

Antidiabetic Agents - Glucagon-like Peptide-1 (GLP-1) Receptor Agonists

- Dual Glucose-dependent Insulinotropic Polypeptide (GIP) and GLP-1 Receptor Agonists
 - Mounjaro (Tirzepatide)
- Glucagon-like Peptide-1 (GLP-1) Receptor Agonists
 - Bydureon BCise (Exenatide)
 - Byetta (Exenatide)
 - Liraglutide (Victoza)
 - Ozempic (Semaglutide)
 - Rybelsus (Semaglutide)
 - Trulicity (Dulaglutide)

Disclaimer

Clinical guidelines are developed and adopted to establish evidence-based clinical criteria for utilization management decisions. Clinical guidelines are applicable according to policy and plan type. The Plan may delegate utilization management decisions of certain services to third parties who may develop and adopt their own clinical criteria.

Coverage of services is subject to the terms, conditions, and limitations of a member's policy, as well as applicable state and federal law. Clinical guidelines are also subject to in-force criteria such as the Centers for Medicare & Medicaid Services (CMS) national coverage determination (NCD) or local coverage determination (LCD) for Medicare Advantage plans. Please refer to the member's policy documents (e.g., Certificate/Evidence of Coverage, Schedule of Benefits, Plan Formulary) or contact the Plan to confirm coverage.

Antidiabetic Agents - Glucagon-like Peptide-1 (GLP-1) Receptor Agonists	1
Summary	2
Definitions	5
Clinical Indications	6
Medical Necessity Criteria for Initial Clinical Review	6
Initial Indication-Specific Criteria	6
Type 2 Diabetes Mellitus	6
Medical Necessity Criteria for Subsequent Clinical Review	8
Subsequent Indication-Specific Criteria	8
Type 2 Diabetes Mellitus	8

Experimental or Investigational / Not Medically Necessary	8
References	9
Appendix A	15
Clinical Guideline Revision / History Information	16

Summary

Incretin mimetics, also known as glucagon-like peptide-1 (GLP-1) receptor agonists and [dual glucose-dependent insulinotropic polypeptide \(GIP\)](#) and [GLP-1 receptor agonists](#), are an important class of antidiabetic agents that potentiate glucose-dependent insulin secretion, suppress glucagon secretion, slow gastric emptying, and promote satiety. They are used to manage type 2 diabetes mellitus (T2DM), a long-term medical condition characterized by high blood sugar levels due to the pancreas not producing enough insulin and/or the body not responding effectively to insulin (insulin resistance).

- Mounjaro (tirzepatide) is a unique dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 receptor agonist. Clinical trials, including the SURPASS series, have demonstrated that Mounjaro (tirzepatide) significantly reduces hemoglobin A1c (HbA1c) levels (up to 2.8%) and body weight (up to 14.8 kg or about 32.5 lb) compared to placebo, semaglutide, insulin degludec, and insulin glargine. Cardiovascular outcome studies are ongoing to assess its impact on major adverse cardiovascular events (MACE). A new single-dose vial formulation of Mounjaro (tirzepatide) is now available, offering additional administration options.
- Other notable GLP-1 receptor agonists include:
 - Exenatide extended-release (Bydureon BCise)
 - Exenatide immediate-release (Byetta)
 - Semaglutide injection (Ozempic)
 - Semaglutide oral (Rybelsus)
 - Dulaglutide (Trulicity)
 - Liraglutide (Victoza)

Several of these medications, particularly dulaglutide (Trulicity), liraglutide (Victoza), and both injectable and oral semaglutide (Ozempic, Rybelsus), have demonstrated cardiovascular benefits. They have been shown to reduce the risk of MACE in adults with T2DM and established cardiovascular disease or multiple cardiovascular risk factors. These therapies are approved and recommended for this indication, aligning with the 2025 American Diabetes Association (ADA) Standards of Medical Care in Diabetes and the 2022 American Association of Clinical Endocrinology (AACE) guidelines.

Ozempic (semaglutide) demonstrated renal-protective effects in adults with type 2 diabetes mellitus and chronic kidney disease. Ozempic (semaglutide) is approved and recommended for this indication, aligning with the 2025 American Diabetes Association (ADA) Standards of Medical Care in Diabetes.

Noteworthy updates include a safety warning for Ozempic (semaglutide) regarding increased reports of ileus, a potentially life-threatening intestinal blockage. Clinicians should monitor individuals for signs of

gastrointestinal obstruction and manage accordingly. Additionally, the 2025 ADA Standards of Medical Care in Diabetes note concurrent use of dipeptidyl peptidase-4 (DPP-4) inhibitors with a GLP-1 RA or a dual GIP and GLP-1 RA is not recommended due to lack of additional glucose lowering beyond that of a GLP-1 RA alone.

Management of T2DM typically involves lifestyle modifications such as diet, exercise, and weight loss. Pharmacologic therapy is often necessary to achieve glycemic control. Metformin is generally preferred for initial treatment; however, GLP-1 receptor agonists with proven cardiovascular benefits are recommended for patients with T2DM and established atherosclerotic cardiovascular disease (ASCVD) or high cardiovascular risk.

NOTE:

1. The Plan requires that members either be unable to use, or have tried and failed preferred medication(s) first. Requests for non-formulary medications are subject to Non-Formulary Products Criteria (PG069).
2. Coverage for prescription medications intended for obesity treatment, weight loss, weight reduction, or dietary control varies depending on a member's specific benefit policy. Please refer to the member's benefit plan document for information on benefit eligibility and terms of coverage. This clinical guideline specifically addresses the use of GLP-1 receptor agonists for type 2 diabetes mellitus. Other indications are managed under separate guidelines.
 - a. For coverage criteria related to the use of GLP-1 receptor agonists for weight management, please refer to the Oscar Clinical Guideline: Weight Loss Agents (PG070).
 - b. For coverage criteria related to Wegovy (semaglutide) for cardiovascular risk reduction in adults with established cardiovascular disease and obesity or overweight, please refer to the Oscar Clinical Guideline: Wegovy for Cardiovascular Risk Reduction or Metabolic Dysfunction-Associated Steatohepatitis (MASH) (PG194).
 - c. For coverage criteria related to Zepbound (tirzepatide) for the treatment of moderate-to-severe obstructive sleep apnea in adults with obesity, please refer to the Oscar Clinical Guideline: Zepbound (tirzepatide) for the Treatment of Obstructive Sleep Apnea (PG255).

Table 1: Glucagon-like peptide-1 (GLP-1) receptor agonists (i.e., incretin mimetics)

Classification	Drug [#]	FDA-Approved Indications
Dual Glucose-dependent Insulinotropic Polypeptide (GIP) and GLP-1 Receptor Agonists	Mounjaro (tirzepatide)	Adjunct to diet and exercise to improve glycemic control in adults with type 2 diabetes mellitus.
	Bydureon BCise (exenatide)	Adjunct to diet and exercise to improve glycemic control in adults and pediatrics aged 10 years and older with type 2 diabetes mellitus ¹
	Byetta (exenatide)	Adjunct to diet and exercise to improve glycemic control in adults with type 2 diabetes mellitus. ¹
Incretin mimetics Antidiabetics	Ozempic (semaglutide)	<p>Diabetes mellitus, type 2, treatment:</p> <ul style="list-style-type: none"> As an adjunct to diet and exercise to improve glycemic control in adults with type 2 diabetes mellitus. To reduce the risk of major adverse cardiovascular events (cardiovascular death, non-fatal myocardial infarction or non-fatal stroke) in adults with type 2 diabetes mellitus and established cardiovascular disease. To reduce the risk of sustained eGFR decline, end-stage kidney disease and cardiovascular death in adults with type 2 diabetes mellitus and chronic kidney disease.
	Rybelsus (semaglutide)	<p>Diabetes mellitus, type 2, treatment:</p> <ul style="list-style-type: none"> As an adjunct to diet and exercise to improve glycemic control in adults with type 2 diabetes mellitus. To reduce the risk of major adverse cardiovascular events (cardiovascular death, non-fatal myocardial infarction, or non-fatal stroke) in adults with type 2 diabetes mellitus who are at high risk for these events.
	Trulicity (dulaglutide)	<p>Diabetes mellitus, type 2, treatment:</p> <ul style="list-style-type: none"> As an adjunct to diet and exercise to improve glycemic control in adults and pediatrics 10 years of age and older with type 2 diabetes mellitus. To reduce the risk of major cardiovascular events (cardiovascular death, nonfatal myocardial infarction, nonfatal stroke) in adults with type 2 diabetes mellitus who have established cardiovascular disease or multiple cardiovascular risk factors.
	Victoza	Diabetes mellitus, type 2, treatment: ^{1,6}

Classification	Drug [#]	FDA-Approved Indications
	(liraglutide)	<ul style="list-style-type: none"> As an adjunct to diet and exercise to improve glycemic control in adults and pediatrics 10 years of age and older with type 2 diabetes mellitus. To reduce the risk of major cardiovascular events (cardiovascular death, nonfatal myocardial infarction, nonfatal stroke) in adults with type 2 diabetes mellitus and established cardiovascular disease.

[#] include both brand and generic and all dosage forms and strengths unless otherwise stated

Limitations of Use:

¹ Coadministration with other exenatide-containing products is not recommended.

² Not for treatment of type 1 diabetes mellitus.

Definitions

“Dipeptidyl Peptidase-4 (DPP-4) Inhibitors” are a class of oral antidiabetic drugs used primarily in the management of type 2 diabetes mellitus. DPP-4 inhibitors work by blocking the action of the DPP-4 enzyme, which is responsible for the degradation of incretin hormones, namely glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP). Examples include alogliptin (Nesina), saxagliptin (Onglyza), sitagliptin (Januvia), Tadjenta (linagliptin), and Zituvio (sitagliptin). Examples of DDP-4 combinations include Jentadueto (linagliptin/metformin), Jentadueto XR (linagliptin/metformin), alogliptin/metformin (Kazano), saxagliptin/metformin (Kombiglyze XR), sitagliptin/metformin (Janumet), sitagliptin/metformin (Janumet XR), Zituvimet (sitagliptin/metformin), Zituvimet XR (sitagliptin/metformin), alogliptin/pioglitazone (Oseni), Glyxambi (empagliflozin/linagliptin), Qtern (dapagliflozin/saxagliptin), and Steglujan (ertugliflozin/sitagliptin).

“Insulin” is a hormone produced by the beta cells in the pancreas. It facilitates the entry of glucose into cells for energy production. Insufficient insulin leads to a high blood glucose level, a condition known as diabetes. Oral and injectable medications can help increase insulin production, enhance the body's sensitivity to insulin, and decrease blood sugar levels.

“Incretin Mimetics” are a class of medications that imitate the function of incretins, natural hormones in the body that help lower post-meal blood sugar levels. These medications, also known as glucagon-like peptide-1 (GLP-1) receptor agonists, slow digestion, prevent the liver from making too much glucose, and help the pancreas produce more insulin when needed.

“Type 1 Diabetes” is an autoimmune condition where the pancreas's beta cells are unable to produce sufficient insulin, leading to elevated blood glucose levels. Patients with Type 1 diabetes often require daily insulin injections to regulate their blood glucose.

“Type 2 Diabetes” is a metabolic disorder characterized by insufficient insulin production or insulin resistance in the body cells. It is more common than Type 1 and often managed through lifestyle changes, non-insulin medications, and, if necessary, insulin injections.

“Blood Glucose” is the primary sugar found in the bloodstream, serving as the body's main energy source. Chronic high blood glucose levels can lead to complications from blood vessel damage.

“Hemoglobin A1c (HbA1c)” is a blood test that measures average blood glucose levels over the past 2 to 3 months. It is also referred to as the A1C or glycosylated hemoglobin test. Various factors, such as age, ethnicity, certain conditions, and pregnancy, can affect A1C results.

“Hyperglycemia” is the medical term for high blood glucose. It can occur due to inadequate fasting (fasting hyperglycemia) or post-meal (postprandial hyperglycemia).

“Hypoglycemia” is a condition characterized by abnormally low blood glucose, typically less than 70 mg/dL. Symptoms include hunger, nervousness, dizziness, confusion, and in severe cases, unconsciousness. Immediate treatment involves consuming carbohydrate-rich foods or using injectable glucagon for severe cases.

“Cardiovascular Disease” refers to a class of diseases involving the heart and blood vessels. It is a common complication in individuals with long-term Type 2 diabetes and is often a key consideration when selecting an appropriate diabetes medication.

Clinical Indications

Medical Necessity Criteria for Initial Clinical Review

Initial Indication-Specific Criteria

Type 2 Diabetes Mellitus

The Plan considers glucagon-like peptide-1 (GLP-1) receptor agonists and dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 receptor agonists (*i.e.*, incretin mimetics) medically necessary when ALL the following criteria are met:

1. The medication is age-appropriate for the member as per the FDA-approved indications; *AND*
 - *For Bydureon BCise (exenatide), Trulicity (dulaglutide), and Victoza (liraglutide), the member must be 10 years of age or older.*
 - *For other glucagon-like peptide-1 (GLP-1) receptor agonists and dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 receptor agonists, the member must be 18 years of age or older.*
2. The member has a diagnosis of type 2 diabetes mellitus based on at least ONE (1) of the following diagnostic criteria:
 - a. A fasting glucose level of greater than 126 mg/dL (7.0 mmol/L)*; *and/or*

- b. A 2-hour glucose tolerance test result of greater than 200 mg/dL (11.1 mmol/L)*; *and/or*
- c. A hemoglobin A1c (HbA1c) level of 6.5% (48 mmol/mol) or higher*; *and/or*
- d. Random plasma glucose \geq 200 mg/dL (11.1 mmol/L) with classic symptoms of hyperglycemia (e.g., frequent urination, extreme thirst, and unexplained weight loss) or hyperglycemic crisis; *AND*

3. The member has ONE (1) of the following:

- a. Is unable to use, or has adequately tried and failed metformin at a minimum effective dose of 1500 mg daily for at least 90 days; *or*
- b. Requires combination therapy to achieve glycemic control AND has an HbA1c of 7.5 percent or greater; *or*
- c. Has established Atherosclerotic Cardiovascular Disease (ASCVD) (e.g., coronary artery disease, cerebrovascular disease, peripheral arterial disease), AND the request is for ONE (1) of the following:
 - i. Liraglutide (Victoza); *or*
 - ii. Ozempic (semaglutide); *or*
 - iii. Rybelsus (semaglutide); *or*
 - iv. Trulicity (dulaglutide); *or*
- d. Has presence of multiple (2 or more) cardiovascular risk factors (e.g., hypertension, dyslipidemia, smoking, obesity, family history of premature ASCVD) AND the request is for Trulicity (dulaglutide) or Rybelsus (semaglutide); *or*
- e. Has CKD with an estimated glomerular filtration rate (eGFR) of 15 mL/min/1.73 m² or greater AND the request is for ONE (1) of the following:
 - i. Liraglutide (Victoza); *or*
 - ii. Ozempic (semaglutide); *or*
 - iii. Trulicity (dulaglutide); *and*

4. The member is not receiving a GLP-1 receptor agonist or dual GIP and GLP-1 receptor agonist in combination with a DPP-4 inhibitor or DPP-4 antidiabetic combination; *AND*

5. The requested medication will not be used concomitantly with another GLP-1 receptor agonist or dual GIP and GLP-1 receptor agonist.

If the above prior authorization criteria are met, the requested drug will be approved for up to 12-months.

Continued Care

Medical Necessity Criteria for Subsequent Clinical Review

Subsequent Indication-Specific Criteria

Type 2 Diabetes Mellitus

The Plan considers glucagon-like peptide-1 (GLP-1) receptor agonists and dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 receptor agonists (i.e., incretin mimetics) medically necessary when ALL the following criteria are met:

1. The member meets ONE (1) of the following:
 - a. A reduction in Hemoglobin A1c (HbA1c) since initiation of therapy, documented within the past 6 months; *or*
 - b. Maintenance of target HbA1c levels (e.g., HbA1c less than 7% or as determined by the treating provider based on member-specific goals); *or*
 - c. Improvement in fasting plasma glucose levels since initiation of therapy; *or*
 - d. Presence of established ASCVD, multiple cardiovascular risk factors, or chronic kidney disease (CKD) AND the requested GLP-1 receptor agonist is ONE (1) of the following agents with proven benefits in these conditions:
 - i. Liraglutide (Victoza); *or*
 - ii. Ozempic (semaglutide); *or*
 - iii. Rybelsus (semaglutide); *or*
 - iv. Trulicity (dulaglutide); *and*
2. The member is not receiving a GLP-1 receptor agonist or dual GIP and GLP-1 receptor agonist in combination with a DPP-4 inhibitor or DPP-4 antidiabetic combination; **AND**
3. The requested medication will not be used concomitantly with another GLP-1 receptor agonist or dual GIP and GLP-1 receptor agonist.

If the above reauthorization criteria are met, the requested drug will be approved for up to 12-months.

Experimental or Investigational / Not Medically Necessary

Glucagon-like peptide-1 (GLP-1) receptor agonists and dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 receptor agonists (i.e., incretin mimetics) for any other indication is considered not medically necessary by the Plan, as it is deemed to be experimental, investigational, or unproven.

NOTE - This clinical guideline specifically addresses the use of GLP-1 receptor agonists and dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 receptor agonists for type 2 diabetes mellitus. For other indications, such as weight management and cardiovascular risk reduction, please refer to the respective clinical guidelines:

- *Weight Loss Agents (PG070), for coverage criteria related to the use of GLP-1 receptor agonists or dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 receptor agonists for weight management.*
- *Wegovy for Cardiovascular Risk Reduction or Metabolic Dysfunction-Associated Steatohepatitis (MASH) (PG194), for coverage criteria related to Wegovy (semaglutide) for cardiovascular risk reduction in adults with established cardiovascular disease and obesity or overweight or Metabolic Dysfunction-Associated Steatohepatitis (MASH)*
- *Zepbound (tirzepatide) for the Treatment of Obstructive Sleep Apnea (PG255), for coverage criteria related to the use of the dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 receptor agonists Zepbound (tirzepatide) for the Treatment of Obstructive Sleep Apnea.*
- *“Type 1.5” Diabetes mellitus. Members may have features of both type 1 diabetes and type 2 diabetes; however, at this time the American Diabetes Association (ADA) “Standard of Care in Diabetes” does not yet recognize the designation of “type 1.5 diabetes.” Please see American Diabetes Association (ADA) “Standard of Care in Diabetes” Chapter 2: Diagnosis and Classification of Diabetes: Standards of Care in Diabetes—2025 figure 2.1 for a reference in these cases. The prescriber will need to determine the primary diabetes diagnosis appropriate for the member.*

References

1. Ahmann AJ, Capehorn M, Charpentier G, et al. Efficacy and Safety of Once-Weekly Semaglutide Versus Exenatide ER in Subjects With Type 2 Diabetes (SUSTAIN 3): A 56-Week, Open-Label, Randomized Clinical Trial. *Diabetes Care.* 2018 Feb;41(2):258-266. doi: 10.2337/dc17-0417. Epub 2017 Dec 15.
2. Ahrén B, Masmiquel L, Kumar H, et al. Efficacy and safety of once-weekly semaglutide versus once-daily sitagliptin as an add-on to metformin, thiazolidinediones, or both, in patients with type 2 diabetes (SUSTAIN 2): a 56-week, double-blind, phase 3a, randomised trial. *Lancet Diabetes Endocrinol.* 2017 May;5(5):341-354. doi: 10.1016/S2213-8587(17)30092-X. Epub 2017 Apr 3.
3. American College of Obstetricians and Gynecologists (ACOG) Committee on Practice Bulletins—Obstetrics. ACOG Practice Bulletin No. 190: Gestational diabetes mellitus. *Obstet Gynecol.* 2018;131(2):e49-e64.
4. American College of Obstetricians and Gynecologists (ACOG). ACOG Practice Bulletin No. 201: Pregestational diabetes mellitus. *Obstet Gynecol.* 2018;132(6):e228-e248. doi:10.1097/AOG.0000000000002960
5. American Diabetes Association Professional Practice Committee; 2. Diagnosis and Classification of Diabetes: Standards of Care in Diabetes—2025. *Diabetes Care* 1 January 2025; 48 (Supplement_1): S27-S49. <https://doi.org/10.2337/dc25-S002>.
6. American Diabetes Association Professional Practice Committee; 6. Glycemic Goals and Hypoglycemia: Standards of Care in Diabetes—2025. *Diabetes Care* 1 January 2025; 48 (Supplement_1): S128-S145. <https://doi.org/10.2337/dc25-S006>.
7. American Diabetes Association Professional Practice Committee; 8. Obesity and Weight Management for the Prevention and Treatment of Type 2 Diabetes: Standards of Care in Diabetes—2025. *Diabetes Care* 1 January 2025; 48 (Supplement_1): S167-S180. <https://doi.org/10.2337/dc25-S008>.

8. American Diabetes Association Professional Practice Committee; 9. Pharmacologic Approaches to Glycemic Treatment: Standards of Care in Diabetes—2025. *Diabetes Care* 1 January 2025; 48 (Supplement_1): S181–S206. <https://doi.org/10.2337/dc25-S009>.
9. American Diabetes Association Professional Practice Committee. 10. Cardiovascular Disease and Risk Management: Standards of Care in Diabetes-2025. *Diabetes Care*. 2025 Jan 1;48(Supplement_1):S207-S238.
10. American Diabetes Association Professional Practice Committee. 11. Chronic Kidney Disease and Risk Management: Standards of Care in Diabetes-2025. *Diabetes Care*. 2025 Jan 1;48(Supplement_1):S239-S251.
11. American Diabetes Association Professional Practice Committee; Summary of Revisions: Standards of Care in Diabetes—2025. *Diabetes Care* 1 January 2025; 48 (Supplement_1): S6–S13. <https://doi.org/10.2337/dc25-SREV>
12. American Diabetes Association Professional Practice Committee, Draznin, B., Aroda, V. R., Bakris, G., Benson, G., Brown, F. M., Freeman, R., Green, J., Huang, E., Isaacs, D., Kahan, S., Leon, J., Lyons, S. K., Peters, A. L., Prahalad, P., Reusch, J., & Young-Hyman, D. (2022). 9. Pharmacologic Approaches to Glycemic Treatment: Standards of Medical Care in Diabetes-2022. *Diabetes care*, 45(Suppl 1), S125–S143. <https://doi.org/10.2337/dc22-S009>
13. American Diabetes Association Professional Practice Committee. 8. Obesity and Weight Management for the Prevention and Treatment of Type 2 Diabetes: Standards of Care in Diabetes-2024. *Diabetes Care*. 2024 Jan 1;47(Suppl 1):S145-S157. doi: 10.2337/dc24-S008. PMID: 38078578; PMCID: PMC10725806.
14. American Diabetes Association Professional Practice Committee. 9. Pharmacologic Approaches to Glycemic Treatment: Standards of Care in Diabetes-2024. *Diabetes Care*. 2024 Jan 1;47(Suppl 1):S158-S178. doi: 10.2337/dc24-S009. Erratum in: *Diabetes Care*. 2024 Jul 1;47(7):1238. doi: 10.2337/dc24-er07a. PMID: 38078590; PMCID: PMC10725810.
15. American Diabetes Association (ADA). Standards of medical care in diabetes—2021. *Diabetes Care*. 2021;44(suppl 1):S1-S232.
16. Anderson SL, Marrs JC. Tirzepatide for type 2 diabetes. *Drugs Context*. 2023 Aug 22;12:2023-6-1. doi: 10.7573/dic.2023-6-1. PMID: 37664792; PMCID: PMC10470858.
17. Aroda VR, Bain SC, Cariou B, et al. Efficacy and safety of once-weekly semaglutide versus once-daily insulin glargine as add-on to metformin (with or without sulfonylureas) in insulin-naïve patients with type 2 diabetes (SUSTAIN 4): a randomised, open-label, parallel-group, multicentre, multinational, phase 3a trial. *Lancet Diabetes Endocrinol*. 2017 May;5(5):355-366. doi: 10.1016/S2213-8587(17)30085-2. Epub 2017 Mar 23.
18. Aroda VR, Rosenstock J, Terauchi Y, et al. PIONEER 1: Randomized Clinical Trial of the Efficacy and Safety of Oral Semaglutide Monotherapy in Comparison With Placebo in Patients With Type 2 Diabetes. *Diabetes Care*. 2019 Sep;42(9):1724-1732. doi: 10.2337/dc19-0749. Epub 2019 Jun 11.
19. Arslanian SA, Hannon T, Zeitler P, et al. Once-Weekly Dulaglutide for the Treatment of Youths with Type 2 Diabetes. *N Engl J Med*. 2022 Aug 4;387(5):433-443. doi: 10.1056/NEJMoa2204601. Epub 2022 Jun 4.
20. Bensignor MO, Bomberg EM, Bramante CT, et al. Effect of liraglutide treatment on body mass index and weight parameters in children and adolescents with type 2 diabetes: Post hoc analysis of the ellipse trial. *Pediatr Obes*. 2021 Aug;16(8):e12778. doi: 10.1111/ijpo.12778. Epub 2021 Feb 25.
21. Bergenstal RM, Wysham C, Macconell L, et al. Efficacy and safety of exenatide once weekly versus sitagliptin or pioglitazone as an adjunct to metformin for treatment of type 2 diabetes (DURATION-2): a randomised trial. *Lancet*. 2010 Aug 7;376(9739):431-9. doi: 10.1016/S0140-6736(10)60590-9. Epub 2010 Jun 26.
22. Blonde L, Umpierrez GE, Reddy SS, et al. American Association of Clinical Endocrinology Clinical Practice Guideline: Developing a Diabetes Mellitus Comprehensive Care Plan-2022 Update. *Endocr Pract*. 2022 Oct;28(10):923-1049. doi: 10.1016/j.eprac.2022.08.002. Epub 2022 Aug 11. Erratum in: *Endocr Pract*. 2023 Jan;29(1):80-81. doi: 10.1016/j.eprac.2022.12.005. PMID: 35963508; PMCID: PMC10200071.

23. Blumer I, Hadar E, Hadden DR, et al. Diabetes and pregnancy: an endocrine society clinical practice guideline. *J Clin Endocrinol Metab*. 2013;98(11):4227-4249.
24. Bosch C, Carriazo S, Soler MJ, Ortiz A, Fernandez-Fernandez B. Tirzepatide and prevention of chronic kidney disease. *Clin Kidney J*. 2022 Dec 23;16(5):797-808. doi: 10.1093/ckj/sfac274. PMID: 37151412; PMCID: PMC10157759.
25. Buse JB, Nauck M, Forst T, et al. Exenatide once weekly versus liraglutide once daily in patients with type 2 diabetes (DURATION-6): a randomised, open-label study. *Lancet*. 2013 Jan 12;381(9861):117-24. doi: 10.1016/S0140-6736(12)61267-7. Epub 2012 Nov 7.
26. Bydureon (exenatide) [prescribing information]. Wilmington, DE: AstraZeneca Pharmaceuticals LP; May 2025.
27. Bydureon BCise (exenatide) [prescribing information]. Wilmington, DE: AstraZeneca Pharmaceuticals LP; May 2025.
28. Byetta (exenatide) [prescribing information]. Wilmington, DE: AstraZeneca Pharmaceuticals LP; September 2025.
29. Conlin PR, Burke BV, Hobbs C, Hurren KM, Lang AE, Morrison JW, Spacek L, Steil EN, Watts SA, Weinreb JE, Pogach LM. Management of Type 2 Diabetes Mellitus: Synopsis of the Department of Veterans Affairs and Department of Defense Clinical Practice Guideline. *Mayo Clin Proc*. 2024 Jul 5:S0025-6196(24)00210-6. doi: 10.1016/j.mayocp.2024.04.014. Epub ahead of print. PMID: 39093266.
30. Dahl D, Onishi Y, Norwood P, et al. Effect of Subcutaneous Tirzepatide vs Placebo Added to Titrated Insulin Glargine on Glycemic Control in Patients With Type 2 Diabetes: The SURPASS-5 Randomized Clinical Trial. *JAMA*. 2022 Feb 8;327(6):534-545. doi: 10.1001/jama.2022.0078.
31. David B Sacks, Mark Arnold, George L Bakris, David E Bruns, Andrea R Horvath, Åke Lernmark, Boyd E Metzger, David M Nathan, M Sue Kirkman, Guidelines and Recommendations for Laboratory Analysis in the Diagnosis and Management of Diabetes Mellitus, *Clinical Chemistry*, Volume 69, Issue 8, August 2023, Pages 808–868, <https://doi.org/10.1093/clinchem/hvad080>
32. Davies MJ, D'Alessio DA, Fradkin J, et al. Management of hyperglycemia in type 2 diabetes, 2018. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care*. 2018;41(12):2669-2701. doi:10.2337/dc18-0033
33. Del Prato S, Kahn SE, Pavo I, et al. Tirzepatide versus insulin glargine in type 2 diabetes and increased cardiovascular risk (SURPASS-4): a randomised, open-label, parallel-group, multicentre, phase 3 trial. *Lancet*. 2021 Nov 13;398(10313):1811-1824. doi: 10.1016/S0140-6736(21)02188-7. Epub 2021 Oct 18.
34. Diamant M, Van Gaal L, Guerci B, et al. Exenatide once weekly versus insulin glargine for type 2 diabetes (DURATION-3): 3-year results of an open-label randomised trial. *Lancet Diabetes Endocrinol*. 2014 Jun;2(6):464-73. doi: 10.1016/S2213-8587(14)70029-4. Epub 2014 Apr 4. Erratum in: *Lancet Diabetes Endocrinol*. 2014 Jun;2(6):e13.
35. ElSayed NA, Aleppo G, Aroda VR, et al. 2. Classification and Diagnosis of Diabetes: Standards of Care in Diabetes-2023. *Diabetes Care* 2023; 46:S19.
36. France NL, Syed YY. Tirzepatide: A Review in Type 2 Diabetes. *Drugs*. 2024 Feb;84(2):227-238. doi: 10.1007/s40265-023-01992-4. Epub 2024 Feb 23. PMID: 38388874.
37. Frías JP, Auerbach P, Bajaj HS, et al. Efficacy and safety of once-weekly semaglutide 2.0 mg versus 1.0 mg in patients with type 2 diabetes (SUSTAIN FORTE): a double-blind, randomised, phase 3B trial. *Lancet Diabetes Endocrinol*. 2021 Sep;9(9):563-574. doi: 10.1016/S2213-8587(21)00174-1. Epub 2021 Jul 21.
38. Frias JP, Bonora E, Nevarez Ruiz L, et al. Efficacy and Safety of Dulaglutide 3.0 mg and 4.5 mg Versus Dulaglutide 1.5 mg in Metformin-Treated Patients With Type 2 Diabetes in a Randomized Controlled Trial (AWARD-11). *Diabetes Care*. 2021 Mar;44(3):765-773. doi: 10.2337/dc20-1473. Epub 2021 Jan 4.
39. Frías JP, Davies MJ, Rosenstock J, et al. Tirzepatide versus Semaglutide Once Weekly in Patients with Type 2 Diabetes. *N Engl J Med*. 2021 Aug 5;385(6):503-515. doi: 10.1056/NEJMoa2107519. Epub 2021 Jun 25.

40. Gadde KM, Vetter ML, Iqbal N, Hardy E, Öhman P; DURATION-NEO-2 study investigators. Efficacy and safety of autoinjectored exenatide once-weekly suspension versus sitagliptin or placebo with metformin in patients with type 2 diabetes: The DURATION-NEO-2 randomized clinical study. *Diabetes Obes Metab.* 2017 Jul;19(7):979-988. doi: 10.1111/dom.12908. Epub 2017 Mar 17. Erratum in: *Diabetes Obes Metab.* 2017 Sep;19(9):1332. doi: 10.1111/dom.13074.
41. Garber AJ, Handelsman Y, Grunberger G et al. Consensus statement by the American Association of Clinical Endocrinologists and American College of Endocrinology on the comprehensive type 2 diabetes management algorithm 2020 executive summary. *Endocr Pract.* 2020; 26:107-139. [PubMed 32022600]
42. Gerstein HC, Colhoun HM, Dagenais GR, et al. Dulaglutide and cardiovascular outcomes in type 2 diabetes (REWIND): a double-blind, randomised placebo-controlled trial. *Lancet.* 2019 Jul 13;394(10193):121-130. doi: 10.1016/S0140-6736(19)31149-3. Epub 2019 Jun 9.
43. Grunberger G, Sherr J, Allende M, Blevins T, Bode B, Handelsman Y, Hellman R, Lajara R, Roberts VL, Rodbard D, Stec C, Unger J. American Association of Clinical Endocrinology Clinical Practice Guideline: The Use of Advanced Technology in the Management of Persons With Diabetes Mellitus. *Endocr Pract.* 2021 Jun;27(6):505-537. doi: 10.1016/j.eprac.2021.04.008. PMID: 34116789.
44. Guja C, Frías JP, Somogyi A, et al. Effect of exenatide QW or placebo, both added to titrated insulin glargine, in uncontrolled type 2 diabetes: The DURATION-7 randomized study. *Diabetes Obes Metab.* 2018 Jul;20(7):1602-1614. doi: 10.1111/dom.13266. Epub 2018 Mar 25.
45. He L, Wang J, Ping F, et al. Association of glucagon-like peptide-1 receptor agonist use with risk of gallbladder and biliary diseases: a systematic review and meta-analysis of randomized clinical trials. *JAMA Intern Med.* 2022;182(5):513-519. doi:10.1001/jamainternmed.2022.0338
46. Honigberg MC, Chang LS, McGuire DK, Plutzky J, Aroda VR, Vaduganathan M. Use of Glucagon-Like Peptide-1 Receptor Agonists in Patients With Type 2 Diabetes and Cardiovascular Disease: A Review. *JAMA Cardiol.* 2020 Oct 1;5(10):1182-1190. doi: 10.1001/jamacardio.2020.1966. PMID: 32584928; PMCID: PMC7744318.
47. Husain M, Birkenfeld AL, Donsmark M, et al. Oral Semaglutide and Cardiovascular Outcomes in Patients with Type 2 Diabetes. *N Engl J Med.* 2019 Aug 29;381(9):841-851. doi: 10.1056/NEJMoa1901118. Epub 2019 Jun 11.
48. Jabbour SA, Frías JP, Ahmed A, et al. Efficacy and Safety Over 2 Years of Exenatide Plus Dapagliflozin in the DURATION-8 Study: A Multicenter, Double-Blind, Phase 3, Randomized Controlled Trial. *Diabetes Care.* 2020 Oct;43(10):2528-2536. doi: 10.2337/dc19-1350. Epub 2020 Aug 18.
49. Kidney Disease: Improving Global Outcomes (KDIGO) Diabetes Work Group. KDIGO 2020 clinical practice guideline for diabetes management in chronic kidney disease. *Kidney Int.* 2020;98(suppl 4):S1-S115. doi:10.1016/j.kint.2020.06.019
50. Kidney Disease: Improving Global Outcomes (KDIGO) Diabetes Work Group. KDIGO 2022 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease. *Kidney Int.* 2022 Nov;102(5S):S1-S127.
51. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney Int.* 2024 Apr;105(4S):S117-S314.
52. LeRoith D, Biessels GJ, Braithwaite SS, et al. Treatment of diabetes in older adults: an Endocrine Society* clinical practice guideline. *J Clin Endocrinol Metab.* 2019;104(5):1520-1574. doi:10.1210/jc.2019-00198
53. Ludvik B, Giorgino F, Jódar E, et al. Once-weekly tirzepatide versus once-daily insulin degludec as add-on to metformin with or without SGLT2 inhibitors in patients with type 2 diabetes (SURPASS-3): a randomised, open-label, parallel-group, phase 3 trial. *Lancet.* 2021 Aug 14;398(10300):583-598. doi: 10.1016/S0140-6736(21)01443-4. Epub 2021 Aug 6.
54. Mann JFE, Fonseca V, Mosenzon O, et al. Effects of Liraglutide Versus Placebo on Cardiovascular Events in Patients With Type 2 Diabetes Mellitus and Chronic Kidney Disease. *Circulation.* 2018 Dec 18;138(25):2908-2918. doi: 10.1161/CIRCULATIONAHA.118.036418.

55. Mann JFE, Fonseca VA, Poulter NR, et al. Safety of Liraglutide in Type 2 Diabetes and Chronic Kidney Disease. *Clin J Am Soc Nephrol*. 2020 Apr 7;15(4):465-473. doi: 10.2215/CJN.11881019. Epub 2020 Mar 4.
56. Marso SP, Bain SC, Consoli A, et al. Semaglutide and Cardiovascular Outcomes in Patients with Type 2 Diabetes. *N Engl J Med*. 2016 Nov 10;375(19):1834-1844. doi: 10.1056/NEJMoa1607141. Epub 2016 Sep 15.
57. McGuire DK, Marx N, Mulvagh SL, et al. Oral Semaglutide and Cardiovascular Outcomes in High-Risk Type 2 Diabetes. *N Engl J Med*. 2025 May 29;392(20):2001-2012. doi: 10.1056/NEJMoa2501006. Epub 2025 Mar 29.
58. Michos ED, Bakris GL, Rodbard HW, Tuttle KR. Glucagon-like peptide-1 receptor agonists in diabetic kidney disease: A review of their kidney and heart protection. *Am J Prev Cardiol*. 2023 May 24;14:100502. doi: 10.1016/j.ajpc.2023.100502. PMID: 37313358; PMCID: PMC10258236.
59. Mosenzon O, Blicher TM, Rosenlund S, et al. Efficacy and safety of oral semaglutide in patients with type 2 diabetes and moderate renal impairment (PIONEER 5): a placebo-controlled, randomised, phase 3a trial. *Lancet Diabetes Endocrinol*. 2019 Jul;7(7):515-527. doi: 10.1016/S2213-8587(19)30192-5. Epub 2019 Jun 9. Erratum in: *Lancet Diabetes Endocrinol*. 2019 Sep;7(9):e21. doi: 10.1016/S2213-8587(19)30246-3.
60. Mounjaro (tirzepatide) [prescribing information]. Indianapolis, IN: Lilly USA LLC; September 2025.
61. Nauck MA, Quast DR, Wefers J, Meier JJ. GLP-1 receptor agonists in the treatment of type 2 diabetes - state-of-the-art. *Mol Metab*. 2021 Apr;46:101102. doi: 10.1016/j.molmet.2020.101102. Epub 2020 Oct 14.
62. Ozempic (semaglutide) [prescribing information]. Plainsboro, NJ: Novo Nordisk Inc; October 2025.
63. Pratley R, Amod A, Hoff ST, et al. Oral semaglutide versus subcutaneous liraglutide and placebo in type 2 diabetes (PIONEER 4): a randomised, double-blind, phase 3a trial. *Lancet*. 2019 Jul 6;394(10192):39-50. doi: 10.1016/S0140-6736(19)31271-1. Epub 2019 Jun 8. Erratum in: *Lancet*. 2019 Jul 6;394(10192):e1. doi: 10.1016/S0140-6736(19)31519-3.
64. Perkovic V, Tuttle KR, Rossing P, et al. Effects of Semaglutide on Chronic Kidney Disease in Patients with Type 2 Diabetes. *N Engl J Med*. 2024 Jul 11;391(2):109-121. doi: 10.1056/NEJMoa2403347. Epub 2024 May 24.
65. Qaseem A, Obley AJ, Shamlivan T, Hicks LA, Harrod CS, Crandall CJ; Clinical Guidelines Committee of the American College of Physicians; Balk EM, Cooney TG, Cross JT Jr, Fitterman N, Lin JS, Maroto M, Miller MC, Shekelle P, Tice JA, Tufte JE, Etxeandia-Ikobaltzeta I, Yost J. Newer Pharmacologic Treatments in Adults With Type 2 Diabetes: A Clinical Guideline From the American College of Physicians. *Ann Intern Med*. 2024 May;177(5):658-666. doi: 10.7326/M23-2788. Epub 2024 Apr 19. PMID: 38639546; PMCID: PMC11614146.
66. Ranjan P, Vikram NK, Choranur A, et al. Executive summary of evidence and consensus-based Clinical Practice Guidelines for management of obesity and overweight in midlife women: An AIIMS-DST initiative. *Diabetes Metab Syndr*. 2022 Mar;16(3):102426. doi: 10.1016/j.dsx.2022.102426. Epub 2022 Feb 12.
67. Rodbard HW, Lingvay I, Reed J, et al. Semaglutide Added to Basal Insulin in Type 2 Diabetes (SUSTAIN 5): A Randomized, Controlled Trial. *J Clin Endocrinol Metab*. 2018 Jun 1;103(6):2291-2301. doi: 10.1210/jc.2018-00070.
68. Rodbard HW, Rosenstock J, Canani LH, et al. Oral Semaglutide Versus Empagliflozin in Patients With Type 2 Diabetes Uncontrolled on Metformin: The PIONEER 2 Trial. *Diabetes Care*. 2019 Dec;42(12):2272-2281. doi: 10.2337/dc19-0883. Epub 2019 Sep 17.
69. Romera I, Cebrián-Cuenca A, Álvarez-Guisasola F, Gomez-Peralta F, Reviriego J. A Review of Practical Issues on the Use of Glucagon-Like Peptide-1 Receptor Agonists for the Management of Type 2 Diabetes. *Diabetes Ther*. 2019 Feb;10(1):5-19.
70. Rosenstock J, Allison D, Birkenfeld AL, et al. Effect of Additional Oral Semaglutide vs Sitagliptin on Glycated Hemoglobin in Adults With Type 2 Diabetes Uncontrolled With Metformin Alone or With Sulfonylurea: The PIONEER 3 Randomized Clinical Trial. *JAMA*. 2019 Apr 16;321(15):1466-1480. doi: 10.1001/jama.2019.2942.

71. Rosenstock J, Wysham C, Frías JP, et al. Efficacy and safety of a novel dual GIP and GLP-1 receptor agonist tirzepatide in patients with type 2 diabetes (SURPASS-1): a double-blind, randomised, phase 3 trial. *Lancet*. 2021 Jul 10;398(10295):143-155. doi: 10.1016/S0140-6736(21)01324-6. Epub 2021 Jun 27. Erratum in: *Lancet*. 2021 Jul 17;398(10296):212. doi: 10.1016/S0140-6736(21)01556-7.
72. Russell-Jones D, Cuddihy RM, Hanefeld M, et al. Efficacy and safety of exenatide once weekly versus metformin, pioglitazone, and sitagliptin used as monotherapy in drug-naïve patients with type 2 diabetes (DURATION-4): a 26-week double-blind study. *Diabetes Care*. 2012 Feb;35(2):252-8. doi: 10.2337/dc11-1107. Epub 2011 Dec 30.
73. Rybelsus (semaglutide) [prescribing information]. Plainsboro, NJ: Novo Nordisk Inc; October 2025.
74. Samson SL, Vellanki P, Blonde L et al. American Association of Clinical Endocrinology Consensus Statement: Comprehensive Type 2 Diabetes Management Algorithm – 2023 Update. *Endocr Pract*. 2023 May; 29 (5):305 - 340. doi: 10.1016/j.eprac.2023.02.001. Erratum in: *Endocr Pract*. 2023 Sep;29(9):746. doi: 10.1016/j.eprac.2023.06.009. Erratum in: *Endocr Pract*. 2023 Dec;29(12):1025. doi: 10.1016/j.eprac.2023.09.008.
75. Sattar N, McGuire DK, Pavo I, Weerakkody GJ, Nishiyama H, Wiese RJ, Zoungas S. Tirzepatide cardiovascular event risk assessment: a pre-specified meta-analysis. *Nat Med*. 2022 Mar;28(3):591-598. doi: 10.1038/s41591-022-01707-4. Epub 2022 Feb 24. PMID: 35210595; PMCID: PMC8938269.
76. Saxenda (liraglutide) [prescribing information]. Plainsboro, NJ: Novo Nordisk Inc; October 2025.
77. Sorli C, Harashima SI, Tsoukas GM, et al. Efficacy and safety of once-weekly semaglutide monotherapy versus placebo in patients with type 2 diabetes (SUSTAIN 1): a double-blind, randomised, placebo-controlled, parallel-group, multinational, multicentre phase 3a trial. *Lancet Diabetes Endocrinol*. 2017 Apr;5(4):251-260. doi: 10.1016/S2213-8587(17)30013-X. Epub 2017 Jan 17.
78. Tamborlane WV, Bishai R, Geller D, et al. Once-Weekly Exenatide in Youth With Type 2 Diabetes. *Diabetes Care*. 2022 Aug 1;45(8):1833-1840. doi: 10.2337/dc21-2275.
79. Trulicity (dulaglutide) [prescribing information]. Indianapolis, IN: Eli Lilly and Company; May 2025.
80. Trujillo JM, Nuffer W, Smith BA. GLP-1 receptor agonists: an updated review of head-to-head clinical studies. *Ther Adv Endocrinol Metab*. 2021 Mar 9;12:2042018821997320. doi: 10.1177/2042018821997320.
81. Tuttle KR, Lakshmanan MC, Rayner B, et al. Dulaglutide versus insulin glargine in patients with type 2 diabetes and moderate-to-severe chronic kidney disease (AWARD-7): a multicentre, open-label, randomised trial. *Lancet Diabetes Endocrinol*. 2018 Aug;6(8):605-617. doi: 10.1016/S2213-8587(18)30104-9. Epub 2018 Jun 14.
82. Vaughan EM, Santiago-Delgado ZM. Management of Type 2 Diabetes Mellitus With Noninsulin Pharmacotherapy. *Am Fam Physician*. 2024 Apr;109(4):333-342. PMID: 38648832.
83. Victoza (liraglutide) [prescribing information]. Plainsboro, NJ: Novo Nordisk Inc; October 2025.
84. Wegovy (semaglutide) [prescribing information]. Plainsboro, NJ: Novo Nordisk Inc; October 2025.
85. Weinberg Sibony R, Segev O, Dor S, Raz I. Drug Therapies for Diabetes. *Int J Mol Sci*. 2023 Dec 5;24(24):17147. doi: 10.3390/ijms242417147. PMID: 38138975; PMCID: PMC10742594.
86. Wysham CH, Rosenstock J, Vetter ML, Dong F, Öhman P, Iqbal N. Efficacy and tolerability of the new autoinjected suspension of exenatide once weekly versus exenatide twice daily in patients with type 2 diabetes. *Diabetes Obes Metab*. 2018 Jan;20(1):165-172. doi: 10.1111/dom.13056. Epub 2017 Aug 22.
87. Writing Committee Members; ACC/AHA Joint Committee Members. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure. *J Card Fail*. 2022 May;28(5):e1-e167.
88. Zepbound (tirzepatide) [prescribing information]. Indianapolis, IN: Lilly USA LLC; September 2025.'

89. Zinman B, Nauck MA, Bosch-Traberg H, et al. Liraglutide and Glycaemic Outcomes in the LEADER Trial. *Diabetes Ther.* 2018 Dec;9(6):2383-2392. doi: 10.1007/s13300-018-0524-z. Epub 2018 Nov 3.
90. Zinman B, Aroda VR, Buse JB, et al. Efficacy, Safety, and Tolerability of Oral Semaglutide Versus Placebo Added to Insulin With or Without Metformin in Patients With Type 2 Diabetes: The PIONEER 8 Trial. *Diabetes Care.* 2019 Dec;42(12):2262-2271. doi: 10.2337/dc19-0898. Epub 2019 Sep 17.

Appendix A

Metformin in Type 2 Diabetes

⁷The recommendation for a minimum effective dose of 1500 milligrams daily of metformin is derived from clinical findings which show that this dosage effectively regulates both fasting blood glucose and glycosylated hemoglobin levels - crucial markers of long-term glucose control.

Metformin functions by decreasing glucose production in the liver and enhancing insulin sensitivity in both the liver and peripheral tissues. This enhancement in turn improves the uptake and usage of glucose. The efficacy of metformin is dose-dependent, with the most clinically meaningful responses usually not seen at doses below 1500 milligrams per day.

The strategy of starting metformin treatment at a lower dose and gradually stepping up the dose over time (typically over a period of weeks) is useful in reducing the occurrence and intensity of gastrointestinal (GI) side effects. These side effects are the most common adverse reactions linked with metformin therapy and can include symptoms such as nausea, vomiting, diarrhea, abdominal cramping, and bloating. Commencing therapy at a lower dose (for instance, 500 mg twice daily or 850 mg once daily) and progressively increasing the dosage over time allows individuals to better tolerate metformin. This results in improved medication adherence and ultimately, superior glycemic control.

- For those who need further glycemic control beyond what can be achieved with a total daily dose of 2000 mg, the dosage of metformin can be boosted up to a maximum of 2550 mg per day, given in divided doses. This upper limit is based on clinical trials that show doses above this level do not provide an additional glycemic control benefit but may increase the risk of adverse effects.
- For pediatrics, the same principle of beginning at a lower dose and incrementally increasing applies, with a maximum limit of 2000 mg per day given in divided doses.

Table 2: Metformin in Diabetes Treatment

Clinical Consideration	Recommendation
Understanding Metformin	Metformin is frequently used due to its efficacy, cost-effectiveness, and cardiovascular benefits. However, GI adverse effects are common and could limit its use.

Managing Patient Expectations	Inform individuals that side effects are often temporary and encourage patience during the dosage adjustment period.
Choosing Metformin Type	Extended-release (ER) versions are generally preferred due to fewer daily doses and reduced discontinuation rates. However, consider cost and coverage on the individual's plan.
Initiating Metformin	Start at a low dose (500 mg for ER/IR or 250 mg for those with GI intolerance history). Consider using liquid formulations or single-ingredient products for easier titration.
Dosage Increase	Gradually up titrate dosage every one to two weeks. Decrease back to the last tolerated dose if GI symptoms occur, and then try to increase more slowly.
Dosage Titration (Adults)	Dosage may be increased by 500 mg at weekly intervals until desired response or a maximum dosage is reached (2.55 g daily for immediate-release, 2.5 g for certain extended-release tablets, and 2 g for others).
Dosage Titration (Children 10–16 years)	Dosage may be increased by 500 mg at weekly intervals until desired response or a maximum dosage of 2 g daily in 2 divided doses is reached.
Maximizing Tolerance	Advice individuals to take metformin during or immediately after meals. Consider dividing doses if tolerability is an issue.
Addressing Complaints	Manage common complaints such as diarrhea and nausea by temporary dose reduction. If odor of the drug is a problem, consider switching brands or generics.
GI Tolerance Issues	If GI symptoms persist, consider using 5-HT3-antagonists like ondansetron or treating underlying Helicobacter pylori infection if present.
Insufficient Dose Tolerance	Even lower doses can improve glucose control. Consider combining metformin with another agent if necessary.
Interrupted Therapy	If therapy is interrupted, consider a full titration when restarting. Lower the dose and increase slowly if adverse effects occur upon restarting.

Clinical Guideline Revision / History Information

Original Date: 06/29/2023

Reviewed/Revised: 07/31/2023, 12/19/2024, 01/30/2025, 07/01/2025, 12/01/2025, 02/02/2026