



**Welcome to
Diabetes in the 21st Century**

Beverly Dyck Thomassian, RN, MPH, BC-ADM, CDE
President, Diabetes Education Services
www.DiabetesEd.net

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Diabetes in the 21st Century:
A Clinical and Educational Update

1. Describe impact of diabetes
2. Discuss prevention, management strategies
3. Discuss different types of diabetes
4. Describe insulin therapy
5. Review glucose patterns and determine how to adjust therapy to improve glucose.
6. Discuss medical nutrition therapy
7. Gain understanding of Type 2 Meds.
8. Demonstrate successful teaching strategies



Diabetes in America 2015

- ▶ 29 million or > 9.3%
- ▶ 27% don't know they have it
- ▶ 37% of US adults have pre diabetes (86 mil)

Diabetes



No Data
 <4.5%
 4.5-5.9%
 6.0-7.4%
 7.5-8.9%
 ≥9.0%

CDC's Division of Diabetes Translation, National Diabetes Surveillance System available at <http://www.cdc.gov/diabetes/statistics>




CDC Announces



35% of
Americans will
have Diabetes
by 2050

Boyle, Thompson, Barker, Williamson
2010, Oct 22:8(1)29
www.pophealthmetrics.com



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Global Epidemic

- ▶ Every 10 seconds
 - ▶ 1 person dies with diabetes
 - ▶ 2 people develop diabetes
- ▶ Every year
 - ▶ 3 million deaths
 - ▶ 6 million new cases
- ▶ World Diabetes Day is November 14
- ▶ March is ADA Sound the Alert Day “find people w/ undetected diabetes”



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World Diabetes Day

November 14

The right education
for all



Diabetes:
protect our future



The right environment
for all



Diabetes:
protect our future



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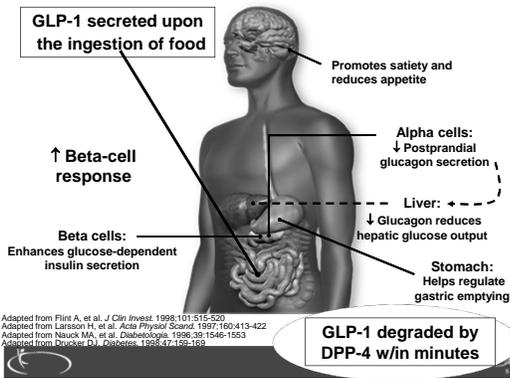
Hormones Effect on Glucose

Hormone	Effect
▶ Glucagon (pancreas)	⬆
▶ Stress hormones (kidney)	⬆
▶ Epinephrine (kidney)	⬆
▶ Insulin (pancreas)	⬇
▶ Amylin (pancreas)	⬇
▶ Gut hormones - incretins (GLP-1) released by L cells of intestinal mucosa, beta cell has receptors	⬇



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GLP-1 Effects in Humans Understanding the Natural Role of Incretins



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Incretin Mimetics

Byetta, Bydureon, Trulicity, Tanzeum

▶ Action (synthetic gut hormone)

- ▶ Insulin release in response to meal
- ▶ Slows gastric emptying
- ▶ Causes Satiety – promotes wt loss
- ▶ Preserves Beta Cells



▶ Details:

- ▶ Daily and long acting version - 1x week injection
- ▶ **Efficacy:** Decreases A1c by 0.5 – 1.6%, wt by 3lbs +

▶ Benefits/Issues – wt loss, no hyp. Expensive, N/V

- Pancreatitis Warning – report signs immediately



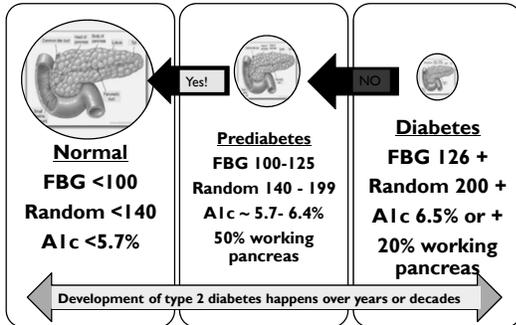
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Bariatric Surgery

- ▶ Consider on diabetes pts w/ BMI >35, esp with comorbidities
- ▶ Remission (BG normalized)
 - ▶ rates range from 40 – 95%
 - ▶ Better results with newer diabetes (more beta cell mass)
 - ▶ Due to increase incretins (gut hormones)
- ▶ Still researching long term benefits, cost effectiveness and risk



Natural History of Diabetes



Signs of Diabetes



- ▶ Polyuria
- ▶ Polydipsia
- ▶ Polyphasia
- ▶ Weight loss
- ▶ Fatigue
- ▶ Skin and other infections
- ▶ Blurry vision
- ▶ Glycosuria, H₂O losses
- ▶ Dehydration
- ▶ Fuel Depletion
- ▶ Loss of body tissue, H₂O
- ▶ Poor energy utilization
- ▶ Hyperglycemia increases incidence of infection
- ▶ Osmotic changes



Diabetes Classifications

- ▶ Type 1
- ▶ Type 2
- ▶ Gestational
- ▶ Secondary



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Case Study

1. Pt profile: 5'8", 192 lb male

Diabetes 12 years, on insulin 3 yrs

What type of DM and how do you know?



2. Pt profile: 5'6", 108 lb female

On insulin 3u Novolog before meals,
10u Lantus at bedtime

What type of DM and how do you know?



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Type 1 Rates Increasing Globally

▶ 23% rise in type 1 diabetes incidence from 2001-2009

▶ Why?

- ▶ Autoimmune disease rates increasing over all
- ▶ Changes in environmental exposure and gut bacteria?
- ▶ Hygiene hypothesis
- ▶ Obesity?



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Incidence of Type 1 in Youth



- ▶ **General Pop 0.3%**
- ▶ **Sibling 4%**
- ▶ **Mother 2-3%**
- ▶ **Father 6-8%**
- ▶ Rate doubling every 20 yrs
- ▶ Many trials underway to detect and prevent (Trial Net)



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Type 1 – 10% of all Diabetes Genetics and Risk Factors

- Auto-immune pancreatic beta cells destruction
- Most commonly expressed at age 10-14
- Insulin sensitive (require 0.5 - 1.0 units/kg/day)
- Combo of genes and environment:
 - Autoimmunity tends to run in families
 - Higher rates in non breastfed infants
 - Viral triggers: congenital rubella, coxsackie virus B, cytomegalovirus, adenovirus and mumps.



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Autoantibodies Assoc w/ Type 1

Panel of autoantibodies –

- ▶ GAD65 - Glutamic acid decarboxylase –
- ▶ ICA - Islet Cell Cytoplasmic Autoantibodies
- ▶ IAA - Insulin Autoantibodies



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Type 1 Diabetes Associated with other immune conditions

- ▶ Celiac disease (gluten intolerance)
- ▶ Thyroid disease
- ▶ Addison's Disease
- ▶ Rheumatoid arthritis
- ▶ Other



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Type 1 in Hospital

- ▶ 43 yr old admitted to evaluate angina.
- ▶ Morning blood sugar is 92.
- ▶ Based on Regular insulin sliding scale, no insulin required.
- ▶ Breakfast tray shows up and patient says, I need my insulin shot before I eat.

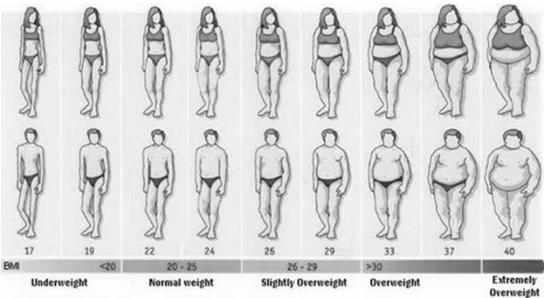


What do you say?



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BMI Categories



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Diabetes 2 - Who is at Risk?

(ADA Clinical Practice Guidelines)

1. Testing should be considered in all adults who are overweight (BMI \geq 25) and have additional **risk factors**:

- ▶ First-degree relative w/ diabetes
- ▶ Member of a high-risk ethnic population
- ▶ Habitual physical inactivity
- ▶ PreDiabetes
- ▶ History of heart disease



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Diabetes 2 - Who is at Risk?

(ADA Clinical Practice Guidelines)



Risk factors cont'd

- ▶ HTN - BP > 140/90
- ▶ HDL < 35 or triglycerides > 250
- ▶ baby >9 lb or history of Gestational Diabetes Mellitus (GDM)
- ▶ Polycystic ovary syndrome (PCOS)
- ▶ Other conditions assoc w/ insulin resistance:
 - ▶ Severe obesity, acanthosis nigricans (AN)



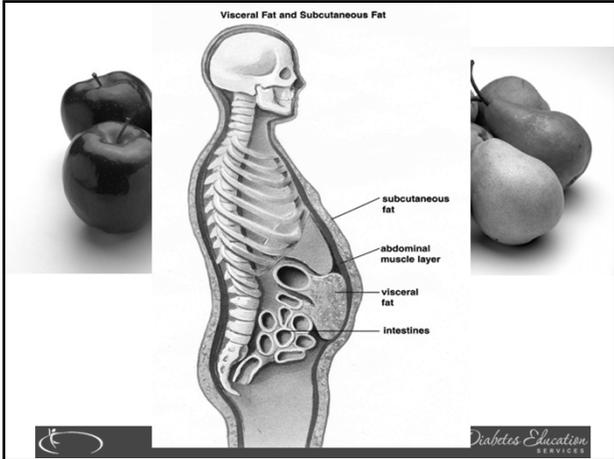
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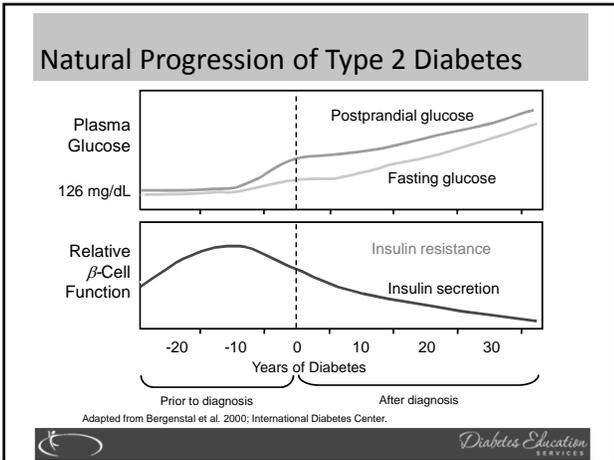
Acanthosis Nigricans (AN)

- ▶ Signals high insulin levels in bloodstream
- ▶ Patches of darkened skin over parts of body that bend or rub against each other
 - ▶ Neck, underarm, waistline, groin, knuckles, elbows, toes
 - ▶ Skin tags on neck and darkened areas around eyes, nose and cheeks.
- ▶ No cure, lesions regress with treatment of insulin resistance



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Cardio Metabolic Risk - 5 Hypers -

- ▶ Hyperinsulinemia (resistance)
- ▶ Hyperglycemia
- ▶ Hyperlipidemia
- ▶ Hypertension
- ▶ Hyper"waistline"emia (35" women, 40" men)



Manifestations of Insulin Resistance

Metformin – 1st agent of choice

- ▶ **Action:** decrease hepatic glucose (glycogen)
- ▶ **Metformin (Glucophage)**
 - ▶ Starting dose: 500 BID, max 2500mg daily
 - ▶ Metformin XR - extended release – less GI upset
- ▶ **Efficacy:**
 - ▶ Decrease fasting plasma glucose 60-70 mg/dl
 - ▶ Reduce A1C 1.0-2.0%
- ▶ **Benefits / Issues**
 - ▶ Cheap, no weight gain; some lose weight, lowers LDL, no hypo
 - ▶ Not indicated if creat > 1.4-1.5 or GFR < 60 (cleared by kidney)



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Diabetes Detectives Needed

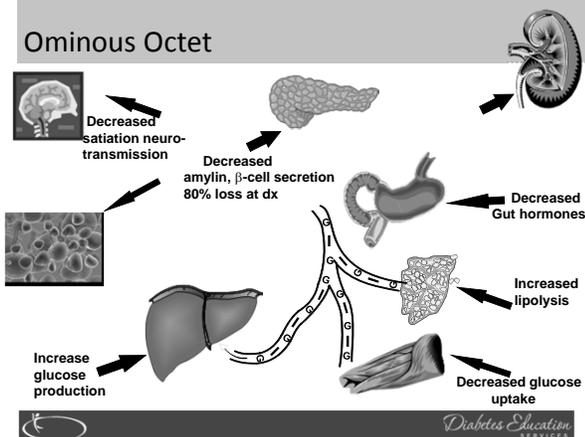


- ▶ On average – takes 6.5 years to diagnose diabetes
- ▶ 1/4 of all people with diabetes don't know they have it



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Ominous Octet



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SGLT2 Inhibitors- "Glucoetics"



▶ **Action:** "Glucoetic" decreases renal reabsorption in the proximal tubule of the kidneys (reset renal threshold and increase glycosuria)

Decreases Glucose Reabsorption

SGLT2 Inhibitors

- Decrease glucose reabsorption in kidneys
- "glucoetic."

Canagliflozin (Invokana)
Dapagliflozin (Farxiga)
Empagliflozin (Jardiance)

100-300 mg once daily
5-10 mg once daily
10-25 mg once daily

▶ **Benefits:** Lowers A1c 0.7 – 1.5%, lowers wt 1-3 lbs, no hypo

▶ **Issues:** Can initially lower GFR, monitor kidney function and lytes. Watch for hypotension/ GU infections. Expensive



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Comparison of Type 1 and Type 2

	<u>Type 1</u>	<u>Type 2</u>
Obesity	x	xxx
Insulin dependence	xxx	30%
Respond to oral agents	0	xxx
Ketosis	xxx	x
Antibodies present	xxx	0
Typical Age of onset	teens	adult
Insulin Resistance	0	xxx



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Other Causes of Hyperglycemia

- ▶ Steroids
- ▶ Agent Orange
- ▶ Tube feedings / TPN
- ▶ Transplant medications
- ▶ Cystic Fibrosis

Regardless of cause, requires treatment

- ▶ Insulin always works
- ▶ Sign of pancreatic malfunction



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Diabetes is also associated with:

- ▶ Fatty liver disease
- ▶ Obstructive sleep apnea
- ▶ Cancer; pancreas, liver, breast
- ▶ Alzheimer's
- ▶ Depression



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DiaBingo

- ▣ Frequent skin and yeast infections.....
- ▣ A BMI of ____ or greater is considered overweight
- ▣ To reduce complications, control **A1c**, **B**lood pressure, **C**holesterol
- ▣ PreDiabetes – fasting glucose level of ____ to ____
- ▣ Erectile dysfunction indicates greater risk for ____
- ▣ Diabetes – fasting glucose level ____ or greater
- ▣ Type 1 diabetes is best described as an _____ disease
- ▣ People with diabetes are _____ times more likely to die of heart dx
- ▣ Elevated triglycerides, < HDL, smaller dense LDL
- ▣ Each percentage point of A1c = ____ mg/dl glucose
- ▣ At dx of type 2, about ____% of the beta cell function is lost
- ▣ Diabetes – random glucose ____ or greater



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Life Study – Mrs. Jones

Mrs. Jones is 62 years old, overweight and complaining of feeling tired and urinating several times a night. She is admitted with a urinary tract Infection. Her WBC is 12.3, glucose 237. She is hypertensive with a history of gestational diabetes. No ketones in urine.

- ▶ What are her risk factors, signs of diabetes
- ▶ What type of diabetes does she have?
- ▶ Does she have insulin resistance?



Strategies – One Step at a Time, Focus on Survival Skills



Look for
“teaching moment”
opportunities



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What Do You Say? Mrs. Jones asks you

- ▶ What is type 2 diabetes?
- ▶ Will this go away?
- ▶ Will I get complications?
- ▶ Will I need to take diabetes medication for the rest of my life?
- ▶ How come I got diabetes?
- ▶ Do I have to check my blood sugars?

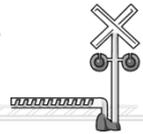


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No one is Unmotivated

.... to lead and long and healthy life

- ▶ **These are the 3 usual Critical Barriers**
 - ▶ Perceived worthlessness
 - ▶ Too many personal obstacles
 - ▶ Absence of support and resources



Bill Polonsky, PhD, CDE



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Overcoming barriers

- ▶ Confront the key misbelief. Ask the question, does dm cause complications?
 - ▶ Offer pts evidence based hope message –
 - ▶ Frequent contact
 - ▶ Paired glucose testing
 - ▶ Ask pt, “Tell me 1 thing that is driving you crazy about your diabetes”
 - ▶ Discuss medication beliefs
 - ▶ To improve outcomes, see pts more often
- Bill Polonsky, PhD, CDE



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How Often Should I Check?

- ▶ Be realistic!!
- ▶ Type 2 on orals – Medicare covers 100 strips for 3 months
- ▶ Based on individual - Consider:
 - ▶ Types and timing of meds
 - ▶ Goals
 - ▶ Ability (physical and emotional)
 - ▶ Finances / Insurance



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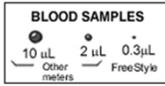
How will it help me?

- ▶ See if your treatment plan is working
- ▶ Make decisions regarding food and/or med adjustment when exercising
- ▶ Find out how that pizza affected your BG
- ▶ Avoid unwanted weight gain
- ▶ Enhanced athletic performance
- ▶ Find patterns
- ▶ Manage illness



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New Meters – a little goes a long way



- 0.3 microliters of blood
- minimal pain



Customer Service (toll-free): Look for 800 number

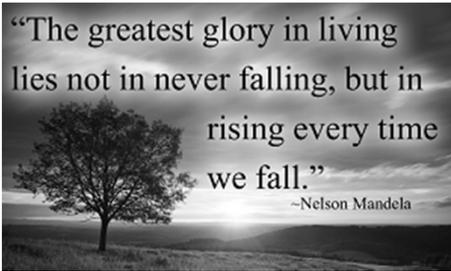


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Diabetes Vacations

“The greatest glory in living lies not in never falling, but in rising every time we fall.”

—Nelson Mandela



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Complications - Why?



- ▶ Degree of hyperglycemia “glucose toxicity”
- ▶ Duration of hyperglycemia
- ▶ Genes
- ▶ Multiple risk factors: smoking, vascular disease, dyslipidemia, hypertension, other



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Diabetes Complications

- ▶ Heart disease leading cause of death.
- ▶ CAD death rates are about 2 -4x's as high as adults without diabetes (it's not getting better)
- ▶ Risk of stroke is 2 - 4 times higher
- ▶ 60% - 65% of people with DM have HTN.
- ▶ DM accounts for 40% of new cases of ESRD
- ▶ 60 - 70% have mild - severe forms of neuropathy
- ▶ Diabetes is the leading cause of blindness
- ▶ Accounts for 50% of lower limb amputations



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Control Matters

- ▶ **Trials**
- ▶ **Practice Recommendations**



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Financial Advisor

- ▶ Mid 30s, friendly, he smiles to greet you and you notice his gums are inflamed. You'd guess a BMI of 26 or so, with most of the extra weight in the waist area.
- ▶ If you could give him some health related suggestions, what would they be?



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Can Type 2 be Prevented in Older Adults?



- Physical activity (30 mins a day)
- Dietary score (higher fiber intake, low saturated fat and *trans*-fat, lower mean glycemic index)
- Not Smoking
- Alcohol use (up to 2 drinks a day);
- BMI <25 and waist circumference

Dariusz Mozaffarian, MD,
Arch Intern Med. 2009;169(8):798-807.

Overall, 9 of 10 new cases of diabetes attributable to these 5 lifestyle factors.

89% risk reduction when all at goal.

35% rel risk reduction for each additional



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Can we stop pre diabetes from progressing?

3, 234 people w/ Pre-Diabetes randomized:

- ▶ Placebo
- ▶ Diet/Exercise or
- ▶ Metformin

over a three year period

Diabetes Prevention Program (DPP) 2001



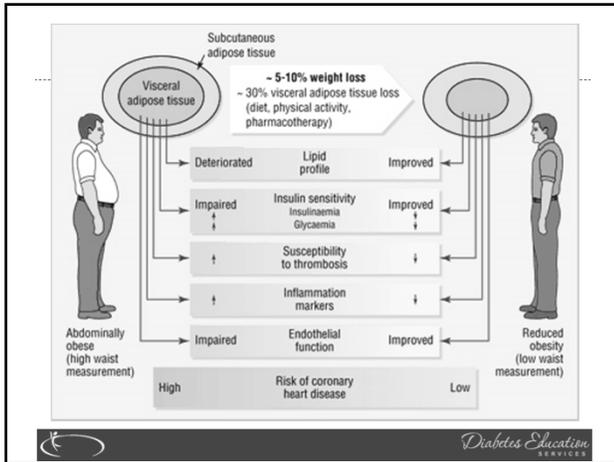
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Diabetes Prevention Program

- ▶ Standard Group - 29% developed DM
- ▶ Lifestyle Results - 14% developed DM
 - ▶ 58% (71% for 60yrs +) Risk reduction
 - ▶ 30 mins daily activity
 - ▶ 5-7% of body wt loss
- ▶ Metformin 850 BID - 22% developed DM
 - ▶ 31% risk reduction (less effective with elderly and thinner pt's)



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Goals of Care

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ABCs of Diabetes –

- ▶ **A**1c less than 7% (avg 3 month BG)
 - ▶ Pre-meal BG 80-130
 - ▶ Post meal BG <180
- ▶ **B**lood Pressure < 140/90
- ▶ **C**holesterol
 - ▶ DM and 40 yrs, start statin
 - ▶ HDL >40
 - ▶ Triglyceride < 150
- ▶ **E**xercise, Education
- ▶ **H**ealthy Eating

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Glucose and BP Control Matter

- ▶ 1% decrease in A_{1c} reduces microvascular complications by 35%
- ▶ 1% decrease in A_{1c} reduces diabetes related deaths by 25%
- ▶ B/P control (144/82) reduced risk of:
 - ▶ Heart failure (56%)
 - ▶ Stroke (44%)
 - ▶ Death from diabetes (32%)

Lancet 352: 837-865, 1998

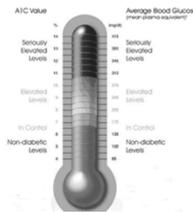


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6. Glycemic Targets

▶ Adult non pregnant A1c goals

- ▶ **A1c < 7%** - a reasonable goal for adults.
- ▶ **A1c < 6.5%** - may be appropriate for those without significant risk of hypoglycemia or other adverse effects of treatment.
- ▶ **A1c < 8%** - may be appropriate for patients with history of hypoglycemia, limited life expectancy, or those with longstanding diabetes and vascular complications.



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A1c and Estimated Avg Glucose (eAG) 2008

A1c (%)	eAG
5	97
6	126
7	154
8	183
9	212
10	240
11	269
12	298

Order teaching tool kit free at diabetes.org



$$eAG = 28.7 \times A1c - 46.7 \sim 29 \text{ pts per } 1\%$$

Translating the A1c Assay Into Estimated Average Glucose Values – ADAG Study
Diabetes Care: 31, #8, August 2008



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“Legacy Effect”

- ▶ For participants of DCCT and UKPDS
 - ▶ long lasting benefit of early intensive BG control prevents
 - ▶ microvascular complications
 - ▶ Macrovascular complications (15-55% decrease)
 - ▶ Even though their BG levels increased over time
 - ▶ Message – Catch early and Treat aggressively



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Exercise Recommendations

- ▶ **Activity update –Don’t sit more than 90 minutes**
- ▶ Evidence supports that everyone, including with diabetes should be encouraged to reduce sedentary time, by not sitting for more than 90 minutes at a time.
- ▶ It is recommended that people with pre diabetes and diabetes engage in 150 minutes of activity a week and at **least 2 weekly sessions of resistance exercise.**



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Good Exercise Info / Quotes

- ▶ 20 % of people walk 30 mins a day
- ▶ Exercise decrease A1c 0.7%
- ▶ No change in body wt, but 48% loss in visceral fat
 - ▶ ADA PostGrad 2010



• “If you don’t have time for exercise, you better make time for disease.”

“I don’t have time to exercise, I MAKE time.”

Mike Huckabee

Vaccinations- Immunizations

- ▶ Flu vaccine
 - ▶ every year starting 6 months
- ▶ Pneumococcal starting at 2 years.
 - ▶ One time Revaccination for those over 64 and had first vaccine >5 years prior
- ▶ Hepatitis B Vaccine
 - ▶ For diabetes pts age 19 – 59 (not previously vaccinated)
 - ▶ Double risk of Hep B due to lancing devices/ glucose meter exposure



DiaBingo- G

- G ADA goal for A1c is less than ____%
- G People with DM need to see their provider at least every month
- G Blood pressure goal is less than
- G People with DM should see eye doctor (ophthalmologist) at least
- G The goal for triglyceride level is less than
- G Goal for my HDL cholesterol is more than
- G The goal for blood sugars 1-2 hours after a meal is less than:
- G People with DM should get this shot every year
- G People with DM need to get urine tested yearly for _____
- G Periodontal disease indicates increased risk for heart disease
- G The goal for blood sugar levels before meals is:
- G The activity goal is to do ___ minutes on most days



Mr. Jones - What are Your Recommendations?

Patient Profile

64 yr old with type 2 for 11 yrs. Hx of CVD.

Labs:

- ▶ A1c 9.3%
- ▶ HDL 37 mg/dl
- ▶ Triglyceride 260mg/dl
- ▶ Proteinuria - neg
- ▶ B/P 152/94

Self-Care Skills

- ▶ Walks dog around block 3 x's a week
- ▶ Bowls every Friday
- ▶ 3 beers daily
- ▶ *What meds?*
- ▶ *What referrals?*
- ▶ *My foot hurts*
- ▶ *Admitted to hospital*



Glucose Management and Hospitalized Patients



In hospitalized patients with critical illness, hyperglycemia is a signal that warrants our attention.

Hospitals and Hyperglycemia What's the Big Deal?

- ▶ Hyperglycemia is associated with increased morbidity and mortality in hospital settings.
 - ▶ Acute Myocardial Infarction
 - ▶ Stroke
 - ▶ Cardiac Surgery
 - ▶ Infection
 - ▶ Longer lengths of stay



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Stress response and hyperglycemia

- ▶ Decreased WBC's
- ▶ Catabolism
- ▶ Abnormal inflammatory response
- ▶ Endothelial cell dysfunction
- ▶ Increased clotting, blood viscosity
- ▶ Tissue breakdown
- ▶ Inflammatory changes
- ▶ Increased blood pressure, pulse



Leads to: Longer lengths of stay, complications, death

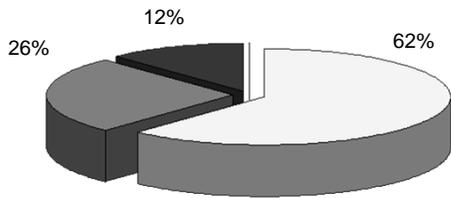
- ▶ Inflammation, "the body on fire"



Diabetes Care, v. 27, #2, Feb 2004

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Hyperglycemia*: A Common Comorbidity in Medical-Surgical Patients in a Community Hospital



Normoglycemia
 Known Diabetes
 New Hyperglycemia

n = 2,020

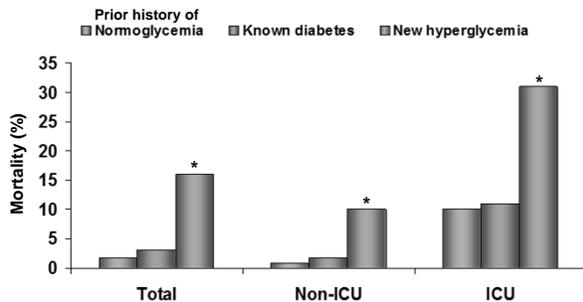
* Hyperglycemia: Fasting BG \geq 126 mg/dl or Random BG \geq 200 mg/dl X 2



Umpierrez G et al. J Clin Endocrinol Metabol. 87:978, 2002

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Effect of Hyperglycemia on Hospital Mortality



*P<.01 compared with normoglycemia and known diabetes.



Umpierrez GE et al. J Clin Endocrinol Metab. 2002;87:978-982.

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BG Above Normal = Trouble



- ▶ Pre Diabetes
 - ▶ Fasting Glucose = 100-125mg/dl
 - ▶ A1c 5.7 – 6.4%
- ▶ Diabetes
 - ▶ Fasting Glucose = 126 mg/dl +
 - ▶ Random Glucose = 200 mg/dl +
 - ▶ A1c 6.5% +

Any blood glucose above 140 requires treatment

Umpierrez et al



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Diabetes Detectives Needed

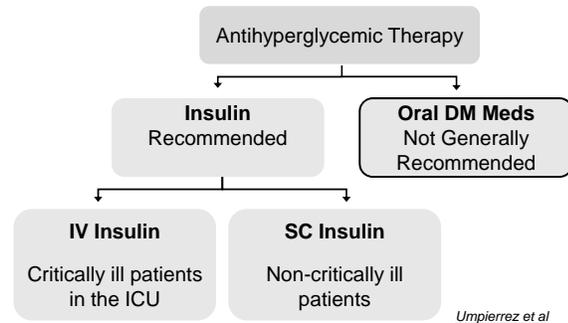


- ▶ On average – takes 6.5 years to diagnose diabetes
- ▶ 1/4 of all people with diabetes don't know they have it



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Recommendations for Managing Patients With Diabetes in the Hospital Setting



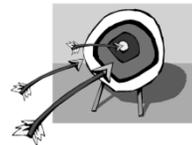
1. ACE/ADA Task Force on Inpatient Diabetes. *Diabetes Care*. 2006; 29:1111-1116.
2. *Diabetes Care*. 2009;31(suppl 1):S1-S110.

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Management of Hyperglycemia and Diabetes

▶ Non-ICU

- ▶ Basal/bolus therapy (MDI)
 - ▶ NPH and Regular insulin
 - ▶ Long-acting and rapid-acting insulin
 - ▶ Premixed insulin



▶ ICU and Critical Care

- ▶ Insulin Drips
- ▶ Basal /Bolus



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Glucose Goals For Hospitalized Patients

Sub-Q Insulin

- Blood glucose goals:
 - Premeal 100 -140
 - Post meal <180

Insulin Drip Goals

- glucose goal 140-180



Patient Name: _____

Date of Birth: _____

Medical Record #: _____

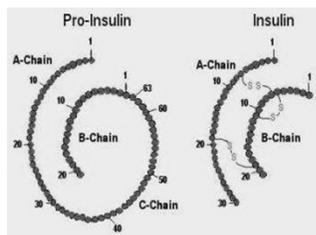
Adult Subcutaneous Insulin Orders



Insulin – the Ultimate Hormone Replacement Therapy

Objectives:

- Discuss the actions of different insulins
- Describe using pattern management as an insulin adjustment tool.



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Psychological Insulin Resistance (PIR)

- ▶ 50% of providers in study threatened pts “with the needle”.
- ▶ Less than 50% of providers realized insulins’ positive effect on type 2 dm
- ▶ Most pts don’t believe that insulin would “better help them manage their diabetes”.
- ▶ Solutions: Find the root of PIR and address it, use more insulin pens

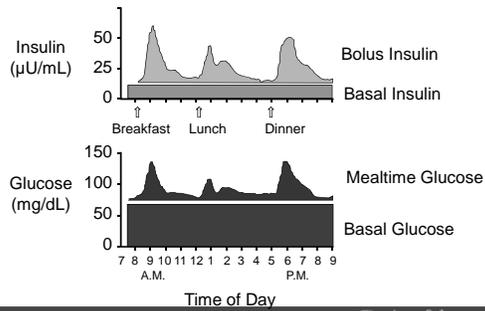


Diabetes Attitudes, Wishes, Needs Study - Rubin



Diabetes Education SERVICES

Physiologic Insulin Secretion: 24-Hour Profile



Diabetes Education SERVICES

Life Study – Mrs. Jones



Mrs. Jones is 62 years old, a little heavy and complains of feeling tired and urinating several times a night. She is admitted with a urinary tract Infection. Her WBC is 12.3, glucose 237. She is hypertensive with a history of gestational diabetes. No ketones in urine.



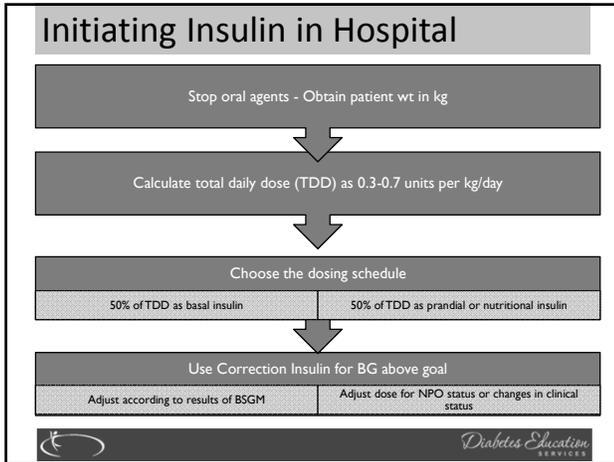
Diabetes Education SERVICES

Life Study – Mrs. Jones

► How would we manage her BG in hospital?



Diabetes Education SERVICES



Insulin Action Teams

- ▶ **Bolus: lowers after meal glucose levels**
 - ▶ Rapid Acting
 - ▶ Aspart, Lispro, Glulisine
 - ▶ Short Acting
 - ▶ Regular
- ▶ **Basal: controls glucose between meals, hs**
 - ▶ Intermediate
 - ▶ NPH
 - ▶ Long Acting
 - ▶ Detemir (Levemir)
 - ▶ Gargine (Lantus)




Diabetes Education SERVICES

Bolus Insulins

(½ of total daily dose ÷ meals)

Name	Onset	Peak Action
▶ *Aspart (NovoLog)	5-15 min	0.5 -1.5 hrs
▶ Lispro (Humalog)		
▶ Glulisine (Apidra)		

*Aspart is insulin of choice

Short Acting – for gastroparesis patients

▶ Regular	30 -60 min	2 - 3 hrs
-----------	------------	-----------

Diabetes Education SERVICES

Bolus Insulin Summary

- ▶ Aspart, Humalog, Apidra, Regular
- ▶ Starts working fast (15-30 mins)
- ▶ Gets out fast (3-6 hours)
- ▶ Post meal BG reflects effectiveness
- ▶ Should comprise about ½ total daily dose
- ▶ Covers food and/or hyperglycemia.
 - ▶ 1 unit
 - ▶ Covers ≈ 10 -20 gms of carb
 - ▶ Lowers BG ≈ 30 – 50 points



More than 200 units a day?

Your patients injecting more than 200 units of insulin per day may be ready for a change

LEARN MORE >

UNITS OF INSULIN **210** **260** **335**

- Maria* has type 2 diabetes with severe insulin resistance
- Her A1C is not at goal
- She is taking multiple insulin injections per day
- Approximately half of her current TDD of insulin is mealtime insulin and half is long-acting insulin



Humulin® R U-500
 (ed) is indicated as an adjunct to diet and exercise to
 adults and children with type 1 and type 2 diabetes

Diabetes Education SERVICES

Consider u-500 High Potency Insulin

5 x's the concentration of u100

- ▶ 500 units per mL vs 100 units per mL
- ▶ How much- When converting from u100?
- ▶ Take total daily dose and divide by 5
 - ▶ 200 units a day/5 = 40 units a day of u500
 - ▶ 300 units a day/5 = ____ units a day of u500
- ▶ 20 mL a vial. 500 units per mL= 10,000 units/vial
- ▶ Costs ~ \$400-\$1,200 per vial – less expensive unit for unit?
- ▶ Less volume



U-500 Insulin: When More With Less Yields Success: Diabetes Spectrum March 20, 2009 vol. 22 no. 2 116-122



Diabetes Education SERVICES

Dosing Strategies u-500

- ▶ Consider U-500 (5 x's more potent)
 - ▶ 1 unit on U-100 syringe = 5 units insulin
 - ▶ Dosing – take total daily needs and split into 2-3 doses
 - ▶ 2 doses: 60% am / 40% pm or
 - ▶ 3 doses: 40/30/30 or 40/40/20
 - ▶ No basal insulin needed, because U-500 has bolus and basal action
 - ▶ Safety is number one concern
 - ▶ Must have Endocrinology consult
 - ▶ TB Syringe must be used in hospital setting



U-500 Insulin: When More With Less Yields Success: Diabetes Spectrum March 20, 2009 vol. 22 no. 2 116-122



Diabetes Education SERVICES

U-500 Dose

U-100 syringe and TB Syringe

If this is your dose of Humulin R U-500	Fill a U-100 insulin syringe up to this marking	Fill a tuberculin syringe up to this marking
25	5	0.05
50	10	0.1
75	15	0.15
100	20	0.2
125	25	0.25
150	30	0.3
175	35	0.35
200	40	0.4
225	45	0.45
250	50	0.5
275	55	0.55
300	60	0.6
325	65	0.65
350	70	0.7
375	75	0.75
400	80	0.8
425	85	0.85
450	90	0.9
475	95	0.95
500	100	1.0



Diabetes Education SERVICES

Bolus Insulin Timing



- ▶ How is the effectiveness of bolus insulin determined?
 - ▶ Before next meal blood glucose
- ▶ Inpt Glucose goals (ADA) – may be modified by provider/pt
 - ▶ 1-2 hours post meal <180
 - ▶ Before next meal – 100- 140



Diabetes Education SERVICES

Insulin Therapy Components

- ▶ Prandial or meal insulin – a bolus insulin that covers food, IV dextrose, enteral nutrition
- ▶ Correction insulin – bolus insulin dosed to correct for hyperglycemia **in addition** to basal and meal insulin
 - ▶ Usually given before meals w/ prandial insulin
- ▶ Basal insulin – long acting insulin covers between meals and through night



Diabetes Education SERVICES

Choosing the Right Bolus Insulin Algorithm

Prandial –

- Choose insulin:carb ratio

Correction –

- Choose Algorithm



Diabetes Education SERVICES

SM/RR - UCLA Insulin Order Sets

- ▶ Adult Subcutaneous Insulin
- ▶ Adult Intravenous Insulin (SM /RR WARD)
- ▶ Adult Intravenous Insulin (ICU ONLY)
- ▶ Adult Intravenous Insulin - Type 1
- ▶ Adult Subcutaneous Insulin Pump
 - ▶ Patient Administered
 - ▶ **REQUIRES** Endocrine Consult
 - ▶ Assess patient – level of ability to self-administer



Diabetes Education SERVICES

How Much Insulin? – Consider the Individual

- ▶ It depends, based on:
 - ▶ Body weight
 - ▶ Overwt, normal wt, or thin
 - ▶ Frail, elderly
 - ▶ Eating status
 - ▶ Normal, poor intake or NPO
 - ▶ Renal or hepatic insufficiency
 - ▶ Type of Diabetes
 - ▶ Current meds; steroids, insulin, oral dm agents
 - ▶ Infected or Septic



Diabetes Education SERVICES

Mealtime Bolus

- ▶ Carbohydrate/ Prandial Coverage
 - ▶ Match the insulin to the carbohydrates
 - ▶ 1 unit for 8gms
 - ▶ 1 unit for 10 gms
 - ▶ 1 unit for 15 gms
 - ▶ 1 unit for 20 gms
- ▶ Adjust ratios depending on Post meal glucose and patterns

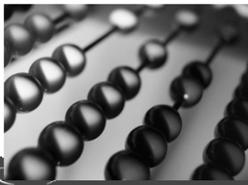
Resistant
↓
Sensitive



Diabetes Education SERVICES

Please calculate the following.

- ▶ Ate 45 gms of carb
- ▶ How much insulin?
 - ▶ 1:8
 - ▶ 1:10
 - ▶ 1:15
- ▶ Ate 75 gms of carb
- ▶ How much insulin?
 - ▶ 1:10
 - ▶ 1:20
 - ▶ 1:15



- Blood Glucose 84
- Blood Glucose 147



Diabetes Education SERVICES

Max Carb Servings per Meal

▶ Breakfast

- ▶ 45 gms
- ▶ 3 servings carb



▶ Lunch / Dinner

- ▶ 75 gms or
- ▶ 5 servings carb



Diabetes Education SERVICES

Now What?

- ▶ Nurse had an emergency and pt already ate lunch?



- ▶ Nurse administered insulin and pt only ate a few bites of turkey and drank non sugar tea?

- ▶ You just gave 3 units of Aspart and patient needs to go to OR NOW!

Now that we covered food, what about Elevated BG?

- ▶ That's where the Correction Bolus comes into play.



Diabetes Education SERVICES

Calculating Correction Bolus

- Algorithm 1
 - ▶ Insulin Sensitive - BMI < 20, Type 1, ESRD
 - Algorithm 2
 - ▶ For avg pt, BMI 20-29, Known Type 2
 - Algorithm 3
 - Insulin resistant pt - obese, on steroids
- Consider continuing usual home insulin dose*



Correction Bolus

3. Schedule: QAC only QAC = QHS 0-4 hours Other

Algorithm #1 (units)	Algorithm #2 (units)	Algorithm #3 (units)	Other (units)
70-110	0	0	0
111-140	0	0	1
141-180	1	1	2
181-220	1	2	4
221-240	2	3	5
241-260	2	4	7
261-280	3	5	9
281-300	4	6	10
301-350	5	7	12
>350	6	8	14
Call Physician	Call Physician	Call Physician	Call Physician

6. HYPOGLYCEMIA (CBG < 70 mg/dL)
- If CBG < 40 mg/dL, then give 50ml of D50 IV, contact the physician, and recheck in 20-30 minutes. Do not give further insulin until ordered by a physician.
 - If CBG 41-69 mg/dL, then give 1/2 cup juice if patient is able to eat 25 ml of D50 IV. Contact the physician, and recheck BG in 20-30 minutes. Do not give further insulin until ordered by a physician.



For following BG levels- How much corrective insulin?

- ▶ BG Alg 1 Alg 2 Alg 3
- ▶ 74
- ▶ 159
- ▶ 378



Basal Insulins
(½ of total daily dose)

Long Acting	Peak Action	Duration
▶ Detemir (Levemir)	No peak	6 - 24 hrs
▶ Glargine (Lantus)	No peak	20- 24 hrs

Intermediate Acting	Peak Action	Duration
▶ NPH	4-10 hrs	10-16

Fasting BG reflects efficacy of basal



Diabetes Education SERVICES

Basal Insulin Summary

- ▶ NPH, Levemir, Lantus
- ▶ Covers in between meals, through night
- ▶ Starts working slow (4 hours)
- ▶ Stays in long (12-24 hours)
 - ▶ NPH 12 hrs
 - ▶ Levemir, Lantus 20-24 hrs
- ▶ Fasting blood glucose reflects effectiveness



Combination SQ Insulin

Insulin Type	Onset	Duration
Humalog Mix 75/25: 75% NPL, 25% lispro 50/50: 50% NPL, 50% lispro	5-15 min	10-16 hrs
NovoLog Mix 70/30: 70% NPA, 30% aspart	5-15 min	10-16 hrs
NPH + Reg Combo 70/30: 70%N /30%R 50/50: 50%N /50%R	30 – 60 min	10-16 hrs

Considerations:

- Pre-mixed, difficult to fine tune therapy



Diabetes Education SERVICES

Insulin Dose – Mrs. Jones



- ▶ Basal
 - ▶ $0.3u/ins \times 70 \text{ kg} = 21\text{units}$
- ▶ Insulin/Carb ratio
- ▶ 1:15
- ▶ Why?
 - ▶ Depends on clinical picture and other oral meds
 - ▶ Average weight, good oral intake, type 2



Diabetes Education SERVICES

Corrective Insulin – Novolog – Algorithm 2

Rapid/Fast Acting Insulin

Blood Glucose Insulin Dose

70-110	0 unit
111-140	0 unit
141-180	1 unit
181-220	2 unit
221-240	3 units
241-260	4 units
261-280	5 units
281-300	6 units
301-350	7 units
>350	8 units and call MD



Diabetes Education SERVICES

Mrs. Jones – Carb 1:15

Alg 2 correction, 21 unit Lantus hs

	Break	Lunch	Dinner	HS
Day 1	admit	219	243	219
		4 + 2u	5 + 4u	
Day 2	129 3 u	197 5 + 2u	184 5 + 2u	195 - NPO
Day 3	67 Held ins	gone	119 clear liquids 3 units	104
Day 4	73 3 units	81 5 units	109 4 units	d/c



Diabetes Education SERVICES

Preparation for Surgery

- ▶ Try to schedule surgery in am, resume meds/insulin when eating and stable.
- ▶ Basal Insulin: Night before
 - ▶ Lantus/Detemir – 100%
 - ▶ NPH –
 - ▶ Give 100% night before
 - ▶ 50% am dose
- ▶ Corrective insulin dose: as prescribed
- ▶ Have D5 or D10 IV available in case of hypo



Diabetes Education SERVICES

BG Running Low?

- ▶ Possible Causes
 - ▶ Too much insulin
 - ▶ Premeal bolus
 - ▶ HS basal
 - ▶ Glucose toxicity improving
 - ▶ Infection improving
 - ▶ Stopped/lowered steroids
 - ▶ Poor kidney function
 - ▶ Skipped meal, poor PO intake
 - ▶ Not eating enough carbs



Diabetes Education SERVICES

Hypoglycemia Symptoms

- ▶ **Autonomic**
 - ▶ Anxiety
 - ▶ Palpitations
 - ▶ Sweating
 - ▶ Tingling
 - ▶ Trembling
 - ▶ Hypoglycemic Unawareness
- **Neuroglycopenia**
 - ↓ Irritability
 - ↓ Drowsiness
 - ↓ Dizziness
 - ↓ Blurred Vision
 - ↓ Difficulty with speech
 - ↓ Confusion
 - ↓ Feeling faint



Diabetes Education SERVICES

Hypoglycemia – The Limiting Factor

- ▶ Defined as BG of 70mg/dl or below
- ▶ 50% of episodes occur during night
- ▶ Higher mortality rate with severe hypoglycemia secondary to sulfonylureas
 - ▶ Especially (glyburide) Micronase®, Diabeta®
- ▶ Blood glucose levels don't describe severity, response is individual



Diabetes Education SERVICES

UCLA Hypo Guidelines

BG 41 – 69 mg/dl

- If eating:
 - ½ cup of juice
 - Not eating
 - 25 ml of D50 IV
- Contact MD
- ▶ Recheck and retreat every 15 mins until BG > 70
- ▶ DO NOT give further insulin until ordered by MD



BG <40 mg/dl

- ▶ Give 50 ml D50 IV
- ▶ Contact MD
- ▶ Recheck and retreat every 15 minutes until BG > 70
- ▶ DO NOT give further insulin until ordered by MD



Diabetes Education SERVICES

Adult Subcutaneous insulin order and Hypo Instructions

0800 0900 1000 1100 1200 1300 1400 1500 1600 1700
 Tuesday, April 07, 2009

Insulin aspart (Novolog) 100 units/ml, liq Subcutaneous - As needed for - Convide insulin

Correct blood sugar based on the following schedule: QIC - QHS

Algorithm K2 (units):

- 75-110 (0 unit)
- 115-140 (0 unit)
- 145-180 (1 unit)
- 185-220 (2 units)
- 225-240 (3 units)
- 245-260 (4 units)
- 265-280 (5 units)
- 285-300 (6 units)
- 305-350 (7 units)
- >350 (8 units and call physician)

0900 Insulin (2) 1134 Insulin (4)

0912 Dose: 2 Units (2) 1138 Dose: 4 Units (2)

dextrose 50% liq (25 g) - Dose: 25 g - IV Push - As needed for - Low blood sugar

The order for hypoglycemia.

FCBG <40 mg/dl, then give 50 ml of D50 IV, contact the physician, and recheck and re-treat every 15 minutes until blood sugar >70 mg/dL. Do not give further insulin until ordered by a physician.

FCBG <41 to 69 mg/dl, then give 1/2 cup juice if patient is able or 25 ml of D50 IV. Contact the physician, and recheck and re-treat every 15 minutes until blood sugar >70 mg/dL. Do not give further insulin until ordered by a physician.

Insulin aspart (Novolog) 100 units/ml, liq Subcutaneous - 3 times daily with meals

Give 1 unit of insulin based on the following carbohydrate ratio: 1:12

Patient on ICR

15 - 20 Gms Carb Sources

- ▶ 3 - 4 Glucose Tablets
- ▶ 8 - 10 Lifesavers candy
- ▶ 2 to 3 peppermints
- ▶ 2 Tablespoons Raisins
- ▶ 4 - 6 oz's Nondiet soda
- ▶ 4 oz's Fruit Juice
- ▶ 8 oz Milk (non fat)
- ▶ Peds – 15 Skittles



Diabetes Education
SERVICES

BG Too Low? Insulin Adjustment Guidelines

- ▶ Before meal Blood glucose <70?
- ▶ Implement hypoglycemia protocol
- ▶ Evaluate cause and make needed adjustments
 - ▶ Missed meal?
 - ▶ Too much insulin?
- ▶ Morning blood glucose < 100?
- ▶ Decrease evening Lantus
- ▶ Evaluate trends, provide feedback



Diabetes Education
SERVICES

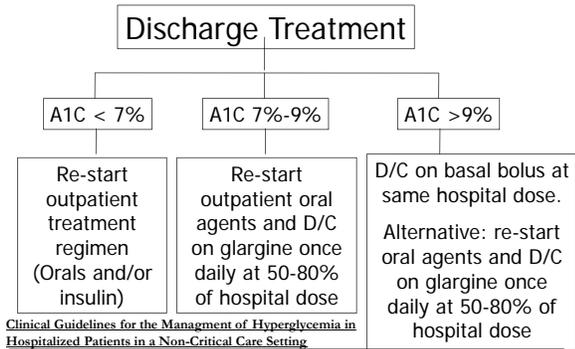
Mrs. Jones ready to go home.

- ▶ What glucose management strategies for home?
- ▶ Her A1c = 8.9%
 - ▶ Creat 1.1
 - ▶ BMI 25



Diabetes Education
SERVICES

Discharge insulin Algorithm



Clinical Guidelines for the Management of Hyperglycemia in Hospitalized Patients in a Non-Critical Care Setting



Diabetes Education SERVICES

Discharge Teaching



- ▶ What supplies will she need?
- ▶ What top 5 things do we need to teach her?
- ▶ What resources can we provide?
- ▶ What referrals?



Diabetes Education SERVICES

5 Survival Skills

1. Basics of Diabetes
 2. Can patient perform self blood glucose monitoring? Do they need meter?
 3. Can pt safely take meds / insulin? Teach side effects.
 4. Meal Planning?
 5. Self Care
- Follow-Up plan - Does pt know who to contact when need help?



Diabetes Education SERVICES

When to Call Provider?*

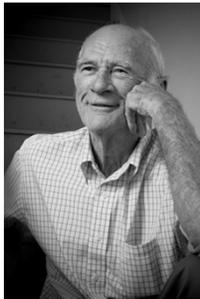
- ▶ Blood glucose <70
- ▶ Blood glucose > 250 twice in a day (adults)
- ▶ Blood glucose >300 anytime, adults and peds
- ▶ *When sick

**Individualize based on pt/provider*



Diabetes Education SERVICES

Mr. R has a foot ulceration How Much Insulin Needed?



- ▶ Creatinine 1.6
- ▶ 76 years old
- ▶ Not very hungry
- ▶ BMI 19
- ▶ Weighs 80kg
- ▶ Glucotrol 5mg at home
- ▶ A1c 7.2%



Diabetes Education SERVICES

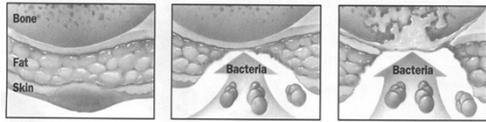
Foot Care

Lift the sheets
and look at the
Feets!



Diabetes Education SERVICES

Foot Wounds



Blisters
Calluses

Ulcers

Bone infection



Diabetes Education
SERVICES

A Quick Foot Assessment

- ▶ Ask - What do you do to take care of your feet?
- ▶ Look - texture, toenails, structural deformities, lesions, corns
- ▶ Assess sensation
- ▶ Assess risk factors
- ▶ Teach, teach, teach



Diabetes Education
SERVICES

Calculate Basal Insulin Needs

- ▶ Typical starting dose
 - ▶ Body wt in Kg x .3
 - ▶ May need more or less based on clinical presentation
 - ▶ 10 units common starting dose



Less 0.1 u/kg 0.2u/kg More 0.35 u/kg

Thin, elderly, ♀ creat Heavy, infection, steroids



Diabetes Education
SERVICES

Calculate Insulin Needs
Basal/ insulin carb/ correct

- ▶ Body wt in Kg x 0.2
- ▶ 80kg x 0.2 = 16 units once daily

- ▶ What insulin:carb ratio?
 - ▶ 1:20

- ▶ What correction alg?
 - ▶ Alg 1



Corrective Insulin – Novolog – Algorithm 1

Rapid/Fast Acting Insulin

Blood Glucose Insulin Dose

70-110	0 unit
111-140	0 unit
141-180	1 unit
181-220	1 unit
221-240	2 units
241-260	2 units
261-280	3 units
281-300	4 units
301-350	5 units
>350	6 units and call MD)



Diabetes Education SERVICES

3 days poor intake, pt started on Tube Feeding



- ▶ If on continuous tube feeding, how would this change his insulin regimen?
- ▶ If on intermittent tube feeding, how would this change his insulin regimen?
- ▶ If patients tube feeding is interrupted, what precautions would you take?



Diabetes Education SERVICES

Mr. R- Pattern – meal + correction
Algorithm 1 plus 16u Lantus hs

	Break	Lunch	Dinner	HS
Day 1		admit	381 3 + 6 units	198
Day 2	98 3 units	127 3 units	69 ins held	98 RN Held Lantus
Day 3	146 3 +1	67 Ins held	72 tube feeding 4 times a day	207 3 +1 unit
Day 6	142 3 + 1 unit	129 Tube pulled – start D10 IV 3 units	Pt feels funny- BG 63 Ins held	184

 Diabetes Education SERVICES

Glycemic Management of the Patient Receiving Enteral Nutrition

Continuous enteral nutrition (EN)

- Basal insulin: NPH Q8 or Q12
- Prandial bolus insulin: to match the feeding

Cycled enteral nutrition

- Based on situation: possibilities include:
- Basal insulin
- Bolus insulin administered q4 to 6 hours
- Correctional insulin given for BG above goal

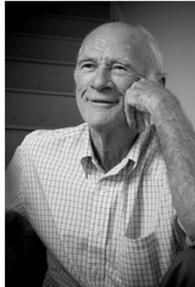
Bolus enteral nutrition

- Rapid acting analog or short acting insulin given prior to each bolus

If tube pulled out, hang D10% at 40cc/hr

 Diabetes Education SERVICES

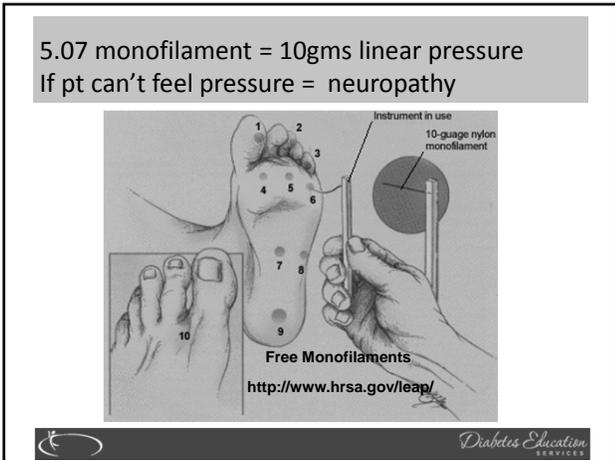
Mr. R after 9 days feeling better, non wt bearing R. Foot. Eating again, regaining strength. DC today.



- ▶ What supplies will he need?
- ▶ What top 3 things do we need to teach him?
- ▶ What resources and referrals?

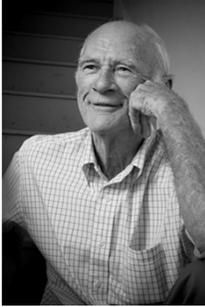
 Diabetes Education SERVICES







Glucose Management for DC?

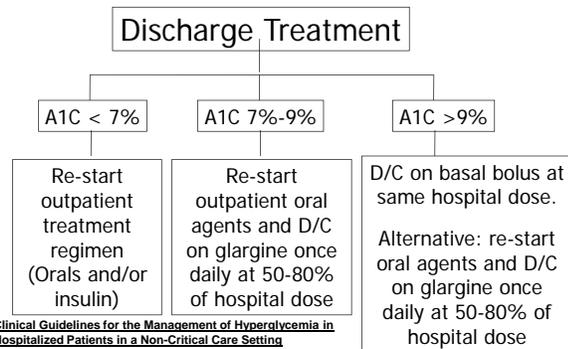


- ▶ Creatinine 1.6
- ▶ 76 years old
- ▶ Not very hungry
- ▶ BMI 19
- ▶ Weighs 80kg
- ▶ Glucotrol 5mg at home
- ▶ A1c 7.2%



Diabetes Education SERVICES

Discharge insulin Algorithm



Clinical Guidelines for the Management of Hyperglycemia in Hospitalized Patients in a Non-Critical Care Setting



Diabetes Education SERVICES

5 Survival Skills

1. Basics of Diabetes
 2. Can patient perform self blood glucose monitoring? Do they need meter?
 3. Can pt safely take meds / insulin? Teach side effects.
 4. Meal Planning?
 5. Self Care
- Follow-Up plan - Does pt know who to contact when need help?



Diabetes Education SERVICES

How Much Insulin Needed?

Mr. K



- ▶ Wt 120kg – BMI 31
- ▶ Creat 0.9
- ▶ Infected Foot Ulcer
- ▶ Asthma
- ▶ Meds
 - ▶ Metformin
 - ▶ Exenatide (ran out)
 - ▶ Actos (worried about ankles swelling)
- ▶ A1c 10.8%



Diabetes Education SERVICES

Started on Prednisone 60mg qd for Asthma



Blood glucose levels running 300-500.



Diabetes Education SERVICES

BG Running High?



- ▶ Possible Causes
 - ▶ Glucose Toxic
 - ▶ Infection
 - ▶ Started on steroids
 - ▶ Physical stress
 - ▶ Insulin dose too low



Diabetes Education SERVICES

BG Too High? Insulin Adjustment Guidelines



- ▶ Morning BG > 140?
 - ▶ Consider:
 - ▶ Could pt be having nocturnal hypo?
 - ▶ Increasing evening Lantus by 10%
- ▶ Pre Lunch/Dinner BG > 140?
- ▶ Post meal BG > 180?
 - ▶ Consider:
 - ▶ Increasing mealtime coverage
 - ▶ Increasing insulin correction scale



Diabetes Education SERVICES

Calculate Insulin Needs Basal/ insulin carb/ correct

- ▶ Body wt in Kg x 0.3
- ▶ 120kg x 0.3 = 36 units once daily

- ▶ What insulin:carb ratio?
 - ▶ 1:10

- ▶ What correction alg?
 - ▶ Alg 3



Diabetes Education SERVICES

Corrective Novolog Insulin Resistant - Algorithm 3

Insulin Resistant, BMI >30, Steroids

Blood Glucose	Insulin Dose
70-110	0 unit
111-140	1 unit
141-180	2 unit
181-220	4 unit
221-240	5 units
241-260	7 units
261-280	9 units
281-300	10 units
301-350	12 units
>350	14 units and call MD)



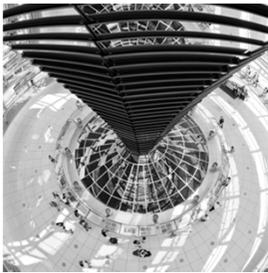
Diabetes Education SERVICES

Mr. K- Pattern (1:10 carb ratio,
Algorithm 3 and 36 Lantus am

	Break	Lunch	Dinner	HS
Day 1		admit	432 8 + 14	182
Day 2	292 4 + 10	417 8 + 14	391 8 + 14	234 5
Day 3	318 5 + 12	497 8 + 14	408 8 + 14	367 14
Day 4	423 4 + 14	429 insulin drip started		



Mr. K BG Levels Too High
Insulin Drip Started



- 100 units insulin in 100 cc NS Bag
- ▶ 1 cc = 1unit of insulin



IV Insulin Infusion

Give extra IV Push insulin x 1 if initial:

- BG 200 -300 – 5units
- BG >300 10 units



- ▶ Monitor BG Q 1 hour for first 4 hours or if BG <100 or >200. Otherwise, monitor Q 2 hours.



Stopping Insulin Infusion

If on insulin infusion, discontinue infusion 2 hours after 1st BASAL insulin dose

insulin glargine (Lantus) 100 units/mL, Inj 12 Units : Dose 12 Units : Subcutaneous : 2 times daily at 8 AM & 8 PM
If on insulin infusion, discontinue infusion in 2 hours after 1st basal (long acting) insulin dose. When eating patients are made NPO, give full dose of scheduled glargine.

0802 Given 12 Units

When eating patients are made NPO, give full dose of scheduled glargine



Diabetes Education SERVICES

Diabetes KetoAcidosis

- ▶ 135,000 Hospitalizations a year
- ▶ \$2.4 billion U.S. dollars spent on treatment
- ▶ Often a cry for help



[ADA article on Hyperglycemic Crises](#)



Diabetes Education SERVICES

DKA Precipitating Factors

- ▶ 25 -30% of time, illness and infection
 - ▶ increases stress hormone release
- ▶ 50% inadequate insulin dosage
- ▶ initial manifestation of type 1
- ▶ emotional stress - especially teens, neglect or mismanagement



Diabetes Education SERVICES

**Extreme Hyperglycemia –
Diabetes KetoAcidosis (DKA)**

- ▶ DKA - profound insulin deficiency
- ▶ Excess stress hormones such as glucagon, epinephrine, and cortisol render insulin less effective
- ▶ Excess glucose production by liver
- ▶ Lipolysis leads to FFA's and ketones
- ▶ Osmotic diuresis, dehydration, lyte imbalances, acidosis



DKA Signs and Symptoms

- ▶ hyperglycemia- leads to weakness, lethargy, malaise, headache
- ▶ GI symptoms - N/V, abd pain
- ▶ Kussmaul's deep, rapid breathing
- ▶ hypothermia, acetone breath
- ▶ hyperpnea - to rid acidosis
- ▶ changes in mentation, hyporeflexia/tonia
- ▶ dehydration, ortho hypo



**Extreme Hyperglycemia –
Hyperosmolar Hyperglycemic State (HHS)**

- ▶ occurs in elderly pt's w/ type 2 - esp if not closely monitored
- ▶ often precipitated by illness or stress
- ▶ symptoms may go unrecognized for wks
- ▶ massive fluid loss from osmotic diuresis
 - ▶ burns, hyperglycemia, diarrhea, hemodialysis, diuretics, steroids
- ▶ MI, infections, hypertonic feedings



DKA vs HHS

- | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> ▶ Usually < 40 yrs old ▶ < 2 days symptoms ▶ Glucose >250 ▶ Serum Ketones: +++ ▶ pH low (<7.3) ▶ Anion Gap > 12 ▶ Usually Type 1 ▶ 3 – 10% mortality | <ul style="list-style-type: none"> ▶ Usually >60 yrs old ▶ > 5 days symptoms ▶ Glucose >600 ▶ Ketones: none to + ▶ pH normal (>7.3) ▶ Usually Type 2 ▶ 10 - 20% mortality |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



Diabetes Education SERVICES

DKA - HHS Presentation and Action

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> ▶ Labs <ul style="list-style-type: none"> ▶ NA - low to high ▶ K+ - moves into vascular space ▶ Hct and Hgb ↑ dehydration ▶ BUN / Creatinine ↑ ▶ WBC ↑ ▶ pH low to normal | <ul style="list-style-type: none"> ▶ Action <ul style="list-style-type: none"> ▶ maintain insulin drip until anion gap closed, ketones negative ▶ glucose < 200 ▶ maintain hydration ▶ check BG q1 hour ▶ assess lytes, K+ ▶ give sub-Q insulin before d/c IV insulin ▶ teach, teach, teach |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



Diabetes Education SERVICES

Anion Gap Calculation

- ▶ Na+ value – (Bicarb +Cl) = anion gap
- ▶ Goal is to be close to 10 as possible.
- ▶ Normal is 10 to 12
- ▶ Bicarb is from venous blood (not arterial blood)

CHEM 7	
Sodium	131
Potassium	4.0
Chloride	89
Total CO2	26
Urea Nitrogen	30
Creatinine	1.7
Glucose	546



131 – (89 +26) =
131 – 115 = 16
Gap = 16



Diabetes Education SERVICES

Tx of DKA	Tx of HHS
<ol style="list-style-type: none"> 1. Fluids-rehydrate 2. Replace insulin to correct glucose, pH, ketosis 3. Correct electrolyte imbalances 4. Provide Glucose 5. Treat underlying medical condition 6. Prevent complications 7. Pt and family ed 	<ol style="list-style-type: none"> 1. Fluids-rehydrate 2. Replace insulin to correct glucose 3. Correct electrolyte imbalances 4. Treat underlying medical condition 5. Prevent complications 6. Pt and family ed

Diabetes Education SERVICES

DKA and HHS



5 most important interventions

- ▶ Fluids (NS, →0.45 NS, →D51/2 NS once glucose 200 – 250 mg/dl)
- ▶ Insulin (.05 - 0.1unit/kg per hour)
- ▶ Potassium / lyte replacement
 - (K⁺, Mg, Ca, Phos)
- ▶ Determine, treat precipitating cause
- ▶ Education to prevent future episodes

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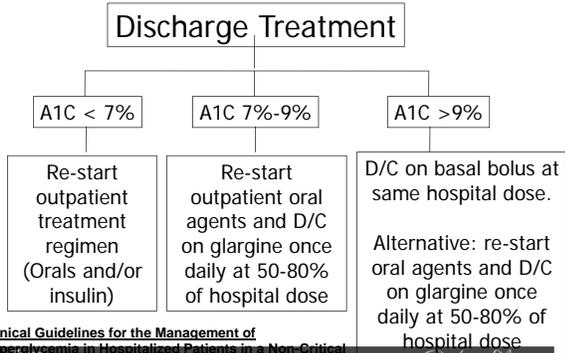
What Glucose Management Strategy for Discharge?



- ▶ Waistline 46"
- ▶ Infected Foot Ulcer
- ▶ A1c 10.8%
- ▶ Creat 1.3
- ▶ Asthma (on pred)
- ▶ Meds?
 - ▶ Basal/Bolus Insulin
 - ▶ Metformin

Diabetes Education SERVICES

Discharge insulin Algorithm



Clinical Guidelines for the Management of Hyperglycemia in Hospitalized Patients in a Non-Critical Care Setting

Diabetes Education SERVICES

MR K. Stable, ready for discharge.

- ▶ What is your biggest concern?
- ▶ What supplies will he need?
- ▶ What top 3 things do we need to teach him?
- ▶ What resources and referrals?



Diabetes Education SERVICES

Insulin Teaching Keys

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> ▶ Bolus insulin with meals ▶ Basal 1-2xs daily ▶ Can't mix Glargine or Detemir with other insulins ▶ Abdomen preferred injection site ▶ Stay 1" away from previous site ▶ Can re-use syringes if patient at low risk for infection | <ul style="list-style-type: none"> ▶ Keep unopened insulin in refrigerator ▶ Toss opened insulin vial after 28 days ▶ Proper disposal ▶ Review patients ability to withdraw and inject. ▶ Side effects include hypoglycemia/wt gain |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



Diabetes Education SERVICES

5 Survival Skills

1. Basics of Diabetes
 2. Can patient perform self blood glucose monitoring? Do they need meter?
 3. Can pt safely take meds / insulin? Teach side effects.
 4. Meal Planning?
 5. Self Care
- Follow-Up plan - Does pt know who to contact when need help?



DiaBingo - I

- I Inhaled insulin
- I Glargine, Detemir, NPH are types of
- I Breakdown of glycogen into glucose
- I Anabolic hormone
- I Insulin is released when glucose levels are low
- I Once opened, insulin vials are good for one _____
- I Elevated post-prandial glucose indicate need for pre-meal
- I Epinephrine increases insulin resistance
- I Creation of glucose from amino acids and lactate
- I Decreasing renal function for people on insulin can cause
- I Bolus insulins
- I A hormone that increases blood glucose levels



Diabetes Education
SERVICES

Medical Nutrition Therapy – ADA 2014 Updates

- No ideal percentage of calories from protein, carbohydrate and fat for people with diabetes.
- Macronutrient distribution should be based on an *individualized assessment* of eating patterns, preferences and metabolic goals.



Diabetes Education
SERVICES

Medical Nutrition Therapy – ADA

- ▶ Focus on the Individual
- ▶ Maintain pleasure of eating
- ▶ Provide positive messages about food
- ▶ Limit food choices only when backed by science
- ▶ Provide practical tools
- ▶ Refer to a RD and Diabetes Education – Lowers A1c by 1-2%



Diabetes Education SERVICES

Approach Depends on Patient

- New Type 2
 - Portion Control
 - Plate Method
 - Record Keeping
 - Education
- On Insulin?
 - Carb counting
 - Post prandial checks



Diabetes Education SERVICES

What are next steps?

- ▶ 72 yr old, thin, lives alone, A1c 7.3%. History of MI, stroke. DM for 12 yrs, “diet controlled”. Creat 1.4
- ▶ Limited income.
- ▶ Good insurance



Diabetes Education SERVICES

DPP-4 Inhibitors – “Incretin Enhancers”

Januvia (sitagliptin) – Tradjenta (linagliptin)
Onglyza (saxagliptin) Nesina (alogliptin)

▶ Action:

- ▶ Increase insulin release w/ meals
- ▶ Suppress glucagon

▶ Dosing:

Januvia – 100mg a day
Onglyza – up to 5mg a day
Tradjenta – 5mg a day
Nesina – up to 25 mg a day

▶ Efficacy:

Decreases A1c by 0.6 -0.8%

▶ Benefits/ Issues:

weight neutral, no hypo, few side effects. Expensive



Diabetes Education SERVICES

Losing 2-8kg Early in diagnosis Type 2 Helpful

ADA 2014

▶ Weight Loss –

- ▶ *The optimal macronutrient intake to lose weight not known*
- ▶ *The literature does not support one particular nutrition therapy to reduce weight, but rather a spectrum of eating patterns that result in reduced energy intake.*



- ▶ To lose one pound – avoid 3,500 cal
 - ▶ Decrease intake 250-500 cal daily + exercise



Diabetes Education SERVICES

Successful weight loss strategies include

- ▶ Weekly self-weighing
- ▶ Eat breakfast
- ▶ Reduce fast food intake.
- ▶ Decrease portion size
- ▶ Increase physical activity
- ▶ Use meal replacements
- ▶ Eat healthy foods



Diabetes Education SERVICES

Diabetes Prevention Program Focus on fat = wt loss success

To help you lose weight and improve your health, stay as close as possible to your fat and calorie goals.
Find your starting weight below. Your fat and calorie goals are in the same row. Circle your fat and calorie goals.

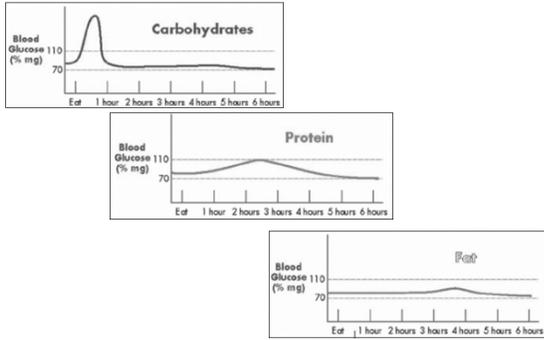
Weight (lb)	Fat Goal (grams)	Calorie Goal
120-174	33	1,200
175-219	42	1,500
220-249	50	1,800
>250	55	2,000

<http://www.cdc.gov/diabetes/prevention/recognition/curriculum.htm>



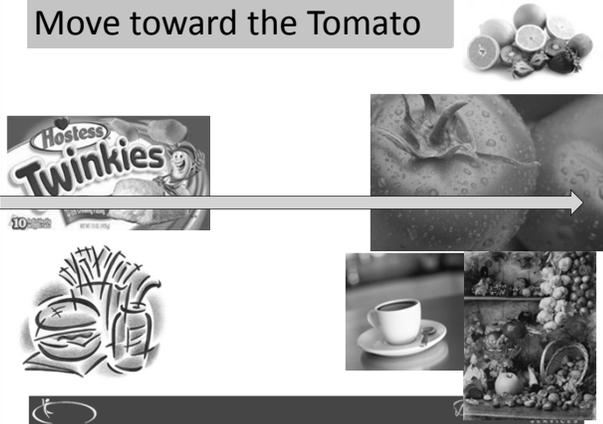
Diabetes Education SERVICES

How nutrients affect blood sugar



Diabetes Education SERVICES

Move toward the Tomato



ADA recommendation Eat Less Junk Food & Sugary Drinks –

- ▶ Less Processed Foods
- ▶ Less Sugary Beverages
 - ▶ increase visceral adiposity
 - ▶ 12 teaspoons sugar in one soda
 - ▶ High fructose corn syrup
- ▶ Avg American eat 25 teaspoons of sugar a day.
- ▶ Soda Tax?
- ▶ Junk Food Tax?



Diabetes Education SERVICES

10 Superfoods

- ▶ Beans
- ▶ Dark Green Leafy Veggies
- ▶ Citrus Fruit
- ▶ Sweet Potatoes
- ▶ Berries
- ▶ Tomatoes
- ▶ Fish High in Omega-3 Fatty Acids
- ▶ Whole Grains
- ▶ Nuts
- ▶ Fat-Free Milk and Yogurt



Diabetes Education SERVICES

USDA Plate Method www.myplate.gov

Balancing Calories

- ▶ Enjoy your food, but eat less.
- ▶ Avoid oversized portions.

Foods to Increase

- ▶ Make half your plate fruits and vegetables.
- ▶ Make at least half your grains whole grains.
- ▶ Switch to fat-free or low-fat (1%) milk.

Foods to Reduce

- ▶ Compare sodium in foods like soup, bread, and frozen meals — and choose the foods with lower numbers.
- Drink water instead of sugary drinks.



Diabetes Education SERVICES

Carbohydrate Needs for Most Adults

	<u>Grams</u>	<u>Servings</u>
Each Meal	45-60 gm	3 - 4
Snacks	15-30 gm	1- 2



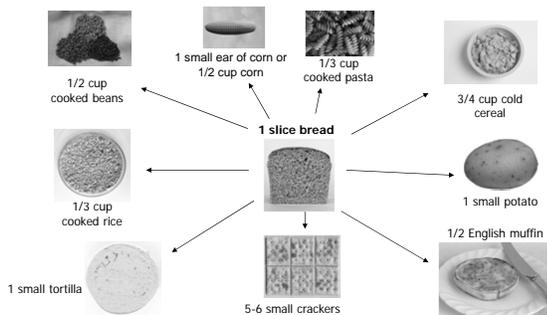
Carbs affect Post Meal Blood Glucose



Diabetes Education SERVICES

Carb Counting - Starch

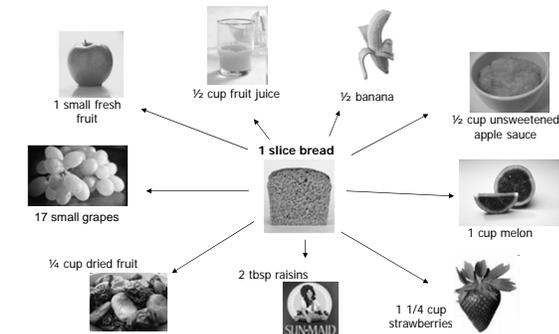
Each Food has:
80 Calories
15 grams carb



Diabetes Education SERVICES

Carb counting- fruit

Each Food has:
60 Calories
15 grams carb



Diabetes Education SERVICES

Carb Counting - Milk

Each Food has:
90-150 calories
12-15 grams carb

1 slice bread

- 1 packet diet hot cocoa
- 8 oz buttermilk
- 6 oz plain yogurt
- 8 oz milk
- 8 oz soy milk
- 6 oz light fruit yogurt

Diabetes Education SERVICES

Carb Counting - Sweets

Each Food has:
Calories vary
15 grams carb

1 slice bread

- 2 inch square cake or brownie, unfrosted
- 1/2 cup diet pudding
- 1/2 cup regular jello
- 2 tsp light syrup
- 2 small cookies
- 1/2 cup ice cream or frozen yogurt
- 1/2 cup sherbet
- 1/4 cup sorbet
- 1 tbsp syrup, jam, jelly, table sugar, honey

Diabetes Education SERVICES

Using Alcohol Safely

- ▶ Women- 1 or fewer alcoholic drinks a day
- ▶ Men 2 or fewer alcoholic drinks a day
 - ▶ 1 alcoholic drink equals
 - ▶ 12 oz beer, 5 oz glass of wine, or 1.5 oz distilled spirits (gin etc)
- ▶ If drink, limit amount and drink w/ food.
- ▶ Ask HCP if safe for you to drink. Tell them your usual quantity and frequency.
- ▶ Can cause hypo and worsen neuropathy

Diabetes Education SERVICES

Ms. Gonzales' Daily Meal plan

Break	Lunch	Dinner	Night
5 corn tortillas, 1/2 c. beans, salsa, peppers, egg beaters	Sandwich, low fat potato chips, 1c. juice, 2-4 lowfat cookies	Lg bowl low salt soup, 1c. rice, BBQ meat, salad & cooked vegs 1 glass wine	1 bowl of cereal
Avg BG 120's	Avg BG 200's	Avg BG 200's	Avg BG 180's



Diabetes Education SERVICES

DiaBingo - N

- N DPP demonstrated that exercise and diet reduced risk of DM by ___%
- N An _____ a day can help prevent heart attack and stroke
- N Rebound hyperglycemia
- N Scare tactics are effective at motivating patients to change behavior
- N Losing ___ % of body weight, can improve blood glucose, BP, lipids
- N Drugs that can cause hyperglycemia
- N 2/3 cups of rice equals _____ serving carbohydrate
- N A1c of 7% equals glucose of _____
- N One % drop in A1c reduces risk of complications by ___%
- N 1 gm of fat equal _____kilo/calories
- N Metabolic syndrome = hyperglycemia, hyperlipidemia, hypertension
- N Average American consumes 25 teaspoons of sugar a day.



Diabetes Education SERVICES

Thank You



- ▶ Questions?
- ▶ Email
bev@diabetesed.net
- ▶ Web
www.DiabetesEd.net



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