

Diabetes

DIABETES

- Types:
 - Type 1: loss of **beta cell function** and **absolute insulin deficiency**
 - Type 2: **insulin resistance** accompanied by insulin deficiency
 - Gestational
 - Secondary (diabetes associated with other syndromes)
 - Prediabetes
- Epidemiology
 - Minority populations are at higher risk for complications and have higher death rates
 - Highest leading cause of non-traumatic amputations, **blindness**, **ESKD**, and death from a disease
- Pathophysiology
 - **Insulin** moves glucose from blood into cells
 - **Pancreas** releases small amounts of insulin continuously
 - **Glucagon** triggers release of glucose into blood from liver

Risk Factors

- Type 1:
 - Less than 5% of population
 - Early onset
 - **Genetic** plays an important role
- Type 2:
 - Family history is important
 - **Obesity**
 - Race
 - Age older than 45
 - Previous impaired glucose intolerance
 - **Hyperlipidemia** (HDL<35; TG>250mg/dL)
 - Delivery of baby greater than 9 lbs

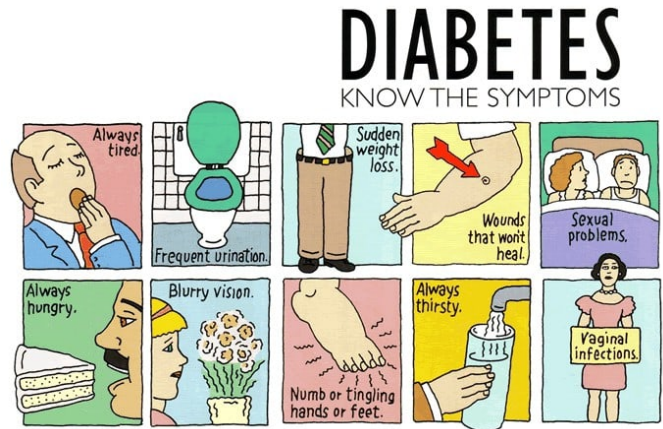
TYPE 1 DIABETES

- Causes
 - Genetic
 - **Immunologic (majority)**
 - Environmental
 - Autoimmune response
- Pathophysiology: **pancreas** can't make insulin
- Characteristics
 - Onset usually before 30 years old

- Insulin is not made
- **Diabetic ketoacidosis** occurs in acute complication of hyperglycemia

Clinical Manifestations

- **Polydipsia**
- **Polyuria**
- **Polyphagia**
- **Weight loss**



TYPE 2 DIABETES

Characteristics:

- More common in adults older than 30
- Ketosis is not common except in infection or stress
- **Hyperglycemic hyperosmolar syndrome (HHS)** occurs in acute hyperglycemic complication

Insulin Resistance

- Def: cells are becoming **insensitive** to insulin and are not reacting to insulin's function
- To overcome insulin resistance and prevent buildup of glucose in blood → pancreas makes more insulin → pancreas eventually fails to keep up → **hyperglycemia**
- **Slow progression** unlike type 1; can go undetected for years
- Very mild symptoms and by the time pt comes to hospital, long-term complications may have already started

Clinical Manifestations

- **Polyuria**
- **Polydipsia**
- **Polyphagia**

- Fatigue
- Weakness
- Vision changes
- Numbness or tingling in hands or feet
- Dry skin
- Infections (vaginal yeast for ex)

Medical Management –Ketone Testing

- If ketone is present in **urine** = serious lack of insulin; **fat** is being used for energy
- Urine dipstick will turn **purple** with ketones
- Ketones should be checked for **type 1 diabetes** during times of **illness/stress** and when **BGL>240 two times in a row**

CRITERIA FOR DIABETES DIAGNOSIS

1. Symptoms: the 3 “P”s
2. Fasting BGL of higher or equal to **126mg/dL**
3. Random BG level higher or equal to **200**
4. A1C level higher or equal to **6.5%**

MEDICAL MANAGEMENT

1. Nutritional therapy (this may be enough for **type 2**)
2. Exercise
3. Monitoring glucose and ketone levels
4. Pharmacologic therapy and medical management

Nutritional Therapy

- **Main goal:** to get pt down to “normal” weight
- Control BGL
- Prevent heart disease
- May need **registered dietitian**

Exercise

- Reduces BGL
 - Increases glucose uptake by muscles
- Reduces risk for cardiac diseases related to **hyperlipidemia**; diabetic pts are already at risk for high lipid concentrations

Monitoring Glucose Levels

- **BG monitoring is the cornerstone of managing diabetes**
- Always **check BGL before** giving insulin
 - Before meals
 - Before snacks
 - Before bedtime
 - Sometimes before and after **exercise**
- Helps you detect **hypoglycemia** or **hyperglycemia**

Medical Management –Pharmacologic Therapy

- Types:
 - **Insulin therapy**
 - **Oral antidiabetics**
- **Main goal: normalize BGL** to prevent **cardiac** and **neuropathic** complications
- **Type 1** will always need insulin therapy
- **Oral agents** are usually only for **type 2** to help overcome insulin resistance and triggers insulin release

Type 2 Diabetes Pharmacologic Therapy

- Most pts with typ2 are on **multiple agents**
 - Usually a combination of **oral agents** and **insulin** (like Lantus/Glargine)
- Most effective treatment
- **Metformin** (type of insulin)
 - If pt is on this med, make sure pt waits at least **24-48 hours** before undergoing **contrast dye** procedure; resume med if pt’s **kidneys** are okay

MEDICAL MANAGEMENT: LAB TESTS

- Labs should be done at least **every 6 months**
- Types:
 - **Fasting lipid profile**
 - **Microalbuminuria test**
 - **Serum creatinine level**
 - **Urinalysis**
 - **ECG** (since diabetic pts have high risk for cardiac issues)
 - **A1C:** reflects BGL for past 3 months; it’s a good way to check if treatment is working
 - If levels are going down to normal over 6 months, then the therapy is working!
 - Normal range: **4-6%**; your goal is to bring down level below **7%**

Hemoglobin A1c % Estimated average glucose (mg/dL)

6%	126
7%	154
8%	183
9%	212
10%	240
11%	269
12%	298

HOSPITALIZED PATIENTS

- Hyperglycemia can lead to
 - Longer hospital stays
 - More infections
 - Higher mortality rates (especially after surgery)

ACUTE COMPLICATIONS OF DIABETS

- Hypoglycemia
- DKA
- HHS

Hypoglycemia

- Def: when insulin level falls **below 70mg/dL**
- **Severe hypoglycemia:** insulin < 40mg/dL
- Causes:
 - Exercising
 - Too much **insulin** or **hypoglycemic meds**
 - Too little **food**
 - Can have other causes
- Clinical Manifestations
 - **Mild hypoglycemia:** SNS (adrenergic) responses due to release of **epinephrine and NE**
 - Hunger, tachycardia, sweating, etc.
 - **Moderate hypoglycemia:** CNS dysfunctions due to brain being deprived on energy
 - Poor concentration, headache, confusion, double vision, etc.
 - **Severe hypoglycemia:** very severe CNS dysfunction that pt needs help for treatment
 - **Decreased LOC, seizures, disorientation, etc.**

- If pts BGL is below normal but pt shows no symptoms, make sure you **re-check BGL** before treating them
- Some pts may not get **adrenergic responses** and only get **CNS impairments**

Management of Hypoglycemia

- For alert pts
 - **Rule of 15:** give **15 grams of carbs** and recheck BGL **after 15 min**
 - Ex of 15g of carbs: 4oz of juice, 1 tbsp of sugar, 203 glucose tablets, etc.
 - You need to keep BGL up after giving initial carb, so **make sure to give other food to keep BGL up**
- For unconscious pts at Home
 - No oral meds or carbs due to danger
 - Give **1mg of glucagon** injection
 - Pts may take up to **20 mins** to regain consciousness
 - Follow up with 15 grams of **concentrated carbs and snacks**
- For pts at hospital or who can't eat
 - Give **25-55 cc/mL of Dextrose 50% water (D50)**
 - Super quick and used in emergency (effects are seen in mins)

Patient Teaching

- Teach preventions of **hypoglycemia**
 - Regular meals
 - Eating more with exercise
 - Consistent insulin administration
 - Routine BGL tests
 - Others
- Wearing a **bracelet** stating that pt has diabetes
- Carrying simple sugars
- Having families and friends know symptoms and actions

Diabetic Ketoacidosis

- Occurs in **extreme hyperglycemia, absence of insulin**
- Cannot use glucose as energy, thus uses **fat**
- Rarely occurs with type 2
- Can progress to **cerebral edema, coma, and death**

Main Clinical Features

1. **Hyperglycemia**
 2. **Dehydration**
 3. **Electrolyte loss**
 4. **Ketosis**
 5. **Metabolic acidosis** (due to accumulation of ketones)
- Others: **orthostatic hypotension, fatigue, headaches, 3 Ps, fruity breath, Kussmaul respirations**

Lab Results

- **BG \geq 250 mg/dL**
- **Low pH**
- **Low HCO₃⁻**
- **Ketone in urine**
- **Low PCO₂** (compensatory)
- **Na⁺ and K⁺** (and other electrolytes) **level may appear normal due to fluid loss, but they are most likely low**
 - You will need to replace them

Precipitating Factors

- When body has stress, thus needs more glucose like during **illness or infection**
- Inadequate insulin
- Neglect

DKA Management

- Main goal is to correct
 - **Dehydration**
 - **Electrolyte loss**
 - **Acidosis**
- Priorities
 1. Give IV fluid to correct fluid depletion (maintain tissue perfusion, prevent circulatory collapse)
 - Use either 0.45 or 0.9% NS for IV fluid
 2. Cardiac monitor; but if **K⁺ levels are imbalanced, connect cardiac monitor before IV fluid**
 3. **K⁺ replacement**
 4. Insulin drip
 - Give insulin via IV
 - You may stop IV insulin once SQ insulin can be give, or pt can eat, or HCO₃⁻ levels are between 15-18 mEq
- Precautions!

- Once BGL is below **300, bring down levels down slowly from this point to prevent cerebral edema**
- Check for **fluid overload** (since you're giving IV fluid)
- Assess **lung sounds** (crackles)
- Check v/s often
- Check I/O
- Restoring electrolytes
 - Major concern is **K⁺**
 - Monitor every **2-4 hours**
- **Monitor BG level at least every hour**

Sick Day Rules

- Applied during times of stress and illness
- Do not eliminate insulin doses
- May need **extra short-acting insulin**
- Encourage more frequent carb snacks
- Check BGL and ketones in urine **every 3-4 hours** (sometimes 2 hours)
- Drink lots of water if pt has **diarrhea or vomiting**
- Teach pt to alert HCP if **BG is higher than 200** or **ketones are present**

Prevention

- Educate pt to administer insulin **even if pt is not eating** or is vomiting
- Monitor **every 2 hours** for BGL if pt is ill or has an infection

Hyperglycemia Hyperosmolar Syndrome

- Mostly occurs in **type 2**
- Mostly occur in pts older than 60
- Usually due to an **unnoticed infection** or other stresses causing higher need of insulin
- Less common than DKA
- BG can rise super high **before symptoms start to appear (higher than 600mg)**
- Serious symptoms: **mental status alterations**
- **No ketosis or acidosis**

Clinical Manifestations

- **Hypotension**
- **Serious dehydration**
- **Tachycardia**
- **Neurologic signs**

HHS Management

- Fluid replacement (check for **cardiac overload**)
- Insulin administration via IV
- Reverse electrolyte imbalance
- **Treating underlying infection**

Precautions

- Fluid overload
- Heart failure
- Cardiac dysrhythmia

DKA vs HHS

DKA	HHS
More common in type 1	More common in type 2
Rapid onset (below 24 hours); BG is higher than 250mg	Takes a while until BG is higher than 600 (usually)
Ketones present	No ketones
ABGs altered	Relatively normal ABGs
Low mortality	Higher mortality (10-20%); due to severe dehydration and older pts

DIABETIC PTS UNDERGOING SURGERY

- Pts are in times of stress → more glucose need
- Pre-op phase: frequent **BG monitoring (every 1-2 hours)**
 - **Morning insulin injection may be withheld or if pt's BG is higher than 200, then you may have to administer half the normal amount**
 - Ask HCP if there's no change in insulin order
 - Look out for pts taking **metformin**
 - Should discontinue 24-48 hours prior to surgery
- During surgery, pt's BG can be maintained via **IV insulin** or via **dextrose infusion**
- After surgery, make sure to give **SQ insulin at least 30 min before** removing IV insulin

DIABETICS PTS WHO ARE NPO

- **Nurses must ensure that insulin dosage has been changed**

- Eliminating **rapid-acting insulin**
- Give half the usual dose of **intermediate insulin**
- **IV dextrose may be given** to prevent hypoglycemia
- Make sure pts are scheduled for tests early morning to prevent complications
- Though not eating, check their BGL according to their **mealtimes** (morning and before bed especially)

DIABETIC PTS ON LIQUID DIET

- **Do not use "sugar free" drinks** since their only calorie source is drinks

LONG TERM COMPLICATIONS OF DIABETES

- **Macrovascular, microvascular, and neuropathy**
- Major cause of **disabilities**
- Occurs both in type 1 and type 2
 - Type 1 is more associated with **kidney disease**
 - Type 2 is more associated with **cardiac disease**

Macrovascular Complications

- **Def:** changes to medium to large blood vessels
 - **Thickening, sclerosis, plaque buildup**
- Happens in early ages
- 3 main types:
 1. **CAD** (highest mortality)
 2. **Cerebrovascular disease**
 3. **PVD**
- **Silent MI:** MI with no early signs
- Management
 - Decreasing risk factors for **atherosclerosis**
 - Controlling weight
 - Controlling HTN (meds)
 - Controlling hyperlipidemia
 - Controlling BG levels
 - **Stop smoking** (since diabetic pts are already at risk for cardiac issues)

Microvascular Complications

- **Def:** capillary basement membrane thickening
- Affects **retina** and **kidneys**

- **Diabetic retinopathy:** proliferation of new blood vessels from retina to vitreous
 - New vessels are prone to rupture → **microaneurysm, intraretinal hemorrhage**
 - Formation of **fibrous scar tissue** → **retinal detachment**
 - Usually damage is non-reversible
 - Clinical manifestations
 - Painless
 - Cobwebs, floaters
 - Hazy vision
 - Loss of vision
 - Management
 - BG control
 - HTN control
 - Stop smoking
 - **Argon laser photocoagulation**
 - **Vitrectomy**
- **Nephropathy:** kidney disease secondary to diabetic microvascular changes; due to increase glomerular capillary pressure
 - Early signs: **albumin** in urine
 - Can lead to **ESKD**
 - Management:
 - Check urine annually
 - BUN and creatinine level check
 - Not using **contrast dye**
 - Control HTN and BG
 - Others
 - Treatment:
 - Dialysis (higher mortality rate for pts with diabetes)
 - Kidney transplant

- Peripheral neuropathy management
 - **Intensive insulin therapy**
 - **Control BG**
 - **Analgesics**
 - **Antiseizure meds**

Foot and Leg Problems

- 50-75% of amputations happen due to diabetes
 - 50% of these are **preventable**
- High risk factors:
 - **Diabetic more than 10 yrs**
 - **Older than 40**
 - **Smoker**
 - **Decreased peripheral pulses**
 - **Decreased sensation**
 - **Had previous amputations**
- Common causes:
 1. Injury in foot
 2. Unable to feel injury
 3. Serious infection occurs
- Prevention: educate pt
 - Inspect feet daily
 - Keep skin **soft and smooth**
 - Trim toenails
 - Consult **podiatrist**
 - Stop smoking
 - Contact HCP immediately if **there's a sore or bruise that doesn't heal after 24 hours**

Diabetic Neuropathy

- **Def:** damage of nerves due to diabetes
 - Peripheral
 - Autonomic
 - Spinal
- Mostly affect lower extremities
- Initial symptoms:
 - **Tingling**
 - **Heightened sensation**
 - **Burning**
- Late symptoms:
 - **Numbness**
 - **Proprioception problems**
 - **Decrease sense of touch**
 - **Gait issue**

Insulin

INSULIN THERAPY

- Type 1 diabetes will **always need insulin therapy**
- Type 2 diabetes may or may not require insulin therapy

Time Course of Action

- **Onset:** how soon the insulin can start lowering blood glucose level
- **Peak:** the time after administration that the insulin works its hardest to get blood glucose level down
- **Duration of action:** how long the blood glucose level can be kept down (after administration)

Rapid Acting Insulin (Lispro)

- Most like **endogenous insulin** in response to meal
- **Shorter duration** than regular insulin
- **Covers:** immediately after injection
- Should be given 5-15 mins before eating

Onset	10-15 min
Peak	1 hour
Duration	2-4 hours

- Mixing in syringe: **NPH + regular insulin**

Short Acting Insulin/Regular Insulin (Humulin R)

- Clear (not cloudy)
- Should be given 20-30mins before meal
- **Covers:** increase in glucose after meals
- Can be given alone or with other **longer acting insulin**
- Can be given **IV, IV insulin drip**
- Mixing in syringe: can be mixed with all insulins **except Glargine and Glulisine**

Basal Insulin

- Def: insulin that is either **intermediate or long acting**
- Needed by **type 1 diabetes** (and sometimes type 2)
- **Intermediate acting insulin**
 - Also known as **NPH**

Onset	2-4 hours
Peak	4-12 hours
Duration	16-20 hours

Very Long-Lasting Insulins

- Types: **Glargine (Lantus)** and **Detimir**
- "Peakless"
- Absorbed very slowly over 24 hours
- Should **never be mixed**
- Provide relatively constant blood glucose level throughout day
- Given **once a day** at same time

CATEGORIES OF INSULIN

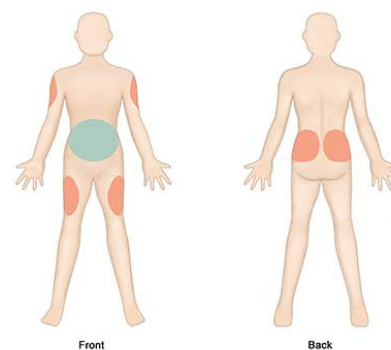
Time course	Agent	Onset	Peak	Duration
Rapid acting	Lispro/Humalog	10-15 min	1 hour	2-4hours
Short acting	Regular (Humulin)	30-60 min	2-3hours	4-6 hours
Intermediate acting	NPH	2-4 hours	4-12 hours	16-20 hours
Very long lasting	Glargine (Lantus)	1 hour	None	24 hour

Insulin Regimes

- Usually a combination of **short-acting insulin** and **intermediate or long-acting insulin**

Insulin Injection Sites

- Most common is **abdomen**



- Insulin syringes:
 - 6mm
 - 12.7mm

Insulin Administration

- Cannot administer **fraction of doses**
- Check facility's policies for **rounding rules** but KSU's rules are:
 - Less than 0.4 → rounds down
 - Equal or more than 0.5 → rounds up

- Insulin sliding scale:
 - For BG>180: **$(BG-100)/30$** = amount of regular insulin or **Aspart insulin**
- Instrument options to give insulin
 - Insulin pen (easier
 - **Insulin pump cannula** (device that mimics the pancreas in releasing small amounts of insulin at a “basal rate”)