



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

OBSTETRICS

Patient and provider perspectives of a new prenatal care model introduced in response to the coronavirus disease 2019 pandemic



Alex F. Peahl, MD; Allison Powell, MSE; Hanna Berlin, BS; Roger D. Smith, MD; Elizabeth Krans, MD; Jennifer Waljee, MD; Vanessa K. Dalton, MD; Michele Heisler, MD; Michelle H. Moniz, MD

BACKGROUND: Randomized controlled trials document the safety and efficacy of reduced frequency prenatal visit schedules and virtual visits, but real-world data are lacking. Our institution created a prenatal care delivery model incorporating these alternative approaches to continue safely providing prenatal care during the coronavirus disease 2019 pandemic.

OBJECTIVE: To evaluate institutional-level adoption and patient and provider experiences with the coronavirus disease 2019 prenatal care model.

STUDY DESIGN: We conducted a single-site evaluation of a coronavirus disease 2019 prenatal care model incorporating a reduced frequency visit schedule and virtual visits deployed at a suburban academic institution on March 20, 2020. We used electronic health record data to evaluate institution-level model adoption, defined as changes in overall visit frequency and proportion of virtual visits in the 3 months before and after implementation. To evaluate the patient and provider experience with the coronavirus disease 2019 model, we conducted an online survey of all pregnant patients (>20 weeks' gestation) and providers in May 2020. Of note, 3 domains of care experience were evaluated: (1) access, (2) quality and safety, and (3) satisfaction. Quantitative data were analyzed with basic descriptive statistics. Free-text responses coded by the 3 survey domains elucidated drivers of positive and negative care experiences.

RESULTS: After the coronavirus disease 2019 model adoption, average weekly prenatal visit volume fell by 16.1%, from 898 to 761 weekly visits; the average weekly proportion of prenatal visits conducted virtually increased from 10.8% (97 of 898) to 43.3% (330 of 761); and the average visit no-show rate remained stable (preimplementation, 4.3%; postimplementation, 4.2%). Of those eligible, 74.8% of providers (77 of 103) and 15.0% of patients (253 of 1690) participated in the surveys. Patient respondents were largely white (180 of 253; 71.1%) and privately insured (199 of 253; 78.7%), reflecting the study site population. The rates of chronic conditions and pregnancy complications also differed from national prevalence. Provider respondents were predominantly white (44 of

66; 66.7%) and female (50 of 66; 75.8%). Most patients and almost all providers reported that virtual visits improved access to care (patients, 174 of 253 [68.8%]; providers, 74 of 77 [96.1%]). More than half of respondents (patients, 124 of 253 [53.3%]; providers, 41 of 77 [62.1%]) believed that virtual visits were safe. Nearly all believed that home blood pressure cuffs were important for virtual visits (patients, 213 of 231 [92.2%]; providers, 63 of 66 [95.5%]). Most reported satisfaction with the coronavirus disease 2019 model (patients, 196 of 253 [77.5%]; providers, 64 of 77 [83.1%]). In free-text responses, drivers of positive care experiences were similar for patients and providers and included perceived improved access to care through decreased barriers (eg, transportation, childcare), perceived high quality of virtual visits for low-risk patients and increased safety during the pandemic, and improved satisfaction through better patient counseling. Perceived drivers of negative care experience were also similar for patients and providers, but less common. These included concerns that unequal access to virtual visits could deepen existing maternity care inequities, concerns that the lack of home devices (eg, blood pressure cuffs) would affect care quality and safety, and dissatisfaction with poor patient-provider continuity and inadequate expectation setting for the virtual visit experience.

CONCLUSION: Reduced visit schedules and virtual visits were rapidly integrated into real-world care, with positive experiences for many patients and providers. Future research is needed to understand the health outcomes and care experience associated with alternative approaches to prenatal care delivery across more diverse patient populations outside of the coronavirus disease 2019 pandemic to inform broader health policy decisions.

Key words: antenatal care, care delivery, coronavirus disease 2019, gestational diabetes mellitus screening, patient-centered care, postpartum care, prenatal care, telemedicine, ultrasound, vaccination, virtual care

Cite this article as: Peahl AF, Powell A, Berlin H, et al. Patient and provider perspectives of a new prenatal care model introduced in response to the coronavirus disease 2019 pandemic. *Am J Obstet Gynecol* 2021;224:384.e1-11.

0002-9378/\$36.00

© 2020 Elsevier Inc. All rights reserved.

<https://doi.org/10.1016/j.ajog.2020.10.008>



Click [Video](#) under article title in Contents at [ajog.org](#)

Introduction

Prenatal care is one of the most common preventive healthcare services in the United States, used by almost 4 million women each year.¹⁻¹⁰ Nonetheless, existing guidelines, which have remained largely unchanged since 1930, recommend a uniform schedule of 14 in-person visits for all women.¹¹ During the coronavirus disease 2019 (COVID-19) pandemic, the United States experienced the largest transition in prenatal

care delivery in almost a century—several alternative prenatal care approaches were rapidly implemented to ensure access to prenatal services while maintaining social distancing, including reduced frequency visits and virtual visits.^{12,13}

Although randomized controlled trials (RCTs) of reduced frequency visits and virtual visits during pregnancy are promising, these approaches are understudied in real-world settings. Existing

AJOG at a Glance

Why was this study conducted?

Alternative approaches to prenatal care delivery (eg, reduced visit frequency and virtual visits) were used during the coronavirus disease 2019 (COVID-19) pandemic to prevent viral transmission. We evaluated a COVID-19 prenatal care model at a single site, including institution-level model adoption and patient and provider experiences of care (ie, access, quality and safety, satisfaction).

Key findings

After the adoption of the COVID-19 prenatal care model, the average weekly prenatal care visit frequency decreased from 898 to 761 visits and the proportion of virtual visits increased from 10.8% to 43.3%. More than 75% of respondents were satisfied with the model, and factors associated with a positive experience included ease, convenience, and improved access. Factors associated with a negative experience included concerns about access inequities, virtual visit quality and safety without home devices (blood pressure cuffs), and poor patient-provider continuity.

What does this add to what is known?

Early findings on the COVID-19 prenatal care model at a single institution are promising but require further evaluation in more diverse populations.

data are limited by highly controlled settings and minimal evaluations of patient or provider perspectives.^{14,15} Thus, the COVID-19 pandemic provides a unique opportunity to evaluate reduced visit schedules and virtual visits in real-world settings. Early findings on alternative prenatal care approaches are critical to helping hospitals and health systems make decisions on how to sustain or modify COVID-19-related prenatal care adaptations made rapidly in response to the pandemic.

In March 2020, our institution deployed a COVID-19 prenatal care model, incorporating reduced frequency visits and virtual visits in response to the pandemic.¹² The objective of this study is to evaluate initial adoption and patient and provider care experience with this model at a single institution, to provide early data on alternative prenatal care approaches launched during the pandemic.

Methods**Study design and data sources**

We conducted a retrospective evaluation of institution-level adoption of a COVID-19 prenatal care model using electronic health record (EHR) data and a survey of patient and provider care

experience. The University of Michigan Institutional Review Board deemed this study exempt (HUM00181021) on April 29, 2020.

Setting

Our suburban academic institution includes more than 150 maternity care providers (including 63 resident physicians), who care for 5000 pregnant patients annually across 12 ambulatory care sites. Our approach for developing the COVID-19 prenatal care model has been described elsewhere.¹² Briefly, we designed a basic prenatal visit schedule, with in-person visits scheduled around evidence-based services that could only be delivered in person, such as laboratory tests and vaccines. Virtual visits were scheduled between in-person visits to provide anticipatory guidance, psychosocial support, and additional services as needed. Guidelines for patients with high-risk conditions (eg, chronic hypertension) were developed with maternal-fetal medicine physicians and were based on the low-risk schedule with additional visits and services (eg, antenatal testing) as appropriate. These plans were implemented within 48 hours, on March 20, 2020, and our prenatal care model was endorsed by national

maternity care organizations for use during the pandemic.¹³ Trained medical students called patients to explain changes in prenatal care and how to obtain home devices (eg, blood pressure cuffs) for use with virtual visits. Device availability was not required for participation. A total of 2 weeks after the COVID-19 model was launched, our organization received a donation of blood pressure cuffs, which were offered to all patients in the third trimester. When the COVID-19 prenatal care model was launched, providers were assigned to cover either inpatient or outpatient care to minimize viral exposure and ensure workforce preservation—disrupting existing outpatient patient-provider continuity.

Measures of coronavirus disease 2019 prenatal care model adoption

Using EHR data, we queried all prenatal visits 3 months before and after the implementation of the new model to understand model adoption (December 16, 2019, to June 28, 2020). We assessed the institutional average weekly visit volume and proportion of visits completed virtually, by week, and averaged over the pre- and post-implementation period. In addition, we calculated the no-show rate and the number of travel miles avoided through virtual care using the patient's address in the EHR and their outpatient clinic site.

Measures of patient and provider care experience**Participants**

All patients at >20 weeks' gestation who were receiving prenatal care at our institution and registered for the EHR portal during the survey fielding window received a 1-time message through the EHR inviting them to participate. Of note, more than 90% of pregnant patients at our institution are active on the EHR portal. All maternity care providers (general obstetricians and gynecologists, maternal-fetal medicine physicians, family medicine physicians, and certified nurse midwives) were invited through division Listservs and announcements at departmental meetings. We did not include resident physicians in our

survey, because most did not provide outpatient prenatal care during the pandemic.

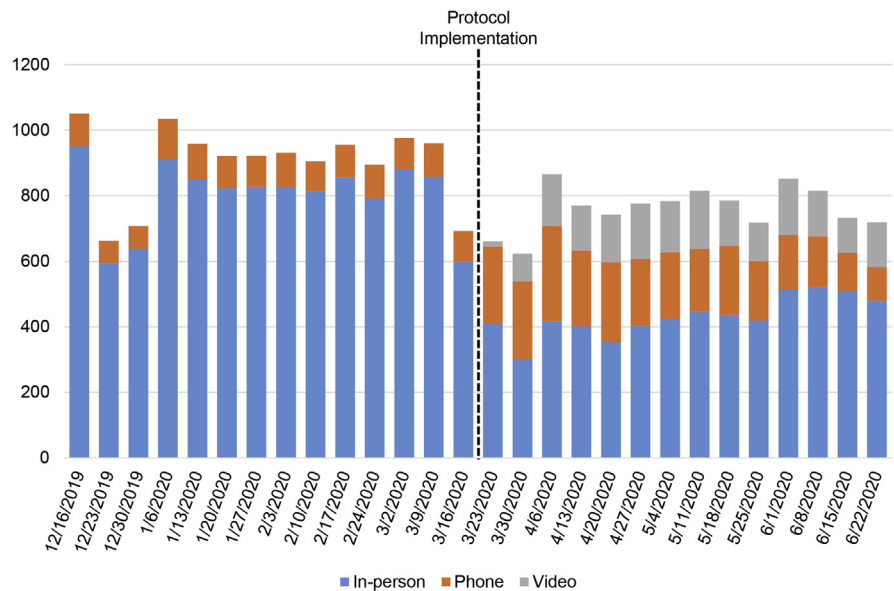
Instruments

We used the Qualtrics software (Provo, UT) to develop 2 new survey instruments—1 each for patients and providers—based on validated measures when available. Experts in survey methodology (M.H. and M.H.M.), maternity care innovations (A.F.P. and R.D.S.), and our institution's patient experience team for virtual care reviewed both surveys before deployment. Surveys were adapted from the Telehealth Usability Questionnaire, a validated instrument for assessing patients' and providers' perceptions of telemedicine,¹⁶ and focused on the following 3 key domains: (1) access (the ability to receive recommended services); (2) quality and safety (the ability to effectively deliver medical services, including use of home devices [blood pressure cuffs, fetal Dopplers]); and (3) satisfaction (the overall desire to use virtual visits). To assess the role of home devices, patients and providers reported their agreement with the statement "It is important for patients to have blood pressure cuffs/fetal Dopplers for virtual visits." Patients also reported whether they used home devices. We assessed demographic data using questions developed from the United States Census¹⁷ adapted from previous survey work with pregnant patients and their providers.¹⁸ Finally, patient and provider surveys included free-text questions on key domains of care experience (access, quality and safety, satisfaction) to provide a richer qualitative understanding of the drivers of variation in survey outcomes.

Analysis

Quantitative EHR data and survey responses were summarized using basic descriptive statistics. All results, including the number of respondents and proportions, were reported for the total number of patients or providers who answered each question.¹⁹ Survey analyses were performed with Qualtrics software. Free-text responses were qualitatively coded using the 3 experience

FIGURE 1
Average total, in person, and virtual prenatal visit utilization



Peahl et al. New prenatal care model. Am J Obstet Gynecol 2021.

domains by 2 authors (A.P. and H.B.). Emerging subthemes within each domain were reviewed with additional authors (A.F.P. and M.H.M.) and applied to all qualitative responses by 2 authors (patients, A.P. and A.F.P.; providers, H.B. and A.F.P.). Discrepancies were discussed until consensus was reached. Free-text responses were integrated in a joint display comparing patient and provider responses across the 3 domains. Because patient and provider themes were similar, we report results by positive and negative care experiences across the 3 domains to elucidate drivers of varying care experiences.^{20,21}

Results

Coronavirus disease 2019 prenatal care model adoption

After the adoption of the COVID-19 model, institution-level weekly prenatal care visit volume decreased by 31.6%, from 1051 visits during the week of December 16, 2020, to 719 visits during the week of June 28, 2020. During this time, virtual visits also increased from 101 to 239 (136.6%). Across the pre- and postimplementation periods, the average total visit volume fell from 898 to 765

visits (16.1%), and the average weekly proportion of virtual prenatal visits increased from 10.8% (97 of 898) to 43.3% (330 of 761)—video visits from 0.0% (0 of 898) to 17.0% (124 of 761) and phone visits from 10.8% (97 of 898) to 26.3% (124 of 761). These changes were sustained over the postimplementation period (Figure 1). The 1265 patients seen over the study period saved more than 40,000 miles of travel through the conversion of in-person visits to virtual care.

Patient and provider care experience

Of the 1690 eligible patients, 253 (15.0%) responded to the survey. Patient demographics matched the characteristics of the study site's general population: mean age, 31.2 years (standard deviation, 6.7), predominantly white (180 of 253; 71.1%), privately insured (199 of 253; 78.7%), and multiparous (133 of 253; 52.6%). Only 11.9% of respondents (30 of 253) saw a high-risk doctor during their pregnancy. Rates of most chronic conditions (diabetes mellitus²² and depression²³) matched the national population prevalence estimates,

TABLE 1
Characteristics of patient survey respondents

Characteristic	N=253
Race	
American Indian or Alaska Native	2 (0.8)
Asian	10 (4.0)
Black or African American	14 (5.5)
Hispanic or Latino	5 (2.0)
White	180 (71.1)
≥2	7 (2.8)
I prefer not to say	9 (3.6)
Did not respond	26 (10.3)
Age	
Y ^a	31.2±6.7
Did not respond	25 (9.9)
Insurance	
Public insurance (Medicaid)	27 (10.7)
Private insurance	199 (78.7)
No insurance	2 (0.8)
Did not respond	25 (9.9)
Education	
Some high school	6 (2.4)
High school graduate or equivalent	10 (4.0)
Some college	24 (9.5)
Trade or technical or vocational school	3 (1.2)
Associate's degree	17 (6.7)
Bachelor's degree	78 (30.8)
Advanced degree	90 (35.6)
Did not respond	25 (9.9)
Confidence in filling out health forms	
Extremely	195 (77.1)
Somewhat	26 (10.3)
Very little	3 (1.2)
Not at all	4 (1.6)
Did not respond	25 (9.9)
Employment status	
Employed for wages	145 (57.3)
Self-employed	18 (7.1)
Out of work	22 (8.7)
Homemaker	26 (10.3)
Student	9 (3.6)
Military	1 (0.4)
Retired	0 (0.0)

Peahl et al. New prenatal care model. Am J Obstet Gynecol 2021.

(continued)

although the rates of chronic hypertension,²⁴ hypertensive disorders of pregnancy,²⁵ and gestational diabetes mellitus²⁶ were slightly higher in the study population. The rates of preterm birth were lower than the national population prevalence rates²⁷ (Table 1). Of the 103 eligible providers, 77 (74.8%) responded. Providers who completed the demographic questions were predominantly female (50 of 66; 75.8%), white (44 of 66; 66.7%), and general obstetricians and gynecologists (23 of 66; 34.9%) or Family Medicine physicians (25 of 66; 37.9%) (Table 2).

Patient and provider survey data on care experience (access, quality and safety, satisfaction) are presented in Table 3, and the joint display of quantitative survey outcomes and qualitative data from the free-text survey questions is shown in Figure 2. Each domain is explored individually below. All free-text questions were completed by 68.8% (53 of 77) and 59.3% (150 of 253) of patients and providers, respectively.

Access

Overall, many patients and almost all providers reported that the COVID-19 prenatal care model improved patients' access to prenatal care (patients, 174 of 253 [68.8%]; providers, 74 of 77 [96.1%]). Most reported that using virtual visits was easy (patients, 235 of 253 [92.9%]; providers, 68 of 77 [88.3%]). More providers than patients reported technical issues (patients, 20 of 253 [7.9%]; providers, 30 of 77 [39.0%]).

In free-text responses, patients and providers reported positive access experiences: virtual visits removed traditional barriers to care, such as employment, childcare, travel time, and clinic inefficiencies. Negative themes included concerns that barriers to care might disproportionately affect vulnerable populations—the ability to afford home devices and access to reliable smart devices and internet were seen as important barriers to equity.

Quality and safety

Fewer than half of patients and providers agreed with the statement “The quality of virtual visits is the same as

TABLE 1
Characteristics of patient survey respondents (continued)

Characteristic	N=253
Unable to work	7 (2.8)
Did not respond	25 (9.9)
Marital status	
Single	9 (3.6)
In a relationship	19 (7.5)
Married	199 (78.7)
Separated	1 (0.4)
Did not respond	25 (9.9)
Prenatal care provider	
Obstetrician and gynecologist	171 (67.6)
Family Medicine physician	16 (6.3)
Certified nurse-midwife	63 (24.9)
Nurse practitioner	22 (8.7)
Community doula	1 (0.4)
Did not respond	28 (11.0)
Pregnancy duration	
Wk ^a	30.1±5.5
Did not respond	27 (10.7)
Previous pregnancy	
Yes	133 (52.6)
No	94 (37.2)
Did not respond	26 (10.3)
High-risk provider	
Yes	30 (11.9)
No	197 (77.9)
Did not respond	26 (10.3)
Pregnancy complications	
None	131 (51.8)
Hypertensive disorder of pregnancy	25 (9.9)
Diabetes mellitus	20 (8.0)
Preterm labor	9 (3.6)
Fetal anomalies	19 (7.5)
Other	68 (26.9)

Peahl et al. New prenatal care model. Am J Obstet Gynecol 2021.

(continued)

exposure during the pandemic. Themes associated with negative quality and safety experiences included concerns that usual prenatal care measurements, including blood pressure and fetal heart tones, were not incorporated into the model. This contributed to the sense that something could “be missed” leading to delayed diagnosis of pregnancy complications.

Home devices were seen as important for patient and provider comfort—92.2% of patients (213 of 231) and 95.5% of providers (63 of 66) believed that a home blood pressure cuff was important for virtual prenatal visits, and 84.8% of patients (196 of 231) and 71.2% of providers (47 of 66) believed that a home fetal Doppler was important. Of the patients surveyed, 36.1% (84 of 233) purchased a blood pressure cuff, 20.2% (47 of 233) received a cuff at their 28-week visit, and 8.8% (9 of 102) without cuffs identified cost as a barrier. Although fetal Dopplers were not offered through the clinic, 25.1% of patients (58 of 231) purchased them. In free-text responses, patients and providers emphasized the importance of home device use in conjunction with virtual visits.

Satisfaction

Most patients and providers felt prepared to conduct virtual prenatal visits (patients, 231 of 253 [91.3%]; providers, 70 of 79 [88.6%]). Patients and providers both reported satisfaction with virtual visits (patients, 196 of 253 [77.5%]; providers, 64 of 77 [83.1%]), but more providers than patients reported willingness to continue them after the pandemic (patients, 102 of 253 [40.3%]; providers, 71 of 77 [92.2%]).

In free-text responses, patients and providers identified the need for improved preparation for virtual visits, including setting clearer expectations (eg, visit structure, time). Themes associated with high satisfaction included improved communication and counseling during virtual visits, facilitated by the patient’s comfort in their own home and the ability to focus on patient questions and concerns. In addition, both groups reflected on the improvement in patients having a more active

in-person care” (patients, 94 of 253 [37.1%]; providers, 35 of 77 [45.5%]), although more than half agreed that “virtual prenatal care is as safe as in-person care” (patients, 124 of 233 [53.2%]; providers, 41 of 66 [62.1%]).

In free-text responses, patients and providers reported the new schedule better fit the needs of low-risk women by eliminating low-value visits. An additional theme associated with positive quality and safety experiences included the new model’s reduction of viral

TABLE 1
Characteristics of patient survey respondents (continued)

Characteristic	N=253
Chronic health problems	
Hypertension	8 (3.2)
Diabetes mellitus	2 (0.8)
Asthma	30 (11.9)
Depression	30 (11.9)
Other	17 (6.7)
Did not respond	181 (71.5)

Values are expressed as number (percentage) unless indicated otherwise.

^a Mean ± standard deviation.

Peahl et al. New prenatal care model. Am J Obstet Gynecol 2021.

role in their care through putting tools, like home devices, in patients' hands. Themes associated with lower satisfaction included concerns about continuity, difficulty maintaining patient-provider relationships in new care models, and the belief that virtual contact is not a perfect substitute for in-person relationship building. Both groups recognized that the COVID-19 prenatal care model may be more difficult for first-time moms, who may desire additional anticipatory guidance.

Comment

Principal findings

A COVID-19 prenatal care model, including reduced frequency visits and virtual visits, was rapidly adopted at a single institution caring for a largely white, privately insured, highly educated population of pregnant patients. Average weekly visit volume fell by 16.1% and virtual visit volume increased by 43.3% in the 3 months after compared with before model implementation. In the subset of patients and providers who participated in the study, satisfaction was high. Key cited advantages over usual care included perceptions of improved access and patient engagement. Although more than half of respondents perceived the COVID-19 model as safe, virtual care was not seen as having equal quality as in-person visits. We identified several important areas for improvement: patient and provider participants agreed that new models must (1) ensure

equitable access to virtual services, (2) address quality and safety concerns through routine use of home devices with virtual visits, and (3) support satisfaction through patient-provider continuity and setting clear expectations about prenatal care from the beginning of pregnancy.

Results

Our study suggests a prenatal care model combining reduced frequency visits and virtual visits is associated with positive care experiences for many, but not all, patients and providers. Ensuring availability of home devices, continuity, and improved introduction to virtual care are important considerations for institutions continuing to use these alternative approaches to prenatal care delivery. Our findings match previous work demonstrating patients have a wide range of preferences for prenatal care delivery, including visit number and modality.¹⁸ Although our study included predominantly privately insured patients, new care models may be particularly advantageous for patients who face the greatest barriers to care, such as transportation, employment, and childcare, as long as patients have access to broadband internet and desire connecting with their care team in this fashion.^{28,29} In fact, by converting visits to a virtual modality, our patients collectively saved 40,000 travel miles in 3 months—using the standard Internal Revenue Service mileage rate for vehicle

wear (\$0.575), this equates to more than \$22,700 saved by patients in travel costs alone, not including reductions in childcare burden or the opportunity cost of missed work.³⁰ Notably, fewer patients than providers perceived an improvement in care access. Future work should explore the role of patient preference in selecting appropriate prenatal care models and how acceptability of virtual care differs outside of a pandemic.

Clinical implications

Our study was conducted in a suburban, predominantly white, privately insured population and does not adequately represent the views of often marginalized groups who experience disproportionately high rates of medical and psychosocial risk factors (eg, chronic conditions, food insecurity^{31–33}), adverse birth outcomes (eg, severe maternal morbidity and mortality^{34,35}), and negative interactions with the healthcare system (eg, discrimination^{36,37}). More representative perspectives are needed to inform local care decisions and broader policy initiatives. Some patients may desire more visits, a different balance of virtual and in-person visits, or augmentation of services (eg, home visits, group prenatal care services) to ensure comprehensive care that meets individuals' preferences. In addition, many patients may lack access to broadband internet or smart devices—necessary tools for participating in virtual prenatal care.²⁹ Advocacy to expand the ACCESS Broadband Act³⁸ and continue coverage of video and phone visits at parity with in-person visits is important for ensuring equity.

Importantly, many patients and providers expressed concerns about the safety of virtual care, and half of both groups reported that the quality of virtual visits was not equivalent to in-person care. Of note, in qualitative responses, the majority of both patients' and providers' worries were linked to the concern about performing virtual care without home devices and missing pregnancy complications such as hypertension in pregnancy. Guaranteeing payer coverage of home devices,

including blood pressure cuffs and Dopplers, without out-of-pocket costs will be important for model acceptability for patients and providers. Other concerns about quality may have been linked to inadequate preparation for visits and lack of continuity. It is possible that when virtual visits are preceded by clear expectations and in-person contact with the same provider, their overall quality will be better perceived. Finally, many patients and providers reported virtual care was acceptable as a way to safely receive care while minimizing exposure to COVID-19; it remains to be seen whether patients and providers will weigh risks and benefits of virtual services similarly after the acute months of the pandemic.

Our findings are informing specific changes to our institution's prenatal care model. First, we have designed patient-facing materials for the first prenatal appointment to help patients understand the new model, including visit schedule, structure of virtual visits, and available resources. We will use shared decision making to help patients determine the best visit number and visit modality for their preferences and needs. For patients selecting virtual care, we will secure home devices for them from their first prenatal appointment, through insurance coverage, health savings accounts, individual purchase, or donation. We will validate devices in the clinic and provide education on proper use. Finally, our institution has returned to usual outpatient provider staffing, facilitating improved patient-provider continuity.

Research implications

Although meta-analysis—level data support the use of reduced visit schedules for low-risk patients, the traditional prenatal care delivery model (eg, 12–14 in-person visits) or the COVID-19 model evaluated in this study has not been studied in rigorous, randomized trials across different care settings and among diverse patient groups.³⁹ High-quality evidence on the impact of prenatal care models on maternal and neonatal health outcomes is of utmost importance. Although new care models

TABLE 2
Characteristics of provider survey respondents

Characteristic	N=66
Sex	
Male	7 (10.6)
Female	50 (75.8)
Prefer not to say	4 (6.1)
Did not respond	5 (7.6)
Postresidency, y	
1–5	19 (28.8)
5–10	13 (19.7)
10–15	12 (18.2)
15–20	4 (6.1)
>20	13 (19.7)
Did not respond	5 (7.6)
Identify as Spanish, Hispanic, or Latinx	
Yes	2 (3.0)
No	59 (89.4)
Did not respond	5 (7.6)
Race	
White	44 (66.7)
Black or African American	3 (4.6)
Asian	4 (6.1)
American Indian or Alaska Native	0 (0.0)
Native Hawaiian or other Pacific Islander	0 (0.0)
≥2	3 (4.6)
I prefer not to say	7 (10.6)
Did not respond	5 (7.6)
Division	
General obstetrics and gynecology	23 (34.9)
Gynecology	2 (3.0)
Maternal-fetal medicine	3 (4.6)
Certified nurse midwifery	8 (12.1)
Family medicine	25 (37.9)
Did not respond	5 (7.6)

Values are expressed as number (percentage) unless indicated otherwise.

Peahl et al. *New prenatal care model. Am J Obstet Gynecol* 2021.

may improve access, efficiency, and experience, there is a potential for unintended maternal and neonatal health consequences such as delayed diagnosis of obstetrical complications, including hypertensive disorders of pregnancy, intrauterine growth restriction, and others. In addition, although new

approaches to prenatal care strive to reduce barriers to care, there is a potential for accidental deepening of existing inequities through the digital divide or perpetuation of patient-provider mistrust. A retrospective evaluation of new approaches to prenatal care will be challenging in nationwide

TABLE 3

Patients' and providers' agreement with questions regarding experiences with the COVID-19 prenatal care model^a

Question	Patients (n=253)	Providers (n=77)
Telemedicine experience		
Access		
Virtual visits improve access to health services.	174 (68.8)	74 (96.1)
It is easy to do virtual visits.	235 (92.9)	68 (88.3)
I had technical issues with virtual visits.	20 (7.9)	30 (39.0)
Quality and safety		
I was able to express myself effectively during virtual visits.	213 (84.2)	73 (94.8)
The quality of virtual visits is the same as in-person care.	94 (37.1)	35 (45.5)
I think the virtual visits are as safe as in-person visits.	164 (64.8)	50 (65.0)
Patient satisfaction		
I felt well-prepared to do virtual visits.	231 (91.3)	70 (88.6)
I think virtual visits are a positive change for patients.	154 (60.9)	54 (70.1)
I am satisfied with doing virtual visits.	196 (77.5)	64 (83.1)
After COVID-19, I would like to continue virtual visits.	102 (40.3)	71 (92.2)
Home device use experience		
I think having a blood pressure cuff is important for virtual prenatal care.	213 (92.2)	63 (95.5) ^b
I think having a fetal Doppler is important for virtual prenatal care.	196 (84.8)	47 (71.2) ^b

Values are expressed as number (percentage) unless indicated otherwise.

COVID-19, coronavirus disease 2019.

^a Questions adapted from the Telehealth Usability Questionnaire; ^b n=66.

Peahl et al. New prenatal care model. *Am J Obstet Gynecol* 2021.

claims analyses, where granular prenatal care delivery information such as visit number and modality is frequently obscured owing to global and bundled billing codes. Still, collaborative EHR datasets that combine outpatient utilization with inpatient data may be important sources of health outcomes. Similarly, a prospective evaluation of service utilization, health outcomes, costs, and patient and provider experiences is sorely needed. Cluster-wedge RCTs hold promise for broadening the findings from single-institution studies. Similarly, implementation science can clarify the barriers and facilitators to the adoption of new models across diverse settings and help determine how best to tailor care delivery innovations to local patient and provider needs. Still, these interim data provide important guidance for key maternity care stakeholders who must make decisions about prenatal care models now.

Strengths and limitations

Our study has several important limitations. Most importantly, the study setting is a single, academic, suburban institution in the Midwest serving a largely white, privately insured patient population, with different rates of some medical comorbidities and obstetrical complications compared with the general US population. Understanding the perspective of patient populations with socioeconomic and racial-ethnic diversity is a vital next step. Second, our patient survey response rate was low, representing only a subset of pregnant patients in our population and limiting the generalizability of our findings; however, the number of respondents was large, reflects the composition of our general patient population, and includes rich qualitative data. In addition, our institution had established virtual care infrastructure before the pandemic, including a supportive EHR platform

and training resources, which may have catalyzed the adoption of prenatal care innovations. Our patients were surveyed through the EHR portal, suggesting respondents may be more technologically savvy; however, more than 90% of our pregnant patients are enrolled in the portal at our institution, suggesting greater generalizability. Finally, this study did not address health outcomes. Adoption and care experience data can guide immediate, iterative changes in care delivery while awaiting robust health outcomes.

Our understanding of how best to integrate prenatal care innovations into routine practice and for which patients is still nascent. Although our institution's guidelines were endorsed as interim recommendations by national organizations during the pandemic, permanent guidelines have yet to be defined. Our work fills an important knowledge gap about new prenatal care models and how

FIGURE 2
Patient and provider perspectives of the COVID-19 prenatal care model

	Themes	Patient Responses (n=150)	Provider Responses (n=53)	
Access to Care	New models decrease barriers to care like employment/childcare	"[I like] not having to load up my kid, get a babysitter, plan around husband's schedule to get to the doctor..." (26 y/o, multiparous patient)	"It provides patients who might not be able to get to clinic due to work or childcare issues an opportunity to obtain care when they might not have previously." (General Ob/Gyn)	Positive Experience
	New models reduce travel time and inefficiencies	"I like the time savings it brings, especially for appointments that were just check in and didn't require an ultrasound or anything additional. Previously, I would need to block 1-2 hours for a 10-15 min in-person visit." (32 y/o, multiparous patient)	"Video visits are so much more convenient than an in person visit, there is no checking in at the front desk, no waiting to be called back, no waiting in the room - I realize now that there is so much wasted time." (General Ob/Gyn)	Positive Experience
	Barriers may disproportionately affect vulnerable patients	"Many people may not be able to afford monitoring devices to have at home." (32 y/o, nulliparous patient)	"Not accessible for all patients given the need for smart device and internet access." (Family Medicine)	Negative Experience
Quality and Safety	New schedules match care to patients' needs	"It gives enough in person time while allowing for easy check in and is a better use of time for the in between visits that are mostly dialogue." (24 y/o, multiparous patient)	"It covers all of the basics of care. It is comprehensive and does not miss any critical components of prenatal care." (General Ob/Gyn)	Positive Experience
	New models allowed for safety during the pandemic	"Mostly I like it because I'm not being I'm not being exposed to COVID-19." (32 y/o, multiparous patient)	"It is a way to make sure patients have excellent prenatal care while limiting visits during COVID." (General Ob/Gyn)	Positive Experience
	Routine measurements are crucial for perceived safety	"I feel like not having my blood pressure, baby's heartbeat, or stomach growth monitored leaves me feeling extremely unsettled and then results in increased stress." (36 y/o, nulliparous patient)	"The only thing is the Doppler - if we could get every patient a blood pressure cuff, scale, and Doppler, I would feel even more comfortable." (Family Medicine)	Negative Experience
Satisfaction	All are concerned about missing something	"I dealt with high blood pressure and preeclampsia with my last pregnancy. With the [new prenatal care model] I feel like this could be missed." (34 y/o, multiparous patient)	"Patients who develop complications, like elevated BP, without us realizing could be harmed." (Family Medicine)	Negative Experience
	Virtual visits make space for counseling and communication	"It was nice to get the appointments with the doctor to be able to ask questions and not worry about travelling." (33 y/o, nulliparous patient)	"There are no rooming/check-in delays, so the appointments can start on-time, leaving more time for conversation. Patients tend to be more open to chatting." (MFM)	Positive Experience
	Virtual care is empowering for patients	"I do find it empowering... I can consume information in regards to my pregnancy, labor and delivery at my own pace and also can refer back to it, versus relying solely on the in-person visits." (36 y/o, nulliparous patient)	"It puts some more of prenatal care back into patients' hands - e.g., teaching them to self-check BP and monitor fetal kick counts instead of having maternal self-awareness supplanted by devices." (CNM)	Positive Experience
Satisfaction	Defining expectations is crucial	"I also did not feel prepared with what to expect from a video visit compared to an in-person visit." (30 y/o, multiparous patient)	"Some patients seem completely unaware that we are still on a schedule...this could be helped by telling them how long their visit is scheduled to be during pre-visit call." (Family Medicine)	Negative Experience
	Relationships are key for virtual visits	"I would have appreciated being scheduled with my regular provider." (33 y/o, multiparous patient)	"I'm not sure that the same level of intimacy/familiarity is achieved virtually (compared to in person)- this is important to help moms feel confident and cared for." (CNM)	
	Lack of connection can be a driver of lower satisfaction	"I prefer in person. Virtual is a little awkward to me. In person I feel more comfortable talking about everything." (22 y/o, nulliparous patient)	"I miss the in-person contact with patients that can be meaningful as part of the therapeutic relationship." (General Ob/Gyn)	
	First-time moms are less comfortable with new models	"As a first time mom, I would feel more comfortable seeing someone in person to know that everything's all right with the baby." (33 y/o, nulliparous patient)	"Multips benefit. Some primips feel disconnected and like something is being robbed from them." (CNM)	

CNM, certified nurse-midwife; COVID-19, coronavirus disease 2019; MFM, maternal-fetal medicine; Ob/Gyn, obstetrics and gynecology.

Peahl et al. New prenatal care model. Am J Obstet Gynecol 2021.

to support sustainability and equity after their initial launch.

Conclusions

Reduced visit schedules and virtual visits were rapidly adopted in a real-world prenatal care practice setting, with positive care experiences for most patients and providers—universal home device access, patient-provider continuity, and clear expectations for virtual visits and feasible modifications to enhance equity and sustainability of this model. These early data come from a single site, with important demographic and health differences from the United States as a whole, leaving important knowledge gaps about prenatal care delivery. Future work must (1) assess the patient and provider care experience in diverse care settings and patient populations; (2) capture health outcomes for moms and babies, with a specific focus on health disparities; and (3) clarify the role of alternative prenatal care models beyond the COVID-19 pandemic. ■

References

- Osterman MJK, Martin JA. Timing and adequacy of prenatal care in the United States, 2016. *Natl Vital Stat Rep* 2018;67:1–14.
- Truven Health Analytics. The cost of having a baby in the United States: Truven health analytics marketscan study. 2013. Available at: <http://www.chqpr.org/downloads/CostofHavingABaby.pdf>. Accessed May 10, 2020.
- Li-Zhen L, Yun X, Xiao-Dong Z, et al. Evaluation of guidelines on the screening and diagnosis of gestational diabetes mellitus: systematic review. *BMJ Open* 2019;9:e023014.
- Henderson JT, Thompson JH, Burda BU, Cantor A. Preeclampsia screening: evidence report and systematic review for the US Preventive Services Task Force. *JAMA* 2017;317:1668–83.
- Alfirevic Z, Navaratnam K, Mujezinovic F. Amniocentesis and chorionic villus sampling for prenatal diagnosis. *Cochrane Database Syst Rev* 2017;9:CD003252.
- Munoz FM, Bond NH, Maccato M, et al. Safety and immunogenicity of tetanus diphtheria and acellular pertussis (Tdap) immunization during pregnancy in mothers and infants: a randomized clinical trial. *JAMA* 2014;311:1760–9.
- Nunes MC, Cutland CL, Madhi SA. Influenza vaccination during pregnancy and protection against pertussis. *N Engl J Med* 2018;378:1257–8.
- Chamberlain C, O'Mara-Eves A, Porter J, et al. Psychosocial interventions for supporting women to stop smoking in pregnancy. *Cochrane Database Syst Rev* 2017;2:CD001055.
- Balogun OO, O'Sullivan EJ, McFadden A, et al. Interventions for promoting the initiation of breastfeeding. *Cochrane Database Syst Rev* 2016;11:CD001688.
- O'Connor E, Senger CA, Henninger ML, Coppola E, Gaynes BN. Interventions to prevent perinatal depression: evidence report and systematic review for the US Preventive Services Task Force. *JAMA* 2019;321:588–601.
- Kilpatrick SJ, Papile L, Macones GA. Guidelines for perinatal care, 8th ed. Elk Grove Village, IL/Washington, DC: American Academy of Pediatrics/The American College of Obstetricians and Gynecologists; 2017.
- 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.
- The American College of Obstetricians and Gynecologists. COVID-19 FAQs for obstetrician-gynecologists, obstetrics. Available at: <https://www.acog.org/clinical-information/physician-faqs/covid-19-faqs-for-ob-gyns-obstetrics>. Accessed April 1, 2020.
- Butler Tobah YS, LeBlanc A, Branda ME, et al. Randomized comparison of a reduced-visit prenatal care model enhanced with remote monitoring. *Am J Obstet Gynecol* 2019;221:638.e1–8.
- Barbour KD, Barreix M, Chou D, McCaw-Binns A, Say L. 874: developing maternal morbidity identification algorithms: results from the pilot study of the WHO Maternal Morbidity Measurement Tool. *Am J Obstet Gynecol* 2017;216(Suppl1):S499–500.
- Parmanto B, Lewis AN Jr, Graham KM, Bertolet MH. Development of the Telehealth Usability Questionnaire (TUQ). *Int J Telerehabil* 2016;8:3–10.
- United States Census 2020. Questions asked on the form. 2020. Available at: <https://2020census.gov/en/about-questions.html?>. Accessed July 1, 2020.
- Peahl AF, Novara A, Heisler M, Dalton VK, Moniz MH, Smith RD. Patient preferences for prenatal and postpartum care delivery: a survey of postpartum women. *Obstet Gynecol* 2020;135:1038–46.
- Schoep ME, Nieboer TE, van der Zanden M, Braat DDM, Nap AW. The impact of menstrual symptoms on everyday life: a survey among 42, 879 women. *Am J Obstet Gynecol* 2019;220:569.e1–7.
- Guetterman TC, Feters MD, Creswell JW. Integrating quantitative and qualitative results in health science mixed methods research through joint displays. *Ann Fam Med* 2015;13:554–61.
- Dickson VV, Lee CS, Riegel B. How do cognitive function and knowledge affect heart failure self-care? *J Mix Methods Res* 2011;5:167–89.
- Centers for Disease Control and Prevention. Diabetes During pregnancy. 2018. Available at: <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/diabetes-during-pregnancy.htm>. Accessed July 13, 2020.
- Bauman BL, Ko JY, Cox S, et al. Vital signs: postpartum depressive symptoms and provider discussions about perinatal depression - United States, 2018. *MMWR Morb Mortal Wkly Rep* 2020;69:575–81.
- American College of Obstetricians and Gynecologists' Committee on Practice Bulletins—Obstetrics. ACOG Practice Bulletin No. 203: chronic hypertension in pregnancy. *Obstet Gynecol* 2019;133:e26–50.
- American College of Obstetricians and Gynecologists' Committee on Practice Bulletins—Obstetrics. Gestational hypertension and preeclampsia: ACOG Practice Bulletin, Number 222. *Obstet Gynecol* 2020;135:e237–60.
- Committee on Practice Bulletins—Obstetrics. ACOG Practice Bulletin No. 190: gestational diabetes mellitus. *Obstet Gynecol* 2018;13:e49–64.
- Centers for Disease Control and Prevention. Preterm birth. 2019. Available at: <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pretermbirth.htm>. Accessed September 9, 2020.
- Nouri S, Khoong EC, Lyles CR, Karliner L. Addressing equity in telemedicine for chronic disease management during the Covid-19 pandemic. *NEJM Catal* 2020:1–13.
- Walker DM, Hefner JL, Fareed N, Huerta TR, McAlearney AS. Exploring the digital divide: age and race disparities in use of an inpatient portal. *Telemed J E Health* 2020;26:603–13.
- Internal Revenue Service. Standard mileage rates. 2020. Available at: <https://www.irs.gov/tax-professionals/standard-mileage-rates>. Accessed July 1, 2020.
- Admon LK, Winkelman TNA, Moniz MH, Davis MM, Heisler M, Dalton VK. Disparities in chronic conditions Among women hospitalized for delivery in the United States, 2005–2014. *Obstet Gynecol* 2017;130:1319–26.
- Admon LK, Winkelman TNA, Zivin K, Terplan M, Mhyre JM, Dalton VK. Racial and ethnic disparities in the incidence of severe maternal morbidity in the United States, 2012–2015. *Obstet Gynecol* 2018;132:1158–66.
- Laraia BA, Siega-Riz AM, Gundersen C, Dole N. Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women. *J Nutr* 2006;136:177–82.
- Centers for Disease Control and Prevention. Severe maternal morbidity in the United States. 2017. Available at: www.cdc.gov/reproductivehealth/maternalinfanthealth/severematernalmorbidity.html. Accessed June 9, 2020.
- Howell EA, Egorova N, Balbierz A, Zeitlin J, Hebert PL. Black-white differences in severe maternal morbidity and site of care. *Am J Obstet Gynecol* 2016;214:122.e1–7.
- Tucker Edmonds B, Mogul M, Shea JA. Understanding low-income African American women's expectations, preferences, and priorities in prenatal care. *Fam Community Health* 2015;38:149–57.

37. Alhusen JL, Bower KM, Epstein E, Sharps P. Racial discrimination and adverse birth outcomes: an integrative review. *J Midwifery Womens Health* 2016;61:707–20.

38. United States Legislative Information. H.R. 1328 - ACCESS BROADBAND Act. 2019. Available at: <https://www.congress.gov/bills/116/congress/house-bill/1328/text>. Accessed June 24, 2020.

39. Dowswell T, Carroli G, Duley L, et al. Alternative versus standard packages of antenatal care for low-risk pregnancy. *Cochrane Database Syst Rev* 2010;10:CD000934.

Author and article information

From the Department of Obstetrics and Gynecology (Drs Peahl, Smith, Dalton, and Moniz), Department of Surgery (Dr Waljee), and Department of Internal Medicine (Dr Heisler), University of Michigan, Ann Arbor, MI; Institute

for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, MI (Drs Peahl, Waljee, Dalton, Heisler, and Moniz); Program on Women's Healthcare Effectiveness Research, Department of Obstetrics and Gynecology, University of Michigan, Ann Arbor, MI (Drs Peahl, Dalton, and Moniz); University of Michigan Medical School, Ann Arbor, MI (Mss Powell and Berlin); Department of Obstetrics, Gynecology, and Reproductive Sciences, University of Pittsburgh, Pittsburgh, PA (Dr Krans); and Magee-Womens Research Institute and Foundation, Pittsburgh, PA (Dr Krans).

Received Aug. 17, 2020; revised Sept. 16, 2020; accepted Oct. 5, 2020.

This study was conducted at Ann Arbor, MI.

E.K. is an investigator on grants for Magee-Womens Research Institute from the National Institutes of Health (NIH), Gilead, and Merck & Co, Inc, outside of the submitted work. V.K.D. is a contributing editor for The Medical Letter, Inc, an author for UpToDate, and a

consultant for Bind. The remaining authors report no conflict of interest.

J.W. received funding for research from the National Institute on Drug Abuse (grant number, R01 DA042859). V.K.D. has received grant funding from the Agency for Healthcare Research and Quality (AHRQ), American Association of Obstetricians and Gynecologists Foundation, the Laura and John Arnold Foundation, National Institute for Reproductive Health, the Blue Cross Blue Shield of Michigan Foundation, and the NIH. M.H.M. is supported by grant number K08 HS025465 from the AHRQ. M.H. is supported by grant number P30 DK092926 from the NIH.

None of the funders played a role in the design and conduct of the study; in the collection, management, analysis, and interpretation of the data; in the preparation, review, or approval of the article; or in the decision to submit the article for publication.

Corresponding author: Alex F. Peahl, MD. alexfr@med.umich.edu