



MANAGEMENT OF

Gestational Diabetes

2017 Update

This care process model (CPM) was developed by clinical experts from Intermountain Healthcare's Women and Newborns Clinical Program and the Diabetes Workgroup of the Primary Care Clinical Program. Based on national guidelines and recent research, it recommends gestational diabetes screening, diagnosis, treatment, and follow-up processes to improve outcomes for pregnant women and their infants.

► Why Focus ON GESTATIONAL DIABETES?

Gestational diabetes (GDM) warrants a clinical care management system for the following reasons:

- **GDM is common and increasing in prevalence.** The prevalence of GDM in the United States has varied in different studies, from 1.4% to 14% of pregnancies.^{DAB} Estimate variation depends on the diagnostic criteria used and the ethnicity of the study population. Overall, the prevalence has been increasing over time in women of all ethnic backgrounds, possibly related to increases in mean maternal age and weight.^{GET}
- **GDM is associated with an increased risk of perinatal complications.** Morbidity associated with GDM includes preeclampsia, polyhydramnios, and macrosomia; the latter is in turn associated with an increased risk for operative delivery and birth complication/trauma. GDM is also associated with neonatal metabolic complications such as hyperbilirubinemia and hypoglycemia.
- **GDM is also linked to long-term risk of metabolic problems for both mother and child.** Both have a significantly higher risk of developing type 2 diabetes later in life along with cardiovascular and other long-term risks.
- **Good care may improve outcomes.** Studies show that appropriate care of patients with GDM can improve pregnancy outcomes; it also offers an opportunity to affect risk factors associated with the subsequent development of type 2 diabetes.

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► GOALS AND MEASURES

- Present an evidence-based, standardized approach for care of GDM
- Educate primary care and obstetrical providers about GDM and opportunities to reduce its incidence and impact
- Provide GDM management tools (referrals for DM education, patient education, and online resources and references)
- Increase the rate of postpartum screening for type 2 DM in women with gestational diabetes (GDM)

RISK FACTORS FOR GDM

GDM is more likely in pregnant women with any of the following:^{SOL, KIM, HED, AACE}

- A family history of diabetes, especially in first-degree relatives
- Prepregnancy body mass index > 30 kg/m² or significant weight gain in early adulthood or between pregnancies
- Age > 25 years
- Previous delivery of a baby > 9 lbs (4.1 kg)
- Personal history of abnormal glucose metabolism
- Member of an ethnic group with a higher-than-background rate of type 2 diabetes (e.g., Hispanic American, African American, Native American, South or East Asian, Pacific Islander)
- Previous unexplained perinatal loss or birth of a malformed child
- Polycystic ovary syndrome

► UNDERSTANDING GESTATIONAL DIABETES

Pregnancy is associated with insulin resistance stemming from placental secretion of diabetogenic hormones such as growth hormone, cortisol, placental lactogen, and progesterone. Additional factors include increased maternal adipose deposition, decreased exercise, and increased caloric intake during pregnancy.

Normally, pregnancy-related insulin resistance is countered by an increased production of insulin; **gestational diabetes mellitus (GDM) occurs when pancreatic function is not sufficient to provide this compensatory rise.**

The prevalence of GDM varies in direct proportion to the prevalence of type 2 diabetes in a given population or ethnic group.^{ACOG} In Utah, the rate of GDM has risen over the last decade.^{UDOH}

GDM is associated with serious health risks for both mother and child. These risks extend beyond the pregnancy and neonatal period and correlate with the level of maternal hyperglycemia.^{MET}

► RISKS: ADVERSE PERINATAL OUTCOMES^{MET, CRO, KWI, GAR, HIL, DOO, LIP, LAZ, ROU, BER, STO, GIR, BLA, HOD}

Perinatal complications associated with GDM include:

- **Macrosomia.** Maternal hyperglycemia significantly increases a woman's chances of having an infant who is large for gestational age. Macrosomia, in turn, is associated with an increased risk of **operative delivery** (cesarean or vaginal) and **birth complication and trauma**, such as shoulder dystocia, brachial plexus injury, and clavicular fracture.
- **Polyhydramnios.** Increased amniotic fluid results from fetal diuresis due to hyperglycemia.
- **Preeclampsia.** Women with GDM are more likely to develop gestational hypertension or preeclampsia.
- **Perinatal mortality.** Fetuses of women with GDM appear to be at higher risk of intrauterine fetal demise. The risk is higher in women who require medication to control their hyperglycemia.
- **Neonatal metabolic complications.** Complications include **hypoglycemia**, **hyperbilirubinemia**, **hypocalcemia**, and **erythremia**.

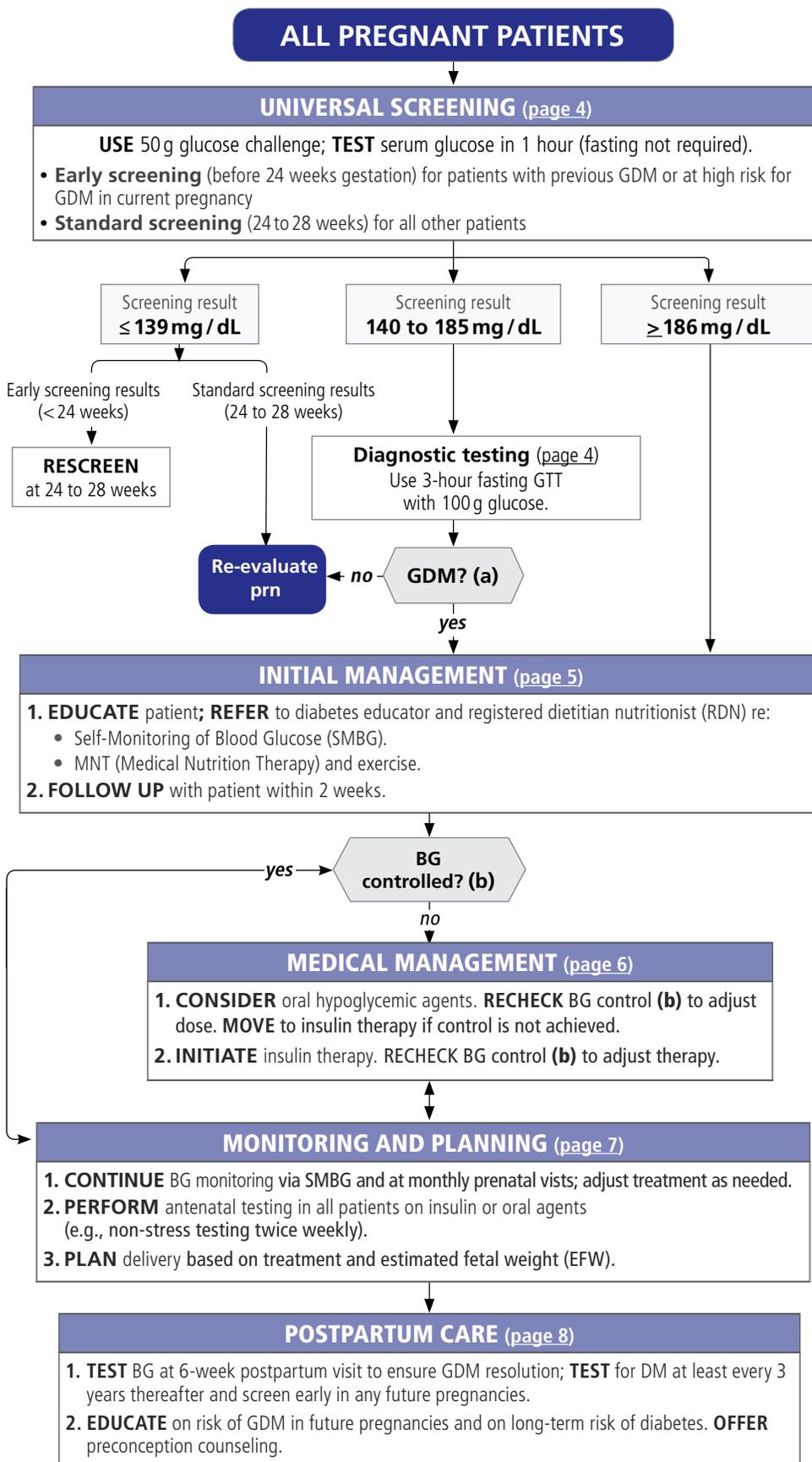
► RISKS: LONG-TERM METABOLIC CONSEQUENCES

Although GDM typically resolves in the weeks after the birth, the health risks for mother and infant continue.

Women with a history of GDM are at increased risk for the condition in subsequent pregnancies. They also have a significantly increased risk of developing diabetes (usually type 2 diabetes) later in life. Between 17% and 63% of women with GDM develop type 2 diabetes within five to 16 years.^{HYE}

In the offspring of women with GDM, the risk of metabolic problems is also increased. Several studies have linked maternal GDM with long-term obesity and diabetes in offspring.^{ACOG}

▶ ALGORITHM: GESTATIONAL DIABETES MANAGEMENT OVERVIEW



ALGORITHM NOTES

(a) Diagnosing GDM

Diagnosis of GDM requires two abnormal values from either set of acceptable criteria below. Note, however, that even one abnormal value is associated with increased risk for preeclampsia and macrosomia; for patients with one abnormal value, consider retesting or other follow up as described on the bottom of [page 4](#).

| GDM DIAGNOSTIC CRITERIA | | |
|-------------------------------|--|---|
| Timing of glucose measurement | CRITERIA: Carpenter and Coustan (1982) | CRITERIA: National Diabetes Data Group (1979) |
| FASTING | 95 mg/dL | 105 mg/dL |
| 1-HOUR | 180 mg/dL | 190 mg/dL |
| 2-HOUR | 155 mg/dL | 165 mg/dL |
| 3-HOUR | 140 mg/dL | 145 mg/dL |



The patient fact sheets, [Gestational Diabetes](#) and [Gestational Diabetes Meal Plan](#) support education. See [\(page 7\)](#) for ordering information.

(b) Assessing control

Maternal blood glucose (BG) levels are optimally controlled when the following criteria are met:

- **At least four BG test values per day for most days of the monitored period** (e.g., for at least 4 of 7 days).
 - **No BG values > 165 mg/dL.**
 - **At least 80% of BG values** within a time category (e.g., 80% of all fasting blood glucose values, 80% of all 1-hour postprandial values, etc.)
- OR**

The average BG value within a time category **MEETS THE STANDARDS suggested in ACOG Practice Bulletin:**^{ACOG}

- Fasting BG ≤ 95 mg/dL
- 1-hour postprandial BG ≤ 140 mg/dL
- 2-hour postprandial BG ≤ 120 mg/dL

CALCULATING BMI

Use the following links to calculate BMI for adults and teens.

[Adults](#)

[Children and teens](#)

► SCREENING AND DIAGNOSIS

Identifying GDM affords an opportunity to improve pregnancy outcomes as well as to affect the risk of diabetes in the decades following the birth. This care process model recommends the screening and diagnostic procedures described below.

Universal screening

Because screening based on the presence of risk factors has yielded an unacceptably high false-negative rate, this CPM affirms the ACOG recommendation for universal screening. Women with a previous medical history of gestational diabetes mellitus, known impaired glucose metabolism, and obesity (body mass index ≥ 30 , calculated as weight (kg) / [height m²], see sidebar on the left) should be offered screening before 24 weeks of gestation. All other pregnant women should be screened at 24 to 28 weeks.^{ACOG}

Recommended screening procedure includes:

- Administer 50 grams of pure glucose solution. (Give regardless of the patient's prandial state.)
- Measure patient's serum glucose one hour after administration. Use a range of 130 mg/dL (sensitivity of 90%) to 140 mg/dL (sensitivity of 80%) to determine positive screening test results. Note that the increased sensitivity at the lower threshold is accompanied by a greater number of false positive results.^{ACOG} Recommended management of screening test results is shown in the algorithm on [page 3](#).

Diagnostic testing: Three-hour fasting GTT

For patients with positive screening results less than 186 mg/dL, further testing is required to diagnose GDM. This is done with a three-hour fasting glucose tolerance test (GTT) using 100 g of glucose.

Advise patients to prepare in the following way:

- For three days prior to the GTT, eat a balanced diet that includes at least 150 grams of carbohydrate. (For most women, their usual daily diet will provide this amount of carbohydrate.)
- In the 12 hours immediately before the GTT:
 - Fast (don't eat or drink anything other than water).
 - Don't exercise vigorously.

In the diagnostic GTT, glucose is first tested while the patient is fasting and then at one, two, and three hours after glucose administration. Test serum glucose; experts recommend against the use of capillary glucose meter.

Two sets of acceptable diagnostic criteria appear in the algorithm on [page 3](#); the superiority of either set has not been demonstrated.

Note that two abnormal values are required to make a diagnosis of GDM. Yet even one abnormal value is associated with an increased risk of preeclampsia and macrosomia.^{ACOG}

Consider retesting a patient 4 to 6 weeks after one abnormal GTT value. In some cases, a provider may wish to manage a patient with one abnormal result in the same manner as those with diagnosed GDM.

► MANAGEMENT OF GDM

Management of GDM centers on efforts to control maternal hyperglycemia; it usually includes some type of fetal surveillance as well. Recommendations for these activities are summarized in the algorithm on [page 3](#) and discussed below.

During management of a pregnancy complicated by GDM, glycemic control is assessed via daily monitoring by the patient and in follow-up visits with the obstetric provider. (See [page 7](#) for details on monitoring and evaluating glycemic control.)

Studies show that appropriate management can decrease fetal and maternal morbidity, particularly macrosomia and neonatal hypoglycemia.^{ACOG, CRO, LAND} The value of GDM treatment to reduce macrosomia is illustrated in two large, randomized trials mentioned in the sidebar at right. Note that although there has been no demonstrated treatment benefit on long-term outcomes for the offspring (such as obesity and the development of diabetes), diagnosis and management of GDM does afford the opportunity to affect metabolic risk factors present in family members.

Initial management

Initial GDM management is essentially lifestyle management — the patient must monitor blood glucose and regulate daily diet and exercise. To help educate patients on the importance and methods of these activities, **this CPM recommends referral to a diabetes educator and registered dietitian nutritionist (RDN).** Intermountain patient fact sheets *Gestational Diabetes* and *Gestational Diabetes Eating Plan* support education and individualized plans; see Diabetes Education on [page 7](#).

Within two weeks of initiating lifestyle management, follow up with the patient to assess control and answer questions. Approximately 70% of patients with GDM are able to maintain glucose control at this initial level of management.^{REA}

Self-monitoring of blood glucose (SMBG)

Most studies of GDM treatment include self-monitoring of blood glucose (SMBG). SMBG informs providers' treatment decisions and likely promotes patient adherence to lifestyle interventions (“you manage what you measure”). This CPM recommends standard SMBG practices, including measurement four times daily (upon waking and after each main meal) and glucose targets similar to these:

- Fasting blood glucose ≤ 95 mg/dL
- One-hour postprandial ≤ 140 mg/dL
- Two-hour postprandial ≤ 120 mg/dL

Instruct patients to maintain SMBG records and call a provider (diabetes educator or provider office) to share SMBG results within the first week of initiating treatment. Thereafter, patients should call when 50% or more of their results are above BG target values. Monthly prenatal visits should also include discussion of SMBG results.

Medical nutrition therapy (MNT)

The goals of MNT for gestational diabetes are to maintain normal glucose levels, avoid ketosis, and provide adequate nutrition for the patient and her developing fetus. ACOG and ADA recommendations include individualized plans that account for appropriate caloric intake, carbohydrate regulation, and timing of meals and snacks. See the sidebar at right.

Exercise

Minimal available data show the efficacy of moderate exercise to lower glucose levels in women with GDM.^{DEM} Based on these and on studies in non-pregnant patients, this CPM recommends a regimen of regular, scheduled physical activity of **at least 30 minutes, five days per week, performed at a moderate level of exertion.** An ideal regimen is 45 to 60 minutes each day, seven days a week (e.g., an hour of walking every day).

KEY GDM TREATMENT STUDIES

- **Crowther, et al. (2005):** Treatment of gestational diabetes reduces serious perinatal morbidity and may also improve health-related quality of life.^{CRO}
- **Landon, et al. (2009):** Treatment for mild gestational diabetes reduces the risks of fetal overgrowth, shoulder dystocia, cesarean delivery, and hypertensive disorders.^{LAND}

MNT FOR GESTATIONAL DIABETES

Women with GDM should receive nutritional counseling, ideally from an RDN, and individual meal plans. Meal plans should account for:

- **Appropriate caloric intake.** For non-obese patients, advise 30 kcal/kg/d based on prepregnancy weight. For obese women (BMI > 30), moderate caloric restriction can be considered. Note that if caloric restriction is used, restriction should be no more than 33%; ketonuria must be avoided.^{ACOG}
- **Regulation of carbohydrates.** Carbohydrates should be restricted to 33% to 40% of calories — though plans should include at least 175 grams of carbohydrate per day to prevent undernourishment and ketosis — with the remainder divided between protein (about 20%) and fat (about 40%).^{JOV, BAN} Complex carbohydrates should be preferred; they have less effect on postprandial blood glucose and are more nutrient-rich than simple sugars.
- **Timing of meals and snacks.** Because insulin resistance is greatest in the morning, patients should have a small breakfast, distributing the remaining planned calories/ carbohydrates among the day's other meals and snacks.

MEDICAL NUTRITION THERAPY (MNT) INFORMATION

For more information on MNT for GDM, see these online resources at [diabetes.org](#):

- American Diabetes Association Position Statement Nutrition Recommendations and Interventions for Diabetes. *Diabetes Care* 31(Suppl. 1):S61-S78, 2008.
- Technical Review Evidence-Based Nutrition Principles and Recommendations for the Treatment and Prevention of Diabetes and Related Complications. *Diabetes Care* 25:148-198; 2002.

Medical management

Medical management of GDM is an option when nutrition therapy and exercise fail to control maternal hyperglycemia. Both oral agents and insulin are used to treat GDM.

Oral agents (glyburide, metformin)

Although the use of glyburide and metformin for GDM is off-label, it has become commonplace over the last decade. Note that oral agents are less effective in very obese patients with very poor glycemic control (BMI >40, FBG > 140 mg/dL, and two-hour postprandial BG > 180 mg/dL). See the table below for guidance in the use of oral agents for GDM.

Insulin therapy^{UDOH}

For GDM, both physiologic and standard insulin regimens are used; neither is demonstrably superior. Adjust based on BG at particular times of the day.

(Note: When starting insulin, metformin may be continued; however, glyburide must be discontinued.)

To initiate insulin therapy:

- 1 Calculate the initial total daily dose (TDD)** for insulin based on the patient's weight: 0.7 to 1.0 units/kg/day.
- 2 Prescribe regimen:**
 - **Physiologic insulin regimen:**
 - Give ½ of TDD as peakless insulin (glargine [Lantus]) once daily at bedtime.
 - Give ½ TDD as rapid-acting insulin (lispro [Humalog]) split equally between the three, main meals (take dose 10 to 15 minutes before meals).
 - **Standard insulin regimen:**
 - Give ⅔ of the TDD 30 minutes before breakfast (⅔ of this amount as NPH, ⅓ as regular insulin).
 - Give ⅓ of the TDD 30 minutes before dinner (½ of this amount as NPH, ½ as regular insulin).
- 3 Adjust insulin based on BG at particular times of the day.** For example, with a standard regimen, address persistent fasting hyperglycemia by moving dinnertime NPH to bedtime.

Table 1: Oral hypoglycemic agents used to treat GDM

| Generic (Brand) names • Drug class • Mechanism | Side effects | Safety | Failures (% of patients that change to insulin) | Dosing |
|---|---|-------------------------------------|--|--|
| glyburide (DiaBeta, Micronase) • Sulfonylurea • Stimulates insulin release | hypoglycemia, nausea, malaise, light-headedness | Class B; minimal placental transfer | 15%–25% | <ul style="list-style-type: none"> • Initial: 2.5 to 5 mg daily (can be twice daily) • Increase by 2.5 to 5 mg • Max daily dose: 20 mg |
| metformin (Glucophage) • Biguanide • Increases insulin sensitivity | nausea/vomiting, bloating, diarrhea (in 33% patients; reason for D/C in 5%) | Class B; crosses placenta | 40%–50% | <ul style="list-style-type: none"> • Initial: 850 mg once daily or 500 mg twice daily • Usual dose: 850 mg twice daily • Max daily dose: 2,550 mg |

Monitoring and planning

Pregnancies complicated by gestational diabetes should be followed more closely than uncomplicated pregnancies; this CPM advises the measures described below.

Monitor patient's glycemic control

Advise patients to continue monitoring blood glucose at least four times a day throughout the pregnancy, obtaining a fasting BG in the morning and postprandial values after each main meal (one hour or two hours postprandial). **Patient SMBG can serve as the main vehicle for evaluating glycemic control; see sidebar on page 3 for control criteria.** Monthly prenatal visits also provide an occasion for spot-checking glycemic control.

When adequate and reliable SMBG values aren't available or additional data are desired, consider testing glycosylated hemoglobin (HbA1c) or fructosamine levels.

- HbA1c is a measure of glycemic control over the previous two to three months. Values less than 6% are normal; values greater than 7.5% to 8% reflect suboptimal control.
- The serum fructosamine level reflects glucose changes over two to three weeks and provides a shorter-term marker of glycemic control than does HbA1c. Normal fructosamine levels are under 265 μmol/L, and acceptable blood glucose control is suggested by levels under 285 μmol/L.

Evaluate fetal growth

Given the risk of macrosomia, an estimated fetal weight (EFW) at term (clinically or via sonography) is recommended.

Perform antenatal testing in all patients treated with oral agents or insulin for GDM

A common practice is to perform twice-weekly, non-stress tests, beginning at 32 to 34 weeks gestation. (There is no consensus on the need for antenatal testing in diet-controlled GDM.)

Plan delivery based on treatment and EFW

- **Timing.** Delivery is generally indicated at 39 weeks gestation in patients requiring oral agents or insulin. There are data to support allowing diet-controlled patients to continue their pregnancy to 40 to 41 weeks.
- **Route of delivery.** The optimal route has been the focus of many published investigations. Given that macrosomia is more common in patients with GDM and that shoulder dystocia is more common at a given birth weight in patients with diabetes than in those without it, a threshold for recommending primary cesarean has received much attention. The *ACOG Practice Bulletin* suggests that:^{ACOG}
 - An EFW of >4500 g should prompt the clinician to offer primary cesarean to the patient. Arrest of the second stage is an indication for cesarean delivery. An instrumented delivery should not be attempted.
 - A prolonged second stage with an EFW of 4,000 to 4,500 g should serve as a contraindication to operative vaginal deliveries.
 - Induction of labor for macrosomia or “impending macrosomia” is to be discouraged. Many studies reinforce the conclusion that this process does not alter the risk of shoulder dystocia or other birth trauma.^{IRI}

DIABETES EDUCATION REFERRALS

Diabetes educators and registered dietitians are available for referrals at all Intermountain hospitals (via perinatology); in some regions of the Intermountain system, patients may be referred to specialty clinics for GDM education.

Patient education resources

- **Gestational Diabetes** fact sheet: This four-page handout explains GDM and its possible impact, introduces the patient's role in management, and emphasizes the need for followup during and after pregnancy. It includes a treatment plan form to be completed with care providers. Available in [English](#) and [Spanish](#).
- **Gestational Diabetes Meal Plan** fact sheet: Use this four-page handout with the Food Finder (below). Both support MNT for patients with GDM and include a meal plan form to be completed with the RDN or diabetes educator. Available in [English](#) and [Spanish](#).



- **Food Finder Meal Plan Basics:**

Use this four-page planner with the Gestational Diabetes Meal Plan handout to help patients make healthy foods choices and understand portion sizes. Available in [English](#) and [Spanish](#).



How to order

These resources, along with ordering information, are available on the *Gestational Diabetes* topic page at intermountainphysician.org/clinicalprograms.

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▶ POSTPARTUM CARE

Postpartum care of the patient diagnosed with GDM should include testing and counseling.

- **Glucose testing.** Test all patients accordingly:
 - **Immediate postpartum management** in the GDM patient may include cessation of blood glucose monitoring. Individualization of management is recommended in the setting of patients who:
 - Received an early (1st or 2nd trimester) diagnosis of GDM and may have type 2 diabetes mellitus
 - OR**
 - Required significant doses of insulin therapy during pregnancy
 - **At six to 12 weeks postpartum**, screen all patients with GDM for type 2 diabetes with either a fasting plasma glucose (FPG) or a two-hour, 75-gram oral glucose tolerance test (OGTT).^{ACOG} (Intermountain Healthcare allows an HbA1c test at six to 12 weeks postpartum.)
 - **At least every three years thereafter** (even with normal postpartum results):
 - Use the HbA1c, two-hour, 75-gram OGTT, FPG, or other accepted test for diagnosing diabetes mellitus.
 - Tell patients to communicate their GDM history and their need for regular DM testing with all primary care providers.
 - **Early in subsequent pregnancies.** Screen the patient for GDM earlier than the standard 24- to 28-week screening and again at 24 to 28 weeks if necessary.
- **Counseling.** Use the patient education resources listed on [page 7](#) to reinforce counseling about the recurrence risk for GDM in future pregnancies, the lifelong risk for type 2 diabetes, lifestyle changes to reduce this risk, and the need for ongoing monitoring.^{BOT} Offer preconception counseling prior to subsequent pregnancies.

REFERENCES AND RESOURCES

For a list of the references used to prepare this care process model, Go to IntermountainPhysician.org/ClinicalPrograms, and select “Diabetes” from the topic list and click on the tab titled “Clinical Guidelines & CPMs.”

To access patient education:

- **As the iCentra EMR system is implemented.** search for Intermountain items in the patient education module.
- **Log in to Intermountainphysician.org** and search for the patient education library under A–Z. Then, search the item number and title in the appropriate area.
- **Use Intermountain’s Online Library and Print Store, iprintstore.org,** for one-stop access and ordering for all Intermountain-approved education, such as fact sheets, booklets, and trackers.

Table 2: Interpreting the postpartum follow-up testing of women with GDM

| | Two-hour, 75g GTT | Fasting BG test | HbA1c |
|----------------------------|-------------------|------------------|-----------|
| Normal results | < 140 mg/dL | < 100 mg/dL | <5.7% |
| Impaired glucose tolerance | 140 to 199 mg/dL | n/a | 5.7%–6.4% |
| Impaired fasting glucose | n/a | 100 to 125 mg/dL | n/a |
| Diabetes mellitus | > 200 mg/dL | > 126 mg/dL | ≥ 6.5% |

This CPM presents a model of best care based on the best available scientific evidence at the time of publication. It is not a prescription for every physician or every patient, nor does it replace clinical judgment. All statements, protocols, and recommendations herein are viewed as transitory and iterative. Although physicians are encouraged to follow the CPM to help focus on and measure quality, deviations are a means for discovering improvements in patient care and expanding the knowledge base. Send feedback to Jean Millar, Clinical Program Director, Women and Newborn, Intermountain Healthcare, Jean.Millar@imail.org.

