

DIABETES MELLITUS AND PHYSIOTHERAPY

-BY

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DEFINITION

Diabetes mellitus is a group of metabolic diseases characterised by hyperglycemia resulting from defects in insulin secretion, insulin action or both. (American Diabetes Association)

CLASSIFICATION

American Diabetes Association, includes 4 major classes of diabetes :

1. **Type 1 diabetes**
2. **Type 2 diabetes**
3. **Gestational diabetes mellitus**
4. **Other specific types of diabetes mellitus**

TYPE 1

- Characterized by Tcell mediated autoimmune destruction of the insulin-producing beta cells of the islets of Langerhans in the pancreas leading to absolute insulin deficiency.
- Sensitivity and responsiveness to insulin are usually normal, especially in the early stages.
- Earlier known as "juvenile diabetes" / IDDM

CAUSE:

- Genetic predisposition : 1/3rd susceptibility

- Linkage with human leucocyte antigen (HLA) on short arm of chromosome 6.

- triggered by environmental factors like :
 1. Viral infections- coxsackie B4, rubella, mumps.
 2. Bovine serum albumin (cow's milk)
 3. Stress. (Davidson, 2006)

TYPE 2

- characterized by insulin resistance / reduced insulin sensitivity leading to relative insulin deficiency.
- most common type (90% of total diabetic cases).
- Earlier known as NIDDM/ Adult onset diabetes.
- Caused by a combination of lifestyle and genetic factors . (Risérus U et al, 2009 and Ripsin et al ,2009)

GESTATIONAL

- resembles type 2 diabetes in several respects, involving a combination of relatively inadequate insulin secretion and responsiveness.
- occurs in about 2%-5% of all pregnancies and may improve or disappear after delivery.
- About 20%-50% of affected women develop type 2 diabetes later in life
- Risks to the baby include macrosomia (high birth weight), congenital cardiac and central nervous system anomalies, and skeletal muscle malformations.

- A 2008 study completed in the U.S. found that the number of American women entering pregnancy with preexisting diabetes is increasing. In fact the rate of diabetes in expectant mothers has more than doubled in the past 6 years. (Lawrence JM, Contreras R, Chen W, Sacks DA , 2008).

OTHER SPECIFIC TYPES

- Genetic mutations (autosomal or mitochondrial) leading to defects in beta cell function.
- Pancreatic diseases (for example, chronic pancreatitis and cystic fibrosis)
- Drug induced (eg corticosteroids)
- Genetic syndromes (eg Down's , Klinefelter's, Turner's etc.)

(Davidson, 2006)

Type I**Type II****Clinical**

Onset < 20 years
Normal weight
Decreased blood insulin
Anti-islet cell antibodies

Onset > 30 years
Obesity
Normal or increased blood insulin
No anti-islet cell antibodies

Genetics

Ketoacidosis common
50% concordance in twins

Ketoacidosis rare
60% to 80% concordance in twins

HLA-D linked

No HLA association

Pathogenesis

Autoimmunity, immunopathologic mechanisms

Insulin resistance

Severe insulin deficiency

Relative insulin deficiency

Islet Cells

Insulinitis early
Marked atrophy and fibrosis
Severe beta-cell depletion

No insulinitis
Focal atrophy and amyloid deposits
Mild beta-cell depletion

COMPARISON OF TYPE 1 AND 2 DIABETES (STEVEN S., 2008).

Feature	<u>Type 1 diabetes</u>	<u>Type 2 diabetes</u>
Onset	Sudden	Gradual
Age at onset	Any age (mostly young)	Mostly in adults
Body habitus	normal or thin	Often obese
Ketoacidosis	Common	rare
Autoantibodies	Usually present	absent
Endogenous insulin	Low or absent	Normal, decreased or increased
Concordance in identical twins	50%	90%
Prevalence	Less prevalent	More prevalent - 90 to 95% of U.S. diabetics

Diabetes Mellitus: Signs and Symptoms

- **polyuria**
- **polydipsia**
- **polyphagia**
- **fatigue**
- **blurred vision**
- **wt loss**

Main symptoms of Diabetes

blue = more common
in Type 1

Central

- Polydipsia
- Polyphagia
- Lethargy
- Stupor

Eyes

- Blurred vision

Systemic

- Weight loss

Breath

- Smell of acetone

Respiratory

- Kussmaul
breathing
(hyper-
ventilation)

Gastric

- Nausea
- Vomiting
- Abdominal
pain

Urinary

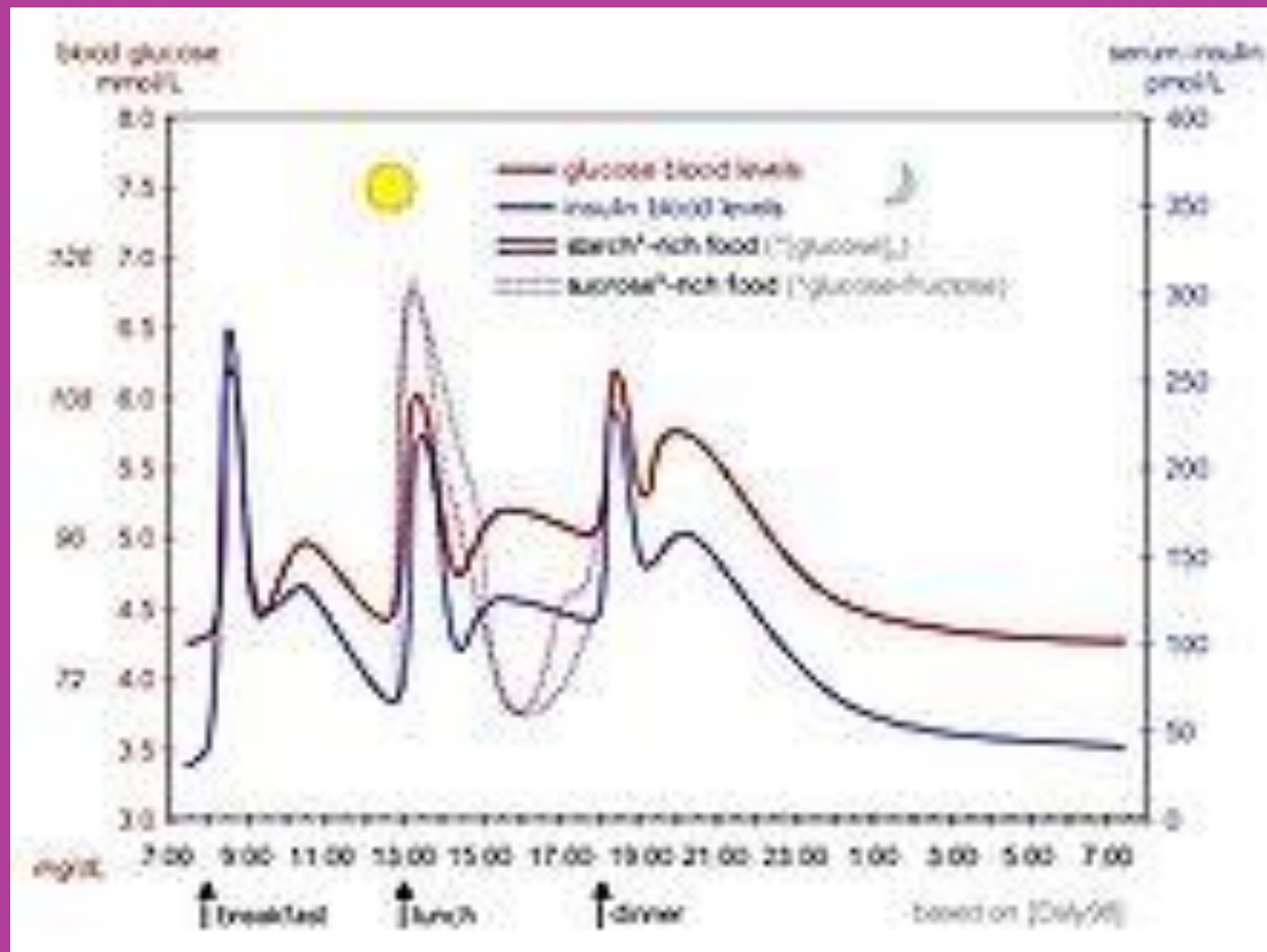
- Polyuria
- Glycosuria



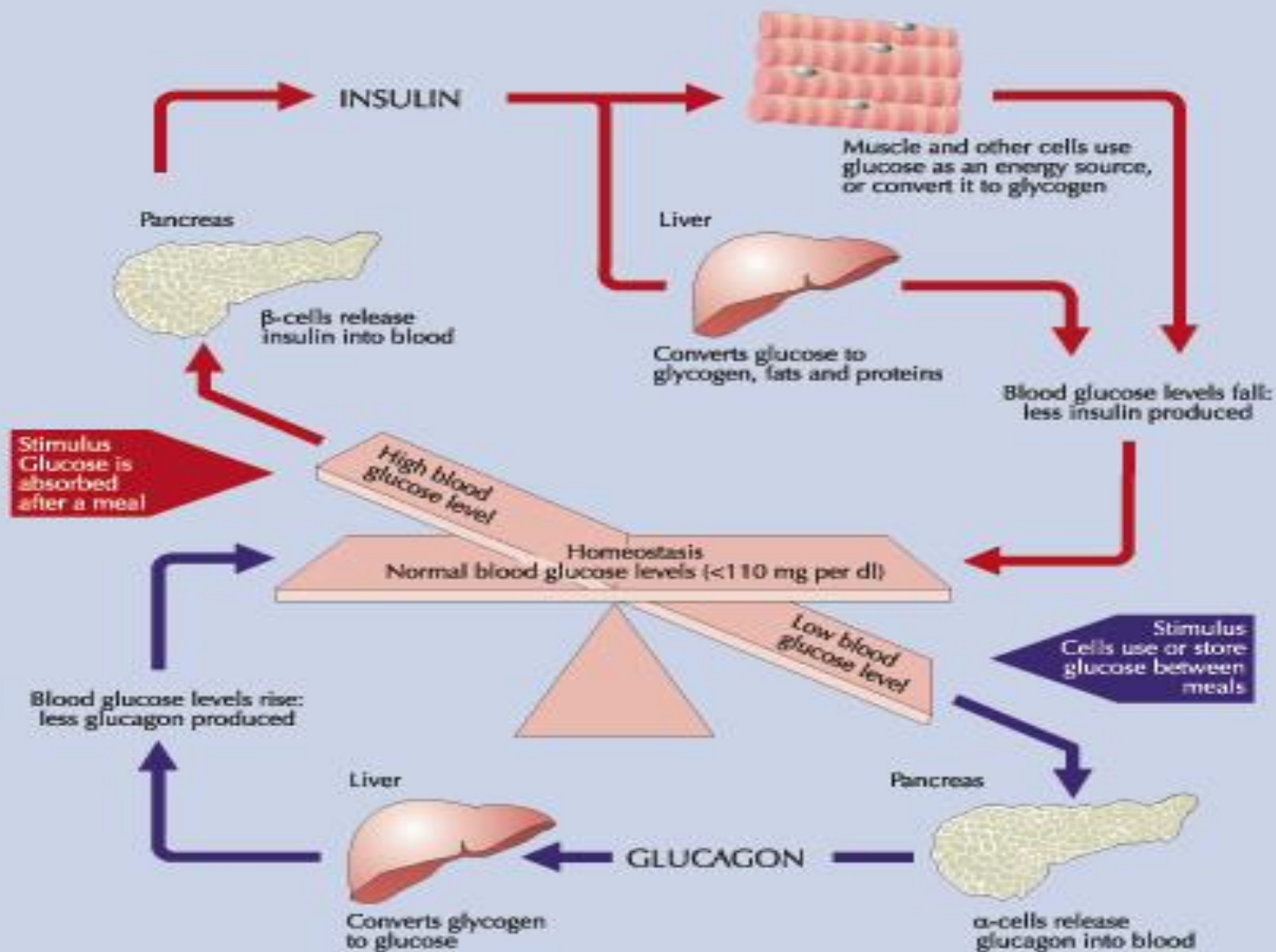
Diabetes Mellitus: Insulin Physiology

- **Anabolic hormone**
 - glucose to glycogen (carbohydrate storage)
 - amino acids to proteins
 - fatty acids to triglycerides (fat storage)
- **Acts at a membrane receptor**
- **Total lack of insulin leads to ketoacidosis**
 - starvation response
 - ketones produced in liver from FA

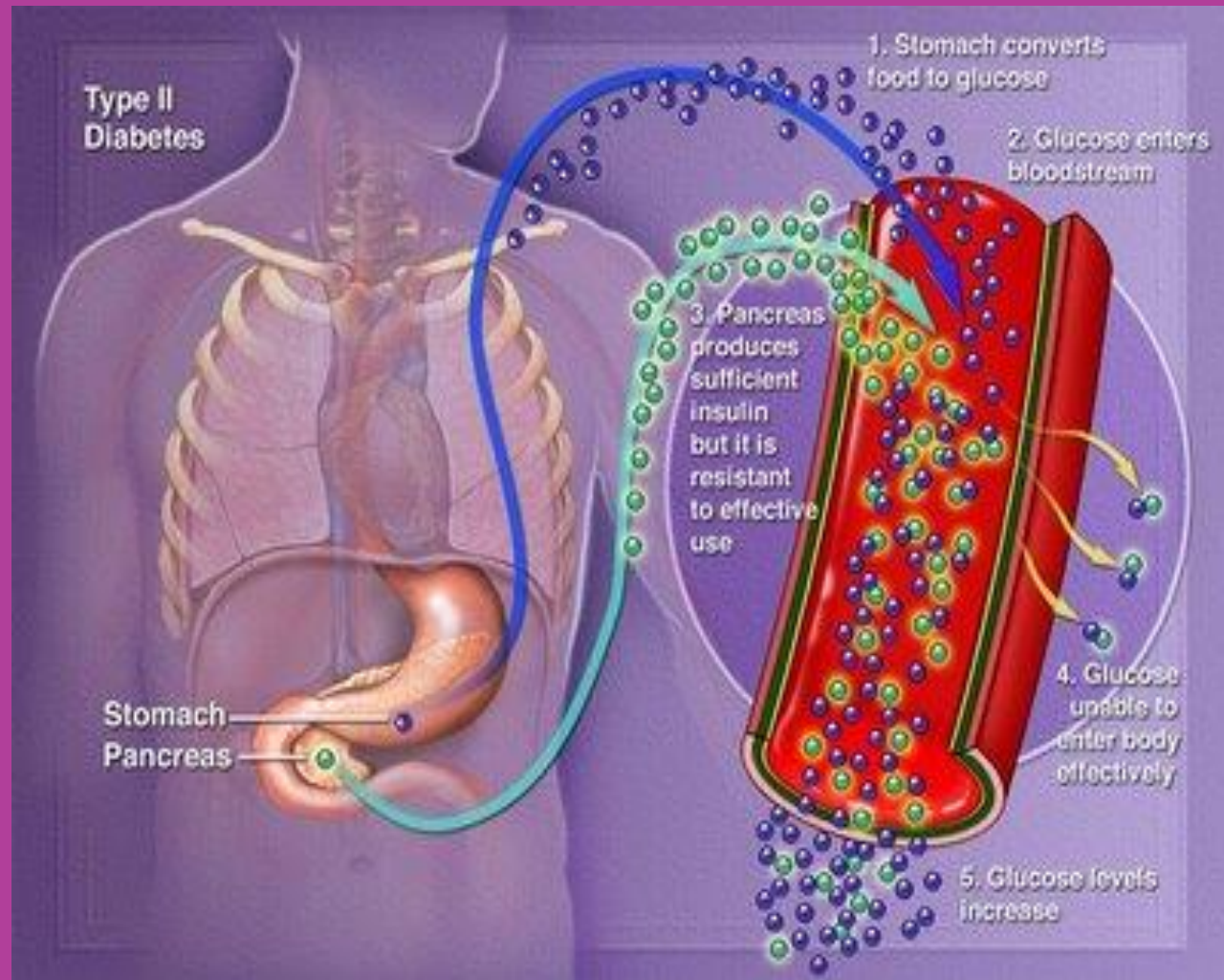
NORMAL INSULIN RESPONSE



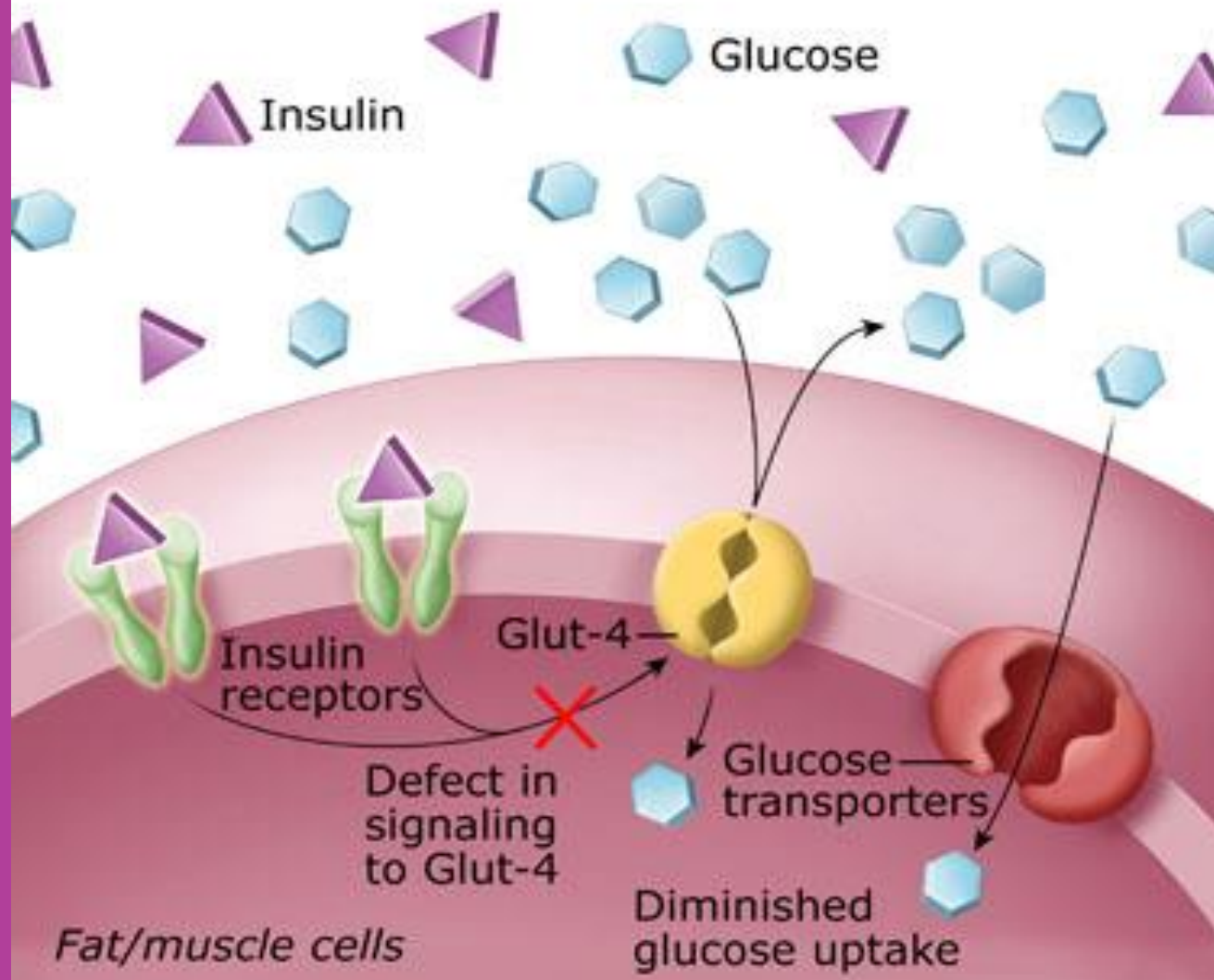
NORMAL PHYSIOLOGY

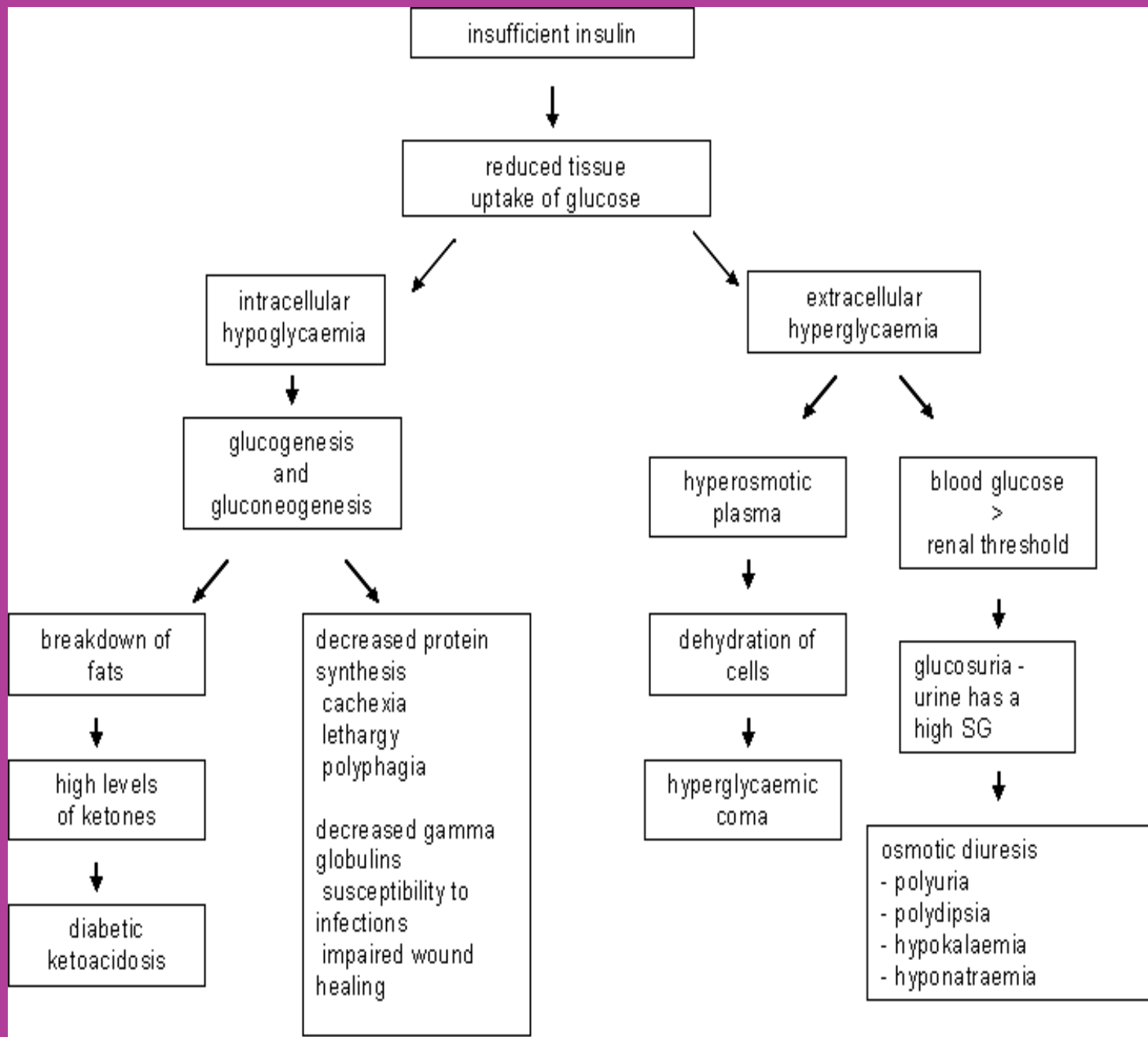


DM 2 : PATHOPHYSIOLOGY



Type 2 Diabetes: Insulin Resistance





COMPLICATIONS:

1. Acute:

- Hyperglycemia with ketoacidosis
- Nonketotic hyperosmolar syndrome
- Hypoglycemia

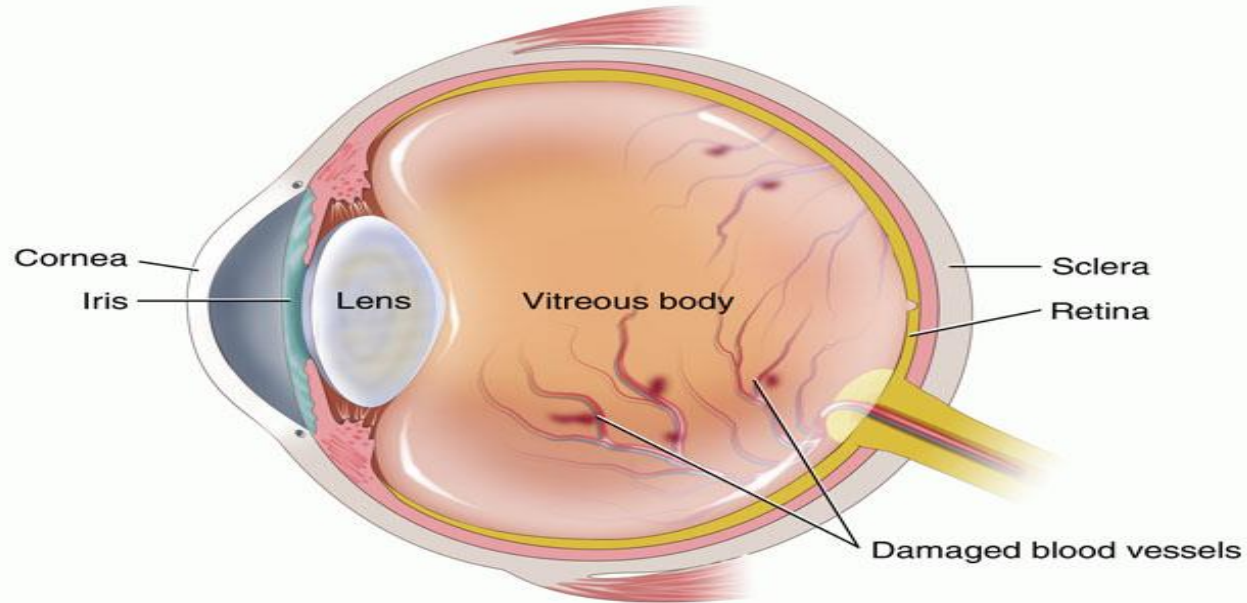
2. Chronic

Microvascular/nephropathic

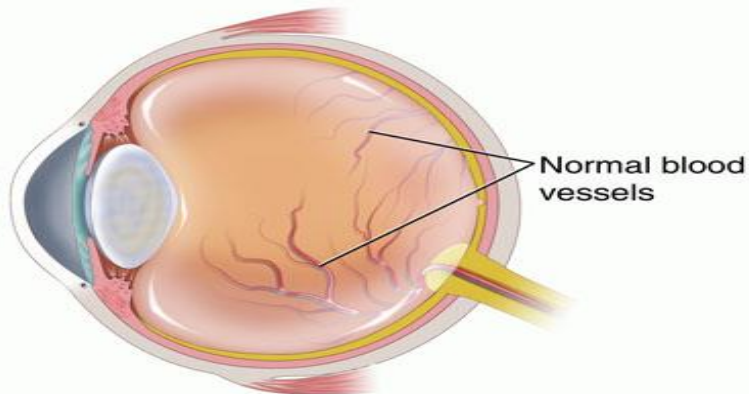
- Retinopathy
- Peripheral neuropathy
- Autonomic neuropathy
- Foot disease

- Macrovascular
 - MI
 - TIA
 - STROKE
 - CLAUDICATION
 - ISCHAEMIA

Diabetic Retinopathy



Diabetic retinopathy affects the blood vessels in the retina, leading to new abnormal blood vessel growth, leakage, and bleeding.



Normal Eye

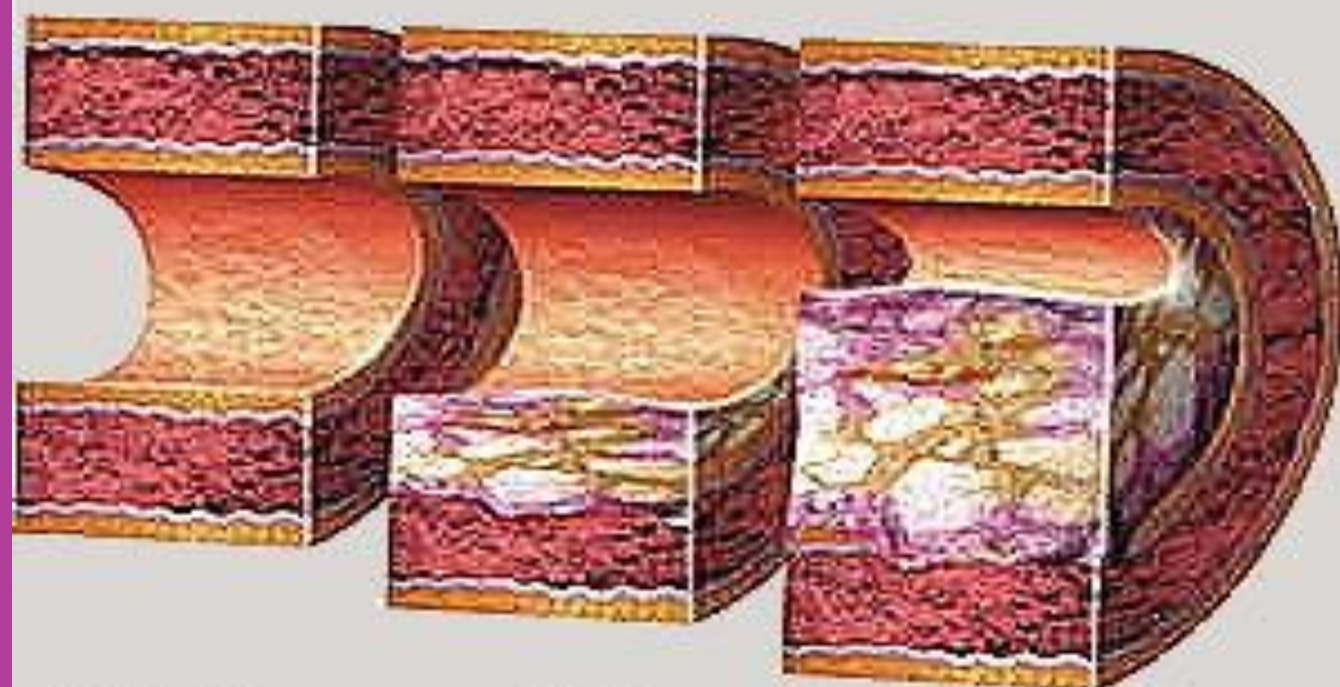


Close-up of leaking vessel

GANGRENE



Atherosclerosis



**Normal
Artery**

**Mild
Atherosclerosis**

**Severe
Atherosclerosis**

STUDIES RELATED TO COPLICATIONS OF DM:

1. Mark cahill, 2001
2. L. Silberstein, 2001
3. Erin G orman, 2010
4. Lindsay m., 2005

DIANOSIS :2006 WHO DIABETES CRITERIA

Condition	2 hour glucose	Fasting glucose
	mmol/l(mg/dl)	mmol/l(mg/dl)
Normal	<7.8 (<140)	<6.1 (<110)
Impaired fasting glycaemia	<7.8 (<140)	≥ 6.1(≥110) & <7.0(<126)
Impaired glucose tolerance	≥7.8 (≥140)	<7.0 (<126)
Diabetes mellitus	≥11.1 (≥200)	≥7.0 (≥126)

DIAGNOSIS: ADA, 2010

Diabetes mellitus is characterized by recurrent or persistent hyperglycemia, and is diagnosed by demonstrating any one of the following:

1. Fasting plasma glucose level ≥ 7.0 mmol/L (126 mg/dL).
2. Plasma glucose ≥ 11.1 mmol/L (200 mg/dL) two hours after a 75 g oral glucose load as in glucose tolerance test.
3. Symptoms of hyperglycemia and casual plasma glucose ≥ 11.1 mmol/L (200 mg/dL).
4. Glycated hemoglobin (Hb A1C) $\geq 6.5\%$.^[21]

- A positive result should be confirmed by a repeat of any of the above-listed methods on a different day.
- It is preferable to measure a fasting glucose level because of the ease of measurement and the considerable time commitment of formal glucose tolerance testing, which takes two hours to complete and offers no prognostic advantage over the fasting test

DIAGNOSIS

TABLE 2. Criteria for Diagnosis of Metabolic Syndrome

International Diabetes Federation³⁷	NCEP-ATP III³⁶
Waist >94 cm in men/>80 cm in women	Any 3 of the following: Waist >102 cm in men/>88 cm in women
Plus 2 of the following: Glucose >5.6 mmol/L HDL <1.20 mmol/L	Glucose >6.1 mmol/L HDL <1.0 mmol/L in men and <1.2 mmol/L in women
Triglycerides >1.7 mmol/L sBP >130 mmHg dBP >85 mmHg	Triglycerides >1.7 mmol/L Blood pressure >130/85 mmHg

dBP, diastolic blood pressure; HDL, high density lipoprotein cholesterol; NCEP, National Cholesterol Education Program; sBP, systolic blood pressure.

MANAGEMENT

- ◉ Diabetes mellitus is a chronic disease which cannot be cured except in very specific situations. Management concentrates on keeping blood sugar levels as close to normal ("euglycemia") as possible, without causing hypoglycemia. This can usually be accomplished with diet, exercise, and use of appropriate medications (insulin in the case of type 1 diabetes, oral medications as well as possibly insulin in type 2 diabetes).

Blood Sugar Levels

Hypoglycemia ← → Hyperglycemia

Nervous, Shakey
Dizzy, Confused
Headache
Hunger
Cold Clammy Skin
Fast Heartbeat
Irritability

Weak, Tired
Frequent Urination
Increased Thirst
Decreased Appetite
Blurry Vision
Itchy dry skin
Breath Smells Fruity



Normal

○ Patient education, understanding, and participation is vital since the complications of diabetes are far less common and less severe in people who have well-managed blood sugar levels.^{[25][26]} The goal of treatment is an HbA1C level of 6.5%, but should not be lower than that, and may be set higher.^[27] Attention is also paid to other health problems that may accelerate the deleterious effects of diabetes. These include smoking, elevated cholesterol levels, obesity, high blood pressure, and lack of regular exercise.^[27]

PERSONAL (HOME) GLUCOSE MONITORING



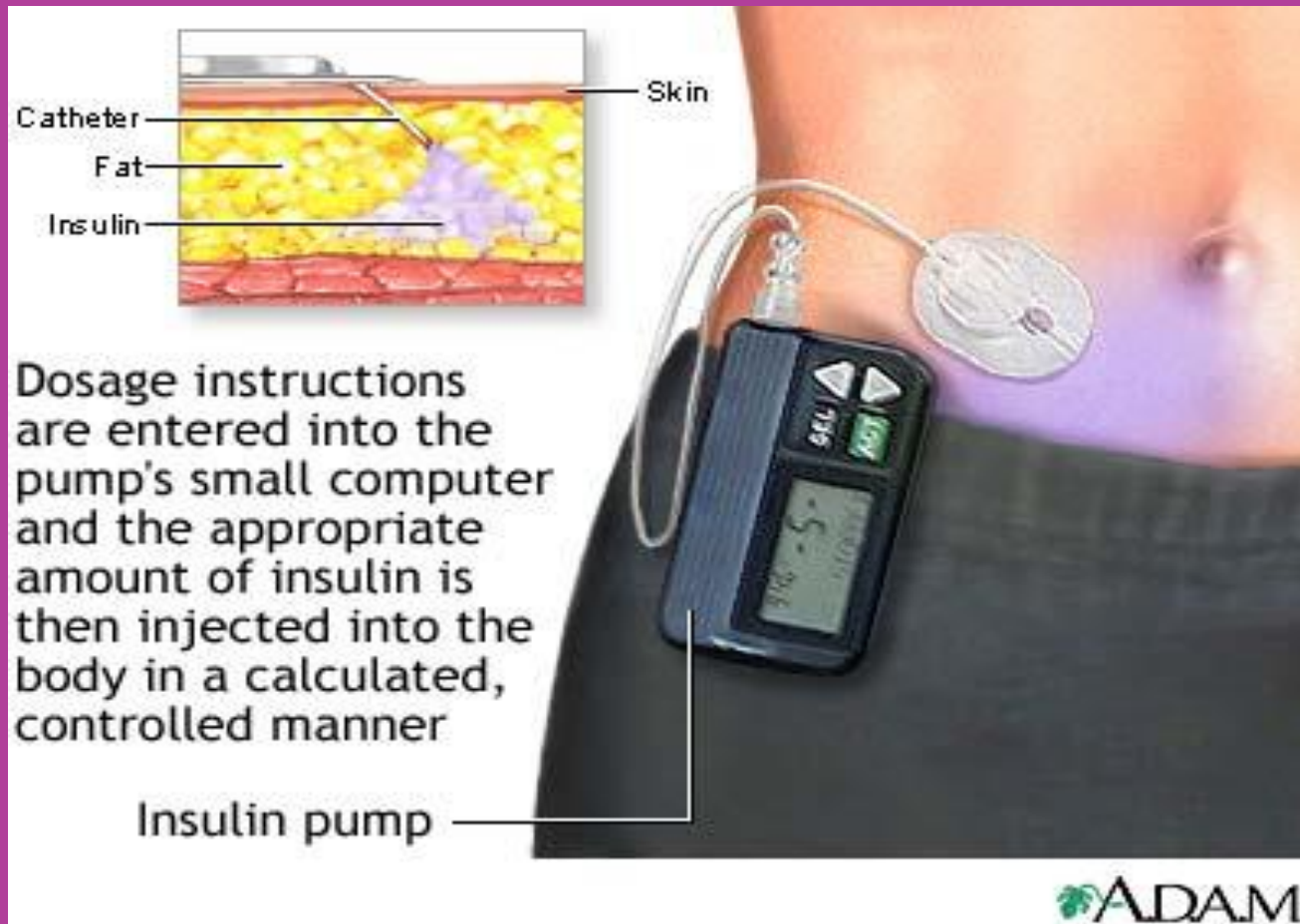
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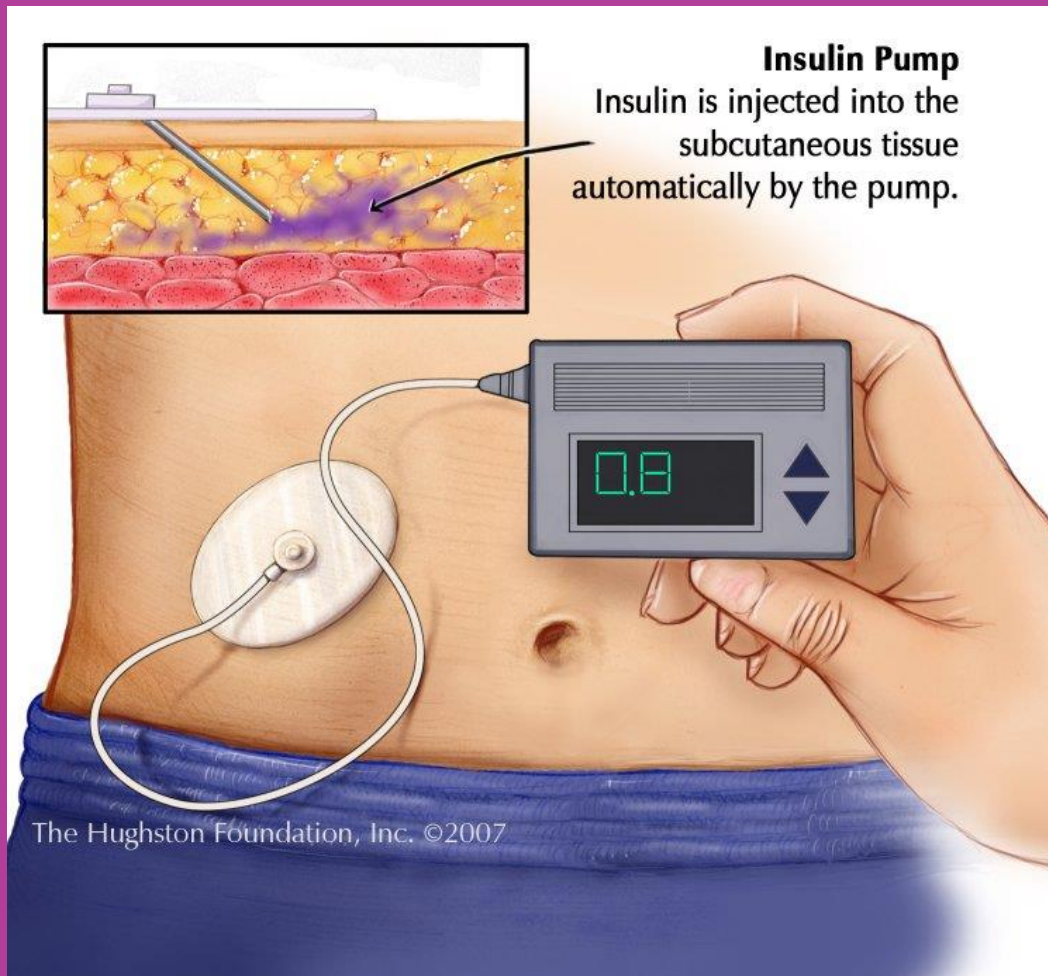
SELF-MONITORING



INSULIN PUMP



INSULIN PUMP



LIFESTYLE

- A study at [UCLA](#) in 2005 showed that the [Pritikin Program](#) of diet and exercise brought dramatic improvement to a group of diabetics and pre-diabetics in only three weeks, so that about half no longer met the criteria for the disease. [\[35\]](#) [\[36\]](#) [\[37\]](#)

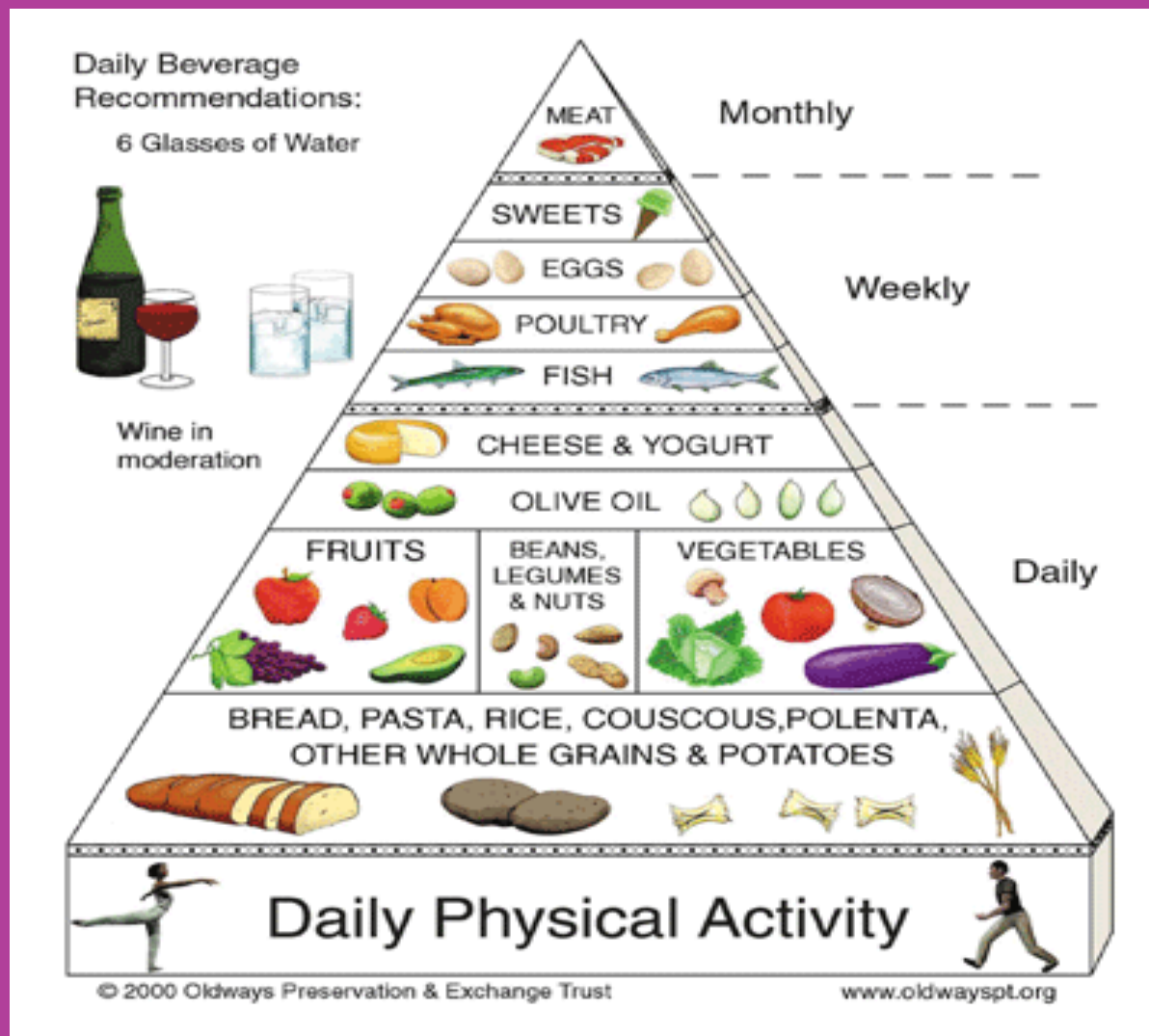
- A study conducted in 2008 used data from the 2002-2004 National Ambulatory Medical Care Survey has used in order to investigate the relationship between counseling/referral for nutrition or exercise and patient factors, provider factors, and geographic location. Overall, counseling/referral for nutrition occurred in 36% of patient visits and counseling/referral for exercise occurred in 18% of patient visits. After adjusting for patient, physician, and practice characteristics, there was no statistically significant association between race and counseling/referral for nutrition. [\[38\]](#)

- **Physical Activity:** a goal of at least 30 minutes of moderate physical activity per day (e.g. brisk walking, swimming, cycling, dancing) on most days of the week.
- **Body weight:** weight loss improves insulin resistance, blood glucose and high lipid levels in the short term, and reduces blood pressure. It is important to reach and maintain a healthy weight.
- **Healthy Eating:** avoiding foods high in sugars and saturated fats, and limiting alcohol consumption.
- **Avoid tobacco:** tobacco use is associated with more complications in people with diabetes.
- **Monitoring for complications:** monitoring and early detection of complications is an essential part of good diabetes care. This includes regular foot and eye checks, controlling blood pressure and blood glucose, and assessing risks for cardiovascular and kidney disease

DIET

- ◎ The American Diabetes Association in 1994 recommended that 60-70% of caloric intake should be in the form of carbohydrates. This is somewhat controversial, with some researchers claiming that 40% is better, [\[39\]](#) while others claim benefits for a high-fiber, 75% carbohydrate diet.↓

FOOD TRIANGLE (ADA, 2010)



MEDICATIONS

Patients with type 1 diabetes mellitus require direct injection of insulin as their bodies cannot produce enough (or even any) insulin. As of 2010, there is no other clinically available form of insulin administration other than injection for patients with type 1: injection can be done by insulin pump, by jet injector, or any of several forms of hypodermic needle. Non-injective methods of insulin administration have been unattainable as the insulin protein breaks down in the digestive tract.

- There are several insulin application mechanisms under experimental development as of 2004, including a capsule that passes to the liver and delivers insulin into the bloodstream.^[46] There have also been proposed vaccines for type I using glutamic acid decarboxylase (GAD), but these are currently not being tested by the pharmaceutical companies that have sublicensed the patents to them.

- For type 2 diabetics, diabetic management consists of a combination of diet, exercise, and weight loss, in any achievable combination depending on the patient. Obesity is very common in type 2 diabetes and contributes greatly to insulin resistance. Weight reduction and exercise improve tissue sensitivity to insulin and allow its proper use by target tissues.^[47] Patients who have poor diabetic control after lifestyle modifications are typically placed on oral hypoglycemics.

- Some Type 2 diabetics eventually fail to respond to these and must proceed to insulin therapy. A study conducted in 2008 found that increasingly complex and costly diabetes treatments are being applied to an increasing population with type 2 diabetes. Data from 1994 to 2007 was analyzed and it was found that the mean number of diabetes medications per treated patient increased from 1.14 in 1994 to 1.63 in 2007. [\[48\]](#)

- [Metformin](#) is generally recommended as a first line treatment for type 2 diabetes as there is good evidence that it decreases mortality

WORLD DIABETES DAY

- ◎ **14 November**
- ◎ Started by the International Diabetes Federation (IDF) and WHO, the Day is celebrated on 14 November to mark the birthday of Frederick Banting who, along with Charles Best, was instrumental in the discovery of insulin in 1922, a life-saving treatment for diabetes patients

UNIVERSAL BLUE CIRCLE SYMBOL FOR DIABETES (IDF, 2006)



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THANK-YOU