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Diabetes from Antepartum to Postpartum:
What the Bedside Nurse Needs to Know

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Diabetes and Pregnancy
Program

Perinatal Outreach
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Disclosures

- I have no financial relationships to disclose

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Objectives

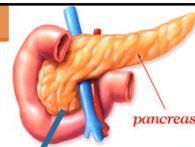
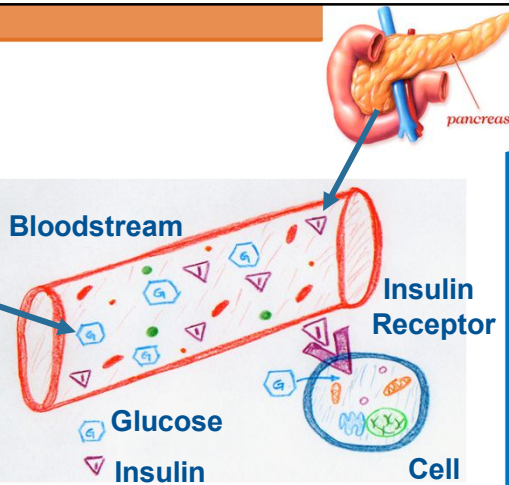
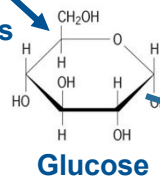
- To review the types of diabetes and the effects of pregnancy on each
- To review glycemic management during pregnancy
- To discuss intrapartum glycemic management techniques and targets prior to birth
- To outline postpartum glycemic monitoring and follow-up recommendations

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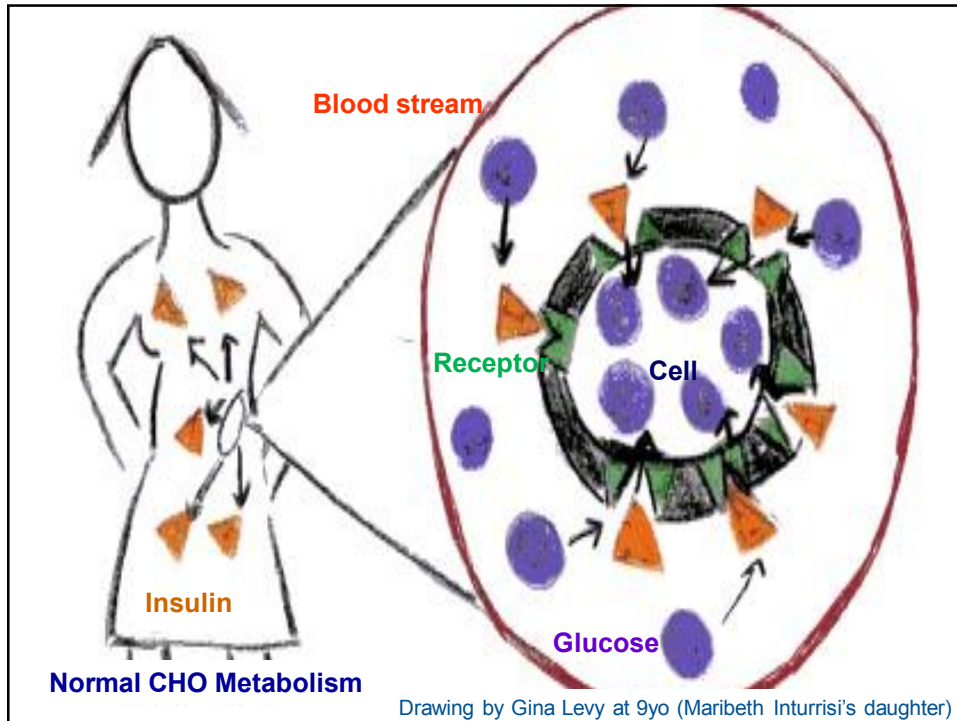
Carbs



Causes of Hyperglycemia:

- Insufficient Insulin
- Insufficient Insulin Receptor Sensitivity
- Glucose >> Insulin

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Pre-Gestational Diabetes Mellitus

Diabetes that precedes pregnancy

- **Complicates around 1-2% of all pregnancies**
 - Up to 10% of pregnancies with diabetes
- **Chronic metabolic disorder**
- **Absolute or relative deficiency of insulin**
- **Microvascular complications (e.g. retinopathy, nephropathy, neuropathies)**
- **Macrovascular disease (e.g., HTN, stroke, cardiovascular disease)**

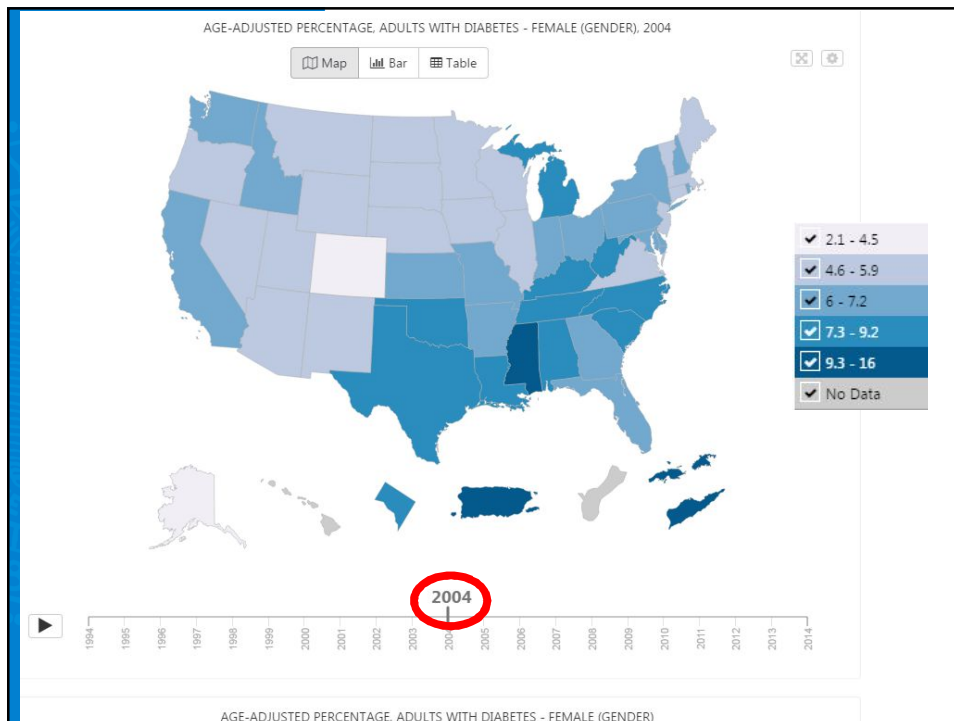
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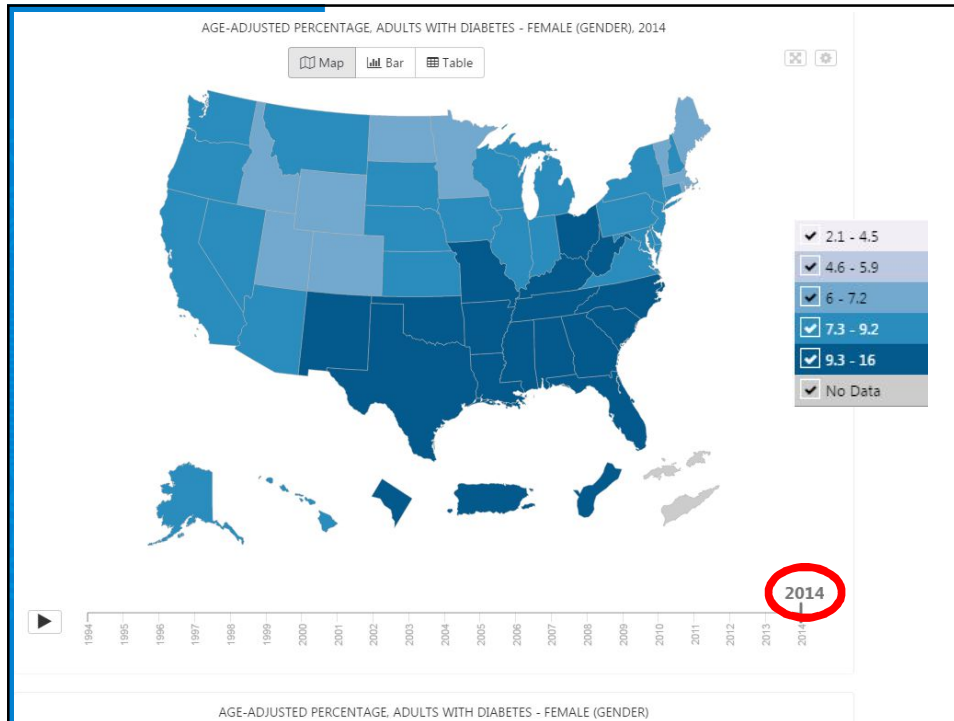
Pre-Gestational Diabetes Mellitus

Diabetes that precedes pregnancy

- Two main types
 - Type 1 Diabetes
 - Type 2 Diabetes

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Type 1 Diabetes

ABSOLUTE insulin deficiency

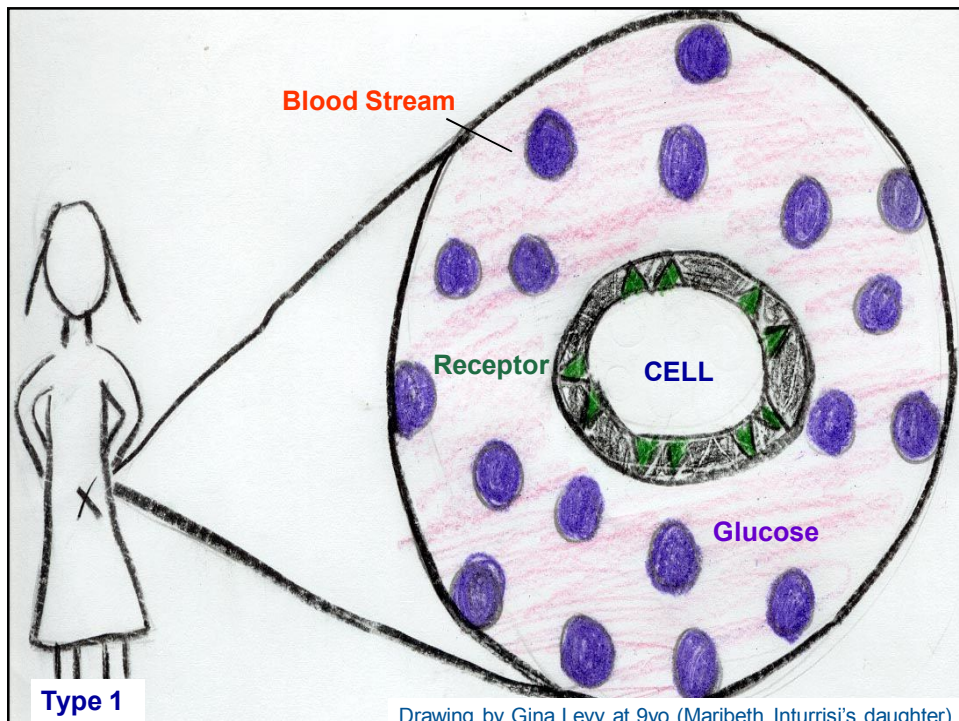
- Genetic and environmental (triggered by viruses or toxins) etiology... may occur any time (usually in childhood/earlier adulthood)
- Autoimmune process that attacks beta-cells of the pancreas
- Must have exogenous insulin to survive
- Prone to ketoacidosis with hyperglycemia

Type 1 Diabetes

ABSOLUTE insulin deficiency

- May develop at any age and is typically associated with lean body habitus and no family history
- Accounts for 5-10% of all diabetes in the US and 0.2-0.5% of pregnancies

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Type 2 Diabetes

RELATIVE insulin deficiency

- **Insulin resistance at the cellular level**
 - Glucose does not readily enter insulin-sensitive tissue (muscle and fat cells)
 - Pancreatic beta-cells increase insulin production in response to this resistance
 - Over time, the extra insulin is ineffective in lowering blood glucose
 - Beta-cells “exhaust” and insulin secretion decreases, resulting in hyperglycemia

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Type 2 Diabetes

RELATIVE insulin deficiency

- **Usually adult onset associated with obesity and strong family history**
- **May also occur in adolescents with a strong family history and obesity**
- **Consist of about 90-95% of pre-gestational diabetics in the US**

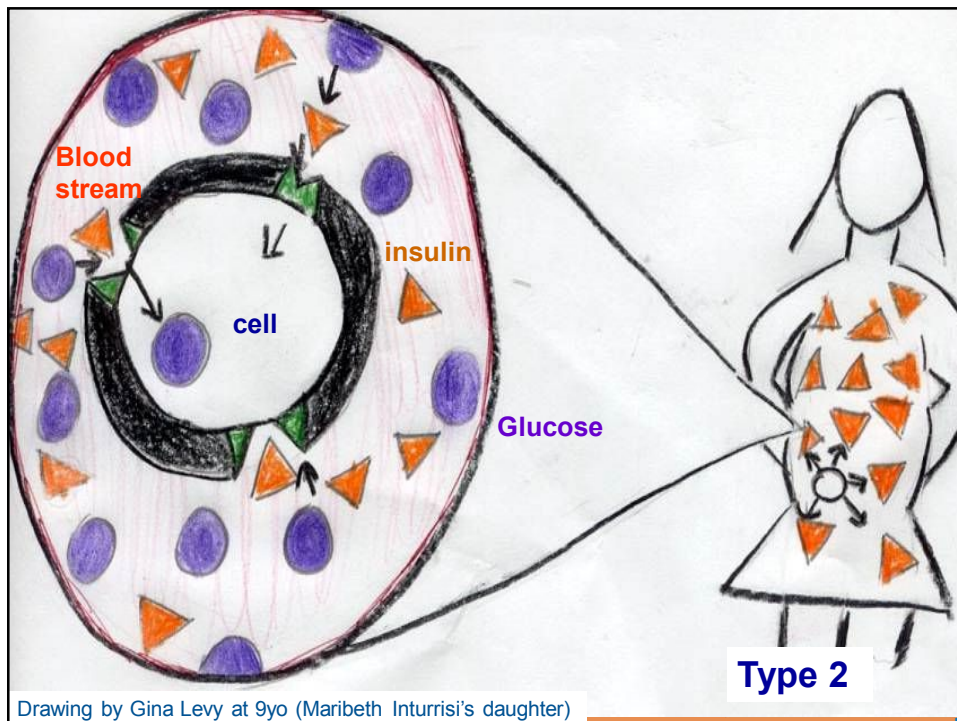
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Type 2 Diabetes

RELATIVE insulin deficiency

- About $\frac{1}{3}$ need diet and exercise therapy alone, $\frac{1}{3}$ need oral hypoglycemics, and $\frac{1}{3}$ need insulin for adequate glucose control
- Almost all need insulin for optimal control during pregnancy

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Gestational Diabetes (GDM)

RELATIVE insulin deficiency from the insulin resistance of pregnancy from placental hormones

- Carbohydrate intolerance of variable severity with first recognition during pregnancy (usually 2nd half)
- Some are able to maintain glycemic control with diet/exercise (GDM-A1) and others require medication (GDM-A2)

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Screening for GDM

- **Low risk for GDM:**
 - < 25 years of age
 - Normal body weight
 - No diabetes in 1st degree relative
 - Member of ethnic group with low prevalence of diabetes
 - No history of abnormal glucose metabolism
 - No history of poor obstetric outcome

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Screening for GDM

- **High Risk (need only 1 for early screening)**
 - Native Americans
 - Obese individuals (BMI >29)
 - Diabetes in 1st degree relative
 - History of GDM or glucose intolerance
 - Previous unexplained IUFD, congenital anomalies (i.e., NTD, cardiac)
- **Moderate Risk (need at least 3 for early screening)**
 - African, Asian, Hispanic, Filipina, Pacific Islander, Middle Eastern
 - Age \geq 35
 - Previous infant with macrosomia (> 4000g)
 - Repetitive glucosuria

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Screening for GDM

- **Low risk women should be screened for GDM no later than 24-28 weeks gestation**
- **Screen women at high risk for gestational diabetes at first visit**
 - If initial screen is negative, repeat at 24-28 weeks gestation
- **Many are moving to universal screening**

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Screening for GDM – 2 hour OGTT

- **Oral Glucose Tolerance Test (OGTT) - new**
 - Fasting 8-10 hr (usually done in morning)
 - Not more than 10 hr fasting...
 - 75 gram glucose load
 - Remain seated during test
 - Fasting, 1 hr after, 2 hr after
 - Diagnostic

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Screening for GDM – 2 hour OGTT

- **If any one of the results are abnormal – diagnosed with GDM**
 - Fasting ≥ 92 mg/dL
 - 1 hour ≥ 180 mg/dL
 - 2 hour ≥ 153 mg/dL
- **Meters SHOULD NOT be used to diagnose GDM**

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Guidelines for Diagnosis of Hyperglycemia in Pregnancy – 2011

First Prenatal Visit (<13 wks)*
 Many cases of diabetes or abnormal glucose tolerance are not detected until pregnancy. Early detection reduces complications.

Test: Women who have ANY risk factor:

- Non-Caucasian
- BMI ≥ 25 (at risk BMI may be lower in some ethnic groups)¹
- History of GDM or pre-diabetes, unexplained stillbirth, malformed infant
- Previous baby 4000 gm or more (8 lbs 13 oz)
- 1st degree relative with diabetes mellitus
- Glucosuria
- Medications that raise glucose (e.g. steroids, betamimetics, atypical antipsychotics)
- Polycystic ovarian syndrome, cardiovascular disease, hypertension, hyperlipidemia

ALTERNATE: Test all women for undiagnosed hyperglycemia at the first visit

Universal Testing at 24-28 weeks

- 2011 ADA standard is 75 gm 2h OGTT for all women not previously diagnosed with diabetes @ 24-28 weeks gestation¹
- Fast 8-10 hours, remain seated during test
- Consider adding to third trimester labs

***If entry to care 13-23 6/7 weeks and risk factors are present, test as soon as possible with a 75 gm 2 hour Oral Glucose Tolerance Test (OGTT)**

Date _____

FPG: _____ 1 hr: _____ 2 hr: _____

≥ 92 mg/dL ≥ 180 mg/dL ≥ 153 mg/dL

Add A1c or FPG or Random Glucose to Prenatal labs

Date: _____ Result: _____

A1c ≥ 6.5%
or FPG ≥ 126 mg/dL,
or Random ≥ 200mg/dL

Diagnose
Type 2 Diabetes

A1c 5.7 - 6.4%,
or FPG ≥ 92 mg/dL and < 126 mg/dL

Treat as Gestational
Diabetes Mellitus (GDM)

A1c < 5.7% or FPG < 92

Test @ 24 – 28 wks with
OGTT

If any value at or above
cut off, treat as GDM

REFER TO SWEET SUCCESS Date Referred: _____

NOTE: For early diagnosis (prior to 24 weeks gestational age), Sweet Success will obtain A1c at initial visit after referral

***If entry to care 13 - 23 6/7 weeks and risk factors are present, test as soon as possible with a 75 gm 2 hour OGTT**

1. American Diabetes Association. Standards of Medical Care in Diabetes. Diabetes Care. 2011;34(Suppl 1):S11-S61.

2. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. Position Statement. Diabetes Care. 2011;34:982-89.

3. International Association of Diabetes and Pregnancy Study Group Consensus Panel. International Association of Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy. Diabetes Care. 2010;33:676-82.

4. Coustan DR, Lowe LF, Metzger BE, Dyer AR. The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) Study: Paving the Way for New Diagnostic Criteria for Gestational Diabetes Mellitus. Am J Obstet Gynecol. 2010;202:154-61.

SS-2100 07/2011

Screening for GDM – 1 hour GTT

- **Glucose screening (GLT)**
 - 50 gram glucose load, non-fasting, anytime of day
 - Blood drawn 1 hour later
 - Abnormal result: ≥ 140mg/dl
 - Not necessarily diagnostic

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Screening for GDM – 1 hour GTT

- **If GLT \geq 200 mg/dl – diagnosed with GDM**
 - DO NOT ADMINISTER 3-hour OGTT
 - Diabetes And Pregnancy Program (DAPP) referral ASAP
- **If GLT \geq 141-199 mg/dl**
 - Administer 3-hour 100-gm OGTT
- **Meters are never used with the diagnostic tests**

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Diagnostic Test for GDM

- **3-hour 100-gm OGTT**
 - Fasting 8-10 hr (usually done in morning)
 - Not more than 10 hr fasting...
 - Get **FASTING** result **FIRST** (if FBG > 110mg/dl, DO NOT LOAD – dx GDM)
 - Remain seated during test
 - FBS \geq 95 mg/dL
 - 1 hour \geq 180 mg/dl
 - 2 hour \geq 155 mg/dl
 - 3 hour \geq 140 mg/dl
- **If two or more hourly values are met or exceeded, or if fasting \geq 110, diagnosis of gestational diabetes is made**

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Types of GDM

The diagram illustrates the process of Gestational Diabetes (GDM). It shows a pregnant woman's torso with a fetus in the uterus. A blood test tube is shown with a yellow band at the top, labeled "High blood glucose levels in mother". An arrow points from the blood test tube to the fetus, labeled "Brings extra glucose to baby". Another arrow points from the fetus to the text "Causes baby to put on extra weight".

- **GDMA1-**
 - Diet
 - Exercise
- **GDMA2-**
 - Diet
 - Exercise
 - Medication

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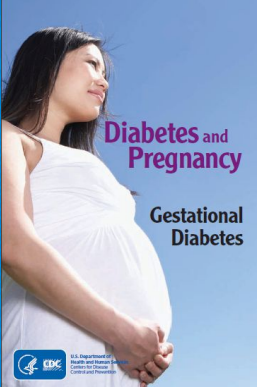
Gestational Diabetes (GDM)

RELATIVE insulin deficiency from the insulin resistance of pregnancy from placental hormones

- **Some women will have GDM in one pregnancy and not in others**
- **Lifetime risk for developing Type 2 diabetes:**
 - 50% develop within 10 years of index pregnancy if insulin was required during pregnancy
 - 25% develop if diet-controlled only during pregnancy

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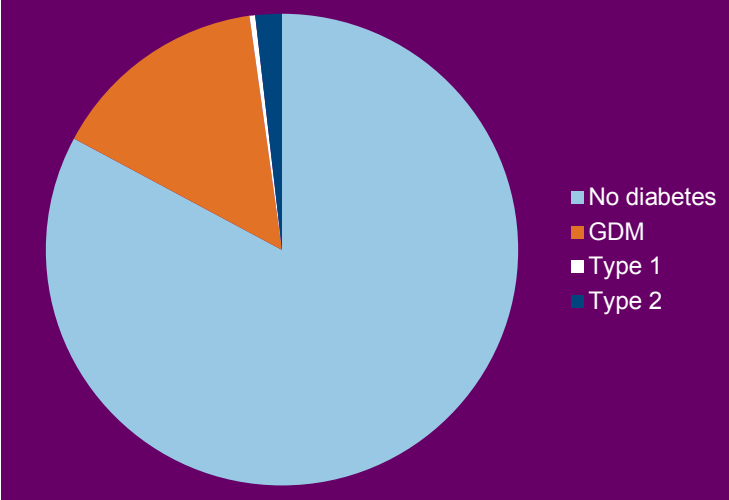
Gestational Diabetes (GDM)



- Incidence of GDM is 2-15% of all pregnancies depending on the ethnic population
- Represents approximately 90% of diabetes in pregnancy
- Postprandial hyperglycemia
 - May be treated with diet and exercise
 - About half will also need the addition of medication
- Fasting hyperglycemia
 - Requires medication therapy
 - Greater risk for stillbirth when FBG >95mg/dL

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Rates of Diabetes in Pregnancy



■ No diabetes
■ GDM
■ Type 1
■ Type 2

Data from Lawrence, 2008 – So.CA Kaiser Database

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Definitions

- **Type 1 Diabetes Mellitus/DM1/T1DM**
 - Used to be called:
 - Juvenile diabetes
 - IDDM: Insulin Dependent Diabetes Mellitus
- **Type 2 Diabetes Mellitus/DM2/T2DM**
 - Used to be called:
 - NIDDM: Non Insulin Dependent Diabetes Mellitus
- **GDM A-1/Gestational Diabetes-Diet Controlled**
- **GDM A-2/Gestational Diabetes-On Medication(s)**

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Similarities

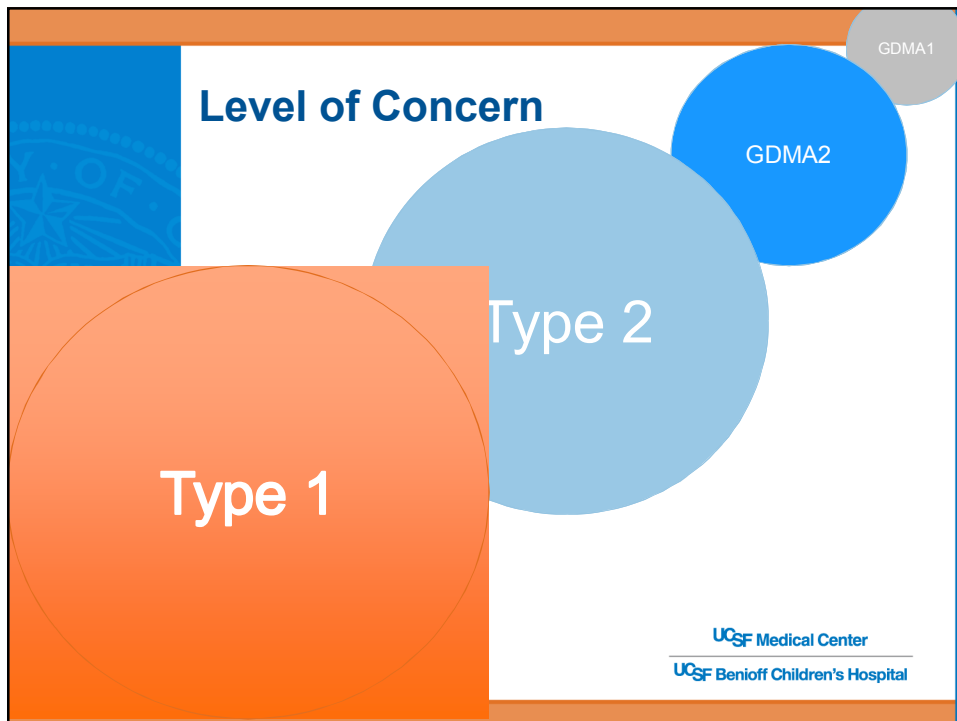
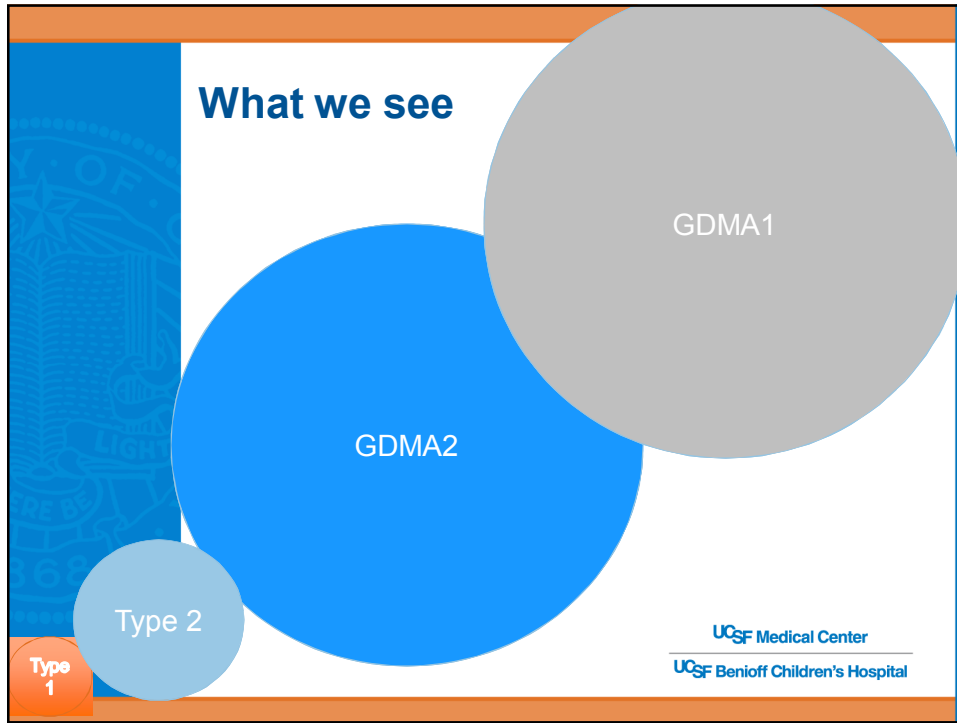
Type 1


GDMA1


GDMA2

Type 2

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CHANGES IN NORMAL PREGNANCY

Picture from
wikicommons:
Petteri Sulonen

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Changes in Normal Pregnancy

As pregnancy progresses

- **Human placental lactogen & progesterone:**
 - Decreased gastric motility
 - Reduced insulin receptor sensitivity/increased insulin resistance
- **Decreased tolerance to glucose**
- **Increased hepatic glucose production**
- **Insulin secretion increases to compensate**
- **Insulin production doubles by the 3rd trimester**

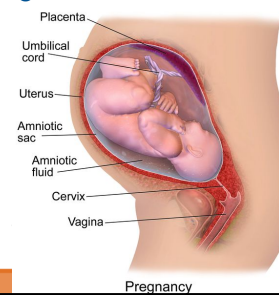


Brown,
2014;
image from
Creative
Commons

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Characteristics of Pregnancy

- **Mild fasting hypoglycemia**
- **Progressive insulin resistance**
- **Hyperinsulinemia**
- **Mild postprandial hyperglycemia**
 - Serves to increase the amount of time of elevated maternal glucose level
 - Increases the flux of maternal ingested nutrients to the fetus



Picture from
wikicommons:
Bruce Blaus

Effect of Pregnancy: Type 1 Diabetes

- **Glucose control often becomes erratic**
- **Insulin requirements can also be erratic**
- **Fetal organogenesis: first 7-8 weeks of gestation critical to have euglycemia**
 - Hyperglycemia is teratogenic
- **Potential acceleration of maternal disease including progression of diabetic retinopathy**
- **Preconception counseling is ideal!**

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Effects on Type 1, continued

- **Insulin requirements in pregnancy**
 - Increase weeks 0-9
 - Decline weeks 9-16
 - Increase to double or triple preconception values weeks 16-36
 - Plateau or start to decline weeks 36-40

Brown,
2014

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Effect of Pregnancy: Type 2 Diabetes

- **Blood glucose control less erratic than in Type 1**
- **Insulin requirement may increase significantly to counteract insulin resistance (i.e. they need a lot more insulin than Type 1)**
- **Potential for fetal defects related to extent of disease and degree of hyperglycemia during first 7-8 weeks of pregnancy**
- **Potential acceleration of maternal disease**
- **Preconception counseling is ideal!**

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Effects on Type 2, continued

- **Women with baseline insulin resistance outside of pregnancy have varying levels of carbohydrate intolerance from the inadequacy of hyperinsulinemia when combined with the pregnancy induced plus underlying insulin resistance**

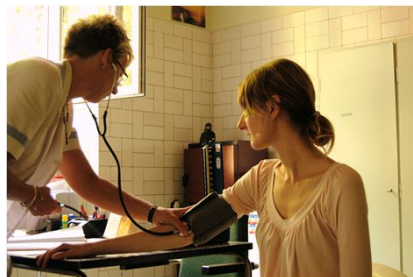
Brown,
2014

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Women with diabetes have

- **Higher incidence of gestational hypertension**
- **Higher incidence of preeclampsia**



Brown,
2014;
Image from
Wikicommons:
KrisD

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A review of why...

Glucose Crosses the Placenta, Insulin Does NOT

- Maternal hyperglycemia —————>
- Fetal hyperglycemia —————>
- Increased fetal insulin production

- Umbilical cord is cut —————>
- Maternal glucose supply stops abruptly —————>
- Neonatal insulin production does not

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Picture from
wikicommons

WHEN & HOW TO DELIVER

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Timing of Birth

- Diabetes—pre-gestational well controlled
 - Late preterm/early term birth not recommended
- Diabetes—pre-gestational with vascular disease
 - 37–39 wk
- Diabetes—pre-gestational, poorly controlled
 - 34–39 wk (individualized to situation)
- Diabetes—gestational well controlled on diet
 - Late preterm/early term birth not recommended
- Diabetes—gestational well controlled on medication
 - Late preterm/early term birth not recommended
- Diabetes—gestational poorly controlled on medication
 - 34–39 wk (individualized)

Spong,
2011

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Timing of Birth – Pre-gestational

- **Used to be recommended to achieve delivery 4-6 weeks early as late-stage fetal death was more common in women with diabetes**
 - At one time, 50% of stillbirths occurred after 38th week of gestation
- **Iatrogenic prematurity has resulted in high rates of NICU admissions to infants of Type 1 diabetics**
- **With tight glucose control, routine pre-term birth is not indicated**

Brown,
2014;
Maresh,
2010

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Timing of Birth – Pre-gestational, cont.

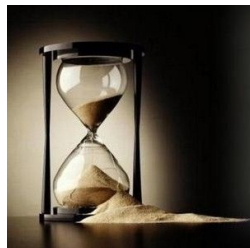
- **Optimal timing relies on balancing the risk of stillbirth with risks of preterm birth**
- **Maternal & fetal factors that may necessitate preterm birth:**
 - Progression of maternal complications: retinopathy, renal impairment, hypertension, neuropathy, prior stillbirth
 - Fetal growth restriction or compromise
 - Poor maternal glycemic control: maternal hyperglycemia can lead to fetal acidemia and higher risk of IUFD
 - ACOG recommends amniocentesis for lung maturity in poorly controlled patients being delivered before 39 weeks

ACOG,
2005;
Maresh,
2010

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Timing of Birth - GDM

- **GDM who achieved adequate glucose control without medication can be managed similar to non-diabetic women**
- **GDM requiring medications or with coexisting medical conditions**
 - Birth by 39-40 weeks



Brown,
2014;
Image from
wikicommons:
Haplo

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Timing of Birth - GDM

- **Not well studied**
- **Spontaneous labor preferred**
- **In GDM A-1 (well controlled with diet and exercise)**
 - Induction by 41+0
- **In GDM A-2 (use of insulin or oral hypoglycemics)**
 - Induction at 39+0
- **Suboptimal glucose control or coexisting medical condition**
 - Induction at 38+0 with documented fetal lung maturity

Caughey,
2013

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Mode of Delivery

- **Diabetes is not an independent contraindication to VBAC**
- **Diabetes is not an independent indication cesarean birth**
- **C/S rates in parts of the world at 50% for women with diabetes**
- **C/S may be considered when EFW \geq 4500 grams with maternal diabetes**
 - 3rd trimester ultrasound have 16-20% +/- variability
 - U/S EFW \geq 4800 g is associated with approx. 50% chance of a birth weight \geq 4500 g

ACOG,
2009;
Brown,
2014;
Caughey,
2013;
Maresh,
2010

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Betamethasone

- Use of corticosteroids should not be withheld due to diagnosis of diabetes
- If BMZ needed due to immature fetal lungs, intensified monitoring indicated as insulin needs increase drastically:
 - GDM A-1 may need insulin
 - GDM A-2, type 1 or type 2 will need markedly more insulin
- If the goal is BMZ then IOL, attempt euglycemia prior to induction to minimize the amount of maternal/fetal hyperglycemia and fetal insulin production

McLaughlin, 2010; Metzger, 2007; NICE, 2008

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Betamethasone, continued

- SQ doses will need to be increased:
 - Day 0: 6-10 hr after 1st dose, increase insulin by 30%
 - Day 1: all insulin doses increase by 50% from baseline
 - Day 2: all insulin doses are doubled from baseline
 - Day 3: if needed, insulin increases by 20-30%
 - Day 4: if needed, insulin increases by 10-20%
 - Day 5-7: insulin is gradually decreased to pre-steroid levels

McLaughlin, 2010; NICE, 2008

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Betamethasone, continued

- **Alternate:**
 - Keep insulin SQ basal doses as they were
 - 6-10 hours after 1st dose, add insulin drip algorithm without any maintenance dextrose infusion *if the patient is eating
- **If a patient is on an insulin drip, this augments or replaces basal insulin, rapid acting insulin must be given for carbohydrate coverage**

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MEDICATIONS



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Oral Hypoglycemics

- Metformin & Glyburide most common
- Metformin has a higher failure rate and crosses the placenta at maternal concentration levels with no outcome studies on fetal exposure
- Glyburide has worse neonatal outcomes (rarely used anymore)
- Treatment with insulin may provide better control
- Often reserved for patients noncompliant with injections

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Treatment of GDM – Oral Agents

- Glyburide (sulfonylurea) – Increases insulin release from beta cells in pancreas
- Metformin (biguanide) – Increases insulin sensitivity, decreases gluconeogenesis

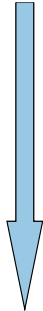
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Action of Insulin

- Facilitates the conversion of glucose to fat in adipose tissue
- Speeds the conversion of glucose to glycogen in the liver
- Speeds the oxidation of glucose in the cells of peripheral tissue (i.e., muscle, fat)
- **Guideline:**
 - 1 unit of insulin disposes of about 5-10 g of CHO when administered premeal in a normoglycemic state
 - 1 unit of insulin will decrease BG levels 15-30 mg/dl

Insulin Action Times

Type	Onset	Peak	Duration	Fast
Lispro (Humalog)	15-30 min	30-90 min	3 - 5 hr	
Aspart (Novolog)	10-20 min	40-50 min	3 - 5 hr	
Regular (Humalin) (Novolin)	30-60 min	2-5 hr	5 - 8 hr	
NPH	1-2 hr	4-12 hr	18-24 hr	
Glargine (Lantus)	1-1.5 hr	mild	20-24	
Detemir (Levemir)	1-2 hr	mild	up to 24	

Commonly Used Insulins

Insulin	Reasons given
Lispro (Humalog); Aspart (Novolog)	Used to cover CHO and high BG corrections
Regular (Novolin; Humulin) rarely recommended SQ	Used in insulin drips
NPH	Used to cover basal needs; if given in AM, may cover lunch CHO
Glargine (Lantus) Detemir (Levemir)	Used to cover basal needs

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Insulin

- Long acting – Glargine (Lantus), Detemir (Levemir)
- Intermediate – NPH (Humalin)
- Short acting – Lispro (Humalog), Aspart (Novolog)



Be Careful!



Think about:

Drug
Brand
Concentration

“U100”- 100 units/ml vs U200 vs U300 vs U500)

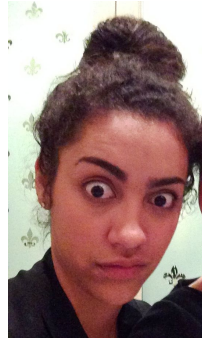
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SQ Insulin Injection

- **All insulin injections should be in the abdomen with < 40-50 units per injection to enhance effectiveness**
 - Divide injections if patient taking > 50 units for any one shot
- **Arms may be acceptable as a last choice for patients who won't inject into the abdomen**
- **Avoid legs**

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What about the PUMP!?!



- Insulin pumps most commonly utilized by type 1 diabetics
- Usually more knowledgeable in features than other pump wearers
- Have been used safely during hospital stays

Photo used with permission

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SQ Insulin Pump

- Animas and Minimed are the most common

Animas



t:slim



Minimed



Omnipod



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Parts of a (Minimed) Pump

The pump delivers tiny amounts of insulin each hour.

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Images from Medtronic Minimed, 2010

SQ Insulin Pump

- **Insulin can be delivered in a pattern that more closely mimics physiologic insulin secretion**
- **Only rapid acting insulin should be used**
 - Aspart (Novolog)
 - Lispro (Humalog)
 - Glulisine (Apidra)
 -rarely Regular, not ideal
- **Replaces the need for any long acting insulin (NPH, Lantus, etc.) through basal rate settings**

ACOG, 2005

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SQ Insulin Pump

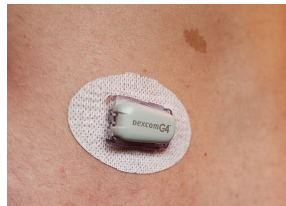
- **Basal rates (around 50-60% total daily dose)**
 - Programmed in 30-60 min increments
 - Usually several different settings/day
- **Blood glucose targets**
 - Can be different at different times of day
- **Corrections**
 - Add or subtract insulin based on sensitivity and current BG level
- **Carbohydrate coverage**
 - How many units/grams of carbohydrate
 - Can be different at different times of day

ACOG, 2005

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Continuous Glucose Monitor (CGM)

Dexcom



Minimed

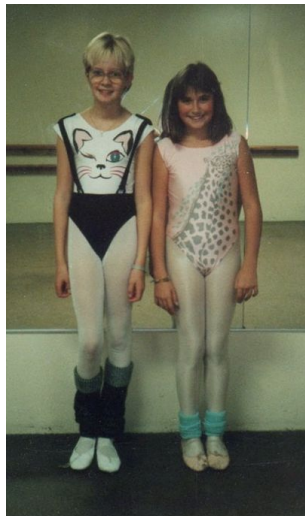


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Continuous Glucose Monitor (CGM)

- Take readings every 1-5 minutes
- Provide visual trends of blood glucose levels
- Must be calibrated with finger stick BGs
- Usually about 15 minutes behind
- Must use finger stick BG value to give insulin
 - These aren't really used inpatient

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INTRAPARTUM MANAGEMENT

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Goals of Intrapartum Management

Euglycemia

- Blood glucose levels of less than 110 mg/dL to prevent fetal hyperglycemia and fetal hypoxia
- Blood glucose levels of greater than 70 mg/dL to prevent maternal hypoglycemia
- Targets based on pre-gestational diabetes as no ideal targets for GDM during labor have been established

ACOG,
2005;
Metzger,
2007

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Managing Glucose Levels in Labor

- Not well studied in GDM
- GDM A-1 will rarely need insulin
- GDM A-2 might not need insulin
- Type 1 & 2 will need insulin
- Insulin needs often decrease in labor
- Uterine contractions and maternal pushing efforts burn energy
- Caloric intake is often decreased

Caughey,
2013;
Jovanovic,
2009

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ACOG BG Targets

- Fasting glucose ≤ 95 mg/dl
- 1 hour post-prandial <130-140 mg/dl
- 2 hour post-prandial ≤ 120 mg/dl
- Active labor <110 mg/dL



ACOG, 2005
& 2001;
Image from
wikicommons:
BruceBlaus

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Hemoglobin A_{1c} glycohemoglobin

- Hemoglobin A1c: target < 6
 - Normal (non-diabetic): 4.5-5.5
 - Diabetic target (non-pregnant): 7



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A1c to Glucose

Hemoglobin A1c value correlates to the estimated average glucose level

A1C%	eAG _{mg/dL}
5	97
5.5	111
6	126
6.5	140
7	154
7.5	169
8	183
8.5	197
9	212
9.5	226
10	240
10.5	255
11	269
11.5	283
12	298

From American Diabetes Association

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EARLY LABOR INDUCTION OF LABOR

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Early Labor or Induction of Labor

- **Continue to achieve pre-labor BG goals**
- **GDM A-1**
 - Capillary blood glucose testing:
 - Fasting, post-prandial
 - Continue carbohydrate controlled diet
- **GDM A-2**
 - Capillary blood glucose testing:
 - Fasting, post-prandial, additional times PRN
 - Continue carbohydrate controlled diet w/ short acting insulin for meal coverage if needed
 - Long acting insulin or oral hypoglycemics “dose by dose”

Maresh,
2010;
McLaughlin,
2010

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Early Labor or Induction of Labor, cont

- **Continue to achieve pre-labor BG goals**
- **Type 1 and 2**
 - Capillary blood glucose testing:
 - Fasting, pre-prandial, post-prandial, bedtime, overnight, PRN
 - Continue carbohydrate controlled diet w/ short acting insulin for meal coverage if needed
 - Long acting insulin “dose by dose”

Maresh,
2010;
McLaughlin,
2010

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ACTIVE LABOR

Picture from wikicommons: William Smellie

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Managing Glucose in Active Labor

- **GDM A-1**
 - Capillary blood glucose testing Q 2-4 hr
 - Consider insulin if consistently > 110-120 mg/dL
 - Avoid dextrose IV fluids unless on insulin drip
 - Diet or non-caloric clear liquids
- **GDM A-2**
 - Capillary blood glucose testing Q 1-2 hr
 - Stop long/intermediate acting insulin
 - Insulin drip if > 110-120 mg/dL
 - Avoid dextrose containing IV fluids until insulin drip
 - Give rapid acting as meal coverage and diet or non-caloric clear liquids when not

Caughey, 2013;
Jovanovic, 2009

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Type 1 and 2 - Active labor

- Capillary blood glucose testing Q 1-2 hr
- Stop long/intermediate acting insulin
- Initiate insulin drip (or insulin algorithm)
- Give rapid acting as meal coverage if eating
- Diet or non-caloric clear liquids when not

Jovanovic,
2009;
McLaughlin,
2010;

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Insulin Use in Active Labor

- **Staff familiarity is the safest**
- **No demonstrated superior model or algorithm**
 - Insulin/glucose combined infusion with supplemental insulin doses
 - Insulin IV with glucose as needed
 - SQ doses of rapid acting insulin
 - Insulin pump
- **Avoid boluses of glucose**
 - Increases risk of neonatal hypoglycemia, fetal hypoxia, fetal/neonatal acidosis

ACOG, 2006;
Langer, 2006;
McLaughlin,
2010; Ryan,
2012

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Insulin Use in Active Labor, continued

- **Can be given SQ**
 - Injections
 - Continuous subcutaneous insulin infusion pump
- **Often given IV**
 - Fixed infusion: 10 units Regular insulin in 1000 mL 5% dextrose at 100-125 mL/hr (1 unit/hr)
 - Tiered infusion: fixed rate of insulin based on hourly capillary blood glucose levels
 - Titrated infusion: insulin rate titrated up or down based on hourly blood glucose levels

Langer, 2006; McLaughlin, 2010; Ryan, 2012

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Tiered (Fixed) Infusion: currently in use at UCSF

- **Fluid Orders**
 - For Type 1 and Type 2:
 - When BG \geq 130 mg/dL – LR at 125 mL/hr
 - When BG < 130 mg/dL – D₅LR at 125 mL/hr
 - For GDM A-2
 - LR at 125 mL/hr until IV Insulin required then
 - When BG \geq 130 mg/dL – LR at 125 mL/hr
 - When BG < 130 mg/dL – D₅LR at 125 mL/hr

Blood glucose (mg/dL)	Type 1 Insulin (units/hour)	GDM Insulin (units/hour)	Type 2 Insulin (units/hour)	Custom Insulin (units/hour)
< 70	0	0	0	
71-90	0.5	0	0	
91-110	1	0	1	
111-130	1.5	1	2	
131-150	2	2	3	
151-170	2.5	3	4	
171-190	3	4	5	
>190	Call MD, check urine ketones	Call MD, check urine ketones	Call MD, check urine ketones	

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Titration Infusion: adapted from Ryan, et al. 2012

- **D₁₀ at 80 mL/hr with 10 mEq KCl**
- **IV Insulin 50 units Regular in 500 mL NaCl (1 unit/10 mL)**
 - Start infusion at 1 unit/hr unless glucose \leq 72 mg/dL
 - If glucose \leq 72 mg/dL, start D₁₀ and hold insulin
- **Adjustments – If glucose is:**
 - \leq 54 mg/dL, stop insulin x 1 hr, increase D₁₀ to 100 mL/hr
 - 55-64 mg/dL, decrease insulin by 1 unit/hr, increase D₁₀ to 75 mL/hr
 - 65-73 mg/dL, decrease insulin by 0.5 units/hr
 - 74-108 mg/dL, leave insulin at current rate
 - 109-126 mg/dL, increase insulin by 0.5 units/hr
 - 127-153 mg/dL, increase insulin by 1 unit/hr
 - 154-180 mg/dL, increase insulin by 1.5 units/hr
 - 181-216 mg/dL, increase insulin by 2 units/hr
 - $>$ 216 mg/dL, increase insulin by 2 units/hr, stop D₁₀ for 1 hr
- **If glucose falls by $>$ 35 mg/dL in 1 hr and is now:**
 - \geq 91, decrease insulin to 1 unit/hr
 - \leq 90, stop insulin infusion
- **Anytime insulin is stopped and glucose is $>$ 81 mg/dL, restart insulin at 0.5 units/hr**

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Labor Conversion from an Insulin Pump to Insulin Drip

- May need to happen before “active”
- Work with the patient regarding relinquishing control of pump
- Downside: hourly BG measurements
- Upside: she can focus on labor instead of on diabetes

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Monitoring for Hyperglycemia

- Check CBG every hour and follow algorithm to maintain normal glucose levels
- Check ketones when CBG >190mg/dL
- Notify provider when CBG outside of range
- Modify insulin algorithm as needed to achieve euglycemia

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Signs & Symptoms of Hypoglycemia

- Mental confusion /"Distant"
- Cold, clammy skin
- Shaking
- Sweating
- Light-headedness
- Pallor
- Numbness of tongue or lips



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CESAREAN SECTION MANAGEMENT

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Insulin Before Scheduled C/S

- **GDM A-1**
 - Fasting blood glucose
- **GDM A-2**
 - Take regular doses of insulin or oral hypoglycemics the day/night before surgery
 - No medications the morning of surgery
 - Glucose checks q 1-2 hours
 - Avoid dextrose containing IV fluids
 - Insulin management if > 110-140 mg/dL
 - Euglycemia will promote maternal wound healing

Jovanovic,
2009

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Insulin Before Scheduled C/S, cont.

- **Type 1 and 2**
 - Take regular doses of insulin the day and night before surgery
 - Should be first OR case
 - No medications the morning of surgery
 - Glucose check on arrival to unit and start active labor insulin algorithm (IV or SQ regimen)
 - Consider postpartum insulin drip to maximize euglycemia to promote wound healing

McLaughlin,
2010

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POSTPARTUM

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Postpartum Care

- **Insulin sensitivity increases dramatically after delivery of placenta**
 - Insulin requirements drop markedly during birth and immediate postpartum period
 - During first few days to 2 weeks postpartum, can drop to less than pre-pregnancy levels with variable return to baseline
 - Aggressive glucose control should be relaxed to avoid significant hypoglycemia
- **Most women will revert back to pre-pregnancy glycemic levels**

Brown, 2014; Caughey, 2013; McLaughlin, 2010; Ryan, 2012

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Postpartum Care, continued

- **Glucose testing should be continued**
- **Resume regular diet**
 - Consistent with what they normally eat
 - Carbohydrate controlled vs. unrestricted
 - Want to see how glucose levels respond to what they will be eating when discharged

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Frequency of Blood Glucose Testing

- **No formal recommendations or studies about how long nor how often blood glucose testing should continue postpartum for GDM**
- **Consider individualizing based on:**
 - Controlled with diet and exercise vs. medications
 - Degree of insulin resistance
 - Mode of delivery
 - Type of diabetes
 - Type 1 and 2 should continue regular testing
 - GDM may only need a few checks

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Managing GDM After Vaginal Birth

GDM A-1

- **Fasting blood glucose on the day after birth**
 - Goal:
 - Fasting \leq 110 mg/dL
 - Fasting $>$ 110 mg/dL, retest next day

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Managing GDM After Vaginal Birth

GDM A-2

- **If on insulin, d/c at delivery of placenta**
- **Fasting and post-prandial x 1 on day 1 vs. continued for 24-48 hours**
 - Goal:
 - Fasting \leq 110 mg/dL
 - 2 hr post-prandial < 140 mg/dL

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Managing GDM After Cesarean Birth

- **Insulin resistance will decrease**
- **Insulin need may continue d/t stress response**
- **If on insulin drip during surgery**
 - Consider continuation until needs decrease or until tolerating POs
- **Follow recommendations as for vaginal birth**
 - May have a lower threshold to restart medications to maximize wound healing

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Managing Suspected Type 2 Postpartum

- **Persistently elevated fasting (>126 mg/dL)**
 - Continue home CBG monitoring
 - May need earlier follow up appointment
 - 2-3 weeks postpartum
 - May need to go home on oral hypoglycemic agent or insulin
 - Approximately 1/3 dose used in pregnancy

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Managing Pre-gestational Diabetes after Vaginal Birth

- **Consider reducing or stopping insulin infusion after birth**
 - Type 1: restart pre-gestational insulin regimen if known, may also use 1st trimester
 - Type 2: return to method of controlling diabetes pre-pregnancy
 - Diet and exercise
 - Oral hypoglycemic medication
 - Insulin regimen

McLaughlin,
2010

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Managing Pre-gestational Diabetes after Cesarean Birth

- **May consider continuing insulin infusion (or other aggressive management routines) to maximize wound healing**
 - Less insulin may be needed per hour
 - Revert to pre-pregnancy regimen once regular diet tolerated

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Breastfeeding

- **Strongly encouraged**
- **Same benefits as the rest of the world**
- **Importance for women with diabetes:**
 - Prevention of hypoglycemia in the newborn
 - Less risk of diabetes to mother and baby
 - Faster recovery and can help with weight loss
 - Can cause a reduction in insulin requirements



Brown,
2014;
Picture from
wikicommons:
Prodnis

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Breastfeeding – Type 1

- **Reduction of insulin requirements during breastfeeding can cause hypoglycemia**
- **Careful monitoring of glucose levels warranted**
 - May need to monitor before feedings
 - Women should be vigilant for signs of hypoglycemia and maximize newborn safety if hypoglycemia occurs
- **Insulin adjustments may be needed during initiation and during weaning**
- **Eating a snack (CHO+protein) before nursing may help to prevent**

ACOG,
2006;
Brown,
2014

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Breastfeeding and Medications



- **Insulin is excreted in human milk**
 - Naturally occurring component of maternal blood but not a risk as it's digested in the infant's gut
- **Oral hypoglycemics in breast milk**
 - Glyburide is virtually undetectable
 - Metformin is seen in too small of an amount to adversely affect the infant

Briggs,
2011

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Ernst Krause

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POSTPARTUM FOLLOW-UP CARE

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Postpartum Follow Up

- **Diet and exercise are still important**
 - Counsel to maintain nutrition information they learned during pregnancy
- **Weight loss and the achievement of healthy weight**
 - May prevent recurrence of GDM
 - May prevent or delay type 2 diagnosis
- **Breastfeed**
- **Contraception**
 - Consider avoiding progesterone only methods if of Latina or Native American descent

ACOG, 2006

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Postpartum Follow Up

- 2 week follow up visit if any insulin or oral hypoglycemics needed on hospital discharge
- 2 hour 75 gram OGTT at 6-12 weeks postpartum for all women with GDM
 - Normal: Fasting < 100 mg/dL, 2 hr < 140 mg/dL
 - Impaired Fasting Glucose: Fasting 100-125 mg/dL
 - Impaired Glucose Tolerance: 2 hr 140-199 mg/dL
 - Type 2 Diabetes: Fasting \geq 126, 2 hr \geq 200

ACOG, 2009; Jovanovic, 2009

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Postpartum Follow Up, continued

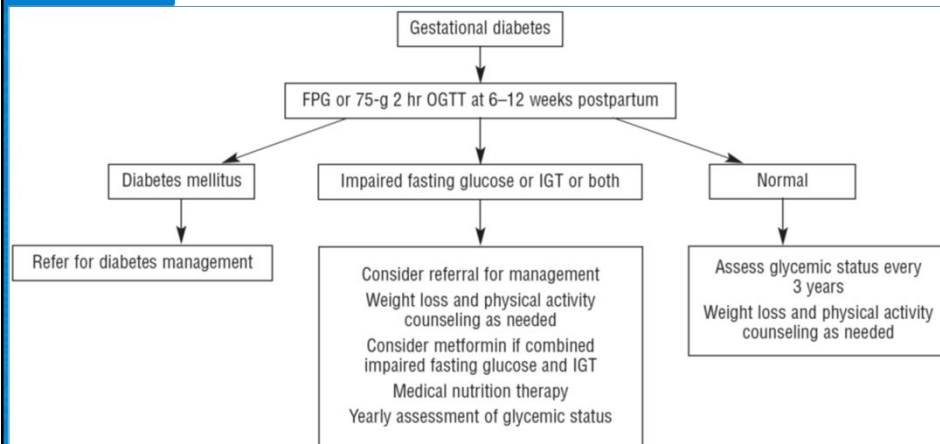


Fig. 1. Management of postpartum screening results. Abbreviations: FPG, fasting plasma glucose; OGTT, oral glucose tolerance test; IGT, impaired glucose tolerance.

From ACOG Practice Bulletin 435 (June, 2009). PP screening for abnormal glucose tolerance in women who had GDM. *Obstetrics & Gynecology*, 113(6), Figure 1, p. 1420

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Postpartum - GDM

- > 40% of women with GDM will develop type 2 diabetes within 10 years
- Low postpartum screening rates (most studies < 50%)

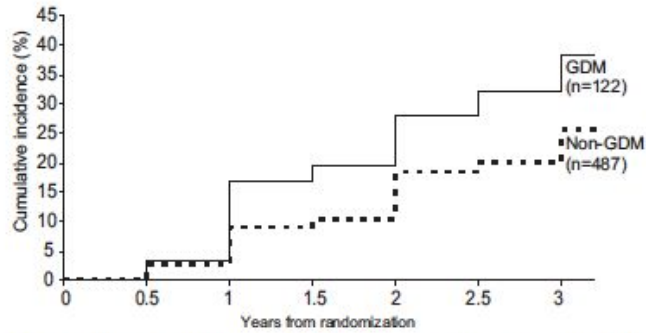
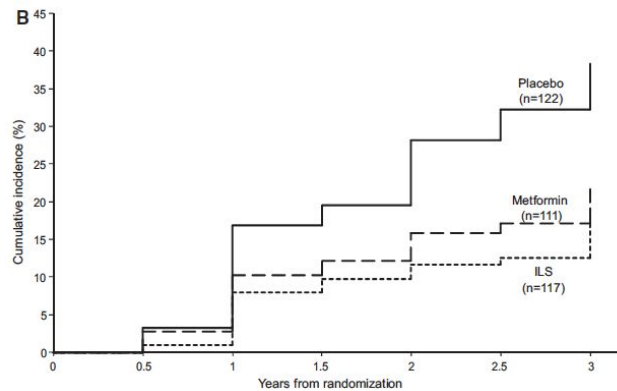


FIG. 2. Cumulative incidence of diabetes mellitus among the placebo group by history of GDM.

Brown, 2014;
Ratner, 2008;
Image from
Ratner et al. J
Clin
Endocrinol
Metab
2008;93:4774

Postpartum - GDM

Cumulative incidence of diabetes in the Diabetes Prevention Program by randomized treatment group in women with a history of GDM:



Intensive Lifestyle: 7% reduction in weight via low-calorie, low-fat diet & moderate physical activity at least 150 min/week

Ratner, 2008;
image from
Ratner et al. J
Clin
Endocrinol
Metab
2008;93:4774

Postpartum Follow Up, continued

- Only approximately 2 out of 5 women with GDM get follow up testing
- Latinas have been shown among the lowest groups to get follow up yet are among the highest risk for elevated results
- Overall outcomes from UCSF of follow up testing
 - 28% with impaired glucose tolerance
 - 2% with type 2 diabetes
- When UCSF implemented nurse counseling of importance of PP screening in 3rd trimester
 - Overall compliance went from 33% to 53%

Stasenko,
2011;
Stasenko,
2010

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Conclusion

- **Maintaining euglycemia can maximize maternal, fetal and neonatal outcomes**
 - Both during pregnancy and during labor & birth
- **GDM brings a lifelong increased risk of developing type 2 diabetes of 15-50%**
 - Refrain from “curing” patients at delivery of placenta and encourage continuation of habits developed in pregnancy

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Conclusion

- **Continuing healthy living habits learned during pregnancy will benefit everyone**
 - Can prolong or prevent the onset of type 2 diabetes in a woman who had GDM
 - Can maximize long-term health outcomes for type 1 and type 2 diabetics

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Four successes from a type 1 mom!



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REFERENCES

- ACOG Practice Bulletin Number 435, (June 2009). Postpartum screening for abnormal glucose tolerance in women who had gestational diabetes mellitus. *Obstetrics and Gynecology*, 113(6), 1419-1421.
- ACOG Practice Bulletin Number 101, (February 2009). Ultrasonography in pregnancy. Accessed from ACOG online.
- ACOG Practice Bulletin Number 73 (June 2006). Use of hormonal contraception in women with coexisting medical conditions. *Obstetrics and Gynecology*, 107(6), 1453-1472.
- ACOG Practice Bulletin Number 60 (March 2005). Pre-gestational diabetes mellitus. *Obstetrics and Gynecology*, 105(3), 675-685.
- ACOG Practice Bulletin Number 40 (November 2002). Shoulder dystocia. *International Journal of Obstetrics and Gynecology*, 80, 87-92.
- ACOG Practice Bulletin Number 180 (July 2017). Gestational diabetes mellitus. *Obstetrics and Gynecology*, 130(1), e17-e31.
- Briggs, G.C., Freeman, R.K & Yaffe, S.J. (2011). *Drugs in Pregnancy and Lactation*, 9th ed. Philadelphia, PA: Lippincott, Williams & Wilkins.
- Brown, F.M. (2014). Chapter 20: pregnancy and diabetes. In Beaser, R.S. (Ed.) *Joslin's Diabetes Deskbook*, 3rd ed. Boston, MA: Joslin Diabetes Center.
- Caughey, A.B. (2013). Obstetrical management of pregnancies complicated by gestational diabetes mellitus. In: *UpToDate*, Greene, M.F. & Barss, V.A. (Eds.). Waltham, MA: UpToDate.

REFERENCES

- Jovanovic, L. (Ed.). (2009). *Medical Management of Pregnancy Complicated by Diabetes*, 4th ed. Alexandria, VA: American Diabetes Association.
- Kjos, S.L. (2013). Intrapartum and postpartum management of insulin and blood glucose. In: *UpToDate*, Greene, M.F., Nathan, D.M. & Barss, V.A. (Eds.). Waltham, MA: UpToDate.
- Lawrence, J.M., Contreras, R., Chen, W. & Sacks, D.A. (2008). Trends in the prevalence of preexisting diabetes and gestational diabetes mellitus among a racially/ethnically diverse population of pregnant women, 1999-2005. *Diabetes Care*, 31(5), 899-904.
- Maresh, M. (2010). Chapter 20: Obstetric management of labor, delivery, and the postnatal period. In McCance, D.R., Maresh, M. & Sacks, D.A. (Eds.). *A practical manual of diabetes in pregnancy* (pp. 199-210). Hoboken, NJ: Wiley-Blackwell.
- McLaughlin, C. & McCance, D.R. (2010). Chapter 21: Diabetic management in labor, delivery, and post delivery. In McCance, D.R., Maresh, M. & Sacks, D.A. (Eds.). *A practical manual of diabetes in pregnancy* (pp. 211-219). Hoboken, NJ: Wiley-Blackwell.
- Medtronic Minimed, Inc. (2010). *The Basics of Insulin Pump Therapy*. Medtronic Diabetes: Northridge, CA.
- Metzger, B.E., Buchanan, T.A., Coustan, D.R., DeLeiva, A., Dunger, D.B., Hadden, D.R., et al. (2007). Summary and recommendations of the Fifth International Workshop-Conference on Gestational Diabetes Mellitus. *Diabetes Care*, 30(2), S251-S260.

REFERENCES.

- National Institute for Clinical Excellence (2008). *Diabetes in pregnancy: management of diabetes and its complications from pre-conception to the postnatal period*. London: NICE. Retrieved from: www.nice.org.uk/CG063
- Ratner, R. E. et al., Diabetes Prevention Program Research Group (2008). Prevention of diabetes in women with a history of gestational diabetes: effects of metformin and lifestyle interventions. *Journal of Clinical Endocrinology and Metabolism*, 93(12), 4774-4779.
- Ryan, E.A., Sia, W.W., Khurana, R., Marnoch, C.A., Nerenberg, K.A. & Ghosh, M. (2012). Glucose control during labor in diabetic women. *Journal of Obstetrics and Gynaecology Canada*, 34(12), 1149-1157.
- Spong, C.Y., Mercer, B.M., D'Alton, M., Kilpatrick, S., Blackwell, S. & Saade, G. (2011). Timing of indicated late-preterm and early-term birth. *Obstetrics and Gynecology*, 118(2), 323-333.
- Stasenko, M., Cheng, Y.W., McLean, T., Jelin, A.C., Rand, L. & Caughey, A.B. (2010). Postpartum follow-up for women with gestational diabetes mellitus. *American Journal of Perinatology*, 27(9), 737-742.
- Stasenko, M., Liddell, J., Cheng, Y.W., Sparks, T.N., Killion, M. & Caughey, A.B. (2011). Patient counseling increases postpartum follow-up in women with gestational diabetes mellitus. *Obstetrics and Gynecology*, 204: 522.e1-6.
- Xenakis, E. (2006). Management of labor: augmentation, induction and glucose control. In Langer, O. (Ed.). *The diabetes in pregnancy dilemma: leading change with proven solutions* (pp. 681-689). Lanham, MD: University Press of America, Inc.