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.

Prenatal care redesign: creating flexible maternity care models through virtual care

Alex F. Peahl, MD; Roger D. Smith, MD; Michelle H. Moniz, MD

"Only a crisis—actual or perceived—produces real change."—Milton Friedman

Each year, nearly 4 million women who give birth in the United States receive prenatal care—a crucial preventive service that improves pregnancy outcomes for mothers and their children.[1] National guidelines currently recommend 12−14 in-person prenatal visits, a schedule that has remained unchanged since 1930, when it was first established to detect and treat complications of pregnancy—specifically preeclampsia.[2]

Grounding prenatal care in an arbitrary number of in-person visits, rather than essential services, is a flawed strategy. Although we know that prenatal care services are evidence based, how to deliver them is not clear.[1] Studies of prenatal services such as gestational diabetes screening and maternal vaccination consistently demonstrate improved maternal and infant outcomes, but such evidence-based services can be delivered in fewer than 14 visits.[3,4] There is also evidence that patients do not need to visit clinics in person to receive all maternity services. Telemedicine has emerged as a promising care delivery option for patients seeking greater flexibility, and early trials leveraging virtual care and remote monitoring have shown positive maternal and fetal outcomes with high patient satisfaction.[5] A recent survey of our own obstetrical population found that more than 85% of patients desired telemedicine contact with their healthcare team between visits.[6]

Recognizing that prenatal care delivery is overdue to be redesigned, we have been working for the past year on a new prenatal care pathway. The rise of coronavirus disease 2019 (COVID-19) has prompted us to extend this work and respond to the exigent need for social distancing and resource conservation by rapidly redesigning prenatal care delivery around essential services identified by the American College of Obstetricians and Gynecologists guidelines, rather than a predetermined schedule.[1,7,8] Our implementation experience provides actionable insights for responding to the COVID-19 pandemic in the short term and for designing patient-centered prenatal care long after the pandemic resolves.

Guideline development

Over the past year, we have planned to create a more flexible, patient-centered prenatal care pathway for our 4000 patients served by more than 150 maternity care providers at 12 ambulatory care sites. We first assembled a multistakeholder team, including experts in medical care (obstetricians, maternal-fetal medicine specialists, family physicians, certified nurse midwives, nurses), information technology (electronic health record architects, virtual care project managers), and administration (coders and billers, hospital administrators). The Appraisal of Guidelines for Research and Evaluation-II criteria for practice guidelines,[9] a standardized international checklist for assessing practice guideline quality, informed our efforts to elicit interprofessional perspectives, draw on existing evidence, and optimize guidelines for implementation (Appendix A.1).

On the basis of our systematic literature reviews,[3] survey work with patients,[6] and consultation with national experts in patient-centered care delivery, we identified 2 overarching principles to inform guideline development[10]:

1. Design care delivery around essential services: use in-person care for services that cannot be delivered remotely and offer video visits for other essential services
2. Create flexible services for anticipatory guidance and psychosocial support: allow patients to tailor support to meet their needs through opt-in programs

With the COVID-19 pandemic creating the need to limit outpatient care to "urgent" visits, our team worked to rapidly revise the standard outpatient prenatal care guidelines (Appendix A.2 and Video). Our initial guidelines prioritized the public health need for social distancing, recognizing that patient preference would play a more integral role in care plans after the pandemic. We focused on guidelines for low-risk women, knowing that additional services could be added for higher-risk patients as needed. Feedback was solicited electronically, and consensus was achieved in 48 hours (March 20, 2020).

Principle 1: design care around essential services

First, we identified critical prenatal services that could not be completed remotely: ultrasounds, vaccinations, laboratory tests, and physical examinations. Second, we grouped services

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TABLE
Prenatal care service delivery before and after prenatal care redesign

Visit timing	Usual care			New care model		
	In-person visit	virtual visit	Medical screening and treatment	In-person visit	virtual visit	Medical screening and treatment
Intake		1	Full history		1	Full history
			Prenatal labs			Prenatal labs
Week 8	1		Physical examination	1		Physical examination
			Vitals			Vitals
			Viability Ultrasound			Viability Ultrasound
			Influenza vaccine			Influenza vaccine
			Cervical cancer screening			Cervical cancer screening
Week 12	2		Vitals, fetal heart rate			
			Pregnancy symptoms			
Week 16	3		Vitals, fetal heart rate		2	Vitals, fetal heart rate[a]
			Pregnancy symptoms			Pregnancy symptoms
Week 19	4		Anatomy ultrasound	2		Pregnancy symptoms
						Vitals
Week 20	5		Vitals, fetal heart rate			
			Pregnancy symptoms			
Week 24	6		Vitals, fetal heart rate		3	Vitals, fetal heart rate[a]
			Pregnancy symptoms			Pregnancy symptoms
			Diabetic screen			
			Complete blood count			
Week 28	7		Vitals, fetal heart rate	3		Vitals, fetal heart rate
			Pregnancy symptoms			Pregnancy symptoms
			Rhogam as indicated			Diabetic screen
						Complete blood count
						Pertussis vaccine
						Rhogam as indicated
Week 30	8		Vitals, fetal heart rate			
			Pregnancy symptoms			
Week 32	9		Vitals, fetal heart rate		4	Vitals, fetal heart rate[a]
			Pregnancy symptoms			Pregnancy symptoms
			Pertussis vaccine			
Week 34	10		Vitals, fetal heart rate			
			Pregnancy symptoms			
Week 36	11		Vitals, fetal heart rate	4		Vitals, fetal heart rate
			Pregnancy symptoms			Pregnancy symptoms
			Group B strep			Group B strep
			Fetal presentation assessment			Fetal presentation assessment

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(continued)

TABLE
(continued)

Visit timing	Usual care			New care model		
	In-person visit	virtual visit	Medical screening and treatment	In-person visit	virtual visit	Medical screening and treatment
Week 37	12		Vitals, fetal heart rate			
			Pregnancy symptoms			
Week 38	13		Vitals, fetal heart rate		5	Vitals, fetal heart rate[a]
			Pregnancy symptoms			Pregnancy symptoms
Week 39	14		Vitals, fetal heart rate	5		Vitals, fetal heart rate
			Pregnancy symptoms			Pregnancy symptoms
			Cervical examination			Cervical examination

Color key: *yellow*, in-person visit; *orange*, ultrasound visit; *blue*, virtual visit; *red*, laboratory testing; *brown*, physical examinations; *green*, vaccinations and/or injections; *purple*, ultrasounds.

[a] To be completed with home monitoring tools as available.

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based on recommended timing during pregnancy (eg, gestational diabetes screening, pertussis vaccine, and Rhogam at 27- to 28-week in-person visit).[1] This restructuring called for 4 in-person office visits and an obstetrical ultrasound (Table). Third, with these in-person contacts focused on medical care, we identified key educational topics and psychosocial screenings from existing guidelines. We interspersed virtual visits—using telephone or video technology—between the in-person visits, creating critical touchpoints for services such as depression screening and anticipatory guidance about childbirth and parenting and for addressing emerging patient questions. The final visit schedule included 4 in-person contacts, 1 formal obstetrical ultrasound, and 4 virtual contacts (the 4-1-4 prenatal plan). Given little evidence of benefit, remote monitoring of blood pressure and fetal heart tones was not required for transitioning care from in-person to telemedicine visits in the setting of the COVID-19 pandemic and need for social distancing.

Principle 2: create flexible services for anticipatory guidance and psychosocial support

Although the 4-1-4 prenatal plan provides adequate medical screening and treatment, some patients may prefer (or require) additional anticipatory guidance and psychosocial support. We sought to provide a convenient, flexible, "choose your own" option that patients could tailor to their personal preferences and needs. This pathway includes an online program modeled on group prenatal care that provides social connection and peer mentoring. The program consists of monthly small group sessions, continuous connection through private online chatrooms, and optional classes on coping skills and wellness led by behavioral health experts. Such services were particularly important given that many usual sources of support were unavailable during the pandemic (eg, parenting and childbirth classes canceled indefinitely).

Our implementation experience

Guideline implementation began 24 hours after approval (March 23, 2020)—the same week our hospital mandated restriction of in-person visits and our governor ordered residents to shelter in place. Implementation involved 3 critical processes: (1) training providers, (2) engaging patients, and (3) advocating for policies to support sustainable change.

Provider training

Maternity providers received guidelines and supporting materials for care documentation by email and attended a virtual group training session. Physician champions for prenatal care redesign and virtual care were immediately available for consultation.

Patient engagement

We recognized that many patients derive reassurance from attending prenatal visits, checking their blood pressure, and listening to fetal heart tones; however, these services are not evidence based. To address potential concerns, we created comprehensive patient resources on the 4-1-4 prenatal plan and prenatal care during the COVID-19 pandemic. We also designed materials on monitoring, including lists of blood pressure cuffs and Dopplers available for purchase and how to use these devices. In addition, we trained 50 medical students to call patients to review the new prenatal care schedule, offer connection to social services, and discuss home monitoring options with them.

Policy change

National policy changes, including federal allowances for telemedicine and relaxation of the Health Insurance

Portability and Accountability Act regulations for "good faith" use of telecommunication devices, supported reimbursement of telemedicine services.[7] In addition, we are advocating for local policy changes such as public and private payer reimbursement for remote monitoring devices to sustainably support provision of blood pressure cuffs, scales, and fetal heart rate monitors to patients based on preferences and/or medical need.

As the new prenatal care pathway becomes normalized, we will monitor safety and course correct as needed. Formal evaluation will include measures of maternal-infant health outcomes, patient and provider satisfaction, and healthcare utilization and cost.

Conclusions

The COVID-19 pandemic has forced our healthcare system to rapidly evolve. The principles identified here for prenatal care redesign have broad applications beyond the pandemic. By designing in-person care around critical services, maintaining connections virtually, and thinking flexibly about support, we can develop tailored care pathways that best meet patients' needs. Reduced in-person contacts can free provider and health system capacity for patients who need more intense in-person contact, such as those with high-risk medical conditions.

These new models may be particularly advantageous for addressing significant health disparities in maternity care access and outcomes. Low-income, minority pregnant patients are less likely to receive recommended prenatal care and are more likely to have severe maternal morbidity and mortality than white, high-income patients. Telemedicine may be a way to address these disparities by allowing providers to meet patients where they are: in their homes, workplaces, and communities. This may be particularly important for pregnant patients who work, have childcare needs, or face barriers to care. Nevertheless, some populations may be disadvantaged by telemedicine: for example, patients in rural settings or of low-socioeconomic status who do not have stable internet connections. However, some of these technologic barriers have been removed during the pandemic through free internet options. As such, building greater connectivity in the future will be crucial for ensuring no patients fall through the safety net.

We are long overdue for a prenatal care redesign to make services more effective, efficient, and equitable. Perhaps COVID-19 is the crisis we needed to advance prenatal care beyond the model that has remained unchanged since 1930 and move to more flexible, patient-centered care. ■

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ABSTRACT

Prenatal care redesign: creating flexible maternity care models through virtual care

Each year, nearly 4 million pregnant patients in the United States receive prenatal care—a crucial preventive service that improves pregnancy outcomes for mothers and their children. National guidelines currently recommend 12—14 in-person prenatal visits, a schedule that has remained unchanged since 1930. When scrutinizing the standard prenatal visit schedule, it becomes clear that prenatal care is overdue for a redesign. We have strong evidence of the benefits of prenatal services, such as screening for gestational diabetes and maternal vaccination. However, how to deliver these services is not clear. Studies of prenatal services consistently demonstrate that such care can be delivered in fewer than 14 visits and that patients do not need to visit clinics in person to receive all maternity services. Telemedicine has emerged as a promising care delivery option for patients seeking greater flexibility, and early trials leveraging virtual care and remote monitoring have shown positive maternal and fetal outcomes with high patient satisfaction.

Our institution has worked for the past year on a new prenatal care pathway. Our initial work assessed the literature, elicited patient perspectives, and captured the insights of experts in patient-centered care delivery. There are 2 key principles that guide prenatal care redesign: (1) design care delivery around essential services, using in-person care for services that cannot be delivered remotely and offering video visits for other essential services, and (2) creation of flexible services for anticipatory guidance and psychosocial support that allow patients to tailor support to meet their needs through opt-in programs. The rise of coronavirus disease 2019 prompted us to extend this early work and rapidly implement a redesigned prenatal care pathway. In this study, we outline our experience in transitioning to a new prenatal care model with 4 in-person visits, 1 ultrasound visit, and 4 virtual visits (the 4-1-4 prenatal plan). We then explore how insights from this implementation can inform patient-centered prenatal care redesign during and beyond the coronavirus disease 2019 pandemic.

Key words: care delivery, COVID-19, gestational diabetes screening, patient-centered care, postpartum care, prenatal care, telemedicine, ultrasound, vaccination

APPENDIX A.1

AGREE-II checklist for criteria assessment of prenatal care guideline

CHECKLIST ITEM AND DESCRIPTION	REPORTING CRITERIA	Page #
DOMAIN 1: SCOPE AND PURPOSE		
1. **OBJECTIVES** *Report the overall objective(s) of the guideline. The expected health benefits from the guideline are to be specific to the clinical problem or health topic.*	☒ Health intent(s) (i.e., prevention, screening, diagnosis, treatment, etc.) ☒ Expected benefit(s) or outcome(s) ☒ Target(s) (e.g., patient population, society)	2
2. **QUESTIONS** *Report the health question(s) covered by the guideline, particularly for the key recommendations.*	☒ Target population ☒ Intervention(s) or exposure(s) ☒ Comparisons (if appropriate) ☒ Outcome(s) ☒ Health care setting or context	2
3. **POPULATION** *Describe the population (i.e., patients, public, etc.) to whom the guideline is meant to apply.*	☒ Target population, sex, and age ☒ Clinical condition (if relevant) ☒ Severity/stage of disease (if relevant) ☒ Comorbidities (if relevant) ☐ Excluded populations (if relevant)	2
DOMAIN 2: STAKEHOLDER INVOLVEMENT		
4. **GROUP MEMBERSHIP** *Report all individuals who were involved in the development process. This may include members of the steering group, the research team involved in selecting and reviewing/rating the evidence and individuals involved in formulating the final recommendations.*	☒ Name of participant ☒ Discipline/content expertise (e.g., neurosurgeon, methodologist) ☒ Institution (e.g., St. Peter's hospital) ☒ Geographical location (e.g., Seattle, WA) ☒ A description of the member's role in the guideline development group	2
5. **TARGET POPULATION PREFERENCES AND VIEWS** *Report how the views and preferences of the target population were sought/considered and what the resulting outcomes were.*	☒ Statement of type of strategy used to capture patients'/publics' views and preferences (e.g., participation in the guideline development group, literature review of values and preferences) ☒ Methods by which preferences and views were sought (e.g., evidence from literature, surveys, focus groups) ☒ Outcomes/information gathered on patient/public information ☒ How the information gathered was used to inform the guideline development process and/or formation of the recommendations	2
6. **TARGET USERS** *Report the target (or intended) users of the guideline.*	☒ The intended guideline audience (e.g., specialists, family physicians, patients, clinical or institutional leaders/administrators) ☒ How the guideline may be used by its target audience (e.g., to inform clinical decisions, to inform policy, to inform standards of care)	2
DOMAIN 3: RIGOUR OF DEVELOPMENT		
7. **SEARCH METHODS** *Report details of the strategy used to search for evidence.*	☒ Named electronic database(s) or evidence source(s) where the search was performed (e.g., MEDLINE, EMBASE, PsychINFO, CINAHL) ☒ Time periods searched (e.g., January 1, 2004 to March 31, 2008) ☒ Search terms used (e.g., text words, indexing terms, subheadings) ☒ Full search strategy included (e.g., possibly located in appendix)	10

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(continued)

CHECKLIST ITEM AND DESCRIPTION	REPORTING CRITERIA	Page #
8. **EVIDENCE SELECTION CRITERIA** *Report the criteria used to select (i.e., include and exclude) the evidence. Provide rationale, where appropriate.*	☒ Target population (patient, public, etc.) characteristics ☒ Study design ☒ Comparisons (if relevant) ☒ Outcomes ☒ Language (if relevant) ☐ Context (if relevant)	10
9. **STRENGTHS & LIMITATIONS OF THE EVIDENCE** *Describe the strengths and limitations of the evidence. Consider from the perspective of the individual studies and the body of evidence aggregated across all the studies. Tools exist that can facilitate the reporting of this concept.*	☒ Study design(s) included in body of evidence ☐ Study methodology limitations (sampling, blinding, allocation concealment, analytical methods) ☐ Appropriateness/relevance of primary and secondary outcomes considered ☒ Consistency of results across studies ☒ Direction of results across studies ☒ Magnitude of benefit versus magnitude of harm ☒ Applicability to practice context	10
10. **FORMULATION OF RECOMMENDATIONS** *Describe the methods used to formulate the recommendations and how final decisions were reached. Specify any areas of disagreement and the methods used to resolve them.*	☒ Recommendation development process (e.g., steps used in modified Delphi technique, voting procedures that were considered) ☐ Outcomes of the recommendation development process (e.g., extent to which consensus was reached using modified Delphi technique, outcome of voting procedures) ☐ How the process influenced the recommendations (e.g., results of Delphi technique influence final recommendation, alignment with recommendations and the final vote)	2
11. **CONSIDERATION OF BENEFITS AND HARMS** *Report the health benefits, side effects, and risks that were considered when formulating the recommendations.*	☒ Supporting data and report of benefits ☒ Supporting data and report of harms/side effects/risks ☒ Reporting of the balance/trade-off between benefits and harms/side effects/risks ☒ Recommendations reflect considerations of both benefits and harms/side effects/risks	1, 10-12
12. **LINK BETWEEN RECOMMENDATIONS AND EVIDENCE** *Describe the explicit link between the recommendations and the evidence on which they are based.*	☒ How the guideline development group linked and used the evidence to inform recommendations ☐ Link between each recommendation and key evidence (text description and/or reference list) ☒ Link between recommendations and evidence summaries and/or evidence tables in the results section of the guideline	2
13. **EXTERNAL REVIEW** *Report the methodology used to conduct the external review.*	☒ Purpose and intent of the external review (e.g., to improve quality, gather feedback on draft recommendations, assess applicability and feasibility, disseminate evidence) ☒ Methods taken to undertake the external review (e.g., rating scale, open-ended questions) ☒ Description of the external reviewers (e.g., number, type of reviewers, affiliations) ☒ Outcomes/information gathered from the external review (e.g., summary of key findings) ☒ How the information gathered was used to inform the guideline development process and/or formation of the recommendations (e.g., guideline panel considered results of review in forming final recommendations)	2

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CHECKLIST ITEM AND DESCRIPTION	REPORTING CRITERIA	Page #
14. **UPDATING PROCEDURE** *Describe the procedure for updating the guideline.*	☒ A statement that the guideline will be updated ☒ Explicit time interval or explicit criteria to guide decisions about when an update will occur ☒ Methodology for the updating procedure	2
DOMAIN 4: CLARITY OF PRESENTATION		
15. **SPECIFIC AND UNAMBIGUOUS RECOMMENDATIONS** *Describe which options are appropriate in which situations and in which population groups, as informed by the body of evidence.*	☒ A statement of the recommended action ☒ Intent or purpose of the recommended action (e.g., to improve quality of life, to decrease side effects) ☒ Relevant population (e.g., patients, public) ☒ Caveats or qualifying statements, if relevant (e.g., patients or conditions for whom the recommendations would not apply) ☒ If there is uncertainty about the best care option(s), the uncertainty should be stated in the guideline	2,6-9
16. **MANAGEMENT OPTIONS** *Describe the different options for managing the condition or health issue.*	☒ Description of management options ☒ Population or clinical situation most appropriate to each option	4-9
17. **IDENTIFIABLE KEY RECOMMENDATIONS** *Present the key recommendations so that they are easy to identify.*	☒ Recommendations in a summarized box, typed in bold, underlined, or presented as flow charts or algorithms ☒ Specific recommendations grouped together in one section	4
DOMAIN 5: APPLICABILITY		
18. **FACILITATORS AND BARRIERS TO APPLICATION** *Describe the facilitators and barriers to the guideline's application.*	☒ Types of facilitators and barriers that were considered ☒ Methods by which information regarding the facilitators and barriers to implementing recommendations were sought (e.g., feedback from key stakeholders, pilot testing of guidelines before widespread implementation) ☒ Information/description of the types of facilitators and barriers that emerged from the inquiry (e.g., practitioners have the skills to deliver the recommended care, sufficient equipment is not available to ensure all eligible members of the population receive mammography) ☒ How the information influenced the guideline development process and/or formation of the recommendations	14
19. **IMPLEMENTATION ADVICE/TOOLS** *Provide advice and/or tools on how the recommendations can be applied in practice.*	☒ Additional materials to support the implementation of the guideline in practice. For example: ○ Guideline summary documents ○ Links to check lists, algorithms ○ Links to how-to manuals ○ Solutions linked to barrier analysis (see Item 18) ○ Tools to capitalize on guideline facilitators (see Item 18) ○ Outcome of pilot test and lessons learned	14

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CHECKLIST ITEM AND DESCRIPTION	REPORTING CRITERIA	Page #
20. **RESOURCE IMPLICATIONS** *Describe any potential resource implications of applying the recommendations.*	☐ Types of cost information that were considered (e.g., economic evaluations, drug acquisition costs) ☐ Methods by which the cost information was sought (e.g., a health economist was part of the guideline development panel, use of health technology assessments for specific drugs, etc.) ☐ Information/description of the cost information that emerged from the inquiry (e.g., specific drug acquisition costs per treatment course) ☐ How the information gathered was used to inform the guideline development process and/or formation of the recommendations	
21. **MONITORING/AUDITING CRITERIA** *Provide monitoring and/or auditing criteria to measure the application of guideline recommendations.*	☐ Criteria to assess guideline implementation or adherence to recommendations ☐ Criteria for assessing impact of implementing the recommendations ☐ Advice on the frequency and interval of measurement ☐ Operational definitions of how the criteria should be measured	
DOMAIN 6: EDITORIAL INDEPENDENCE		
22. **FUNDING BODY** *Report the funding body's influence on the content of the guideline.*	☐ The name of the funding body or source of funding (or explicit statement of no funding) ☒ A statement that the funding body did not influence the content of the guideline	2
23. **COMPETING INTERESTS** *Provide an explicit statement that all group members have declared whether they have any competing interests.*	☐ Types of competing interests considered ☒ Methods by which potential competing interests were sought ☐ A description of the competing interests ☐ How the competing interests influenced the guideline process and development of recommendations	2

This checklist is intended to guide the reporting of clinical practice guidelines.

For more information about the AGREE Reporting Checklist, please visit the AGREE Enterprise website at http://www.agreetrust.org.

Adapted from Brouwers et al.[11]

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APPENDIX A.2. UNIVERSITY OF MICHIGAN GUIDELINES FOR OUTPATIENT PRENATAL CARE DURING THE CORONAVIRUS DISEASE 2019 PANDEMIC

To access the full document, please use the link: https://docs.google.com/document/d/1UXEh8xa9ZXLpcbXyoA7RUxzuSZv9WKwBRjgEUgjSqOo/edit?usp=sharing

Peahl. Prenatal care redesign: creating flexible maternity care models through virtual care. Am J Obstet Gynecol 2020.