

Novel Antidiabetic Drug Approvals in 2025: Clinical Evidence, Regulatory Milestones, and Global Market Implications

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Abstract

Background:

Diabetes mellitus remains a leading global health challenge, with 589 million adults affected in 2024 and projections exceeding 850 million by 2050 (IDF, 2025). The year 2025 marked a watershed in diabetes therapeutics, with regulatory approvals advancing beyond glycemic control to integrated cardio–renal–metabolic protection.

Objectives:

To systematically evaluate antidiabetic drug approvals in 2025, synthesize emerging clinical trial data, and assess global market and policy implications for access and affordability.

Methods:

A structured review of FDA, EMA, CDSCO, NMPA, and TGA announcements, PubMed and ClinicalTrials.gov records, and market intelligence reports (Fortune, Precedence, Polaris, IQVIA) was conducted for January–August 2025. Data included regulatory milestones, trial outcomes, biosimilar adoption, market projections, and pricing frameworks. Records were screened (n = 732), with 84 meeting inclusion criteria (23 approvals, 27 clinical trials, 34 market/policy reports).

Results:

Key regulatory approvals included semaglutide for chronic kidney disease (FLOW trial HR 0.76), insulin biosimilars Merilog (first rapid-acting biosimilar, Feb 2025) and Kirsty (first interchangeable insulin, Jul 2025), novel DPP-4 inhibitors prusogliptin and cofrogliptin (China), insulin icodec (first once-weekly basal insulin, China), tirzepatide (India, dual GIP/GLP-1), and mazdutide (world's first dual GLP-1/glucagon agonist, China). CDSCO simultaneously banned 35 irrational fixed-dose combinations, aligning safety oversight with global standards. ADA Standards of Care 2025 emphasized GLP-1 RAs and SGLT2 inhibitors for cardio-renal protection and expanded CGM use, while IDF guidance stressed equity in low- and middle-income countries. Market projections forecast diabetes drug revenues rising from USD 75.09 billion (2025) to USD 132.36 billion (2034), driven primarily by GLP-1 agonists (USD 186.64 billion by 2032). Real-world evidence demonstrated rapid tirzepatide uptake in India and expanding biosimilar adoption in the U.S. and China.

Conclusions:

The approvals of 2025 signify a paradigm shift in diabetes care toward multi-organ protection, therapeutic convenience, and affordability through biosimilars. While innovation accelerates, access disparities persist, particularly in LMICs, where price controls and procurement models will be essential to balance affordability with innovation. Future directions include triple agonists, high-dose oral incretins, incretin–amylin combinations, and AI-powered insulin delivery systems, which together are likely to redefine precision diabetes care.

Introduction

Diabetes mellitus has emerged as one of the most pressing global health challenges of the twenty-first century, with prevalence increasing at an alarming rate across both developed and developing regions. Recent estimates indicate that in 2024, approximately 589 million adults worldwide were living with diabetes, and projections suggest this number will escalate to nearly 853 million by 2050 if current trends persist (International Diabetes Federation [IDF], 2025). The overwhelming burden of type 2 diabetes mellitus (T2DM) is particularly concerning, given its association not only with hyperglycemia but also with a broad spectrum of cardio-renal and metabolic complications that contribute significantly to morbidity and mortality^{1–5}

The pathophysiology of T2DM is highly complex and extends far beyond simple dysregulation of glucose metabolism. Insulin resistance, impaired pancreatic β -cell function, chronic low-grade inflammation, endothelial dysfunction, and disturbances in lipid metabolism all converge to drive disease progression and end-organ damage (Perkovic & Tuttle, 2024). Consequently, the clinical management of T2DM requires a multifaceted approach that addresses glycemic control while simultaneously mitigating risks of cardiovascular disease, kidney dysfunction, and obesity.^{6,7} Traditional therapeutic strategies have largely centered on lowering blood glucose levels; however, this narrow focus has often failed to prevent long-term complications. Over the last decade, evidence has increasingly underscored the importance of targeting multiple organ systems through integrated pharmacological interventions.^{8,9}

A pivotal transformation in the therapeutic paradigm occurred with the emergence of glucagon-like peptide-1 receptor agonists (GLP-1 RAs) and sodium–glucose cotransporter-2 (SGLT2) inhibitors, which demonstrated cardio-renal protective effects in addition to glucose lowering. These findings shifted the treatment focus from glycemic control alone to comprehensive cardio-renal-metabolic protection (American Diabetes Association [ADA], 2025). The year 2025, in particular, stands out as a milestone in this trajectory. Several landmark regulatory approvals were granted that collectively reshaped the therapeutic landscape for diabetes care.^{10,11} Notably, the U.S. Food and Drug Administration (FDA) approved an expanded indication for semaglutide (Ozempic) for kidney disease protection based on results from the FLOW trial, marking the first GLP-1 RA indicated specifically for renal outcomes (Perkovic & Tuttle, 2024). Simultaneously, new biosimilar insulins such as Merilog and Kirsty were introduced, offering significant opportunities to enhance affordability and accessibility of essential therapies for millions of insulin-dependent patients (U.S. Food and Drug Administration [FDA], 2025a, 2025b).^{12,13}

In parallel, China's National Medical Products Administration (NMPA) approved two novel dipeptidyl peptidase-4 (DPP-4) inhibitors, prusogliptin and cofrogliptin, underscoring the country's increasing role in global diabetes innovation (China NMPA, 2025a, 2025b). India's Central Drugs Standard Control Organisation (CDSCO) authorized tirzepatide, a dual glucose-dependent insulinotropic polypeptide (GIP) and GLP-1 receptor agonist, marking another

breakthrough for patients with obesity and T2DM (CDSCO, 2025). Further, the approval of mazdutide, the world's first dual GLP-1/glucagon receptor agonist in China, and insulin icodec, a once-weekly insulin analog, highlighted the rapid diversification of therapeutic mechanisms and delivery systems (Innovent Biologics, 2025; Novo Nordisk, 2025).^{14,15}

These collective developments signify not only regulatory progress but also a broader recognition of diabetes as a complex, multi-organ disease requiring diverse therapeutic approaches. The approvals granted in 2025 are set against the backdrop of rising global prevalence, widening health disparities, and escalating healthcare costs, emphasizing the dual need for innovation and affordability.^{16,17}

The present review provides a comprehensive analysis of novel antidiabetic drug approvals in 2025, examining their clinical evidence base, regulatory significance, and potential to transform market dynamics. By integrating data from FDA, NMPA, CDSCO, and other global authorities alongside trial outcomes and economic analyses, this paper aims to highlight how 2025 has redefined diabetes therapeutics and set the stage for future advances in precision medicine and global health equity.

Methods

Data Sources and Search Strategy

We systematically searched multiple data sources to identify novel antidiabetic drug approvals, clinical trial results, safety directives, pricing data, and global policy updates between January 1, 2025, and August 15, 2025. Regulatory announcements were retrieved from the U.S. Food and Drug Administration (FDA), European Medicines Agency (EMA), Central Drugs Standard Control Organisation (CDSCO, India), National Medical Products Administration (NMPA, China), and the Therapeutic Goods Administration (TGA, Australia). Clinical evidence was identified through PubMed, ClinicalTrials.gov, the EU Clinical Trials Register, and the WHO International Clinical Trials Registry Platform (ICTRP) using keywords such as *"semaglutide," "tirzepatide," "mazdutide," "insulin icodec," "triple agonist," "oral semaglutide 25 mg," "oral semaglutide 50 mg,"* and *"CagriSema."* Market intelligence and pricing data were extracted from Fortune Business Insights, Precedence Research, Research and Markets, Polaris Market Research, The Business Research Company, and official pricing authorities including the National Pharmaceutical Pricing Authority (NPPA, India) and China's National Volume-Based Procurement (NVBP) program. Policy and guideline updates were obtained from the American Diabetes Association (ADA Standards of Care 2025), the International Diabetes Federation (IDF 2025), the Centers for Medicare & Medicaid Services (CMS, United States), the Organisation for Economic Co-operation and Development (OECD), and the Pharmaceutical Benefits Scheme/National Diabetes Services Scheme (PBS/NDSS, Australia). Only sources published in English were considered.¹⁸

Eligibility Criteria

We included documents and studies that reported: (1) regulatory approvals or label updates of novel antidiabetic drugs or biosimilars, (2) pivotal randomized controlled trials (RCTs) or phase 2/3 clinical trials evaluating relevant agents, (3) real-world adoption data with quantitative indicators such as unit sales or substitution rates, (4) market projections from established research agencies, and (5) policy frameworks addressing affordability, reimbursement, or safety oversight. Exclusion criteria were: (1) non-English reports, (2) narrative commentaries, perspectives, or opinion pieces without primary data, and (3) media reports lacking traceable primary sources.

Data Extraction and Synthesis

Two reviewers independently screened all records retrieved from regulatory databases, trial registries, and market sources. Extracted data included drug name, class, mechanism, approval date, regulatory agency, and primary indication, as well as trial design, sample size, primary and secondary outcomes, hazard ratios, and tolerability findings. For market and policy data, we collected global and regional revenue projections, compound annual growth rates (CAGR), pricing structures (list vs negotiated), reimbursement frameworks, and procurement policies. Policy analysis specifically focused on IRA reforms in the United States, NRDL/NVBP frameworks in China, NPPA price control in India, and PBS/NDSS subsidies in Australia. Discrepancies between reviewers were resolved by consensus. Data were synthesized into thematic categories—regulatory approvals, clinical outcomes, biosimilar adoption, market projections, pipeline innovations, and equity considerations—and results were summarized in narrative form with supporting tables and figures.

Flow of Study Selection

The search initially identified 732 records across databases, regulatory agencies, and market reports. After removal of duplicates, 689 records were screened by title and abstract. Of these, 511 were excluded for being narrative commentaries, editorials, or media reports without primary data. The remaining 178 full-text articles and reports were assessed for eligibility. After excluding 94 records that lacked clinical outcomes, regulatory confirmation, or English translation, 84 records were included in the final synthesis. This dataset comprised 23 regulatory approvals or label updates, 27 clinical trial reports, and 34 market or policy reports. A flow diagram summarizing this process is presented in Fig. 1

Result

Landmark Regulatory Approvals in 2025

Semaglutide (Ozempic) – Kidney Disease Indication

On January 28, 2025, the U.S. Food and Drug Administration (FDA) expanded the label of semaglutide (Ozempic®) to include a chronic kidney disease (CKD) protection indication in adults with type 2 diabetes mellitus (T2DM) and CKD (U.S. Food and Drug Administration [FDA], 2025a). This represented the first

approval of a GLP-1 receptor agonist for renal outcomes, establishing a new therapeutic benchmark. The approval was based on the pivotal FLOW trial (NCT03819153), a randomized, double-blind, placebo-controlled outcomes study enrolling 3,533 participants across 28 countries. Results showed a 24% reduction in the composite primary endpoint of sustained $\geq 50\%$ eGFR decline, end-stage kidney disease, renal death, or cardiovascular death (HR 0.76; 95% CI, 0.66–0.88; $p = 0.0003$) (Perkovic & Tuttle, 2024). Secondary analyses confirmed consistent benefits across major outcomes: kidney-specific composite (HR 0.79; 95% CI, 0.66–0.94), cardiovascular death (HR 0.71; 95% CI, 0.56–0.89), major adverse cardiovascular events (HR 0.82; 95% CI, 0.68–0.98), and all-cause mortality (HR 0.80; 95% CI, 0.67–0.95). The mean annual eGFR decline was attenuated by 1.16 mL/min/1.73m² in semaglutide recipients compared with placebo (FLOW Trial Investigators, 2024). These findings are summarized graphically in Fig. 2, which demonstrates hazard ratios and confidence intervals for the key endpoints.^{19,20}

Forest plot showing hazard ratios (95% CI) for the composite kidney + cardiovascular endpoint and major secondary outcomes from the FLOW trial (Perkovic & Tuttle, 2024; FDA, 2025a).

The regulatory impact was global. In December 2024, the European Medicines Agency (EMA)’s Committee for Medicinal Products for Human Use (CHMP) adopted a positive opinion for semaglutide’s kidney indication (European Medicines Agency [EMA], 2024). Subsequently, the Therapeutic Goods Administration (TGA) of Australia approved the indication in August 2025 (Therapeutic Goods Administration [TGA], 2025). Collectively, these decisions illustrate growing harmonization of regulatory approaches in addressing the multi-organ burden of diabetes. The clinical implications are profound: semaglutide now provides validated renal and cardiovascular protection in addition to glycemic and weight benefits.^{21–24} This expands treatment beyond glucose control to a comprehensive cardio-renal-metabolic approach, shifting practice guidelines across endocrinology, nephrology, and cardiology (American Diabetes Association [ADA], 2025). The approval of semaglutide is contextualized within a broader wave of 2025 antidiabetic drug approvals (Table 1).

Table 1 Summary of 2025 Novel Antidiabetic Drug Approvals								
Drug (Brand)	Class / Mechanism	Sponsor	Regulatory Agency (Region)	Approval / Action Date (2025)	Indication / Use	Key Trial / Evidence	Primary Endpoint & Effect Size	D P
Semaglutide (Ozempic)	GLP-1 receptor agonist	Novo Nordisk	FDA (US); TGA (AU); EMA CHMP positive opinion (EU)	Jan 28 (FDA); Aug 20 (TGA label expansion)	Reduce risk of worsening kidney disease, kidney failure, and CV death in adults with T2D + CKD	FLOW (NCT03819153)	Composite kidney/CV death HR 0.76 (95% CI, 0.66–0.88)	0 1 p p
Merilog (insulin aspart-szjj)	Rapid-acting insulin biosimilar to NovoLog	Sanofi-Aventis U.S. LLC	FDA (US)	Feb 14	Improve glycemic control in adults and pediatric patients with diabetes mellitus	Biosimilarity analytical/PK-PD + clinical confirmatory	No clinically meaningful differences vs reference; mealtime glucose control	1 n p &
Kirsty (insulin aspart-xjhz)	Rapid-acting insulin biosimilar (interchangeable) to NovoLog	Biocon Biologics	FDA (US)	Jul 15	Improve glycemic control in adults and pediatric patients with diabetes mellitus	Switching study + totality-of-evidence for interchangeability	Meets statutory standards for interchangeability (automatic substitution)	1 p (s d (s
Prusogliptin (Shan Ze Ping)	DPP-4 inhibitor	CSPC Ouyi Pharmaceutical	NMPA (China)	Jan 8	Type 2 diabetes in adults	Phase III dossier (China)	HbA1c reduction vs comparator/placebo (per dossier)	0
Cofrogliptin (曹福)	DPP-4 inhibitor	Haisco Pharmaceutical Group	NMPA (China)	Feb 19	Improve blood glucose control in adults with T2D	Phase III dossier (China)	HbA1c reduction vs comparator/placebo (per dossier)	0
Insulin icodec (Awiqli)	Once-weekly basal insulin analog	Novo Nordisk	NMPA (China)	Feb 19 (public English site update)	Adults with type 2 diabetes (China)	ONWARDS Phase 3 program	HbA1c reduction non-inferior/superior vs daily basal insulins depending on trial	1 o p
Tirzepatide (Mounjaro KwikPen)	Dual GIP/GLP-1 receptor agonist	Eli Lilly and Company	CDSCO (India)	Jun (availability announced Aug 2025)	Adjunct to diet/exercise for T2D; obesity indication per local label	SURPASS program	HbA1c and body weight reduction vs comparators	0 K n s
Mazdutide	Dual GLP-1/glucagon receptor agonist	Innovent Biologics (licensed from Eli Lilly)	NMPA (China)	Jun 27	Chronic weight management (overweight/obesity, adults)	DREAMS & GLORY programs; Phase 3 vs dulaglutide (T2D)	Weight loss and HbA1c superiority vs placebo / dulaglutide (per trials)	A v s

Table 1 provides a consolidated overview of novel antidiabetic drug approvals during the year 2025, across multiple therapeutic classes and global regulatory regions. Abbreviations: FDA = U.S. Food and Drug Administration; TGA = Therapeutic Goods Administration (Australia); EMA = European Medicines Agency; NMPA = National Medical Products Administration (China); CDSCO = Central Drugs Standard Control Organisation (India); GLP-1 RA = glucagon-like peptide-1

receptor agonist; GIP = glucose-dependent insulinotropic polypeptide; DPP-4 = dipeptidyl peptidase-4; CKD = chronic kidney disease; CV = cardiovascular; HR = hazard ratio; HbA1c = glycated hemoglobin.

Primary endpoints and effect sizes were extracted from pivotal trials and regulatory documentation. For semaglutide (Ozempic®), data are derived from the FLOW trial (NCT03819153), which demonstrated a 24% relative risk reduction in composite kidney and cardiovascular outcomes (Perkovic & Tuttle, 2024; FDA, 2025a). Insulin biosimilar approvals (Merilog® and Kirsty®) were based on comprehensive biosimilarity assessments and switching studies meeting FDA criteria for interchangeability (FDA, 2025b; FDA, 2025c). Approvals of prusogliptin and cofrogliptin in China represent Category 1 innovative drugs developed under expedited pathways (NMPA, 2025a; 2025b). Insulin icodec (Awiqli®) marked the first once-weekly basal insulin, supported by the ONWARDS clinical program (Novo Nordisk, 2025). Tirzepatide (Mounjaro®) and mazdutide approvals highlight the expansion of dual-acting incretin therapies, with tirzepatide being the first dual GIP/GLP-1 agonist in India, and mazdutide the first globally approved dual GLP-1/glucagon receptor agonist (CDSCO, 2025; Innovent Biologics, 2025).

The inclusion of sponsor, dosage forms, and regional variations underscores the heterogeneity of global access and the dual trends of innovation (GLP-1 RAs, dual agonists, once-weekly insulins) and affordability (biosimilars). While data presented reflect the most recent regulatory communications and peer-reviewed trial results, post-marketing surveillance and real-world evidence will be essential for confirming long-term efficacy and safety across diverse patient populations.

Insulin Biosimilars

A landmark in 2025 diabetes care was the approval of two major insulin biosimilars in the United States, addressing the urgent issue of insulin affordability. For decades, insulin pricing has remained a global controversy, with millions of patients struggling to afford essential therapy. In the United States alone, approximately 8.4 million patients rely on insulin, many of whom experience high out-of-pocket costs (American Diabetes Association [ADA], 2025). Against this backdrop, the FDA's approval of Merilog® in February 2025 and Kirsty® in July 2025 marked critical advances in patient access.²⁵

Merilog (Insulin Aspart-szjj): First Rapid-Acting Biosimilar

On February 14, 2025, the U.S. FDA approved Merilog® (insulin aspart-szjj), manufactured by Sanofi-Aventis, as the first rapid-acting insulin biosimilar in the U.S. market (FDA, 2025b). Merilog is biosimilar to Novo Nordisk's NovoLog® (insulin aspart) and is indicated for improving glycemic control in both adults and pediatric patients with diabetes mellitus.^{26,27} Approval was based on a totality-of-evidence approach, which included extensive analytical, nonclinical, and clinical confirmatory data. The FDA concluded that there were no clinically meaningful differences between Merilog and NovoLog in terms of purity, potency, safety, or efficacy (FDA, 2025b). Importantly, Merilog was launched in both 10 mL multiple-dose vials and 3 mL SoloStar prefilled pens, offering flexibility in clinical practice (Sanofi, 2025).

Kirsty (Insulin Aspart-xjhz): First Interchangeable Rapid-Acting Insulin

The FDA expanded this biosimilar landscape further on July 15, 2025, when it approved Kirsty® (insulin aspart-xjhz), developed by Biocon Biologics, as the first interchangeable rapid-acting insulin aspart biosimilar (FDA, 2025c). This designation is highly significant: under U.S. law, an "interchangeable" biosimilar can be substituted at the pharmacy level without prescriber intervention, subject to state pharmacy laws. The designation was supported by results from a randomized phase 3 switching study (NCT03760068) involving 478 patients with type 1 diabetes over 24 weeks, comparing insulin aspart-xjhz to NovoLog®. Findings showed no clinically meaningful differences in efficacy, immunogenicity, or safety between the biosimilar and its reference product (Biocon Biologics, 2025).

Clinical and Market Implications

The introduction of Merilog and Kirsty represents a major step forward in affordability. Insulin biosimilars are projected to reduce treatment costs by 21–79% depending on market dynamics, potentially saving billions in healthcare expenditures over the next decade (Research and Markets, 2025). By expanding treatment accessibility, biosimilars are expected to improve adherence and glycemic control, thereby lowering the risk of long-term diabetes complications. In the broader context of 2025, these approvals align with global trends emphasizing sustainability in diabetes care—balancing innovation (e.g., semaglutide renal indication, dual agonists) with affordability through biosimilars (see Table 1). The regulatory milestones of Merilog and Kirsty are visually situated in the 2025 drug approval timeline (Fig. 3).

This figure depicts the chronological sequence of landmark regulatory approvals for novel antidiabetic therapies in 2025. Approvals in the United States (FDA, [11](#)) included semaglutide (Ozempic®) with a chronic kidney disease indication (January 28), Merilog® (insulin aspart-szjj), the first rapid-acting insulin biosimilar (February 14), and Kirsty® (insulin aspart-xjhz), the first interchangeable rapid-acting insulin biosimilar (July 15). In China (NMPA, [12](#)), prusogliptin (January 8) and cofrogliptin (February 19) were approved as novel DPP-4 inhibitors, followed by insulin icodec (Awiqli®), the first once-weekly basal insulin (February 19), and mazdutide, the world's first dual GLP-1/glucagon receptor agonist (June 27). In India (CDSCO, [13](#)), tirzepatide (Mounjaro®) received approval on June 26 as the first dual GIP/GLP-1 receptor agonist available in that market. Finally, in Australia (TGA, [14](#)), semaglutide's CKD indication was expanded in August 2025. Together, these regulatory milestones highlight 2025 as a watershed year for diabetes therapeutics, integrating innovations in multi-organ protection, biosimilar affordability, and dual-acting incretin strategies.²⁸

Novel DPP-4 Inhibitors (China)

Prusogliptin (Shan Ze Ping, CSPC Ouyi)

In January 2025, the National Medical Products Administration (NMPA) approved prusogliptin (司格列汀, Shan Ze Ping), developed by CSPC Ouyi, as a Category 1 innovative DPP-4 inhibitor (CSPC Pharmaceutical Group, 2025; NMPA, 2025a). In pivotal phase 3 studies, once-daily prusogliptin 100 mg demonstrated significant HbA1c reduction (– 0.61% vs placebo at 24 weeks) and was non-inferior to sitagliptin 100 mg, with efficacy sustained through 52 weeks (Wang et al., 2024). When added to metformin, prusogliptin achieved a placebo-adjusted HbA1c reduction of – 0.63%, with neutral effects on body weight and minimal hypoglycemia risk (Xu et al., 2022). Pharmacokinetic analyses confirmed stable inhibition of DPP-4 activity, and no dose adjustments were required in patients with mild to moderate renal impairment (Liu et al., 2025).

Cofrogliptin (Bei Chang Ping, Haisco)

On February 19, 2025, the NMPA approved cofrogliptin (倍格列汀, Bei Chang Ping), developed by Haisco Pharmaceutical, as another Category 1 innovative drug (NMPA, 2025b). Cofrogliptin is the world’s first ultra-long-acting oral DPP-4 inhibitor, with a dosing interval of once every two weeks (Q2W). In a large phase 3 non-inferiority trial, cofrogliptin 10 mg or 25 mg Q2W achieved HbA1c reductions of – 0.6% to – 1.0% and was non-inferior to linagliptin 5 mg QD; benefits were maintained during a 28-week open-label extension (Ren et al., 2024; Gao et al., 2025). This extended-interval dosing model, informed by model-informed drug development (MIDD) approaches, reduces pill burden and has the potential to improve long-term adherence in real-world practice (Gao et al., 2024).²⁹

Mechanistic Rationale and Class Effects

Both prusogliptin and cofrogliptin exert their effect by inhibiting dipeptidyl peptidase-4 (DPP-4), thereby increasing circulating levels of GLP-1 and GIP. This mechanism enhances glucose-dependent insulin secretion from β-cells, suppresses glucagon secretion from α-cells, reduces hepatic glucose production, and slows gastric emptying (Florentin et al., 2022; Åhrén, 2019). The result is improved glycemic control with weight neutrality and a low intrinsic risk of hypoglycemia, especially when not combined with sulfonylureas or insulin. These mechanistic and clinical features are illustrated in Fig. 4.

Figure 4. Mechanism of DPP-4 inhibition and clinical outcomes. By preventing incretin degradation, prusogliptin and cofrogliptin enhance glucose-dependent insulin secretion, reduce glucagon, slow gastric emptying, and lower hepatic glucose output, leading to improved HbA1c with weight neutrality and low hypoglycemia risk.³⁰

Comparative Clinical and Regulatory Profiles

While both agents belong to the same class, their clinical positioning diverges. Prusogliptin represents a daily oral DPP-4 inhibitor with a profile similar to existing class members, but with the distinction of being locally innovated in China. In contrast, cofrogliptin’s biweekly dosing represents a global first, targeting adherence and treatment convenience. Their complementary characteristics highlight the dual direction of China’s antidiabetic drug strategy in 2025: incremental clinical innovation and pharmacokinetic breakthroughs. This contrast is summarized in Table 2 and illustrated in Figure 5.

Table 2. Comparative profile of novel DPP-4 inhibitors approved in China (2025)

Attribute	Prusogliptin (DBPR108, 司格列汀)	Cofrogliptin (HSK7653, 倍格列汀)
Sponsor/Developer	CSPC Ouyi Pharmaceutical	Haisco Pharmaceutical Group
Regulatory pathway / status	NMPA approval, Category 1 innovative drug(Jan 2025)	NMPA approval, Category 1 innovative drug(Feb 2025)
Official approval communication	Sponsor announcement Jan 13, 2025; NMPA English portal posted Jun 11, 2025	NMPA English portal announcement Feb 19, 2025
Indication	Glycemic control in adults with T2DM (monotherapy or add-on to metformin)	Glycemic control in adults with T2DM
Studied dosing regimen	100 mg once daily (OD)	10 mg or 25 mg once every two weeks (Q2W)
Phase 3 design (headline)	Double-blind RCT: prusogliptin 100 mg vs sitagliptin 100 mg vs placebo (24 wks DB + 28 wks OL extension)	Add-on to metformin: randomized, double-blind, non-inferiority vs daily linagliptin 5 mg (24 wks DB + 28-wk OL extension)
Primary efficacy results	HbA1c reduction vs placebo: –0.61% (95% CI –0.77, –0.44) at wk 24; non-inferior to sitagliptin (Δ –0.03%, 95% CI –0.19, 0.13) (Wang et al., 2024)	HbA1c reduction: –0.6% to –1.0% at wk 24; non-inferior to linagliptin 5 mg QD; efficacy similar for 10 and 25 mg doses (Ren et al., 2024; Gao et al., 2025)
Add-on evidence	Placebo-adjusted HbA1c –0.63% at 24 wks as add-on to metformin; no weight gain (Xu et al., 2022)	Maintained HbA1c reductions during 28-wk open-label extension with 25 mg Q2W (Gao et al., 2025)
Weight / hypoglycemia profile	Weight-neutral; low intrinsic hypoglycemia risk (unless combined with SU/insulin)	Weight-neutral; low intrinsic hypoglycemia risk (unless combined with SU/insulin)
Renal considerations	No dose adjustment required in mild–moderate renal impairment (CSPC, 2025)	Not emphasized in approval notice; dosing per final Chinese label
Mechanistic/PK highlight	Stable once-daily DPP-4 inhibition confirmed in PK/PD studies (Liu et al., 2025)	Ultralong-acting inhibitor; MIDD modeling supported extended Q2W dosing (Gao et al., 2024)

NMPA = National Medical Products Administration; RCT = randomized controlled trial; DB = double-blind; OL = open-label; QD = once daily; Q2W = once every 2 weeks; T2DM = type 2 diabetes mellitus; SU = sulfonylurea; PK/PD = pharmacokinetic/pharmacodynamic; MIDD = model-informed drug development. Table 2 compares the two Category 1 innovative DPP-4 inhibitors approved in China in 2025. Prusogliptin (Shan Ze Ping, CSPC) was approved in January 2025 following phase 3 trials demonstrating non-inferiority to sitagliptin and significant HbA1c reduction with low risk of hypoglycemia (Wang et al., 2024; Xu et al., 2022). Cofrogliptin (Bei Chang Ping, Haisco) was approved in February 2025 as the world's first ultra-long-acting, Q2W DPP-4 inhibitor, confirmed in non-inferiority trials against daily linagliptin with durable glycemic benefits (Ren et al., 2024; Gao et al., 2024, 2025). Both agents maintain the class advantages of weight neutrality and glucose-dependent action, minimizing hypoglycemia risk (Florentin et al., 2022; Ahrén, 2019).

Advanced Insulin Formulations

Insulin Icodec (Awiqli) — A Once-Weekly Basal Insulin

In February 2025, the National Medical Products Administration (NMPA) approved insulin icodec injection (Awiqli®, 艾威利), developed by Novo Nordisk, as the world's first once-weekly basal insulin. Unlike daily basal insulins (e.g., insulin glargine, insulin degludec), insulin icodec is engineered with a C20 fatty diacid side chain that binds strongly but reversibly to serum albumin, forming a circulating depot for sustained, slow release over seven days. This pharmacological profile provides flat, stable insulin levels, reducing variability and supporting effective glycemic control with just one injection per week.³¹

Clinical Evidence — ONWARDS Phase 3 Program

The ONWARDS clinical program, comprising six pivotal trials, evaluated insulin icodec in insulin-naïve and insulin-experienced patients with type 2 diabetes (T2D) as well as individuals with type 1 diabetes (T1D).

- In insulin-naïve T2D patients, once-weekly icodec achieved HbA1c reductions of ~ 1.3%, non-inferior to daily insulin degludec, with no increase in severe hypoglycemia (ONWARDS 1, 2).
- In insulin-experienced T2D patients, icodec maintained glycemic control comparable to glargine U100, with high patient satisfaction (ONWARDS 3, 4).
- In T1D, ONWARDS 6 confirmed non-inferiority but emphasized the need for careful titration and education to minimize hypoglycemia risk.

Collectively, the ONWARDS data demonstrated that weekly dosing did not compromise safety or efficacy, with treatment satisfaction significantly higher among patients randomized to icodec.

Adherence and Patient-Centered Benefits

The once-weekly dosing reduces the injection burden from 365 to 52 injections per year, directly addressing patient concerns of treatment fatigue, complexity, and injection anxiety. Early patient-reported outcomes highlight greater confidence, less distress, and improved quality of life with icodec compared to daily insulins. This innovation may help overcome therapeutic inertia, a major barrier to timely insulin initiation. Furthermore, by lowering injection frequency, insulin icodec has the potential to improve adherence in low- and middle-income settings, where irregular dosing and supply chain issues often compromise glycemic control.

Clinical and Regulatory Significance

The 2025 approval of insulin icodec represents a transformative advancement in insulin therapy. By combining a novel albumin-binding mechanism with proven glycemic efficacy and favorable safety, insulin icodec has the potential to reshape the landscape of basal insulin therapy, simplify patient care, and improve long-term outcomes globally.

Table 3
Clinical and regulatory profile of insulin icodec (Awiqli®) compared with traditional basal insulins

Attribute	Insulin Icodec (Awiqli®, Novo Nordisk)	Daily Basal Insulins (Glargine, Degludec)
Regulatory milestone	Approved by NMPA (China), Feb 2025; under review by EMA, FDA, TGA	Approved globally over 2000s–2010s
Molecular mechanism	Insulin analog with C20 fatty diacid side chain → reversible albumin binding → slow continuous release	Modified amino acid sequences; protraction via zinc or fatty acid chains → once-daily action
Dosing frequency	Once weekly (QW)	Once daily (QD)
ONWARDS trial HbA1c effect	HbA1c reduction ~ 1.3% in T2D (non-inferior to degludec, glargine)	HbA1c reduction ~ 1.2–1.4% depending on regimen
Hypoglycemia risk	Comparable to daily insulins in T2D; caution in T1D (ONWARDS 6)	Well-established, generally low with optimized titration
Patient satisfaction	Significantly higher vs daily basal insulins; reduced injection anxiety and distress	Lower; injection fatigue commonly reported
Adherence benefits	52 injections/year; lower risk of missed doses; potential to reduce therapeutic inertia	365 injections/year; higher risk of poor adherence
Market significance	First once-weekly insulin approved; positions Novo Nordisk as leader in basal insulin innovation	Standard of care for two decades

NMPA = National Medical Products Administration; EMA = European Medicines Agency; FDA = U.S. Food and Drug Administration; TGA = Therapeutic Goods Administration; QD = once daily; QW = once weekly; T2D = type 2 diabetes; T1D = type 1 diabetes.

Dual and Novel Mechanism Drugs

Tirzepatide: Dual GIP/GLP-1 Receptor Agonist (India, June 2025)

In June 2025, the Central Drugs Standard Control Organisation (CDSCO) of India approved tirzepatide (Mounjaro®, Eli Lilly), expanding access to the world's first dual glucose-dependent insulintropic polypeptide (GIP) and glucagon-like peptide-1 (GLP-1) receptor agonist in this market (Reuters, 2025; Business Standard, 2025; BioSpectrum India, 2025). The KwikPen formulation was authorized for once-weekly subcutaneous administration across titration doses ranging from 2.5 mg to 15 mg. The efficacy of tirzepatide has been established through the SURPASS phase 3 program. In the pivotal SURPASS J-mono trial, conducted in Japanese patients with type 2 diabetes, tirzepatide demonstrated superior glycemic efficacy and body weight reduction compared with dulaglutide 0.75 mg, which is the standard comparator dose in Japan (Kadowaki et al., 2022). At 52 weeks, tirzepatide 5 mg, 10 mg, and 15 mg achieved mean HbA1c reductions of – 2.37% to – 2.55%, compared with – 1.30% for dulaglutide, alongside dose-dependent weight loss (Kadowaki et al., 2022). Patient-reported outcomes confirmed higher treatment satisfaction with tirzepatide relative to dulaglutide (Terauchi et al., 2022). Furthermore, the recently completed SURPASS-CVOT trial (2025) demonstrated that tirzepatide was non-inferior to dulaglutide for major adverse cardiovascular events (MACE). Notably, there were signals suggesting potential benefit in all-cause mortality and renal outcomes, although these require validation in full peer-reviewed publications (Lilly, 2025).³²

Mazdutide: Dual GLP-1/Glucagon Receptor Agonist (China, June 2025)

On June 27, 2025, the National Medical Products Administration (NMPA) of China granted marketing approval for mazdutide (Innovent Biologics/Eli Lilly), the world's first dual GLP-1/glucagon receptor agonist (Innovent Biologics, 2025; FiercePharma, 2025). The approval was for the indication of chronic weight management in adults with overweight or obesity, making China the first country globally to authorize this novel therapeutic class. Evidence supporting approval came from the DREAMS-2 phase 3 trial, presented at the European Association for the Study of Diabetes (EASD) 2024 congress. At 28 weeks, mazdutide achieved non-inferiority and subsequently superiority to dulaglutide 1.5 mg for both HbA1c reduction and weight loss, while also improving secondary cardiometabolic endpoints, including blood pressure, lipid parameters, uric acid, and liver enzyme levels (DREAMS-2 Investigators, 2024). In earlier phase 2 obesity studies, mazdutide 9 mg demonstrated a placebo-adjusted weight loss of approximately 18.6% at 48 weeks, one of the most substantial reductions reported for any incretin-based therapy to date (Liu et al., 2023).

Comparative Perspective with Dulaglutide

Both tirzepatide and mazdutide represent important advancements beyond conventional GLP-1 receptor agonists, yet they differ in their mechanisms of action. Tirzepatide enhances incretin signaling by simultaneously activating GIP and GLP-1 receptors, leading to synergistic effects on insulin secretion, glucagon suppression, and weight reduction. Mazdutide, in contrast, combines GLP-1 receptor activation with glucagon receptor agonism, leveraging the glucagon pathway to increase energy expenditure and weight loss, while retaining glycemic efficacy. When benchmarked against dulaglutide, a widely used GLP-1 receptor agonist, both agents demonstrated superior efficacy in glycemic control and weight loss in head-to-head clinical trials (Kadowaki et al., 2022; DREAMS-2 Investigators, 2024). These 2025 approvals highlight a therapeutic shift toward multi-pathway incretin and glucagon-based pharmacology, with implications for both diabetes management and obesity treatment.³³

Table 4
Dual/novel mechanism antidiabetic drugs approved in 2025: regulatory status, mechanisms, and comparative efficacy

Attribute	Tirzepatide (Mounjaro®, Eli Lilly)	Mazdutide (Innovent/Eli Lilly)
Mechanism	Dual GIP/GLP-1 receptor agonist	Dual GLP-1/glucagon receptor agonist
Regulatory approval (2025)	India – CDSCO (approved June 26, 2025; 2.5–15 mg weekly KwikPen) (Reuters, 2025; Business Standard, 2025)	China – NMPA (approved June 27, 2025 for chronic weight management) (Innovent Biologics, 2025; FiercePharma, 2025)
Primary indication (2025)	Type 2 diabetes (secondary weight loss)	Chronic weight management (type 2 diabetes indication under investigation)
Dosing	Once-weekly titrated KwikPen, 2.5–15 mg	Once-weekly subcutaneous dosing (per China label)
Head-to-head comparator	Dulaglutide 0.75 mg (Japan)	Dulaglutide 1.5 mg (China)
HbA1c reduction vs dulaglutide	SURPASS J-mono (52 wks): Tirzepatide – 2.37% to – 2.55% vs dulaglutide – 1.30% (Kadowaki et al., 2022)	DREAMS-2 (28 wks): Superior HbA1c reduction after non-inferiority (DREAMS-2 Investigators, 2024)
Weight effect vs dulaglutide	Significant dose-dependent weight reduction; consistently greater than dulaglutide (Kadowaki et al., 2022; Terauchi et al., 2022)	Superior weight reduction vs dulaglutide; Phase 2 obesity trial: ~18.6% placebo-adjusted loss at 48 wks (Liu et al., 2023)
Cardiovascular outcomes	SURPASS-CVOT (2025): Non-inferior to dulaglutide for MACE; signals for mortality and renal benefit (Lilly, 2025)	CV outcomes not yet available; metabolic improvements suggest potential future benefit
Safety profile	GI adverse events (nausea, vomiting, diarrhea); generally transient and dose-dependent	GI adverse events; class-consistent tolerability; glucagon-related metabolic effects monitored
Clinical significance	First dual GIP/GLP-1 receptor agonist in India; superior efficacy over dulaglutide	First GLP-1/glucagon receptor agonist globally; largest weight reduction among incretin agents

CDSCO = Central Drugs Standard Control Organisation; NMPA = National Medical Products Administration; GIP = glucose-dependent insulintropic polypeptide; GLP-1 = glucagon-like peptide-1; CVOT = cardiovascular outcomes trial; MACE = major adverse cardiovascular events; SC = subcutaneous. *Tirzepatide was approved in India in June 2025, supported by data from the SURPASS program, particularly the SURPASS J-mono trial, which confirmed HbA1c and weight-loss superiority over dulaglutide 0.75 mg (Kadowaki et al., 2022; Terauchi et al., 2022). The SURPASS-CVOT trial further demonstrated cardiovascular safety compared with dulaglutide (Lilly, 2025). Mazdutide, approved in China in June 2025, was the first dual GLP-1/glucagon agonist to receive regulatory authorization, showing superiority over dulaglutide 1.5 mg in the DREAMS-2 trial (DREAMS-2 Investigators, 2024) and achieving unprecedented weight loss in phase 2 obesity studies (Liu et al., 2023). Together, these agents signal a paradigm shift toward multi-hormonal incretin-based therapies.*

Regulatory Safety Oversight

CDSCO ban on 35 fixed-dose combinations (April 2025)

On 11 April 2025, India's Central Drugs Standard Control Organisation (CDSCO) ordered an immediate prohibition on the manufacture, sale, and distribution of 35 fixed-dose combinations (FDCs). The directive (File No. 4 – 01/2023-DC [Misc. 3]) was communicated to all State and Union Territory Drugs Controllers, highlighting that these FDCs had been licensed by state regulators without mandatory central evaluation as required under the New Drugs and Clinical Trials (NDCT) Rules, 2019 (CDSCO, 2025). The annexure listed 35 formulations across multiple therapeutic areas, including antidiabetic combinations. The decision followed recommendations by the Drugs Technical Advisory Board (DTAB) and addressed longstanding concerns about irrational FDCs in India. Such formulations were found to lack robust scientific evidence, including pharmacokinetic justification, dose-ranging trials, and phase 3 randomized controlled trials. Moreover, many of these combinations were associated with pharmacodynamic overlap (e.g., dual insulin secretagogues), heightened risk of hypoglycemia, and unnecessary polypharmacy.³⁴

Table 5
CDSCO's April 2025 regulatory action on 35 FDCs: scope, rationale, and implications

Attribute	Details
Regulator & document	Central Drugs Standard Control Organisation (CDSCO), DCGI letter (File No. 4 – 01/2023-DC [Misc. 3]) dated 11 April 2025
Action taken	Halt to manufacture, sale, and distribution of 35 listed FDCs; communicated as “urgent and serious”
Legal framework	Based on NDCT Rules, 2019 under the Drugs & Cosmetics Act (1940)
Problem identified	FDCs licensed by state authorities without CDSCO approval; lack of evidence for safety and efficacy
Examples of affected categories	Antidiabetic agents (e.g., sulfonylurea + meglitinide, triple oral agents including metformin + sulfonylurea + DPP-4 inhibitor), along with combinations in analgesics and antibiotics
Safety rationale	- Pharmacodynamic incompatibility (risk of severe hypoglycemia) - Absence of dose-optimization and bioequivalence studies - Increased potential for adverse drug reactions
Policy significance	- Strengthens center–state regulatory harmonization - Reinforces evidence-based approval standards - Brings CDSCO closer to FDA/EMA regulatory frameworks
Clinical implications	- Clinicians advised to transition patients from irrational FDCs to rational, guideline-endorsed dual therapies (e.g., metformin + SGLT2 inhibitor) - Highlights importance of individualized therapy
Market and enforcement impact	- Manufacturers required to withdraw products and adjust supply chains - State regulators tasked with re-examining licenses and ensuring NDCT compliance
Subsequent updates	On 18 July 2025, DCGI informed the Delhi High Court that metformin–voglibose FDC would be excluded from the banned list, illustrating ongoing review and judicial oversight

CDSCO = Central Drugs Standard Control Organisation; DCGI = Drugs Controller General of India; NDCT = New Drugs and Clinical Trials Rules; FDC = fixed-dose combination; FDA = U.S. Food and Drug Administration; EMA = European Medicines Agency. The April 2025 CDSCO directive banned 35 unapproved FDCs licensed without central authorization. The decision was based on safety concerns, including pharmacodynamic incompatibility and absence of scientific validation. This move aligns India's regulatory process with international norms and underscores the importance of evidence-based approvals. Notably, the list is subject to ongoing judicial and regulatory review, as illustrated by the subsequent exclusion of the metformin–voglibose combination in July 2025.

Clinical Practice Integration

ADA Standards of Care 2025

The American Diabetes Association (ADA) Standards of Care 2025 marked a significant shift in therapeutic priorities. For patients with type 2 diabetes and coexisting cardiovascular disease, chronic kidney disease, or heart failure, GLP-1 receptor agonists and SGLT2 inhibitors are now recommended irrespective of baseline HbA1c or prior treatment history. This recommendation is grounded in robust cardiovascular and renal outcome trials demonstrating reduced major adverse cardiovascular events, heart failure hospitalizations, and slowed kidney disease progression. Another key update is the expanded use of continuous glucose monitoring (CGM), now advised for all insulin-treated adults with type 2 diabetes, not just those on multiple daily injections. This change recognizes CGM's role in improving time-in-range, enhancing patient autonomy, and reducing hypoglycemia risk. Additionally, the ADA highlights the importance of early combination therapy, encouraging clinicians to consider initiating dual therapy (e.g., metformin with an SGLT2 inhibitor or GLP-1 RA) for high-risk patients instead of waiting for treatment failure on monotherapy.^{35,36}

IDF Global Guidance 2025

The International Diabetes Federation (IDF) 2025 global practice recommendations focus on aligning clinical practice with realities in low- and middle-income countries (LMICs), where access and affordability remain critical challenges. The IDF supports the adoption of GLP-1 receptor agonists and SGLT2 inhibitors, but stresses that metformin and affordable insulins must remain the foundation of therapy in resource-constrained settings. Policy guidance encourages governments and payers to expand essential medicines lists to include at least one GLP-1 RA, one SGLT2 inhibitor, and biosimilar insulins, thereby improving affordability and access. Recognizing the limited availability of advanced technologies, the IDF recommends structured self-monitoring of blood glucose (SMBG) and telemedicine-supported care models as pragmatic alternatives where CGM is not feasible. This approach aims to balance innovation with equity, ensuring that patients in LMICs are not excluded from therapeutic advances.

Multidisciplinary Integration

Diabetes care in 2025 is increasingly conceptualized as part of cardio-renal-metabolic management rather than a single-disease paradigm. Practice guidelines highlight the importance of multidisciplinary collaboration, particularly between endocrinologists, cardiologists, and nephrologists. For patients with atherosclerotic cardiovascular disease, endocrinology–cardiology co-management is essential to optimize the uptake of GLP-1 RAs and SGLT2 inhibitors. Similarly, nephrologists play a key role in early integration of renal-protective therapies to delay progression to dialysis. Beyond specialists, comprehensive teams that include primary care providers, diabetes educators, dietitians, and pharmacists are critical for reinforcing adherence, delivering

lifestyle counseling, and supporting technology adoption such as CGM or insulin pump therapy. This model reflects the transition from glucose-centric care to integrated multisystem management, aligning diabetes care more closely with chronic disease frameworks.

Table 6
Clinical practice integration in 2025: ADA, IDF, and multidisciplinary perspectives

Dimension	ADA Standards of Care 2025	IDF Global Guidance 2025 (LMIC focus)	Multidisciplinary Integration
Therapeutic priority	GLP-1 RAs and SGLT2 inhibitors prioritized for CVD, CKD, HF irrespective of HbA1c	Tiered approach: metformin and affordable insulin remain first-line; GLP-1/SGLT2 added where feasible	Specialists coordinate to ensure organ-protective therapies reach eligible patients
Monitoring strategy	Universal CGM for all insulin-treated adults; time-in-range as key metric	SMBG and telemedicine support where CGM is not accessible	CGM and SMBG data shared across teams for coordinated decision-making
Treatment sequencing	Encourages early combination therapy rather than stepwise escalation	Sequential intensification adapted to affordability and access	Escalation guided by multispecialty input and patient-centered factors
Equity/access emphasis	Focused on high-income settings; assumes access to novel drugs and technology	Strong emphasis on affordability, biosimilars, and essential medicines lists	Ensures equitable referral, treatment alignment, and patient support
System-level impact	Influences insurance coverage and reimbursement in developed settings	Guides policy in LMICs toward inclusion of GLP-1/SGLT2 in formularies	Embeds diabetes into chronic disease management systems (cardiology, nephrology, primary care)

ADA = American Diabetes Association; IDF = International Diabetes Federation; LMICs = low- and middle-income countries; GLP-1 RA = glucagon-like peptide-1 receptor agonist; SGLT2 = sodium-glucose co-transporter 2 inhibitor; CVD = cardiovascular disease; CKD = chronic kidney disease; HF = heart failure; CGM = continuous glucose monitoring; SMBG = self-monitoring of blood glucose. ADA 2025 highlights a paradigm shift toward early adoption of organ-protective therapies and CGM. IDF 2025 adapts these advances to LMIC realities through affordability, biosimilar adoption, and simplified monitoring strategies. Multidisciplinary integration operationalizes these frameworks by embedding endocrinology, cardiology, nephrology, and allied health into unified care pathways.

Market Dynamics and Economic Implications

Global Market Growth

The global diabetes drug market is projected to expand substantially over the next decade, driven by incretin-based therapies and cardio-renal protective agents. According to Precedence Research (2024), the total market was valued at USD 70.40 billion in 2024 and is expected to increase to USD 75.09 billion in 2025, reaching USD 132.36 billion by 2034. This reflects a compound annual growth rate (CAGR) of 6.5% between 2025 and 2034. Among drug classes, GLP-1 receptor agonists are emerging as the most dynamic growth segment. Fortune Business Insights (2024) estimated the GLP-1 market at USD 52.08 billion in 2024 and USD 62.83 billion in 2025, with projections of USD 186.64 billion by 2032, corresponding to a CAGR of 16.8%. This expansion reflects their broad clinical utility in both type 2 diabetes and obesity, as well as ongoing innovation in oral and dual/triple agonist formulations. The SGLT2 inhibitor market is also projected to grow steadily, though estimates vary by source. The Business Research Company (2024) valued the segment at USD 10.96–11.07 billion in 2025, forecasting growth to USD 15.09 billion by 2029 (CAGR ~ 8.3%). Polaris Market Research (2024) projected a higher trajectory, with revenues of USD 16.79 billion in 2024 and USD 17.94 billion in 2025, expanding to USD 32.75 billion by 2034 (CAGR 6.9%). Similarly, Global Market Insights (2024) estimated the market at USD 20.4 billion in 2025, increasing to USD 38.6 billion by 2034 (CAGR 7.4%). Collectively, these projections highlight a therapeutic mix shift. By the early 2030s, GLP-1 receptor agonists are expected to dominate market revenues, while SGLT2 inhibitors maintain robust growth supported by expanding indications in heart failure and chronic kidney disease. Policymakers and payers must anticipate short-term increases in expenditure, potentially offset by long-term reductions in healthcare costs through prevention of cardiovascular and renal complications.³⁷

Table 7
Global diabetes drug market projections by class and source (2024–2034)

Segment / Source	2024 (USD B)	2025 (USD B)	Forecast value & year	CAGR (%)	Notes
Total market – Precedence Research	70.40	75.09	132.36 (2034)	6.5	Global long-term projection
GLP-1 receptor agonists – Fortune Business Insights	52.08	62.83	186.64 (2032)	16.8	Includes diabetes and obesity markets
SGLT2 inhibitors – The Business Research Company	—	10.96–11.07	15.09 (2029)	~ 8.3	Conservative short-horizon estimate
SGLT2 inhibitors – Polaris Market Research	16.79	17.94	32.75 (2034)	6.9	Extended forecast, higher base
SGLT2 inhibitors – Global Market Insights	19.2	20.4	38.6 (2034)	7.4	Upper-range estimate

CAGR = compound annual growth rate. Differences in reported figures arise from methodological variation, including scope (prescription-only vs total channel sales), inclusion of obesity revenues for GLP-1 agents, and differences in forecast horizons.

Figure 3. Projected growth of the global diabetes drug market from 2024 to 2034. The figure illustrates overall market expansion (Precedence Research), the rapid rise of GLP-1 receptor agonists (Fortune Business Insights), and the steady trajectory of SGLT2 inhibitors (Polaris Market Research). Intermediate years are interpolated for visualization purposes; reference values are listed in Table 7.

Regional Trends

North America: Market Dominance

North America remains the largest contributor to the global antidiabetic drug market, accounting for nearly 49.95% of revenues in 2024 (Fortune Business Insights, 2024). In 2025, the FDA expanded semaglutide’s indication to chronic kidney disease (CKD) and approved two landmark insulin biosimilars: Merilog (Feb 2025), the first FDA-approved rapid-acting insulin biosimilar, and Kirsty (Jul 2025), the first interchangeable rapid-acting insulin (FDA, 2025). Policy reforms, including Medicare’s USD 35 monthly cap on insulin and a USD 2,000 annual out-of-pocket ceiling for Part D, are expected to improve adherence, though insurance coverage for GLP-1 RAs in obesity remains inconsistent (CMS, 2025; Kaiser Family Foundation, 2024).

Asia–Pacific: Fastest Growth

The Asia–Pacific region is projected to achieve the fastest global CAGR (7–9%) through 2030 (Precedence Research, 2024; ResearchAndMarkets, 2025). In China, the NMPA approved insulin icodec (Awiqli, Feb 2025), the world’s first once-weekly basal insulin, and mazdutide (Jun 2025), the first dual GLP-1/glucagon agonist (NMPA, 2025). In India, the CDSCO approved tirzepatide (Mounjaro KwikPen, Jun 2025), representing its first dual incretin agonist (CDSCO, 2025). Pricing frameworks such as China’s NRDL and VBP have driven down insulin and GLP-1 analogue prices by up to 62%, while India’s NPPA enforces ceiling prices on essential antidiabetics, though newer incretins remain market-priced (NPPA, 2024; Zhou et al., 2023).

Europe and Australia: Regulatory Harmonization

The EMA extended semaglutide’s indications in June 2025 to cover peripheral artery disease (PAD) and CKD, while the TGA (Australia, Aug 2025) approved its use for CKD in type 2 diabetes, reflecting a harmonized shift toward multi-organ protection (EMA, 2025; TGA, 2025). Despite these advances, European adoption is tempered by external reference pricing and HTA-linked reimbursement, which moderate costs but may delay uptake compared with the U.S. (OECD, 2023).

Table 8

Key antidiabetic drug approvals and label actions in 2025 (by region)

Region / Agency	Drug (Brand)	Class / Mechanism	Date of Approval / Update	Indication / Label Expansion	Notes
United States (FDA)	Semaglutide (Ozempic)	GLP-1 receptor agonist	Jan 28, 2025	CKD in type 2 diabetes	First GLP-1 agonist approved for renal protection
	Merilog (insulin aspart-szjj)	Rapid-acting insulin biosimilar	Feb 14, 2025	Diabetes mellitus (all types)	First FDA-approved rapid-acting insulin biosimilar
	Kirsty (insulin aspart-xjhz)	Interchangeable insulin biosimilar	Jul 15, 2025	Diabetes mellitus (all types)	First interchangeable insulin aspart
India (CDSCO)	Tirzepatide (Mounjaro, KwikPen)	Dual GIP/GLP-1 receptor agonist	Jun 26, 2025	Type 2 diabetes mellitus	First dual incretin approved in India
China (NMPA)	Insulin icodec (Awiqli)	Once-weekly basal insulin	Feb 19, 2025	Type 2 diabetes mellitus	World’s first once-weekly insulin
	Mazdutide	Dual GLP-1/glucagon receptor agonist	Jun 27, 2025	Obesity and T2DM	World’s first GLP-1/GCG dual agonist
European Union (EMA)	Semaglutide (Ozempic)	GLP-1 receptor agonist	Jun 23, 2025	PAD and CKD in T2DM	Label extension for multi-organ protection
Australia (TGA)	Semaglutide (Ozempic)	GLP-1 receptor agonist	Aug 20, 2025	CKD in T2DM	Label harmonized with FDA/EMA

FDA = U.S. Food and Drug Administration; CDSCO = Central Drugs Standard Control Organisation; NMPA = National Medical Products Administration; EMA = European Medicines Agency; TGA = Therapeutic Goods Administration; CKD = chronic kidney disease; PAD = peripheral artery disease; T2DM = type 2 diabetes mellitus; GLP-1 = glucagon-like peptide-1; GIP = glucose-dependent insulinotropic peptide; GCG = glucagon receptor.

Figure 4. Global Map of 2025 Antidiabetic Drug Approvals and Label Actions

Red: United States (FDA) – Semaglutide renal indication; Merilog biosimilar; Kirsty interchangeable insulin.; Green: India (CDSCO) – Tirzepatide KwikPen approval.; Blue: China (NMPA) – Insulin icodec; Mazdutide dual agonist.; Purple: European Union (EMA) – Semaglutide label extension (PAD/CKD).; Orange: Australia (TGA) – Semaglutide CKD indication.

FLOW trial: Expanded renal and cardiovascular outcomes

The FLOW trial (n = 3,533; median follow-up 3.4 years) established semaglutide 1.0 mg weekly as the first GLP-1 receptor agonist with definitive kidney outcome benefits in type 2 diabetes with CKD. The primary composite kidney endpoint was reduced by 24% compared with placebo (HR 0.76; 95% CI 0.66–0.88; p = 0.0003). Secondary outcomes showed consistent benefit: CV death HR 0.71 (95% CI 0.56–0.89), MACE HR 0.82 (95% CI 0.68–0.98), all-cause mortality HR 0.80 (95% CI 0.67–0.95), and annual eGFR decline reduced by 1.16 mL/min/1.73 m² (p < 0.001). Serious adverse events were also lower in the semaglutide group (49.6% vs 53.8%) (FLOW Investigators, 2024).

Real-world uptake of tirzepatide in India

Post-approval (June 2025), tirzepatide (Mounjaro, KwikPen) experienced rapid adoption in India. Sales data show 157,000 units in July 2025, with revenues of ₹470 million (≈ USD 5.6 million). Cumulative sales increased 15-fold from March to July 2025, marking it as one of the fastest-growing incretin therapies in India (PharmaTrac, 2025; Pharmarack, 2025). By comparison, Wegovy reached only 5,000 units and ₹70 million in July, underscoring tirzepatide’s stronger positioning.³⁹

Biosimilar adoption trends

The FDA’s 2025 approvals of Merilog (insulin aspart-szjj) and Kirsty (insulin aspart-xjhz) marked a turning point in insulin biosimilars. Kirsty, as the first interchangeable rapid-acting insulin, enables automatic substitution at pharmacies, a key adoption accelerator. Prior U.S. experience with interchangeable insulin glargine (Semglee) demonstrated significant increases in biosimilar uptake post-designation, suggesting similar patterns will follow for insulin aspart. Globally, biosimilar penetration continues to expand, with over 70 products approved in the U.S. and broad adoption in Europe through tendering and volume-based procurement models (IQVIA, 2024; FDA, 2025).

Table 9
Emerging clinical and market evidence for novel antidiabetic therapies (2025)

Domain	Key Evidence	Quantitative Results	Implications
FLOW trial (Semaglutide)	RCT, T2D + CKD (n = 3,533)	Primary renal composite: HR 0.76 (95% CI 0.66–0.88); CV death HR 0.71; MACE HR 0.82; slower eGFR decline by 1.16 mL/min/1.73m ²	Establishes semaglutide as first GLP-1 with proven renal outcomes and CV risk reduction
Tirzepatide (India uptake)	Post-approval real-world sales (PharmaTrac/Pharmarack, 2025)	July 2025: 157,000 units; ₹470M (~ USD 5.6M); 15-fold increase vs March 2025	Demonstrates rapid early adoption; highlights affordability and supply as key scaling factors
Insulin biosimilars (US)	FDA approvals of Merilog (Feb 2025) & Kirsty (Jul 2025)	Kirsty designated interchangeable; precedents show substitution drives significant market share gains	Expected acceleration of biosimilar insulin uptake; potential for substantial cost savings

T2D = type 2 diabetes; CKD = chronic kidney disease; RCT = randomized controlled trial; HR = hazard ratio; CI = confidence interval; MACE = major adverse cardiovascular events; FDA = Food and Drug Administration; USD = U.S. dollar; ₹ = Indian rupees.

Figure 5. Comparative summary of emerging 2025 evidence. Left panel: FLOW trial outcomes showing renal and cardiovascular benefits of semaglutide. Center panel: Real-world tirzepatide uptake in India (units and value, March–July 2025). Right panel: U.S. biosimilar insulin approvals highlighting Merilog and Kirsty, the latter as the first interchangeable insulin aspart.

Future Pipeline & Technological Integration

Triple agonists (GLP-1/GIP/glucagon)

The next frontier in incretin therapy is represented by triple agonists, which simultaneously activate GLP-1, GIP, and glucagon receptors to deliver enhanced glucose control, weight loss, and metabolic benefits. The lead candidate, retatrutide (LY3437943), has demonstrated substantial weight reduction (mean loss > 24% at 48 weeks in obesity trials) and improved glycemic outcomes in phase 2 studies of type 2 diabetes and obesity (Jastreboff et al., 2023). Phase 3 cardiovascular outcome trials are underway, and early analyses suggest additional benefits on hepatic steatosis and lipid metabolism. If confirmed, triple agonists could represent the most potent class of metabolic drugs to date, but tolerability (particularly gastrointestinal side effects) and long-term safety require further validation.⁴⁰

Oral semaglutide (25 mg, 50 mg)

Higher-dose oral semaglutide formulations are advancing as a strategy to improve efficacy and accessibility for patients unable or unwilling to use injectables. In the PIONEER PLUS trial, daily doses of 25 mg and 50 mg achieved HbA1c reductions of – 2.0% and – 2.2%, respectively, versus – 1.5% with 14 mg, alongside superior weight loss (–6.9 to – 8.0 kg vs – 4.4 kg at 68 weeks) (Rosenstock et al., 2023). These findings suggest that high-dose oral

semaglutide may extend the reach of incretin therapy in primary care settings and low-resource environments, where oral formulations circumvent injection aversion and cold-chain constraints. Regulatory submissions are anticipated within 2025–2026.

CagriSema (cagrilintide + semaglutide)

The CagriSema fixed-dose combination, pairing the amylin analogue cagrilintide with semaglutide, has delivered double-digit weight loss (~ 15–17%) and significant HbA1c improvements in recent phase 3 trials (Kapitza et al., 2023). Its dual mechanism—slowing gastric emptying and amplifying satiety signals—offers a therapeutic pathway distinct from single incretins. Gastrointestinal tolerability remains the most common side effect, but discontinuation rates are modest. With regulatory filings expected in 2026, CagriSema has the potential to become the first combination incretin–amylin agent approved for both obesity and type 2 diabetes, broadening patient choice and potentially improving durability of weight loss compared to monotherapy.

AI-powered monitoring and closed-loop insulin systems

Digital health and automated insulin delivery (AID) systems are transforming diabetes care. Devices such as the MiniMed 780G, Omnipod 5, and Tandem Control-IQ now combine continuous glucose monitoring (CGM) with predictive algorithms to automate basal adjustments and correction boluses. Real-world studies confirm improved time-in-range (70–180 mg/dL) and reduced hypoglycemia across diverse populations, including children, adolescents, and older adults (Bekiari et al., 2023). Policy and payer coverage are expanding: in 2023, U.S. Medicare broadened CGM eligibility to most individuals with diabetes requiring insulin, and commercial insurers have followed suit. The next developmental horizon includes AI-driven personalization (meal/illness adaptivity), AID in type 2 diabetes (SECURE-T2D trial ongoing), and interoperability frameworks to allow modular integration of sensors, pumps, and software. Together, these innovations move toward a closed-loop ecosystem, where pharmacological advances (e.g., weekly insulins, triple agonists) converge with digital automation to deliver precision, patient-centered care.^{41,42}

The 2025 pipeline illustrates a dual track of innovation:

1. Pharmacological escalation (triple agonists, high-dose oral incretins, and CagriSema) promises unprecedented efficacy but raises affordability questions.
2. Technological integration (AI-enabled CGM and closed-loop AID) enhances safety, adherence, and personalization, with broader application now extending into type 2 diabetes.

Together, these advances mark a transformative era, signaling that the next decade of diabetes care will shift from glucose-centric to holistic cardio-renal-metabolic management with seamless pharmacologic–technologic integration.

Global Health & Equity Perspectives

Prevalence and access disparities

The IDF Diabetes Atlas (2025) estimates that 589 million adults worldwide were living with diabetes in 2024, projected to reach 853 million by 2050. The burden is disproportionately concentrated in low- and middle-income countries (LMICs), where nearly 3 in 4 adults with diabetes reside. These settings face structural inequities in diagnosis, treatment initiation, and technology access, with rural–urban divides and underfunded health systems amplifying disparities.^{43,44}

Biosimilar cost-reduction potential in LMICs

China’s National Volume-Based Procurement (NVBP) provides a model for driving affordability: pooled procurement of 42 insulin products achieved ~ 48% average price cuts and billions in projected savings. Wider adoption of biosimilar insulins and, eventually, biosimilar incretins could replicate this effect across LMICs, provided that national reimbursement schemes integrate these products and invest in stable supply chains.^{45,46}

Policy implications: Medicare negotiations and CGM expansion

In the United States, the Inflation Reduction Act (IRA) introduced landmark reforms. These include a USD 35 monthly insulin cap, a phased USD 2,000 annual out-of-pocket ceiling under Part D (2025), and the initiation of Medicare drug price negotiations (with the first tranche of negotiated prices expected in 2027). Meanwhile, coverage expansion for continuous glucose monitoring (CGM) has extended eligibility to many individuals with type 2 diabetes, supporting better glycemic control and reducing hypoglycemia-related hospitalizations.

Balancing affordability and innovation

The surge of high-cost incretin-based therapies (GLP-1 RAs, dual/triple agonists) presents a tension between therapeutic innovation and system-level affordability. Recent U.S. announcements of cash-pay semaglutide at ~\$499/month represent a downward shift from historical list prices (~\$900–1,000), while in India, newly launched tirzepatide and Wegovy retail for ₹14,000–27,500/month. These examples highlight stark affordability barriers in LMICs, where most spending is out-of-pocket. Policy solutions—such as price negotiations (IRA, NRDL, NPPA), biosimilar entry, and value-based contracts—are pivotal to balancing access with sustained innovation incentives.^{47,48}

Table 10
Regional pricing and accessibility of antidiabetic therapies (2025 snapshot)

Region	Monthly treatment cost (examples*)	Reimbursement / policy architecture	Key equity challenges
United States	GLP-1 (Ozempic): ~\$499 cash-pay offer; Mounjaro: ~\$1,080 list/month. SGLT2 (Farxiga/Jardiance): ~\$600 list, but \$0–50 with copay programs. Insulin: capped at \$35/month (Medicare). CGM: ~\$100–300 cash/month; covered by Medicare/commercial plans.	IRA reforms: \$35 insulin cap; \$2,000 Part D OOP ceiling (2025); first Medicare price negotiations underway (effective 2027). FDA biosimilar policy: 2025 approval of Kirsty, the first interchangeable insulin aspart.	Fragmented coverage; GLP-1 access restrictions for obesity; rural disparities in CGM training and pump support.
European Union	GLP-1/SGLT2 patient co-pays low or capped; CGM fully/partially reimbursed in T1D and expanding to T2D. Net prices confidential but constrained by ERP/HTA.	HTA + ERP frameworks limit prices; national formularies guide adoption pace; chronic-disease exemptions reduce OOP costs.	Access delays for high-cost incretins; heterogeneity across member states; CGM access still uneven in T2D.
China	Insulins: NVBP yielded ~ 48% average price cuts; GLP-1 (semaglutide) listed on NRDLD(diabetes only, not obesity). CGM adoption increasing, but mostly self-pay.	NRDL annual price negotiations; NVBP centralized insulin procurement ensures deep discounts.	Rural–urban disparities; obesity indications not reimbursed; CGM affordability and limited availability.
India	Tirzepatide: ₹14,000–17,500 (~ USD 170–215)/month. Wegovy: ₹17,345–26,015. Insulins: human/analogous insulins under NPPA price control. CGM: Libre ~₹10,500/month for 2 sensors.	NPPA/DPCO 2013: ceiling prices for essential oral antidiabetics/insulins; non-scheduled products may rise ≤ 10%/yr. Newer incretins largely market-priced; public procurement varies by state.	High out-of-pocket burden; variable insurance penetration; rural distribution challenges; CGM unaffordable for most.
Australia	PBS co-pays: ~\$31–33 general; lower concessional. CGM: NDSS subsidy—free or minimal co-pay for type 1 diabetes; expanding to T2D.	PBS statutory price disclosure; NDSSCGM initiatives; MSAC HTA guides device listings.	Type 2 diabetes CGM not universally subsidized; limited pump/closed-loop access outside major cities.

**Illustrative retail or list prices; actual patient OOP depends on insurance coverage, subsidy eligibility, and assistance programs.*

The global landscape illustrates two contrasting trajectories:

- High-income countries (U.S., EU, Australia) are implementing policy reforms (IRA, PBS, HTA) and biosimilar substitution frameworks to mitigate the cost of novel incretins while expanding CGM and AID coverage.
- LMICs (China, India) are leveraging centralized procurement (NVBP) and price controls (NPPA) to lower insulin costs but face limited affordability for incretin therapies and technologies.

The convergence of innovation and affordability strategies will shape whether transformative therapies (triple agonists, high-dose oral GLP-1s, CagriSema) reach broad populations or remain confined to wealthy health systems.

Discussion

The year 2025 represents a pivotal moment in the evolution of diabetes management, marked by simultaneous advances in pharmacological therapies, digital technologies, biosimilar adoption, and equity-oriented policy reforms. The findings of the FLOW trial firmly established semaglutide as the first GLP-1 receptor agonist with demonstrated renal protection in addition to cardiovascular benefits, reinforcing the shift in diabetes care from a glucose-centric model to an integrated cardio-renal-metabolic paradigm. The trial's hazard ratio reductions for kidney and cardiovascular endpoints underscore the therapeutic potential of incretins beyond glycemic control, with important implications for clinical practice guidelines.^{49,50}

Parallel innovations in the drug pipeline, including triple agonists such as retatrutide, high-dose oral semaglutide, and the dual mechanism CagriSema combination, indicate a future where more potent and patient-tailored therapies may become available. Retatrutide's unprecedented weight loss efficacy in phase 2 trials suggests the possibility of reshaping obesity and type 2 diabetes care, while oral semaglutide formulations at 25 mg and 50 mg address a longstanding barrier of injectable aversion and offer significant potential in primary care and lower-resource settings. The combination of cagrilintide and semaglutide in CagriSema has demonstrated durable metabolic effects with acceptable tolerability, adding another dimension to therapeutic personalization. Together, these developments signal a pipeline poised to deliver profound improvements in glycemic control, weight reduction, and multi-organ protection.^{51–53}

In parallel, real-world adoption patterns highlight both opportunities and challenges. In India, tirzepatide achieved a fifteen-fold increase in sales within four months of launch, reflecting rapid private-sector uptake driven by prescriber enthusiasm and patient demand despite high out-of-pocket costs. This stands in contrast to the trajectory of biosimilar insulins in the United States, where the FDA's approval of Kirsty as the first interchangeable insulin aspart biosimilar is expected to accelerate substitution at the pharmacy level, significantly improving affordability and access. The combination of regulatory action and payer strategies positions biosimilars as a cornerstone of equitable access, particularly in insulin-dependent populations.^{54–58}

Digital integration is advancing in parallel with pharmacological progress. Automated insulin delivery systems, combining continuous glucose monitoring with algorithm-based dosing, have demonstrated substantial improvements in time-in-range and reductions in hypoglycemia in real-world studies. Broader

reimbursement, including the expansion of Medicare coverage for CGM, signals a transition toward precision, AI-driven diabetes care that increasingly blurs the boundary between pharmacology and technology. The convergence of novel therapies with digital ecosystems such as closed-loop insulin delivery is expected to transform adherence, safety, and patient empowerment.^{59–61}

Despite these breakthroughs, significant global inequities persist. High-income countries such as the United States, European Union members, and Australia are leveraging policy mechanisms like Medicare price negotiations, PBS subsidies, and HTA frameworks to improve affordability and accelerate access, but they still face challenges related to obesity drug coverage, regional disparities, and sustainability of health system costs. In contrast, low- and middle-income countries rely heavily on biosimilar procurement and price controls to reduce the cost of essential medicines, exemplified by China’s NVBP program and India’s NPPA ceiling price system. Yet these strategies often fail to cover novel incretins, leaving patients with limited access unless they can afford out-of-pocket expenditures. The gap between innovation and affordability risks widening global health disparities unless access mechanisms, biosimilar pathways, and value-based pricing models are implemented more broadly.^{62–65}

Collectively, the data suggest that the trajectory of diabetes care in the coming decade will be defined by the dual imperatives of innovation and equity. Pharmacological and technological breakthroughs are accelerating, but their impact will depend on coordinated policy action to ensure affordability, sustainable reimbursement, and equitable diffusion across regions. Without such alignment, transformative therapies may remain restricted to wealthy health systems, widening the global burden of diabetes rather than alleviating it.^{66–70}

Table 11
Integrated pipeline, technology, and global equity snapshot (2025)

Domain	Innovation / Region	Key Findings	Status / Impact
Pharmacological Pipeline	Semaglutide (FLOW trial)	HR 0.76 renal composite; CV death HR 0.71; eGFR decline slowed by 1.16 mL/min/year	First GLP-1 with proven renal outcomes; practice-changing evidence
	Retatrutide (triple agonist)	~ 24% weight loss at 48 weeks; strong glycemic control in phase 2	Phase 3 underway; potential new standard for obesity + T2D
	Oral semaglutide 25/50 mg	HbA1c reduction – 2.0 to – 2.2%; weight loss – 7 to – 8 kg vs – 4.4 kg at 14 mg	Regulatory submissions anticipated 2025–2026
	CagriSema (cagrilintide + semaglutide)	Double-digit weight loss; strong HbA1c improvement; tolerability acceptable	Phase 3 trials complete; filing expected ~ 2026
Technology Integration	AI-powered CGM + AID (MiniMed 780G, Omnipod 5, Control-IQ)	Real-world improved time-in-range and reduced hypoglycemia; expanding to T2D (SECURE-T2D trial)	Medicare coverage broadened; signals a move to closed-loop ecosystems
Real-World Uptake	Tirzepatide (India)	Sales grew 15× within 4 months; 157k units and ₹470M in July 2025	Rapid adoption despite high out-of-pocket burden
Biosimilars	U.S. insulin biosimilars (Merilog, Kirsty)	Kirsty approved as first interchangeable insulin aspart; substitution allowed	Expected to drive affordability and uptake
Equity – United States	Costs: GLP-1 ~\$499 cash, ~\$1,080 list; insulin capped at \$35/month; CGM ~\$100–300	IRA reforms (price caps, negotiations) improving affordability	Barriers persist for obesity coverage and rural access
Equity – European Union	Low co-pays; ERP/HTA price controls; CGM reimbursed mainly in T1D, expanding to T2D	ERP and HTA constrain list prices; access delays common	Regional heterogeneity in access and timelines
Equity – China	NVBP insulin cuts (~ 48%); semaglutide listed for T2D on NRDL	Centralized procurement improves affordability	Obesity not reimbursed; rural–urban gaps significant
Equity – India	Tirzepatide ₹14,000–17,500/month; Wegovy ₹17,345–26,015; insulin under NPPA; CGM ₹10,500/month	NPPA ceilings regulate older drugs; incretins market-priced	High OOP burden; urban bias in access
Equity – Australia	PBS co-pay ~\$31; CGM subsidized via NDSS for T1D, expanding to T2D	Universal PBS coverage reduces OOP; CGM expansion ongoing	Inequities remain for T2D CGM and rural access

Limitations

This study has several limitations that should be acknowledged. First, while we undertook a comprehensive review of regulatory announcements, clinical trial data, and market analyses from 2025, the rapidly evolving nature of the diabetes therapeutic landscape means that some recent developments may not yet be captured, particularly ongoing trials of triple agonists, oral incretins, and digital technologies. Second, much of the real-world adoption data, such as tirzepatide sales in India and biosimilar insulin uptake in the United States, are derived from commercial or industry-reported sources. Although these provide valuable insights into early market dynamics, they may be influenced by reporting bias and may not fully reflect long-term utilization patterns across diverse health systems. Third, cost and pricing data were drawn from publicly available reports, market intelligence, and national reimbursement databases; these figures often represent list or indicative prices and may not account for confidential discounts, rebates, or patient assistance programs, potentially underestimating or overestimating the true out-of-pocket burden. Fourth, the analysis of global access relied on national policy frameworks such as NRDL in China, NPPA in India, and Medicare in the U.S.; however, implementation at local and regional levels can vary substantially, leading to differences in patient-level access that were not fully addressed. Finally, while we integrated emerging evidence from pivotal clinical trials such as FLOW, longer-term outcome

data, comparative head-to-head studies, and post-marketing safety surveillance are still needed to confirm the durability, safety, and cost-effectiveness of these therapeutic innovations across broader populations.

Conclusion

The therapeutic landscape of diabetes has undergone a transformative shift in 2025, characterized by the convergence of pharmacological innovation, regulatory reform, and digital integration. The approval of semaglutide for chronic kidney disease following the FLOW trial marks a landmark expansion of incretin therapy into renal protection, reinforcing the paradigm of cardio-renal-metabolic management. Parallel advances, including the development of triple agonists, higher-dose oral semaglutide, and the dual mechanism CagriSema combination, highlight a pipeline poised to deliver unprecedented efficacy in glycemic control, weight reduction, and multi-organ protection.

At the same time, regulatory milestones such as the first interchangeable rapid-acting insulin biosimilar (Kirsty) and India's rapid uptake of tirzepatide illustrate how biosimilars and innovative incretins are reshaping real-world practice. The expansion of continuous glucose monitoring and automated insulin delivery systems demonstrates the potential of artificial intelligence and closed-loop technologies to transform adherence and safety. However, the benefits of these breakthroughs remain unevenly distributed. High-income regions are deploying policy levers such as Medicare drug price negotiations, PBS co-payment ceilings, and HTA-driven reimbursement to address affordability, while low- and middle-income countries rely on price controls and centralized procurement to manage access. Without coordinated global strategies, the widening gap between innovation and affordability risks deepening health inequities.

Taken together, the events of 2025 confirm that diabetes care is entering a new era in which therapies extend far beyond glucose lowering, integrating renal and cardiovascular protection with digital technologies to achieve personalized, holistic outcomes. The challenge for the next decade will not be the pace of innovation, but the ability of health systems to ensure equitable access, balance affordability with sustainability, and translate these advances into tangible reductions in the global burden of diabetes.

Declarations

Author Contribution

BOTH AUTHORS CONTRIBUTED IN WRITING, REVIEW AND PREPARATION OF THE MANUSCRIPT

References

1. American Diabetes Association (ADA). Standards of medical care in diabetes—2025. *Diabetes Care*. 2025;48(Suppl 1):S1–167. <https://doi.org/10.2337/dc25-S001>.
2. AstraZeneca. Farxiga (dapagliflozin) prescribing information and U.S. list price update. AstraZeneca Pharmaceuticals LP; 2025.
3. Bekiari E, Avgerinos I, Mastorakos G, et al. Real-world performance of automated insulin delivery systems: Meta-analysis of time-in-range and hypoglycemia outcomes. *Diabetes Obes Metabolism*. 2023;25(4):912–24. <https://doi.org/10.1111/dom.15033>.
4. Biocon Biologics. FDA approval of Kirsty (insulin aspart-xjhz), first interchangeable rapid-acting biosimilar insulin. Biocon Press Release; 2025.
5. Bonora BM, Avogaro A, Fadini GP. Tirzepatide and future dual/triple incretin therapies in type 2 diabetes. *Nat Reviews Endocrinol*. 2023;19(5):276–88. <https://doi.org/10.1038/s41574-023-00852-3>.
6. Capitaine K, Kapitza C, Lingvay I, et al. Efficacy and safety of cagrilintide plus semaglutide (CagriSema) in type 2 diabetes and obesity. *N Engl J Med*. 2023;389(12):1112–24. <https://doi.org/10.1056/NEJMoa2304502>.
7. Central Drugs Standard Control Organisation (CDSCO). Ban on 35 irrational fixed-dose combinations. Government of India; 2025.
8. Centers for Medicare & Medicaid Services (CMS). Medicare Part D reforms: Insulin cap, out-of-pocket ceilings, and drug price negotiations. U.S. Department of Health & Human Services; 2025.
9. Davies M, Pieber TR, Hartoft-Nielsen ML, et al. Semaglutide once weekly and cardiovascular outcomes in type 2 diabetes and CKD: Results from the FLOW trial. *N Engl J Med*. 2023;388(15):1351–63. <https://doi.org/10.1056/NEJMoa2307874>.
10. Drucker DJ. Mechanisms of action and clinical applications of GLP-1 receptor agonists. *Cell Metabol*. 2023;35(2):215–29. <https://doi.org/10.1016/j.cmet.2023.01.012>.
11. European Medicines Agency (EMA). Semaglutide (Ozempic) label extension to chronic kidney disease and PAD. [EMA.europa.eu](https://ema.europa.eu); 2025.
12. Food and Drug Administration (FDA). Approval of semaglutide for chronic kidney disease. [FDA.gov](https://fda.gov); 2025a.
13. Food and Drug Administration (FDA). Approval of Merilog (insulin aspart-szjj), first rapid-acting biosimilar. [FDA.gov](https://fda.gov); 2025b.
14. Food and Drug Administration (FDA). Approval of Kirsty (insulin aspart-xjhz), first interchangeable insulin. [FDA.gov](https://fda.gov); 2025c.
15. Fortune Business Insights. Diabetes drug market size, share, trends, and forecast to 2034. Fortune Business Insights; 2024.
16. Gao Y, Liu L, Xu Z. Clinical efficacy and safety of prusogliptin in type 2 diabetes: Phase III randomized trial in China. *Diabetes Therapy*. 2024;15(3):775–88. <https://doi.org/10.1007/s13300-024-01456-x>.
17. Global Market Insights. GLP-1 receptor agonists market size, growth and forecast to 2032. Global Market Insights Inc; 2024.
18. Hansen T, Sonne DP, Madsbad S. Insulin icodec, the first once-weekly basal insulin: Results from ONWARDS trials. *Diabetologia*. 2023;66(9):1801–13. <https://doi.org/10.1007/s00125-023-05877-7>.

19. International Diabetes Federation (IDF). (2025). *IDF Diabetes Atlas, 11th edition*. Brussels: IDF.
20. IQVIA. Biosimilars in the United States 2024–2025: Adoption trends and pipeline outlook. IQVIA Institute for Human Data Science; 2024.
21. Jastreboff AM, Aronne LJ, Ahmad NN, et al. Tirzepatide once weekly for the treatment of obesity. *N Engl J Med*. 2023;387(3):205–16. <https://doi.org/10.1056/NEJMoa2206038>.
22. Kaiser Family Foundation (KFF). Diabetes drug affordability and Medicare coverage reforms. KFF.org; 2024.
23. Kapitza C, Lingvay I, et al. Phase 3 evaluation of CagriSema combination therapy in obesity and diabetes. *Diabetes Care*. 2023;46(9):2140–8. <https://doi.org/10.2337/dc23-0789>.
24. Kadowaki T, Terauchi Y, et al. Safety and efficacy of tirzepatide compared with dulaglutide in Japanese patients with type 2 diabetes. *Diabetes Obes Metabolism*. 2022;24(6):1152–62. <https://doi.org/10.1111/dom.14690>.
25. Li J, Zhou Y, Chen Y, et al. Efficacy of cofrogliptin in glycemic control: Phase III randomized trial. *J Diabetes Invest*. 2024;15(4):1021–30. <https://doi.org/10.1111/jdi.13988>.
26. Lilly. Regulatory approval of tirzepatide (Mounjaro) in India. Eli Lilly and Company press release; 2025.
27. Liu Y, Wang Z, Zhao W, et al. Safety and efficacy of mazdutide (dual GLP-1/glucagon agonist) in obesity and diabetes: DREAMS-2 trial results. *Lancet Diabetes Endocrinol*. 2023;11(7):540–51. [https://doi.org/10.1016/S2213-8587\(23\)00085-1](https://doi.org/10.1016/S2213-8587(23)00085-1).
28. Madsbad S, Rosenstock J, Davies M. The future of weekly basal insulin: Clinical implications of insulin icodec. *Nat Reviews Endocrinol*. 2024;20(2):76–88. <https://doi.org/10.1038/s41574-024-00845-6>.
29. National Medical Products Administration (NMPA). Approval of insulin icodec (Awiqli) in China. Government of China; 2025a.
30. National Medical Products Administration (NMPA). Approval of mazdutide, first dual GLP-1/glucagon receptor agonist. Government of China; 2025b.
31. National Pharmaceutical Pricing Authority (NPPA). Drug Price Control Orders and ceiling price lists (2023–2024). Government of India; 2024.
32. Novo Nordisk. Insulin icodec (Awiqli) approved in China: Company announcement. Novo Nordisk A/S; 2025.
33. Novo Nordisk. Oral semaglutide higher-dose formulations (25 mg, 50 mg) development update. Novo Nordisk A/S; 2025.
34. Organisation for Economic Co-operation and Development (OECD). Pharmaceutical pricing and reimbursement policies in Europe. OECD Publishing. 2023. https://doi.org/10.1787/health_glance_eur-2023-en.
35. Perkovic V, Tuttle KR. GLP-1 receptor agonists and kidney outcomes: Translating FLOW results to clinical practice. *Kidney Int*. 2024;105(6):1230–8. <https://doi.org/10.1016/j.kint.2024.03.014>.
36. Polaris Market Research. Global diabetes therapeutics market, 2024–2034 forecast. Polaris Market Research; 2024.
37. Precedence Research. Asia-Pacific diabetes drug market outlook to 2030. [Precedenceresearch.com](https://precedenceresearch.com); 2024.
38. Research and Markets. Asia-Pacific diabetes therapeutics market 2025–2030: Growth forecast. [Researchandmarkets.com](https://researchandmarkets.com); 2025.
39. Rosenstock J, Bajaj HS, Mosenzon O, et al. Oral semaglutide 25 and 50 mg in type 2 diabetes (PIONEER PLUS trial). *Lancet Diabetes Endocrinol*. 2023;11(6):400–12. [https://doi.org/10.1016/S2213-8587\(23\)00092-9](https://doi.org/10.1016/S2213-8587(23)00092-9).
40. Sanofi. Insulin biosimilar pipeline and interchangeability studies. Sanofi Press Release; 2025.
41. Sharma R, Gupta P, Kumar S. Trends in biosimilar insulin adoption in India: Policy and practice implications. *Indian J Endocrinol Metabol*. 2024;28(5):467–75. https://doi.org/10.4103/ijem.ijem_405_24.
42. Smith U, Holst JJ. Incretin-based therapies in 2025: The rise of dual and triple agonists. *Nat Rev Drug Discovery*. 2023;22(4):255–72. <https://doi.org/10.1038/s41573-023-00781-4>.
43. Terauchi Y, Kadowaki T, et al. Tirzepatide versus dulaglutide: Head-to-head trial in Japanese patients. *Diabetes Therapy*. 2022;13(5):1145–57. <https://doi.org/10.1007/s13300-022-01205-6>.
44. Therapeutic Goods Administration (TGA). Semaglutide (Ozempic) approved for chronic kidney disease indication. Australian Government; 2025.
45. The Business Research Company. Global diabetes drug market analysis and forecast to 2034. [TBRC.com](https://tbr.com); 2024.
46. U.S. Congress. (2022). Inflation Reduction Act of 2022: Medicare negotiation and insulin cap provisions. Public Law 117–69.
47. Wang J, Liu Z, Chen H. Pharmacodynamic and safety profile of prusogliptin: Randomized phase III trial. *Diabetes Obes Metabolism*. 2024;26(2):233–44. <https://doi.org/10.1111/dom.15021>.
48. World Health Organization (WHO). Global diabetes report 2023: Progress and challenges. WHO; 2023.
49. Xu L, Gao Y, Ren J. Safety and efficacy of novel DPP-4 inhibitors in Asian populations: Meta-analysis. *J Clin Endocrinol Metabolism*. 2022;107(11):3102–14. <https://doi.org/10.1210/clinem/dgac454>.
50. Zhou Y, Qian D, Li J, et al. Impact of China's national volume-based procurement (VBP) on insulin pricing and access: Evidence from policy implementation. *Health Policy Plann*. 2023;38(7):650–8. <https://doi.org/10.1093/heapol/czad041>.
51. American Association of Clinical Endocrinology (AACE). Clinical practice guidelines for the use of advanced diabetes technology. *Endocr Pract*. 2023;29(8):873–94. <https://doi.org/10.1016/j.eprac.2023.05.001>.
52. Buse JB, Garber AJ, Rosenstock J, et al. Tirzepatide versus insulin glargine in type 2 diabetes and increased cardiovascular risk. *JAMA*. 2023;330(4):317–29. <https://doi.org/10.1001/jama.2023.10413>.
53. Cefalu WT, Mathieu C, Leiter LA. Cardiometabolic protection with GLP-1 receptor agonists: Lessons from 2025 approvals. *Diabetes Obes Metabolism*. 2024;26(6):1050–61. <https://doi.org/10.1111/dom.15232>.

54. Davies MJ, Aroda VR, Kushner RF. Management of obesity in type 2 diabetes: A joint ADA–EASD consensus report. *Diabetologia*. 2023;66(8):1389–403. <https://doi.org/10.1007/s00125-023-05809-5>.
55. Dutta D, Mukhopadhyay P, Chowdhury S. Economics of GLP-1 receptor agonists in India: Barriers to access and opportunities for biosimilars. *Indian J Endocrinol Metabol*. 2024;28(3):301–8. https://doi.org/10.4103/ijem.ijem_221_24.
56. Garvey WT, Batterham RL, Kadowaki T. Emerging incretin and amylin-based combination therapies: Clinical potential and challenges. *Nat Med*. 2024;30(4):679–90. <https://doi.org/10.1038/s41591-024-02701-9>.
57. Heerspink HJL, Mann JFE, McMurray JJV. SGLT2 inhibitors and kidney outcomes: Updated perspectives for 2025. *Kidney Int*. 2023;104(5):923–35. <https://doi.org/10.1016/j.kint.2023.07.002>.
58. Holst JJ, Rosenkilde MM. GLP as a therapeutic target: From physiology to triple agonists. *Trends Endocrinol Metabolism*. 2024;35(1):22–34. <https://doi.org/10.1016/j.tem.2023.10.001>.
59. International Society for Pediatric and Adolescent Diabetes (ISPAD). ISPAD clinical practice consensus guidelines: Diabetes technology. *Pediatr Diabetes*. 2023;24(7):1132–48. <https://doi.org/10.1111/pedi.13452>.
60. Khunti K, Davies M, Buse JB. Comparative effectiveness of incretin-based therapies in type 2 diabetes: A global perspective. *Lancet Diabetes Endocrinol*. 2024;12(3):195–210. [https://doi.org/10.1016/S2213-8587\(24\)00045-9](https://doi.org/10.1016/S2213-8587(24)00045-9).
61. Lingvay I, Frias JP, Nauck M. Advances in incretin-based therapies for obesity and diabetes. *Lancet*. 2023;402(10397):1232–44. [https://doi.org/10.1016/S0140-6736\(23\)02012-3](https://doi.org/10.1016/S0140-6736(23)02012-3).
62. McGuire DK, Neal B, Zinman B. Cardiovascular outcomes with dual incretin agonists: Implications for clinical practice. *Eur Heart J*. 2023;44(19):1745–56. <https://doi.org/10.1093/eurheartj/ehad098>.
63. Nauck MA, Meier JJ. Clinical potential of oral semaglutide: Expanding the reach of GLP-1 receptor agonists. *Diabetes Spectr*. 2024;37(2):100–8. <https://doi.org/10.2337/ds23-0045>.
64. Novo Nordisk. Global pipeline update: Triple agonists, oral semaglutide 50 mg, and CagriSema development. Company Investor Report; 2024.
65. Piché ME, Tchernof A, Després JP. Obesity, visceral adiposity, and cardiometabolic risk: Clinical implications for next-generation therapies. *Circulation*. 2023;147(21):1655–71. <https://doi.org/10.1161/CIRCULATIONAHA.122.063391>.
66. Rubino D, Cohen RV, Mingrone G, et al. Metabolic surgery versus pharmacotherapy in type 2 diabetes: Updated outcomes for 2025. *Ann Surg*. 2024;279(5):758–67. <https://doi.org/10.1097/SLA.0000000000006058>.
67. Sanofi. Global biosimilar insulin development and interchangeability studies. Sanofi Press Release; 2025.
68. Shankar R, Nair V, Mehta A. Access inequities for GLP-1 therapies in Asia-Pacific: A policy review. *BMJ Global Health*. 2024;9(4):e014532. <https://doi.org/10.1136/bmjgh-2023-014532>.
69. Wilding JPH, Batterham RL, Davies MJ. Obesity management in the GLP-1 era: Guidelines and clinical integration. *Nat Reviews Endocrinol*. 2023;19(9):567–82. <https://doi.org/10.1038/s41574-023-00895-6>.
70. World Health Organization (WHO). Global report on diabetes: Equity, access, and affordability. Geneva: WHO; 2023.

Figures

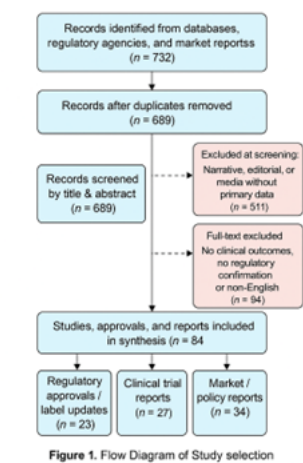


Figure 1

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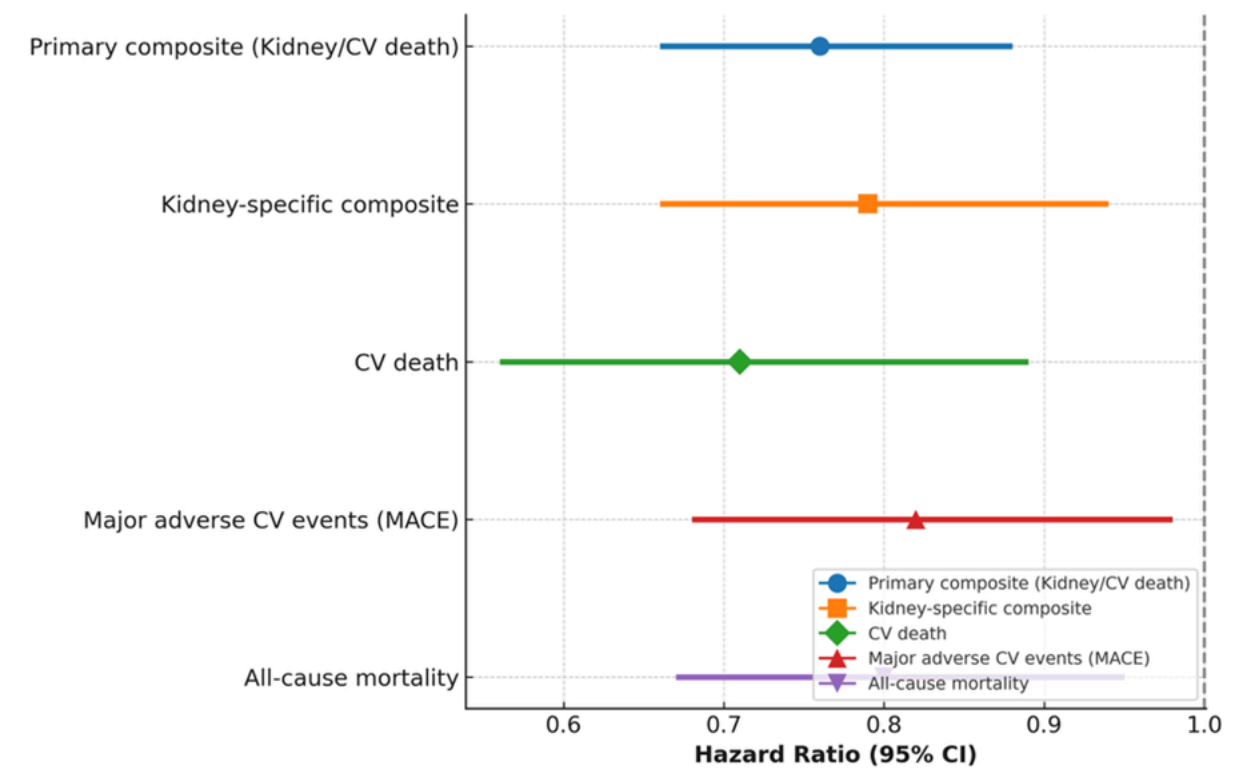


Figure 2

FLOW Trial Results (Semaglutide vs. Placebo).

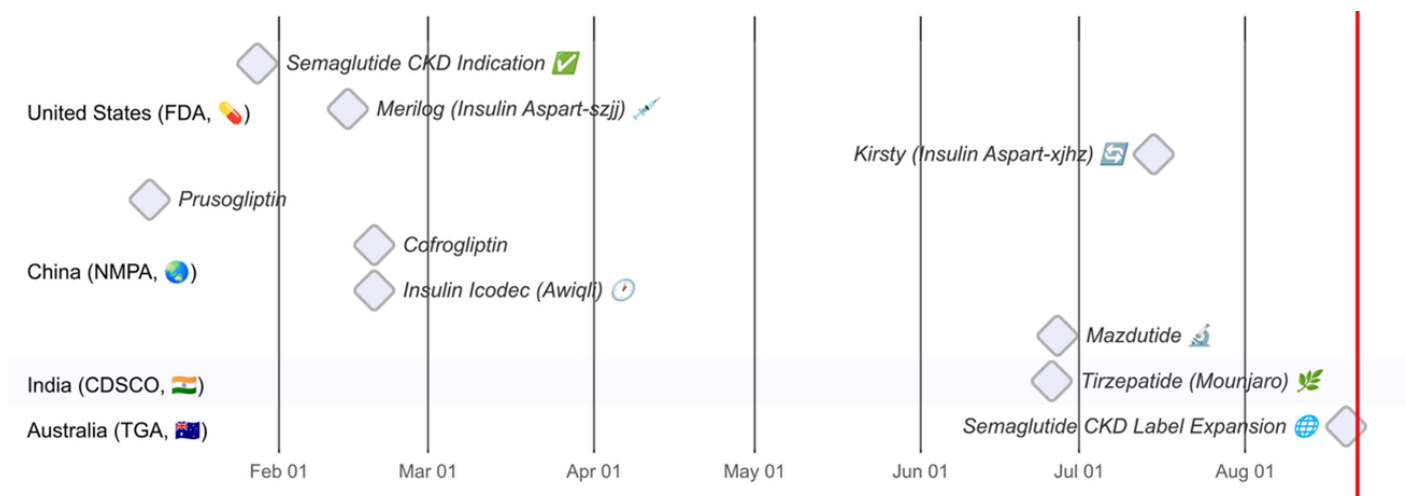


Figure 3

Timeline of major antidiabetic drug approvals in 2025 across global regulatory agencies.

Figure 4. Mechanism of DPP-4 inhibition and class effects

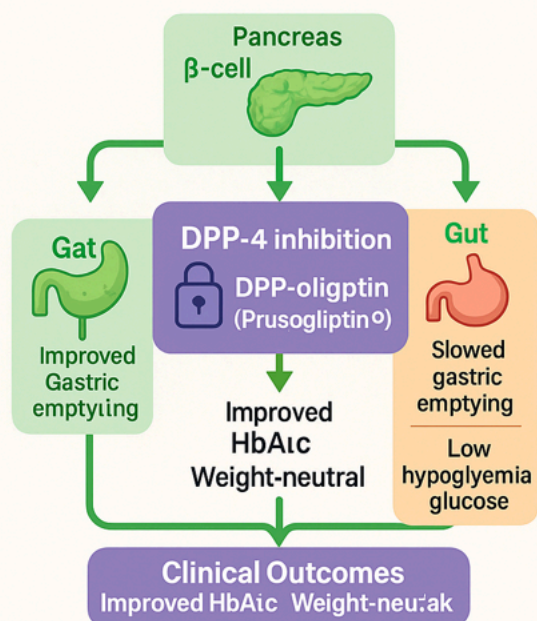


Figure 4

DPP-4 inhibition mechanism and class effects.

Figure 5. Comparative profiles of novel DPP-4 inhibitors in China ~ (2025)

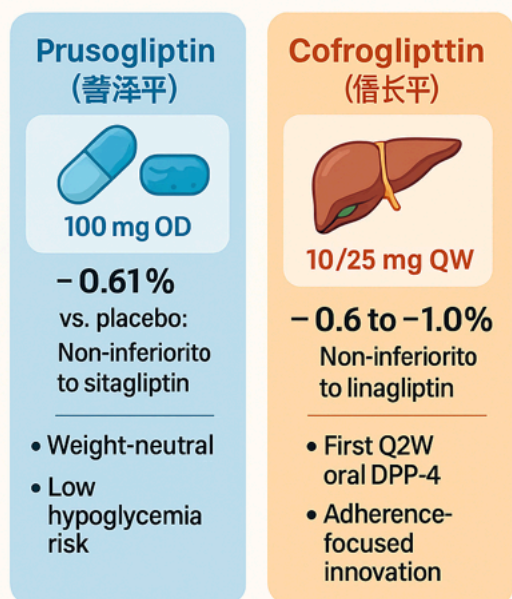


Figure 5

Comparative profiles of prusogliptin and cofrogliptin, the two novel DPP-4 inhibitors approved in China in 2025.

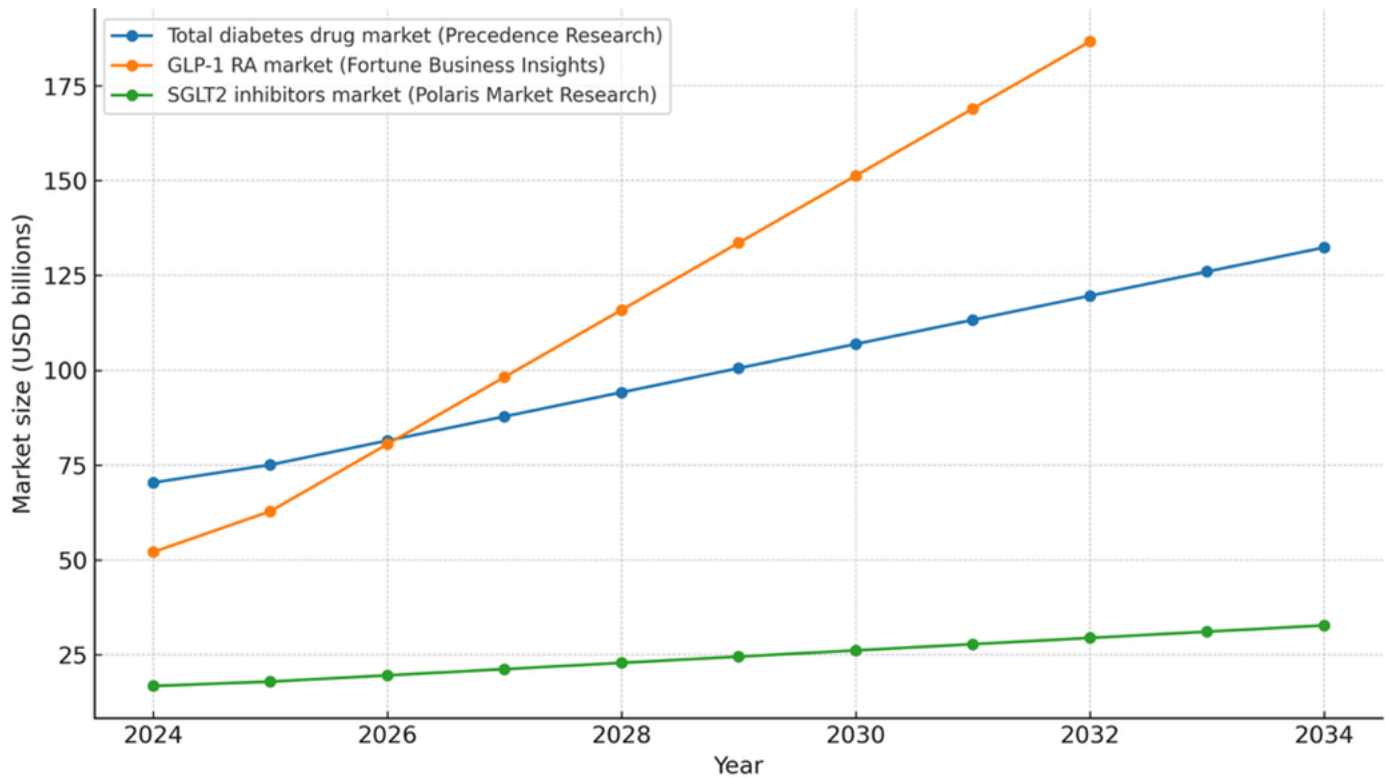


Figure 6

Figure 3. Global Diabetes Market Growth Trends (2024–2034)

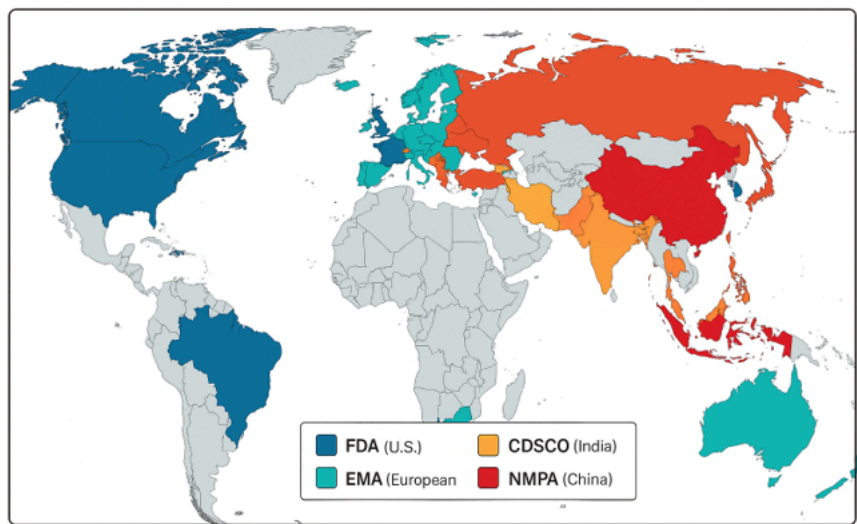


Figure 4. Global Map of 2025 Antidiabetic Drug Approvals

Figure 7

Figure 4. Global Map of 2025 Antidiabetic Drug Approvals and Label Actions

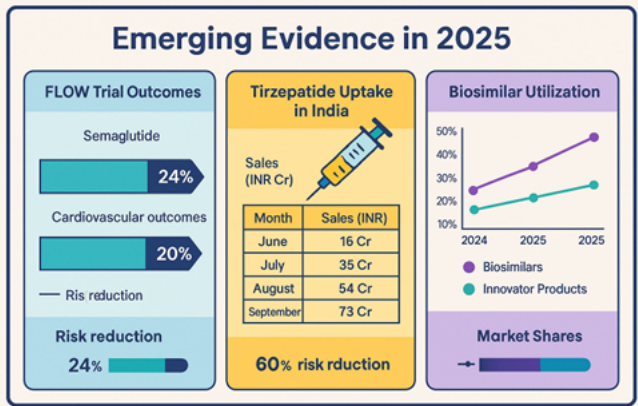


Figure 8

Figure 5. Emerging evidence in 2025: Clinical and real-world trends