Stanford HEALTH CARE

Understanding Lab Values and Adjunct Medication in Diabetes

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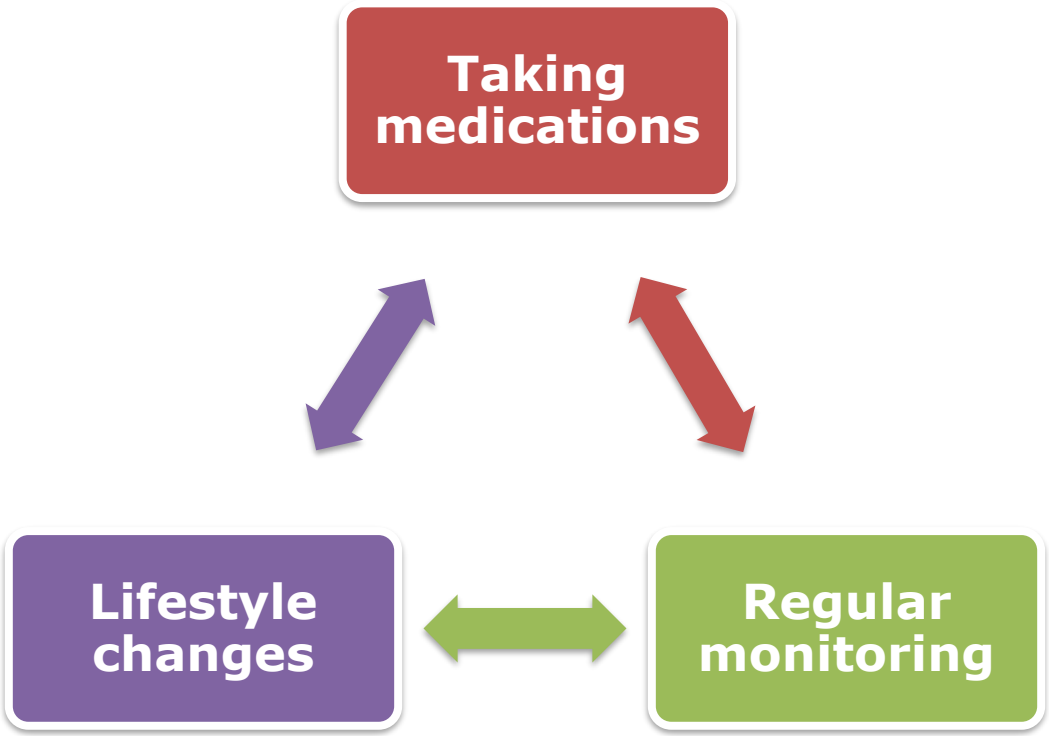
Objectives

- Recognize essential lab values in diabetes and understand their clinical relevance
- Interpret lab results using normal reference ranges
- Explore adjunctive medications and their role in reducing diabetes-related complications

Definition of Diabetes

- **Diabetes**: A condition where blood sugar (glucose) levels are too high due to problems with how the body uses or produces insulin
- Managing diabetes involves multiple strategies, including **medications**, **lifestyle changes**, and **regular monitoring**.

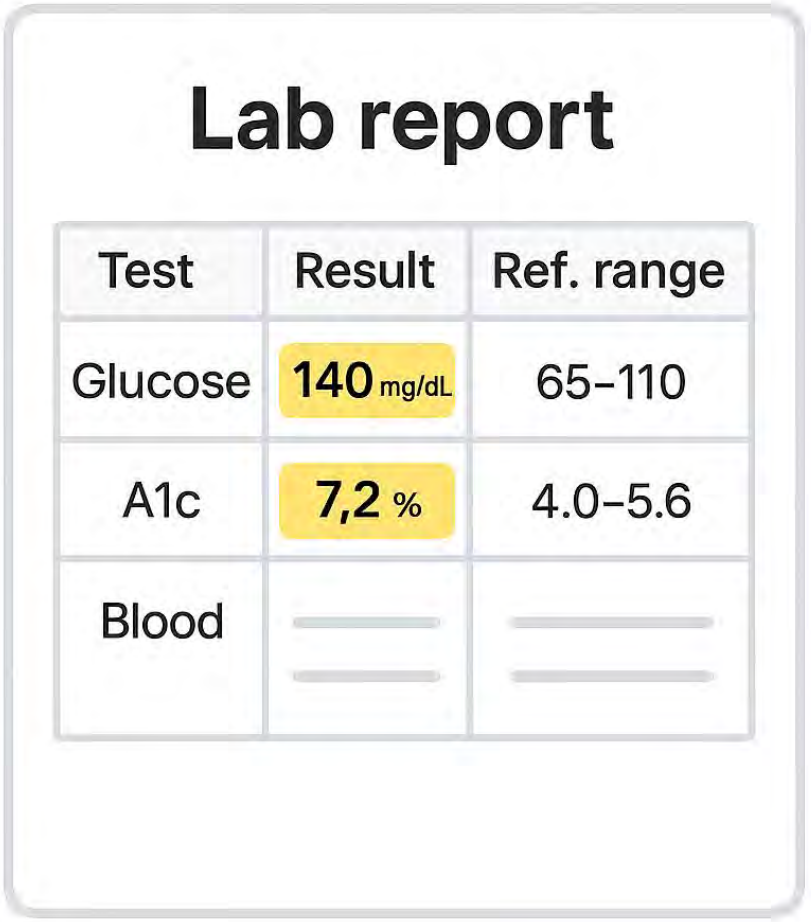


Why are Medications Needed

- Medications can't cure diabetes, but they can delay or prevent health complications by helping keep blood sugars controlled
- Diabetes increases the risk for other health conditions, such as heart or kidney related problems, so additional medications are often needed to prevent those problems

LAB VALUES

Why Lab Values Matter



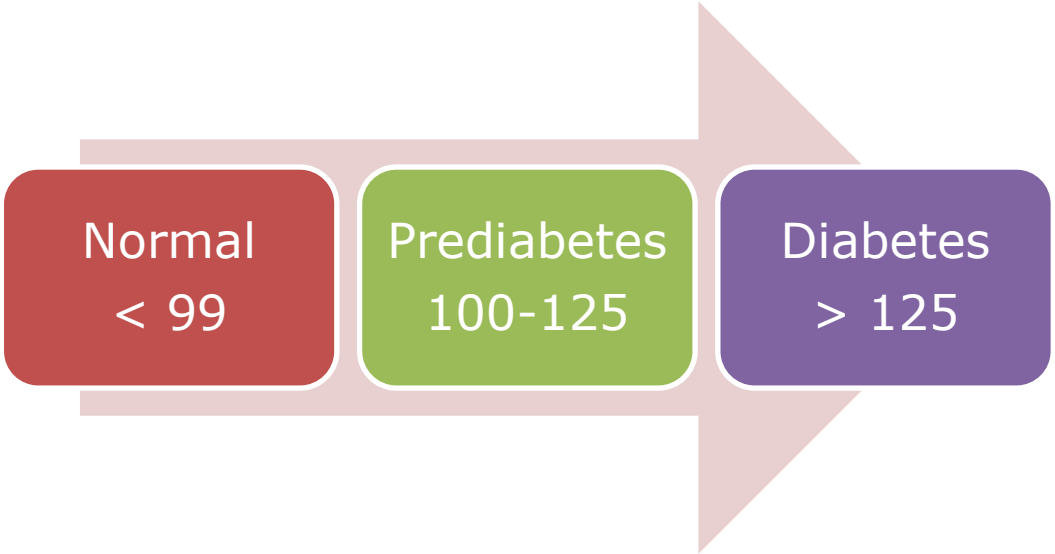
- Guide diagnosis and monitoring
- Assess treatment effectiveness
- Identify complications
- Empower patient understanding

Lab Values Needed in Diabetes Management

- Fasting plasma glucose (FPG)
- Post-prandial blood glucose (PPBG)
- Hemoglobin A1c
- Fructosamine
- Urine albumin/creatinine
- Lipids

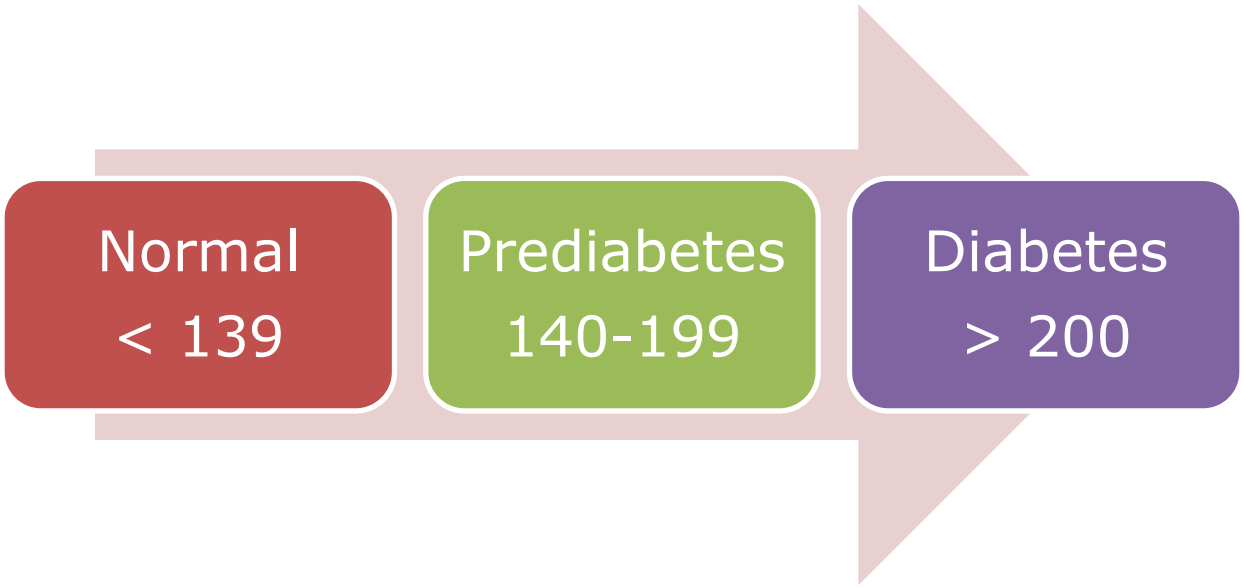
Fasting Plasma Glucose (FPG)

- Measures blood glucose when fasting
- Can be measured using a glucometer at home or through a blood test at the lab
- Helps with diagnosing and monitoring blood glucose
- Typically monitored daily at home or every 3–6 months in the clinic, depending on treatment goals and stability
- **Goal:** 80 – 130 mg/dL



Post-prandinal Blood Glucose (PPBG)

- Measures blood glucose after eating
- Can be measured using a glucometer at home or through a blood test at the lab
- Helps with assessing eating habits and blood sugar response to meals
- Typically monitored 1–2 hours after meals
- **Goal:** less than 180 mg/dL



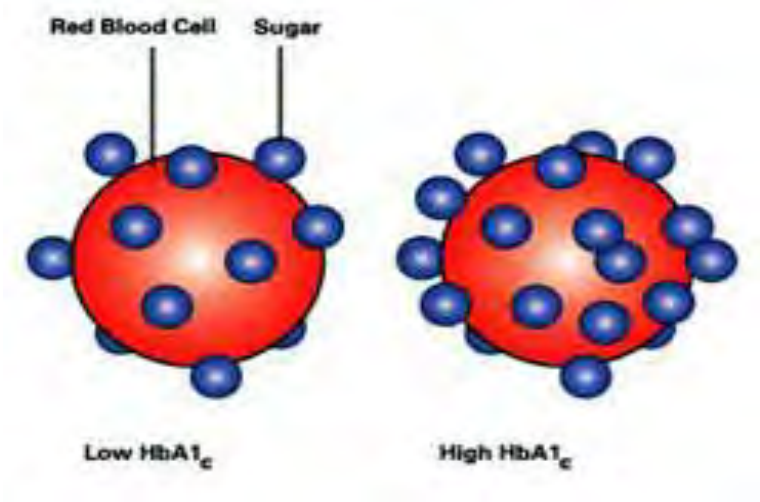
What Are The Targets (Glucometer)

- *American Diabetes Association targets:*

Before a meal “preprandial glucose”	1-2 hours after the start of a meal “postprandial glucose”	Ideal blood glucose rise 1.5 - 2 hours after a meal
80-130 mg/dl	**Under 180 mg/dl**	**30-50 mg/dl**

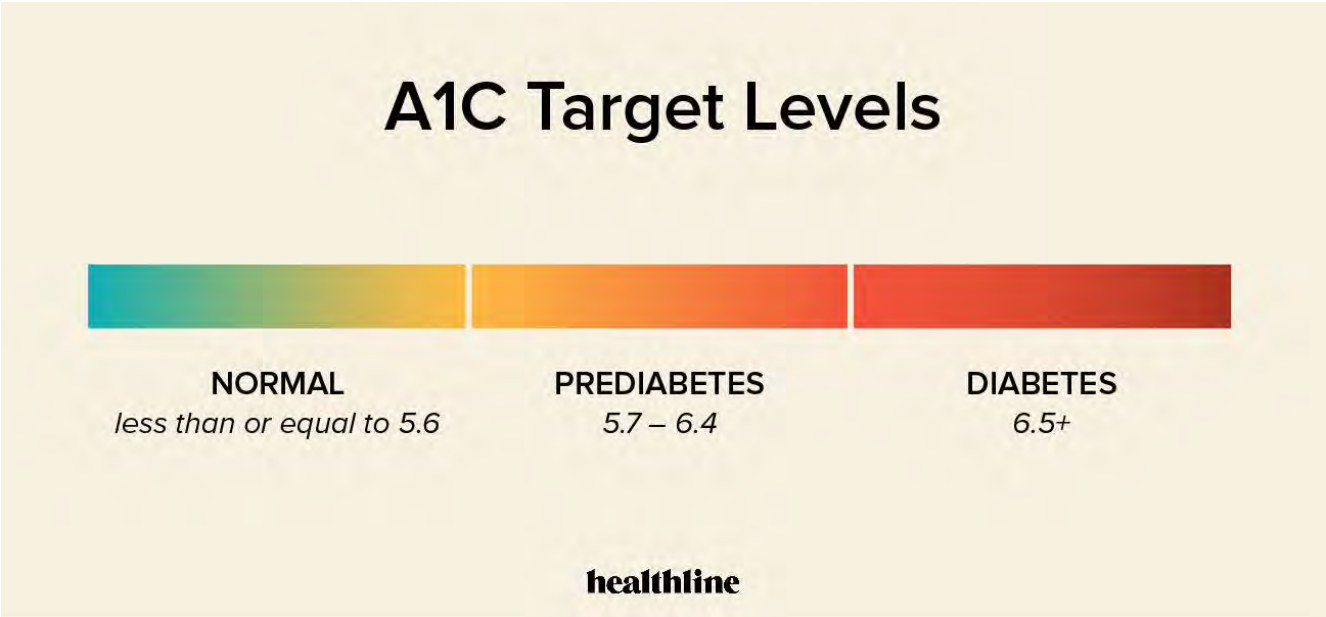
Understanding the Numbers: A1c Test (Glycated Hemoglobin)

- Measures the percentage of blood sugar attached to hemoglobin, the oxygen-carrying protein, in red blood cells
- Measures the percentage of glycated hemoglobin over the past 3 months
- The more “sugar coated” your red blood cells → greater the A1c value



Hemoglobin A1c

- Indicates long-term glucose control
- Typically monitored every 3–6 months depending on diabetes control
- **Goal:** less than 7%



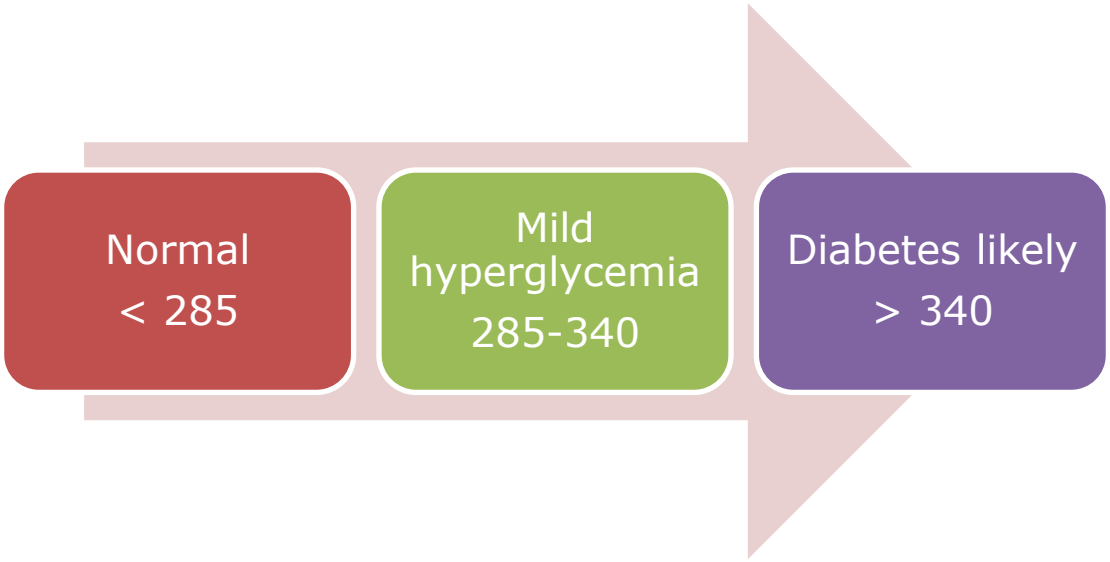
A1c to Estimated Average Blood Glucose

Recommended A1C: < 7%
(A1C may also be reported as eAG: **154 mg/dl)**

A1C	Estimated Average Glucose (eAG)
12%	298 mg/dL
11.5%	283 mg/dL
11%	269 mg/dL
10.5%	255 mg/dL
10%	240 mg/dL
9.5%	226 mg/dL
9%	212 mg/dL
8.5%	197 mg/dL
8%	183 mg/dL
7.5%	169 mg/dL
7%	154 mg/dL
6.5%	140 mg/dL
6%	126 mg/dL
5.5%	111 mg/dL
5%	97 mg/dL

Fructosamine

- Measures average blood glucose over the past 2–3 weeks
- Reflects glucose attached to serum albumin
  - Albumin is the most abundant protein in the blood and acts as the binding site for glucose in this test
- Useful for short-term monitoring or when A1c is unreliable (e.g., anemia)
- **Goal**: less than 285

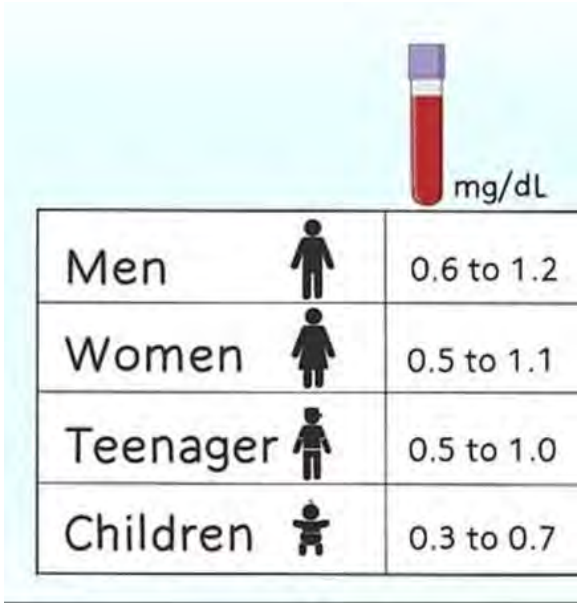


Frucotsamine to A1c Conversion

Glucose (mg/dl)	A1c (%)	Fructosamine (µmol)
90	5	212.5
120	6	250
150	7	287.5
180	8	325
210	9	362.5
240	10	400
270	11	437.5
300	12	475
330	13	512.5
360	14	550
390	15	587.5

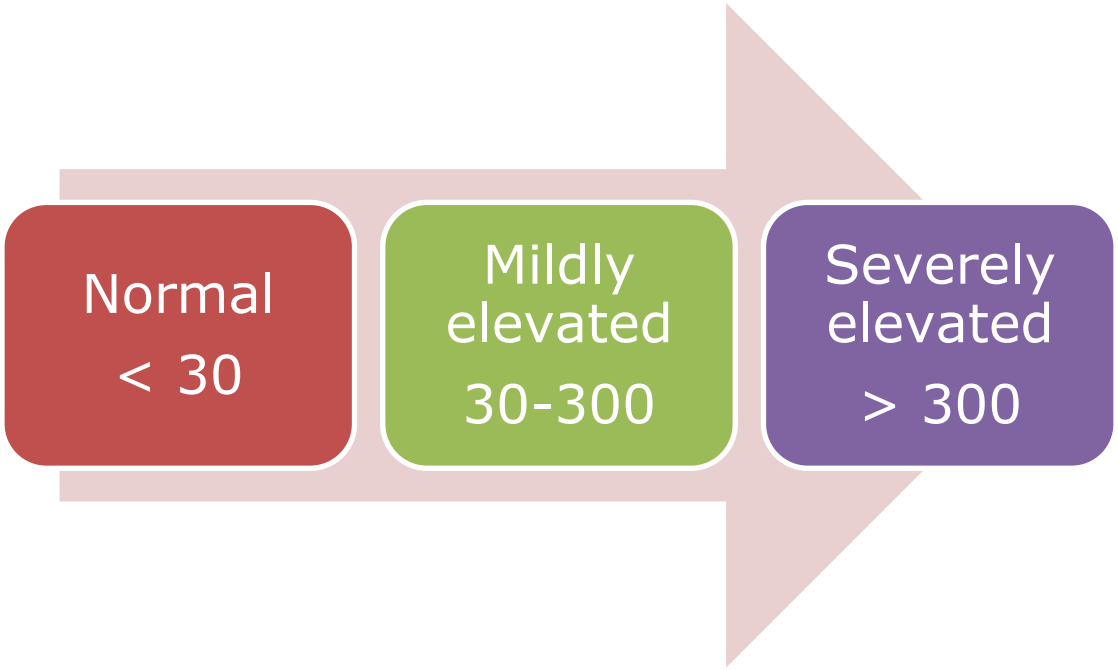
Serum Creatinine

- **Creatinine is a waste product** from muscle breakdown, normally removed from the body by the kidneys
- Serum creatinine:
  - A blood test that measures the amount of creatinine in the bloodstream
  - Reflects how well the kidneys are filtering waste
  - Higher levels may indicate reduced kidney function
  - Used to calculate **eGFR** (estimated glomerular filtration rate)

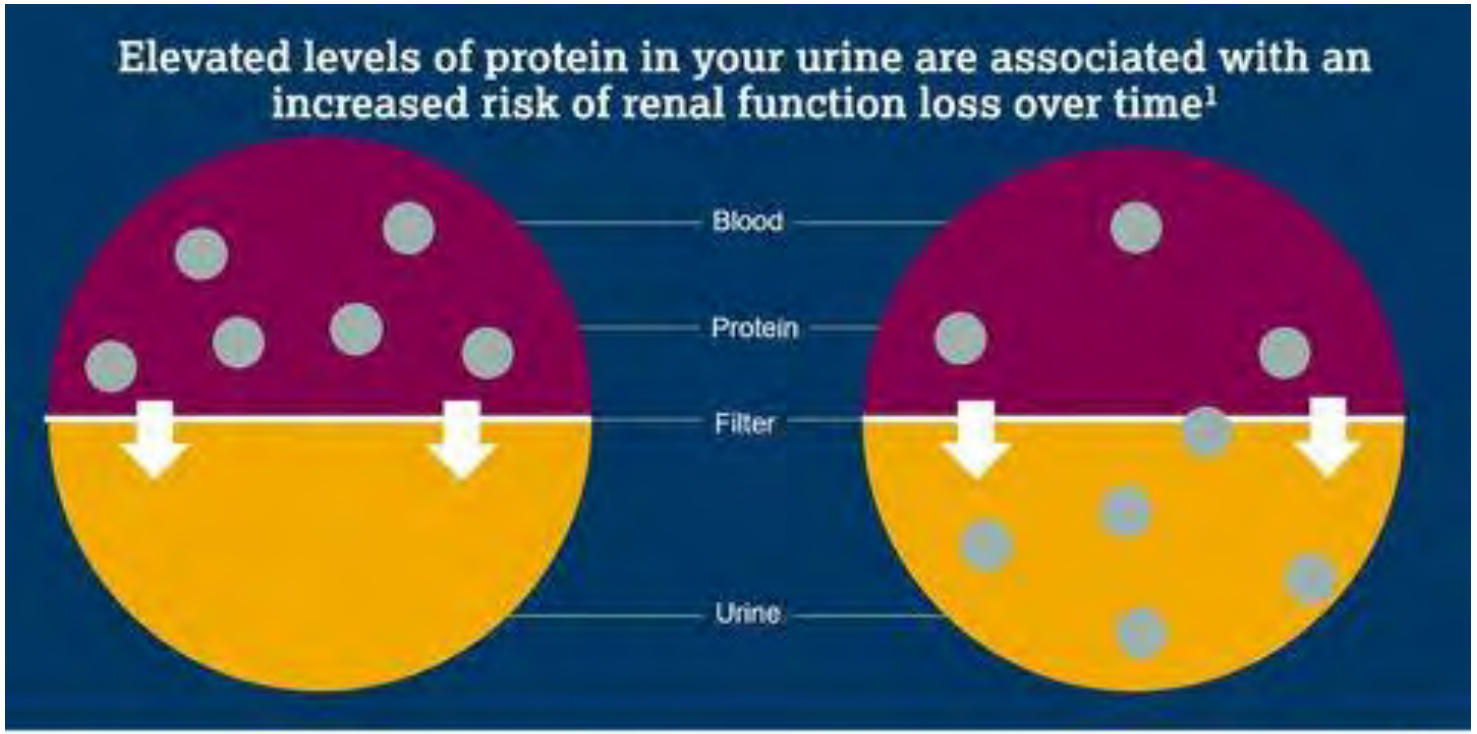


Urine Albumin / Creatinine

- Measures the amount of albumin (a type of protein) in your urine compared to creatinine
- Detects early kidney damage due to diabetes or high blood pressure
- **Goal**: Urine albumin-to-creatinine ratio (UACR) < 30 mg/g



Proteinuria



T. Lambers Heerspink, HJ, et al. Clin J Am Soc Nephr. 2015;10(6):1079-1088.

AstraZeneca

Lipid Panel

- Lipids are fats and fat-like substances that are essential for building cells, storing energy, and making hormones. In the blood, they include cholesterol and triglycerides

- **Key components measured in a lipid panel:**
  - **LDL-C ("bad" cholesterol):** Contributes to plaque buildup in arteries
  - **HDL-C ("good" cholesterol):** Helps remove LDL from bloodstream
  - **Triglycerides (TG):** Type of fat used for energy; elevated levels can increase cardiovascular and pancreatitis risk
  - **Total Cholesterol (TC):** Overall measure of cholesterol in blood

- **Why we check them:**
  - To assess cardiovascular risk
  - To monitor response to lipid-lowering therapy (e.g., statins)

People with type 2 diabetes are at risk of ASCVD similar to those with existing ASCVD. Therefore, lipid management is vital to reduce their risk.

Lipid Goals

Lipid Component	Desirable Range
LDL-C	< 100 mg/dL < 70 if diabetes < 55 if prior heart attack, stroke, other cardiovascular events
HDL-C	> 40 mg/dL (men), > 50 mg/dL (women)
Triglycerides	< 150 mg/dL
Total Cholesterol	< 200 mg/dL

Lab Values

Lab	Target	Frequency
A1c	<7% (individualized)	Every 3-6 months
Fasting BG	80–130 mg/dL	Daily
uACR	<30 mg/g	Yearly
Lipid Panel	LDL < 70 mg/dL	Yearly

Note: Target values may be individualized

ADJUNCTIVE MEDICATIONS

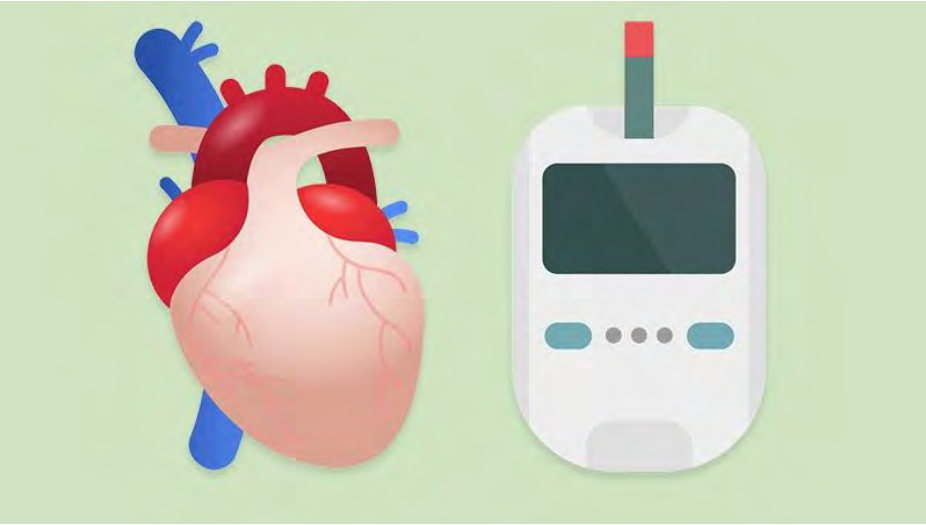
Choosing the Right Antidiabetic Medication

Benefit	Medication Class	Medications
Cardiovascular protection 	• GLP-1 receptor agonists • SGLT-2 inhibitors	• Injectable semaglutide, dulaglutide, liraglutide • Canagliflozin, empagliflozin
Kidney protection 	• SGLT-2 inhibitors • GLP-1 receptor agonists	• Canagliflozin, empagliflozin, dapagliflozin • Injectable semaglutide, dulaglutide, liraglutide
Heart failure 	• SGLT-2 inhibitors	• Canagliflozin, empagliflozin, dapagliflozin, ertugliflozin
Weight loss 	• GLP-1 and dual GLP-1/GIP receptor agonists • SGLT-2 inhibitors	• All agents in these medication classes
Cost-effective 	• Metformin • Insulin secretagogues • Pioglitazone	• Metformin • Glipizide, glyburide, glimepiride, repaglinide, nateglinide • Pioglitazone
Glucose-lowering efficacy 	• Metformin • Insulin • GLP-1 receptor agonists	• All agents in these medication classes

Why more medications are needed?

ASCVD and Diabetes

- Atherosclerotic cardiovascular disease (ASCVD) refers to a history of cardiovascular event, such as heart attack, stroke, and angina.
- ASCVD is the leading cause of morbidity and mortality in people with diabetes.
- Diabetes is a risk factor of a major cardiovascular event
- Other risk factors of ASCVD are high blood pressure, high cholesterol, and obesity



Lowering ASCVD Risk

- Controlling diabetes, blood pressure, and cholesterol is key to lowering your risk of heart attacks and strokes

Adjunct Medications Needed in Diabetes Management

- ACEIs/ARBs
- Statins
- Finerenone

ACEIs/ARBs

ACE Inhibitors

- **Lisinopril** *(Zestril, Prinivil)*
- **Ramipril** *(Altace)*
- **Enalapril** *(Vasotec)*
- **Benazepril** *(Lotensin)*
- **Quinapril** *(Accupril)*

ARBs

- **Losartan** *(Cozaar)*
- **Valsartan** *(Diovan)*
- **Olmesartan** (*Benicare*)
- **Irbesartan** *(Avapro)*

ACEIs/ ARBs

🔍 How does it work?

ACE inhibitors block the enzyme that forms angiotensin II

ARBs block angiotensin II from binding to its receptor

Both actions relax blood vessels and lower blood pressure

ACEIs/ ARBs

💊 How to take it?

Take once or twice daily

With or without food

Try to take it around the same time every day

ACEIs/ ARBs

⚠ Side effects

Dry cough (ACE)

Dizziness

High potassium levels

Rare: swelling of the lips

ACEIs/ ARBs

Why to take it?

Lowers blood pressure

Protect kidneys

Prevent or treat heart failure

Reduce the risk of heart attacks and strokes

Cholesterol-Lowering Medications

Statins

- **Atorvastatin** (*Lipitor*)
- **Rosuvastatin** *(Crestor)*
- **Simvastatin** *(Zocor)*
- **Pravastatin** *(Pravachol)*
- **Lovastatin** *(Mevacor)*
- **Fluvastatin** *(Lescol)*
- **Pitavastatin** *(Livalo)*

Non-statins

- **Ezetimibe** *(Zetia)*
- **PCKS9 Inhibitors**
  - **Alirocumab** *(Praluent)*
  - **Evolocumab** *(Repatha)*

Cholesterol-Lowering Medications

🔍 How does it work?

Statins: block cholesterol production in the liver

Ezetimibe: blocks cholesterol absorption in the gut

PCSK9 inhibitors: help the liver remove more LDL from the blood

Cholesterol-Lowering Medications

💊 How to take it?

Statins and ezetimibe: taken once daily, usually by mouth

PCSK9 inhibitors: injection under the skin every 2–4 weeks

Cholesterol-Lowering Medications

⚠️ Side effects

Statins: muscle pain, liver changes, rare muscle injury

Ezetimibe: stomach upset, rare liver enzyme changes

PCSK9 inhibitors: injection site reaction, cold-like symptoms

Cholesterol-Lowering Medications

Why to take it?

Lower LDL (bad) cholesterol

Reduce risk of heart attack, stroke, and heart disease

Finerenone

🔍 How does it work?

Finerenone blocks a hormone called aldosterone, which can cause scarring and inflammation in the kidneys and heart

By blocking this hormone, it helps protect the kidneys and heart from damage

Finerenone

💊 How to take it?

Taken once daily by mouth

Dose may be adjusted based on potassium levels and kidney function (eGFR)

Finerenone

⚠ Side effects

High potassium (hyperkalemia)

Low blood pressure (hypotension)

Dizziness, especially when starting treatment

Finerenone

Why to take it?

Slows progression of chronic kidney disease (CKD) in people with type 2 diabetes

Lowers risk of kidney failure, heart attack, and hospitalization for heart failure

Why It All Matters?

- Lab values play a key role in assessing diabetes control and helping prevent serious complications
- Knowing what your medications do and why they're prescribed is key to preventing long-term complications of diabetes

THANK YOU FOR LISTENING!

QUESTIONS?