyads included in this study were referred to child welfare for “substance exposure a newborn” and that referral was substantiated. This means that either the infant tested positive at birth for a schedule I controlled substance, as defined in section 18-18-203, C.R.S., or a schedule II controlled substance, as defined in section 18-18-204, C.R.S., unless the child tests positive for a schedule II controlled substance as a result of the mother's lawful intake of such substance as prescribed OR when there are observable effects of substance exposure in the infant (e.g., in ability to eat, sleep, and soothe).

Research Aims for Phase One

- **Aim 1: Compare participation in prenatal care and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), the health of mothers during pregnancy, and newborn health at the time of birth for child welfare-involved mother-infant dyads impacted by prenatal substance use to the general population of Colorado mother-infant dyads.**
- **Aim 2: Describe trends in initial child welfare involvement of mother-infant dyads impacted by substance use during the pregnancy.**



- **Aim 3: Identify risk and protective factors (e.g., prenatal care, WIC participation, medical fragility) of mother-infant dyads impacted by prenatal substance use that are associated with infant removal from the home and placement into foster care.**

Phase One Study Findings

Study findings show several factors associated with the risk of infant removal from their family by the child welfare system due to prenatal substance use, including:

- **Consistent participation in prenatal care** is associated with a lower risk of infant removal by child welfare. Less than one-third of mothers began prenatal care early in their pregnancy and participated in the recommended number of visits.
- **Higher household income levels** are associated with lower risk of infant removal by child welfare. The majority (72%) of mothers indicated their household income was less than \$25,000 a year.
- **Special Supplemental Nutrition Program for WIC participation** is associated with lower risk of infant removal by child welfare. Household income data suggest there were more women eligible for WIC than engaged in these services.
- **Families involved in child welfare due to prenatal substance use care for infants that tend to be more medically fragile at the time of birth** and are admitted to the neonatal intensive care unit (NICU) at three times the rate of the general population. Infants who are medically fragile, which is characterized by conditions such as respiratory problems and/or being born preterm, are at higher risk of infant removal by child welfare.
- For infants removed from the home by child welfare, **the rate of placement with relatives while in foster care decreased by 15% from 2016 to 2019**. More infants being placed in non-relative foster care is concerning as placing children with kin is shown to promote healthy child development.^{18, 19}

Study Implications

Study findings inform prenatal opportunities for wrapping services around families impacted by prenatal substance use, beginning in the pregnancy and using [Plans of Safe Care](#), with the long-term goal of proactively preventing child welfare involvement and setting families who are involved in child welfare on a trajectory of safety and well-being. Prenatal opportunities for strengthening families include:

- **Prenatal care.** Prenatal care can provide guidance to mothers and other caregivers on infant health and care (e.g., breastfeeding, safe sleep, postpartum depression), what to expect in terms of caring for newborns with prenatal substance exposure, and referrals to specialists in care of opioid-exposed infants.
- **WIC participation.** WIC services can support prenatal food security and provide formula and breastfeeding support, while also creating vital parenting social support networks.
- **Family concrete support.** Child welfare services assess family needs and can offer referrals and service support for childcare and economic security.



- **Health and well-being support.** Health care providers can work together with pregnant people and their families during the prenatal period to create a Plan of Safe Care and introduce services that can support the health and well-being of mother-infant dyads over the long term (e.g., home-visiting programs, Maternal Opioid Misuse model, co-located services).

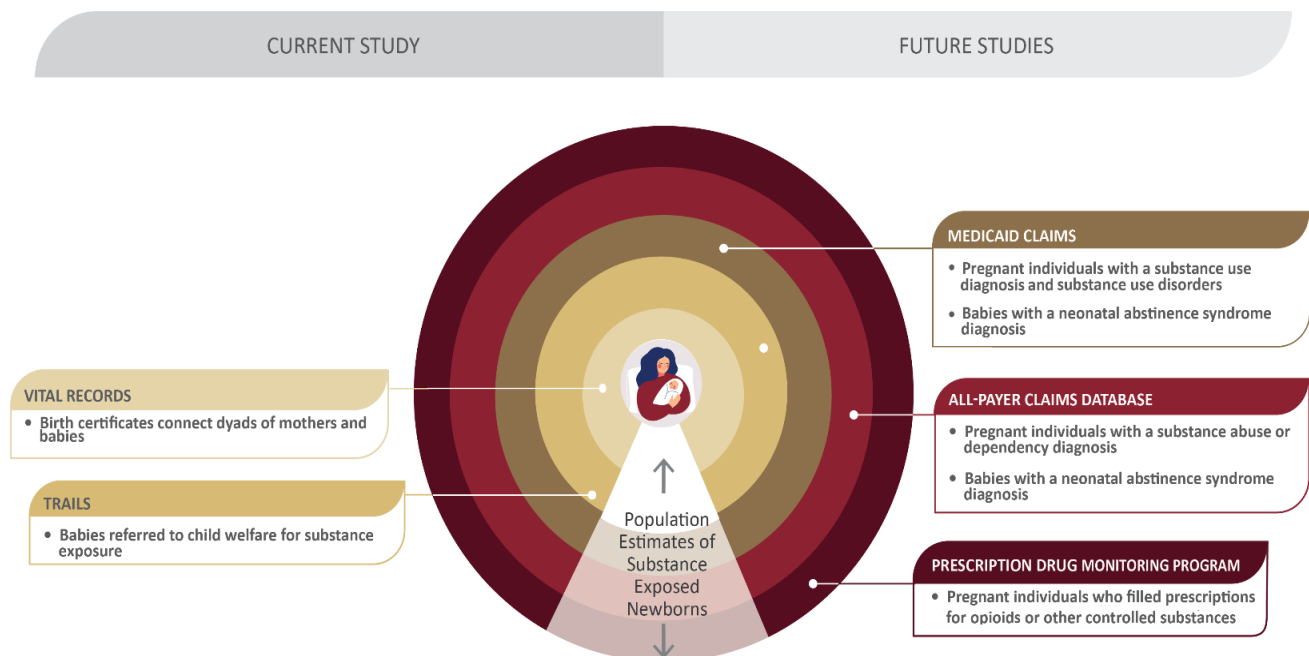
Plans of Safe Care

A federal mandate requiring provision and reporting of appropriate services for infants affected by substance abuse or withdrawal symptoms or Fetal Alcohol Spectrum Disorder (FASD) and their families. The goal is to identify programs that will continue to support the health and well-being of mother-infant dyads over the long term (e.g., home-visiting programs, Maternal Opioid Misuse model, co-located services). It is worth noting that Plans of Safe Care can occur outside of the child welfare system as well.

Putting policies and practices in place that incentivize care coordination across health care, public assistance, and child welfare systems can strengthen support networks for individuals experiencing perinatal substance use disorders. As a result, these changes can increase the opportunity for infants and mothers to remain together, giving them the consistency, predictability, and attachment they need to thrive.

Next Phases of Research

Future phases of the data linkage project will build the capacity to routinely monitor population-level incident rates of prenatal substance use and health outcomes for mother-infant dyads throughout the perinatal period (i.e., pregnancy through the first year after the birth). A companion qualitative study will engage mothers impacted by perinatal substance use, eliciting their lived experiences on processes, barriers, stigmas, and supports that influence access to and successful navigation of substance use disorder prevention and treatment, engagement with social services, and health care utilization More information is available in the [Future Research](#) section of this report.



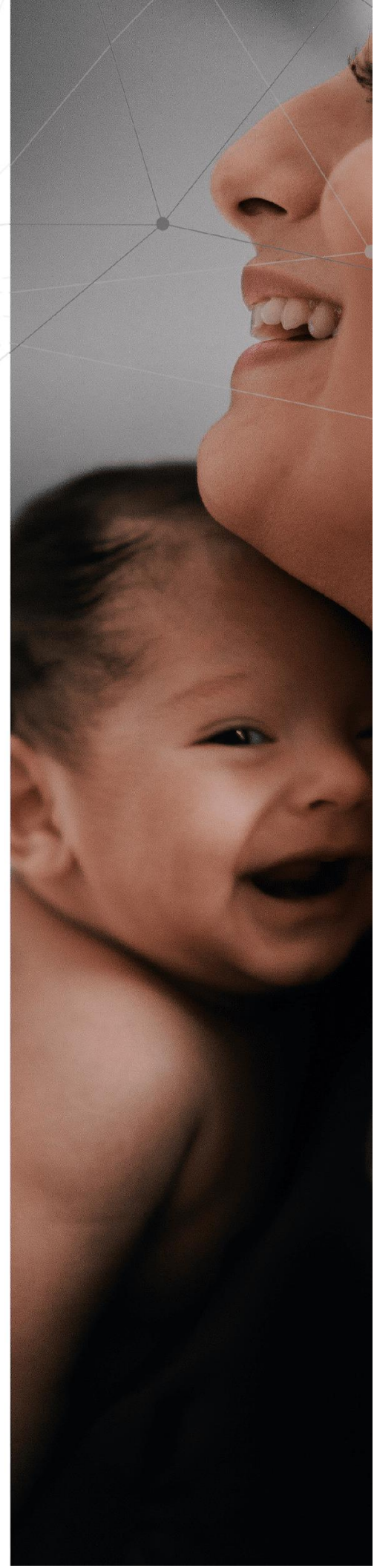


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Literature Review

- Impacts of substance use during pregnancy
- Factors associated with perinatal substance use and substance use disorders





Literature Review

Impacts of Substance Use During Pregnancy

The use of opioids, marijuana, alcohol, tobacco, and other substances during pregnancy can, depending on multiple factors, have immediate and long-term health implications for infants, their mothers, and their families. These effects can be exacerbated if the substance use disorder is not identified and treated.

The impacts vary depending on factors such as the extent and frequency of substance use and can be compounded by the use of multiple substances at the same time. Regular use of certain drugs, like opioids, can result in infants experiencing withdrawal symptoms after birth. For women who have developed a substance dependency, suddenly discontinuing use can result in miscarriage, fetal distress, or preterm labor.²⁰ Research also indicates that women with substance use disorders are more likely to experience inadequate prenatal care, poor nutrition, chronic medical problems, poverty, and domestic and interpersonal violence.²¹

Table 1 highlights the most prevalent impacts that substance use during pregnancy may have on children, mothers, and families, and on communities and society as a whole.

Table 1: Possible Impacts of Substance Use During Pregnancy

Children	Mothers & Families	Society
<ul style="list-style-type: none"> • Preterm birth and stillbirth²² • Low birth weight²³ • Birth defects (e.g., neural tube defects, gastroschisis, congenital heart defects)²⁴ • Breathing and feeding problems • Fetal alcohol spectrum disorders • Neonatal abstinence syndrome • Impaired cognitive and fine motor function^{25, 26} • Adverse speech and language outcomes²⁷ • Increased likelihood of substance use disorder later in life²⁸ 	<ul style="list-style-type: none"> • Accidental drug overdose (leading cause of maternal mortality in Colorado 2004-2012^{29, 30})/premature death • Co-occurring mental and behavioral health challenges³¹ • Parenting challenges that impede healthy child development • Economic challenges and loss of income/living wage • Increased potential for involvement in the criminal justice system³² • Increased likelihood for children of parents with substance use issues to enter the child welfare system and be placed in out-of-home care^{33, 34} 	<ul style="list-style-type: none"> • Increased demands on health system (United States cost of care for newborns experiencing withdrawal symptoms increased from \$65.4m in 2004 to \$462m in 2014)³⁵ • Increased need for social services (e.g., Temporary Assistance for Needy Families, TANF/Supplemental Nutrition Assistance Program, SNAP)



A Growing Issue in Colorado and the Nation

The opioid epidemic is a growing issue in Colorado. Colorado has seen a steady increase in drug overdose death rates over the past decade. The opioid overdose rate climbed 179% between 2001 and 2015, with heroin-related overdose deaths increasing by 77% from 2013 to 2017.³⁶ In 2017, 558 Coloradans died from prescription opioid or heroin overdose.³⁷ Opioid overdose in Colorado is also a leading cause of maternal mortality.³⁸

These state trends mirror nationwide trends in opioid use. In the United States (U.S.), an estimated 11.8 million people misused opioids in 2016, and more than 2.1 million people were diagnosed with an opioid use disorder in 2017.^{39, 40} Along with the rising incidence of opioid dependence comes rising costs, from the increased demand on the healthcare system to a greater need for social services and supports. Analysis from the White House Council of Economic Advisers estimated that the opioid epidemic cost between \$293.9 and \$622.1 billion in 2015, with the estimate of \$504 billion being commonly referenced.⁴¹ When the costs of the Drug War as a system of policy response to drug use is considered, the costs are even higher.

The impacts of the opioid epidemic extend to newborns who are exposed to these substances prenatally. Birth defects caused by opioid exposure (e.g., neural tube defects and congenital heart defects) can occur as a result of exposure during the first few weeks of pregnancy when the infant's organs are forming.⁴² Because women do not always know they are pregnant at this stage, opioid prescriptions present a serious risk for women of reproductive age. A study of opioid prescription claims between 2008-2012 found that one in three women of reproductive age filled an opioid prescription each year.⁴³ Researchers have also noted an increase in filled opioid prescriptions during pregnancy over the past two decades, and national rates of opioid use disorder at the time of delivery more than quadrupled between 1999-2014.^{44, 45} The Centers for Disease Control and Prevention estimate that between 14-22% of women fill an opioid prescription during pregnancy.⁴⁶

The growing use of opioid prescriptions amongst pregnant women parallels the growing incidence of neonatal abstinence syndrome (NAS) in the U.S. From 2009 to 2012, the national incidence of NAS almost doubled.⁴⁷ Longer, costlier hospital stays for infants experiencing withdrawal accounted for \$1.5 billion in annual hospital expenditures, with over 80% of those infants enrolled in a state Medicaid program⁴⁸ (although this cost could be driven by costly treatment modalities and newborn separation, which is no longer considered best practice). More recent data from 2015 estimated that the incidence of NAS was seven for every 1,000 births, which translates to one newborn diagnosed with NAS every 19 minutes.⁴⁹

In Colorado, the state health department reported a 98% increase in newborns experiencing withdrawal due to prenatal opioid exposure from 2012 to 2018, as identified by Colorado Medicaid claims.⁵⁰ Birth rates in Colorado have remained relatively stable, indicating that the increase in NAS is not simply due to more infants being born in the state.⁵¹

There are some regional differences in prescription rates across Colorado. Opioids are generally prescribed at higher rates than benzodiazepines throughout the state, while the southeast corner has the highest prescription rates for both types of drugs.⁵² Counties in the southeast corner of Colorado also experience high drug overdose death rates.⁵³



Sixty-two of Colorado's 64 counties currently have a medication-assisted treatment provider to offer an evidence-based combination of medication and social support services for those seeking treatment for substance abuse.^v Many of the rural counties have only one provider. Many of the counties without a provider are located in rural parts of the state, meaning that residents in areas that have seen rising drug overdose deaths (e.g., northwest, southwest, and southeast Colorado) do not have access to a treatment center within 30 miles.⁵⁴

Through statewide efforts and campaigns to combat substance use trends, Colorado has made recent progress toward reducing the number of opioid prescriptions. As a percentage of all prescriptions, opioid prescriptions in Colorado went down from 11.3% in 2013 to 6.4% in 2018.⁵⁵ In 2018, providers in Colorado wrote 45.1 opioid prescriptions for every 100 people, slightly lower than the U.S. average of 51.4 prescriptions.⁵⁶

In addition to opioids, the misuse of other substances like alcohol and marijuana poses a growing issue in Colorado and the broader United States. SAMHSA estimates that approximately 400,000 infants (10-11% of live births in 2005) are affected by prenatal exposure to alcohol or illicit drugs.⁵⁷ Prenatal exposure to alcohol affects as many as one in five pregnancies during the first trimester, with differences variably observed by race and ethnicity.⁵⁸ In Colorado, a 2017 survey found that slightly more than half of women of reproductive age drank alcohol in the past 30 days.⁵⁹ Of the women surveyed, 22.8% engaged in binge drinking (defined as four or more drinks on one occasion) at least once in the last month, while 8.5% engaged in heavy drinking (defined as eight or more drinks per week).⁶⁰ The 2017 National Survey on Drug Use and Health found substantial increases in the number of pregnant women using marijuana regularly⁶¹ with around 7% reporting using marijuana in the past 30 days and 3% reporting daily use.⁶²

Factors Associated with Prenatal Substance Use and Substance Use Disorders

There are multiple contextual elements that influence substance use in the perinatal period, including underlying environmental, behavioral, and social factors (Table 2).^{63, 64, 65, 66} Research has found that mothers with substance use disorders are more likely to be younger, less educated, unmarried, and not privately insured.⁶⁷ They are also less likely to receive adequate prenatal care, while simultaneously being more likely to have pregnancy-related health conditions.⁶⁸ Previous research has documented that those living in neighborhoods with concentrated disadvantage—marked by the prevalence of poverty and low income, low educational attainment, and high unemployment—are exposed to higher levels of chronic stress, which in turn can lead to substance use as a coping mechanism, while also commonly having less access to prevention and treatment services as well as informal supports.^{69, 70, 71} Intimate partner violence, histories of sexual and physical abuse, and mental health co-occurring disorders are also documented as risk factors for perinatal substance use.^{72, 73, 74, 75} Racial and ethnic differences in patterns of substance use, as well as disparities in the contextual factors that surround use and equitable access to treatment, are also documented.^{76, 77, 78} Additionally, lack of adequate social support is an identified risk factor for perinatal substance use and is a barrier to successful treatment, especially for young women and those living in disadvantaged areas.^{79, 80, 81}

Perinatal substance use variably impacts women of all races, incomes, education and employment levels, and geographic regions. Young women and those living in poverty experience the highest prevalence rates, often due to multiple social inequities and structural factors.

^v Based on correspondence with CDHS's Office of Behavioral Health. [Availability of MAT](#) includes mobile health units.



Table 2: Prenatal Substance Use and Substance Use Disorders by Social & Structural Determinants of Health

Race & Ethnicity	Education & Socioeconomic Status	Geographic Region	Mental Health and History of Trauma
<ul style="list-style-type: none"> The National Survey on Drug Use and Health found that Black pregnant women were more likely to have used an illicit drug in the past month, White pregnant women were more likely to have smoked cigarettes, and both groups were more likely than Hispanic pregnant women to have consumed alcohol.⁸² Other studies found that newborns of White mothers are most at risk of alcohol and tobacco exposure, newborns of Black mothers are most at risk of exposure to illicit drugs, and newborns of Hispanic and Asian mothers are least likely to be exposed to substances in the prenatal period.^{83, 84} Women in Colorado who drink alcohol during their pregnancy are also more likely to be White.⁸⁵ 	<ul style="list-style-type: none"> Women with substance use disorders during pregnancy are more likely to have lower levels of education and income.⁸⁶ Women who are employed are less likely to use substances during pregnancy.⁸⁷ Higher socioeconomic status increases the risk of any drinking during pregnancy, but lower socioeconomic status increases the risk of binge drinking in the second and third trimesters.⁸⁸ In one Colorado survey, women who drank during the last three months of pregnancy had higher educational attainment.⁸⁹ Women in Colorado with lower levels of education or who live in poverty are more likely to smoke.⁹⁰ 	<ul style="list-style-type: none"> One study found that pregnant women in rural areas were more likely to report illicit drug use than their urban counterparts.⁹¹ Another study found that substance use, treatment, and demographic characteristics of pregnant women with opioid use disorders differ by U.S. census region, with those in the South being more likely to use opioids and benzodiazepines, but least likely to have medication-assisted treatment.⁹² 	<ul style="list-style-type: none"> Mental health disorders commonly co-occur with substance use and can be heightened during the pregnancy, where perinatal mood disorders may present and intensify underlying mental illness.^{93, 94, 95} Women with histories or current experiences of trauma, including intimate partner violence, physical abuse, and sexual abuse, are more likely to report perinatal substance use.^{96, 97, 98}

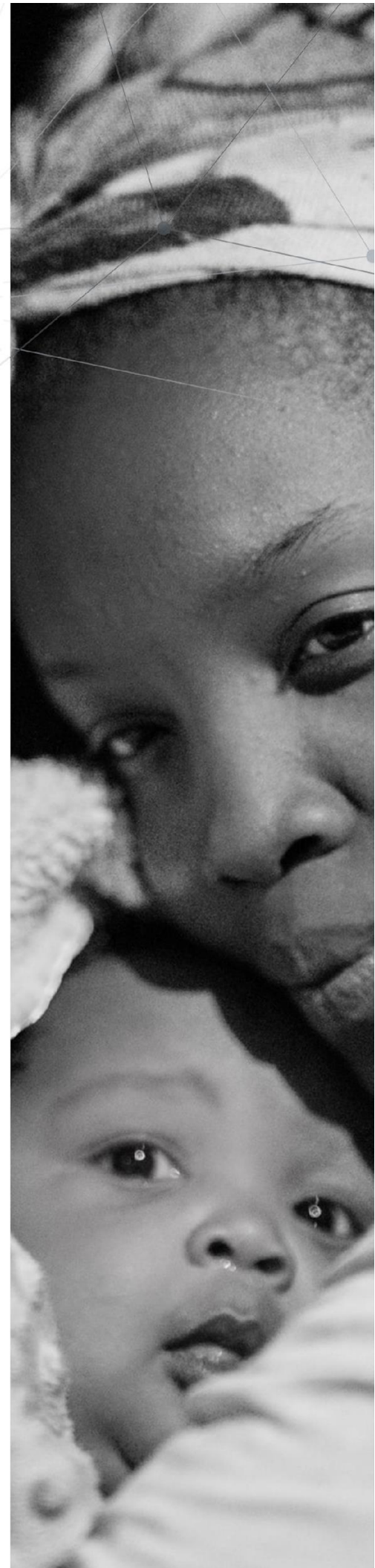


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Methods

- Establishing cohorts
- Sampling strategy
- Linking child welfare records to vital records
- Measurement of constructs
- Data analysis





Methods

Establishing Cohorts

The cohort of focus includes all mother-infant dyads who were Colorado residents at the time of the child's birth (2013-2019) and met the definition of substance exposure of a newborn during the prenatal period as substantiated by a child welfare agency. The first step for establishing the study cohort was to pull all birth records for mother-infant dyads during the period of interest. In order to ensure a large enough study sample of newborns meeting the definitions of substance exposure as substantiated by a child welfare agency, birth records over a seven-year period (2013-2019) were included. This allowed for trends to be examined annually and for a more detailed examination of smaller subgroups of interest. The second step was to reduce the study sample to those mothers and infants who, using child welfare records, were identified as meeting the child welfare definition of substance exposure of a newborn.

Sampling Strategy

Substantiated child welfare referrals for substance exposure of a newborn were used to create the sample for this first phase of the project.

Anyone can call the Colorado Child Abuse and Neglect Hotline, 844-CO-4-Kids, to report potential child abuse or neglect. Medical providers, and other mandatory reporters, are required to notify child welfare agencies of suspected child maltreatment. Medical providers may identify prenatal substance use and/or substance exposure of a newborn through review of the mother's medical records, observation of behavior and health during the prenatal period, testing at the time of the birth event, clinical presentation of the infant or mother during or after the birth, and during well- and sick-infant visits. It is then the role of county child welfare agencies to determine if a referral for substance exposure of a newborn requires an assessment of the allegations. If, at the conclusion of the assessment, the county department feels that the preponderance of evidence indicates substance exposure of the newborn occurred, then the allegation is substantiated.

The Colorado Children's Code that applied during the study period (2013-2019) specified that a child welfare substantiation of abuse should be made for:

"Any case in which a child tests positive at birth for either a schedule I controlled substance, as defined in section 18-18-203, C.R.S., or a schedule II controlled substance,⁹⁹ as defined in section 18-18-204, C.R.S., unless the child tests positive for a schedule II controlled substance as a result of the mother's lawful intake of such substance as prescribed."¹⁰⁰

Referrals could also be substantiated when there is evidence of effects of substance exposure in the infant, such as the inability to eat, sleep, or be soothed.



Linking Child Welfare Data to Vital Records

The data integration and de-identification work for this study was accomplished by [the Linked Information Network of Colorado \(LINC\)](#). LINC is a public-private collaborative among the Colorado Lab and state and local data owners in Colorado that rely upon a data linking hub in the Governor’s Office of Information Technology. LINC is available on a fee-for-service basis to link and de-identify data approved by the data owners for research and analytics. The LINC Data Scientist performing the functions of the linking hub has technical expertise in identity resolution and has met all certification and background check requirements that permit the handling of protected health records.

This study is a [LINC project](#) approved by the Colorado Department of Human Services (CDHS) Office of Children, Youth and Families as well as the Colorado Department of Public Health and Environment’s (CDPHE) Center for Health and Environmental Data. Child welfare data come from the state’s administrative database, Trails (or the Colorado Comprehensive Child Welfare Information System), as maintained by CDHS. Vital Records data on live births and deaths are maintained by CDPHE. The child welfare data that were linked to vital records was a broader sample than what was ultimately used in this study. The purpose of this broader linkage was to facilitate a long-term research agenda. Thus, the numbers of records matched was substantially larger than the sample reported in the results section. Table 3 delineates data sources, date ranges, and other data restrictions.

In 2020, thanks to community, provider, researcher, and policy stakeholder efforts, the Colorado Children’s Code language was updated to the following for a child welfare substantiation of abuse: “Any case in which a child is born affected by alcohol or substance exposure, except when taken as prescribed or recommended and monitored by a licensed health care provider, and the newborn child’s health or welfare is threatened by substance use.”¹⁰¹

Table 3: Linked Data Sources

Data Source Received	Organization	Data Date Ranges	Other Data Restrictions
Trails Child Welfare Extract (15,417 Records)	Colorado Dept. of Human Services, Office of Children, Youth and Families	Trails clients with referrals between 1/1/2013 to 12/31/2019 which satisfied any one of three criteria: (1) Referral record flagged as Substance Exposed Newborn, regardless of findings; (2) Substantiated substance abuse by mother or removal for mother’s substance abuse and action initiated before child’s first birthday; or (3) Removal of child for case with Substance Abuse when child was less than one year of age.	Utilized LINC Trails extract, rather than a direct pull from Trails. After identity resolution, substance abuse by mother was restricted to actions initiated within 0-2 days of the date of birth.



Data Source Received	Organization	Data Date Ranges	Other Data Restrictions
		<p><i>Note.</i> The analytic sample was later limited to substantiated substance abuse by mother or removal for mother’s substance abuse and action initiated before child’s first birthday.</p>	
<p>Colorado Vital Records Birth Records Extract (452,347 Records)</p>	<p>Colorado Dept. of Public Health and Environment, Center for Health and Environmental Data</p>	<p>All Colorado live births (including maternal and infant information) and infant death data from 1/1/2013 to 12/31/2019.</p>	<p>Only mother/child identifiers were provided for identity resolution with other data. Once identity resolution was performed, Vital Records at CDPHE provided additional approved data on the matches to be used in the study.</p>

Dyads of mothers and infants were connected by LINC, then all personal identifiers were stripped, and data were anonymized to prevent re-identification of individuals by the research team.

Data were deduplicated within the Trails data. The vital records data did not require deduplication, and the mother-infant relationship was preserved by leaving all records as pairs and allowing for twice as many identifiers than could be examined simultaneously (e.g., a mother’s name, birth date, and SSN as well as the child’s name and birth date).

Two tools were available for performing the identity resolution: (1) the Senzing identity resolution application; and (2) SQL queries. Senzing uses a pre-trained analytical model that already understands how to identify these slight variations and how much weight to give to a similar first name, last name, date of birth, SSN, etc. Senzing has been used effectively for projects of matching two sets of personal identifiers, with SQL queries used afterwards as a secondary means of identification. But, in this case, we had four sets (mother-infant pairs in two datasets) of personal identifiers, and the off-the-shelf Senzing application could not readily handle the defined mother-infant relationship in each record pair. Thus, the process was reversed, and SQL was used as the primary means of matching up the record pairs, followed by Senzing as a secondary method and quality control check.

The matching methodology to connect vital records and child welfare records consisted of the following iterative process: (1) run a SQL query to match the mother-infant pair across datasets; (2) sample the results to confirm the matches were accurate without false matches; (3) set a flag to indicate the match; and (4) remove previous matches from future queries. Personal identifiers of both the mother and infant were used to identify matches. The process began with the tightest possible queries and then loosening the queries over time as previous matches had been removed, thus reducing the possibility of false future matches as the queries became looser. Three examples of queries are shown in Table 4.



Table 4: Query Examples

Restrictive Query Example	Less Restrictive Query Example	Least Restrictive Query Example
Mother DOB exact match	Child DOB exact match	Child last name exact match
Mother SSN exact match	Child gender exact match	Child DOB exact match
Mother last name exact match	Mother’s last name in Trails matches mother’s maiden name in Vital Records	Child gender exact match
Child DOB exact match		Child first letter of first name exact match

By slowly iterating and finding valid matches, linking them and then removing them from future searches, the mother-infant pairs were linked. These queries resulted in approximately 13,675 of a maximum 15,417 child welfare records (89%) being linked to vital records.

Final Quality Check

A stratified, random sample of 100 individuals was drawn from the study matches to assess the quality of the identity resolution process by race and ethnicity. The study matches were drawn in three segments: 34 White, non-Hispanic individuals; 33 Black, non-Hispanic individuals; and 33 Hispanic individuals of any race. There were no major differences among the samples noted except that there were fewer discrepancies among the Black records than Hispanic or White. Thirty of the records (30%) had at least one discrepancy in identifier fields; despite these discrepancies, the human judgment was that 100% of the records were correctly paired between the two systems.

Measurement of Constructs

All health-related measures were based on information reported on the birth certificate. All child welfare involvement data were based on information reported in Trails.

Prenatal Care

Adequacy of prenatal care was defined by the widely applied Kotelchuck Index that uses data from birth certificates.

The Kotelchuck Index measures adequacy of prenatal care.¹⁰² This index contains two scores that are based on data reported on the birth certificate: (1) initiation or when prenatal care began; and (2) received services or the number of prenatal care visits. The initiation score reflects the assumption that beginning prenatal care early in the pregnancy is better than initiating care late in the pregnancy. The received services are a ratio of observed to expected visits based on when prenatal care was initiated. These scores are combined to create a single summary score that categorizes prenatal care as “Inadequate,” “Intermediate,” “Adequate,” or “Adequate Plus.” A noteworthy limitation of this scale is that the number of expected visits is based on recommendations for low-risk pregnancies; higher-risk pregnancies may necessitate additional prenatal visits, which are not captured by the Index approach.



Maternal Chronic Conditions

Pre-gestational (pre-pregnancy) chronic hypertension and previous preterm birth were the maternal chronic health conditions included in this study.

Pregnancy Conditions

Gestational diabetes and hypertensive disorders (i.e., gestational hypertension, eclampsia, and HELLP syndrome) were the pregnancy conditions included in this study. Pre-eclampsia is not reported on birth certificates and, therefore, not able to be included.

Maternal Delivery Complications

Maternal blood transfusion, maternal intensive care unit admission, and unplanned hysterectomy are the severe maternal morbidity outcomes included as delivery complications in this study.

Health Outcomes for Newborns at Time of Birth

Health outcomes for newborns were measured for those who had a substantiated referral for substance exposure within six weeks of birth.

The categories of infant health issues indicate one or more of the following was noted in the vital record at the time of birth:

- *Respiratory*: assisted ventilation immediately following delivery, assisted ventilation for more than six hours, supplemental oxygen for more than four hours, surfactant replacement therapy, hyaline membrane disease, or meconium aspiration syndrome.
- *Congenital*: anencephaly, meningomyelocele/spina bifida, cyanotic heart disease, diaphragmatic hernia, omphalocele, gastroschisis, limb reduction deficit, cleft lip, cleft palate, down's syndrome, other chromosomal anomaly, hypospadias, urogenital anomaly, other circulatory/respiratory anomaly, other musculoskeletal anomaly, or other congenital anomaly noted.
- *Metabolic/Nutrition*: hypoglycemia.
- *Infection Disease*: antibiotics received by newborn for suspected neonatal sepsis.
- *Neurological*: seizure or serious neurological dysfunction.
- *Hematological*: hyperbilirubinemia.

Child Welfare Involvement Shortly After Birth

Sixty days from the referral date was the time period of interest for child welfare involvement for this study.

Child Welfare Involvements

Colorado is one of nine states in the nation¹⁰³ with a state-supervised, county-administered child welfare system, thus creating county-level variation in child welfare practices.¹⁰⁴ In general, however, child welfare involvement follows a phased course of referral, assessment, open case, child removal from the home or family preservation, and case closure, as briefly described below.



Referrals of suspected child abuse and neglect can be made by both mandatory reporters and community members, most commonly through the statewide and county-designated hotlines. Referrals received are screened to determine if further assessment is required. All referrals are entered into the statewide Trails system. Referrals are assigned for further assessment if they contain allegations of abuse or neglect as defined in the statutes and regulations and if there is sufficient information to locate the alleged victim.

Each county determines the type of response they follow. In some Colorado counties, there is a multi-track process called Differential Response (DR). DR was initiated in Colorado in 2010 in response to variation in family needs and severity of cases that come to the attention of child protective services, alongside an increasing focus on family strengthening. There are two primary assessment tracks in DR: (1) Family Assessment Response (FAR) for low- to moderate-risk referrals; and (2) High Risk Assessment (HRA), which is the traditional investigative approach for high-risk referrals. (Note: at any time, a FAR case may be track-changed to an HRA case if child safety concerns become elevated). In FAR, no formal finding of maltreatment occurs and rather, the focus is on the larger context of family strengths and needs. In HRA, the assessment can result in a substantiated, unsubstantiated, or inconclusive finding of maltreatment. As of December 2020, over 40 of Colorado's 64 counties are approved for DR (the remaining counties follow the traditional investigative approach only). Data in this study were limited to substantiated assessments related to prenatal substance use and substance exposure of a newborn and, thus, only HRA open cases were examined. It is important to note that clinical findings are not required for DR counties to confirm substance exposure. This is one of the challenges in this research since these different, but interconnected systems, categorize people in different ways and using different tools.

Assessment. Once assigned, the purpose of the assessment process is to assess and ensure safety of the child, as well as to assess the risks, needs, and strengths of families. This assessment includes a review of previous involvement with child welfare, discussions with collateral individuals and agencies involved with the family, and meetings with the family. This assessment is commonly undertaken by a caseworker. An assessment can yield two outcomes—an open case or a closed assessment. A case is opened if the family is unable to mitigate safety concerns. It is expected that assessments were conducted for nearly all infants in the sample because the study sample was limited to those with a substantiated referral for substance exposure of a newborn (i.e., not screened out) and this can only occur at the end of an assessment.

Open cases. Child welfare cases are opened either through court action or voluntary agreement with the family. If court action is required, orders are issued by a judge to either temporarily remove the child from the home or to issue protective orders that will help the family comply with the Safety Plan. Caseworkers then file a Dependency & Neglect (D&N) petition to formally initiate the court process and to provide the family ongoing child welfare services. At the time of a D&N petition, a temporary custody hearing is held to determine whether the child will stay with the family or if removal from the home is necessary to assure the safety of the child. Children and families receive services independently and alongside their parents/caregivers to strengthen the family unit and prevent additional maltreatment.

Removals refer to a situation in which the child is removed from the home and placed in out-of-home care (also known as out-of-home placement). While the child is in out-of-home care, services are provided to families with the ultimate goal of reunification of child and parents/caregivers.

Placement options exist along a continuum, from the least restrictive, most family-like environment to the most restrictive, least-family like environment. When a child is removed from the home, the least restrictive setting is prioritized to support the child's developmental well-being and increase the



probability of family placement stability and permanency, including reunification success. Placement options (from least to most restrictive) are: Kinship Care (placement with other relatives or family-identified kin); Family Foster Care (placement with families in the community who have been certified to provide temporary care for children while parents/caregivers receive support); and Congregate Care (structured settings with 24-hour supervision, including group homes and residential treatment facilities).

Case closure results when a family no longer meets the criteria for child welfare involvement and child safety is reasonably assured due to reunification with the biological family, permanent custody by kin, termination of legal rights and adoption or permanent legal guardianship by another, or independent living (due to aging out of the system, emancipation, etc.)

Data Analysis

All data were analyzed on a secure sever at the Colorado Evaluation and Action Lab. Prior to removing any output from the server, output was reviewed to ensure compliance with data privacy standards outlined in the Data Use License for this project.

A variety of statistical software applications were used. Brief descriptions of the analytic methods are located in the Results section adjacent to each research aim. Statistical code is documented and available upon request.



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Sample

Description of demographic characteristics





Sample

Infants born between January 1, 2013 and December 31, 2019 who had a substantiated child welfare referral for substance exposure of a newborn and their biological mother were included in this study. For health outcomes, the study sample was further limited to infants for whom the referral was made within six weeks of their birth (97.7% of full sample). Approximately two-thirds of these referrals (68.3%) occurred within the first three days following the birth event. This length of time aligns with standard hospital stays, and almost all of the infants included in this study were born in a hospital (97.8%).

4,178 unique dyads of mothers and infants were included in this study, providing a robust sample to explore trends in care engagement and health outcomes.

As demonstrated in Table 5, Colorado mothers of infants with a substantiated referral for substance exposure of a newborn were primarily lower income (57.6% had an annual household income of less than \$15,000; 14.1% had an annual household income between \$15,000 and \$24,999), never married (51.4%), White (79.4%), and experienced lower educational attainment with 62.7% holding a high school education or less. At the time of the birth, the average age of mothers was 28.0 years old and the average age of fathers was 31.3 years old. The primary source of payment was Medicaid for 83.4% of the deliveries, private insurance for 9.1% of the deliveries, and self-pay or other for 7.5% of the deliveries.

46.2% of mothers participated in WIC during the pregnancy; household income data suggest that more were eligible.

This sample is a subset of the population of families affected by substance use during pregnancy. Future studies aim to expand the sample to include mother-infant dyads facing perinatal substance use based on mother and infant care claims and filling of prescription drugs. Read more in the [CO SB19-228 legislative report](#).

About the Study Sample

The mother-infant dyads included in this study were referred to child welfare for “substance exposure of a newborn” and that referral was substantiated. This means that either the infant tested positive at birth for a schedule I controlled substance, as defined in section 18-18-203, C.R.S., or a schedule II controlled substance, as defined in section 18-18-204, C.R.S., unless the child tests positive for a schedule II controlled substance as a result of the mother's lawful intake of such substance as prescribed OR when there are observable effects of substance exposure in the infant (e.g., in ability to eat, sleep, and soothe).



Table 5: Description of the Sample

	Mother	Father	Household
Age at Time of Birth			
12 to 17	1.6%	0.4%	
18 or 19	5.0%	1.4%	
20 to 24	28.1%	14.5%	
25 to 29	31.8%	20.4%	
30 to 34	20.8%	16.3%	
35 to 39	9.3%	9.6%	
40+	3.4%	9.7%	
Unknown	0.2 %	27.7%	
Race			
White	79.40%	49.71%	
Black or African American	10.39%	9.70%	
American Indian or Alaska Native	3.09%	2.08%	
Other	3.65%	3.72%	
Unknown	3.48%	34.79%	
Highest Level of Education			
8th grade or less	1.91%	1.60%	
9th-12th grade, no diploma/GED	25.40%	12.90%	
High school graduate/GED	35.37%	29.90%	
Some college, no degree	26.35%	15.40%	
Associate's degree	5.22%	4.50%	
Bachelor's degree	2.47%	1.80%	
Master's degree	0.44%	0.30%	
Doctorate or professional degree	0.00%	0.20%	
Unknown	2.82%	100.00%	
Household Income			
< \$15,000			57.6%
\$15,000 - \$24,999			14.1%
\$25,000 - \$34,999			6.5%
\$35,000 - \$49,999			4.5%
\$50,000 - \$74,999			2.3%
\$75,000+			1.2%
Unknown			13.8%



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Results

Aim 1: Compare participation in prenatal care and WIC, the health of mothers during pregnancy, and newborn health at the time of birth for child welfare-involved mother-infant dyads impacted by prenatal substance use to the general population of Colorado mother-infant dyads.

Aim 2: Describe trends in initial child welfare involvement of mother-infant dyads impacted by substance use during the pregnancy.

Aim 3: Identify risk and protective factors (e.g., prenatal care, WIC participation, medical fragility) of mother-infant dyads impacted by prenatal substance use that are associated with infant removal from the home and placement into foster care.





Results

The three research aims were designed to inform prenatal opportunities for wrapping services around families impacted by prenatal substance use, beginning in the pregnancy and using [Plans of Safe Care](#), with the long-term goal of proactively preventing child welfare involvement and setting families who are involved in child welfare on a trajectory of safety and well-being. Results are organized by research aim.

Research Aim 1

Compare participation in prenatal care and the WIC, the health of mothers during pregnancy, and newborn health at the time of birth for child welfare-involved mother-infant dyads impacted by prenatal substance use to the general population of Colorado mother-infant dyads.¹⁰⁵

Adequacy of Prenatal Care

Adequacy of prenatal care utilization index, developed by Kotelchuck, groups individual's prenatal care utilization into categories based on when the individual first initiated prenatal care and how many visits were attended relative to what is expected for the gestational age of the infant at birth. The information about when and how much prenatal care was received is based on information listed on the infant's birth certificate. It is not uncommon to have missing data for this variable—in this study, only 2.3% of birth certificates in the sample did not have information on prenatal care.

Colorado mothers with a substantiated child welfare referral for substance exposure of a newborn experienced lower engagement with prenatal care compared to the general birthing population:

One in four mothers in this study had no prenatal care, compared to one in 20 in the general population.

Three out of 10 mothers in this study received inadequate prenatal care, more than double that of the general population.¹⁰⁶

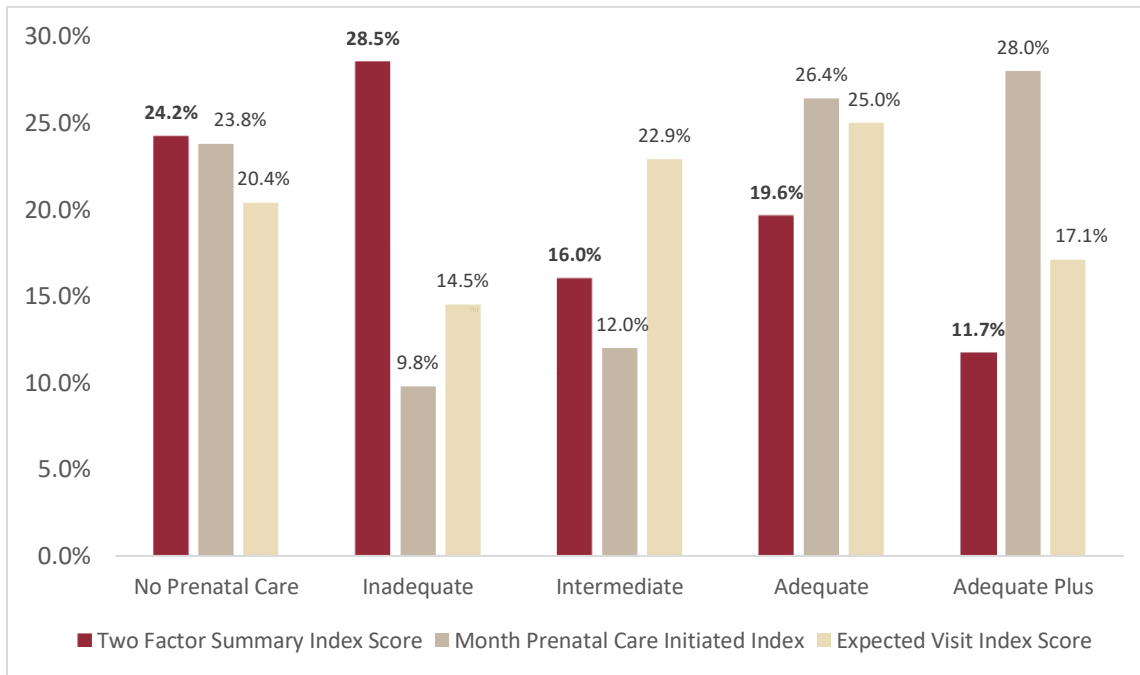
Mothers experiencing prenatal substance use and substance use disorders typically connected with prenatal care providers early in their pregnancy but did not attend appointments consistently.

For those mothers who participated in some prenatal care but did not meet the threshold for adequate levels of care, they typically initiated prenatal care early enough in their pregnancy (i.e., month prenatal care-initiated index score), but participated in less than the expected number of visits (i.e., expected visit index score) based on when they initiated prenatal care. This is illustrated in Figure 1.

Importantly, inadequate prenatal care or inconsistency in prenatal care can be influenced by a number of social and structural factors, beyond individual motivation. For instance, previous research has shown that stigma, bias, and fear are key factors¹⁰⁷ that decrease health care utilization, and Medicaid coverage can limit access in some geographic areas due to a lack of Medicaid-eligible providers.¹⁰⁸



Figure 1: Adequacy of Prenatal Care



Maternal Chronic Health and Pregnancy Conditions

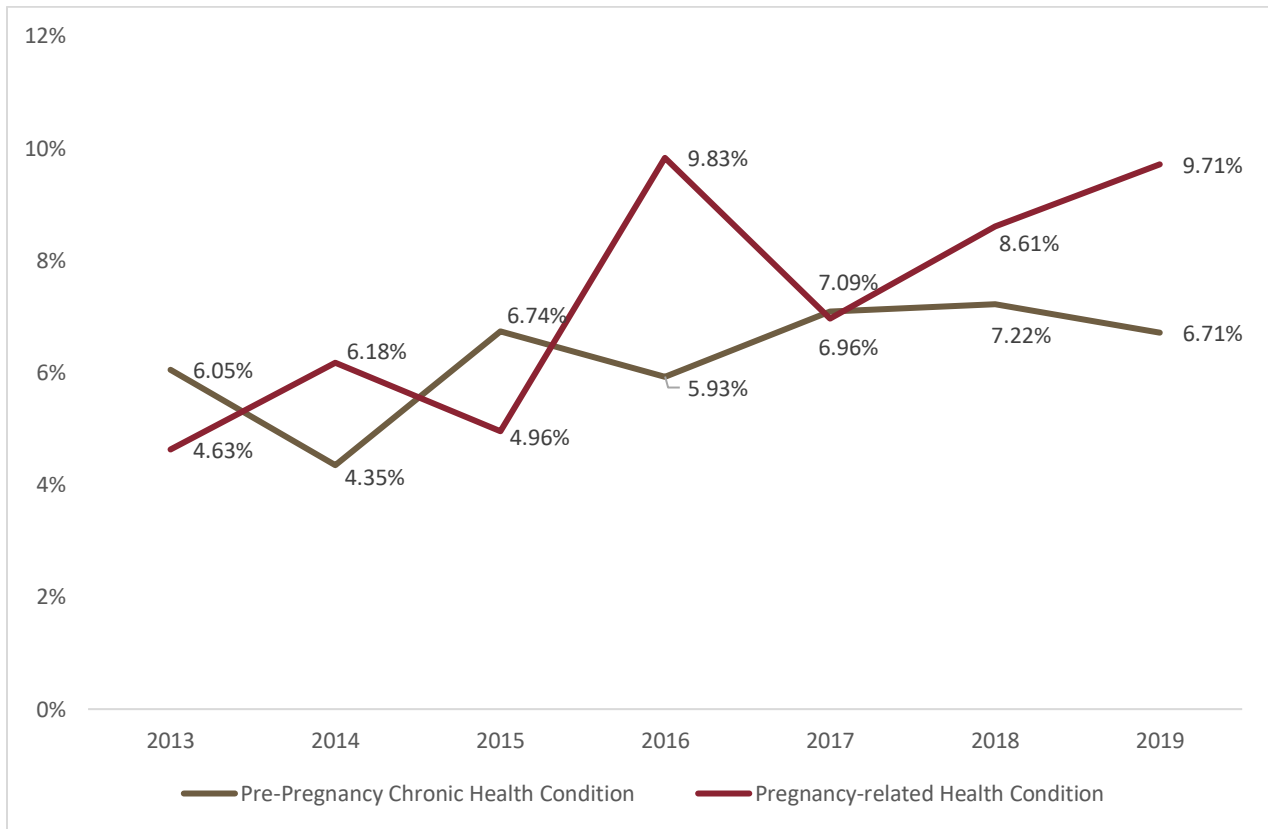
For some Colorado mother-infant dyads with a substantiated child welfare referral for substance exposure of a newborn, challenges experienced were further intensified by ongoing and newly arising health issues:

Examples of chronic health conditions are pre-pregnancy diabetes and chronic hypertension. Examples of pregnancy conditions are gestational diabetes, eclampsia, and HELLP syndrome. Maternal chronic health conditions and pregnancy conditions by birth year are illustrated in Figure 2.

- Across all years of the study, 6.5% of mothers experienced at least one pre-pregnancy chronic health condition.
- Across all years of the study, 7.6% of mothers experienced at least one pregnancy-related health condition.



Figure 2: Maternal Chronic Health and Pregnancy Conditions by Birth Year



Note. n = 4083

Delivery Method and Complications

For Colorado mother-infant dyads with a substantiated child welfare referral for substance exposure of a newborn, there were relatively few delivery-related complications.

- Across all years of the study, the cesarean delivery rate was 17.1%, which is lower than the state average of 26.1%.
- Less than 1% of mothers experienced delivery-related complications (0.93%).

Table 6 delineates delivery method by birth year, with a cesarean delivery rate of 17.1% across all study years observed. This finding is both surprising and encouraging. Prevention of primary cesareans and access to vaginal birth after cesarean are key priorities of the obstetric community and perinatal public health professionals alike, given the benefits to both mother and infant of physiologic, vaginal birth.^{109, 110, 111, 112} Additionally, the low rate of delivery-related complications suggests that prenatal substance use did not substantially increase maternal delivery risks.



Table 6: Delivery Method by Birth Year

	2013	2014	2015	2016	2017	2018	2019
Vaginal Birth	79.00%	80.78%	79.43%	81.36%	76.84%	79.17%	83.00%
Vaginal Birth After Cesarean (VBAC)	3.56%	1.83%	1.42%	3.39%	2.53%	4.03%	2.86%
Primary Cesarean	8.54%	7.09%	9.22%	10.17%	10.25%	10.00%	12.57%
Repeat Cesarean	8.90%	10.30%	9.93%	5.08%	10.38%	6.81%	1.57%

Health Outcomes for Newborns at Time of Birth

The analysis of newborn health outcomes was limited to infants where a substantiated referral to child welfare for substance exposure of a newborn was made within six weeks of the birth (97.7% of total sample). It is possible that the health of infants for whom the referral was made later than six weeks after their birth is systematically different.

Across all years of the study, the rate of low birth weight was 25.15% for infants in this study. This rate is about 2.8 times higher than the general population at 9.07%.

Across all years of the study, the NICU admission rate was 30.03% for infants in this study. This rate of NICU admission is approximately three times higher than the general population at 9.96% of all live births.

Table 7 describes characteristics of newborns at birth across study years, including gestational age at birth, Apgar scores, and birth weight.

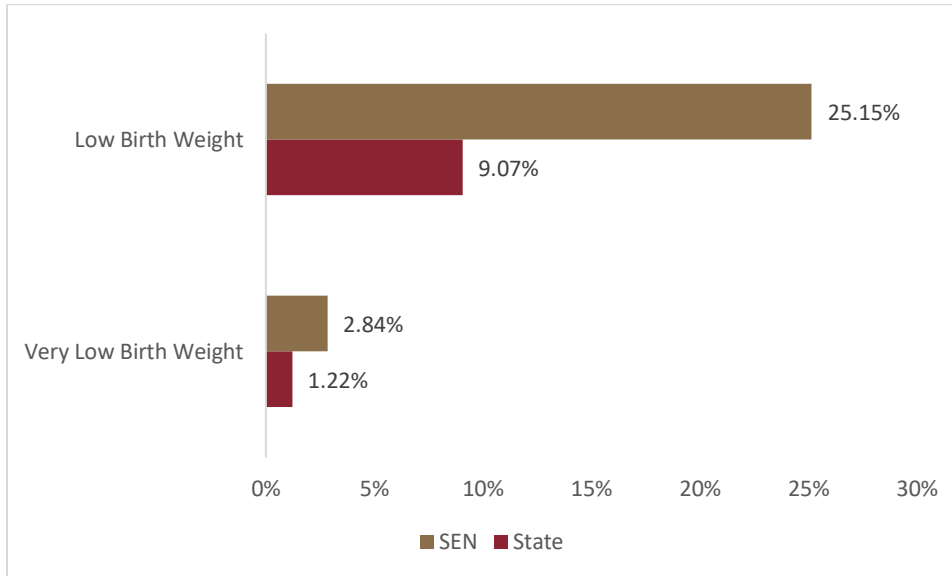
Table 7: Characteristics of Newborns at Birth Averaged Across Study Years (2013-2019)

	N	Minimum	Maximum	Mean	Std. Deviation
Estimated Weeks Gestation	4068	23	42	37.57	2.570
Apgar 5-Minute	4007	0	10	8.56	.988
Apgar 10-Minute	86	0	10	6.50	2.057
Birth Weight, Ounces	4074	0:15	11:09	5:51	1:18
Birth Weight, Grams	4074	425	5245	2816.45	591.259



Figure 3 compares low birth weight among infants with a substantiated referral to child welfare for substance exposure of a newborn to the state average across study years.

Figure 3: Percentage of Low Birth Weight for Study Newborns Compared to the State Average (2013-2019)



Note. Low birth weight is defined as <2500 grams and very low birth weight is defined as <1500g regardless of gestational age.

As discussed previously, those living in poverty experience the highest prevalence rates of perinatal substance use, often due to multiple social inequities and structural factors. Several studies have documented the association between socioeconomic disadvantage and low birth weight.^{113, 114, 115} As such, the higher rate of low birth weight observed may also reflect poverty as a contributing factor.

Select newborn health conditions, averaged across study years, are presented in Table 8.

Table 8: Neonatal Conditions Averaged Across Study Years (2013-2019)

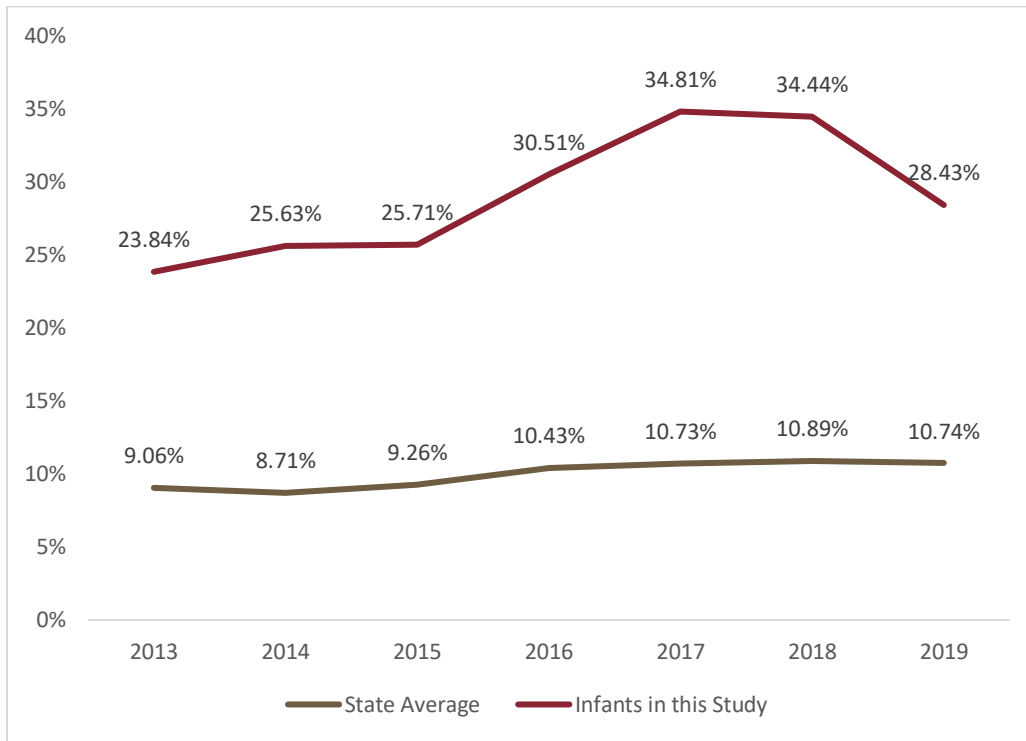
	All	>=35 weeks	>=37weeks
Respiratory	13.86%	10.84%	9.46%
Congenital	6.29%	5.71%	5.58%
Metabolic / Nutritional	2.51%	2.40%	2.21%
Infectious Disease	5.01%	3.47%	2.95%
Neurological	<0.5%	---*	---*
Hematological	6.42%	5.13%	4.65%

Note. *not reported due to low incident rate



Figure 4 illustrates NICU admission rates by birth year for newborns in the study sample.

Figure 4: NICU Admission Rates by Birth Year



For newborns in this study requiring NICU care, reasons for receipt of intensive care may be due to acute medical conditions related to prematurity and/or due to monitoring needs as opioid withdrawal symptoms increase and pharmacologic treatment is indicated. Importantly, in the most recent clinical report on neonatal opioid withdrawal syndrome (NOWS), the American Academy of Pediatrics (AAP) acknowledge that “many infants at risk for or with NOWS do not need NICU-level care” and discuss how physical separation of the mother-infant dyad, alongside an overly stimulating NICU environment, can heighten withdrawal symptoms for the infant while also being traumatic for the mother during an already vulnerable postpartum experience.¹¹⁶ AAP thus makes clear recommendations for NICU practices that keep the mother-infant dyad together and promote their bonding. Additionally, it is important to monitor NICU trends in state data in light of larger, national data that demonstrate complex patterns of racial and ethnic disparities in NICU process and outcome measures.¹¹⁷



Research Aim 2

Describe trends in initial child welfare involvement of mother-infant dyads impacted by substance use during the pregnancy.

Initial Child Welfare Involvement

Child welfare involvement is specific to those infants with a substantiated referral to child welfare for substance exposure of a newborn, as defined in the Children's Code in place during study years. Initial child welfare involvement is defined by the 60-day timeframe from when a referral is made to child welfare to when an assessment must be completed.

Assessment

99% of referrals are connected with at least one assessment within 60 days of the initial referral.

It was expected that assessments were conducted for nearly all infants in the sample because the study sample was limited to those with a substantiated referral for substance exposure of a newborn (i.e., not screened out) and this can only occur at the end of an assessment. The practice of conducting and completing an assessment within 60 days was consistent across counties and study years. In some cases, more than one assessment was conducted during this time frame.

Cases Opened and Removals

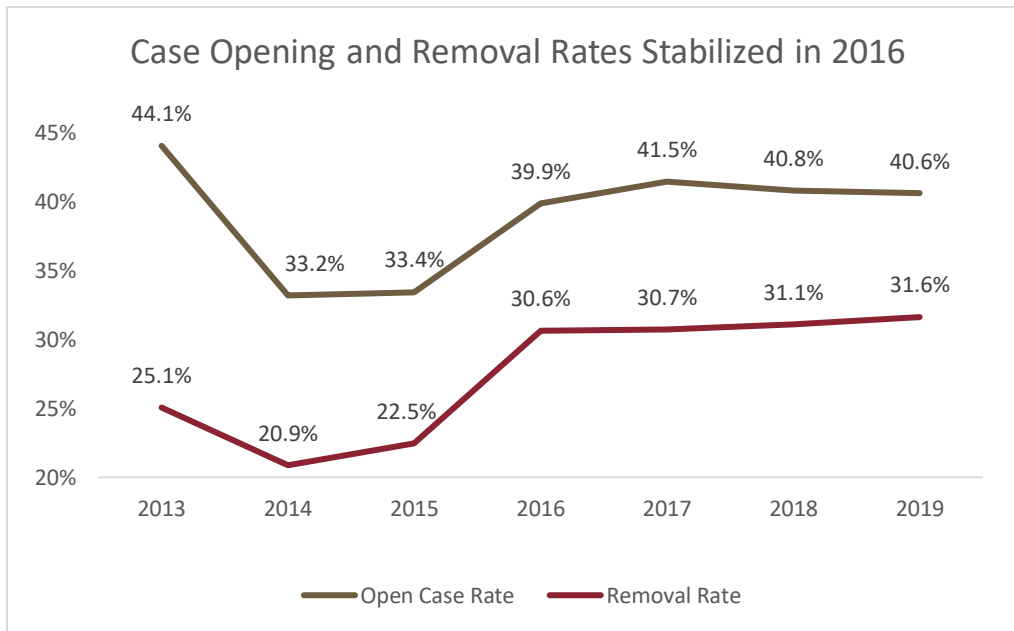
From 2016 to 2019, the rate of case openings and subsequent infant removals by child welfare stabilized. On average across this four-year period:

- **40.7% of substantiated referrals resulted in an open child welfare case.**
- **31.5% of substantiated referrals led to removal of the infant from the home.**

The opening of a case reflects a court action, following a D&N petition, to provide the family ongoing child welfare services. At the time of a D&N petition, a temporary custody hearing is held to determine whether the child will stay with the family or if removal from the home is necessary to assure the safety of the child. Children who remain in the home receive services alongside their parents/caregivers to strengthen the family unit and prevent additional maltreatment. As illustrated in Figure 5, trends in case openings and removals suggest ongoing safety concerns that require child welfare intervention and other supports.



Figure 5: Child Welfare Case Opening and Infant Removal Rates by Birth Year



Note. n = 311 (2013), 479 (2014), 628 (2015), 637 (2016), 837 (2017), 743 (2018), 702 (2019) with a substantiated referral to child welfare for substance exposure of a newborn.

Placement Types

Placing children with kin (i.e., relatives) can promote healthy child development and increase the likelihood of placement stability and permanency.¹¹⁸ For mother-infant dyads with a substantiated referral for substance exposure of a newborn, trends since 2015 indicate a decline in the rate of kinship care:

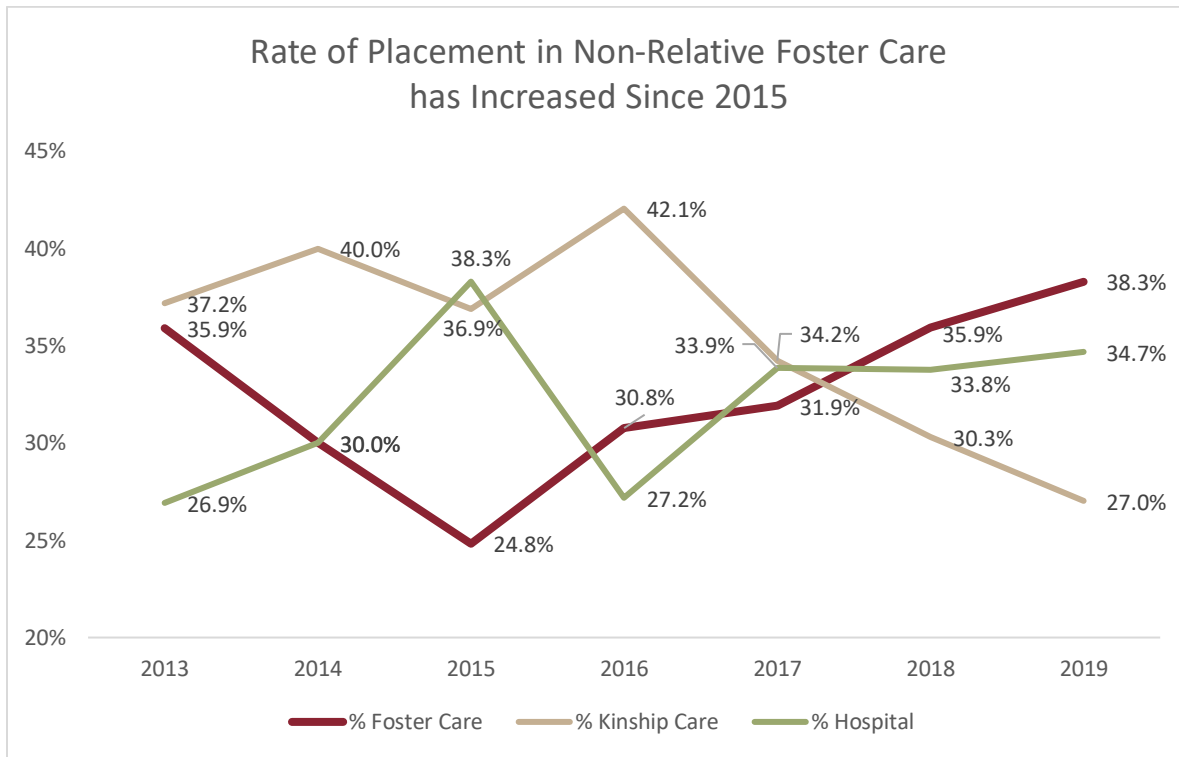
There was a 13.5% increase in placement of newborns into non-relative foster care, jumping from 24.8% in 2015 to 38.3% in 2019.

There was an 11.3% decrease in placement of newborns into kinship care, dropping from 38.3% in 2015 to 27.0% in 2019.

The medically fragile nature of these children is also demonstrated in the rate of hospital placement, which has stabilized since 2017 at approximately 35% of all newborns in the study sample.



Figure 6: Rate of Placement Type by Birth Year





Research Aim 3

Identify risk and protective factors (e.g., prenatal care, WIC participation, medical fragility) of mother-infant dyads impacted by prenatal substance use that are associated with infant removal from the home and placement into foster care.

Binary Logistic Regression Model on Risk and Protective Factors for Infant Removal from the Home

Binary logistic regression was used to explore how mother's demographic characteristics, use of prenatal care, WIC enrollment during pregnancy, health of mother during pregnancy and delivery, and the newborn's health at the time of birth relate to child welfare removal within the first 60 days after a substantiated referral is made for substance exposure of a newborn. The model was a good fit for the data,¹¹⁹ and this combination of data elements accurately predicted whether or not the infant was removed in 69.3% of cases. This analytic approach considers circumstances and factors in the presence of each other.

In Table 9, column "B" indicates the direction of the relationship. Column "Exp(B)" is an odds ratio and provides information on the extent to which the odds increase or decrease based on that factor. The farther the value is from 1.0 in either direction, the larger the effect.

For example, education level and household income are both negatively associated with infant removal, meaning that as education and income increase, the odds of a removal decrease. The Exp(B) value for household income is 0.645 and farther from 1.0 than the value for education at 0.838, which means that increases in income level, as opposed to an additional education credential, are associated with greater reduction in the odds of an infant removal when holding all other variables in the model constant.

Risk Factors Associated with Removal of the Infant from the Home by Child Welfare

The odds of the infant being removed from their family was related to key social, economic, and health vulnerabilities. An increased likelihood of removal was associated with:

- Increasing age of the mother
- Mothers in lower income households
- Mothers with lower educational attainment
- Mother-infant dyads who received no prenatal care or inadequate prenatal care
- Late preterm infants born between 35 and 36 weeks of pregnancy
- Newborns experiencing respiratory complications at birth



Protective Factors Associated with Decreased Odds of Infant Removal from the Home by Child Welfare

Multiple social, economic, and health characteristics and conditions were associated with decreased odds of the child being removed from the home:

- Mothers who identified as American Indian and Native American
- Mothers who were married
- Mother-infant dyads who received WIC during pregnancy
- Deliveries paid for by private insurance

Additionally, there was no evidence of disproportionality in infant removal for Black mothers when considering other factors included in the model. Analysis specific to other race/ethnicity groups was limited because of sample size issues.

Some of these identified risk and protective factors are modifiable during the course of a pregnancy and, thus, intentional investment into documented protective factors are a vital implication of this study. For instance, the odds ratios suggest that increasing participation in prenatal care and WIC are expected to reduce the odds of an infant removal from the home being necessary. Programs that increase household income and economic security may also be beneficial given that the odds of infant removal by child welfare decrease as income levels increase. Late preterm births and infant respiratory problems are associated with increased risk of infant removal, reinforcing that the medical fragility of infants is important in planning for their safe care.



Table 9: Binary Logistic Regression Model

	B	S.E.	Wald	df	Sig.	Exp(B)
Mother's Characteristics						
Age	0.056	0.007	61.272	1	0.000*	1.058
Race						
White			9.171	3	0.027	
Black or African American	0.097	0.441	0.048	1	0.826	1.102
American Indian or Alaska Native	-0.356	0.130	7.498	1	0.006*	0.700
Other	0.233	0.217	1.160	1	0.282	1.263
Marital Status						
Never Married			4.947	2	0.084	
Married	-0.185	0.084	4.796	1	0.029*	0.831
Divorced or Widowed	-0.025	0.183	0.019	1	0.891	0.975
Education Level	-0.177	0.042	17.776	1	0.000*	0.838
Household Income	-0.438	0.047	87.277	1	0.000*	0.645
Pregnancy						
Adequacy of Prenatal Care						
No Prenatal Care	1.341	0.149	81.336	1	0.000*	3.822
Inadequate	0.915	0.142	41.778	1	0.000*	2.497
Intermediate	0.475	0.157	9.215	1	0.002*	1.608
Adequate	0.016	0.156	0.011	1	0.917	1.016
Adequate Plus			150.547	4	0.000	
WIC Participation During Pregnancy	-0.370	0.081	20.732	1	0.000*	0.691
Mother's Chronic Health Conditions	-0.178	0.164	1.183	1	0.277	0.837
Pregnancy-Related Conditions	0.078	0.154	0.255	1	0.614	1.081
Delivery						
Delivery Payment Type						
Self-Pay			17.708	3	0.001	
Medicaid	-0.414	0.249	2.766	1	0.096	0.661
Private	-1.041	0.293	12.624	1	0.000*	0.353
Other	-0.345	0.324	1.130	1	0.288	0.709
Delivery Complications	0.678	0.467	2.108	1	0.147	1.969
Twin/Multiple	0.226	0.329	0.470	1	0.493	1.253
Infant Health						
Weeks' Gestation						



	B	S.E.	Wald	df	Sig.	Exp(B)
Full Term (≥ 37 weeks)			12.499	2	0.002	
<35 weeks	0.112	0.163	0.473	1	0.492	1.119
35 or 36 weeks	0.438	0.125	12.365	1	0.000*	1.550
Low Birth Weight	0.209	0.112	3.490	1	0.062	1.232
Respiratory	0.429	0.130	10.877	1	0.001*	1.536
Congenital	0.091	0.163	0.309	1	0.578	1.095
Metabolic	-0.379	0.258	2.164	1	0.141	0.684
Infectious Disease	0.014	0.199	0.005	1	0.943	1.014
Hematological	-0.094	0.166	0.318	1	0.573	0.910
Constant	-1.435	0.343	17.540	1	0.000*	0.238



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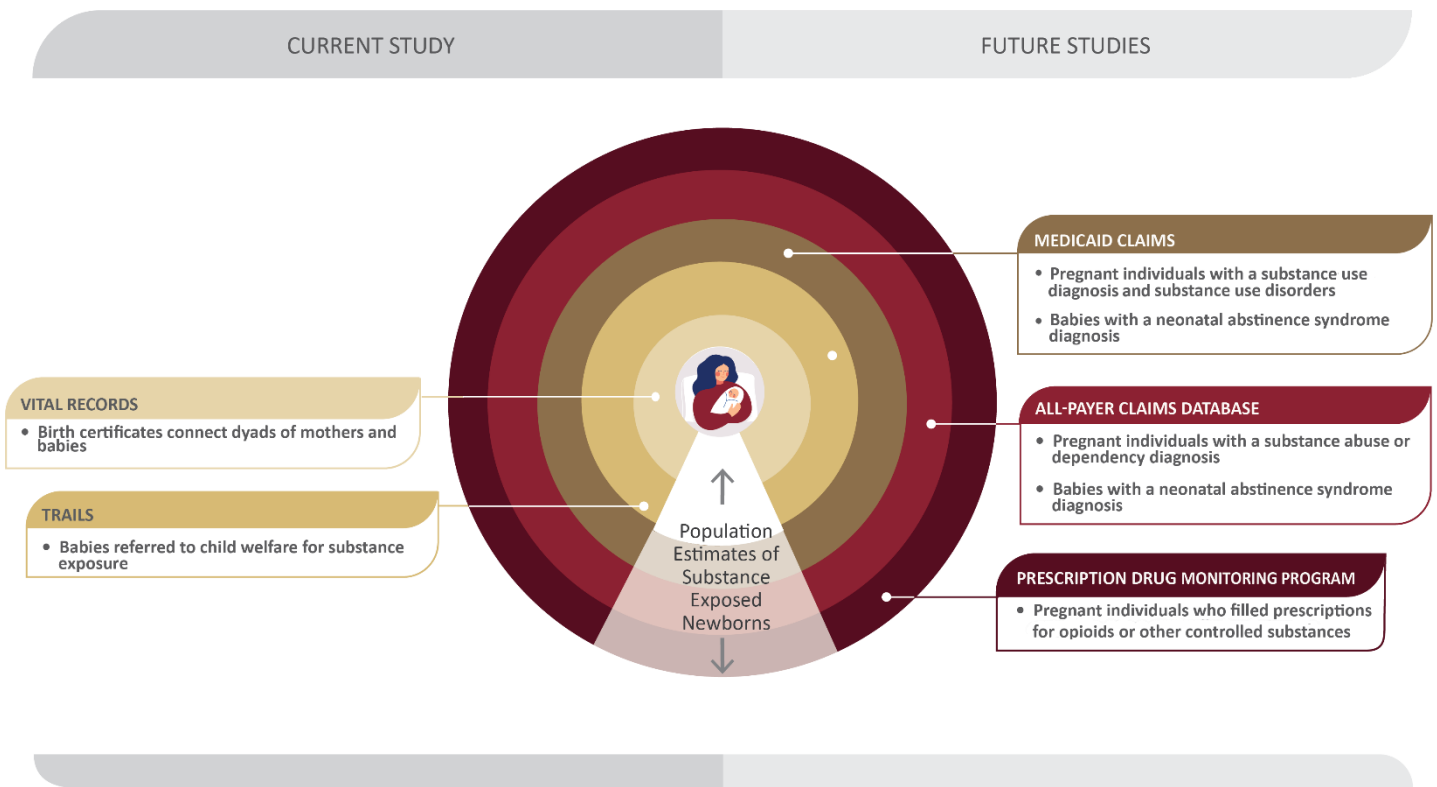




Future Research

This report reflects the first phase of the perinatal substance use data linkage project. As illustrated in the graphic below, this first phase uses Vital Records and Trails data sources. Future phases will leverage additional state administrative data sources to: (1) expand the sample to mother-infant dyads where substance use during pregnancy is evidenced in health care records and filling of prescription drugs; and (2) examine how mother-infant dyads engagement with health care, social services, public assistance, and substance use disorder prevention and treatment supports can set families on a trajectory for long-term health and well-being.

Future phases (see Table 10) of the study will expand to monitor population-level incident rates of prenatal substance use and health outcomes for mother-infant dyads throughout the perinatal period (pregnancy to one year after the birth event). Collectively, results will inform strategic investments in policies and practices that strengthen families during the prenatal, birth, neonatal, infancy, and postpartum periods, with an emphasis on reducing maternal and infant morbidity and mortality. A qualitative study will complement the data linkage project by ensuring that the lived experiences of birthing individuals contextualize and inform recommendations for policy and practice advancements.



The research team welcomes conversations about potential partnerships for all phases of the research.

The potential of this work will be realized by bringing together the experts and change makers who are part of the family, government, lawmaker, provider, non-profit, advocacy, and research communities.



Table 10: Overview of Planned Phases of Research

RESEARCH PHASE			
Current Phase	Future Phases of Research		
<p>1 (2020) Risk and Protective Factors Associated with Infant Removal by Child Welfare</p>	<p>2 (2021-2022) Population-Level Estimates of Newborns at Risk for Prenatal Substance Exposure</p>	<p>3A (TBD) System Engagement and the Health and Well-being of Mother-Infant Dyads</p>	<p>3B (TBD) Accessing Services, Supports & Treatments</p>
<p>Describe the risk and protective factors associated with infant removal within the first 60 days after a substantiated referral to child welfare is made for substance exposure of a newborn.</p> <p><i>Points of Intervention: Birth/60 days after child welfare referral</i></p>	<p>Generate reliable estimates of newborns at risk for substance exposure prenatally that leverage Colorado’s administrative data. Stratify these estimates by substance type.</p> <p><i>Points of Intervention: Pregnancy through one year postnatal</i></p>	<p>Use various longitudinal datasets to examine how engagement in supportive resources by the mother-infant dyad, such as prenatal care, WIC, substance use disorder treatment, early intervention, and subsidized childcare programs contribute to their health and well-being during the perinatal period.</p> <p><i>Points of Intervention: Pregnancy through one year postnatal</i></p>	<p>Examine how informal and formal supports and systems engagement can help or hinder well-being for families experiencing perinatal substance use.</p> <p>Explore the evolving, multi-faceted nature of substance use disorders during the pregnancy-to-parenting journey.</p> <p><i>Points of Intervention: Pregnancy through one year postnatal</i></p>
DATA SOURCES			
<p><i>(Quantitative)</i></p> <p>Vital Records (birth data) Trails (child welfare data)</p> <p><i>(Qualitative)</i></p> <p>Experiential data from birthing individuals</p>	<p><i>(Quantitative)</i></p> <p><u>Minimally required</u> Vital Records (birth data) Trails (child welfare data) Medicaid</p> <p><u>More comprehensive</u> All-Payers Claims Database^{vi120} Prescription Drug Monitoring Program</p>	<p><i>(Quantitative)</i></p> <p><u>Minimally required</u> Vital Records (birth data) Trails (child welfare data) Medicaid</p> <p><u>More comprehensive</u> All-Payers Claims Database Prescription Drug Monitoring Program Behavioral Health Services Immunization Early Intervention Child Care Assistance Programs</p>	<p><i>(Qualitative)</i></p> <p>Birthing individuals will be interviewed at three points during the perinatal period to address their experiences accessing and navigating substance use disorder services and treatment as well as health care, public assistance, child welfare, early childhood, and community-based supports and services.</p>

^{vi} All-Payers Claim Database could allow for an expansion of the sample to include mother-infant dyads with private insurance, which acts as an equity measure to reduce disproportionality in representation of Medicaid populations in research on vulnerability and stigmatizing topics.



RESEARCH FINDINGS			
Identify mothers and babies most at risk for poor health outcomes, including where and how these families interact with child welfare, health care, and other support systems.	Detail the scope and types of perinatal substance use in Colorado and describe how trends have changed over time.	Describe the structural, behavioral, and community-level factors that influence and mediate trends in health outcomes, care utilization, and child welfare involvement.	Understand the experiences of birthing families and factors that lead to healthy outcomes. Characterize the processes, barriers, stigmas, and supports that influence access to and successful navigation of substance use disorder treatment, engagement with social services, and health care utilization.
GOALS			
Offer insights into how coordination among health care and child welfare systems can prevent involvement in the child welfare system and reduce the need for infant removal for mother-infant dyads impacted by substance use during the pregnancy.	Targeting resources and monitoring impacts of policy and practice changes aimed at preventing perinatal substance use and wrapping supports around families during a pregnancy and following the birth of a newborn.	Inform data-driven interventions to screen and treat pregnant and parenting people with substance use disorders and improve health and well-being of mothers and infants. Identify gaps in service utilization and opportunities to better align systems that serve mother-infant dyads. Tailor prevention and intervention strategies to better address both risk and resiliency factors within the mother-infant dyad.	Identify areas where system policies and practices can improve to strengthen the health and life path of mother-infant dyads and families impacted by perinatal substance use. Understand barriers and facilitators to inform feasible, sustainable policies and the development of care models and resources for perinatal substance use prevention and treatment.

Legislative Report: CO SB19-228

Realizing the full potential of the CO SB19-228 data linkage project also requires addressing barriers to data sharing and additional resources. The Colorado legislative report submitted by the Center for Prescription Drug Abuse Prevention to the Health and Insurance Committee and the Public Health Care and Human Services Committee of the House of Representatives and the Health and Human Services Committee of the Senate in December 2020 is linked [here](#).



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