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Closing-the-loop: a novel care coordination tool to reduce maternal healthcare utilization postpartum and collaboratively build interventions to address community needs

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Abstract

Background In August 2020, Sarasota Memorial Health Care System (Sarasota Memorial) invested in Unite Us, a closed-loop referral platform, to address obstetric (OB) patients' non-medical needs. The platform was used to electronically refer patients delivering at Sarasota Memorial who screened positive for these needs to a local network of community-based organizations.

Methods A pre-post intervention study with a quasi-experimental, 1:1 matched design was used to measure the impact of implementing a technology-enabled care coordination platform on postpartum health care utilization. Deliveries were matched on patient and birth characteristics including age, race and ethnicity, marital status, insurance type, maternal comorbidities, and birth-specific factors. The impact of the Unite Us platform was assessed using conditional logistic regression, and results were stratified by insurance type, delivery method, low birthweight, preterm delivery, marriage status, infection complications, mental health diagnoses, and race/ethnicity.

Results The study consisted of 1,996 deliveries with a live birth, 998 of which were to patients referred for community care through Unite Us from August 27, 2020 to January 31, 2023. These were matched with 998 deliveries with a live birth prior to Unite Us implementation, from January 1, 2019 to August 26, 2020. Matches were predominantly Medicare or Medicaid insured (65.0%), White, Non-Hispanic (56.6%) or Hispanic (28.2%), and never married (62.6%). When stratified by insurance type, patients who were enrolled in Medicaid/Medicare insurance at delivery were 59% less likely (OR: 0.41; 95% CI: 0.17 to 0.99) to be readmitted to the hospital within thirty days of discharge and were 55% less likely (OR: 0.45; 95% CI: 0.21 to 0.99) to have any OB-related inpatient admission within six months of discharge when compared to those who received usual care before Unite Us' implementation.

Conclusions Using the Unite Us platform as a digital tool to advance care coordination, the OB Service line within Sarasota Memorial observed statistically significant reductions in postpartum healthcare utilization in Medicaid/ Medicare beneficiaries indicating that addressing non-medical, health-related needs may improve postpartum

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outcomes and reduce costs. These referral data are also used to facilitate community discussions on ways to build a more supportive network to improve maternal and child health outcomes.

Keywords Maternal health, Non-medical needs, Obstetric outcomes, Closed-loop referral networks, Collective impact

Background

Maternal and child health inequities have persisted in the United States (U.S.) for decades despite having one of the most advanced healthcare systems in the world [1]. The root causes of these inequities are multifaceted but include factors such as deep seated social divisions [2], socio-ecological indicators like wealth disparities and the built environment [3], as well as limited access to care in rural areas [4]. These root causes, also known as the social drivers of health (SDOH), account for up to 80% of health outcomes [5]. Defined by the World Health Organization (WHO) as "the conditions in which people are born, grow, work, live, and age" ([6] p1), individuals experiencing these environmental drivers (e.g., living in a food desert) may result in the presence of non-medical, health-related needs (e.g. food insecurity). It follows then that improving maternal and child health outcomes must include addressing non-medical needs as standard of care.

Technology-enabled, closed-loop referral networks have emerged as one promising digital tool to increase access to community resources, address non-medical needs, and improve health outcomes [7, 8]. The foundational theory behind digital closed-loop referral networks is a socioecological framework that recognizes the interconnected layers influencing our health: policy, institutions, community, relationships and individual-level factors [9]; and seeks to overlay these with technical infrastructure to produce a digital care continuum.

This focus on a care continuum is critical given that health and community care delivery is highly fragmented, placing a significant burden on individuals to self-navigate complex systems to meet their needs [10]. "Closing the loop" infers that the resulting referral network is not a one-way system, but rather a person-centered community of care that values and captures outcomes delivered through engaged community partners. This allows technology-enabled closed-loop referral networks to answer not only whether an individual was connected to services, but also whether their needs were ultimately resolved [11].

Moving from a maze of resources to a coordinated system of care

First 1,000 Days Suncoast is a tri-county initiative in southwest Florida that was started in 2018 by the Charles & Margery Barancik Foundation, Sarasota Memorial, and other stakeholders [12]. What started with 32 partner organizations has now grown to more than 95 community partners addressing the needs of families with young children [12]. The initiative connects healthcare providers and nonprofit organizations to reduce systemic barriers to care and improve outcomes for new parents and their children.

A critical construct of First 1,000 Days was to move from a "maze of resources" to a streamlined and coordinated system of care (Fig. 1) [12–14]. In 2020, the initiative partnered with Unite Us, a healthcare technology company specializing in closed-loop referral platforms, to provide the technical infrastructure needed to fulfill the initiative's vision. This tool has been critical in understanding the needs of the community and provides an efficient care pathway for patients with non-medical needs, giving mental health and healthcare providers the confidence to implement universal SDOH screening with a tool for taking action when needs are identified.

Following the Collective Impact Model, Sarasota Memorial serves as the backbone organization for First 1,000 Days Suncoast. As the safety net hospital system for Sarasota and surrounding counties, it provides care to a significant number of low-income and underserved pregnant patients. Sarasota Memorial is one of the largest public community health care systems in the state of Florida, including two hospitals, urgent care centers, and a free-standing Emergency Care Center. It has nationally recognized level 3 maternity obstetrical services with a level 3 NICU. It is Joint Commission accredited and Magnet and Baby Friendly designated. In August 2020, as part of the First 1,000 Days initiative, Sarasota Memorial incorporated the Unite Us closed-loop technology into its obstetric care units to ensure new parents with non-medical needs were referred to First 1,000 Days' community partners upon discharge.

The purpose of this study was to determine whether the implementation of the Unite Us platform at Sarasota Memorial between August 27, 2020, and January 31, 2023, reduced all-cause and OB-related healthcare resource utilization (HCRU) up to six months postpartum for patients with a live birth and one or more care referrals through Unite Us, when compared with those who had a live birth at the hospital prior to implementation.

Methods

This quasi-experimental, pre-post intervention study included patients delivering at one of two Sarasota Memorial hospitals from January 1, 2019, to January 31, 2023. The post-implementation group included deliveries
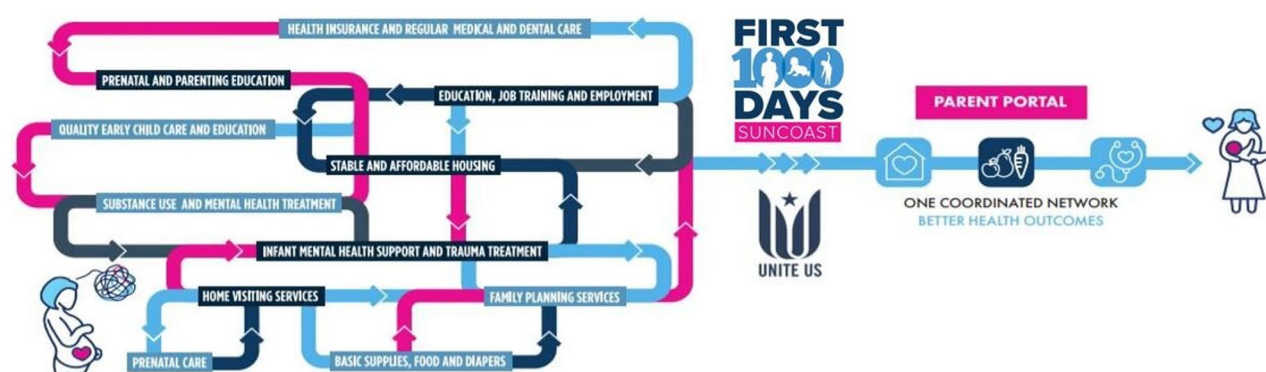
Fig. 1 First 1,000 Days Suncoast Theory of Change Infographic

with at least one live birth from August 27, 2020 to January 31, 2023, by patients who received a care referral through Unite Us during their pregnancy or within seven days of their discharge. The comparison group consisted of deliveries with at least one live birth from January 1, 2019 to August 26, 2020, the period before the implementation of the Unite Us platform.

Using propensity score matching, pre- and post-implementation deliveries were matched 1:1 on age, race and ethnicity, marital status, insurance type, maternal comorbidities (i.e., obesity and gestational diabetes), and birth-related factors (i.e., gestational age, preterm status, low birth weight, birth weight, and delivery method). Preterm births were defined as babies born before 37 weeks of pregnancy, and low birth weight deliveries were defined as babies born weighing less than 2,500 g. Maternal comorbidities were classified using International Classification of Diseases (ICD-10) codes as binary indicators captured during the delivery visit or in the year pre-delivery and were aligned with Premier Perinatal Improvement Collaborative (PPIC) Maternal Morbidity Classifications extracted from Premier's Quality Advisory® Healthcare Database (Charlotte, NC), an all-payer administrative database used for quality and efficiency improvement. To ensure that prenatal HCRU was not incorrectly counted as postpartum visits, patients were excluded if they had two deliveries within a 630-day span (i.e., 21 months).

Patient visit histories for Emergency Care Center (ECC) visits (also known as the Emergency Room or Emergency Department) and inpatient admissions were extracted from Sarasota Memorial electronic health records (EHR) and used to define all-cause and obstetric-related (i.e., visits having a primary ICD10 diagnosis code O00-O9A) outcomes enumerated over the 6-month postpartum period. Unite Us platform data were also analyzed to understand the top non-medical needs (e.g. food, housing, transportation, etc.) and resolution rates for the post-implementation group.

Differences between the matched (Unite Us care referral, and demographic and clinical criteria most likely to influence health care resource utilization) and unmatched post-implementation deliveries (i.e., those who could not be matched on demographic and clinical characteristics with a pre-implementation delivery) were assessed. Conditional logistic regression models were used to assess the likelihood of all-cause and obstetric-related HCRU within 1 month, 2 months, 3 months, and 6 months of discharge from the delivery visit. Odds ratios (OR) and 95% confidence intervals (CI) for admission were reported at each time point. The primary analyses were then repeated and stratified by insurance type and delivery method. Statistical significance was defined as $p < 0.05$, and analyses were performed using SAS statistical software version 9.4 [15].

Results

1,646 post-implementation deliveries included a care referral through Unite Us during the observation window and were therefore eligible to be matched. Of those, 998 deliveries (60.6%) were matched to a pre-implementation delivery and included in this study. Compared to those who were unmatchable, those who were matched differed in age, race and ethnicity, marital status, insurance type, maternal comorbidities, and birth-related factors (Table 1). The final study sample included 1,996 deliveries, 998 deliveries with a care referral through Unite Us and 998 deliveries that took place prior to Unite Us implementation. The sample was predominantly Medicare or Medicaid insured (65.0%), White, Non-Hispanic (56.6%) or Hispanic (28.2%), never married (62.6%), and had vaginal deliveries (67.3%) (Table 2).

The top five needs captured for patients referred through Unite Us were Individual & Family Support (51.1%), Food Assistance (47.9%), Benefits Navigation (20.1%), Clothing & Household goods (18.8%), and Education (8.9%). An average of 1.64 needs were identified

Table 1 Comparison of the patient characteristics for matched and unmatched deliveries

Characteristic	Unmatched (*N* = 648)[1]	Matched (*N* = 998)[1]	*p*-value[2]
Age at Delivery, years	29.5 (6.2)	28.1 (6.0)	< 0.001
Birth weight, grams	2,937 (811)	3,280 (508)	< 0.001
Gestational Age, weeks	37.08 (3.28)	38.69 (1.72)	< 0.001
Race/Ethnicity			< 0.001
White, Non-Hispanic	296 (45.7%)	565 (56.6%)	
Black, Non-Hispanic	140 (21.6%)	124 (12.4%)	
Asian, Non-Hispanic	7 (1.1%)	6 (0.6%)	
Other, Non-Hispanic	31 (4.8%)	18 (1.8%)	
Hispanic	164 (25.3%)	281 (28.2%)	
Unknown	10 (1.5%)	4 (0.4%)	
Insurance			< 0.001
Medicare/Medicaid	376 (58.0%)	649 (65.0%)	
Private	236 (36.4%)	332 (33.3%)	
Pre-pay/Package	6 (0.9%)	3 (0.3%)	
Uninsured/Self-Pay	14 (2.2%)	5 (0.5%)	
Other	3 (0.5%)	1 (0.1%)	
VA	13 (2.0%)	8 (0.8%)	
Marital Status			< 0.001
Married or Partnered	213 (32.9%)	353 (35.4%)	
Previously Married	46 (7.1%)	16 (1.6%)	
Never Married	378 (58.3%)	625 (62.6%)	
Unknown	11 (1.7%)	4 (0.4%)	
Preterm Delivery	195 (30.1%)	65 (6.5%)	< 0.001
Low Birth Weight Delivery	173 (26.7%)	48 (4.8%)	< 0.001
Delivery Method			< 0.001
Cesarean Section	329 (50.8%)	326 (32.7%)	
Vaginal Delivery	319 (49.2%)	672 (67.3%)	
Comorbid Conditions (PPIC)			
Obesity	153 (23.6%)	44 (4.4%)	< 0.001
Hypertension	159 (24.5%)	42 (4.2%)	< 0.001
Mental Health	311 (48.0%)	104 (10.4%)	< 0.001
Diabetes	115 (17.6%)	37 (3.7%)	< 0.001
Venous Thrombosis	2 (0.3%)	0 (0.00%)	0.2
Substance Misuse	108 (16.7%)	41 (4.1%)	< 0.001
Severe Maternal Mortality	65 (10.0%)	2 (0.2%)	< 0.001
Sepsis	5 (0.8%)	0 (0.0%)	0.009
Infection	245 (37.8%)	153 (15.3%)	< 0.001
Unite Us Case Needs			
Age at Delivery, years	1.94 (1.21)	1.64 (1.06)	< 0.001
Birth weight, grams	363 (56.0%)	510 (51.1%)	0.051
Gestational Age, weeks	356 (54.9%)	478 (47.9%)	0.005
Race/Ethnicity	108 (16.7%)	201 (20.1%)	0.078
White, Non-Hispanic	161 (24.9%)	188 (18.8%)	0.004
Black, Non-Hispanic	75 (11.6%)	89 (8.9%)	0.079
Asian, Non-Hispanic	77 (11.9%)	73 (7.3%)	0.002
Other, Non-Hispanic	50 (7.7%)	36 (3.6%)	< 0.001
Hispanic	17 (2.6%)	11 (1.1%)	0.02
Unknown	9 (1.4%)	10 (1.0%)	0.5
Insurance	8 (1.2%)	10 (1.0%)	0.7
Medicare/Medicaid	7 (1.1%)	9 (0.9%)	0.7
Private	8 (1.2%)	8 (0.8%)	0.4
Pre-pay/Package	2 (0.3%)	7 (0.7%)	0.5

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Table 1 (continued)

Characteristic	Unmatched (*N*=648)[1]	Matched (*N*=998)[1]	*p*-value[2]
Uninsured/Self-Pay	13 (2.0%)	6 (0.6%)	0.009
Other	4 (0.6%)	3 (0.3%)	0.4

[1] Mean (SD); n (%)

[2] Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test

Table 2 Patient and delivery characteristics for matched deliveries

Characteristic	Post-Implementation (*N*=998)[1]	Pre-Implementation (*N*=998)[1]
Age at Delivery, **years**	28.1 (6.0)	28.1 (5.6)
Birth Weight, **grams**	3,280 (508)	3,307 (478)
Gestational Age, **weeks**	38.69 (1.72)	38.87 (1.62)
Race/Ethnicity		
White, Non-Hispanic	565 (56.6%)	565 (56.6%)
Black, Non-Hispanic	124 (12.4%)	124 (12.4%)
Asian, Non-Hispanic	6 (0.6%)	6 (0.6%)
Other, Non-Hispanic	18 (1.8%)	18 (1.8%)
Hispanic	281 (28.2%)	281 (28.2%)
Unknown	4 (0.4%)	4 (0.4%)
Insurance		
Medicare or Medicaid	649 (65.0%)	649 (65.0%)
Private	332 (33.3%)	332 (33.3%)
Pre-pay/Package	3 (0.3%)	3 (0.3%)
VA	8 (0.8%)	8 (0.8%)
Uninsured/Self-Pay	5 (0.5%)	5 (0.5%)
Other	1 (0.1%)	1 (0.1%)
Marital Status		
Married or Partnered	353 (35.4%)	353 (35.4%)
Previously Married	16 (1.6%)	16 (1.6%)
Never Married	625 (62.6%)	625 (62.6%)
Unknown	4 (0.4%)	4 (0.4%)
Preterm Delivery	65 (6.5%)	65 (6.5%)
Low Birth Weight Delivery	48 (4.8%)	48 (4.8%)
Delivery Method		
Cesarean Section	326 (32.7%)	326 (32.7%)
Vaginal Delivery	672 (67.3%)	672 (67.3%)
Comorbid Conditions (PPIC)		
Obesity	44 (4.4%)	44 (4.4%)
Hypertension	42 (4.2%)	42 (4.2%)
Cardiovascular	81 (8.1%)	81 (8.1%)
Mental Health	104 (10.4%)	104 (10.4%)
Diabetes	37 (3.7%)	37 (3.7%)
Venous Thrombosis	0 (0.0%)	0 (0.0%)
Substance Misuse	41 (4.1%)	41 (4.1%)
Severe Maternal Mortality	2 (0.2%)	2 (0.2%)
Sepsis	0 (0.0%)	0 (0.0%)
Infection	153 (15.3%)	153 (15.3%)

[1] Mean (SD); n (%)

per person, with 61.6% of referrals ultimately closed as resolved (i.e., the need was met) (Table 1).

Table 1: Comparison of the patient characteristics for matched and unmatched deliveries.

Table 2: Patient and delivery characteristics for matched deliveries.

Overall, the odds of obstetric-related 30-day readmissions and inpatient admissions up to 6 months postpartum were slightly reduced for patients referred through Unite Us compared with patients who received usual care prior to the implementation of Unite Us. However, these reductions were not statistically significant (Figs. 2 A and 2B). Differences in Emergency Care Center (ECC) utilization were not statistically significant (Figs. 2 C and 2D).

When stratified by insurance type, those who received a care referral through Unite Us and were enrolled in Medicaid or Medicare insurance at delivery were 59% less likely (OR: 0.41; 95% CI: 0.17 to 0.99) to be readmitted to the hospital within thirty days of discharge than patients who received usual care before Unite Us implementation (Fig. 3A and B). All 30-day readmissions had an obstetric-related primary diagnosis. Patients who received a care referral through Unite Us and were enrolled in Medicaid or Medicare insurance at delivery were 57% less likely (OR: 0.43; 95% CI: 0.20 to 0.94) to have an all-cause inpatient admission for up to 3 months (Fig. 3A) and were 55% less likely (OR: 0.45; 95% CI: 0.21 to 0.99) to have an obstetric-related inpatient admission within six months of discharge (Fig. 3B).

When assessing all-cause or obstetric-related ECC utilization in the six months after discharge, no statistically significant differences were observed overall (Fig. 2C and D) or in the Medicaid/Medicare-specific population (Fig. 3C and D).

When stratified by delivery method, patients who received a care referral through Unite Us and delivered via cesarean section were approximately two times (OR: 1.93; 95% CI: 1.04 to 3.61) as likely to have visited the ECC within two months of discharge than patients who received usual care before Unite Us implementation (Fig. 4D).

Further stratifications by low birth weight, preterm delivery, marital status, race/ethnicity, and PPIC comorbidity classifications did not yield statistically significant differences, potentially due to sub-group sample sizes.
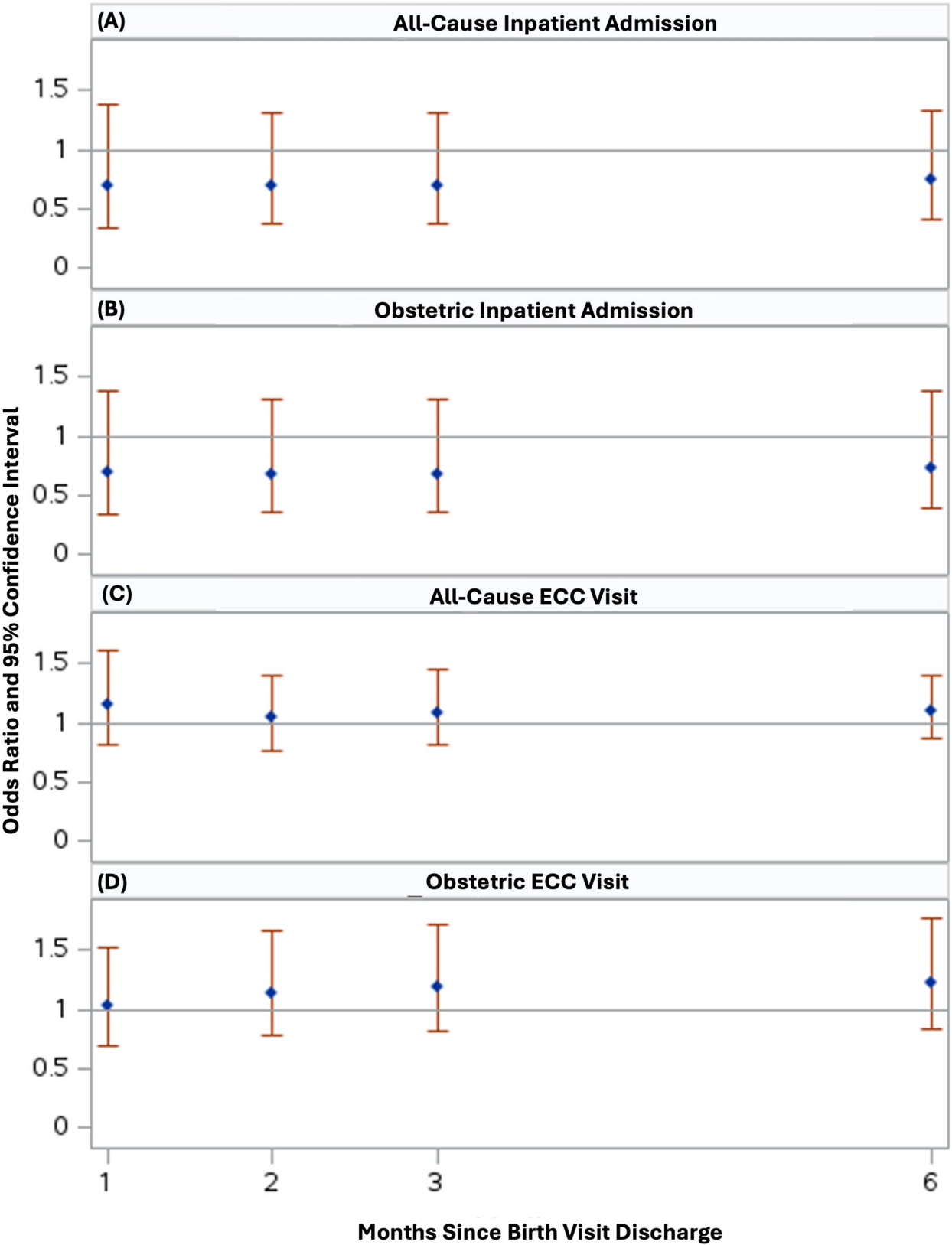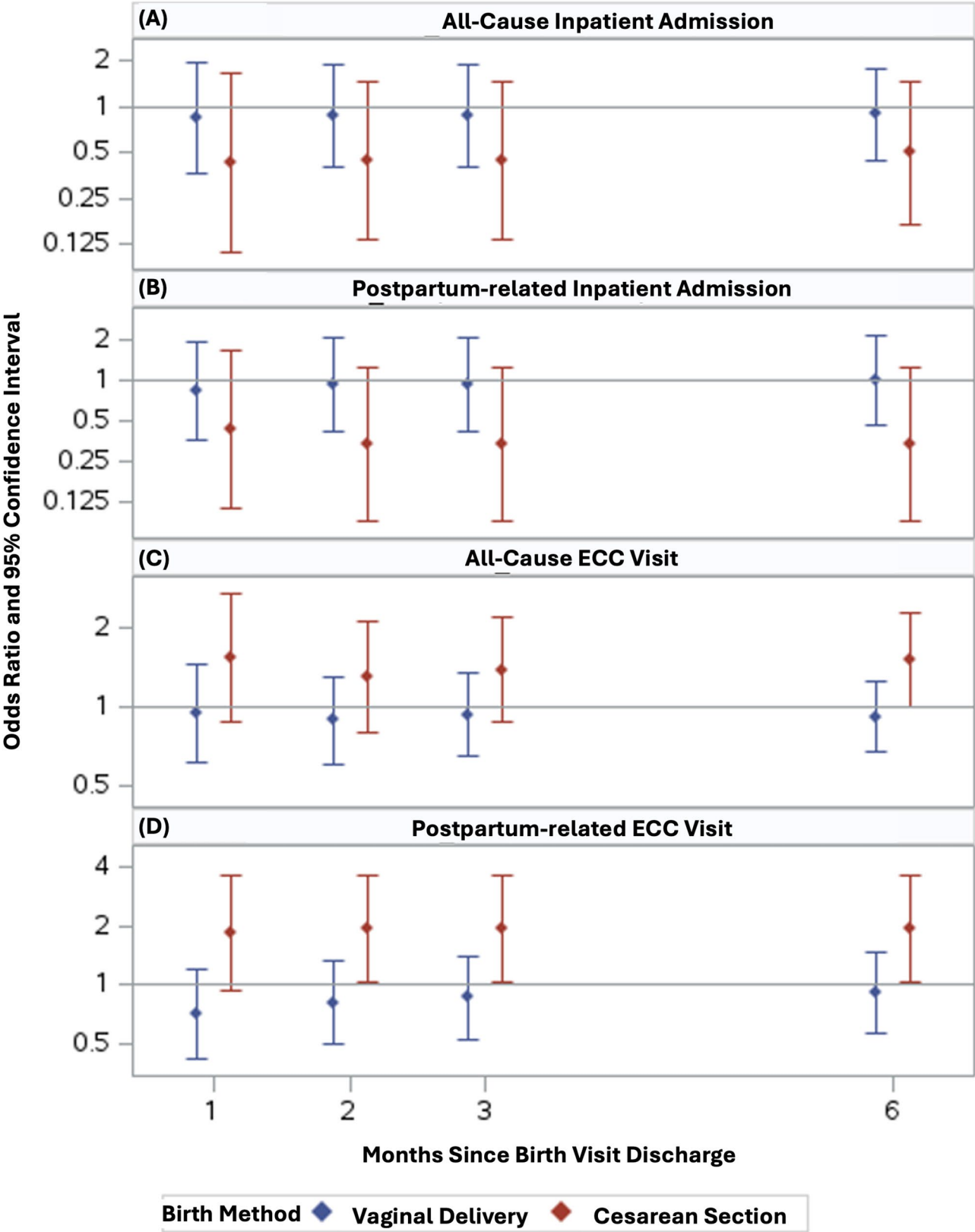
Fig. 2 (**A**-**D**): Likelihood of HCRU within six months post-delivery, comparing pre- and post-Unite Us implementation groups overall
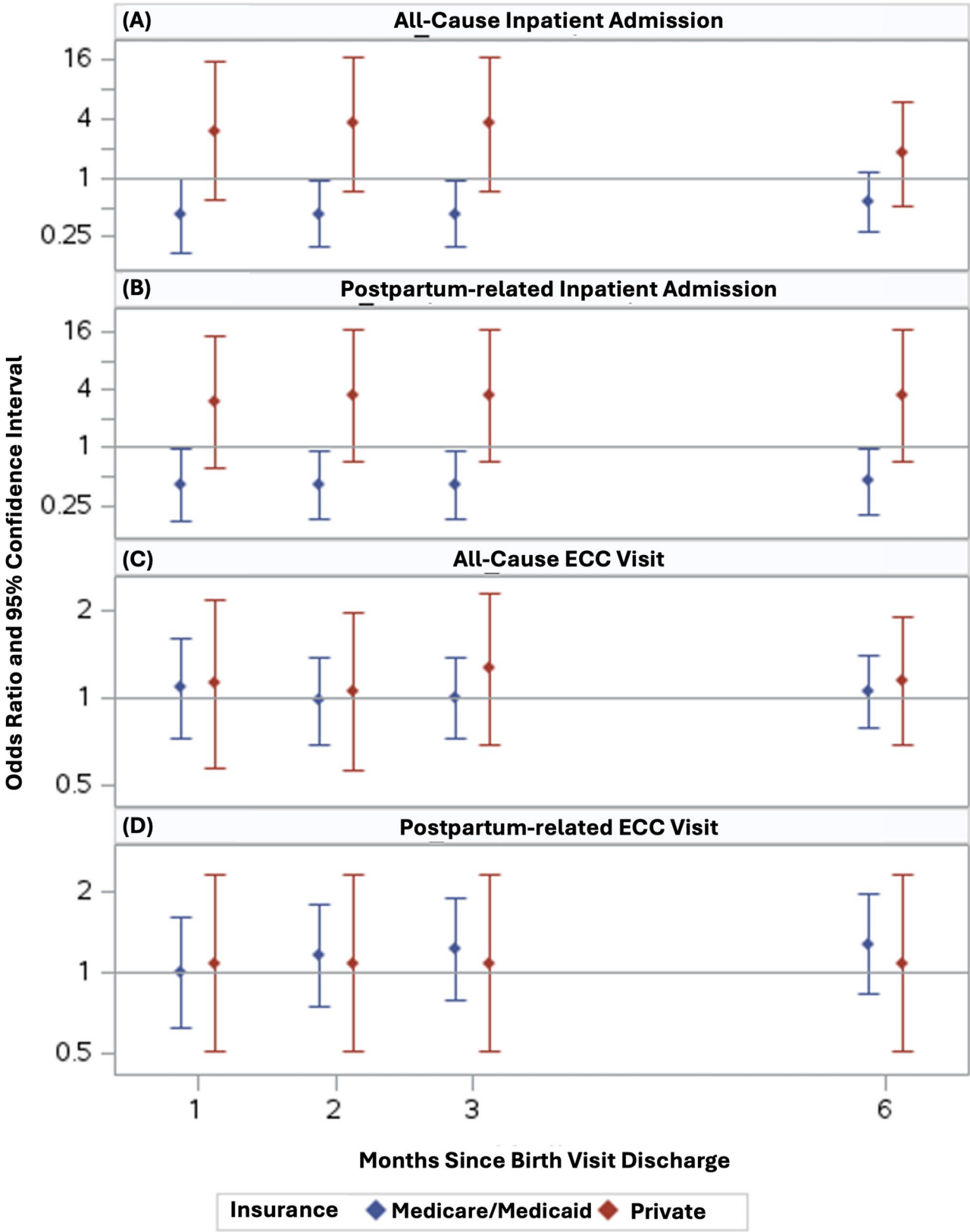
Fig. 3 (**A**-**D**): Likelihood of healthcare resource utilization up to 6 months after delivery discharge, by insurance type

Fig. 4 (**A**-**D**): Likelihood of healthcare resource utilization up to six months after delivery discharge by delivery method

Discussion

As of January 1, 2024, the Centers for Medicare and Medicaid Services (CMS) required healthcare organizations to screen for at least five non-medical factors: food insecurity, interpersonal safety, housing insecurity, transportation insecurity, and utilities [16]. While screening is critical to identifying and accurately capturing non-medical needs in our communities, what is perhaps even more important is what healthcare organizations do with that information. The results of this study demonstrate efficacy in implementing digital closed-loop referral interventions in an in-patient clinical care setting for patients who screen positive for one or more non-medical needs. More than 90% of patients who screened positive consented to have their information shared with community partners via the Unite Us tool. This indicates a high degree of patient willingness to accept care coordination initiated by their healthcare providers and was higher than the SDOH screening and referral acceptability rates cited in recent literature [17].

A critical component of the successful implementation of the Unite Us closed loop referral tool by Sarasota Memorial is the consensus and buy-in from First 1,000 Days Suncoast community partners in adopting the closed-loop platform, with only 15% of all referrals received by community partners rejected, the majority due to the patient not meeting program eligibility criteria or due to a lack of program capacity. Closed-loop referral networks are reliant upon the active participation of community-based organizations and their willingness to respond to referrals and document outcomes within the system. As previously stated, the First 1,000 Days Suncoast initiative was designed using the Collective Impact framework for community engagement [12, 13]. A central component of the Collective Impact model is the assignment of a backbone organization that can guide the strategy and lead the operational work, freeing community partners to focus on important consensus building and service delivery [18].

Sarasota Memorial's role as a well-respected local healthcare entity was key to the initiative's success and highlights the central role health systems can play in local community engagement and galvanizing cross-sector collaboration to improve outcomes for patients and community members.

The first few weeks of life are a critical window for parents and newborns [19]. The majority of postpartum readmissions occur in the first 30 days and are due to complications of birth (e.g. infection, hypertension) and maternal mental health concerns (e.g. postpartum depression) [20]. While all new parents need significant social support to thrive, parents who screen positive for non-medical needs are more likely to lack strong social support networks and access to basic needs like reliable transportation, than their socially connected peers [21]. The results of this study demonstrate that proactively identifying at-risk new parents and ensuring they're connected to community-based supports like home visiting services, food assistance, and mental health care within the first days at home, can significantly reduce the likelihood of hospital readmissions. These supports may provide an important outlet for new parents to express concerns like pain at the incision point or malaise, that can be addressed before they become an emergent issue or require hospital admission. Importantly, these concerns may go unexpressed or ignored until they require medical attention without connection to community supportive services in the days and weeks following delivery.

Considerations and limitations

Interpreting these findings is complicated by the lack of socioeconomic status (SES) data for pre-implementation deliveries, making it uncertain whether those giving birth before Unite Us had similar levels of non-medical need as those after its implementation, where a positive SDOH screening was necessary for inclusion. Considering insurance type as the closest proxy for SES, those who were Medicaid or Medicare-insured were likely better matches; therefore, the observed results in this subpopulation may more accurately reflect the effect of addressing non-medical needs on admission rates within the first six months postpartum. While this consideration helps to contextualize the finding's validity, some limitations were unavoidable.

First, the implementation of Unite Us occurred approximately five months after the start of the COVID-19 pandemic, with the beginning of the pre-implementation period occurring before the start of the pandemic. Potential impacts of the COVID-19 pandemic and implementation timing on inpatient admission findings are likely limited, given previous findings indicating that the pandemic had little effect on prenatal care utilization and postpartum hospital readmission rates [22, 23]. The implications of emergency care avoidance attributable to pandemic risk are harder to quantify as research shows that ED utilization was reduced in the early months of the pandemic [24], before implementation, but it is unclear how long this reduction persisted. Reduced ECC utilization before implementation may have artificially nullified the impact of Unite Us on ECC utilization.

Second, there were a number of quality improvement projects implemented within Sarasota Memorial's obstetric services during the study period that may have impacted the results of the study. Specifically, in September 2020, Sarasota Memorial augmented their follow-up discharge phone calls to new parents to include more medical questions and add SDOH screenings. Additionally, First 1,000 Days implemented a community-facing

Family Navigation program for families who needed assistance navigating services. Prior to discharge parents were educated about this service; there was also a large social media campaign targeting pregnant individuals who needed support prior to delivery [13]. In October 2021, the Columbia Suicide Screening was added to the OB workflow. This screening could have impacted healthcare utilization by identifying at-risk patients who required additional mental health services prior to discharge, thus potentially decreasing the postpartum utilization rates. These inter-connected interventions targeting maternal health outcomes within the First 1,000 Days Suncoast's partner network, create potential confounders that must be considered when interpreting the results. However, they also exemplify the power of multidisciplinary collaborative projects and the value of one system of record serving the community.

Further investigation is required to clarify how the integration of digital health technologies into care coordination influences maternal health outcomes and HCRU, particularly regarding the impact of specific non-medical needs and their resolution. Additionally, given the intergenerational nature of maternal health inequities [25], work is needed to understand if the positive effects observed in this study translate to improved infant health outcomes and HCRU within the first year of life.

Conclusions
Statistically significant reductions in postpartum HCRU in Medicaid/Medicare beneficiaries indicate that addressing non-medical needs may improve postpartum outcomes and reduce costs. These results are indicative of the critical impact non-medical needs have on the health and well-being of mothers, particularly those who have limited resources and/or may be living in poverty. It also exemplifies the value of healthcare systems' investment in placing time, effort, and funding towards care coordination infrastructure as a standard of care. Closed-loop referral technology offers a promising digital tool for streamlining this work, capturing the data required to measure its value and impact, and providing real-time referral data for community stakeholders to collaborate and build innovative solutions to help their most vulnerable residents.

Additionally, the collective action of community partners engaged in care coordination generates community-driven data. The information collected through this collaborative approach is grounded in a unique community context. These data can therefore offer a nuanced understanding of community level needs and the factors driving persistent maternal and child health inequities. While public health programming and community investment decisions often rely on national datasets and local needs assessments conducted through a healthcare lens, a robust, locally reflective dataset collected through digital closed-loop networks can uncover the true needs and priorities of the communities they reflect and serve.

Abbreviations
CMS	Centers for medicare & medicaid services
ECC	Emergency care center
HCRU	Health-care resource utilization
ICD	International classification of diagnoses
MBU	Mother-baby unit
OB	Obstetrics
PPIC	Premier perinatal improvement collaborative
ROI	Return on investment
SAS	Statistical analysis software
SDOH	Social drivers of health
U.S.	United states
WHO	World health organization

Author contributions
AT was a significant contributor to the conception and design of this study and in writing the manuscript. CA and MO championed the tool's implementation and clinical data acquisition, approved the study design, and provided substantive revisions to the manuscript. ZW contributed to the study's design, analyzed and interpreted the patient's clinical and social care data, and was a major contributor to writing the manuscript. HM was a significant contributor to the conception and design of this study and the revision of the manuscript. GF was a significant contributor to the revision of the manuscript. All authors read and approved the final manuscript.

Data availability
Upon request, the corresponding author is available to discuss the study and materials further, but the datasets analyzed during the current study are not publicly available to maintain the patient population's data privacy.

Declarations

Ethics approval and consent to participate
This study was approved by the Sarasota Memorial Research Institute's Institutional Review Board (IRB) as a minimal-risk study, #1914137-18, with a waiver of informed consent documentation. It was conducted in accordance with guidelines from the Declaration of Helsinki, and the rights of all participants were protected. Clinical trial number: not applicable.

Consent for publication
Not applicable.

Competing interests
AT, HM, ZW, and GF are employed by Unite Us, the creator of the technology implemented in this study, and have a financial interest in its success. MO and

CA are employed by the Sarasota Memorial Health Care System and have an interest in ensuring the continued success of the program that implements this technology. The authors declare that they have no other competing interests.

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