

# DIABETES & PREGNANCY POCKET GUIDE FOR HEALTHCARE PROFESSIONALS

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

## DEFINITIONS

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

### DM1:

- Accounts for ~ 5% of all diabetes
- Absence of pancreatic beta cells (autoimmune)
- ABSOLUTE deficiency of insulin
- Exogenous insulin required for survival/ DKA prevention

### DM2:

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

**Gestational Diabetes Mellitus (GDM):** Impaired glucose intolerance and utilization of insulin during pregnancy. Complicates 7% of pregnancies.

- Accounts for ~ 90% 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 DM2 after pregnancy

**GDMA1:** GDM controlled with meal plan and physical activity

**GDMA2:** GDM controlled with meal plan, physical activity, and oral agents or insulin

**PRE-DIABETES:** Impaired Fasting Glucose (IFG) and/or Impaired Glucose Tolerance (IGT)

– non-pregnant:

- IFG: Fasting values that are  $\geq 100$  mg/dL and  $< 126$  mg/dL
- IGT: Blood glucose (BG) values  $\geq 140$  mg/dL and  $< 200$  mg/dL after a 2-hr 75 gm glucose tolerance test

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, nephropathy
T	History of renal transplant

White (1971)

## EARLY SCREENING FOR GDM

In accordance with ACOG, 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:

ACOG recommends considering early screening in all women who are overweight or obese and have one or more of the following risk factors.

Physical inactivity	High risk race/ethnicity (African American, Latinx, Native American, Asian American, Pacific Islander)
History of prior GDM	1 <sup>st</sup> degree relative with DM (parents/siblings)
Presence of glycosuria	History of prior $\geq 4000$ gram fetus
Hypertension	Hyperlipidemia (HDL $< 35$ , TG $> 250$ )
PCOS	Pre-diabetes (HgbA1c $\geq 5.7$ , IGT or IFG)
BMI $\geq 40.0$ kg/m <sup>2</sup>	History of cardiovascular disease

If early GDM is diagnosed, obtain a Hemoglobin A1c to determine if suspicion for pre-gestational DM is high or low. If  $> 6.3$ , obtain fetal echocardiogram at 22-26 weeks.

## DIAGNOSTIC CRITERIA

### Diagnosis of GDM:

Screening is completed for all pregnant patients by ACOG recommended two-step approach with a 1-hr 50 gm glucose challenge test (GCT) followed by a 3-hr 100 gm oral glucose tolerance test (OGTT) for women who fail the GCT.

Women with a history of roux-en-y gastric bypass surgery should not be screened with OGTT due to risk of dumping syndrome (rapid gastric emptying with a large glucose load).

If women cannot tolerate the OGTT (i.e. history of bariatric surgery), provide the patient with a BG meter. If greater than 30% of BGs are elevated after 2 weeks, GDM is confirmed.

Diagnosing GDM – Two Step Approach
Non-fasting 1-hr 50 gm glucose tolerance test (GCT).
<ul style="list-style-type: none"> <li>▪ Patient is to remain seated and not smoke.</li> <li>▪ Obtain venous blood glucose 1 hr after the start of the GCT ingestion.</li> <li>▪ Threshold to perform a 3-hour OGTT is <math>\geq 140</math> mg/dL.</li> <li>▪ If GCT is <math>\geq 200</math>, diagnosis of GDM is confirmed. Do NOT perform 3-hour OGTT.</li> </ul>
If GCT $\geq 140$ , perform a diagnostic 3-hour 100 gm OGTT on a separate day.
<ul style="list-style-type: none"> <li>▪ Women should have 3 days of at least 150 gm of CHO per day prior to the test. Test after a 10 hr fast before 9AM.</li> <li>▪ A diagnosis of GDM requires at least two abnormal venous BG values:               <ul style="list-style-type: none"> <li>▪ FBG: <math>\geq 95</math> mg/dL</li> <li>▪ 1-HR <math>\geq 180</math> mg/dL</li> <li>▪ 2-HR <math>\geq 155</math> mg/dL</li> <li>▪ 3-HR <math>\geq 140</math> mg/dL</li> </ul> </li> </ul>
<p><u>One abnormal value on OGTT (impaired glucose tolerance or impaired fasting glucose):</u> 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. Proceed to:</p> <ol style="list-style-type: none"> <li>1. Self-monitored blood glucose (SMBG) instruction. Patient to check fingerstick BG 4 times daily for 1-2 wks. If <math>&gt; 30\%</math> of BG values are abnormal <math>\rightarrow</math> GDM.</li> <li>2. If results are normal, repeat 3-hour OGTT in 4 weeks or continue checking blood glucose as above.</li> </ol>

ACOG (2018), Carpenter & Coustan (1982)

## PSYCHOSOCIAL ASSESSMENT

Assess patients for the following to evaluate barriers to adherence to diabetes care:

- Anxiety/Depression/Bipolar disorder/Disordered Eating Habits
- Attention Deficit/Attention Deficit Hyperactive Disorder (ADD/ADHD)
- Childcare stress, lack of family, financial and social support
- Food insecurity

Selective screening via Edinburgh Postnatal Depression Scale (EPDS) during pregnancy is recommended. Low-income pregnant women with DM have nearly twice the risk of depression (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 consult with a DAPP to allow the patient to meet with a Certified Diabetes Care and Education Specialist (CDCES)
- Diabetes Consistent CHO (carbohydrates) Meal Plan prescribed as CHO divided into 3 meals and 3 snacks every 2-3 hours, which typically includes:
  - 2 servings at breakfast (30 grams of CHO)
  - 3 servings at lunch and dinner (45 grams of CHO)
  - 1 serving with all snacks (15 grams of CHO)
- Meal plan may need to be adjusted based on maternal diagnoses (i.e. CSII pump use, multiple gestation, optimal weight gain), cultural needs, and food security.
- Teach patients to count CHOs and read food labels. Smartphone application recommendations and handouts will be provided to aid in nutrition literacy.

## 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. No randomized trials have been performed to identify optimal glycemic targets, but **A1C**  $< 6.5\%$  before pregnancy is associated with reduced rate of congenital malformation. **A1C**  $< 6.0\%$  during pregnancy is associated with decreased fetal macrosomia (Kitzmilller 2008) Likewise, HAPO trial demonstrated that increasing hyperglycemia is associated with increasing adverse outcome but was based on 2 hour GTT not treatment strategies. (NEJM 2008).

Testing	ADA goal
❖ FBG and pre-prandial meals	70- 95 mg/ dL
❖ 1 hour after the START of meal	110-140 mg/dL
❖ AC HS snack and 3 AM	

## CONTINUOUS GLUCOSE MONITORING SENSOR (CGMS)

Continuous glucose monitoring (CGM) systems record interstitial glucose every 5 minutes, up to 288 readings per day. CGM use in T1DM in pregnancy has been shown to improve outcomes including lowering hemoglobin A1c without an increase in hypoglycemia, reduction of LGA births, reduced length of neonatal stay and reduced neonatal hypoglycemia (Lancet 2017, ADA 2023).

CGM is increasingly being used in pregnancy, but according to the ADA, there are not sufficient data yet to support use in people with GDM or T2DM. Meta-analyses of use in GDMA2 and T2DM in pregnancy have suggested improved maternal and fetal outcomes. Utilization of CGM should be based on patient's circumstances, preferences and needs. It tends to underestimate BG when compared to SBGM. If CGM is used, it is an adjunct, not a replacement for, BG meter. We recommend BG are taken with meter at least 4 times per day (fasting and pre-prandial) as well as with values < 60 and >200. Blood glucose monitor should also be used prior to driving. Please contact the CDCES for CGMS placement. CPT for placement is 95251 and interpretation is 95250.

## PHYSICAL ACTIVITY

The recommendations for physical activity are:

- 30-60 minutes/day to increase insulin sensitivity and lipid metabolism
- 30 minutes after a meal for at least 15-30 minutes
- Sessions may be divided into 15 minute segments 3 times daily
- 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 grams of carbohydrate to reduce the risk of hypoglycemia
- To be able to carry on a conversation without shortness of breath
- Wear an ID bracelet that indicates DM status

## EVALUATE SAFETY OF MEDICATION REGIMEN

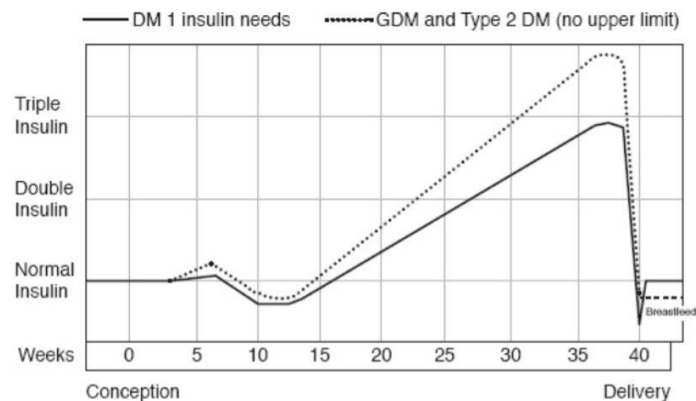
- Angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARB's) are contraindicated during pregnancy
- Nifedipine, labetalol, and hydralazine are preferred alternatives for hypertension
- All lipid lowering medications are contraindicated during pregnancy

## INCREASED INSULIN REQUIREMENTS

Insulin requirements during pregnancy generally increase by 2-3 fold during pregnancy. Other factors that may further increase insulin requirements are:

- Obesity
- Sepsis or other infections
- Corticosteroids (e.g. betamethasone or prednisone)

## INSULIN REQUIREMENTS DURING PREGNANCY



Shields 2015.

## 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 SC tissue in the **abdomen**. Insulin is first line for T1/T2 DM. It should be considered in women with GDM prior to 20 weeks. Table below is a guide for starting insulin:

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 Aspart/Lispro (rapid-acting) insulin. 1/2 of the PM dose = 10 units of Aspart/Lispro before dinner and 10 units of NPH before the bedtime snack.

If inpatient consider perinatology.com starting dose.

COMMONLY PRESCRIBED INSULINS				
Type	Example	Onset	Peak	Duration
Rapid-acting (Analog) Bolus or for meals	Lispro (Humalog)	5-15 min	45-90 min	4 hrs
	Aspart (Novolog)	5-15 min	45-90 min	4 hrs
Short-acting (Regular) Usually IV use	Regular insulin (Humulin R)	30 min	2-3 hrs	6 hrs
	(Novolin R)	30 min	2-3 hrs	6 hrs
Intermediate-acting (NPH) Basal Insulin	NPH (Humulin N)	2-4 hrs	4-10 hrs	10-16 hrs
	(Novolin N)	2-4 hrs	4-10 hrs	10-16 hrs
Long-acting Basal insulin	Detemir (Levemir)	1.5-2 hrs	Modest, 8-12 hrs	12-24 hrs
	Glargine (Lantus)	1.5- 2hrs	Modest, 8-12 hrs	24 hs
Other FDA approved insulins in pregnancy include: regular U-100, regular U-500, Glulisine, Glargine U-100, Glargine U-300, Degludec U-100 and U-200, inhaled insulin. The insulin used in the CSII pump for pregnancy is Aspart/Lispro.				



**DO NOT USE POST MEAL SLIDING SCALE INSULIN –**  
This practice leads to over treatment without avoiding fetal exposure to hyperglycemia.

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** meals.

**DO NOT USE THIS ALGORITHM TO TREAT BETWEEN MEALS. ALTERNATIVELY, MAY CALCULATE CORRECTION FACTOR**



de Veciana & Evans (2007)

CSII PUMP CALCULATION FOR PREGNANCY	
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	MDI TDD x 0.75 = _____ TDD
3. To calculate TDD units/kg:	<u>Wt calculated TDD =</u>
a. Pre-pregnant: x 0.6 units/kg	Current wt in kg x units/kg = Total units/24 hours
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 units/kg	
f. Week 0-6 Postpartum : x 0.4 units/kg	
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>	TDD x 0.5 = <u>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 <sup>rd</sup> basal rate calculated as TDD divided by 24 hrs being the key value:	1700 divided by the TDD = <u>Correction Factor</u>
a. The 1 <sup>st</sup> basal rate is from 12MN to 3AM and equals 3 <sup>rd</sup> basal rate x 0.8.	
b. The 2 <sup>nd</sup> basal rate is from 3AM to 8AM and equals 3 <sup>rd</sup> basal rate x 1.2.	
c. The 3 <sup>rd</sup> basal rate is from 8AM to 12 MN and equals TDD divided by 24 hrs.	500 divided by the TDD = <u>I:C Ratio</u>
7. Correction Factor (Sensitivity Factor)	
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	
<b>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 (Journsay 1998).</b>	

Adapted from Walsh (2000)

For example, calculate the TDD (60 units). Multiply 60 units x 0.5 = 30 units. Divide 30 units by 24 hrs for 3<sup>rd</sup> basal rate = 1.25 units/hr. Multiply 3<sup>rd</sup> basal rate (1.25 units/hr) by 0.8 for the 1<sup>st</sup> basal rate = 1 unit/hr. Multiply the 3<sup>rd</sup> basal rate (1.25 units/hr) by 1.2 for the 2<sup>nd</sup> 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).

## 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 used for hypoglycemia management.

- **15 grams** of fast acting CHO
- Recheck BG in **15 minutes**
- **Should rise** 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 delays the absorption of glucose.
- Recheck fingerstick BG in **15 minutes**
- Repeat BG check every 15 minutes until BG  $\geq 60$  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 delays the absorption of glucose.
- Recheck fingerstick BG in 15 minutes.
- **DO NOT** leave the patient alone.
- Repeat BG check every 15 minutes until BG  $\geq 60$  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 D<sub>5</sub>NS @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 fingerstick BG **every 15 minutes** until BG is  $\geq 60$  mg/dL x 2

## UNRESPONSIVE OR UNCOOPERATIVE

**Hypoglycemia, unresponsive or uncooperative**

**UNCONSCIOUS OR UNRESPONSIVE:**

- Give **GLUCAGON 1 mg IM** injection **STAT**
- **Ensure venous access**
- Recheck fingerstick BG **every 5 minutes** until patient is **alert and responsive**.
- **If BG is not >60 mg/dL after 15 minutes**, start infusion of D<sub>5</sub>NS or D<sub>10</sub>NS @ 200 mL/hr until BG is  $\geq 60$  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 5-10 minutes
- **Notify the attending physician**

## USE OF GLUCAGON

**Glucagon** (a hormone with the opposite effect of insulin) raise 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 decreased risk of subsequent rebound hyperglycemia. Glucagon is used as follows:

- Glucagon is packaged as:
  - GVOKE - 1 mg dose, pre-filled emergency kit for subcutaneous injection
  - Baqsimi – 3 mg dose, pre-filled emergency kit for intranasal spray
- All of the glucagon is used.
- Onset of action, with reversal of severe hypoglycemia is rapid, within 15 minutes.
- The dose may be repeated in 20 minutes for persistent severe hypoglycemia.
- Patients may experience 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 proper use.

## ORAL AGENTS FOR GDM

GDM that is not properly controlled with diet alone can be managed with oral agents:

- METFORMIN has been used in early pregnancy for women with PCOS and is recommended by ACOG and SMFM as a 1<sup>st</sup> line oral agent for pregnancy. In our practice, it is typically used for pre-prandial elevations, although it increases insulin sensitivity and can help with postprandial elevations as well.
- GLYBURIDE is a hypoglycemic agent and particularly useful for treating pre-meal hyperglycemia.
- ACARBOSE is an anti-hyperglycemic used for treating post-meal hyperglycemia.

Pregnant women taking oral agents should continue their MNT, SMBG and have the same maternal/fetal surveillance as women taking insulin. Patients who do not achieve optimal glycemic control on oral agent(s) should be changed to insulin.

Oral agents are not typically recommended in pregestational diabetes nor early pregnancy (< 20 wks gestation). Insulin remains the treatment of choice for pre-gestational and newly diagnosed DM at <20 weeks gestation.

### METFORMIN protocol (biguanide)

Begin metformin nightly for 1 week
Then increase to 500 mg BID, may increase to 1000 mg BID. Maximum dose is 2500 -3000 mg in 2-3 divided doses.
Do not use in chronic renal disease (consider checking creatinine at baseline)

ACOG 2018.

### ACARBOSE PROTOCOL (Alpha-glucosidase inhibitor)

Begin with 25 mg 3 times daily just prior to each meal
Increase by 25 mg three times daily every 7 days until BG targets are reached
Maximum daily dose is 300 mg given as 100 mg three times daily

Langer (2000), deVeciana & Evans (2007).

## GLYBURIDE PROTOCOL (Sulfonylurea)

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 hypoglycemia 1-2 hours post meal
To manage FBG, 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 in breastfeeding
Increased rates of macrosomia and hypoglycemia when compared to insulin.

Langer (2000) de Veciana & Evans (2007)

## CORTICOSTEROID THERAPY

### RESPONSE TO CORTICOSTEROID IN PREGNANCY

- Glycemic response to antenatal corticosteroids given for increased risk for preterm birth is variable and requires individualization of treatment.
- The normal response for pregnant women without diabetes is transient hyperglycemia after the first dose with a peak glucose response at 48-72 hours.
- The onset of hyperglycemia response to steroids may be delayed for several days and may be present for 1-2 weeks. Typically, the maximum BG less than 180 mg/dL.
- For those on insulin, doses should be increased aggressively and proportionately to the level of hyperglycemia.

### GLYCEMIC MANAGEMENT FOR STEROID-INDUCED HYPERGLYCEMIA

- Check BG for 72 hours after steroid administration.
- Check BG every 8 hours while NPO, and ACHS for those on a regular diet.
- After 72 hours, if BG <200 mg/dL, discontinue BG monitoring.
- If BG is >200 mg/dL during 72-hour screening period, initiate a carb counting pregnancy diet and check BGs 7x per day with treatment as necessary.
- Rapid acting insulin can be used on an as-needed basis for BG values >200 mg/dL.

**If hyperglycemia persists for >3 days post steroid administration**, consider initiation of treatment (oral or insulin) as indicated. Use caution in treatment, as transient hyperglycemia response likely resolves 1-2 weeks following steroid administration as BG values are anticipated to return to pretreatment levels (2012).

### DEFINITION AND EPIDEMIOLOGY

- Occurs in 5-10% of pregnant women with pregestational T1DM
- Typically defined by hyperglycemia, positive serum ketones, acidosis.
  - Euglycemic DKA is more common in pregnancy
- Risk factors: Type I DM or new onset DM, infections (commonly respiratory or UTI), poor compliance, insulin pump failure, or steroid treatment.
- Symptoms: abdominal pain, nausea, vomiting, altered sensorium
- Concerning labs
  - pH < 7.3
  - Bicarb < 15 mEq/L
  - Increased anion gap (> 10)
  - Serum ketones elevated

### INITIAL EVALUATION

- Vital signs, EKG
- Laboratory evaluation
  - VBG (ABG if altered sensorium or unstable vital signs/non-reassuring fetal tracing, obtain VBG while awaiting ABG)
  - CMP with anion gap
  - Serum Ketones
- Evaluation for underlying etiology – history, infectious work up, etc.
- Fetal assessment – Classical teaching is to not intervene while patient is in DKA
- Consider ICU admission if altered sensorium/pH < 7.1/abnormal EKG/Kussmaul

### CONTINUED EVALUATION

- BG every hour
- Vital signs every 1-2 hours
- Serum electrolytes including anion gap), VBG and ketones until normalization of pH/anion gap
- Continuous maternal ECG and pulse oximetry
- CEFM if > 24 weeks, otherwise FHT every 4-8 hours
- Insert foley catheter, I&O every hour
- NICU/Anesthesia consult

### FOR MORE DETAILS OF MANAGEMENT SEE DKA IN PREGNANCY PROTOCOL TENETS OF MANAGEMENT:

- Aggressive hydration, use normal saline
- IV insulin (may need to give D5 in order to facilitate insulin administration in euglycemic DKA, which is more common in pregnancy)
- Correction of underlying etiology

#### Fluid resuscitation

- Fetal assessment – Classical teaching is to not intervene while patient is in DKA
- Aggressive hydration, use normal saline
- 1 L in first hour
- Hours 2-4 0.5-1L/hour
- Thereafter: give 250 mL/h 0.45NS until 80% deficit corrected
- Once BG < 300 mg/dL, change IV fluids to D51/2NS and follow intrapartum IV insulin algorithm (Refer to Veciana & Evans 2007).

#### Insulin

- Loading dose of 0.1-0.4 units/kg
- Maintenance of 2-10 units/hour (start with insulin gtt in labor protocol and adjust as necessary). Double insulin infusion rate if BG does not decrease by 20% in first 2 hours if hyperglycemic
- Continue insulin therapy until bicarbonate/anion gap normalize (serum GB/potassium/anion gap)

#### Potassium replacement

- If K is initially normal or reduced, consider an infusion of K of up to 15-20 mEq/h
- If K is elevated, do not add supplemental K until levels are normal, then 20-30 mEq/L
- Phosphate – consider replacement if serum phosphate < 1.0 mg/dL or cardiac dysfunction present or patient obtunded

## ANTEPARTUM IV INSULIN INFUSION

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

- Maintain capillary BG between **60 and 100 mg/dL**
- Place an order for "Diabetes Consistent CHO Meal Plan for Pregnancy"
  - Calculate ICR for meals (500 divided by TDD = ICR (u/gms) and inject to cover meals
- Begin IV fluids @ 125 mL/hr (LR or D5NS)
- Initiate IV insulin drip using Regular insulin 100 units/100 mL NS (1u/1mL) at 0.5 u/hr and titrate the infusion per IV insulin algorithm (adjust from protocols as needed)
- When converting patient to SC split dose wt based insulin, increase the TDD by 25% to reduce risk of hyperglycemia.

## INTRAPARTUM IV INSULIN INFUSION – ACTIVE LABOR

**DM1 AND DM2:**

**GDMA2** usually does not require insulin during labor unless BG is >110 mg/dL

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

- Maintain capillary BG between **60 and 100 mg/dL**
- Keep patient NPO or non-CHO containing clear liquids
- Begin IV fluids as D5NS in T1DM or LR @ 125 mL/hr
- Initiate IV insulin drip using Regular insulin 100 units/100 mL NS (1 u/mL) at 0.5 u/hr and titrate the infusion per IV insulin algorithm.
- If hypoglycemic, call MD and follow hypoglycemic protocol. STOP insulin
- Restart insulin infusion if BG becomes > 80 mg/dL x 2

**Labor or induction of labor:** Maintain NPO.. Do not give daily scheduled dose of SC insulin. If BG is >100 mg/dL, consider IV Insulin Algorithm. Modify insulin algorithm if BG targets are not achieved within 4 hours.

## INTRAPARTUM IV INSULIN – ACTIVE LABOR (cont.)

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

## DELIVERY PLANNING

- **Insulin:** Give usual dose the day prior to delivery. Discontinue insulin at midnight and keep patient NPO until delivery.
- **Oral agents:** Give usual dose the day before and discontinue the day of delivery.
- **BG:** Every 1 hour in active labor, every 2 hours in latent labor.
- **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 (IOL):** Manage the same as active labor. If IOL is prolonged, discontinue pitocin in time to give usual dinner calories. Give pre-dinner (Humalog/Novolog) and HS (Humulin N/NovolinN) insulin.



## CSII PUMP - ACTIVE LABOR AND POSTPARTUM

### Active labor:

- Keep patient NPO. Use lowest basal setting until active labor. CSII pumps can usually be discontinued during labor or the basal rate can be decreased by 50%.
- BG values should be checked every 1 hr.
- If necessary, the CSII pump can be used for intrapartum hyperglycemia (alternatively consider insulin GTT)
- Suspend the pump if glucose < 80 mg/dL or active labor and glucose < 100 mg/dL
- Patients having cesarean section should maintain the 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

#### Postpartum pump settings

- Reset the basal rates to 1/3 – 1/2 pre-delivery doses (reference pre-pregnancy pump settings)
- Increase the insulin to carb ratios (ICRs) and insulin sensitivity factors (ISFs) by 50%
- Reset BG targets to 80-120 mg/dL
- Assure postpartum follow-up

## IMMEDIATE POSTPARTUM DIABETES MANAGEMENT

Insulin requirements decrease by 50-75% 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 <180 mg/dL

### FOR GDMA1/GDMA2

- D/C IV insulin immediately after delivery of the placenta
- Resume regular diet
- Check FBG and 1 hr postprandial values until discharge. If >100 mg/dL fasting or >180 mg/dL postprandial have patient continue SMBG and report BG values outside targets to a member of the DAPP healthcare team. Typically start metformin if BG > 180 despite DM diet.

### 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 25-33% of SQ end-pregnancy insulin dose when on PO intake and/or BG values exceed above parameters. Alternatively, if controlled pre-pregnancy with metformin, restart metformin. Titrate as indicated.

## OUTPATIENT POSTPARTUM DIABETES FOLLOW UP

### DM1 and DM2:

- Counsel patient to follow up with a member of the DAPP healthcare team and 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 regimen. Outpatient BG targets are:
  - FBG: <100 mg/dL
  - 1 hour postprandial <140 mg/dL

### GESTATIONAL DIABETES

- Reclassify for pre-diabetes or DM with a 2 hour 75 g OGTT by 6-12 weeks postpartum. If negative rescreen every 3 years
- Counsel patient to follow up with a member of the DAPP at 4-6 weeks postpartum unless indication for additional visits

Criteria for pre-diabetes	Criteria for Diabetes
FBGs >100-125 mg/dL	FBGs >126 mg/dL
2 hr PG >140-149 mg/dL	2 hr PG >200 mg/dL
A1c between 5.7 and 6.4% (> 12 w PP)	A1c > 6.5% (> 12 weeks PP)

- It is estimated that up to 70% of women will develop T2DM 22-28 years after pregnancy
- Counsel regarding benefits of breastfeeding for mother/infant
- Review risks of poorly controlled DM at time of conception and pregnancy planning
- Early 1 hour at next pregnancy
- Review diet, exercise, weight control for DM prevention

## BREASTFEEDING

The American Academic of Pediatrics (AAP) recommends exclusive breastfeeding for approximately 6 months followed by continued breastfeeding with complementary foods for at least 2 years and beyond as mutually desired.

### Breastfeeding

- **Breastfeeding improves glucose and lipid metabolism**
- Diabetes Consistent CHO Meal Plan, 500 calories over pre-pregnant level
- Check BGs prior to breastfeeding especially at night.
  - If BG <100 mg/dL, provide 15 gm CHO snack
- Hyperglycemia is transmitted through breast milk.
  - 1 hr postprandial BG target <150 mg/dL
- Teach women taking insulin hypoglycemia precautions
- Glyburide, Metformin and Acarbose are not contraindicated while breastfeeding.
- Teach patient how to monitor for mastitis

## Maternal and Fetal Evaluation

Pregestational/early gestational diabetes with a suspicion for pre-gestational DM

Pre-gestational/ Early Gestational Diabetes with suspicion of pre-gestational DM	Trimester		
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Hemoglobin A1c	X	X	X
Tobacco	X	As indicated	As indicated
Maternal echo/ECG (>35 , DM > 10 y, HTN)	X		
TSH/T4	X	As indicated	As indicated
24H urine/ baseline labs	X		
Dental	X		
Ophthalmology	X		
Aspirin 81 mg daily starting at 12 weeks	X	X	X
Breastfeeding consult (if has not breastfed)			X
First trimester anatomy	X		
Fetal Anatomy		X	
Fetal Echo		X	
Growth/ANFS		X	X

Gestational diabetes evaluation. Of note, for GDMA, serial growth assessments

Gestational Diabetes, Class A2			
	Trimester		
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Fetal Anatomy		X	
Growth/ANFS			X
1st breast LC consult (Order at 28-36w)			X

## 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)  
 MDI - Multiple Daily Injections (of insulin)  
 LGA – Large for Gestational Age  
 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  
 SC – Subcutaneous  
 SGA – Small for Gestational Age  
 SMBG - Self-monitoring of Blood Glucose  
 TDD - Total Daily Dose [of insulin]  
 TSH – Thyroid Stimulating Hormone  
 VBAC – Vaginal Birth after Cesarean

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**DIABETES AND PREGNANCY**  
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