



Diabetes Screening

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Outline

- Diagnostic criteria for diabetes
- Blood glucose goals for diabetic patients
- Interpreting blood glucose values for diabetes screening
- Introduction to anti-diabetic drug classes
- Diabetes treatment algorithm
- Finger stick technique
- Practice!



Diabetes

Clinical Class	Description	Treatment
Type 1	β -cell destruction leading to absolute insulin deficiency	<ul style="list-style-type: none"> • Insulin • Non-insulin injectable: pramlintide (Symlin)
Type 2	Progressive insulin secretory effect on the background of insulin resistance	<ul style="list-style-type: none"> • Oral Agents • Insulin • Non-insulin injectable

Criteria for Diagnosis of Diabetes

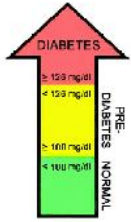
Criteria
*Laboratory A1c \geq 6.5 OR
*Fasting Plasma Glucose (FPG) \geq 126mg/dl (8-hour fast) OR
*2HR Oral Glucose Tolerance Test \geq 200 mg/dL (following 75g of anhydrous glucose dissolved in water) OR
Symptoms of Diabetes + plus casual plasma glucose \geq 200mg/dL

* In the absence of unequivocal hyperglycemia, criteria should be confirmed by repeat testing.

Standards of Medical Care in Diabetes 2012, American Diabetes Association

Blood Glucose Screening

Evaluation of Fasting Blood Glucose



Fasting plasma glucose \geq 100mg/dL, refer to MD for evaluation

Fasting Plasma Glucose (8-12 hour fast)

Evaluation of Random Blood Glucose

Random blood glucose **≥ 200mg/dL**,

- Refer to MD for evaluation
- Assess for symptoms of hyperglycemia

3 P's : Polydipsia, Polyuria, Polyphagia
 2) Blurred vision
 3) Drowsiness
 4) Dry skin
 5) Slow healing wounds

Blood Glucose Goals for Diabetic Patients

Guideline	ADA (American diabetes Association)	AACE (American Association of Endocrinology)
Fasting Plasma Glucose	70-130 mg/dL	<110mg/dL
Postprandial Plasma Glucose	<180 mg/dL	<140mg/dL
Hypoglycemia	<70 mg/dL	<70 mg/dL
A1C ¹	< 7% (general) <6% (individual) ¹	<6.5% ¹

¹ goal for patients "in general" is <7% or 6.5%; goal for individual patients is A1c as close to normal (<6%) as possible without significant hypoglycemia

Treatment Algorithm

(This section is mostly blank in the provided image, likely representing the flowchart content.)

Initial drug monotherapy
 Efficacy (HbA1c) high
 Hypoglycemia low risk
 Weight neutral
 Side effects GI / lactic acidosis
 Costs low

If needed to reach individualized HbA1c target after ~3 months, proceed to 2-drug combination (order not meant to denote any specific preference)

Two drug combinations
 Efficacy (HbA1c) high
 Hypoglycemia low risk
 Weight gain
 Major side effect(s) edema, HF, IV's
 Costs high

Three drug combinations
 Efficacy (HbA1c) high
 Hypoglycemia low risk
 Weight gain
 Major side effect(s) edema, HF, IV's
 Costs high

If combination therapy that includes basal insulin has failed to achieve HbA1c target after 3-6 months, proceed to a more complex insulin strategy, usually in combination with 1-2 non-insulin agents

More complex insulin strategies
 Insulin (multiple daily doses)

Diabetes Care 2012;35:1364-1379

AACE/ACE DIABETES ALGORITHM For Glycemic Control

A1C Goal ≤ 6.5%

LIFESTYLE MODIFICATION

A1C 6.5 - 7.5%
 MET + DPP-4 or GLP-1 RA or TZD + AGI¹

A1C 7.6 - 9.0%
 MET + GLP-1 or DPP-4 or TZD¹ or SU on Glime^{2,3}

A1C > 9.0%
 Insulin + Other Agent(s)¹

AGI: Acetaminophen, NSAIDs, Opioids, Anticholinergics, Sedatives, Antipsychotics, Antidepressants, Antiepileptics, Anticoagulants, Antiarrhythmics, Anticancer drugs, Antidiabetics, Antihypertensives, Antihistamines, Antimicrobials, Antiparasitics, Antipsychotics, Antiretrovirals, Antivirals, Cardiac drugs, Chemotherapy, Diuretics, Enzymes, Herbal products, Hormones, Immunosuppressants, Intravenous contrast, Laboratory tests, Local anesthetics, Muscle relaxants, Nitrates, Nitroglycerin, Pesticides, Potassium supplements, Sulfonamides, Topical agents, Vaccines, Vitamins, X-ray contrast, Z-drugs.

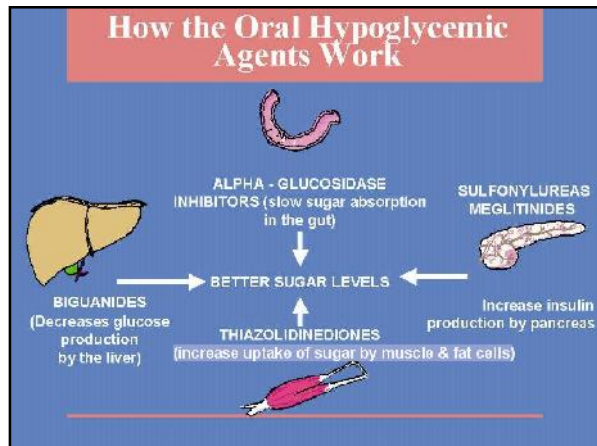
AGI: Acetaminophen, NSAIDs, Opioids, Anticholinergics, Sedatives, Antipsychotics, Antidepressants, Antiepileptics, Anticoagulants, Antiarrhythmics, Anticancer drugs, Antidiabetics, Antihypertensives, Antihistamines, Antimicrobials, Antiparasitics, Antipsychotics, Antiretrovirals, Antivirals, Cardiac drugs, Chemotherapy, Diuretics, Enzymes, Herbal products, Hormones, Immunosuppressants, Intravenous contrast, Laboratory tests, Local anesthetics, Muscle relaxants, Nitrates, Nitroglycerin, Pesticides, Potassium supplements, Sulfonamides, Topical agents, Vaccines, Vitamins, X-ray contrast, Z-drugs.

SUMMARY OF KEY BENEFITS AND RISKS OF MEDICATIONS

MEDICATIONS*	MEDICATIONS*										
	Metformin	DPP-4 inhibitor	GLP-1 Agonist (exenatide, liraglutide, semaglutide)	Sulfonylurea (SU)	Thiazolidinedione (TZD)	Thiazolidinedione (TZD)	GLP-1 receptor agonist	Insulin	Insulin	Insulin	Insulin
Reduction in cardiovascular morbidity and mortality	Yes	No	No	No	No	No	No	No	No	No	No
Reduction in cardiovascular mortality	Yes	No	No	No	No	No	No	No	No	No	No
Reduction in total mortality	Yes	No	No	No	No	No	No	No	No	No	No
Reduction in hypoglycemia	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in weight	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in HbA1c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reduction in quality of life	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in cost	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of hypoglycemia	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of weight gain	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of edema	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of heart failure	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of liver disease	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of kidney disease	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of retinopathy	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of neuropathy	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of foot ulcers	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Reduction in risk of amputation	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No

Oral Agents

Type 2 Diabetics Only



Biguanide

- Metformin (Glucophage)
- MOA:
 - Decreases hepatic gluconeogenesis
 - Increases glucose utilization
 - Decreased intestinal absorption of glucose
 - Increase peripheral insulin sensitivity
- Efficacy: ↓A1c 1-2%
- Common ADR: GI symptoms (N/V/D)
- Contraindications
 - Renal dysfunction
 - Males: SCr ≥ 1.5 mg/dL
 - Females: SCr ≥ 1.4 mg/dL
 - Radiological studies with iodinated contrast
 - Hold **48 hrs prior to** and **after** procedure

Sulfonylurea

- First Generation
 - Rarely used in clinical practice
- Second Generation
 - Glimperide (Amaryl)
 - Glipizide (Glucotrol)
 - Glyburide (Diabeta/Micronase)
 - **all equally efficacious
- MOA
 - Stimulate insulin release from pancreatic islet cells (taken with food)
- Efficacy: ↓ A1c ≈ 1-2%
- Common ADR
 - Hypoglycemia
 - Weight gain

Meglitinides

- Repaglinide (Prandin)
- Nateglinide (Starlix)
- MOA:
 - Similar to SFU (↑ insulin production)
 - Fast onset and shorter duration – skip dose if skip meal
- Efficacy: ↓ A1c 1-1.5%
- Common ADRs: hypoglycemia and weight gain

Thiazolidinedione (TZDs)

- Pioglitazone (Actos)
- Rosiglitazone (Avandia) - REMS
- MOA:
 - Increases insulin sensitivity
 - Decreases gluconeogenesis
- Efficacy: ↓ A1c 1-1.5%
- Common ADRs: weight gain and edema

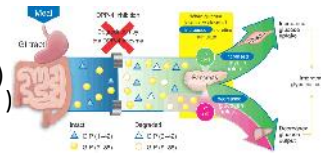
Alpha Glucosidase Inhibitors

- Acarbose (Precose)
- Miglitol (Glyset)
- MOA:
 - inhibits intestinal alpha-glucosidase, delaying absorption of complex sugars from the intestine and decreasing post-prandial glucose
- ↓ A1c 0.5-1%



DPP-4 Inhibitor

- sitagliptin (Januvia)
- saxagliptin (Onglyza)
- linagliptin (Tradjenta)
- MOA:
 - Inhibits DPP-4, which breaks down natural incretins
 - Active incretins increase insulin release, slow gastric emptying, and inhibit glucagon release thus lowering blood glucose
- Efficacy: ↓ A1c 0.5-1%
- GI side effects: gas, bloating, diarrhea



Selecting an Agent...

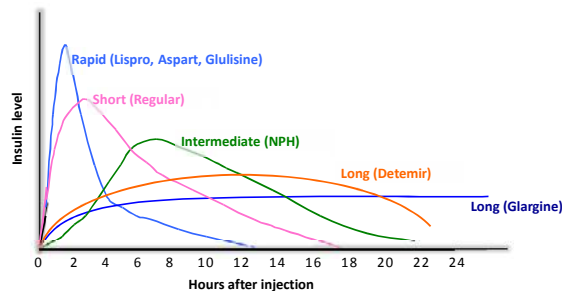
Problem	Drugs to avoid/ use caution	Better choice
Weight Gain	SFUs, meglitinides, TZDs	metformin, DPP-4 inhibitor
GI symptoms	Metformin, α-glucosidase inhibitor	SFUs, meglitinides, TZDs, DPP-4 inhibitor
Hypoglycemia	SFUs, meglitinides	Metformin, TZDs, DPP-4 inhibitor
Impaired renal fxn	Metformin, SFUs, DPP-4 inhibitor (linagliptin ok)	Meglitinides, TZDs
Impaired hepatic fxn	Metformin, TZDs, α-glucosidase inhibitor	SFUs, DPP-4 inhibitor
Impaired CV/pulm fxn	Metformin, TZDs	SFUs, meglitinides, DPP-4 inhibitor

Insulin

Insulin: Preparations


- **Rapid-acting**
 - Lispro/Aspart/Glulisine
 - **Short-acting**
 - Regular (OTC, except U-500)
 - **Intermediate-acting**
 - NPH (OTC)
 - **Long-acting**
 - Detemir, Glargine
 - **Premixed**
 - NPH/Regular: 70/30, 50/50 (OTC)
 - Lispro protamine/Lispro: 50/50, 75/25
 - Aspart protamine/Aspart: 70/30
- } Bolus/Meal Insulin
- } Basal Insulin

Insulin: PK Profile of different insulins




Basal Insulin

- Slow, steady release of insulin
- Basal insulin includes:
 - intermediate-acting
 - Onset: 2 to 4 hours Peak: 4 to 12 hours
 - Duration: 14 to 24 hours
 - NPH (N) – cloudy
 - long-acting
 - Onset: 2-4 hrs Peak: flat
 - Duration: 24 hours
 - Insulin Glargine (Lantus)
 - Insulin Detemir (Levemir)



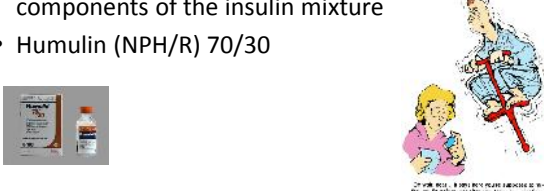
Meal Time Insulin

- Used before, during, or after a meal
- Works like the insulin your body would normally produce when food is consumed
- Rapid-acting
 - Onset: 15 minutes after injection
 - Peak: 30 min post injection
 - Duration: 3 to 5 hours
 - Insulin lispro (Humalog)
 - Insulin Aspart (Novolog)
 - Insulin Glulisine (Apidra)
- Regular (short-acting)
 - Onset: 30 minutes
 - Peak: 2 to 3 hours post injection
 - Duration: 4 to 8 hours
 - Humulin or Novolin (Regular Insulin, R)



Pre-mixed insulin

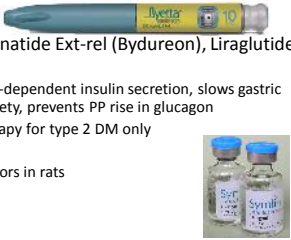
- Combination of specific proportions of intermediate-acting and short-acting insulin in one bottle or insulin pen
- Onset, peak and duration depends on the components of the insulin mixture
- Humulin (NPH/R) 70/30



Non-Insulin Injectables

Non-Insulin Injectables

- Incretin Mimetic
 - Exenatide (Byetta), Exenatide Ext-rel (Bydureon), Liraglutide (Victoza)
 - **MOA:** increases glucose-dependent insulin secretion, slows gastric emptying, increases satiety, prevents PP rise in glucagon
 - **Indication:** Adjunct therapy for type 2 DM only
 - **S/E:** GI (N/V)
 - **BBW:** thyroid C-cell tumors in rats
- Amylin Mimetic
 - Pramlintide (Symlin)
 - **MOA:** slows GI emptying, prevents PP rise in glucagon
 - **Indication:** Adjunct therapy for type 1 and 2 DM on insulin
 - **S/E:** Nausea
 - **BBW:** severe hypoglycemia with insulin
 - Decrease insulin dose by 50% when starting pramlintide



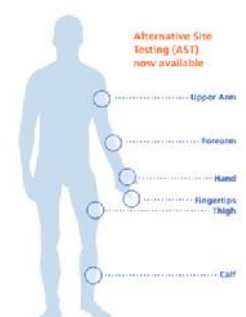
Fingerstick Technique

Non-invasive Monitoring

Suggested Procedure for blood glucose monitoring:

- Wash hands with soap and water. To prevent infection, avoid an area that is cracked, sore, or irritated. Gloves should be worn when working with blood samples and should always be changed between each patient.
- Insert a test strip into the glucose meter.
- Glucose is measured from the side of one of the outer fingers of either hand. To help increase blood flow, the fingers and hands should be warm to the touch. To warm the hand, you can:
 - wash the patient's hands with warm water, or
 - apply a warm (not hot) compress to the hand for several minutes, or
 - Gently massage the finger. Do not rub the site several times to break the blood to the glucose.
- Clean the site with an alcohol swab. Dry thoroughly with a gauze pad before pricking the finger or loading the strip. Do not prick the selected site with a finger.
- Touch one edge of the test strip to the drop of blood to allow the reading to take. The test strip will automatically draw up the drop of blood through capillary action. If necessary to assist, use a separate alcohol swab. Do not wipe the site with gauze or massage again. If the blood strip will not pick up blood from the site, do not use.
- Wipe off any excess blood and use the gauze to apply pressure to the puncture until the bleeding stops.
- Apply a band-aid to the puncture site.

Alternate SMBG Testing Sites



- Fingertips vs. forearm, upper arm, palm, thigh, calf
 - LAG TIME: 20-30 minutes
- Do NOT use alternative sites when:
 - BG rapidly changing
 - Suspect low BG
 - Hypoglycemic unawareness
 - Within 1-2 hours after meals

USE fingertips!

<http://www.bd.com/us/diabetes/blood-glucose-monitoring/how-to-test/alternate-site/>

Demonstration and Practice