

SUBSTANCE USE DURING PREGNANCY

2006-2020



Allegheny County

Substance Use During Pregnancy

2006-2020

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SUMMARY

Substance use during pregnancy is a significant public health issue, as it increases the risk of morbidity and mortality to both those who are pregnant and the exposed infants. Efforts to reduce substance use and provide support to people before, during, and after delivery can improve health and well-being of parents and families in Allegheny County and reduce infant and pregnancy-related morbidity and mortality.

The purpose of this report is to (1) quantify substance use prevalence during pregnancy and hospital delivery stays, (2) examine temporal patterns to monitor changes in substance use over time, and (3) identify relationships between the literature and local data to understand the population of those who are pregnant and use substances. This report reflects time trends for deliveries between 2006-2020 and associations with select health conditions and birth outcomes. Hospital discharge data represent 98 percent of non-home births when compared to Allegheny County birth certificates and contain risk factors and health conditions not provided on the birth certificate, such as substance use.

Hospital discharge data for female residents ages 12 to 55 revealed the presence of alcohol, tobacco, marijuana, opioids, psychostimulants and sedatives among any labor and delivery ICD-9 (2006-2015 Q3) or ICD-10 (2015 Q4-2020) primary diagnosis codes. Annual percentages of labor and delivery stays including an ICD code for substance use were calculated by substance category. Select demographics, health characteristics and outcomes were aggregated to understand associations with substance use during pregnancy. Associations were tested for significance using chi-square statistics.

Key findings of this analysis include:

1. Each substance, other than alcohol and sedatives, was associated with individual health conditions, such as anxiety/depression and hepatitis C, cesarean delivery, preterm birth (less than 37 weeks), and poor fetal growth.
2. Hepatitis C was higher among people who used any substance during pregnancy compared to those who did not.
3. Marijuana use increased since 2016 and opioid use decreased since 2017.
4. Individuals under age 30 were more likely to use substances during pregnancy, regardless of the type of substance.
5. Black people more frequently had codes for marijuana use and White people more frequently had codes for alcohol, tobacco, opioids, psychostimulants and sedatives.

6. Eighty-seven percent of records with psychostimulants, 85 percent with marijuana and opioids, and 84 percent with sedatives had Medicaid as the primary payer compared to 30 percent of pregnancies overall using Medicaid.
7. Thirty percent of people who used opioids and 48 percent of people who used marijuana during pregnancy had a zip code in the lowest household income quintile, making \$22,584-\$46,058 per year.
8. Prevalence of both anxiety and depression diagnoses were significantly higher among people who used substances during pregnancy compared to those who did not.
9. Maternal length of stay (LOS) of more than three3 days for vaginal deliveries was associated with each individual substance.
10. While each substance was examined individually, multiple substance use, or polysubstance use, was common.

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INTRODUCTION

In the United States, tobacco, alcohol and marijuana are the most used substances during pregnancy. According to the National Survey on Drug Use and Health (NSDUH), between 2016-2019, 11.6 percent of those who were pregnant (15-44 years old) used tobacco, 9.8 percent used alcohol, 5.5 percent used marijuana, and 1.2 percent used opioids or cocaine.¹ There was a significant decrease in tobacco use between 2017 to 2019 (14.7% and 9.6%, respectively).¹ In 2019, the Pregnancy Risk Assessment Monitoring System (PRAMS) estimated that 6.6 percent of those who were pregnant reported using prescription opioid pain relievers during pregnancy, and among these individuals, 21.2 percent reported misuse.²

Rates of reported substance use during pregnancy, especially in late pregnancy, tend to be lower than rates of pre-pregnancy substance use. For example, among respondents of childbearing age to the NSDUH (2019), 14.7 percent who were not pregnant reported cannabis use compared to 5.4 percent for those who were pregnant.¹ Similarly, among respondents to the survey from 2016-18, prevalence of alcohol use declined from 20 percent among those in their first trimester compared to less than 5 percent among those in their second or third trimester.³

Maternal and infant health effects from substance use can be serious, and lifelong. While not meant to be a comprehensive list, potential maternal and infant health effects are described by substance (Table 1). The relationships between substance use and health outcomes are complex and depend on many other factors, such as trimester of exposure, frequency of exposure or dose, use of more than one substance and/or prescription medication, and co-occurring health conditions. These are challenging to untangle from a host of social and home factors. Additionally, polysubstance use is common; approximately 40 percent of those who are pregnant who use alcohol also use at least one more substance,³ potentially resulting in complementary effects. For example, infants born to a person who both used alcohol and smoked cigarettes after the first trimester of pregnancy had a 12-fold increase of Sudden Unexplained Infant Death Syndrome (SUIDS) compared to those who were exposed only during the first trimester or were not exposed.⁷

Additionally, research suggests that the COVID-19 pandemic may have increased the risk of substance use among those who are pregnant reporting poor mental health and financial stress.^{8,9} For example, a recent study from Kaiser found that prenatal marijuana use increased from 6.8 percent to 8.1 percent during this time due to increased mental and financial stress, with recent data suggesting use may have increased up to 25 percent compared to the 15 months prior to the pandemic.¹⁰

The leading cause of pregnancy-associated deaths in Pennsylvania between 2013-2018 among both Black and White residents was accidental poisonings, which includes drug overdoses. In 2018, they accounted for 40 percent of all pregnancy-associated deaths.¹¹ While mortality data describe the most

severe outcomes, prevalence and morbidity data are also needed to support prevention efforts, yet prevalence of substance use disorder (SUD) and morbidity data are scarce at the local level. The Centers for Disease Control and Prevention (CDC) defines maternal morbidity as physical and psychologic conditions that result from or are aggravated by pregnancy and have an adverse effect on a woman’s health.¹² The most severe complications of pregnancy are referred to as severe maternal morbidity (SMM); however, this report also includes non-severe morbidities, such as anxiety and hepatitis C, as their contribution to poor health outcomes cannot be understated. Furthermore, the CDC recommends that states conduct mortality reviews to investigate all pregnancy-associated deaths to help clinicians and public health professionals understand trends and clinical causes of pregnancy-related deaths that can inform actions to prevent them.¹³

Overall, in Allegheny County we do not know the prevalence of substance use among pregnant women or how it affects outcomes among those who are pregnant. Furthermore, we cannot assess causality from the data. Given these data limitations, this report aims to quantify substance use during pregnancy and hospital delivery stays. It also aims to identify relationships established in the literature to assess both the ongoing use of local data and the population of those who are pregnant and use substances. These data can be used for further hypothesis generation and to support local efforts around substance use.

Table 1. Potential Maternal and Infant Health Effects by Substance ^{4,5,6}

Substance		Examples of Potential Maternal and Infant Health Outcomes
Alcohol	Maternal	<ul style="list-style-type: none"> Miscarriage Stillbirth
	Infant	<ul style="list-style-type: none"> Fetal Alcohol Spectrum Disorders (FASD) Low birthweight Sudden Unexpected Infant Death (SUID)
Tobacco	Maternal	<ul style="list-style-type: none"> Miscarriage Stillbirth Preterm birth
	Infant	<ul style="list-style-type: none"> Low birthweight Sudden Unexpected Infant Death (SUID) Birth Defects Childhood obesity Learning and behavioral problems
Marijuana (Cannabis)	Maternal	<ul style="list-style-type: none"> Preterm birth Stillbirth
	Infant	<ul style="list-style-type: none"> Low birthweight Delayed neurological development Poor fetal growth
Opioids	Maternal	<ul style="list-style-type: none"> Maternal death Stillbirth Preterm birth
	Infant	<ul style="list-style-type: none"> Neonatal abstinence syndrome (NAS) / neonatal opioid withdrawal syndrome (NOWS) Poor fetal growth Birth Defects
Psychostimulants (Cocaine and Methamphetamine)	Maternal	<ul style="list-style-type: none"> Maternal migraines and seizures Premature membrane rupture Placental abruption Preterm birth Stillbirth Miscarriage Preeclampsia
	Infant	<ul style="list-style-type: none"> Low birthweight Smaller head circumference Cognitive and emotional problems

*Sedatives were not included in this table due to sparse and inconclusive literature

**This table does not address the potential health outcomes of polysubstance use, nor does it capture potential health outcomes of substance use specific to just the pregnant person.

METHODOLOGY

The Allegheny County Health Department (ACHD) obtained de-identified hospital discharge records from the Pennsylvania Health Care Cost Containment Council (PCH4) for the years 2006-2020 for all delivery hospitalizations. Inclusion criteria included Allegheny County resident, female sex, age 12-55 years, and a primary diagnosis of a labor and delivery ICD-9 (2006-2015 Q3) or ICD-10 code (2015 Q4-2020).^{*} To understand how well the hospital discharge data represents a comprehensive accounting of Allegheny County births, counts of births with labor and delivery ICD codes were compared to counts in birth certificates for the most recent year of available birth certificate data, 2019 (See Table 8 in Appendix).

Records with a primary diagnostic ICD-code^{**} for labor and delivery and a substance use ICD-code were categorized into the following: alcohol, tobacco, marijuana, opioids, psychostimulants (cocaine and stimulants) and sedatives. Because polysubstance use is common, categories were not mutually exclusive, and records could be included in multiple substance categories. Demographic characteristics (race, age, primary insurance payer, and zip code income quintile (proxy for income), co-morbidities and health conditions (anxiety, depression, gestational hypertension, gestational diabetes, and hepatitis C), and health outcomes (preterm birth, poor fetal growth, premature rupture of membrane, severe maternal morbidity (SMM), cesarean delivery, and length of maternal hospital stay by delivery type) were analyzed for each individual substance category to compare the rate of people who used the identified substance during pregnancy to those who did not use any substances.

- Zip code income quintile was calculated using median household income by zip code from American Community Survey (ACS 2015-2019) data.
- Severe maternal morbidity (SMM) consists of [21 indicators](#) as defined by the CDC; for the purpose of this analysis, we grouped all 21 indicators as having any.¹⁴
- Length of hospital stay (LOS) was conditional on delivery type. For vaginal deliveries, stays greater than three days were considered extended, and for cesarean deliveries, stays greater than five days were considered extended.
- All ICD-9 and ICD-10 codes used to determine substance use categories and health conditions can be found in Table 9 (See Appendix).¹⁵

The percentage and counts of labor and delivery hospitalizations for each substance group for the years 2006-2020 were described over time. Demographics, co-morbidities, health conditions, and health outcomes were analyzed for 2016-2020 aggregated. Any estimate based on a count < 10 was censored and not displayed. Chi-square tests were used for bivariate associations and all analyses were completed in SAS 9.4.

Like many public health data sources, hospital discharge data have limitations such as miscoding or omission of ICD codes, and therefore may not provide a complete picture of substance use at delivery. Nevertheless, trends and associations can be corroborated with findings in the literature and compared to results of analyses using National Violent Death Reporting System (NVDRS), toxicology data from fatal overdoses, death certificates and other local data sources.

* In quarter 4 of 2015, ICD-9 codes were converted to ICD-10. The change included an expansion of codes and improved specificity in code assignments; therefore, trends in surveillance data have been impacted by this change, and trends prior to 2016 should not be compared to those after 2016.

**Diagnostic ICD10 codes were validated against corresponding years of birth certificates. Roughly 98% of records were matched, validating the diagnostic codes as effectively capturing hospital births. Procedure codes were used to capture delivery type.

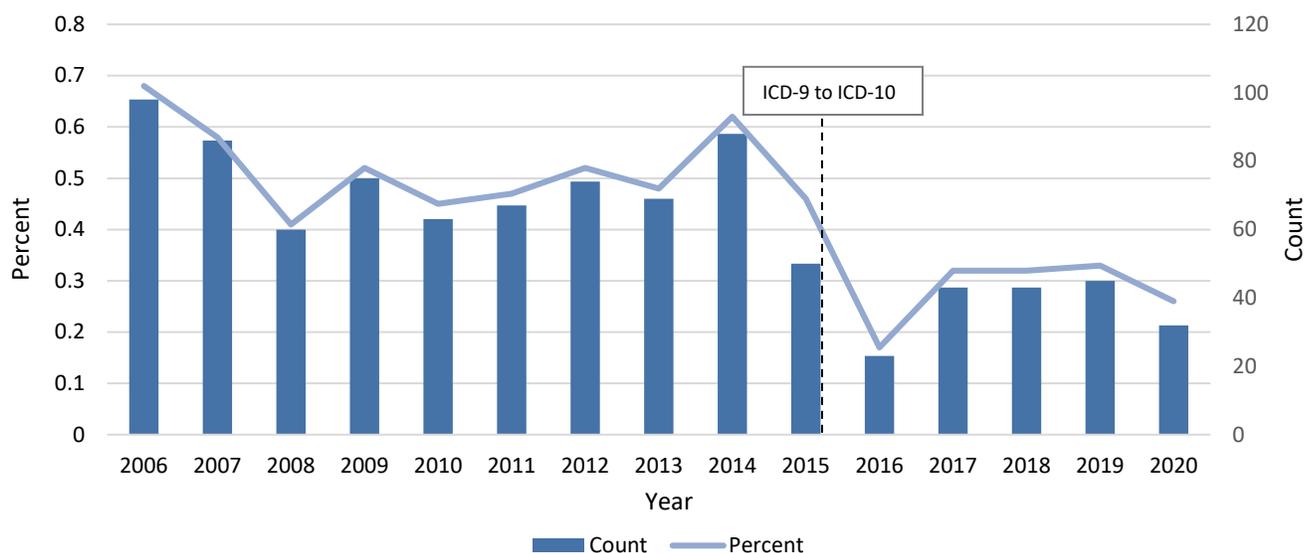
RESULTS

Among the sample population of 66,977 people who gave birth from 2016-2020, 23 percent had an ICD code indicating substance use during pregnancy, and 77 percent did not. For each substance category, time trends are shown for 2006-2020 followed by bivariate and descriptive tables for 2016-2020 aggregate data.

ALCOHOL USE

Alcohol use during pregnancy remained under one percent for the study period, decreasing from 0.68 percent in 2006 to 0.25 percent in 2020. Trends appear to change following the ICD-9 to ICD-10 coding change which could partially explain the drop in alcohol use during pregnancy after 2015.

Figure 1. Percent and Count of Alcohol Use During Pregnancy, 2006-2020



- Alcohol use during pregnancy was more prevalent among people ages 25-29, identified as White, insured by Medicaid, and/or were low-income (Table 2).
- Anxiety, depression, and hepatitis C were significantly more common among people who used alcohol during pregnancy compared to people who did not; there was no significant difference for gestational hypertension and diabetes.
- Poor fetal growth, maternal health conditions (co-morbidities), and extended LOS > three days were significantly more common among people who used alcohol during pregnancy.
- SMM was seven times higher among people who used alcohol during pregnancy compared to those who did not.

Table 2. Demographic Characteristics for Alcohol Use During Pregnancy, 2016-2020

Demographics	Alcohol n (%)	No Substance n (%)	P value*
Total Number	186	51624	-
Maternal Age Group			
<25	22 (12%)	7512 (15%)	0.29
25-29	62 (33%)	13602 (26%)	0.03
30-34	51 (27%)	19583 (38%)	0.003
35-39	42 (23%)	9280 (18%)	0.10
40+	ND	1647 (3%)	0.20
Maternal Race			
White	91 (49%)	34479 (67%)	<0.001
Black	86 (46%)	10005 (19%)	<0.001
Other	ND	7140 (14%)	<0.001
Health Insurance Payer			
Commercial	33 (18%)	36218 (70%)	<0.001
Medicaid	134 (72%)	12835 (25%)	<0.001
Other	18 (10%)	2568 (5%)	0.003
Zip Code Income Quintile			
\$22,585 - \$46,058 (lowest)	70 (38%)	8174 (16%)	<0.001
\$46,059 – \$56,293	44 (24%)	9156 (18%)	0.03
\$56,294 - \$65,832	37 (20%)	10753 (21%)	0.75
\$65,833 - \$79,082	21 (11%)	11215 (22%)	<0.001
\$79,083+ (highest)	14 (8%)	11237 (22%)	<0.001
Co-morbidities			
Anxiety	64 (34%)	3357 (7%)	<0.001
Depression	66 (35%)	2634 (5%)	<0.001
Gestational Hypertension	13 (7%)	2134 (4%)	0.05
Gestational Diabetes	ND	702 (1%)	0.77
Hepatitis C	26 (14%)	82 (0%)	<0.001
Outcomes			
Preterm Birth	10 (5%)	1687 (3%)	0.11
Poor Fetal Growth	10 (5%)	1159 (2%)	0.004
Premature Rupture of Membranes	15 (8%)	4795 (9%)	0.56
Severe Maternal Morbidity [†]	13 (7%)	613 (1%)	<0.001
Cesarean Delivery	21 (12%)	13118 (25%)	<0.001
Maternal Length of Stay in Hospital			
Vaginal Delivery (> 3 days)	37 (27%)	2573 (7%)	<0.001
Cesarean Delivery (>5 days)	ND	725 (5%)	<0.001

*Based on chi-square tests

[†] [The CDC defines delivery hospitalizations with severe maternal morbidity using 21 indicators](#)

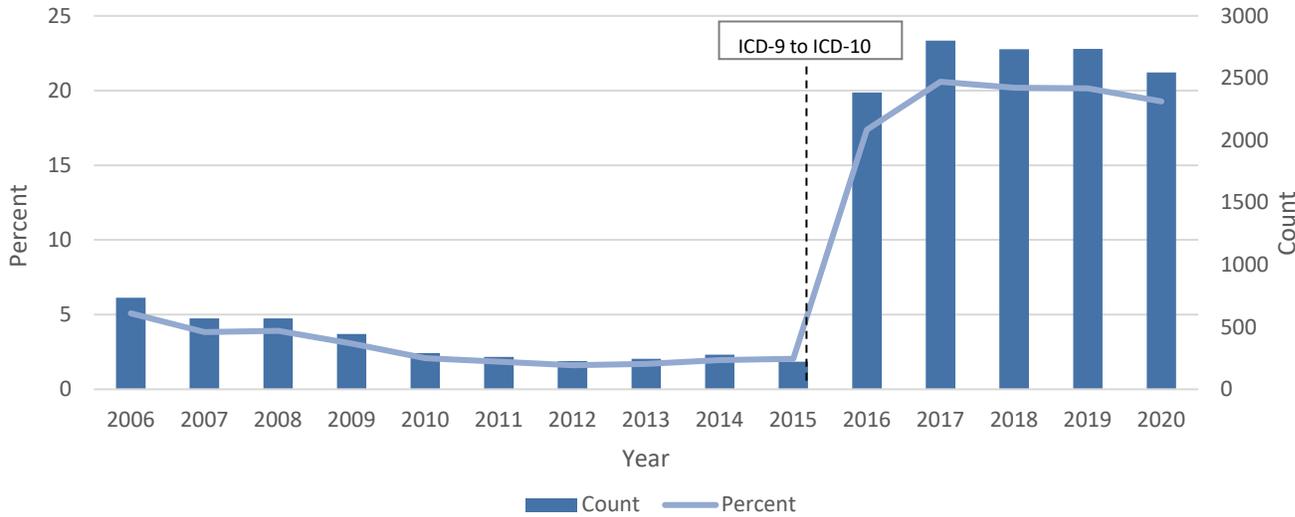
ND= Not displayed if counts are less than 10

**ICD-10 codes for demographics, substances, and outcomes found in Table 9 in the Appendix

TOBACCO USE

There is a significant change in the prevalence of tobacco use after the ICD-9 to ICD-10 coding change in the fourth quarter of 2015, increasing from 2 percent in 2015 to 17 percent in 2016. Since 2017, the prevalence of tobacco use has remained around 20 percent.

Figure 2. Percent and Count of Tobacco Use During Pregnancy, 2006-2020



- Tobacco use during pregnancy was more prevalent among people who were under 30 years of age, identified as White, were insured by Medicaid, and/or were low-income.
- Anxiety, depression, gestational hypertension, gestational diabetes, and hepatitis C were more prevalent among people who used tobacco compared to those who did not.
- Preterm birth, poor fetal growth, SMM, and cesarean delivery were more common among people who used tobacco compared to those who did not; no difference was observed for PROM.
- Extended LOS > three days for vaginal deliveries was more common among people who used tobacco compared to those who did not; there was no significant difference between LOS for cesarean deliveries.

Table 3. Demographic Characteristics for Tobacco Use During Pregnancy, 2016-2020

Demographics	Tobacco n (%)	No Substance n (%)	P value*
Total Number	13198	51624	-
Maternal Age Group			
<25	2989 (23%)	7512 (15%)	<0.001
25-29	4082 (31%)	13602 (26%)	<0.001
30-34	3722 (28%)	19583 (38%)	<0.001
35-39	2015 (15%)	9280 (18%)	<0.001
40+	390 (3%)	1647 (3%)	0.17
Maternal Race			
White	8313 (63%)	34479 (67%)	<0.001
Black	4309 (33%)	10005 (19%)	<0.001
Other	576 (4%)	7140 (14%)	<0.001
Health Insurance Payer			
Commercial	4453 (34%)	36218 (70%)	<0.001
Medicaid	8116 (61%)	12835 (25%)	<0.001
Other	627 (5%)	2568 (5%)	0.29
Zip Code Income Quintile			
\$22,584 - \$46,058 (lowest)	4257 (32%)	8174 (16%)	<0.001
\$46,059 - \$56,293	3226 (24%)	9156 (18%)	<0.001
\$56,294 - \$65,832	2772 (21%)	10753 (21%)	0.66
\$65,833 - \$79,082	1728 (13%)	11215 (22%)	<0.001
\$79,083+ (highest)	1192 (9%)	11237 (22%)	<0.001
Co-morbidities			
Anxiety	1976 (15%)	3357 (7%)	<0.001
Depression	1819 (14%)	2634 (5%)	<0.001
Gestational Hypertension	900 (7%)	2134 (4%)	<0.001
Gestational Diabetes	267 (2%)	702 (1%)	<0.001
Hepatitis C	868 (7%)	82 (0%)	<0.001
Outcomes			
Preterm Birth	593 (4%)	1687 (3%)	<0.001
Poor Fetal Growth	540 (4%)	1159 (2%)	<0.001
Premature Rupture of Membranes	1288 (10%)	4795 (9%)	0.10
Severe Maternal Morbidity [†]	250 (2%)	613 (1%)	<0.001
Cesarean Delivery	3449 (26%)	13118 (25%)	<0.001
Maternal Length of Stay in Hospital			
Vaginal Delivery (>3 days)	935 (10%)	2573 (7%)	<0.001
Cesarean Delivery (>5 days)	196 (5%)	725 (5%)	0.72

*Based on chi-square tests

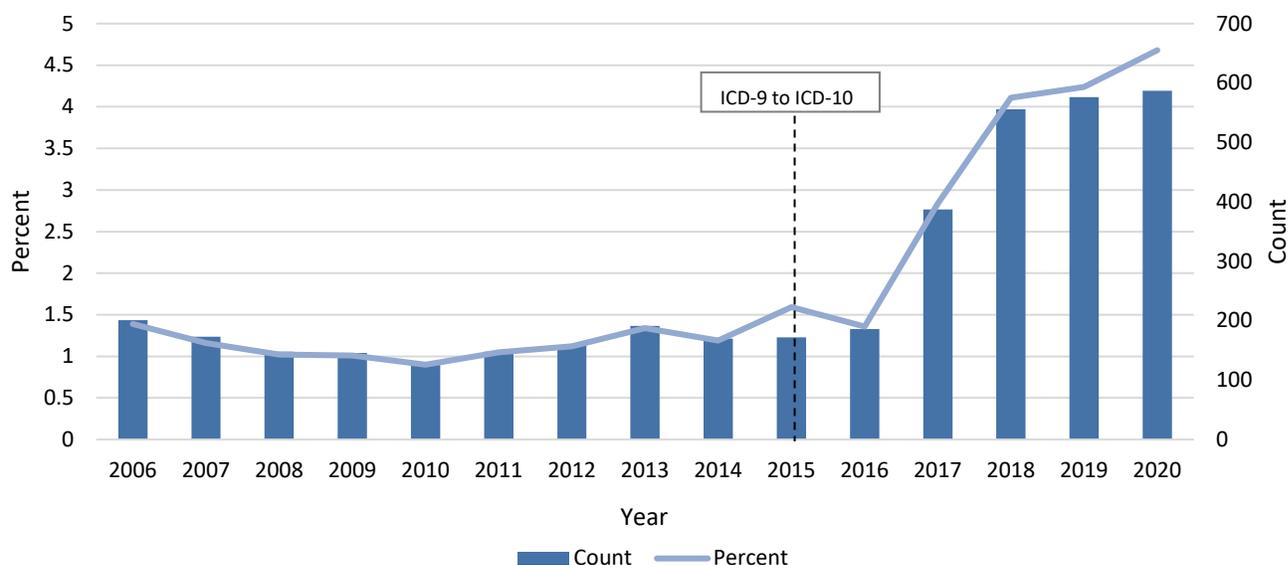
[†] [The CDC defines delivery hospitalizations with severe maternal morbidity using 21 indicators](#)

**ICD-10 codes for demographics, substances, and outcomes found in Table 9 in the Appendix

MARIJUANA USE

The percent of people who use marijuana use during pregnancy increased from 1.4 percent in 2006 to 4.7 percent in 2020. Between 2006 and 2016, fewer than 2 percent of births contained codes for marijuana use; in 2018 the rate of marijuana use increased to 4 percent and has remained relatively stable since.

Figure 3. Percent and Count of Marijuana Use During Pregnancy, 2006-2020



- Marijuana use during pregnancy was more prevalent among people younger than 30 years of age, identified as Black, insured with Medicaid, and/or were low-income.
- Anxiety, depression, gestational hypertension, and hepatitis C were significantly more common among people who used marijuana during pregnancy compared to those who did not; there was a small but significant difference between groups for gestational diabetes.
- Preterm birth and poor fetal growth were more common among people who used marijuana during pregnancy compared to those who did not; there was no difference between groups for PROM, and SMM.
- Extended LOS days for vaginal deliveries was more common among people who used marijuana during pregnancy compared to those who did not; there was no significant difference between LOS days for cesarean deliveries.

Table 4. Demographic Characteristics for Marijuana Use During Pregnancy, 2016-2020

Demographics	Marijuana n (%)	No Substance n (%)	P value*
Total Number	2292	51624	-
Maternal Age Group			
<25	881 (38%)	7512 (15%)	<0.001
25-29	724 (32%)	13602 (26%)	<0.001
30-34	464 (20%)	19583 (38%)	<0.001
35-39	189 (8%)	9280 (18%)	<0.001
40+	34 (1%)	1647 (3%)	<0.001
Maternal Race			
White	733 (32%)	34479 (67%)	<0.001
Black	1481 (65%)	10005 (19%)	<0.001
Other	78 (3%)	7140 (14%)	<0.001
Health Insurance Payer			
Commercial	231 (10%)	36218 (70%)	<0.001
Medicaid	1954 (85%)	12835 (25%)	<0.001
Other	106 (5%)	2568 (5%)	0.45
Zip Code Income Quintile			
\$22,584 - \$46,058 (lowest)	1095 (48%)	8174 (16%)	<0.001
\$46,059 - \$56,293	635 (28%)	9156 (18%)	<0.001
\$56,294 - \$65,832	357 (16%)	10753 (21%)	<0.001
\$65,833 - \$79,082	136 (6%)	11215 (22%)	<0.001
\$79,083+ (highest)	64 (3%)	11237 (22%)	<0.001
Co-morbidities			
Anxiety	374 (16%)	3357 (7%)	<0.001
Depression	430 (19%)	2634 (5%)	<0.001
Gestational Hypertension	155 (7%)	2134 (4%)	<0.001
Gestational Diabetes	47 (2%)	702 (1%)	0.006
Hepatitis C	132 (6%)	82 (0%)	<0.001
Outcomes			
Preterm Birth	162 (7%)	1687 (3%)	<0.001
Poor Fetal Growth	129 (6%)	1159 (2%)	<0.001
Premature Rupture of Membranes	231 (10%)	4795 (9%)	0.20
Severe Maternal Morbidity [†]	42 (2%)	613 (1%)	0.006
Cesarean Delivery	480 (21%)	13118 (25%)	<0.001
Maternal Length of Stay in Hospital			
Vaginal Delivery (>3 days)	201 (12%)	2573 (7%)	<0.001
Cesarean Delivery (>5 days)	36 (7%)	725 (5%)	0.07

*Based on chi-square tests

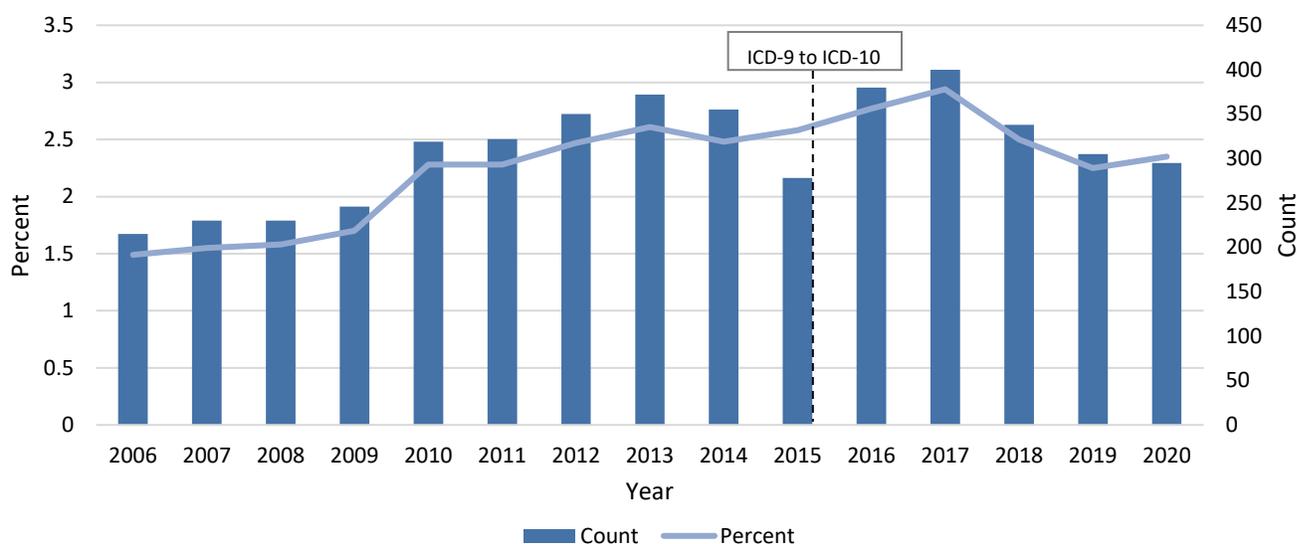
[†] [The CDC defines delivery hospitalizations with severe maternal morbidity using 21 indicators](#)

**ICD-10 codes for demographics, drugs, and outcomes found in Table 9 in the Appendix

OPIOID USE

The percent of people with opioid use during pregnancy increased from 1.5 percent in 2006 to 2.4 percent in 2020. Since, 2010, between 250 and 400 people were identified with opioid use ICD codes during pregnancy each year.

Figure 4. Percent and Count of Opioid Use During Pregnancy, 2006-2020



- Opioid use during pregnancy was more prevalent among people ages 25-34 years, identified as White, insured with Medicaid, and/or were low-income.
- Anxiety, depression, and hepatitis C were more common among people who used opioids during pregnancy compared to those who did not; there was a small but significant difference across groups for gestational hypertension.
- Preterm birth, poor fetal growth, and SMM were significantly more common among people who used opioids during pregnancy compared to those who did not; PROM prevalence was similar to other outcomes such as preterm birth, but there was no significant difference compared to pregnancies with no opioid use.
- Extended LOS for vaginal deliveries was significantly more common among people who used opioids during pregnancy compared to those who did not.

Table 5. Demographic Characteristics for Opioid Use During Pregnancy, 2016-2020

Demographics	Opioid n (%)	No Substance n (%)	P value*
Total Number	1718	51624	-
Maternal Age Group			
<25	224 (13%)	7512 (15%)	0.08
25-29	596 (35%)	13602 (26%)	<0.001
30-34	587 (34%)	19583 (38%)	0.001
35-39	276 (16%)	9280 (18%)	0.04
40+	35 (2%)	1647 (3%)	0.007
Maternal Race			
White	1479 (86%)	34479 (67%)	<0.001
Black	186 (11%)	10005 (19%)	<0.001
Other	53 (3%)	7140 (14%)	<0.001
Health Insurance Payer			
Commercial	168 (10%)	36218 (70%)	<0.001
Medicaid	1464 (85%)	12835 (25%)	<0.001
Other	86 (5%)	2568 (5%)	0.95
Zip Code Income Quintile			
\$22,584 - \$46,058 (lowest)	514 (30%)	8174 (16%)	<0.001
\$46,059 - \$56,293	464 (27%)	9156 (18%)	<0.001
\$56,294 - \$65,832	379 (22%)	10753 (21%)	0.22
\$65,833 - \$79,082	203 (12%)	11215 (22%)	<0.001
\$79,083+ (highest)	155 (9%)	11237 (22%)	<0.001
Co-morbidities			
Anxiety	502 (29%)	3357 (7%)	<0.001
Depression	443 (26%)	2634 (5%)	<0.001
Gestational Hypertension	88 (5%)	2134 (4%)	0.04
Gestational Diabetes	19 (1%)	702 (1%)	0.37
Hepatitis C	771 (45%)	82 (0%)	<0.001
Outcomes			
Preterm Birth	111 (6%)	1687 (3%)	<0.001
Poor Fetal Growth	114 (7%)	1159 (2%)	<0.001
Premature Rupture of Membranes	136 (8%)	4795 (9%)	0.05
Severe Maternal Morbidity [†]	51 (3%)	613 (1%)	<0.001
Cesarean Delivery	406 (24%)	13118 (25%)	<0.001
Maternal Length of Stay in Hospital			
Vaginal Delivery (>3 days)	192 (17%)	2573 (7%)	<0.001
Cesarean Delivery (>5 days)	27 (7%)	725 (5%)	0.14

*Based on chi-square tests

[†] The CDC defines delivery hospitalizations with severe maternal morbidity using 21 indicators

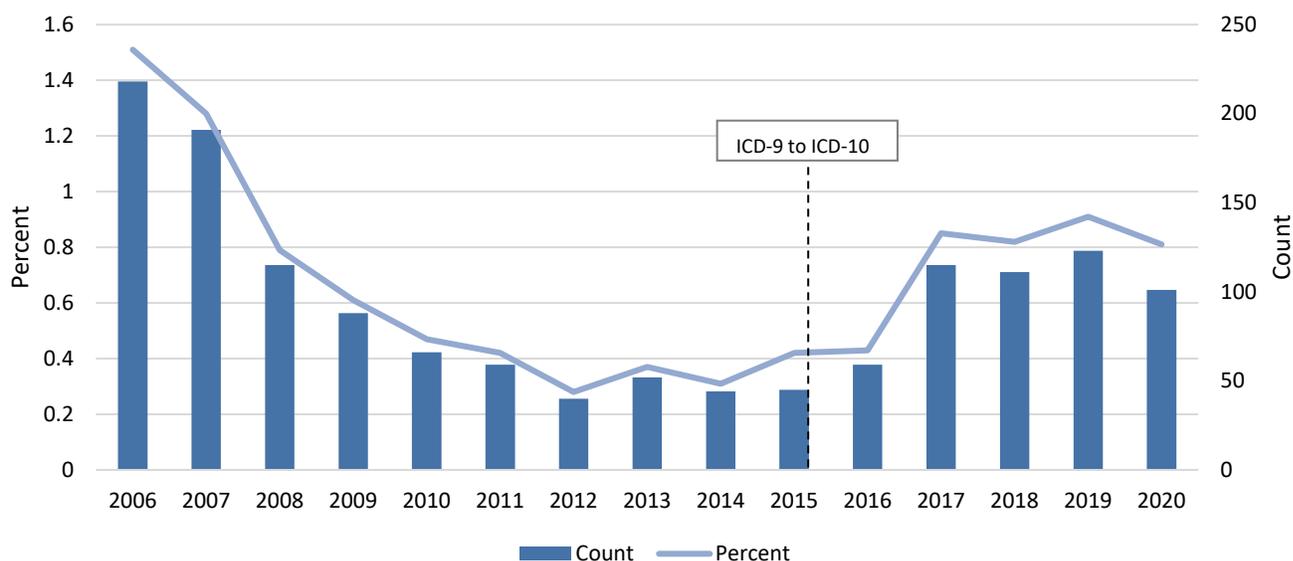
**ICD-10 codes for demographics, substances, and outcomes found in Table 9 in the Appendix

PSYCHOSTIMULANT USE

The percent of people with an ICD code for psychostimulant use during pregnancy remained under 2 percent throughout the study period and gradually declined from 1.5 percent in 2006 to 0.3 percent in 2014. Trends remained relatively stable until 2016, then increased to almost one percent in 2019.

While trends are primarily driven by cocaine use, the use of non-cocaine stimulants increased from 2018 (n=2) to 2019 (n=12).

Figure 5. Percent and Count of Any Psychostimulant Use During Pregnancy, 2006-2020



- Psychostimulant use during pregnancy was more prevalent among people between the ages of 25-34, identified as White, insured with Medicaid, and/or were low income; 70 percent of all people with a psychostimulant code were among those living in zip codes with the two lowest income quintiles.
- Anxiety, depression and hepatitis C were significantly more common among people who used psychostimulants during pregnancy compared to those who did not; there was no significant difference between groups for gestational hypertension and diabetes.
- Preterm birth, poor fetal growth, and SMM were significantly more common among people who used psychostimulants during pregnancy compared to those who did not, while there was no difference for PROM.
- Extended LOS for vaginal deliveries was significantly more common among people who used psychostimulants during pregnancy compared to those who did not; there was no significant difference between extended LOS for cesarean deliveries.

Table 6. Demographic Characteristics for Psychostimulant Use During Pregnancy, 2016-2020

Demographics	Psychostimulant n (%)	No Substance n (%)	P value*
Total Number	509	51624	-
Maternal Age Group			
<25	60 (12%)	7512 (15%)	0.08
25-29	163 (32%)	13602 (26%)	0.004
30-34	188 (37%)	19583 (38%)	0.64
35-39	84 (17%)	9280 (18%)	0.39
40+	14 (3%)	1647 (3%)	0.57
Maternal Race			
White	323 (63%)	34479 (67%)	0.11
Black	175 (34%)	10005 (19%)	<0.001
Other	11 (2%)	7140 (14%)	<0.001
Health Insurance Payer			
Commercial	29 (6%)	36218 (70%)	<0.001
Medicaid	442 (87%)	12835 (25%)	<0.001
Other	38 (7%)	2568 (5%)	0.01
Zip Code Income Quintile			
\$22,584 - \$46,058 (lowest)	204 (40%)	8174 (16%)	<0.001
\$46,059 - \$56,293	151 (30%)	9156 (18%)	<0.001
\$56,294 – \$65,832	87 (17%)	10753 (21%)	0.04
\$65,833 - \$79,082	48 (9%)	11215 (22%)	<0.001
\$79,083+ (highest)	18 (4%)	11237 (22%)	<0.001
Co-morbidities			
Anxiety	135 (27%)	3357 (7%)	<0.001
Depression	155 (30%)	2634 (5%)	<0.001
Gestational Hypertension	24 (5%)	2134 (4%)	0.51
Gestational Diabetes	ND	702 (1%)	0.98
Hepatitis C	200 (39%)	82 (0%)	<0.001
Outcomes			
Preterm Birth	51 (10%)	1687 (3%)	<0.001
Poor Fetal Growth	21 (5%)	1159 (2%)	0.004
Premature Rupture of Membranes	47 (9%)	4795 (9%)	0.97
Severe Maternal Morbidity [†]	17 (3%)	613 (1%)	<0.001
Cesarean Delivery	72 (14%)	13118 (25%)	<0.001
Maternal Length of Stay in Hospital			
Vaginal Delivery (>3 days)	80 (23%)	2573 (7%)	<0.001
Cesarean Delivery (>5 days)	ND	725 (5%)	0.07

*Based on chi-square tests

[†] [The CDC defines delivery hospitalizations with severe maternal morbidity using 21 indicators](#)

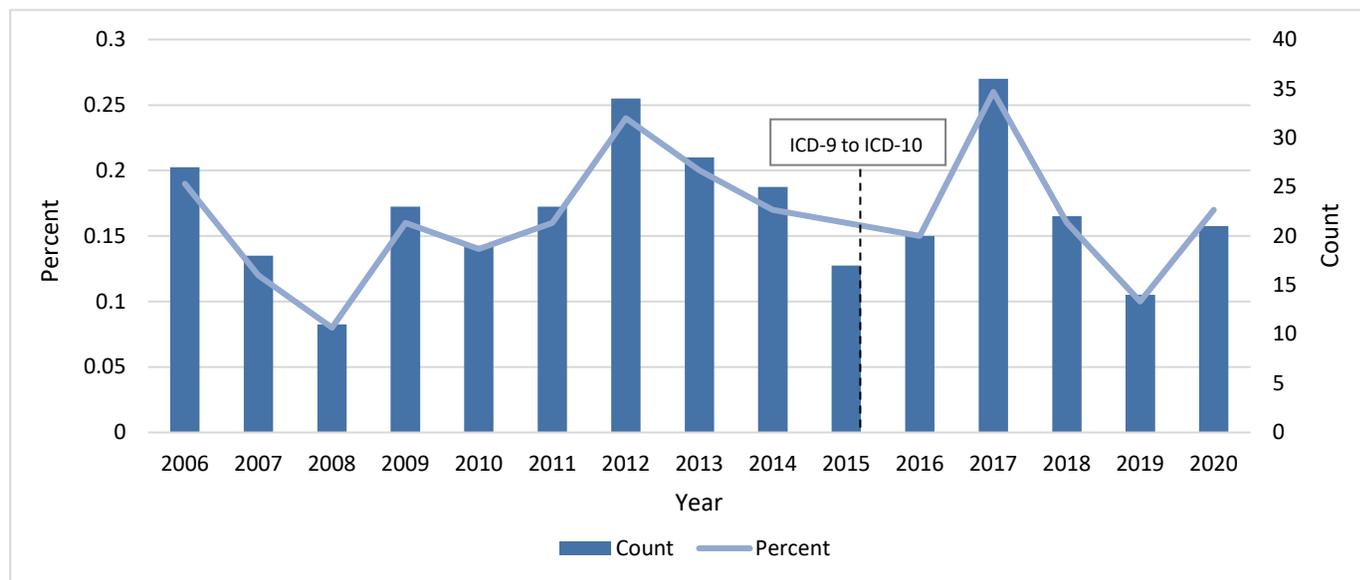
ND= Not displayed if counts are less than 10

**ICD-10 codes for demographics, drugs, and outcomes found in Table 9 in the Appendix

SEDATIVE USE

Throughout the study period, the percent of sedative use during pregnancy fluctuated but has remained below 0.05 percent which accounted for less than 40 pregnancies per year.

Figure 6. Percent and Count of Any Sedative Use During Pregnancy, 2006-2020



- Sedative use during pregnancy was significantly more common among people who identified as White, insured by Medicaid, and/or were lower income.
- Anxiety, depression and hepatitis C were much more common among people who used sedatives during pregnancy compared to those who did not; there were no significant differences observed between groups for gestational hypertension and diabetes.
- PROM and SMM were significantly more common among people who used sedatives during pregnancy compared to those who did not; all other co-morbidities were not significant.
- Extended LOS for vaginal deliveries was over ten times higher among people who used sedatives compared to those who did not; there was no significant difference for extended LOS for cesarean deliveries.

Table 7. Demographic Characteristics for Sedative Use During Pregnancy, 2016-2020

Demographics	Sedative n (%)	No Substance n (%)	P value*
Total Number	113	51624	-
Maternal Age Group			
<25	23 (20%)	7512 (15%)	0.08
25-29	35 (31%)	13602 (26%)	0.26
30-34	32 (28%)	19583 (38%)	0.03
35-39	23 (20%)	9280 (18%)	0.51
40+	ND	1647 (3%)	0.05
Maternal Race			
White	96 (85%)	34479 (67%)	<0.001
Black	12 (11%)	10005 (19%)	0.02
Other	ND	7140 (14%)	0.004
Health Insurance Payer			
Commercial	NA	36218 (70%)	<0.001
Medicaid	95 (84%)	12835 (25%)	<0.001
Other	ND	2568 (5%)	0.14
Zip Code Income Quintile			
\$22,584 - \$46,058 (lowest)	37 (33%)	8174 (16%)	<0.001
\$46,059 - \$56,293	29 (26%)	9156 (18%)	0.03
\$56,294 - \$65,832	29 (26%)	10753 (21%)	0.21
\$65,833 - \$79,082	13 (12%)	11215 (22%)	0.008
\$79,083+ (highest)	ND	11237 (22%)	<0.001
Co-morbidities			
Anxiety	62 (55%)	3357 (7%)	<0.001
Depression	48 (42%)	2634 (5%)	<0.001
Gestational Hypertension	ND	2134 (4%)	0.21
Gestational Diabetes	ND	702 (1%)	0.71
Hepatitis C	61 (54%)	82 (0%)	<0.001
Outcomes			
Preterm Birth	ND	1687 (3%)	0.37
Poor Fetal Growth	ND	1159 (2%)	0.73
Premature Rupture of Membranes	ND	4795 (9%)	0.006
Severe Maternal Morbidity [†]	ND	613 (1%)	0.02
Cesarean Delivery	10 (9%)	13118 (25%)	<0.001
Maternal Length of Stay in Hospital			
Vaginal Delivery (>3 days)	34 (45%)	2573 (7%)	<0.001
Cesarean Delivery (>5 days)	ND	725 (5%)	0.45

*Based on chi-square tests

[†] [The CDC defines delivery hospitalizations with severe maternal morbidity using 21 indicators](#)

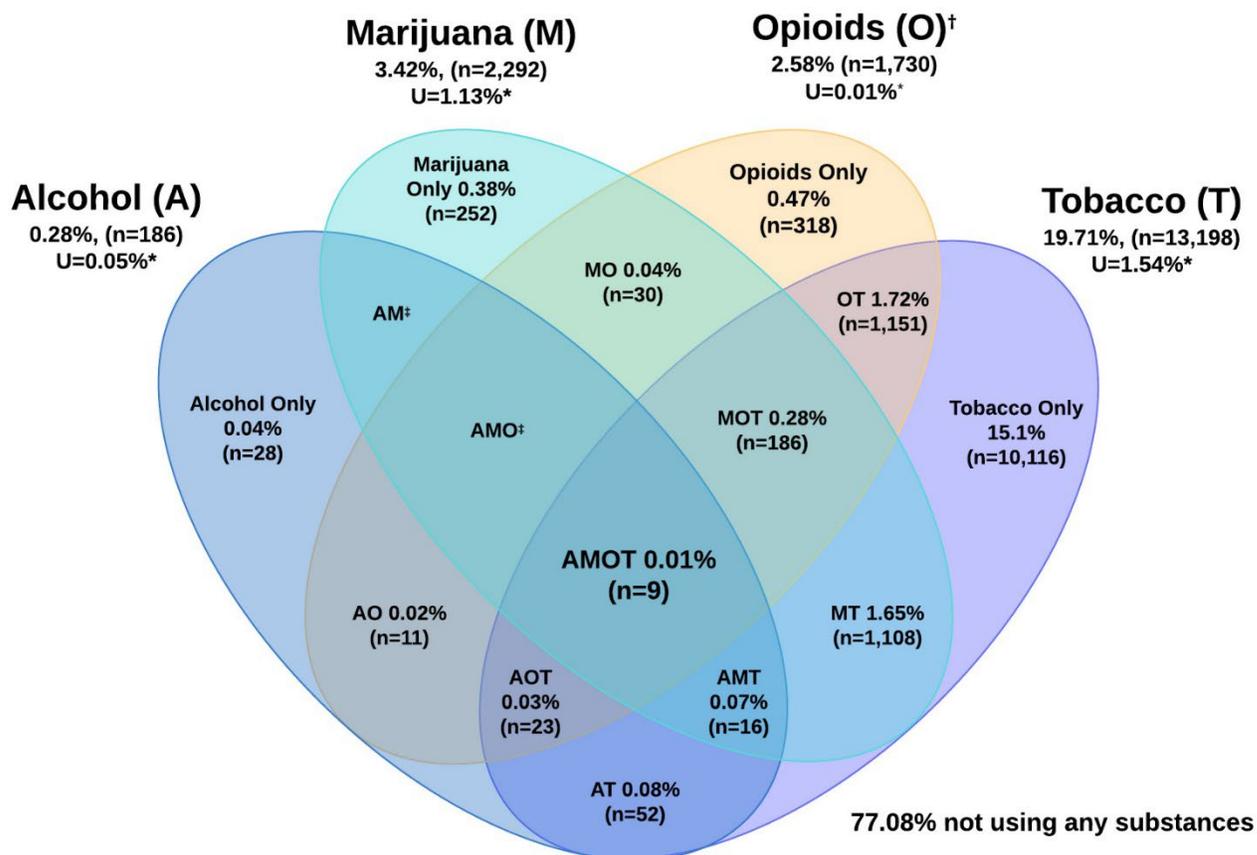
ND= Not displayed if counts are less than 10

**ICD-10 codes for demographics, substances, and outcomes found in Table 9 in the Appendix

POLYSUBSTANCE USE

Hepatitis C (acute and chronic) was significantly more prevalent among people who used substances during pregnancy for each individual substance compared to people who did not use substances, prompting the investigation of multi-drug or polysubstance use. People who inject drugs (PWID), particularly opioids, are at a greater risk of having hepatitis C, compared to those who do not inject drugs.¹⁶ Therefore, for all labor and delivery stays between 2016-2020, any records with substance use were analyzed to understand co-occurrence of other substance use. For this analysis, psychostimulants and sedatives were grouped together with opioids; however, opioids account for 99 percent of the people with these substance use codes. Eighteen percent of all people who used opioids during pregnancy only used these substances. Co-occurring opioid prevalence occurred among 10 percent of all records with marijuana, 10 percent of records with tobacco, and 24 percent of records with alcohol. Figure 7 shows the prevalence of substances used during pregnancy independently and co-occurring. Overall, tobacco use was the most prevalent independently and co-occurring for each substance group; opioids were the most common substance used with tobacco (1.7%). Alcohol was the least co-occurring substance followed by marijuana.

Figure 7. Prevalence of Multiple Substance Use During Pregnancy, 2016-2020



*U=Percent of unspecified substances diagnosed with the O9931 code; drug use complicating pregnancy, childbirth, and the puerperium.

† The opioid group also includes sedatives and stimulants; opioids account for 99% (n= 1,718) of these substances used.

‡ Data not displayed if counts are less than 10.

DISCUSSION

PRIMARY TAKEAWAYS

Among 2016-2020 Allegheny County labor and delivery stays, 23 percent had an ICD-10 code for use of one or more substances during pregnancy. Tobacco was the most common substance used and impacted nearly one out of every five labor and delivery stays, followed by marijuana and opioids (3% and 2.5% of stays, respectively). Approximately four percent of all stays had ICD codes for multiple substances, with tobacco as the most prevalent co-occurring substance.

Patterns of substance use during pregnancy differed based on drug category. Marijuana use has been trending upward since 2016, while opioid use is trending downward since peaking in 2017. Other drug trends remained steady or had no apparent change.

Significant associations were observed between substance use during pregnancy with demographics and co-morbidities. People who were younger than 30 years old, were insured by Medicaid, had anxiety, depression, or hepatitis C were more likely to have a substance use ICD code compared to their counterparts.

Maternal and infant health outcomes such as preterm birth, poor fetal growth, and extended length of maternal hospital stay were more common among those who used substances during pregnancy.

Given that the findings of this analysis are consistent with the literature, continuation of the use of hospital discharge data, in addition to other local data, can support efforts to understand maternal substance use. The consequences of maternal smoking are well-documented and mirrored in our results, except we found no association with smoking and PROM; despite this, the associations with risk factors and outcomes such as PROM could also be at least partially attributed to polysubstance use. Future analyses examining tobacco use alone may help to better quantify associations with comorbidities and health outcomes.

In 2017, nearly three percent (n=400) of labor and delivery stays had an ICD code for opioid use, the highest yearly prevalence in the study period (2006-2020), likewise, that year also had the highest number (n=684) of overall opioid overdose deaths in Allegheny County.¹⁷ Opioid use is associated with preterm birth, poor fetal growth, PROM, longer hospital stays and SMM.¹⁸ Opioid use was associated with each of these factors except for PROM. Opioid use disorder is complex, and our analysis included many opioid ICD codes that could reflect either current opioid use or ongoing treatment for opioid use disorder; it was not possible to differentiate between prescription, heroin or treatment opioids in this analysis.

Approximately 2.6 percent of people at labor and delivery had a non-marijuana substance ICD-10 code, almost all opioid-related; 3.4 percent were associated with marijuana, and less than 0.5 percent were associated with alcohol. Nationally in 2017, less than one percent of delivery hospitalizations were associated with maternal opioid-related diagnosis.¹⁹ In 2019, maternal opioid use disorder was present in 1.7 percent of deliveries in Allegheny County, with Pennsylvania county-level prevalence ranging from 0.6% in Lancaster to 6 percent in Elk County.

Before 2017, marijuana use fluctuated between 1.3 percent and 1.4 percent of all labor and delivery stays, then increased to 2.8 percent in 2017 and 4.7 percent in 2020; while ICD code changes in the fourth quarter of 2015 may have contributed to this trend, the increase may also relate to the 2016 legalization of medical marijuana in Pennsylvania. The association of marijuana with maternal and infant outcomes is unclear, as there are conflicting results among recent studies.²⁰ One challenge of understanding independent effects of marijuana on outcomes is isolating the effect of marijuana and other substances like tobacco and opioids known to be associated with preterm birth, PROM and slow fetal growth. Polysubstance use was not uncommon; while 23 percent of labor and delivery stays had at least one ICD code for substance use, approximately four percent of all stays had ICD codes for more than one substance.

Hepatitis C (acute and chronic) is significantly more common among people who use opioids and was associated with each individual substance analyzed, which could represent an underestimate of polysubstance use or a history of injecting drugs. Half of all people with polysubstance use (2%) had codes for both tobacco and marijuana. The relatively high prevalence of tobacco and marijuana co-use is documented in the literature.²¹

Limitations

The data may overestimate the percentage of people who smoke in the third trimester of pregnancy, as birth certificate data indicate 10 percent of people smoke during pregnancy (2015-2019).²² However, hospitalization rates may capture vaping and other uses of tobacco, while birth certificates only capture cigarette smoking. Additionally, administrative data may represent both an overestimate (potentially containing former smokers) and bias toward people who use opioids, as people who use tobacco in our dataset were significantly more likely to have hepatitis C. This may artificially increase some rates of substance use. Finally, all substance prevalence estimates may be underestimated, as only labor and delivery stays were analyzed; substance use tends to decline throughout pregnancy and poor outcomes of earlier gestation, such as fetal loss, were not included.²³

Conclusion

This analysis demonstrates the utility of using hospitalization data to monitor maternal substance use trends and understand associations with risk factors and outcomes to improve the health and well-being of parents and families and reduce infant and pregnancy-related morbidity and mortality. While perinatal substance use screening is important, the potential stigmatization of substance use during pregnancy can be a barrier to identifying and treating substance use. However once identified, effective interventions exist that can improve health outcomes.²⁰ Consideration of risk factors and root causes of

maternal substance use must be considered; in our analysis many chronic diseases and mental health conditions, particularly anxiety and depression, were strongly associated with substance use. These conditions, along with factors not included in this analysis such as poverty, adverse childhood experiences, intergenerational trauma, and intergenerational substance use, are associated with an increased likelihood of substance use. Therefore, prevention efforts that are culturally specific and trauma informed should be considered when designing and implementing local public health approaches to reduce maternal substance use and provide support before, during, and after delivery.

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APPENDIX

Table 8. Comparison of PHC4 Hospitalization Data and Birth Records: Allegheny County, 2019

	Hospitalizations n (%)	Birth Records n (%)
Preterm Birth	472 (3.8%)	1,264 (9.9%)
PROM	1,450 (11.8%)	651 (5.1%)
Hypertension	509 (4.1%)	220 (1.7%)
Diabetes	149 (1.2%)	82 (0.6%)
Hepatitis C	150 (1.2%)	116 (0.9%)
Cesarean Delivery	3,854 (31.2%)	3,853 (30.2%)
Tobacco	2,372 (19.3%)	882 (7.0%)
Total	12,322	12,747

Table 9. Substance Use and Health Outcome ICD-9 and ICD-10-Codes¹⁵

Substance and Outcomes	ICD-9	ICD-10
Maternal Hospital Stays	4449, 997, V890, V724, V659, V6511, V61, V22, V24, V27, V28, V30-V39, 630-679, 760-769	O, Z03, Z640, Z7681, A34
Labor and Delivery Stays	V27	Z37
Type of Delivery	650, 669, 740-742, 722, 723, 727, 728, 732, 735, 736	O80, O82, 10D00Z0-10D00Z2, 10D07Z3-10D07Z8, 10E0XZZ, 0W8NXZZ
Alcohol	5710-5713, 291, 3030, 3050, 3039, 3575, 4255, 5353, 6554, 76071, 9800, E860	F100-F109, T510-T519, K700-K709, T501, X45, Y15, G612, G321, G721, I426, K929, K852, K860, O9931, P043, Q860
Tobacco	3051	F172, Z720, Z87891, O9933, T652
Marijuana	3043, 3052	F12, T407
Opioids	96500-96509, 3040, 3047, 3055, E850, E9350	T400-T404, F11, T406
Psychostimulants	3042, 3056, 9685, 97081, E9385, 3044, 3057, 9670, E854	F14, T405, F15, T436
Sedatives/ Hypnotics	E853, 9694, 3041, 3054, E855	F13, T424
Hypertension	NA	O131, O132, O133, O139, O161-O163, O169
Diabetes	NA	O2441-O2443, O2491-O2493

Anxiety/ Depression	NA	F320-F339, F53, F400-F419
Hepatitis C	NA	B1710, B1711, B182, B1920, B1921
Preterm Birth	NA	O602,P037
Poor Fetal Growth	NA	O365910-O365915, O3659190-O365925, O365929-O365935, O365939, O365990- O365995, O365999
Premature Rupture of Membranes (PROM)	NA	O42
Severe Maternal Morbidity (SMM)	NA	I2101, I2102, I2109, I2111, I2119, I2121, I2129, I213, I214, I219, I21A1, I21A9, I220, I221, I222, I228, I229, I7100, I7101, I7102,I7103, I711, I712, I713, I714, I715, I716, I718, I719, I790, N170, N171 N172, N178, N179, O904, J80, J951, J952, J953, J95821, J95822, J9600, J9601, J9602, J9620, J9621, J9622, R092, O88111, O88112, O88113, O8812, O8813, I462, I468, I469, I4901, I4902, 5A2204Z, 5A12012, D65, D688, D689, O723, O1500, O1502, O1503, O151, O152, O159, O1422, O1423, I97120, I97121, I97130, I97131, I97710, I97711, I6000, I6001, I6002, I6010, I6011, I6012, I6020, I6021, I6022, I6030, I6031, I6032, I1604, I6050, I6051, I6052, I606, I607, I608, I609, I611, I612, I613, I614, I615, I616, I618, I619, I6200, I6201, I6202, I6203, I621, I629, I6300, I6301, I6302, I6303, I6309, I6310, I6311, I6312, I6313, I6319, I6320, I6321, I6322, I6323, I6329, I6330, I6331, I6332, I6333, I6334, I6339, I6340, I6341, I6342, I6343, I6344, I6349, I6350, I6351, I6352, I6353, I6354, I6359, I636, I638, I639, I6501, I6502, I6503, I6509, I651, I6521, I6522, I6523, I6529, I658, I659, I6601, I6602, I6603, I6609, I6611, I6612, I6613, I6619, I6621, I6622, I6623, I6629, I663, I668, I669, I670, I671, I672, I673, I674, I675, I676, I677, I6781, I6782, I6783, I6784, I6789, I679, I680, I682, I688, O2251, O2252, O2253, I97810, I97811, I97820, I97821, O873, J810, I501, I5020, I5021, I5023, I5030, I5031, I5033, I5040, I5041, I5043, I509, O740, O741, O742, O743, O8901, O8909, O891, O892, O85, O8604, T80211A, T814XXA, T8144, T8144XA, T8144XD, T8144XS, R6520, A400, A401, A403, A408, A409, A4101, A4102, A411, A412, A413, A414, A4150, A4151, A4152, A4153, A4159, A4181, A4189, A419, A327, O751, R570, R571, R578, R579, R6521, T782XXA, T882XXA, T886XXA, T8110XA, T8111XA, T8119XA, D5700,

		<p>D5701, D5702, D57211, D57212, D57219, D57411, D57412, D57419, D57811, D57812, D57819, I2601, I2602, I2609, I2690, I2692, I2699, O88011, O88019, O8802, O8803, O88211, O88219, O8822, O8823, O88311, O88319, O8832, O8833, O8881, O8882, O8883, I260, 990, 30233H1, 30233K1, 30233L1, 30233M1, 30233M1, 30233N1, 30233P1, 30233R1, 30233T1, 30240H1, 30240K1, 30240L1, 30240M1, 30240N1, 30240P1, 30240R1, 30240T1, 30243H1, 30243K1, 30243L1, 30243M1, 30243N1, 30243P1, 30243R1, 30243T1, 30233N0, 30233P0, 30240N0, 30240P0, 30243N0, 30243P0, OUT90ZZ, OUT94ZZ, OUT97ZZ, OUT98ZZ, OUT9FZZ, OB110Z4, OB110F4, OB113Z4, OB113F4, OB114Z4, OB114F4, 5A1935Z, 5A1945Z, 5A1955Z O82, 10D00Z0-10D00Z2</p>
Cesarean Delivery	NA	