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
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?

Will it be me?
## GDM Prevalence by Age and Ethnicity

<table>
<thead>
<tr>
<th>Maternal characteristics</th>
<th>GDM n = 3,108,877</th>
<th>Prevalence ratio (PR)</th>
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<td>PR</td>
<td>95% CI</td>
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<td><strong>Age (years)</strong></td>
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<td>&lt;20</td>
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<td>American Indian/Alaskan Native</td>
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<td>Asian/Pacific Islander, total</td>
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<td>Pacific Islander</td>
<td>5761</td>
<td>5.17</td>
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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”

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 $\geq 92$ mg/dL (5.1 mmol/l)
  – 1-hour $\geq 180$ mg/dL (10.0 mmol/l)
  – 2-hour $\geq 153$ 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](https://www.cdappsweetsuccess.org/Resources/Free-Patient-Education-Material)

- **Physical Activity**
  - [https://www.cdappsweetsuccess.org/Portals/0/2015Guidelines/6_Exercise.pdf](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 your 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, not a Vegetable.

**Daily Amount**
- 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**
- 1 ounce fish, poultry, lean meat, or cheese
- 1/4 cup cottage cheese
- 1 egg
- 1 ounce nuts
- 1/2 cup tofu

0 g carbohydrate per serving

### Grains
For diabetes, beans & starchy vegetables count as Grains.

**Daily Amount**
- 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.

**Daily Amount**
- 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.

**Daily Amount**
- 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.

0 g carbohydrate per serving

- Fish has healthy fats. Eat cooked fish at two meals each week.
- Limit oils to 6 teaspoons each day.
California
My Nutrition Plan for Gestational Diabete

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

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

© CDPH 2018; Funded by Federal Title V Block Grant through the Maternal, Child and Adolescent Health Division, Center for Family Health March 14, 2018
## My Food and Physical Activity Diary

### Date:

<table>
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<th>Meal/Time</th>
<th>Meal Plan</th>
<th># of portions</th>
<th>Food Group</th>
<th>My Food and Activity Yesterday</th>
<th>Recommendations</th>
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</table>
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 |
| Input Height | 54 cm |
| Trimester | First |
| Twins? | No |

Activity level What's this? ε Sedentary ε Low Active ε Active ε Very Active

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 be 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.

<table>
<thead>
<tr>
<th>Weeks of Gestation</th>
<th>Total Daily Insulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1-17</td>
<td>0.7 to 0.8 U/kg actual body weight</td>
</tr>
<tr>
<td>Weeks 18-24</td>
<td>0.8 to 1 U/kg actual body weight</td>
</tr>
<tr>
<td>Weeks 25-32</td>
<td>0.9 to 1.2 U/kg actual body weight</td>
</tr>
<tr>
<td>Weeks 33-38</td>
<td>1.2 to 2 U/kg actual body weight</td>
</tr>
</tbody>
</table>

Input current weight: 210 kg lbs
Input insulin dose: .9 units/kg day

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.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Frequency</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock, fear and anxiety</td>
<td>35</td>
<td>(8.9)</td>
</tr>
<tr>
<td>Uncertainty and scepticism</td>
<td>37</td>
<td>(9.4)</td>
</tr>
<tr>
<td>An opportunity to improve one’s health</td>
<td>38</td>
<td>(9.6)</td>
</tr>
<tr>
<td>Adapting to life with GDM</td>
<td>46</td>
<td>(11.6)</td>
</tr>
<tr>
<td>The need for support</td>
<td>68</td>
<td>(17.2)</td>
</tr>
<tr>
<td>Better awareness</td>
<td>14</td>
<td>(3.5)</td>
</tr>
<tr>
<td>Abandoned</td>
<td>59</td>
<td>(14.9)</td>
</tr>
<tr>
<td>Staying healthy and preventing diabetes</td>
<td>54</td>
<td>(13.7)</td>
</tr>
<tr>
<td>Information</td>
<td>31</td>
<td>(7.8)</td>
</tr>
<tr>
<td>Other</td>
<td>33</td>
<td>(8.4)</td>
</tr>
</tbody>
</table>

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

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

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

  – Insulin is first line; but oral antidiabetic agents “increasingly are being used”

  – Insulin is first line; metformin can be alternate first line

  – Insulin is first line

## Professional guidelines for diabetes pharmacologic management in pregnancy

<table>
<thead>
<tr>
<th>Glucose targets for GDM and Pregestational DM</th>
<th>ACOG</th>
<th>ADA</th>
<th>SMFM</th>
<th>NICE UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting &lt;95 mg/dL 1-h postprandial &lt;140 mg/dL 2-h postprandial &lt;120 mg/dL</td>
<td>Fasting &lt;95 mg/dL 1-h postprandial &lt;140 mg/dL 2-h postprandial &lt;120 mg/dL</td>
<td>Not specified</td>
<td>Fasting &lt;95 mg/dL 1-h postprandial &lt;140 mg/dL 2-h postprandial &lt;115 mg/dL</td>
<td></td>
</tr>
</tbody>
</table>

| 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 |

## Summary of Commonly Insulins Used During Pregnancy

<table>
<thead>
<tr>
<th>Type</th>
<th>Generic</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid-acting</td>
<td>Lispro</td>
<td>15 minutes</td>
<td>30-60 minutes</td>
<td>3-5 hours</td>
</tr>
<tr>
<td></td>
<td>Aspart</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-acting</td>
<td>Regular</td>
<td>30-60 minutes</td>
<td>2-4 hours</td>
<td>5-8 hours</td>
</tr>
<tr>
<td>Intermediate</td>
<td>NPH</td>
<td>1-3 hours</td>
<td>8 hours</td>
<td>12-16 hours</td>
</tr>
<tr>
<td>Long acting</td>
<td>Glargine</td>
<td>1 hour</td>
<td>Peakless</td>
<td>20-26 hours</td>
</tr>
<tr>
<td></td>
<td>Detemir</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 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**

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

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.

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”

Promoting Health After Gestational Diabetes

Why target women with prior GDM?

• GDM will recur in 30 – 84% of women \text{(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 \text{(Clausen, et al, 2008)}
Promoting Health After Gestational Diabetes

200,000 women each year diagnosed with GDM

Outcomes of PP Testing for GDM

162000

30000

DM

IGT

Normal testing

(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”

“Have you ever had gestational diabetes?” should be a standard question at each pp visit
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

Diabetes
FBS > 126 OR
2-hr > 200

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

Normal
FBS < 100 AND
2hr < 140

Abnormal

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

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

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

Adherence to PP Screening after GDM

Are women with insurance more likely to get screened?

- Kaiser Permanente (n= 11,825) – 32 – 54%

- San Antonio; largely disadvantaged MA women (n= 707) - 57%
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

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

• Reminders needed for provider and patient

• 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%)
Insulin Resistance of GDM

Prior GDM

- Obesity
- Elevated BP
- Abnormal Glucose Tolerance
- Dyslipidemia

Retnakaran et al., 2010; Verma, Boney Tucker & Vohr, 2002
# Metabolic Assessments Recommended After GDM

<table>
<thead>
<tr>
<th>Time</th>
<th>Test</th>
<th>FIWC -GDM</th>
<th>ADA</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-delivery (1-3 days)</td>
<td>FBS or RBS</td>
<td>FBS</td>
<td>ADA</td>
<td>Detect persistent, overt DM</td>
</tr>
<tr>
<td>Early postpartum</td>
<td>75g OGTT</td>
<td>75g OGTT</td>
<td>75g OGTT*</td>
<td>PP classification of glucose metabolism</td>
</tr>
<tr>
<td>1 yr postpartum</td>
<td>75g OGTT</td>
<td></td>
<td></td>
<td>Assess glucose metabolism</td>
</tr>
<tr>
<td>Annually</td>
<td>FBS</td>
<td></td>
<td></td>
<td>Assess glucose metabolism</td>
</tr>
<tr>
<td>Tri- annually</td>
<td>75g OGTT</td>
<td>75g OGTT*</td>
<td></td>
<td>Assess glucose metabolism</td>
</tr>
<tr>
<td>Pre-pregnancy</td>
<td>75g OGTT</td>
<td></td>
<td></td>
<td>Classify glucose metabolism</td>
</tr>
</tbody>
</table>

- **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

<table>
<thead>
<tr>
<th>Highly Effective &lt;1%</th>
<th>Effective 6-9%</th>
<th>Less Effective &gt;10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterilization</td>
<td>COC</td>
<td>Condom</td>
</tr>
<tr>
<td>Copper T IUD</td>
<td>Patch</td>
<td>Spermicides</td>
</tr>
<tr>
<td>LNG IUS</td>
<td>Ring</td>
<td>Diaphragm</td>
</tr>
<tr>
<td>Implant</td>
<td>POP</td>
<td>Withdrawal</td>
</tr>
<tr>
<td></td>
<td>DMPA</td>
<td>NFP</td>
</tr>
</tbody>
</table>

2016 U.S. MEC and SPR App

CDC Contraception 2016

- MEC by Condition
- MEC by Method
- SPR

Select Method (MEC)

- Intrauterine Contraception
- Progestin-only Contraceptives
- Combined Hormonal Contraceptives
- Barrier Methods
- Fertility Awareness-based Methods
- Lactational Amenorrhea Method
- Coitus Interruptus

SPR

- How To Be Reasonably Certain That A Woman Is Not Pregnant
- Cu-IUD
- LNG-IUD
- Implants
- Injectables
- Combined Hormonal Contraceptives
- Progestin Only Pills
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”

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No restriction (method can be used)</td>
</tr>
<tr>
<td>2</td>
<td>Advantages generally outweigh theoretical or proven risks</td>
</tr>
<tr>
<td>3</td>
<td>Theoretical or proven risks usually outweigh the advantages</td>
</tr>
<tr>
<td>4</td>
<td>Unacceptable health risk (method not to be used)</td>
</tr>
</tbody>
</table>

https://www.cdc.gov/reproductivehealth/contraception/mmwr/mec/summary.html
## Previous GDM and Contraception

<table>
<thead>
<tr>
<th>Condition Diabetes</th>
<th>Combined pill, patch, ring</th>
<th>Progestin-only pill</th>
<th>Injection</th>
<th>Implant</th>
<th>LNG--IUD</th>
<th>Copper-IUD</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) History of GDM only</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>b) Without vascular dz Type 1 or 2 ID or NIDDM</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>c) Nephropathy/ retinopathy/ neuropathy</td>
<td>3 (I) / 4 (C)</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
IUDs are First Line Agents!

- Long term
- Require provider removal
- Metabolically neutral

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

<table>
<thead>
<tr>
<th>Normoglycemic</th>
<th>Prior GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved glucose tolerance in early pp period in women in general (Tigas et al, 2002)</td>
<td>Breastfeeding lowered serum glucose levels at 4 wks and at 6 wks pp (Kjos et al, 1993)</td>
</tr>
<tr>
<td>Promoted weight loss; breastfeeding &gt;6 mo associated with weight loss &gt; 2kg (4.5 lb) at one year pp as compared to bottle feeding (Gunderson, 2007)</td>
<td>— Lower mean fasting glucose ( (p = .001) )</td>
</tr>
<tr>
<td>Parous women who breastfed had a 14% reduced likelihood of DM per each yr of breastfeeding (Liu, 2010; Stuebe, 2005 [level 4])</td>
<td>— Lower mean 2-hr glucose ( (p&lt; .01) )</td>
</tr>
<tr>
<td>▼ metabolic syndrome with increasing duration of breastfeeding in all women (Gunderson et al, 2010):</td>
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<td>— Non-GDM from 15.8% (95% CI, 11.3-21.5) to 9.2% (95% CI, 5.3-14.6)</td>
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</tr>
<tr>
<td>— GDM from 49.4% (95% CI, 25.8-84.7) to 8.5% (95% CI, 1.8-24.8)</td>
<td>— GDM mothers with greater than 9 months breastfeeding had incidence of metabolic syndrome (8.5%) comparable to non-GDM (9.2%).</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Normoglycemic</th>
<th>Prior GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Breastfeeding protects against obesity in childhood/adolescence (Grummer-Strawn &amp; Mei, 2004)</td>
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</tr>
<tr>
<td></td>
<td>• Gunderson (2007) meta-analysis with 11 studies (greater than 500 participants)</td>
</tr>
<tr>
<td></td>
<td>– Inverse association between breastfeeding and obesity</td>
</tr>
<tr>
<td></td>
<td>– 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</td>
</tr>
</tbody>
</table>
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

• 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

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 normoglycemic 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]


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.

Women with GDM need a team!

Take advantage of carpooling – it’s for everyone’s safety!
Thank you!