

University of Cincinnati Physicians
Department of Obstetrics and Gynecology
Division of Maternal Fetal Medicine

DIABETES AND PREGNANCY PROGRAM (DAPP)
POCKET GUIDE FOR HEALTHCARE PROFESSIONALS

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*This pocket guide is a quick reference for the basic principles of managing diabetes complicating pregnancy. These principles are an integral part of the **UC Physicians Diabetes and Pregnancy Program**. For information, please visit our website at: <http://www.uchealth.com/maternal-fetal-medicine/treatments-services>.*

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DIABETES & PREGNANCY POCKET GUIDE FOR HEALTHCARE PROFESSIONALS

This pocket guide is a concise reference for healthcare professionals to use while caring for pregnant women with diabetes.

DEFINITIONS

Diabetes mellitus (DM) is a heterogeneous set of metabolic diseases all characterized by impaired glucose utilization resulting in hyperglycemia.

DM1:

- ◆ Accounts for ~ 5-10% of all diabetes
- ◆ Pancreatic Beta cells have been destroyed
- ◆ ABSOLUTE deficiency of insulin
- ◆ Exogenous insulin required for survival and to prevent DKA

DM2:

- ◆ Accounts for 90-95% of all diabetes
- ◆ Associated with obesity and sedentary life style
- ◆ Characterized by insulin resistance and a relative insulin deficiency
- ◆ Managed by diet and physical activity alone ± oral agents or insulin
- ◆ Requires insulin for optimum control during pregnancy

Gestational Diabetes Mellitus (GDM): Impaired glucose intolerance and Utilization of insulin during pregnancy

- ◆ Accounts for ~ 90-95% of all diabetes in pregnancy
- ◆ Glucose intolerance first recognized during pregnancy
- ◆ Requires diet, scheduled physical activity ± oral agents/insulin for optimum control
- ◆ Risk factor for developing diabetes mellitus after pregnancy

GDMA1: GDM controlled with meal plan and physical activity

GDMA2: GDM controlled with meal plan, physical activity and the addition of oral agents or insulin

PRE-DIABETES: Impaired Fasting Glucose (IFG) and/or Impaired Glucose Tolerance (IGT) – non-pregnant:

- ◆ IFG: Fasting values that are ≥ 100 mg/dL and < 126 mg/dL
- ◆ IGT: Blood glucose (BG) values ≥ 140 mg/dL and < 200 mg/dL after a 2-hr 75 gm glucola

WHITE CLASSIFICATION FOR PREGNANT WOMEN WITH DM

CLASS	CRITERIA
A1	Gestational diabetes (GDM) not requiring insulin or oral agents
A2	Gestational diabetes requiring insulin or oral agents
B	Onset at ≥ 20 years of age or duration of < 10 years
C	Onset at 10 to 19 years of age or duration of 10 to 19 years. No vascular disease.
D	Onset at < 10 years of age or duration of > 20 years or, any onset/ duration but with background retinopathy or hypertension only
F	Nephropathy (≥ 500 mg proteinuria per day at < 20 weeks of pregnancy)
H	Arteriosclerotic heart disease, clinically evident
R	Proliferative diabetic retinopathy (active) or vitreous hemorrhage
R, F	Retinopathy and nephropathy
T	History of renal transplant

White (1971)

SCREENING & DIAGNOSTIC CRITERIA FOR GDM

The policy at the UC Physicians OB/GYN, Division of Maternal-Fetal Medicine is to provide universal screening for GDM for all pregnant women. Early pregnancy screening is used for women who meet risk criteria. All other pregnant women receive GDM screening at **24-28 weeks** or later if necessary.

Early Pregnancy (< 20 weeks) Screening and Diagnosis for GDM:

The ADA Standards of Medical Care in Diabetes 2014 suggests screening women with risk factors for type 2 diabetes at their initial prenatal visit. If negative, the screen should be repeated at **24-28 weeks**. The high risk indicators are:

PCOS	A1c $> 5.7\%$, IGT or IFG
Physical inactivity	1 st degree relative with DM (parents/ siblings)
Insulin resistance associated with severe obesity or acanthosis nigricans	HTN (BP $\geq 140/90$ or antihypertensive therapy)
Delivery of LGA infant > 9 lbs	Hx of CVD
HDL cholesterol level < 35 mg/dL and/or a triglyceride level > 250 mg/dL	
Ethnic group: African American, Latino, Native American, Asian or Pacific Islander	

SCREENING & DIAGNOSTIC CRITERIA (CONT.)

Routine Screening and Diagnosis for GDM:

Because of the inherent complexity of selecting pregnant women at “low-risk” for GDM, the Division of MFM **recommends universal screening of all pregnant women at 24-28 weeks** regardless of presence or absence of risk factors. Screening is done per the ACOG recommend two-step approach with a 1-hr 50 gm glucose challenge test (GCT) initially and a 3-hr 100 gm oral glucose tolerance test (OGTT) for women who fail the initial screen.

- ◆ Women with a history of **Roux-en-Y gastric bypass surgery** should not be screened with oral glucola because the patient may experience dumping syndrome, which is rapid gastric emptying that occurs when an overly large amount of sugar is consumed.
- ◆ Provide the patient with a BG meter. If greater than 30% of the BGs are elevated after 2 weeks, diagnosis of GDM is confirmed.

Diagnosing GDM – Two Step Approach

- ◆ Non-fasting 1-hr 50 gm glucose tolerance test (GCT)
- ◆ Patient is to remain seated and not smoke
- ◆ Obtain venous blood glucose 1 hr after the start of the glucola ingestion
- ◆ The upper limit threshold after a 50-gm glucola load is ≥ 140 mg/dL
- ◆ Perform a diagnostic 3-hr 100 gm OGTT on a separate day in women who exceed the 1-hr GCT threshold.
- ◆ Women should have 3 days of at least 150 gm of CHOs per day prior to the test. Test after a 10 hr fast before 9AM.
- ◆ If fasting venous blood glucose is ≥ 126 mg/dL or GCT is ≥ 200 mg/dL, report laboratory results to DAPP team to expedite care.
- ◆ **DO NOT** proceed with 3-hr 100 gm OGTT. Diagnosis of GDM is confirmed.
- ◆ A diagnosis of GDM requires at least two abnormal venous BG values:
 - FPG: ≥ 95 mg/dL
 - 1-hr: ≥ 180 mg/dL
 - 2-hr: ≥ 155 mg/dL
 - 3-hr: ≥ 140 mg/dL

***One value abnormal (impaired glucose tolerance):** Women with a single abnormal value on the 3-hr OGTT have been reported to demonstrate insulin resistance similar to women with GDM and are more likely to deliver an LGA infant.

Therefore, proceed as follows:

1. SMBG meter instruction. Patient to check fasting and postprandial finger stick (4 times daily) for 1-2 wks. If $> 30\%$ of BG values are abnormal = GDM.
2. If results are normal ($< 30\%$ of BG values elevated), repeat 3 hr. OGTT in 4 weeks or continue checking BGs as above.

PSYCHOSOCIAL ASSESSMENT

Assess patients for the following to evaluate barriers to adherence to diabetes self-management:

- ◆ Anxiety/Depression/Bi-Polar Illness/Disordered Eating Habits
- ◆ Attention Deficit/Attention Deficit Hyperactive Disorder (ADD/ADHD)
- ◆ Childcare stress, lack of family, financial and social support

Motivational interviewing including attitudes about diabetes and selective screening with Edinburgh Postnatal Depression Scale (EPDS) during pregnancy and during the postpartum period is recommended. Low-income pregnant women with DM have almost twice the risk of antepartum and postpartum depression and are frequently underdiagnosed (JAMA 2007).

MEDICAL NUTRITION THERAPY (MNT)

The goal of MNT is to provide adequate kilocalories and nutrient requirements for pregnancy that are culturally appropriate.

- ◆ Initiate a nutrition consult with a RD for individualized MNT.
- ◆ Diabetes Consistent CHO Meal Plan prescribed with at least 175 gm of CHO divided into 3 meals and 3 snacks every 2-3 hours apart.
 - 2 servings at breakfast and at the bedtime snack
 - 1 serving at mid-morning, mid-afternoon
 - 3 servings at lunch and dinner
- ◆ Calories are based on EER formulas for each trimester. Adjust according to maternal parameters and optimal weight gain for pregnancy.
- ◆ Teach women to count CHOs and read food labels.
- ◆ The meal and snack regimen should be individualized for women using continuous subcutaneous insulin infusion (CSII) pumps.

SELF-MONITORING of BLOOD GLUCOSE (SMBG)

BG values are routinely monitored as FBG, pre-meal, 1-hr postprandial **after the start of meals** and before the bedtime snack. The BG targets are:

Testing	BG Targets
◆ FBG and pre-prandial BGs	60-90 mg/dL
◆ 1 hr. postprandial after the start of meals	90-120 mg/dL
◆ Pre-meal HS snack and 3 AM	60-90 mg/dL

A1C < 6.5% prior to pregnancy is associated with reduced rate of congenital malformation.

A1C < 6.0% during pregnancy is associated with decreased fetal macrosomia (Kitzmilller, 2008)

CONTINUOUS GLUCOSE MONITORING SYSTEM (CGMS)

The CGMS system is primarily used for pregnant women having difficulty with glycemic control because of confusing or erratic BG patterns. The CGMS records interstitial glucose every 5 minutes, up to 288 readings per day. The patient wears the CGMS for a minimum of 3 to a maximum of 7 consecutive days. The data is analyzed with specific computerized software and provides a glycemic profile which identifies BG trends and response patterns. This system helps improve pregnancy outcomes by increasing both hypoglycemia and postprandial hyperglycemia awareness, guiding insulin dose adjustments and normalizing overall glycemic control. Please contact the Diabetes Nurse Educator for CGMS placement.

PHYSICAL ACTIVITY

The recommendations for physical activity are:

- ◆ 30-60 minutes after the largest meal of the day for 30-60 minutes to increase insulin sensitivity and lipid metabolism
 - Additional 15-minute sessions may be added after other meals
- ◆ Monitor BG before, during and after exercise
 - Carry blood glucose meter, a fast-acting CHO and water
 - If BG <100 mg/dL before exercise, consume 15 gms of carbohydrate to reduce the risk of hypoglycemia
 - To be able to carry on a conversation without shortness of breath
- ◆ Wear an ID bracelet

EVALUATE SAFETY OF MEDICATIONS

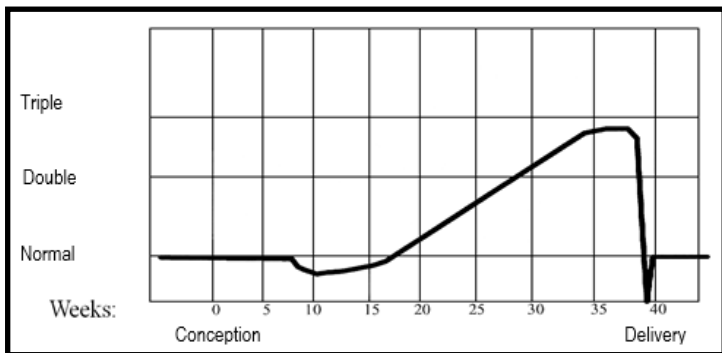
- ◆ Angiotension-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs) are contraindicated during pregnancy
- ◆ Nifedipine and Aldomet are safe alternatives
- ◆ All lipid lowering medications are contraindicated during pregnancy

INCREASED INSULIN REQUIREMENTS

Insulin requirements during pregnancy generally increase by 50-150%. Other factors that may further increase insulin requirements are:

- ◆ OBESITY with BMI >30 kg/m² (may need 1.2 units/kg)
- ◆ SEPSIS or infections
- ◆ STEROIDS with betamethasone or prednisone
- ◆ TOCOLYSIS with betamimetics

INSULIN REQUIREMENTS DURING PREGNANCY



INSULIN DOSE & REGIMEN FOR PREGNANT WOMEN

The insulin dose and regimen is individualized based on the type of diabetes, BG control and gestational age. Insulin absorption is most effective when injected into the SQ tissue in the **abdomen**. The table on the next page includes dosing recommendations for women with DM1, DM2 and GDMA2.

INSULIN DOSE & REGIMEN FOR PREGNANT WOMEN (CONT.)

Weeks of Gestation	Total Daily Dose (TDD)
Week 1 – 18	0.7 units/kg
Week 18 – 26	0.8 units/kg
Week 26 – 36	0.9 units/kg
Week 36 – 40	1 units/kg
For obesity >150% of DBW	1.5 to 2 units/kg
Week 0-6 Postpartum	0.4 units/kg
Calculate total daily dose (TDD) as above (Maternal weight divided by 2.2 kg)	

After calculating the TDD, divide by 1/3; 2/3s of the insulin for the AM dose and 1/3 for the PM dose. For example, 60 units (TDD) = 40 units AM and 20 units PM. 2/3s of the AM dose = 27 units of NPH (intermediate-acting) insulin and 1/3 of the AM dose = 13 units of HumaLog®/NovoLog® (rapid-acting) insulin. 1/2 of the PM dose = 10 units of HumaLog®/NovoLog® before dinner and 10 units of NPH before the bedtime snack.

COMMONLY PRESCRIBED INSULINS

Type	Example	Category	Onset	Peak	Duration
Rapid-acting (Analog) Bolus or for meals	Humalog (lispro)	B	5-15 min	45-90 min	4 hrs
	Novolog (aspart)	B	5-15 min	45-90 min	4 hrs
Short-acting (Regular) Usually for IV use	Humulin R Novolin R	B	30 min 30 min	2-3 hrs 2-3 hrs	6 hrs 6 hrs
Intermediate-acting (NPH) Basal Insulin	Humulin N Novolin N	B	2-4 hrs 2-4 hrs	4-10 hrs 4-10 hrs	10-16 hrs 10-16 hrs
Long-acting (analog) Basal Insulin	Lantus (Glargine)	C	2-4 hrs.	None	24 hrs

NPH and Lantus are usually given before bedtime (HS). Lantus is commonly used outside of pregnancy due to duration of action. There is limited experience with the use of Lantus in pregnant women and Lantus should not be prescribed during pregnancy.

The insulin used in the CSII pump for pregnancy is Humalog/Novolog.

Adapted from the FDA website

Also consider insulin therapy for A1GDMs who are <20 weeks if:

- ◆ FBGs are persistently (3 or more/week) ≥ 100 mg/dL
- ◆ 1 hr postprandial BGs are persistently (30% or more/week) ≥ 140 mg/dL

CONTINUOUS SUBCUTANEOUS INSULIN INFUSION (CSII) PUMP CALCULATION

Adapted from Walsh (2012)

1. Obtain total daily dose (TDD) of multiple daily injections (MDIs) (all types of insulin)	Amount of MDIs of insulin over 24 hrs.
2. Reduce MDI TDD by 25% when switching from MDIs to CSII and 35% for obesity	MDI TDD x 0.75 = ____ TDD
3. To calculate TDD units/kg: a. Pre-pregnant: x 0.6 units/kg b. Week 1-18: x 0.7 units/kg c. Week 18-26: x 0.8 units/kg d. Week 26-36: x 0.9 units/kg e. Week 36-40: x 1.0 units/kg f. Week 0-6 Postpartum: x 0.4 units/kg	Wt calculated TDD = Current wt in kg x units/kg = Total units/24 hours
4. Choose the lower of the 2 TDD amounts for the rest of the calculations	<u>Final TDD</u>
5. Use 50% of TDD as <u>Total Daily Basal Insulin</u>	<u>TDD x 0.5 = Total Daily Basal Insulin</u>
6. To start the pump, the <u>Total Daily Basal Insulin</u> is divided into 3 basal rates with the 3 rd basal rate calculated as TDD divided by 24 hrs being the key value: a. The 1 st basal rate is from 12MN to 3AM and equals 3 rd basal rate x 0.8 b. The 2 nd basal rate is from 3AM to 9AM and equals 3 rd basal rate x 1.2 c. The 3 rd basal rate is from 9AM to 12 MN and equals TDD divided by 24 hrs	
7. Sensitivity/Correction Factor (12am, 6am, 10pm)	<u>1700 divided by the TDD = Correction Factor</u>
8. Insulin to carbohydrate (I:C) ratio ♦ Grams of carbohydrate that 1 unit of insulin will cover ♦ Usually about 60% of the TDD during pregnancy	<u>500 divided by the TDD = I:C Ratio</u>
9. Insulin Pump BG Targets: ♦ 12am: 70-110mg/dL, 6am: 60-100mg/dL, 10pm: 70-110mg/dL	

After the 1st trimester the ratio often changes to 60% bolus and 40% basal insulin due to the increasing insulin resistance associated with CHO intake (Journeys 1998).

Example: calculate the TDD (60 units). Multiply 60 units x 0.5 = 30 units. Divide 30 units by 24 hrs. for 3rd basal rate = 1.25 units/hr. Multiply 3rd basal rate (1.25 units/hr.) by 0.8 for the 1st basal rate = 1 unit/hr. Multiply the 3rd basal rate (1.25 units/hr.) by 1.2 for the 2nd basal rate = 1.5 units/hr. Calculate the correction factor, divide 1700 by TDD (60 units) = 28 units. Calculate the I:C ratio, divide 500 by the TDD (60 units) = 1 unit of insulin to 8 gm CHO (1:8).

PRE-MEAL INSULIN DOSE ADJUSTMENT ALGORITHM

For pre-prandial hyperglycemia correction using Humalog/Novolog

BG (mg/dL)	Humalog/Novolog (units)
<100	0
100-140	2
141-160	3
161-180	4
181-200	5
201-250	6
251-300	8
>300	10



Use during the day only **BEFORE** breakfast, lunch and dinner.

Use ½ the pre-meal insulin dose **BETWEEN** 10PM to 6AM.

DO NOT USE THIS ALGORITHM TO TREAT BG BETWEEN MEALS



de Veciana & Evans (2007)

POST MEAL SLIDING SCALE INSULIN



- ◆ This practice leads to over treatment and “insulin stacking” without avoiding fetal exposure to hyperglycemia
- ◆ Use the pre-meal insulin dose adjustment algorithm to treat pre-meal hyperglycemia

HYPOGLYCEMIA MANAGEMENT

The **DEFINITION** of hypoglycemia in pregnancy is BG values **below 60 mg/dL**.

SIGNS AND SYMPTOMS OF HYPOGLYCEMIA

Hunger	Blurred or tunnel vision	Drowsy
Headache	Disoriented	Nausea
Diaphoresis	Confusion	Coma
Weakness/lethargy	Stupor	Numbness (circumoral)
Tremulousness	Loss of consciousness	Seizure

THE RULE OF 15 is taught to pregnant women with diabetes and used for hypoglycemia management.

- ◆ **15 grams** of fast acting CHO, recheck BG in **15 minutes** will produce at least a **15 mg/dL** increase in the BG level **within 15 minutes**.

NORMAL BLOOD GLUCOSE (BG)

BG >60 mg/dL: DO NOT TREAT

- ◆ Ensure the patient receives 3 meals and 3 snacks **ON TIME** 2-3 hours apart

ALERT AND RESPONSIVE AND CAN TAKE PO

BG <60 mg/dL:

- ◆ Give 4 oz (½ cup) of apple juice or 4 glucose tablets (4 gm CHO each) with 8 oz (1 cup) of water
- ◆ **DO NOT GIVE** complex CHOs such as milk, cookies, candy, peanut butter crackers or sandwiches, as complex CHOs delay the absorption of glucose
- ◆ Recheck finger stick BG in **15 minutes**
- ◆ Repeat BG check every 15 minutes until BG ≥ 60 mg/dL x 2

BG <40 mg/dL + SIGNS AND SYMPTOMS:

- ◆ Give 8 oz (1 cup) of apple juice
- ◆ **DO NOT GIVE** complex CHOs such as milk, cookies, candy, peanut butter crackers or sandwiches, as complex CHOs delay the absorption of glucose
- ◆ Recheck finger stick BG in 15 minutes.
- ◆ **DO NOT** leave the patient alone.
- ◆ Repeat BG check every 15 minutes until BG ≥ 60 mg/dL x 2

UNCONSCIOUS OR UNRESPONSIVE:

- ◆ Give GLUCAGON 1 mg SC or IM stat
- ◆ Observe closely and recheck BG values in 5-10 minutes
- ◆ Glucagon may be repeated if necessary
- ◆ Be prepared to start D₅NS @ 125 mL/hr if BG remains <20 mg/dL

ALERT AND RESPONSIVE AND CANNOT TAKE PO

- ◆ If BG is <60 mg/dL:
 - Give GLUCAGON 1 mg IM stat
 - Recheck finger stick BG **every 15 minutes** until BG is ≥ 60 mg/dL x 2
- ◆ If BG >60 mg/dL, no additional treatment is necessary.

UNRESPONSIVE OR UNCOOPERATIVE

- ◆ **Give GLUCAGON 1 mg IM injection STAT**
- ◆ **Ensure venous access**
- ◆ Recheck finger stick BG **every 5 minutes** until patient is **alert and responsive**
- ◆ **If BG is not >60 mg/dL after 15 minutes**, start infusion of D₅NS or D₁₀NS @ 200 mL/hr. until BG is ≥ 60 mg/dL x 2
- ◆ **A member of the healthcare team must remain with the patient until the patient becomes fully conscious, stable and has a normal BG.**
- ◆ Observe closely and recheck BG values in 15 minutes
- ◆ **Notify the attending physician**

USE OF GLUCAGON FOR AN EMERGENCY

Glucagon (a hormone with the opposite effect of insulin) raises the BG level by rapidly releasing glycogen stored in the liver. This agent is used to counteract severe hypoglycemia due to excess insulin, particularly when the patient is unable to take calories orally. Glucagon has a physiologic effect which decreases the risk of subsequent rebound hyperglycemia.

Glucagon is used as follows:

- ◆ Glucagon is packaged as a 1 mg dose, pre-filled emergency kit
- ◆ All of the glucagon (1 mg) solution is injected IM
- ◆ Onset of action, with reversal of severe hypoglycemia is rapid, within 15 minutes
- ◆ The dose may be repeated in 15 minutes for persistent severe hypoglycemia
- ◆ Patients may experience nausea and vomiting, therefore position the patient on their side.

Pregnant women with diabetes taking insulin should have a glucagon emergency kit at home and family members should be instructed for proper use.

ORAL AGENTS FOR GDM

GDM that is not properly controlled with diet alone can be managed with select oral agents: GLYBURIDE and ACARBOSE

- ◆ **GLYBURIDE** is a hypoglycemic agent and particularly useful for treating pre-meal hyperglycemia.
- ◆ **ACARBOSE** is an anti-hyperglycemic which is particularly useful for treating post-meal hyperglycemia. This agent has a wide safety margin with minimal hypoglycemia risk.
- ◆ **METFORMIN** is a less potent hypoglycemia agent that has been used in early pregnancy for women with PCOS but is not recommended as a 1st line oral agent for pregnancy. This agent crosses the placenta, is less effective and has less available safety data in pregnancy than glyburide.

Women using Glyburide and Acarbose together must use glucose tablets to treat hypoglycemia.

Oral agents are NOT RECOMMENDED in early pregnancy (<20 wks) for treatment of hyperglycemia. Insulin remains the treatment of choice for pre-gestational and newly diagnosed GDM at <20 weeks gestation.

ACARBOSE PROTOCOL

Begin with 25 mg 3 times daily just prior to each meal

Increase by 25 mg 3 times daily every 7 days until BG targets are reached

Maximum daily dose is 300 mg given as 100 mg 3 times daily

Langer (2000) de Veciana & Evans (2007)

GLYBURIDE PROTOCOLLanger (2000)
de Veciana & Evans (2007)

Begin with 2.5 mg either daily or twice daily (AM and/or PM)

Administer 60 minutes pre-meal. Administration too close to the meal may result in maternal hypoglycemia 1-2 hrs post meal

To control FPG, administer Glyburide at 10 PM

Increase by 2.5 to 5 mg every 7 days until BG targets are achieved.

Maximum daily dose is 20 mg given as 10 mg twice daily.

Teach hypoglycemia prevention and management.

Teach meal plan compliance to avoid hypoglycemia.

Glyburide is associated with weight gain

Glyburide can be used by women who breastfeed as the agent does not cause hypoglycemia in the infant.

CORTICOSTEROID THERAPY**Betamethasone is the preferred steroid for fetal lung maturation**

- ◆ Betamethasone dose: 12 mg IM 24 hours apart x 2 doses
- ◆ Glycemic response to steroid therapy is variable and requires individualization of insulin dose management. Note that unexpectedly severe and sustained hyperglycemia secondary to betamethasone therapy can occur
- ◆ The normal response for pregnant women without diabetes is transient hyperglycemia after the first dose with a peak glucose response at 48-72 hrs
- ◆ The onset of hyperglycemia response to steroids may be delayed for several days and may be present for 1-2 wks
- ◆ Typically the maximum BG does not exceed 180 mg/dL
- ◆ The insulin dose should be increased aggressively and proportionately to the level of hyperglycemia and individualized for each patient

GLYCEMIC MANAGEMENT FOR STEROID-INDUCED HYPERGLYCEMIA:

- ◆ Test BGs for 72 hrs after steroid administration (1st dose)
- ◆ Check BG every 8 hrs while NPO (1st 24-48 hrs in most cases). For patients eating a regular diet during 72 hrs after steroids, check BG 1 hr PP meals (3 x per day)
- ◆ After 72 hrs, if BG \leq 200 mg/dL, discontinue BG monitoring
- ◆ If any BG is \geq 200 mg/dL during the 72 hr screening period, initiate a carb counting pregnancy meal plan and check BGs 7 x per day per DAPP protocol.
- ◆ Rapid acting insulin can be used on an as-needed basis for BG values \geq 200 mg/dL

If hyperglycemia persists for >3-4 days post steroid administration, consider split dose weight-based insulin or oral agents (Acarbose and/or Glyburide) depending on BG profile. Insulin may be necessary for refractory persistent hyperglycemia, but should be used with caution as the transient hyperglycemia response likely resolves 1-2 wks following steroid administration as BG values are anticipated to return to pre-treatment levels (2012).

TOCOLYTIC THERAPY

- ◆ Refer to Preterm Labor Protocol for recommended therapy
- ◆ Avoid betamimetics due to potential for hyperglycemia

DIABETIC KETOACIDOSIS MANAGEMENT

- ◆ Check maternal vital signs every 1 hr
- ◆ Draw serum BG, potassium and anion gap every 1 hr until normal, then 2-4 hrs
- ◆ Continuous maternal ECG and pulse oximetry
- ◆ Continuous EFM if ≥ 24 weeks gestation; otherwise FHTs every 4 hrs
- ◆ NPO if BG is >300 mg/dL, elevated anion gap and/or non-reassuring fetal status; otherwise, Diabetes Consistent CHO Meal Plan for Pregnancy
- ◆ Start IVF 0.9 NaCl @ 1-2 Liters/hr over 4-6 hours, then follow DKA orders
- ◆ Insert Foley catheter. Check and record I & O every 1 hr
- ◆ Start with 10 units of insulin as an IV bolus (20 units with severe DKA) and continue 5-10 units/hr IV infusion. Goal: Normalize BG values over 4-8 hrs
- ◆ When BG <300 mg/dL, change IV fluids to D5 $\frac{1}{2}$ NS and follow Intrapartum IV Insulin Algorithm.
- ◆ Initiate referral for Neonatology Consult

ANTEPARTUM IV INSULIN INFUSION

Check BG on admission and every hour. Discontinue all SQ insulin.

- ◆ Maintain capillary blood glucose between **60 and 100 mg/dL**
- ◆ Initiate a nutrition consult with registered dietitian and place order for "Diabetes Consistent CHO Meal Plan for Pregnancy"
 - Calculate ICR for meals (500 divided by TDD = ICR (u/mgs)) and inject 5 minutes AC meals
- ◆ Begin main line IV fluids @ 125 mL/hr (LR or D5NS).
- ◆ Initiate IV insulin drip using Regular insulin 100 units/100 mL Normal Saline (1 unit/1 mL) at 0.5 units/hr and titrate the infusion per IV insulin algorithm
- ◆ Maintain infusion for at least 24 hrs after glucose values normalize to reduce the risk of rebound hyperglycemia
- ◆ When converting patient to SQ split-dose weight-based insulin, increase the TDD by 25% to reduce risk of hyperglycemia (see formula on Page 8)

INTRAPARTUM MANAGEMENT

- ◆ **Insulin:** Give usual dose the day prior to delivery. D/C insulin at midnight and keep patient NPO until delivery
- ◆ **Oral agents:** Give usual dose the day before and D/C the day of delivery
- ◆ **Finger stick glucose values:** Every 1 hr (every 2 hrs for GDMA1)
- ◆ **Hyperglycemia:** If BG >110 mg/dL and <140 mg/dL X 2 or >140 mg/dL x 1, start IV insulin infusion
- ◆ **Active Labor:** Hold all insulin and keep patient NPO until delivery
- ◆ **Induction of Labor:** Manage the same as active labor. If IOL fails, D/C pitocin infusion in time to give usual dinner calories, pre-dinner (Humalog®/Novolog®) and HS (Humulin N/NovolinN) insulin

INTRAPARTUM IV INSULIN INFUSION – ACTIVE LABOR

DM1 and DM2:

- ◆ Check BG on admission and every hour. Discontinue all SQ insulin
 - ◆ Maintain capillary blood glucose between **60 and 100 mg/dL**
 - ◆ Begin main line IV fluids as D5NS @ 125 mL/hr
 - ◆ Keep patient NPO or provide non-CHO containing clear liquids
 - ◆ Initiate IV insulin drip using Regular insulin 100 units/100 mL Normal Saline (1 unit/1 mL) at 0.5 units/hr and titrate the infusion per IV insulin algorithm
- Labor or induction of labor:** Main NPO. Do not give the daily scheduled dose of SQ insulin. If the BG value is >100 mg/dL, consider IV Insulin Algorithm for specific dose below. Modify insulin algorithm if BG targets are not achieved within 4 hours
***GDMs usually do not require insulin during labor unless BG is >100 mg/dL**
 If IV insulin infusion is necessary, the use of D5NS or LR solution may be individualized based on the degree of hyperglycemia and rate of insulin infusion.

Blood Glucose	Insulin (u/hr.)	IV Solution
< 80 mg/dL	Discontinue drip	Main line IVF D5NS at 125 mL/hr
100-120 mg/dL	0.5 u/hr	Main line IVF D5NS at 125 mL/hr
121-140 mg/dL	1.0 u/hr	Main line IVF D5NS at 125 mL/hr
141-160 mg/dL	1.5 u/hr	Main line IVF D5NS at 125 mL/hr
161-180 mg/dL	2.0 u/hr	Main line IVF D5NS at 125 mL/hr
181-200 mg/dL	2.5 u/hr	Main line IVF D5NS at 125 mL/hr
>200 mg/dL	3 u/hr	Main line IVF D5NS at 125 mL/hr
>300 mg/dL	Call MD	Main line IVF D5NS at 125 mL/hr

For BG <80 mg/dL:

- ◆ Stop IV insulin infusion
- ◆ Continue D5NS solution @125 mL/hr. If <60 mg/dL call MD .
- ◆ Check BG every 60 minutes or as clinically indicated
- ◆ Restart insulin infusion if BG becomes >100 mg/dL X 2

CSII PUMP - ACTIVE LABOR AND POSTPARTUM

Active Labor:

- ◆ Keep patient NPO
- ◆ Patients generally do not require significant insulin coverage
 - Identify the lowest basal rate and run that basal until active labor.
 - BG values should be checked every 1 hr
 - If necessary, the CSII pump can be used for basal insulin coverage for intrapartum hyperglycemia
 - Suspend the pump if glucose <80mg/dL or patient is in active labor and glucose <100mg/dL
- ◆ Patients scheduled for a cesarean section should maintain their basal rates until 6AM and have the CSII pump discontinued prior to going to the operating room

Postpartum:

- ◆ Restart CSII pump when patient demonstrates hyperglycemia (>180 mg/dL) particularly for patients with T1DM to reduce the risk of hypoglycemia
- ◆ Instruct patient to:
 - Reset the basal rates to 1/3 the pre-delivery doses
 - Increase the insulin to carb ratios (ICRs) and insulin sensitivity factors (ISFs) by 50%
 - Reset the BG targets to 80-120 mg/dL at 6AM, 90-130 at 12am and 10pm
 - Refer patient to the advanced practice nurse (APN) for follow up

IMMEDIATE POSTPARTUM DIABETES MANAGEMENT

Insulin requirements decrease by 50-150% immediately after the delivery of the placenta. The goal for the immediate postpartum period is to avoid hypoglycemia and extreme hyperglycemia. BG targets are:

- ◆ FBG <126 mg/dL
- ◆ 1 hr after the start of the meal <180mg/dL

FOR ALL GDMs:

- ◆ Resume regular diet
- ◆ Check FBG and 1 hr postprandial values until discharge (4 times a day)
- ◆ Use oral agents or insulin based on the following criteria

GDM POSTPARTUM GLYCEMIC MANAGEMENT (0-6 weeks)

Acceptable BG Values	Sustained Glucose Intolerance ($\geq 30\%$ total values)	Maximum BG Values (any single value)
Group I	Group II	Group III
FBG <100 mg/dL	100-125 mg/dL	FBG \geq 126 mg/dL
1 hr. PP <150 mg/dL	150-179 mg/dL	1 hr. PP \geq 180 mg/dL
No intervention	Continue BG monitoring	Immediate intervention

GDM POSTPARTUM GLYCEMIC MANAGEMENT (CONT.)

FOR DM1 or DM2: NSVD and C-Section

- ◆ D/C IV insulin immediately after delivery of the placenta
- ◆ Resume CHO counting meal plan (if lactating, resume pregnancy calories)
- ◆ Check fasting, preprandial and 1 hr postprandial BG values
- ◆ Give patient 1/3 of SQ end-pregnancy insulin dose when on PO intake and/or BG values exceed above parameters
 - Insulin dose is then titrated to control BG values to desired levels

OUTPATIENT POSTPARTUM DIABETES FOLLOW UP

DM1 and DM2:

- ◆ Counsel patient to follow up with a member of the DAPP healthcare team at 2 and 6 weeks after delivery
- ◆ Counsel patient about the advantages of breastfeeding for mother and infant
- ◆ Encourage family planning and provide counseling
- ◆ Discuss pre-conception diabetes self-management for next pregnancy
- ◆ BG values are adjusted to normal non-pregnant targets by gradually increasing the insulin or oral agent dose. Outpatient BG targets are:
 - Fasting 70-100 mg/dL
 - 1 hr postprandial meals between 100-140 mg/dL

GDM:

- ◆ Reclassify for pre-diabetes or DM with a 2-hr 75-gm OGTT by 6-12 wks postpartum. If negative, re-screen every 3 years

Criteria for Pre-diabetes	Criteria for Diabetes Mellitus
FBGs \geq 100-125 mg/dL	FBGs \geq 126 mg/dL
2 hr PG \geq 140-199 mg/dL	2 hr PG \geq 200 mg/dL
A1c between 5.7 and 6.4%	A1c \geq 6.5%

- ◆ Counsel patient regarding lifetime diabetes risk (approximately 50% over the next 5-10 years). DM occurs more frequently in obese women and women with a family history of DM and among the African American, Hispanic/Latina, Native American and Native Alaskan women (NIDDK 2005).
- ◆ Counsel the patient about the advantages of breastfeeding for mother and infant
- ◆ Avoid all progesterone-only birth control due to the hyperglycemia effects, but strongly encourage pregnancy planning; consider IUD (Metzger et al. 2007)
- ◆ Early screen for GDM at 1st prenatal visit during next pregnancy
- ◆ Weight control, physical activity, meal planning, multiple vitamins with folic acid daily and stress management

BREASTFEEDING

The American Academic of Pediatrics (AAP) recommends that all women breastfeed for **6 months exclusively** and continue to breastfeed for at least **12 months**

- ◆ Breastfeeding improves glucose and lipid metabolism
- ◆ Breastfeeding requires an additional 500 calories over pre-pregnant level
- ◆ Check BGs PRIOR to breastfeeding to reduce the risk of hypoglycemia
 - If BG <100 mg/dL, provide 15 gm CHO snack
- ◆ Hyperglycemia is transmitted through breast milk.
 - 1 hr postprandial BG target 100-150 mg/dL
- ◆ Reinforce hypoglycemia precautions to women taking insulin
- ◆ Glyburide, Metformin and Acarbose may be considered while breastfeeding
- ◆ Teach patient how to monitor for mastitis
- ◆ Avoid progesterone-containing birth control until lactation is firmly established

PREGESTATIONAL DIABETES – MATERNAL EVALUATION

	Trimester		
	1 ST	2 nd	3 rd
A1c	X	X	X
Maternal EKG and echocardiogram: Age \geq 35 or DM $>$ 10 yrs.	X		
TSH and T4	X	As needed	As needed
24-hour urine for total protein, creatinine and creatinine clearance	X	As needed	As needed
Dental exam	Upon entry into care		
Ophthalmology Exam	X	Repeat with retinopathy	Repeat with retinopathy

PREGESTATIONAL AND GDM - FETAL EVALUATION

Ultrasound to confirm dates/viability	X	6-13 wks	
Fetal genetic evaluation or Cell-free fetal DNA (Early Aneuploidy Screening)	X	11-13.6 wks	
Quad screen		15-20 wks (defer with 1 st trimester screening)	
Ultrasound for fetal anatomy (pregestational DM)	X	18-20 wks	Every 4 wks after 28 wks
Ultrasound anatomy (GDM)	X	18-20 wks	38 wks
Fetal echocardiogram (pregestational DM)		22-24 wks	
Fetal kick counts		Twice daily, begin at 28 wks	
Fetal testing: Antepartum-Fetal Testing Protocol		Presence of vasculopathy, CHTN, uncontrolled DM or DKA at 26-28 wks	Pregestational and GDMA2, at 32 wks GDMA1 with no risk factors at 40 wks

DELIVERY PLAN

DM1, DM2: Vascular disease 37-39 wks

DM1, DM2, GDM: 39 wks

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

- ◆ AFI – Amniotic Fluid Index
- ◆ BG - Blood Glucose
- ◆ BMI - Body Mass Index
- ◆ BPP – Biophysical Profile
- ◆ CDE - Certified Diabetes Educator
- ◆ CGMS – Continuous Glucose Monitoring Sensor
- ◆ CHO – Carbohydrate
- ◆ CSII - Continuous Subcutaneous Insulin Infusion (i.e. personal insulin pump)
- ◆ DAPP – Diabetes and Pregnancy Program
- ◆ DBW - Desirable Body Weight
- ◆ DKA - Diabetic Ketoacidosis
- ◆ DM – Diabetes Mellitus; DM1 - Diabetes Mellitus Type 1; DM2 - Diabetes Mellitus Type 2
- ◆ EFM – External Fetal Monitoring
- ◆ EER - Estimated Energy Requirement
- ◆ EFW – Estimated Fetal Weight
- ◆ EPDS - Edinburgh Postnatal Depression Scale (available online)
- ◆ FBG - Fasting Blood Glucose
- ◆ GDM - Gestational Diabetes Mellitus
- ◆ GDM A1 - Gestational Diabetes Mellitus, Diet Controlled
- ◆ GDM A2 - Gestational Diabetes Mellitus, Oral Meds/Insulin Controlled
- ◆ GCT - Glucose Challenge Test
- ◆ IFG - Impaired Fasting Glucose (pre-diabetes)
- ◆ IGT - Impaired Glucose Tolerance (pre-diabetes)
- ◆ LGA – Large for Gestational Age
- ◆ MDI - Multiple Daily Injections (of insulin)
- ◆ MNT - Medical Nutrition Therapy
- ◆ MSW - Master of Social Work
- ◆ NST – Non-stress Test
- ◆ NSVD - Normal Spontaneous Vaginal Delivery
- ◆ OGTT - Oral Glucose Tolerance Test
- ◆ PCOS - Polycystic Ovary Syndrome
- ◆ RD - Registered Dietitian
- ◆ SGA – Small for Gestational Age
- ◆ SMBG - Self-monitoring of Blood Glucose
- ◆ SQ – Subcutaneous
- ◆ TDD - Total Daily Dose [of insulin]
- ◆ TSH – Thyroid Stimulating Hormone
- ◆ VBAC – Vaginal Birth after Cesarean

REFERENCES

- White, P. (1971) Pregnancy and Diabetes. In: Marble, White, et. Al, eds. Joslin's Diabetes Mellitus, 11th edition. Philadelphia: Lea & Febiger; pp. 581-98.
- Carpenter MW, Coustan DR (1982). Criteria for screening tests for gestational diabetes. *Am J Obstet Gynecol*; 144: 768-773
- American Diabetes Association (2014). *Standards of Medical Care in Diabetes-2014. Diabetes Care*, vol. 37 no. Supplement 1 S14-S80
- American College of Obstetricians and Gynecologists (2013). Gestational Diabetes Mellitus. Practice Bulletin, No 137, Vol. 122., 2, Part 1, 406-416.
- Russell, M. A., Carpenter, M. W., Coustan, D. R. (2007) Screening and Diagnosis of Gestational Diabetes Mellitus. *Clinical Obstet & Gynecol*, Vol. 50, No 4: 949-958.
- NIH Development Conference: Diagnosing Gestational Diabetes Mellitus. National Institutes of Health (013) from <https://consensus.nih.gov/2013/gdmstatement.htm>.
- Lemieux, L., et al. (2004). The need for insulin in subjects with impaired glucose tolerance of pregnancy. *Canadian Journal of Diabetes*, 28(3): 196-200.
- Lindsay, M. K., et. al (1998). The relationship of one abnormal glucose tolerance test value and pregnancy complications. *Obste. Gynecol*, 73(1): 103-6
- McLaughlin, G. et al. (2006). Women with one elevated 3-hour glucose tolerance test value: Are they at risk for adverse perinatal outcomes? *American Journal of Obstetrics and Gynecology*. 194: 16-19.
- Kitzmilller, J. et al. (2008). Manager preexisting diabetes for pregnancy: Summary of evidence and consensus recommendations for care. *Diabetes Care*, 31(5): 1060-1079.
- Combs, C. A. et al. (1992). Relationship of fetal macrosomia to maternal postprandial glucose control during pregnancy. *Diabetes Care*, 15: 1251-1257.
- Journsay, D. L. (1998). Continuous subcutaneous insulin therapy during pregnancy. *Diabetes Spectrum*, 11: 26-32.
- DeVeciana, M. & Evans, A. & Lintner, N. (2014). Endocrine disorders: Diabetes. *Manual of Obstetrics* (8th Ed), pp. 279-307. Lippincott Williams & Wilkins, Philadelphia, PA.
- Kozhimannil, K., et al (2009). Association between Diabetes and Perinatal Depression in Low-Income Women. *JAMA*; 301:842-847
- Moghissi, E. (2004). Hospital management of diabetes: Beyond the sliding scale. *Cleveland Clinic Journal of Medicine*, 71(10).
- Hirsch, I. B. & Hirsch, R. F. (2001). Sliding scale or sliding scare: It's all sliding nonsense. *Diabetes Spectrum*, 14(2).
- Bobak, I., et al. (1989). *Maternity and gynecology care: The nurse and the family*, 4th Ed. St. Louis, C. V. Mosby
- Langer, O., Conway, D. L., et al. (2000). A comparison of glyburide and insulin in women with gestational diabetes mellitus. *N Eng J Med*, 343(16): 1134-1138.
- Langer, O. (1996). Is normoglycemia the correct threshold to prevent complications in the pregnant diabetic patient? *Diabetes Reviews*, 4(1): 2-10.
- Jovanovic, L. (2000) Editor in chief. *Medical management of pregnancy complicated by diabetes*, 3rd Ed. American Diabetes Association, Alexandria, VA.

REFERENCES

- Briggs, G. G. et al. (2005). *Drugs in pregnancy and lactation* (7th Ed.). Philadelphia: Lippincott Williams & Wilkins.
- Metzger, et al. (2007). Summary and recommendations of the Fifth International Workshop-Conference on gestation diabetes mellitus. *Diabetes Care*, 30 (suppl2).
- National Institute of Diabetes and digestive and Kidney Diseases: National diabetes statistics fact sheet: General information and national estimates of diabetes in the United States (2005). Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health (2005).
- Walsh, P.A., & Roberts, R. (2012). *Pumping Insulin* (5th Ed.) Torrey Pines Press, San Diego, CA.
- Carbohydrate Counting. Access on March 5, 2009 from: <http://www.mfm-vms.org/dm6acarbsdiabetes.html>