

Lecture 4: Diabetes (MED 531 B)

Insulin control, pathology, diagnostics, complications, and treatments.

¶ 4.1

The Definition & Global Scope

>500,000,000



Numbers rising sharply alongside global obesity rates.



Diabetes Mellitus
= 'Sweet Urine'
(Excess glucose spilling into urine)

A condition of raised blood sugar (glucose).

1. Too little insulin.
2. Resistance to insulin's effects.
3. Or both.

The Physiology of Metabolic Homeostasis

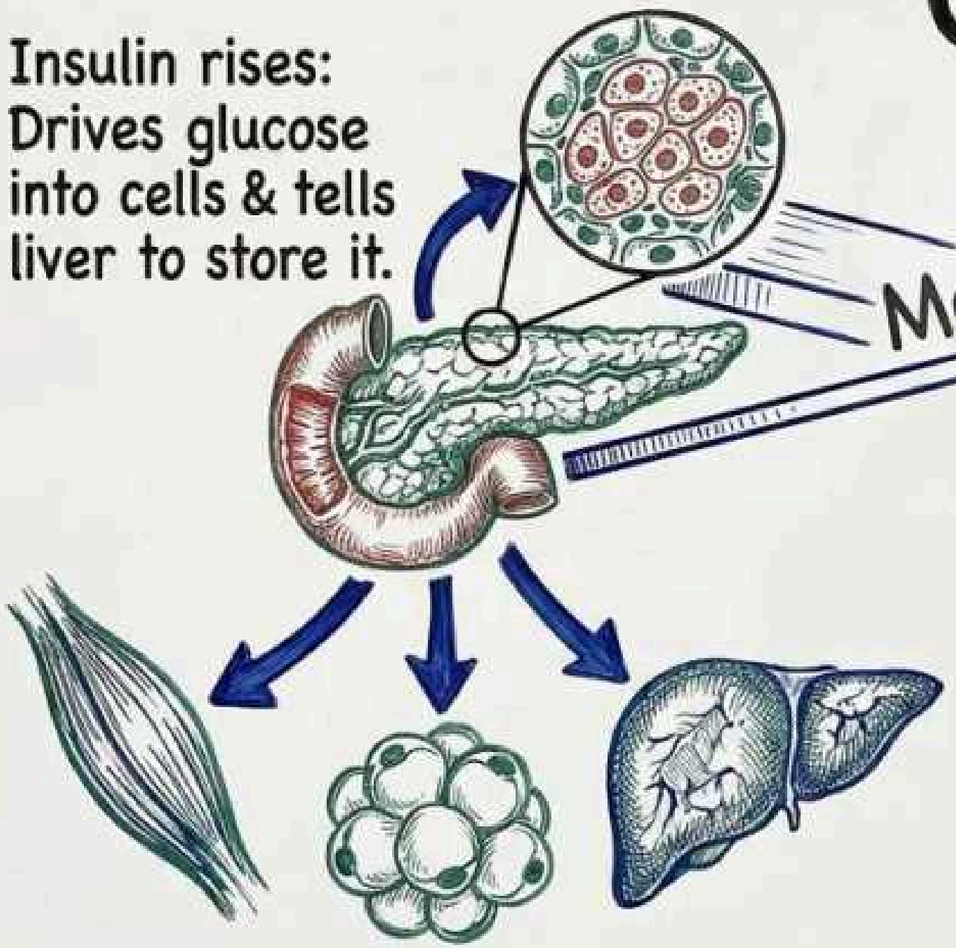
¶ 4.2

Post-Meal

$C_6H_{12}O_6$

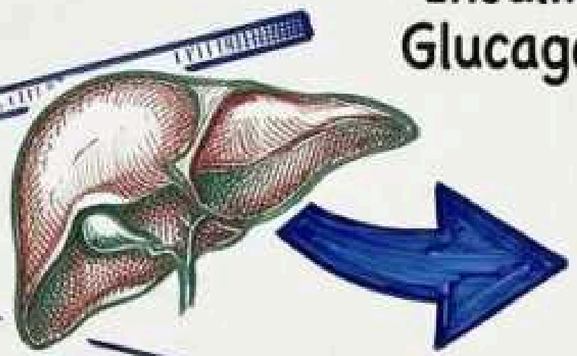
Between Meals

Insulin rises:
Drives glucose into cells & tells liver to store it.



Metabolic Seesaw

Insulin falls,
Glucagon rises.



Releases stored glucose to keep levels steady.

Blood Sugar Homeostasis

A Medical Turning Point



Discovery in Toronto by Frederick Banting & Charles Best (working with John Macleod & James Collip).

1921

First patient treated.

[Before this, Type 1 was a death sentence within months/years.]

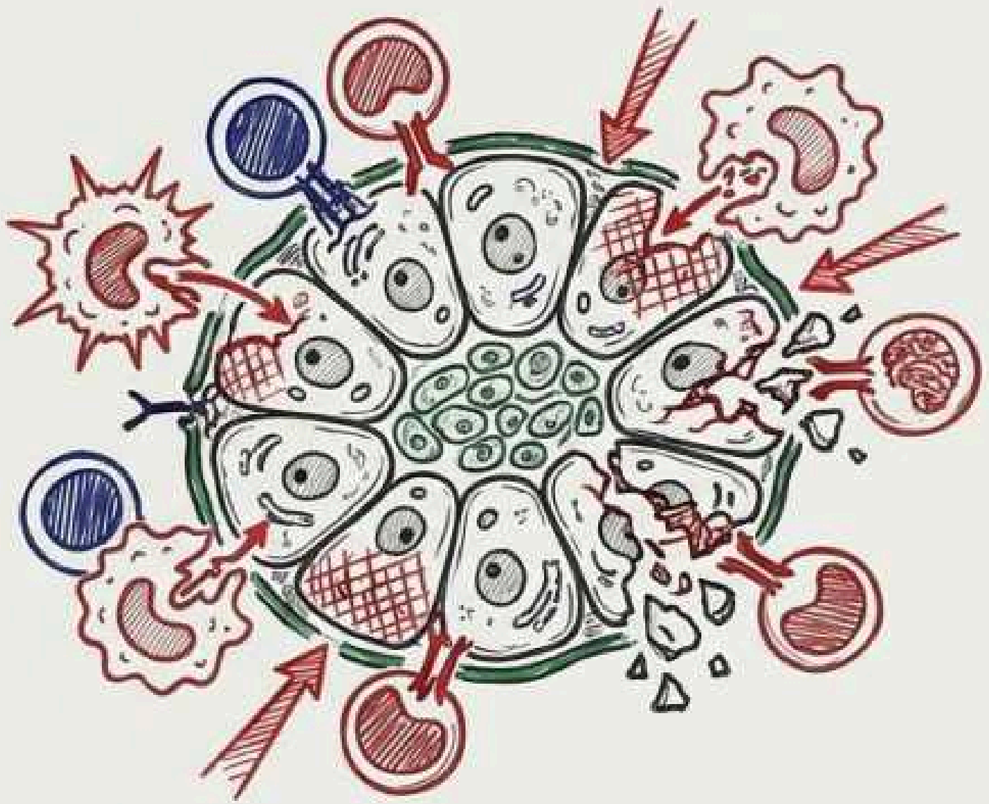
1922

Nobel Prize awarded to Banting and Macleod.

1923

Type 1: Autoimmune Beta Cell Destruction

¶ 4.4



Body makes almost zero insulin

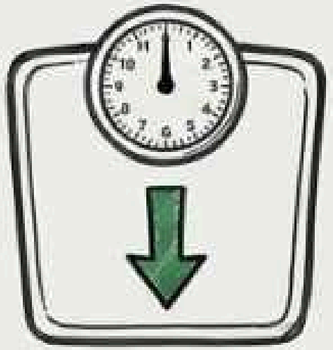
Requires insulin replacement for life



Thirst



Polyuria / passing large amounts of urine



Weight loss



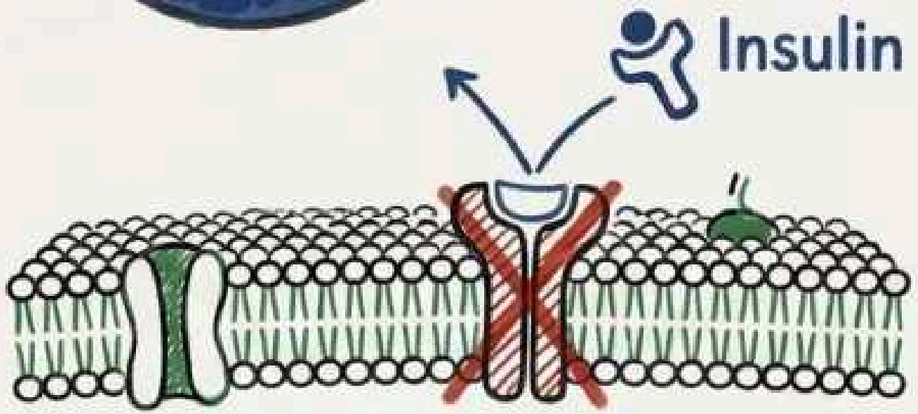
Tiredness

Type 2: Tissue Resistance and Gradual Decline

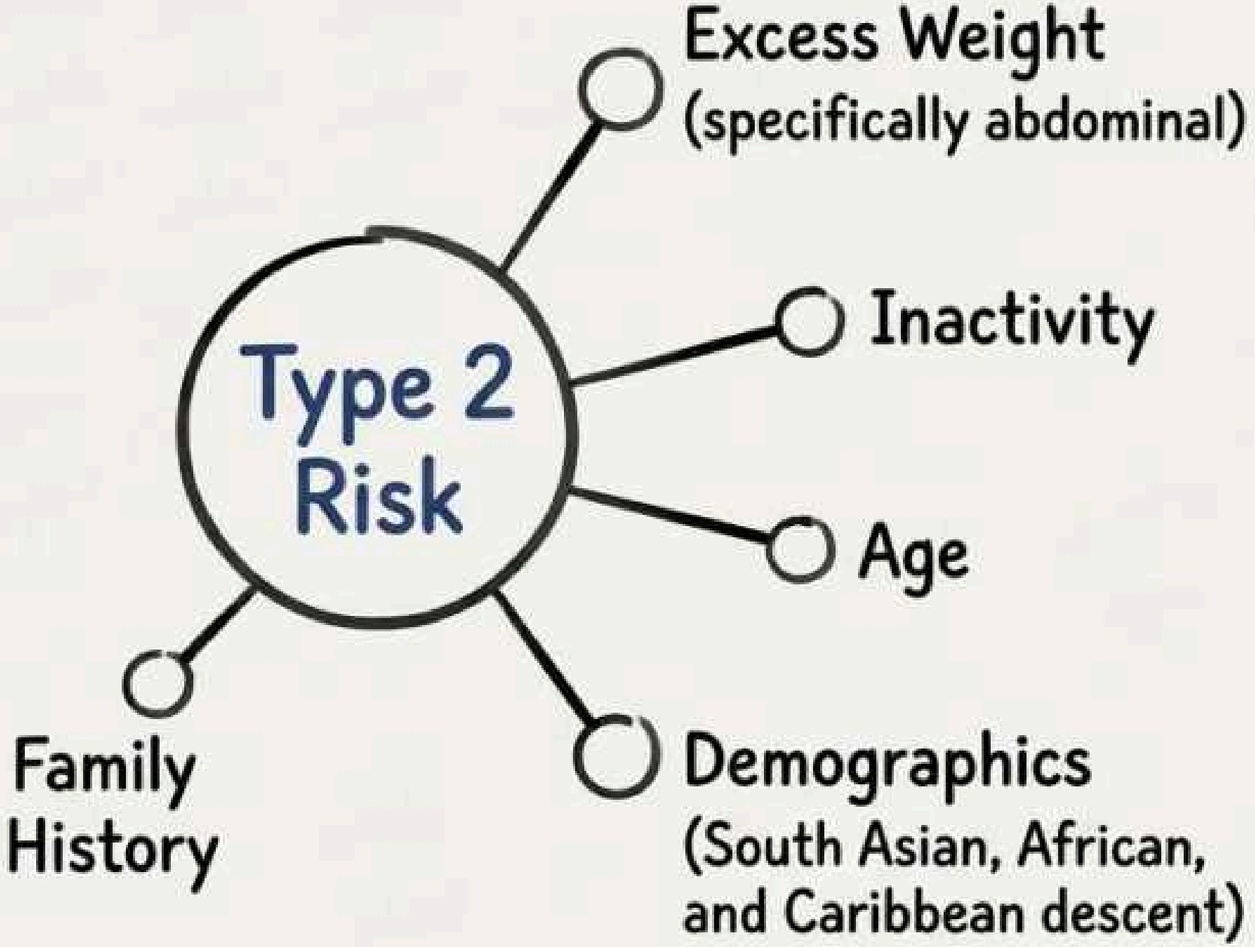
¶ 4.5



9 in 10 cases



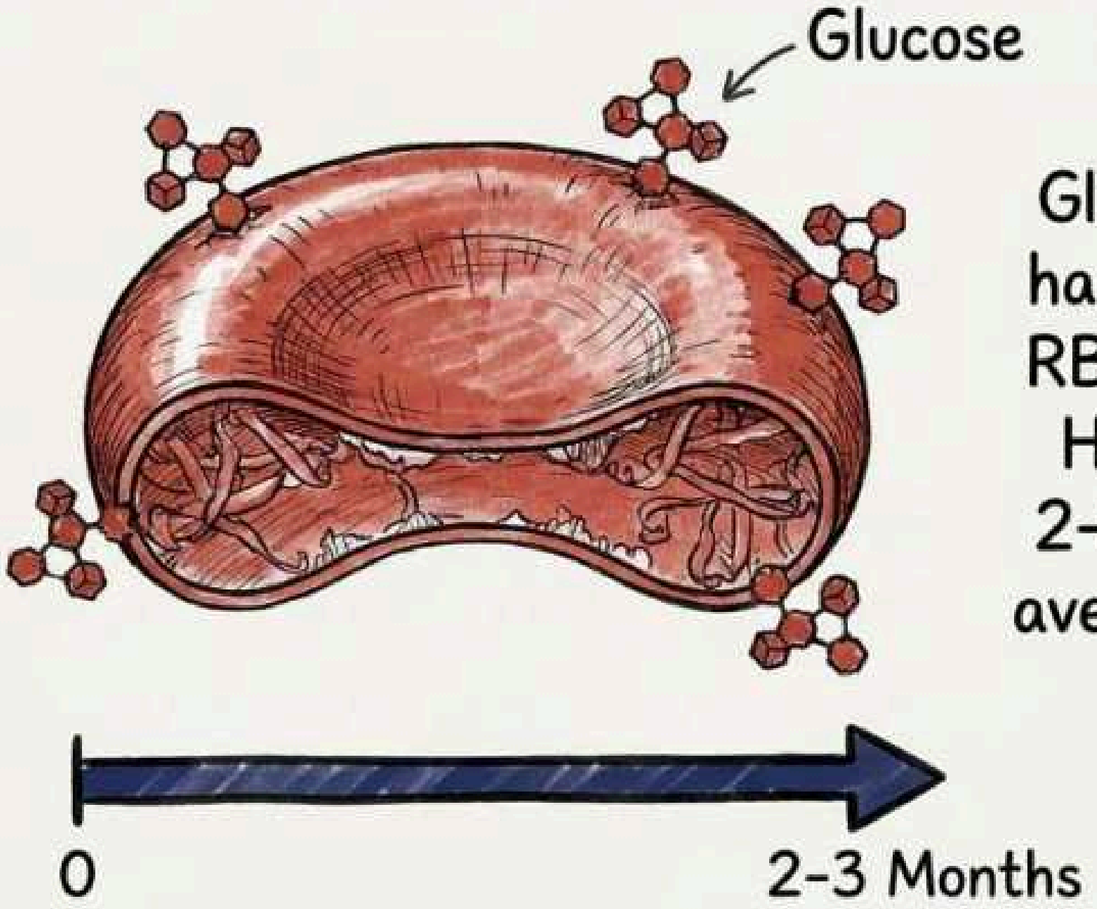
Tissue Insulin Resistance
+ Gradual Pancreatic Decline



Often develops silently over many years.

Diagnosis & The HbA1c Biomarker

Acute measures:
Fasting Blood Glucose or Post-Glucose Drink Test.



Glucose attaches to haemoglobin. Because RBCs live for months, HbA1c reflects the 2-3 month historical average of blood sugar.

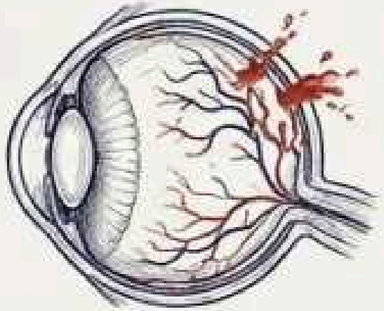
HbA1c is the primary measure used to judge how well diabetes is controlled.

The Systemic Toll on Blood Vessels

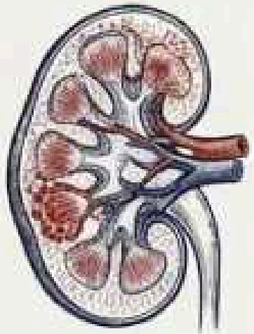
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Years of high blood sugar relentlessly damages both small and large vascular networks.

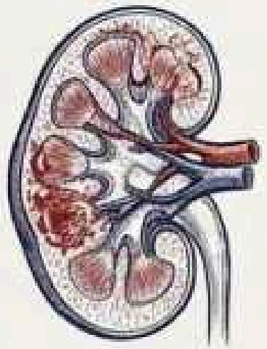
Microvascular / Small Vessels



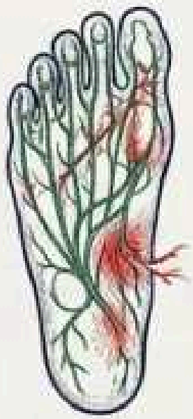
Diabetic Retinopathy - leading cause of working-age blindness



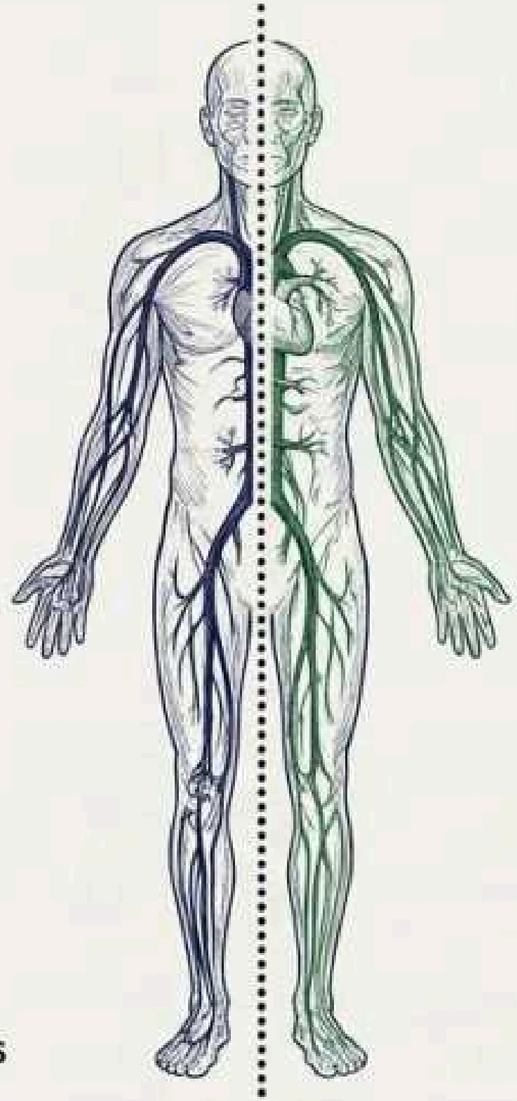
Nephropathy



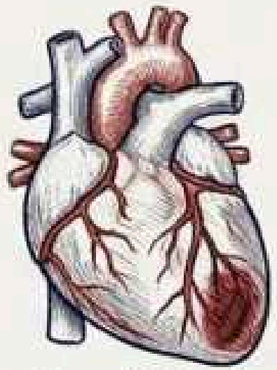
Nephropathy



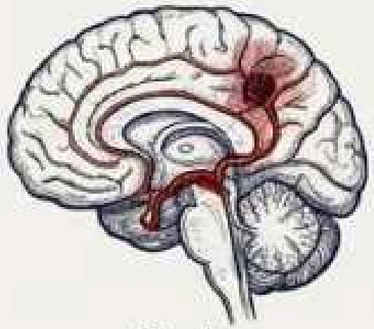
Neuropathy/Numbness



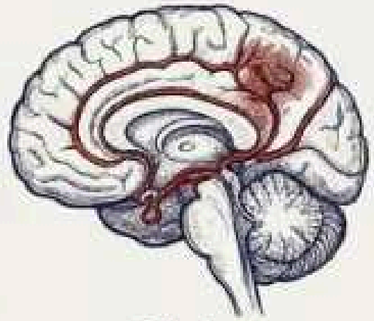
Macrovascular / Large Vessels



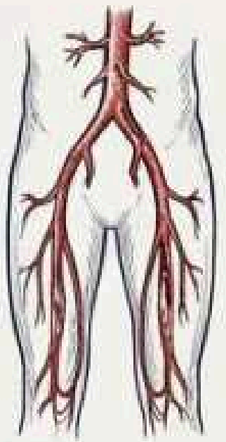
Heart Attack



Stroke



Stroke



Poor Circulation

Compounding Risk: The Diabetic Foot

Nerve Numbness + Poor Leg Circulation → Foot Ulcer → High Amputation Risk

Prevention Checkpoints



Foot Checks

Prevention Checkpoints



Eye Screening

Prevention Checkpoints



Kidney Tests

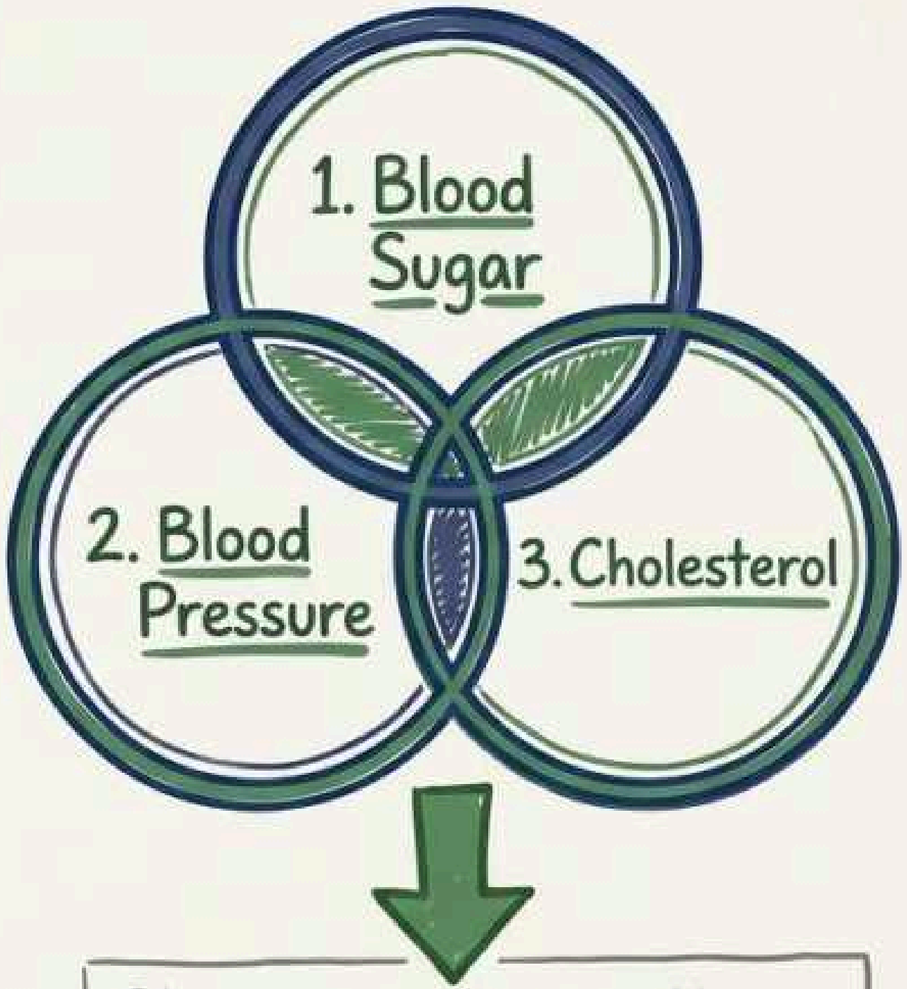
Diabetes is a leading cause of amputation. Regular screening catches problems early when treatment can prevent the worst outcomes.

The Evidence for Clinical Control

1993: DCCT Trial (Type 1)

1998: UKPDS Trial (Type 2)

Proof:
Strict blood sugar control significantly reduces complications.



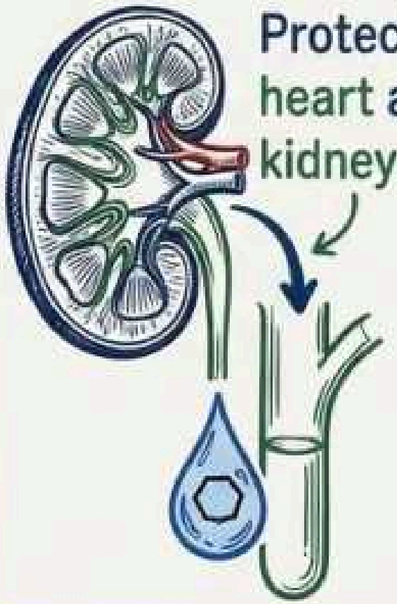
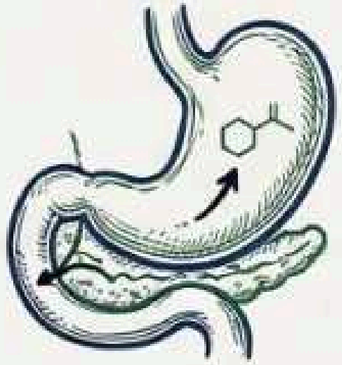
Stopping smoking matters just as much for preventing heart disease.

Type 2 Interventions: A Modern Pharmacological Staircase

Step 1
Diet, Physical Activity, and Weight Loss

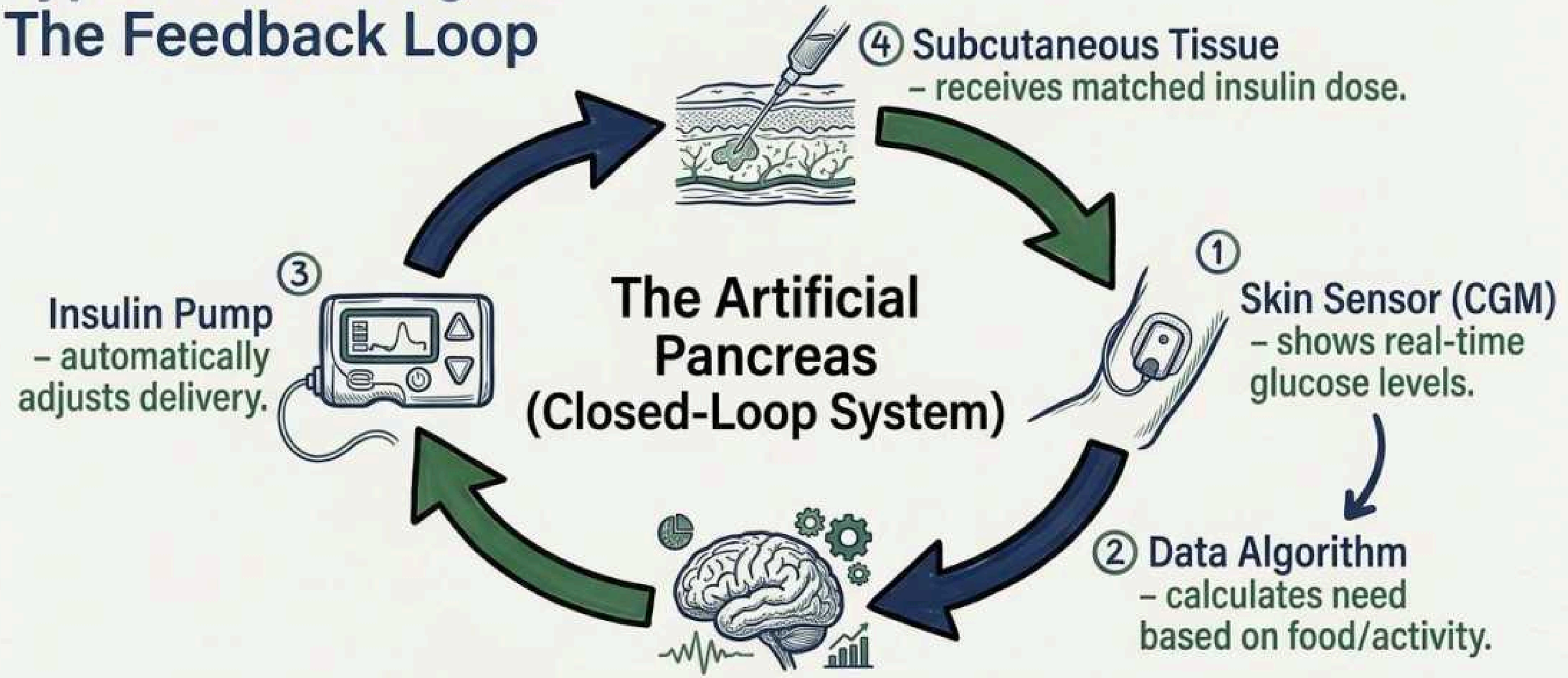
Step 2
Metformin
(The universal first-line drug)

Step 3

SGLT2 Inhibitors	GLP-1 Agonists
Protects heart and kidneys. 	 Mimics gut hormone, lowers glucose, causes substantial weight loss, reduces heart disease.

Step 4
Insulin
(Added when needed)

Type 1 Technologies: The Feedback Loop



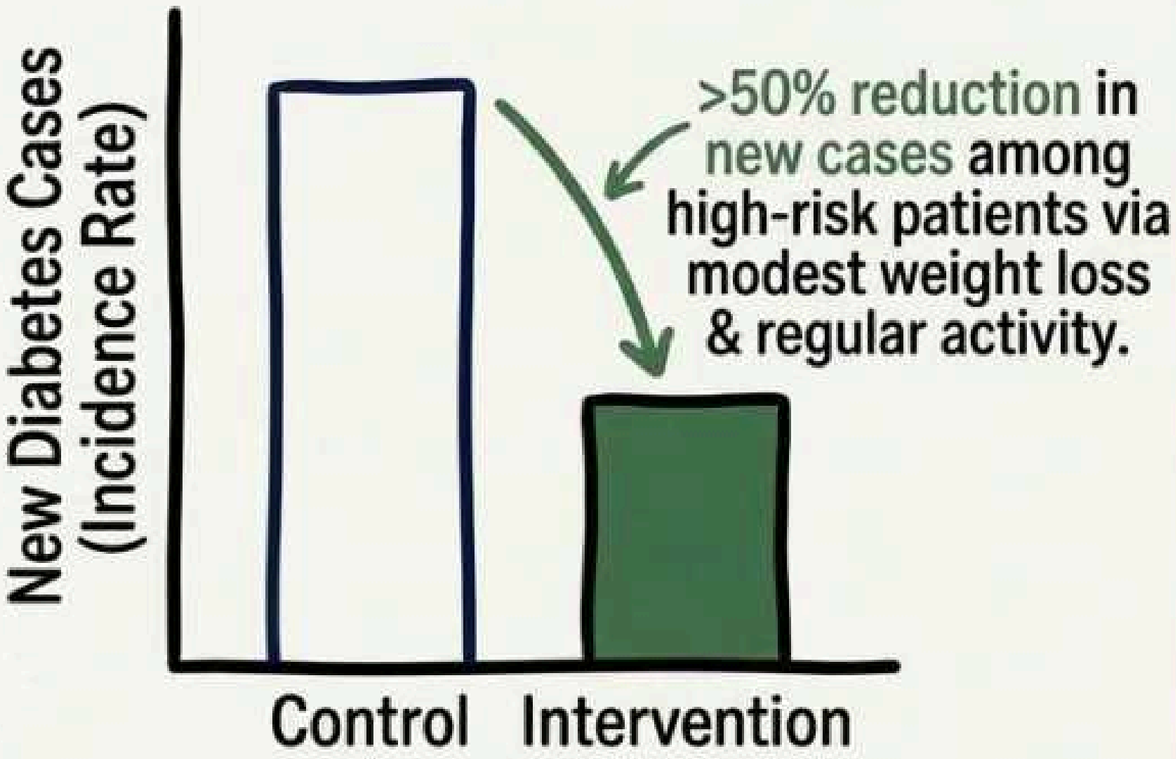
Traditional treatment relies on manual injections matching food/activity. Modern systems link continuous monitors directly to pumps for automatic adjustment.

Two Acute Diabetic Emergencies

	Hypoglycaemia	Diabetic Ketoacidosis (DKA)
Trigger	Too much insulin or certain tablets causing low blood sugar.	Lack of insulin causes body to break down fat into toxic toxic acids (Mainly Type 1).
Symptoms	Shaking, sweating, confusion, potential unconsciousness.	Vomiting, dehydration, rapid breathing.
Treatment	Fast-acting sugar (or Glucagon if unable to swallow).	Urgent hospital IV fluids and insulin.

Prevention, Delay, and Remission

Diabetes Prevention Program (2002)





For some with recent Type 2 diabetes, the condition is not inevitable—it can be delayed, prevented, or even put into remission.

Synthesis: The Unifying Logic of Diabetes



Next Lecture: Calcium & Bone →