Incidence and Risk Factors for Suicide Attempt During Pregnancy and the Postpartum Period

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Abstract

Background: In the United States, suicide accounts for 1 out of every 20 deaths that occur during pregnancy and the first 12 months postpartum. Although nonfatal suicide attempts are the strongest known predictor of death by suicide, there are no prior population-based estimates of the incidence of and clinical risk factors for pregnancy-associated suicide attempts.

Methods: This retrospective cohort study used statewide, all-payer, longitudinally linked hospital and emergency department (ED) patient records from California. Participants included all California residents with an index hospital delivery of a live infant between 2010 and 2020. Outcomes included ED presentation for nonfatal suicide attempt during pregnancy or up to 12 months postpartum. Clinical risk factors of interest included healthcare utilization patterns during pregnancy and behavioral health diagnoses recorded at index delivery.

Results: Among delivering patients with an index delivery (N = 3,737,792), 0.13% (n = 4,968) had a suicide attempt during pregnancy or the postpartum period. After adjusting for background demographic characteristics, risks of a postpartum suicide attempt were increased 4- to 30-fold by several clinical factors, including prenatal suicide attempt ED visits, psychiatric ED visits, and assault ED visits, and by psychotic disorders, bipolar disorder, alcohol use disorder, recurrent and single-episode major depressive disorder, and anxiety disorders recorded at delivery.

Conclusions: Risks of postpartum suicide attempt were substantially elevated for patients who had behavioral healthrelated ED visits during pregnancy and by several psychiatric disorders at delivery. Clinical consideration should be given to monitoring these patients for suicide attempt risk.

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n the United States, suicide accounts for 1 out of every 20 deaths that occur during pregnancy and the first postpartum year.¹ Suicide deaths among pregnant and postpartum people are devastating events that arise from contexts of traumatic life stress, psychiatric and substance use disorders, intimate partner violence, and feelings of entrapment and despair.²⁻⁴ After slightly increasing between 2010 and 2019,1 pregnancy-associated suicide deaths declined during the COVID-19 pandemic,⁵ but this overall decrease masked increases of 8%-66% among racial and ethnic minority subpopulations.6 Suicide deaths are excluded from standard maternal mortality measures because they are not considered directly attributable to pregnancy or its management.^{1,7,8} Nevertheless, growing attention to their public health importance has helped motivate efforts (including the 2021 TRIUMPH for New Moms Act9) to prevent and

address maternal mental health crises that can increase the risk of suicide. $^{\rm 10-14}$

Nonfatal suicide attempt is the strongest known risk factor for death by suicide,¹⁵ and a serious adverse outcome in its own right, with implications for long-term maternal health as well as infant and family wellbeing.¹⁶⁻²⁰ To our knowledge, however, population-based prospective examinations of the incidence of and risk factors for pregnancy-associated suicide attempt in the US do not exist. Most studies lump episodes of suicide attempt with those of suicidal ideation, which occurs considerably more frequently but poses lower acuity.²¹⁻²³

The risk for maternal suicidal behavior is elevated among those with current or prior psychiatric and substance use disorder, mental health treatment, history of abuse, non-Hispanic Black race and ethnicity, and

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Clinical Points

- Suicide attempts in pregnant and postpartum people are devastating events with long-term maternal and infant health consequences, but incidence of and clinical risk factors for such attempts remain poorly understood.
- Pregnant patients with mood, psychotic, or substance use disorders—especially those whose conditions require emergency department care—are at high risk of postpartum suicide attempts and should be prioritized for clinical intervention services.

indicators of socioeconomic precarity.23-28 Absolute and relative risks of suicide attempt among pregnant or postpartum women with these characteristics, however, have not been evaluated in prospective population-based US samples. Little is also known about which specific psychiatric disorders at delivery pose elevated risks of suicide attempt during the postpartum period. Moreover, a range of other factors that signal elevated risk for suicidal behavior in the general population and among reproductive-aged women-including emergency department (ED) and hospital utilization,²⁹ as well as chronic physical health conditions^{30,31}—have not been examined in pregnant or postpartum people. Such characteristics are readily ascertainable in clinical settings, offering potential opportunities to identify highrisk individuals and connect them to prevention-oriented resources.32-36

We used population-based, linked administrative patient record data from California, with a cohort study design, to evaluate incidence and disparities in nonfatal suicide attempt among pregnant or postpartum people with a live-birth delivery during 2010–2021. We examined a range of risk factors for such suicide attempts, focusing on risk factors easily ascertainable in hospital settings during pregnancy or at the time of delivery to increase the study's clinical relevance. Prior to performing these analyses, we hypothesized that sociodemographic disadvantage, hospital-based care utilization during pregnancy, and presence of psychiatric disorder, including especially mood disorders, would be significantly associated with nonfatal suicide attempt in pregnant or postpartum people.

METHODS

Study Design and Data Source

The institutional review board of the University of California, Merced, approved this study. The study design and analytic sample have been previously described.³⁷ Briefly, we obtained nonpublic hospital and ED discharge data from the California Department of Health Care Access and Information (HCAI) on all visits to all California-licensed hospitals from January 1, 2010, to December 31, 2021, by people with California residential zip codes and unique identifiers (encrypted Social Security numbers [SSNs]). We then extracted all records for people aged 10–54 years with an inpatient delivery of a live infant (ie, "delivering people"). Linkage across hospital and ED records for the same individual was conducted using unique identifiers. Delivery records lacking a valid SSNderived unique identifier (approximately 20% per year) could not be linked and were excluded from analysis (see Supplementary Figure 1). Excluded delivery records were more likely than included records to be from individuals who were young, Hispanic, and covered by Medicaid.³⁷

Delivery hospitalizations were identified using International Classification of Diseases, Ninth/Tenth Revision, Clinical Modification (*ICD-9/ICD-10-CM*) diagnosis codes. US healthcare facilities transitioned from *ICD-9-CM* to *ICD-10-CM* on October 1, 2015; thus, deliveries were identified using *ICD-9-CM* codes 650, V27.0, V27.2-.3, V27.5-.6, V30-V34, V36, and V39 through September 30, 2015, and ICD-10-CM codes O80, Z37.0, Z37.2-.3, Z37.5-.6, and Z38 thereafter.³⁸ If a person delivered more than once during a given calendar year, the first observed delivery in that calendar year (the "index delivery") was retained for analysis. This selection criterion led to the exclusion of ~0.1% of deliveries per year across the study period. Repeated deliveries to the same person across different calendar years were retained.

Using the index deliveries in each calendar year from 2010 to 2020, we constructed annual cohorts of delivering people (Supplementary Table 1). For each index delivery, pregnancy was considered to begin 9 months prior to delivery and end the day prior to hospital admission for the delivery; the postpartum period began the day after hospital discharge and ended 365 days later. Delivery hospitalizations prior to October 1, 2010, were excluded to ensure that all people were observed during pregnancy. People with index deliveries after January 1, 2020, were observed for their full postpartum periods through linkage with 2021 ED and hospital records. Any ED visits that occurred out of state were not observed.

Measures

The primary study outcome was cumulative incidence of any pregnancy-associated ED visit for suicide attempt. (ICD coding does not distinguish between events intended to be fatal and those in which the self-harm was intentional but involved no intent to die. For simplicity, such events are referred to as suicide attempts.³⁹) To ascertain incidence, delivering people were followed backwards (for events occurring during pregnancy) and forwards (for events occurring during postpartum) from their index delivery; "pregnancy-associated suicide attempt" includes any event that occurred during either pregnancy or the postpartum year. We also examined postpartum suicide attempt, which excluded attempts occurring during pregnancy.

ED visit records in HCAI data contain up to 25 diagnosis codes and up to 5 supplementary external cause-of-injury codes (E-codes). Suicide attempt ED visits were defined as those with a diagnosis in any coding position of E950-E958.9 for *ICD-9-CM* or, for *ICD-10-CM*, of X71-X83, T71.11, T71.12, T71.13, T71.15, T71.16, T71.19, T71.22, T71.23, or T36-T50 with a fifth/sixth character of 2 (asphyxiation or drug overdose involving intentional self-harm) and a seventh character of A (initial encounter). These diagnostic codes have a high positive predictive value for confirmed suicidal behavior among perinatal women and the general population.^{40,41} External cause-of-injury coding in California is considered virtually complete.⁴²

Sociodemographic characteristics of delivering people at index delivery were examined for descriptive purposes and as potential risk factors. These characteristics included age group (10–17, 18–24, 25–29, 30–34, and 35–54 years), race and ethnicity (coded using the HCAI categories Asian/Pacific Islander, non-Hispanic; Black, non-Hispanic; Hispanic; White, non-Hispanic; and other or multiple race/ethnic groups), insurance status (private, Medicaid, other/self-pay), and urbanicity of residential zip code (metropolitan, micropolitan, or rural/small town).⁴³ The reference group for age was 25–29 years^{37,44}; reference groups for race/ethnicity, insurance status, and urbanicity were Hispanic, privately insured, and metropolitan area residence, respectively, as they were the largest categories in our dataset.

Clinical risk factors of interest comprised (1) prenatal hospital-based care utilization factors (assessed during pregnancy) and (2) comorbid psychiatric diagnoses-including substance use disorders-assessed at delivery. Prenatal hospital-based care utilization factors included total number of ED visits $(0, 1, 2, \ge 3)$, any psychiatric ED visit, any suicide attempt ED visit, any assault ED visit, any ED visit for a serious chronic physical condition,^{29,30,45} and any inpatient hospitalization. Psychiatric diagnoses assessed at hospital delivery comprised co-occurring mood disorder (with subcategories for bipolar disorder, single-episode major depression, and recurrent depression), anxiety disorder, psychotic disorder, alcohol use disorder, and drug use disorder, as well as total number of comorbid psychiatric disorders $(0, 1, 2, \ge 3)$ (Supplementary Table 2).

Statistical Analyses

We first calculated cumulative incidence of pregnancy-associated suicide attempt for each calendaryear cohort. Because overall incidence by annual cohort did not appreciably change between 2010 and 2020 after adjustment for secular trends in age, race and ethnicity,

Table 1.

Sociodemographic Factors and Co-Occurring Psychiatric Diagnoses at Delivery, and Hospital-Based Care Utilization Characteristics During Pregnancy, Among 3,737,792 California Individuals With an Index Delivery, 2010–2020

Characteristic	N (%)
Age group at delivery	
10–17 years	45,647 (1.2)
18–24 years	823,048 (22.0)
25–29 years	991,389 (26.5)
30–34 years	1,091,529 (29.2)
35–54 years	786,160 (21.0)
Race and ethnicity at delivery	
Asian/Pacific Islander, non-Hispanic	494,880 (13.2)
Black, non-Hispanic	246,561 (6.6)
Hispanic	1,518,311 (40.6)
Other/multiple race, non-Hispanic	188,108 (5.0)
White, non-Hispanic	1,289,909 (34.5)
Payer at delivery	
Private	2,086,454 (55.8)
Medicaid	1,519,337 (40.7)
Other/self-pay	132,001 (3.5)
Zip code urbanicity at delivery	
Metropolitan	3,523,511 (94.3)
Micropolitan	150,463 (4.0)
Rural/small town	61,828 (1.7)
Number of ED visits during pregnancy	
0	2,647,245 (70.8)
1	645,191 (17.3)
2	232,409 (6.2)
≥3	212,947 (5.7)
Any psychiatric ED visit during pregnancy	8,318 (0.2)
Any suicide attempt ED visit during pregnancy	1,672 (0.04)
Any assault ED visit during pregnancy	14,224 (0.4)
Any chronic physical condition ED visit during pregnancy	98,951 (2.7)
Any hospitalization during pregnancy	166,827 (4.5)
Any mood disorder at delivery	106,227 (2.8)
Bipolar disorder	17,672 (0.5)
Major depressive disorder, single episode	46,644 (1.3)
Major depressive disorder, recurrent	15,393 (0.4)
Anxiety disorder at delivery	111,955 (3.0)
Psychotic disorder at delivery	3,564 (0.1)
Alcohol use disorder at delivery	5,014 (0.1)
Drug use disorder at delivery	39,076 (1.1)
Number of comorbid psychiatric disorders at delivery	
0	3,519,569 (94.2)
1	174,107 (4.7)
2	40,910 (1.1)
≥3	3,206 (0.1)

and payer³⁷ (adjusted odds ratio for cohort year = 0.99; 95% CI, 0.98–0.99), all cohorts were combined for subsequent analyses. We then tested whether incidence of pregnancy-associated suicide attempt differed by sociodemographic subgroup using general linear models (GLM) with log link, Poisson family,⁴⁶ and cluster-robust standard errors to account for multiple deliveries to the same individual across the study period,⁴⁷ with a covariate for cohort year.

Table 2.

Associations Between Sociodemographic Characteristics at Index Delivery and Risk of Pregnancy-Associated Suicide Attempt in California, 2010–2021

Characteristic	N (%) with characteristic who had suicide attempt in pregnancy or postpartum	Model 1ª Risk ratio (95% CI)	Model 2⁵ Risk ratio (95% CI)
Age group			
10–17 years	246 (0.5)	4.14 (3.61–4.75)	3.34 (2.90–3.85)
18–24 years	2,196 (0.3)	2.08 (1.93-2.23)	1.75 (1.62–1.88)
25–29 years	1,266 (0.1)	Ref	Ref
30–34 years	839 (0.1)	0.60 (0.55–0.66)	0.74 (0.68-0.81)
35–54 years	421 (0.1)	0.42 (0.37-0.47)	0.56 (0.50-0.62)
Race and ethnicity			
Asian/PI, NH	279 (0.1)	0.43 (0.37-0.48)	0.89 (0.78–1.01)
Black, NH	669 (0.3)	2.03 (1.85–2.22)	2.00 (1.83–2.19)
Hispanic	2,013 (0.1)	Ref	Ref
Other/multiple, NH	227 (0.1)	0.91 (0.79–1.05)	1.23 (1.06–1.41)
White, NH	1,780 (0.1)	1.03 (0.97–1.10)	1.71 (1.59–1.84)
Payer			
Private	1,197 (0.1)	Ref	Ref
Medicaid	3,489 (0.2)	4.00 (3.74-4.28)	3.01 (2.78–3.26)
Other/self-pay	282 (0.2)	3.70 (3.24-4.21)	3.01 (2.63-3.44)
Zip code urbanicity			
Metropolitan	4,502 (0.1)	Ref	Ref
Micropolitan	320 (0.2)	1.66 (1.48–1.87)	1.21 (1.08–1.37)
Rural/small town	123 (0.2)	1.56 (1.30–1.88)	1.06 (0.88-1.28)

^aModel 1 results represent associations between each sociodemographic characteristic and risk of pregnancyassociated suicide attempt, controlling for year of index delivery.

^bModel 2 results include all variables in table as well as year of index delivery.

Abbreviations: NH = non-Hispanic, PI = Pacific Islander, Ref = reference.

Lastly, we examined associations between each clinical risk factor of interest and incidence of suicide attempt during the postpartum period. We focused on the postpartum period only in this analysis, to ensure temporal ordering. The risk factor models used the same GLM specification as above, with controls for age group, race and ethnicity, payer, urbanicity, and year. We also used these models to compute predicted probabilities. Coefficients in all models were reported as risk ratios. Analyses were conducted using Stata v. 16 (StataCorp LLC, College Station, TX).

RESULTS

Incidence of Pregnancy-Associated Suicide Attempt

The study population included 3,737,792 index deliveries between 2010 and 2020. These index deliveries were made by 2,603,540 unique individuals, of whom 35.2% (n = 917,063 people) had >1 delivery during the study period. Table 1 shows sociodemographic, psychiatric comorbidity, and hospital-based care utilization characteristics of the study population. Compared to all births in the state, our study population

had a very similar age distribution but lower proportions of Hispanic individuals (47.7% vs 40.6%) and higher proportions of non-Hispanic White (29.1% vs 34.5%) and Black individuals (5.3% vs 6.6%).

Across study years, 0.13% (n = 4,968) of delivering individuals made at least 1 pregnancy-associated nonfatal ED visit for suicide attempt (ie, either during pregnancy or postpartum). Of individuals who had a pregnancy-associated suicide attempt in any given year, 93.3% made 1 suicide attempt visit, 5.6% made 2 visits, and 1.1% had \geq 3 visits. Two-thirds of pregnancy-associated suicide attempts (67.9%) occurred during the postpartum period. The most common methods of suicide attempt were drug overdose (60.0% of events), cutting/piercing injuries (26.4%), and "other unspecified" methods (7.9%).

Incidence of pregnancy-associated suicide attempt (and postpartum suicide attempt; results available in Supplementary Table 3) varied substantially by sociodemographic characteristics of delivering people (Table 2). Risk was highest among those aged 10–17 years, those of non-Hispanic Black race/ethnicity, those whose deliveries were covered by Medicaid or selfpay/other insurance, and those who lived in micropolitan zip codes.

Table 3.

Associations Between Hospital-Based Care Utilization Factors During Pregnancy and Risk of Postpartum Suicide Attempt in California, 2010–2021

Factor	Adjusted risk ratio (95% CI)ª
Number of ED visits	
None	Ref
1	2.00 (1.82–2.20)
2	2.92 (2.61–3.27)
3 or more	5.80 (5.27–6.38)
Any psychiatric ED visit	14.67 (12.50–17.23)
Any suicide attempt ED visit	29.23 (23.23–36.76)
Any assault ED visit	5.43 (4.51–6.53)
Any chronic condition ED visit	2.95 (2.63–3.30)
Any inpatient hospitalization	2.65 (2.39–2.94)

^aRisk ratio results represent associations between each factor and risk of postpartum suicide attempt, controlling for age group, race and ethnicity, payer, urbanicity, and year of index delivery.

Abbreviation: ED = emergency department.

Clinical Risk Factors for Postpartum Suicide Attempt

Nearly 30% of delivering people made at least 1 prenatal ED visit. ED utilization was associated with increased postpartum suicide attempt risk in a doseresponse manner—risk was elevated 2-fold for those with 1 ED visit, 3-fold for those with 2 ED visits, and nearly 6-fold for those with \geq 3 visits (Table 3). A visit for a chronic general medical health condition was the most common type of ED utilization we examined and was associated with 3-fold increased risk of postpartum suicide attempt (adjusted risk ratio [RR_{adj}] = 2.95, 95% CI, 2.63–3.30). Inpatient hospitalization was also associated with elevated risk (RR_{adj} = 2.65, 95% CI, 2.39–2.94). Absolute risk of postpartum suicide attempt remained well below 1% for each of these groups.

Fewer than 1% of the study population made a prenatal ED visit for psychiatric disorder, suicide attempt, or assault injury. Absolute risk of postpartum suicide attempt in these individuals, however, was substantially more common—1 in 20 pregnant people with a suicide attempt ED visit, 1 in 50 with a psychiatric ED visit, and 1 in 100 with an assault ED visit subsequently attempted suicide during the postpartum period, resulting in approximately 30-, 15-, and 5-fold increased relative risks, respectively (Table 4). Predicted probabilities of postpartum suicide attempt associated with clinical risk factors examined are shown in Figure 1.

Approximately 5% of delivering people had a psychiatric disorder recorded at their index hospital delivery, while 1.1% had 2 disorders and 0.1% had 3 or more. Presence of any psychiatric disorder at delivery was associated with substantially increased risk of

Table 4.

Associations Between Risk Factors Assessed at Delivery and Risk of Postpartum Suicide Attempt in California, 2010–2021

Risk factor	Adjusted risk ratio (95% CI)ª
Any mood disorder	7.04 (6.40–7.73)
Bipolar disorder	10.91 (9.50–12.52)
Major depressive disorder, single episode	4.46 (3.78-5.28)
Major depressive disorder, recurrent	4.98 (3.72-6.67)
Anxiety disorder	3.82 (3.38-4.32)
Psychotic disorder	17.31 (13.78–21.75)
Alcohol use disorder	6.96 (5.06–9.57)
Drug use disorder	5.12 (4.48–5.86)
Number of comorbid psychiatric diagnoses	
None	Ref
1	4.75 (4.32-5.22)
2	10.00 (8.77–11.41)
3 or more	14.87 (10.89–20.32)

^aAdjusted risk ratio results represent associations between each diagnosis and risk of postpartum suicide attempt, controlling for age group, race and ethnicity, payer, urbanicity, and year of index delivery.

postpartum suicide attempt (Table 4). The strongest associations were with psychotic disorder (RR_{adi} = 17.31, 95% CI, 13.78–21.75); any mood disorder ($RR_{adj} = 7.04$, 95% CI, 6.40–7.73), but particularly bipolar disorder (RR_{adi} = 10.91, 95% CI, 9.50–12.52), and alcohol use disorder ($RR_{adi} = 6.96$, 95% CI, 5.06-9.57); however, anxiety and drug use disorders also conveyed excess risk. Moreover, excess risk increased with the number of psychiatric disorders: Delivering people with 1 disorder had nearly 5-fold higher risk of postpartum suicide attempt (RR_{adj} = 4.75, 95% CI, 4.32–5.22), but those with \geq 3 disorders had nearly 15-fold higher risk (RR_{adi} = 14.87, 95% CI, 10.89-20.32). Nevertheless, half of all individuals with a postpartum suicide attempt had no comorbid psychiatric disorder recorded at delivery.

DISCUSSION

This is the first population-based, all-payer study from the US to prospectively evaluate incidence, disparities, and risk factors for suicide attempt during pregnancy or the postpartum period. Pregnancyassociated suicide attempts resulting in an ED visit were rare—observed among 0.1% of delivering individuals—and occurred mostly during the postpartum period. Delivering individuals who had behavioral health disorders, including especially psychotic disorders and bipolar disorder, or who utilized the ED during pregnancy (especially for psychiatric disorder, suicide attempt, or assault) faced substantially excess risk for a postpartum suicide attempt. Given the gravity of

Figure 1.



Predicted Probabilities of a Suicide Attempt ED Visit During the Postpartum Period Among Delivering People With Various Clinical Risk Factors of Interest, California, 2010–2021^a

^aPredicted probabilities were computed using GLM models with log link, Poisson family, and cluster-robust SEs, adjusted for cohort year and sociodemographic characteristics, as described in the Methods. Clinical risk factors are defined in the Methods section and Supplementary Table 1. Whiskers depict 95% CIs.

Abbreviations: ED = emergency department, GLM = general linear model, MDD = major depressive disorder.

attempted suicide and its repercussions for maternal, infant, and family well-being, our findings underscore the need for focused interventions to support this vulnerable patient group.

Previous studies using medical record data estimated similar or lower incidence rates of suicide attempt in perinatal populations.^{21,22,24} However, these studies used more restrictive outcome definitions or were limited to commercially insured women⁴⁸; thus, our estimate may be the most accurate to date across all payers. Because we ascertained suicide attempts that resulted in an ED visit, even this rate is a significant undercount of the true frequency. In the general population, approximately 50% of suicide attempts receive any medical attention.⁴⁹ However, ED visits for suicide attempt likely reflect high-acuity events that warrant evidence-based treatments oriented toward reducing patients' suicide risk and engaging them in follow-up mental health care.³⁶

Psychiatric disorders recorded at the time of delivery-especially the presence of multiple disorders-were associated with substantially increased risk of postpartum suicide attempt, which has not previously been reported. Psychotic disorder and bipolar disorder conveyed the greatest magnitude of excess risk, followed by mood and alcohol use disorders. The high trait impulsivity, poor behavioral control, and increased interpersonal stressors characterizing these disorders may mediate associations with suicidal behavior.⁵⁰⁻⁵² It is imperative to assess and decrease barriers to care for not just prenatal depression, but also the other high-risk disorders we identified; individuals with these disorders should also be prioritized for suicide risk monitoring during the postpartum period. Critically, future clinical research should evaluate whether a broad array of promising psychological interventions (eg, antidepressant medications, cognitive behavioral therapies, regional perinatal psychiatry access

programs) can address individual patient needs in ways that are effective at decreasing perinatal suicidal behavior.^{12,53} It will also be important to determine the impact of the American College of Obstetricians and Gynecologists' recommendations for universal screening for perinatal depression¹⁴ on rates of suicidal behavior.

Our study also builds on prior literature by examining prenatal ED utilization as a risk factor for postpartum suicide attempt. An ED visit for any reason was associated with 2-fold higher risk of a postpartum suicide attempt, and making ≥ 3 visits was associated with nearly 6-fold higher risk; the strongest associations were for ED visits for psychiatric conditions or suicide attempt. Because nearly one-third of delivering people made ≥ 1 ED visit during pregnancy, such visits may offer opportunities for intervention. Future research should evaluate whether brief interventions in ED contexts³⁶ can provide suicide risk reduction benefits among pregnant patients. Clinical algorithms that flag subgroups of pregnant patients as at high risk should consider including the ED-related and other risk factors that we identified in this analysis.54

Our finding that nonfatal suicide attempt was associated with young age, Black race, and public insurance is consistent with other research in perinatal populations.^{21–23} Excess risk among these groups likely stems from multiple systemic and interrelated disadvantages, including poverty, structural racism, and experiences of interpersonal violence, warranting focused attention along the perinatal care continuum and policy contexts.^{55–57} Future research should also examine heterogeneity and risk factors within these groups. Potential policy opportunities to address these disparities include expanding Medicaid coverage, increasing colocation of services to facilitate behavioral health screening and treatment, and enacting supportive policies like paid parental leave.⁵⁸

Our findings should be interpreted in light of several limitations. First, the ICD-9/10-CM codes used to ascertain suicide attempt do not distinguish between intentional self-harm with and without intent to die; however, they have high positive predictive value for confirmed suicidal behavior among perinatal women.40 These codes also tend to be under-utilized in ED clinical practice, and our estimated rate is therefore likely an undercount of the true frequency.59 Furthermore, all diagnostic codes used in the study were based on clinical judgment and not subject to expert independent validation. Psychiatric disorders at delivery reflect clinically diagnosed disorders and are likely under-ascertained, given that only 10% of perinatal women with mental health problems seek treatment.60 Our estimates are therefore conservative with respect to patient mental health needs, although similar to national clinical diagnostic data.⁶⁰⁻⁶³

We could not ascertain outcomes for people with index deliveries lacking a unique identifier, who were primarily Hispanic. This may have resulted in either over- or underestimating suicide attempt rates among Hispanic delivering people, depending on the extent of other suicidal behavior risk factors within this missing group. Lastly, data from California may not be generalizable to the entire US; in particular, the state's suicide rates are lower than the national average.⁶⁴

In this population-based longitudinal study, approximately 0.1% of pregnant or postpartum patients made a suicide attempt, and this incidence was markedly higher among individuals with psychiatric disorders—particularly mood, psychotic, and alcohol use disorders—and other factors ascertainable in healthcare settings. These findings provide motivation to monitor patients with these clinical risk factors for risk of postpartum suicide attempt. Additional research is needed to determine whether enhanced access to appropriate treatment and universal depression screening can prevent these devastating events in pregnant and postpartum individuals.

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Supplementary Material

Article Title: Incidence and Risk Factors for Suicide Attempt During Pregnancy and the Postpartum Period

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DISCLAIMER

This Supplementary Material has been provided by the authors as an enhancement to the published article. It has been approved by peer review; however, it has undergone neither editing nor formatting by in-house editorial staff. The material is presented in the manner supplied by the author.

Supplementary Figure 1. Flowchart for study analytic sample selection.



Supplementary Table 1. Characteristics of California people with hospital deliveries of live infants in each calendar-year cohort.											
	2010 ^a	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total number (n)	97,300	381,174	381,630	374,702	378,980	375,223	372,559	359,321	348,032	342,286	326,585
Age group (%)											
10-17 years	2.4	2.1	1.8	1.5	1.3	1.1	1.0	0.8	0.7	0.7	0.6
18-24 years	26.5	25.8	25.4	24.8	23.7	22.5	21.3	20.3	18.9	17.9	17.1
25-29 years	26.4	26.4	26.2	26.1	26.3	26.5	26.9	26.9	26.9	26.8	26.4
30-34 years	25.8	26.7	27.4	28.2	28.9	29.4	29.9	30.0	30.5	30.9	31.7
35-54 years	18.8	18.9	19.2	19.4	19.8	20.4	21.0	22.0	23.1	23.7	24.3
Race and ethnicity (%)											
NH Asian/PI	12.6	12.6	13.3	12.6	13.3	13.1	13.7	13.5	13.7	13.6	13.3
NH Black	7.1	7.0	6.9	6.9	6.7	6.4	6.5	6.5	6.4	6.3	6.2
Hispanic	38.2	38.7	39.0	39.5	39.8	40.6	41.0	41.6	41.9	42.1	43.3
Other/multiple	4.4	4.7	4.8	4.9	4.8	4.9	4.8	4.8	5.0	6.0	6.1
NH White	37.7	37.0	36.0	36.1	35.6	35.0	34.1	33.5	33.2	32.1	31.8
Payer (%)											
Private	56.3	56.3	56.1	55.4	55.4	55.3	54.9	55.3	56.1	56.7	57.1
Medicaid	40.2	40.1	40.0	40.7	40.5	41.1	41.6	41.6	40.8	40.0	39.7
Other/self-pay	3.5	3.7	3.9	3.9	4.0	3.6	3.3	3.1	3.1	3.3	3.3
Zip code urbanicity (%)											
Metropolitan	94.3	94.3	94.4	94.3	94.4	94.3	94.4	94.4	94.2	94.3	94.3
Micropolitan	4.1	4.1	4.1	4.1	3.9	4.0	4.0	4.0	4.1	4.0	4.1
Rural/small town	1.6	1.6	1.6	1.6	1.6	1.7	1.6	1.6	1.7	1.7	1.7
^a To prevent left-censoring of pregnancy data for people delivering in the first nine months of 2010, the 2010 cohort was restricted to people with index											
deliveries in October through December.											

Supplementary Table 2. Definitions of risk factor variables.					
Risk factor	ICD-9-CM codes	ICD-10-CM codes			
Assessed during pregnancy					
Number of ED visits	ED for any condition visits included; categorized as 0, 1, 2, or \geq 3.	ED for any condition visits included; categorized as 0, 1, 2, or ≥ 3 .			
Any psychiatric ED visitª	Visit has a diagnosis code within the first 3 coding positions of: 291.0-294.9, 295-299.9, 300-309.9, V62.84. Visits with any DSH code excluded.	Visit has a primary diagnosis code of: F20-F25, F28-F34, F39-F45, F48, R45.851. Visits with any DSH code excluded.			
Any suicide attempt ED visit ^a	Visit has a diagnosis code in any coding position of: E950-E958.9.	Visit has a diagnosis code in any coding position of: X71-X83 or T71.11, T71.12, T71.13, T71.15, T71.16, T71.19, T71.22, T71.23, or T36-T50, with fifth/sixth character 2 and seventh character A.			
Any assault ED visit	Visit has a diagnosis code in any coding position of: E960-E969; 995.81- 995.85.	Visit has a diagnosis code in any coding position of: X92-X99; Y00-Y09; T74.01xA-T74.02xA; T74.11xA- T74.12xA; T74.21xA-T74.22xA; T74.91xA-T74.92xA; T76.01xA- T76.02xA; T76.11xA-T76.12xA; T76.21xA-T76.22xA; T76.91xA- T76.92xA.			
Any chronic condition ED visit	Visit has a primary diagnosis code of: 140-209, 250, 410-414, 490-492, 494, 496, 32.3, 32.4, 36.82, 53.12, 53.13, 56.71, 88.81, 98.12, 98.32, 131.03, 250.60, 250.61, 250.62, 274, 282.41, 282.42, 282.5, 282.6, 307.81, 307.89, 33.94, 337, 338, 339, 346, 350, 352.1, 353, 354, 355, 356.4, 356.8, 356.9, 357.2, 377.33, 377.34, 377.39, 377.41, 379.91, 411.1, 413, 524.6, 526.89, 526.9, 550, 552, 553, 564.1, 574, 592, 594, 595.1, 614.3, 614.4, 614.5, 614.7, 614.8, 614.9, 615, 616.0, 617, 625, 710-716.99, 717.7, 717.8, 718.0, 718.3, 719.4, 719.5, 718.88, 719, 719.3, 719.4, 720-730.99, 733.6, 733.99, 724, 735-736.9, 738.0-739.9, 755.67, 755.9, 756.1, 780.96, 784.0, 784.92, 786.50, 786.52, 786.59, 789.0, 839.00, 839.21, 839.40	Visit has a primary diagnosis code of: C00-C96, J44, E08-E13.9, 121-125.9, A22.3, A22.4, A18.01, A39.83, A52.16, A54.22, A59.02, A69.20, A69.23, B22.2, B22.3, B68.2, D57.1, D57.20, D57.219, D57.3, D57.40, D57.419, D57.80, D57.819, D86.86, D86.87, E84.2, E10.4, E10.610, D11.4, E11.610, E13.4, F45.42, G25.81, G43, G44, G50, G521, G54, G56, G57, G580, G587, G58.9, G59, G60.2, G60.3, G60.8, G60.9, G61.9, G62.0, G62.89, G62.9, G63, G72.9, G89, G90.09, G90.5, G96.11, G99.0, H46.2- H46.9, H47.0, H57.1, I20.1-I20.9, I77.6, K40, K41, K42.0, K42.9, K43, K44.0, K44.9, K45.0, K45.8, K46.0, K46.9, K58.0-K58.9, K80, L40.53, L97.414, L98.494, M00, M01.X, M02, M05, M06, M07.6, M08, M10, M11.162, M11.2, M11.8, M11.9, M12, M13, M14.6, M14.80, M15-M19.93, M1A, M20- M20.62, M21, M22.01-M22.42, M23.50, M24.1, M24.4, M24.5, M24.6, M25.50- M25.579, M25.7, M26.5, M26.6, M27, M32.10, M32.8, M32.9, M33.2, M33.9, M34.0, M34.1, M34.89, M34.9, M35.2- M35.9, M43, M45, M46.0-M48.38, M48.8X, M48.9, M49.8, M50, M51, M53, M54, M60.8, M62.4, M62.8, M65-M67.99, M70, M71, M72.2, M72.9, M75.0-M77.9, M79.1, M79.2, M79.6-M79.7, M86,			

Any hospitalization	Inpatient admission for any condition.	M87.9, M89.3, M89.5, M89.8X, M89.9, M90.8, M94.0, M94.1, M94.26, M94.352, M94.8X, M94.9, M95, M96.1, M99, N20- N22, N30.10, N30.11, N71-N73, N80, N94, Q66.89, Q67.5, Q74.9, Q76.0- Q76.419, Q76.49, R07.1, R07.2, R07.8, R07.9, R10.10-R10.13, R10.2, R10.30- R10.33, R10.84, R10.9, R25.2, R51, R52, R68.84, T83.84XA, T83.84XD, T84.84X, T85.84XA, T85.84XD Inpatient admission for any condition.
Assessed at delivery		· · · ·
Comorbid mood disorder	Visit has a diagnosis code in any coding position of: 296.0-296.99, 311.	Visit has a diagnosis code in any coding position of: F30-F39.99.
Bipolar disorder	Visit has a diagnosis code in any coding position of: 296.0-296.16 or 296.4-296.89.	Visit has a diagnosis code in any coding position of: F30-F30.9 or F31-F31.9.
Major depressive disorder, single episode	Visit has a diagnosis code in any coding position of: 296.2-296.26.	Visit has a diagnosis code in any coding position of: F32-F32.9.
Major depressive disorder, recurrent episode or persistent	Visit has a diagnosis code in any coding position of: 296.3-296.36.	Visit has a diagnosis code in any coding position of: F33-F33.9 or F34-F34.9.
Comorbid anxiety disorder	Visit has a diagnosis code in any coding position of: 300.0-300.9, 308.0-308.9, 309.0-309.9.	Visit has a diagnosis code in any coding position of: F40-F48.9.
Comorbid psychotic disorder	Visit has a diagnosis code in any coding position of: 295.0-295.95, 297.0-297.9, 298.0-298.9.	Visit has a diagnosis code in any coding position of: F20-F29.99.
Comorbid alcohol use disorder	Visit has a diagnosis code in any coding position of: 291.0-291.9, 303.0-303.93, 305.0-305.03.	Visit has a diagnosis code in any coding position of: F10-F10.99.
Comorbid drug use disorder	Visit has a diagnosis code in any coding position of: 292.0-292.9, 305.3- 305.73, 305.9-305.93, 304.0-304.23, 304.4-304.93.	Visit has a diagnosis code in any coding position of: F11-F11.99, F13-F13.99, F14-F16.99, F18-F19.99.
Total number of comorbid psychiatric/substance use disorders	From the above-listed categories: 0, 1, 2, or ≥3.	From the above-listed categories: 0, 1, 2, or \geq 3.
^a Psychiatric ED and self-harm ED visits	were defined to be mutually exclusive.	

postpartum suicide attempt in California, 2010-2021.					
Characteristic	N (%) with characteristic who had a postpartum suicide attempt	Model 1ª Risk Ratio (95% CI)	Model 2 ^b Risk Ratio (95% Cl)		
Age group					
10-17 years	154 (0.3%)	3.71 (3.13, 4.41)	3.05 (2.56, 3.64)		
18-24 years	1,470 (0.2%)	2.00 (1.83, 2.17)	1.70 (1.56, 1.86)		
25-29 years	881 (0.1%)	Ref.	Ref.		
30-34 years	575 (0.1%)	0.59 (0.54, 0.66)	0.73 (0.65, 0.81)		
35-54 years	293 (0.04%)	0.42 (0.37, 0.48)	0.55 (0.48, 0.63)		
Race and ethnicity					
NH Asian/PI	188 (0.04%)	0.43 (0.37, 0.50)	0.88 (0.75, 1.03)		
NH Black	437 (0.2%)	1.99 (1.78, 2.22)	1.96 (1.76, 2.19)		
Hispanic	1,342 (0.1%)	Ref.	Ref.		
Other/multiple	163 (0.1%)	0.98 (0.84, 1.16)	1.32 (1.12, 1.55)		
NH White	1,243 (0.1%)	1.08 (1.00, 1.17)	1.77 (1.62, 1.93)		
Payer					
Private	852 (0.04%)	Ref.	Ref.		
Medicaid	2,334 (0.2%)	3.76 (3.48, 4.07)	2.87 (2.61, 3.16)		
Other/self-pay	187 (0.1%)	3.44 (2.94, 4.04)	2.80 (2.38, 3.30)		
Zip code urbanicity					
Metropolitan	3,049 (0.1%)	Ref.	Ref.		
Micropolitan	225 (0.2%)	1.73 (1.51, 1.98)	1.26 (1.09, 1.44)		
Rural/small town	84 (0.1%)	1.57 (1.26, 1.96)	1.06 (0.85, 1.32)		

Supplementary Table 3. Associations between sociodemographic characteristics at index delivery and risk of

^a Model 1 results represent associations between each sociodemographic characteristic and risk of postpartum suicide attempt, controlling for year of index delivery.

^b Model 2 results include all variables in table as well as year of index delivery.