Indian Diabetes

EDUCATOR JOURNAL

RESEARCH SOCIETY FOR THE STUDY OF DIABETES IN INDIA

Theme of the Month

Advances in Diabetes Care

To keep Members of Diabetes Care team abreast about
DSME/DSMS - (Diabetes Self management Education/Support) Concepts

2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026

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RSSDI Indian Diabetes
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1st time in India
To keep the members of diabetes care team abreast with DSME and DSMS concepts

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*DSME: Diabetes Self-Management Education, DSMS: Diabetes Self-Management Support

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RSSDI Indian Diabetes EDUCATOR JOURNAL

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FOREWORD

The Research Society for the Study of Diabetes in India (RSSDI), founded in 1972 by Prof. M.M.S. Ahuja, is the largest scientific association of healthcare professionals dedicated to advancing diabetes education and research in India. RSSDI is pleased to collaborate with USV in their vision to make India the "Diabetes Care Capital of the World." Through this partnership, RSSDI aims to strengthen the cadre of diabetes educators by equipping them with the latest updates in diabetes management, thereby helping bridge the gap between physicians and patients. Today, the rule of 50% is prevailing in terms of awareness, detection, treatment, and control in T2DM. Our aspiration is to achieve 90-90-90-90, i.e., 90% of people with diabetes should be made aware, 90% should be detected, 90% of those detected should be treated, and 90% of those treated should reach their goals.

The Indian Diabetes Educator Journal (IDEJ) is the first of its kind in India and the longest-running monthly journal for diabetes educators, published since April 2015. It continues its mission to promote awareness, disseminate knowledge, and support healthcare teams in effectively managing individuals with diabetes while empowering them for self-care. RSSDI IDEJ remains committed to keeping members of the diabetes care team updated with key concepts of Diabetes Self-Management Education and Support (DSME/S), with a digital outreach of over 44,000 doctors and diabetes educators.

This February edition of IDEJ highlights the theme "Advances in Diabetes Care," reflecting the rapid progress in diabetes management across therapeutics, technology, and nutrition science. Innovations now extend beyond glucose-lowering to address weight management, cardiovascular risk reduction, and long-term metabolic health. This issue equips diabetes educators with practical, evidence-based insights to support individualized, person-centred care in everyday practice. Emphasis is placed on integrating emerging therapies, digital tools, and lifestyle interventions to improve outcomes and quality of life. As diabetes care continues to evolve, this edition reinforces the educator's role in translating advances into meaningful, sustainable benefits for people living with diabetes.

We sincerely thank our contributors for making this issue delightful reading for our readers. We dedicate this journal to all the healthcare professionals who are working relentlessly towards making "India–The Diabetes Care Capital of the World."

Sincere Regards,

Dr. Rakesh Parikh
RSSDI Secretary

*DSME: Diabetes Self-Management Education, DSMS: Diabetes Self-Management Support

Expert Contributors
of the month

Dr. Sandeep Suri

MBBS, MD (General Medicine), FIDM
Consulting Diabetologist, Ever Healthy Hospital, Hisar

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Dr. Mohd Yusuf Ansari

MBBS, PGDCC-NI, CCEBDM, CCCS
Consultant Cardiologist, Balrampur Govt. Hospital, Lucknow

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Dr. Ambuj Yadav

MBBS, MD (Internal Medicine), PDCC, CCM
Associate Professor, Department of Medicine, King George's Medical University, Lucknow

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Dr. M. A. Karmur

MBBS, FDRC, PGDHSc (Diabetology)
Consultant Diabetologist, Saurashtra Diabetes Centre, Rajkot

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Dr. Ameya Joshi

MD (Medicine), DM (Endocrinology)
Consultant Endocrinologist and Diabetologist, Bhaktivedanta Hospital and Endocrine and Diabetes Clinic, Mumbai

Article: Interview of the Month with Dr. Ameya Joshi

Dr. Shweta Deshmukh

MBBS, MD (Medicine), DNB (Internal Medicine), PG Diploma in Diabetes
Consultant Physician and Asst. Professor, Smt. Kashibai Navale Medical College and General Hospital, Pune

Article: Glossary of Glucose Control Measures

Expert Contributors
of the month

Dr. Kshitiz Awadhwal

MBBS, DNB – Medicine, FICM, MRCP-ACUMEN, ACMDC-Advanced Certificate in Diabetes (PHFI), Certificate Course in GDM (PHFI), Certificate Course in Obesity (British Accreditation Council)

Consultant Physician and Diabetologist, Apollomedics Super Speciality Hospital, Lucknow

Article: Next-Generation Insulin Delivery: Inhaled Insulin

Dr. Meraj Rasool

MBBS, MD (Medicine)

Associate Professor, T. S. Misra Medical College and Hospital, Lucknow

Article: Automated Insulin Delivery Systems in Diabetes Care

Dr. Sunil Bhojane

MBBS, MD, C. Diabetes, CCEBDM

Consultant Diabetologist, Siddhiksha Diabetes Clinic, City Criticare and Century Rayon Hospitals, Thane

Article: Diabetes Educator's Toolkit: Skill of the Month - Health Literacy

Dr. Shiva Madan

MBBS, MD Medicine, DM Endocrinology (SGPGI), SCE MRCP (UK)

Consulting Endocrinologist and Diabetologist, Marwar Hospital Bikaner, Rajasthan

Article: Frequently Asked Questions on Advances in Diabetes Care

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RSSDI Indian Diabetes EDUCATOR JOURNAL

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Cover Story: Next-Gen Diabetes Care: Integrating Innovation, Science, and Lifestyle

Dr. Sandeep Suri

MBBS, MD (General Medicine), FIDM

Consulting Diabetologist, Ever Healthy Hospital, Hisar

Diabetes care is undergoing a transformative evolution, moving well beyond the traditional regimen of periodic glucose checks and standard medication strategies to a holistic model that integrates technology, advanced pharmacotherapy, and personalized lifestyle interventions. This convergence of innovation, science, and lifestyle has created a dynamic paradigm aimed at improving clinical outcomes, enhancing quality of life, and empowering individuals to manage their condition with flexibility.

Transforming monitoring: Continuous, intelligent, and patient-centered

One of the most impactful advances in diabetes care is the widespread adoption of continuous glucose monitoring (CGM) systems. Unlike traditional finger-stick methods, CGM devices provide real-time glucose trends, helping individuals and clinicians make proactive adjustments in diet, activity, and medications. Integration of CGM with smartphones and cloud-based platforms facilitates remote monitoring and data sharing, enabling tailored interventions without frequent clinic visits.

Advances in CGM have enabled insulin delivery systems that can automatically respond to glucose levels, commonly referred to as hybrid closed-loop or “artificial pancreas” systems. These technologies combine CGM sensor data with insulin pumps and intelligent algorithms to automate insulin dosing, substantially improving time-in-range metrics and reducing glycemic variability, a key determinant of long-term complications.

Advanced pharmacotherapy

Modern pharmacological advances in diabetes management now extend well beyond simple glucose lowering, with a strong focus on improving long-term clinical outcomes. There has been a clear shift from a glucose-centric approach to a more patient-centered strategy that accounts for cardiovascular and renal risk, co-existing comorbidities, and weight management goals. In this evolving landscape, incretin-based therapies such as glucagon-like peptide-1 (GLP-1) receptor agonists, glucose-dependent insulinotropic polypeptide (GIP) receptor agonists, and dual incretin agonists are increasingly being used due to their multifaceted metabolic benefits. In parallel, several novel agents with complementary and synergistic mechanisms, such as GIP/glucagon/GLP-1 triple receptor agonists, are currently under development, further expanding the therapeutic options in diabetes care.

Lifestyle integration: Personalized, motivational, evidence-driven, digital platforms

While technology and pharmacology are pillars of next-gen care, lifestyle interventions remain foundational. Digital platforms now deliver personalized nutrition plans and exercise recommendations tailored to metabolic responses. Meta-analytical data suggest that adopting structured lifestyle and digital health programs can yield clinically meaningful improvements in glycemic control, weight management, and overall metabolic health. Digital health platforms including telemedicine, mobile apps, and connected health ecosystems that facilitate a continuous care continuum, where clinicians can review trends and intervene earlier, and individuals receive real-time coaching and behavioral recommendations.

Artificial intelligence (AI)

AI is rapidly becoming a powerful force in diabetes care. AI models can analyze vast amounts of patient data from glucose readings to dietary logs to predict glucose excursions, inform insulin dosing, and tailor lifestyle guidance. These AI-enabled tools enrich self-management and clinical support systems, shortening the feedback loop between patient behavior and health outcomes. However, while early results are promising, further robust clinical studies are needed to validate their long-term effectiveness, safety, generalizability, and real-world impact across diverse populations.

The holistic model

The integration of technological innovation, advanced pharmacotherapies, and lifestyle science reflects a broader shift in diabetes care towards individualized, data-driven, and holistic model. These next-generation strategies strive to reduce the burden of daily disease management, improve adherence and satisfaction, and ultimately lower the risk of acute and chronic complications.

While challenges remain, including equitable access to technologies, cost barriers, and the digital divide, the trajectory is clear: Diabetes care is becoming more intelligent, interconnected, and responsive. Clinicians and patients are now equipped not just to react to hyperglycemia, but to anticipate, prevent, and personalize every aspect of care.

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Modern Approaches to Glucose Monitoring

Dr. Mohd Yusuf Ansari

MBBS, PGDCC-NI, CCEBDM, CCCS
Consultant Cardiologist, Balrampur Govt. Hospital, Lucknow

For effective diabetes management, monitoring blood glucose levels accurately and conveniently is essential. From erratic fingerprick tests to continuous, real-time systems that empower both people with diabetes and doctors, technology has transformed glucose monitoring over the past few decades. With the development of non-invasive sensors, artificial intelligence (AI), and continuous glucose monitoring (CGM), modern glucose monitoring has become more about optimization than survival.

Continuous glucose monitoring

Self-monitoring of blood glucose (SMBG) provides snapshots of a person's blood sugar levels at a particular time by using the traditional fingerprick test method. Significant trends such as nocturnal hypoglycemia are frequently not recorded by SMBG since it is unable to record continuous glucose changes throughout the day and night.

A CGM works by placing a small sensor under the skin that measures glucose levels in interstitial fluid at regular intervals. CGM provides a precise glucose profile with real-time readings, trend arrows, and rate of change and high/low alerts.

CGM significantly enhances glycemic outcomes compared to SMBG in both type 1 and type 2 diabetes. CGM users experience reduced glycated hemoglobin (HbA1c), longer time in target range (TIR), and fewer hypoglycemia episodes in various populations.

Smart apps, AI, and predictive insights

Use of mobile apps and artificial intelligence to convert raw glucose readings into meaningful data is one of the most significant changes in monitoring. Instead of simply displaying glucose measurements, new systems use powerful algorithms to forecast what glucose levels might do next, allowing users to react before high and low levels occur. This can make management safer and proactive.

Apps connected to CGMs can also provide:

- Summary of daily glucose trends
- Predicted hypoglycemia alerts
- Personalized insights based on meals, sleep and activity

With this method, glucose monitoring becomes predictive and preventive from reactive.

Non-invasive technology

Non-invasive blood glucose monitoring devices are being developed as technology advances. Non-invasive blood glucose monitoring uses technologies such as reverse iontophoresis, spectroscopy, ultrasound, electromagnetic detection, and other new technologies. Other innovative technologies, such as a polynorepinephrine-based biosensor connected with a smartphone to serve as a point-of-care glucose analyzer, have been presented. Despite extensive study, development is gradual, and there are currently very few devices approved by regulatory organizations globally.

According to research, digital health solutions are helping to bridge the accessibility gap. These tools are used by all people with diabetes to reverse metabolic patterns before they can cause long-term consequences. With these new approaches, diabetes can achieve better glucose control, fewer complications, and a more proactive approach to lifelong health.

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Role of GLP-1 Receptor Agonists in Diabetes

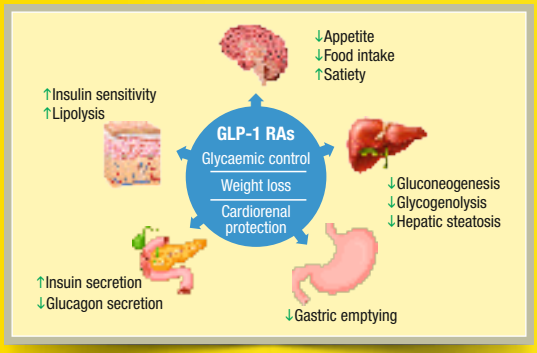
Dr. Ambuj Yadav

MBBS, MD (Internal Medicine), PDCC, CCM

Associate Professor, Department of Medicine,
King George's Medical University, Lucknow

Glucagon-like peptide-1 receptor agonist's (GLP-1 RAs) are a well-established class of anti-hyperglycemic agents used in the management of type 2 diabetes mellitus (T2DM). These therapies are derived from the incretin hormone glucagon-like peptide-1 (GLP-1), which enhances glucose-dependent insulin secretion but is functionally impaired in individuals with T2DM. Over time, GLP-1 RAs have progressed from short-acting injectable agents to long-acting weekly formulations and oral preparations, improving treatment convenience and adherence. Currently available GLP-1 RAs for diabetes treatment include exenatide, lixisenatide, liraglutide, dulaglutide, semaglutide (injectable and oral), and efpeglenatide in selected regions. Newer incretin-based therapies incorporating dual receptor activity, such as GLP-1/glucose-dependent insulinotropic polypeptide (GIP) receptor agonists, have demonstrated enhanced glycemic efficacy and durability, reflecting ongoing innovation within GLP-1-based diabetes therapy.

Mechanism of action



GLP-1 receptor agonists improve glycemic control by enhancing glucose-dependent insulin secretion from pancreatic β-cells, thereby improving both fasting and postprandial glucose levels. Simultaneously, they suppress glucagon secretion from α-cells leading to reduced hepatic glucose output.

GLP-1 RAs also slow gastric emptying, thereby attenuating the rate of glucose absorption and reducing postprandial glucose excursions. Central nervous system effects mediated through hypothalamic and brainstem pathways contribute to appetite regulation and improved metabolic control. Experimental and clinical data indicate that GLP-1 receptor signaling within the brain may also modulate neuroinflammation and insulin sensitivity, mechanisms that are relevant to metabolic regulation in diabetes. Because insulin secretion is glucose dependent, GLP-1 RAs are associated with a low risk of hypoglycemia when used without insulin or insulin secretagogues.

Across clinical studies, GLP-1 RAs consistently demonstrate clinically meaningful reductions in glycated hemoglobin (HbA1c), with efficacy influenced by baseline glycemic status, agent potency, and duration of therapy. In clinical practice, GLP-1 RAs are initiated at low doses and gradually adjusted primarily to improve gastrointestinal tolerability rather than enhance glycemic efficacy. Long-acting agents provide more stable glycemic control, while short-acting formulations have greater effects on postprandial glucose; oral and injectable options differ in administration requirements and dosing frequency.

Safety and tolerability

GLP-1 receptor agonists are generally well tolerated, with transient gastrointestinal effects such as nausea and vomiting being most common. Hypoglycemia risk is low due to glucose-dependent action but increases with insulin or sulfonylureas, while injection-site reactions are usually mild. Its favorable effects on weight and insulin resistance support improved diabetes outcomes. GLP-1 RAs remain contraindicated in medullary thyroid carcinoma or multiple endocrine neoplasia type 2.

Conclusion

GLP-1 RAs play a central role in the management of T2DM by addressing multiple components of disease pathophysiology, including impaired insulin secretion, excess glucagon release, and postprandial hyperglycemia. Their glucose-dependent mechanism, simplified dosing strategies, and overall favorable safety profile makes them effective and durable therapeutic options. Continued advances in GLP-1–based therapies, including multi-receptor agonists, are further strengthening their role in comprehensive diabetes care.

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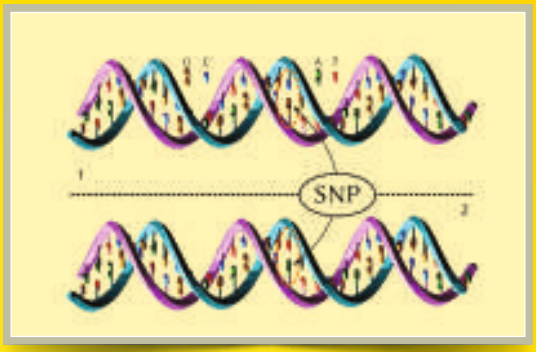
From Genes to Glucose: How Nutrigenomics Can Transform Diabetes Management

Dr. M. A. Karmur

MBBS, FDRC, PGDHSc (Diabetology)

Consultant Diabetologist, Saurashtra Diabetes Centre, Rajkot

The management of diabetes is moving beyond generalized dietary guidelines towards a more individualized approach. Nutrigenomics, the study of how nutrients interact with human genes to influence the metabolic outcomes, is increasingly highlighted. It offers a blueprint for understanding modern strategies that emphasize integrating functional foods, gut microbiome, and genetic profiles for creating an effective and individualized approach for glycemic control.



Through the identification of individual genetic variations like single-nucleotide polymorphisms (SNPs), healthcare professionals can better predict how patients will respond to specific foods. This enables dietary recommendations that align with a particular biological makeup. At the molecular level, nutrients can modulate specific gene expression involved in the metabolism of glucose, inflammation, and insulin signaling.

For example, epigallocatechin–3–gallate (EGCG), a bioactive compound found in green tea, is known to be a potent regulator that activates the AMP-activated protein kinase (AMPK) pathway, thereby improving insulin sensitivity and lipid metabolism.

The gut microbiome also adds a critical layer to the diet – gene relationship. Its composition affects how nutrients get metabolized. Strategies are now considering the use of microbiotics, including prebiotics and probiotics, for diabetes management. One of the many advantages of nutrigenomics is its potential to replace one – size fits all dietary guidance with individualized nutrition plans.

These genetic insights can help to enhance the dietary patterns, such as the carbohydrate quality, composition of fat, and intake of fiber, to better support the management of glucose. This method may improve adherence, metabolic results, and long-term disease management. Nutrigenomics enhances current diabetic treatments rather than replacing them.

Gene-based nutrition can help with more accurate and proactive treatment for diabetes when made a part of lifestyle changes, monitoring glucose, and medical care. It builds the gap between genes and glucose by personalizing nutrition as per an individual's genetic and metabolic profile. As advancements in this field continue, nutrigenomics may become increasingly important in tailoring diabetes management.

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In uncontrolled T2DM with A1c >8.5%, **Choose 1st**

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Dapagliflozin 10 mg + Sitagliptin 100 mg + Metformin 500 mg XR

Abridged Prescribing Information

UDAPA-TRIO Forte, UDAPA-TRIO, Dapagliflozin, Sitagliptin & Metformin Hydrochloride Extended Release Tablets

Composition: Dapagliflozin 10 mg, Sitagliptin 100 mg & Metformin Hydrochloride Extended Release 1000 mg tablets Dapagliflozin propanediol monohydrate eq. To Dapagliflozin 10 mg Sitagliptin Phosphate Monohydrate IP Eq. Sitagliptin 100 mg Metformin Hydrochloride IP (as Extended Release) 1000 mg Dapagliflozin10 mg, Sitagliptin 100 mg & Metformin Hydrochloride Extended Release 1000 mg tablets Dapagliflozin propanediol monohydrate eq. To Dapagliflozin 10 mg Sitagliptin Phosphate Monohydrate IP Eq. Sitagliptin 100 mg Metformin Hydrochloride IP (as Extended Release) 500 mg **Indication:** It is indicated as an adjunct to diet and exercise to improve Glycemic Control adults with type 2 diabetes mellitus **Recommended Dosage:** As directed by the physician. **Method of Administration:** Oral **Adverse Reactions:** Most common adverse reactions reported are: Dapagliflozin - Female genital mycotic infections, Nasopharyngitis, Urinary tract infections. Sitagliptin - Upper respiratory tract infection, nasopharyngitis and headache. Metformin - Diarrhea, nausea/vomiting, flatulence, asthenia, indigestion, abdominal discomfort, and headache. **Warnings and Precautions:** Dapagliflozin: Volume depletion; Ketoacidosis in patients with Diabetes Mellitus; Urosepsis and Pyelonephritis; Hypoglycemia; Genital mycotic infections Sitagliptin: General: Sitagliptin should not be used in patients with type 1 diabetes or for the treatment of Diabetic Ketoacidosis. Acute pancreatitis: Hypoglycemia is used in combinations when combined with other anti-hyperglycemic medicinal product; Renal impairment: Hypersensitivity reactions including anaphylaxis, angioedema, and exfoliative skin conditions - Steven johnson syndrome; Bullous pemphigoid Metformin Hydrochloride: Lactic acidosis; In case of dehydration (severe diarrhea or vomiting, fever or reduced fluid intake), metformin should be temporarily discontinued and contact with a healthcare professional is recommended. **Contraindications:** Hypersensitivity to the active substance of Dapagliflozin, Sitagliptin & Metformin or to any of the excipients listed. Any type of acute metabolic acidosis (such as lactic acidosis, diabetic ketoacidosis). Diabetic pre-coma; Severe renal failure (eGFR < 30ml/min); Acute conditions with the potential to alter renal function such as: Dehydration, Severe infection, Shock; Acute or chronic disease which may cause tissue hypoxia such as: Cardiac or respiratory failure, Recent myocardial infarction, Shock, Renal Impairment, Acute intoxication, Alcoholism. **Use in special population:** Pregnant women: Due to lack of human data, drugs should not be used during pregnancy. Lactating women: It should not be used during breastfeeding. Pediatric patients: The safety and efficacy of drugs has not yet been established. No data is available. Geriatric Patients: In patients >65 years, it should be used with caution as age increases. For Additional Information/full prescribing information, please write to us: USV Private Limited, Arvind Vithal Gandhi Chowk, B.S.D. Marg, Govandi, Mumbai - 400088 Last updated on 02/04/2024.

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For Better Outcomes

Ref.: L Ravikumar et al.Cardiology and Cardiovascular Medicine. 2023; 7: 141-144. |

Abridged Prescribing Information

Composition: Each Film Coated Tablet Contains: Dapagliflozin Propanediol Monohydrate eq. to Dapagliflozin (10 mg) + Sitagliptin Phosphate Monohydrate IP eq. to Sitagliptin (100 mg). **Indications:** For the treatment of type 2 diabetes mellitus inadequately controlled on Metformin monotherapy. Recommended Dosage: As directed by the physician. **Method of Administration:** Oral. **Adverse Reactions:** Female genital mycotic infections, nasopharyngitis, and urinary tract infections are most common adverse reactions associated with dapagliflozin. While, upper respiratory tract infection, nasopharyngitis, and headache are most common adverse reactions associated with sitagliptin. **Warnings and Precautions: Risk of Volume Depletion in Elderly** - Before initiating Dapagliflozin and Sitagliptin, assess volume status and renal function in the elderly, patients with renal impairment or low systolic blood pressure, and in patients on diuretics. Monitor for signs and symptoms during therapy. **Ketoacidosis in Patients with Diabetes Mellitus** - Assess patients who present with signs and symptoms of metabolic acidosis for ketoacidosis regardless of blood glucose level. If suspected, discontinue UDAPA™-S, evaluate and treat promptly. Before initiating UDAPA™-S, consider risk factors for ketoacidosis. Patients on UDAPA™-S may require monitoring and temporary discontinuation of therapy in clinical situations known to predispose to ketoacidosis. **Urosepsis and Pyelonephritis** - Evaluate for signs and symptoms of urinary tract infections and treat promptly, if indicated. Hypoglycemia - Consider a lower dose of insulin or the insulin secretagogue to reduce the risk of hypoglycemia when used in combination with Dapagliflozin and Sitagliptin. **Necrotizing Fasciitis of the Perineum** - Serious, life-threatening cases have occurred in patients with diabetes, both females and males. Assess patients presenting with pain or tenderness, erythema, or swelling in the genital or perianal area, along with fever or malaise. If suspected, institute prompt treatment. **Genital Mycotic Infections** - Monitor and treat if indicated. **Contraindications:** Patients with a history of hypersensitivity reaction to the active substance or to any of the excipients. In patients with varying degrees of renal impairment, adjusting the dosage is advised based on the severity of the condition. Prohibited medications include strong CYP2C8 inhibitors/ inducers, drugs increasing/decreasing hypoglycemic action, drugs known to cause QT prolongation, or other oral hypoglycemic agents other than study medications.

For Additional Information/full prescribing information, please write to us:
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Updated on 20th March 2024

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Patient-centered Diabetes Care: Combining Insulin Therapy with Education
A Doctor's Experience with the MyCare Patient Support Program

Dr. Swathi Yadavalli

MBBS, F. Diab, CCEBDM, CCGDM

Sr. Physician and Diabetologist

A 78-year-old woman with type 2 diabetes mellitus was managed by Dr. Swathi Yadavalli.

Here's what Dr. Swathi Yadavalli has to say:

A 78-year-old woman was referred to me with very high blood glucose levels. Given her elevated readings, I initiated insulin therapy and prescribed both basal and bolus insulin to help stabilize her blood glucose. She was consuming only two meals per day, and her blood glucose was around 230 mg/dL. After evaluating her lifestyle, particularly that she lived alone and was very particular about her diet, I referred her to MyCare Diabetes Educator (MDE) Ms. Pravalika for comprehensive counseling.

MDE Pravalika provided detailed education on proper injection techniques, timing, and handling of both basal and bolus insulin, including hands-on guidance for using the insulin cartridge, which helped her feel confident and independent. She conducted a thorough dietary recall, identified gaps in her eating patterns, and suggested practical modifications, emphasizing portion control, reducing high-carbohydrate intake, and balancing meals with fiber and protein.

Understanding her preferences and limitations, she recommended gentle physical activities such as yoga and light exercises to support glucose regulation and overall well-being. She also encouraged regular blood glucose monitoring, interpreted readings, and reinforced adherence to both insulin therapy and lifestyle changes through ongoing follow-ups and motivation. Through this continuous guidance, she experienced improved appetite, a reduction of symptoms such as tingling in the feet, and better overall blood glucose control.

Ms. Pravalika

NDEP and T1DE Certified Diabetes Educator

Here's what MDE Pravalika has to say:

This case shows how proper insulin education and personalized support can transform diabetes care. By teaching correct insulin techniques, including handling the insulin cartridge, timing, and dose adherence, alongside guidance on diet and physical activity, the individual gains confidence in managing diabetes. Regular follow-ups reinforced adherence and supported ongoing improvement.

MyCARE

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*PWD: People with Diabetes

Contact for more information
Nikita Thawarkar | 7304930643 | nikita.thawarkar@usv.in

Interview of the Month with Dr. Ameya Joshi

Dr. Ameya Joshi

MD (Medicine), DM (Endocrinology)

Consultant Endocrinologist and Diabetologist, Bhaktivedanta Hospital and Endocrine and Diabetes Clinic, Mumbai

Dr. Ameya Joshi is a distinguished endocrinologist and Director of Diabetes and Endocrine Clinics, Mumbai. He serves as Consultant at Bhaktivedanta Hospital and Research Institute and Karuna Hospital, where he is respected for clinical excellence and compassionate, patient-centred care. Dr. Joshi specialises in the comprehensive management of diabetes, thyroid disorders, metabolic diseases, and complex endocrine conditions, combining advanced medical expertise with personalized treatment strategies. He believes in empowering patients through clear communication, preventive guidance, and long-term wellness strategies. He actively promotes lifestyle modification as a cornerstone of effective disease management and sustainable health outcomes. A recipient of the prestigious IDF and European Society of Endocrinology Young Scholar Grant, he is recognized for academic contributions and commitment to advancing endocrine science. His dedication to ethical practice, continuous learning, and community education reflects his commitment to improving healthcare standards with lasting impact on patient lives.

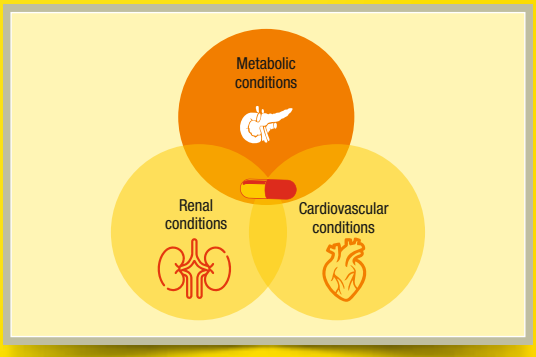
Advances in Diabetes Care

1. What is the most important recent advancement in diabetes care?

The most important recent advancement in diabetes care is the shift from glucose-centric management to comprehensive cardio-renal-metabolic risk reduction, thanks to newer medications that modify these risks. Earlier, success was largely defined by glycated hemoglobin (HbA1c) targets. Today, we recognize that preventing cardiovascular events, preserving kidney function, reducing weight, and improving quality of life are equally important, if not more important than outcomes. This paradigm shift has fundamentally changed clinical decision-making, guideline development, and patient counseling.

Equally significant is the integration of technology-driven monitoring, enabling real-time feedback and shared decision-making. Together, these advances have transformed diabetes care from reactive glycemic correction to proactive long-term risk modification.

2. How have newer drugs changed goals beyond glucose control?



Newer antidiabetic drugs have expanded treatment goals well beyond HbA1c reduction. We now aim for cardiovascular protection, renal preservation, weight reduction, and hypoglycemia avoidance as parallel objectives. This is particularly relevant because most people with type 2 diabetes die from cardiovascular or renal complications rather than hyperglycemia per se. These therapies have demonstrated that glucose-lowering and organ protection can coexist. For example, weight loss has emerged as a legitimate therapeutic goal, not merely a lifestyle aspiration. Blood pressure, lipid

control, and inflammation are now indirectly influenced through diabetes medications themselves. From a clinician's perspective, this has enabled phenotype-based prescribing, choosing therapy based on obesity, heart failure, chronic kidney disease, or atherosclerotic cardiovascular disease. For educators, it means reframing patient conversations: Diabetes treatment is no longer just about "glucose control," but about living longer and better.

3. What are the biggest challenges in adopting newer diabetes therapies in India?

The foremost challenge in India is affordability and access. Many newer therapies remain beyond the financial reach of a large proportion of patients, especially those without insurance coverage. Cost-related non-adherence is a real and under-recognized barrier. The second challenge is therapeutic inertia and knowledge gaps, both among healthcare providers and patients. Busy primary care settings often default to older, familiar regimens, while patients may resist newer drugs due to fear of injections, side effects, or misinformation. A third issue is fragmented follow-up and limited educator support. Newer therapies require counseling on expectations, side effects, and long-term benefits, something difficult to achieve in time-constrained clinics. The fourth is the injectable nature of some therapies, which is a deterrent to a fairly large number of people with diabetes.

4. What is the role of lifestyle and digital tools today?

Lifestyle modification remains the foundation of diabetes management, but its delivery has evolved significantly. Today, lifestyle is no longer limited to generic advice on diet and exercise; it is increasingly personalized, measurable, and technology-supported. Digital tools such as mobile apps, continuous glucose monitoring–linked insights, and teleconsultations have enhanced patient engagement and self-efficacy. They allow patients to see, in real time, how food choices, physical activity, sleep, and stress influence glucose patterns. This immediacy improves adherence far more than retrospective advice. For diabetes educators, digital platforms have expanded reach beyond clinic walls, enabling remote coaching, behavior reinforcement, and early problem identification. However, technology should complement, not replace, human interaction. The most effective model remains a tech-enabled, educator-led lifestyle intervention, tailored to cultural, socioeconomic, and individual realities.

5. What innovation will shape the future of diabetes care?

The future of diabetes care will be shaped by precision medicine combined with intelligent technology. We are moving toward an era where treatment choices will be guided by individual metabolic profiles, genetics, comorbidities, and behavioral patterns rather than a one-size-fits-all algorithm. Artificial intelligence–driven decision support, smarter glucose sensors, and integrated health platforms will help predict risk, personalize therapy, and prevent complications earlier. At the same time, pharmacological innovation is moving toward disease modification, including sustained weight loss and possible diabetes remission in selected patients.

Equally important will be innovation in care delivery models, team-based care where physicians, educators, nutritionists, and digital tools work seamlessly together. In my view, the greatest future impact will not come from a single drug or device, but from integrated, patient-centric ecosystems that make high-quality diabetes care scalable and sustainable.

Glossary of Glucose Control Measures

Dr. Shweta Deshmukh

MBBS, MD (Medicine), DNB (Internal Medicine), PG Diploma in Diabetes

Consultant Physician and Asst. Professor, Smt. Kashibai Navale Medical College and General Hospital, Pune

- **Time in range (TIR):** The percentage of time glucose values remain within a predefined target range, most commonly 70–180 mg/dL (3.9–10.0 mmol/L). Higher TIR is associated with reduced risk of complications and improved health outcomes.
- **Time above range (TAR):** The percentage of time glucose levels are above the target range, typically >180 mg/dL. Level 1 TAR: 181–250 mg/dL and Level 2 TAR: >250 mg/dL. It reflects hyperglycemia burden and increased risk of long-term complications.
- **Time below range (TBR):** The percentage of time glucose levels fall below the target range, usually <70 mg/dL. Level 1 TBR: 54–69 mg/dL and Level 2 TBR: <54 mg/dL. TBR reflects the burden and severity of hypoglycemia.
- **Time in tight range (TITR):** The percentage of time glucose values are within a narrower, more stringent range, commonly 70–140 mg/dL. It is used in pregnancy and for intensive diabetes management.
- **Mean amplitude of glycemic excursions (MAGE):** The average of the absolute differences between consecutive glucose peaks and nadirs that exceed one standard deviation of mean glucose. It quantifies major glucose swings and is linked to oxidative stress and endothelial dysfunction.
- **Largest amplitude of glycemic excursion (LAGE):** The single largest difference between the maximum and minimum glucose values within a defined time period (usually 24 hours). It highlights extreme glucose variability and instability.
- **Standard deviation of glucose (SD):** A statistical measure indicating the dispersion of glucose values around the mean glucose level. Higher SD reflects greater glycemic variability and increased hypoglycemia risk.
- **Coefficient of variation (CV):** The ratio of glucose standard deviation to mean glucose, expressed as a percentage. CV <36% is generally considered acceptable. Preferred metric for assessing glucose variability as it is independent of mean glucose levels.
- **Glucose management indicator (GMI):** An estimate of glycated hemoglobin (HbA1c) derived from mean continuous glucose monitoring (CGM) glucose values over time. Helps reconcile discrepancies between laboratory HbA1c and CGM data.
- **Mean glucose:** The arithmetic average of all glucose readings over a specified monitoring period. Correlates with HbA1c but does not capture glucose variability.
- **Postprandial glucose excursion (PPGE):** The rise in blood glucose from pre-meal baseline to post-meal peak, typically measured within 1–2 hours after eating. Reflects meal-related glycemic impact and carbohydrate quality.
- **Area under the curve (AUC):** The integrated area under the glucose-time curve over a defined period, representing total glucose exposure. Captures both magnitude and duration of hyperglycemia.

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Next-Generation Insulin Delivery: Inhaled Insulin

Dr. Kshitiz Awadhwal

MBBS, DNB – Medicine, FICM, MRCP-ACUMEN, ACMDC-Advanced Certificate in Diabetes (PHFI), Certificate Course in GDM (PHFI), Certificate Course in Obesity (British Accreditation Council)

Consultant Physician and Diabetologist, Apollomedics Super Speciality Hospital, Lucknow

Despite advances in insulin analogues, subcutaneous administration remains limited by injection burden and delayed pharmacodynamics compared with physiological insulin secretion. Pulmonary delivery of inhaled Technosphere insulin enables rapid systemic absorption, offering a next-generation prandial option to improve adherence and postprandial glycemic control.

The lungs offer a highly efficient route for systemic drug delivery due to their large absorptive surface area and extensive vascularization. Technosphere insulin utilizes fumaryl diketopiperazine particles for deep alveolar deposition, rapidly dissolving at physiological pH to enable prompt systemic insulin absorption. Inhaled techno sphere insulin reaches peak plasma concentrations within 12–15 minutes and has a short duration of action of approximately 2–3 hours, closely mimicking physiological first-phase insulin secretion. This ultra-rapid profile effectively targets postprandial hyperglycemia while limiting late postprandial hypoglycemia.

Phase 3 trials demonstrated that inhaled techno sphere insulin combined with basal insulin achieves glycated hemoglobin (HbA1c) reductions non-inferior to subcutaneous rapid-acting analogues in both type 1 diabetes (T1D) and type 2 diabetes (T2D), with improved postprandial glucose control. A recent randomized trial showed that inhaled insulin plus insulin degludec achieved non-inferior HbA1c outcomes over 17 weeks compared with usual care in adults with T1D. Notably, a greater proportion of patients receiving inhaled insulin achieved clinically meaningful HbA1c reductions (>0.5%), supporting its role as an effective prandial component of modern basal bolus therapy. Inhaled insulin demonstrates an acceptable safety profile, with hypoglycemia rates comparable to subcutaneous prandial insulin. The most common adverse event is a mild, transient cough, typically occurring early

in treatment, and pulmonary contraindications include chronic lung disease and active or recent smoking. Baseline and periodic pulmonary function testing (e.g., forced expiratory volume in one second [FEV_1]) is recommended to ensure long-term respiratory safety.

Inhaled insulin is approved solely for prandial use with basal insulin in T1D and is best suited for carefully selected patients, requiring education on inhalation technique, dose titration, and pulmonary monitoring. Ongoing research is focused on optimizing inhaled insulin delivery, integrating digital health technologies, and generating long term real world and cost effective data to define its role in routine clinical practice.

Inhaled insulin represents a validated next generation insulin delivery strategy that offers rapid prandial insulin action through a non-invasive route. Evidence from pharmacokinetic studies and randomized clinical trials demonstrates that techno sphere insulin provides glycemic control non-inferior to conventional prandial insulin regimens, with particular benefits in postprandial glucose management. With appropriate patient selection and monitoring, inhaled insulin has the potential to expand therapeutic options and improve patient centered diabetes care.

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Automated Insulin Delivery Systems in Diabetes Care

Dr. Meraj Rasool

MBBS, MD (Medicine)

Associate Professor, T. S. Misra Medical College and Hospital, Lucknow

The landscape for management of diabetes has undergone a revolution, moving from manual injection and finger-prick testing to the automated insulin delivery (AID) systems, often referred to as closed – loop systems or the artificial pancreases.

What is an automated insulin delivery system?

An AID system is a closed-loop ecosystem that duplicates the glucose-regulating function of a healthy pancreas. It primarily consists of three components:

- **Continuous glucose monitoring (CGM):** An electronic sensor that tracks blood glucose levels in real time.
- **Insulin pump:** A device that delivers insulin subcutaneously.
- **Control algorithm:** The brain that automatically computes and modifies insulin administration from data received through the CGM.

Hybrid vs. fully closed-loop

The most current commercial systems are hybrid closed loop (HCL). These handle the basal (background), bolus (food related) insulin and correction doses automatically. They still require the user to announce meals by inputting carbohydrate count.

- **Fully automated systems:** These systems require no meal announcements. While majority of the systems still need user input, like the newer models iLet.
- **Bionic pancreases:** These are moving closer to full automation by only needing a size estimate of the meal (e.g.: small, medium, or large) rather than precise carb count.

Key technologies: Tubed vs. tubeless pumps

A key factor in the user preferences is the mechanism of physical delivery. AID systems generally use two types of pumps:

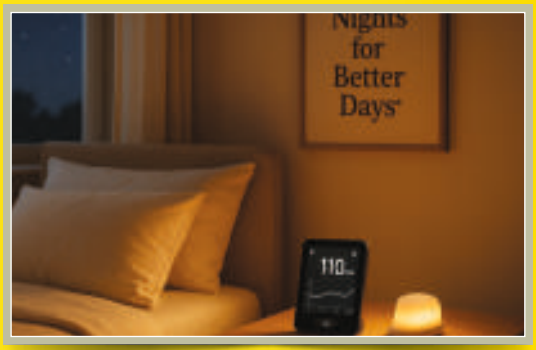
- **Tubed pumps: e.g., Medtronic MiniMed 780G**

  These systems use a tethered pump connected to the body through a flexible tube and infusion set. These offer large reservoirs for insulin and integrated touchscreen surfaces.

- **Tubeless pumps: e.g., Omnipod 5**

  These small-sized, waterproof pods attach directly to the skin. There are no tubes to catch, making them the most popular choice for children and active individuals. The Omnipod 5 stands out in this category by offering the first tubeless AID system.

  Studies have shown that these systems significantly improve the time in range (TIR), i.e., the percentage of the days spent between 70–180 mg/dL, by approximately 8–12 percentage points. However, the benefits move beyond the blood glucose numbers:



- **Reduced hypoglycemia episodes:** The AID systems can drastically reduce the risk for "lows or hypo" incidents, particularly occurring in the night, due to their automated insulin suspending feature when the blood glucose trends appear downward.
- **Improved quality of life:** The users usually report decreased "diabetes distress" and improved sleep as the system handles the continuous micro-adjustments which earlier required manual interventions.
- **Expansion to type 2 diabetes:** While traditionally for type 1 diabetes, the automated systems can be highly effective, but these are also helpful for people with type 2 diabetes or with high requirements for insulin or for those in hospital settings.

As the technology advances, several innovations are on the go to further reduce the burden of care like:

- **Ultra-rapid insulin:** The use of fast-acting insulins can help the algorithms for better management of postprandial glucose spikes.
- **Dual hormone systems:** Ongoing research on bi-hormonal pumps which can deliver insulin and glucagon both, providing an even stronger safety net against hypoglycemia.

Conclusion

Automated insulin delivery systems have evolved from being a medical curiosity to the standard of care. By building the gap between human error and biological demand, these systems offer a future where diabetes can be managed with precision, allowing patients to focus on enjoying life to the fullest.

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Diabetes Educator's Toolkit:
Skill of the Month-Health Literacy

Dr. Sunil Bhojane

MBBS, MD, C. Diabetes, CCEBDM,

Consultant Diabetologist, Siddhiksha Diabetes Clinic, City Criticare and Century Rayon Hospitals, Thane

Knowledge about diabetes, self-management skills, life style choices are all important while achieving a good glycemic control in case of type 2 diabetes mellitus (T2DM). World Health Organization (WHO) stresses that the social resources and personal characteristics needed for communities and individuals to appraise, access, understand, and use information and services while making decisions about health are termed 'health literacy'.

Role in diabetes self-management education (DSME)

Health literacy plays a vital role in DSME; it is an indicator of how accurately individuals with diabetes have understood their condition, interpreted health-related care, and carried out daily self-care tasks. Individuals with diabetes who have low health literacy have difficulties understanding medical information, which can have a detrimental impact on their healthcare management. Apart from this, health literacy indirectly impacts behaviors related to self-care by moderating self-efficacy, which minimizes the risk of complications related to T2DM.

According to a Korean study, "The relationship between DSME participation along with suitable self-care monitoring was significantly moderated by higher verbal and health-text literacy. A 2018 study revealed a substantial correlation between health literacy and diabetes knowledge and self-care, but less consistent correlations with glycated hemoglobin (HbA1c) and monitoring. Another study (2016) found that HbA1c was lowered with health literacy-sensitive interventions (oral, written, and empowering).

Practical implications for DSME programs

Assess literacy:

Diabetes educators must evaluate the participants before the start of the DSME regarding health literacy, which includes numeracy, language skills, including the capacity to understand blood glucose (BG) levels, reading medication labels, carrying out easy carbohydrate calculations, and decoding visual tools like self-monitoring of blood glucose (SMBG) charts and food labels. Early literacy assessments avoid information overload and assist educators in recognizing students who are at risk of misinterpreting self-care instructions. Making use of basic screening techniques (e.g., asking people to repeat instructions or show glucose monitoring) to use appropriate teaching strategies.

Tailor communication:

For learners with varying reading levels, it is crucial to personalize communication in DSME by using simple language, illustrations, and analogies in order to make complex diabetes concepts understandable and actionable. To assist students in understanding the various facets of diabetes care, and the importance of straightforward language, clear glossaries, and accessible metaphors like the "4-legged chair" analogy. A recent systematic review found that video-based education is effective in improving understanding and self-management outcomes among people with diabetes, supporting the integration of multimedia into routine DSME delivery. Using visual aids, such as educational videos, diagrams, and pictorial tools, can further enhance comprehension and engagement, especially for individuals who struggle with dense text or numerical information.

Special populations: Language, culture, and education may present significant challenges for immigrants, the elderly, and ethnic minorities. Programs should include resources that are appropriate for both culture and language.

Increase awareness and self-efficacy

Teach-back techniques, real-world examples, repeating key knowledge, and more straightforward goal-setting all boost self-efficacy and enhance comprehension. Literacy-responsive DSME eventually improves glycemic outcomes by enabling people to apply knowledge to long-term self-care habits.

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Frequently Asked Questions on Advances in Diabetes Care

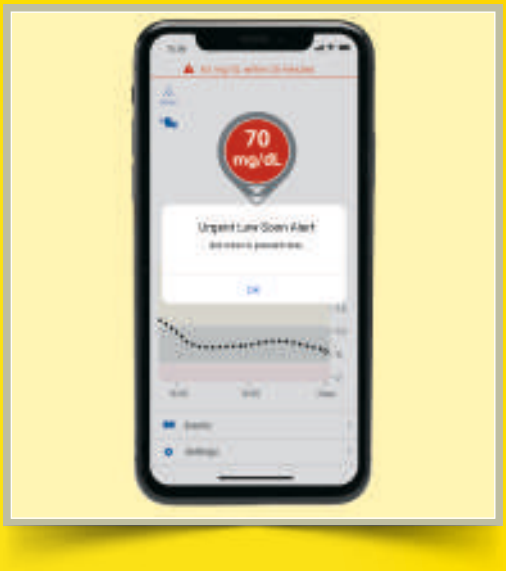
Dr. Shiva Madan

MBBS, MD Medicine, DM Endocrinology (SGPGI), SCE MRCP (UK)

Consulting Endocrinologist and Diabetologist, Marwar Hospital Bikaner, Rajasthan

1. I'm 45 years old and have type 2 diabetes. Because of my job, I travel a lot and find it hard to check my blood glucose frequently. I've also noticed that my glucose levels sometimes drop at night. What can I do to manage my diabetes better in this situation?

Answer: Managing type 2 diabetes while traveling for work is easier today because of continuous glucose monitoring (CGM). It is helpful during a busy lifestyle where frequent finger-pricking is difficult.



The advantage of CGM

Since you find it hard to check your blood glucose levels frequently, a CGM allows you to see the glucose levels in real-time on the phone without constant finger-pricking.

- It can alert you with an alarm if your glucose levels drop during sleep, which is essential for managing night-time lows.
- It shows how irregular meal timings or long flights affect glucose levels throughout the day.

Handling night-time lows and travel

- **Bedside prep:** A hypo kit containing sugar or glucose powder should always be kept ready.
- **Smart dining:** When eating at hotels, start with fiber (soup or salad), then protein (egg, paneer, or grilled chicken). This helps prevent glucose spikes and keeps levels steady overnight.
- **Meal and insulin adjustments:** It is important to consult the doctor/dietitian about adjusting insulin and choosing the right meals while traveling.

2. I've been living with type 2 diabetes for some time now, and as I've reached 50, my doctor suggests adding a glucagon-like peptide-1 receptor agonist (GLP-1 RA) injection to my medication list to help manage my levels better. I'm quite scared of needles and worried about what the side effects might be. Could you explain how this medication actually works and if it's a safe option for me?

Answer: It's very normal to feel worried about starting injections. However, this is a modern advancement in diabetes care designed to work with the body's natural processes.

How the treatment works

- It acts like a natural hormone that helps control blood glucose by releasing insulin only when needed, which lowers the risk of low glucose.
- It reduces appetite and slows digestion, helping prevent sharp rises in blood glucose after meals and supporting weight control.
- Most GLP-1 RA injections are taken once a week using a very small, nearly painless needle.

What are the possible side effects?

- The most common side effects are nausea, bloating, or constipation, especially in the first few weeks.
- Some people may have mild vomiting or acidity, which usually improves as the body adjusts.
- Serious side effects are rare, and your doctor will monitor you regularly.

Once you start with the injection, the benefits often outweigh the discomfort.

3. I was recently diagnosed with type 2 diabetes at 28 and have noticed many packaged foods labeled as "sugar-free" or "diabetes-friendly" in stores and online. Are these foods actually healthy for me, and how do I choose the right ones?

Answer: Making food choices can feel overwhelming after being diagnosed with diabetes, especially with so many special labels on food. Food labeled as "sugar-free" or "diabetes friendly" is not always healthy. Many of these products may still contain refined carbohydrates, unhealthy fats, excess sodium, or artificial sweeteners that can affect blood glucose levels and overall health. "Sugar-free" only means no added sugar; it does not guarantee that the food will not raise blood glucose due to the presence of other carbohydrates.

When choosing packaged foods:

- Check total carbohydrate, fiber, and fat, not only sugar content.
- Choose foods that are high in fiber and protein and low in refined carbohydrates.
- Review the ingredient list, which is arranged from highest to lowest quantity, and limit foods that list refined flour, sugar, or oil among the first three ingredients.

Did You Know? CGM Measures Interstitial Fluid Glucose and Not Blood Glucose

Continuous glucose monitoring (CGM) systems do not measure glucose directly from the blood. Instead, CGM sensors measure glucose levels in the interstitial fluid, the fluid that surrounds the body's cells just beneath the skin. Glucose moves from the bloodstream into the interstitial fluid, and this transfer takes time. As a result, CGM readings may show a physiological lag of approximately 5–10 minutes compared to capillary blood glucose values. This lag is most noticeable during periods of rapid glucose change, such as after meals, during physical activity, or following insulin administration.

This difference between CGM and finger-stick readings is expected and normal, and does not indicate inaccuracy of the device. CGM systems are designed to provide continuous glucose trends, patterns, and direction of change rather than isolated point values.

While finger-stick testing offers a single snapshot of blood glucose at a specific moment, CGM provides a dynamic and real-time glucose profile, enabling better anticipation of hypoglycemia and hyperglycemia, improved time-in-range, and more informed diabetes self-management decisions.

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Role Play

A 10-year-old girl was recently diagnosed with type 1 diabetes mellitus (T1DM). She is physically active and enjoys playing badminton regularly. Her mother reports that her glucose levels tend to rise during play and drop overnight, particularly on days with evening sports activity.

Diabetes educator (DE): Hello, please have a seat. How can I help you?

Mom: My daughter was recently diagnosed with T1DM. She loves badminton, but her glucose rises during play and drops at night.

DE: That's common. During and immediately after exercise, glucose can rise because intense activity triggers stress hormones like epinephrine, signaling the liver to release glucose. Later, particularly at night, glucose may drop (hypoglycemia, <70 mg/dL) because her muscles take up more glucose, and insulin sensitivity is increased after exercise.

Mom: How do we manage this?

DE: How are you checking her glucose currently?

Mom: With finger pricks.

DE: A glucometer is helpful, but continuous glucose monitoring (CGM) is even better. It provides real-time readings and trends, measures glucose every few minutes, reduces finger pricks, and alerts you to high, low, and overnight glucose changes. Smart glucometers with apps can also store readings, show trends, and share data with caregivers. Until CGM is started:

- Check glucose before badminton. If <120 mg/dL, give a 15 g carbohydrate snack. Avoid correcting highs immediately post activity; wait 15–20 minutes and recheck.
- Before bedtime, check glucose. If <120 mg/dL, give a 15 g snack and keep fast-acting carbs nearby.
- On active days, a basal insulin reduction may be needed; discuss with your doctor.
- Consistent carbohydrates in evening meals, dinner, and regular monitoring help adjust insulin to activity levels.

DE: With CGM and careful planning, you can safely balance food, insulin, and exercise, making management easier for your daughter.

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Metformin Hydrochloride 1000 mg SR + Glimepiride 4 mg

Abridged Prescribing Information

Active Ingredients: Metformin hydrochloride (as sustained release) and glimepiride tablets **Indication:** For the management of patients with type 2 diabetes mellitus when diet, exercise and single agent (glimepiride or metformin alone) do not result in adequate glycaemic control. **Dosage and Administration:** The recommended dose is one tablet daily during breakfast or the first main meal. Each tablet contains a fixed dose of glimepiride and Metformin Hydrochloride. The highest recommended dose per day should be 8 mg of glimepiride and 2000mg of metformin. Due to prolonged release formulation, the tablet must be swallowed whole and not crushed or chewed. **Adverse Reactions:** For Glimepiride: hypoglycaemia may occur, which may sometimes be prolonged. Occasionally, gastrointestinal (GI) symptoms such as nausea, vomiting, sensations of pressure or fullness in the epigastrium, abdominal pain and diarrhea may occur. Hepatitis, elevation of liver enzymes, cholestasis and jaundice may occur; allergic reactions or pseudo allergic reactions may occur occasionally. For Metformin: GI symptoms such as nausea, vomiting, diarrhea, abdominal pain, and loss of appetite are common during initiation of therapy and may resolve spontaneously in most cases. Metallic taste, mild erythema, decrease in Vit B12 absorption, very rarely lactic acidosis, Hemolytic anemia, Reduction of thyrotropin level in patients with hypothyroidism, Hypomagnesemia in the context of diarrhea, Encephalopathy, Photosensitivity, hepatobiliary disorders. **Warnings and Precautions::** For Glimepiride: Patient should be advised to report promptly exceptional stress situations (e.g., trauma, surgery, febrile infections), blood glucose regulation may deteriorate, and a temporary change to insulin may be necessary to maintain good metabolic control. Metformin Hydrochloride may lead to Lactic acidosis; in such cases metformin should be temporarily discontinued and contact with a healthcare professional is recommended. Sulfonylureas have an increased risk of hypoglycaemia. Long-term treatment with metformin may lead to peripheral neuropathy because of decrease in vitamin B12 serum levels. Monitoring of the vitamin B12 level is recommended. Overweight patients should continue their energy-restricted diet, usual laboratory tests for diabetes monitoring should be performed regularly. **Contraindications:** Hypersensitivity to the active substance of glimepiride & Metformin or to any of the excipients listed. Any type of acute metabolic acidosis (such as lactic acidosis, diabetic ketoacidosis, diabetic pre-coma). Severe renal failure (GFR<30ml/min). In pregnant women. In lactating women.Acute conditions with the potential to alter renal function (dehydration, severe infection, shock, intravascular administration of iodinated contrast agents); acute or chronic disease which may cause tissue hypoxia (cardiac or respiratory failure, recent myocardial infarction, shock); hepatic insufficiency; acute alcohol intoxication; alcoholism. **Use in a special population:** Pregnant Women: Due to a lack of human data, drugs should not be used during pregnancy. Lactating Women: It should not be used during breastfeeding. Pediatric Patients: The safety and efficacy of drugs has not yet been established. Renal impairment: A GFR should be assessed before initiation of treatment with metformin containing products and at least annually thereafter. In patients at increased risk of further progression of renal impairment and in the elderly, renal function should be assessed more frequently, e.g. every 3-6 months.

Additional information is available on request.

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In case of any adverse events, kindly contact: pv@usv.in For the use of registered medical practitioner, hospital or laboratory.

USV Private Limited
Arvind Vithal Gandhi Chowk, B. S. D. Marg, Govandi, Mumbai - 400 088. | Tel.: 91-22-2556 4048 | Fax: 91-22-2558 4025 | www.usvindia.com

Corvette Team

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