Screening for Gestational Diabetes Mellitus: Challenges and Controversies

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Disclosures

• David G. Grenache has no financial conflicts of interest to disclose
Objectives

• Describe the risk factors and adverse outcomes associated with GDM

• Explain the objective and the results of the HAPO study

• Compare and contrast recommendations for screening and diagnosing GDM
Gestational Diabetes Mellitus (GDM)

• Most frequent metabolic complication of pregnancy

• Any degree of glucose intolerance with onset or first recognition during pregnancy that is not overt diabetes

• Accounts for 90% of diabetes in pregnancy

• Affects ~7% of all pregnancies (range 1-14%)
  – Highest in ethnic groups with high frequencies of type 2 diabetes (Hispanic, African, Native America, Asian, and Pacific Island ancestry)
U.S. GDM Trends

AJOG 2008;198:525.e1-5
U.S. Diabetes Trends in Pregnancy

Diabetes Care 2010;33:768–773
Pathophysiology of GDM

Mother

- ↓ Insulin availability (resistance)
- ↑ Glucose

Placenta

- Anti-insulin hormones: Human placental lactogen, Estrogens, Progesterone

Fetus

- Pancreas
- ↑ Insulin
- Excess nutrient storage
- Macrosomia
- Hypoglycemia
Consequences of GDM

**Maternal Morbidity**
- Hypertension
- Preeclampsia
- Increased likelihood of C-section
- Development of diabetes after pregnancy

**Fetal Morbidity**
- Macrosomia (excessive birth weight)
- Neonatal hypoglycemia
- Polycythemia
- Increased perinatal mortality
- Congenital malformation
- Hyperbilirubinemia
- Respiratory distress syndrome
- Hypocalcemia
Heinrich Gottlieb Bennewitz
• First recorded case of diabetes in pregnancy
• “An unquenchable thirst,” polyuria, glycosuria
• 12 pound infant died during delivery
• Glycosuria and large baby is “one aspect of a wider kind of disease not yet adequately researched”

Hugh Wilkerson
• Use of 50 gram 1 hour screening test (cutoff 130 mg/dL)

J.P. Hoet
• Published “Carbohydrate Metabolism During Pregnancy”
• Described as “metagestational diabetes”
O’Sullivan & Mahan
- 100 g 3 hour OGTT given to 752 pregnant women
- Whole blood glucose by Somogyi method
- Cutoffs established as 2 SD of the mean for each time point (predicted increased risk of diabetes after pregnancy)
  - Fasting: 90 mg/dL
  - 1 hour: 165 mg/dL
  - 2 hour: 145 mg/dL
  - 3 hour: 125 mg/dL
- Required 2 abnormal results to avoid “misclassification due to laboratory error”

Boston 1964

Copenhagen 1967

Chicago 1978

Jorgen Pedersen
- “Gestational diabetes”

ACOG
- Recommends use of O’Sullivan criteria to diagnose GDM
NDDG
- Increases O’Sullivan cutoffs by ~15% due to use of plasma/serum (not whole blood) glucose
  - Fasting: 105 mg/dL
  - 1 hour: 190 mg/dL
  - 2 hour: 165 mg/dL
  - 3 hour: 145 mg/dL

Carpenter & Coustan
- Modified O’Sullivan cutoffs to reflect use of enzymatic glucose methods (-5 mg/dL + 14%)
  - Fasting: 95 mg/dL
  - 1 hour: 180 mg/dL
  - 2 hour: 155 mg/dL
  - 3 hour: 140 mg/dL

1st International Workshop-Conference on GDM
- Universal testing at 24-28 weeks
- 100 g 3 hour OGTT with NDDG cutoffs
ADA
• Recommends 100 g 3 hour OGTT with NDDG cutoffs

3rd International Workshop-Conference on GDM
• No change in diagnostic criteria

2nd International Workshop-Conference on GDM
• Universal screening at 24-28 weeks
• Use 50 g 1 hour screening test (cutoff 140 mg/dL)
• 100 g 3 hour OGTT with NDDG cutoffs
4th International Workshop-Conference on GDM
- Risk-based screening strategy
- 1- or 2-step testing
  - Use 50 g 1 hour screening test (cutoff 130 or 140 mg/dL)
  - 100 g 3 hour OGTT with Carpenter/Coustan cutoffs

ACOG
- Recommends risk-based testing and 1- or 2-step testing
  - Use 50 g 1 hour screening test (cutoff 130 or 140 mg/dL)
  - 100 g 3 hour OGTT with NDDG or Carpenter/Coustan cutoffs

ADA
- Adopts recommendations of 4th IWC on GDM
Hyperglycemia and Adverse Pregnancy Outcome Study Cooperative Research Group
- Publishes results of its 6-year study

International Association of Diabetes and Pregnancy Study Groups
- Publishes revised GDM testing protocol based on HAPO study

5th International Workshop-Conference on GDM
- No change in diagnostic criteria

ACOG
- Reaffirms its 2001 guideline

ADA
- Adopts IADPSG recommendations

Chicago 2005

HAPO 2008

IADPSG 2010

Virginia 2011

Washington, DC 2011
# GDM Testing Protocols

<table>
<thead>
<tr>
<th>WHO</th>
<th>ACOG</th>
<th>ADA (pre-2011)</th>
<th>ADA (2011)</th>
</tr>
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<tbody>
<tr>
<td>Test all pregnant women at 24-28 weeks</td>
<td>Test is risk-based</td>
<td>Test is risk-based</td>
<td>Test all pregnant women without overt diabetes at 24-28 weeks</td>
</tr>
<tr>
<td>1-step</td>
<td>2-step (2 versions)</td>
<td>1-step or 2-step</td>
<td>1-step</td>
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| 75 g glucose, exceeds 1 of the following:  
  Fasting: $\geq 110$  
  2 h: $\geq 140$ and $<$200 | 50 g glucose, exceeds 130-140  
  *AND*  
  100 g glucose, exceeds 2 of the following:  
  Fasting: $\geq 95$  
  1 h: $\geq 180$  
  2 h: $\geq 155$  
  3 h: $\geq 140$ | 100 g glucose, exceeds 2 of the following:  
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  2 h: $\geq 155$  
  3 h: $\geq 140$ | 75 g glucose, exceeds 1 of the following:  
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  1 h: $\geq 180$  
  2 h: $\geq 153$ |
| 50 g glucose, exceeds 130-140  
  *AND*  
  100 g glucose, exceeds 2 of the following:  
  Fasting: $\geq 105$  
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  2 h: $\geq 165$  
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  Fasting: $\geq 95$  
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  *AND*  
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  2 h: $\geq 155$  
  3 h: $\geq 140$ |
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## Risk-based Testing

<table>
<thead>
<tr>
<th>Low Risk</th>
<th>Average Risk</th>
<th>High Risk</th>
</tr>
</thead>
</table>
| • Of ethnic group with low GDM prevalence  
• No diabetes in 1st degree relatives  
• Age <25 years  
• Weight normal before pregnancy  
• No history of abnormal glucose metabolism  
• No history of poor obstetric outcome | • Not low or high risk | • Severe obesity  
• Strong family history of type 2 diabetes  
• History of GDM, impaired glucose metabolism, or glucosuria |

| No need to test | Test at 24-28 weeks | Test immediately |
Protocol Limitations

Established in 1964

Cutoffs identified those at high risk of diabetes after pregnancy

ACOG & ADA (pre-2011)

Cutoffs were determined as 2 SD above the mean

Not based on maternal or fetal morbidity
Protocol Limitations

- Not widely used in US
- GDM diagnosed when criteria for diabetes or impaired glucose tolerance met
- Uses same interpretive criteria as for non-pregnant women
- Not based on maternal or fetal morbidity

WHO
Protocol Limitations

- No universal protocol
- Impossible to compare different studies of GDM
- What is the true prevalence of GDM?
- What are the risks associated with maternal hyperglycemia?
Objective: to clarify the risks of adverse outcomes associated with various degrees of maternal glucose intolerance less severe than that in overt diabetes mellitus
HAPO Study

• 23,316 pregnant women without overt diabetes

• 15 centers in 9 countries over 6 years (July 2000 – April 2006)

• 75 g OGTT at 24 – 32 weeks

• Random glucose at 34 – 37 weeks

• Excluded
  – Fasting OGTT >105 mg/dL
  – 2 h OGTT >200 mg/dL
  – Random glucose ≥160 or <45 mg/dL

HAPO Study

25,505 completed testing

746 excluded
1,443 incomplete data
23,316 included

Cord blood glucose & C-peptide at delivery

1° outcomes
- BW >90%
- C-section
- Fetal hypoglycemia
- Fetal hyperinsulinemia

2° outcomes
- Delivery <37 weeks
- Shoulder dystocia
- NICU
- Hyperbilirubinemia
- Preeclampsia

1º Outcome:
Birth weight >90th Percentile

### Table

<table>
<thead>
<tr>
<th>Category</th>
<th>Fasting (mg/dL)</th>
<th>1 hour (mg/dL)</th>
<th>2 hour (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;75</td>
<td>≤105</td>
<td>≤90</td>
</tr>
<tr>
<td>2</td>
<td>75-79</td>
<td>106-132</td>
<td>91-108</td>
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<tr>
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<td>90-94</td>
<td>172-193</td>
<td>140-157</td>
</tr>
<tr>
<td>6</td>
<td>95-99</td>
<td>194-211</td>
<td>158-177</td>
</tr>
<tr>
<td>7</td>
<td>≥100</td>
<td>≥212</td>
<td>≥178</td>
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</table>

*NEJM 2008;358:1991-2002*
1° Outcome: C-section

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<td>≥178</td>
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</tbody>
</table>

**Figure:**

- **B. Primary Cesarean Section**
  - Graph showing frequency (%) vs. glucose category.
  - Categories 1 to 7 are represented with different colors:
    - Fasting glucose
    - 1-Hr glucose
    - 2-Hr glucose

1° Outcome: Fetal Hyperinsulinemia

D Cord-Blood Serum C Peptide >90th Percentile

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<td>≥178</td>
</tr>
</tbody>
</table>

1° Outcome: Neonatal Hypoglycemia

<table>
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<th>2 hour (mg/dL)</th>
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Maternal Glucose as Continuous Variable: Primary Outcomes

<table>
<thead>
<tr>
<th>Primary outcome</th>
<th>Odds Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fasting</td>
</tr>
<tr>
<td>Birth weight &gt;90\text{th} percentile</td>
<td>1.38</td>
</tr>
<tr>
<td>Primary C-section</td>
<td>1.11</td>
</tr>
<tr>
<td>Neonatal hypoglycemia</td>
<td>1.08*</td>
</tr>
<tr>
<td>Cord C-peptide &gt;90\text{th} percentile</td>
<td>1.55</td>
</tr>
</tbody>
</table>

*Not significant

Maternal Glucose as Continuous Variable: Secondary Outcomes

<table>
<thead>
<tr>
<th>Secondary outcome</th>
<th>Odds Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fasting</td>
</tr>
<tr>
<td>Delivery &lt;37 weeks</td>
<td>1.05*</td>
</tr>
<tr>
<td>Shoulder dystocia or birth injury</td>
<td>1.18</td>
</tr>
<tr>
<td>NICU</td>
<td>0.99*</td>
</tr>
<tr>
<td>Hyperbilirubinemia</td>
<td>1.00*</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>1.21</td>
</tr>
</tbody>
</table>

*Not significant

HAPO Conclusions

• Strong, continuous associations with maternal glucose and increased birth weight and neonatal hyperinsulinemia

• Broad inclusion criteria and geographic diversity supports the development of universal outcome-based criteria for classifying glucose metabolism in pregnancy

• No obvious risk cutoffs make translating results into clinical practice challenging

• Current criteria for diagnosing hyperglycemia during pregnancy need to be reconsidered
Consensus Needed for New Criteria

- International Association of Diabetes in Pregnancy Study Groups (IADPSG)
- 2008 conference to review HAPO and related studies data
- Establish new diagnostic criteria for GDM

Diabetes Care 2010;33:676-682
Establishing IADPSG Cutoffs

• Reference values needed to evaluate potential cutoffs
  – Mean glucose for entire HAPO cohort selected
    • Fasting: 80.9 mg/dL
    • 1 hour: 134.1 mg/dL
    • 2 hour: 111.0 mg/dL

• Determined mean glucose concentrations at which the odds for three specific outcomes reached 1.75 times the reference values
  – Birth weight >90th percentile
  – Cord C-peptide >90th percentile
  – Percent body fat >90th percentile

*Diabetes Care* 2010;33:676-682
IADPSG Cutoffs

<table>
<thead>
<tr>
<th>Time relative to 75 g OGTT</th>
<th>Glucose (mg/dL)</th>
<th>Above cutoff (%)</th>
<th>Above cutoff (cumulative %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting</td>
<td>92</td>
<td>8.3</td>
<td>8.3</td>
</tr>
<tr>
<td>1 hour</td>
<td>180</td>
<td>5.7</td>
<td>14.0</td>
</tr>
<tr>
<td>2 hour</td>
<td>153</td>
<td>2.1</td>
<td>16.1</td>
</tr>
</tbody>
</table>

- One or more cutoffs must be equaled or exceeded to make a diagnosis of GDM

- 16.1% of HAPO cohort diagnosed with GDM using these cutoffs
  - Increases to 17.8% when those excluded by study design are considered

*Diabetes Care* 2010;33:676-682
# Outcome Frequency by IADPSG Criteria

<table>
<thead>
<tr>
<th>Outcome</th>
<th>All results &lt;cutoffs (%)</th>
<th>One or more result ≥cutoff (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary C-section</td>
<td>16.8</td>
<td>24.4*</td>
</tr>
<tr>
<td>Cord C-peptide &gt;90th percentile</td>
<td>6.7</td>
<td>17.5*</td>
</tr>
<tr>
<td>Percent body fat &gt;90th percentile</td>
<td>8.5</td>
<td>16.6*</td>
</tr>
<tr>
<td>Birth weight &gt;90th percentile</td>
<td>8.3</td>
<td>16.2*</td>
</tr>
<tr>
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<td>8.0</td>
<td>10.0*</td>
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<td>9.4*</td>
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<tr>
<td>NICU</td>
<td>7.8</td>
<td>9.1**</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>4.5</td>
<td>9.1*</td>
</tr>
<tr>
<td>Neonatal hypoglycemia</td>
<td>1.9</td>
<td>2.7**</td>
</tr>
<tr>
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<td>1.3</td>
<td>1.8**</td>
</tr>
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*\(p<0.001\)  **\(p<0.01\)

*Diabetes Care 2010;33:676-682*
IADPSG GDM Detection Strategy

Fasting glucose, random glucose, or Hb A1c at 1st prenatal visit

- Fasting ≥126 mg/dL or Random ≥200 mg/dL or HbA1c ≥6.5%
- Fasting ≥92 mg/dL and <126 mg/dL
- Fasting <92 mg/dL

- Overt diabetes
- GDM
- 75 g 2 hour OGTT at 24-28 weeks

Diabetes Care 2010;33:676-682
Diagnosis and Classification of Diabetes Mellitus

Table 4—Screening for and diagnosis of GDM

Perform a 75-g OGTT, with plasma glucose measurement fasting and at 1 and 2 h, at 24-28 of weeks gestation in women not previously diagnosed with overt diabetes. The OGTT should be performed in the morning after an overnight fast of at least 8 h.

The diagnosis of GDM is made when any of the following plasma glucose values are exceeded:

- Fasting: ≥92 mg/dl (5.1 mmol/l)
- 1 h: ≥180 mg/dl (10.0 mmol/l)
- 2 h: ≥153 mg/dl (8.5 mmol/l)
Screening and Diagnosis of Gestational Diabetes Mellitus

• Continues to recommend a 2-step approach to screening and diagnosis
  1. IADPSG criteria more than doubles the incidence of GDM
  2. No evidence its use would produce clinically significant improvements in maternal and neonatal outcomes
  3. Would significantly increase in health care costs
ACOG vs. IADPSG

**ACOG (2-step)**
- 50 g 1 h
  - >130-140 mg/dL
- 100 g 3 h OGTT
  - Fasting: ≥95
  - 1 h: ≥180
  - 2 h: ≥155
  - 3 h: ≥140
  - (2 or more above cutoff)

**IADPSG (1-step)**
- No screen
- 75 g 2 h OGTT
  - Fasting: ≥92
  - 1 h: ≥180
  - 2 h: ≥153
  - (1 or more above cutoff)

**~4-7% GDM**

**~18% GDM**
GDM Treatment and Outcomes

• Is there evidence that use of the IADPSG protocol would produce clinically significant improvements in maternal and neonatal outcomes?

1. Australian Carbohydrate Intolerance Study in Pregnant Women (ACHOIS) Trial Group
   • To determine whether treatment of GDM reduced the risk of perinatal complications

2. National Institute of Child Health and Human Development (NICHD) Maternal–Fetal Medicine Units (MFMU) Network Study
   • To determine whether treatment of women with mild GDM reduces perinatal and obstetrical complications
ACHOIS Design

1,000 pregnant women at 24-34 weeks
(GDM risk factors or abnormal 50 g 1 hour test)

WHO OGTT (75 g 2 hour test)
Fasting: <140 mg/dL
2 hour: 140-198 mg/dL

Intervention group (N=490)
Self-glucose monitoring
Diet counseling
Insulin to keep fasting/pre-meal glucose <99 mg/dL

Control group (N=510)
Routine care
(replicated clinical care in which screening for GDM is not available)

NEJM 2005;352:2477-2486
# ACHOIS Results

(partial list)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention group</th>
<th>Control group</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (g)</td>
<td>3,351 ± 551</td>
<td>3,482 ± 660</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Birth weight &gt;90&lt;sup&gt;th&lt;/sup&gt; percentile (%)</td>
<td>13</td>
<td>22</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Macrosomia (%)</td>
<td>10</td>
<td>21</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Preeclampsia (%)</td>
<td>12</td>
<td>18</td>
<td>0.02</td>
</tr>
<tr>
<td>Hypoglycemia requiring therapy (%)</td>
<td>7</td>
<td>5</td>
<td>0.16</td>
</tr>
</tbody>
</table>

*NEJM 2005;352:2477-2486*
NICHD-MFMU Study

19,665 pregnant women at 24-30 weeks
(Abnormal 50 g 1 hour test)

7,298 completed 100 g 3 h OGTT

900 with “mild” GDM
Fasting: <95 mg/dL and ≥2 timed results abnormal
1 h: >180 mg/dL  2 h: >155 mg/dL  3 h: >140 mg/dL

Treatment group (N=460)
Nutrition counseling/diet therapy
Insulin (if required)

Control group (N=440)
Usual prenatal care

*NEJM* 2009;361:1339-1348
### NICHG-MFMU Results

**(partial list)**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Treatment group</th>
<th>Control group</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (g)</td>
<td>3,302 ± 502</td>
<td>3,408 ± 589</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Birth weight &gt;90(^{th}) percentile (%)</td>
<td>7.1</td>
<td>14.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Macrosomia (%)</td>
<td>5.9</td>
<td>14.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Preeclampsia (%)</td>
<td>2.5</td>
<td>5.5</td>
<td>0.02</td>
</tr>
<tr>
<td>C-section (%)</td>
<td>26.9</td>
<td>33.8</td>
<td>0.02</td>
</tr>
<tr>
<td>C-peptide &gt;90(^{th}) percentile (%)</td>
<td>17.7</td>
<td>22.8</td>
<td>0.07</td>
</tr>
<tr>
<td>NICU (%)</td>
<td>9.0</td>
<td>11.6</td>
<td>0.19</td>
</tr>
</tbody>
</table>

*NEJM 2009;361:1339-1348*
## Summary of Outcome & Interventional Studies

<table>
<thead>
<tr>
<th>HAPO outcome by IADPSG criteria (all were significant)</th>
<th>ACHOIS</th>
<th>MFMU</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-section</td>
<td>⇔</td>
<td>⇩</td>
</tr>
<tr>
<td>Cord C-peptide &gt;90&lt;sup&gt;th&lt;/sup&gt; percentile</td>
<td>Not evaluated</td>
<td>⇔</td>
</tr>
<tr>
<td>Increased infant body fat</td>
<td>Not evaluated</td>
<td>⇩</td>
</tr>
<tr>
<td>Birth weight &gt;90&lt;sup&gt;th&lt;/sup&gt; percentile</td>
<td>⇩</td>
<td>⇩</td>
</tr>
<tr>
<td>Hyperbilirubinemia</td>
<td>Not evaluated</td>
<td>⇔</td>
</tr>
<tr>
<td>Delivery &lt;37 weeks</td>
<td>Not evaluated</td>
<td>⇔</td>
</tr>
<tr>
<td>NICU</td>
<td>Not evaluated</td>
<td>⇔</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>⇩</td>
<td>⇩</td>
</tr>
<tr>
<td>Neonatal hypoglycemia</td>
<td>⇔</td>
<td>⇔</td>
</tr>
<tr>
<td>Shoulder dystocia/birth injury</td>
<td>⇔</td>
<td>⇩</td>
</tr>
</tbody>
</table>
Is the use of the IADPSG protocol cost-effective?

- Two studies have addressed cost-effectiveness of IADPSG protocol

1. IADPSG is cost-effective when post-delivery care reduces likelihood of future diabetes

2. IADPSG screening is more expensive but is cost-effective in improving maternal and neonatal outcomes
# IADPSG: Pros and Cons

<table>
<thead>
<tr>
<th>Arguments in favor</th>
<th>Arguments against</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ACOG protocol not outcome-based</td>
<td>• OGGT has poor reproducibility, especially with minor degrees of glucose elevations</td>
</tr>
<tr>
<td>• Striking increase in obesity and type 2 diabetes in general population corresponds to GDM incidence of ~20%</td>
<td>• Even with strict cutoffs, a minority of fetal macrosomia will be identified</td>
</tr>
<tr>
<td>• Treatment of GDM improves outcomes</td>
<td>• Overdiagnosis of GDM will result in overtreatment</td>
</tr>
<tr>
<td>• Treatment of GDM is generally lifestyle modifications (diet, exercise) with insulin treatment needed in only ~10%</td>
<td>• Stricter OGGT criteria will result in increased workload</td>
</tr>
<tr>
<td>• Cost-effective</td>
<td></td>
</tr>
</tbody>
</table>

AJOG in press (http://dx.doi.org/10.1016/j.ajog.2012.10.881)
Coming to Consensus

**Glucose Tolerance Test Equals 51 mmol/L**

3 Hours *New Criteria (IADPSG)*

92, 180, 153 mg/dL

153 equals 8.5 mmol

Sgm postglucola > 135 mg/dL

**Diagnosing Gestational Diabetes Mellitus**

92

1 Hour

92/180/153

Check Fasting

March 4-6, 2013

Natchez Conference Center

National Institutes of Health

Bethesda, Maryland

http://prevention.nih.gov/cdp

180 equals 10 mmol/L

95/180/155/140

100 gm GTT 2 Hour

Carpenter/Coustan 105/190/165/145
Laboratory Considerations
Which Protocol to Offer

- No consensus on which approach is best
- Get input of physicians
- May find it necessary to offer both
OGTT Management

• 4 OGTT protocols to manage
  – ADA for diabetes outside of pregnancy (75 g, fasting & 2 hour glucose)
  – ADA for GDM (75 g, fasting, 1, and 2 hour glucose)
  – ACOG GDM screening test (50 g, 1 hour glucose)
  – ACOG GDM diagnostic test (100 g, fasting, 1, 2, and 3 hour glucose)

• Test ordering errors

• Result reporting challenges

• Patient safety concerns
Measurement of Glucose

• Per IADPSG:
  – Measure plasma or serum glucose using an enzymatic method with high accuracy and precision
  – Requires proper sample collection and processing to minimize pre-analytic glycolysis
  – Capillary and plasma glucose concentrations are not interchangeable and conversion factors do not accurately estimate equivalent values

• In other words:
  – Don’t use a glucose meter
  – Be aware of pre-analytic sources of variation
  – Don’t use capillary samples (again, no glucose meters)
Alternative Approaches?

- **Hb A1c**
  - Evaluated in HAPO
  - Not a useful alternative to OGTT

- **Jelly beans for GDM screening** *(AJOG 1999;181:1154–1157)*
  - 50 g glucose beverage is intensely sweet
    - 15-20% of patients experience nausea and vomiting (voids test)
  - 28 Brach’s No. 110 jelly beans = 50 g glucose
  - Poor sensitivity compared to beverage (40 vs. 80%, respectively)
Summary

• The incidence of GDM is steadily increasing

• Clear associations between maternal hyperglycemia and adverse outcomes

• Treatment of GDM improves maternal and fetal outcomes

• Three protocols for identifying GDM with current lack of consensus regarding ideal method