Insulin Management

Marie Russell, MD, MPH

Objectives

- Important Studies
- Approach to Hyperglycemia Management
- Pathophysiology of Insulin
- Types of Insulin
- Side Effects of Insulin
- Insulin Regimens
- Case Studies

UKPDS

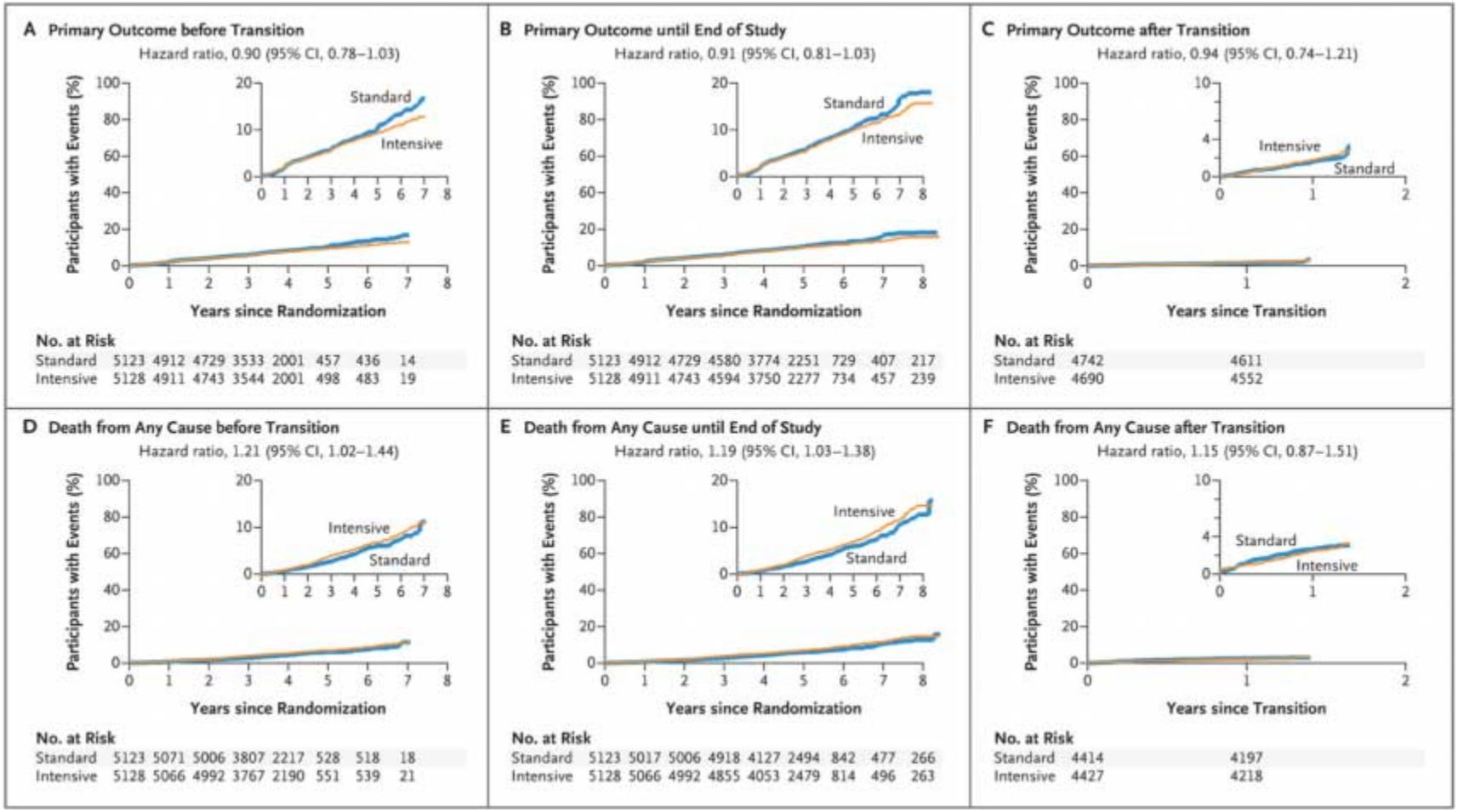
- Retinopathy, nephropathy, and possibly neuropathy benefit by lowering blood glucose levels in type 2 diabetes with intensive therapy, which achieved a median HbA_{1c} of 7.0% compared with conventional therapy with a median HbA_{1c} of 7.9%. The overall microvascular complication rate was decreased by 25%.
- Continuous relationship between the risks of microvascular complications and glycemia, such that for every percentage point decrease in HbA_{1c} (e.g., 9 to 8%), there was a 35% reduction in the risk of complications.
- Risks of complications can be significantly lowered even in the range of hyperglycemia where HbA_{1c} levels are <8.0%. There was no evidence of any glycemic threshold for any of the microvascular complications above normal glucose levels (i.e., HbA_{1c} >6.2%).
- No significant effect of lowering blood glucose on cardiovascular complications was observed. A 16% reduction (which was not statistically significant, *P = 0.052*) in the risk of combined fatal or nonfatal myocardial infarction and sudden death was observed.

Diabetes Care January 2002 Vol 25 No Suppl 1 528-532

ACCORD

- The Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial was designed to determine whether a strategy of targeting normal glycated hemoglobin levels (i.e., <6.0%) would reduce the risk of serious cardiovascular events in middle-aged and elderly people with type 2 diabetes mellitus, glycated hemoglobin levels of 7.5% or more, and additional cardiovascular risk factors.
- Trial terminated at 3.5 years because of finding of no significant reduction in cardiovascular events but a higher mortality in intensive group
- Of note:
  - Study involved patients who had diabetes for median of 10 years, HgbA1c of 7.5%, and had high risk of cardiovascular disease

The ACCORD Study Group. N Engl J Med 2011;364:818-828.



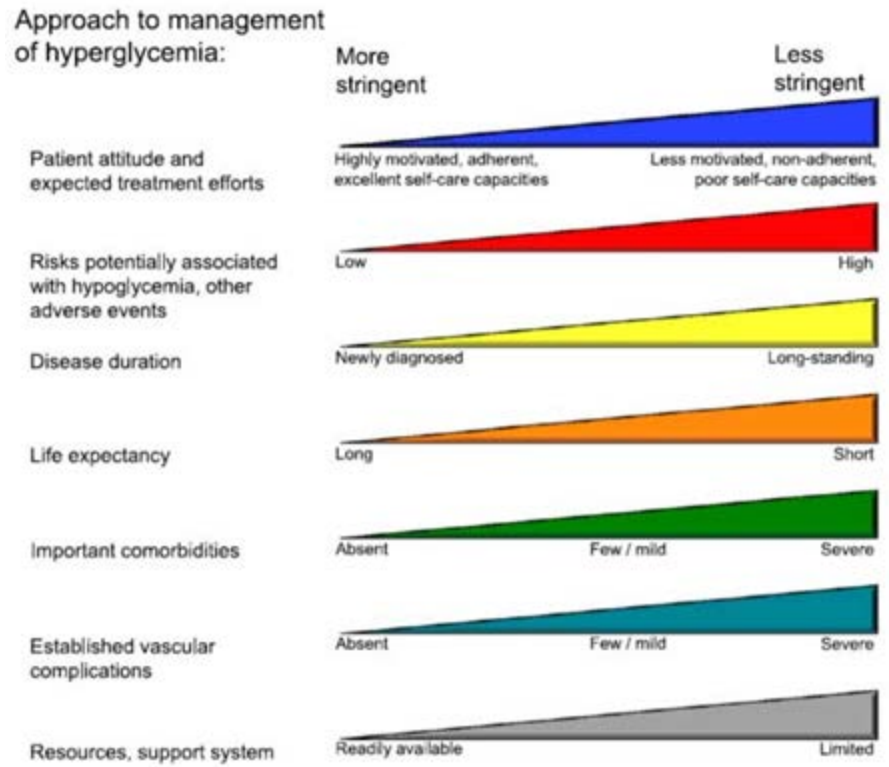
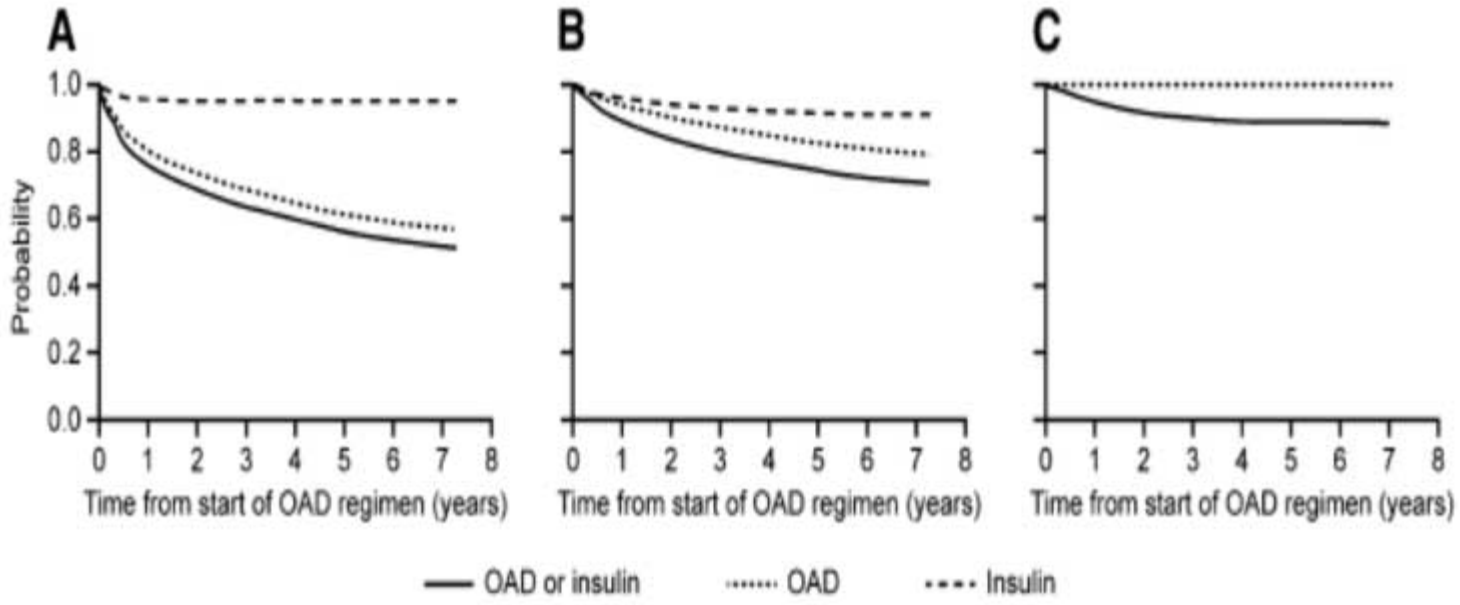


Figure 1—*Depiction of the elements of decision making used to determine appropriate efforts to achieve glycemic targets. Greater concerns about a particular domain are represented by increasing height of the ramp. Thus, characteristics/predicaments toward the left justify more stringent efforts to lower* HbA_{1c}*, whereas those toward the right are compatible with less stringent efforts. Where possible, such decisions should be made in conjunction with the patient, reflecting his or her preferences, needs, and values. This "scale" is not designed to be applied rigidly but to be used as a broad construct to help guide clinical decisions. Adapted with permission from Ismail-Beigi et al. (20).*

Not One Size Fits All

- Glycemic Target
  - Duration of DM
  - Age
  - CVD
- Readiness for change
- Predisposition to hypoglycemia
- Important Co-morbidities
- Resources

Clinical Inertia



Diabetes Care July 22, 2013

Clinical Inertia

Table 2—*Probability at end of follow-up/median time (in years) of going from HbA_{1c} above cutoff to intensification, reaching glycemic target, or end of follow-up data*

Cutoff HbA_{1c}	Number of OADs*	Patients with treatment intensified with additional OAD	Patients with treatment intensified with insulin	Patients with treatment intensified with additional OAD or insulin
≥7% (≥53 mmol/mol)				
n = 35,988	1	65.0, 2.9	6.5, >7.2*	71.5, 2.2
n = 21,858	2	31.5, >7.2*	13.7, >7.2*	45.2, >7.2*
n = 5,050	3	—	17.5, >7.1*	17.5, >7.1*
≥7.5% (≥58 mmol/mol)				
n = 31,375	1	66.9, 1.9	7.6, >7.1*	74.5, 1.5
n = 20,164	2	32.1, >7.2*	17.1, >7.2*	49.2, >7.2*
n = 4,733	3	—	20.6, >6.1*	20.6, >6.1*
≥8% (≥64 mmol/mol)				
n = 25,096	1	67.0, 1.6	8.8, >6.9*	75.8, 1.1
n = 16,991	2	30.1, >6.9*	20.2, >6.9*	50.3, 6.3
n = 4,112	3	—	22.0, >6.0*	22.0, >6.0*

Data are probability (%), median (years) unless otherwise indicated. *The symbol > indicates that <50% of subjects have intensified treatment. Differences in this value are due to variation between subcohorts.

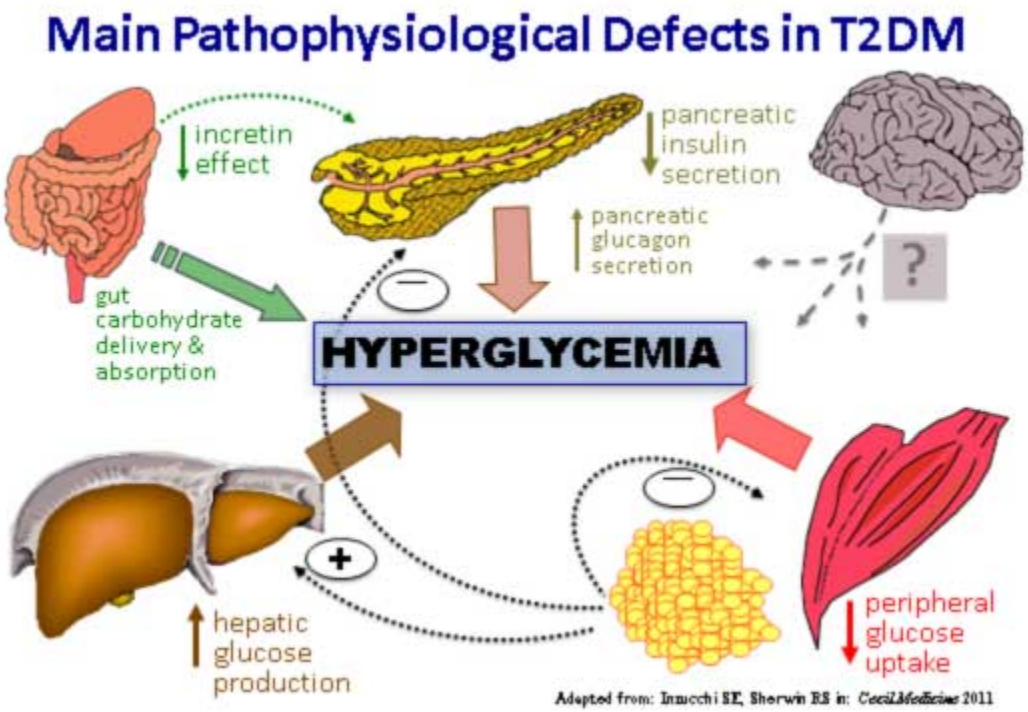
Diabetes Care July 22, 2103

ADA-EASD Position Statement: Management of Hyperglycemia

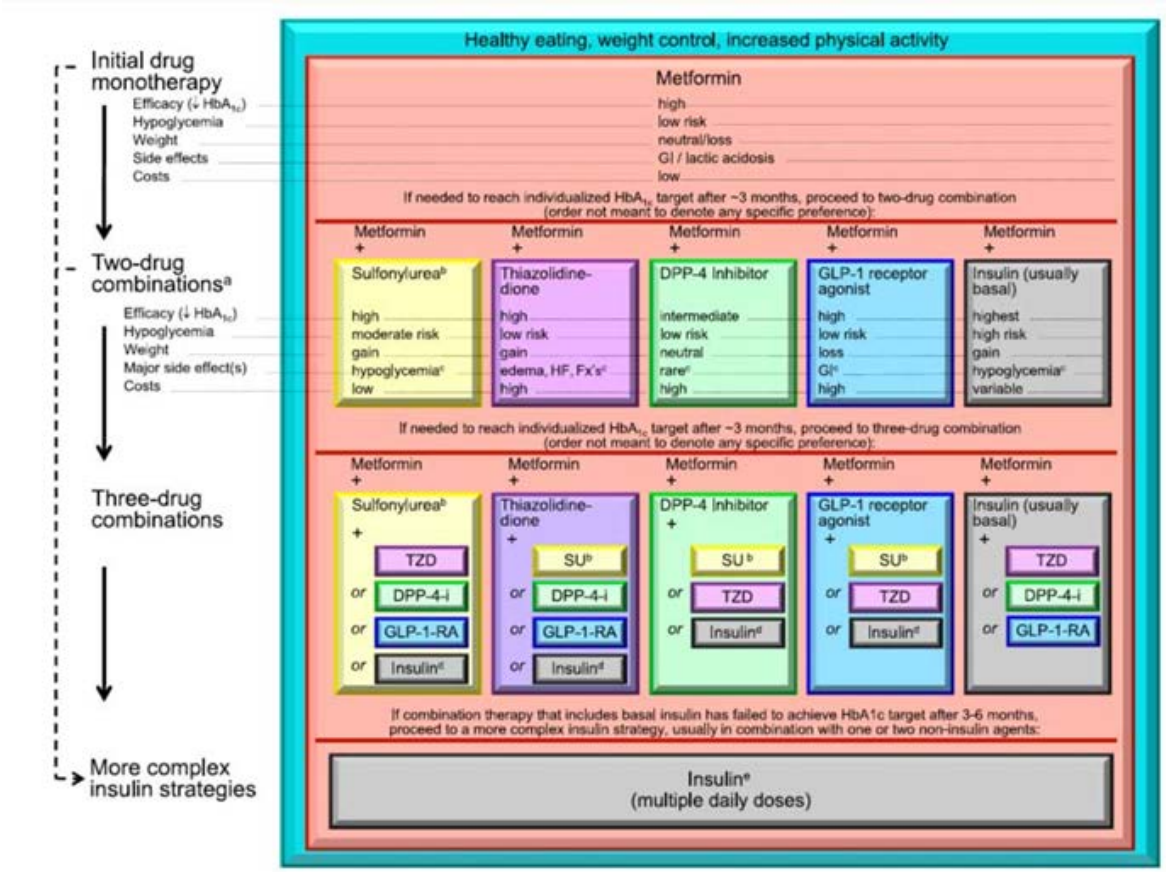
3. Antihyperglycemic Therapy

- Therapeutic options: ***Lifestyle***
  - Weight Optimization
  - Healthy Diet
  - Increased Activity Level

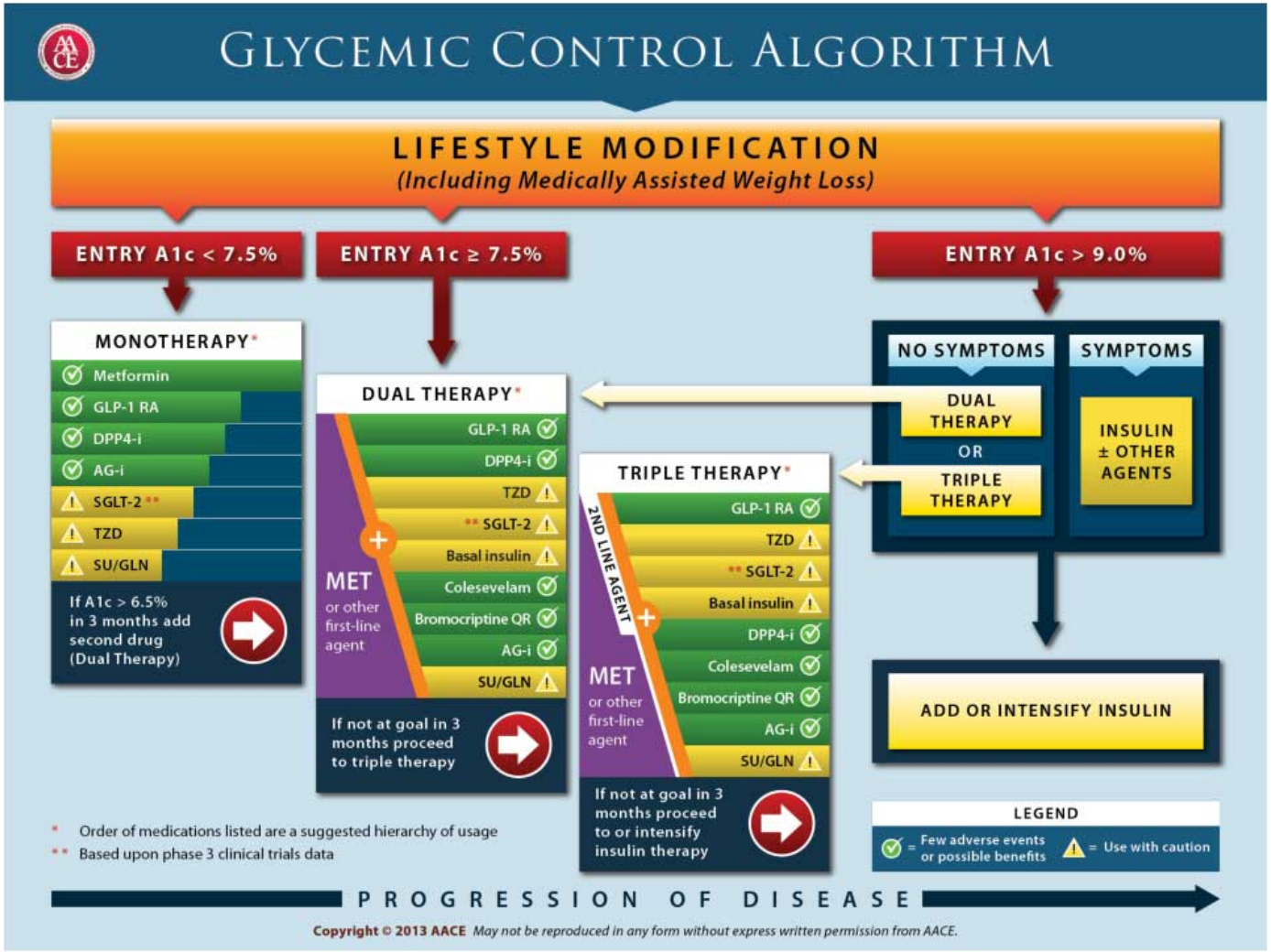
Diabetes Care, Diabetologia. **19 April 2012**


Main Pathophysiological Defects in T2DM
incretin effect
pancreatic insulin secretion
pancreatic glucagon secretion
?
gut carbohydrate delivery & absorption
HYPERGLYCEMIA
hepatic glucose production
peripheral glucose uptake
Adapted from: Inzucchi SE, Sherwin RS in: CecilMedicine 2011

ADA/EASD Antihyperglycemic Therapy in Type 2 Diabetes



Diabetes Care, Volume 35, June 2012


GLYCEMIC CONTROL ALGORITHM
LIFESTYLE MODIFICATION
(Including Medically Assisted Weight Loss)
ENTRY A1c < 7.5%
ENTRY A1c ≥ 7.5%
ENTRY A1c > 9.0%
MONOTHERAPY*
Metformin
GLP-1 RA
DPP4-i
AG-i
SGLT-2 **
TZD
SU/GLN
If A1c > 6.5% in 3 months add second drug (Dual Therapy)
DUAL THERAPY*
MET or other first-line agent
GLP-1 RA
DPP4-i
TZD
** SGLT-2
Basal insulin
Colesevelam
Bromocriptine QR
AG-i
SU/GLN
If not at goal in 3 months proceed to triple therapy
TRIPLE THERAPY*
2ND LINE AGENT
MET or other first-line agent
GLP-1 RA
TZD
** SGLT-2
Basal insulin
DPP4-i
Colesevelam
Bromocriptine QR
AG-i
SU/GLN
If not at goal in 3 months proceed to or intensify insulin therapy
NO SYMPTOMS
SYMPTOMS
DUAL THERAPY
OR
TRIPLE THERAPY
INSULIN ± OTHER AGENTS
ADD OR INTENSIFY INSULIN
LEGEND
= Few adverse events or possible benefits
= Use with caution
* Order of medications listed are a suggested hierarchy of usage
** Based upon phase 3 clinical trials data
PROGRESSION OF DISEASE
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Type 2 Diabetes - Glucose Control

DM DX – confirm with second test

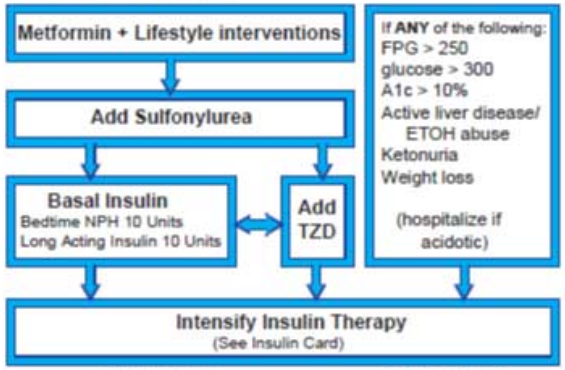
1. A1c ≥ 6.5% (preferred method)
2. FPG ≥ 126
3. 2° (OGTT) ≥ 200
4. Non-fasting lab glucose ≥ 200 with sx

Prediabetes is defined as A1c 5.7-6.4%, FPG 100-125, or 2 ° (OGTT) 140-199

DM BG Targets

Premeal:	< 70-130
2° PP:	< 160-180
A1c:	< 7%

Individualize targets based on patient condition



Immunizations

Pneumovax—At Dx & again at age 65 (if ≥5 yrs. since 1st shot)
Flu shots yearly
Td /Tdap (routine)
PPD once after Dx of DM (Pos is ≥10mm)

Don't Forget

Glucose toxicity— Insulin production↓'s if prolonged hyperglycemia; insulin shots short-term reverse this.
Pancreatic Exhaustion— Almost all Type 2 diabetics will eventually require insulin.

Monitoring of DM

- A1c every 3-6 months
- Creatinine and eGFR yearly
- UACR yearly
- Lipid Panel yearly
- LFTs yearly
- ECG every 2-5 years
- Complete Foot Exam yearly
  - Foot inspection each visit
- Retinopathy exam yearly
- Paps, Mammograms, and Contraception
- Evaluate sexual function
- Depression, Tobacco, ETOH, and DV screening yearly

Estimated Average Glucose (eAG)

A1c %	6	7	8	9	10	11	12
Mean plasma gluc	126	154	183	212	240	269	298mg/dL

Type 2 Diabetes - Glucose Control

Biguanides: Metformin & Metformin XR (Glucophage,)
Start 500 mg daily with meals and increase no faster than 500 mg each week. If GI sx occur may increase more slowly.
Max. dose: 2000mg daily or divided with XR tablets. Do not split XR tablets.
2500 mg divided BID-TID with regular release tablets.
Can decrease weight. Pt. must have normal creatinine (males <1.5, females <1.4). Do not use if liver disease (check ALT) or significant ETOH use. Discontinue before surgery or IV contrast dye administration.

Sulfonylureas: Glyburide (Micronase,) and Glipizide (Glucotrol®)
Start 2.5-5mg daily – Max 10 mg BID
Can increase weight and cause hypoglycemia

Thiazolidinediones (TZD): *Pioglitazone (Actos®)*
Start 15mg daily; may increase to 30mg daily (little benefit dosing over 30mg)
Max A1c changes may take up to 12 weeks to occur
Check ALT at baseline & periodically. No underlying liver dz or significant ETOH use. Warning: heart failure and fracture risk. May use in renal insufficiency. Can cause weight gain.

DPP-4 Inhibitors: May reduce weight, mild to mod A1c lowering
Sitagliptan (Januvia®) - Dose: 100mg PO daily; Reduce dose if ≥ Stage 3 CKD
Saxagliptan (Onglyza®) - Dose: 2.5-5mg PO daily
Dose 2.5mg if strong P450 3A/4 inhibitors or mod-sev renal impairment

GLP-1 Mimetics: Can decrease weight, mild to mod A1c lowering
May be associated with pancreatitis – seek medical care if persistent severe abdominal pain with or without vomiting
Exenatide (Byetta®) Start 5 mcg/dose BID SC inj in thigh, abdomen, or upper arm
May increase to 10 mcg/dose BID after 1 month of treatment
Administer within 60 minutes before meals Do not use if ≥ Stage 4 CKD
Liraglutide (Victoza®) - Start 0.6mg daily SC inj in thigh, abdomen, or upper arm
Inc to 1.2mg daily in 1 week. May increase to 1.8mg daily

Pramlintide (Symlin®) - Amylin mimetic
Mild A1c lowering, small decrease in weight
Start 60 mcg daily subcutaneously immediately before a major meal
(Reduce preprandial (short acting) insulin by 50% as appropriate)
Start with lower doses in type 1 diabetes
May increase to 120 mcg after significant nausea is gone x 3-7 days

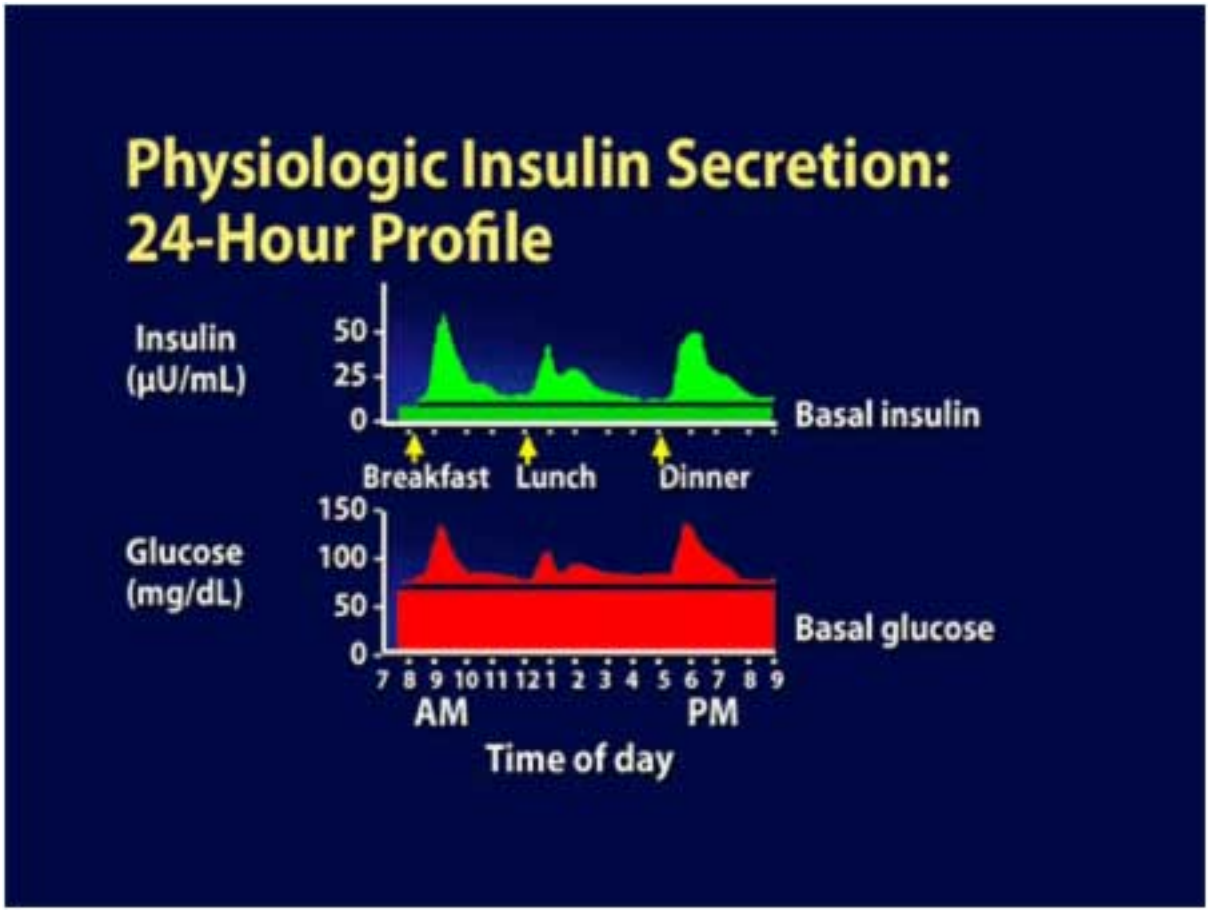
Drug names in italics are not on the IHS National Core Formulary

Ref: ADA Clinical Practice Recommendations 2010 Diabetes Care 2010;33
Ref: Medical Management of Hyperglycemia in Type 2 Diabetes: A Consensus Algorithm for the Initiation and Adjustment of Therapy Diabetes Care 2009;32(1):193-203

Goal of Insulin Therapy

We are trying to duplicate how the pancreas works in releasing insulin for someone who does not have diabetes

Physiologic Insulin Secretion



Type 2 DM – Insulin

Basal Insulin – intermediate to long acting insulin

Insulin	Onset	Peak	Duration
NPH (Novolin N ®) *(Humulin N ®)*	1-3 hours	6-10 hours	12-20 hours
Levemir (Detemir ®) *Glargine (Lantus ®)*	1 hour 1 hour	None None	12-24 hours 24 hours

Bolus Insulin – shorter acting insulin

Insulin	Onset	Peak	Duration
Aspart (Novolog ®) *Lispro (Humalog ®)* *Glulisine (Apidra ®)*	15-30 min	30-90 min	3-5 hours
Regular (Novolin R ®) *(Humulin R ®)*	30-60 min	1-2 hours	5-8 hours

Premixed Insulin – longer and shorter acting

Consider for people who cannot mix insulin, use an insulin pen, or whose stable dose of insulin is the same as the premix.

Insulin	Onset	Peak	Duration
Novolin, Novolog 70/30	30 min	2-5 hours	18-24 hours
Humulin 50/50	30 min	2-4 hours	14-24 hours
Humalog 75/25	15 min	½-2½ hrs	16-20 hours

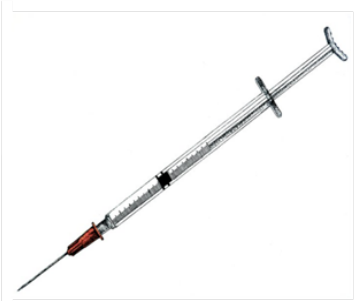
Drugs names in italics are not on the National Core Formulary

Ref: Nathan, Buse, Davidson, et al. Medical Management of Hyperglycemia in Type 2 Diabetes.: a Consensus Algorithm for the Initiation and Adjustment of Therapy. (2009). Diabetes Care 32, 193-203.

ADA-EASD Position Statement: Management of Hyperglycemia in T2DM

3. ANTI-HYPERGLYCEMIC THERAPY

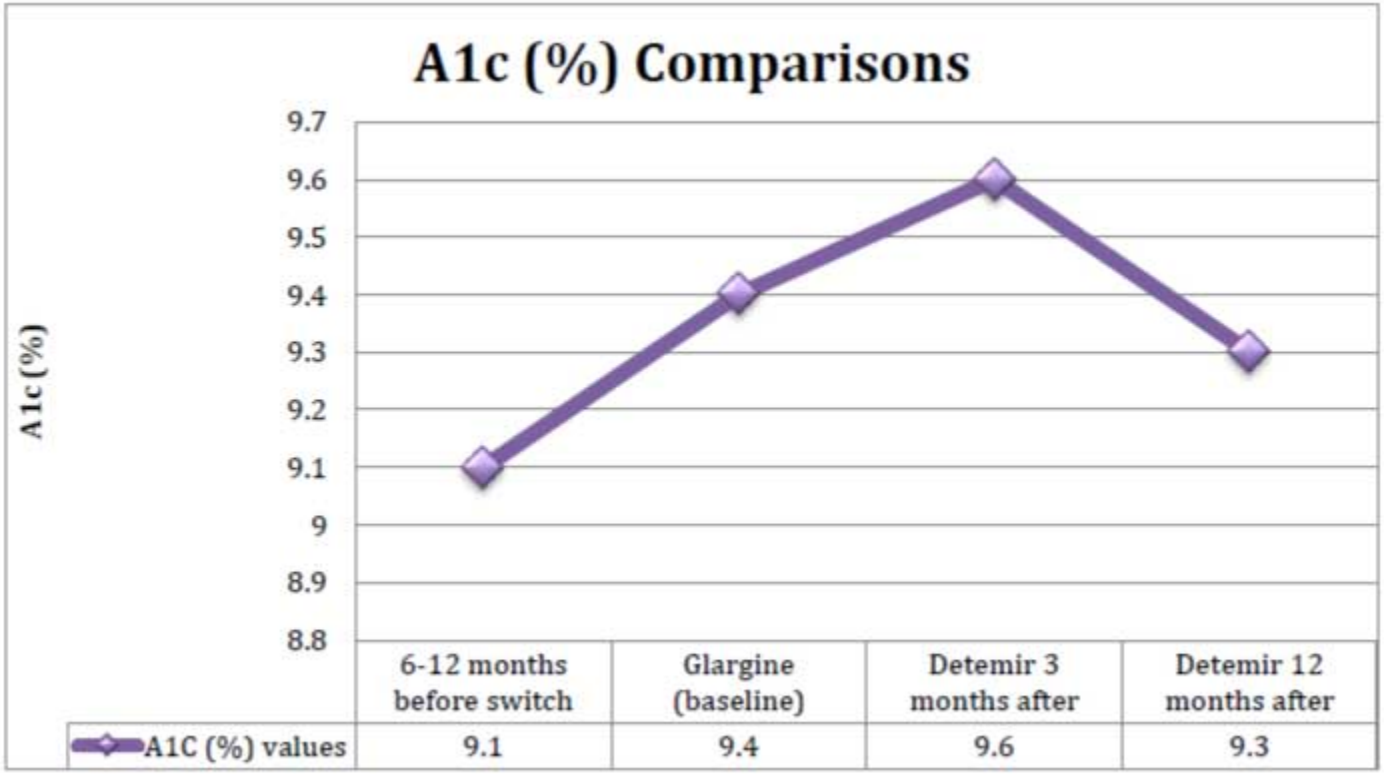
- **Therapeutic options: Insulin**



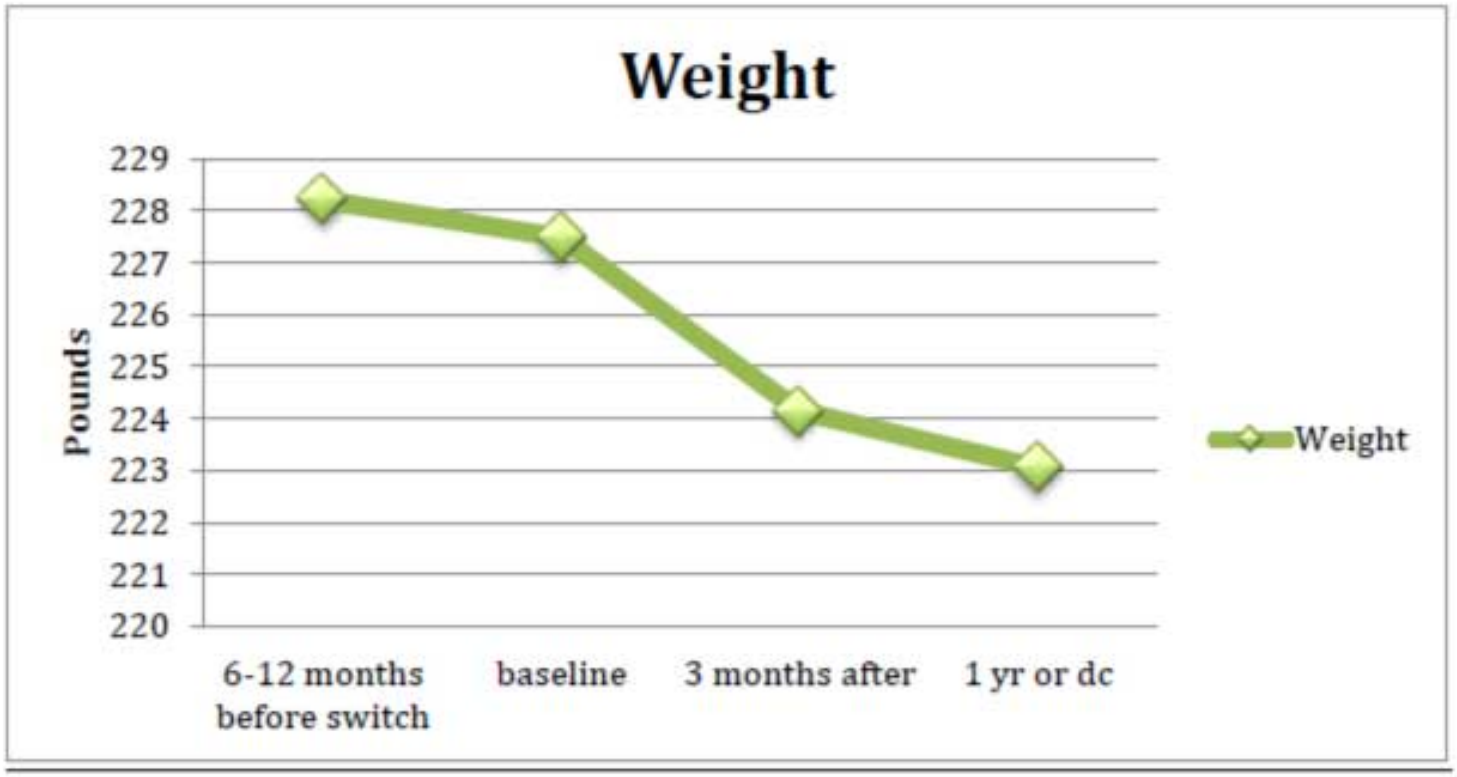
Glargine vs Detemir PIMC Experience

- In February 2011 detemir added as formulary long acting insulin and all patients on glargine required to switch
- Anectodotally, patients were not as well controlled after switch
- RPMS search was used to identify patients with prescriptions for both glargine and detemir from March 2011-April 2012
- Inclusion criteria
  - Patients with type 2 diabetes
  - Prescribed glargine insulin for at least 6 months
  - Converted to detemir insulin
- Exclusion criteria
  - Patients less than 18 years of age
  - Pregnant
  - Lack of follow-up within one year of switching insulins
  - Discontinuation of detemir before 3 months of use
  - Absence of "paired" glycosylated hemoglobin (HbA1c) values (while on glargine and after at least 3 months of treatment with detemir)

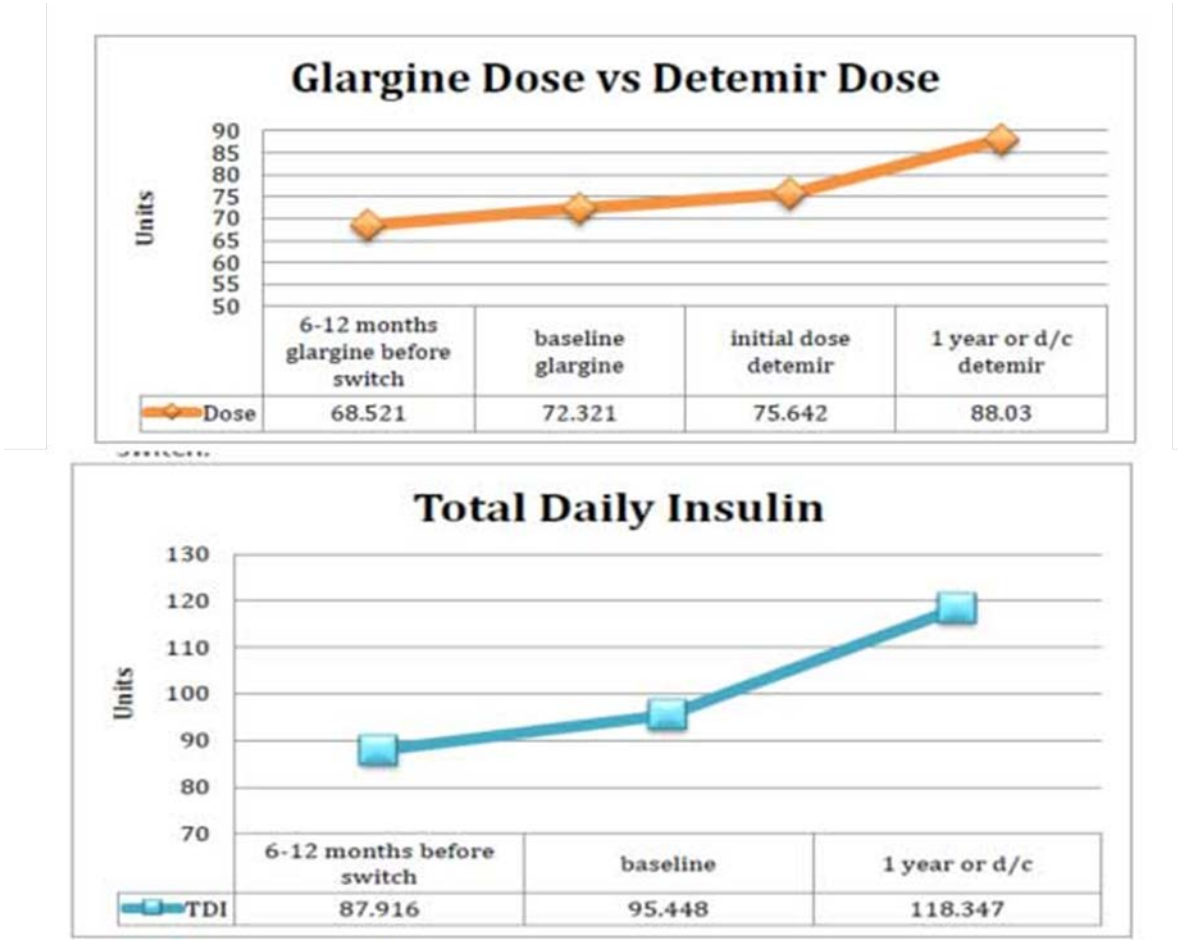
Primary Outcome



Impact on Weight



Dose Requirements



Summary

- Effectiveness:
  - At 3 months, A1c values showed a statistically significant increase for patients switched to detemir compared to baseline. However, A1c at 1 year compared to baseline was not statistically significant.
- Safety:
  - 12.21% (74) of patients discontinued detemir
  - Most common reason for discontinuation:
    - Poor glucose control (52.7% of ADRs)
    - Of note, some uncommon ADRs were seen such as leg stiffness, jittery feeling, palpitations, and metallic taste
- Insulin requirements:
  - Long-acting insulin requirements increased at 3 months and 1 year, by a statistically significant amount (detemir is less potent)
  - Total daily dose of insulin increased at all time frames
- Dosing Frequency:
  - 43.4% of patients went from once daily to twice daily dosing
- Amount saved:
  - $224,883 after switching from glargine to detemir at 1 year
- -

Basal Insulins

- NPH
  - Longest history with most experience
  - Cheapest
- Detemir
  - Potentially less weight gain
  - Really needs to be used twice daily
- Glargine
  - Once daily dosing
  - Less hypoglycemia
  - Most Costly
  - Cancer Risk?

Short Acting Insulin

- Novolog/Humalog
  - Food on fork
  - Better match to action time with meals
  - Less activity before bedtime so less likely to have nighttime hypoglycemia
  - Less likely to "stack"
- Regular insulin
  - Less costly

IHS Cost of Insulin

Type of Insulin	Cost/vial (1000 units/vial)	Cost/pen (300 units/pen)	Cost/1000 units via pen	IHS National Core Formulary (vials)
NPH	$ 4.79	$ 3.42	$ 11.40	yes
Detemir (Levemir®)	$ 19.99	$ 8.00	$ 26.66	yes
Glargine (Lantus®)	$ 48.23	$ 21.63	$ 72.10	no
Regular	$ 4.79	N / A	N / A	yes
Aspart (Novolog®)	$ 19.81	$ 5.94	$19.81	yes
Lispro (Humalog®)	$ 42.84	$ 16.06	$53.53	no

Hypoglycemia

- Signs/Symptoms
- Shakiness
- Nervousness or anxiety
- Sweating, chills and clamminess
- Irritability or impatience
- Confusion, including delirium
- Rapid/fast heartbeat
- Lightheadedness or dizziness
- Hunger and nausea
- Sleepiness
- Blurred/impaired vision
- Tingling or numbness in the lips or tongue
- Headaches
- Weakness or fatigue
- Anger, stubbornness, or sadness
- Lack of coordination
- Nightmares or crying out during sleep
- Seizures
- Unconsciousness

- Treatment
- Consume 15-20 grams of glucose or simple carbohydrates
  - 15 grams of simple carbohydrates commonly used:
    - glucose tablets (follow package instructions)
    - Gel tube (follow package instructions)
    - 2 tablespoons of raisins
    - 4 ounces (1/2 cup) of juice or regular soda (not diet)
    - 1 tablespoon sugar, honey, or corn syrup 8 ounces of nonfat or 1% milk
    - hard candies, jellybeans, or gumdrops (see package to determine how many to consume)

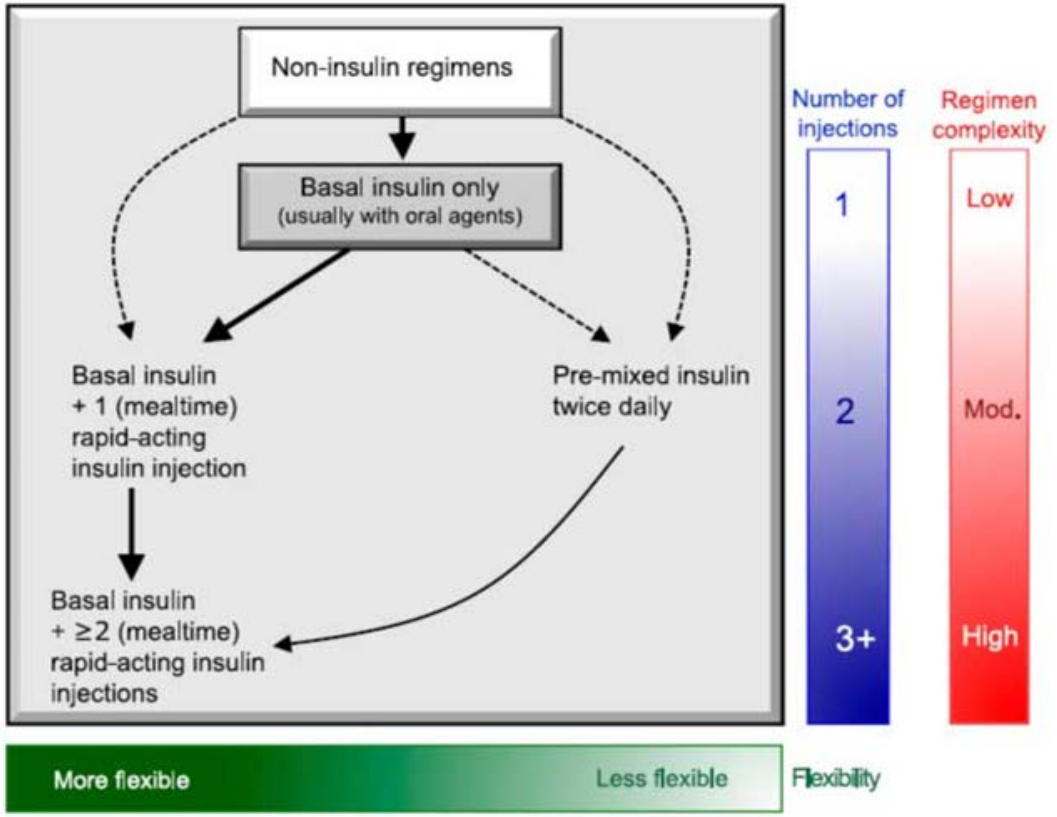
- Recheck your blood glucose after 15 minutes
- If hypoglycemia continues, repeat.
- Once blood glucose returns to normal, eat a small snack if your next planned meal or snack is more than an hour or two away.

Weight Gain

- In general, 2-4kg increase in body weight
- Mechanism Unclear - Possibly explained by reductions in glucosuria and resting energy expenditure when glycemic control is improved
- Perhaps less with detemir than NPH or glargine

Diabetes Care November 2009 Vol 32 no. supp 2 S253-259

Sequential Insulin Strategies



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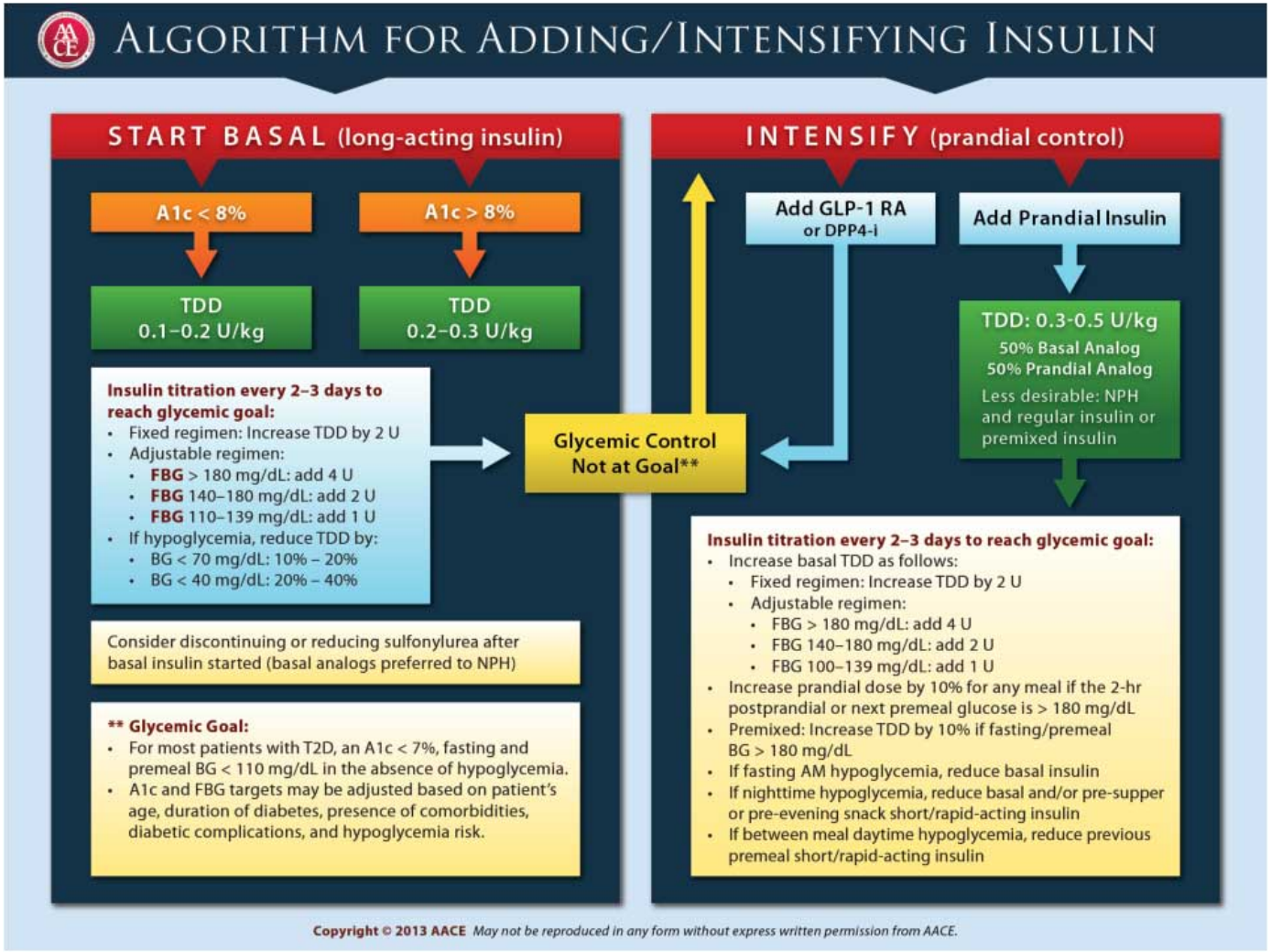
ALGORITHM FOR ADDING/INTENSIFYING INSULIN
START BASAL (long-acting insulin)
A1c < 8%
A1c > 8%
TDD 0.1–0.2 U/kg
TDD 0.2–0.3 U/kg
Insulin titration every 2–3 days to reach glycemic goal:
• Fixed regimen: Increase TDD by 2 U
• Adjustable regimen:
• FBG > 180 mg/dL: add 4 U
• FBG 140–180 mg/dL: add 2 U
• FBG 110–139 mg/dL: add 1 U
• If hypoglycemia, reduce TDD by:
• BG < 70 mg/dL: 10% – 20%
• BG < 40 mg/dL: 20% – 40%
Consider discontinuing or reducing sulfonylurea after basal insulin started (basal analogs preferred to NPH)
** Glycemic Goal:
• For most patients with T2D, an A1c < 7%, fasting and premeal BG < 110 mg/dL in the absence of hypoglycemia.
• A1c and FBG targets may be adjusted based on patient's age, duration of diabetes, presence of comorbidities, diabetic complications, and hypoglycemia risk.
Glycemic Control Not at Goal**
INTENSIFY (prandial control)
Add GLP-1 RA or DPP4-i
Add Prandial Insulin
TDD: 0.3-0.5 U/kg
50% Basal Analog
50% Prandial Analog
Less desirable: NPH and regular insulin or premixed insulin
Insulin titration every 2–3 days to reach glycemic goal:
• Increase basal TDD as follows:
• Fixed regimen: Increase TDD by 2 U
• Adjustable regimen:
• FBG > 180 mg/dL: add 4 U
• FBG 140–180 mg/dL: add 2 U
• FBG 100–139 mg/dL: add 1 U
• Increase prandial dose by 10% for any meal if the 2-hr postprandial or next premeal glucose is > 180 mg/dL
• Premixed: Increase TDD by 10% if fasting/premeal BG > 180 mg/dL
• If fasting AM hypoglycemia, reduce basal insulin
• If nighttime hypoglycemia, reduce basal and/or pre-supper or pre-evening snack short/rapid-acting insulin
• If between meal daytime hypoglycemia, reduce previous premeal short/rapid-acting insulin
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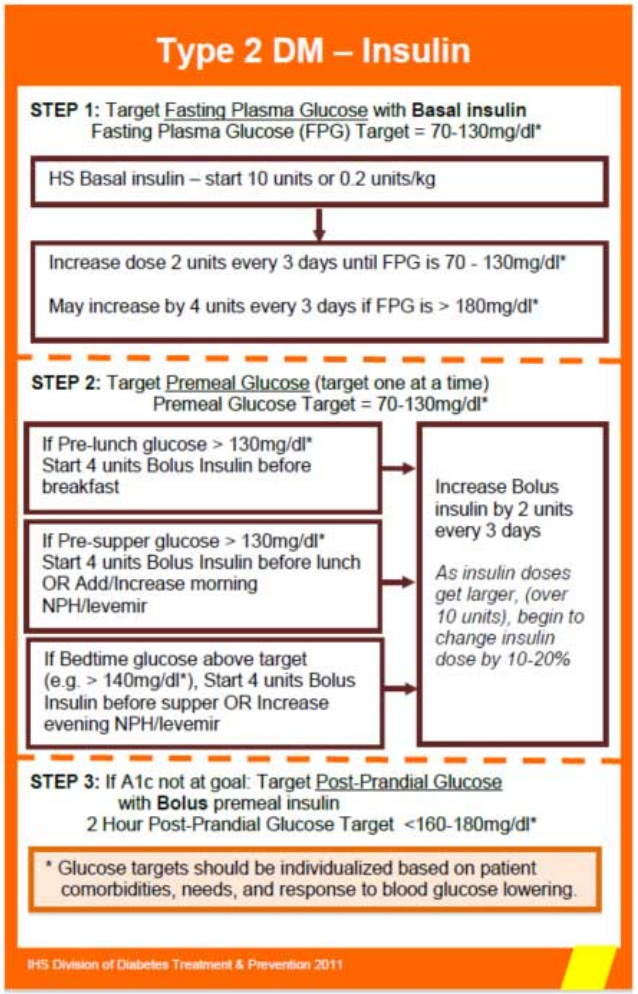

Type 2 DM – Insulin
STEP 1: Target Fasting Plasma Glucose with Basal insulin
Fasting Plasma Glucose (FPG) Target = 70-130mg/dl*
HS Basal insulin – start 10 units or 0.2 units/kg
Increase dose 2 units every 3 days until FPG is 70 - 130mg/dl*
May increase by 4 units every 3 days if FPG is > 180mg/dl*
STEP 2: Target Premeal Glucose (target one at a time)
Premeal Glucose Target = 70-130mg/dl*
If Pre-lunch glucose > 130mg/dl* Start 4 units Bolus Insulin before breakfast
If Pre-supper glucose > 130mg/dl* Start 4 units Bolus Insulin before lunch OR Add/Increase morning NPH/levemir
If Bedtime glucose above target (e.g. > 140mg/dl*), Start 4 units Bolus Insulin before supper OR Increase evening NPH/levemir
Increase Bolus insulin by 2 units every 3 days
As insulin doses get larger, (over 10 units), begin to change insulin dose by 10-20%
STEP 3: If A1c not at goal: Target Post-Prandial Glucose with Bolus premeal insulin
2 Hour Post-Prandial Glucose Target <160-180mg/dl*
* Glucose targets should be individualized based on patient comorbidities, needs, and response to blood glucose lowering.
IHS Division of Diabetes Treatment & Prevention 2011

Table 1. Selected barriers to insulin injection therapy among patients, providers, and health care system[11,12,35,36]

PATIENT BARRIERS	PROVIDER BARRIERS	SYSTEM BARRIERS
Psychological resistance • Myth-based fear of insulin • Fear of hypoglycemia • Concern about weight gain • Fear of needles and pain • Self-blame • Loss of control • Social stigma • Poor self-efficacy **Lifestyle** • Time-consuming; inconvenient • Travel issues **Physical/mental** • Poor recall/cognitive impairment • Visual/hearing/dexterity impairment • Learning difficulties; low literacy/ numeracy skills **Financial** • Reimbursement issues	• Perceived patient resistance • Patient's adherence behavior • Belief that patient's improved status negates need to start insulin therapy • Concerns about adverse effects (hypoglycemia; weight gain) • Provider time constraints (instruction; titration) • Lack of resources/ organizational structure to facilitate guideline adherence	• Overburdened workload among providers • Access to education • Limited training of providers in injection technique • Underutilization of resources (within clinical practices, hospitals, and community) • Reimbursement issues • Poor follow-up system • Suboptimal team collaboration; poor chronic care model

American Association of Diabetes Educator, Strategies for insulin Injection Therapy in Diabetes Self-Management

TABLE 3 General strategies for initiating insulin therapy

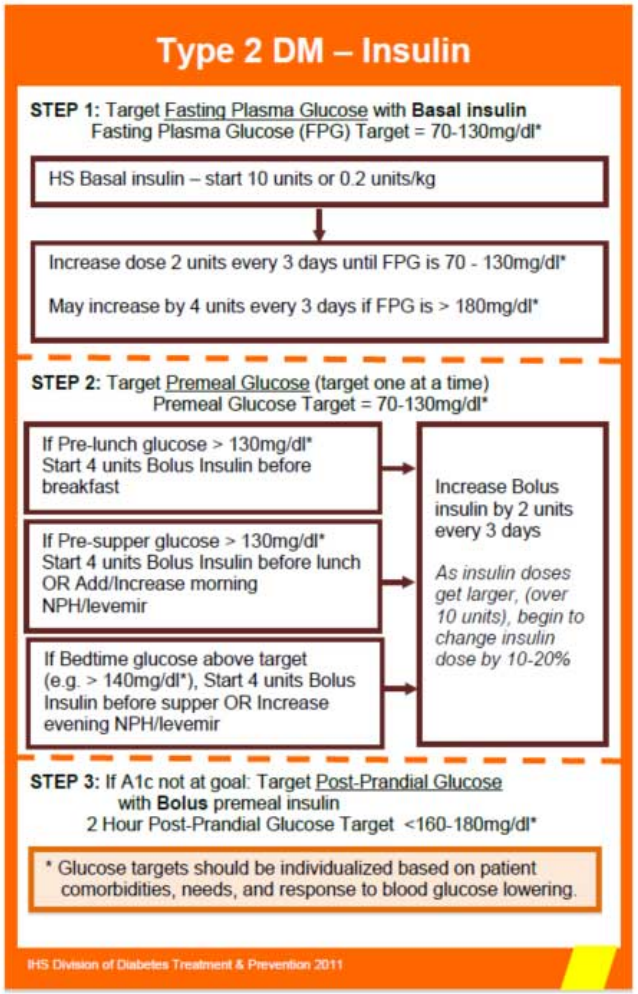
Invite the patient to take an active role in treatment decisions.
Remind the patient that type 2 diabetes is primarily self-managed.
Discuss the progressive nature of β-cell dysfunction in type 2 diabetes.
Emphasize the physiologic role of insulin to maintain glucose homeostasis.
Discuss that insulin will help to achieve glycemic control and minimize the risk for long-term complications.
Discuss that treatment will be modified as needed to maintain glycemic control and to best meet their needs, capabilities, and interest.
Utilize insulin pen devices whenever possible.
Emphasize the importance of lifestyle management.
Ask if hearing other patients talk of their experiences with insulin therapy would be helpful; consider a group office visit.
Discuss and provide the patient with an individualized, written action plan that includes insulin dosing, self-monitoring of blood glucose, and signs/symptoms of hypoglycemia and other adverse events with appropriate action(s) to take.
Simplify diabetes (and comorbidities) treatment whenever possible.

Supplement to the Journal Of Family Practice, Vol 61, No 5, May 2012

Case Study #1

- 52 year old male with 10 year h/o Type 2 DM.
- Current Medications:
  - Glucophage 1000 mg po bid
  - Glypizide XL 20 mg po qd
- Glycemic Control:
  - HgbA1c 9.3%
  - Fasting Blood sugars are 250

What do you do next?


Type 2 DM – Insulin
STEP 1: Target Fasting Plasma Glucose with Basal insulin
Fasting Plasma Glucose (FPG) Target = 70-130mg/dl*
HS Basal insulin – start 10 units or 0.2 units/kg
Increase dose 2 units every 3 days until FPG is 70 - 130mg/dl*
May increase by 4 units every 3 days if FPG is > 180mg/dl*
STEP 2: Target Premeal Glucose (target one at a time)
Premeal Glucose Target = 70-130mg/dl*
If Pre-lunch glucose > 130mg/dl* Start 4 units Bolus Insulin before breakfast
If Pre-supper glucose > 130mg/dl* Start 4 units Bolus Insulin before lunch OR Add/Increase morning NPH/levemir
If Bedtime glucose above target (e.g. > 140mg/dl*), Start 4 units Bolus Insulin before supper OR Increase evening NPH/levemir
Increase Bolus insulin by 2 units every 3 days
As insulin doses get larger, (over 10 units), begin to change insulin dose by 10-20%
STEP 3: If A1c not at goal: Target Post-Prandial Glucose with Bolus premeal insulin
2 Hour Post-Prandial Glucose Target <160-180mg/dl*
* Glucose targets should be individualized based on patient comorbidities, needs, and response to blood glucose lowering.
IHS Division of Diabetes Treatment & Prevention 2011

Oral Medication and Bedtime Insulin

"I take diabetes pills and one shot of insulin"

	Start Phase	Adjust Phase	Maintain Phase
Oral medications and bedtime insulin	Fasting daily for 1 week – return to clinic for adjustments	Fasting daily for 1-2 weeks– AND – Before and after an event 1-2 days/week	Fasting and 1 test before and 1 test after an event each week

"Events" 1) Meal or Snack* - a "snack" is 100 calories or less
2) Exercise ** - ask your doctor for an exercise plan
3) Low blood sugar symptoms (Hypoglycemia)

The purpose of the bedtime insulin is to control the blood sugar while you are asleep. Checking your blood sugar before you eat breakfast will tell you if the dose is correct.

Don't hesitate to check your blood sugar if you wake up in the middle of the night and are shaky, hungry, having nightmares, etc.

*- Remember – if your blood sugar before your meal is at goal, and it's too high after your meal, think about what kind of food you just ate, and how much.

- Did you drink something with sugar in it?? (regular soda, tea, Gatorade, coffee with "real" sugar)
- Did you eat too much starchy food? (Bread, tortilla, potato, pasta)

** Remember – when you first begin to exercise, you MAY see your blood sugar go up a little bit… your body thinks you need extra energy to deal with this "stress"…. Just stay with your exercise plan, and you'll see your blood sugars start to go down after exercise

*** Remember – if you are dizzy, shaky, have blurred vision or frequent urination or you feel "some way" - test your blood sugar. If blood sugar is below 70 mg/dl, drink ½ glass (4 oz) of juice or regular soft drink or 1 glass (8 oz) of milk or eat some soft candies (not chocolate!).

Case Study #1

- Patient returns for f/u after 1 week:

Day	Fasting Blood sugar	Insulin dose	Dose Adjustment
Day 1	230	10 units qhs	None
Day 2	225	14 units qhs	Increase by 4 units
Day 3	207	14 units qhs	None
Day 4	199	14 units qhs	None
Day 5	179	16 units	Increase by 2 units
Day 6	160	16 units	None

Beware

- Early morning hypoglycemia
  - Patient might need to take NPH later (around 11 pm) to delay peak
  - Reduce nighttime dose of insulin
  - Over correction of counter regulatory hormones can result in fasting hyperglycemia
- Fasting hyperglycemia
  - If can't figure out why, make sure you ask about early morning hypoglycemia
  - Alternatively could be due to just taking night time insulin too early or needing to increase dose

Case Study #2

- 54 year old male with 12 year h/o Type 2 DM.
- Current Medications:
  - Glucophage 1000 mg po bid
  - Glypizide XL 20 mg po qd
  - NPH 40 units bid
- Glycemic Control:
  - HgbA1c 8.9%

What do you do next?

Day	Fasting Blood Sugar	Pre-meal blood sugar
Day 7	145	L – 200
Day 10	152	D - 210
Day 14	133	L - 193
Day 18	129	D - 220
Day 23	141	L - 201
Day 30	137	D - 250

Case Study #2

- Multi-Daily Dosing-
  - Most complicated
  - Most time intensive
  - Most like our pancreas
  - Not for everyone

Insulin Plan

"I take insulin every day"

	Start Phase	Adjust Phase	Maintain Phase
Insulin	4 times or more daily – before and after an event	2-4 times daily – before and after an event	2-4 times per day at least 2 days per week. – before and after an event

"Events" 1) Meal or Snack* - a "snack" is 100 calories or less
2) Exercise ** - ask your doctor for an exercise plan
3) Low blood sugar symptoms (Hypoglycemic)

*- Remember – if your blood sugar before your meal is at goal, and it's too high after your meal, think about what kind of food you just ate, and how much.

- Did you drink something with sugar in it?? (regular soda, tea, Gatorade, coffee with "real" sugar)
- Did you eat too much starchy food? (Bread, tortilla, potato, pasta)

** Remember – when you first begin to exercise, you MAY see your blood sugar go up a little bit… your body thinks you need extra energy to deal with this "stress"…. Just stay with your exercise plan, and you'll see your blood sugars start to go down after exercise

*** Remember – if you are dizzy, shaky, have blurred vision or frequent urination or you feel "some way" - test your blood sugar. If blood sugar is below 70 mg/dl, drink ½ glass (4 oz) of juice or regular soft drink or 1 glass (8 oz) of milk or eat some soft candies (not chocolate!).

Carb Counting and Insulin Bolusing

Sample Meal	
1 c. orange juice	30 g
2 slices toast	30 g
½ c. oatmeal	15 g
1 soft-cooked egg	
1 tsp margarine	
Coffee & 1 T cream	
Total CHO:	75 g
Insulin bolus:	5 units

Sample Meal	
2 slices wheat bread	30 g
2 oz. turkey breast	
Lettuce leaf, tomato slice	
1 tsp mayonnaise	
6-8 3-ring pretzels	15 g
2 small choc cookies	15 g
Diet soda, 16 o	
Total CHO:	60 g
Insulin bolus:	4 units

1 unit insulin: 15 grams CHO

Case Study #2

- Add 4 units regular insulin before largest meal
  - Patient to check BS pre and 2 hr post prandial of all meals (6 accuchecks/day)
  - Increase bolus insulin by 2 units every 3 days until 2 hr post prandial <180
  - Add in regular to before meals based on BS readings
  - Teach carb counting
    - Use Corrective dosing NOT Sliding scale when possible

Case Study #3

- 56 y/o female long standing DM on NPH 100 units bid and Regular insulin 100 units bid. Patient has surgical procedure planned for tomorrow.
- What do you tell the patient to do with her insulin in the 24-hour period prior to surgery?

Insulin Therapy before surgery

- Three Basic Steps
  - Ascertain the type of diabetes
  - Adjust the basal insulin dose
  - Stop the prandial insulin
- Hyperglycemia in perioperative period can
  - Result in delay of surgery
  - Delayed wound healing
  - Wound infection
  - Fluid and electrolyte shifts
  - Diabetic Ketoacidosis/Hyperosmolar states

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Pre-Operative Basal Insulin Adjustment

Basal Insulin	Regimen	Preoperative Adjustment	Morning of Surgery
Long Acting	Equal basal (nighttime) and prandial	Full Basal Dose given	None
Long Acting	Disproportionately more basal (nighttime) than prandial	50% Total daily dose	None
Long Acting	Basal dose given in morning	None	50%
Long Acting	Twice daily	50% (night before surgery)	50%
Intermediate Acting	Twice daily	Full dose	50%
70/30		None	50% Total daily dose as basal only

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Insulin Before Surgery

- If patient has tendency for hypoglycemia reduce an additional 25%
- Post surgery, restart normal regimen that evening
  - Resume prandial insulin once on regular diet
- Key: Patients require some form of basal insulin even in fasting state

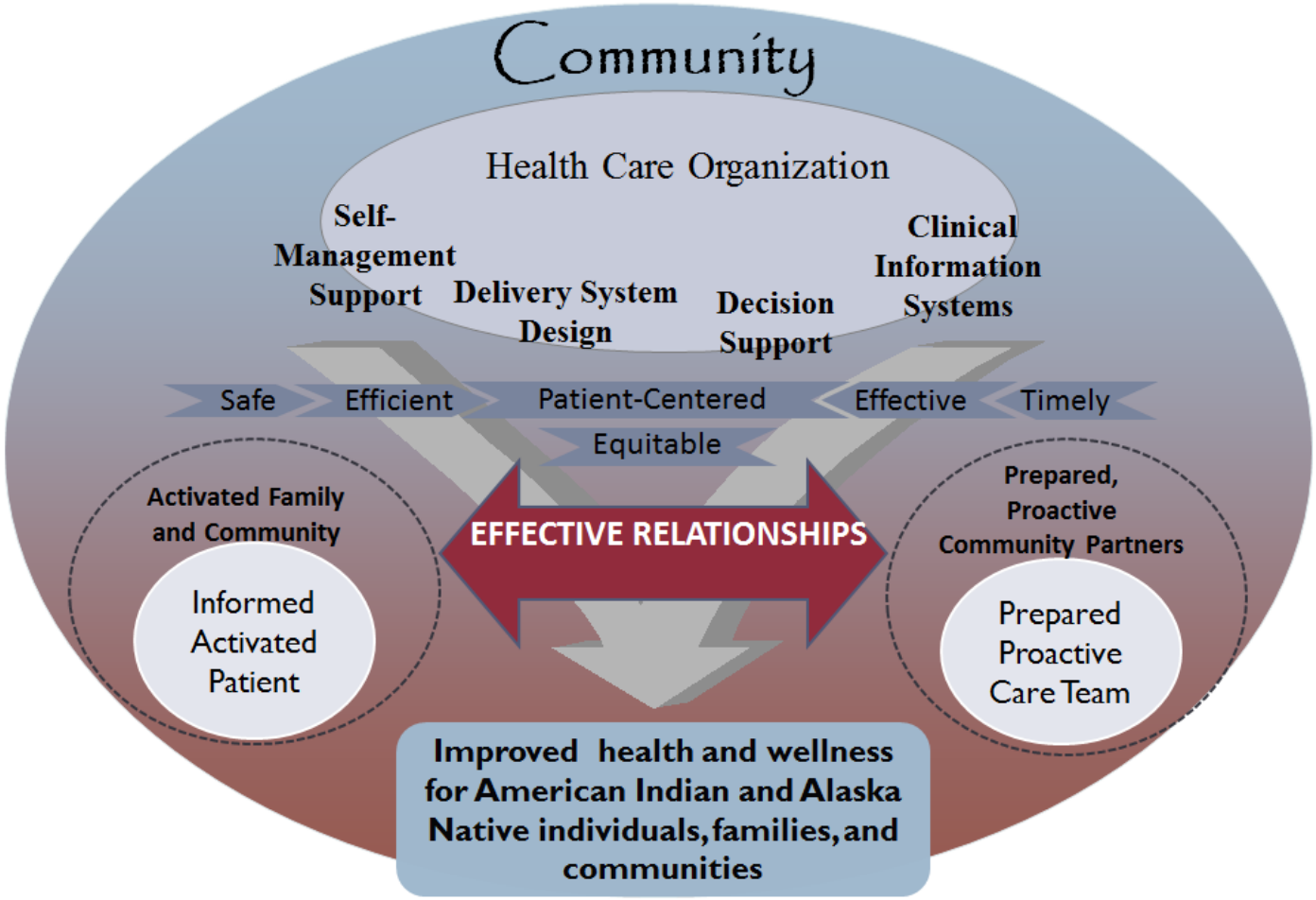
Case Study #3

- 56 y/o female long standing DM on NPH 100 units bid and Regular insulin 100 units bid. Patient has surgical procedure planned for tomorrow.
- Pre-Operative Plan:
  - Day prior to Surgery – Normal regimen
  - Morning of Surgery
    - No prandial insulin
    - NPH 50 Units

Summary

- Good Glucose control = improved outcomes
- Diabetes management can be complicated….but doesn't have to be
- One size does not fit all – individualize treatment plan
- Don't let your patients be victims of clinical inertia
- It takes a team!

Care Model for the Indian Health System



Chronic Care Model developed by MacColl Institute

Questions??????

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