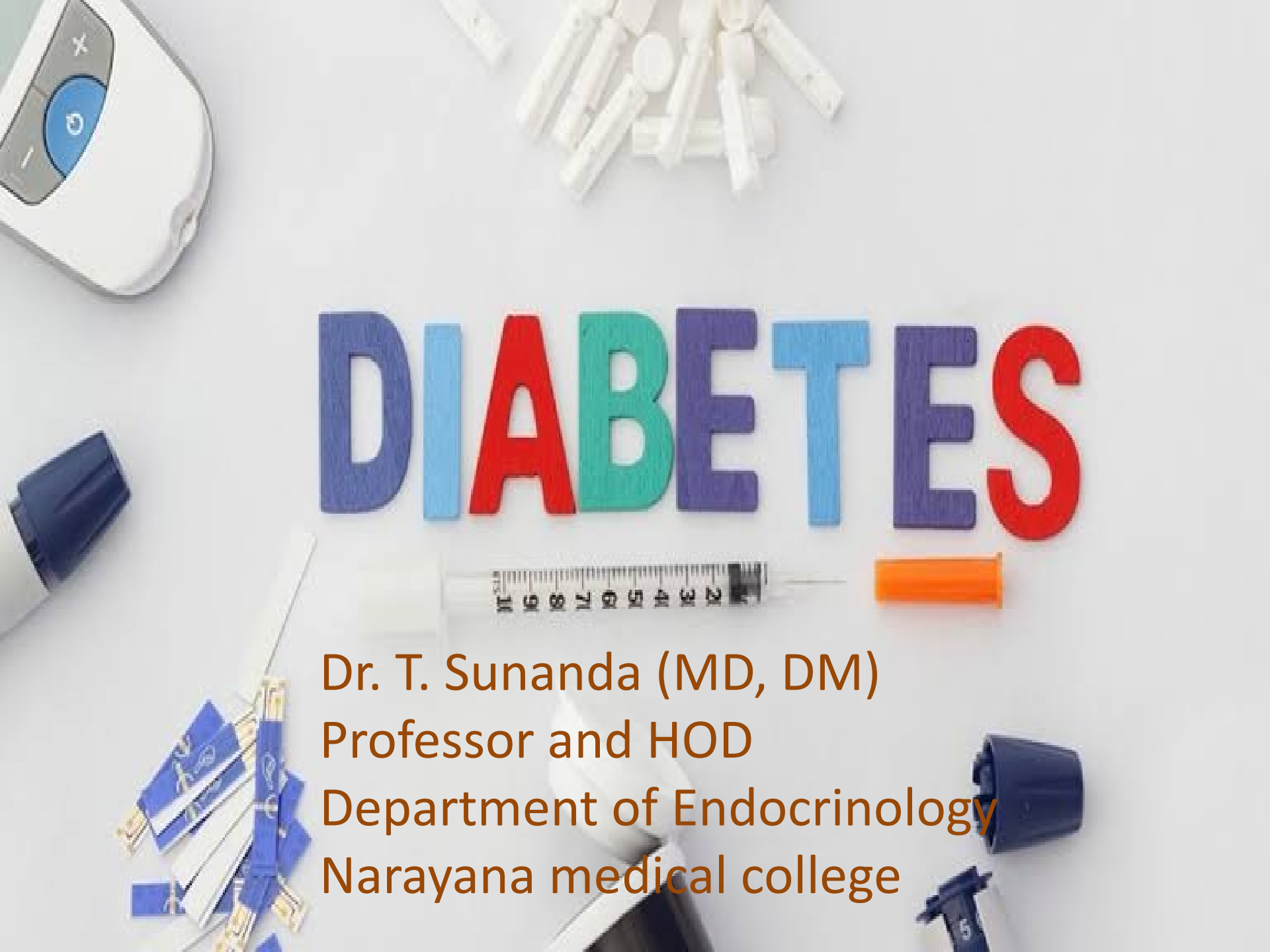
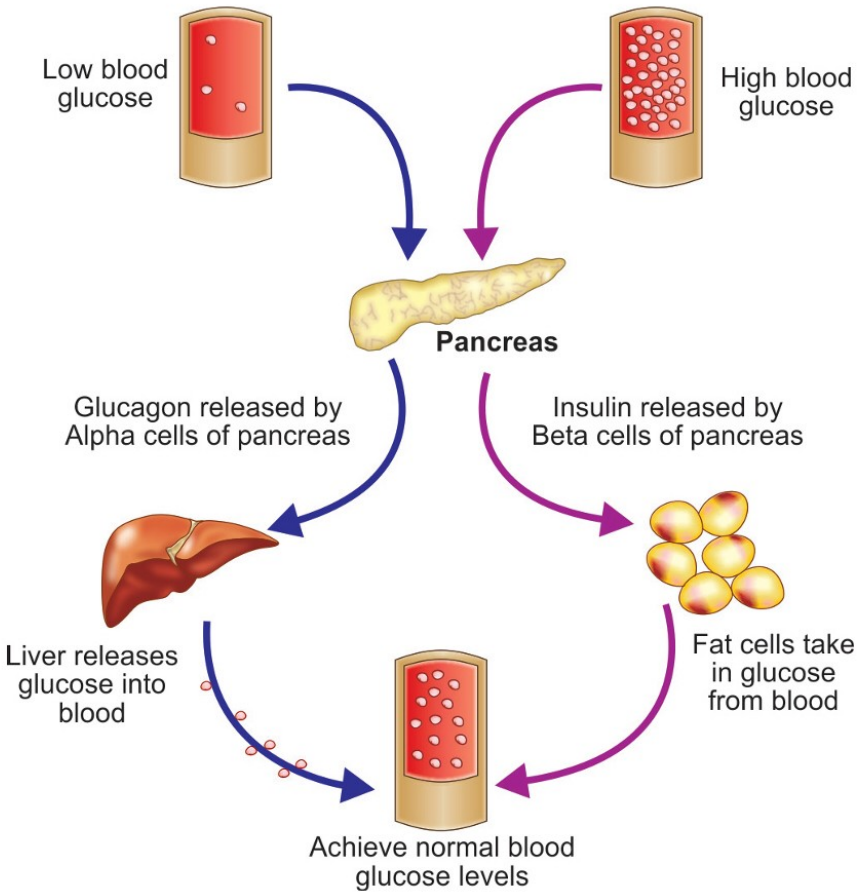


Dr. T. Sunanda (MD, DM)
Professor and HOD
Department of Endocrinology
Narayana medical college

Definition

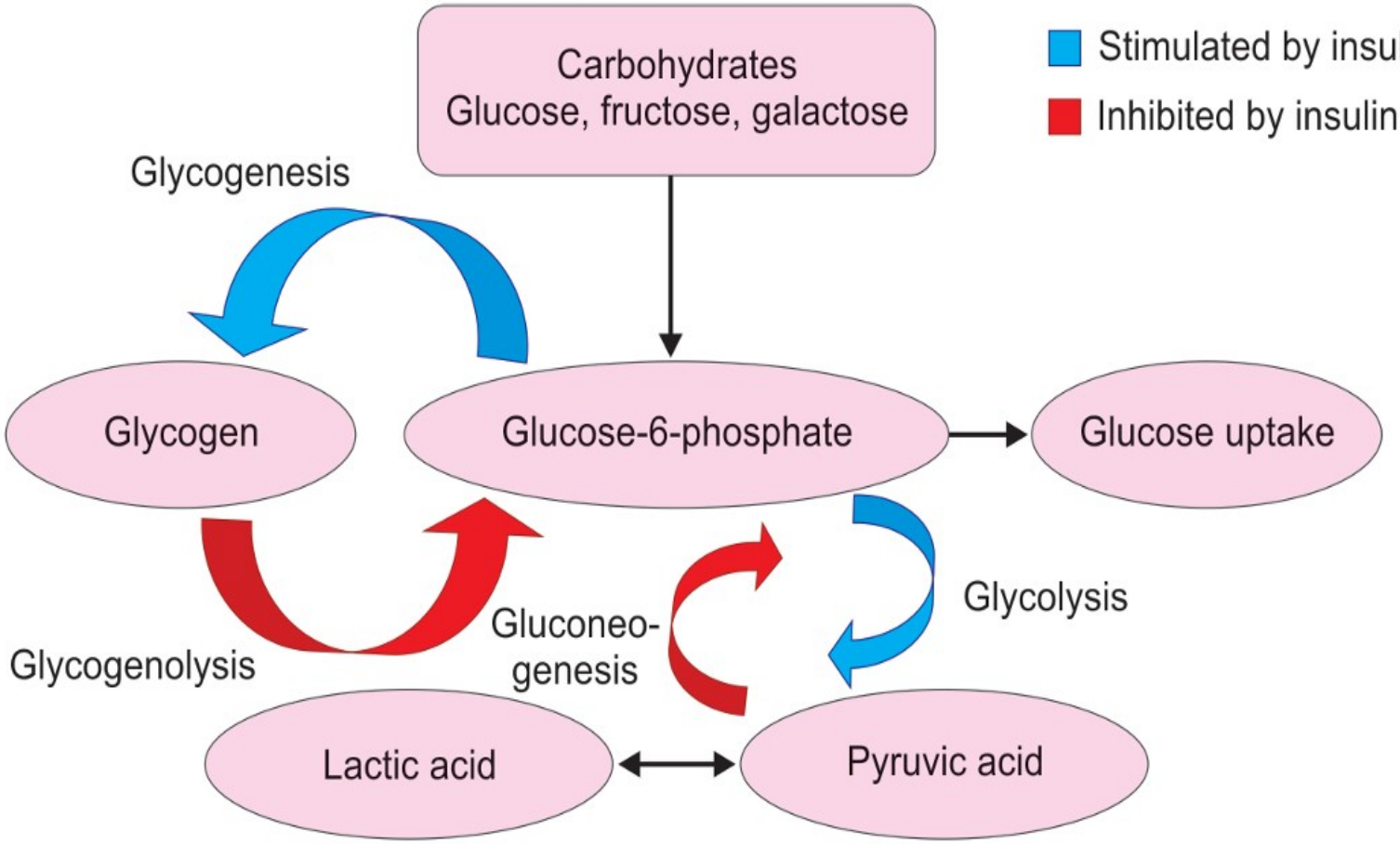
- Diabetes mellitus is a group of metabolic diseases characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action,or both.

Normal blood glucose Regulation



: Normal regulation of blood glucose.

Actions of Insulin on carbohydrate metabolism



Actions of insulin on carbohydrate metabolism.

Symptoms of diabetes

Always thirsty

Always tired

Blurry vision

Sexual problems

Wounds that won't heal

Numbness or tingling in hands or feet

Vaginal infections

Frequent urination

Always hungry

Systemic weight loss

Diagnosis

Table 2.1—Criteria for the diagnosis of diabetes in nonpregnant individuals

A1C ≥6.5% (≥48 mmol/mol). The test should be performed in a laboratory using a method that is NGSP certified and standardized to the DCCT assay.*
OR
FPG ≥126 mg/dL (≥7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 h.*
OR
2-h PG ≥200 mg/dL (≥11.1 mmol/L) during OGTT. The test should be performed as described by the WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.*
OR
In an individual with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose ≥200 mg/dL (≥11.1 mmol/L). Random is any time of the day without regard to time since previous meal.

Pre-diabetes

Table 2.2—Criteria defining prediabetes in nonpregnant individuals
A1C 5.7–6.4% (39–47 mmol/mol)
OR
FPG 100 mg/dL (5.6 mmol/L) to 125 mg/dL (6.9 mmol/L) (IFG)
OR
2-h PG during 75-g OGTT 140 mg/dL (7.8 mmol/L) to 199 mg/dL (11.0 mmol/L) (IGT)

Whom to screen

Table 2.6—Risk-based screening for type 2 diabetes or prediabetes in asymptomatic children and adolescents in a clinical setting

Screening should be considered in youth* who have overweight (≥85th percentile) or obesity (≥95th percentile) and who have one or more additional risk factors:

- Maternal history of diabetes or GDM during the child's gestation
- Family history of type 2 diabetes in first- or second-degree relative
- High-risk race, ethnicity, and ancestry (see **Table 2.5**)
- Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovary syndrome, large- or small-for-gestational-age birth weight)

Table 2.5—Criteria for screening for diabetes or prediabetes in asymptomatic adults

1. Testing should be considered in adults with overweight or obesity (BMI ≥25 kg/m^2 or ≥23 kg/m^2 in individuals of Asian ancestry) who have one or more of the following risk factors:
   - First-degree relative with diabetes
   - High-risk race, ethnicity, and ancestry (e.g., African American, Latino, Native American, Asian American)
   - History of cardiovascular disease
   - Hypertension (≥130/80 mmHg or on therapy for hypertension)
   - HDL cholesterol level <35 mg/dL (<0.9 mmol/L) and/or triglyceride level >250 mg/dL (>2.8 mmol/L)
   - Individuals with polycystic ovary syndrome
   - Physical inactivity
   - Other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans, metabolic dysfunction–associated steatotic liver disease)
2. People with prediabetes (A1C ≥5.7% [≥39 mmol/mol], IGT, or IFG) should be tested yearly.
3. People who were diagnosed with GDM should have testing at least every 1–3 years.
4. For all other people, testing should begin at age 35 years.
5. If results are normal, testing should be repeated at a minimum of 3-year intervals, with consideration of more frequent testing depending on initial results and risk status.
6. Individuals in other high-risk groups (e.g., people with HIV, exposure to high-risk medicines, evidence of periodontal disease, history of pancreatitis) should also be closely monitored

GDM, gestational diabetes mellitus; IFG, impaired fasting glucose; IGT, impaired glucose tolerance.

Classification of Diabetes

Table 2.4: Etiological classification of diabetes.

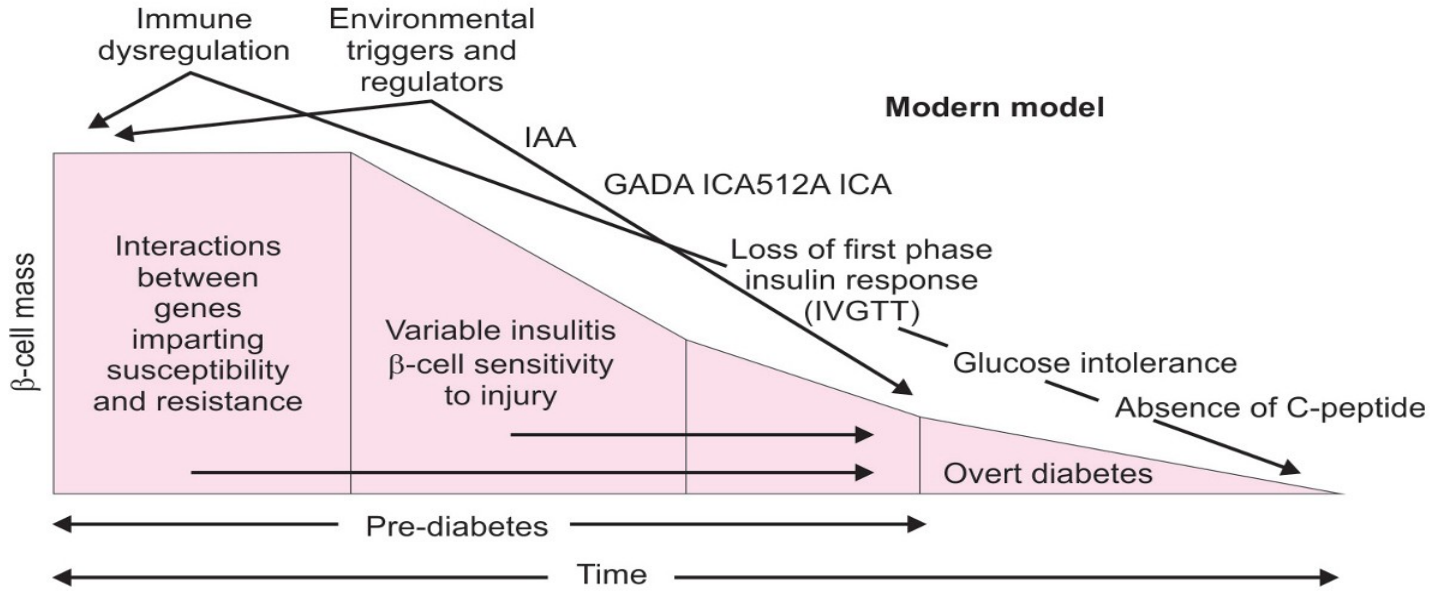
I.	Type 1 diabetes mellitus	
	A. Immune mediated	
	B. Idiopathic	
II.	Type 2 diabetes mellitus	
III.	Other specific types	
	A. Genetic defects in beta cell function	– MODY type 1 to type 6 Mitochondrial diabetes
	B. Genetic defects in Insulin action	– Type A Insulin resistance
		– Lipoatrophic diabetes
	C. Pancreatic diseases	– Fibrocalcific pancreatitis
		Pancreatectomy
		Cystic fibrosis
	D. Endocrinopathies	– Acromegaly
		Cushing's syndrome
		Pheochromocytoma
		Hyperthyroidism
	E. Drug induced	– Glucocorticoids
		Thyroid hormone
		Diazoxide
		Thiazides
		Dilantin
		Vacor, Pentamidine, Olanzapine, Rifampicin
	F. Infections	– Congenital Rubella
		Cytomegalovirus
		Mumps
	G. Uncommon forms of immune mediated diabetes	– "Stiff-man" syndrome
		Anti-insulin receptor antibodies
	H. Genetic syndrome association	– Down's syndrome
		Turner's syndrome
		Klinefelter's syndrome
		Myotonic dystrophy
		Prader-Willi syndrome
IV.	Gestational Diabetes	

(MODY: Maturity onset diabetes of the young).

Type 1 diabetes

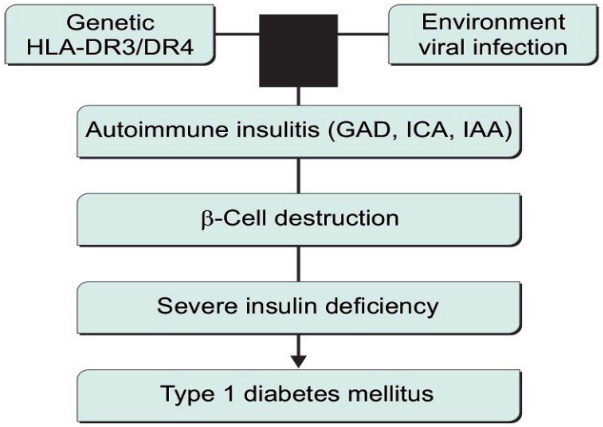
- ✓ β-cell destruction (mostly immune mediated) and absolute insulin deficiency
- ✓ onset most common in childhood and early adulthood

T1DM pathogenesis



.2: Model of type 1 diabetes mellitus (T1DM) pathogenesis.

Pathogenesis of type 1 diabetes.



(IAA: Insulin autoantibody; GAD: Glutamic acid decarboxylase; ICA: Islet cell antibodies; HLA: Human leukocytic genes).

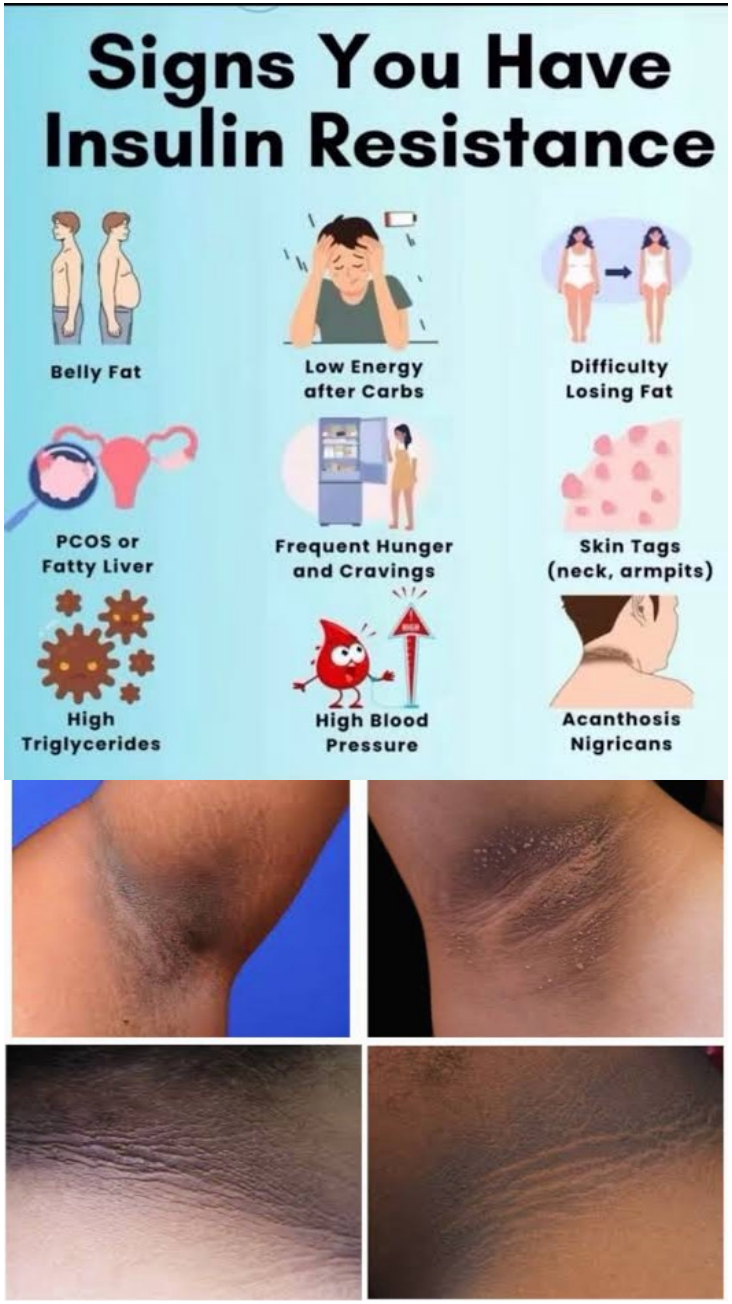
Antibodies in Type 1 DM

Table 2.2: Antibodies in type 1 diabetes mellitus (T1DM).	
GAD	Exists in two isomeric forms GAD65 and GAD68, based on molecular weight Most persistent autoantibody and is also useful in the diagnosis of LADA Catalyzes the conversion of glutamic acid to the inhibitory neurotransmitter GABA (γ-amino butyric acid)
IA-2A	Member of the protein tyrosine phosphatase family and is a transmembrane protein Less common at T1DM onset Autoreactivity to the predominant c-terminal epitope of IA-2A is known as ICA512 autoantibodies
ICA	Detected in 70–80% individuals with T1DM First antibody to appear in T1DM Declines in few years after diagnosis and about less than 5% of individuals remain positive for longer periods Most difficult antibody to measure because ICA assays are subject to variations in pancreatic tissue, conjugate incubation time, etc. Reacts against sialoglyco conjugate, an insulinoma associated autoantigen
IAA	Is the only specific β-cell autoantibody Most common in the new onset young T1DM than adults IAA determinations in serum are no longer valid once insulin treatment is initiated in patients with T1DM Most difficult to accurately measure and reproduce
ZnT8A	Is a 369 AA, 6-transmembrane ZnT8 protein that concentrates Zn in insulin secretory granules The ZnT8 protein is encoded by SLC30A8 gene. Alleles of SLC30A8 have been shown to be also associated with T2DM

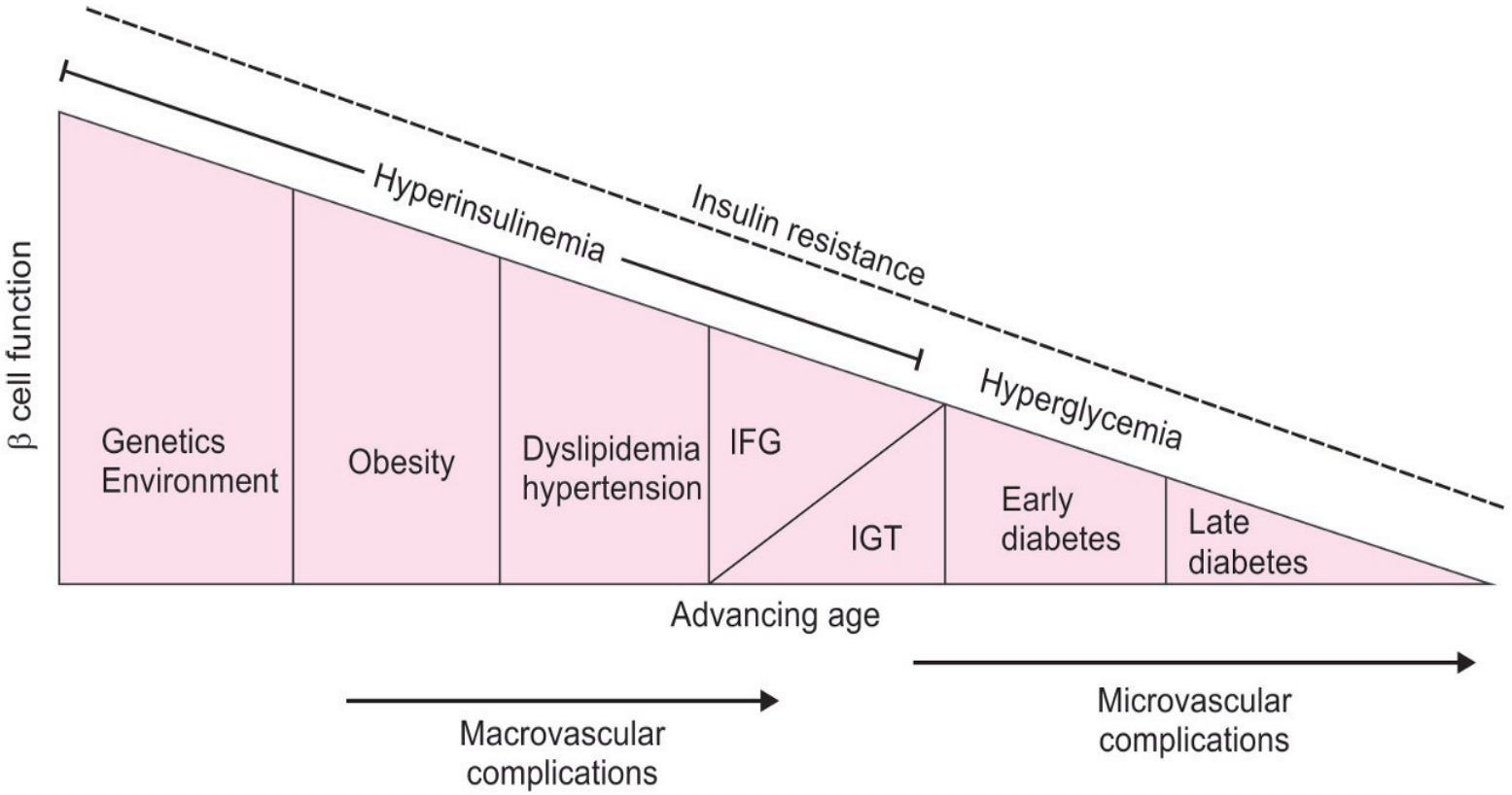
(IAA: Insulin autoantibody; GAD: Glutamic acid decarboxylase; ICA: Islet cell antibodies; T2DM: Type 2 diabetes mellitus; ZnT8: Zinc transporter 8; IA-2A: Insulinoma associated-2 autoantibodies; LADA: Latent autoimmune diabetes of adults).

Type 2 DM

- ✓ Most common type
- ✓ Various degrees of β-cell dysfunction and insulin resistance
- ✓ Commonly associated with overweight and obesity



Natural history of T2DM



Natural history of type 2 diabetes: Disease evolution.

American Diabetes Association.
Connected for Life.

Are you at risk for type 2 diabetes?

Diabetes Risk Test

WRITE YOUR SCORE IN THE BOX.

1. How old are you?

Less than 40 years (0 points)
40–49 years (1 point)
50–59 years (2 points)
60 years or older (3 points)

2. Are you a man or a woman?

Man (1 point) Woman (0 points)

3. If you are a woman, have you ever been diagnosed with gestational diabetes?

Yes (1 point) No (0 points)

4. Do you have a mother, father, sister or brother with diabetes?

Yes (1 point) No (0 points)

5. Have you ever been diagnosed with high blood pressure?

Yes (1 point) No (0 points)

6. Are you physically active?

Yes (0 points) No (1 point)

7. What is your weight category?

See chart at right.

ADD UP YOUR SCORE

Height	Weight (lbs.)		
4′ 10″	119–142	143–190	191+
4′ 11″	124–147	148–197	198+
5′ 0″	128–152	153–203	204+
5′ 1″	132–157	158–210	211+
5′ 2″	136–163	164–217	218+
5′ 3″	141–168	169–224	225+
5′ 4″	145–173	174–231	232+
5′ 5″	150–179	180–239	240+
5′ 6″	155–185	186–246	247+
5′ 7″	159–190	191–254	255+
5′ 8″	164–196	197–261	262+
5′ 9″	169–202	203–269	270+
5′ 10″	174–208	209–277	278+
5′ 11″	179–214	215–285	286+
6′ 0″	184–220	221–293	294+
6′ 1″	189–226	227–301	302+
6′ 2″	194–232	233–310	311+
6′ 3″	200–239	240–318	319+
6′ 4″	205–245	246–327	328+
	1 point	2 points	3 points

If you weigh less than the amount in the left column: **0 points**

Adapted from Bang et al., Ann Intern Med 151:775–783, 2009 • Obesity algorithm was validated without gestational diabetes as part of the model

If you scored 5 or higher:

You are at increased risk for having type 2 diabetes. However, only your doctor can tell for sure if you do have type 2 diabetes or prediabetes, a condition in which blood glucose levels are higher than normal but not yet high enough to be diagnosed as diabetes. Talk to your doctor to see if additional testing is needed.

Type 2 diabetes is more common in African Americans, Hispanic/Latino individuals, Native Americans, Asian Americans, and Native Hawaiians and Pacific Islanders.

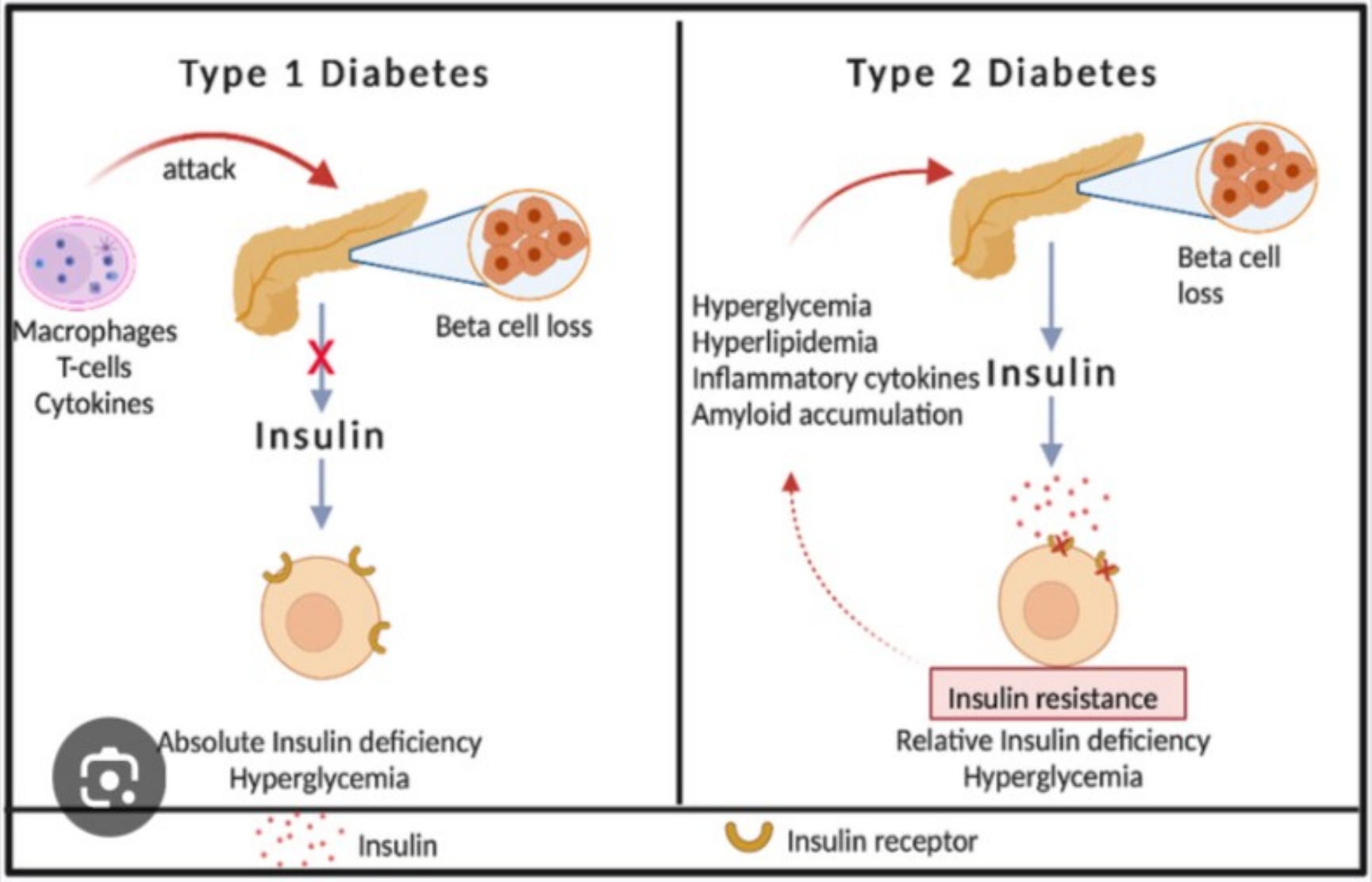
Higher body weight increases diabetes risk for everyone. Asian Americans are at increased diabetes risk at lower body weight than the rest of the general public (about 15 pounds lower).

Lower your risk:

The good news is you can manage your risk for type 2 diabetes. Small steps make a big difference in helping you live a longer, healthier life.

If you are at high risk, your first step is to visit your doctor to see if additional testing is needed.

Visit diabetes.org or call 1-800-DIABETES (800-342-2383) for information, tips on getting started, and ideas for simple, small steps you can take to help lower your risk.

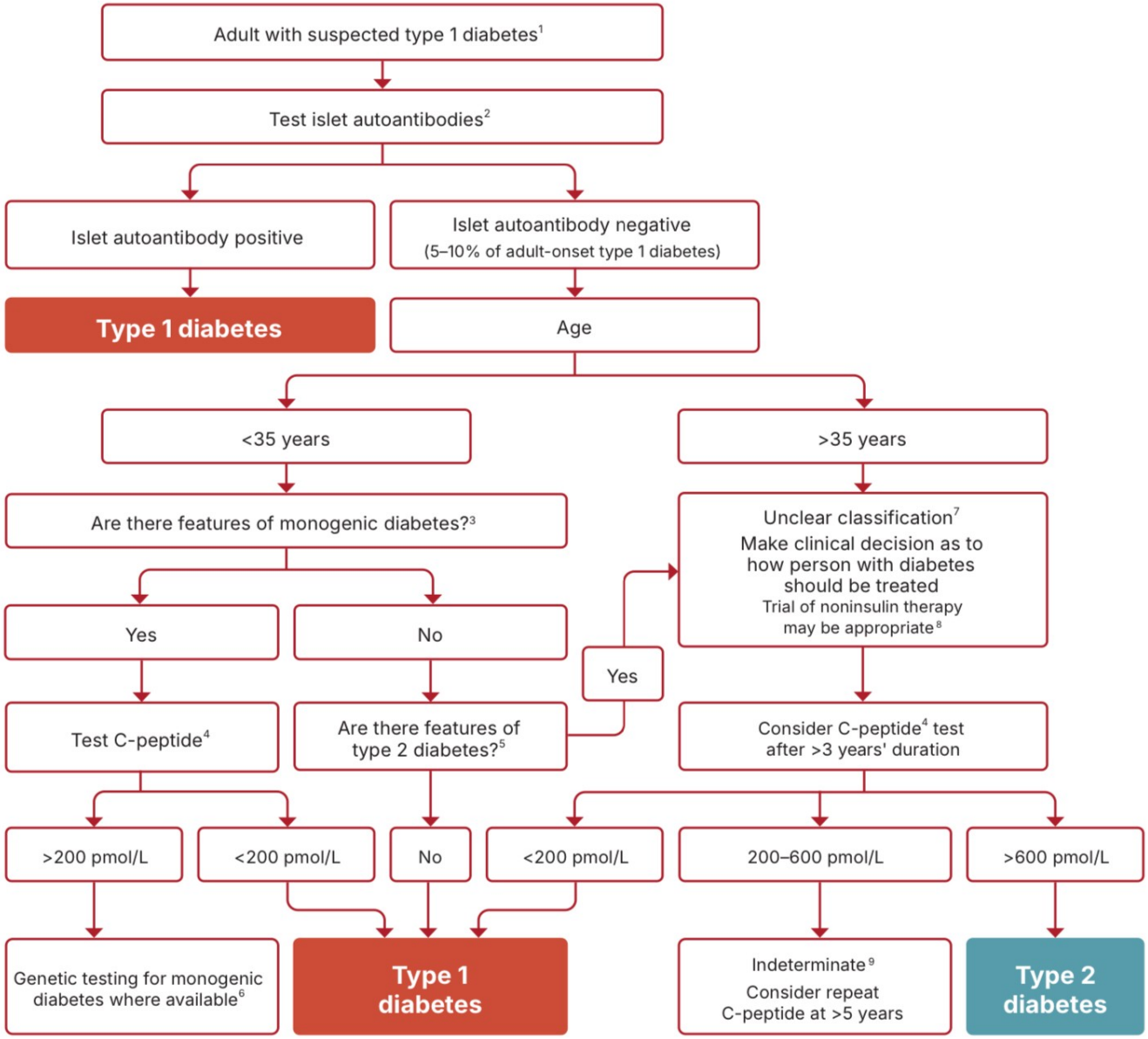

Type 1 Diabetes
attack
Macrophages
T-cells
Cytokines
Beta cell loss
Insulin
Absolute Insulin deficiency
Hyperglycemia
Type 2 Diabetes
Beta cell
loss
Hyperglycemia
Hyperlipidemia
Inflammatory cytokines
Amyloid accumulation
Insulin
Insulin resistance
Relative Insulin deficiency
Hyperglycemia
Insulin
Insulin receptor

Diabetes: Type 1 vs. Type 2

Diabetes is on the climb — but there is a difference between Type 1 and Type 2. Do you know it?

Type 1 Diabetes		Type 2 Diabetes
Your body is no longer able to produce insulin	Why	Your body still produces insulin, but it doesn't make enough of it or it doesn't use it efficiently
Usually develops during childhood, but can develop at any age	Age	Can develop at any age but is most common in adults over 45
Family history	Risk Factor	- Overweight and/or inactive - Family history - High blood pressure
- Bedwetting - Blurry vision - Frequent urination - Increased appetite and thirst - Mood changes and irritability - Tiredness and weakness - Unexplained weight loss	Symptoms	- Increased appetite and thirst - Dark patches on armpits/neck - Frequent urination - Blurry vision - Tiredness and weakness - Unexplained weight loss
No known prevention methods	Prevention	Healthy lifestyle
Insulin injections	Treatment	Healthy living, possible insulin support

Flowchart for investigation of suspected type 1 diabetes in newly diagnosed adults, based on data from White European populations



Hybrid forms of diabetes

1. Slowly evolving, immune-mediated diabetes of adults

- ✓ Similar to slowly evolving type 1 diabetes in adults, but more often has features of the metabolic syndrome,
- ✓ Has a single glutamic acid decarboxylase (GAD) autoantibody, and retains greater β-cell function

2. Ketosis-prone type 2 diabetes

- ✓ Presents with ketosis and insulin deficiency but later does not require insulin
- ✓ Common episodes of ketosis
- ✓ Not immune mediated

Other specific types

1. Monogenic diabetes

❑Monogenic defects of β-cell function

- ✓ Caused by specific gene mutations
- ✓ Has several clinical manifestations requiring different treatment,
- ✓ Some occurring in the neonatal period, others by early adulthood

Table 2.7—Most common causes of monogenic diabetes

	Gene	Inheritance	Clinical features
MODY	*HNF1A*	AD	HNF1A-MODY: progressive insulin secretory defect with presentation in adolescence or early adulthood; lowered renal threshold for glucosuria; large rise in 2-h PG level on OGTT (>90 mg/dL [>5 mmol/L]); low hs-CRP; sensitive to sulfonylureas
	HNF4A	AD	HNF4A-MODY: progressive insulin secretory defect with presentation in adolescence or early adulthood; may have large birth weight (macrosomia) and transient neonatal hypoglycemia; sensitive to sulfonylureas
	HNF1B	AD	HNF1B-MODY: developmental renal disease (typically cystic); genitourinary abnormalities; atrophy of the pancreas; hyperuricemia; gout
	GCK	AD	GCK-MODY: higher glucose threshold (set point) for glucose-stimulated insulin secretion, causing stable, nonprogressive elevated fasting blood glucose; typically does not require treatment; microvascular complications are rare; small rise in 2-h PG level on OGTT (<54 mg/dL [<3 mmol/L])
Neonatal diabetes	*KCNJ11*	AD	Permanent or transient: IUGR; possible developmental delay and seizures; responsive to sulfonylureas
	INS	AD	Permanent: IUGR; insulin requiring
	ABCC8	AD	Permanent or transient: IUGR; rarely developmental delay; responsive to sulfonylureas
	6q24 (*PLAGL1*, *HYMA1*)	AD for paternal duplications	Transient: IUGR; macroglossia; umbilical hernia; mechanisms include UPD6, paternal duplication, or maternal methylation defect; may be treatable with medications other than insulin
	GATA6	AD	Permanent: pancreatic hypoplasia; cardiac malformations; pancreatic exocrine insufficiency; insulin requiring
	EIF2AK3	AR	Permanent: Wolcott-Rallison syndrome: epiphyseal dysplasia; pancreatic exocrine insufficiency; insulin requiring
	EIF2B1	AD	Permanent diabetes: can be associated with fluctuating liver function (154)
	FOXP3	X-linked	Permanent: immunodysregulation, polyendocrinopathy, enteropathy X-linked (IPEX) syndrome: autoimmune diabetes, autoimmune thyroid disease, exfoliative dermatitis; insulin requiring

❑ Monogenic defects in insulin action

- ✓ Caused by specific gene mutations
- ✓ Has features of severe insulin resistance without obesity
- ✓ Diabetes develops when β cells do not compensate for insulin resistance

2. Diseases of the exocrine pancreas

Various conditions that affect the pancreas can result in hyperglycaemia (FCPD, Trauma, tumour, inflammation, Cystic fibrosis etc.)

3. Endocrine disorders - Occur in diseases with excess secretion of hormones that are insulin antagonists

- ✓ Cushing's syndrome
- ✓ Acromegaly
- ✓ Hyperthyroidism
- ✓ Glucoganoma
- ✓ Somatostatinoma
- ✓ Pheochromocytoma

4. **Drug or chemical induced** - Some medicines and chemicals impair insulin secretion or action, some can destroy β cells

- ✓ Glucocorticoids
- ✓ Alpha and beta adrenergic agonists
- ✓ Pentamidine
- ✓ Nicotinic acid
- ✓ Thiazides

5. **Infection-related diabetes** - Some viruses have been associated with direct β-cell destruction(CMV, Congenital Rubella)
6. **Other genetic syndromes sometimes associated with diabetes-** Many genetic disorders and chromosomal abnormalities increase the risk of diabetes

- ✓ Down's syndrome
- ✓ Kinefilters syndrome
- ✓ Turners syndrome etc.,

- **Unclassified diabetes**

✓ Used to describe diabetes that does not clearly fit into other categories.

✓ This category should be used temporarily when there is not a clear diagnostic category, especially close to the time of diagnosis

- In Pregnancy

- **Hyperglycaemia first detected during pregnancy**
- **Diabetes in pregnancy** - Type 1 diabetes or type 2 diabetes first diagnosed during pregnancy
- **Gestational diabetes -** Hyperglycaemia below diagnostic thresholds for diabetes in pregnancy

SCREENING

- Whom to test? All pregnant women in india
- When to test ? In the 1st visit itself ,if it is normal repeat test at 24-28 weeks with atleast gap of 4 weeks
- Wha

DIAGNOSTIC TEST	WEEK OF GESTATION
1st diagnostic test	Ideally at 12-16 wks/ 1st visit
2nd diagnostic test	At 24-28 wks
3 rd diagnostic test	At 32-34 wks

Screening and Diagnosis of Gestational diabetes

❑One-step strategy(IADPSG)

- Perform a 75 g OGTT, with plasma glucose measurement when the individual is fasting and at 1 h and 2 h, at 24–28 weeks of gestation in women not previously diagnosed with diabetes.
- The OGTT should be performed in the morning after an overnight fast of at least 8 h.

- The diagnosis of gestational diabetes is made when any of the following plasma glucose values are **met or exceeded**
- **Fasting: 92 mg/dl (5.1 mmol/l)**
- **1 h: 180 mg/dl (10.0 mmol/l)**
- **2 h: 153 mg/dl (8.5 mmol/l)**

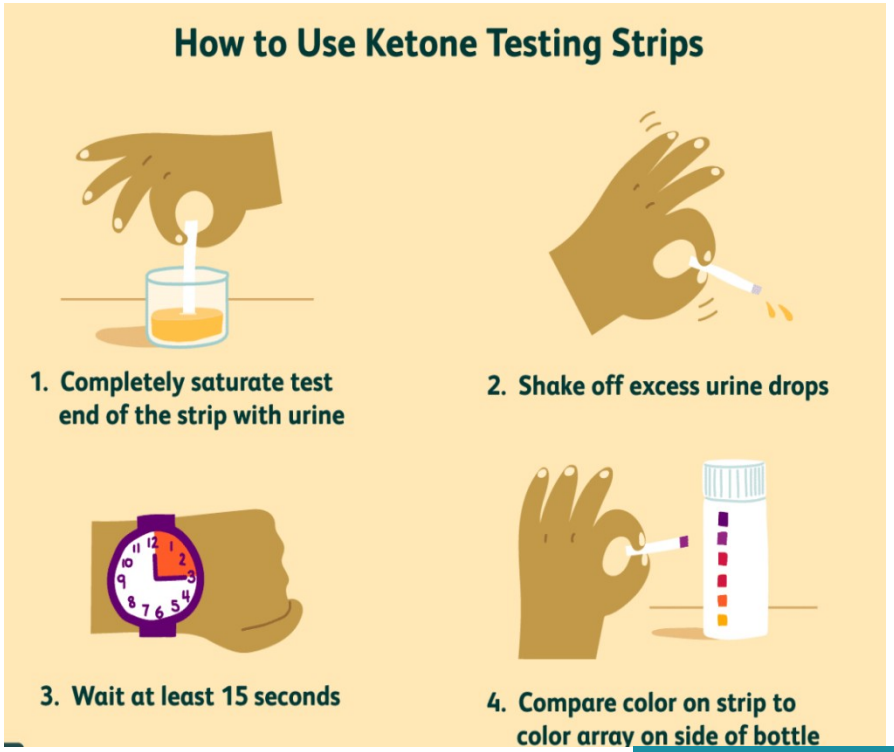
❑Two-step strategy

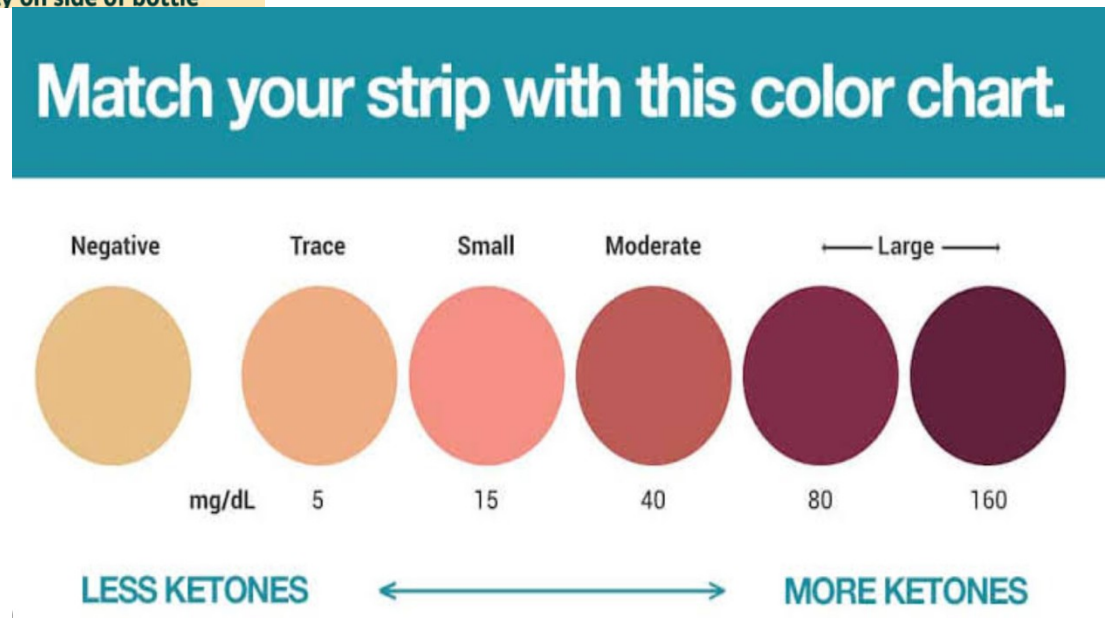
- **Step 1**: Perform a 50 g GLT (non-fasting), with plasma glucose measurement at 1 h, at 24–28 weeks of gestation in women not previously diagnosed with diabetes.
- If the plasma glucose level measured 1 h after the load is ≥130,135, or 140 mg/dl (7.2, 7.5, or 7.8 mmol/l, respectively), proceed to a 100 g OGTT.

- **Step 2**: The 100 g OGTT should be performed when the individual is fasting.
- The diagnosis of gestational diabetes is made when at least two *of the following*four plasma glucose levels (measured fasting and at 1, 2, and 3 h during OGTT) are met or exceeded:

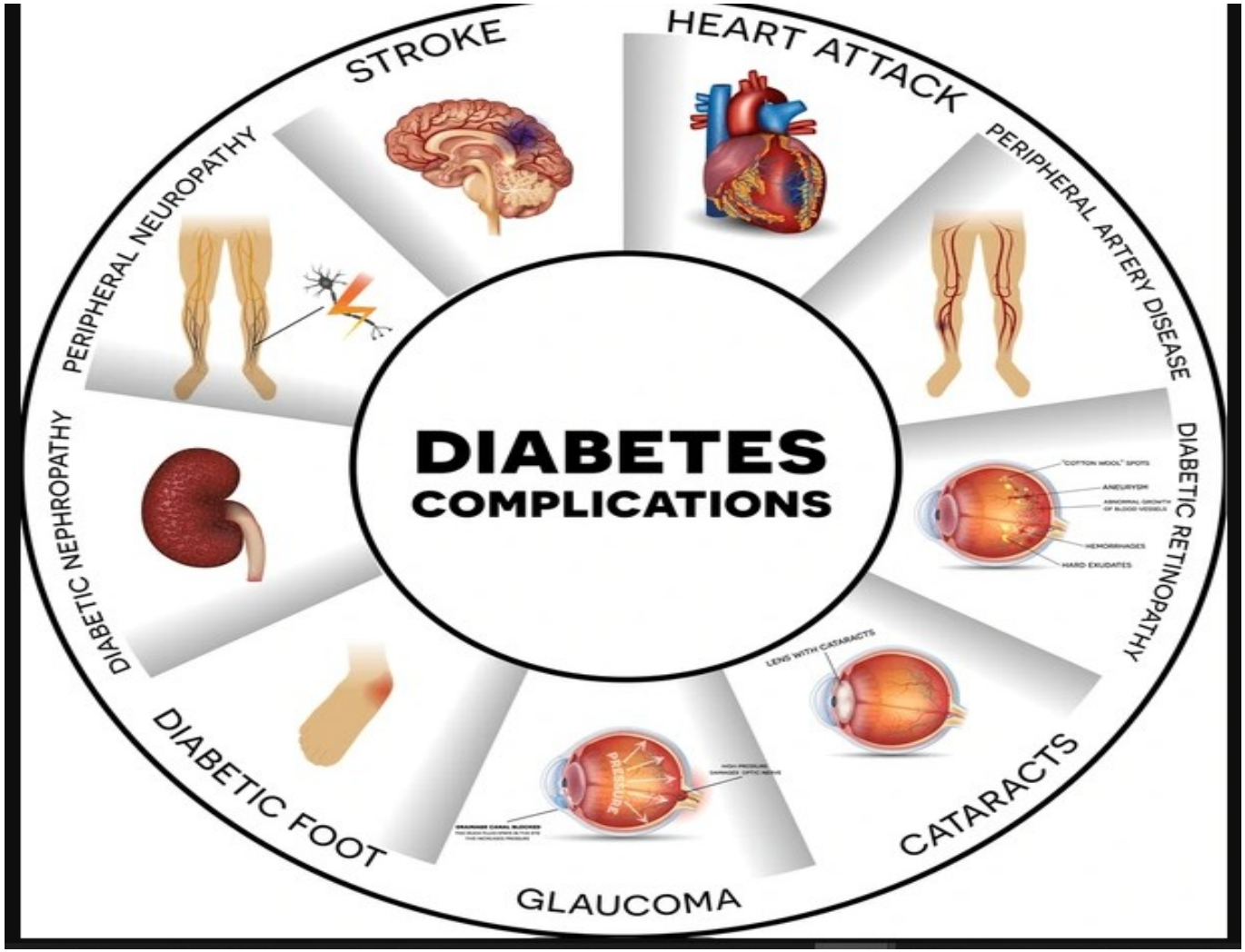
- Fasting: 95 mg/dl (5.3 mmol/l)
- 1 h: 180 mg/dl (10.0 mmol/l)
- 2 h: 155 mg/dl (8.6 mmol/l)
- 3 h: 140 mg/dl (7.8 mmol/l)

Urine ketones





Complications



Complications

Acute

- Diabetic ketoacidosis
- Hyperglycemic hyperosmolar state
- Hypoglycemia

Chronic

- Microvascular
- macrovascular

	Pure DKA	Pure HHS
Epidemiology	• Very common • Often younger • Often in T1DM • Comorbidities are less often present	• Relatively rare • Often older • Often in T2DM • Comorbidities are more often present
Time required for disease to develop	Several hours to days	Several days to weeks
Precipitating factors	Variable, often absent in mild DKA and usually present in mod-severe DKA	Variable, often absent in mild HHS and usually present in mod-severe HHS
Pathogenesis	• Severe (absolute) insulin deficiency below the critical level, causes unleased ketogenesis. • Ketones are not well-tolerated, accounting for *early* development of disease manifestations. • Shorter duration of hyperglycemia accounts for less severe volume depletion and absence of severe hypernatremia	• Moderate (relative) insulin deficiency in which there is enough insulin to prevent ketogenesis. • *Prolonged* period of hyperglycemia causes osmotic diuresis and severe hypovolemia and hypovolemic hypernatremia
Primary physiologic abnormality	Ketoacidosis	Hypertonicity
Core features	• ↑Serum ketones (predominantly BHB) • ↑Anion gap • ↑Blood glucose and metabolic acidosis	• Severe hyperglycemia • Altered mental status • ↑Serum osmolality (>320 mOsm) • Severe volume depletion
Key factor to monitor during treatment	Serum anion gap	Serum osmolality

Hypoglycemia

Table 6.4—Classification of hypoglycemia

	Glycemic criteria/description
Level 1	Glucose <70 mg/dL (<3.9 mmol/L) and ≥54 mg/dL (≥3.0 mmol/L)
Level 2	Glucose <54 mg/dL (<3.0 mmol/L)
Level 3	A severe event characterized by altered mental and/or physical status requiring assistance for treatment of hypoglycemia, irrespective of glucose level

Table 6.5—Assessment of hypoglycemia risk among individuals treated with insulin, sulfonylureas, or meglitinides

Clinical and biological risk factors	Social, cultural, and economic risk factors
Major risk factors • Recent (within the past 3–6 months) level 2 or 3 hypoglycemia • Intensive insulin therapy* • Impaired hypoglycemia awareness • End-stage kidney disease • Cognitive impairment or dementia	Major risk factors • Food insecurity • Low-income status§ • Housing insecurity • Fasting for religious or cultural reasons • Underinsurance
Other risk factors • Multiple recent episodes of level 1 hypoglycemia • Basal insulin therapy* • Age ≥75 years† • Female sex • High glycemic variability‡ • Polypharmacy • Cardiovascular disease • Chronic kidney disease (eGFR <60 mL/min/1.73 m^2 or albuminuria) • Neuropathy • Retinopathy • Major depressive disorder • Severe mental illness	Other risk factors • Low health literacy • Alcohol or substance use disorder

Microvascular

Eye

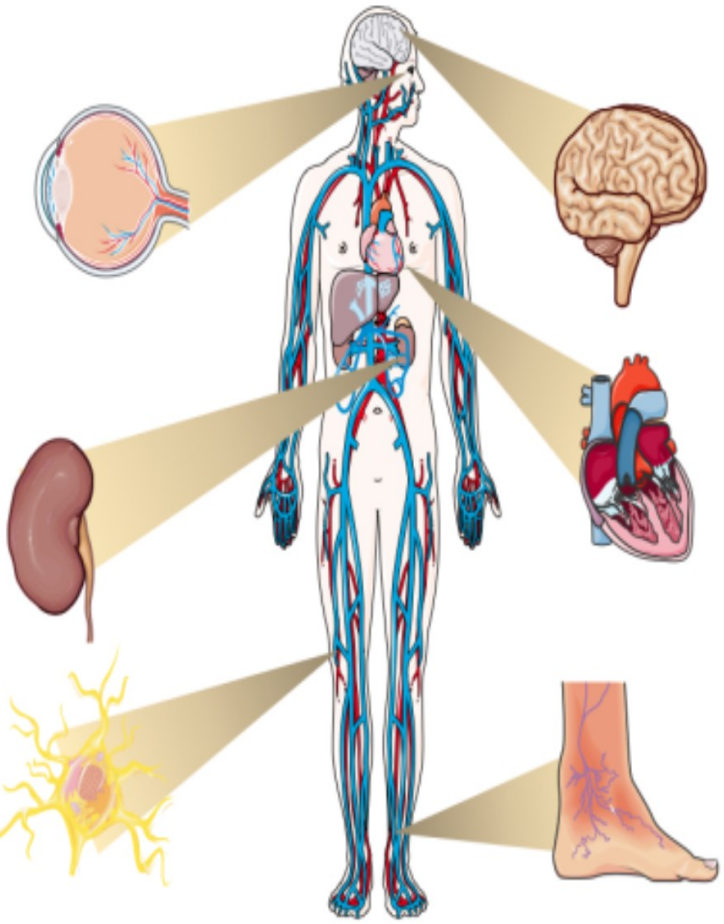
High blood glucose and high blood pressure can damage eye blood vessels, causing retinopathy, cataracts and glaucoma

Kidney

High blood pressure damages small blood vessels and excess blood glucose overworks the kidneys, resulting in nephropathy.

Neuropathy

Hyperglycemia damages nerves in the peripheral nervous system. This may result in pain and/or numbness. Feet wounds may go undetected, get infected and lead to gangrene.



Macrovascular

Brain

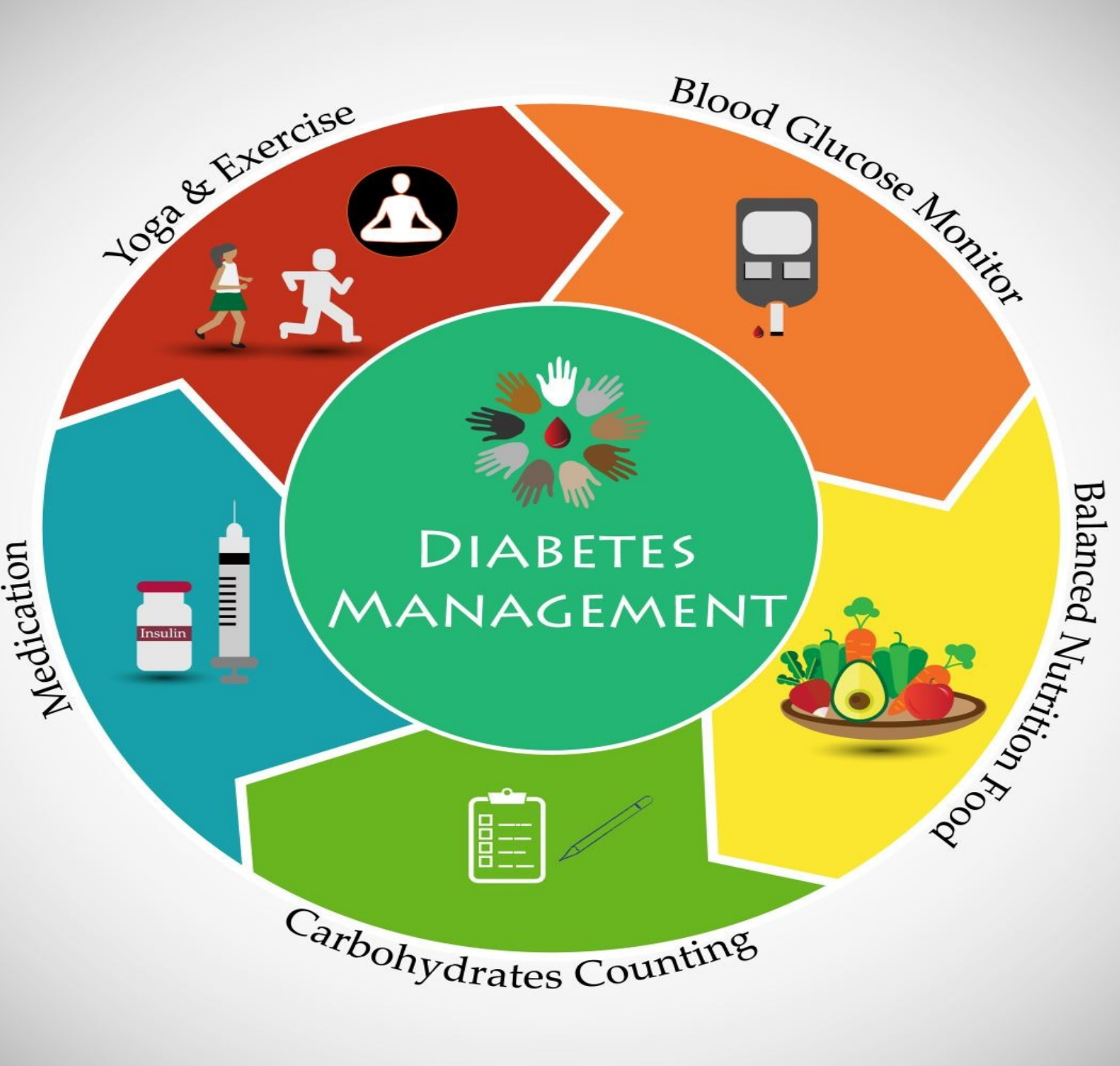
Increased risk of stroke and cerebrovascular disease, including transient ischemic attack, cognitive impairment, etc.

Heart

High blood pressure and insulin resistance increase risk of coronary heart disease

Extremities

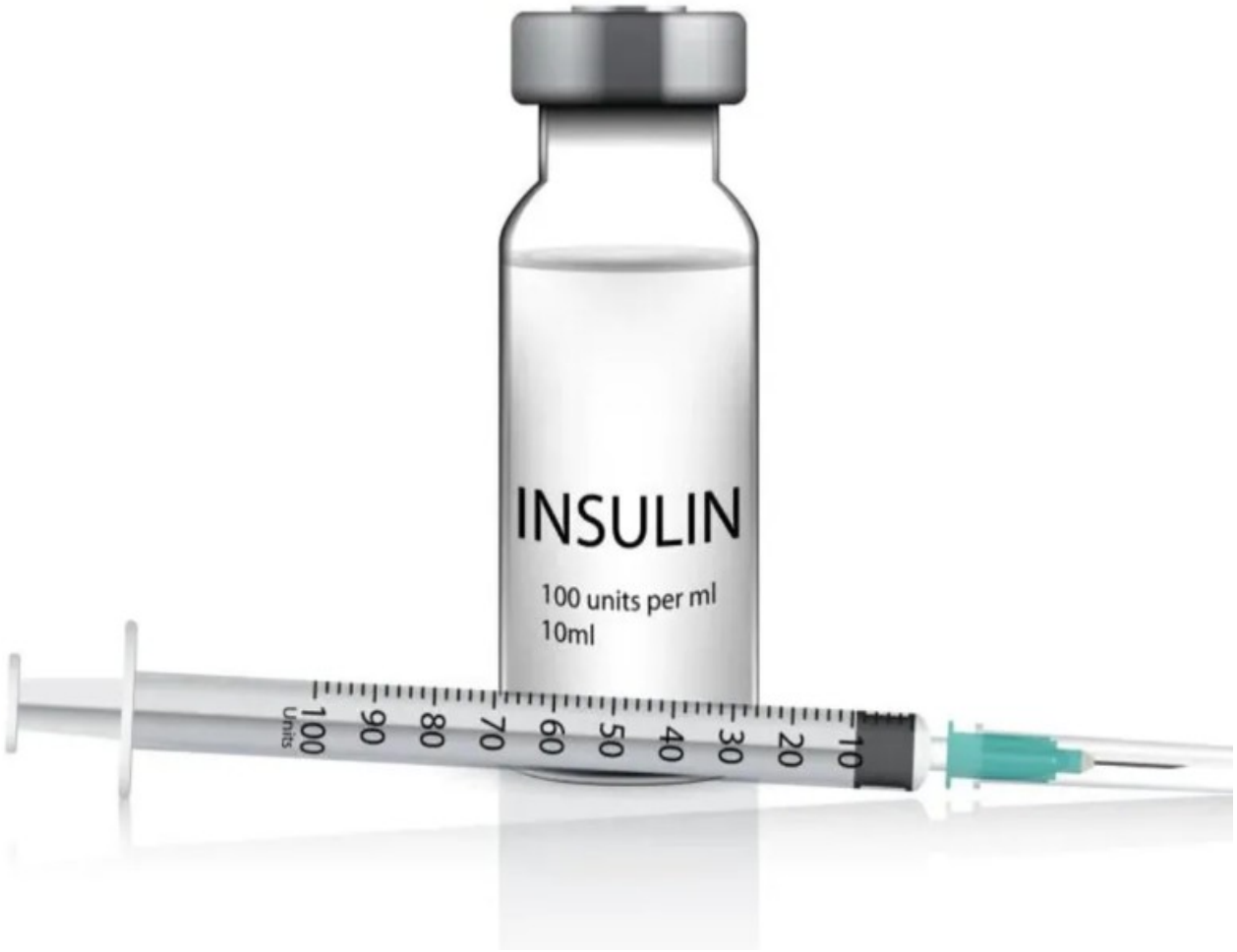
Peripheral vascular disease results from narrowing of blood vessels increasing the risk for reduced or lack of blood flow in legs. Feet wounds are likely to heal slowly contributing to gangrene and other complications.


Yoga & Exercise
Blood Glucose Monitor
Medication
Balanced Nutrition Food
Carbohydrates Counting
DIABETES MANAGEMENT
Insulin

Anti diabetic drugs

Biguanides	• Metformin	500 mg (ER) 850 mg (IR) 1,000 mg (IR) 1,000 mg (ER) 500 mg (Sol)
Sulfonylureas (2nd generation)	• Glimepiride • Glipizide • Glyburide	4 mg 10 mg (IR) 10 mg (XL/ER) 6 mg (micronized) 5 mg
Thiazolidinedione	• Pioglitazone	45 mg
α-Glucosidase inhibitors	• Acarbose • Miglitol	100 mg 100 mg
Meglitinides	• Nateglinide • Repaglinide	120 mg 2 mg
DPP-4 inhibitors	• Alogliptin • Linagliptin • Saxagliptin • Sitagliptin	25 mg 5 mg 5 mg 100 mg
SGLT2 inhibitors	• Bexagliflozin • Canagliflozin • Dapagliflozin • Empagliflozin • Ertugliflozin	20 mg 300 mg 10 mg 25 mg 15 mg
GLP-1 RAs	• Dulaglutide • Exenatide • Exenatide (ER) • Liraglutide • Semaglutide	4.5 mg pen 10 mg pen 2 mg pen 18 mg/3 mL pen 2 mg pen 14 mg (tablet)
Dual GIP and GLP-1 RA	• Tirzepatide	15 mg pen

Insulin
Administration and Storage


INSULIN
100 units per ml
10ml
100
90
80
70
60
50
40
30
20
10
Units


40
35
30
25
20
15
10
5
Units

Insulin adminstration

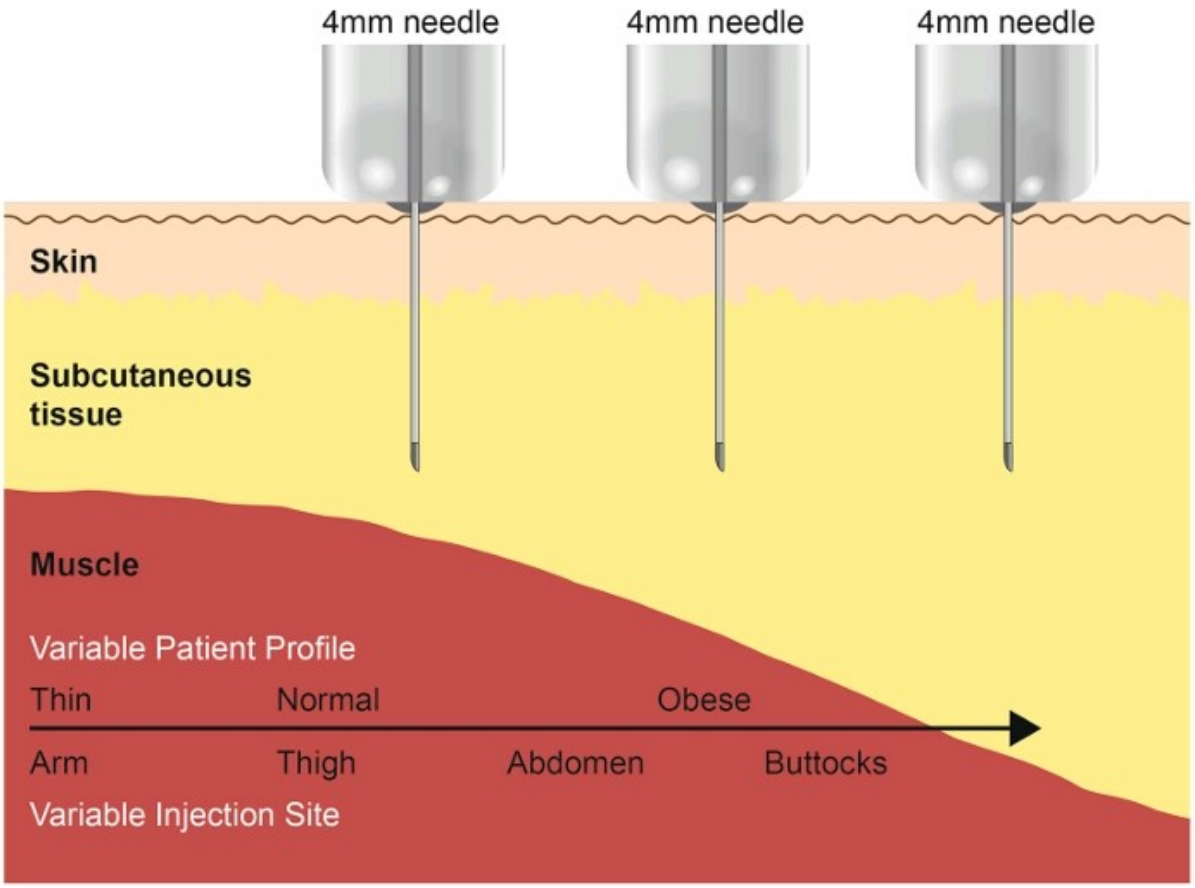
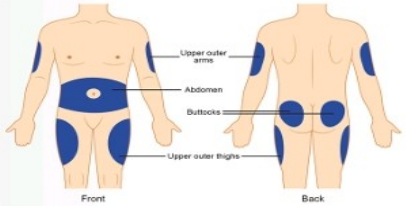
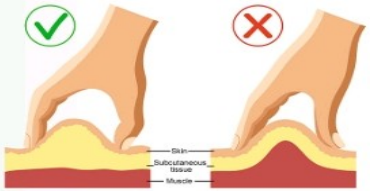


Fig. 1 The use of a 4-mm needle is appropriate for subcutaneous injections at all injection sites

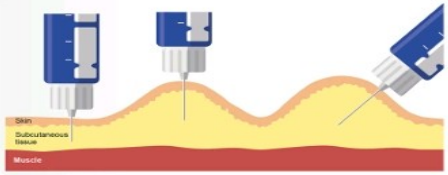
1. It is important to choose the right injection site. Typically, the abdomen, thighs, and buttocks are the most common sites due to their consistent absorption rates. It is not advisable to utilize the upper arm and lower leg regions as access to the correct zone may be limited and the lower thickness of subcutaneous fat in these regions may increase the risk of IM injection



2. If required, it is essential to lift a fold of skin. This involves gently lifting the skin and the underlying subcutaneous tissue, or fatty layer between the thumb and index finger, while leaving the muscle untouched.



3. Insert the needle at a 90° angle into the skin. For patients with a lean build, combined use of lifted skin fold and angled insertion may be done. Avoid indenting the skin while injecting to prevent the needle from penetrating the muscle.



4. Inject insulin gradually and withdraw the syringe needle at the same angle. Keep the needle under the skin for at least 10 seconds after pressing the plunger.

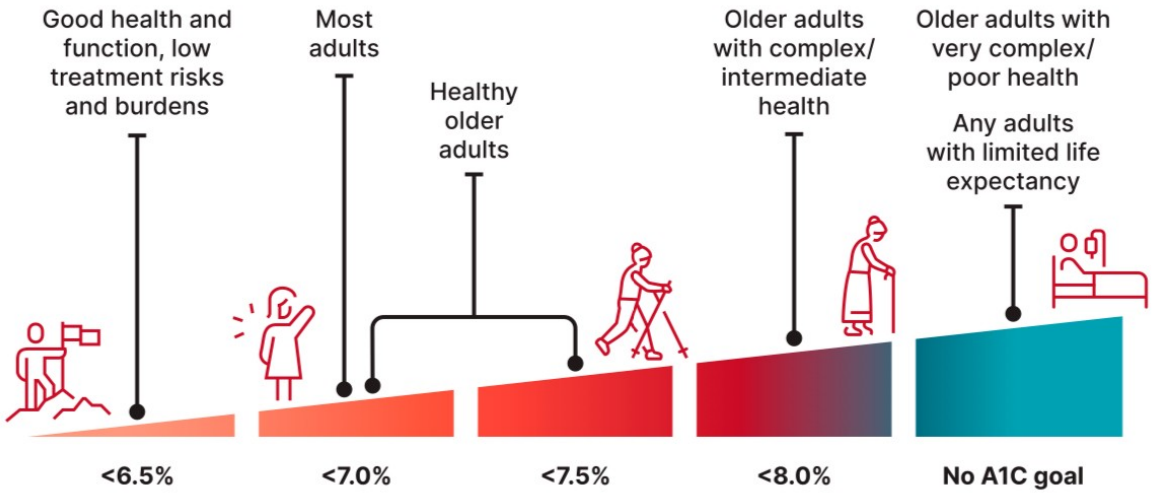
5. Once done, discard the used needle safely.

Insulin storage

Glycemic goals in non pregnant adults with diabetes

A1C	<7.0% (<53 mmol/mol)*†
Preprandial capillary plasma glucose	80–130 mg/dL* (4.4–7.2 mmol/L)
Peak postprandial capillary plasma glucose‡	<180 mg/dL* (<10.0 mmol/L)

Individualised A1c goals for non pregnant adults



Modifying Factors

Favor more stringent goal	Favor less stringent goal
Short diabetes duration	Long diabetes duration
Low hypoglycemia risk	High hypoglycemia risk
Low treatment risks and burdens	High treatment risks and burdens
Pharmacotherapy with cardiovascular, kidney, weight, or other benefits	Pharmacotherapy without nonglycemic benefits
No cardiovascular complications	Established cardiovascular complications
Few or minor comorbidities	Severe, life-limiting comorbidities

Thank you