Managing Gestational Diabetes: An Evidence-Based Approach

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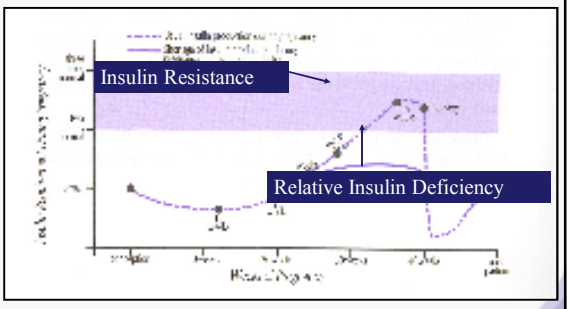
Overview of Presentation

- Definition, Incidence, Pathophysiology
- Maternal and Fetal Complications
- Evidence Analysis Process Steps
- Questions, Conclusion Statements and Grades
- Nutrition Practice Guidelines and Recommendations
- Future Areas of Research

Definition of GDM

- "Gestational diabetes is defined as glucose intolerance of variable severity with onset or first recognition during pregnancy"

Pathophysiology of GDM



Gestational Diabetes: Caring for Yourself and Your Baby, IDC Publishing

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Diagnosis of GDM

- High risk women screened at first prenatal visit
- Normal risk women screened with 50 gram glucose challenge test at 24-28 weeks
  - If glucose >140 mg/dL referred for 100 OGTT

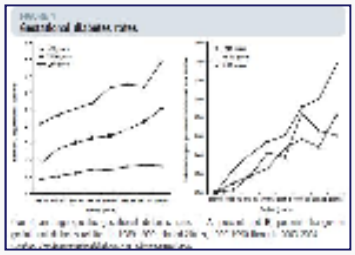
	100 gm OGTT
Diagnostic criteria	2 values equal to or greater than:
Fasting	95 mg/dL
1 hour	180 mg/dL
2 hour	155 mg/dL
3 hour	140 mg/dL

Maternal-Fetal Complications of GDM

- Maternal
  - Hypertension
  - Preterm delivery
  - Cesarean section
  - Difficult deliveries
  - Polyhydramnios
- Fetal
  - Macrosomia
  - Neonatal hypoglycemia
  - Respiratory distress syndrome
  - Neonatal hypocalcemia
  - Neonatal hyperbilirubinemia
  - Polycythemia

The Incidence of GDM is Rising

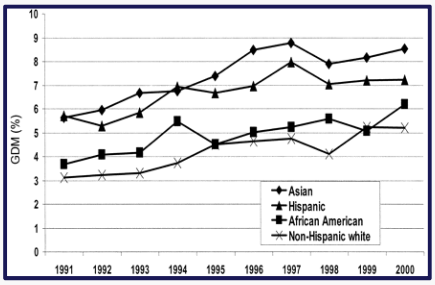
- Incidence is increasing as population becomes more sedentary and obese
- Incidence of GDM reflects the increase in type 2



1984-2004

Getahun et al. Trends in gestational diabetes. Am J Obstet Gynecol; 2008.

Prevalence of GDM by Race/Ethnicity Northern California Kaiser Permanente



Diabetes Care, July 2007 supplement

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Costs of GDM in US

- Significant economic burden
- Conservative because focus on near-term medical costs, omitting increased long-term risks
- 36% paid by government (Medicaid); 56% paid by private insurance

	Women with GDM	Newborn
Increase cost per pregnancy	Additional $3,305	Additional $209
Increase in National medical costs	Additional $230 million	Additional $40 million

Chen, Y. Population Health Management, 2009

Women with GDM Hx have Increased Type 2 Diabetes Risk

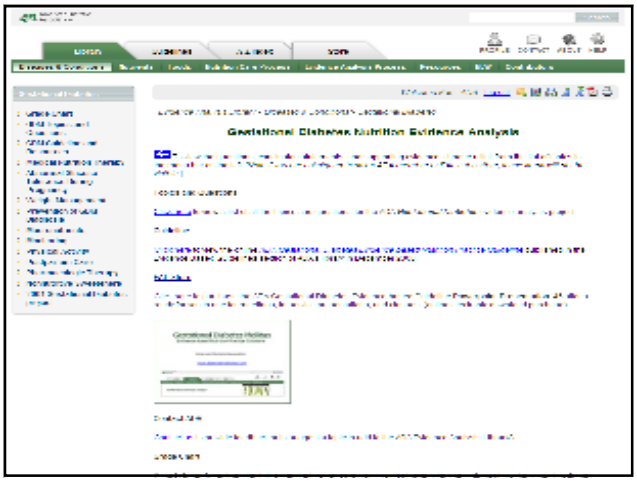
- Women with GDM are at risk for developing diabetes post-partum
- About 50% develop at 10 years post delivery
- Target these women to hopefully decrease the incidence of type 2 diabetes
- Women in DPP with history of GDM had a 50% reduction in incidence of developing diabetes with intervention

Ratner RE. Prevention of diabetes in women with hx of GDM: Effect Of metformin and lifestyle interventions. J Clin Endocrin Metab. 2008

American Dietetic Association Evidence Analysis Process

- A rigorous and systematic process for searching, analyzing and summarizing research on a specific nutrition topic

New in 2009 GDM Guidelines



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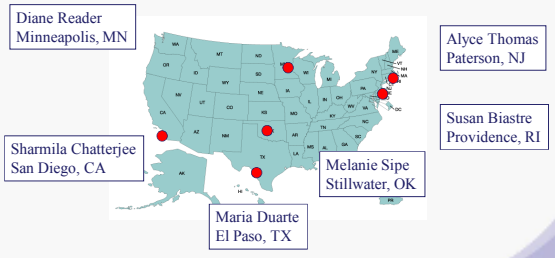
Evidence-Analysis Process Steps

1. Select topic and appoint expert work group
2. Define questions and determine inclusion/ exclusion criteria
3. Conduct literature review for each question
4. Analyze articles/ critical appraisal
5. Overview table and evidence summary
6. Develop conclusion statements and assign grade
7. Write practice guidelines within scope of nutrition care process

Expert Workgroup

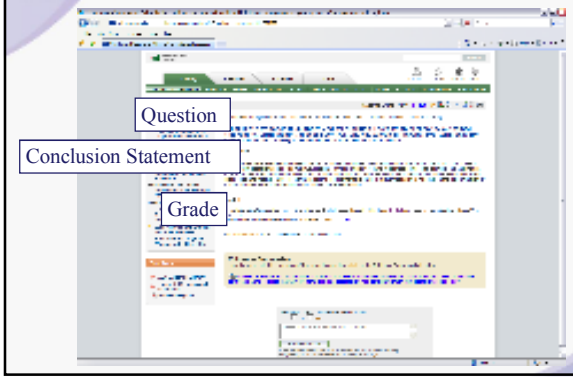
- Experts in field of gestational diabetes, diabetes, pregnancy
- Balance of researchers and practitioners
- Review work of analysts and provide final approval



Classification of Studies

A	Randomized controlled trials
B	Cohort study or non-randomized trial with concurrent or historical controls
C	Case-control study or study of sensitive and specificity of diagnostic test
D	Case series; case report; before and after study
M	Decision analysis; cost-benefit analysis
R	Consensus report or statement; medical opinion

Questions, Conclusion Statements and Grades



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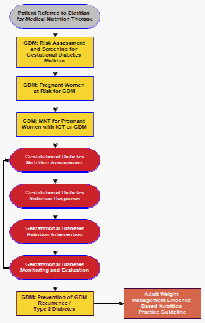
ADA EAL Grading Scale

Grade	Strength of Evidence Elements
I Good	Strong study design; consistent findings
II Fair	Strong study design with minor methodological errors; weaker design; inconsistent results
III Limited weak	Weak design; inconclusive findings; inconsistent findings
IV Expert Opinion	No studies available; conclusion based on usual practice or informed commentators
V Grade not assigned	No evidence

Write Practice Guidelines using the Nutrition Care Process



- Screening and Referral
- Assessment
- Intervention
- Monitoring and Evaluation
- Outcomes Management

What is the evidence to support MNT on pregnancy outcomes (morbidity, birth weight, glucose control, pharmacological therapy, pre-term delivery, satisfaction with care) in women with GDM?

Nutrition Practice Guidelines Field Test- 1999

Class - A

- First edition of the NPG written in 1997-1998
- Randomized to NPG (12 sites) to Usual Care (13)
- In 3 clinical settings: diabetes, ob-gyn, other
  - Use of NPG improved care in ob-gyn and other clinics
  - NPG reflected care being provided by RD in diabetes clinics

	NPG	Usual Care
Insulin Use	24.6%	31.7%
Insulin Initiated at Week	31.6%	30.4%
A1C at delivery	5.0%	5.2%
A1C greater than 6% at delivery	8.1%	13.6%

Reader D, Gunderson, Splett. JADA, 2006

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Australian Carbohydrate Intolerance Study

Class A

Nutrition/Monitoring Vs. Routine Care

- To determine if treatment of GDM reduced risk of perinatal complications
- 1000 pregnant women were randomized
  - Intervention: nutrition therapy-individualized advice from a RD; glucose monitoring
  - Insulin added if 2hr post-meal glucose > 126 mg/dL (20%)

	MNT/ Monitoring	Routine Care
Serious complications	1%	4%
Birth weight	3335 grams	3482 grams
Macrosomia rate	49 (10%)	110 (21%)
Perinatal deaths	0	5

Crowther, NEJM, June 16, 2005

What is the evidence to support MNT on pregnancy outcomes in GDM pregnancies?

Results of implementing MNT for GDM

- Decreased hospital admissions
- Decrease in insulin use
- Improved likelihood of normal fetal and placental growth
- Reduced risk of perinatal complications, especially when diagnosed and treated early

Grade: I – Good

What is the evidence to support a relationship between IGT during pregnancy and poor outcomes?

- Twenty studies evaluated to investigate the relationship between impaired glucose tolerance during pregnancy and poor outcomes
- Impaired glucose tolerance was shown to have similar effects of GDM
- Risks associated with IGT: LGA infants, macrosomia, preterm birth, perinatal morbidity and neonatal hypoglycemia

Impaired glucose tolerance increases the risk of poor pregnancy outcome

Grade: I - Good

Weight Management

- What is the relationship between caloric restriction, weight management and ketonuria for the obese woman with GDM?
- What is the evidence to support a particular caloric intake recommendation for appropriate weight gain?

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Energy Restriction in Obese Women with GDM

Class A

	Intervention N=66	Control N=58
BMI kg/m^2	37.9	38.0
Pre-treatment Calories	2570	2480
Intervention Calorie Goal	1590-1776	2010-2220
Actual Cal Intake	1566	1630
A1C	5.3%	5.5%
B-hydroxybutyrate	465	488
Insulin Use	17.5%	16.7%
Weight gain tx to delivery	0.24 kg	0.91 kg
Total wt gain	11.5 kg	9.7 kg

Rae et al. Aust N Z J Obstet Gynaecol. 40; 2000.

Caloric Intake Recommendations for Appropriate Weight Gain

- Durnin — B Class
  - Assessed food intake during various stages of pregnancy
  - Daily intake ≤ 100 kcal/d (mean 50 kcal/d); 300 kcal/d last 3 -4 wks of gestation
  - Extra calorie intake unnecessary for most pregnant women
- Ho — B Class
  - 62 non-obese women with GDMA1
  - Results: Mean daily calorie intake 1384 – 1863
  - No significant differences in weight gain, length of gestation, birth weight, birth length, Apgar score, %LGA, %SGA, or placental weight

Durnin. *Lancet, 1985;* Ho. *Nurs Health Sci,* 2005

Weight Management

- What is the evidence to support a particular caloric intake recommendation for appropriate weight gain?

Grade: II - Fair

- What is the relationship between caloric restriction, weight management and ketonuria for the obese woman with GDM?

Grade: III - Limited

What is the evidence to support a specific amount, type, and form of carbohydrate, fat and protein?

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Predictors of Birth Weight in GDM

353 women with GDM

B Class

Variable	Underwt	Normal wt	Overweight	Obese	P-value
Energy (calories)	2046	2034	2067	2072	0.075
Carb (g)	171	172	175	177	0.41
Total wt gain (kg)	13.85	13.65	12.47	9.8	<0.001
Rate of gain pre Kg/week	0.36	0.37	0.35	0.27	<0.001
Tx by diet alone	80%	63%	36.8%	24 %	<0.001
Mean FBG	72	77	85	85	<0.001
Mean 1 hr post	106	108	112	117	<0.001
Birth weight (g)	3423	3500	3671	3635	0.020

Snyder. *AJCN*, 1994

Carbohydrate Restriction in Diet-controlled GDM

- 42 women, diet controlled GDM
- 2 groups
  - Low carb (<42%)
  - High carb (45 – 50%)

C Class

Characteristic	< 42% carb	45-50% carb	P-values
Fasting before diet	97 ± 12 mg/dl	99 ± 10.3 mg/dl	NS
Fasting after diet	92 ± 9.2 mg/dl	94 ± 8/6 mg/dl	NS
Post meal before diet	161±10.4 mg/dL	158 + 9.4 mg/dl	NS
Post meal after diet	110 ± 18 mg/dl	132 ± 19 mg/dl	0.04
Insulin requiring	1/21 (4.8%)	7/21 (33%)	0.047
Birth weight	3694 ± 378 (9%)	3890 ± 455 (42%)	<.035

Major. *Ob Gyn*, 1998.

What is the evidence to support a specific amount, type, form of carbohydrate, fat and protein?

- Carbohydrate intake affects postprandial glucose levels
  - Increased postprandial glucose levels are associated with increased risk for LGA and C-section
- Research is limited regarding protein, fat, fiber and glycemic index

Grade: II - Fair

What is the evidence to support glucose monitoring and ketone testing?

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Benefits of Post-Prandial Glucose Testing in GDM

A Rating

- Post-prandial glucose levels impact pregnancy outcomes
- Study of 66 women @ 30 wks who required insulin therapy
  - Randomized to pre-meal or post-meal testing
  - Pre-meal target 60-105 & one hour post- meal <140 mg/dl

	A1C %	Insulin dose	Outcomes
Pre-meal testers	8.1+2.2	0.9+0.1U/kg	Higher infant wt More LGA
Post-meal testers	6.5+1.4	1.1+0.2 U/kg	↓ pp hypoglycemia Fewer C-sections

De Veciana M. N Engl J Med. 1995;333:1237-1241.

Impact of SMBG and Pregnancy Outcome

A Class

Outcome	SMBG: FBG + 1 hr pp 4 times/wk	Periodic Monitoring: Fasting + 1 Hr pp @ visit
FBG (mg/dl)	85.5	89.4
Post meal BG, mg/dl	110.6	102.1
Birth weight, g	3236.8	3394.2
Macrosomia rate, >90th %	16.1	22.2

Outcome: no difference in self-efficacy, emotional adjustment or other maternal/fetal complications

Grade: II - Fair

Homko; The Diabetes Educator; May/June 2002

What is the evidence to support ketone testing?

- Two of three studies regarding ketonemia and ketonuria with poor metabolic control during a diabetic pregnancy report a positive association with lower IQ in offspring
  - Rizzo study (1991) - B rating
  - Naeye study (1981) - B rating
  - Churchill study (1969) - C rating

Grade: II - Fair

What is the Relationship Between Physical Activity during Pregnancy on Outcomes and Glycemic Control

- Fourteen studies investigated the relationship between physical activity during pregnancy and maternal/neonatal outcomes and glycemic control in GDM
- Regular physical activity during pregnancy reduces the risk of gestational diabetes mellitus
- Physical activity may need to be sustained for longer periods;

Grade: II - Fair

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What is evidence to support use of artificial sweeteners?

- Benefit to controlling glucose levels
- Limited data to support use or non-use
- FDA approves Acesulfame-K (Sunette); Aspartame (NutraSweet); Sucralose (Splenda)
- AMA does not recommend use of saccharin
  - Crosses placenta; slow fetal clearance

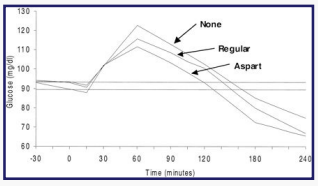
Grade: IV – Expert Opinion

What is the evidence to support pharmacological therapy?

- Twenty-four studies were evaluated
- In conjunction with nutrition therapy, pharmacological therapy is indicated when optimal blood glucose levels have not been maintained and/or when the rate of fetal growth is excessive
- Insulin therapy has been shown to be safe and effective in maintaining optimal blood glucose levels and reducing poor outcomes
  - Five studies regarding the use of insulin analogs reported that lispro or aspart as rapid acting insulin may improve glycemic control and reduce the incidence of macrosomia in neonates.
  - Limited research on glargine/determir

Aspart, Regular and MNT in GDM

- 15 women with GDM needed insulin therapy
- 3 consecutive days: MNT, either aspart or reg
- Breakfast test meal: Plain yogurt and ½ banana
  - 34 grams carbohydrate



A Class

Pettitt. *Diabetes Care,* 2003.

Use of Glyburide in Pregnancy

- Eight studies reported glyburide therapy as effective in maintaining glycemic control in conjunction with nutrition therapy, especially in women with less severe disease.
- 2000: Langer study showed safety and efficacy of glyburide
- Research on metformin is limited

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Glyburide in GDM Treatment: San Antonio Experience

B Class

OGT results Mg/dL	Glyb Success	Glyb Failure	P -value
Fasting	102	115	0.02
1 hour	205	230	<0.01
2 hour	169	204	<0.01
3 hour	133	176	<0.01

- If unable to achieve glucose targets within 2 weeks on MNT, started on glyburide 2.5 mg a.m. and dose adjusted upwards
- Success with glyburide (84%)
  - Lower OGT values
  - Initiated later gestation
  - 75% successful on 2.5-5 mg/day

Conway. J Maternal-Fetal and Neonatal Medicine, 2004

What is the evidence to support pharmacological therapy in women with GDM?

Grade: II Good

What are the nutrition interventions that may prevent the diagnosis of type 2 diabetes or GDM recurrence in women with previous GDM?

Predictors of Diabetes in Women with Previous GDM

- 302 followed post GDM
- OGT at 9 months, 2, 5, 8 and 11 yrs.
- 8 year risk of postpartum diabetes = 52.7%
- Increase risk with:
  - Women who required insulin
  - Women with BMI >30
  - Women with more than 2 prior pregnancies
  - Auto-antibodies to GAD

Lobner K. *Diabetes,* March 2006.

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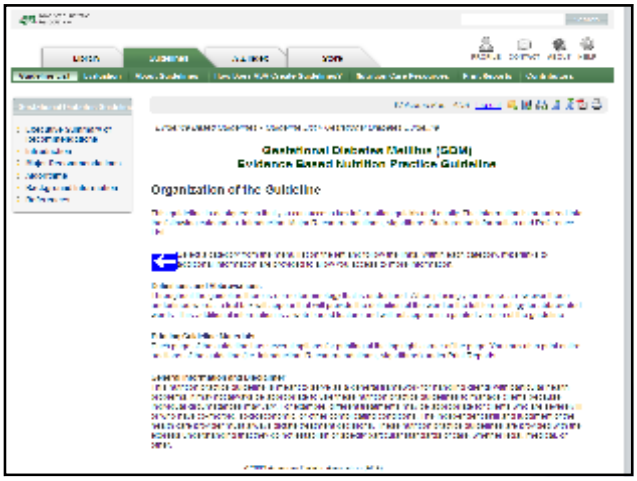
Prevention of GDM Recurrence/ Type 2 Diabetes

- Diabetes Prevention Trial showed 58% reduction in diabetes
- 5-7% weight loss
- Regular activity of 150 min/week

Advise women with GDM to lose weight after delivery which includes a combination of diet modification and physical activity

Grade: I - Good



GDM Nutrition Practice Guidelines and Recommendations

- MNT for pregnant women with IGT or GDM
- Caloric intake
- Macronutrient and micronutrient intake
- Physical activity
- Promotion of breastfeeding
- Blood glucose monitoring and ketone testing
- Indications for pharmacologic therapy
- Monitoring and evaluation
- Prevention of GDM recurrence and type 2 diabetes

Recommendations Rating Scale

Statement Rating	Definition
Strong	Benefits of the recommended approach clearly exceed the harms
Fair	Benefits exceed the harms, but quality of evidence is not as strong
Weak	Quality of evidence that exists is suspect
Consensus	Expert opinion supports the guideline recommendation though scientific evidence did not present consistent results
Insufficient Evidence	Lack of pertinent evidence and/or unclear balance between benefits and harms

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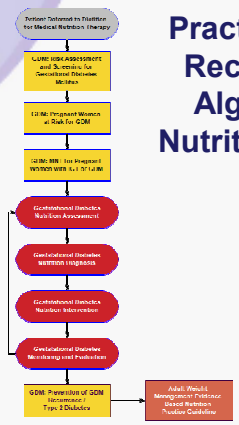
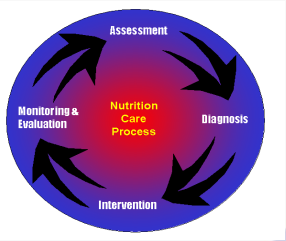
Practical Application: Recommendations, Algorithm and the Nutrition Care Process





Case Study- Marisol

- 35 year old, Hispanic female
- 10 weeks pregnant
- Weight: 182 lb; Height: 62”
- Prepregnancy weight 180 lb.
- 5th pregnancy; 3 living children, 2nd pregnancy: miscarriage
- Birthweight of last child: 4200 gm – 36 wks gestation
- Mother and paternal grandmother have T2DM

Risk Assessment and Screening for GDM

- All pregnant women should be assessed for risk of GDM at the first prenatal visit
- Depending on level of risk, timing of screening for GDM and/or IGT will differ
  - Most women are screened between 24 - 28 weeks of gestation.
- Research indicates similarities between GDM and IGT
  - Both associated with increased risks of poor maternal/neonatal outcomes if left untreated

- **Strong**
- **Imperative**

Marisol’s Risk Factors for GDM

- 35 year old, Hispanic female
- Weight: 182 lb
- Prepregnancy weight - 180 lb. (BMI = 32.9)
- Birthweight of last child: 4200 gm – 36 wks gestation
- Mother and paternal grandmother have T2DM
- Initial glucose challenge test (GCT) – 125 mg/dL

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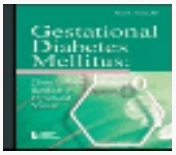
Second Trimester Glucose Screening

- Wt: 190 lb
- GCT repeated at 26 weeks
- 1 hour result: 155 mg/dL
- 3 hour GTT one week later

	Normal Criteria	Marisol's Results
Fasting	≤95 mg/dL	89 mg/dL
1 hour	≤180 mg/dL	215 mg/dL
2 hour	≤155 mg/dL	180 mg/dL
3 hour	≤140 mg/dL	126 mg/dL

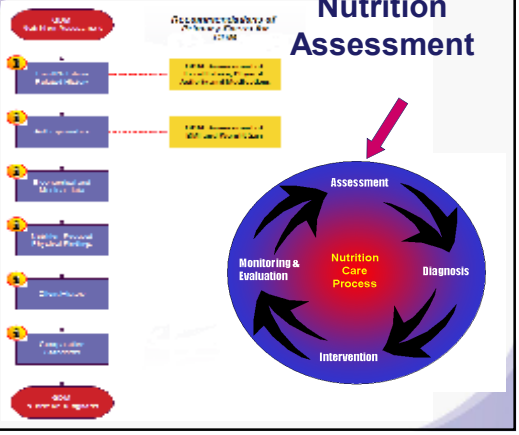
Referral for Diabetes Self-Management of GDM



- Refer within one week
- Self Management Training
  - Blood glucose monitoring
  - Ketone testing
  - Food plan
  - Record keeping and follow up
  - Additional therapy: if needed- glyburide or insulin
  - 3 MNT visits with RD

Nutrition Assessment



Assess Food Intake, Physical Activity and Medications

- RD should assess food intake, physical activity and medications of pregnant women, including those with GDM
- Evaluation of a pregnant woman's dietary pattern, augmented by questions about medications, special concerns, conditions, and/or food preferences that may affect her nutritional adequacy or needs, provides the basis for MNT.

◆Consensus

◆Imperative

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Assessment of BMI and Wt Gain

The RD should assess BMI as baseline to determine recommended weight gain in pregnant women

Institute of Medicine – 2009

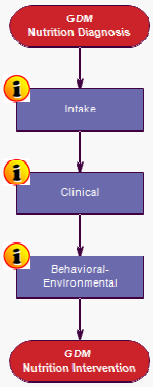
Category	BMI	Total Gain in pounds	Total Gain in kilograms
Underweight	<18.5	28-40	12.5-18
Normal	18.6-24.9	25-35	11.5-16
Overweight	25-29.9	15-25	7-11.5
Obese	>30.0	11-20	5-9

- **Consensus**
- **Imperative**

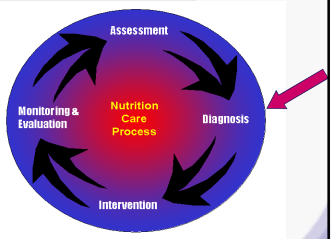
Marisol's Typical Day's Intake

Breakfast, 10 a.m.	1 egg, breakfast burrito, 1 cup juice, 1 cup café con leche
Lunch. 2-3 pm	Rice with refried beans, 2 chicken enchiladas with lettuce and tomatoes, 20 oz. soda
Dinner, 7-8 pm	Corn flakes, 1 cup whole milk, 1 pan dulce

Nutrition Diagnosis



Recommendations of Primary Focus for GDM



Marisol's Nutrition Diagnosis

- Excessive Carbohydrate Intake
  - as evidenced by elevated glucose when carbohydrate intake is reasonable.
- Food and Nutrition Related Knowledge Deficit
  - as evidenced by new diagnosis of gestational diabetes.

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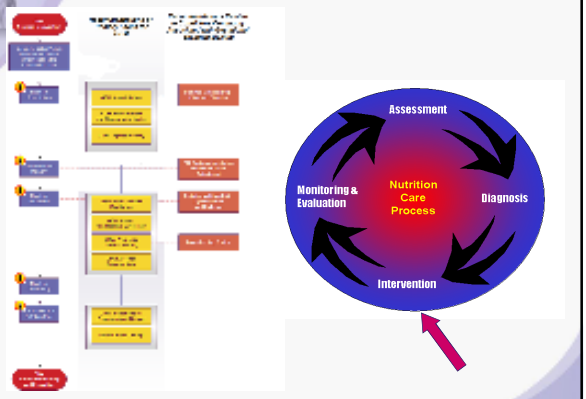
Nutrition Intervention



Interventions

- Caloric intake for obese/overweight women
- Carbohydrate intake
- Protein and fat intake
- Vitamin/Mineral supplementation
- Physical Activity
- Blood glucose monitoring & ketone testing
- Use of non-nutritive sweeteners
- Promotion of breastfeeding
- Alcohol consumption
- Pharmacologic therapy

Specific Recommendations for Obese Women with GDM

- Since weight loss in pregnancy is not recommended, encourage a modest energy restriction to slow weight gain in overweight/obese women
- Caloric restriction [70% of DRI] results in considerable slowing of maternal weight gain in obese women with GDM without causing maternal or fetal compromise or ketonuria

- **Fair**
- **Conditional**

NPG for Carbohydrates

- Encourage pregnant women, including those with GDM, to consume daily minimum of 175 g carbohydrate to provide glucose for the fetal brain and to prevent ketosis.
  - 130 gm non-pregnant plus about 33 gm/day for fetal brain
- Total carbohydrate should be less than 45% of energy to prevent hyperglycemia.

- **Fair**
- **Imperative**

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Current vs. Recommended Intake

Topic	Current Intake	Recommended Intake
# meals/snacks	❖3 meals, no snacks ❖> 12 hr between dinner and breakfast	❖Add afternoon snack ❖Add bedtime snack
Intake of high carb foods	❖Drinks regular soda ❖Does not eat dessert-type foods	❖Discontinue regular soda ❖Limit diet soda to 1-2/day
Total carbs each meal/snack	❖Breakfast – 4 carbs ❖Lunch – 8 carbs ❖Dinner - carbs	❖↓ total carbs/meal (3-4/meal) ❖Test postmeal ❖Add snacks
Estimate cal intake & wt. gain goal	❖Gained 10 lb. ❖BMI category – overweight	❖Wt. Gain on track ❖Rec. gain: ½ lb/wk ❖Wt. Gain goal: 15-25 lb.

Recommendations (continued)

Topic	Current Intake	Recommendations
Fat content	❖Uses whole milk ❖Fries most meals	❖Substitute 1% milk ❖Change cooking methods
Anticipation of potential challenges	❖Cornflakes at breakfast ❖Fast foods	❖Avoid processed cereals at breakfast ❖Avoid fast foods if post meal reading is too high
Adequate nutrition in all food group	❖Fruit: 1 serving/day ❖Milk: only with cereal ❖Protein: 2 servings/day ❖Vegetables: only at dinner	❖ ↑ fruit intake; add between meals or at lunch ❖ Increase milk to 3-4 servings/day ❖ Add 1-2 vegetables servings/day

Marisol's New Food Plan

- Breakfast, 10 a.m. — 1 corn tortilla with 1 egg, 1 cup 1% milk
  - 2 carb choices
- Snack, 12 pm — 1 Small apple
  - 1 carb choice
- Lunch, 2-3 pm — 2 chicken enchiladas with lettuce and tomatoes, rice and baked beans, 1 cup 1% milk
  - 4 carb choices
- Dinner, 6-7 pm — 1 turkey sandwich, 1 small orange
  - 3 carb choices
- Bedtime snack, 9-10 pm — 1 % cup milk + 6 crackers with cheese
  - 2 carb choices

Initial Therapy for Marisol

- Self-monitoring
- Weight gain
- Ketone testing
- Food records
- Blood glucose records
- Physical activity





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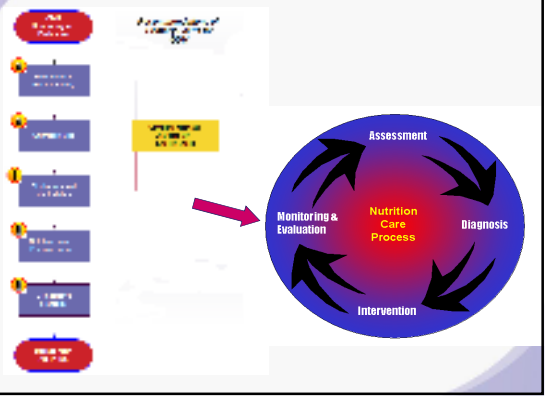
Monitoring and Evaluation



Monitoring and Evaluation

Monitor and evaluate blood glucose, weight, food intake, physical activity and pharmacological therapy (if indicated) in women with GDM at each visit.

- **Consensus**
- **Imperative**

30 Weeks – 2nd MNT Visit

- Wt. 187 lb (↓ 3 lb)
- FBG: 89 – 107 mg/dL (<95mg/dL)
- 2 hr postmeal: 125 – 162 mg/dL (<120 mg/dL or <130 – 140 mg/dL)
- Spilling ketones
- Eliminated regular soda
- No physical activity
- Constantly hungry
- Carbohydrate counting

Date	Pre	Med	Post	Pre	Med	Post	Pre	Med	Post	HS
Mon	89		141			142			135	
Tues	103		125			148			142	
Wed	102		156			160			139	
Thur	99		138			128			137	
Fri	107		133			147			130	

Potential Reasons for Poor Outcomes

- Weight changes
  - Loss due to undereating, skipping meals/snacks
  - Excessive gain due to high fat choices, inactivity
- Post-meal glucose levels
  - Portion sizes and carbohydrate counting
  - Food choices, including regular soda, juices
  - Inactivity; bedrest; tocolytic drugs; illness
  - Certain foods raise BG more than others
- Ketones levels
  - Positive due to fear of eating; skipping evening snack
- Understanding the food plan and ability to implement

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When is the Time to Add Insulin or Glyburide?

- When optimal blood glucose levels have not been maintained with MNT and/or the rate of fetal growth is excessive, advise the healthcare team to initiate of pharmacological therapy for treatment of women with GDM
- Research indicates that pharmacological therapy improves glycemic control and reduces the incidence of poor maternal and neonatal outcomes

- **Strong**
- **Conditional**

Revised Plan – 2nd Visit

- Continue food plan
- Emphasized consistency in carbohydrate intake
- Daily 30-minute walk after dinner
- Continue food and blood glucose records
- Started on glyburide
- Ketone testing

31 Weeks Gestation - 3rd MNT Visit

- Wt. 188 lb (↑ 1 lb)
- Walking 45 minutes, 5 times per week
- Following food plan
- Ketones - negative

Date	Pre	Med	Post	Pre	Med	Post	Pre	Med	Post	HS
Mon	**97**		126			97			122	
Tue	**102**		**162**			125			**141**	
Wed	**104**		105			**145**			130	
Thur	**100**		121			**133**			107	
Fri	**108**		**149**			129			**158**	

Revised Plan – 3rd Visit

- Continue present food plan
- Continue physical activity regimen
- Continue SMBG (4 times daily)
- Insulin initiation – 3 injections daily (short acting and intermediate acting)
- Hypoglycemic awareness
- Periodic ketone testing
- Telephone follow-up contact with RD

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33 Weeks Gestation - 4th MNT Visit

- Wt. 189 lb (↑ 1 lb)
- Following MNT, exercise, insulin and SMBG regimen
- Ketones – negative

Date	Pre	Med	Post	Pre	Med	Post	Pre	Med	Post	HS
Mon	93		102			114			107	
Tue	83		94			119			110	
Wed	99		115			109			98	
Thur	86		106			97			121	
Fri	91		108			126			118	

Revised Plan – 4th Visit

- Continue present food plan
- Continue physical activity regimen
- Continue SMBG (4 times daily)
- Discuss insulin resistance in 3rd trimester
- Pattern control and insulin adjustment
- Continue telephone follow-up contact with RD
- Discuss infant feeding
- Discuss postpartum lifestyle changes

Post Delivery

- Delivered 3970 gm baby boy at 39 weeks
- Vaginal delivery
- Baby's BG – 70 mg/dL
- Initiated breastfeeding in delivery room
- Marisol's BG level returned to normal 3 days after delivery
- Instructed to monitor BG levels 1/wk: FBG & 2 hr postmeal
- Return 6 weeks for postpartum check-up and OGTT

Prevention of GDM Recurrence/Type 2 Diabetes

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Postpartum

Breastfeeding is Encouraged

- **Fair**
- **Conditional**

- Assess glycemic status at 6-12 weeks postpartum visit
  - Home glucose records: check fasting and 2 hour BG- once a week
  - 75 gm OGT; fasting glucose alone not sensitive to pick up IGT

5th International Conference on GDM. *Diabetes Care*. July 2007.

Six-Week Postpartum Visit

- Wt. 168 lb
- Exclusively breastfeeding
- SMBG 1/wk
- Continued with food plan and exercise regimen

Week	Pre	Post	Post	Post
Wk 1	83			
Wk 2		93		
Wk 3			110	
Wk 4				113
Wk 5	92			
Wk 6		102		

	American Diabetes Association Guidelines			Marisol's Results
	Normal	Prediabetes	Diabetes Mellitus	
FBG	< 100 mg/dL	≥ 100 – 125 mg/dL	≥ 126 mg/dL	83 mg/dL
2 Hr	< 140 mg/dL	≥ 140 – 199 mg/dL	≥ 200 mg/dL	130 mg/dL

Postpartum Recommendations

Research indicates that the risks of recurrent GDM or development of type 2 diabetes can be reduced with weight loss.

- Risk of recurrent GDM: 30% - 65%
- Prevalence of type 2 DM after GDM: 15% - 40%
- Factors that prevent risk of recurrent GDM/type 2 DM
  - Weight gain between pregnancies
  - Hip-to-waist ratio
  - Diet composition
  - Lifestyle changes

- **Strong**
- **Conditional**

Case Study Wrap-Up

- Screen at one year post-delivery
- Screen at least every 3 years after that
- Encourage weight loss, lifestyle and behavioral changes
- RD should refer to the Adult Weight Management Nutrition Practice Guidelines

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Future Research Areas

- Calorie Requirements for Women with GDM
- Carbohydrates
  - amount, type, form
- Protein, Fat
- Physical Activity
- Ketone Testing
- Breastfeeding

Hyperglycemia Adverse Pregnancy Outcomes Trial- HAPO

- Study designed to evaluate maternal hyperglycemia and its association with increased risks of adverse pregnancy outcomes
  - Birth weight above 90th percentile
  - Cesarean delivery
  - Clinically diagnosed neonatal hypoglycemia
  - Cord serum C-peptide above the 90th percentile
- At 28 weeks- 75 gram Oral Glucose Tolerance
  - FPG < 105 mg/dL or 2 hour < 200mg/dL
- Over 23,000 women, in 9 countries over 7 years
- Strong continuous association of maternal glucose levels below those diagnostic of DM with increased birth weight, cord-blood C-peptide

IADPSG Recommendations

	Current OGTT	IADPSG Proposal
OGT	100 gram	75 gram
Diagnostic criteria	2 values equal to or greater than:	1 value equal to or greater than:
Fasting	95 mg/dL	92 mg/dL
1 hour	180 mg/dL	180 mg/dL
2 hour	155 mg/dL	153 mg/dL
3 hour	140 mg/dL	

- 1st Trimester testing to determine "Probable undiagnosed diabetes" or "Overt diabetes in pregnancy"
  - A1C ≥6.5%
  - Random ≥200 mg/dL

Questions?

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