ORIGINAL RESEARCH

Landscape of Pregnancy Care in US Community Health Centers

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Purpose: **Community health centers (CHCs) provide critical health care access for people who experience high risks during and after pregnancy, however it is unclear to what extent they provide prenatal care. This study seeks to describe clinic and patient characteristics associated with longitudinal prenatal care delivery in CHC settings.**

Methods: **This retrospective cohort study utilized electronic health record (EHR) data from the Accelerating Data Value Across a National Community Health Center Network (ADVANCE) between 2018 to 2019 to describe prenatal care provision among CHCs (n = 408), and pregnant CHC patients (n = 28,578) and compared characteristics of patients who received longitudinal prenatal care at CHCs versus those who did not.**

Results: **41% of CHCs provided longitudinal prenatal care; these CHCs were more likely to be larger, have multidisciplinary teams, and serve higher proportions of nonwhite or non-English speaking patients. Patients who received longitudinal prenatal care at CHCs were racially and ethnically diverse and many had comorbidities. Patients who received longitudinal prenatal care at CHCs (compared with pregnant patients who did not) were more likely to be white or Latinx and more likely to have non-English language preference.**

Conclusions: **Many CHCs in this national network provide prenatal care and serve pregnant patients at high risk of pregnancy-related complications, including people of color, those with low income, and those with comorbidities. CHCs provide critical access to care for vulnerable populations and will be an important partner in work addressing inequities in maternal morbidity and mortality. (J Am Board Fam Med 2023;36:574–582.)**

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Introduction

Maternal morbidity and mortality in the US are high and racial and economic disparities in pregnancy outcomes are rising.[1–4] Healthy People 2030 calls for decreasing maternal morbidity and mortality by promoting high-quality interdisciplinary preventive and prenatal care for people of reproductive age.[5–8] Currently, nearly 15% of pregnant patients in the US receive inadequate prenatal care and 11 to 51% of patients do not receive postpartum care.[9–16] Understanding the settings in which pregnancy care is received, particularly among

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individuals with higher risk of adverse pregnancy outcomes, is critical to addressing maternal morbidity and mortality and closing existing disparities.

Community health centers (CHCs) – Federally Qualified Health Centers (FQHCs), Rural Health Clinics, and FHQC 'look alike' clinics – are a cornerstone of primary care access in the US, delivering health care services across the lifespan.[17–20] CHCs provide access to care regardless of ability to pay or health insurance status and tend to serve a racially and ethnically diverse population that has a high prevalence of low income and uninsurance.[18] People of reproductive potential comprise a large proportion of the CHC patient population, and even before the Affordable Care Act expansions, CHCs provided care to nearly one in three low-income reproductive-aged females in the US.[20–23] Compared with other primary care clinic settings, CHCs tend to care for more individuals who are nonwhite, who smoke and use other substances, and who have multiple chronic medical and mental health conditions,[18] all risk factors for severe maternal morbidity.[24]

The majority of CHCs are staffed by family medicine physicians[18] who are trained to provide care across the lifespan including preconception, prenatal, postpartum, and contraceptive care. Despite this training, decreasing proportions of family physicians provide obstetric care[25–29] and it is unclear to what extent CHCs provide pregnancy care. The Uniform Data System (UDS) provides a limited view of prenatal care provision among Federally Qualified Health Centers (FQHCs), reporting only patients' age and trimester of prenatal care initiation.[30] Electronic health record (EHR) data provide a unique opportunity to use real-time clinical care information to describe prenatal care delivery in CHCs, the characteristics of CHCs that provide longitudinal prenatal care, and characteristics of the patients receiving longitudinal care in CHC settings across each of their pregnancies.

A better understanding of prenatal care provision in CHCs, including clinical measures such as longitudinal or episodic care, and patient-level demographics as well as health status and prenatal care during each completed pregnancy, could help better align care with patient needs and focus future interventions to reduce disparities in maternal morbidity and mortality.

This study aims to describe the extent to which US CHCs provide prenatal care, and identify characteristics of clinics providing this care and the patients receiving this care during their pregnancies. This information is critically needed to consider the role of CHCs in addressing disparities in maternal morbidity and mortality.

Methods

Data Source and Analytic Sample

We used electronic health record (EHR) data to conduct a retrospective cohort study using individual patient-level data from the Accelerating Data Value Across a National Community Health Center Network (ADVANCE) Clinical Research Network, a member of Patient-Centered Outcome Research Network (PCORnet).[31,32] ADVANCE is a multi-center, CHC-focused collaborative led by OCHIN (not an acronym) in partnership with Health Choice Network (HCN), Fenway Health, and Oregon Health & Science University.[31,33] ADVANCE is demographically and clinically similar to CHC patients nationally.[18,31] In this analysis, we limited inclusion to OCHIN and HCN networks because of the completeness of their reproductive health data. Health centers were included if they were 'live' on the EHR throughout the study period (January 1 2018 – December 31 2019), and provided primary care to women of reproductive age (age 15 to 44). With a time frame before the COVID-19 pandemic, this study provides a glimpse into care before pandemic-related disruptions ensued. This study was approved by Western Institutional Review Board.

Outcome Variables

The primary outcome of interest was clinic-level provision of longitudinal prenatal care, defined as providing more than 1 prenatal visit (confirmed by CPT codes) during a single pregnancy. These prenatal visit codes specify provision of pregnancy-related ambulatory care (see Online Appendix for codes utilized). First, we categorized clinics (as the unit of analysis) as either providing longitudinal prenatal care (delivering 2 or more prenatal visits per pregnancy), providing occasional prenatal care (delivering only 1 prenatal visit per pregnancy for all observed pregnancies) or as not providing prenatal care (no prenatal care visits observed). In the ADVANCE Network, a "clinic" typically represents a unique delivery location that may or may not be affiliated with a larger health system.

Second, we assessed patient characteristics among females during each completed pregnancy in the study period (pregnancy episode at the unit of analysis). Pregnancies were identified using indicators established by the Office of Population Affairs[34] and supplemented by EHR laboratory data (eg, positive pregnancy tests), and indicator(s) of a live birth (documented delivery date, presence of a postpartum ICD-10 code, or presence of a postpartum visit). Pregnancies without any indication of live birth were excluded because the need for prenatal care would have been uncertain. For patients with more than one pregnancy during the study period, we defined the second pregnancy as one occurring at least 10 months after the end date of the preceding pregnancy. Detailed descriptions of these definitions are included in the Online appendix.

Other Variables

Additional variables were selected based on prior studies of clinic- and patient-level factors that impact primary care delivery.[35–38] Clinic-level factors included the size of the clinic (total number of unique patients and total number provided visits), scope of practice (eg, care of children), team structure (eg, presence of a multidisciplinary team), participation in the Title X program,[37] clinic rurality based on ZIP code of address,[38] geographical region of the US determined by US Census Bureau, and aggregate patient population characteristics (eg, proportion reproductive aged women, proportion low-income, etc.). At the patient level, we used EHR data including ICD-10 codes to describe demographic characteristics (age, race, ethnicity, language preference, income, and insurance status), health before pregnancy (presence of any medical, mental health, and substance use disorders, and multiple morbidity using an updated version of the Charlson Comorbidity Index adapted for ambulatory care),[39] and health during pregnancy (gestational diabetes, hypertensive disorders of pregnancy). A detailed list of ICD-10 codes used and definitions applied is included in the Online Appendix.

The primary purpose of this study was to describe the characteristics of CHCs that provided longitudinal prenatal care and describe the characteristics the pregnancies for which they provided longitudinal care. However, because natural comparisons arise between the 3 clinic groups (longitudinal vs occasional vs none) and between the 2 pregnancy groups (presence or absence of longitudinal prenatal care at the CHC) we opted to provide some unadjusted descriptive statistics to help identify between-group differences that may be important for future consideration. We conducted Chi-squared tests to compare differences between pregnancy-provision groups. Analyses were conducted in SAS, version 8.3.

Results

Findings Among Clinics

In our sample of 408 clinics across 21 states, 41% (n = 168) delivered longitudinal prenatal care, 53 clinics (13%) provided occasional pregnancy-specific care but did not have repeated prenatal visits, and the remaining 187 clinics (45%) did not provide pregnancy-specific care during the study period (Table 1). On average, clinics that provided longitudinal prenatal care were larger than clinics that did not (mean, 4402 active patients per year vs 1370 active patients per year), although their populations included similar proportions of female patients of reproductive age (13.4% vs 14.7%, $P < .001$). Clinics providing longitudinal pregnancy care were more likely than other clinics to have multidisciplinary teams and participate in the Title X program. Clinics providing longitudinal prenatal care were more likely to be from the western US (54.2% vs 47.1% overall) and less likely to be in rural areas (3.6% rural vs 6.4% nonrural), $P = .014$). Though there were statistically significant between-group demographic differences in patient populations, the magnitudes were small and lacked consistency. All clinics provided care to diverse populations (23.2% nonwhite, 28.2% Latinx, 22.1% non-English language preference). Compared with clinics that provided no pregnancy care, clinics providing longitudinal prenatal care served fewer patients with Medicaid (19.2% vs 25.2%, $P < .001$) and without health insurance (16.9% vs 27.5%, $P < .001$).

Findings Among Pregnancies

There were 28,578 pregnancies among 28,064 included patients; 514 patients had 2 observed pregnancies in the study time frame. Most pregnancies identified within the EHR received longitudinal prenatal care at CHC clinics (92%), however 8% of pregnancies did not receive longitudinal prenatal care at included CHCs. Pregnant patients who received longitudinal prenatal care from CHCs

Table 1. Characteristics of Community Health Centers (CHCs) by Provision of Prenatal Care, 2018-2019

	All CHCs	CHCs Providing Longitudinal Prenatal Care[a]	CHCs Providing Occasional Prenatal Care[b]	CHCs Providing No Prenatal Care	*p*-Value
Total number of community health centers, N	408	168 (41%)	53 (13%)	187 (46%)	
Health Center Size	Number (SD)	Number (SD)	Number (SD)	Number (SD)	
Annual visit volume	13,380 (16,582)	22,214 (21,361)	9211 (7911)	6627 (7296)	<0.001
Number active patients per year	2728 (2943)	4402 (3606)	2217 (1721)	1370 (1412)	<0.001
Health Center Structure & Location	Number (%)	Number (%)	Number (%)	Number (%)	
Presence of multidisciplinary team[c]	304 (74.5)	145 (86.3)	37 (69.8)	122 (65.2)	0.004
Participation in Title X	58 (14.2)	37 (22.0)	8 (15.1)	13 (7.0)	<0.001
Provision of care to persons aged 0 to 18[d]	310 (75.9)	161 (95.8)	41 (77.3)	108 (57.7)	<0.001
Rural location[e]	21 (5.1)	6 (3.6)	3 (5.7)	12 (6.4)	0.014
Region of the U.S.[f]					<0.001
West	192 (47.1)	91 (54.2)	22 (41.5)	79 (42.2)	
Midwest	51 (12.5)	23 (13.7)	7 (13.2)	21 (11.2)	
Northeast	46 (11.3)	23 (13.7)	7 (13.2)	16 (8.6)	
Southeast	119 (29.2)	31 (18.5)	17 (32.1)	71 (38)	
Aggregate Demographic Characteristics	Mean % (SD)	Mean % (SD)	Mean % (SD)	Mean % (SD)	
Proportion female patients of reproductive age (15 to 44)	31.0 (15.2)	33.6 (13.4)	34.1 (20.3)	27.9 (14.7)	<0.001
Proportion patients with income <138% FPL	68.5 (20.9)	68.4 (20.0)	71.9 (18.1)	67.7 (22.5)	<0.001
Proportion non-white patients	25.7 (23.2)	26.2 (23.7)	25.5 (24.3)	25.5 (22.9)	<0.001
Proportion Latinx patients	33.0 (28.2)	36.9 (26.9)	36.1 (29.9)	28.7 (28.4)	<0.001
Proportion patients with non-English language preference	25.4 (22.1)	30.1 (21.4)	28.5 (24.4)	20.4 (21.2)	<0.001
Proportion patients with Medicaid	49.2 (23.2)	56.8 (19.2)	51.6 (19.5)	41.8 (25.2)	<0.001
Proportion patients with no insurance	33.0 (23.6)	28.8 (16.9)	27.3 (22.7)	38.5 (27.5)	<0.001

[a]Longitudinal prenatal care defined as more than 1 prenatal visit per pregnancy.
[b]Occasional prenatal care defined as never more than 1 prenatal visit per pregnancy.
[c]Multidisciplinary team defined as clinic with additional specialty providers such as social workers, psychologists, dentists, physical therapists, and medical specialists in addition to traditional primary care providers.
[d]Care of pediatric patients defined as ambulatory encounters with >100 patients under age 18 per year.
[e]Defined by 2010 rural-urban commuting area codes.
[f]Regions defined by US census bureau, no participating clinics from pacific region (Alaska/Hawaii).
Abbreviations: FPL, federal poverty limit; SD, standard deviation.

received an average of 10 prenatal visits and 2 postpartum visits per pregnancy. Patients who did not receive prenatal care at CHCs were still likely to receive postpartum care at CHCs with an average of 1.6 postpartum visits in this group (Table 2).

Pregnant patients who received longitudinal prenatal care at CHCs were more likely to be white (59.1% vs 50.4%), Latinx (52.6% vs 32.8%), have Spanish language preference (35.5% vs 18.3%), and have private health insurance (13.1% vs 3.7%) compared with women who did not receive longitudinal prenatal care at CHCs. Overall, many pregnant CHC patients experienced chronic conditions before pregnancy including hypertension (1.8%), diabetes (0.8%) mental health diagnoses (13.6%), and substance use disorders (tobacco 2.6%, other substances 3.4%). Aside from small increased prevalence of diabetes and gestational diabetes among

Table 2. Characteristics of Pregnant Patients at Community Health Centers (CHCs) During Each Completed Pregnancy*, 2018-2019

	Total Pregnancies Seen at all CHCs	Pregnancies Receiving Longitudinal CHC Prenatal Care	Pregnancies NOT Receiving Longitudinal CHC Prenatal Care	*p*-Value
Total number pregnancies (%)	28,578	26,244 (92%)	2334 (8%)	
Total number unique patients (%)	28,064	25,989 (92%)	2309 (8%)	
Pregnancy Characteristics		Mean (SD)	Mean (SD)	
Age at delivery	28.4 (6.1)	28.4 (6.1)	28.4 (6.1)	0.284
Total # prenatal visits	9.2 (6.6)	10.0 (6.3)	0.8 (0.4)	<0.001
Total # postpartum visits	1.9 (1.7)	2.0 (1.7)	1.6 (1.2)	<0.001
Patient Demographic Characteristics		Number (% of pregnancies)	Number (% of pregnancies)	
Race				
White	16,676 (58.2)	15,500 (59.1)	1176 (50.4)	<0.001
Black	6002 (20.9)	5444 (20.7)	558 (23.9)	
Other	2913 (10.1)	2553 (9.7)	360 (15.4)	
Missing	3053 (10.6)	2800 (10.7)	253 (10.8)	
Ethnicity				
Latinx	14,583 (50.9)	13,817 (52.6)	766 (32.8)	<0.001
Not Latinx	13,039 (45.5)	11,580 (44.1)	1459 (62.5)	
Missing	1022 (3.6)	900 (3.4)	122 (5.2)	
Primary language				
English	16,348 (57.1)	14,677 (55.9)	1671 (71.6)	<0.001
Spanish	9748 (34.0)	9322 (35.5)	426 (18.3)	
Other	2462 (8.6)	2217 (8.4)	245 (10.5)	
Missing	86 (0.3)	81 (0.3)	5 (0.2)	
Income <138% FPL	20,337 (71.0)	18,608 (70.9)	1729 (74.1)	<0.001
Health insurance status‡				
Medicaid	21,808 (76.1)	19,831 (75.6)	1977 (84.7)	<0.001
Private Insurance	3528 (12.3)	3441 (13.1)	87 (3.7)	
Uninsured	3308 (11.6)	3025 (11.5)	283 (12.1)	
Pre-pregnancy Comorbidities		Number (% of pregnancies)	Number (% of pregnancies)	
Diabetes	237 (0.8)	208 (0.8)	29 (1.2)	0.023
Hypertension	448 (1.6)	409 (1.6)	39 (1.7)	0.691
Mental health disorder	3898 (13.6)	3587 (13.7)	311 (13.3)	0.598
Substance use disorder	968 (3.4)	872 (3.3)	96 (4.1)	0.047
Tobacco use	730 (2.6)	651 (2.5)	79 (3.4)	0.009

Continued

Table 2. Continued

Pre-pregnancy Comorbidities		Number (% of pregnancies)	Number (% of pregnancies)	
Charlson comorbidity index				<0.001
0	23,502 (82.1)	21,526 (82.0)	1976 (84.7)	
1	2955 (10.3)	2789 (10.6)	166 (7.1)	
2+	2178 (7.6)	1982 (7.6)	205 (8.8)	
Pregnancy-related Comorbidities		**Number (% of pregnancies)**	**Number (% of pregnancies)**	
Gestational diabetes	514 (1.8)	493 (1.9)	21 (0.9)	0.001
Gestational hypertension	116 (0.4)	110 (0.4)	6 (0.3)	0.235
Pre-eclampsia	173 (0.6)	165 (0.6)	8 (0.3)	0.086

*Completed pregnancies defined as those with an indicator of a live birth outcome.
‡Health insurance status measured during the last prenatal care visit.
Abbreviations: FPL, federal poverty limit; SD, standard deviation.

pregnancies receiving longitudinal prenatal CHC care, there were not significant differences in health status (before or during pregnancy) between pregnancies receiving longitudinal CHC clinic care versus those receiving occasional or no prenatal care.

We performed a sensitivity analysis which identified only minor demographic differences between patients with 1 observed pregnancy and those with 2 pregnancies (Online Appendix Table 4).

Discussion

The majority of CHCs in our large national network (54%) provide prenatal care, and most of these clinics (76%) provide longitudinal prenatal care. Similar to the population of CHC patients overall, pregnant CHC patients are racially and ethnically diverse, and experience comorbidities and psychosocial challenges. Pregnant CHC patients also tend to be at high risk of adverse pregnancy-related outcomes which disproportionately impact people of color, people with fewer resources, and people with comorbid conditions.[1,40–44] As disparities in pregnancy outcomes continue to widen, CHCs are well-positioned to provide critically-needed interventions through their strong relationships with this high-risk population.[20,45]

The fact that CHCs providing longitudinal prenatal care in our network tended to be larger, more likely to have a multidisciplinary team, more likely to receive Title X funding, and have fewer patients with Medicaid or no health insurance, suggests that clinics providing longitudinal prenatal care had access to more well-developed resources overall. Title X provides reimbursement to clinics for delivery of reproductive health care, but does not provide coverage for prenatal care so finding a higher proportion of Title X recipients among CHCs providing longitudinal prenatal care demonstrates an important overlap between clinics providing reproductive care outside of pregnancy and those providing prenatal care. Similarly, clinics providing longitudinal prenatal care were more likely to care for children, suggesting more comprehensiveness overall at these clinics.

Many patients who received longitudinal prenatal care at CHCs in this study had comorbid mental health or substance use conditions. This high prevalence is similar to previously published averages in CHC populations and is higher than that in the general public.[18,46–48] Many CHCs in this study provided a multidisciplinary team, consistent with national efforts to expand multidisciplinary primary care through positions like resource specialists, care managers, health educators, behavioral health teams and more.[18,49] These services may be particularly useful in caring for pregnant patients with complex medical and social needs and has previously been associated with better health outcomes.[36] These resources may also be important for improving screening and treatment for postpartum depression, which is a Healthy People 2030 initiative goal.[5]

The average number of prenatal visits (among patients receiving longitudinal prenatal care at CHCs) was 10, which is similar to the US national

average number of prenatal visits (11) and fewer than the number recommended by the American College of Obstetrics and Gynecology (ACOG) at the time of the study (12 to 14).[50] The relationship between number of prenatal visits and care quality has been debated and new guidelines were published in 2021 and endorsed by ACOG and others.[51] However, these new guidelines are based on expert opinion and still require rigorous validation to determine how they relate to health outcomes, particularly among higher risk populations. This information will be important to a more complete assessment of pregnancy care delivery at CHCs.

Of physician staff at CHCs nationally, 46% are family physicians[18] who are uniquely trained to provide comprehensive longitudinal care for pregnant people – including care for medical comorbidities, mental health issues, and substance use disorders as well as primary prenatal, postpartum and pediatric care. Provision of pregnancy care among family physicians has declined substantially, and in 2012 only 9% of family physicians reported providing these services. Though we did not measure provision of pregnancy care at the individual physician level, our findings suggest that family physicians who practice in CHC settings may be more likely than other family physicians to provide pregnancy care. As family medicine specialty groups consider strategies to ensure a continued pipeline of family physician staff to our nation's CHCs, they should consider the importance of skills in pregnancy care for this important practice setting. As policy makers strive to improve maternal morbidity, mortality, and infant health, adequate support and staffing to CHCs should be a high priority.

Though the majority of CHCs in this study provided longitudinal pregnancy care, 46% of CHCs did not provide this service. Describing the reasons for this were beyond the scope of this study, but merit further research, particularly since CHCs tend to serve proportionally more patients of reproductive potential and people for whom pregnancy may pose health risks.[18] Future research is also needed to assess the quality and effectiveness of pregnancy care delivered at CHCs to determine the best ways to improve pregnancy outcomes in this population.

Limitations

The use of EHR data were a strength of this study as it is free from sampling and recall biases that affect survey studies. Still, ambulatory EHR data provide a number of challenges in measuring pregnancy outcomes. Because pregnancy start-dates were sometimes extrapolated or estimated from other data (such as postpartum care) and precise delivery dates were unknown, we were unable to accurately quantify trimester of presentation to care. Because comprehensive delivery information such as birth outcome, is not reliably available within the EHR, assessment of these outcomes was beyond the scope of this study. Though ICD-10 codes are widely used to measure health conditions of all kinds, there is a well-documented risk of misclassification[52] that has not been specifically quantified for pregnancy-related diagnoses. Among patients with limited prenatal care, it is likely that pregnancy-related comorbidity is underestimated as many comorbid conditions (eg, gestational diabetes, preeclampsia) are typically diagnosed later in pregnancy. Because pregnancies were considered the unit of analysis and some individuals experienced 2 pregnancies in the study period, there may be a slight overrepresentation of the pregnancy characteristics among these individuals, though this impacted only a small number of individuals.

Use of national sample of CHCs serving a very large number of patients is a clear strength of this study, though use of 'big data' like this comes with 2 important limitations. First, statistically significant differences may or may not equate to clinically significant differences and studies with large sample sizes often demonstrate statistical significance at lower levels of absolute difference. Second, the study may not be generalizable to all CHCs or geographic regions. Though clinics came from 21 states across major geographic regions of the US, they were disproportionately clustered in western states and tended to be located in nonrural areas, which may have over-represented the proportion of CHCs providing longitudinal prenatal care. More research is needed to assess the impact of regional and geographical differences in practice patterns at CHCs.

Conclusions

CHCs provide longitudinal pregnancy care to a large population of patients who may be at higher risk for pregnancy-related complications. With increasing investment in multidisciplinary strategies to combat maternal morbidity and mortality in the

US, CHCs are critically important partners for addressing disparities and ensuring access to high quality longitudinal prenatal and postpartum care. Ensuring continued support for CHCs and a pipeline of comprehensively trained staff should be high priorities in the fight to reduce maternal morbidity and mortality.

To see this article online, please go to: http://jabfm.org/content/36/4/574.full.

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Appendix.

Inclusion/exclusion details:

– Clinics were in 21 states, specifically AK, CA, CO, FL, GA, HI, IN, KS, MA, MD, MN, MO, MT, NC, NM, OH, OR, RI, TX, WA and WI.

– Receipt of Title X funding was determined by cross-referencing clinic names and addresses with data from the Office of Population Affairs for 2018.

– School-based health centers and correctional facilities were excluded.

– Pregnancies without any indication of live birth were excluded because the need for prenatal care would have been uncertain in that group (eg, pregnancies that end in early miscarriage or abortion).

Patient Covariate Details

– Gestational complications were categorized using ICD10 codes (gestational diabetes, O24; preeclampsia, O11, O14, O15; hypertensive disorders of pregnancy O10, O13, O16) from the patients' problem list during the time frame of each pregnancy. For chronic conditions, each was captured at the patient level during the study time period.

– Charlson Comorbidity Index was calculated from active problem list diagnoses before the study end date, and includes added weights for transplantation history, inflammatory bowel disease, seizures, sickle cell anemia, hemophilia, muscular dystrophy, Down syndrome, cystic fibrosis, Tay-Sachs disease, developmental delay, mental retardation, cerebral palsy, autism, schizophrenia, bipolar disorder, and drug or alcohol abuse.

– Diagnoses during pregnancy were ascertained exclusively during the period 30 days before the pregnancy start to 30 days after the pregnancy end date from the patients' problem lists.

Sensitivity Analysis Interpretation

Pregnancies to women with 2 observed pregnancies had an average of 6.8 prenatal care visits per pregnancy, compared with 9.3 visits to women with 1 observed pregnancy ($P < .001$). Women with 2 observed pregnancies were more likely to be Black (23.9% compared with 21.0%) and not to be Latinx (53.8% compared with 45.2%, These mothers had higher proportions of all prepregnancy health comorbidities (diabetes, hypertension, mental health disorder, substance use disorder, tobacco use) and had higher Charlson Comorbidity Index scores. In each separate pregnancy, pregnancies to women with 2 pregnancies have greater proportions of gestational diabetes, gestational hypertension and preeclampsia ($P < .001$ for all).

Appendix Table 1. Codes (Number (Percent)) Used to Identify Prenatal Care Encounters

Code	Code Description	Pregnancies	Patients
O09.00	Supervision of pregnancy with history of infertility, unspecified trimester	3 (0)	3 (0)
O09.01	Supervision of pregnancy with history of infertility, first trimester	6 (0)	6 (0)
O09.02	Supervision of pregnancy with history of infertility, second trimester	5 (0)	5 (0)
O09.03	Supervision of pregnancy with history of infertility, third trimester	11 (0)	11 (0)
O09.10	Supervision of pregnancy with history of ectopic pregnancy, unspecified trimester	7 (0)	7 (0)
O09.11	Supervision of pregnancy with history of ectopic pregnancy, first trimester	14 (0.1)	14 (0.1)
O09.12	Supervision of pregnancy with history of ectopic pregnancy, second trimester	11 (0)	11 (0)
O09.13	Supervision of pregnancy with history of ectopic pregnancy, third trimester	12 (0)	12 (0)
O09.211	Supervision of pregnancy with history of pre-term labor, first trimester	53 (0.2)	53 (0.2)
O09.212	Supervision of pregnancy with history of pre-term labor, second trimester	124 (0.5)	123 (0.5)
O09.213	Supervision of pregnancy with history of pre-term labor, third trimester	133 (0.5)	130 (0.5)
O09.219	Supervision of pregnancy with history of pre-term labor, unspecified trimester	36 (0.1)	34 (0.1)
O09.291	Supervision of pregnancy with other poor reproductive or obstetric history, first trimester	153 (0.6)	151 (0.6)
O09.292	Supervision of pregnancy with other poor reproductive or obstetric history, second trimester	198 (0.7)	194 (0.7)
O09.293	Supervision of pregnancy with other poor reproductive or obstetric history, third trimester	247 (0.9)	246 (0.9)
O09.299	Supervision of pregnancy with other poor reproductive or obstetric history, unspecified trimester	503 (1.9)	480 (1.8)
O09.30	Supervision of pregnancy with insufficient antenatal care, unspecified trimester	417 (1.5)	406 (1.5)
O09.31	Supervision of pregnancy with insufficient antenatal care, first trimester	12 (0)	12 (0)

Continued

Appendix Table 1. Continued

Code	Code Description	Pregnancies	Patients
O09.32	Supervision of pregnancy with insufficient antenatal care, second trimester	949 (3.5)	937 (3.5)
O09.33	Supervision of pregnancy with insufficient antenatal care, third trimester	1550 (5.7)	1528 (5.7)
O09.40	Supervision of pregnancy with grand multiparity, unspecified trimester	45 (0.2)	44 (0.2)
O09.41	Supervision of pregnancy with grand multiparity, first trimester	83 (0.3)	81 (0.3)
O09.42	Supervision of pregnancy with grand multiparity, second trimester	184 (0.7)	180 (0.7)
O09.43	Supervision of pregnancy with grand multiparity, third trimester	261 (1)	255 (1)
O09.511	Supervision of elderly primigravida, first trimester	141 (0.5)	139 (0.5)
O09.512	Supervision of elderly primigravida, second trimester	187 (0.7)	187 (0.7)
O09.513	Supervision of elderly primigravida, third trimester	295 (1.1)	290 (1.1)
O09.519	Supervision of elderly primigravida, unspecified trimester	44 (0.2)	43 (0.2)
O09.521	Supervision of elderly multigravida, first trimester	906 (3.3)	888 (3.3)
O09.522	Supervision of elderly multigravida, second trimester	1372 (5.1)	1353 (5.1)
O09.523	Supervision of elderly multigravida, third trimester	1691 (6.2)	1670 (6.3)
O09.529	Supervision of elderly multigravida, unspecified trimester	355 (1.3)	347 (1.3)
O09.611	Supervision of young primigravida, first trimester	29 (0.1)	29 (0.1)
O09.612	Supervision of young primigravida, second trimester	75 (0.3)	74 (0.3)
O09.613	Supervision of young primigravida, third trimester	108 (0.4)	106 (0.4)
O09.619	Supervision of young primigravida, unspecified trimester	21 (0.1)	20 (0.1)
O09.621	Supervision of young multigravida, first trimester	24 (0.1)	23 (0.1)
O09.622	Supervision of young multigravida, second trimester	20 (0.1)	19 (0.1)
O09.623	Supervision of young multigravida, third trimester	44 (0.2)	44 (0.2)
O09.629	Supervision of young multigravida, unspecified trimester	6 (0)	6 (0)
O09.70	Supervision of high risk pregnancy due to social problems, unspecified trimester	23 (0.1)	22 (0.1)
O09.71	Supervision of high risk pregnancy due to social problems, first trimester	29 (0.1)	27 (0.1)
O09.72	Supervision of high risk pregnancy due to social problems, second trimester	49 (0.2)	49 (0.2)
O09.73	Supervision of high risk pregnancy due to social problems, third trimester	82 (0.3)	81 (0.3)
O09.811	Supervision of pregnancy resulting from assisted reproductive technology, first trimester	4 (0)	4 (0)
O09.812	Supervision of pregnancy resulting from assisted reproductive technology, second trimester	2 (0)	2 (0)
O09.813	Supervision of pregnancy resulting from assisted reproductive technology, third trimester	8 (0)	8 (0)
O09.819	Supervision of pregnancy resulting from assisted reproductive technology, unspecified trimester	11 (0)	11 (0)
O09.821	Supervision of pregnancy with history of in utero procedure during previous pregnancy, first trimester	1 (0)	1 (0)
O09.891	Supervision of other high risk pregnancies, first trimester	290 (1.1)	276 (1)
O09.892	Supervision of other high risk pregnancies, second trimester	559 (2.1)	543 (2)
O09.893	Supervision of other high risk pregnancies, third trimester	1042 (3.8)	1018 (3.8)
O09.899	Supervision of other high risk pregnancies, unspecified trimester	1045 (3.9)	1011 (3.8)
O09.90	Supervision of high risk pregnancy, unspecified, unspecified trimester	844 (3.1)	817 (3.1)
O09.91	Supervision of high risk pregnancy, unspecified, first trimester	1219 (4.5)	1186 (4.5)
O09.92	Supervision of high risk pregnancy, unspecified, second trimester	2259 (8.3)	2196 (8.2)
O09.93	Supervision of high risk pregnancy, unspecified, third trimester	3503 (12.9)	3411 (12.8)
Z34.00	Encounter for supervision of normal first pregnancy, unspecified trimester	786 (2.9)	773 (2.9)
Z34.01	Encounter for supervision of normal first pregnancy, first trimester	3085 (11.4)	3058 (11.5)
Z34.02	Encounter for supervision of normal first pregnancy, second trimester	4583 (16.9)	4514 (16.9)
Z34.03	Encounter for supervision of normal first pregnancy, third trimester	6266 (23.1)	6148 (23.1)
Z34.80	Encounter for supervision of other normal pregnancy, unspecified trimester	2679 (9.9)	2627 (9.9)
Z34.81	Encounter for supervision of other normal pregnancy, first trimester	6093 (22.5)	5926 (22.2)
Z34.82	Encounter for supervision of other normal pregnancy, second trimester	9447 (34.8)	9194 (34.5)

Continued

Appendix Table 1. Continued

Code	Code Description	Pregnancies	Patients
Z34.83	Encounter for supervision of other normal pregnancy, third trimester	12,316 (45.4)	12,027 (45.2)
Z34.90	Encounter for supervision of normal pregnancy, unspecified, unspecified trimester	3675 (13.5)	3610 (13.6)
Z34.91	Encounter for supervision of normal pregnancy, unspecified, first trimester	2578 (9.5)	2502 (9.4)
Z34.92	Encounter for supervision of normal pregnancy, unspecified, second trimester	4467 (16.5)	4365 (16.4)
Z34.93	Encounter for supervision of normal pregnancy, unspecified, third trimester	5855 (21.6)	5725 (21.5)

Appendix Table 2. Codes (Number (Percent)) Used to Identify Births

Code	Code Description	Pregnancies	Patients
59400	ROUTINE OBSTETRIC CARE, ANTEPARTUM CARE, VAGINAL DELIVERY, & POSTPARTUM CARE	561 (8.4)	553 (8.4)
59400	Routine obstetric care including antepartum care, vaginal delivery (with or without episiotomy, and/or forceps) and postpartum care	561 (8.4)	553 (8.4)
59409	Vaginal delivery only (with or without episiotomy and/or forceps)	705 (10.5)	675 (10.2)
59410	. . .including postpartum care	2702 (40.3)	2669 (40.4)
59410	VAGINAL DELIVERY ONLY (W/WO EPISIOTOMY &/OR FORCEPS); W/ POSTPARTUM CARE	2702 (40.3)	2669 (40.4)
59510	Routine obstetric care including antepartum care, cesarean delivery and postpartum care	441 (6.6)	439 (6.6)
59514	Cesarean delivery only	732 (10.9)	726 (11)
59515	. . .including postpartum care	1484 (22.2)	1477 (22.4)
59515	CESAREAN DELIVERY ONLY; W/POSTPARTUM CARE	1484 (22.2)	1477 (22.4)
59610	ROUTINE OBSTETRIC CARE, VAGINAL DELIVERY, W/ANTEPARTUM, POSTPARTUM CARE, PREVIOUS C-SECTION	9 (0.1)	9 (0.1)
59610	Routine obstetric care including antepartum care, vaginal delivery (with or without episiotomy and/or forceps) and postpartum care, after previous cesarean delivery	9 (0.1)	9 (0.1)
59612	Vaginal delivery only, after previous cesarean delivery (with or without episiotomy and/ or forceps)	40 (0.6)	37 (0.6)
59614	VAGINAL DELIVERY ONLY, PREVIOUS CESAREAN DELIVERY; W/ POSTPARTUM CARE	8 (0.1)	8 (0.1)
59614	. . .including postpartum care	8 (0.1)	8 (0.1)
59618	ROUTINE OB CARE, ANTE/POSTPARTUM, CESAREAN DELIVERY AFTER FAILED VAG DELIVERY, PREV CESAREAN DELIVER	1 (0)	1 (0)
59618	Routine obstetric care including antepartum care, cesarean delivery and postpartum care, following attempted vaginal delivery after previous cesarean delivery	1 (0)	1 (0)
59620	Cesarean delivery only, following attempted vaginal delivery after previous cesarean delivery	5 (0.1)	5 (0.1)
59622	CESAREAN DELIVERY, AFTER FAILED VAGINAL DELIVERY, PREVIOUS CESAREAN DELIVERY; W/POSTPARTUM CARE	6 (0.1)	6 (0.1)
59622	. . .including postpartum care	6 (0.1)	6 (0.1)
59812	Treatment of incomplete abortion, any trimester, completed surgically	6 (0.1)	6 (0.1)
59820	Treatment of missed abortion, completed surgically; first trimester	8 (0.1)	8 (0.1)
O01.0	Classical hydatidiform mole	1 (0)	1 (0)
O01.1	Incomplete and partial hydatidiform mole	1 (0)	1 (0)
O01.9	Hydatidiform mole, unspecified	4 (0.1)	4 (0.1)
O02.0	Blighted ovum and nonhydatidiform mole	28 (0.4)	28 (0.4)
O02.1	Missed abortion	131 (2)	127 (1.9)
O02.81	Inappropriate change in quantitative human chorionic gonadotropin (hCG) in early pregnancy	8 (0.1)	8 (0.1)
O02.89	Other abnormal products of conception	6 (0.1)	6 (0.1)
O03.1	Delayed or excessive hemorrhage following incomplete spontaneous abortion	2 (0)	2 (0)
O03.30	Unspecified complication following incomplete spontaneous abortion	1 (0)	1 (0)
O03.39	Incomplete spontaneous abortion with other complications	4 (0.1)	4 (0.1)
O03.4	Incomplete spontaneous abortion without complication	51 (0.8)	48 (0.7)
O03.5	Genital tract and pelvic infection following complete or unspecified spontaneous abortion	1 (0)	1 (0)
O03.6	Delayed or excessive hemorrhage following complete or unspecified spontaneous abortion	1 (0)	1 (0)
O03.80	Unspecified complication following complete or unspecified spontaneous abortion	6 (0.1)	6 (0.1)
O03.89	Complete or unspecified spontaneous abortion with other complications	3 (0)	3 (0)
O03.9	Complete or unspecified spontaneous abortion without complication	340 (5.1)	328 (5)
O04.80	(Induced) termination of pregnancy with unspecified complications	1 (0)	1 (0)
O08.89	Other complications following an ectopic and molar pregnancy	1 (0)	1 (0)

Continued

Appendix Table 2. Continued

Code	Code Description	Pregnancies	Patients
O36.4XX0	Maternal care for intrauterine death, not applicable or unspecified	11 (0.2)	10 (0.2)
O36.4XX1	Maternal care for intrauterine death, fetus 1	4 (0.1)	4 (0.1)
O36.4XX9	Maternal care for intrauterine death, other fetus	1 (0)	1 (0)
O80	Encounter for full-term uncomplicated delivery	3082 (46)	3029 (45.9)
O82	Encounter for cesarean delivery without indication	826 (12.3)	813 (12.3)
Z33.2	Encounter for elective termination of pregnancy	7 (0.1)	7 (0.1)
Z37.0	Single live birth	4837 (72.2)	4794 (72.6)
Z37.1	Single stillbirth	10 (0.1)	10 (0.2)
Z37.2	Twins, both liveborn	38 (0.6)	37 (0.6)

Appendix Table 3. Codes (Number (Percent)) Used to Identify Postpartum Encounters

Code	Code Description	Pregnancies	Patients
0503F	POSTPARTUM CARE VISIT	4534 (16.3)	4504 (16.5)
58605	LIGATION/TRANSECTION, FALLOPIAN TUBE, ABD/VAGINAL APPROACH, POSTPARTUM (SEP PROC)	107 (0.4)	106 (0.4)
59160	CURETTAGE, POSTPARTUM	24 (0.1)	24 (0.1)
59412	EXT CEPHALIC VERSION, W/WO TOCOLYSIS	36 (0.1)	35 (0.1)
59414	DELIVERY, PLACENTA (SEP PROC)	17 (0.1)	17 (0.1)
59430	POSTPARTUM CARE ONLY (SEP PROC)	7601 (27.4)	7512 (27.6)
59510	ROUTINE OBSTETRIC CARE W/ANTEPARTUM CARE, CESAREAN DELIVERY, & POSTPARTUM CARE	441 (1.6)	439 (1.6)
LP1236	POSTPARTUM 75-GRAM GLUCOSE TOLERANCE	7 (0)	7 (0)
O86.0	Infection of obstetric surgical wound	23 (0.1)	23 (0.1)
O86.00		31 (0.1)	31 (0.1)
O86.00	Infection of obstetric surgical wound, unspecified	31 (0.1)	31 (0.1)
O86.01		25 (0.1)	25 (0.1)
O86.01	Infection of obstetric surgical wound, superficial incisional site	25 (0.1)	25 (0.1)
O86.02		2 (0)	2 (0)
O86.09	Infection of obstetric surgical wound, other surgical site	5 (0)	5 (0)
O86.11	Cervicitis following delivery	4 (0)	4 (0)
O86.12	Endometritis following delivery	75 (0.3)	73 (0.3)
O86.13	Vaginitis following delivery	25 (0.1)	25 (0.1)
O86.19	Other infection of genital tract following delivery	1 (0)	1 (0)
O86.20	Urinary tract infection following delivery, unspecified	25 (0.1)	25 (0.1)
O86.21	Infection of kidney following delivery	1 (0)	1 (0)
O86.22	Infection of bladder following delivery	4 (0)	4 (0)
O86.29	Other urinary tract infection following delivery	4 (0)	3 (0)
O86.4	Pyrexia of unknown origin following delivery	20 (0.1)	20 (0.1)
O86.89	Other specified puerperal infections	5 (0)	4 (0)
O87.0	Superficial thrombophlebitis in the puerperium	1 (0)	1 (0)
O87.1	Deep phlebothrombosis in the puerperium	6 (0)	5 (0)
O87.2	Hemorrhoids in the puerperium	36 (0.1)	36 (0.1)
O87.4	Varicose veins of lower extremity in the puerperium	4 (0)	4 (0)
O87.8	Other venous complications in the puerperium	3 (0)	3 (0)
O88.23	Thromboembolism in the puerperium	3 (0)	3 (0)
O89.4	Spinal and epidural anesthesia-induced headache during the puerperium	7 (0)	6 (0)
O89.9	Complication of anesthesia during the puerperium, unspecified	1 (0)	1 (0)
O90.0	Disruption of cesarean delivery wound	103 (0.4)	101 (0.4)
O90.1	Disruption of perineal obstetric wound	32 (0.1)	32 (0.1)
O90.2	Hematoma of obstetric wound	9 (0)	9 (0)
O90.3	Peripartum cardiomyopathy	10 (0)	8 (0)
O90.4	Postpartum acute kidney failure	1 (0)	1 (0)
O90.5	Postpartum thyroiditis	14 (0.1)	12 (0)
O90.6	Postpartum mood disturbance	115 (0.4)	113 (0.4)
O90.81	Anemia of the puerperium	332 (1.2)	322 (1.2)
O90.89	Other complications of the puerperium, not elsewhere classified	280 (1)	266 (1)
O90.9	Complication of the puerperium, unspecified	32 (0.1)	32 (0.1)
O91.02	Infection of nipple associated with the puerperium	30 (0.1)	26 (0.1)
O91.12	Abscess of breast associated with the puerperium	4 (0)	4 (0)
O91.22	Nonpurulent mastitis associated with the puerperium	70 (0.3)	67 (0.2)
O92.02	Retracted nipple associated with the puerperium	1 (0)	1 (0)
O92.12	Cracked nipple associated with the puerperium	38 (0.1)	37 (0.1)

Continued

Appendix Table 3. Continued

Code	Code Description	Pregnancies	Patients
TO029	POSTPARTUM VISIT (GLOBAL)	1 (0)	1 (0)
Z1038	POSTPARTUM	2896 (10.4)	2832 (10.4)
Z39.0	Encounter for care and examination of mother immediately after delivery	1009 (3.6)	985 (3.6)
Z39.1	Encounter for care and examination of lactating mother	2847 (10.3)	2752 (10.1)
Z39.2	Encounter for routine postpartum follow-up	25,962 (93.5)	25,465 (93.4)
Z6208	POSTPARTUM NUTRITIONAL ASSESSMENT	1446 (5.2)	1416 (5.2)
Z6308	POSTPARTUM PSYCHOSOCIAL ASSESSMENT	1544 (5.6)	1510 (5.5)
Z6414	POSTPARTUM HEALTH EDUCATION ASSESSMENT	2776 (10)	2714 (10)

Appendix Table 4. Sensitivity Analysis: Demographic and Health Characteristics by Number of Observed Pregnancies During Study Time Period

	Total Pregnancies Seen at All CHCs	Women with 1 Observed Pregnancy	Women with 2 Observed Pregnancies	*p*-Value
Total number pregnancies (%)	28,578	27,550 (92%)	1094 (8%)	
Total number unique patients (%)	28,064	27,550 (92%)	518 (8%)	
Pregnancy characteristics		Mean (SD)	Mean (SD)	
Age at delivery (each preg)	28.4 (6.1)	28.4 (6.1)	27.9 (5.9)	<0.001
Total # prenatal visits	9.2 (6.6)	9.3 (6.5)	6.8 (6.7)	<0.001
Total # postpartum visits	1.9 (1.7)	1.9 (1.7)	1.9 (1.4)	<0.001
Patient Demographic Characteristics		Number (% of pregnancies)	Number (% of pregnancies)	
Race				
White	16,676 (58.2)	16,018 (58.1)	658 (50.4)	<0.001
Black	6002 (20.9)	5790 (21.0)	212 (23.9)	
Other	2913 (10.1)	2787 (10.1)	126 (5.4)	
Missing	3053 (10.6)	2955 (10.7)	98 (10.8)	
Ethnicity				
Latinx	14,583 (50.9)	14,111 (51.2)	472 (43.1)	<0.001
Not Latinx	13,039 (45.5)	12,451 (45.2)	588 (53.8)	
Missing	1022 (3.6)	988 (3.6)	34 (3.1)	
Primary language				
English	16,348 (57.1)	15,640 (56.7)	708 (64.7)	<0.001
Spanish	9748 (34.0)	9474 (34.4)	274 (25.1)	
Other	2462 (8.6)	2352 (8.5)	110 (10.1)	
Missing	86 (0.3)	84 (0.3)	2 (0.2)	
Income < 138% FPL	20,337 (71.0)	19,518 (70.9)	819 (74.9)	0.014
Health insurance status[†]				
Medicaid	21,808 (76.1)	20,915 (75.9)	893 (81.6)	<0.001
Private Insurance	3528 (12.3)	3446 (12.5)	82 (7.5)	
Uninsured	3308 (11.6)	3189 (11.6)	119 (10.8)	
Pre-pregnancy Comorbidities		Number (% of pregnancies)	Number (% of pregnancies)	
Diabetes	237 (0.8)	221 (0.8)	16 (1.5)	0.018
Hypertension	448 (1.6)	422 (1.5)	26 (2.4)	0.027
Mental health disorder	3898 (13.6)	3632 (13.2)	266 (24.3)	<0.001
Substance use disorder	968 (3.4)	918 (3.3)	50 (4.6)	0.026
Tobacco use	730 (2.6)	680 (2.5)	50 (4.6)	<0.001
				<0.001

Continued

Appendix Table 4. Continued

Pre-pregnancy Comorbidities		Number (% of pregnancies)	Number (% of pregnancies)	
Charlson comorbidity index				
0	23,502 (82.1)	22,710 (82.4)	792 (72.4)	
1	2955 (10.3)	2817 (10.2)	138 (12.6)	
2+	2178 (7.6)	2023 (7.3)	164 (14.5)	
Pregnancy-related Comorbidities		**Number (% of pregnancies)**	**Number (% of pregnancies)**	
Gestational diabetes	514 (1.8)	478 (1.8)	36 (3.3)	0.001
Gestational hypertension	116 (0.4)	106 (0.4)	10 (0.9)	0.007
Pre-eclampsia	173 (0.6)	157 (0.6)	16 (1.4)	<0.001

[†]Health insurance status measured during the last prenatal care visit.
Abbreviations: FPL, federal poverty limit; SD, standard deviation; CHC, Community health centers.