How sweet it is: Modern treatment approaches for type II diabetes

ANGELA L. GOODHART, PHARMD, BCACP
ASSISTANT PROFESSOR OF CLINICAL PHARMACY AND FAMILY MEDICINE
WEST VIRGINIA UNIVERSITY
ANGELA.GOODHART@HSC.WVU.EDU

DISCLOSURES

I have nothing to disclose concerning possible financial relationships with ineligible companies that may have a direct or indirect interest in the subject matter of this presentation.

LEARNING OBJECTIVES

Review the pharmacokinetics, efficacy, and safety considerations of diabetes medications, including glucagon-like peptide-1 (GLP-1) receptor agonists and sodium glucose cotransporter 2 (SGLT2) inhibitors.

Explain the fundamental concepts of continuous glucose monitor (CGM) technology and interpretation of data.

Assess the evidence supporting CGM use in diabetes.

Discuss the role of pharmacists providing diabetes care within a multidisciplinary team.

THE EVOLUTION OF DIABETES PHARMACOTHERAPY

Safety	• Concern for adverse events • Required CV trials
Cardiovascular Benefits	• Major Adverse Cardiovascular Events (MACE) • Heart Failure
Renal Benefits	• Chronic Kidney Disease (CKD)
Weight Benefits	• Obesity • Overweight
Liver Benefits	• Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD) • Metabolic Dysfunction-Associated Steatohepatitis (MASH)

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

WHAT WE WILL NOT COVER TODAY:

Insulin	Sulfonylureas
Thiazolidinediones (TZDs)	Dipeptidyl peptidase-4 inhibitors (DDP-4 inhibitors)

Biguanide

metformin

METFORMIN

- Mechanism: decreases hepatic glucose production, improves insulin sensitivity, thought to provide appetite regulation

- FDA indications: diabetes type 2

- Off label: prevention of diabetes type 2; gestational diabetes; polycystic ovarian syndrome, antipsychotic induced weight gain

Lexicomp. Metformin. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

METFORMIN ADVERSE EFFECTS

- Common side effects:
  - GI: nausea, vomiting, diarrhea, flatulence

- Severe side effects (SAE):
  - Lactic acidosis
  - Vitamin B12 deficiency (monitor every 2-3 years)

Lexicomp. Metformin. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

METFORMIN DOSING CONSIDERATIONS

Starting dose 500 mg daily; increase by **500 mg** per day every week as tolerated
Maximum**: 2000-2500** mg **total** daily **dose**
Extended release better tolerated → improved adherence
Counsel to take with food to minimize side effects
Avoid extended release if history of bariatric surgery; immediate release tablets can be cut/crushed

Lexicomp. Metformin. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

ADDITIONAL CLINICAL CONSIDERATIONS: METFORMIN

Contraindications:

- GFR < 30 ml/min (can use if GFR 30-44 ml/min if already taking but requires 50% dose reduction)
- Metabolic acidosis including lactic acidosis and diabetic ketoacidosis and associated risk factors (excessive alcohol intake)
- Severe liver disease or heart disease (caution)

Safe in pregnancy

$ cheap

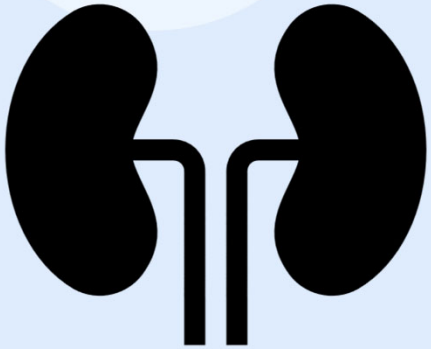
Lexicomp. Metformin. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

Sodium glucose cotransporter –2 inhibitors (SGLT2 inhibitors)

bexagliflozin, canagliflozin, dapagliflozin, empagliflozin, ertugliflozin, sotagliflozin

SGLT-2 INHIBITORS

- Agents: bexagliflozin, canagliflozin, dapagliflozin, empagliflozin, ertugliflozin, sotagliflozin
- Mechanism: decreases reabsorption of glucose in the proximal tubules by inhibiting sodium-glucose cotransporter 2 → increased glucose excretion
- FDA indications: Diabetes type 2, chronic kidney disease, heart failure



Lexicomp. Empagliflozin. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

ADVERSE EFFECTS

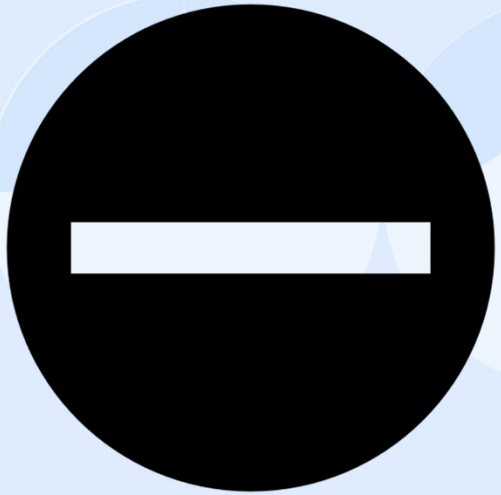
- Commons side effects:
  - Minimal

- Serious side effects:
  - Infections (urinary tract and genitourinary fungal)
  - Acute kidney injury
  - Hypotension/volume depletion
  - Ketoacidosis
  - Amputations?

Lexicomp. Empagliflozin. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

AMPUTATION RISK

- Initial BBW with canagliflozin (2017)
  - Specifically toe, foot, and lower leg
- Conflicting data, specific to canagliflozin
  - CANVAS/CANVAS-R → increased risk
  - CREDENCE → no difference
- BBW removed in 2020
  - “risk of amputation…is lower than previously described, particularly when appropriately monitored” (8-26-2020 FDA Drug Safety Communication)



Lexicomp. Canagliflozin. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

SGLT-2 INHIBITORS – RENAL DOSING

Do not initiate in dialysis or with GFR less than:	20 ml/min (empagliflozin)
	25 ml/min (dapagliflozin)
	30 ml/min (bexagliflozin, canagliflozin)
	45 ml/min (ertugliflozin)

Drugs **79**, 219–230 (2019). https://doi.org/10.1007/s40265-019-1057-0

CLINICAL CONSIDERATIONS FOR SGLT-2 INHIBITORS

Contraindications:

- DM type 1
- Any history of ketoacidosis
- Pregnancy

Euglycemia

- Must be able to maintain adequate PO intake

Weight loss

- Variable, average 1-3 kg

$$$ brand only, expensive

Lexicomp. Canagliflozin. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

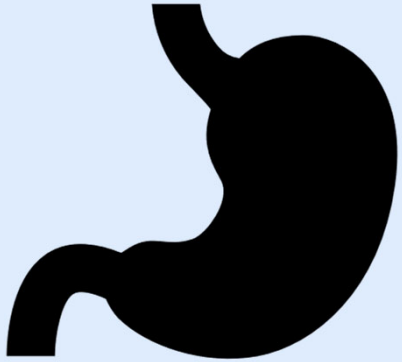
Glucagon-like peptide-1 agonists (GLP-1 agonists)

dulaglutide, liraglutide, semaglutide

GLP-1 AGONISTS

- Mechanism: GLP-1 is an incretin hormone → glucose dependent insulin secretion, decreases inappropriate glucagon secretion, increases B-cell growth, slows gastric emptying, decreases food intake, improves insulin sensitivity

- FDA indications: Diabetes type 2, weight management – chronic



Lexicomp. Liraglutide. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

ADVERSE EFFECTS

Common side effects

- GI: diarrhea, nausea, vomiting, constipation, abdominal pain

Severe side effects

- Renal: AKI (through dehydration)
- GI: pancreatitis, cholelithiasis, cholecystitis

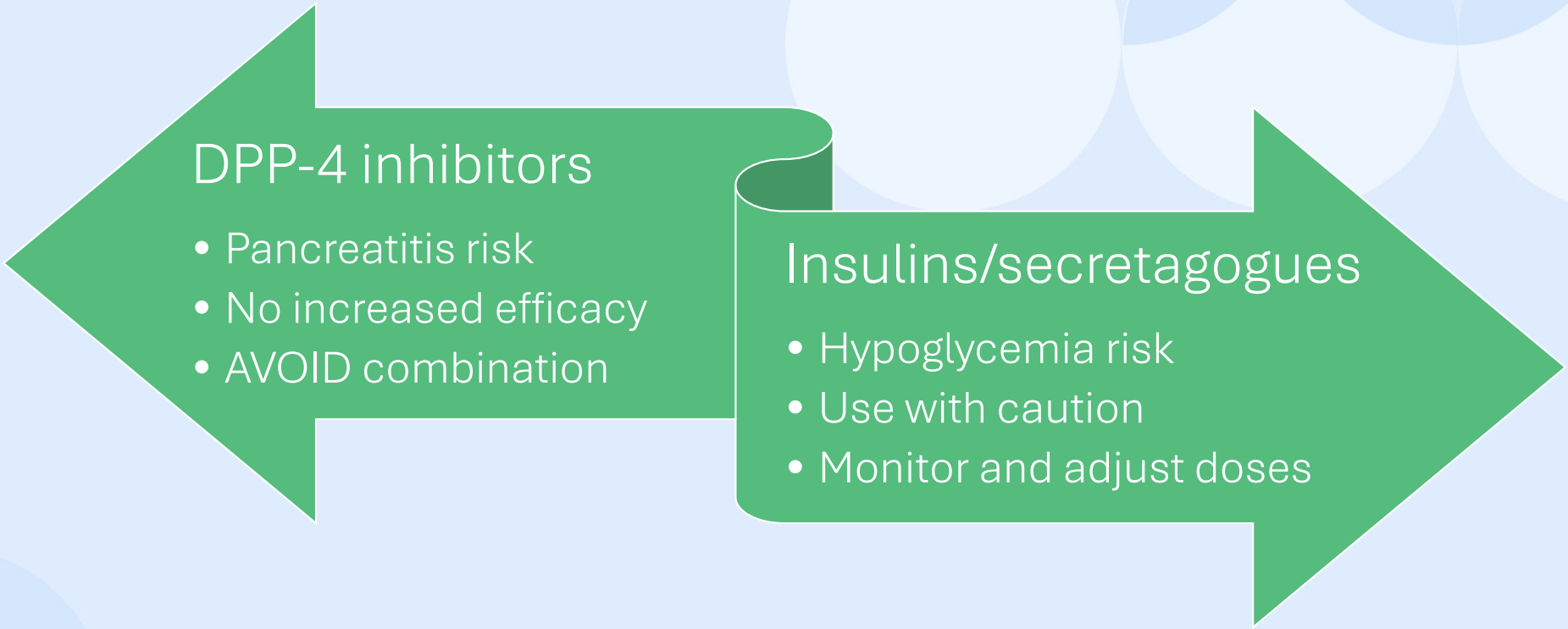
Contraindications

- Personal or family history of medullary thyroid cancer or MEN2 syndrome (due to association in rodents)
- Pregnancy
- Pancreatitis (caution)

MEN2-multiple endocrine neoplasia 2

Lexicomp. Liraglutide. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

GLP-1 AGONISTS: DRUG INTERACTIONS



Lexicomp. Liraglutide. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

Liraglutide (Victoza®, Saxenda®)

2010, 2014

LIRAGLUTIDE AND CARDIOVASCULAR OUTCOMES IN TYPE 2 DIABETES (LEADER)

- **Study Design:** Multicenter, double-blind, randomized, placebo-controlled trial
- **Participants:** 9,340 adults with type 2 diabetes and established cardiovascular disease or high cardiovascular risk
- **Duration:** Median follow-up 3.8 years
- **Intervention:** Liraglutide (up to 1.8 mg daily) vs. placebo
- **Primary Endpoint:** Composite major adverse cardiovascular events (MACE):
  - Cardiovascular death
  - Nonfatal myocardial infarction (MI)
  - Nonfatal stroke
- **Key Findings:**
  - Significant reduction in MACE (HR: 0.87, 95% CI: 0.78–0.97, p=0.01)
  - Lower cardiovascular mortality (HR: 0.78, p=0.007)
  - No increased risk of severe hypoglycemia or pancreatic adverse events

The New England Journal of Medicine, 375(4), 311–322.
https://doi.org/10.1056/NEJMoa1603827

Liraglutide Literature – Weight Loss

- Trials included: 11 RCTs, n=3964 in treatment groups
- Mean age: 43-59 years
- Predominantly female
- Lifestyle: calorie deficit with variable restrictions

Mean Starting Weight	Mean Starting BMI	Mean Starting Waist Circumference	Comorbidities Included	Follow Up Duration
100-105 kg	> 30 kg/m^2	-	DM type 2 in 3 studies, 1 allowed insulin	52 weeks

Gastroenterology. 2022;163(5):1198-1225.

Liraglutide Outcomes – Weight Loss

% TBWL*	Weight loss*	Percent achieving 5% TBWL*	Percent achieving 10% TBWL*	Percent achieving 15% TBWL*
4.81%	5.3 kg	28.9%	17.3%	9.2%

*Reported as mean difference compared to placebo group

SCALE insulin RCT – majority of patients no longer using insulin at end of the trial

Gastroenterology. 2022;163(5):1198-1225.

LIRAGLUTIDE SAFETY

Discontinuation significantly higher in liraglutide groups (9.1%)

- Reasons: GI adverse effects
- No difference in severe adverse events

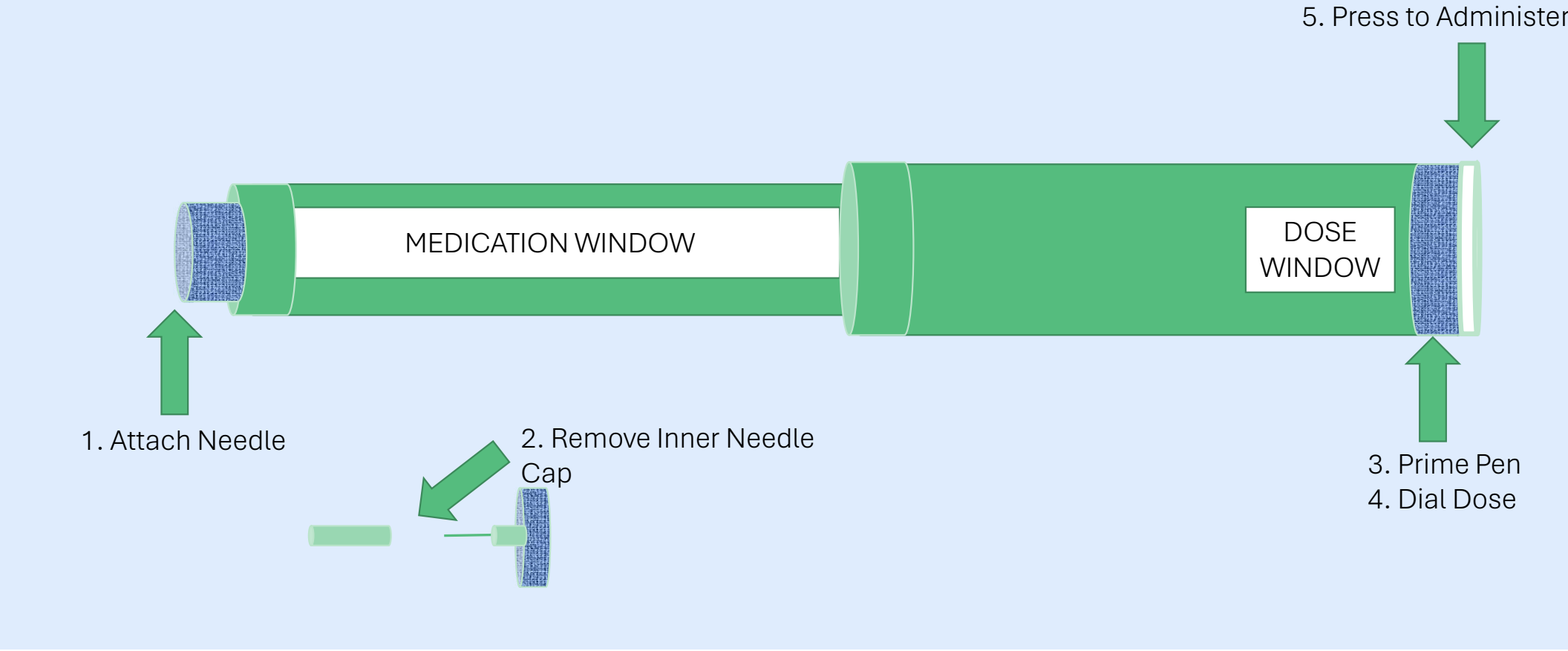
Nausea and vomiting more common in liraglutide group

- Nausea 40%
- Vomiting 16%

Acute pancreatitis < 0.1%

Gastroenterology. 2022;163(5):1198-1225.

Liraglutide Injection



Clinical considerations for liraglutide

- Available as 2 brand names (and now generic)
- Similar injection technique but different max doses
- Dial up pen with ability to self-titrate dose
- Need Rx for pen needles!!

Semaglutide (Ozempic®, Wegovy®)

2017, 2021

Semaglutide Literature – Weight Loss

- Trials included: 8 RCTs, n=2658 in treatment groups
- Mean age: 46-59.5 years
- Predominantly female
- Lifestyle: most included 500 kcal/d deficit

Mean Starting Weight	Mean Starting BMI	Mean Starting Waist Circumference	Comorbidities Included	Follow Up Duration
86.9-113.2 kg	32-39.9kg/m^2	103.8-119 cm	4 excluded DM, 3 mixed, 1 required DM	52-72 weeks

Gastroenterology. 2022;163(5):1198-1225.

Semaglutide Outcomes – Weight Loss

% TBWL*	Weight loss*	Percent achieving 5% TBWL*	Percent achieving 10% TBWL*	Percent achieving 15% TBWL*
10.76%	10.8 kg	51.7%	52.6%	40.7%

*Reported as mean difference compared to placebo group

- Dose dependent response
- Potentially less weight loss observed in patients with diabetes

Gastroenterology. 2022;163(5):1198-1225.

Semaglutide Safety

Discontinuation higher in semaglutide groups (6.4% vs. 3.1%)

- Reasons: GI adverse effects

Higher SAE in semaglutide groups

- Abdominal pain, vomiting, pancreatitis, cholecystitis, cholelithiasis, gastroenteritis
- All event rates low overall

Acute pancreatitis < 0.002%

Gastroenterology. 2022;163(5):1198-1225.

Clinical considerations for semaglutide

Two brand names approved for different indications with different injection devices

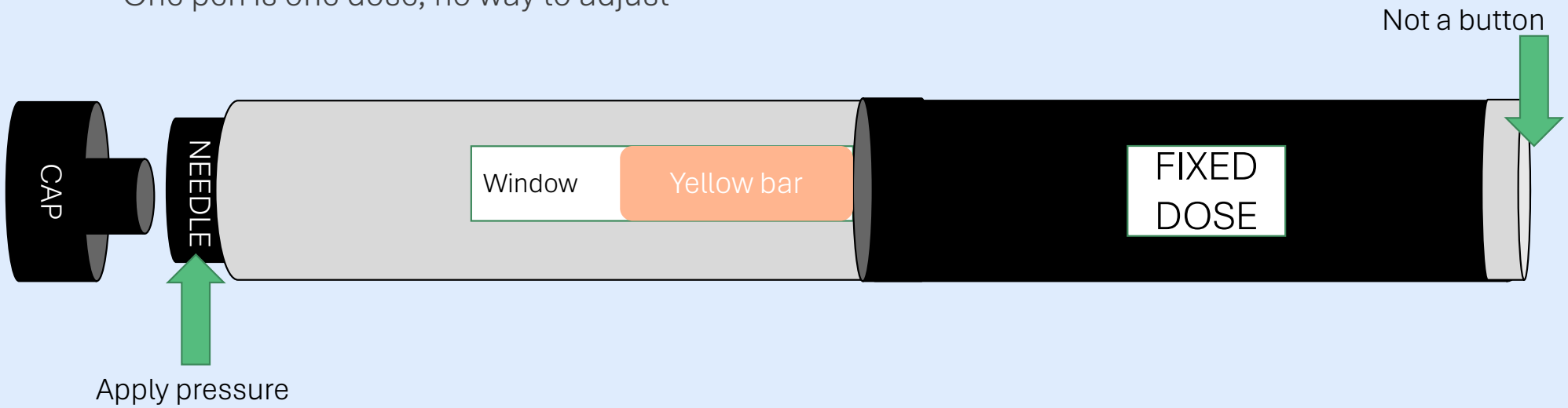
Washout period for pregnancy

Taper orders and refills/days supply

Semaglutide Injection – Ozempic®

Semaglutide injection – Wegovy®

- No visible needle
- Pressure activated
- Patients sometimes say they did not get full dose
- One pen is one dose, no way to adjust



ORAL SEMAGLUTIDE: RYBELSUS®

Did report CV benefit, but only when pooled results with injectable

Administration: morning on empty stomach with 4 oz of water at least 30 minutes before food, drink, or other medicines

OTHER GLP-1 AGONISTS

Dulaglutide (Trulicity®)	Approved for diabetes only
	Once weekly dosing with autoinjector
Exenatide (Bydureon®)	Daily versus weekly

SWITCHING BETWEEN GLP-1 AGONISTS

- Consider reason for switch:
  - GI side effects → STOP agent, wait for side effects to resolve and start with lowest available dose
  - Other → start new agent when next dose due; start equivalent or lower dose
- Monitor for side effects and efficacy

Agent	Frequency	Equivalent Dose (mg)					
Liraglutide	Weekly	0.6	1.2	1.8	2.4*	3*	
Semaglutide	Weekly		0.25	0.5	1	1.7*	2.4*
Oral semaglutide	Daily	3	7	14			
Exenatide	Weekly			2			
Dulaglutide	Weekly		0.75	1.5	3*	4.5*	

Diabetes Ther 12, 943–954 (2021).

GLP-1 and GIP Dual Agonist

TIRZEPATIDE (MOUNJARO®, ZEPBOUND®)

TIRZEPATIDE

- Mechanism:
  - Dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 agonist
  - GIP – intestinal hormone, stimulates glucose dependent insulin secretion postprandially, stimulated glucagon secretion in periods of eu- and hypoglycemia

- FDA indication: Diabetes type 2; weight management, chronic

- Contraindications, cautions, side effects: same as GLP-1 agonists

Lexicomp. Tirzepatide. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp

Tirzepatide Literature – weight loss

- n=3964 in treatment group
- Mean age: 44.9 years
- Predominantly female
- Lifestyle: calorie deficit

Mean Starting Weight	Mean Starting BMI	Mean Starting Waist Circumference	Comorbidities Included	Follow Up Duration
10.8.8 kg	38 kg/m^2	114.1 cm	Excluded DM	72 weeks

N Engl J Med 2022; 387:205-216.

Tirzepatide Outcomes

Dose	% TBWL*	Percent achieving 5% TBWL*	Percent achieving 10% TBWL*	Percent achieving 20% TBWL*
5 mg	11.9%	50%	49.7%	26.9%
10 mg	16.4%	54%	59.3%	47%
15 mg	17.8%	56%	64.7%	54%

*Reported as mean difference compared to placebo group

- Improvements in all prespecified cardiometabolic measures with tirzepatide

N Engl J Med 2022; 387:205-216.

Tirzepatide Safety

Discontinuation higher in tirzepatide groups (4.3-7.1% vs.2.6%)

- Reasons: mild-moderate GI adverse effects
- No difference in SAE

Nausea and diarrhea more common in tirzepatide group

Acute pancreatitis: 0.2% (similar to placebo group)

N Engl J Med 2022; 387:205-216.

DIETARY TIPS FOR GLP-1 AGONISTS

Smaller portions. Start with half size (may help to use smaller plate)

Eat protein to prevent loss of muscle mass (¼ of plate each meal and with snacks)

Eat produce for nutrients (non-starchy veggies for ½ of plate each meal plus fruit)

Add extra fiber through whole grains and starchy veggies to reduce constipation

Keep fat portions small and from heart healthy, unsaturated sources (olive oil, nuts, seeds, avocado)

Greasy, fried foods NOT well tolerated

Drink plenty of fluids (mostly water) separately from eating to not interfere with food intake

Eat regularly - 3 small meals per day plus healthy snack as needed

Let’s Review

45

What is the primary mechanism of action of SGLT-2 inhibitors in type 2 diabetes?

A. Increasing insulin secretion

B. Inhibiting glucose reabsorption in the kidneys

C. Slowing gastric emptying

D. Blocking carbohydrate absorption in the intestines

Which class of medications has shown cardiovascular benefits in type 2 diabetes patients?

A. Insulins

B. Sulfonylureas

C. GLP-1 receptor agonists

D. DPP-4 inhibitors

A patient is prescribed liraglutide. What is a common side effect they might experience?

A. Hypoglycemia

B. GI disturbances (nausea, vomiting)

C. Increased appetite

D. Weight gain

Which of the following is a recommended dietary adjustment for patients using GLP-1 receptor agonists?

A. Eat larger meals to prevent nausea

B. Drink plenty of fluids separately from meals

C. Increase fat intake for better absorption

D. Avoid fiber to reduce GI side effects

Which of the following statements is TRUE regarding the oral formulation of semaglutide (Rybelsus®)?

A. It must be taken with food to enhance absorption

B. It is less effective than injectable semaglutide in reducing A1C

C. It should be taken on an empty stomach with water at least 30 minutes before eating

D. It has no cardiovascular benefit compared to injectable forms

Diabetes Management Approaches

Obesity and Weight Management for the Prevention and Treatment of Type 2 Diabetes

Obesity is a chronic disease with metabolic, physical, and psychosocial complications.

Weight management can delay the progression from prediabetes to type 2 diabetes and is beneficial in treating type 2 diabetes.

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

ASSESSMENT AND MONITORING

Use	Use person-centered, nonjudgmental language.
Measure	Measure BMI and other body fat distribution metrics.
Monitor	Monitor obesity-related measurements annually or more frequently during active weight management.

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

TREATMENT GOALS

WEIGHT MANAGEMENT SHOULD BE A PRIMARY GOAL ALONG WITH GLYCEMIC MANAGEMENT.

AIM FOR 3-7% WEIGHT LOSS TO IMPROVE GLYCEMIA AND CARDIOVASCULAR RISK FACTORS.

10% WEIGHT LOSS CAN LEAD TO DISEASE-MODIFYING EFFECTS AND POSSIBLE DIABETES REMISSION.

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

TREATMENT APPROACHES

Lifestyle and Nutritional Therapy: Individualized based on medical history, preferences, and motivation.

- Create an energy deficit of 500-750 kcal/day.
- Individualize nutrition plans based on preferences and needs.
- Long-term weight maintenance programs with ongoing support and monitoring.

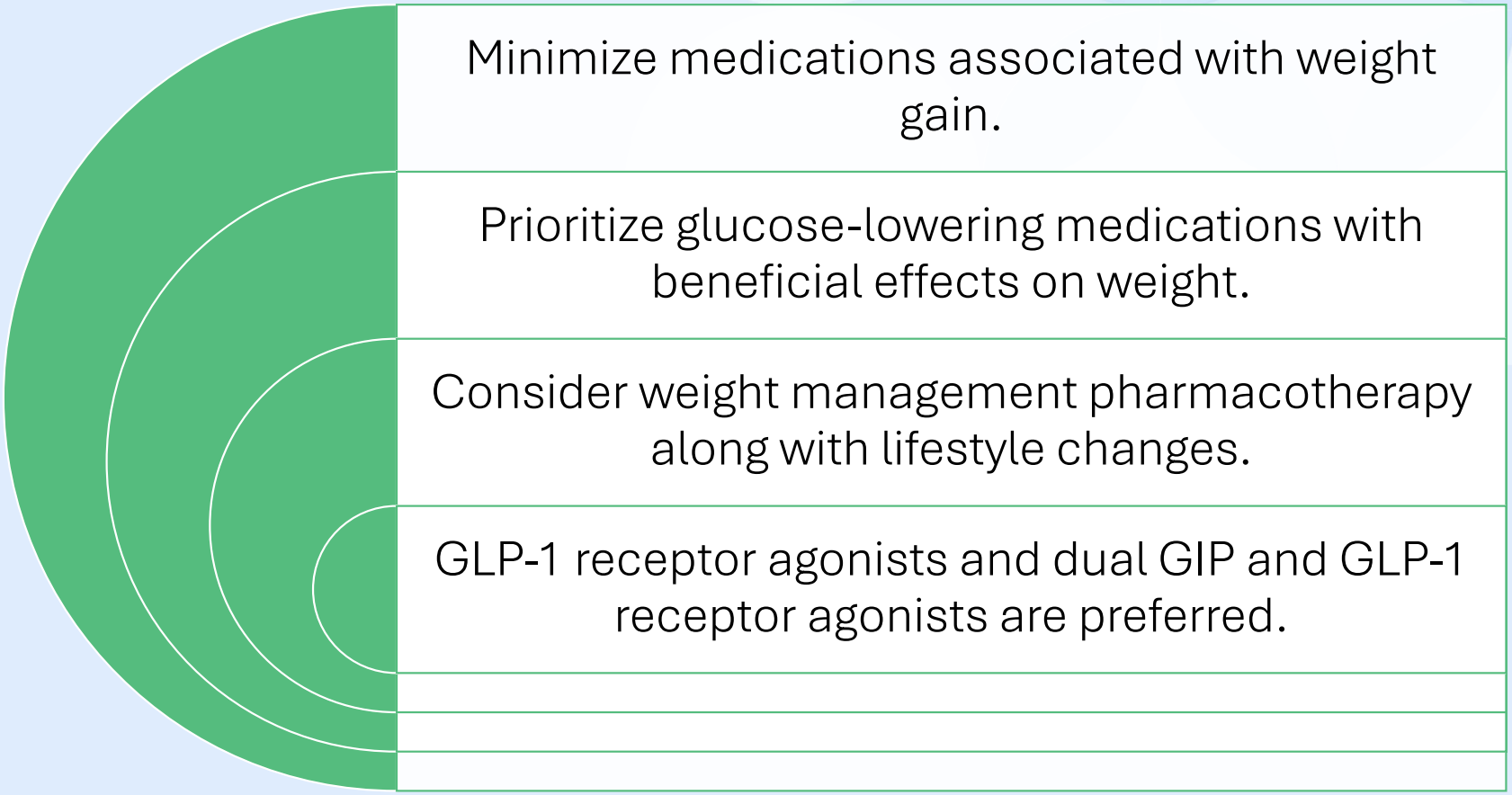
Metabolic Surgery: For significant weight loss and glycemic improvement.

- Consider for individuals with BMI ≥30 kg/m^2 (≥27.5 kg/m^2 for Asian Americans).
- Long-term medical and behavioral support is essential post-surgery.

Pharmacologic Agents: Consider medications with beneficial effects on weight.

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

PHARMACOTHERAPY



American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

COMMON MEDICATIONS ASSOCIATED WITH WEIGHT GAIN

Types of Medication	Medications or Classes
Antidepressants	TCAs, phenelzine, paroxetine, mirtazapine,
Mood stabilizers	Lithium, chlorpromazine, clozapine, olanzapine, paliperidone, quetiapine, risperidone
Cardiovascular	CCB, atenolol, metoprolol, propranolol
Diabetes agents	Insulin, sulfonylureas, TZDs
Hormones	Estrogen, steroids
Hypnotics	Diphenhydramine
Antiepileptics	Carbamazepine, gabapentin, pregabalin, valproate

Am Fam Physician. 2016;94(5):361-8.

COMMON MEDICATIONS THAT ARE WEIGHT NEUTRAL

Types of Medication	Medications or Classes
Antidepressants	Citalopram, desvenlafaxine, duloxetine, escitalopram, fluoxetine, sertraline, venlafaxine
Antipsychotics	Aripiprazole, haloperidol, ziprasidone
Cardiovascular	ACE inhibitors
Diabetes agents	DPP4 inhibitors
Hypnotics	Benzodiazepines, trazodone
Mood stabilizers/ antiepileptics	Oxcarbazepine, lamotrigine, levetiracetam, phenytoin

Am Fam Physician. 2016;94(5):361-8.

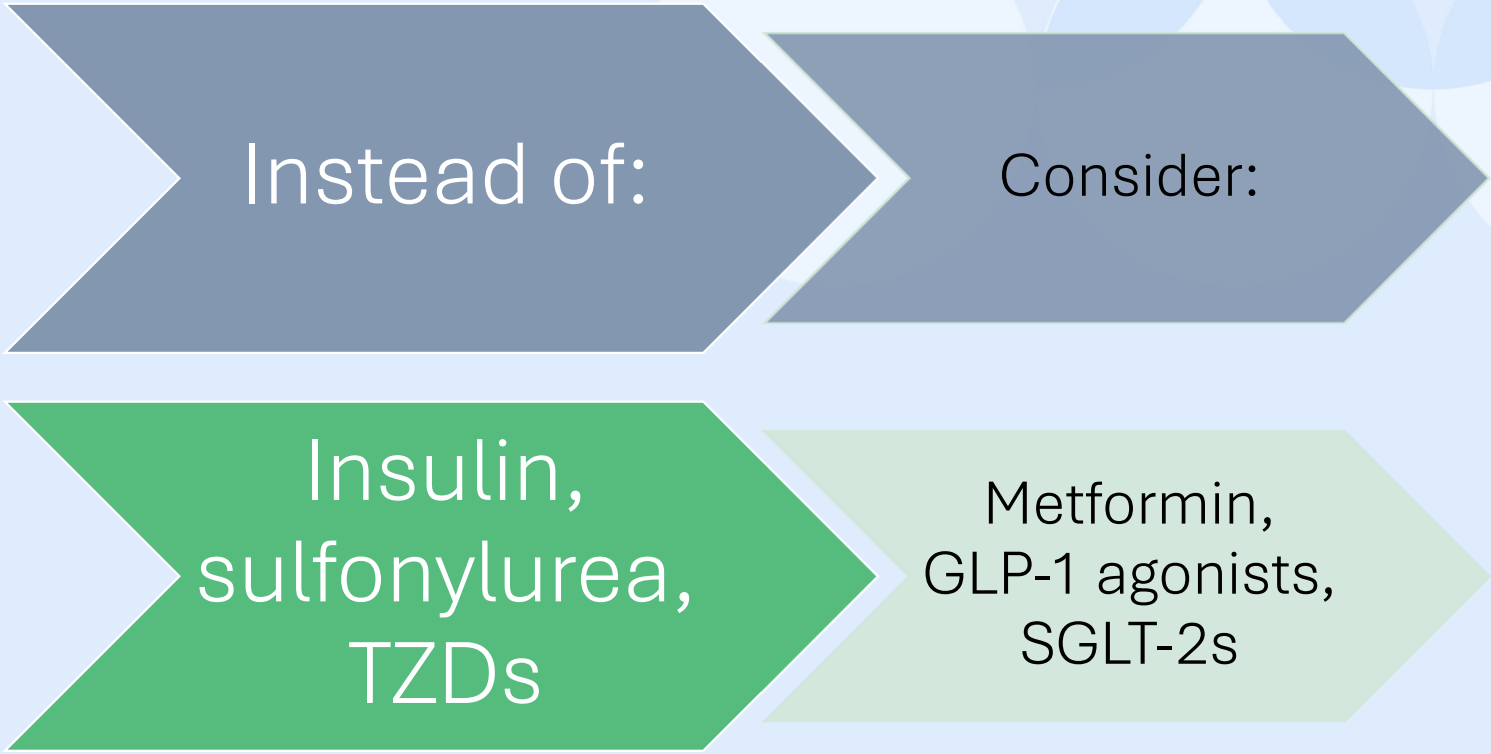
COMMON MEDICATIONS ASSOCIATED WITH WEIGHT LOSS

Types of Medication	Medications or Classes
Antidepressants	Bupropion
Diabetes agents	Alpha-glucosidase inhibitors, GLP1 agonists, GLP-1/GIP agonists, metformin, pramlintide, SGLT-2 inhibitors
Hormones	Progestins, testosterone
Antiepileptics	Felbamate, topiramate, zonisamide
Stimulants	Amphetamines, methylphenidate, phentermine

Am Fam Physician. 2016;94(5):361-8.

ALTERNATIVE MEDICATIONS IN DIABETES

Practical Examples



PHARMACIST'S ROLE IN PHARMACOTHERAPY

- Educate patients on the use and benefits of weight management medications.
- Monitor for side effects and interactions with other medications.
- Adjust medication regimens based on patient response and preferences.

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

Cardiovascular Disease and Risk Management in Diabetes

Atherosclerotic cardiovascular disease (ASCVD) is the leading cause of morbidity and mortality in people with diabetes.

Diabetes increases the risk of ASCVD, with common coexisting conditions like hypertension, hyperlipidemia, and obesity.

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

LIPID MANAGEMENT

- High-intensity statin therapy is recommended for individuals aged 40-75 years with diabetes and high cardiovascular risk.

- Target LDL cholesterol reduction by ≥50% of baseline and aim for LDL <70 mg/dL (<1.8 mmol/L).

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

ANTIPLATELET THERAPY

- Aspirin (75-162 mg/day) is recommended for individuals with diabetes and a history of ASCVD. **(SECONDARY PREVENTION)**

- Consider aspirin therapy for primary prevention in individuals at high cardiovascular risk after discussing potential benefits and risks.

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

HEART FAILURE MANAGEMENT

- Heart failure is a major cause of morbidity and mortality in people with diabetes.
- Use SGLT2 inhibitors to reduce the risk of heart failure hospitalization.

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

Chronic Kidney Disease and Risk Management in Diabetes

Chronic Kidney Disease (CKD) is a common complication in diabetes, affecting 20-40% of people with diabetes.

CKD increases the risk of cardiovascular disease and healthcare costs

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

SCREENING RECOMMENDATIONS

- Assess kidney function (urine albumin creatinine ratio (UACR) and eGFR) in type 1 diabetes (duration ≥5 years) and all type 2 diabetes patients.
- Monitor urinary albumin and eGFR 1-4 times per year in established CKD.

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

PHARMACOTHERAPY TO LOWER ALBUMINURIA

ACE Inhibitors or ARBs

- Diabetes + hypertension + moderately increased albuminuria (UACR 30–299 mg/g creatinine)
- **Strongly recommended** for those with severely increased albuminuria (UACR ≥300 mg/g creatinine) and/or eGFR <60 mL/min/1.73 m^2
- Monitor serum creatinine and potassium

SGLT2 Inhibitors

- Reduce CKD progression and cardiovascular events
- With eGFR ≥20 mL/min/1.73 m^2

GLP-1 Receptor Agonists

- Reduce cardiovascular risk and kidney disease

Nonsteroidal Mineralocorticoid Receptor Antagonists (MRAs)

- Reduce cardiovascular events and CKD progression
- eGFR ≥25 mL/min/1.73 m^2
- Monitor potassium

American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.

ADDITIONAL CONSIDERATIONS TO LOWER ALBUMINURIA

Effective glucose management

Optimize Blood Pressure Management

- Blood pressure target of <130/80 mmHg

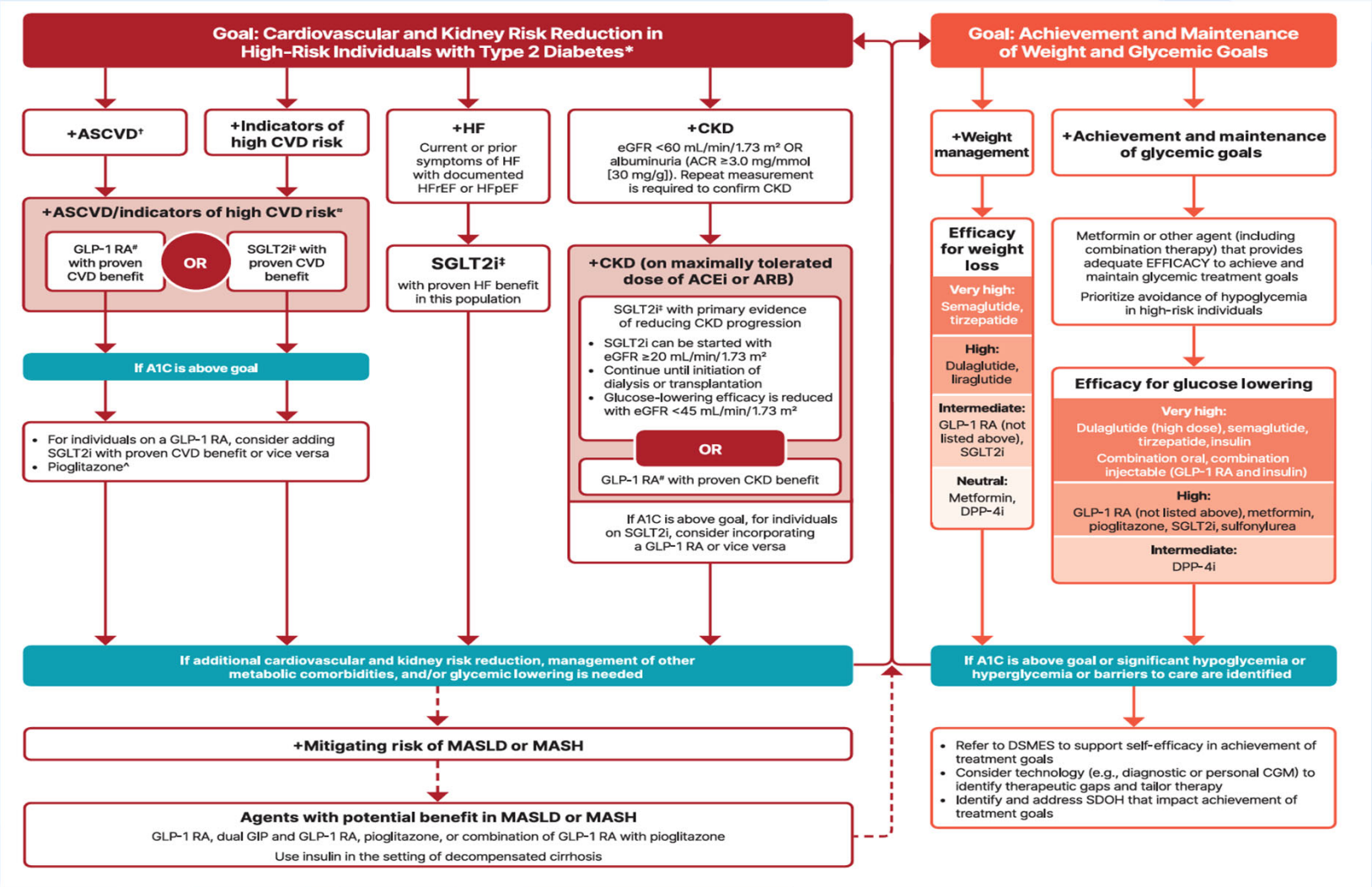
Dietary Protein Intake

- non-dialysis stage G3 or higher CKD → 0.8 g/kg body weight/day
- Dialysis →1.0–1.2 g/kg/day

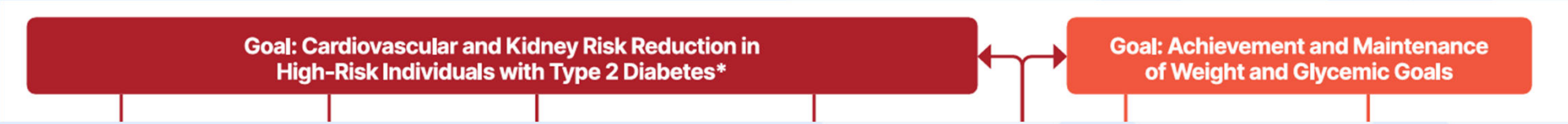
Lifestyle Modifications

- Smoking cessation
- Weight loss
- Changes in eating patterns (e.g., decreased salt and protein intake)

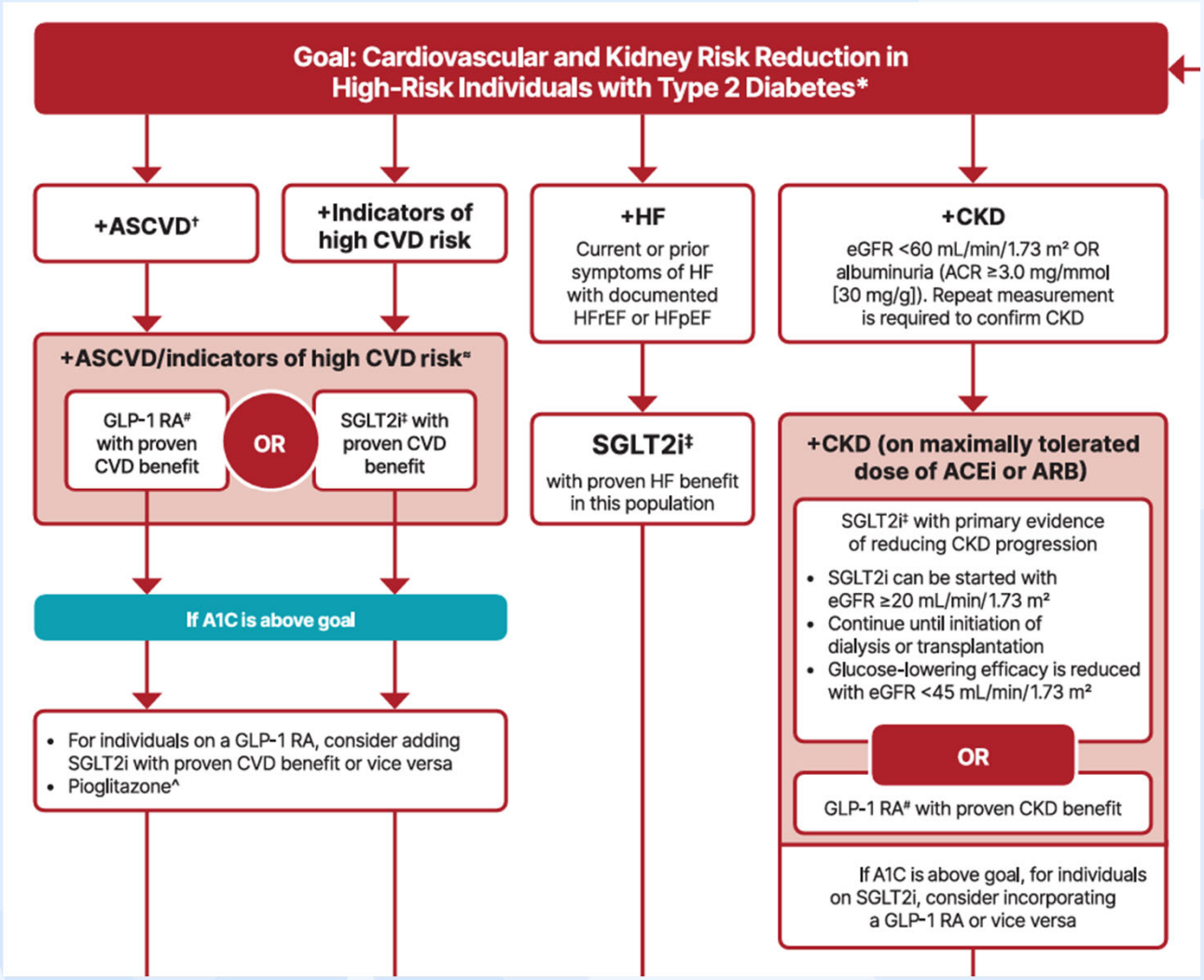
American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.



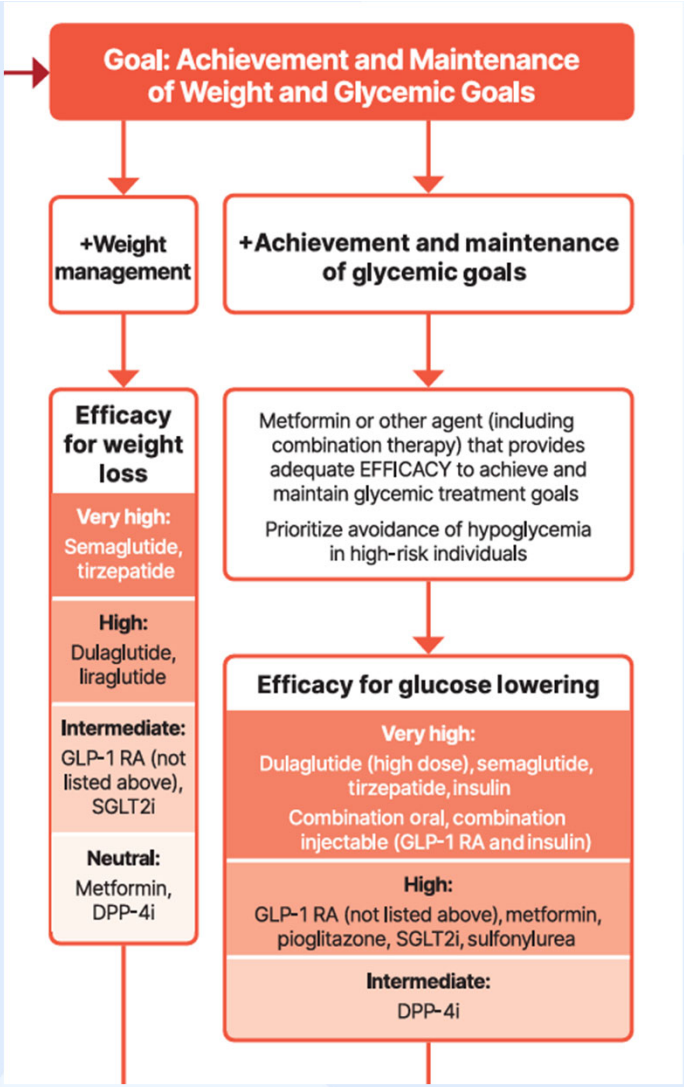
AMERICAN DIABETES ASSOCIATION. 9. PHARMACOLOGIC APPROACHES TO GLYCEMIC TREATMENT: STANDARDS OF CARE IN DIABETES—2025. DIABETES CARE. 2025;48(SUPPL 1):S181-S200. FIGURE 9.3.



AMERICAN DIABETES ASSOCIATION. 9. PHARMACOLOGIC APPROACHES TO GLYCEMIC TREATMENT: STANDARDS OF CARE IN DIABETES—2025. DIABETES CARE. 2025;48(SUPPL 1):S181-S200. FIGURE 9.3.



AMERICAN DIABETES ASSOCIATION. 9. PHARMACOLOGIC APPROACHES TO GLYCEMIC TREATMENT: STANDARDS OF CARE IN DIABETES—2025. DIABETES CARE. 2025;48(SUPPL 1):S181-S200. FIGURE 9.3.



AMERICAN DIABETES ASSOCIATION. 9. PHARMACOLOGIC APPROACHES TO GLYCEMIC TREATMENT: STANDARDS OF CARE IN DIABETES—2025. DIABETES CARE. 2025;48(SUPPL 1):S181-S200. FIGURE 9.3.

Let’s Review

What is a key potential benefit of GLP-1 receptor agonists in patients with type 2 diabetes beyond glycemic control?

A. Increased insulin resistance

B. Weight gain

C. Cardiovascular risk reduction

D. Increased hepatic glucose production

Which class of diabetes medications has been shown to provide cardiovascular benefits, including reduced risk of major adverse cardiovascular events in patients with type 2 diabetes and established cardiovascular disease?

A. Sulfonylureas

B. Dipeptidyl peptidase-4 (DPP-4) inhibitors

C. Sodium-glucose cotransporter-2 (SGLT2) inhibitors

D. Insulin

What class of medication has NOT been shown to help reduce albuminuria?

A. Nonsteroidal Mineralocorticoid Receptor Antagonists (MRAs)

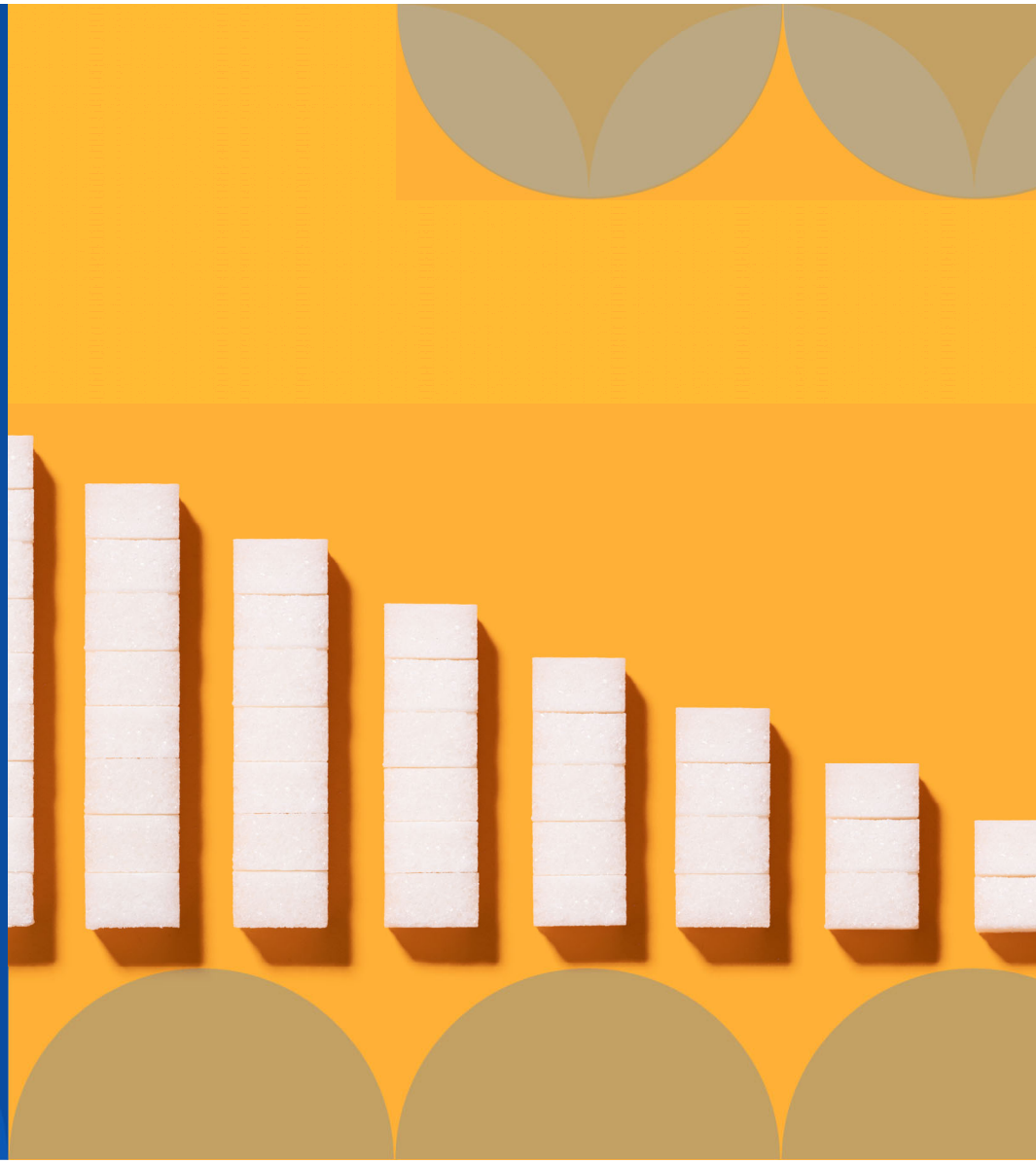
B. ACE Inhibitors

C. Sulfonylureas

D. GLP-1 Receptor Agonists

E. GLP-1 Receptor Agonists

Continuous Glucose Monitors (CGMs)



WHAT ARE CGMS?

- Thin filament inserted under skin that connects to a small sensor and wirelessly transmits to a reader/smartphone
- Personal (patient monitored)
  - Can upload device to computer
  - Can remotely transmit data to provider practice
- Professional (provider monitored)
- Real time or intermittent scanning

Select CGM brands

- Abbott Freestyle Libre®
- Dexcom®
- Eversense®
- Guardian®

Common Personal Use CGMs

	Abbott Freestyle Libre 2 (plus) ®	Abbott Freestyle Libre 3 (plus) ®
Components	1. Disposable sensor/transmitter 2. Reader for data display/storage	
Maximum wear time	14(15) days	
Approved sites	Back of upper arm	
Warm up time	1 hour	
Downloading Software	LibreView	
FDA approved for Medication Adjustment	Yes	
Alarms for highs/lows	Yes	
Interfering substances	Ascorbic acid (>500 mg)	
Water resistance	3 feet/30 minutes	
FDA approved ages	≥ 4	
Sensor size	2 stacked quarters	2 stacked pennies
Data capture	Intermittent scanning required	Every minute, no scanning

Abbott. FreeStyle [Internet]. Abbott; [cited 2025 Mar 2]. Available from: https://www.freestyle.abbott/us-en/home.html

Common Personal Use CGMs - Dexcom

	Dexcom G6 ®	Dexcom G7 ®
Components	Disposable sensor Reusable transmitter Reader for data display/storage	Disposable sensor/transmitter Reader for data display/storage
Maximum wear time	10 days	10 days* --> 15 days
Approved sites	Lower abdomen	Back of upper arm Upper buttocks (children)
Warm up time	2 hours	30 minutes
Downloading Software	Dexcom Clarity, Glooko, Tidepool	
FDA approved for Medication Adjustment	Yes	
Alarms for highs/lows	Yes	
Interfering substances	Hydroxyurea, acetaminophen (≥ 1 gram)	
Water resistance	8 feet/24 hours	
FDA approved ages	≥ 2 years	
Sensor size	oval size of 2 quarters	2 stacked pennies
Data capture	Every 5 minutes (no scanning)	

Dexcom. Dexcom G7 [Internet]. Dexcom; [cited 2025 Mar 2]. Available from: https://uk.provider.dexcom.com/products/dexcom-g7

Who may benefit?

BASAL INSULIN USE AND CGM

Design	Multicenter, randomized, parallel group
Intervention	CGM or traditional blood glucose meter (BGM)
Primary Outcome	HbA1c
Key Secondary Outcomes	•CGM-measured time in target glucose range (70-180 mg/dL) •Time with glucose > 250 mg/dL •Mean glucose level
Population	•Adults with type 2 diabetes •Receiving care from PCP •1-2 daily injections of long or intermediate acting basal insulin without prandial insulin •With or without noninsulin medications

JAMA. 2021;325(22):2262-2272.

BASAL INSULIN USE AND CGM - RESULTS

	CGM (n=116)	BGM (n=59)	P value
Change in HbA1c (%)	-1.1%	-0.6%	0.02
Percent CGM-measured time in target range (70-180 mg/dL)	+19%	+3%	<0.001
Percent time with glucose > 250 mg/dL	-14%	+2%	<0.001
Mean glucose level (mg/dL)	-30	0	<0.001

JAMA. 2021;325(22):2262-2272.

How much do CGMs cost?

$$$

CASH

- Abbott Freestyle Libre 3: $140-170/month with GoodRx coupon (cost for 2 boxes, one sensor each)
- Dexcom G7: $170-190/month with GoodRx coupon (cost for 3 boxes, one sensor each)

INSURANCE COVERAGE: MEDICARE

- Requires diagnosis of diabetes
- As of 2021, no longer requires patients to check blood glucose 4 times per day
- MUST have a daily insulin regimen (1 injection per day) OR have a history of documented problematic hypoglycemia
- Have been trained (or had caregiver trained) to use a continuous glucose monitor
- Provider visits every 6 months
- Covered as durable medical equipment in many plans

Centers for Medicare & Medicaid Services. Local Coverage Determination (LCD): Glucose Monitors (L33822) [Internet]. Baltimore (MD): CMS; [cited 2025 Mar 2]. Available from: https://www.cms.gov/medicare-coverage-database/view/lcd.aspx?lcdid=33822

INSURANCE COVERAGE: WV MEDICAID

REQUIRES 3+ daily insulin administrations

6 months of adherence based on fill history

INSURANCE COVERAGE: OH MEDICAID

All patients with diagnosis of diabetes (2023)

INSURANCE COVERAGE: COMMERCIAL

- Variable
- May or may not require prior authorization
- WVU Employee Health Plan and Highmark – covered with prior authorization

OTC Options

- Stelo® (Dexcom)
  - Subscriptions available for discount
- Lingo® (Abbott)
  - Subscription based
  - Sensors + coaching
- FSA/HSA eligible
- Targeted for patients without diabetes

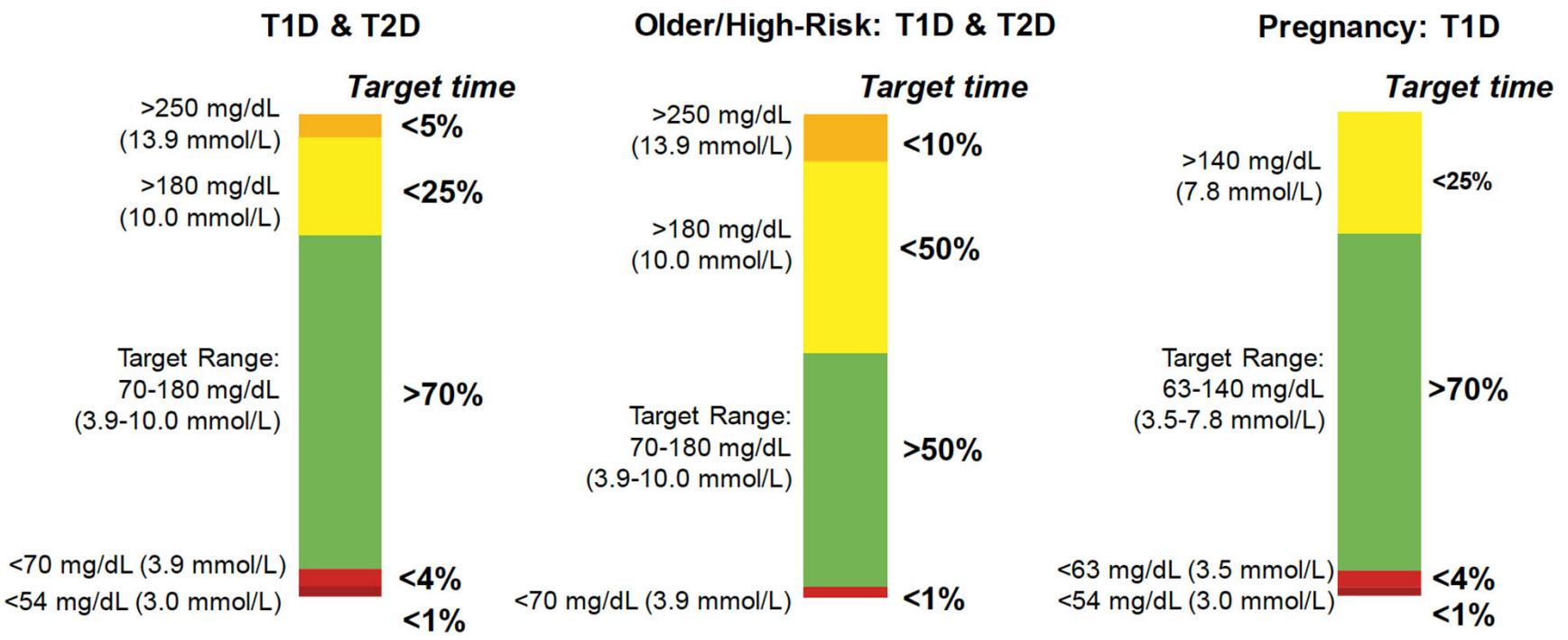
Key Counseling Points

- Application
- Alerts
- Adhesive
- Irritation
- Water
- Replacements

Key Standardized Metrics

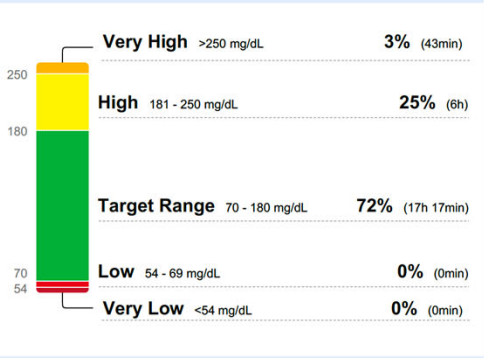
Time in Range	• Fasting AND post-prandial while avoiding hypoglycemia (70-180)
Number of Days Worn	• 14+ recommended
Percent of Time Active	• >70% recommended
Mean Glucose	• based on selected date range
Glucose Management Indicator (GMI)	• Estimate of HbA1c
Coefficient of Variation	• ≤ 36% recommended
Ambulatory Glucose Profile (AGP)	• Summary of glucose values with mean and percentiles as one day

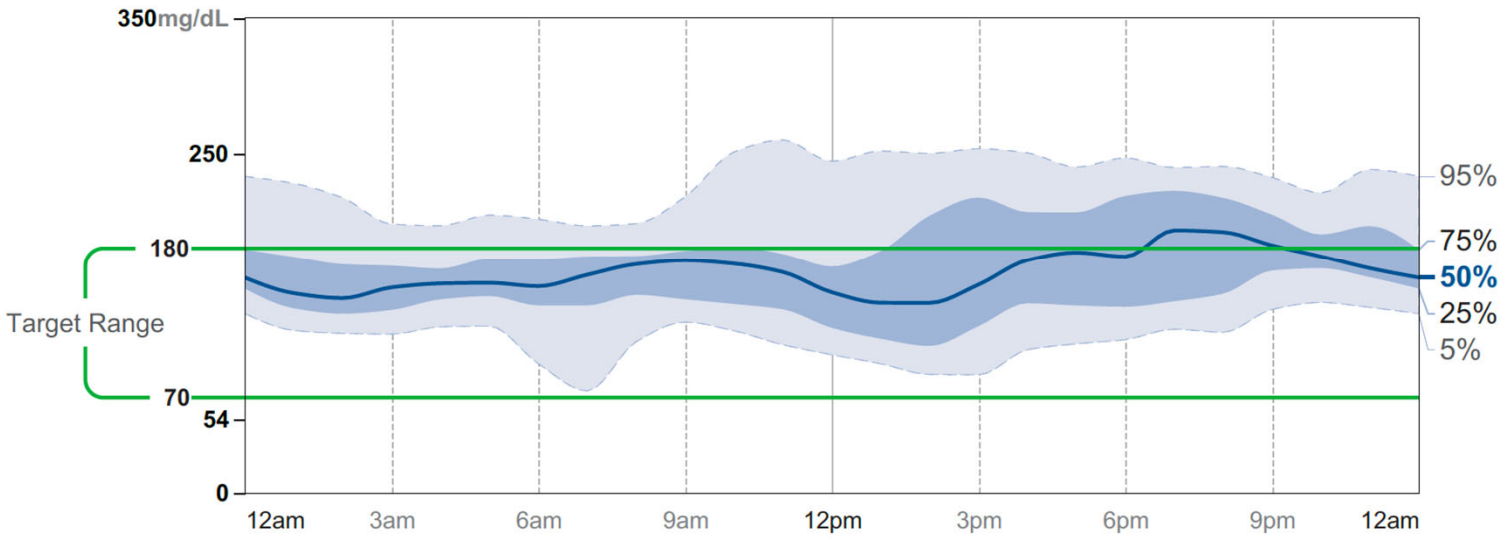
TIME IN RANGE



Battelino T, Danne T, Bergenstal RM, Amiel SA, Beck R, Biester T, et al. Clinical targets for continuous glucose monitoring data interpretation: recommendations from the International Consensus on Time in Range. Diabetes Care [Internet]. 2019 Aug;42(8):1593-1603. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC6973648/

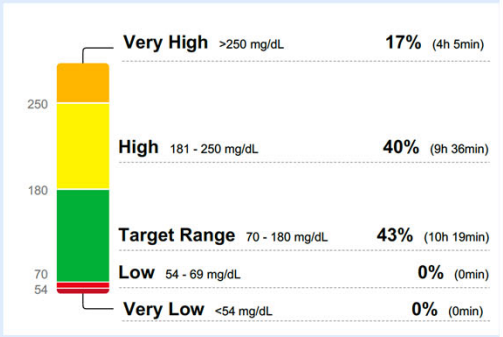
AMBULATORY GLUCOSE PROFILE
EXAMPLE 1

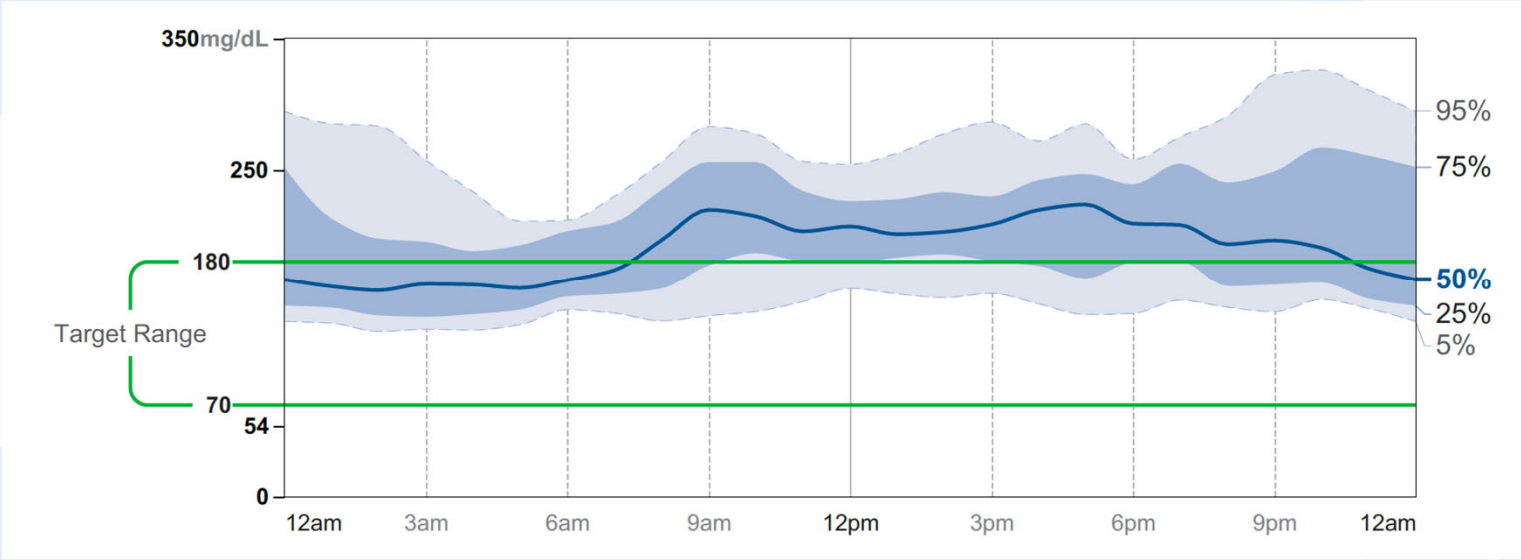




Abbott Diabetes Care. LibreView glucose report [Internet]. Alameda (CA): Abbott; 2025 Mar 2 [cited 2025 Mar 2]. Available from: https://www.libreview.com

AMBULATORY GLUCOSE PROFILE
EXAMPLE 2





Abbott Diabetes Care. LibreView glucose report [Internet]. Alameda (CA): Abbott; 2025 Mar 2 [cited 2025 Mar 2]. Available from: https://www.libreview.com

Reports

GLUCOSE STATISTICS AND TARGETS

June 30, 2021 - July 13, 2021 **14 Days**

% Time CGM is Active **75%**

Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges	**Targets** % of Readings (Time/Day)
Target Range 70-180 mg/dL	Greater than 70% (16h 48min)
Below 70 mg/dL	Less than 4% (58min)
Below 54 mg/dL	Less than 1% (14min)
Above 180 mg/dL	Less than 25% (6h)
Above 250 mg/dL	Less than 5% (1h 12min)
Each 5% increase in time in range (70-180 mg/dL) is clinically beneficial.	

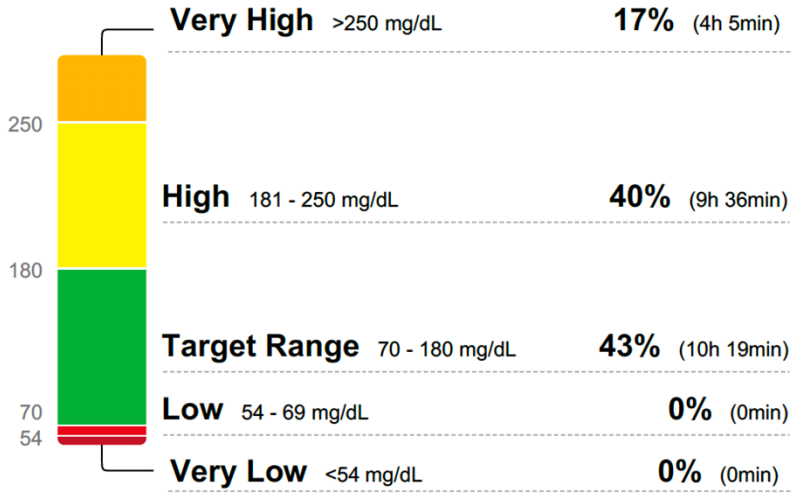
Average Glucose **197** mg/dL

Glucose Management Indicator (GMI) **8.0%**

Glucose Variability **24.5%**

Defined as percent coefficient of variation (%CV); target ≤36%

TIME IN RANGES

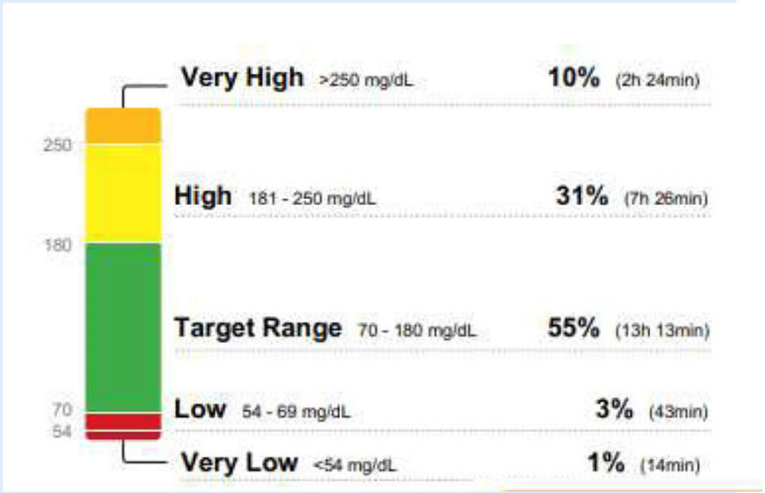


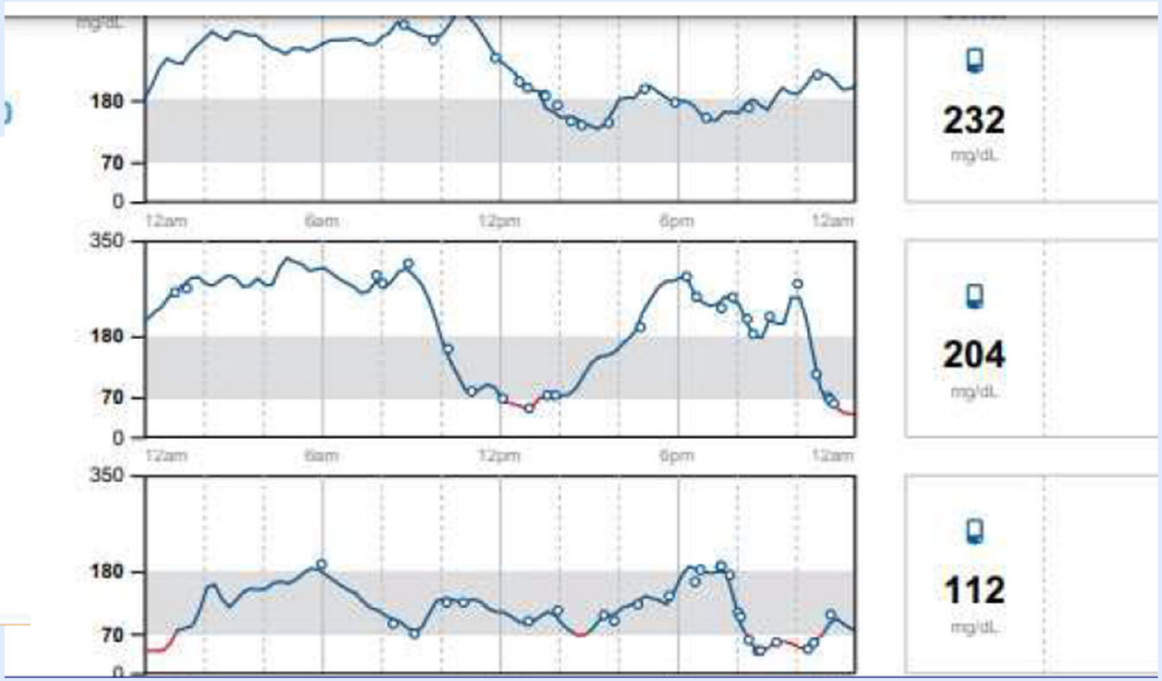
Abbott Diabetes Care. LibreView glucose report [Internet]. Alameda (CA): Abbott; 2025 Mar 2 [cited 2025 Mar 2]. Available from: https://www.libreview.com

Real World Application

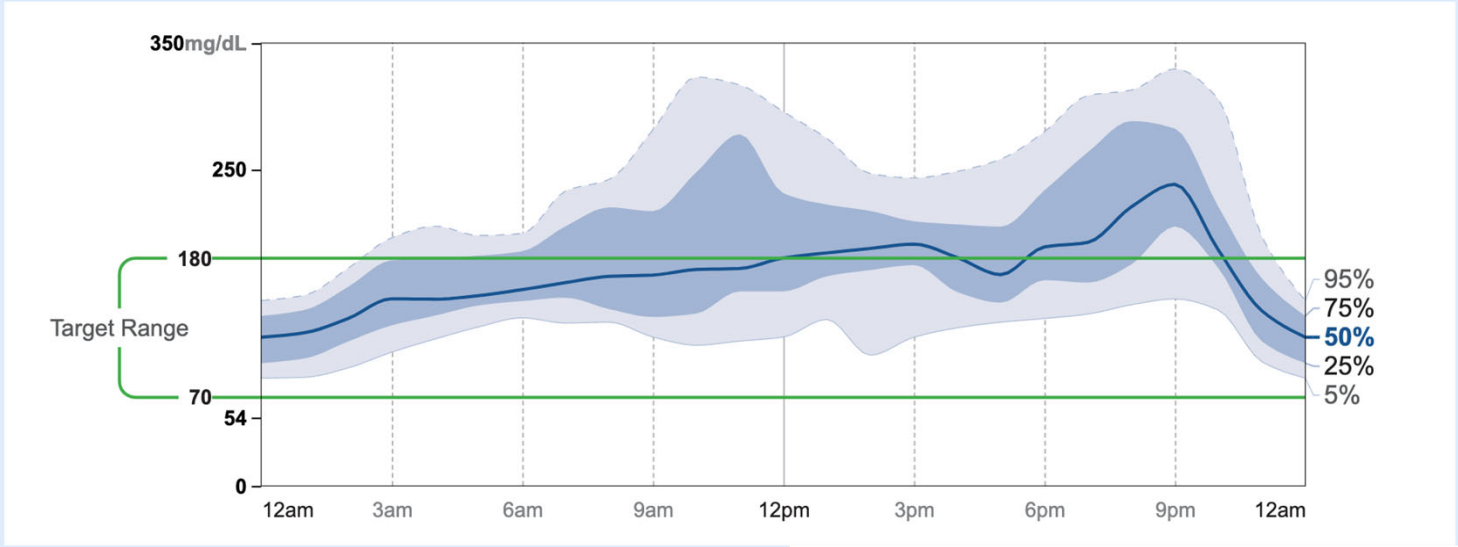
67 yof taking metformin 1000 mg BID, dapagliflozin 10 mg daily, insulin glargine 50 units nightly, insulin lispro 22 units TIDac

“I’m afraid to take my insulin”





Abbott Diabetes Care. LibreView glucose report [Internet]. Alameda (CA): Abbott; 2025 Mar 2 [cited 2025 Mar 2]. Available from: https://www.libreview.com



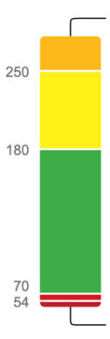
GLUCOSE STATISTICS AND TARGETS

July 12, 2021 - July 25, 2021	**14 Days**
% Time CGM is Active	**58%**

Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges Target Range 70-180 mg/dL	**Targets** % of Readings (Time/Day) Greater than 70% (16h 48min)
Below 70 mg/dL	Less than 4% (58min)
Below 54 mg/dL	Less than 1% (14min)
Above 180 mg/dL	Less than 25% (6h)
Above 250 mg/dL	Less than 5% (1h 12min)
Each 5% increase in time in range (70-180 mg/dL) is clinically beneficial.	

Average Glucose	**179** mg/dL
Glucose Management Indicator (GMI)	**7.6%**
Glucose Variability	**30.5%**
Defined as percent coefficient of variation (%CV); target ≤36%	

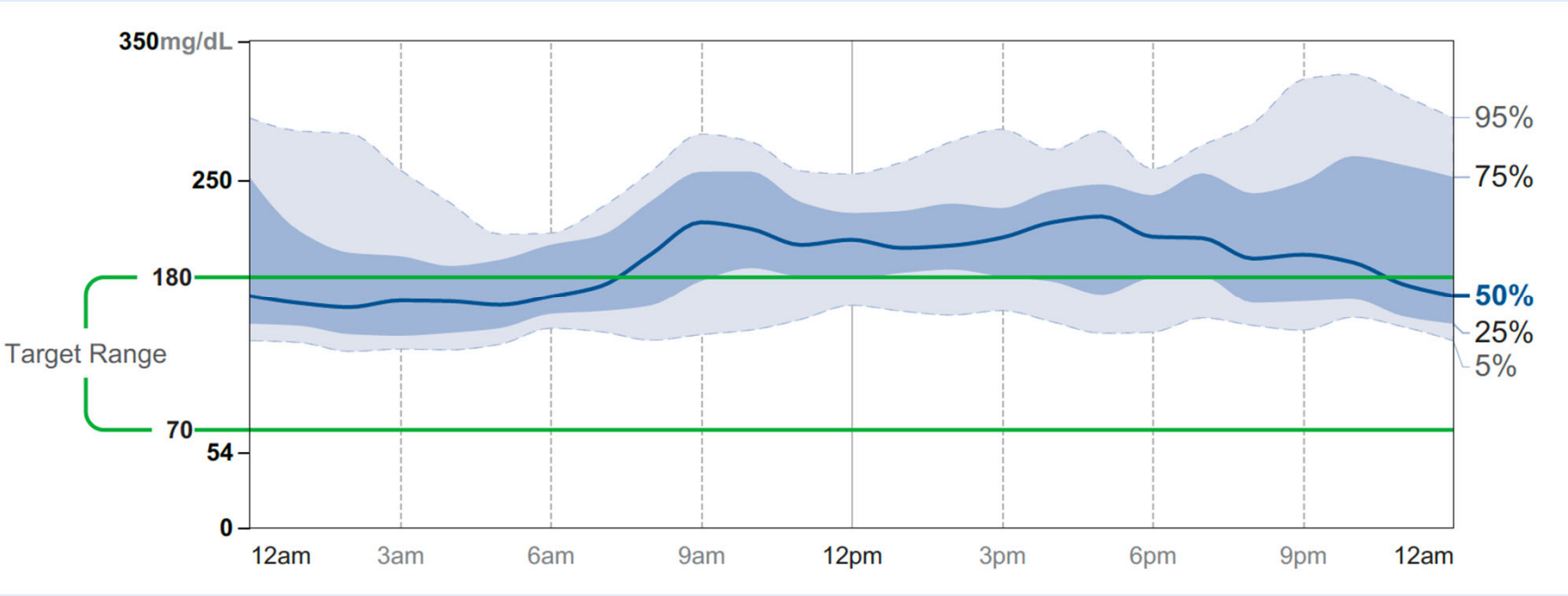
TIME IN RANGES



Very High	>250 mg/dL	**12%**	(2h 53min)
High	181 - 250 mg/dL	**30%**	(7h 12min)
Target Range	70 - 180 mg/dL	**58%**	(13h 55min)
Low	54 - 69 mg/dL	**0%**	(0min)
Very Low	<54 mg/dL	**0%**	(0min)

Abbott Diabetes Care. LibreView glucose report [Internet]. Alameda (CA): Abbott; 2025 Mar 2 [cited 2025 Mar 2]. Available from: https://www.libreview.com

- Type 1 diabetes
- Insulin glargine 48 units nightly
- Insulin aspart 8 units TIDac



Abbott Diabetes Care. LibreView glucose report [Internet]. Alameda (CA): Abbott; 2025 Mar 2 [cited 2025 Mar 2]. Available from: https://www.libreview.com

Let’s Review

Which of the following is a benefit of continuous glucose monitoring (CGM)?

A. Eliminates the need for insulin in type 1 diabetes

B. Provides real-time glucose data for better management

C. Cures type 2 diabetes

D. Replaces the need for HbA1c testing

What is a key requirement for Medicare coverage of CGM?

A. The patient must be using insulin or have hypoglycemia

B. The patient must check blood glucose 4 times daily

C. The patient must have type 1 diabetes

D. The patient must be over 65 years old

Take Home Points

- SGLT-2 inhibitors and GLP-1 agonists provide multiple benefits beyond glucose lowering effects.
- Diabetes management should include a comprehensive approach, including considerations for weight management, cardiovascular health, and kidney disease.
- CGMs are becoming more accessible and may help patients be more aware of their glycemic control and lower HbA1c without additional therapies being needed
- CGM reports can be used to tailor therapy to individual patients.
- Pharmacists are positioned to help manage diabetes in conjunction with the healthcare team.

References

- American Diabetes Association. Standards of medical care in diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S1-S336. Available from: https://diabetesjournals.org/care/issue/48/Supplement_1. Accessed 2025 Mar 3.
- Lexicomp. Lexi-Drugs. Hudson, OH: Wolters Kluwer Clinical Drug Information, Inc.; [updated 2025 Mar 03; cited 2025 Mar 03]. Available from: https://www.wolterskluwer.com/en/solutions/lexicomp
- Davies, M., D'Alessio, D. A., Fradkin, J., Garratt, C. J., Holman, R. R., Kahn, S. E., ... & Marso, S. P. (2016). Liraglutide and Cardiovascular Outcomes in Type 2 Diabetes (LEADER). The New England Journal of Medicine, 375(4), 311–322. https://doi.org/10.1056/NEJMoa1603827
- Erlandson M, Ivey LC, Seikel K. Update on office-based strategies for the management of obesity. Am Fam Physician. 2016;94(5):361-368.
- American Diabetes Association Professional Practice Committee. 10. Cardiovascular Disease and Risk Management: Standards of Care in Diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S207-S238. doi:10.2337/dc25-S010.
- American Diabetes Association Professional Practice Committee. 11. Chronic Kidney Disease and Risk Management: Standards of Care in Diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S239-S253. doi:10.2337/dc25-S011.
- Martens T, Beck RW, Bailey R, Ruedy KJ, Calhoun P, Peters AL, et al. Effect of continuous glucose monitoring on glycemic control in patients with type 2 diabetes treated with basal insulin: a randomized clinical trial. JAMA. 2021 Jun 8;325(22):2262-2272. doi: 10.1001/jama.2021.7444.
- Battelino T, Danne T, Bergenstal RM, Amiel SA, Beck R, Biester T, et al. Clinical targets for continuous glucose monitoring data interpretation: recommendations from the International Consensus on Time in Range. Diabetes Care [Internet]. 2019 Aug;42(8):1593-1603. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC6973648/
- Dexcom. Dexcom G7 [Internet]. Dexcom; [cited 2025 Mar 2]. Available from: https://uk.provider.dexcom.com/products/dexcom-g7
- Centers for Medicare & Medicaid Services. Local Coverage Determination (LCD): Glucose Monitors (L33822) [Internet]. Baltimore (MD): CMS; [cited 2025 Mar 2]. Available from: https://www.cms.gov/medicare-coverage-database/view/lcd.aspx?lcdid=33822
- Abbott Diabetes Care. LibreView glucose report [Internet]. Alameda (CA): Abbott; 2025 Mar 2 [cited 2025 Mar 2]. Available from: https://www.libreview.com

Questions?

CE Evaluation Access Code

******

Capital Letters, No spaces, complete by March 16, 2025

Note: CE credit will be reported to NABP CPE Monitor within 4-6 weeks

How sweet it is: Modern treatment approaches for type II diabetes

ANGELA L. GOODHART, PHARMD, BCACP
ASSISTANT PROFESSOR OF CLINICAL PHARMACY AND FAMILY MEDICINE
WEST VIRGINIA UNIVERSITY
ANGELA.GOODHART@HSC.WVU.EDU