

# Implementation of Preconception Care for Women With Diabetes

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■ **IN BRIEF** Women with diabetes who are of reproductive age should receive preconception risk assessment and counseling to maximize pregnancy outcomes. This article summarizes the concept of preconception care for women with diabetes and provides a description of an implementation of collaborative preconception care for primary care and obstetrics and gynecology specialty providers.

Recent studies have shown that the incidence of both gestational diabetes mellitus (GDM) and pregestational diabetes in pregnancy has doubled during the past 14 years, and the overall societal burden of diabetes in pregnancy is growing (1). Women with diabetes in pregnancy have high rates of complications for themselves and their babies. These complications impose significant costs to individuals and to society that may be reduced by attention to preconception counseling and interventions. The preconception period is a crucial and sensitive time to improve birth outcomes. Evidence-based practices can be implemented in the preconception period to decrease adverse pregnancy outcomes for women with diabetes. One model of preconception care (PCC) was implemented in a pilot project within an academic medical center and is described below as a model for clinicians to increase PCC through a collaborative approach.

## Diabetes in Pregnancy

### Types of Diabetes in Pregnancy

The American Diabetes Association (ADA) describes three classes of glucose intolerance in pregnancy: type 1 diabetes, type 2 diabetes, and GDM

(2). Pregestational diabetes exists before the start of the pregnancy and includes type 1 and type 2 diabetes. GDM is diagnosed during pregnancy, but may include some undiagnosed pregestational diabetes. Research has shown that women diagnosed with GDM have a 7- to 9.6-times increased risk for developing type 2 diabetes later in life (3,4).

### Increasing Incidence of Diabetes in Women of Childbearing Age

The incidence of diabetes among women of reproductive age (18–44 years) increased from 2.2 to 3.8 per 1,000 women between 1997 and 2013 (5). This increase in diabetes incidence in women translates into increased rates of diabetes in pregnancy. To illustrate, in 2006, the incidence of diabetes during pregnancy, including diabetes diagnosed both before and during pregnancy, was reported to be just over 4% (6). This rate increased to 6% in 2013 (7). Approximately 80–90% of these pregnancies are related to GDM, and the remainder are complicated by pregestational diabetes (8,9).

The prevalence of diabetes in pregnancy increases with maternal age (10), which may partially explain

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the increasing rates of diabetes in pregnancy. The mean age of women at first birth has been rising, and was 26.0 years in 2013, up from 25.8 years in 2012 (7). Other factors that may contribute to this trend include increased screening and an increase in populations with risk factors for type 2 diabetes, including those who are obese and physical inactive (8,10–12).

### **Effects of Diabetes on Pregnancy**

Normal pregnancy itself is regarded as a diabetogenic state in which postprandial glucose levels are elevated and insulin sensitivity is decreased due to the effects of placental hormones, growth factors, and cytokines (13,14). Pregnant women with diabetes may have progression of their disease, and careful management of diabetes is necessary before and during pregnancy.

Diabetes-related disease may have deleterious effects on pregnancy outcomes (8). The effects of diabetes in pregnancy include adverse maternal and neonatal outcomes such as miscarriage, stillbirth, growth abnormalities, increased risk for maternal hypertension and preeclampsia during pregnancy, birth defects, and preterm delivery. Other morbidities include birth trauma, as well as neonatal hypoglycemia and jaundice (10,15).

In pregestational diabetes, there is an increased risk of embryopathy, which correlates with elevations in A1C in the early weeks of pregnancy (2). There is a strong association between A1C levels  $>7.0\%$  at the time of conception and increased risk for major congenital malformations (16). The rate of structural anomalies has been reported to be as high as 6–12% of infants of women with diabetes, a two- to fourfold increase in malformations compared to women without diabetes (8,16,17). Fetal anomalies are seen in multiple organ systems, including the cardiovascular, genitourinary, musculoskeletal, and other systems. Caudal regression, which includes hypoplasia or agenesis of the femorae and lower

vertebrae, is another condition seen more frequently in mothers with pregestational diabetes (17).

In addition to increased fetal and neonatal complications, there are also adverse maternal effects of diabetes in pregnancy. Maternal metabolic and vascular changes during pregnancy affect glycemic control and increase the risk for progression of diabetes complications, which can contribute to poor pregnancy outcomes. Maternal complications for women with preexisting diabetes include worsening of preexisting retinopathy and nephropathy, as well as increased risk for hypertension and preeclampsia (8). A portion of maternal morbidity and mortality stems from these complications related to maternal diabetes.

Women with GDM have underlying insulin resistance and increased risk for fetal macrosomia and birth complications (2). The disease signals an increased risk of maternal type 2 diabetes, as well as childhood obesity and metabolic syndrome for the child (18). Up to 30% of women with GDM develop type 2 diabetes by 5–10 years postpartum (19). Factors such as BMI affect the risk of developing postpartum diabetes after gestational diabetes (20).

Postpartum care for women with GDM must include screening for type 2 diabetes at 6–12 weeks using a 75-g oral glucose tolerance test (OGTT) (2). A 2-hour plasma glucose  $\geq 200$  mg/dL indicates type 2 diabetes. If negative for diabetes, the OGTT should be repeated every 1–3 years. These women should be aware that maintaining a normal BMI and healthy eating and exercise patterns may delay progression to type 2 diabetes and minimize risks for adverse outcomes in future pregnancies (2).

### **Cost Burden of Adverse Birth Outcomes Associated With Diabetes in Pregnancy**

Adverse birth outcomes carry immediate and lifetime societal costs. These costs include medical services,

special education, developmental services, and lost productivity. Evidence suggests that preconception interventions could offset the costs associated with pregestational diabetes. Peterson et al. (21) analyzed data from a systematic review (22) that reported the frequency of various adverse birth outcomes for women with pregestational diabetes who did not receive PCC. Of these women, 41.4% delivered preterm (before 37 weeks' gestation), 7.3% had children with birth defects, and 4.4% had children who died in the fetal or neonatal period. Peterson et al. calculated the preventable cost burden for preterm birth, birth defects, and perinatal mortality by applying average rates of relative risk reduction associated with PCC; they estimated a lifetime societal cost savings of up to \$5.5 billion (21).

### **The Impact of Preconception and Interconception Health on Future Pregnancy**

#### **Definitions of Preconception and Interconception Health**

The importance of PCC for all women of reproductive age has been promoted since the 1980s (23,24), and evidence-based guidelines were published in 2006 (25) to inform clinicians about the appropriate content of PCC. According to the Centers for Disease Control and Prevention (CDC) (25), PCC is "a set of interventions that aim to identify and modify biomedical, behavioral, and social risks to a woman's health or pregnancy outcome through prevention and management." Interconception care includes comprehensive PCC plus additional interventions for women who have had a previous pregnancy that ended with an adverse outcome (25).

PCC and interconception care focus on health promotion for women of reproductive age by identifying and modifying risks for adverse pregnancy outcomes before conception. PCC includes health activities such as family planning and assessment of risk related to social conditions,

**TABLE 1. Preconception Health Recommendations (25)**

1.	Individual responsibility across the life span	Each man and woman should be encouraged to have a reproductive life plan.
2.	Consumer awareness	Increase public awareness of the importance of preconception health behaviors and preconception care services by using information and tools appropriate across various ages.
3.	Preventive visits	Provide risk assessment and educational and health promotion counseling to all women of childbearing age to reduce reproductive risks and improve pregnancy outcomes.
4.	Interventions for identified risks	Increase the proportion of women who receive interventions as follow-up to preconception risk screening.
5.	Interconception care	Use the interconception period to provide additional intensive interventions to women who have had a previous adverse pregnancy outcome.
6.	Prepregnancy checkups	Offer, as a component of maternity care, one prepregnancy visit for couples and individuals who are planning pregnancy.
7.	Health coverage for low-income women	Increase public and private health insurance coverage for women with low incomes to improve access to preventive women's health and preconception and interconception care.
8.	Public health programs and strategies	Integrate components of preconception health into existing public health and related programs.
9.	Research	Increase the evidence base and promote the use of evidence to improve preconception health.
10.	Monitoring improvements	Maximize public health surveillance and related research mechanisms to monitor preconception health.

nutrition, infections, immunizations, medications, and reproductive and family history. These interventions aim to identify and modify biochemical, behavioral, and social risks to a woman's health that might affect a future pregnancy outcome (25). It has been shown that improvement of preconception health improves reproductive health outcomes and decreases societal costs (26).

### **Reproductive Life Planning**

It is recommended that PCC be adopted by every health care provider at every encounter with women of reproductive age. The CDC (25) has published recommendations for the provision of PCC to help improve pregnancy outcomes (Table 1). These recommendations were based on a review of published research and expert opinion. Their goals include improving knowledge, attitudes, and behaviors related to preconception health; ensuring that all women receive PCC; reducing risks related to previous adverse pregnancy outcomes; and reducing disparities. PCC is described

as a continuum of care designed to meet the needs of women throughout their reproductive life and includes evidence-based risk screening, health promotion, and interventions that enable women to enter pregnancy in optimal health (25).

The first CDC recommendation for provision of PCC advocates the use of a reproductive life plan (RLP). An RLP is a tool to help patients realize their reproductive plans and maximize their health before pregnancy (25). The CDC defines the RLP as a set of personal goals related to childbearing intentions. The RLP is used to assess a woman's pregnancy goals and guide the assessment of risk to provide appropriate interventions. The aim of reproductive life planning is to reduce the number of unintended pregnancies and maximize health before conception to improve pregnancy outcomes. Initiation of an RLP can help patients and providers explore family planning, genetic risks, and psychosocial goals. Professional organizations and agencies have recommended the use of

this tool to facilitate the delivery of PCC (25,27–30).

After assessment of the woman's pregnancy goals and risk evaluation, providers may then provide appropriate interventions. For women with diabetes, these interventions may include health promotion activities or referrals to specialists. All women of reproductive age (15–44 years) with type 1 or type 2 diabetes should receive risk assessment and counseling before pregnancy occurs. Counseling should include information about the fetal and maternal effects of diabetes in pregnancy, as well as the impact of pregnancy on glycemic control and potential diabetes progression. Women should be encouraged to plan pregnancies carefully and to optimize their glycemic control before conception to minimize chances for congenital malformations. A collaborative approach is most effective, with support from multidisciplinary professionals, including dietitians, nurses, diabetes educators, psychologists, and specialty providers.

### **PCC and Diabetes**

PCC is associated with improved pregnancy preparation and reduced risk of adverse pregnancy outcomes in both type 1 and type 2 diabetes. Women with chronic medical conditions often have limited knowledge about pregnancy risks related to their condition and minimal knowledge regarding optimizing preconception health. This lack of awareness has been noted even after women experience adverse pregnancy outcomes and includes knowledge deficits and a lack of intent to engage in health promotion activities before conception (31). These findings support the need for clinicians to provide PCC for women with diabetes.

Research has shown that PCC for women with preexisting diabetes results in lower rates of adverse pregnancy outcomes, including major congenital malformations and perinatal deaths, and is cost-effective (16). A regional PCC program for women with pregestational diabetes noted benefits beyond improved glycemic control and found that this care was a stronger predictor of pregnancy outcome than maternal obesity, ethnicity, or social disadvantage (32). PCC is associated with a significant reduction in A1C during the first trimester of pregnancy and lowers the incidence of preterm delivery, birth defects, and perinatal mortality for women with diabetes (22).

One example of a program that provides PCC for women with diabetes is the ATLANTIC Diabetes in Pregnancy (DIP) group. This group provides care in a large region in Ireland and has studied the process and effects of PCC on women with diabetes. In a study published in 2012 (33), the ATLANTIC DIP group investigated the effect of changes in clinical practice that increased the provision of PCC for women with diabetes. Changes in practice included more collaboration between clinicians providing antepartum care and diabetes specialists. Dedicated PCC clinics were initiated, utilizing

electronic data collection, clinical care guidelines, and professional and patient education materials. As a result of these changes, more women received PCC and achieved better glycemic control, resulting in improved pregnancy outcomes (33).

### **Risk Assessment and Preconception Diabetes Care**

According to the ADA, women with pregestational diabetes who are planning pregnancy should aim for an A1C <6.5% (2). However, published guidelines from professional organizations, including the American College of Obstetricians and Gynecologists (ACOG) (8), the ADA (2), and the Endocrine Society (34), are not entirely consistent. These guidelines are summarized in Table 2.

If possible, a multidisciplinary team should be involved to assist women with diabetes in preparing for pregnancy. Providers must assist to maximize women's prepregnancy health to provide a healthy milieu for a fetus. Before conception, women with diabetes should be evaluated and treated for related conditions, including nephropathy, neuropathy, retinopathy, cardiovascular disease, hypertension, dyslipidemia, depression, and thyroid disease. Medications may need to be changed if contraindicated in pregnancy.

After pregnancy, interconception care for women with diabetes should begin at the first postpartum visit. Counseling and support should be provided regarding recommended spacing of pregnancies, healthy lifestyle, and glucose management. Subsequent diabetes after a history of GDM was found to be significantly lower in women who followed healthy eating patterns (35). Also, postpartum or interpregnancy weight gain was found to be associated with increased risk for adverse pregnancy outcome and earlier progression to type 2 diabetes (36).

Women with pregestational diabetes who are contemplating pregnancy should be aware of the increased risk

for fetal structural anomalies and of antenatal testing options during the first and second trimesters of pregnancy. Noninvasive options exist to screen fetuses for genetic and structural abnormalities. For many years, the sequential screen has been used to screen for common genetic defects, as well as structural malformations. A newer method consists of cell-free fetal DNA (cffDNA) testing in combination with maternal serum alpha-fetoprotein and is widely used for women at high risk of fetal aneuploidy. The cffDNA test is based on the discovery that fetal DNA fragments can be found in maternal blood to detect aneuploidy (37). There is a shift away from the sequential screen and multiple markers to the cffDNA. In the near future, the cffDNA will be acceptable for low-risk patients. The best time to counsel about these options is before pregnancy occurs, to allow women and their partners to educate themselves about choices. Testing options are offered early in pregnancy, limiting the time available for this counseling after conception occurs. Providers can refer patients to an obstetrics and gynecology (OB/GYN) clinician or genetic counselor for this specialized counseling.

### **Barriers and Supports to PCC**

#### **Barriers**

Impediments to PCC include limited resources, time constraints, lack of knowledge of clinicians and patients, and difficulty in targeting patients who are planning conception (23,38–40). Also, fragmentation of care for women interferes with continuity of care across the life span and is the result of separated reproductive and nonreproductive services in the U.S. health care delivery system (41).

The high prevalence of unintended pregnancies represents another barrier to PCC. Approximately 50% of pregnancies are unplanned, representing missed opportunities to maximize a woman's health status before conception (42). This is a major public health issue because women with

**TABLE 2. Recommendations for PCC for Women With Diabetes (2,29,34,52)**

	<b>Endocrine Society</b>	<b>ADA</b>	<b>ACOG</b>
<i>For women with pregestational diabetes</i>			
PC counseling	For all women with diabetes who are considering pregnancy	For women of childbearing age who are considering pregnancy; contraception options reviewed at regular intervals for women of childbearing age	PC counseling has been reported to be beneficial and cost-effective and should be encouraged
PC A1C	As close to normal as possible (no exact number)	<6.5%	No recommendation
PC folic acid dose and timing	5 mg 3 months before stopping contraception; reduce to 0.4–1.0 mg at 12 weeks' gestation	At least 400 µg, no timing mentioned	At least 400 µg, no timing mentioned
PC ocular assessment	Yes	Yes	Yes
PC renal assessment	Urine albumin-to-creatinine ratio, serum creatinine, and GFR	Urinary albumin-to-creatinine ratio testing	Serum creatinine and urine albumin-to-creatinine ratio or 24-hour urine collection for protein excretion assessment
If reduced GFR, nephrology consult	Yes	No recommendation	No recommendation
PC blood pressure	<130/80 mmHg		Should be controlled before pregnancy
Medications	Discontinuation of ACE inhibitor or ARB before or around the time of conception	Review of medications for potentially teratogenic drugs (i.e., ACE inhibitors, statins)	Discontinue ACE inhibitor or ARB before conception
Screen for CAD	If there is vascular risk based on duration of diabetes and age		EKG
Counseling about the risks of CAD	As appropriate		May be a potential contraindication to pregnancy
PC statins	Recommend against	Assess for preconceptional use; contraindicated during pregnancy	No recommendation
Thyroid function testing	For women with type 1 diabetes	Thyroid-stimulating hormone (does not specify type of diabetes)	For women with type 1 diabetes
PC weight reduction	If overweight or obese	Weight management mentioned	No recommendation
Other screenings	No recommendation	Rubella, RPR, hepatitis B, HIV, pap smear, cervical cultures, blood typing	No recommendation
<i>For women who have had GDM</i>			
Postpartum testing	2-hour, 75-g OGTT 6–12 weeks postpartum	Screen at 12 weeks postpartum using nonpregnancy criteria	Screen at 6–12 weeks postpartum using an FPG or 75-g, 2-hour OGTT
FBG, random plasma glucose, or A1C	Check periodically and before future pregnancies	Rescreen every 1–3 years	Rescreen every 3 years
Other	Lifestyle counseling to prevent type 2 diabetes after GDM		GDM history should be discussed at all health care encounters

ARB, angiotensin II receptor blocker; CAD, coronary artery disease; EKG, electrocardiogram; FBG, fasting blood glucose; FPG, fasting plasma glucose; GFR, glomerular filtration rate; RPR, rapid plasma regain.

unintended pregnancies usually are not practicing good health promotion behaviors, which can lead to worse outcomes for themselves and their babies. Women with chronic illnesses, including pregestational diabetes, are more likely to experience an unintended pregnancy than women without chronic illness (43). Studies have found that women with diabetes have low rates of contraceptive use (26).

Poor attention to recommended screenings is another barrier that can affect a future pregnancy. Despite recommendations to screen for type 2 diabetes after pregnancy, the postpartum screening rate for women with GDM is only ~50% (44), representing a missed opportunity to enhance wellness before another pregnancy occurs.

### Supports

Use of electronic medical records (EMRs) can enhance consistency among providers so that messages regarding PCC are part of a continuum of care. Education of providers and use of a standardized screening tool can enhance delivery of PCC (45). Additional tools that have been found to be effective in supporting PCC include patient brochures, handouts, and waiting room posters (40).

### Implementation of PCC: A Pilot Project

The identified problem of poor pregnancy outcomes and the opportunity to provide PCC according to evidence-based guidelines to improve those outcomes led to the development of a pilot project at one academic medical center. This project was focused on the collaborative provision of PCC for all women of childbearing age. Although the focus was not on women with any particular preconception risk factor, this strategy can serve as a model for delivery of PCC specifically for women with diabetes. The project, called Implementation of Preconception Care (46), was launched at a satellite outpatient facility affiliated with a large urban

medical center. The setting includes primary and specialty care providers, with an integrated model of care. Clinicians' documentation was within a common EMR system with shared support staff to support patient care.

### Purpose

The purpose of this pilot project was to design, implement, and evaluate an interprofessional, collaborative PCC model congruent with current evidence. A goal of the project was to increase collaborative provision of PCC among internal medicine and OB/GYN providers, which included advanced practice nurses and physicians. To increase delivery of PCC, the strategy addressed important barriers that impede the provision of PCC at every health care encounter with women.

### Methods

#### Organization of Evidence and Team

The project leader performed a literature review, critical appraisal, and synthesis of the evidence regarding PCC. The literature strongly supported provision of PCC to maximize pregnancy outcomes for all women of childbearing age. Specific barriers to PCC were considered, as well as the culture, workflow, and resources available at the health care setting during project development.

Managers, staff, physicians, and nurse practitioners in the OB/GYN and internal medicine groups were counted as stakeholders in the project design. A leadership team was established early in the planning stages and consisted of the project leader, the medical director, practice managers, an information technology specialist, and a quality director. Preferences were taken into account, especially the need for ease of use and time efficiency. Special attention was given to factors that could minimize disruptions in patient care. Barriers, including time constraints and lack of resources, were addressed by designing an efficient tool in the EMR

system. Incorporation of the RLP into the EMR streamlined its use and minimized time demands for providers. A workflow was designed to ensure smooth utilization of the RLP during busy patient hours. The roles of staff and providers were defined to ensure smooth implementation.

#### Provider, Staff, and Patient Education

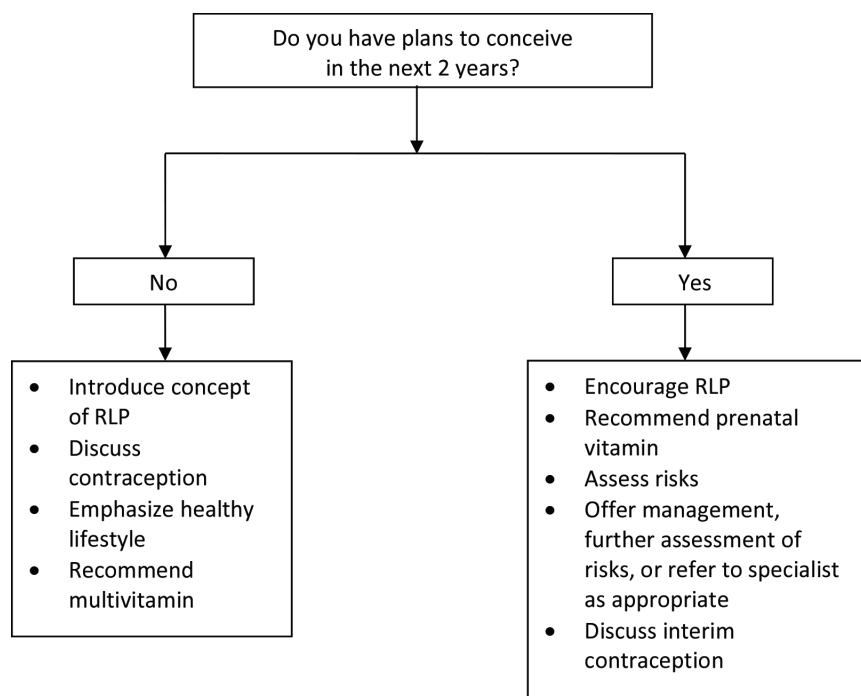
To maximize the knowledge of providers who cared for women, an evidence-based educational program was provided. This program module, *Every Woman, Every Time: Integrating Health Promotion Into Primary Care*, was written by content experts and is available online from the National Preconception Health and Health Care Initiative through its National Preconception Curriculum and Resources Guide for Clinicians (47). Managers and support staff received training in the form of a PowerPoint presentation to maximize success of the workflow and reinforce concepts when patients requested information.

In addition to the educational curriculum for staff and providers, clinicians received instruction regarding use of the RLP and provision of appropriate counseling, interventions, and referrals based on patients' pregnancy intentions. Basic instructions for clinicians were to provide PCC for women who are 18–44 years of age and included the following:

- Discuss timing or avoiding pregnancy as desired
- Assess for risks that could affect pregnancy outcomes
- Obtain screenings (e.g., for sexually transmitted diseases and genetics) and provide immunizations (e.g., for rubella and varicella) before pregnancy
- Treat or refer for care for chronic diseases
- Provide handouts for patients

Figure 1 presents a schematic diagram of the RLP used for this project.

Posters were created based on information from the CDC and



■ **FIGURE 1.** Introducing the RLP.

were hung in waiting areas and exam rooms to inform patients about PCC. Patient educational materials were created as handouts and were made available as printable forms in the EMR for easy access by clinicians during health care encounters.

#### Pre- and Post-Tests

A pre-test/post-test design was used to assess changes in clinicians' knowledge of PCC after participation in the educational curriculum. Before providing the educational curriculum, a pre-test was administered to assess providers' baseline knowledge. After receiving the education, providers took a post-test to assess the increase in their knowledge.

The pre- and post-tests included 15 questions devised by the project leader after review of the evidence about provision of PCC. In the pre-test, three additional questions asked clinicians to identify their role (physician or advanced practice nurse), whether they provide preconception counseling for women of reproductive age (yes or no), and, for those who answered yes, asked them to estimate what percentage of the time they pro-

vide PC counseling and also to state whether they have heard of an RLP (yes or no).

After administration of the pre-test, the leader asked each clinician to view the curriculum and take the post-test within the next 2 weeks and then return. The pre- and post-tests were scored to measure the change in knowledge resulting from viewing the online PCC curriculum.

#### EMR Tool

The providers at the clinical site used a common EMR. A best practice alert (BPA), which is a function of the EMR, was used as a reminder for clinicians to open the RLP. The BPA was designed to trigger only for women aged 18–44 years who have not had a hysterectomy or tubal ligation who presented for routine care with their primary care provider or OB/GYN. Teenagers are not generally seen at this facility; therefore, the project did not include patients <18 years of age.

The EMR tool was designed to reinforce the initiation of an RLP and pregnancy risk assessment by alerting clinicians at the start of health care encounters to ask women if they might

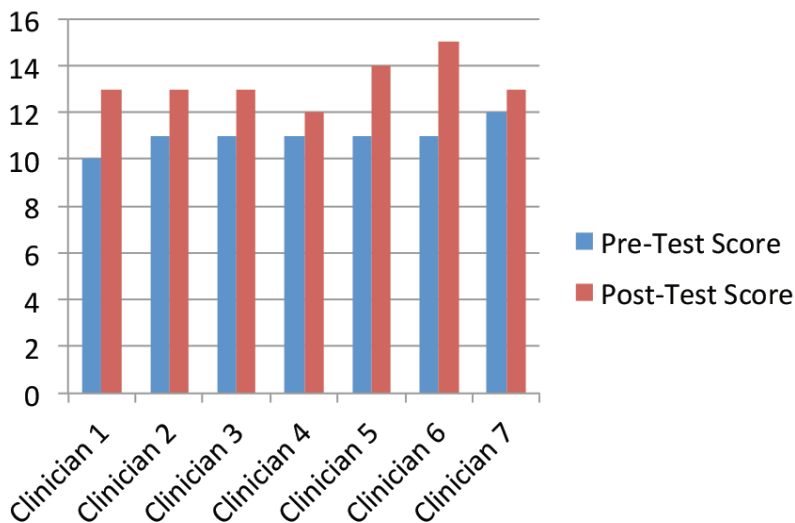
be planning a pregnancy within the next 2 years. This tool supported the concept of reproductive life planning for every woman of reproductive age at every health care encounter, matching Recommendation 1 of the CDC preconception guidelines (25). The practice of embedding evidence-based guidelines into EMR tools was a goal of the health care system entity and empowered the project team to develop this tool.

#### Results

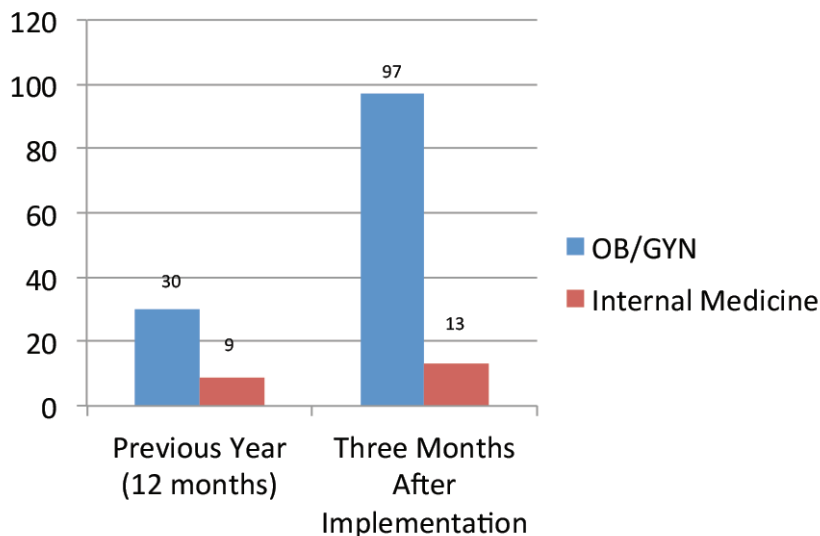
The primary outcome measure for this project was increased knowledge among the seven providers after receiving the educational curriculum. Secondary outcome measures focused on staff (100% would be knowledgeable about PCC), providers (100% would use the RLP), and patients (the number of eligible women receiving PCC would increase). During implementation, assessment of the number of women aged 18–44 years who received PCC was performed through the EMR at regular intervals.

Evaluation of the outcome measures revealed increased knowledge of staff and providers after participation in the educational curriculum. Scoring of the pre- and post-tests revealed all seven clinicians increased their knowledge after receiving the education. The two questions that showed the most improvement in knowledge asked about the percentage of unplanned pregnancies (correct answer 48%) and the correct dose of folic acid (correct answer 400 µg daily). Figure 2 depicts increased clinician knowledge after the Implementation of Preconception Care project. There was an increase in the rate of PCC after the project for both the internal medicine and OB/GYN practices, as depicted in Figure 3.

Use of the EMR enhanced consistency among providers so that messages regarding PCC were part of a continuum of care. Analysis of the outcomes indicated that the project enabled providers in the clin-



**FIGURE 2.** Clinician knowledge of PCC. The pre- and post-tests included 15 questions dealing with knowledge of PCC. All seven clinicians in the project exhibited increased knowledge after viewing the educational curriculum.



**FIGURE 3.** Rate of provision of PCC. In the previous full year, the OB/GYN clinic provided 30 encounters for PCC, and the internal medicine clinic provided 9 encounters for PCC. During the 3 months after implementation of the pilot program, OB/GYN provided 97 encounters, and internal medicine provided 13 encounters that included PCC. Increased provision of PCC was observed for OB/GYN and internal medicine in the 3 months after the implementation of PCC.

ical setting to effectively translate the concept of PCC into a tangible intervention. Costs for this project were minimal and included copying handouts and signs, as well as time spent creating the RLP tool and educating staff.

**Summary**

Population trends demonstrate an increasing prevalence of diabetes in pregnancy (11). Women with diabetes in pregnancy and their babies are at risk for a wide spectrum of complications. Risk of adverse pregnancy

outcomes for women with diabetes can be minimized by comprehensive PCC, which can enhance the fetal environment and improve maternal health behaviors. Barriers to PCC, which include gaps in knowledge for providers and women with diabetes, as well as lack of time, should be addressed by delivery of educational programs and improved processes of care. Clinicians, health care administrators, and policy-makers must work together to develop successful PCC programs for women with diabetes. Studies have reported improved knowledge, decreased perception of barriers, earlier antenatal registration, and improved glycemic control after provision of PCC to women with pre-gestational diabetes (48).

All providers who care for women with diabetes should be aware of published PCC guidelines. An RLP should be used as a tool to assess patients’ reproductive intentions. A complete health care evaluation should be performed with a multi-disciplinary approach to promote health before pregnancy occurs. Women who choose to delay pregnancy require effective contraception or referral to an OB/GYN provider. Folate supplementation should be recommended before conception. A1C should be normalized, and any diabetes complications should be treated. Medications should be reviewed and changed as appropriate if contraindicated during pregnancy. After pregnancy in women with diabetes, the 6-week postpartum visit should be considered as the first opportunity to provide PCC for a future pregnancy. Women should receive risk counseling about potential adverse pregnancy outcomes related to diabetes, as well as practices to optimize glycemic control and diabetes-related conditions.

Fragmentation of care for women interferes with continuity of care across the life span and is a result of separated reproductive and non-reproductive services in the U.S. health care delivery system (41).



Clinical decision support in the EMR streamlines clinical services by making patient education and health promotion efforts consistent at all health care visits (49). Health care outcomes, including for pregnancies for women with diabetes, can benefit from systems that integrate PCC across levels of care and areas of expertise. Providers at all types of health care encounters should attend to PCC, including visits for women's health, screenings, chronic disease management, and acute disease care.

PCC has been described as a continuum of care designed to meet the needs of women during the reproductive life (25), and national campaigns promote PCC. Goals for PCC have been established by *Healthy People 2020* (50). Safe Motherhood is a campaign advanced by the CDC to decrease adverse birth outcomes caused by chronic diseases such as diabetes (51).

Designing systems for providing PCC to women with diabetes is an essential factor to success in maximizing pregnancy outcomes for women, children, and families. Successful prevention of avoidable adverse reproductive outcomes will minimize costs for individuals, communities, and society as a whole.

The preconception period is a crucial time for preventing adverse pregnancy outcomes for women with diabetes. Preconception risk assessment and counseling may help to alert women to the important need to improve their health status before conception and may decrease rates of unintended pregnancies before disease management is optimized. Health care providers can contribute to improvement in overall pregnancy outcomes for women with diabetes through reproductive life planning. A holistic, wellness-oriented standard of care should be implemented at every health care encounter with women with diabetes who are of reproductive age. Asking every woman with diabetes about her reproductive intentions promotes the idea that pregnancies

should be intended and planned. By keeping these concepts in mind, we can maximize the health of women of reproductive age, decrease unintended pregnancies, and improve pregnancy outcomes.

### Duality of Interest

No potential conflicts of interest relevant to this article were reported.

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