

# Diabetes Mellitus

## Biomedical Engineering - URJC

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# Introduction

## Definition

Diabetes mellitus (DM) is a metabolic disease characterized by inadequate control of blood glucose levels.

## Subclassifications

- Type 1 DM
- Type 2 DM
- MODY (maturity-onset diabetes of the young)
- LADA (latent autoimmune diabetes of adults)
- Gestational diabetes
- Neonatal diabetes
- Steroid-induced diabetes

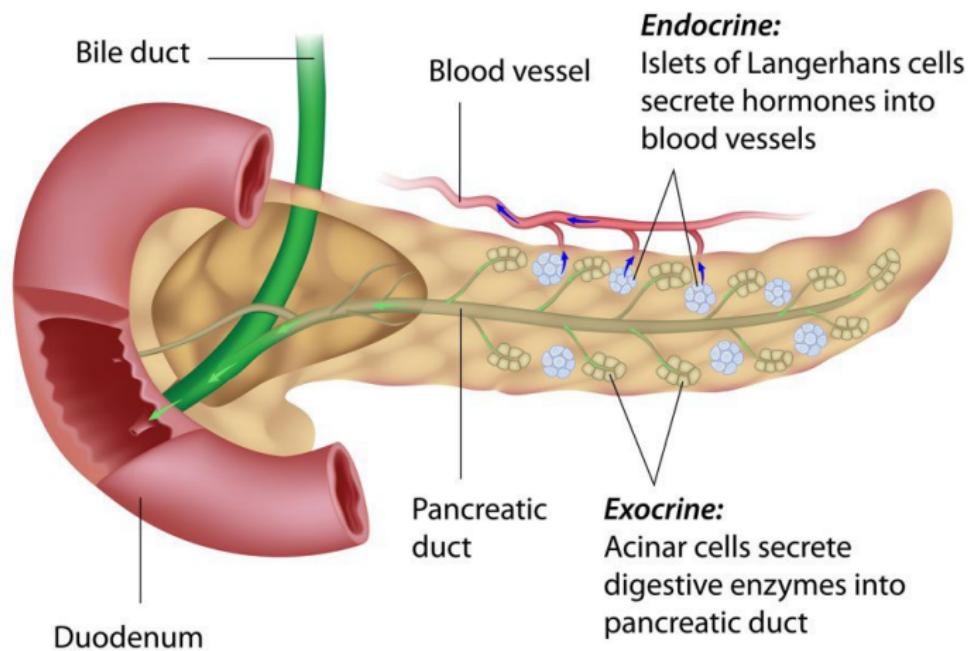
# Introduction

## Main subtypes

- 1 Type 1 DM
- 2 Type 2 DM

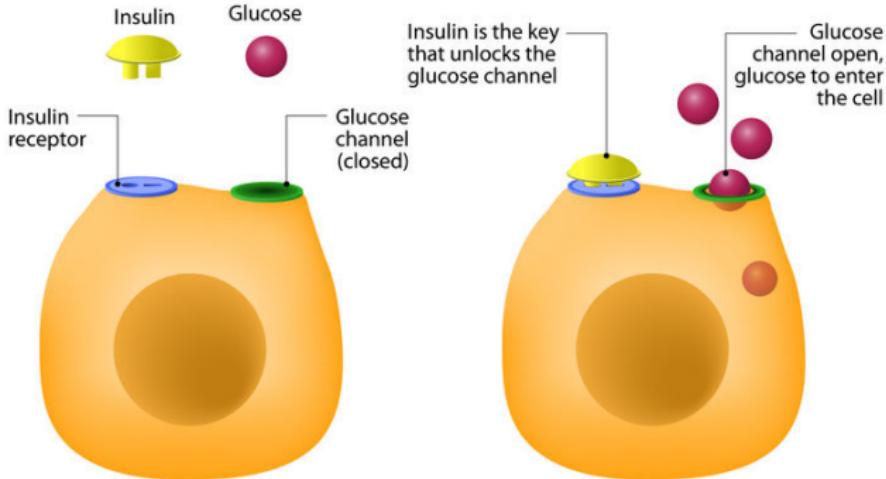
Each type has **different** pathophysiology, presentation, and management, but both can lead to **hyperglycemia**.

# Pancreas and insulin secretion

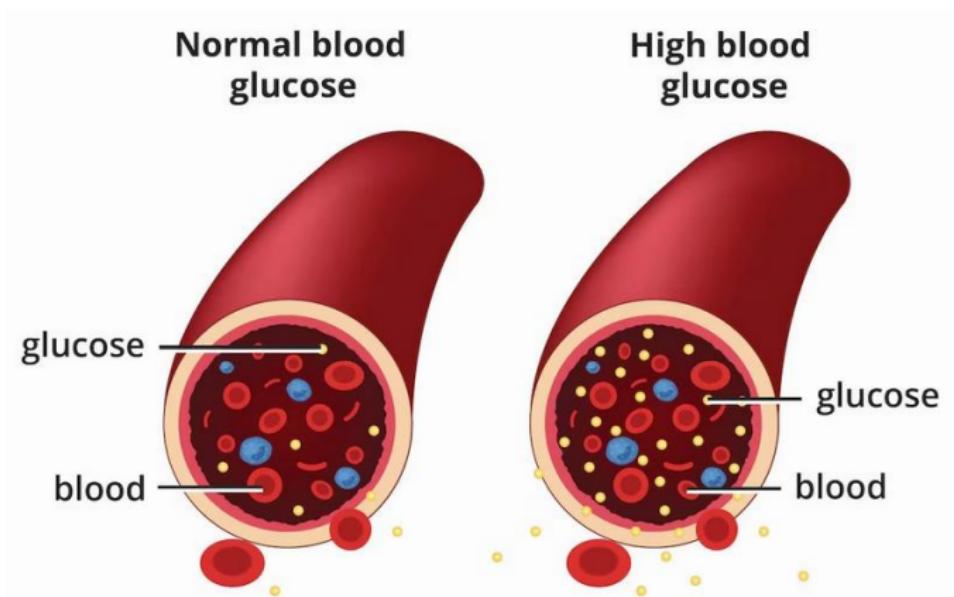


# Mechanism of action of insulin

## HOW DOES INSULIN WORK?



# What is hyperglycemia?



# Pathophysiology

## Main subtypes

- 1 Type 1 DM: autoimmune disease (auto-antibodies against pancreas), with **defective** (abstent) insulin **secretion**
- 2 Type 2 DM: insulin resistance, with **defective insulin action** (normal or increased insulin levels, limited effect/scare effect on tissues)

# Type 1 Diabetes Mellitus

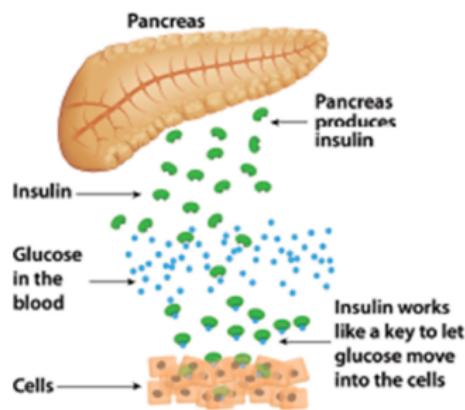
## Summary of Type 1 diabetes

- Accounts for 5-10 % of diabetes cases.
- **Autoimmune destruction** of insulin-producing **beta cells** in the pancreas.
- Presents most commonly in **children** and adolescents.
- Requires **lifelong insulin replacement** therapy.

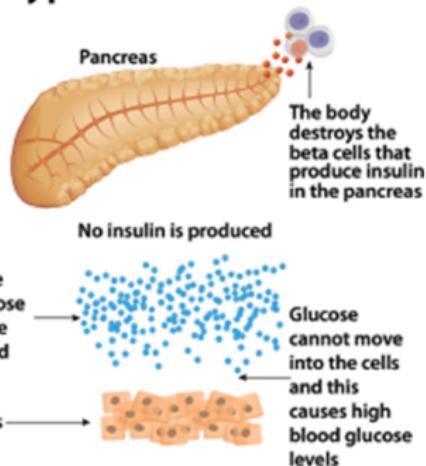
# Type 1 Diabetes Mellitus

## Type 1 diabetes

### Person without diabetes



### Person with type 1 diabetes



In type 1 diabetes, the pancreas stops making insulin.

# Type 2 Diabetes Mellitus

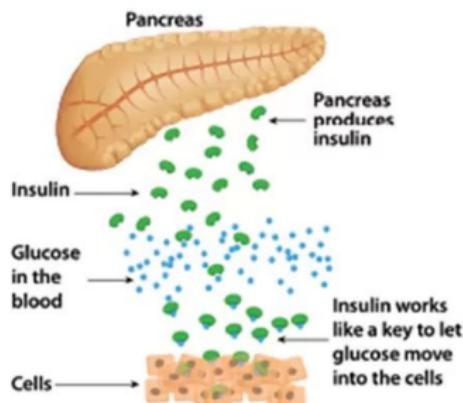
## Summary of Type 2 diabetes

- Accounts for around 90 % of diabetes cases.
- **Diminished response** to insulin, defined as **insulin resistance**.
- Initially, insulin production increases to compensate for resistance, but over time, production decreases.
- Most commonly seen in individuals **older than 45**, but increasingly observed in younger populations due to rising obesity rates.

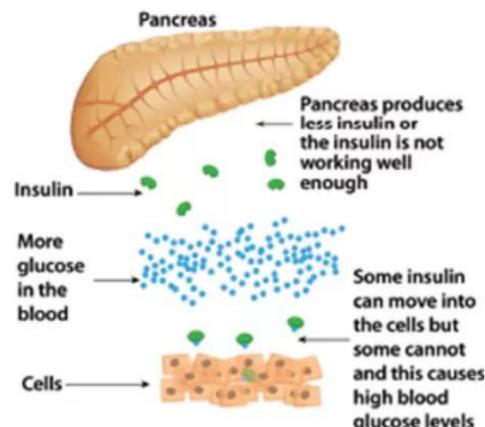
# Type 2 Diabetes Mellitus

## Type 2 diabetes

### Person without diabetes

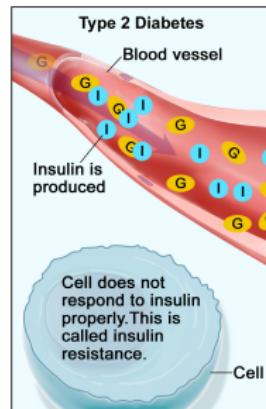
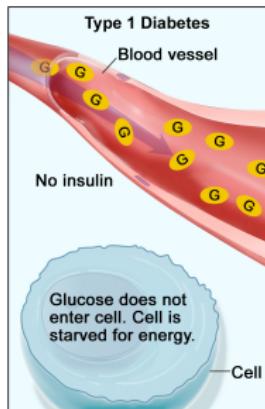
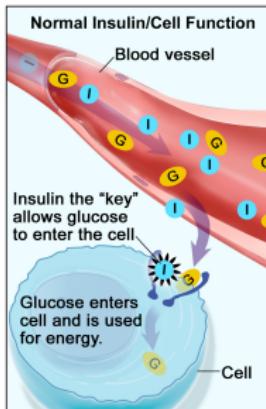
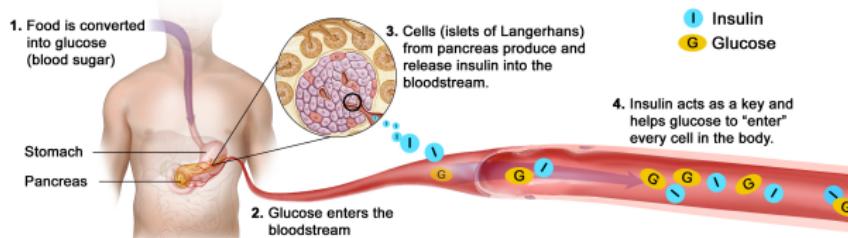


### Person with type 2 diabetes



In type 2 diabetes, the pancreas makes some insulin  
but it is not working as well as it used to.

# Type 1 versus Type 2 Diabetes Mellitus

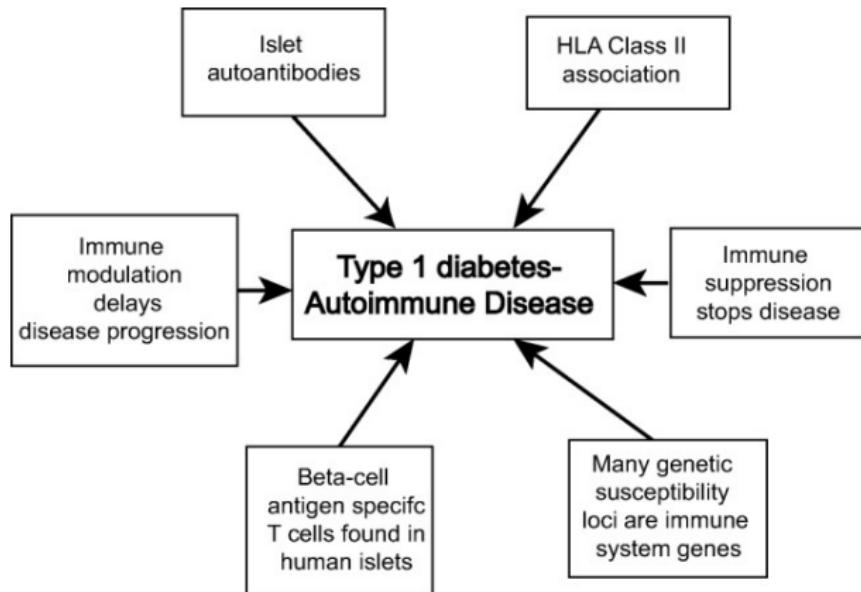


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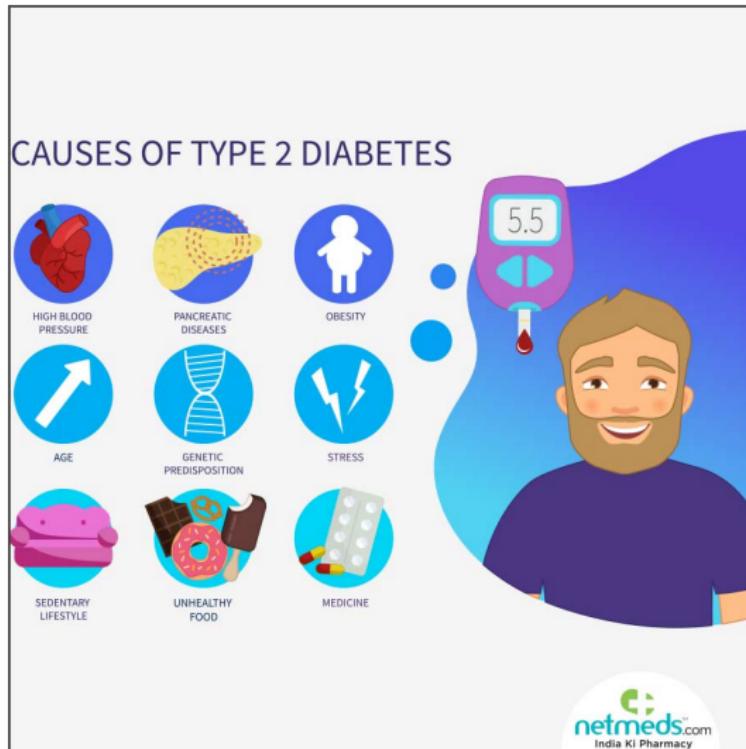
# Etiology

- Involves a complex interplay of genetic and environmental factors.
- **Type 1:** Autoimmune destruction of pancreatic beta cells.
- **Type 2:** Insulin resistance and beta-cell dysfunction.

# Causes of Type 1 Diabetes Mellitus



# Causes of Type 2 Diabetes Mellitus



# Clinical Manifestations (I): type I diabetes

## Classic symptoms

Classic symptoms include polyuria, polydipsia, polyphagia, and weight loss.

## Vocabulary

- 1 **Polyuria** is excessive (increased) production of urine
- 2 **Polydipsia** is excessive thirst or excess drinking
- 3 **Polyphagia** is an abnormally strong, incessant sensation of hunger

# Clinical Manifestations (I): type I diabetes

## Know the 4T early signs



Toilet      Thirsty      Tired      Thinner

If your child has one or more of these symptoms, they may have type 1 diabetes. A delay in diagnosing type 1 diabetes can lead to a severe and potentially fatal complication called diabetes ketoacidosis, or DKA. An easy, fast and free blood glucose check from your GP is all that it takes to diagnose type 1 diabetes.

For further information visit [www.JDRF.org.au](http://www.JDRF.org.au)

**D**iabetes **K**now the signs **A**sk

**JDRF** IMPROVING LIVES. CURING TYPE 1 DIABETES.

**diabetes australia**

Queensland Government

# Clinical Manifestations (II)

## Diabetic ketoacidosis (I)

- 1 DKA is brought on by a **complete lack of insulin**: glucose cannot provide energy to cells (even the hyperglycemia)
- 2 Without insulin/energy, tissues (muscles, brain, organs) begin to **break down fat** in attempt to get the energy
- 3 Metabolization of fatty acids ultimately results in a **dangerous accumulation of ketones** (acids) in blood
- 4 With a pH < 7.3 (acidosis), a body can go into **shock**, as the acid accumulation causes swelling in the brain. This requires emergency care, as it can induce a coma and even become **life-threatening**.

# Clinical Manifestations (II)

## Diabetic ketoacidosis (II)

- Diabetic ketoacidosis (DKA) is a life-threatening complication of type 1 diabetes.
- Sometimes is the first presentation of T1DM (20 % of T1DM)

## DKA criteria

- Blood glucose > 300 mg/dL
- Dehydratation
- Presence of ketones in both blood and urine
- Serum Bicarbonate < 15 mEq/L
- Acidic pH (< 7.25), that is, metabolic acidosis

# Clinical Manifestations (III)

## Hyperglycemic hyperosmolar syndrome

Hyperglycemic hyperosmolar syndrome (HHS) can occur in type 2 diabetes.

## HHS criteria

- Similar mechanisms as DKA, with no increased ketone concentration
- Dehydratation
- No significant acidosis (no ketones)
- Dehydratation
- High serum osmolarity

# Diagnosis

- Diagnosis based on **characteristic symptoms**, and..
- **elevated serum glucose** levels
  - Fasting glucose > 126 mg/dL, or
  - Random glucose > 200 mg/dL (or after an oral overload of glucose), or
  - Glycated hemoglobin or HbA1c > 6.5 %.

# Treatment and Management

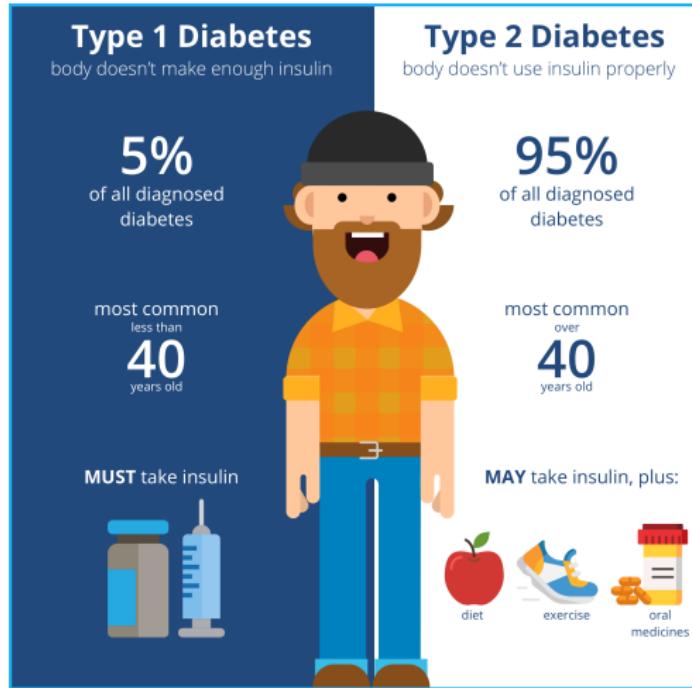
## Type 1 DM

Lifelong insulin

## Type 2 DM

- Lifestyle modifications including diet and exercise.
- Pharmacological interventions such as insulin, metformin, GLP-1 agonists, and SGLT-2 inhibitors.
- Regular screenings for complications including retinopathy and nephropathy.

# Treatment and Management



# Treatment and Management: Complications

- Microvascular complications include retinopathy, neuropathy, and nephropathy.
- Macrovascular complications include cardiovascular disease and stroke.
- Regular monitoring and management are crucial to prevent complications.