



OB Nest: Reimagining Low-Risk Prenatal Care

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Abstract

Using a human-centered design method, our team sought to envision a new model of care for women experiencing low-risk pregnancy. This model, called OB Nest, aimed to demedicalize the experience of pregnancy by providing a supportive and empowering experience that fits within patients' daily lives. To explore this topic, we invited women to use self-monitoring tools, a text-based smartphone application to communicate with their care team, and moderated online communities to connect with other pregnant women. Through observations of tool use and patient- and care team—provided feedback, we found that self-measurement and access to a fetal heart monitor provided women with confidence and joy in the progress of their pregnancies while shifting their position to being an active participant in their care. The smartphone application gave women direct access to their care team, provided continuity, and removed hurdles in establishing communication. The online community platform was a space where women in the same obstetric clinic could share nonmedical questions and advice with one another. This created a sense of community, leveraged the knowledge of women, and provided a venue beyond the clinic visit for information exchange. These findings were integrated into the design of the Mayo Clinic OB Nest model. This model redistributes care based on the individual needs of patients by providing self-measurement tools and continuous flexible access to their care team. By enabling women to meaningfully participate in their care, there is potential for cost savings and improved patient satisfaction.

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Between 2004 and 2010, the cost of prenatal care drastically increased in the United States. The costs of vaginal births increased 40% to an average of \$29,800 for Medicaid payers and \$18,329 for commercial payers, and costs for cesarean sections increased to an average of \$50,373 for Medicaid payers and \$27,866 for commercial payers.¹ With a cumulative cost exceeding \$111 billion annually for approximately 4 million births, American obstetric (OB) care is the most expensive in the world.² Despite this high level of spending for OB care, the United States has one of the highest rates of both infant and maternal deaths among industrialized nations, and with a 1 in 1800 risk of maternal death, maternal mortality is on the rise.³ Moreover, 52,000 women each year experience a severe maternal morbidity, which may lead to health problems that last a lifetime.⁴ Considering the unparalleled investment and

disproportionately poor outcomes, there is a need for prenatal care reform.

In the United States, prenatal care typically involves 13 to 14 visits with an obstetrician or midwife during a pregnancy.^{5,6} This model of care derives from a traditional approach designed to detect complications of pregnancy, particularly preeclampsia. Low-risk pregnancies are physiologic events, and this high-intensity contact leads to an unnecessary use of diagnostic tools (eg, laboratory evaluations, imaging, and biophysical testing) because of a “more is safer attitude.”⁷ In addition, more than 30% of American women give birth via cesarean section or have labor induced with drugs, a percentage far higher than that of other developed countries and far higher than rates that the American College of Obstetricians and Gynecologists considers necessary and reasonable.⁸⁻¹⁰ The overmedicalization of

low-risk pregnancies induces unjustifiably higher costs and higher risks of complications to both the mother and the child, while forcing these women into a sickness model of care. This further obscures the unique needs of this low-risk population and presents opportunities for major improvement in the OB care of expectant mothers.

Even without the aforementioned overuse of testing, the standard approach to prenatal care relies on traditional medical infrastructure, which greatly increases the cost of each encounter. The lack of reimbursement directed specifically to prenatal care provides disincentives to provide reassurance and relationship building, which would improve communication when a true medical need does arise. Pregnant women lose many productive hours in seeking this traditional model of care as well. We see a need to reform this care model to address its weaknesses and excessive costs.

The Mayo Clinic Center for Innovation (CFI) is an embedded human-centered design (HCD) group with expertise in practice redesign in health care.¹¹ Being embedded within the clinical practice, the CFI thrives through collaborations spanning the enterprise, working in a multidisciplinary and multispecialty team-based manner. In 2012, the CFI made a strategic decision, in collaboration with the Department of Obstetrics and Gynecology, to focus on prenatal care for several reasons. First, the widespread adoption of mobile technology and self-monitoring devices and desire of women to have a more participatory and less clinic-centric OB experience enabled us to experiment in this space with ease. Second, at least 60% of the Mayo Clinic OB practice included healthy pregnant women who were Mayo Clinic employees. Since the organization is self-insured, this created an opportune setting where all major parties were in direct alignment for innovation.¹² Third, because the existing care model was reimbursed as bundled care, and not fee-for-service, there was freedom to innovate with the patient's needs in mind.¹³ In addition, modifying this care model was thought to potentially benefit other patient populations seeking medical assistance for either a physiologic state or a chronic condition. In these scenarios, medical treatment is supportive and the focus of care lies on coping strategies, leaving patients with unmet needs under the traditional sick care paradigm.¹⁴

In this project, we used an HCD method to create a patient-centered care model that includes novel care tools for women experiencing low-risk pregnancy. Methods of HCD are becoming more widely used in the health care industry, and HCD is the standard process used at the CFI.¹⁵⁻¹⁸ This method consists of 4 phases: (1) qualitative research to understand user needs, (2) synthesizing research into design concepts that are rapidly prototyped and iteratively tested in situ to validate the designs, (3) robustly prototyping designs and testing them in research studies, and (4) scaling and implementing across our organization. Solutions and opportunities identified using HCD methods must carefully account for any contextual factors, such as cultural, technical, and financial constraints. In this article, we describe the findings from the first 2 phases of HCD activities, which are framed as design opportunities for building a more flexible, affordable, and empowering service for pregnant women.

METHODS

The team established a scalable and modular model to offer a customizable service to the individual. Key objectives included creating a more empowering, supportive, flexible, and continuous pregnancy care experience. Frustrations with the American prenatal care model reported in the literature include dissatisfaction with waiting times, lack of continuity, and not having enough time to ask questions.^{19,20} These insights were taken into account and used to design a diverse preliminary tool set.

This article focuses on the first 2 phases of the HCD method. The first phase began with semistructured interviews with 20 patients and partners and approximately 100 hours of observation in the outpatient and inpatient settings. To obtain the care team perspective, ongoing conversations were had with individuals representing various roles in the OB and midwife care teams. In this phase, the selection of these individuals was largely by convenience.

The second phase of the HCD method began with a preliminary analysis of the data collected through the first phase, revealing several themes or opportunities for further exploration. Working closely with various representatives from the OB department over several ideation sessions, the team identified and then selected from a wide

range of potential design concepts to be rapidly prototyped and iterated in the OB practice to validate the designs in situ. Through these small studies, design concepts are positioned as probes to further enhance our understanding of the unique needs of women experiencing low-risk prenatal care. During this phase, the team observed the execution of each concept and interviewed participants toward the completion of their experience. Data collected through this phase were analyzed and synthesized into insights that informed the final integrated design concept. The 3 components expounded on in this article—self-monitoring, online communities, and text-based communication—are integral in the design and conceptualization of the OB Nest model of care. For each of these components, postexperience debriefing was performed with the participants. Selection for these interviews was largely related to the availability of the participants.

Patient Selection

Patient and care team acceptance was the main criteria for design validation. Patients were selected based on the following inclusion criteria: absence of factors that would suggest a high-risk pregnancy, proficiency in written and spoken English, older than 18 years, less than 5 months in gestation, and receiving Mayo Clinic prenatal care. Women who were identified by their OB care team as high risk, who were not proficient in English, or who were not at an appropriate gestational stage were excluded. This patient population was primarily local to Rochester, Minnesota, where the race/ethnicity of the population is largely white (85%), with a median household income of \$64,554.²¹ Ninety-one percent of residents older than 25 years have graduated from high school, and 41.3% have a bachelor's degree or higher.

This qualitative study was deemed an institutionally sanctioned mechanism for improvement of clinical flow and activities by the Mayo Clinic Institutional Review Board, which guided data collection methods.

Components of the OB Nest Model of Care

Self-monitoring. The OB Nest model was designed with the intent of offering pregnant women a more flexible care experience while maintaining patient safety and quality of

care. Establishing patient competence with traditionally office-bound tools allowed for the continuous collection of patient data, which would normally be only sparsely available to the patient and care team. To explore this method, 6 pregnant women were taught how to self-measure important clinical parameters, such as weight, fundal height, and blood pressure. Women were also given a handheld fetal Doppler device (Natus Nicolet Elite 200 Doppler with digital display; Natus Medical Inc), which allowed them to assess fetal heart rate at their leisure, providing reassurance during periods of minimal fetal movement. Participants in this experience were selected largely from the group of women with upcoming visits scheduled in the OB department and willing to be interviewed at the completion of their experience. In addition, the number of participants was determined by availability and access to self-monitoring equipment.

In addition, 4 private drop-in stations were created where women could freely access these same devices on their own schedules as an additional way to demonstrate to the OB care teams on a broader scale that women could build competency with these devices. Because of patient confidentiality and logistical constraints, it was not possible to get an exact number of drop-in participants, but through anonymous write-in comments left in the rooms and the amount of supplies that needed to be refilled over time, more than 50 women used these stations over 8 months. Of these interactions, 10 women were interviewed about their experiences using these devices.

Text-Based Communication. To provide pregnant women with more flexibility in care team contact, they were provided with a more direct line of communication with their care team. This was facilitated by the development of an encrypted digital application, allowing women to communicate questions and concerns directly to their care team, outside of their face-to-face appointments. A nurse within the care team was the primary responder and would triage any concerns requiring a physician or midwife. To select patients for this experience, the team called patients currently receiving Mayo Clinic OB care and screened participants based on the

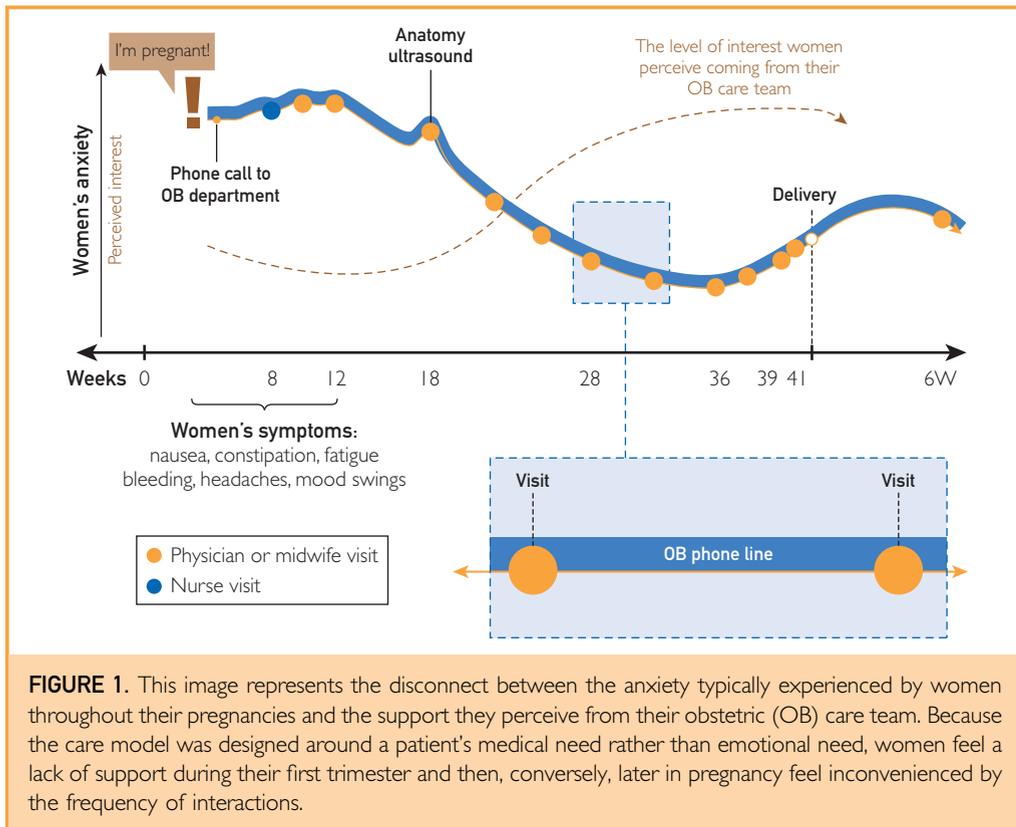


FIGURE 1. This image represents the disconnect between the anxiety typically experienced by women throughout their pregnancies and the support they perceive from their obstetric (OB) care team. Because the care model was designed around a patient's medical need rather than emotional need, women feel a lack of support during their first trimester and then, conversely, later in pregnancy feel inconvenienced by the frequency of interactions.

eligibility criteria mentioned previously herein. An additional inclusion criterion for this experience was access to either the Internet or a smartphone. Nine of the 15 participants were interviewed about their experiences.

Online Communities. Medical issues arising during early pregnancy are often untreatable by current medical technology, as traditional care models focus on diagnostics and screening of the mother and newborn. This leads to a relative sparsity of care team contact in the first trimester.⁵ However, not all questions or concerns during a healthy pregnancy are medical in nature, and a sickness model of care affords little time or opportunity to address these important issues.

Ironically, such nonmedical concerns tend to occur early on in pregnancy, especially in primipara, when there is surfeit of uncertainty and fear due to dramatic changes in physiology and physiognomy. Indeed, in the case of women experiencing low-risk pregnancies, this may be most of their perceived prenatal care needs. A mismatch between the need for support and

regular follow-up may then fuel a sense of disinterest and abandonment by the care team (Figure 1). Although the population-specific needs of primipara, particularly those experiencing low-risk pregnancies, have gone mostly unrecognized by the medical community, it is worth noting that currently more than 45% of women receiving prenatal care in the United States are experiencing their first pregnancy. This emphasizes the importance of medical guidance of both medical and nonmedical concerns in early pregnancies.²²

The misalignment, however, stretches beyond primipara. Because the current American care model is centered around the potential effectiveness of medical interventions, it tends to undervalue the emotional need of pregnant women. This results in a care model that is inflexible to patients' individual needs. Women who were more confident in their pregnancies may, therefore, feel inconvenienced by the frequency of their follow-up visits, and less confident women, perhaps due to personality or history, fail to receive the attention they need and deserve.

To explore this issue further, 63 women experiencing prenatal care at Mayo Clinic were invited to join an online community. Within these spaces, moderated by a nurse or midwife, groups of pregnant women could consult with one another concerning their questions and thoughts regarding pregnancy, childbirth, and parenthood. Ongoing feedback was collected through the online platforms, and 25 women were interviewed either individually or in groups about their experiences. The team recruited patients via phone who were currently receiving Mayo Clinic OB midwifery care using the eligibility criteria mentioned previously herein. In addition, to be eligible, each patient needed to have access to the Internet either at home or at work. We intended to recruit as many women as possible to stimulate group engagement within these online communities, and therefore, no participation limit was set.

Analysis Methods

Because the intent was to identify opportunities to design a care model that aligns with patient needs, we collected data through the following activities: semistructured ethnographic interviews, systematic in-clinic observation, care team feedback sessions, and observations of use behaviors and patient-provider communication through online tools. These data were synthesized using an HCD method called Affinity Diagramming, which is a structured method for mapping ideas into logical, cohesive groups.^{23,24} This inductive, bottom-up method enables the design team to identify themes and insights from multiple data sources that are then interpreted and reframed as design opportunities. These design opportunities serve as the underlying rationale for solution options that then undergo further development and iteration.

RESULTS

The findings articulated in this section describe themes and opportunities discovered through synthesis of the qualitative data captured through this project.

Self-monitoring

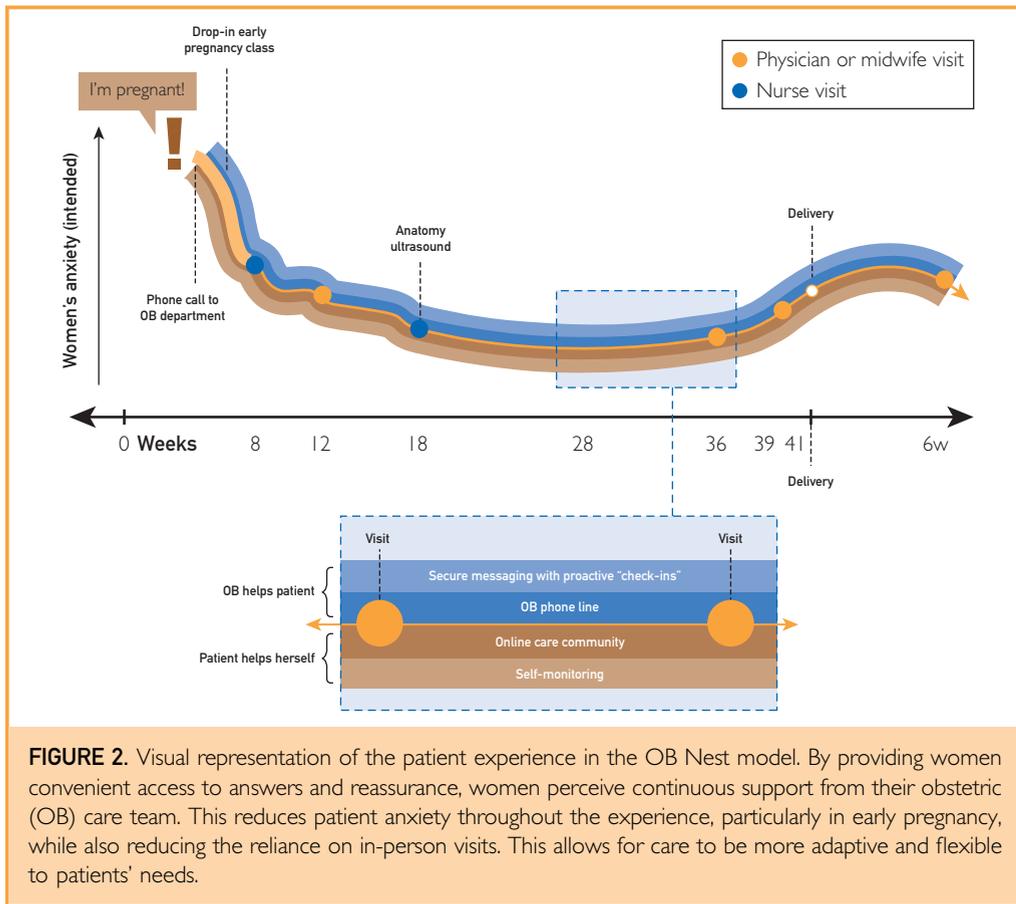
Patients who exchanged prenatal care measurements with their care team reported an increased sense of control, confidence, and reassurance. During ongoing feedback sessions,

the care team commented that the multitude of measurements collected by the patient in the comfort of their home (blood pressure, fetal heart rate, weight, and fundal height) inspired similar confidence in the continued normalcy of the pregnancy as onsite visits. Having the tools and knowledge to be experts on their own pregnancy has broadly been perceived by patients as an empowering experience. Moreover, it created an opportunity to shift away from a sickness model of care and a typically paternalistic communication style. As patients interacted with their care team, we observed high levels of engagement, such as articulating norms and trends in blood pressure levels and forming hypotheses between collected measures and health behaviors. Patients also described satisfaction with their care and communication with their care team. Self-monitoring of the fetal heart rate was not only a reassuring and joyous experience, interviews revealed that it allowed for meaningful participation in the pregnancy for both prospective parents and helped to foster a bond with the fetus among the family.

Text-Based Communication

In traditional prenatal care models, one of the primary mediums for communication is phone-based. Logistically, this often involves several relays between nonmedical and medical personnel before the patient is able to speak to a known care team member. During interviews, women commented that they felt inconvenienced having to repeat, often multiple times, their private and personal health details with additional personnel who were unknown to the patient. In addition, these phone calls would have to be returned by the care team at a later time, which was often when the women were no longer in a private setting to receive their call. By following patients through the course of their care, we observed that this barrier contributed to preventing low-threshold care seeking, with the undesirable result that women would delay their questions and concerns until their upcoming clinic visits with either their doctor or midwife.

Through the use of this text-based communication, women reported that they had a private space to share questions and concerns outside of visits with a designated point person. Moreover, they reported that a direct line of communication with a nurse on their care



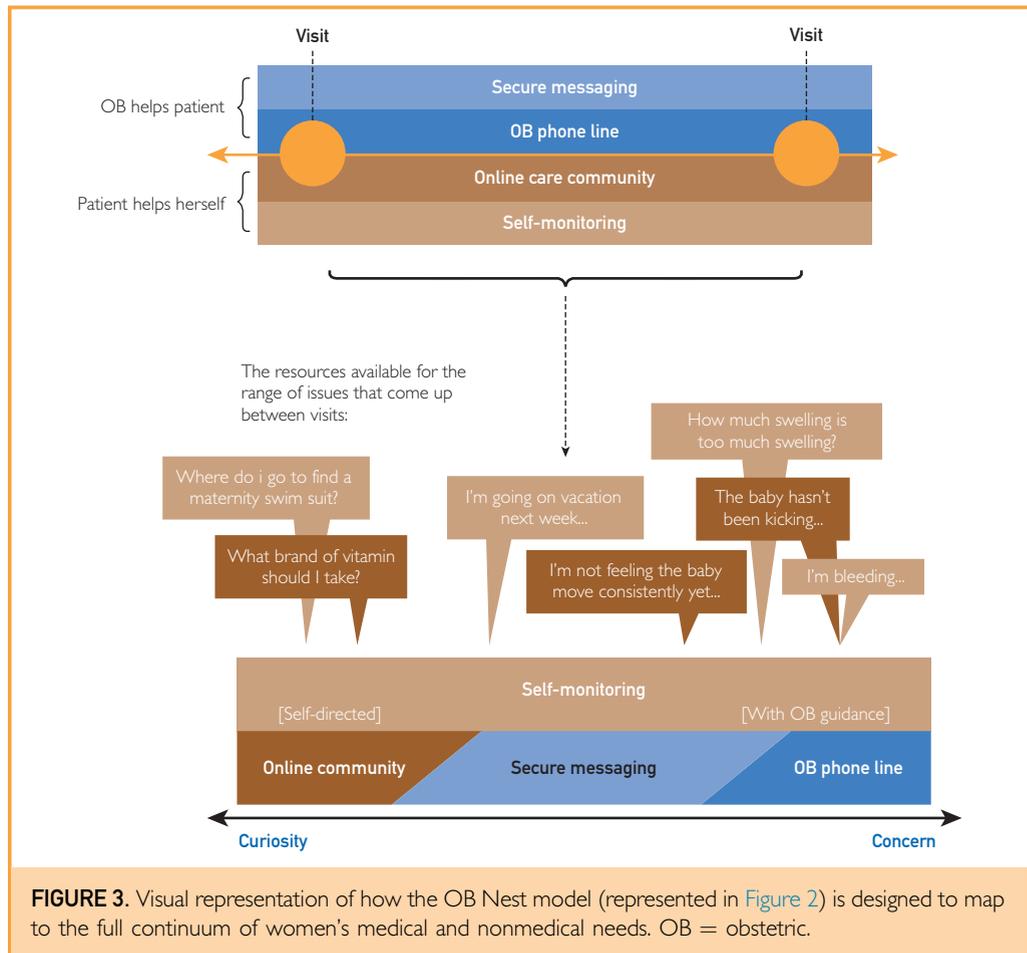
team fostered a trusted partnership throughout the pregnancy. The nurses and patients noted that the knowledge of help within reach contributed to a sense of continuous care, which is especially important in a flexible care model. Because this communication was text-based, it left a trace of interactions that showed both patients and the care team that information was recorded and reviewed. Women, particularly those who worked outside of the home, also commented that they appreciated the added convenience and privacy of this communication method over phone-based communication. Not only were communication hurdles removed, written correspondence ensured accuracy of information relay, and a low threshold for care seeking. Because the communication was asynchronous, women stated that they felt at ease knowing that they had a place “to hold their questions” and “get them out of their head,” as opposed to waiting until office hours to contact the clinic. The following patient quote exemplified

the experience of connected support: “Just knowing this was there was a subconscious comfort — even though you wouldn’t know it because I didn’t use it that much.”

Recently, secure messaging systems and tools are becoming more widely used in health care organizations. By giving women access to this text-based application, it became evident that in the new model of care, 1 or 2 nurses should be assigned early in pregnancy as the primary point of contact for nonvisit care. In addition, these nurses should be given a text-based platform for easy communication and care continuity.

Online Communities

During interviews, patients responded favorably overall to having an online community where their own experience and knowledge about pregnancy, childbirth, and parenthood were welcomed. Women were respected and empowered for their active contribution as a resource to others rather than being a passive recipient of care. Women reported feeling a bond in sharing



their pregnancy experiences and self-care ideas. In addition, although online pregnancy forums are widely available, the participants commented that they appreciated having a moderated online community provided by their care team. The space became a way for the care team not only to expand their impact and reach but also to validate and leverage the expertise of its patients, helping reposition the care team from authoritative expert to supportive partner. Finally, the team saw the potential for these online communities to serve an important transitional role that could bridge the gap between prenatal and postpartum care and ease some of the isolation commonly experienced by women during this phase.

DISCUSSION

In this project, we reported the outcomes of efforts to validate a series of design concepts, which are a combination of tools collectively

referred to as the OB Nest model. This participatory care model, as visualized in Figure 2, was designed to demedicalize the healthy pregnancy experience and endeavor to evolve from an inflexible linear model to a mother- and family-centric model.

Although most women experience pregnancy without substantial complications, the goals of prenatal care remain the detection, management, and amelioration of those complications when they do arise. In envisioning a less medicalized experience for low-risk pregnancies, strategies considered were always within a framework that could equal or even exceed the ability of on-site care to detect complications. If complications develop, a patient's care can be readily converted to a medical model of intervention, which at that point is clearly justified.

Previous studies have demonstrated that a reduced prenatal care visit schedule did not produce suboptimal outcomes.²⁵⁻²⁷ However,

a reduced visit schedule in prenatal care may leave patients dissatisfied.^{28,29} This may, in part, be due to a perceived sense of disinterest and disengagement of the care team between scheduled visits. The OB Nest model sought to investigate a model in which visits are redistributed over the prenatal period according to the needs of patients while providing continuous access to the care team and responsive engagement for both emergent and nonemergent needs (Figure 3). The intent behind the design of this model is not to keep women from coming to the clinic. Instead, it is to anticipate their needs and provide access to reassurance in a way that fits patients' lives. The place of care becomes home based instead of clinic based, and the pregnant woman is no longer a passive recipient of care but instead an engaged partner. This shifts the role of the clinic and physician/midwife from expert to supportive partner, enabling the overall prenatal care experience to be more empowering. In addition, by reducing the overall emphasis on in-clinic visits and leveraging the entire care team, this model, under a bundled reimbursement model, offers the potential for a lower-cost alternative to traditional care (Table). Although it is possible for patients to be seen electronically as often, if not more within the OB Nest model than they would have been seen in the office visits of the traditional care model, this care can more easily be distributed among the full care team. In addition, these patients can access the other self-service tools in the OB Nest model for support and reassurance.

From the initiation of care, women are presented with a plan of care that communicates what to expect throughout the pregnancy experience, along with medically relevant milestones (Figure 2). The OB Nest model establishes the nurse as the primary point person early in pregnancy, establishing a consistent and coherent model for access to information and, when necessary, medical care. A proactive plan of care early in pregnancy generated a partnership between the care team and the patient through regular remote "check-ins." The nurse then serves as the primary contact for the woman's nonvisit care experience, providing continuity of care between visits. This nonvisit care experience includes the self-monitoring of key prenatal care metrics, starting at appropriate gestational milestones.

TABLE. Objectives in the Design of the OB Nest Model

• Strengthen women's confidence, autonomy, self-awareness, and engagement
• Activate partners, families, support people, and communities
• Signal wellness, normalcy, joy, and celebration
• Establish the prenatal care team as a guide, collaborator, and connection to resources
• Share accountability, continuity, and relationships across the care team
• Enable staff to operate at their highest level of licensure
• Build the perception of "unobstructed access" to care for patients
• Provide access to reassurance on the patient's schedule
• Establish transparency around the rhythm of care
• Increase systems memory and recall: allow for better information sharing across all team members
• Enable proactive interactions throughout the entire pregnancy experience

Through this qualitative study that sought to validate the design of a new model of care for women experiencing low-risk pregnancy, we found that the OB Nest model has the potential for the following benefits to women as well as to the practice: (1) lower cost of care, (2) increased access for higher-acuity patients, (3) decreased loss of productivity for the pregnant patient population, (4) greater connections and stronger relationships between patients and their care team, (5) increased patient satisfaction, (6) increased continuity of care, (7) facilities savings, and (8) increased provider engagement and satisfaction. The result of this exploration was the design of an integrated care model. The benefits of the OB Nest model applied to a larger population of women were confirmed in a subsequent randomized clinical trial.³⁰

Moving away from a sickness model of care can be challenging to hospital philosophy and logistics. However, the application of the insights and tools presented herein may well extend beyond the scope of just low-risk pregnancies, or OB all together. The principles behind this participatory care model could also be well suited for other physiologic or chronic medical conditions.

CONCLUSION

In summary, the OB Nest project used an iterative HCD approach to explore opportunities to envision a new, low-risk prenatal care model that is supportive, is empowering, and fits within patients' daily lives. The use of patient-centric care models such as OB Nest have the potential to transform OB care in

the United States by providing a more desirable, participatory experience for expectant mothers and their care teams while providing high-quality care at lower cost.

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Abbreviations and Acronyms: CFI = Mayo Clinic Center for Innovation; HCD = human-centered design; OB = obstetric

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