

Perinatal Outcomes Among Patients Using OB Teleflex, A Hybrid Prenatal Telemedicine Program

Devika Lekshmi, MPH;¹ Sophie Nader, MS;² Jennifer Roberts-Barry, BSN, RN;¹ Laura E. Baecher Lind, MD, MPH;¹ Alysa St. Charles, MA;¹ Erika F. Werner, MD, MS;¹ Sebastian Z. Ramos, MD³

¹Department of Obstetrics and Gynecology, Tufts Medical Center, Boston, MA

²Tufts University, Doctor of Medicine (MD), Boston, MA

³Tufts University School of Medicine, Boston, MA

ABSTRACT

Objectives: To assess obstetric outcomes among participants of the OB Teleflex program, in which roughly half of prenatal care was virtual, compared to those who were eligible, but elected traditional prenatal care.

Methods: This retrospective cohort study of patients who delivered between October 1, 2021, and September 30, 2022, compared OB Teleflex participation to routine prenatal care. Low-risk patients with a singleton, viable, non-anomalous fetus, and without hypertension requiring medication, were eligible for OB Teleflex and included in the study. Inverse-probability weighting was used to obtain unbiased estimates of the program effect on a composite of adverse outcomes that included primary cesarean delivery, neonatal intensive care unit admission, preterm birth, insufficient gestational weight gain, and hypertensive disorders of pregnancy.

Results: Out of 674 patients who delivered at our centre during the study period, 347 were eligible for OB Teleflex and met the study criteria. Of the 347 patients eligible for OB Teleflex, 63 (18%) chose to participate in the program. Those who elected OB Teleflex compared to those who did not, differed by race, parity, and history of

cesarean deliveries. In both adjusted and unadjusted analyses of the composite of adverse outcomes, there was no difference between OB Teleflex participants and those receiving standard care.

Conclusions: Hybrid prenatal telemedicine did not differ from standard prenatal care in the rate of adverse maternal and perinatal outcomes. Programs like OB Teleflex may help to remove barriers from care without worsening birth outcomes. Larger studies are needed to investigate whether hybrid prenatal care can improve outcomes.

RÉSUMÉ

Objectifs : Évaluer les issues obstétricales chez les participantes au programme OB Teleflex, où environ la moitié des soins prénataux se font en mode virtuel, par comparaison aux issues des participantes admissibles qui ont plutôt choisi un suivi prénatal traditionnel.

Méthode : Cette étude de cohorte rétrospective portant sur les patientes ayant accouché entre le 1^{er} octobre 2021 et le 30 septembre 2022 a comparé la participation au programme OB Teleflex et le suivi prénatal de routine. Les critères d'admissibilité au programme et d'inclusion à l'étude étaient : grossesse monofoetale à faible risque, avec fœtus viable sans anomalie, sans hypertension nécessitant un traitement médicamenteux. La pondération de probabilité inverse a été utilisée pour obtenir des estimations non biaisées de l'effet du programme sur un ensemble d'issues défavorables comprenant la césarienne primaire, l'admission aux soins intensifs néonataux, l'accouchement prématuré, le gain de poids gestationnel insuffisant et les troubles hypertensifs de la grossesse.

Résultats : Des 674 patientes qui ont accouché dans notre centre pendant la période de l'étude, 347 étaient admissibles au programme OB Teleflex et répondaient aux critères de l'étude. Des 347 patientes admissibles au programme, 63 (18 %) ont choisi d'y participer. Des différences ont été relevées en ce qui concerne la race, la parité et les antécédents de césarienne entre les femmes qui ont adhéré au programme OB Teleflex et celles qui ont opté pour le suivi traditionnel. Dans l'analyse ajustée et non ajustée de l'ensemble des issues défavorables, aucune différence n'a été relevée entre les participantes au programme OB Teleflex et celles ayant reçu les soins habituels.

Conclusion : Le modèle de suivi prénatal hybride avec télé-médecine n'a pas différé des soins prénataux standard en ce qui concerne le

Keywords: prenatal care; hybrid; telemedicine; pregnancy outcomes

Corresponding author: Devika Lekshmi, devika.lekshmi@tuftsmedicine.org

Disclosures: Dr. Ramos is supported by the National Institutes of Health (NIH)/Office of Research on Women's Health Building Interdisciplinary Research Careers in Women's Health (Grant number: 3K12AR084217-08S1). The project described was supported by data provided and accessed via the National Center for Advancing Translational Sciences, National Institutes of Health, Award Number UM1TR004398. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

The remaining authors declare they have nothing to disclose.

Each author has indicated they meet the journal's requirements for authorship.

Received on November 4, 2024

Accepted on March 24, 2025

Available online April 18, 2025

taux d'issues maternelles et périnatales défavorables. Des programmes comme OB Teleflex peuvent contribuer à éliminer les obstacles d'accès aux soins sans aggraver les issues de grossesse. D'autres études de plus grande envergure seront nécessaires pour déterminer si le suivi prénatal hybride peut améliorer les issues.

© 2025 The Society of Obstetricians and Gynaecologists of Canada/La Société des obstétriciens et gynécologues du Canada. Published by Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

J Obstet Gynaecol Can 2025;47(6):102911

<https://doi.org/10.1016/j.jogc.2025.102911>

KEY POINTS

- The OB Teleflex program streamlines in-person prenatal visits to those requiring physical examination or intervention, supplementing care with telemedicine visits led by an OB Nurse Navigator.
- In our hybrid prenatal care program, OB Teleflex, the rate of adverse maternal and perinatal outcomes including neonatal intensive care unit admissions, primary cesarean deliveries, spontaneous preterm birth, insufficient gestational weight gain, and hypertensive disorders of pregnancy, did not differ from standard prenatal care.

CLINICAL APPLICATION

- Alternative prenatal care models may be implemented to improve care accessibility by providing patients with convenient and flexible care options, such as hybrid telehealth, to supplement some in-person visits.
- Supplying patients with remote monitoring devices such as blood pressure cuffs and fetal Dopplers and delivering continuous antenatal and postpartum care with a dedicated nurse navigator, may drive patient engagement and foster patient-provider communication

INTRODUCTION

Telemedicine has proven to be a valuable tool in improving access to health care and reducing health care disparities outside of obstetrics.^{1,2} In pediatric care, for instance, the implementation of telemedicine has advanced the provision of subspecialty care in rural communities by increasing patient satisfaction, minimizing the burden for caregivers, and reducing costs associated with travel.² Telehealth has also demonstrated notable success in improving outcomes for patients with select conditions including hypertension or Parkinson's disease.³ However, obstetrics has been relatively slow in adopting telehealth practices, largely due to the number of screening and diagnostic appointments that necessitate in-person

visits.⁴ Certain populations stand to benefit from remote care more than others and some telehealth models are less effective at improving outcomes, emphasizing the current novelty of telemedicine in health care.^{3,5} As telehealth becomes more prevalent across all aspects of health care, hybrid telemedicine, where there is a combination of in-person and telehealth visits, should be further explored as an alternative to traditional prenatal care.⁵⁻⁷

Prenatal care augmented with specialized telehealth interventions has shown promise in optimizing patient care and improving health outcomes.⁵ Telehealth initiatives incorporating text messaging services, online portals, and/or remote monitoring have demonstrated improved breastfeeding rates, vaccination rates, and patient satisfaction.^{5,8,9} Text4Baby, the largest text messaging service for pregnant individuals across the United States, has shown success in promoting smoking cessation.⁹ While comprehensive prenatal telehealth programs are less common in pregnancy, the Mayo Clinic's novel prenatal care model, OB Nest, supplements on-site visits with virtual appointments, and provides patients home-monitoring devices and access to an online forum for expectant mothers. The Mayo Clinic found improved qualitative outcomes associated with the program including decreased stress and increased patient satisfaction.¹⁰ Prenatal care plays a vital role in preventing health complications during pregnancy by providing screening services and encouraging healthy lifestyle behaviours. Conversely, poor prenatal care utilization has been identified as a potential risk factor for adverse pregnancy outcomes including neonatal intensive care unit (NICU) admission, preterm births, insufficient gestational weight gain, cesarean delivery, and hypertensive disorders of pregnancy.¹¹⁻¹⁵ However, these studies do not investigate the effect of a hybrid approach to prenatal care on these outcomes. While telehealth is increasingly explored as a means to improve patient experience, there is limited research assessing how prenatal care may impact pregnancy when supplemented with remote telehealth.^{3,16}

Thus, we sought to determine if a hybrid program similar to OB Nest could affect pregnancy outcomes in our urban population. Informative and bidirectional communication between patient and provider is proven to be essential for optimizing health outcomes, treatment adherence, trust, and overall care experience.¹⁷ As OB Nest is a program which emphasizes childbirth education and patient-provider communication, we speculated that hybrid prenatal care could be associated with better pregnancy outcomes.

METHODS

Modelled after the OB Nest program's hybrid approach to prenatal care, we designed the OB Teleflex program (Figure). OB Teleflex was offered to all patients who met eligibility criteria after their intake. In this program, in-person visits are limited to those requiring examination or intervention (such as ultrasound, phlebotomy, or Group B strep screening). The remaining 5–6 traditional appointments where physical presence is not required are replaced by telemedicine visits. The OB Teleflex program also includes an additional 2-week postpartum follow-up visit which is unique to OB Teleflex and not part of the OB Nest Program.

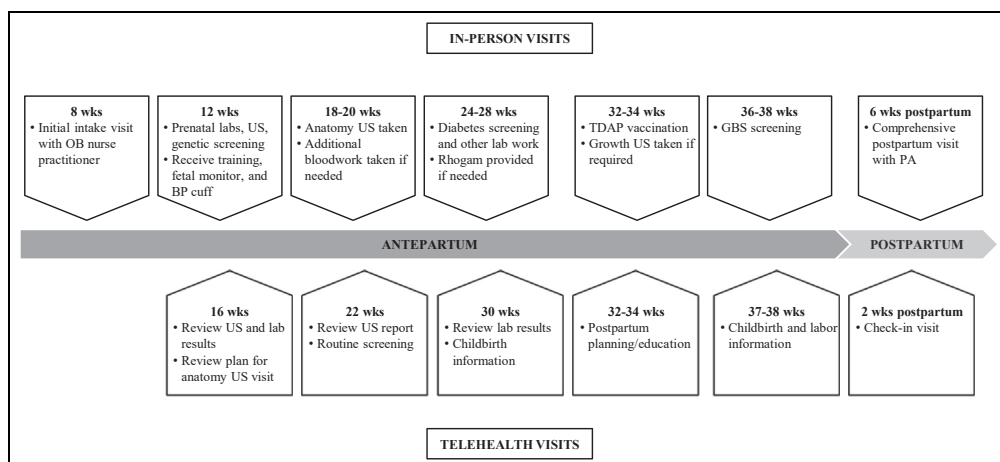
This study included individuals who delivered at Tufts Medical Center between October 1, 2021, and September 30, 2022 and received prenatal care at our primary academic low-risk practice. English-speaking patients with a singleton, viable, non-anomalous pregnancy, and with regular access to a cellphone or computer, were eligible for participation. Patients transferred to Maternal-Fetal Medicine at their initial prenatal visit or those who were taking medication for blood pressure control were not eligible for OB Teleflex and therefore not included in the study.

All study participants had lab work and ultrasound testing completed per American College of Obstetricians and Gynecologists guidelines. During visits when no lab or

ultrasound testing was required, those in OB Teleflex had a virtual visit with a dedicated OB Nurse Navigator (Figure). The standard of care group had routine in-person prenatal visits with a nurse practitioner or physician. The OB Teleflex group received a blood pressure cuff and fetal Doppler for remote monitoring throughout pregnancy, while the routine care group received only blood pressure cuffs if prescribed due to hypertension. In addition, the OB Teleflex group was given their nurse navigator's contact information to text or call during business hours for further inquiries, personal support, or to coordinate in-person evaluations. The routine care group received the clinic's phone number which is attended by OB nurses who could answer questions, provide support, and coordinate care. All labour and delivery care management were informed by hospital protocols and applied to both groups.

To determine the effect of hybrid prenatal telehealth, our primary end point was a composite of adverse perinatal and maternal outcomes evidenced to be associated with inadequate prenatal care. This composite outcome consisted of >1 of the following: NICU admission, hypertensive disorders of pregnancy, insufficient gestational weight gain, primary cesarean delivery, and spontaneous preterm birth.^{11–15} By combining relevant outcomes, we aimed to increase statistical power and provide a more robust measure of the overall impact of prenatal care on adverse pregnancy outcomes. The rate of primary cesarean deliveries is reported in comparison to vaginal deliveries,

Figure. OB Teleflex Program Outline. This figure displays the OB Teleflex program schematic. The top row describes routine visits which occur in person with an MD Obstetrician. The bottom row consists of telehealth visits which are unique to the OB Teleflex program and are conducted virtually with an OB Nurse Navigator. The OB Nurse Navigator is accessible via text outside of scheduled visits to answer questions, provide support, and coordinate in-person evaluation if needed.



BP: blood pressure; GBS: Guillain-Barré syndrome; PA: physician assistant; TDAP: tetanus-diphtheria and pertussis; US: ultrasound; Wks: weeks.

which comprises both spontaneous and assisted vaginal births. Cesarean deliveries were classified as scheduled or unscheduled. Scheduled cesarean deliveries included elective primary, elective repeat, or obstetrically indicated by a contraindication to labour. Unscheduled cesarean deliveries were deliveries performed after a trial of labour. Gestational weight gain was calculated using pre-pregnancy BMI and total weight gain, categorized as adequate, insufficient, or excessive according to the Institute of Medicine's guidelines.¹¹ Hypertensive disorders of pregnancy included gestational hypertension, preeclampsia without severe features and preeclampsia with severe features as classified by American College of Obstetricians and Gynecologists.¹⁸ Preterm birth was defined by spontaneous labour before 37⁰ weeks of gestational age. NICU admission included any neonates admitted to the unit postpartum. Secondary outcomes of interest abstracted from the electronic medical records (EMRs) included length of hospital stay (1–2 days, 3–4 days, or >5 days), birthweight (1500 g–2500 g, 2501 g–4000 g, or >4000 g), and breastfeeding initiation. Pregnancy-related complications such as polyhydramnios and gestational diabetes mellitus (GDM) were also collected.

Covariates were selected based on the literature review and our prior understanding of factors that may have the potential to influence program enrolment or the incidence of the primary outcome. Participants' demographics were obtained and included self-reported race and ethnicity (non-Hispanic Black, non-Hispanic Asian, non-Hispanic White, Hispanic, or other (classified as more than 1 race or unknown). Other demographic data collected included age at delivery (<35 or ≥35 years old), distance from facility (miles), and insurance status (public or private).^{18,19} Clinical information including parity (nulliparous or multiparous), pre-pregnancy BMI (kg/m²), history of GDM in a prior pregnancy, chronic hypertension, history of prior cesarean delivery, and contraindications to vaginal delivery (prior uterine surgery, malpresentation, or placenta previa) were also obtained.^{20–23}

Abstraction was performed by S.N. and D.L. with 10% of charts re-abstracted to ensure accuracy of >95% and any discrepancies were adjudicated by A.S.C.

Participants in the OB Teleflex program were compared to those who chose standard prenatal care over the specified study period. Participants' characteristics and outcomes are summarized in [Tables 1](#) and [2](#), using proportions for nominal variables and means for continuous variables. Univariate analyses of prognostically important covariates

Table 1. Baseline measures of OB Teleflex and standard prenatal care participants

Variables	OB Teleflex (n = 63)	Standard care (n = 284)	P> z
Race/ethnicity, n (%)			0.022
Non-Hispanic White	30 (48)	138 (49)	
Non-Hispanic Asian	6 (10)	42 (15)	
Non-Hispanic Black	17 (27)	34 (12)	
Hispanic	8 (13)	39 (14)	
Other	2 (3)	31 (11)	
Private insurance, n (%)	42 (71)	171 (60)	0.12
Parity, n (%)			0.011
Nulliparous	42 (67)	139 (49)	
Multiparous	21 (33)	145 (51)	
Maternal age, x (SD)	31 (6)	31 (4)	0.48
Distance to facility, x (SD)	96 (455)	27 (179)	0.055
Previous GDM, n (%)	2 (3)	14 (5)	0.75
Pre-pregnancy BMI, x (SD)	26 (6)	27 (7)	0.19
Chronic hypertension, n (%)	3 (5)	7 (2)	0.39
Prior cesarean, n (%)	2 (3)	40 (14)	0.017
Contraindication to VD, n (%)			1.00
Prior uterine surgery	0 (0)	1 (5)	
Placenta previa	1 (17)	4 (18)	
Uterine abnormality	1 (17)	2 (9)	
Breech	4 (67)	15 (68)	

GDM: gestational diabetes mellitus; VD: vaginal delivery.

on the composite of adverse outcomes and the individual components are available in [Supplementary Table S1](#).

To accurately evaluate the program effect, we employed the doubly robust estimation method, inverse-probability weighted regression adjustment. This approach produces unbiased estimates of the average treatment effect on the treated, providing a robust framework for causal inference. Propensity scores (PS) were calculated using a multivariate logistic regression to statistically balance OB Teleflex and standard of care groups across baseline measures related to treatment assignment. A patient's decision to participate in hybrid prenatal telehealth could be attributable to demographic factors, in addition to pre-existing conditions or comorbidities (i.e., chronic hypertension). All cases were weighted by the inverse probability of participating in the program, equal to 1/PS for OB Teleflex and 1/(1–PS) for traditional prenatal care, resulting in pseudo-populations balanced by age, race and ethnicity, insurance, distance from facility, parity, pre-pregnancy BMI, prior cesarean deliveries, chronic hypertension, and history of GDM. Using the estimated

Table 2. Outcomes of OB Teleflex and standard prenatal care participants

Variables	OB Teleflex (n = 63)	Standard care (n = 284)	P> z
Gestational age, n (%)			0.75
≥37 ⁰ wk	61 (97)	268 (95)	
<37 ⁰ wk	2 (3)	16 (6)	
GDM in index pregnancy, n (%)	4 (6)	25 (9)	0.62
Gestational hypertension, n (%)	10 (16)	45 (16)	1.00
Preeclampsia, n (%)	3 (5)	16 (6)	1.00
Polyhydramnios, n (%)	3 (5)	23 (8)	0.60
Gestational weight gain, n (%)			0.41
Appropriate	22 (35)	73 (28)	
Inadequate	13 (21)	72 (28)	
Excessive	27 (44)	114 (44)	
Cesarean delivery, n (%)	12 (19)	99 (35)	0.015
Indication for cesarean, n (%)			0.12
Unplanned cesarean	7 (58)	59 (60)	
Elective repeat cesarean	0 (0)	19 (19)	
Elective primary cesarean	1 (8)	2 (2)	
Contraindication to labour	4 (33)	19 (19)	
Breastfeeding initiation, n (%)	16 (25)	39 (14)	0.022
Birthweight class, n (%)			0.20
1501 g–2500 g	7 (11)	20 (7)	
2501 g–4000 g	52 (83)	226 (80)	
>4000 g	4 (6)	38 (13)	
NICU admission, n (%)	1 (2)	26 (9)	0.039
Length of stay (days), n (%)			0.016
1–2 days	21 (33)	92 (32)	
3–4 days	42 (67)	165 (58)	
>5 days	0 (0)	27 (10)	

GDM: gestational diabetes mellitus; NICU, neonatal intensive care unit.

inverse-probability weights, non-linear regression models compute treatment-specific predicted outcomes to estimate the average effect of hybrid prenatal telehealth on program participants. Standardized mean differences were calculated to assess covariate balance, with a standardized mean differences exceeding 0.2 indicating a meaningful imbalance that would necessitate additional adjustments in multivariate analysis (Supplementary Table S2).²⁴ Overidentification tests were performed to ensure the validity of comparisons between the OB Teleflex and standard of care groups.

A 2-sided *P* value of <0.05 was considered statistically significant and all statistical analyses were performed using STATA (version SE 17.0).

RESULTS

Out of 674 patients who delivered at our centre during the study period, 347 were eligible for the OB Teleflex program and met the study criteria. There were 63 (18%) patients who self-elected to participate in OB Teleflex compared to 284 (82%) who elected standard prenatal care. Demographic and baseline characteristics of OB Teleflex and standard prenatal care participants are summarized in Table 1. The cohort was diverse and consistent with our hospital population, with 15% of the total cohort self-identifying as non-Hispanic Black, 14% self-identifying as non-Hispanic Asian and 14% identifying as Hispanic (0.3% Hispanic Asian, 0.8% Hispanic Black, and 6.6% Hispanic White). Individuals who elected to participate in the OB Teleflex program were more likely to self-identify as non-Hispanic Black (27%), more likely to be primiparous (67%), and less likely to have a history of cesarean delivery (3%) when compared to those who elected routine care. Length of stay, NICU admission, breastfeeding initiation, and mode of delivery significantly differed between OB Teleflex and standard of care cohorts.

In the univariate analysis of the composite of adverse pregnancy outcomes, participation in OB Teleflex was not associated with a statistically significant reduction in the risk of adverse outcomes compared to standard in-person care (relative risk [RR] 0.85; 95% CI 0.64–1.13) (Supplementary Table S1). This finding remained true in the inverse-probability weighted regression adjustment multivariate model adjusted for variables confounding treatment selection and the outcome at baseline (RR 0.91; 95% CI 0.80–1.04). Unadjusted and adjusted analyses of the individual components of the composite adverse outcome revealed similar results as OB Teleflex did not significantly affect the risk of spontaneous preterm birth, hypertensive disorders of pregnancy, insufficient gestational weight gain, or primary cesarean delivery (Table 3). However, program participation was associated with a reduced RR of NICU admissions when compared to standard of care (RR 0.93; 95% CI 0.88–0.99).

DISCUSSION

Patients who selected our hybrid telehealth model differed by race and ethnicity, parity, and other baseline characteristics than those who selected routine in-person prenatal care. Participants' race differed between OB Teleflex and standard prenatal care cohorts, with more non-Hispanic Black individuals self-electing OB Teleflex services.

Table 3. Results of IPWRA estimator of OB Teleflex effect on composite adverse prenatal outcome and its individual components

Intervention	Adverse outcomes	Multivariate analysis		
		ATT	95% CI	P value
OB Teleflex Participation	Composite of combined outcomes	0.91	0.80–1.04	0.159
	NICU admission	0.93	0.88–0.99	0.018
	Primary cesarean delivery	0.96	0.79–1.15	0.638
	Spontaneous preterm birth	1.03	0.98–1.08	0.217
	Hypertensive disorders of pregnancy	1.08	0.97–1.20	0.183
	Insufficient gestational weight gain	0.75	0.84–1.12	0.696

Multivariate analysis of the IPWRA (inverse probability of regression adjustment) cohort adjusted for race and ethnicity, insurance, pre-pregnancy BMI, maternal age, parity, distance to facility, history of GDM, history of cesarean delivery, and chronic hypertension.

ATT: average treatment effect on the treated; GDM: gestational diabetes mellitus; NICU: neonatal intensive care unit; RR: relative risk.

Secondary outcomes including mode of delivery among all comers, breastfeeding initiation, NICU admission, and length of stay differed between the groups. Lastly, we identified comparable birth outcomes across OB Teleflex and standard care groups when assessing a composite of NICU admissions, spontaneous preterm birth, primary cesarean delivery, insufficient gestational weight gain, and hypertensive disorders of pregnancy. When solely examining NICU admissions, participation in hybrid telehealth conferred a reduced risk in comparison to the standard of care group. At a minimum, this suggests that hybrid prenatal care can achieve similar outcomes to routine prenatal care, and as others have suggested, may reduce barriers to care for some.^{4,6}

It is well established that patient-provider interactions are instrumental in determining the quality of care pregnant patients receive, and may ultimately influence their birth outcomes.^{17,24} Observational studies examining delivery outcomes of women who received antenatal and intrapartum care versus those who did not have shown significantly lower rates of maternal and perinatal mortality, demonstrating the benefits of prenatal care provision.⁷ Inadequate prenatal care utilization has been associated with adverse outcomes in pregnancy including hypertensive disorders of pregnancy or insufficient gestational weight gain, potentially due to untimely screening or the lack of counselling on healthy lifestyle habits.¹¹ However, evidence of an association between adverse perinatal outcomes and alternative prenatal care models is lacking.

Alternative prenatal care programs are typically adopted to improve accessibility and continuity of care using approaches like virtual or remote monitoring and are oftentimes accompanied by fewer in-person visits. Programs which target pregnancy-related health behaviours

such as vaccination uptake, smoking cessation, and breastfeeding initiation, are a few examples of non-traditional care models that have shown promise in improving some obstetric outcomes.^{5,8,9} We found similar rates of preterm birth, primary cesarean delivery, gestational weight gain, and hypertensive disorders of pregnancy among participants in our hybrid prenatal telehealth program, OB Teleflex compared to those receiving standard of care. Our findings suggest patients can have similar pregnancy outcomes using a hybrid telemedicine program which may portend more convenience by requiring fewer in-person prenatal visits when compared to standard in-person prenatal care. Furthermore, our study reaffirms the idea that flexible, patient-centred care can serve as an optional model for prenatal care that prioritizes patients' desire for convenience.

Our examination of the study population's preferences provides valuable insights into the appeal of alternative prenatal care among pregnant individuals. Participants in our hybrid telehealth program lived further away on average and were more likely to be nulliparous. Previous studies assessing patient preferences for prenatal care delivery saw that patients preferred fewer visits overall and most desired continued contact with their provider in between prenatal visits.^{25,26} As the current recommendation of 12–14 in-person prenatal visits proves impractical or inaccessible for some, patients are increasingly receptive toward novel forms of prenatal care.^{6,26} Some even identify remote monitoring as an instant solution to transportation challenges and timely access to care as one of the greatest advantages of telemedicine.¹ Patient preferences should be considered when creating alternative care models, as interventions emphasizing patient-provider communication and continuity of care have shown promise in improving health outcomes.^{16,26}

The utilization of antepartum and postpartum services by various subpopulations should be explored to determine which aspects of hybrid prenatal care incentivize participant engagement. Notably, a greater proportion of non-Hispanic Black women self-elected our hybrid prenatal telehealth program over standard of care. Given this population faces significant barriers to care and is more likely to endure adverse birth outcomes, this finding necessitates further investigation into how a hybrid approach to prenatal care, may help to address existing disparities in maternal health care by improving care administration.^{1,27}

Ancillary studies should focus on surveying patients about their experiences with the OB Teleflex program, to evaluate the overall satisfaction and cost-effectiveness of this program, especially within this population. While the underlying factors contributing to inequities in birth outcomes are multifaceted, interventions like OB Teleflex, which highlight patient-provider communication and continuity of care, may have the potential to improve outcomes and mitigate disparities in reproductive health.

Our study has several strengths. The study cohort is diverse making our findings more generalizable to other urban clinics. Our EMR is comprehensive, and all race and ethnicity information is obtained from self-reported data. Collecting self-reported race and ethnicity data for our study upholds the fundamental human right to accurately define one's ancestral heritage, thereby respecting patients' identities and fostering inclusivity in research.²⁸ Additionally, to reduce potential selection bias and account for unmeasured confounding, we used inverse-probability weighting with regression adjustment to improve the robustness of effect estimates of OB Teleflex participation. Finally, our intervention, OB Teleflex, is an innovative and pragmatic way to reduce in-person visits for patients who may have barriers to care, while still providing the education and support that are vital in pregnancy.

Our study findings should be taken in the context of some limitations. There is a possibility of recruitment bias in our study, as not all potential participants may have had a delivery record that could be linked to their prenatal encounters on the EMR. Additionally, OB Teleflex utilization was assessed in a binary manner, potentially overlooking nuances in participant engagement with various components of the program. For instance, factors such as time spent with the nurse navigator, or the extent of education and support received were not comprehensively measured. Further research is warranted to delve deeper into these components and identify which key factors drive participant benefit. Information regarding patient's socioeconomic background, their mental health status, and access

to transportation were not readily available in the EMR and could not be controlled for. Our analyses on birth outcomes of primiparous patients in OB Teleflex was limited by a small sample size. A larger study focusing on the implications of hybrid telehealth in exclusively multiparous or primiparous populations are needed to determine the benefits of alternative prenatal care models in this subpopulation as they encounter prenatal care for the first time. Our study sample size and EMR availability greatly limited our analysis of perinatal survival and neonatal outcomes. Future studies with larger cohorts are needed to confirm these findings.

Our findings underscore the potential significance of hybrid prenatal telehealth in obstetrics.

Participation in OB Teleflex, which we consider to be a more convenient model of prenatal care for patients compared to standard in-person care, did not lead to worse birth outcomes. With its commitment to accessible and patient-centred care, innovative programs like OB Teleflex have the potential to redefine traditional prenatal care by mitigating persistent barriers without compromising the quality of care and outcomes.

ETHICS

This study was approved and determined to be exempt by the Tufts Health Sciences Institutional Review Board (STUDY00003104).

NOTES

This manuscript was presented during the Society for Maternal-Fetal Medicine 43rd Annual Pregnancy Meeting as a poster in February 2024.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jogc.2025.102911>.

REFERENCES

1. George SM, Hamilton A, Baker R. Pre-experience perceptions about telemedicine among African Americans and Latinos in South Central Los Angeles. *Telemed J E Health* 2009;15:525–30.
2. Marcini JP, Shaikh U, Steinhorn RH. Addressing health disparities in rural communities using telehealth. *Pediatr Res* 2016;79:169–76.
3. Noah B, Keller MS, Mosadeghi S, et al. Impact of remote patient monitoring on clinical outcomes: an updated meta-analysis of randomized controlled trials. *NPJ Digit Med* 2018;1:20172.

4. Peahl AF, Smith RD, Moniz MH. Prenatal care redesign: creating flexible maternity care models through virtual care. *Am J Obstet Gynecol* 2020;223:389.e1–10.
5. DeNicola N, Grossman D, Marko K, et al. Telehealth interventions to improve obstetric and gynecologic health outcomes: a systematic review. *Obstet Gynecol* 2020;135:371–82.
6. Kern-Goldberger AR, Srinivas SK. Obstetrical telehealth and virtual care practices during the COVID-19 pandemic. *Clin Obstet Gynecol* 2022;65:148–60.
7. Dowswell T, Carroli G, Duley L, et al. Alternative versus standard packages of antenatal care for low-risk pregnancy. *Cochrane Database Syst Rev* 2015;2015:CD000934.
8. Stockwell MS, Westhoff C, Kharbanda EO, et al. Influenza vaccine text message reminders for urban, low-income pregnant women: a randomized controlled trial. *Am J Public Health* 2014;104(Suppl 1):e7–12.
9. Abrams LC, Johnson PR, Leavitt LE, et al. A randomized trial of text messaging for Smoking Cessation in pregnant women. *Am J Prev Med* 2017;53:781–90.
10. Theiler RN, Butler-Tobah Y, Hathcock MA, et al. OB Nest randomized controlled trial: a cost comparison of reduced visit compared to traditional prenatal care. *BMC Pregnancy Childbirth* 2021;21:71.
11. Yeo S, Crandell JL, Jones-Vessey K. Adequacy of prenatal care and gestational weight gain. *J Womens Health (Larchmt)* 2016;25:117–23.
12. Dutra GRSDF, Dutra LDC, Fonsêca GKSD, et al. Prenatal care and hypertensive gestational syndromes: a systematic review. *Rev Bras Ginecol Obstet* 2018;40:471–6.
13. Milcent C, Zbiri S. Prenatal care and socioeconomic status: effect on cesarean delivery. *Health Econ Rev* 2018;8:7.
14. Krueger PM, Scholl TO. Adequacy of prenatal care and pregnancy outcome. *J Am Osteopath Assoc* 2000;100:485–92.
15. Malhi R, Nussey L, Krueger S, et al. 153 neonatal outcomes of inadequate prenatal care. *Paediatr Child Health* 2019;24(Suppl 2):e61.
16. Cabana MD, Jee SH. Does continuity of care improve patient outcomes? *J Fam Pract* 2004;53:974–80.
17. Kennedy BM, Rehman M, Johnson WD, et al. Healthcare Providers versus Patients' Understanding of Health Beliefs and Values. *Patient Exp J* 2017;4:29–37.
18. Gestational hypertension and preeclampsia. ACOG practice bulletin, number 222. *Obstet Gynecol* 2020;135:e237–60.
19. Crane SS, Wojtowycz MA, Dye TD, et al. Association between pre-pregnancy obesity and the risk of cesarean delivery. *Obstet Gynecol* 1997;89:213–6.
20. Ramos Filho FL, Antunes CMF. Hypertensive disorders: prevalence, perinatal outcomes and Cesarean section rates in pregnant women hospitalized for delivery. *Rev Bras Ginecol Obstet* 2020;42:690–6.
21. Dempsey JC, Ashiny Z, Qiu CF, et al. Maternal pre-pregnancy overweight status and obesity as risk factors for cesarean delivery. *J Matern Fetal Neonatal Med* 2005;17:179–85.
22. Pasokpuckdee K, Boriboonhirunsarn D. Incidence of preeclampsia and Cesarean section rate according to the Robson classification. *Cureus* 2023;15:e49845.
23. Stuart EA, Lee BK, Leacy FP. Prognostic score-based balance measures can be a useful diagnostic for propensity score methods in comparative effectiveness research. *J Clin Epidemiol* 2013;66(Suppl):S84–90.e1.
24. Dahlem CHY, Villarruel AM, Ronis DL. African American women and prenatal care: perceptions of patient-provider interaction. *West J Nurs Res* 2015;37:217–35.
25. Kozinszky Z, Orvos H, Zoboki T, et al. Risk factors for cesarean section of primiparous women aged over 35 years. *Acta Obstet Gynecol Scand* 2002;81:313–6.
26. Peahl AF, Novara A, Heisler M, et al. Patient preferences for prenatal and postpartum care delivery: a survey of postpartum women. *Obstet Gynecol* 2020;135:1038–46.
27. Peahl AF, Moniz MH, Heisler M, et al. Experiences with prenatal care delivery reported by Black patients with low income and by health care workers in the US: a qualitative study. *JAMA Netw Open* 2022;5:e2238161.
28. Witzig RS. The right to identity: implications of using subjectively-assigned race in US healthcare. *Soc Med* 2014;8:43–52.