



Missouri Department of Health and Senior Services

# Missouri Consensus Guide on Pregnancy and Diabetes



# Gestational Diabetes Management Guideline Workgroup

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The authors of this guideline, the Missouri Gestational Diabetes Management Guideline Work Group, represent key organizations committed to improving diabetes care in Missouri. Other individuals were also involved in the review and revision of various drafts and the finalization of the guideline. The Missouri Diabetes Prevention and Control Program extends appreciation to all those who participated for their collaboration, expertise and perseverance regarding this statewide project.



## Missouri Consensus Guide on Pregnancy and Diabetes

The Missouri Consensus Guide on Pregnancy and Diabetes was developed to equip medical providers across the state with screening, diagnosis and treatment guidance for the prenatal diagnosis of gestational diabetes mellitus (GDM).

Prenatal care for the woman with GDM must be a partnership between the woman, family members and the prenatal team. This team may include, but is not limited to, family physicians, obstetrician-gynecologist, advanced practice nurse, diabetes educator, nurse, dietitian, pharmacist and other specialists. Abnormal physical or lab findings should result in appropriate interventions.

In addition, this guide provides follow-up guidance for the postpartum woman and her child. It is not intended to replace or preclude clinical judgment. These guidelines are a supplement to the standard general medical care provided to pregnant women with diabetes and GDM as described in the Supplemental Information Section (SIS).

The guidelines and supplemental information can be accessed at [www.dhss.mo.gov/diabetes/Guidelines.html](http://www.dhss.mo.gov/diabetes/Guidelines.html) or by calling 573-522-2861.

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P.O. Box 570  
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02/2010



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# Missouri Consensus Guide on Pregnancy and Diabetes

(Supplemental Information Section (SIS) on page 7 of guide)

Component of Care	Care/Test	Frequency
<b>Preconception Counseling</b>	<ul style="list-style-type: none"> <li>✦ Educate on effective contraception and need for pre-conception counseling and evaluation of glycemic control prior to planned pregnancies</li> <li>✦ See SIS</li> </ul>	<ul style="list-style-type: none"> <li>✦ Teaching as needed prior to a confirmed pregnancy</li> </ul>
<b>Screening</b>	<ul style="list-style-type: none"> <li>✦ Complete a risk assessment for all women of childbearing age (See SIS)</li> <li>✦ Complete a screening test based on the risk status of the woman:               <ul style="list-style-type: none"> <li>➤ <b>Pregnant women at high risk for developing Gestational Diabetes Mellitus (GDM) have one or more of the following risk factors:</b> <ul style="list-style-type: none"> <li>• Ethnic origin with a higher known prevalence of type 2 diabetes (American Indian or Alaska Native, African-American, Asian, Middle Eastern, Hispanic or Pacific Islander)</li> <li>• Glycosuria at the first prenatal visit</li> <li>• Diagnosis of polycystic ovary syndrome (or other signs of insulin resistance)</li> <li>• Family history of diabetes, especially in first degree relatives<sup>37,43</sup></li> <li>• Pre-pregnancy weight <math>\geq 110\%</math> of ideal body weight or significant weight gain in early adulthood – or Body Mass Index (BMI) over 30</li> <li>• Age <math>&gt; 25</math> years old and BMI <math>&gt; 27</math> <sup>5,16,21,27,37</sup></li> <li>• Previous delivery of a baby greater than nine pounds (4.1 kg)</li> <li>• Personal history of abnormal glucose tolerance<sup>5,16,27</sup></li> <li>• Woman who was low birth weight (LBW) at birth<sup>34</sup> (See SIS)</li> <li>• Previous history of GDM during past pregnancy</li> <li>• Sedentary lifestyle</li> </ul> </li> <li>➤ <b>Pregnant women at average risk for developing GDM are those who are neither high nor low risk</b></li> <li>➤ <b>Pregnant women at low risk for developing GDM must meet all of the following criteria:</b><sup>5</sup> <ul style="list-style-type: none"> <li>• Age <math>&lt; 25</math> years</li> <li>• Normal pre-pregnancy weight defined as below 25 BMI</li> <li>• Member of an ethnic group with a low prevalence of diabetes</li> <li>• No known diabetes in first-degree relatives</li> <li>• No history of abnormal glucose tolerance</li> <li>• No history of poor obstetric outcome or birthing complications</li> <li>• Woman that was normal weight at birth<sup>38</sup> and not a LBW baby</li> </ul> </li> </ul> </li> <li>✦ Test using the two-step approach. Perform an initial screening by measuring the plasma or serum glucose concentration one hour after a 50-g glucose load. If an abnormal reading occurs, then perform a diagnostic 100-g Oral Glucose Tolerance Test (OGTT) on those exceeding the glucose threshold value on the glucose challenge.<sup>16</sup> To ensure accuracy, better not to screen using a Fasting Plasma Glucose (FPG), random blood glucose or urinalysis.<sup>37</sup> (See SIS)</li> </ul>	<ul style="list-style-type: none"> <li>✦ At first prenatal visit<sup>16</sup></li> <li>✦ Test high-risk women as soon as feasible. If negative, screen again at 24-28 weeks<sup>16</sup></li> <li>✦ Test average-risk women between 24 and 28 weeks<sup>16</sup></li> <li>✦ Low-risk women do not require testing, but testing maybe requested at the discretion of the physician<sup>16</sup></li> </ul>
<b>Diagnosis</b>	<ul style="list-style-type: none"> <li>✦ Diagnose with a 100-g oral glucose load, meeting two or more of the plasma glucose levels (See SIS)</li> </ul>	<ul style="list-style-type: none"> <li>✦ Fasting: <math>\geq 95</math> mg/dl or 5.3 mmol/l</li> <li>1-hr: <math>\geq 180</math> mg/dl or 10.0 mmol/l</li> <li>2-hr: <math>\geq 155</math> mg/dl or 8.6 mmol/l</li> <li>3-hr: <math>\geq 140</math> mg/dl or 7.8 mmol/l<sup>16</sup></li> </ul>

Component of Care	Care/Test	Frequency
<b>Therapeutic Management</b>	<ul style="list-style-type: none"> <li>✦ Instruct to perform self monitoring of blood glucose and to bring glucose log to each prenatal care appointment (See SIS)</li> <li>✦ Provide and/or refer for individual medical nutrition therapy (MNT) to achieve treatment goals, preferably provided by a registered dietitian/certified diabetes educator (CDE) familiar with the components of MNT (See SIS)</li> <li>✦ Initiate insulin therapy or accepted hypoglycemic agents when MNT fails to maintain self-monitored glucose at any of the following levels: <ul style="list-style-type: none"> <li>• Fasting: <math>\leq 95</math> mg/dl (5.3 mmol/l)</li> <li>• 1-hr postprandial: <math>\leq 140</math> mg/dl (7.8 mmol/l)</li> <li>• 2-hr postprandial: <math>\leq 120</math> mg/dl (6.7 mmol/l)</li> </ul> </li> <li>✦ See SIS for further information on insulin control, glycemic ranges and approved hypoglycemic agents during pregnancy</li> <li>✦ Begin, continue, and encourage a program of moderate exercise<sup>12</sup> (See SIS)</li> </ul>	<ul style="list-style-type: none"> <li>✦ At diagnosis, instruct to check blood glucose up to nine times a day, especially one to two hours after meals<sup>27</sup></li> <li>✦ At diagnosis, with follow-up as needed until initial goals are met<sup>16</sup></li> <li>✦ At time glucose levels deteriorate. Instruct on appropriate daily insulin therapy. Insulin pumps are a possibility to maintain insulin compliance.</li> <li>✦ Discuss at first and subsequent prenatal visits. Should participate in 30 minutes/day of moderate exercise on most, if not all, days of the week. The literature advises 150 minutes of moderate exercise per week.</li> </ul>
<b>Prenatal Surveillance &amp; Education</b>	<ul style="list-style-type: none"> <li>✦ Schedule prenatal care appointments</li> <li>✦ Ensure adequate energy intake that provides appropriate weight gain<sup>15</sup> (See SIS)</li> <li>✦ Detect maternal hypertensive disorders through blood pressure measurement and urine protein monitoring<sup>21</sup></li> <li>✦ Maintain target blood pressure goal of 110-129/65-79 mmHg for the pregnant patient with diabetes and chronic hypertension<sup>16</sup> (See SIS)</li> <li>✦ Educate on the benefits of breastfeeding for mother and child, including the possibility of reducing obesity and the risk of developing diabetes. Refer to lactation consultant or registered dietician when available. (See SIS)</li> <li>✦ Refer to social worker<sup>22</sup> for needed resources (e.g., uninsured, history of illicit drug/alcohol use or other issues)</li> <li>✦ Instruct to call to review self monitored blood glucose data with physician or appropriate health professional by phone if glucose data exceeds prescribed parameters</li> <li>✦ Refer to a dentist for dental and periodontal exam<sup>11,19,20,22</sup> (See SIS)</li> <li>✦ Follow-up with treatment of gross caries, abscesses and periodontal infection. Coach to proficiency in oral hygiene practices which minimize bacterial load and transfer of oral pathogens to the infant.<sup>11,19,20,22</sup> (See SIS)</li> <li>✦ Monitor for deterioration of glucose tolerance, which occurs normally during pregnancy<sup>14</sup></li> <li>✦ Instruct to assess fetal kick count, keep a log, and bring log to each prenatal visit for review</li> <li>✦ Perform non-stress test (NST) and biophysical profile (NST and amniotic fluid index)<sup>9,22</sup> (See SIS)</li> </ul>	<ul style="list-style-type: none"> <li>✦ Every four weeks up to 28 weeks; every two weeks up to 36 weeks, then weekly<sup>27</sup></li> <li>✦ First and subsequent prenatal visits</li> <li>✦ First and subsequent prenatal visits</li> <li>✦ First and subsequent prenatal visits<sup>1</sup></li> <li>✦ First prenatal visit</li> <li>✦ At diagnosis (should call one to two times per week)<sup>27</sup></li> <li>✦ First trimester</li> <li>✦ Every one to four months as periodontal health needs direct, particularly in the third trimester<sup>14</sup></li> <li>✦ Daily at 28 weeks.<sup>27</sup> Should obtain at least four fetal movements every hour. Assess after eating. Report immediately any reduction in the perception of fetal movements.<sup>9,13,33</sup></li> <li>✦ After 32-34 weeks, perform weekly if diet is controlled. Twice if medically regulated (oral agents or insulin) until end of pregnancy.<sup>33</sup></li> </ul>

Component of Care	Care/Test	Frequency
<b>Prenatal Surveillance &amp; Education continued</b>	<ul style="list-style-type: none"> <li>✦ Assess fetal growth and amniotic fluid volume by ultrasonography (to assess for anticipated delivery management)</li> <li>✦ Whenever feasible, a maternal fetal management consultation is recommended</li> <li>✦ Refer to other team members based on medical co-morbidities, patient medical history and/or adequacy of glucose control: ophthalmologist, optometrist, cardiologist, endocrinologist, nephrologists, etc.</li> </ul>	<ul style="list-style-type: none"> <li>✦ Conduct at 28, 32, and 36 weeks gestation<sup>21</sup></li> <li>✦ As indicated</li> <li>✦ Refer to a nephrologist if Creatinine &gt; 120 micromol/L or GFR &lt; 45 mL/min<sup>37</sup></li> <li>✦ Current retinal and renal assessments advised if not done within the last year</li> </ul>
<b>Delivery Management</b>	<ul style="list-style-type: none"> <li>✦ Counsel on issues of possible cesarean delivery without labor when<sup>8</sup> <ul style="list-style-type: none"> <li>➢ At 39 weeks based on fetal weight</li> <li>➢ At 38 weeks based on pre-existing medical condition (hypertension)</li> <li>➢ Before 38 weeks when unusual medical condition exists</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>✦ Dependent upon fetal weight- if 4500-g is reached</li> <li>✦ Elected cesarean delivery is reasonable when fetal weight is &gt;5000-g; however, depending on the size of the maternal pelvis, cesarean delivery may be recommended when fetal weight is between 4,000-4,500-g.<sup>52</sup></li> </ul>
<b>Postpartum Follow-up</b>	<ul style="list-style-type: none"> <li>✦ Encourage breastfeeding and assist to initiate breastfeeding as soon as possible after birth<sup>1</sup> (See SIS)</li> <li>✦ Monitor blood glucose levels fasting and before meals while in hospital to guide changes in therapy upon discharge, especially if on insulin. If fasting blood sugar &gt;105 and/or blood sugar &gt;130 two times, follow-up with OGTT. If diagnosed follow adult diabetes management guidelines. (See SIS)</li> <li>✦ Educate lactating women on possible fluctuations in blood glucose relating to nursing session. A carbohydrate snack before or during breastfeeding may be required.<sup>15</sup></li> <li>✦ Self-monitor fasting blood glucose after discharge. If fasting blood glucose &gt;120 mg/dl, and/or postprandial blood glucose &gt;160 mg/dl, evaluate for diabetes.</li> <li>✦ Educate mother on lifestyle modifications aimed at reducing weight and increasing physical activity.<sup>15</sup> Provide ongoing support by utilizing appropriate health professionals for follow-up visits when possible and offering fasting plasma glucose if not already diagnosed with GDM.<sup>37</sup></li> <li>✦ Screen mother for diabetes and follow-up with subsequent screenings for the development of diabetes or pre-diabetes</li> </ul>	<ul style="list-style-type: none"> <li>✦ Prior to first feeding and continuing as needed to support and encourage continued breastfeeding</li> <li>✦ Four times per day minimum during the first 24 hours with recommended testing before and one to two hours following meals and once more at bedtime<sup>44</sup></li> <li>✦ Two hours after breakfast, once a day until first postpartum visit<sup>27</sup></li> <li>✦ Six to twelve weeks postpartum<sup>16</sup></li> <li>✦ At three to six months and yearly thereafter<sup>12,27</sup> or sooner if weight increases or symptoms develop</li> </ul>
<b>Preconception Counseling Following Pregnancy</b>	<ul style="list-style-type: none"> <li>✦ Educate on effective contraception and need for pre-conception counseling and evaluation before future pregnancies<sup>5,13</sup> (See SIS)</li> </ul>	<ul style="list-style-type: none"> <li>✦ Six to twelve weeks postpartum and as indicated in future visits</li> </ul>
<b>Child Follow-up</b>	<ul style="list-style-type: none"> <li>✦ Encourage and support breastfeeding exclusively for six months<sup>1</sup> to decrease risk of child becoming obese or developing diabetes (See SIS)</li> <li>✦ Perform well child visits and immunizations</li> <li>✦ Monitor child closely for the development of obesity and/or abnormalities of glucose tolerance<sup>12</sup> (See SIS)</li> </ul>	<ul style="list-style-type: none"> <li>✦ Prior to first feeding, and continuing as needed to support and encourage continued breastfeeding</li> <li>✦ According to established schedules</li> <li>✦ <i>Obesity monitoring:</i> at well child visits</li> <li>✦ <i>Glucose tolerance monitoring:</i> after 10 years of age based on risks<sup>35</sup></li> </ul>

# Missouri Consensus Guide on Pregnancy and Diabetes

## Supplemental Information Section (SIS)

### Why Gestational Diabetes Mellitus (GDM) Management and Follow-up?

These guidelines for management *and* follow-up of the Pregnant Woman with GDM were developed to provide guidance for all Missouri health care providers, as there is an abundance of evidence that women with GDM have a significant risk of developing health problems during as well as after pregnancy. It is important to include follow-up information in the guidelines as a reminder to providers that a GDM diagnosis is a predictor for possible future development of chronic conditions in a woman. Women with a history of GDM are at increased risk for developing diabetes (generally type 2 diabetes) after pregnancy. Diabetes will be diagnosed in some women soon after pregnancy, suggesting they had diabetes that was not diagnosed prior to pregnancy.<sup>8</sup> Obesity and other risk factors that promote insulin resistance appear to enhance the risk of type 2 diabetes after GDM, while markers of islet cell — directed autoimmunity — are associated with an increase in the risk of type 1 diabetes. The offspring of women with a history of GDM are at increased risk of developing health-altering conditions such as obesity, glucose intolerance and diabetes in late adolescence and young adulthood.<sup>12</sup>

By including follow-up components in the guidelines, Missouri places emphasis on prevention and early detection strategies of modern health care and medicine. This should benefit Missourians by limiting future health problems and reducing the costs of health care.

### **GDM Care and Management**

Women with GDM should receive medical care from a physician-coordinated interdisciplinary team. Such teams may include, but are not limited to physicians, nurse practitioners, physician's assistants, nurses, dietitians, pharmacists and mental health professionals with expertise and special interest in diabetes. It is essential in this collaborative and integrated team approach that women with GDM assume an active role in their care.<sup>16</sup>

The management plan should be formulated as an individualized therapeutic alliance among the woman with GDM, her family, the physician and other members of the health care team. Any plan should recognize diabetes self-management as an integral component of care. In developing the plan, consideration should be given to the age, school or work schedule and conditions, physical activity, eating patterns, social situation and personality, cultural factors and presence of other medical conditions of the woman with GDM. A variety of strategies and techniques should be used to provide adequate education and development of problem-solving skills in the various aspects of GDM management. Implementation of the management plan requires that each aspect is understood and agreed upon by the woman with GDM and the care providers, and that the goals and treatment plan are reasonable.<sup>35</sup>

### **Importance of Preconception Counseling**

Women of childbearing age suffer from various chronic conditions and are exposed to (or consume) substances that can have an adverse effect on pregnancy outcomes, leading to pregnancy loss, infant death, birth defects or other complications for mothers and infants. Preconception health care is critical because several risk behaviors and exposures affect fetal development and subsequent postnatal outcomes. The greatest adverse effects can occur early in pregnancy, often before women enter prenatal care or even know that they are pregnant. For example, for optimal effect on reducing the risk for neural



tube defects, folic acid supplementation should start at least three months before conception. During the first weeks of pregnancy (before 52 days gestation), exposure to teratogens such as alcohol, tobacco and illicit drugs; lack of essential vitamins (e.g., folic acid); and workplace hazards can adversely affect fetal development and therefore result in pregnancy complications and poorer outcomes for both the mother and infant. This evidence demonstrates the potential impact of preconception care on the health of women and their infants.<sup>23</sup>

A pre-pregnancy program that includes preconception counseling improves pregnancy outcomes. A significant difference occurs in decreased fetal birth defects among women attending preconception counseling programs. Starting at female puberty, health care professionals should discuss the effects of pre-diabetes and diabetes on sexual activity and pregnancy, preventing an unplanned pregnancy and the positive effects of preconception counseling.<sup>6</sup>

To minimize the occurrence of devastating fetal malformations and pregnancy complications related to diabetes, standard care for all women with diabetes of childbearing potential (and women in the pre-diabetes range or with a previous history of GDM) should include:

- 1) Asserting the importance of establishing/maintaining good glycemic control prior to and throughout the duration of pregnancy<sup>43</sup> and assisting each woman with diabetes in achieving that goal
- 2) Repetitive counseling about the risk of malformations associated with unplanned pregnancies and poor metabolic control
- 3) Use of effective contraception at all times unless the patient is in good metabolic control and actively trying to conceive<sup>5,13</sup>
- 4) Recording any intentions of conception and/or contraceptive use at each obstetric consult<sup>37</sup>

If the patient expresses a wish to become pregnant or that she is currently trying to become pregnant, providers should offer instruction regarding the effects of diabetes on a pregnancy including the following (and other necessary) topics:<sup>37</sup>

- Risks associated with diabetes for a pregnant woman and possible ways to reduce such risks
- The need for diet modifications, weight control, and changes in physical activity regarding a GDM pregnancy
- Nausea and vomiting (related to) pregnancy (NVP) and its effects on glycemic control
- What can result from a large (for) gestational age (LGA) (or macrosomic) baby, i.e., birth trauma, induction, delivery complications resulting in a Caesarean section, shoulder dystocia, rebound neonatal hypoglycemia, etc., and the possibility of a Neonatal Intensive Care Unit (NICU) admission
- Risk of baby developing obesity or diabetes later on in life
- Importance of maintaining glycemic control during pregnancy, labor, delivery and breastfeeding
- Reminder that there will be frequent contact with the prenatal team throughout pregnancy

The desired outcome of the preconception phase of care is to lower A1C test values to a level associated with optimal development during organogenesis. Levels that are <1% above the normal range are desirable. Women who have an HbA1C level above 10 percent should be advised to avoid pregnancy.<sup>37</sup> When the risks of maternal diabetic complications are low and the status of any coexisting medical conditions are stable, then contraception may be discontinued. If conception does not occur within one year, the patient's fertility should be assessed.<sup>13</sup>

Adverse perinatal outcomes associated with maternal obesity include neural tube defects, preterm delivery, diabetes, cesarean section and hypertensive and thromboembolic disease to name a few. Appropriate weight loss and nutritional intake before pregnancy has been shown to reduce these risks.<sup>23</sup>

The goal of preconception counseling is to routinely provide a woman with diabetes with adequate information, care and support; so that her overall risk for developing GDM might be reduced and she will become empowered in her own health and care and might help to further facilitate positive outcomes.

## **Initial Risk Assessment and GDM Evaluation**

The complete medical evaluation of a new pregnant woman should assist in classifying the risk of developing GDM. Laboratory tests appropriate to the evaluation of the general medical condition of women with GDM should be performed by the clinical obstetrician at the first prenatal visit. For a pregnant woman with an existing diagnosis of diabetes, the evaluation should review the previous treatment and the past and present degrees of glycemic control, detect the presence or absence of diabetes complications, assist in formulating a management plan and provide the basis for continuing care. A focus on the components of comprehensive care will assist the health care team to ensure optimal management of pregnant women with diabetes, GDM or at risk of developing GDM.<sup>16</sup>

## **Screening Process**

There is a major difference between diagnostic testing and screening. Both utilize the same clinical tests, which should be done in the context of the health care setting. When an individual exhibits symptoms or signs of the disease, diagnostic tests are performed, and such tests do not represent screening. The purpose of screening is to identify asymptomatic individuals who are likely to have GDM or at risk of developing diabetes. Once screening results suggest a possible diagnosis, separate diagnostic tests should be performed to establish a definitive diagnosis.<sup>16</sup>

The screening test generally should be performed on venous plasma or serum samples using well-calibrated and well-maintained laboratory instruments.<sup>8</sup> The literature states screening tests may be conducted using either a one step or two step approach.<sup>16</sup> When the two-step approach is used, a glucose threshold value of  $\geq 140$  mg/dl identifies  $\sim 80\%$  of women with GDM, and the yield is further increased to 90 percent by using a cutoff of  $\geq 130$  mg/dl.<sup>16</sup> The two step approach is most commonly done. It is usually more cost-effective and less stressful to the patient, therefore the one step approach is not recommended by this advisory group. The diagnosis can be made using a 2-h, 75-g glucose tolerance test, but that test is not as well validated for detection of at-risk infants or mothers as the 3-h, 100-g OGTT.<sup>16</sup> Women with borderline results should be screened again at a future visit, as they will become less tolerant to glucose.

There are certain risk factors that should warrant an immediate screening for GDM. For example, ethnic groups with high risk prevalence include American Indian or Alaska Native, African-American, Asian or Pacific Islander, Middle Eastern and Hispanic.<sup>5,27,37</sup> It is important not to assume ethnic origin, and is crucial to ask each individual patient about her ethnic background. A BMI of  $<25$  is considered to be low risk. However, a BMI between 25-28 is considered average risk and a BMI  $\geq 28$  is considered high risk. There are several other unmodifiable risk factors that predispose a woman to GDM listed under the screening section of the guidelines table. The important thing to remember is that low-risk women do not require screening, moderate risk women should be screened between 24-28 weeks, and high risk women should be screened as soon as possible.

## **Diagnosis**

A fasting plasma glucose (FPG) level  $\geq 126$  mg/dl (7.0 mmol/l) or a casual plasma glucose  $\geq 200$  mg/dl (11.1 mmol/l) meets the threshold for the diagnosis of diabetes. Fasting is defined as no caloric intake for at least eight hours. Casual is defined as any time of day without regard to time since last meal.<sup>16</sup>

Both the fasting and casual glucose tests should be conducted two times on two different days. In the absence of unequivocal hyperglycemia, the diagnosis must be confirmed on the subsequent day. Confirmation of the diagnosis precludes the need for any glucose challenge.<sup>14</sup> The 100-g oral glucose tolerance test (OGTT) should be done in the morning after an overnight fast of eight to fourteen hours and after at least three days of unrestricted diet ( $\geq 150$  g carbohydrate per day) and unlimited physical activity. The subject's glucose levels are tested at the end of each hour. The subject should also remain seated and not smoke throughout the test. The diagnosis can be made using a 2-hour, 75-g glucose test, but once again that test is not as well validated for detection of at-risk infants or mothers as the 3-hour, 100-g OGTT.<sup>12</sup>

## **Therapeutic Management**

### ***Glycemic Control***

Daily self-monitoring of blood glucose is superior to intermittent office monitoring of plasma glucose. For women treated with insulin, limited evidence indicates that postprandial monitoring is superior to preprandial monitoring. Urine glucose monitoring is not useful in GDM. Urine ketone monitoring may be useful in detecting insufficient caloric or carbohydrate intake in women treated with calorie restriction.<sup>12</sup> There is currently a controversy in the literature regarding glucose ranges that constitute normoglycemia in women with GDM. Per ADA 2008, Clinical Practice Standards of Care in Diabetes recommend from the Fourth International Workshop-Conference on GDM that guidelines should lower maternal capillary whole-blood glucose concentrations to preprandial: 95 mg/dl (5.3 mmol/L) and either 1-hr postmeal: 140 mg/dl (7.8 mmol/L) or 2-hr postmeal: 120 mg/dl (6.7 mmol/L).<sup>46</sup> These new values are different from the original values set by the ADA Position Statement on GDM which were 105 mg/dl (5.8 mmol/l), 155 mg/dl (8.6 mmol/l), and 130 mg/dl (7.2 mmol/l)<sup>12</sup> respectively. It is in the recommendations of these guidelines that the lower numbers be used according to updated clinical findings.

### ***Insulin***

Studies show that despite adequate Medical Nutritional Therapy (MNT), 39 percent of patients with GDM will require insulin therapy during their pregnancy.<sup>45</sup> Insulin is required when dietary therapy is inadequate in controlling glucose levels or there are signs of excessive fetal growth despite MNT. Patients with insulin-treated diabetes require an individualized insulin regimen based on their exercise plan and blood glucose levels.<sup>22</sup> The short-acting insulin (lispro or aspart) are preferred during pregnancy with studies demonstrating equivalent perinatal outcomes and improved maternal glycemic control over regular insulin.<sup>48, 50</sup> Insulin glargine has limited experience in pregnancy. Few studies exist demonstrating satisfactory results and care must be exercised in using it to avoid severe nocturnal hypoglycemia in pregnancy.<sup>50, 51</sup> The choice of insulin regimen should be decided between the physician and the patient striving for overall glycemic control, patient compliance, and improved fetal outcome. Continuous Subcutaneous Insulin Infusion (CSII) or insulin pump would be an effective delivery of insulin.

### ***Hypoglycemic Agents***

Oral glucose-lowering agents have generally not been recommended during pregnancy due to their ability to cross the placental barrier. However, one randomized, unblinded clinical trial compared the

use of insulin and glyburide in women with GDM who were not able to meet glycemic goals of MNT.<sup>30</sup> All patients were beyond the first trimester of pregnancy at the initiation of therapy and treatment with either agent resulted in similar perinatal outcomes. Of all the sulfonylureas, only glyburide has been demonstrated to have minimal transference across the placenta (four percent ex vivo) and has not been associated with excess neonatal hypoglycemia in clinical studies. It has proven to be a useful adjunct to MNT/physical activity to maintain target glucose levels, however, as with insulin, must be carefully balanced with meals and snacks to prevent maternal hypoglycemia.<sup>47</sup> As mentioned previously,

glyburide does not cross the placenta and has been safely used in pregnancy without adverse effects on the fetus.<sup>49</sup> In contrast, metformin, rosiglitazone, and pioglitazone freely cross the placenta and at present time, there is no evidence that justifies or recommends the use of any of these agents for GDM outside of clinical trials.<sup>47</sup> Additional evidence is needed to determine how exposure to these drugs will affect a fetus before they are prescribed to pregnant patients.<sup>49</sup>

### ***Diet Modifications and Medical Nutrition Therapy (MNT)***

Medical Nutrition Therapy should include the provision of adequate calories and nutrients to meet the needs of pregnancy and should be consistent with the maternal blood glucose goals that have been established.<sup>12</sup> Due to the continuous fetal draw of glucose from the mother, consistent times and amounts of food eaten are important to avoid hypoglycemia. Medical Nutrition Therapy for GDM primarily involves a carbohydrate-controlled meal plan that promotes optimal nutrition for maternal and fetal health with adequate energy for appropriate gestational weight gain, achieving and maintaining normoglycemia and absence of ketosis.<sup>15</sup> Non-caloric sweeteners may be used in moderation.<sup>12</sup>

Medical Nutrition Therapy, along with exercise, is a cornerstone of diabetes self-management. The American Dietetic Association provides evidence-based practice guidelines to ensure consistent MNT delivery that should be utilized at each nutrition training session.<sup>18</sup> The American Dietetic Association has developed flow sheets to assist with the implementation of their guidelines. These flow sheets can be found at [www.dhss.mo.gov/diabetes/Guidelines.html](http://www.dhss.mo.gov/diabetes/Guidelines.html).

### ***Weight Management***

Maternal weight gain, an index of nutrition, strongly influences infant birth weight, the primary indicator of infant health. The “optimal maternal weight gain” is dependent upon maternal height and pre-pregnancy weight. Pre-pregnancy weight is a crude index of nutritional status before pregnancy. These two nutrition-related factors, maternal weight gain in pregnancy and pre-pregnancy weight, together are major factors influencing infant health at birth. In 1990, the Institute of Medicine released recommendations for pregnancy weight gain contingent upon pre-pregnancy weight status. Under the institute’s 1990 guidelines, those with a “normal” body mass index – a combination of height and weight – were encouraged to gain 25 to 35 pounds. Women with a higher BMI have a lower target – 15 pounds or less for the most obese women.<sup>53</sup> Women with a lower BMI should gain more weight during pregnancy – up to 40 pounds. The total amount of weight gain is not as important as the weekly rate of gain. Most women are diagnosed with GDM during the second or third trimester, when the rate of weight gain is normally approximately  $\frac{3}{4}$  - 1 lb/week. Many women are gaining almost two pounds per week when they are diagnosed with GDM. Slowing down the rate of weight gain to one pound per week often restores blood glucose levels to normal.<sup>43</sup> The Institute of Medicine is currently considering changes to the current medical guidelines for how much weight a woman should gain during pregnancy.

Weight loss is not recommended for overweight and obese women with GDM. Available evidence does not support a recommendation for or against moderate caloric restriction in obese women with GDM.

However, if caloric restriction is used, the diet should be restricted by no more than 33 percent of calories.<sup>8</sup> Modest carbohydrate restriction may be appropriate. The NICE Clinical guidelines advises that women obtaining a pre-pregnancy BMI above 27 percent should restrict their caloric intake to 2,500 kcal/day.<sup>37</sup> Ketonemia from ketoacidosis or starvation ketosis should be avoided.<sup>15</sup>

In a random study of GDM women to either diet alone or diet plus circuit-type resistance training groups, the number of women requiring insulin did not differ between groups. However, overweight women who exercised were less likely to need insulin compared to overweight women who had diet only interventions.<sup>21</sup>

### ***Physical Activity***

Physical activity and fitness are essential to the woman's health. Multiple studies support either continuing or initiating an exercise program during pregnancy. Exercise should be a part of the daily requirements during the antepartum period.<sup>14</sup> Sedentary lifestyle is a risk factor for developing GDM. The common link between obesity and GDM is physical inactivity, with both obesity and GDM as risk factors for type 2 diabetes.<sup>10</sup>

In one study, authors found that women who were most active within the first 20 weeks of pregnancy had a 48 percent reduction in GDM. In addition, women who were most active one year prior to pregnancy had a 51 percent reduction in GDM risk.<sup>24</sup> Programs of moderate physical exercise have been shown to lower maternal glucose concentrations by increasing insulin sensitivity in women with GDM. Although the impact of exercise on neonatal complications awaits rigorous clinical trials, the beneficial glucose lowering effects warrant a recommendation that women without medical or obstetrical contraindications be encouraged to start or continue a program of moderate exercise as a part of treatment for GDM.<sup>12</sup>

The exercise intensity should be determined by a target heart rate range based on maternal age and fitness level. Research has shown the most physically active women have the lowest prevalence of GDM.<sup>30</sup> However, frequency, intensity, time and type of activity leading to the best possible outcomes for women with GDM have yet to be determined.<sup>10</sup>

Musculoskeletal adaptations of pregnant women should be considered to ensure safe and effective exercise prescriptions and avoid provocation of symptoms or injury. There have been few randomized controlled studies designed to evaluate either acute or chronic maternal musculoskeletal effects of exercise.<sup>10</sup> Weight bearing exercise is often uncomfortable for pregnant women due to softening of the ligaments that supports the pelvis. From this observation, it is understandable that most pregnant women tolerate swimming or walking, but not jogging.

Before beginning a program of physical activity more vigorous than brisk walking, women with diabetes should be assessed for conditions that might be associated with increased likelihood of cardiovascular disease or might contraindicate certain types of exercise or predispose to injury, such as uncontrolled hypertension, severe autonomic neuropathy, severe peripheral neuropathy and preproliferative or proliferative retinopathy or macular edema.<sup>10</sup>

## **Other Related Health Concerns**

### ***Hypertension***

During pregnancy in women with GDM and chronic hypertension, target blood pressure goals of systolic blood pressure 110-129 mmHg and diastolic blood pressure 65-79 mmHg are reasonable, as

they may contribute to long-term maternal health. Lower blood pressure levels may be associated with impaired fetal growth. During pregnancy, treatment with angiotensin converting enzyme (ACE) inhibitors and angiotensin II receptor antagonists are contraindicated,<sup>37,43</sup> since they are likely to cause fetal damage. Antihypertensive drugs known to be effective and **safe in pregnancy** include **methyldopa, labetalol, diltiazem, clonidine, and prazosin.**<sup>16</sup>

### ***Periodontal Disease and Diabetes***

Where studies link periodontal disease and pregnancy, it may be inferred that the consequences in GDM are likely greater than in otherwise healthy individuals who are pregnant and have periodontal disease. While inflammation plays an obvious role in periodontal diseases, there is evidence that periodontal disease can worsen a patient's control of diabetes and that proper management of periodontal disease can improve control of diabetes.<sup>19</sup> Treatment of periodontal disease and reduction of oral inflammation may have a positive effect on diabetes; however, evidence for this remains somewhat equivocal.<sup>11</sup>

## **Prenatal Surveillance and Education for Fetal Wellbeing**

### ***Prenatal Visits***

Pregnant women should follow the typical schedule of prenatal visits in addition to the special visits needed to monitor their diabetes. It is established that prenatal visits occur one time every four weeks for the first 28 weeks. Prenatal visits should then increase to every two weeks until 36 weeks of gestation, and then weekly until the baby is born. Further information on frequency of visits and management of a pregnant woman with diabetes is presented in the guidelines table.

### ***Breastfeeding Promotion and Education***

Breastfeeding should be encouraged at the first and subsequent prenatal visits. Most women will make a decision about breastfeeding early in pregnancy.<sup>32</sup> Family physicians may provide prenatal care and labor support, deliver the infant, help in the prompt initiation and continuation of breastfeeding, and continue caring for the baby and family. Breastfeeding education and support can be woven throughout these visits. Family physicians have the unique opportunity to emphasize breastfeeding education beginning with preconception visits and continuing throughout prenatal care, delivery, postpartum care and during ongoing care of the family.<sup>2</sup>

One study found that increasing body mass index (BMI) correlated with incidence of GDM. This study also showed high rates of obstetric and neonatal complications associated with obesity. Obese women were significantly less likely to be breastfeeding their infants at time of hospital discharge.<sup>25</sup> It is therefore not surprising that women with diabetes breastfeed at lower rates than women without diabetes. Furthermore, those with more severe diabetes breastfeed at lower rates than those with milder disease. Early breastfeeding is not only possible for women with diabetes during pregnancy, but it may improve the hospital course of their neonates. In general, studies of both high and low risk women suggest that lactation may reduce the mothers' risk of subsequently developing type 2 diabetes. Given the higher rates of maternal and pediatric complications, early initiation and full support of breastfeeding is especially important for mothers with diabetes who wish to breastfeed. For a woman with a history of GDM, current practice guidelines recommend six-week post-partum screening with fasting plasma glucose followed by annual screening, regardless of whether she breastfed her infant or not.<sup>7</sup>

Higher rates of pregnancy and neonatal complications among women with type 2 or gestational diabetes can pose significant challenges to breastfeeding. Low estrogen levels that accompany breastfeeding may have a protective effect on glucose metabolism and subsequent risk of diabetes in those women who choose to do so. Breastfeeding for at least two months may lower the risk of diabetes in children. Initial research has begun on the long-term effects of diabetes during pregnancy on children. Breastfeeding

may lower both maternal and pediatric rates of diabetes. Women with diabetes should be strongly encouraged to breastfeed because of benefits to mother and child, specific to diabetes, that are above and beyond other known benefits of breastfeeding.<sup>7</sup>

Breastfeeding confers huge immunological advantage in the form of antibodies passed between mother and baby in the breastmilk. Babies not fed breastmilk have higher rates of otitis media, allergies, respiratory tract infection, necrotizing enterocolitis, urinary tract infection and gastroenteritis in infancy. Babies who are not breastfed have a higher risk of hospitalization in the first year of life due to serious bacterial illness. They have higher rates of type 1 and 2 diabetes, allergic disease and asthma, lymphomas and inflammatory bowel disease later in life.<sup>1,2,3,32,40</sup>

Epidemiologic research shows that human milk and breastfeeding of infants provide advantages with regard to general health, growth and development, while significantly decreasing risk for a large number of acute and chronic diseases. Maternal health outcomes are also affected by breastfeeding. Mothers who do not breastfeed risk higher rates of anemia and closer child spacing. Women who have a significant lifetime history of breastfeeding have lower rates of ovarian, endometrial and breast cancer compared with the general population.<sup>1</sup> Lactation affects calcium metabolism, with increased bone density after weaning, and may decrease a woman's risk of postmenopausal osteoporosis.<sup>2,3,29</sup> Recent research demonstrates that lactating women have an earlier return to pre-pregnant weight,<sup>25</sup> and the mother using insulin may require less insulin because of calories expended with nursing. Furthermore, research studying the combination of breastfeeding with physical activity has shown that exercise improves aerobic fitness, plasma lipids and insulin response.<sup>10</sup>

The strongest evidence indicates that these positive effects of breastfeeding are most significant with six months of exclusive breastfeeding. Most of the studies, however, show that the effects are dose-related, with improved outcomes being associated with longer breastfeeding.<sup>2</sup> One particular study found no difference in weight-loss between breastfeeding and formula feeding mothers from one to three months, but a highly significant difference from three to six months postpartum. This suggests women should breastfeed for  $\geq 6$  months if they expect lactation to enhance weight loss.<sup>25</sup>

### ***Fetal Assessment***

Tests for fetal assessment include non-stress fetal heart rate monitoring, contraction stress testing, sonographic biophysical profile including amniotic fluid measurement, Doppler studies and maternal assessment of fetal activity using the method of fetal kick count. Of these fetal assessment tests, the amniotic fluid measurement has the best predictive value regarding perinatal morbidity. A measured amniotic fluid  $< 2$  cm is considered to be significantly reduced and should prompt delivery.<sup>26</sup>

Although ultrasound has improved, its effect on reduction of perinatal morbidity and mortality remains to be proven, and its use to detect large-for-gestation-age (LGA) fetuses is unreliable. Clinical decisions based on birth weight prediction by sonography are often in error. Measurement of the insulin-sensitive fetal fat layer and fetal abdominal circumference may better reflect the impact of diabetes on the fetus.<sup>9</sup>

The use of ultrasonography is no different for women with GDM than the general recommendation for normal pregnancies. It is recommended:

- 1) Between 8 and 12 weeks gestation, every pregnant woman should have an early sonogram for the correct estimation of gestation age
- 2) At 20-24 weeks gestation, every pregnant woman should have a sonogram for detailed fetal organ check
- 3) From 28 weeks gestation on, growth estimation should be conducted using biparietal diameter, abdominal circumference and femur length parameters to detect small-for-gestation-age (SGA)

fetuses, particularly in pregnancies complicated by micro- or macrovascular disease resulting from diabetes or to detect LGA fetuses in other groups of diabetic pregnant women. Fetal abdominal circumference (AC) is the parameter best correlated with the nutritional state of the fetus with AC decreased in SGA or increased in LGA fetuses relative to the head of the fetus.

- 4) If growth retardation is evident, Doppler studies should be conducted biweekly or more frequently if pathological wave curves are present. Doppler studies are not useful for LGA fetuses.
- 5) If an LGA fetus is suspected, soft tissue markers should be evaluated to detect the impact of fetal hyperinsulinism stimulated by excessive maternal hyperglycemia. Fetal abdominal circumference is still the most sensitive parameter for excessive fetal growth. Additional measurements should include frontal truncal skin fat layer (best obtained by the abdominal circumference measurement), skin thickness above the scapula and amniotic fluid index. An amniotic fluid measurement >18 cm suggests hydramnios; <6 cm may indicate inadequate placental supply.<sup>26</sup>

Research is controversial whether assessing fetal growth by ultrasonography aids in identifying fetuses that can benefit from maternal insulin therapy in the third trimester as recommended in the American Diabetes Association's Position Statement on GDM.<sup>12</sup> One study reports GDM management based on fetal growth combined with high glycemic criteria provides outcomes equivalent to management based on strict glycemic criteria alone. The authors theorize the inclusion of fetal growth might provide the opportunity to reduce glucose testing in low-risk pregnancies.<sup>39</sup> Kitzmiller questions the findings by stating recent data show maternal-fetal hyperglycemia can affect fetal/placental gene expression, which might be important in short and long-term outcomes.<sup>28</sup>

## **Delivery Management**

Infants of mothers with GDM and preexisting diabetes experience higher rates of serious injury at birth, cesarean delivery, and newborn intensive care unit admission. Recent studies indicate that the risk of these morbidities in individual cases is proportional to the degree of maternal hyperglycemia. For this reason, the excessive fetal and neonatal morbidity attributable to diabetes in pregnancy should be considered preventable.<sup>36</sup>

## **Postpartum Follow-up**

For vaginal deliveries, monitor blood glucose four times a day during the first 24 hours. If fasting blood sugar >95 and/or blood sugar is >120, follow-up with OGTT. Additional follow-up if two abnormal OGTT tests occur.<sup>44</sup>

## **Child Follow-up**

Research indicates that higher birth weight predicts an increased risk of obesity in adolescence. Having been born to a mother with GDM is also associated with increased risk for adolescent obesity. However, the effect of GDM on offspring obesity seems only partially explained by its influence on birth weight, and adjustment for the mother's own BMI attenuated the GDM associations. Results only modestly support a causal role of altered maternal-fetal glucose metabolism in the genesis of obesity in the offspring. Alternatively, GDM is a risk marker for offspring obesity, but to what extent it exerts a causal influence remains to be determined by additional research.<sup>4</sup>



## Medical Acronyms

<b>AC</b>	abdominal circumference
<b>ACE</b>	angiotensin converting enzyme (inhibitor)
<b>AFI</b>	amniotic fluid index
<b>BMI</b>	body mass index
<b>BPP</b>	biophysical profile
<b>CDE</b>	clinical diabetes educator
<b>FPG</b>	fasting plasma glucose
<b>GDM</b>	Gestational Diabetes Mellitus
<b>GFR</b>	glomerular filtration rate
<b>LBW</b>	low birth weight
<b>LGA</b>	large (for) gestational age
<b>MNT</b>	medical nutrition therapy
<b>NICU</b>	neonatal intensive care unit
<b>NPH</b>	neutral protamine hagedorn
<b>NST</b>	non stress test
<b>NVP</b>	nausea and vomiting (related to) pregnancy
<b>OGTT</b>	oral glucose tolerance test
<b>PP</b>	postpartum
<b>SGA</b>	small (for) gestational age
<b>SIS</b>	supplemental information section

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- ◆ Both the “*State of Missouri Consensus Screening Guideline for Pre-Diabetes and Diabetes in a Medical Setting*” and the “*Missouri Consensus Diabetes Management Guideline for Adults\**” can be found at <http://www.dhss.mo.gov/diabetes/Guidelines.html> Development of this guideline was supported by Grant/Cooperative Agreement Number U32/CCU722693-04 from Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.



## Notes



