Title: Association between utilization of digital prenatal services and vaginal birth after cesarean

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Precis: Digital prenatal care services, including care coordination and education, can improve rates of vaginal birth after cesarean in patients with a history of cesarean birth.

ABSTRACT

Introduction: Digital health services are a promising but understudied method for reducing common barriers to vaginal birth after cesarean (VBAC), including connection to facilities offering labor after cesarean and patient-centered counseling about mode of delivery. This study assesses the relationship between use of digital prenatal services and VBAC.

Methods: In this retrospective cohort study, we analyzed the use of digital prenatal services and mode of delivery among users of an employer-sponsored digital women's and family digital health platform. All users had a prior cesarean birth. Users' self-reported data included demographics, medical history, and birth preferences. We used basic descriptive statistics and logistic regression models to assess the association between digital services utilization and VBAC, adjusting for key patient characteristics.

Results: Of 271 included users, 44 (16.2%) had a VBAC and 227 (83.8%) had a cesarean birth. Users of both groups were similar in age, race, and ethnicity. Fewer users in the VBAC group (5/44, 11.4%) as compared to the cesarean birth group (62/227, 27.3%) had a pre-pregnancy body mass index of ≥ 30 kg/m^2 (P=.02). Likewise, more users in the VBAC group preferred vaginal birth (34/44, 77.3% vs 55/227, 24.2%; P<.01). In adjusted models, the services associated with VBAC were care advocate appointments (aOR 7.67; 95% CI 1.99-54.4), provider appointments (aOR 1.12; 95% CI 1.02-1.25), and resource reads (aOR=1.05, 95% CI 1.00-1.09).

VBAC rates were higher for users who reported the digital health platform influenced aspects of their pregnancy and birth.

Discussion: Reducing cesarean birth rates is a national priority. Digital health services, particularly care coordination and education, are promising for accomplishing this goal through increasing rates of trial of labor after cesarean and subsequent VBAC rates.

Key words: cesarean delivery, vaginal birth after cesarean, telemedicine, digital health services, patient-centered care, TOLAC, labor after cesarean

Quick points:

1. Leading national and international maternity care organizations support labor after cesarean as an important strategy for reducing cesarean birth rates, yet rates of labor after cesarean are low.

2. Barriers to labor after cesarean could be overcome by improving access to standard information, autonomy-supportive counseling, and connection to facilities that can support labor after cesarean.

3. Digital care coordination, provider appointments, and use of online resources were all associated with higher rates of VBAC.

4. Users who reported the digital platform influenced their delivery type, birth plan, and approach to maternity experience were more likely to have a VBAC than users who reported no influence.

INTRODUCTION

One in 3 pregnant people in the United States undergo cesarean birth, a major abdominal surgery associated with higher morbidity and mortality, longer recovery, and increased costs when compared to vaginal birth.[1] Thirty percent of these births are repeat cases with elective repeat cesareans making up an increasing portion of these surgeries.[2] Labor after cesarean is a safe, effective option for appropriately selected patients, with a 75% average chance of successful vaginal birth.[3] Recent estimates however, demonstrate that only 30-40% of pregnant people choose to labor after cesarean, resulting in a vaginal birth after cesarean (VBAC) success rate of 13.3%.[3–5] Thus, leading national and international maternity care organizations support increasing rates of labor after cesarean as one strategy to increase VBAC and improve maternity care outcomes.[6–9]

Low rates of labor after cesarean may be driven by factors across multiple levels, including patient, provider, and health system factors. Patient factors include preference for birth type, knowledge of options, whereas physician factors are related to counseling style and liability concerns.[10] Lastly, health system factors such as the availability of facilities that can support labor after cesarean further limit this option.[11] Giving patients access to standard information, autonomy-supportive counseling (e.g., counseling that emphasizes the individual's perspective, offers choices, and supports the individual's decision making),[12] and connection to facilities that can support labor after cesarean could help overcome these barriers. This access could in turn reduce the cesarean delivery rate and subsequent adverse maternal outcomes at the individual and population level.[9]

Background

Established in 2014, Maven Clinic was developed to support users' pregnancies and birth experiences through telehealth services. To date, Maven has served over 450 employer and health plan clients and is the largest women's and family digital health platform in the United States. Users receive access to Maven as an employer-sponsored health benefit through their own or their partner's employer. Upon signing up for the benefit, users voluntarily complete app-based assessments to identify areas where Maven can best support them. Within the virtual platform, users meet with a care advocate, an allied health professional (e.g., nurse,

social worker) who serves as the primary point of contact. The assigned care advocate then supports the coordination of digital prenatal services and directs users to providers and services. Maven care advocates can also help users identify a prenatal care provider and hospital that meets their preferences, including desire for labor after cesarean.

Users can access curated educational materials, online classes, and a diverse team of providers including midwives, doulas, obstetrician-gynecologists, lactation consultants, and mental health professionals for scheduled appointments. All team users are trained in autonomy supportive methods of eliciting and supporting member preferences. Maven's digital services help to address existing barriers to labor after cesarean across multiple levels. This includes increasing patients' awareness of options through articles, improving access to additional provider perspectives and discussion of labor after cesarean as an option, and identifying hospitals that offer labor after cesarean through care advocate referrals.

Though access to educational materials, care advocates, and providers could address gaps in services to support labor after cesarean, it is unknown how these services actually affect the rates of VBAC. Thus, the primary aim of this study was to assess how the use of Maven services, including care coordination, additional counseling, and member support, is associated with VBAC among Maven users with a history of cesarean birth.

METHODS

Study Design

This retrospective cohort analysis assessed the association between engagement with a women's and family digital health platform and VBAC. We included users who enrolled in the program on or after January 1, 2020, and were past their due date (e.g.at least 40 weeks gestation). Users were included if they completed health assessments at both program onboarding and after giving birth, their zip code could be mapped to the Social Vulnerability Index, and they had a previous cesarean birth. No other inclusion or exclusion criteria were applied. All users consented to the use of their de-identified data for scientific research upon creating an account. All data were accessed and analyzed by the study team between February and May 2022. This study used de-identified data only, and the protocol was designated as exempt by Western Institutional Review Board, an independent ethical review board headquartered in Washington state.

Study Measures

The primary study outcome was self-reported mode of birth, and the primary predictor was utilization of digital prenatal services. All utilization data were tracked within the digital platform. Utilization of services included use of resources and interactions with care providers. All services were digital. Use of resources included the number of birth-related articles (e.g., "Vaginal Birth after Cesarean 101" and "Understanding Your Birth Options") viewed and whether the member viewed at least one of 2 childbirth education videos (Childbirth Education and Postpartum Recovery). Provider interactions included online activities with: (1) their assigned care advocates; and (2) healthcare providers (e.g., midwives, doulas, obstetrician-gynecologists, mental health providers, nutritionists, wellness coaches). For care advocate utilization, we assessed whether patients had at least one appointment with their care advocate and the number of subsequent messages they sent. Most patients who completed this initial appointment follow-up through messaging. We assessed provider utilization using the number of appointments a member had with providers, the number of messages a member sent to providers, whether the member had attended one of 2 live virtual classes on childbirth education with a healthcare provider and whether a member completed a birth planning appointment. A birth planning appointment was a specific 75-minute appointment with an obstetrician-gynecologist or midwife to provide education and counseling in preparation for labor and birth,

The secondary predictor was member-reported influence of the digital health platform on birth experience and outcomes. This influence was assessed after birth using 5 dichotomous questions about how the digital health platform influenced the user's pregnancy and birth, including whether the digital health platform (1) influenced the member's birth type, (2) influenced the member's approach to maternity experience, (3) influenced the member's birth plan or birth method preference, (4) helped the member learn medically accurate information about pregnancy and complications, and (5) helped the member in the hospital during labor and birth. Items 1 and 2 were asked independently with dichotomous response options that included yes or no. Items 3, 4, and 5 were presented as response options to the question, "In what way did Maven influence your experience?". Responses were recorded as yes if users checked the box for each response option and as no if they were unchecked.

Study Covariates

Social vulnerability reflects a community's ability to prevent human suffering and is used in research as a proxy for social determinants of health when individual-level data is not available.[13] We included social vulnerability as a demographic characteristic by assigning the Social Vulnerability Index (SVI) [14] to each member based on ZIP code. To convert member ZIP codes to census tract-based SVI, we used a 2020 weighted crosswalk from the US Department of Housing and Urban Development. [15,16] Since ZIP codes do not map directly onto census tracts, for each ZIP code, the proportion of the residential addresses within each census tract that intersect with the ZIP codes was multiplied by the respective SVI score for that census tract and summed. The summed value was then divided by the summed proportion of residential addresses within each census tract that intersected with that ZIP code to correct for rounding errors for ZIP codes whose sum of proportion of residential addresses did not total to 1.[15] The SVI includes 4 subscales which incorporate the following neighborhood measures: (1) socioeconomic status: the number of people living below 150% of the poverty level, who are unemployed, individuals older than 25 years old without a high school diploma; (2) household composition: individuals ≥65 or <18 years, and single parent households with children <18 years; (3) minority status and language; people with race and ethnicity other than non-Hispanic White, and individuals >5 years who speak English "less than well;" and (4) housing and transportation: housing structures with >10 units, mobile homes, homes with more people than rooms, households without a vehicle, and people who are institutionalized. Low SVI scores in each domain overall reflect lower neighborhood level social vulnerability when compared to other zip codes across the country.

Other covariates included self-reported age, pre-pregnancy weight and height, medical and pregnancy complications, birth preferences, and pregnancy anxiety. Medical conditions were self-selected from a list that included chronic conditions (e.g., heart disease, diabetes, high blood pressure, blood disorder, thrombophilia, kidney disease, thyroid disease, autoimmune disease) as well as current pregnancy conditions (e.g., cholestasis, fetal growth restriction, gestational hypertension, preeclampsia, and gestational diabetes).Similarly, mental health conditions were selected from a list that included depression, anxiety, perinatal mood disorders, and pregnancy-related anxiety. Medical conditions and mental health conditions were aggregated into one

dichotomous variable for any medical conditions verses no medical conditions and any mental health conditions versus no mental health conditions.

Users' birth preferences were assessed in the onboarding assessment with a single question, "What kind of birth are you hoping to have for this pregnancy?". Pregnancy-related anxiety was assessed on a 5-item Likert scale in response to "On a scale of 1 - 5, how anxious are you feeling about your pregnancy?", with responses of 3 ("somewhat"), 4 ("very") or 5 ("extremely") indicating the presence of pregnancy-related anxiety.

Statistical Analysis

We first conducted descriptive analyses to assess the relationship between users' characteristics, digital prenatal service utilization, and perceived influence of the digital health platform with mode of birth. For bivariate analyses, Chi-square or Fisher's exact test were used to assess categorical variables, and t-tests and Mann-Whitney U-tests were used to assess continuous variables.

Logistic regression was used to assess the relationship between digital prenatal service utilization and perceived influence of the digital health platform on mode of birth. Adjusted logistic regression models controlled for age, pre-pregnancy body mass index (BMI) ≥ 30 kg/m^2, medical conditions, mental health conditions, pregnancy-related anxiety, SVI, and preferred mode of birth. All confounders were assessed categorically except age and SVI.

We acknowledge the significant role that racism and other structural determinants of health have in contributing to disparities in birth outcomes. To avoid reinforcing race and ethnicity as biological constructs, we followed recent guidance that the inclusion of these variables can perpetuate these disparities. [17] Therefore, we did not adjust for race and ethnicity in these models but did include SVI as a proxy measure of structural racism.

All analyses were conducted using the R statistical software, v.3.6.3. [18]

RESULTS

Based on study inclusion criteria, the final sample size was 271 users (Figure 1). Of included users, 44 (16.2%) had a VBAC and 227 (83.8%) had a repeat cesarean birth. The mean (SD) age of our sample was 35.2 (4.1) years. Race and ethnicity rates were white (41.7%), Asian or Pacific Islander (14.8%) Black (9.6%) and Hispanic (5.5%). Many participants preferred not to disclose their racial (31%) or ethnic (26.6%) identity. The median SVI was 0.32, reflecting low social vulnerability. Demographic characteristics did not differ between participants by mode of birth (Table 1).

Nearly half of participants had at least one medical condition (48.0%) with gestational diabetes (17.0%) and thyroid disease (12.5%) being most prevalent. One in 4 users identified the presence or history of a mental health condition (26.2%), with one-third reporting pregnancy-related anxiety (35.4%) and another 23% reporting general anxiety. Having a BMI of ≥30 kg/m^2 was the only condition that varied between groups (VBAC 11.4%; Cesarean 27.3%, *P*=0.02). Rates of birth complications were comparable to national rates and did not differ based on mode of delivery.[6,19,20] Preference for mode of delivery was significantly different between groups, with more participants in the VBAC group preferring vaginal birth (VBAC: 77.3%, Cesarean: 24.2%, P<0.01).

Utilization of digital prenatal services is summarized in Table 2. The median number of completed resource reads was 3 (IQR 0-7), and the median number of appointments with providers from the digital health platform was 1 (IQR 1-3). In bivariate comparisons, users who had a successful VBAC had higher engagement with the platform across all utilization categories, aside from messages with their provider. Many users believed the digital health platform influenced their approach to the maternity experience and helped them learn medically accurate information.

In adjusted models, elements of each type of utilization, asynchronous engagement, interactions with care advocates and interactions with providers, were associated with higher odds of VBAC (Table 3). Completing an appointment with a care advocate was most strongly associated with VBAC (adjusted odds ratio [aOR], 7.67; 95% CI, 1.99-51.4). The measures that had a statistically significant but small effect on the odds of having a VBAC were total number of appointments, messaging care advocates, and appointments with providers.

Users who reported the digital health platform influenced aspects of their pregnancy and birth were also more likely to have a VBAC (Table 4). Specifically, the odds of VBAC were higher for users who reported the digital health platform influenced their delivery type (aOR 7.90; 95% CI 2.30-30.1), birth plan or delivery method preference (aOR 4.34; 95% CI, 1.69-11.3), approach to maternity experience (aOR 2.81; 95% CI, 1.20-6.95), or helped them learn medically accurate information (aOR 2.48; 95% CI, 1.15-5.48). Users who reported the digital health platform helped them in the hospital during labor and delivery did not have a significantly increased odds of VBAC (aOR 2.09; 95% CI, 0.63-6.76).

DISCUSSION

Principal Findings:

In this largely white, non-Hispanic sample with low social vulnerability, the overall VBAC rate (16.2%) was higher than the national average (13.3%). [21] Utilization of services through a digital women's and family digital health platform was associated with higher VBAC rates, even when controlling for patient characteristics and preferences for mode of birth. The service with the strongest relationship with mode of delivery was engagement with a care advocate. Users who completed at least one appointment had seven-times greater odds of having a VBAC. Users who reported that the digital health platform influenced aspects of their pregnancy and birth journey were also more likely to have a VBAC, suggesting the relationship between utilization of services and improved outcomes was not just due to member self-selection. Rather, users perceived that engagement with digital prenatal services drove specific changes in their pregnancy experience, birth plan, and in turn, mode of birth.

Though reducing the cesarean delivery rate has been an international priority for over a decade, rates have remained steady at roughly one-third of people giving birth by cesarean in the United States. [22] Leading maternity care organizations have identified increasing VBAC rates as a critical lever to reduce overall cesarean births, yet VBAC rates in the United States have remained steady in recent years around 10%. [6–9] These persistently low rates are driven by several factors, including availability of centers that can support labor after cesarean and decision-making around mode of birth. [6]

To offer labor after cesarean, hospitals must be prepared for emergent cesarean delivery at any time. At minimum, this requires an available operating room, anesthesia provider, surgeon, and supporting staff and resources to ensure patients can quickly be delivered and cared for in the event of uterine rupture. [6,23,24] With increasing hospital closures, particularly in rural areas, these limitations make labor after cesarean inaccessible for many patients. [25,26]

Even when resources are available for labor after cesarean, many patients still do not pursue this option. While labor after cesarean is not a risk-free endeavor, patients with successful VBAC have lower rates of birth complications and faster recovery.[6] This must be balanced with the increased risk of uterine rupture, hemorrhage, and infection for those who require unplanned cesarean birth when compared to patients undergoing scheduled repeat cesarean birth. [27] Thus, the decision to labor after cesarean must incorporate patients' individual risk tolerance and preference. Trial of labor after cesarean calculators have been used by some to inform birth planning, providing an estimate of the likelihood of successful VBAC.[17] Yet, data from an academic center with the ability to support labor after cesarean reported less than one-third of patients with a greater than 70% likelihood of successful VBAC selected this option.[5] Research suggests provider concerns about liability and individual risk-aversion [9,10,28], and insufficient patient information may exert an undue influence on decision-making, limiting the selection of this option even when chances of a good outcome are high.

Our data suggest that digital health platforms offering multidisciplinary prenatal services can help to overcome key barriers to reducing cesarean birth rates by increasing VBAC rates. First, digital services can help patients navigate complex health systems and find providers and

facilities that best support their needs, including identifying providers and hospitals that offer labor after cesarean. Second, connecting patients with comprehensive services, including robust information and autonomy-supportive care coordination and counseling, may be an important complement to traditional prenatal care birth planning.

Implications for Practice and Policy

Traditional perinatal care services have failed to reduce cesarean birth rates or improve VBAC rates. Our study suggests digital prenatal services are promising for moving the needle on this critical measure. The ubiquity of digital information alone appears unlikely to address systemic challenges in healthcare: our data show only modest improvements in VBAC rates through viewing educational resources. Rather, connection to human services through care coordinators demonstrated the greatest effects. When thoughtfully deployed, digital services eliminate traditional care barriers, including time and distance. [29] This can allow patients to fit consultations into lunch breaks, rather than requiring a half day of missed work or childcare to access resources. [30] Additionally, digital services can help patients connect with providers who share their racial and ethnic identity, a practice that has in some studies demonstrated improved health outcomes and patient experience. [31–34] In sum, digital services can be important tools to improve health equity.

Prenatal care delivery has traditionally centered on medically focused, 10-minute in-person visits directed by the obstetric provider. [35] These short encounters may not be optimally designed for providing autonomy-supportive counseling and person-centered care. Care advocates and patient navigators have been implemented across women's and reproductive health care to accomplish these goals, helping patients navigate the complexities of medical care with a focus on their preferences and needs, as well as pragmatic steps. [36–38]

The midwifery model of care promotes many practices missed in traditional prenatal care delivery, emphasizing patient provider partnership, open and frequent communication, and care tailored to pregnant people's individual needs. [39] Many of these principles are echoed in the structure of a digital health platform like Maven, where pregnant people can access the right

care, from the right provider, at the right time. These team-based models offer patients more comprehensive services with fully wrap-around, patient-centered care that can be difficult to replicate in brick-and-mortar health systems due to the constraints of time and space.

Strengths and Limitations

Our study has several strengths, including a national cohort that is not limited to a single center. Additionally, we include nuanced assessments of patients' characteristics including their preferred mode of birth and presence of pregnancy-related anxiety, factors that may exert a strong influence on birth planning decisions. Our unique data set also includes patients' perceptions of the influence of digital services on key outcomes, allowing us to better understand the mechanism through which increased counseling and support and decision-making can influence mode of delivery.

Still, there are limitations inherent in our observational study design, including the inability to establish causal relationships between our primary predictor (utilization) and outcome of interest (VBAC). We were also unable to measure patients' routine prenatal care service utilization. To address these limitations, we explored the relationship between our outcome and secondary predictor (the influence of the digital health platform on aspects of pregnancy and birth). To assess key covariates, we limited our cohort to users who completed program assessments and compared them to users who did not complete assessments. In bivariate comparisons users who completed all assessments were slightly older, had a slightly different racial and ethnic composition, and had a lower proportion of users with BMI greater than 30 kg/m^2 and depression. However, users did not differ on key characteristics including preferred mode of delivery and pregnancy-related anxiety, two key factors expected to drive differences in decision to labor after cesarean. Our use of self-reported data may limit reporting of some medical conditions; however, this method also allows for more in-depth assessment of users' preferences and experiences, including preferred mode of delivery and pregnancy-related anxiety, variables typically missed in insurance claims and even electronic health record analyses.

In this assessment, we were unable to identify key drivers of successful VBAC for patients who engaged with care advocates. Care advocates may have helped direct patients to providers who offer labor after cesarean or may have provided counseling, resources, and support that helped facilitate patients' decision-making. Future work will explore these nuances and how care advocates can contribute to other critical maternity care outcomes including cesarean birth rates in nulliparous patients, risk-reduction, and identification of hypertensive disorders of pregnancy, and others.

This work faces several additional limits to generalizability. We focused on patients with a history of cesarean birth, as the digital health platform has tools specifically designed to improve rates of vaginal birth in this population. Our cohort included exclusively commercially insured users, and the majority of patients who reported racial and ethnic identifiers were white and non-Hispanic. Future work is needed to assess how online services can improve rates of vaginal birth in broader populations. Of note, almost a third of patients preferred not to report racial and ethnic identity. While this rate is comparable to other surveys, it demonstrates an opportunity for building trust across health services. [40]

Conclusions

Our study suggests that digital prenatal services, particularly care coordination, are promising for addressing the high cesarean birth rate in the United States through increasing rates of VBAC. Future work is needed to clarify the pathways through which digital services can improve access, decision-making, and ultimately, birth outcomes, and to expand digital case management in prenatal care to broader patient populations and conditions.

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Tables and Figures

Figure 1. Cohort flowchart

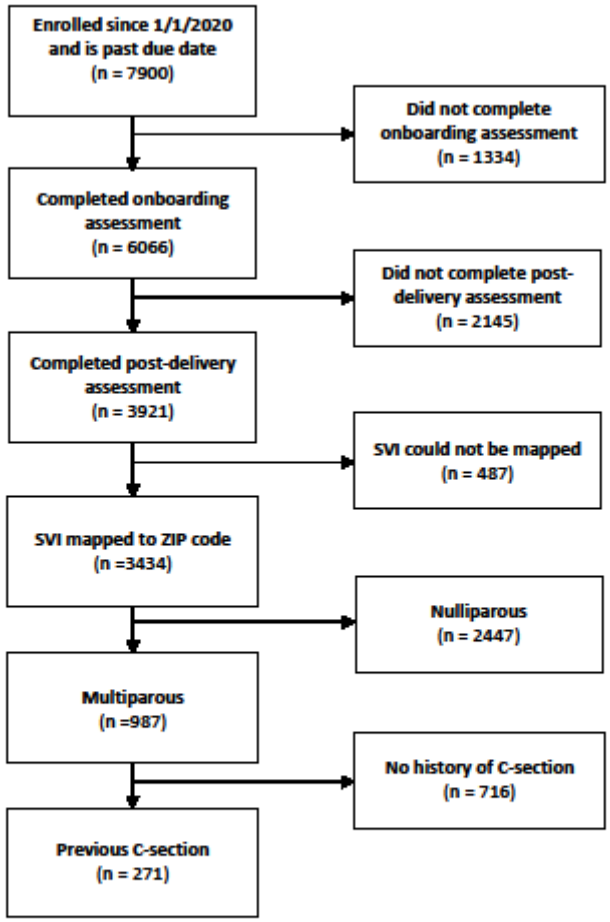

Table 1. User characteristics by mode of delivery

	Full sample N = 271	**Multiparous, with previous C-section**		
		Vaginal Birth N = 44	**C-Section N = 227**	**P-value**
Demographics				
Age, Mean (SD)	35.2 (4.06)	35.5 (3.87)	35.1 (4.10)	0.65
Race, N (%)				0.96
White	113 (41.7)	21 (47.7)	92 (40.5)	
Asian or Pacific Islander	40 (14.8)	6 (13.6)	34 (15.0)	
Black	26 (9.6)	4 (9.1)	22 (9.7)	
American Indian	1 (0.4)	0 (0)	1 (0.4)	
Multiple races	7 (2.6)	1 (2.3)	6 (2.6)	
I prefer not to say	84 (31.0)	12 (27.3)	72 (31.7)	
Ethnicity, N (%)				0.81
Hispanic/Latinx	15 (5.5)	2 (4.5)	13 (5.7)	
Not Hispanic/Latinx	184 (67.9)	32 (72.7)	152 (67.0)	

I prefer not to say	72 (26.6)	10 (22.7)	62 (27.3)	
Social vulnerability index (SVI), Median (Q1, Q3)				
Social Vulnerability Index (SVI) Total	0.32 (0.19, 0.48)	0.31 (0.21, 0.50)	0.32 (0.19, 0.48)	0.86
SVI 1 (Socioeconomic)	0.27 (0.14, 0.46)	0.30 (0.13, 0.53)	0.27 (0.14, 0.40)	0.49
SVI 2 (Household composition/disability)	0.28 (0.16, 0.42)	0.33 (0.20, 0.42)	0.26 (0.16, 0.43)	0.32
SVI 3 (Minority status/language)	0.57 (0.39, 0.72)	0.55 (0.40, 0.72)	0.57 (0.39, 0.72)	0.90
SVI 4 (Housing type/transportation)	0.43 (0.27, 0.58)	0.42 (0.25, 0.58)	0.43 (0.28, 0.57)	0.74
Medical Conditions, N (%)				
Any medical condition	130 (48.0)	20 (45.5)	110 (48.5)	0.71
BMI ≥ 30 kg/m^2	67 (24.7)	5 (11.4)	62 (27.3)	0.02[a]
Heart/Cardiovascular disease	4 (1.5)	1 (2.3)	3 (1.3)	0.51
Diabetes	9 (3.3)	1 (2.3)	8 (3.5)	1.0
High blood pressure	26 (9.6)	3 (6.8)	23 (10.1)	0.78
Blood disorder	5 (1.8)	0 (0)	5 (2.2)	1.0

Antiphospholipid Antibody Syndrome/ Thrombophilia	1 (0.4)	0 (0)	1 (0.4)	1.0
Kidney disease	0 (0)	0 (0)	0 (0)	1.0
Thyroid disease	34 (12.5)	5 (11.4)	29 (12.8)	0.80
Autoimmune disease	9 (3.3)	2 (4.5)	7 (3.1)	0.64
Cholestasis	4 (1.5)	0 (0)	4 (1.8)	1.0
Intrauterine growth restriction	6 (2.2)	0 (0)	6 (2.6)	0.59
High blood pressure (in pregnancy)	26 (9.6)	3 (6.8)	23 (10.1)	0.78
Gestational diabetes	46 (17.0)	9 (20.5)	37 (16.3)	0.51
Mental Health Conditions, N (%)				
Any mental health condition	71 (26.2)	9 (20.5)	62 (27.3)	0.34
Anxiety	61 (22.5)	7 (15.9)	54 (23.8)	0.25
Depression	30 (11.1)	4 (9.1)	26 (11.5)	0.80
Perinatal mood disorder	11 (4.1)	3 (6.8)	8 (3.5)	0.39
Pregnancy-related anxiety	96 (35.4)	13 (29.5)	83 (36.6)	0.37
Birth Complications, N (%)				

Preeclampsia	12 (4.4)	2 (4.5)	10 (4.4)	1.0
Preterm birth	29 (10.7)	7 (15.9)	22 (9.7)	0.22
Peripartum infection	7 (2.6)	3 (6.8)	4 (1.8)	0.10
Fetal intolerance	11 (4.1)	3 (6.8)	8 (3.5)	0.41
Postpartum hemorrhage	8 (3.0)	3 (6.8)	5 (2.2)	0.14
Shoulder dystocia	3 (1.1)	2 (4.5)	1 (0.4)	0.08
NICU admission	36 (13.3)	8 (18.2)	28 (12.3)	0.40
Pregnancy Preferences, N (%)				
Preferred mode of delivery				<0.01[a]
Vaginal	89 (32.8)	34 (77.3)	55 (24.2)	
C-section	148 (54.6)	5 (11.4)	143 (63.0)	
No preference	34 (12.5)	5 (11.4)	29 (12.8)	

Abbreviations: SVI, social vulnerability index; NICU, neonatal intensive care unit;

[a] Indicates a P-value of < 0.05

Table 2. Digital platform utilization and influence by mode of delivery

	Full sample N = 271	Multiparous, with previous C-section		
		Vaginal Birth N = 44	C-Section N = 227	P-value
Utilization				
Asynchronous engagement				
Resource reads, Median (Q1, Q3)	3.00 (0, 7.00)	7.00 (2.00, 11.5)	3.00 (0, 6.00)	<0.01[a]
Viewed childbirth education video, N (%)	7 (2.6)	4 (9.1)	3 (1.3)	<0.01[a]
Interactions with care advocate				
Messages to care advocate, Median (Q1, Q3)	1.00 (0, 3.00)	2.00 (0, 8.50)	1.00 (0, 3.00)	0.02[a]
Completed at least one appointment with a care advocate, N (%)	212 (78.2%)	42 (95.5%)	170 (74.9%)	<0.01[a]
Interactions with provider				
Messages to provider, Median (Q1, Q3)	0 (0, 2.00)	0 (0, 3.00)	0 (0, 2.00)	0.22
Appointments with providers, Median (Q1, Q3)	0 (0, 2.00)	1.00 (0, 5.00)	0 (0, 2.00)	<0.01[a]

Completed birth plan appointment, N (%)	16 (5.9)	8 (18.2)	8 (3.5)	<0.01[a]
Attended childbirth education group class, N (%)	22 (8.1)	9 (20.5)	13 (5.7)	<0.01[a]
Total appointments, Median (Q1, Q3)	1.00 (1.00, 3.00)	2.00 (1.00, 6.00)	1.00 (1.00, 3.00)	<0.01[a]
Influence of Digital Health Platform, N (%)				
Influenced member delivery type	16 (5.9)	10 (22.7)	6 (2.6)	<0.01[a]
Influenced member approach to maternity experience	139 (51.3)	32 (72.7)	107 (47.1)	<0.01[a]
Influenced member birth plan or delivery method preference	32 (11.8)	15 (34.1)	17 (7.5)	<0.01[a]
Helped member learn medical accurate information about pregnancy and/or complications	96 (35.4)	24 (54.5)	72 (31.7)	0.60
Helped member in the hospital during labor and delivery	18 (6.6)	7 (15.9)	11 (4.8)	0.11

Table 3. Effect of utilization on odds of vaginal birth after cesarean (VBAC)

Utilization	**Unadjusted**	**Adjusted**

	Odds Ratio (95% CI)	Odds Ratio [a] (95% CI)
Asynchronous engagement		
Resource reads	1.06 (1.02, 1.10)[b]	1.05 (1.00, 1.09)[b]
Viewed childbirth education video	7.50 (1.60, 39.3)[b]	3.89 (0.70, 26.7)
Interactions with CA		
Messages to CA	1.06 (1.01, 1.12)[b]	1.06 (1.01, 1.12)[b]
Completed at least one appointment with CA	7.04 (2.08, 44.0)[b]	7.67 (1.99, 51.4)[b]
Interactions with provider		
Messages to provider	1.02 (0.99, 1.04)	1.01 (0.98, 1.04)
Appointments with providers	1.13 (1.04, 1.23)[b]	1.12 (1.02, 1.25)[b]
Completed birth plan appointment	6.08 (2.11, 17.6)[b]	3.25 (0.90, 12.4)
Attended childbirth education group class	4.25 (1.65, 10.6)[b]	2.63 (0.84, 8.24)
Total appointments		
Total appointments	1.13 (1.04, 1.24)[b]	1.12 (1.03, 1.25)[b]

Abbreviations: CA, care advocate

[a] Adjusted for age, BMI≥ 30 kg/m^2, medical conditions, mental health conditions, pregnancy

related anxiety, SVI, preferred mode of delivery

[b] Indicates a P-value of < 0.05

Table 4. Effect of reported influence of the women's and family digital health platform on odds of vaginal birth after cesarean (VBAC)

Influence of Digital Health Platform	**Unadjusted Odds Ratio (95% CI)**	**Adjusted Odds Ratio[a] (95% CI)**
Influenced member delivery type	10.8 (3.78, 33.7)[b]	7.90 (2.30, 30.1)[b]
Influenced member approach to maternity experience	2.99 (1.50, 6.32)[b]	2.81 (1.20, 6.95)[b]
Influenced member birth plan or delivery method preference	6.39 (2.87, 14.2)[b]	4.34 (1.69, 11.3)[b]
Helped member learn medically accurate information about pregnancy and/or complications	2.58 (1.34, 5.02)[b]	2.48 (1.15, 5.48)[b]
Helped member in the hospital during labor and delivery	3.71 (1.29, 10.1)[b]	2.09 (0.63, 6.76)

[a] Adjusted for age, BMI ≥ 30 kg/m^2, medical conditions, mental health conditions, pregnancy related anxiety, SVI, preferred mode of delivery

[b] Indicates a P-value of < 0.05