What Every Diabetic Wants You To Know

Even If They Don't Know It

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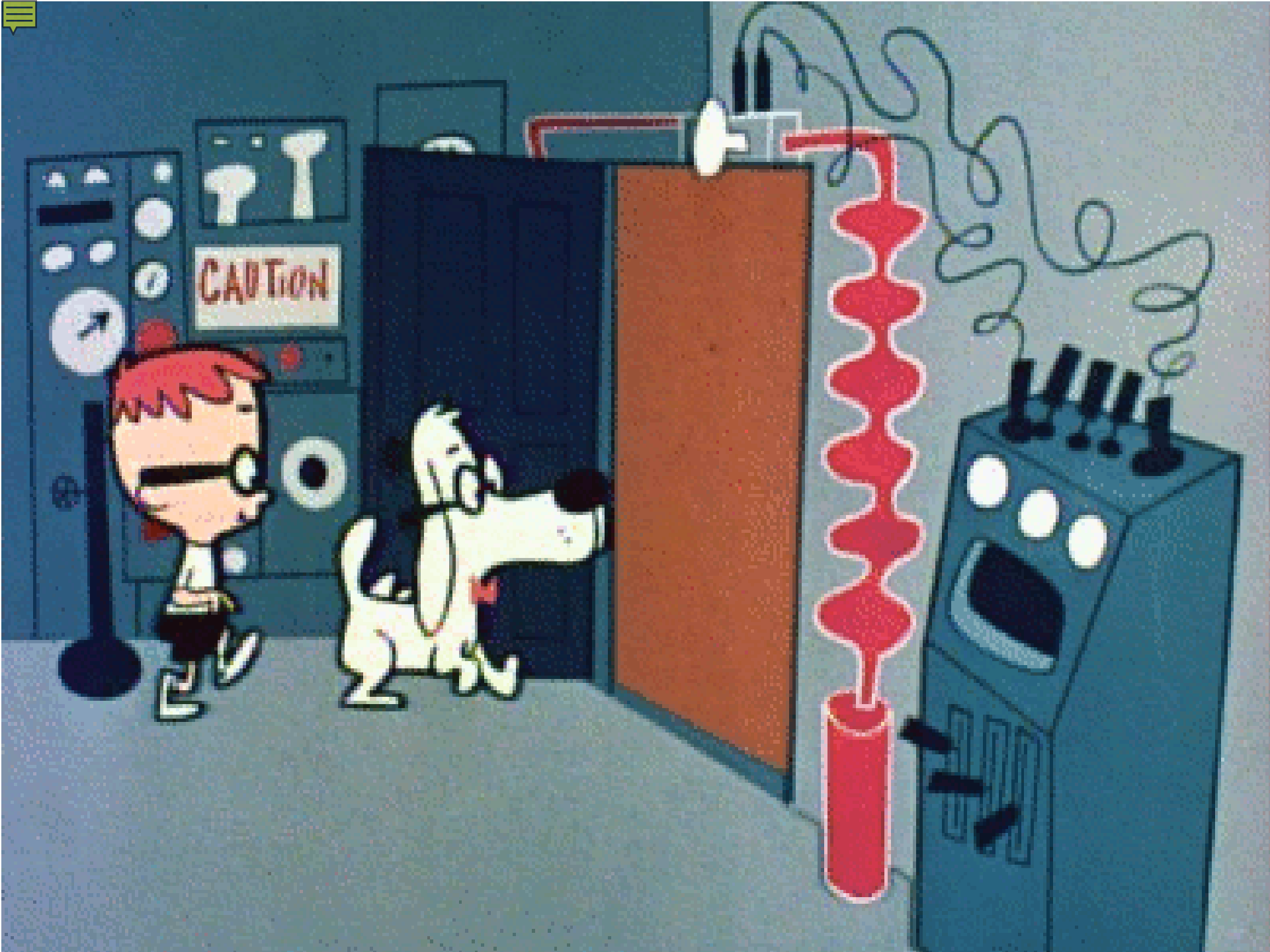
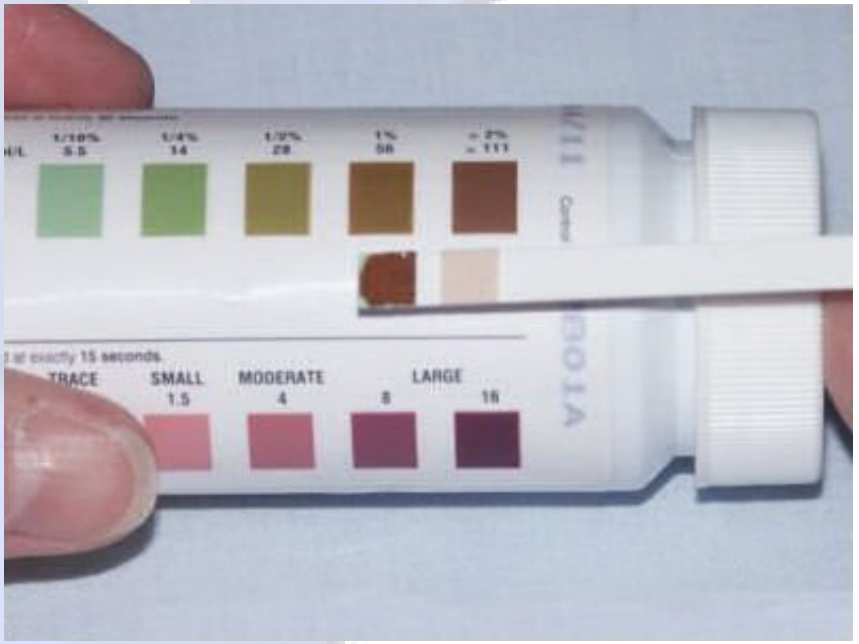

CAUTION

Tools Of The Trade. . .Then

- Dexi Sticks
- Lancets
- Water Bottle
- D50
- IV Fluid
- Administration Set
- Glucagon
- Syringe & IM Needle



Objectives

- Increase understanding of diabetes and its effects on the body
- Understand how diabetes effects field assessment and treatment
- Introduction of diabetes related medications and technology

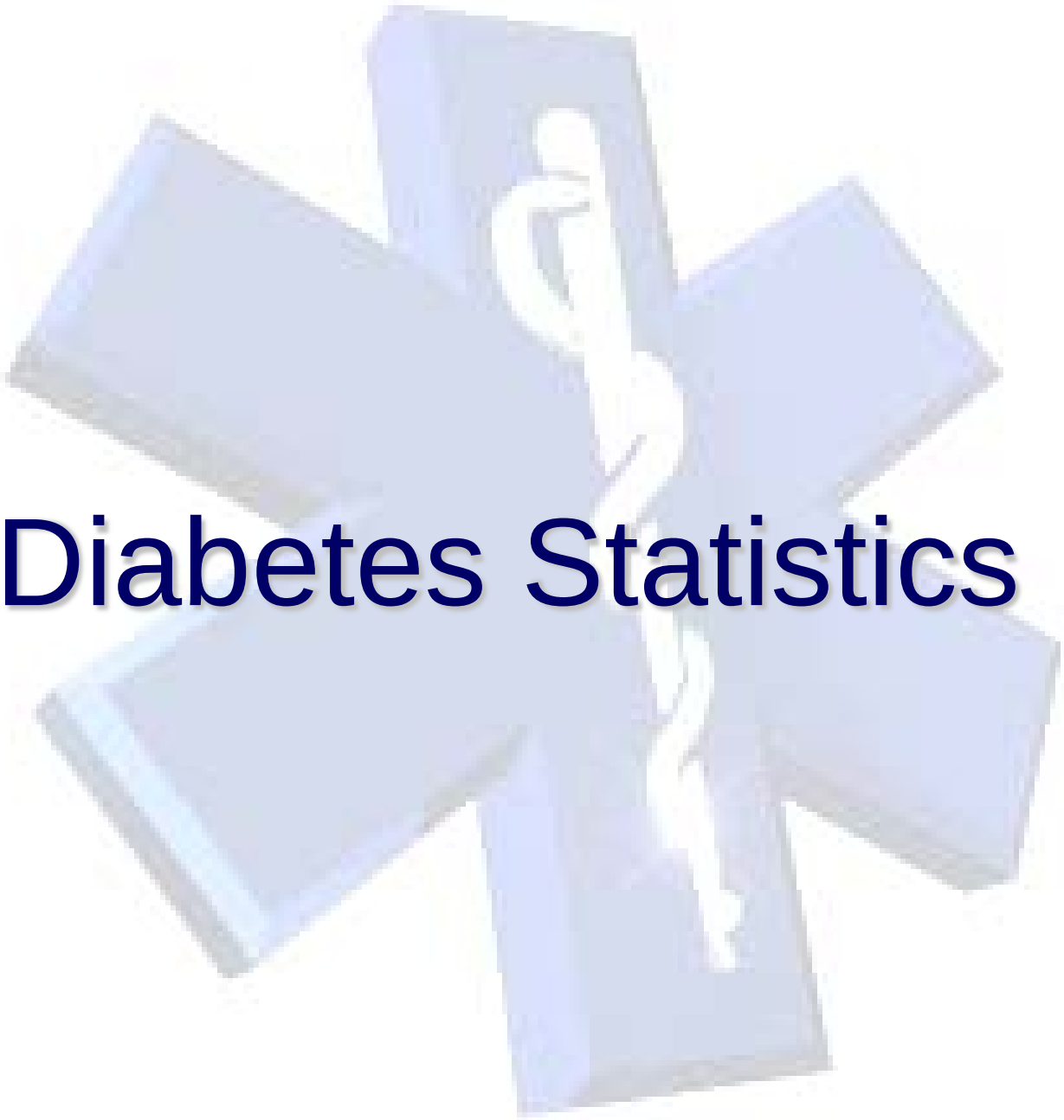
Goal

To be able to provide the proper treatment for all diabetic patients through better assessment, treatment, and destination determination.

Diabetes is...

...a group of diseases marked by high levels of glucose resulting from defects in insulin production, insulin action, or both.

– American Diabetes Association



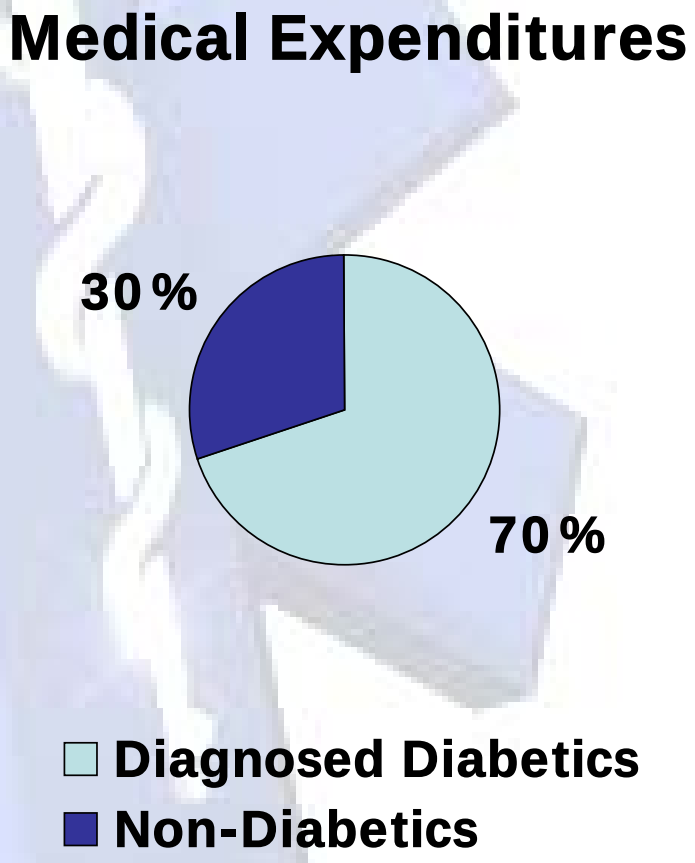
Diabetes Statistics

United States (2010)[1]

- 25.8 million cases in the United States (8.3%)
  - 18.8 million diagnosis / 7.0million undiagnosed
- Racial and ethnic minorities are at greater risk than non-Hispanic whites
- Seventh leading cause of death
  - Thought to be higher due to gross underreporting on death certificates
- Number ***one*** cause of. . .
  - Kidney failure
  - Non-traumatic lower limb amputations in adults
  - New cases of blindness in adults < 75 years old

Cost of Diabetes (2007)[1]

- Total Cost = $174B
  - Direct = $116B
  - Indirect = $58B
- The cost has risen $8B/year since 2002
- Medical expenditures are 2.3 times higher for diagnosed diabetics than non-diabetics



Virginia (2010)[2]

- 531,366 diagnosed adult cases (8.7%)
  - An estimated additional 312,568 adults are undiagnosed
- Non-Hispanic Blacks are more likely to have diabetes.
- Seventh leading cause of death (2009)
- Total Cost = $366M (2007)
  - Direct = $215M
  - Indirect = $151M

"Number of Americans with Diabetes Expected to Double or Triple by 2050"[3]

By the year 2050. . .

- As many as 1 in 3 adults could have diabetes
- Number of new cases could be as many as 15 per 1,000 adults

Causes???

- Aging population
- Increase in minority groups
- People with diabetes living longer

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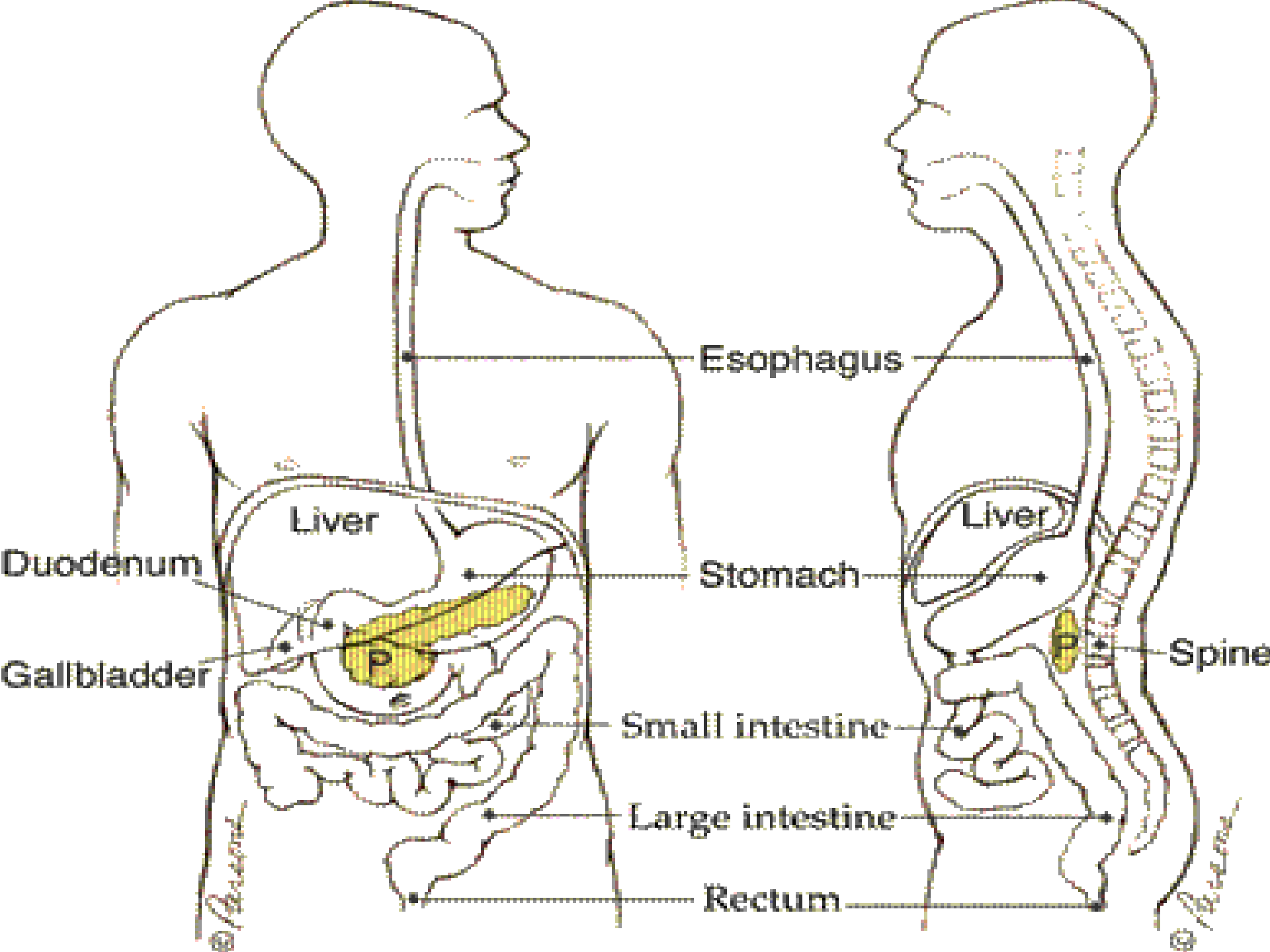
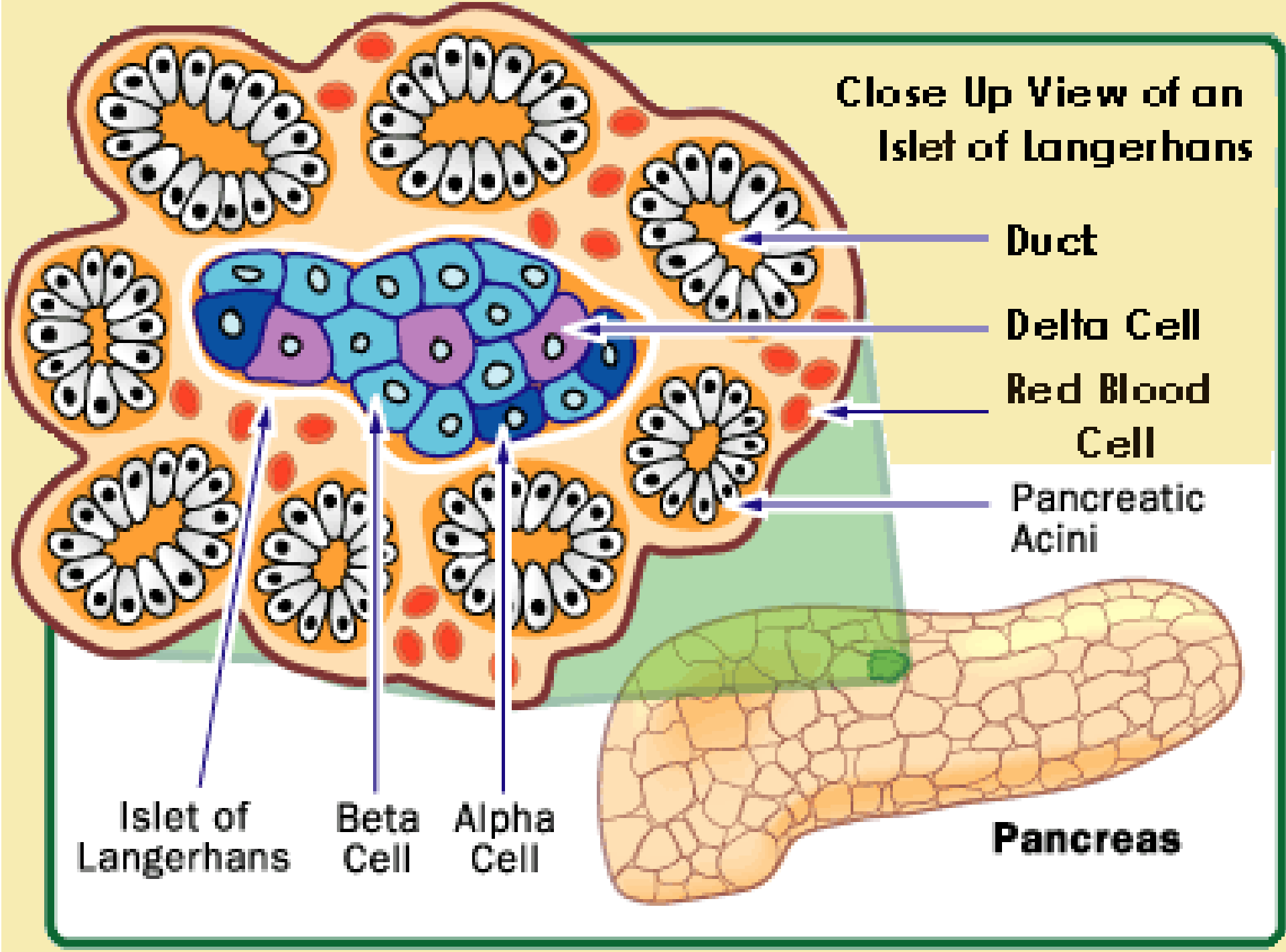
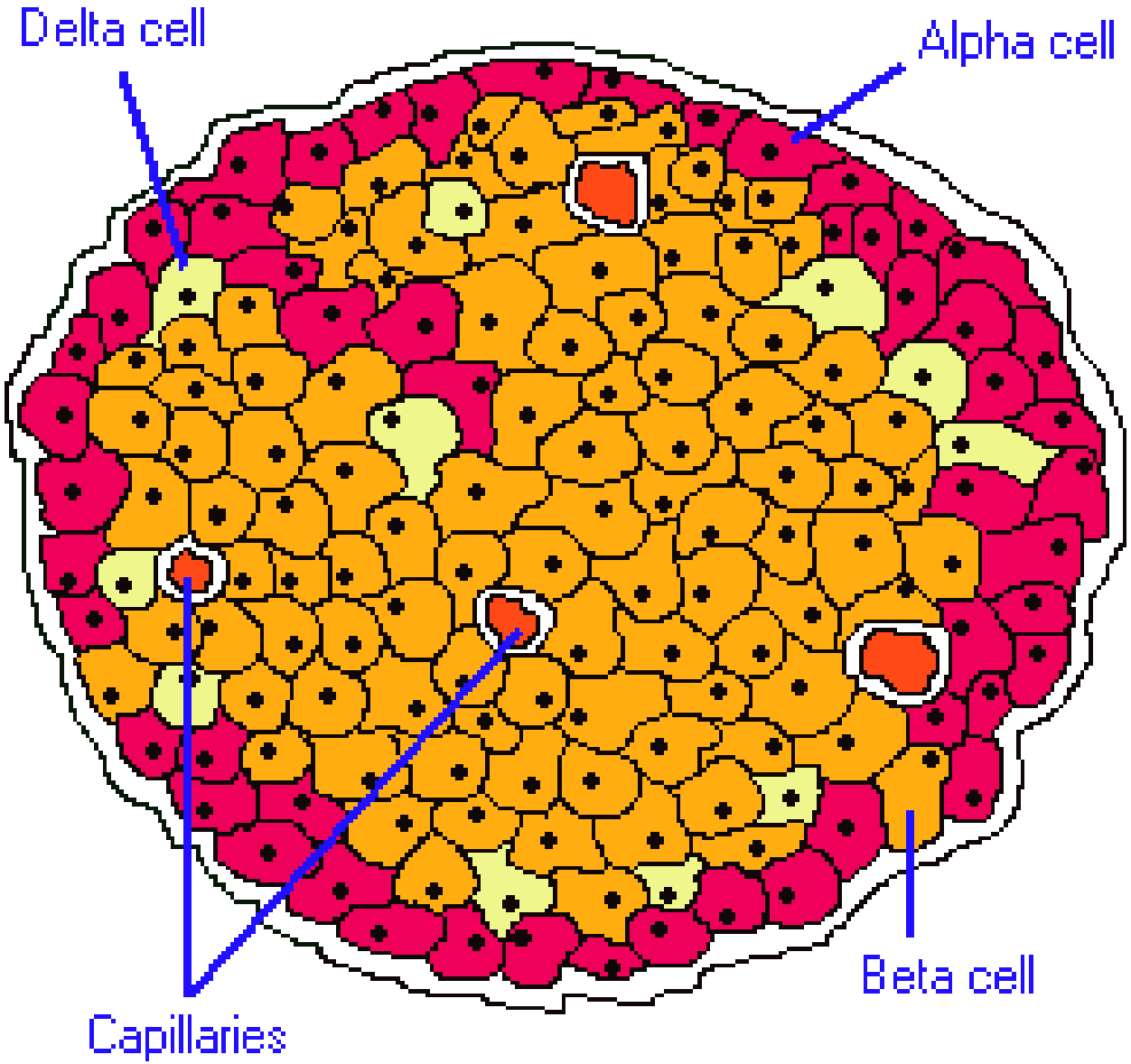
A Little Anatomy & Physiology

The Pancreas

- Located in the upper retroperitoneal space
- Has both endocrine and exocrine functions
- Islets of Langerhans
  - Alpha cells - Glucagon
  - Beta cells – Insulin
  - Delta cells - Somatostatin


Esophagus
Liver
Duodenum
Stomach
Gallbladder
Small intestine
Large intestine
Rectum
Liver
Spine


Close Up View of an Islet of Langerhans
Duct
Delta Cell
Red Blood Cell
Pancreatic Acini
Islet of Langerhans
Beta Cell
Alpha Cell
Pancreas


Delta cell
Alpha cell
Capillaries
Beta cell

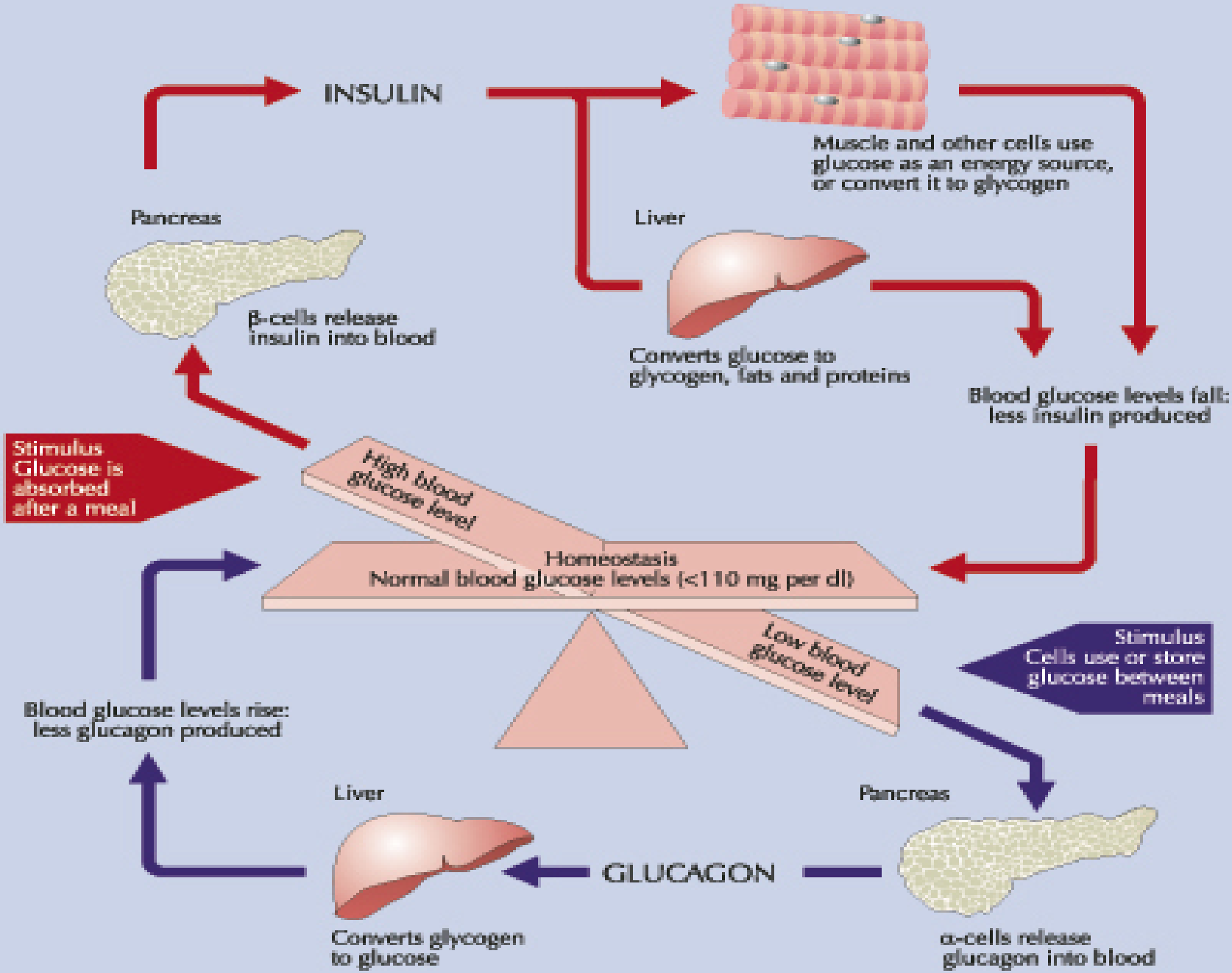
Liver

- Located in the upper right abdominal quadrant
- Stores glucose as glycogen, fats, and proteins
- Removes poisons from the blood and makes bile

Insulin

- Stimulates the liver to convert glucose to glycogen, fats, and proteins
- Transports glucose from the bloodstream into muscles and other cells for use as an energy source **OR** conversion to glycogen

Normal Function


INSULIN
Muscle and other cells use glucose as an energy source, or convert it to glycogen
Pancreas
β-cells release insulin into blood
Liver
Converts glucose to glycogen, fats and proteins
Blood glucose levels fall: less insulin produced
Stimulus Glucose is absorbed after a meal
High blood glucose level
Homeostasis
Normal blood glucose levels (<110 mg per dl)
Low blood glucose level
Stimulus Cells use or store glucose between meals
Blood glucose levels rise: less glucagon produced
Liver
Converts glycogen to glucose
GLUCAGON
Pancreas
α-cells release glucagon into blood

When A Good Pancreas Goes Bad

Types of Diabetes

- Pre-diabetes
- Type 1
- Type 2
- Gestational

Pre-diabetes

- Fasting glucose levels are higher than normal, but not high enough to be diagnosed as diabetes

  $100 \text{ mg/dl} \leq \text{blood glucose} < 126 \text{ mg/dl}$

- Damage to the heart and circulatory system may already be occurring
- In 2010, estimated to be 79 million people with pre-diabetes

Type 1 Diabetes
(Juvenile Diabetes / Insulin Dependent Diabetes)

- 5% to 10% of all diabetes diagnoses
- The body does not produce insulin
- Primarily diagnosed in children and young adults
- Autoimmune disease

Type 1 Diabetes Risk Factors

- Genetic Marker
  - Human leukocyte antigen (HLA) complex
- Viral Infections
  - German measles, coxsackie, and mumps
- Race/Ethnicity
  - Caucasian
- Geography
  - Northern (cold) climates
- Family History
  - Parents (father > mother)
- Early Diet
  - Cow's milk
- Other Autoimmune Conditions
  - Grave's disease, multiple sclerosis, and pernicious anemia

Type 2 Diabetes

(Adult-Onset Diabetes / Non-Insulin Dependent Diabetes)

- 90% to 95% of all diabetes diagnoses
- The body either does not make enough insulin, is resistant to insulin, or both
- Primarily diagnosed in adults >40 years

Type 2 Diabetes Risk Factors

- Family History
  - Immediate Family Member
- Race/Ethnicity
  - African-Americans, Hispanic Americans, Native Americans, Asian Americans
- Overweight
- Age > 45 years old
- Gestational Diabetes
- Polycystic Ovary Syndrome

Gestational Diabetes

- Occurs in about 2% to 10% of pregnant women
- Generally, occurs late in pregnancy
- Not sure of cause
- No previous diagnosis of diabetes
- Complications for the infant

Gestational Diabetes Risk Factors

- Age > 25 years
- Overweight
- Race/Ethnicity
  - African Americans, Native American, Asian Americans, Hispanic Americans, Pacific Islanders
- Family History
  - Family member with any type of diabetes
- Pre-diabetes
- Previous pregnancy with gestational diabetes

Diabetes Signs & Symptoms General

- Fatigue
- Extreme thirst
- Dehydration
- Frequent urination, copious amounts
- Extreme hunger
- Weight loss
- Slow wound healing
- Blurry vision

Diabetes Signs & Symptoms

- Type 1
  - Abdominal pain
  - Nausea and/or vomiting
  - Irritability
  - Menstrual changes
  - Tachycardia
  - BP < 90/60 mmHg
  - Body temperature < 97°F (36.1°C)
- Type 2
  - Infections
  - Severe gum problems
  - Itching
  - Erectile dysfunction in men
  - Unusual sensations in extremities

Complications

Diabetic Complications

- Over 60 different complication
- Affect every body system
- Range from very minor to very severe

Diabetic Complications
(by system)

- Cardiovascular
  - Atherosclerosis
  - Hypertension
  - Coronary Artery Disease
  - Heart Attack
  - Cerebral Vascular Disease
  - Stroke/TIA
  - Heart Failure
  - Peripheral Arterial Disease
  - Diabetic Vascular Disease
- Digestive
  - Gum Disease / Infections
  - Tooth loss
  - Gastroparesis
  - Gastroesophageal Reflex Disease (GERD)
  - Diabetic Enteropathy
  - Constipation

Diabetic Complications
(by system)

- Endocrine
  - Hypoglycemia
  - Hyperglycemia
  - Diabetic Ketoacidosis
  - Hyperosmolar Hyperglycemic Nonketotic Syndrome
- Immune
  - Allergic Reaction

Diabetic Complications
(by system)

- Integumentary
  - Infections
  - Itching
  - Diabetic Dermopathy
  - Necrobiosis Lipoidica Diabeticorum
  - Atherosclerosis
  - Diabetic Blisters
  - Eruptive Xanthomatosis
  - Digital Sclerosis
  - Disseminated Granuloma Annulare
  - Acanthosis Nigricans

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Diabetic Complications
(by system)

- Musculoskeletal
  - General
    - Charcot's Joint/Foot
    - Diabetic Hand Syndrome
    - Osteoporosis
    - Osteoarthritis
    - Forestier's Disease
    - Dupuytren's Contracture
    - Frozen Shoulder
    - Amputation
  - Feet
    - Infections
    - Ulcers
    - Dry, Cracked Skin
    - Corns and Calluses
    - Nail Disorders
    - Hammertoes and Bunions

Diabetic Complications
(by system)

- Nervous
  - General
    - Diabetic Myelopathy
    - Diabetic Neuropathy
  - Eyes
    - Diabetic Retinopathy
    - Glaucoma
    - Cataracts
- Reproductive
  - Erectile Dysfunction
  - Retrograde Ejaculation
  - Decreased Vaginal Lubrication
  - Decreased/Absent Sexual Response
  - Pregnancy Complications

Diabetic Complications
(by system)

- Respiratory
  - Flu
  - Pneumonia
- Urinary
  - Kidney Disease
  - Diabetic Nephropathy
  - Overactive Bladder
  - Neurogenic Bladder
  - Urinary Tract Infection

Hypoglycemia

- Lower than normal blood sugar
  - Absolute hypoglycemia is blood sugar < 70 mg/dl
- Causes
  - Too much insulin for the available glucose
  - Insulin absorbs too quickly
  - Glucose releases too slowly

Hypoglycemia
Signs and Symptoms

- Cold sweats
- Confusion
- Convulsions
- Coma
- Decreased alertness
- Dizziness
- Double/blurry vision
- Excessive sweating
- Fatigue
- General discomfort, uneasiness or ill feeling
- Headache
- Hunger
- Irritability
- Nervousness
- Paleness
- Tachycardia
- Trembling
- Other Possible Symptoms
  - Hallucinations
  - Memory loss
  - Muscle pain
  - Pounding heartbeat
  - Sleeping difficulty

Hypoglycemia Treatment

- SUGAR!!!
  - Conscious AND Alert
    - Sugared beverage, preferably juice or soda
    - Oral glucose
  - Lowered level of consciousness
    - D50 25gm in 50cc IV/IO
    - Glucagon 1mg IM, if no IV access
- 12-Lead ECG
- MAKE SURE PATIENT EATS SOMETHING!!!
- Consider Transport!

Hyperglycemia

- Higher than normal blood sugar
  - Fasting – Blood sugar greater than 130 mg/dl
  - Postprandial (after meal) – Blood sugar greater than 180 mg/dl, 1-2 hours after a meal
- Causes
  - Skipping/forgetting glucose-lowering medicine
  - Eating too many carbohydrates for the amount of insulin administered
  - Increased stress
  - A stressful event such as infection, illness, heart attack, stroke, or recent surgery
  - Decreased activity

Hyperglycemia
Signs & Symptoms

- Early
  - Increased thirst
  - Headaches
  - Difficulty concentrating
  - Blurred vision
  - Frequent urination, copious amounts
  - Fatigue
  - Weight loss
  - High blood glucose
- Prolonged
  - Vaginal and skin infections
  - Slow-healing cuts and sores
  - Decreased vision
  - Nerve damage causing painful cold or insensitive feet, loss of hair on the legs, and/or erectile dysfunction
  - Stomach and intestinal problems such as chronic constipation or diarrhea

Hyperglycemia Treatment

- FLUID!
- Transport
- 12-Lead ECG
- Emergency Department
  - Fluid
  - Insulin
  - Treat underlying cause

Diabetic Ketoacidosis (DKA)

- A serious condition in which high blood sugar levels and little or no insulin result in the breakdown of fat for energy. The breakdown of fats produces a toxic acid called ketones.
- Occurs primarily in Type 1 diabetes

Diabetic Ketoacidosis (DKA) Causes

- Not taking enough insulin or insulin pump problems
- A stressful event such as infection, illness, heart attack, stroke, or recent surgery

Diabetic Ketoacidosis (DKA) Signs & Symptoms

- Early
  - Blood glucose levels >240 mg/dl
  - High levels of ketones in the urine
  - Thirst or a very dry mouth
  - Frequent urination, copious amounts
- Later
  - Constantly feeling tired
  - Dry or flushed skin
  - Nausea/Vomiting
  - Abdominal pain
  - Deep, rapid breathing
  - Fruity odor on breath
  - Hard time paying attention, or confusion
  - Coma

Diabetic Ketoacidosis (DKA) Treatment

- FLUID, FLUID, FLUID!!!
  - 1-3 liters in the first 1-2 hours
  - 300-500 cc/hr after the first hour
- Transport
- 12-Lead ECG
- Emergency Department
  - Insulin
  - Fluid
  - Electrolyte replacement
  - Treat underlying cause

Hyperosmolar Hyperglycemic Nonketotic Syndrome (HHNS)

- A serious condition that involves very high blood glucose levels, without the presence of ketones, resulting in severe dehydration.
- Occurs primarily in older people with Type 2 diabetes

Hyperosmolar Hyperglycemic Nonketotic Syndrome (HHNS)

Causes

- A stressful event such as infection, illness, heart attack, stroke, or recent surgery
- Medications that lower glucose tolerance or increase fluid loss
- Poor kidney function
- Poor management of diabetes
- Stopping insulin or other medications that lower glucose levels

Hyperosmolar Hyperglycemic Nonketotic Syndrome (HHNS)
Signs & Symptoms

- Blood glucose levels >600 mg/dl
- Dry, parched mouth
- Extreme thirst (may gradually disappear)
- EXTREME dehydration
- Warm, dry skin that does not sweat
- Nausea
- Fever > 101°F (38.3°C)
- Tachycardia
- Low systolic blood pressure
- Loss of vision
- Hallucinations (visual or auditory)
- Weakness, usually on one side of the body
- Seizures
- Coma

Hyperosmolar Hyperglycemic Nonketotic Syndrome (HHNS) Treatment

- FLUID, FLUID, FLUID!!!
  - 1-3 liters of a hypotonic solution in the first 1-2 hours
  - Math
- Transport
- 12-Lead ECG
- Emergency Department
  - Fluid
  - Potassium
  - Insulin
  - Treat underlying cause

Diabetic Neuropathies

- Family of nerve disorders caused by diabetes
- Can occur in every organ system
- More common in people who have had diabetes for >25 years, poorly controlled diabetes, hypertension, and/or hyperlipidemia
- 60% to 70% of all diabetics have some form of neuropathy

Diabetic Neuropathies
Types

- Peripheral
- Proximal
- Autonomic
- Focal

Peripheral Neuropathy
(Damage to peripheral nervous system)

- Areas Affected
  - Toes
  - Feet
  - Legs
  - Hands
  - Arms
- Symptoms
  - Numbness or insensitivity to pain or temperature
  - Tingling, burning, or prickling sensation
  - Sharp pain or cramps
  - Extreme sensitivity to touch
  - Loss of balance or coordination
  - Often worse at night

Proximal Neuropathy
(Form of Peripheral Neuropathy)

- Affects
  - Thighs
  - Hips
  - Buttocks
  - Legs
  - Usually one side of body
  - More common in elderly, Type II diabetics
- Symptoms
  - Sudden, severe pain
  - Weakness and atrophy of the thigh
  - Difficulty standing from a seated position

Autonomic Neuropathy
(Damage to the autonomic nervous system)

- Affects
  - Cardiovascular System
  - Blood Glucose Levels
  - Digestive System
  - Respiratory Function
  - Urination
  - Sexual Response
  - Vision
  - Sweat Glands
- Symptoms
  - Depend on the system affected

Focal Neuropathy
(Damage to specific nerves)

- Affects
  - Head
  - Torso
  - Legs
  - More common in older adults

- Symptoms
  - Appear suddenly
  - Inability to focus
  - Double vision
  - Aching behind one eye
  - Bell's palsy
  - Severe low back or pelvic pain
  - Chest or abdominal pain
  - Carpal tunnel syndrome
  - Pain in the front of a thigh
  - Pain on the outside of the shin or inside of the foot

Diabetic Neuropathy Treatment

- CONTROL BLOOD SUGAR LEVELS!!!
- Pain Management
  - Tricyclic antidepressants
  - Other antidepressants
  - Anticonvulsants
  - Opioids and opioid-like drugs
- Other treatments based on type of nerve problem

Cardiovascular Complications

- Diabetics are two to four times as likely as non-diabetics to have heart disease or a stroke
- At least 65% of people with diabetes die from heart disease or stroke[4]
- Hypertension and hyperlipidemia increase the risk for heart disease and stroke

The Look AHEAD[5] Trial

- Collaborative trial by the 16 Look AHEAD Clinical Centers, the Look AHEAD Data Collection Center, the NIH, and the CDC
- Study length = 13.5 years
- 5,145 obese patients with Type 2 diabetes
- Through achieved and maintained weight loss, by decreased caloric intake and increased physical activity, participants will have reduced incidences of cardiovascular death, non-fatal myocardial infarction, hospitalized angina, and non-fatal stroke.

Results[6]

- Trial ended in September 2012
- “The intervention group did not have fewer cardiovascular events than the group receiving general diabetes support and education…”
- There was good news. “...both groups had a low number of cardiovascular events compared to previous studies of people with diabetes."

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Coronary Artery Disease and Heart Attack

- Caused by thickening or hardening of the arteries that feed the heart
- Once coronary blood flow is significantly reduced or blocked, a heart attack may result
- Heart attack is the number one cause of death in diabetics
- Diabetic are more like to have mild or absent symptoms.

Cerebral Vascular Disease, Stroke, & Transischemic Attack (TIA)

- Caused by thickening or hardening of the arteries that feed the brain
- Stroke is caused by blockage or rupture of a blood vessel in the brain or neck
- TIA is caused by a temporary blockage of a blood vessel in the brain or neck
- People who have had a TIA have an increased risked for stroke
- * Diabetics who have had a stroke are at greater risk for a second stroke

Metabolic Syndrome (Syndrome X)

- A group of risk factors that increases a person's risk for blood vessel and heart disease, and diabetes.
- Risk Factors (must have three)
  - Hypertension or hypertension medication
  - High triglycerides or cholesterol medication
  - Low high density lipoproteins (HDL) or cholesterol medication
  - Elevated blood sugar levels
  - Abdominal fat

Heart Failure

- Chronic condition in which the heart cannot properly pump blood
- Left side heart failure may result in pulmonary edema
- Right side heart failure may result in peripheral edema
- ✱Diabetics are twice as likely as non-diabetics to develop heart failure

Peripheral Arterial Disease (PAD)

- Caused by thickening or hardening of the arteries that feed the lower extremities
- The most common symptom is pain, cramping or aching in the calves, thighs, or buttocks when walking
- Pain on rest, tissue loss, or gangrene
- African Americans and Hispanics are at greater risk than non-Hispanic whites
- 30% mortality rate
- For diabetics, PAD is a major risk factor for lower limb amputation

Diabetic Vascular Disease

- Development of blockages in arteries throughout the body due to diabetes.
- May cause blindness, severe kidney disease, stroke, heart attack, foot sores, and amputation
- Risk increases with length of time with diabetes, hypertension, smoking, lack of exercise, being overweight, and high-fat diet

Gastroparesis

- An autonomic neuropathy in which the stomach takes too long to empty
- Occurs when the vagus nerve is damaged and the muscles of the stomach and intestines do not work normally

Gastroparesis
Signs & Symptoms

- Heartburn
- Upper abdominal pain
- Nausea
- Vomiting of undigested food
- Early feeling of fullness
- Weight loss
- Abdominal bloating
- Uncontrolled blood glucose levels
- Lack of appetite
- Gastroesophageal reflux (GERD)
- Spasms in the stomach area
- Bacterial infection
- Solid masses of hardened food
- Stomach obstruction

Renal Failure / Diabetic Nephropathy

- A serious condition in which the kidneys no longer work properly and fail to rid the body of waste
- Excessive amounts of blood glucose causes kidney function to decrease
- Diabetes is the number one cause of renal failure

Amputation

- Diabetes is the number one cause of non-traumatic amputation
- Causes
  - Peripheral arterial disease
  - Poor circulation
  - Gangrene
  - Foot sores
  - Slow healing wounds

Depression

- Link between diabetes and depression[7]
- People with diabetes AND depression are more likely to experience severe / life threatening diabetic complications
- Group Health Research Institute / University of Washington study[8]
  - 36% higher risk of developing microvascular complications
  - 25% higher risk of developing macrovascular complications

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Medications

Medications

- There are over 70 medications for diabetes
  - Approximately 50 oral medications
  - More than 20 insulins
  - Three non-insulin injectables

Oral Medications

Category	Action	Name
Sulfonylureas	Stimulates beta cells to release more insulin	chlorpropamide (Diabinese)
		glipizide (Glucotrol)
		glyburide (DiaBeta/Micronase/Glynase)
		glimepiride (Amaryl)
Meglitinides	Stimulates beta cells to release more insulin	repaglinide (Prandin)
		nateglinide (Starlix)
Biguanides	Reduces glucose production in the liver	metformin (Glucophage)
	Makes muscle tissue more sensitive to insulin	
Thiazolidinediones (the glitazones)	Helps insulin work better in the muscle and fat	rosiglitazone (Avandia)
		pioglitazone (ACTOS)
	Reduces glucose production in the liver	
DPP-4 Inhibitors	Prevents the breakdown of GLP-1	sitagliptin (Januvia)
Alpha-glucosidase Inhibitors	Blocks the breakdown of starches, and some sugars, in the intestine	acarbose (Precose)
		meglitol (Glyset)
Combination Drugs	Combined action of the individual drugs in the combination	glyburide and metformin (Glucovance)
		glipizide and metformin (Metaglip)
		rosiglitazone and metformin (Avandemet)
		pioglitazone and metformin (ACTOS plus Met)
		sitagliptin and metformin (Janumet)

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Insulins

Category	Name	Onset	Peak	Duration
Rapid Acting	aspart (Novolog)	10 to 20 minutes	1 to 3 hours	3 to 5 hours
	lispro (Humalog)	15 to 30 minutes	1 to 2 hours	3 to 5 hours
	glulisine (Apidra)	10 to 15 minutes	30 to 90 minutes	<3 hours
Short Acting	regular (Novolin R/Humulin R)	30 to 60 minutes	2 to 4 hours	4 to 8 hours
Intermediate Acting	NPH (Novolin N/Humulin N)	1 to 2 hours	6 to 14 hours	16 to 24 hours
Long Acting (Basal)	glargine (Lantus)	1 to 2 hours	no peak	24 to 28 hours
	detemir (Levemir)	1 to 4 hours	no peak	≤24 hours
Premixed	70% aspart protamine with 30% aspart (NovoLog 70/30)	10 to 20 minutes	1 to 4 hours	15 to 18 hours
	70% NPH with 30% regular (Novolin 70/30 / Humulin 70/30)	30 to 60 minutes	2 to 12 hours	10 to 16 hours
	50% NPH with 50% regular (Humulin 50/50)	30 to 60 minutes	2 to 5.5 hours	10 to 16 hours
	75% lispro protamine with 25% lispro (Humalog 75/25)	15 to 30 minutes	1 to 6.5 hours	≤24 hours

Other Injectables

Name	Drug Type	Action
pramlintide (Symlin)	synthetic amylin	Signals the liver to make the right amount of glucose
		Slows gastic emptying
		May reduce appetite
exenatide (Byetta)	incretin mimetic	Signals the pancreas to make the right amount of insulin
		Signals the liver to make the right amount of glucose
		Slows gastic emptying
		May reduce appetite
liraglutide (Victoza)	incretin mimetic	Signals the pancreas to make the right amount of insulin
		Signals the liver to make the right amount of glucose
		Slows gastic emptying
		May reduce appetite

Medication Considerations

- Patients who take oral glucose-lowering medication may still need to go to the hospital after hypoglycemia is corrected
- When getting the name of the patient's medications, get the name of the insulin **OR** at least the category of insulin
- Patients may take be taking medication(s) for something other than its intended use

Technology

Blood Glucose Meters

- More than 60 different meters
- Very simple to complex
- Many come with computer software
- Alternate site testing
- Hold a minimum of 100 readings
- Good source of information about blood glucose levels
  - Family members may not know how to access this information

Contour USB
BLOOD GLUCOSE MONITORING SYSTEM

Insulin Pumps

- Six different pumps
- Continually delivers a small amount of insulin (basal rate)
- Patient delivers a dose of insulin to match the amount of food to be eaten or to treat hyperglycemia (bolus dose)
- Better blood sugar control
- Improved quality of life
- *Do you turn it off in an emergency?*

One of the First Insulin Pumps

Current Insulin Pumps

Continuous Glucose Monitors

- Three different continuous glucose monitors
- Continually monitors glucose levels in the interstitial fluid for up to seven (7) days
- Reveals short-term glucose trends
- Alerts wearer to user-determined highs and lows
- Wearer must still check blood glucose levels

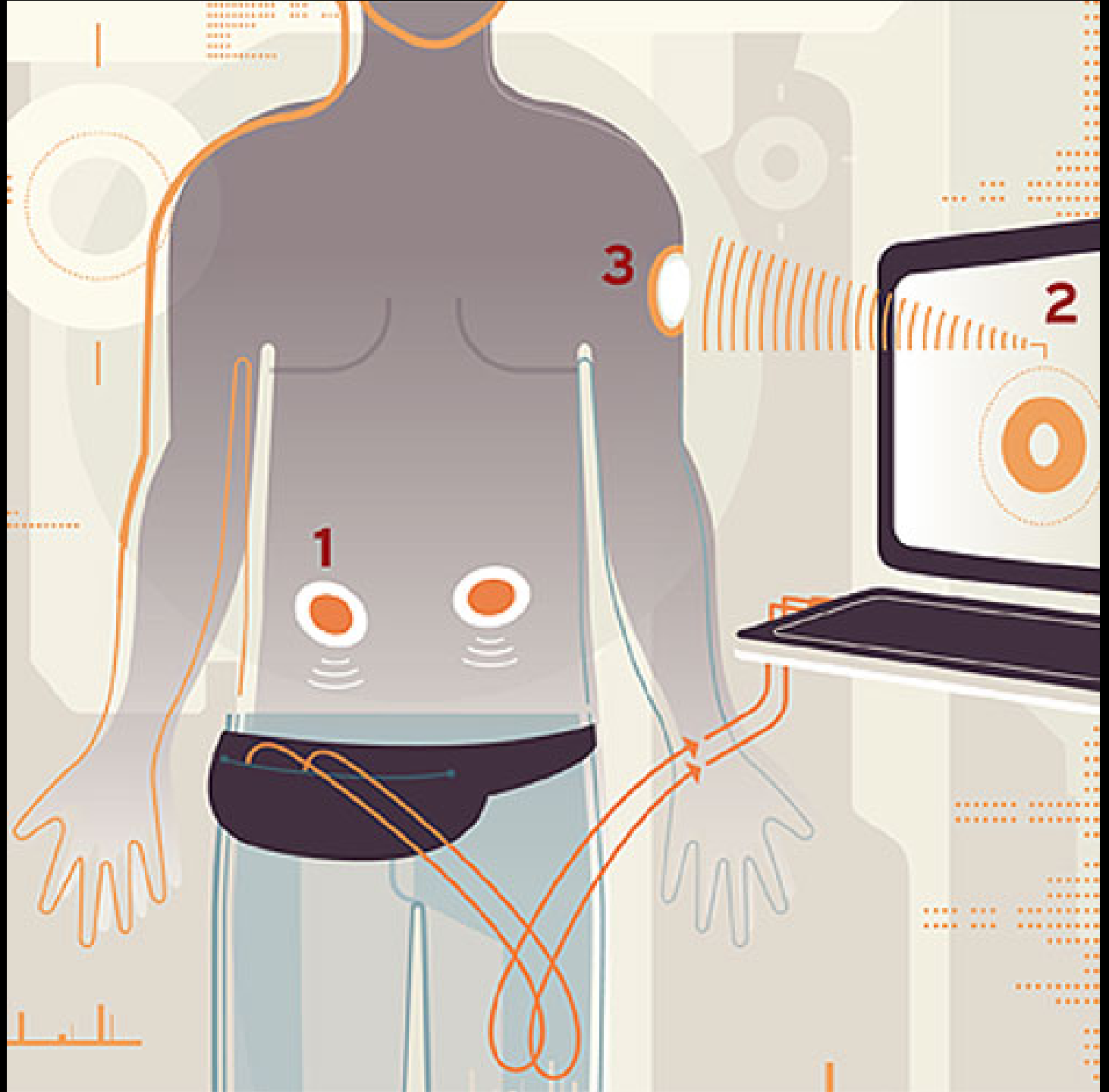

400
350
300
250
200
150
100
50
160
02:03 P
3hr
OK
dexcom

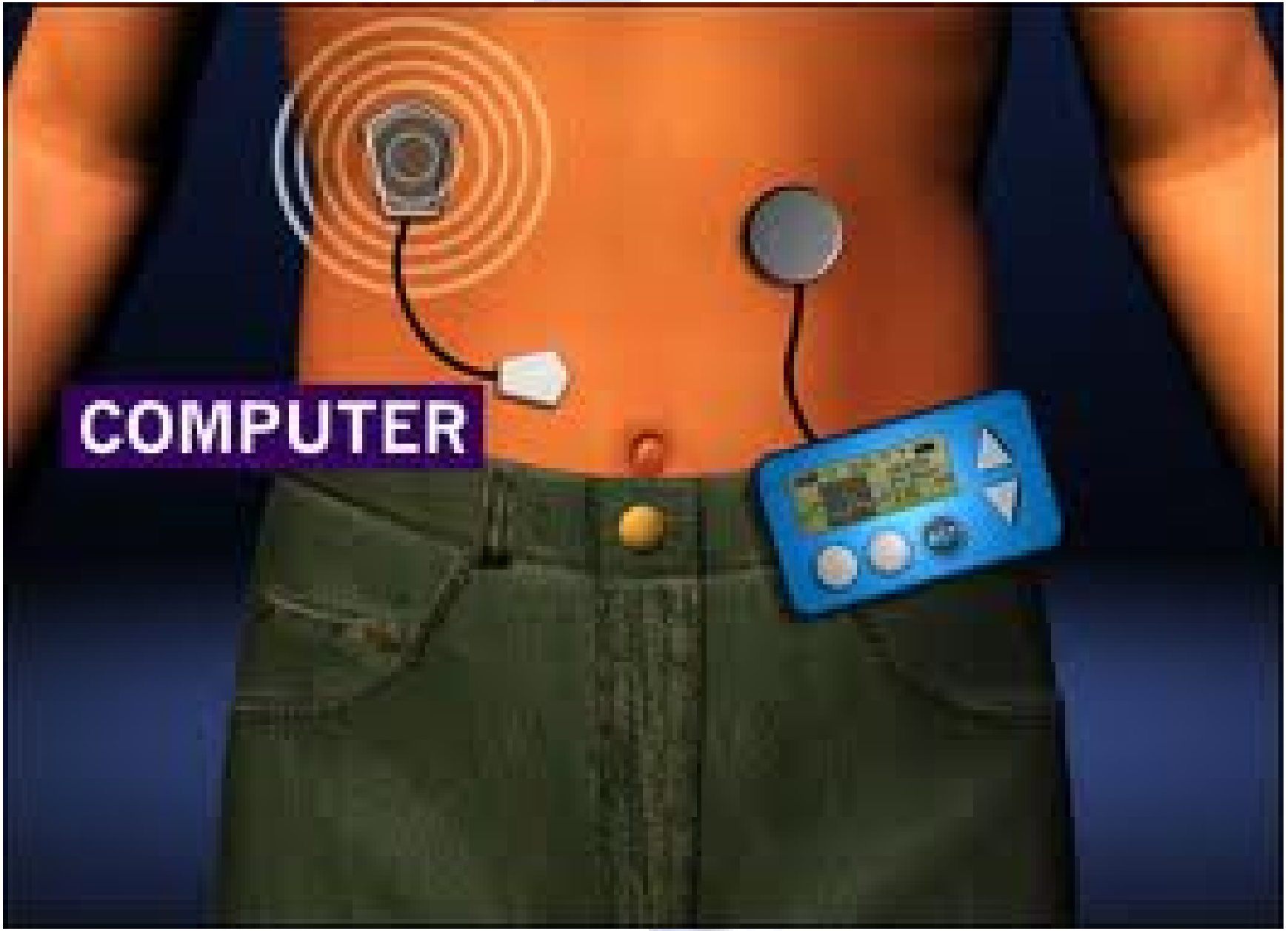

1:46P
24 Hour
128
GUARDIAN
SHIFT
ESC
ACT


108
ACT

Artificial Pancreas

- Not a true organ replacement
- Only replaces the function of the beta cells in the pancreas
- Made up of existing technology
  - Continuous Glucose Monitor
  - Insulin Pump
  - Algorithm stored on laptop or handheld device
- Currently in testing stages


3
2
1


COMPUTER

Indwelling Subcutaneous Cannulas

- i-port® and insuflon™
- Disposable
- Can be worn for up to 72 hours
- Application sites
  - Abdomen (recommended site)
  - Lateral upper arm
  - Lateral thigh (i-port®)
  - Anterior thigh (insuflon™)
  - Top of the buttocks (insuflon™)

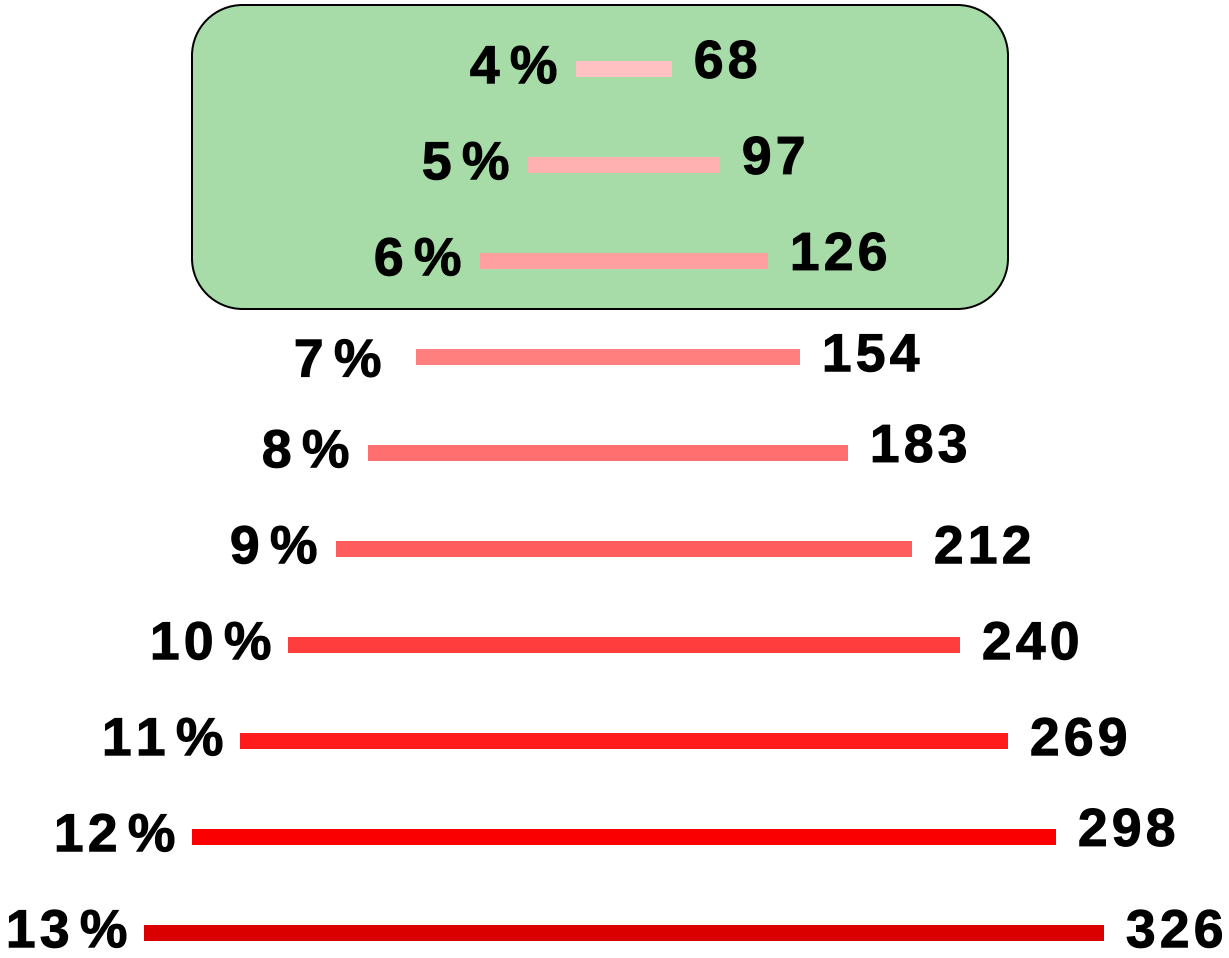
Some Important Numbers

Hemoglobin A_{1c} (HbA_{1c})
(A1C)

- Provides a two to three month average of blood glucose levels
- Measured in percent (%)
- Measures the percent of glycated hemoglobin
- Advantage: Information about blood sugar control
- Disadvantages:
  - No information on actual blood sugar levels
  - Difficult for patients to interpret/understand

Estimated Average Glucose (eAG)[4]

- Linear relationship to A1C
  - eAG = 28.7 X AIC – 46.7
- Expressed in mg/dl (or mmol/l), the same measurement as blood glucose readings
- Advantages:
  - Information about blood sugar control
  - Easy for patients to interpret/understand
- Disadvantage:
  - No information on actual blood sugar levels


A1C (%)
4%
68
5%
97
6%
126
7%
154
8%
183
9%
212
10%
240
11%
269
12%
298
13%
326
Estimated Average Glucose (mg/dl)

Better Assessment

- Type of diabetes
- Ask about blood sugar levels/contol
- Medication(s)
- Full set of vitals on all patients
- Be observant during physical exam
- 12-Lead EKG
- Think outside the box!


BACK
TO THE FUTURE

Tools Of The Trade. . .Now

- Glucometer
- Test Strips
- Lancets
- Drug Box
- IV Fluid
- Administration Set
- Syringes & Needles

- ECG Monitor w/ 12 Lead Capabilities
- Aid Bag
- O2 Bag

Questions???

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N

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