Gestational Diabetes – from Pregnancy to Beyond

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Presentation Objectives:

By the end of the presentation, the learner will:

- Define the prevalence of GDM based on screening strategy utilized
- Apply knowledge of possible fetal/maternal outcomes of GDM to clinical management
- Discuss management principles of GDM in pregnancy
- Adapt knowledge of GDM maternal/fetal outcomes to interconception care of women with prior GDM

Eisner Health - Women's Health Center

- Collaborative practice (CNMs, MDs) in DTLA
- Full-scope (low to high risk) care in a Federally Qualified Health Center and two nearby hospitals
  - Approximately 200 pregnant women with diabetes seen prenatally and delivered each year
  - 4 CNMs with MFM/OB residents provide care in SCC (Special Care Clinic)
  - CNMs hold ICC (Interconception Clinic)
  - Centering and individual care

DM Definitions & Prevalence

Gestational diabetes mellitus (AKA) gestational diabetes (GDM, GD) is carbohydrate intolerance that **develops during pregnancy**

- A1GDM - GDM adequately controlled with diet/exercise
- A2GDM – GDM requiring medication for euglycemia

Vs.

Type 1 DM - autoimmune process that destroys pancreatic B cells – requires insulin

Type 2 DM - insulin resistance; obesity – Rx variable

In 2009, 7% of pregnancies complicated by any type of diabetes

- 86% of those cases were GDM
- 50-70% of women with GDM will have T2DM later in life

Who is most likely to develop GDM?

GDM Prevalence by Age and Ethnicity

Maternal characteristics	GDM $n = 3{,}108{,}877$		Prevalence ratio (PR)	
	n	%	PR	95% CL
Age (years)				
<20	339,898	1.25	1.00	–
20–24	808,437	2.30	1.85	1.78, 1.90
25–29	854,036	3.70	2.97	2.87, 3.05
30–34	683,482	5.19	4.16	4.01, 4.27
35–39	346,423	6.80	5.45	5.27, 5.62
≥40	76,601	8.73	7.00	6.71, 7.23
Race				
White non-Hispanic	1,873,925	3.82	1.00	–
Black non-Hispanic	394,081	3.54	0.93	0.91, 0.94
Hispanic	677,392	3.63	0.95	0.94, 0.96
American Indian/Alaskan Native	14,617	5.13	1.34	1.25, 1.44
Asian/Pacific Islander, total	148,862	6.28	1.64	1.61, 1.68
Japanese	5326	3.45	0.91	0.79, 1.04
Asian Indian	32,460	8.03	2.10	2.03, 2.18
Chinese	25,530	6.44	1.69	1.61, 1.77
Filipino	25,785	6.90	1.81	1.73, 1.89
Korean	11,561	3.90	1.02	0.93, 1.12
Vietnamese	21,721	6.14	1.61	1.53, 1.70
Other Asian	20,718	5.07	1.33	1.25, 1.41
Pacific Islander	5761	5.17	1.36	1.21, 1.51

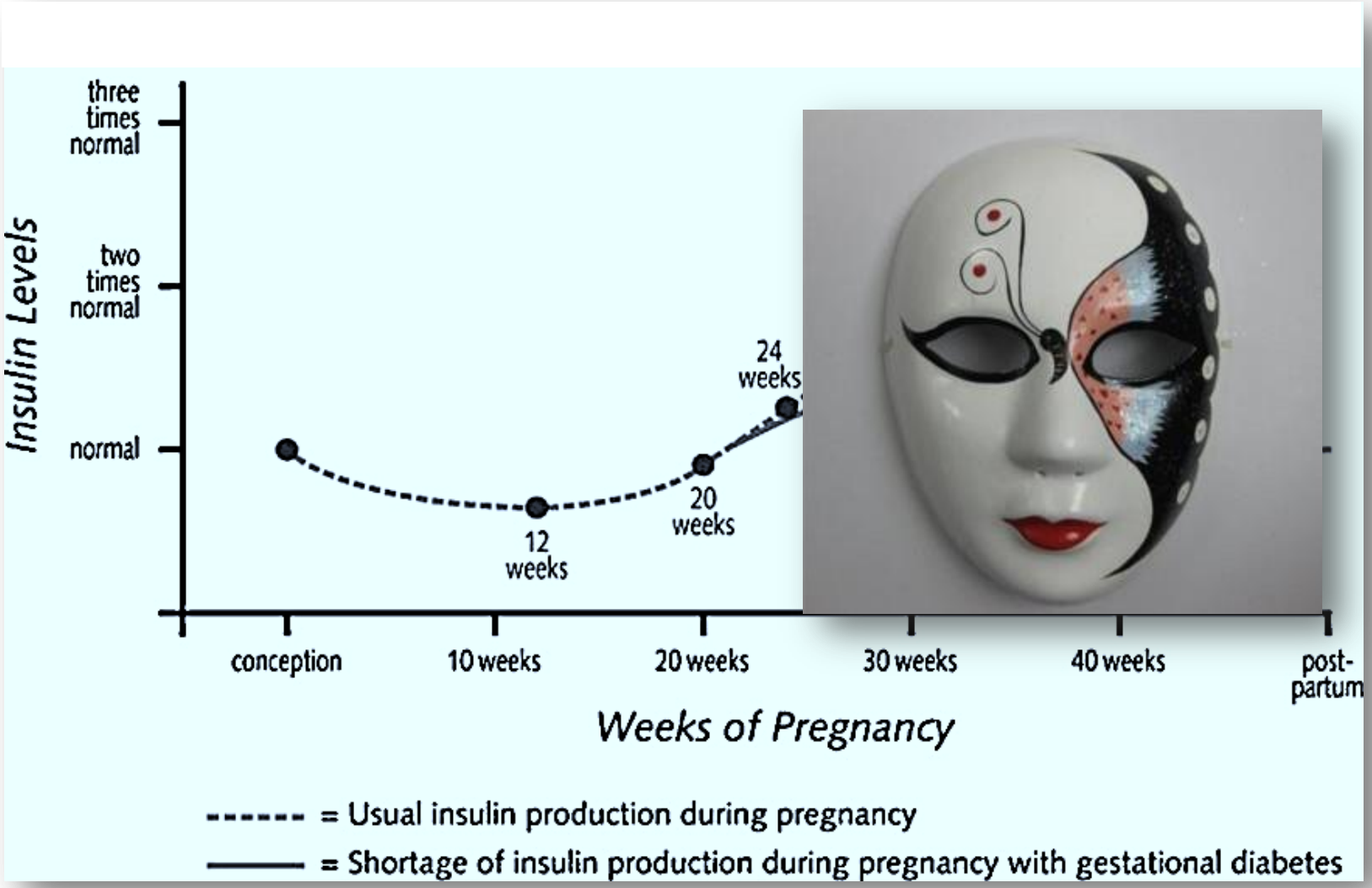
Chu SY, Abe K, Hall LR, Kim SY, Njoroge T, Qin C. *Preventive Medicine.* 2009;49(2-3):265-268.

GDM and Asian Pacific Island Women

- **So…In this study, GDM rates** were higher among API mothers than among AA, NHW or Hispanic mothers
- Women of API ethnicity:
  - Have a higher percentage of body fat than NHW women with the same BMI
  - Greater tendency to accumulate central body fat
    - Excess visceral adipose tissue is a risk factor for impaired glucose tolerance and type 2 diabetes
  - Develop insulin resistance in pregnancy at a lower BMI

Chu, et al, 2009

Insulin Requirements: Pregnancy vs. GDM Pregnancy



Source: Gestational Diabetes BASICS © 2010 International Diabetes Center at Park Nicollet

Influence of DM on Perinatal Outcomes

Pre-existing DM (esp. T2DM)

- Early exposure to hyperglycemia causes ↑perinatal mortality D/T
  - Congenital malformations
  - Spontaneous abortions
- Preeclampsia
- Increased CD
- Offspring risks
  - Macrosomia
  - Neonatal hypoglycemia
  - Shoulder dystocia
  - Birth trauma
  - Stillbirth

Gestational DM

- Later exposure to persistent hyperglycemia
  - Congenital malformations (2-3%)
  - SABs (15%) same as general OB population
- Preeclampsia
- Increased CD
- Offspring risks
  - Macrosomia
  - Neonatal hypoglycemia
  - Shoulder dystocia
  - Birth trauma
  - Stillbirth

Hyperglycemia and Adverse Pregnancy Outcome (HAPO) Study

- Performed in response to need for internationally agreed upon diagnostic criteria for gestational diabetes, based upon their predictive value for adverse pregnancy outcome (n=25,505 women in nine countries)

Research question: When maternal hyperglycemia is less severe than that in diabetes mellitus, are there increased risks of adverse pregnancy outcomes?

- Noted that increases in each of the three values on the **standard 75 gram, 2-hour oral glucose tolerance test** are associated with graded increases in the likelihood of pregnancy outcomes:
  - large for gestational age, cesarean delivery, and neonatal fat content

- International Association of Diabetes in Pregnancy Study Groups (IADPSG) suggested that the diagnosis of gestational diabetes be made when any of the following three 75 gram 2-hour OGTT thresholds are met or exceeded:
  - Fasting 92 mg/dL, one hour 180 mg/dL, two hours 153 mg/dL.
- "Various authoritative bodies around the world are expected to deliberate the adoption of these criteria"

Be M. Hyperglycemia and adverse pregnancy outcomes. *NEJM.* 2008;358(19):1991-2002.

Screening and Diagnosis of GDM
(24-28 weeks GA)

International Association of Diabetes and Pregnancy Study Groups

One Step (diagnose)

- Perform 75g oral glucose tolerance test on all women, after an overnight fast, not previously found to have overt diabetes or GDM earlier in pregnancy
- Diagnose GDM when one or more of the following plasma glucose values are exceeded:
  - Fasting ≥ 92 mg/dL (5.1 mmol/l)
  - 1-hour ≥ 180 mg/dL (10.0 mmol/l)
  - 2-hour ≥ 153 mg/dL (8.5 mmol/l)*
- Note: these values are lower than the 2 hr OGTT used in non-pregnant women to test for DM
- Results in increased diagnosis – about 18% of women with GDM

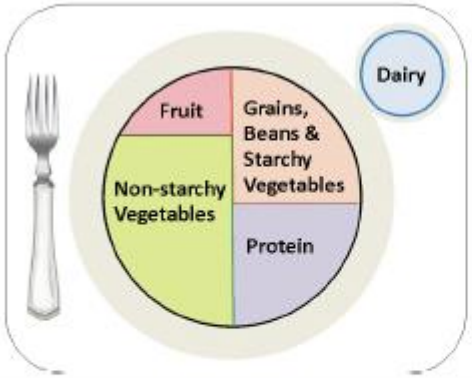
American College of Obstetricians and Gynecologists

Two Step (screen then diagnose)

- **STEP 1**: 50g oral glucose solution followed by a 1 hour venous glucose measurement:
- Values used:
  - 130 or 135 mg/dL – lower cut-off threshold –may identify women who may have GDM but also increase false positive rates
  - 140 mg/dL – higher cut-off threshold – which may limit the number of screen positive women, but may miss those with GDM
- **STEP 2**: If STEP 1 is positive, diagnostic test, 3 hour oral glucose tolerance test (OGTT) done:
  - Two threshold metrics are used; 2 or more elevated values are diagnostic; one suggests impaired glucose tolerance

Mainstay of GDM management is Diet and Physical Activity

- Dietary Adjustments (Medical Nutrition Therapy)
  - https://www.cdappsweetsuccess.org/Resources/Free-Patient-Education-Material
- Physical Activity
  - https://www.cdappsweetsuccess.org/Portals/0/2015Guidelines/6_Exercise.pdf



California MyPlate for Gestational Diabetes

When you are pregnant and have diabetes, you have special nutrition needs. Use *MyPlate for Gestational Diabetes* to help you manage your blood sugar. This will help keep you and your baby healthy. Every day, eat the number of servings/choices of food shown below. Talk to a registered dietitian (RD) to develop a meal and exercise plan that will meet <u>your</u> needs.

⚠ **Limit Your Carbohydrates.** When you have gestational diabetes, the type and amount of carbohydrates matter. Vegetables, Grains, Fruits, and Milk contain carbohydrates. Some have more and some have less. Eating too many or the wrong type of carbohydrate may raise your blood sugar. Avoid foods with added sugar or white flour, such as cookies, candy and soda.

Vegetables

Eat non-starchy vegetables.

Use fresh, frozen or low-sodium canned vegetables.

For diabetes, starchy vegetables like potatoes, sweet potatoes, yams, peas, corn & winter squash count as a Grain, <u>not</u> a Vegetable.

Daily Amount

6 or more of these choices:

- 2 cups raw leafy vegetables
- 1 cup raw vegetables
- 1/2 cup cooked vegetables

5 grams (g) carbohydrate per serving

Protein

Choose lean protein.

Avoid bacon, hot dogs & bologna.

Daily Amount

6 or more of these choices:

- 1 ounce fish, poultry, lean meat, or cheese
- 1/4 cup cottage cheese
- 1 egg
- 1 ounce nuts
- 1/2 cup tofu
- 2 Tablespoons nut butter

0 g carbohydrate per serving

Grains

For diabetes, beans & starchy vegetables count as Grains.

Eat 100% whole grains. Avoid cold breakfast cereals. Avoid instant rice, noodles & potatoes.

Daily Amount

7 of these choices:

- 1 slice whole wheat bread
- 1/2 cup potato or yam
- 1 small whole grain tortilla
- 1/2 cup cooked dried beans, non-instant cereal, corn or peas
- 1/3 cup cooked pasta, rice

15 g carbohydrate per serving

Fruits

Eat unsweetened fruits of all colors.

Do not drink fruit juice. Avoid fruit at breakfast. Limit dried fruit to 1/4 cup a day.

Daily Amount

2 of these choices:

- 1 small apple
- 17 small grapes
- 1 cup papaya
- 1/2 banana

15 g carbohydrate per serving

Milk

Choose only pasteurized plain milk or yogurt.

For diabetes, cheese is in the Protein group. Do not eat yogurt or drink milk at breakfast.

Daily Amount

3 of these choices for women

or

4 of these choices for teens:

- 1 cup 1% or fat free milk
- 1 cup soy milk with calcium
- 3/4 cup of plain yogurt

15 g carbohydrate per serving

Fats & Oils

- Use healthy plant oils like canola, safflower & olive oil for cooking.
- Read labels to avoid saturated & trans fats (hydrogenated fats).
- Avoid solid fats such as lard, shortening & butter.
- Fish has healthy fats. Eat cooked fish at two meals each week.
- Limit oils to 6 teaspoons each day.

0 g carbohydrate per serving

March 14, 2018

California

My Nutrition Plan for Gestational Diabetes

This is my plan until I meet with a registered dietitian (RD) for my personal meal and exercise plan.

EVERY day, I will:

- ☐ Eat 3 meals and 3 snacks, 2 to 3 hours apart.
- ☐ Eat my bedtime snack so that no more than 10 hours pass before I eat breakfast the next day.
- ☐ Drink plenty of fluids. I will choose caffeine-free, sugar-free beverages. I will limit coffee to 2 cups daily & not drink alcohol.
- ☐ Limit artificial sweeteners to 1 - 2 servings a day.
- ☐ Try to walk for 10 - 15 minutes after each meal, especially breakfast.

Include protein and carbohydrates at each meal and snack.
Eat at least 175 grams (g) of carbohydrates a day. For the amount of carbohydrates in one serving of food, see below:

◆ **Non-starchy Vegetables** = 5g ◆ **Protein** = 0g ◆ **Grains, Beans and Starchy Vegetables** = 15g ◆ **Fruit** = 15g ◆ **Milk** = 15g

As a sample, meals may look like this:

Breakfast

Eat 15g carbohydrates from the Grains group

Include:

- ◆ 1-2 servings Protein
- ◆ unlimited servings of non-starchy Vegetables

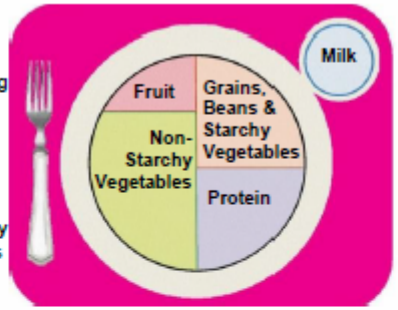
Do not eat Fruit, yogurt or drink milk.

Example of a breakfast:
One egg omelet with cheese & vegetables and one slice toast

Lunch and Dinner

0-1 serving Fruit

unlimited servings non-starchy Vegetables



0-1 serving milk or yogurt

2 servings Grains, beans or starchy vegetables

2-3 servings Protein

Eat 45g carbohydrates, not including non-starchy vegetables

- ◆ Choose only one serving fruit, milk or yogurt at lunch and at dinner

Snacks

Eat 15g-30g carbohydrates from Fruit, Grains, or Milk group

Include:

- ◆ At least 1 serving Protein with every snack
- ◆ unlimited servings of non-starchy Vegetables

Examples of snacks:

- ◆ 1 small tortilla + 1 ounce cheese
- ◆ 2 rice cakes + celery + 2 tablespoons nut butter
- ◆ 1/2 banana + 24 almonds

CDPH Sweet Success® California Diabetes and Pregnancy Program

Use *MyPlate for Gestational Diabetes* for serving sizes and the total number of servings from each group you need every day.

March 14, 2018

SELF REFLECTION

My Food and Physical Activity Diary

Date:

Meal/Time	Meal Plan # of portions	Meal Plan Food Group	My Food and Activity Yesterday	Recommendations
Breakfast Time_____ My medicine: Clear (H)_____ Cloudy (N)_____ Pill _____	_____ _____ _____ _____ _____ _____	Milk Protein Vegetable Fruit Grains (CHO) Oils/Fats	Activity: _____ for _____ min	
Snack Time_____	_____ _____ _____	Milk/Yogurt Fruit Grains (CHO)		
Lunch Time_____	_____ _____ _____ _____ _____ _____	Milk Protein Vegetable Fruit Grains (CHO) Oils/Fats	Activity: _____ for _____ min	
Snack Time_____	_____ _____	Milk/Yogurt Fruit Grains		
Dinner Time _____ My medicine: Clear (H)_____ Cloudy (N)_____ Pill _____	_____ _____ _____ _____ _____ _____	Milk Protein Vegetable Fruit Grains (CHO) Oils/Fats	Activity: _____ for _____ min	
Snack Time_____ My medicine: Cloudy (N)_____ Pill _____	_____ _____ _____	Milk/Yogurt Fruit Grains (CHO)		

Mi Diario De Comida y Ejercicio

Fecha:

Comida/Hora	Plan de Comida # de porciones — Grupo de comida	Mi Comida de Ayer	Recommendaciones
Desayuno Hora _____ Mi medicina: Clara (H)_____ Lechosa (N)_____ Pastilla _____	_____ Leche _____ Proteinas _____ Vegetal/Verdura _____ Fruta _____ Grano/Almidon _____ Aceite/Grasa	Ejercicio: _____ para _____ min	
Bocado Hora_____	_____ Leche/yogur _____ Fruta _____ Grano/Almidon		
Comida de mediodía (Almuerzo) Hora _____	_____ Leche _____ Proteinas _____ Vegetal/Verdura _____ Fruta _____ Grano/Almidon _____ Aceite/Grasa	Ejercicio: _____ para _____ min	
Bocado Hora_____	_____ Leche/yogur _____ Fruta Grano/Almidon		
Cena Hora_____ Mi medicina: Clara (H)_____ Lechosa (N)_____ Pastilla_____	_____ Leche _____ Proteinas _____ Vegetal/Verdura _____ Fruta _____ Grano/Almidon _____ Aceite/Grasa	Ejercicio: _____ para _____ min	
Bocado Hora_____ Mi medicina: Lechosa (N)_____ Pastilla_____	_____ Leche/yogur _____ Fruta _____ Grano/Almidon		

perinatology.com

Gestational Diabetes: Calculation of Caloric Requirements and Initial Insulin Dose

Recommended Caloric Intake and Weight Gain Calculator

The calculator below will estimate the BMI , recommended weight gain and energy requirement for a singleton or twin pregnancy [1,5] .To use the calculator enter the patient's age , prepregnancy weight, height, trimester , whether or not the pregnancy is a twin pregnancy ,and the mother's activity level, then press the 'calculate' button.

Input age	34
Input prepregnancy weight	200 ○ kg ◉ lbs
Input Height	54 ○ cm ◉ in
Trimester	○ First ○ Second ◉ Third
Twins?	◉ No ○ Yes

Activity level What's this? ○ Sedentary ◉ Low Active ○ Active ○ Very Active

Calculate

Pre-pregnancy body mass index (BMI) is 48.2 which is considered obese.

The desired BMI range is 18.5 to 24.9.

Desirable prepregnancy weight: 77 to 103 pounds (35 to 47 kilograms).

During this pregnancy, weight gain should between 11 and 20 pounds (5 and 9 kilograms).

At full term (40 weeks), weight should be between 211 and 220 pounds (96 and 100 kilograms).

Estimated Energy Requirement for singleton pregnancy: 2637 kcal/day.

Recommended Initial Insulin Dose Calculator for Diabetic Patient

The calculator below will estimate a simple insulin regimen using multiple daily injections of rapid-acting or regular insulin and NPH insulin [2-4] . To use the calculator enter the current weight, select the units /kg of insulin to give using the table below and press the 'calculate' button.

Weeks of Gestation	Total Daily Insulin
Week 1-17	0.7 to 0.8 U/kg actual body weight
Weeks 18-24	0.8 to 1 U/kg actual body weight
Weeks 25-32	0.9 to 1.2 U/kg actual body weight
Weeks 33-38	1.2 to 2 U/kg actual body weight

Input current weight 210 ○ kg ◉ lbs

Input insulin dose .9 **units /kg day**

Calculate

Calculated Initial Insulin Regimen

Breakfast : Rapid-acting or regular insulin 19 units SC and NPH insulin 39 units SC .

Dinner : Rapid-acting or regular insulin 14 units SC.

Hour of Sleep (HS): NPH insulin 14 units SC

Australian women's experiences of living with gestational diabetes

393 women diagnosed with GDM 3 years previously who were registered with the National Diabetes Services Scheme provided feedback on their experiences of living with GDM

Table 2
Themes described by women reflecting on their experiences with GDM.

Theme	Frequency[a] *n* (%)
Shock, fear and anxiety	35 (8.9)
Uncertainty and scepticism	37 (9.4)
An opportunity to improve one's health	38 (9.6)
Adapting to life with GDM	46 (11.6)
The need for support	68 (17.2)
Better awareness	14 (3.5)
Abandoned	59 (14.9)
Staying healthy and preventing diabetes	54 (13.7)
Information	31 (7.8)
Other	33 (8.4)

[a] Results do not tally to 100% because of multiple themes described by respondents.

Morrison MK, Lowe JM, Collins CE. Australian women's experiences of living with gestational diabetes. *Women and Birth.* 2014;27(1):52-57.

Australian women's experiences of living with gestational diabetes

Negative

- ''When told I had GDM, my level of stress and anxiety increased. I felt extra pressure and responsibility that every single thing I did (especially eating) had a huge impact on my unborn child. And I became scared about hurting her if I didn't manage to control my levels constantly. Each fluctuation of my levels scared me'' ''. . .I truly found my pregnancy, in particular the diabetes quite traumatic and I still feel the fear today''.
- ''I was pretty much yelled at rather than supported. …There was a sense that it's your fault, you're fat and at risk of diabetes!
- ''There's a lot of support while you are pregnant. No-one cares once you're not pregnant.

Positive

- ''In a way I am glad I was diagnosed with GDM – I have had to make changes to my diet and lifestyle and as a result managed to lose 16kg after my last birth, I feel and look much healthier''
- ''I found it very hard to manage by diet alone. I was much happier being on insulin''.

Management principles in pregnancy

- Adjunct Medication
  - When to start – not written in stone so…majority of BS's are elevated even though a reasonable trial of MNT and PA have been done; BS's at certain times are elevated (e.g. fasting)
  - How to choose – likelihood that will use - esp. in the case of insulin, gestational age, cultural context
  - Opinions on optimal treatment – insulin vs. oral; professional organizations; pt's personal beliefs about medication use during pregnancy (e.g. what their neighbor told them)

When it's time for insulin…

When you say…

What if she says…

¡NO, NO PUEDO

Pharmacologic Options

Agent	Pharm. Action	Safety	Notes
Insulin	Stimulates peripheral glucose uptake; inhibits hepatic glucose production	Does not cross placenta	↑ risk of hypoglycemia (though uncommon in GDM)
Glyburide	Sulfonylurea; Stimulates B-cell insulin release in pancreas	Crosses placenta – 70% of maternal levels; no LT studies of offspring exposed *en utero*	Use peaked in 2011; now oral agent least used D/T more LGA, RDS, birth injury, NICU admissions
Metformin	Oral biguanide; ↓ hepatic glucose production; ↑ glucose uptake in peripheral tissues; ↓ glucose absorption in GI	Crosses placenta – similar concentrations in fetus and mother; may lead to more favorable distribution of offspring body fat (more subcutaneous vs. intraabdominal)	Bridge between preconception to pregnancy and pp; ↓ maternal wt. gain, ↓lower GA at delivery, ↓GHTN, ↓ neonatal hypoglycemia

Rx: point/counterpoint

- Practice Bulletin No. 180: Gestational Diabetes Mellitus. *Obstetrics & Gynecology.* 2017;130(1):e17-e37.
  - Insulin is first line; but oral antidiabetic agents “increasingly are being used”
- SMFM Statement: Pharmacological treatment of gestational diabetes. *American Journal of Obstetrics & Gynecology.* 2018;218(5):B2-B4.
  - Insulin is first line; metformin can be alternate first line
- Sonne D, Hemmingsen B. Standards of Medical Care in Diabetes-2017. Diabetes Care 2017;40(Suppl. 1):S1-S135. *Diabetes Care.* 2017;40(7):E92-E93.
  - Insulin is first line

Langer O. Pharmacological treatment of gestational diabetes mellitus: point/counterpoint. *American Journal of Obstetrics and Gynecology.* 2018;218(5):490-499.

Professional guidelines for diabetes pharmacologic management in pregnancy

	ACOG	ADA	SMFM	NICE UK
Glucose targets for GDM and Pregestational DM	Fasting <95 mg/dL 1-h postprandial <140 mg/dL 2-h postprandial <120 mg/dL	Fasting <95 mg/dL 1-h postprandial <140 mg/dL 2-h postprandial <120 mg/dL	Not specified	Fasting <95 mg/dL 1-h postprandial <140 mg/dL 2-h postprandial <115 mg/dL
HbA1c targets for pregestational DM	<6%	6%–6.5%; <6% if w/o significant hypo-glycemia and <7% if necessary to prevent hypoglycemia	Not specified	If no hypoglycemia <6.5%
Drug therapy	Insulin—preferred agent for diabetes in pregnancy	Insulin—preferred agent for diabetes in pregnancy	Metformin—reasonable and safe first-line alternative to insulin	Pregestational: NPH—first choice for long acting insulin GDM: Metformin—first-line; Add insulin if blood glucose targets not met

Feghali MN, Umans JG, Catalano PM. Drugs to control diabetes during pregnancy. *Clinics in Perinatology.* 2019;46(2):257-272.

Summary of Commonly Insulins Used During Pregnancy

Type	Generic	Onset	Peak	Duration
Rapid-acting	Lispro	15 minutes	30-60 minutes	3-5 hours
	Aspart			
Short- acting	Regular	30-60 minutes	2-4 hours	5-8 hours
Intermediate	NPH	1-3 hours	8 hours	12-16 hours
Long acting	Glargine	2 hour	Peakless	20-26 hours
	Detemir			

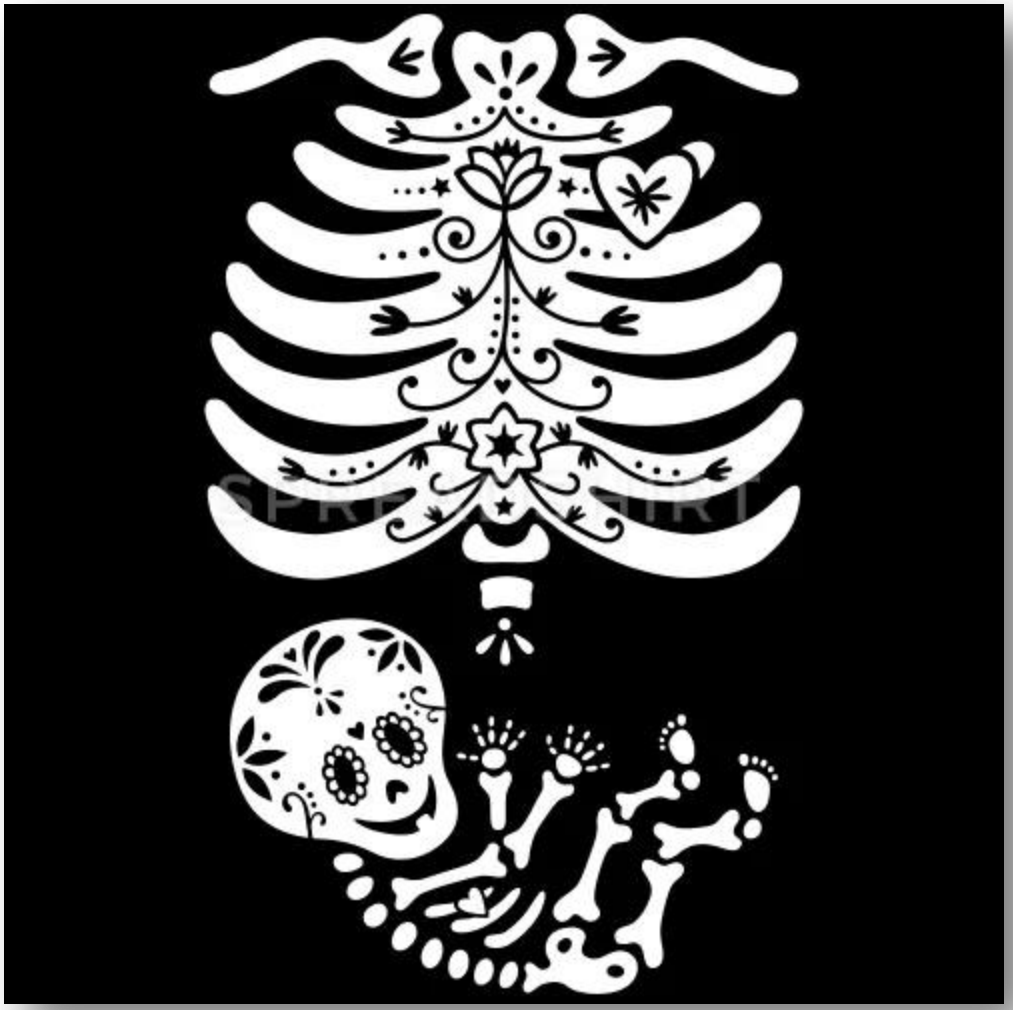
BOLUS

BASAL

- Onset time = when blood lowering action comes into effect
- Onset = the point that insulin will affect blood glucose
- Physiologic administration of insulin requires 3-4 injections; with 50-60 % as the basal insulin

What are we really doing?

- The goal of treatment of diabetes in pregnancy is to minimize maternal and fetal adverse events related to hyperglycemia.



Is GDM treatment safe? Does GDM treatment influence outcomes?

Table 1

Characteristics of the included studies

Study, Country of Origin	N	Mean Age (SD)	Mean BMI (SD)	Intervention		Diagnostic Criteria	Patients on Insulin[Ψ]
				Exp.	Control		
Bevier 1999[16], USA	83	26.8 (5.7)	NA	Diet/Insulin	Usual care, Insulin if RBG >120 mg/dl	50 g GCT 1 h>140 mg/dl & negative on 100 g OGTT	3%
Bonomo 2005[17], Italy	300	30.9 (4.9)	23 (4.4)	Diet	Usual care	50 g GCT 1 h≥140 mg/dl & negative on 100 g OGTT	NA
Crowther 2005[18], Australia/UK	1000	30.5 (5.5)	26.4	Diet/Insulin	Usual care	75 g OGTT 2 h≥140 mg/dl ≤198 mg/dl	20%
Deveer 2013[19], Turkey	100	30.3 (5.7)	28.5 (4.2)	Diet	Usual care	50 g GCT 1 h≥140 mg/dl<180 mg/dl & negative on 100 g OGTT	NA
Garner 1997[20], Canada	300	30.7 (4.7)	NA	Diet/Insulin	Usual care. Insulin if FPG>140 mg/dl	75 g OGTT Any abnormal: F>86.4 mg/dl, 1 h>196 mg/dl, 2 h>172 mg/dl	24%
Landon 2009[21], USA	958	29.1 (5.7)	30 (5)	Diet/Insulin	Usual care	100 g OGTT F<95 mg/dl& 2 abnormal: 1 h≥180 mg/dl, 2 h≥155 mg/dl, 3 h≥140 mg/dl	7.6%
Langer 1989[22], USA	126	29.5 (5.5)	NA*	Diet/Insulin	Usual care	100 g OGTT 2 Abnormal: F≥105 mg/dl, 1 h≥190 mg/dl, 2 h≥165 mg/dl 3 h≥145 mg/dl	35%
Li 1987[23], Hong Kong	158	28.3 (4.5)	NA	Diet	Usual care	100 g OGTT 2 abnormal: F≥105 mg/dl, 1 h≥190 mg/dl, 2 h≥165 mg/dl, 3 h≥145 mg/dl	NA
O'Sullivan 1966[24], USA	615	30.8 (NA)	NA	Diet & Insulin for all	Usual care	100 g OGTT 2 Abnormal: F≥110 mg/dl, 1 h≥170 mg/dl, 2 h≥120 mg/dl 3 h≥110 mg/dl	100%
O'Sullivan 1974[25], USA	241	30(NA)	NA	Diet &Insulin for all	Usual care	100 g OGTT 2 Abnormal: F≥90 mg/dl, 1 h≥165 mg/dl, 2 h≥145 mg/dl, 3 h≥125 mg/dl	100%

Is GDM treatment safe? Does GDM treatment influence outcomes?

Significantly reduced:

- Risk for macrosomia
  (RR, 0.47; 95% CI, 0.38–0.57)
- Large for gestational age births
  (RR, 0.55; 95% CI, 0.45–0.67)
- Shoulder dystocia
  (RR, 0.42; 95% CI, 0.23–0.77)
- Gestational hypertension
  (RR, 0.68; 95% CI, 0.53–0.87)

Did not cause increased:

- Risk for small for gestational age babies

No significant difference was observed between the two groups in:

- Perinatal/neonatal mortality
- Neonatal hypoglycemia
- Birth trauma
- Preterm births
- Pre-eclampsia
- Caesarean/labor induction

Poolsup N, Suksomboon N, Amin M. Effect of treatment of gestational diabetes mellitus: a systematic review and meta-analysis. *PloS one.* 2014;9(3):e92485-e92485.

Timing of Delivery

- In women with GDM that is controlled with only diet and exercise (A1GDM) should not be before 39 weeks of gestation, unless otherwise indicated.
  - In such women, expectant management up to 40 6/7 weeks of gestation in the setting of indicated antepartum testing is generally appropriate.
- For women with GDM that is well controlled by medications (A2GDM), delivery is recommended at 39 0/7 to 39 6/7 weeks of gestation.

Practice Bulletin No. 180: Gestational Diabetes Mellitus. *Obstetrics & Gynecology.* 2017;130(1):e17-e37

Whew…that's over with!

"Women with GDM experience intensive monitoring during pregnancy, but after giving birth, women often perceive that previous concerns for their health and that of the newborn dissipate"

Mielke RT, Kaiser D, Centuolo R. Interconception care for women with prior gestational diabetes mellitus. *Journal of Midwifery & Women's Health.* 2013;58(3):303-312.

Promoting Health After Gestational Diabetes

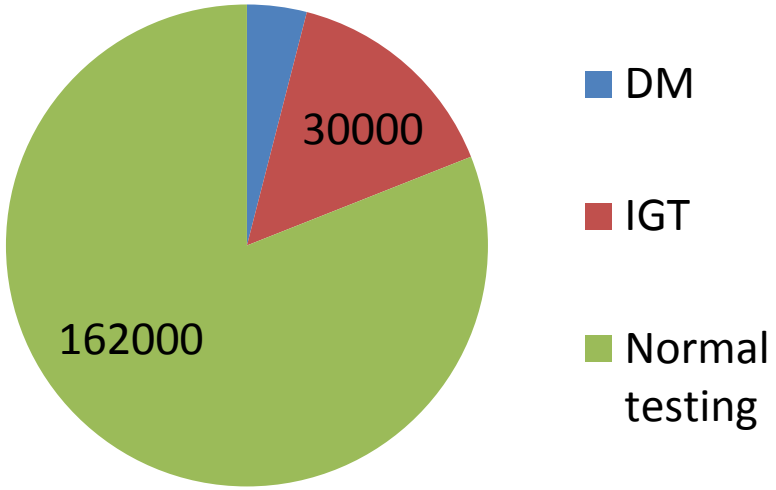
Why target women with prior GDM?

- GDM will recur in 30 – 84% of women (Kim, Berger, & Chamany, 2007)
- Regular support/monitoring in the **interconception** period:
  - Early identification of DM in the interconception period to ensure normoglycemia in early gestation
  - Impetus to initiate, maintain, and enhance modifiable risk factors to delay or prevent GDM and/or DM
  - Promote behaviors like breastfeeding and use of effective contraception which may have particular benefit to these women
- Intergenerational impact
  - Intrauterine imprinting →offspring of GDM over 7x as likely to develop DM as adults (Clausen, et al, 2008)

Promoting Health After Gestational Diabetes

200,000 women each year diagnosed with GDM

Outcomes of PP Testing for GDM



(England et al, 2009)

Case Finding: Identification of Women with Prior GDM

- Patient may not return for pp check
- Pregnancy data relocated in paper charts
- Patient seen in outside clinic for HR OB care, then returns for pp
- ICD10 code (Z86.32) for "personal history of gestational diabetes"

Postpartum Screening for Diabetes and Pre-diabetes

- ADA, ACOG, Fifth International Workshop on GDM - Use 75-g OGTT at 6-12 weeks pp
- Gold standard as it has greater sensitivity than fasting plasma glucose (FPG) test alone
  - FPG alone fails to diagnose about 30% of those with diabetes
  - Women can have defects in either the fasting glucose, post challenge glucose, or both
  - 2hr OGTT will detect more glucose intolerance women than an FPG alone

Prior GDM: Postpartum Visit Algorithm

75g 2hr GTT
6-12 weeks PP

Normal
FBS < 100
AND
2hr < 140

Education
↑ Risk in subsequent pregnancies
Contraception
Weight management prn
2hr GTT q 1-3 years

Abnormal

Diabetes
FBS ≥ 126 **OR**
2-hr ≥ 200

DM Management
Blood glucose meter, testing supplies
Oral medications
Hgb A1c
Weight loss & physical activity
Follow-up visits with PCP

IFG/IGT
(pre-diabetes)
FBS 100 - 125 **OR**
2 hr 140 - 199

Pre-diabetes management
Nutritionist referral
Weight loss & physical activity
2hr GTT q year

Adapted from Interconception Care Project for California (ACOG) and 2010 Standards of Medical Care in Diabetes (ADA)

PP Diagnosis of DM

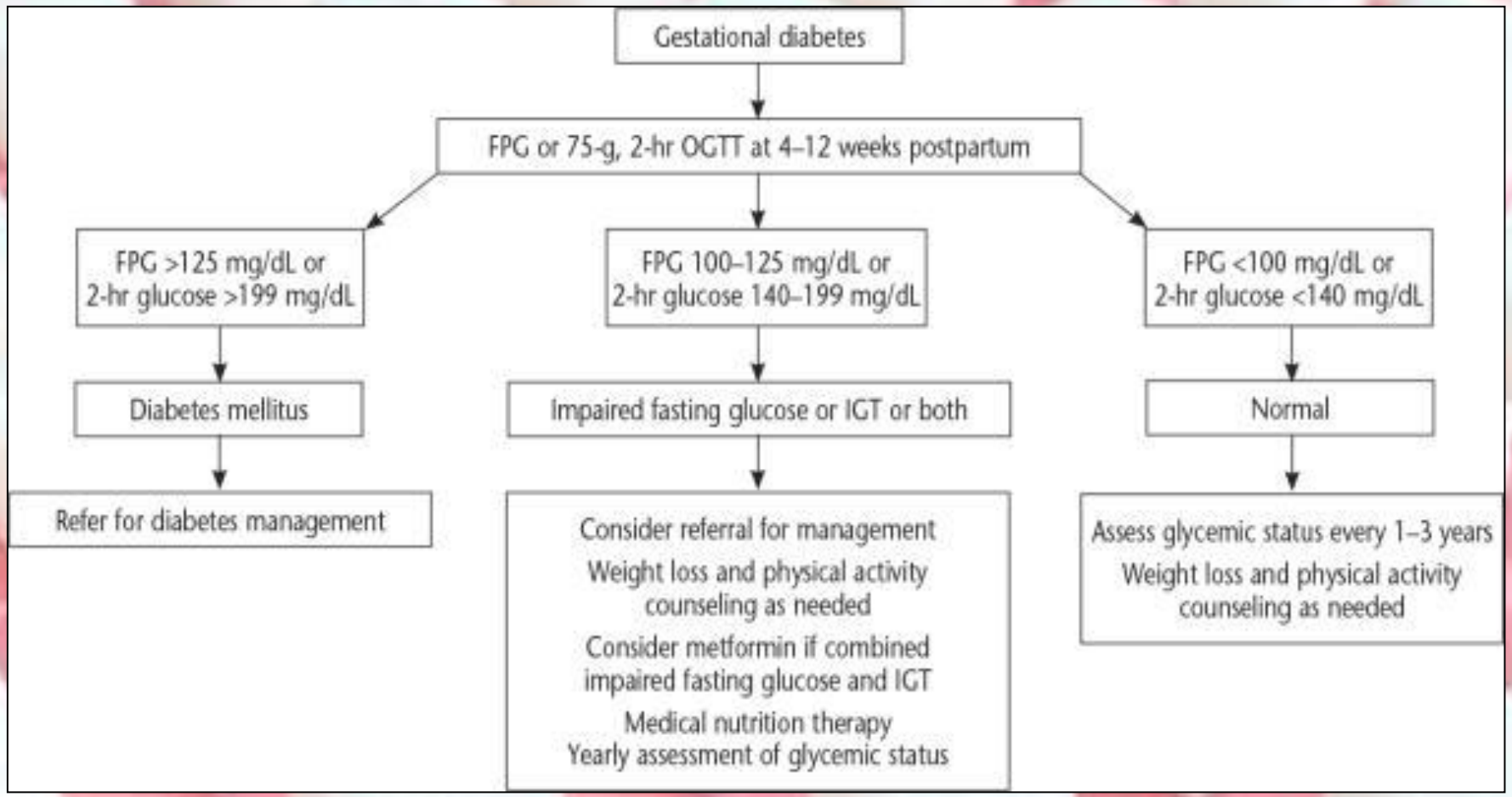


Figure 1 . Management of postpartum screening results. Abbreviations: FPG, fasting plasma glucose; OGTT, oral glucose tolerance test; IGT, impaired glucose tolerance.

ACOG Practice Bulletin No. 190 Summary: Gestational Diabetes Mellitus.
Obstetrics & Gynecology. 131(2):406-408, February 2018.
DOI: 10.1097/AOG.0000000000002498

Adherence to PP Screening after GDM

Are women with insurance more likely to get screened?

- Kaiser Permanente (n= 11, 825) – 32 – 54%
  Lawrence JM, Black MH, Hsu J-W, Chen W, Sacks DA. *Diabetes Care.* 2010;33(3):569-576.

- San Antonio; largely disadvantaged MA women (n= 707) - 57%
  Hunt, Conway. *Amer J of Obstet Gynecol*. 2008;198(4):401-404

PP Screening Issues

- Women at ↑ risk for DM may avoid screening
  - Women given lab slips before D/C, case manager followed but even so…
  - 400/700 (57%) women with GDM had pp screening – and of those only 4.5% DM
- However, those not screened were:
  - More likely to have had multiple prior GDM
  - More likely to have had high pre-pregnancy BMI
  - Higher glucose values in pregnancy
  - More likely to have used medication in GDM pregnancy

Hunt, Conway. *American Journal of Obstetrics and Gynecology*. 2008;198(4):401-404

PP Screening Issues

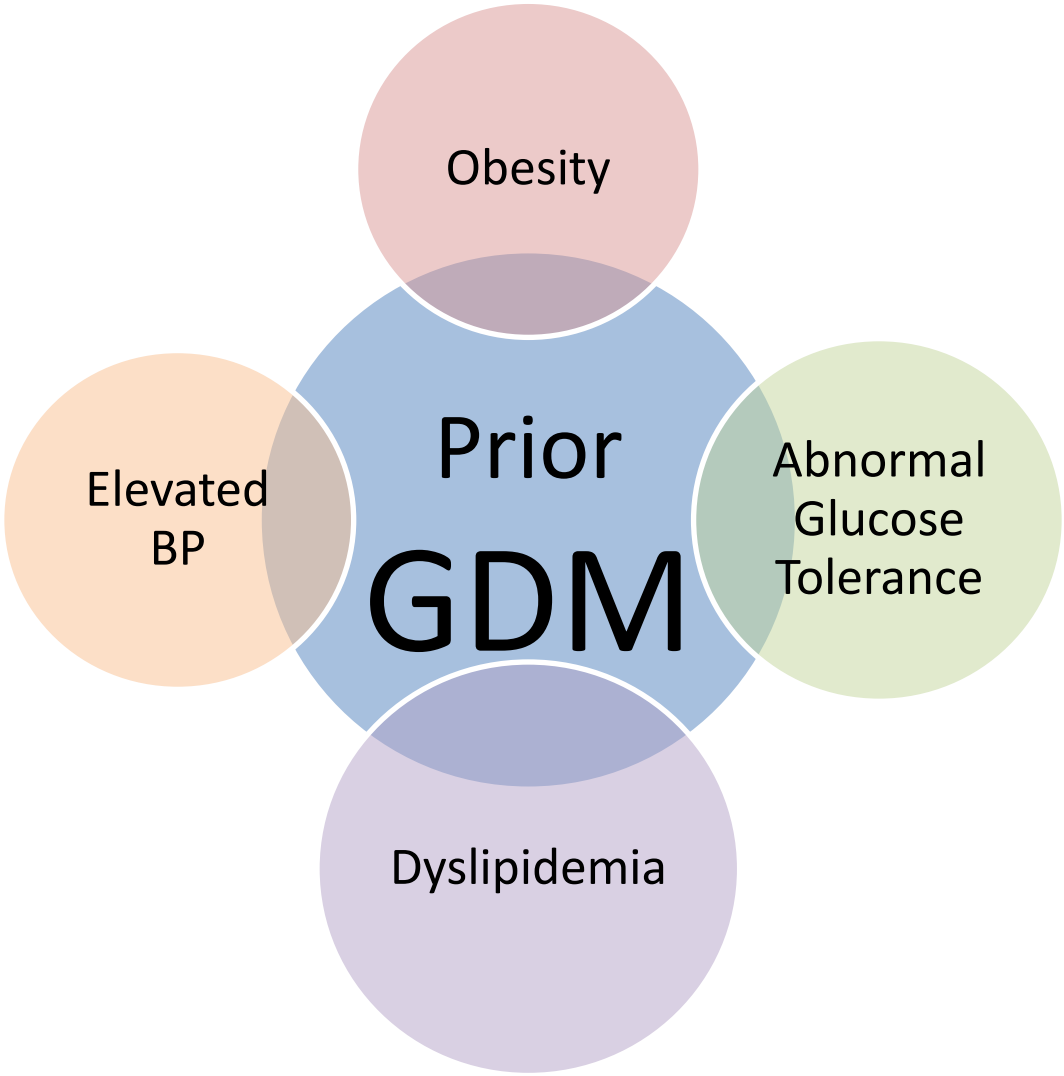
- Women with prior GDM do not get advice re: screening from their provider
  - Only 18/90 women (20%) with prior GDM had documented orders from OB/GYN for screening

    Almario, Ecker, Moroz , Bucovetsky, Berghella, Baxter. Obstetricians seldom provide postpartum diabetes screening for women with gestational diabetes. *Amer J Obstet Gynecol*. 2008;198(5):521-528
- Reminders needed for provider and patient

  Shea, Shah, Clark, Malcolm, Karovitch, Keely. *Chronic Disease in Canada*. 2011;31(2):58-64.
  Clark, Graham, Karovitch, Keely. *Amer J Obstet Gynecol*. 2009;200(6)631-634
- Multiple means of reminders needed
  - Letter and phone call better than letter alone (Shea, 2011)
  - If checklist visible on front of chart (pp lab requisition, info on pp screening, pp appt made) 3 times more likely to get OGTT (62% vs 36%)

    Lega, McLaughlin, Coroneos, Handley-Derry, Donovan, Lipscombe. *Diabetes Research & Clinical Practice*. 2012;95(3):352-357.

Insulin Resistance of GDM



Retnakaran et al.,2010; Verma, Boney Tucker & Vohr, 2002

Metabolic Assessments Recommended After GDM

Time	Test		Purpose
	FIWC -GDM	ADA	
Post-delivery (1-3 days)	FBS or RBS		Detect persistent, overt DM
Early postpartum	75g OGTT	75g OGTT*	PP classification of glucose metabolism
1 yr postpartum	75g OGTT		Assess glucose metabolism
Annually	FBS		Assess glucose metabolism
Tri- annually	75g OGTT	A1C, FPG, or 75g OGTT *	Assess glucose metabolism
Pre-pregnancy	75g OGTT		Classify glucose metabolism

- Is she normoglycemic? OR
- Is there impaired glucose tolerance? (AKA pre-diabetes?)

* If pre-diabetes is diagnosed, monitoring for the development of diabetes should be performed at least every year.

Adapted from: Summary and Recommendations of the Fifth International Workshop-Conference on GDM (2007) and ADA, Standards of Medical Care in Diabetes—2010

Prior GDM and Contraception

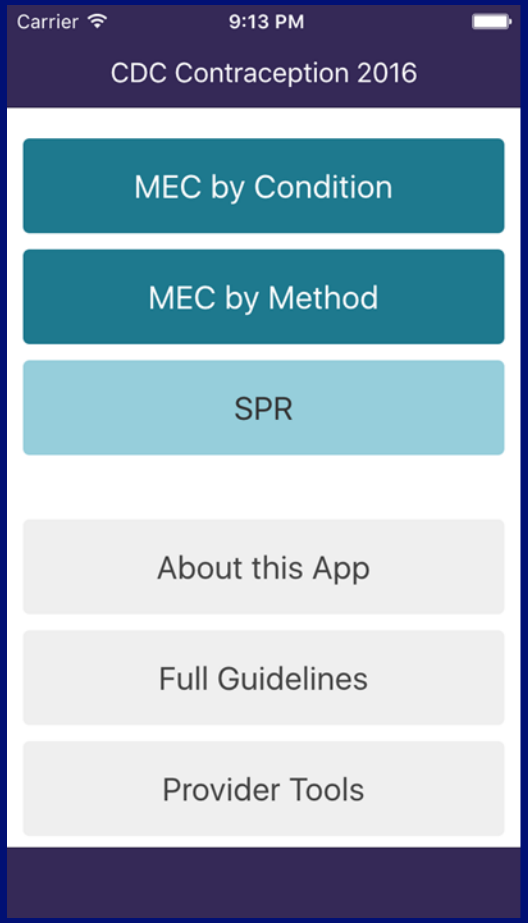
- Topic of contraception should be a theme beginning in prenatal care, to immediate postpartum, and in all interconception visits
  - Prior GDM in one pregnancy increases risk for GDM in subsequent pregnancies, particularly in non-white women (Kim, 2002)
  - Subsequent pregnancies may accelerate the process of β-cell exhaustion and thereby exacerbate the process to DM (Peters, Xiang, Kjos, & Buchanan, 1996; Xiang , Kjos , Takayanagi , Trigo, Buchanan, 2010)
  - Efficacy of method is critical in that women with prior GDM who become overtly diabetic during the interconception period at risk for an unplanned pregnancy during maternal hyperglycemia

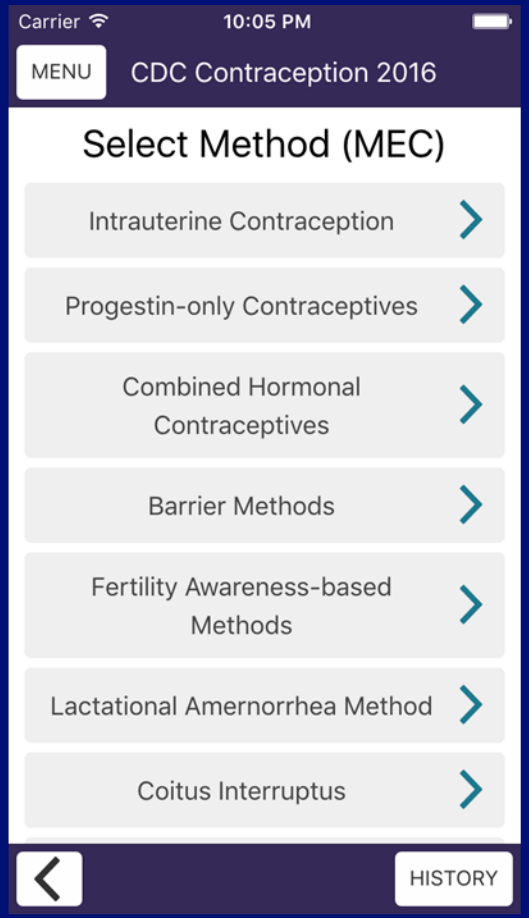
“Typical Use” First Year Contraceptive Failure Rates

Highly Effective <1%	Effective 6-9%	Less Effective >10%
Sterilization	COC	Condom
Copper T IUD	Patch	Spermicides
LNG IUS	Ring	Diaphragm
Implant	POP	Withdrawal
	DMPA	NFP

Trussell J. Contraceptive failure in the United States. *Contraception.* 2011;83(5):397-404.

2016 U.S. MEC and SPR App





U.S. Medical Eligibility Criteria for Contraceptive Use, 2016

*"The majority of the U.S. guidance does not differ from the WHO guidance and covers >60 characteristics or medical conditions. However, some **WHO recommendations were modified for use in the United States**"*

Risk Level	
1	**No restriction (method can be used)**
2	**Advantages generally outweigh theoretical or proven risks**
3	**Theoretical or proven risks usually outweigh the advantages**
4	**Unacceptable health risk (method not to be used)**

https://www.cdc.gov/reproductivehealth/contraception/mmwr/mec/summary.html

Previous GDM and Contraception

Condition Diabetes	Combined pill, patch, ring	Progestin-only pill	Injection	Implant	LNG--IUD	Copper-IUD
a) History of GDM only	**1**	**1**	**1**	**1**	**1**	**1**
b)Without vascular dz Type 1 or 2 ID or NIDDM	**2**	**2**	**2**	**2**	**2**	**1**
c)Nephropathy/ retinopathy/ neuropathy d) Other vascular dz or DM of >20 yr duration	**3 (I) / 4 (C)**	**2**	**3**	**2**	**2**	**1**

IUDs are First Line Agents!

- Long term
- Require provider removal
- Metabolically neutral
  Rogovskaya, *Obstet Gyn* 2005, *105*, 811-5)

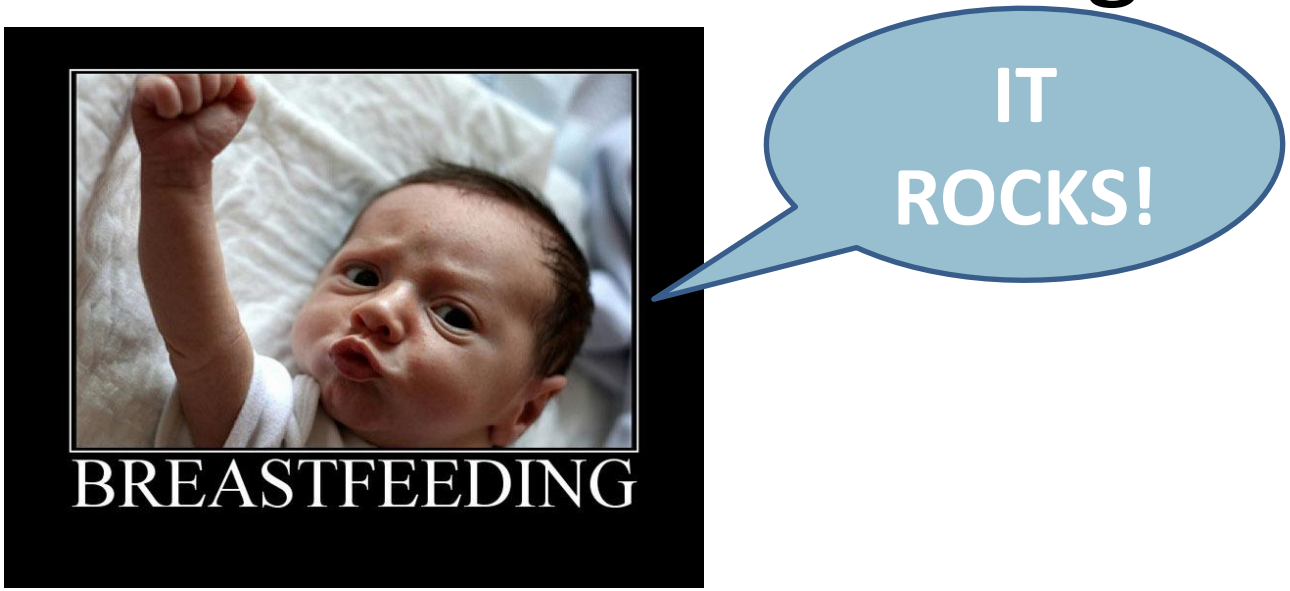
Few studies, have specifically focused on women with prior GDM, and have not demonstrated significant disturbance of glucose metabolism while using hormonal contraception

Therefore, choice is based on risk factors

- Obesity
- Hypertension
- Dyslipidemia

Kerlan, *Diabetes and Metabolism,* 2010*,36,* 566-574

Prior GDM and Breastfeeding



- **Does breastfeeding facilitate glycemic control?**
- **Does breastfeeding reduce risk of DM in the mother and/or baby?**
- **What are barriers to effective breastfeeding in women with previous GDM?**

Breastfeeding: Maternal Metabolic Benefits

Normoglycemic

- Improved glucose tolerance in early pp period in women in general (Tigas et al, 2002)
- Promoted weight loss; breast feeding >6 mo associated with weight loss > 2kg (4.5 lb) at one year pp as compared to bottle feeding (Gunderson, 2007)
- Parous women who breastfed had a 14% reduced likelihood of DM per each yr of breastfeeding (Liu, 2010; Stuebe, 2005 [level 4])

Prior GDM

- Breastfeeding lowered serum glucose levels at 4 wks and at 6 wks pp (Kjos et al, 1993)
  - Lower mean fasting glucose (p = .001)
  - Lower mean 2-hr glucose (p< .01)
- ↓ metabolic syndrome with increasing duration of breastfeeding in all women (Gunderson et al, 2010):
  - Non-GDM from 15.8% (95% CI, 11.3-21.5) to 9.2% (95% CI, 5.3-14.6)
  - GDM from 49.4% (95% CI, 25.8-84.7) to 8.5% (95% CI, 1.8-24.8)
  - GDM mothers with greater than 9 months breastfeeding had incidence of metabolic syndrome (8.5%) comparable to non-GDM (9.2%).

Recent Studies

SWIFT Cohort (Gunderson, et al, 2012)

N. California - 522 women with prior GDM using 3 hr OGTT Carpenter/Coustan criteria

Key findings

- Exclusive breastfeeding/mostly breastfeeding (<6oz formula/24 hr) women had lower FPG levels- 93.8 vs. 98.1 for women formula feeding (p=0.001)
- These women also displayed improved insulin sensitivity at 6-8 wks pp –fasting insulin 21.5 vs. 27.8 for women formula feeding (p=0.001)

Atlantic DIP (O'Reilly, Avalos, Dennedy, O'Sullivan, Dunne, 2012)

Irish study- 300 women with GDM and 220 controls (normoglycemic)

Key findings

- Breastfeeding women (BF at least 4 times/24 hr and infant gaining wt) had fewer elevated 2-hr OGTT results vs. those in women who were formula feeding
- In breastfeeding women, prevalence of elevated 2hr OGTT was 8.2% vs. 18.4% in women who formula fed (p< 0.001)

Breastfeeding: Neonatal/Pediatric Metabolic Benefits

Normoglycemic

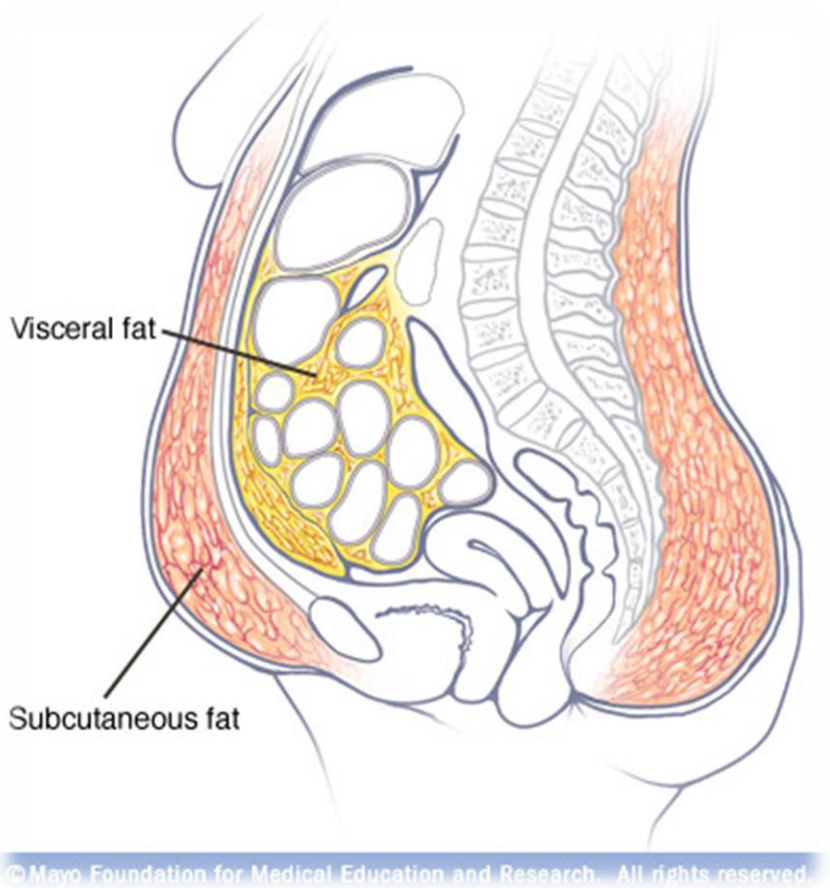
- Breastfeeding protects against obesity in childhood/adolescence (Grummer-Strawn & Mei, 2004)

Prior GDM

- Breastfeeding protects against obesity in childhood/adolescence (Schaeffer-Graf, 2006)
- Gunderson (2007)meta- analysis with 11 studies (greater than 500 participants)
  - Inverse association between breastfeeding and obesity
  - Consistency of the association across all age-groups, from infancy to adulthood, suggests early breastfeeding may have lasting protective effects independent of dietary and physical activity patterns later in life

Visceral Fat

- A significant increase in visceral fat is observed in third trimester (Kinoshita, 2006)
- Visceral fat is more metabolically active than other fat depots and correlates better than BMI with insulin resistance, GDM, type 2 DM, metabolic syndrome & CVD



Breastfeeding & Subsequent Maternal Visceral Fat

- Breastfeeding requires mothers to expend ~500 kcal/d to produce milk.
- ~50 g/d of glucose is diverted by lactogenesis via noninsulin-mediated pathways of uptake by mammary gland (Butte, et al, 1999)
- Lactating women exhibit lower blood glucose & insulin levels along with higher rates of glucose production & lipolysis compared with nonlactating women (Tigas, Sunehag, & Haymond, 2002)

Breastfeeding & Subsequent Maternal Visceral Fat

It's not too early to think ahead! Heart health prep for middle age!

- 351 women 45-58 y without CVD
  - Self-report of breastfeeding and CT scan to assess adiposity
- Compared to women who had breastfed ≥ 3 mo after each birth, those who never breastfed had
  - 28% more visceral fat
  - 6.5cm greater WC
- Breastfeeding appears to mobilize accumulated visceral fat

McClure, et al, 2011

Breastfeeding Challenges

Women with prior GDM are more likely to be overweight or obese:

- Mechanical factors such as large breasts/ flat nipples due to increased adipose tissue
- Some evidence that lactogenesis is delayed in obese women- due to ↑progesterone, also decreased prolactin response to suckling
- Obese women more likely to have difficult delivery- delayed time to first feed and skin to skin contact
- Obese women initiate breastfeeding less often, are also less likely to continue breastfeeding

(Trout, Averbuch & Barowski, 2011)

Interconception Lifestyle Modifications

- What lifestyle modifications reduce recurrence of GDM in future pregnancies?
- What lifestyle modifications prevent or delay DM?

Prevention of GDM:BMI Management

- Meta-analysis of 20 cohort studies that included over 1,000, 000 normogylcemic women
- Risk of GDM positively correlated with BMI:

  Compared to normal BMI women, risk of GDM:

  Overweight – **OR 1.86 [95% CI 1.22-2.78]**

  Obese – **OR 3.34 [2.43-4.55]**

  Severely obese – **OR 5.77 [3.60-9.39]**

  (Chu SY, Callaghan WM, Kim SY, et al. *Diabetes Care.* 2007;30(8):2070-2076)

Recommendations

The American Diabetes Association

Women should lose at least 7% of their total body weight to decrease risk of developing type 2 diabetes.

The U.S. Preventive Service Task Force – Grade B recommendation

Clinicians to screen all adult patients for obesity

Offer intensive counseling and behavioral interventions to promote sustained weight loss.

Prevention of GDM: Physical Activity

- Meta-analysis of 8 studies (n= 34, 929/2813 with GDM)
  - Vigorous physical activity has shown to have protective factors against developing GDM in pregnancy (as much as 55%) compared with women who participated in low level activity (Tobias, Zhang, van Dam, Bowers, Hu. *Diabetes Care.* 2010;34(1):223-229)
- A prospective cohort study of 909 participants women (Level 3)
  - Those with ≥4.2 hours/week PA had 76% reduction in GDM (Dempsey. *American Journal of Epidemiology.* 2004;159(7):663-670.)

Recommendations

The American Diabetes Association

Regular physical activity (150 min/week)

Summary and Recommendations of the Fifth International Workshop-Conference on Gestational Diabetes Mellitus

Participating in 30-60 minutes of vigorous exercise such as brisk walking with arm movements or stair climbing at least 5 days a week can reduce risk of developing GDM. (Metzger, Buchanan, Coustan, et al.. *Diabetes Care.* 2007;30(Supplement_2):S251-S260)

Our call to action!

- The diagnosis of GDM signals lifelong risk of diabetes and cardiovascular disease; therefore, women with prior GDM must be identified and provided with preventive interconception care.
- Critical elements of interconception care for women with prior GDM include regular metabolic and cardiovascular monitoring as well as health promotion in topic areas of breastfeeding, contraception, and lifestyle modifications to promote healthy body mass index.
- The increasing proportion of women with prior GDM is a public health opportunity for clinicians to be involved in the delay or prevention of subsequent GDM and diabetes mellitus.

Mielke RT, Kaiser D, Centuolo R. Interconception care for women with prior gestational diabetes mellitus. *Journal of Midwifery & Women's Health.* 2013;58(3):303-312.

Women with GDM need a team!

Take advantage of carpooling – it's for everyone's safety!


Thank you!