



NEW FRONTIERS IN DIABETES MANAGEMENT: INNOVATIONS, INTEGRATIONS, AND IMPACT IN THE INDIAN CONTEXT

Diabetology

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ABSTRACT

India, often called the diabetes capital of the world, is witnessing a rapid surge in diabetes mellitus cases, with over 101 million adults affected by Type 2 Diabetes Mellitus (T2DM) as per NFHS-5 and ICMR-INDIAB data. While conventional diabetes care has revolved around diet, exercise, blood glucose monitoring, and pharmacotherapy, emerging innovations in digital health, pharmacogenomics, regenerative therapy, and patient-centric care models are redefining diabetes management. This article explores these new frontiers with a special emphasis on their relevance, accessibility, and scalability in the Indian healthcare ecosystem.

KEYWORDS

INTRODUCTION

The burden of diabetes in India is staggering. According to the ICMR-INDIAB (Indian Council of Medical Research - India Diabetes) study, over 101 million Indians are living with diabetes, with another 136 million in the prediabetic stage [1]. The challenges are multifaceted—ranging from limited awareness and delayed diagnosis to poor access to multidisciplinary care, especially in rural areas. Given these challenges, India needs scalable, cost-effective, and culturally appropriate strategies to prevent complications and improve outcomes. This article outlines emerging trends and technologies that hold promise for transforming diabetes care in India.

1. Digital Health and Technology Integration

1.1 Continuous Glucose Monitoring (CGM) and Flash Glucose Monitoring (FGM)

India is witnessing a significant transformation in diabetes care through the adoption of Continuous Glucose Monitoring (CGM) and Flash Glucose Monitoring (FGM) technologies. Devices like the FreeStyle Libre by Abbott and Dexcom G6 are becoming increasingly popular, particularly among insulin-dependent patients, urban populations, and tech-savvy youth. These devices provide real-time blood glucose data, allowing patients to monitor glycaemic trends, Time in Range (TIR), and glucose variability more effectively [2].

According to a 2022 IQVIA India report, the Indian CGM market is projected to grow at a CAGR of 15.2%, with a market valuation expected to cross INR 800 crore by 2027 [3]. The adoption is strongest in metro cities such as Mumbai, Bengaluru, and Delhi but is expanding to smaller towns due to increasing awareness.

Abbott India, through its FreeStyle LibreView platform, has taken a step forward in remote glucose monitoring by enabling patients in tier-2 and tier-3 cities to share glucose data with their physicians digitally. This is especially important in India where the diabetologist-to-patient ratio is disproportionately low. According to Abbott, more than 500,000 Indian users have used FreeStyle Libre systems since its launch, and their digital LibreView platform currently hosts over 1 million glucose reports monthly [4].

Moreover, CGMs have been shown to reduce HbA1c levels by 0.5–1.0% over a 3–6 month period when coupled with continuous data review and behaviour change strategies and could prove a promising direction for India's overburdened healthcare system [5].

1.2 Mobile Health Applications and Telemedicine

India's digital ecosystem has facilitated the rapid growth of mobile health (mHealth) platforms and telemedicine services, particularly during and after the COVID-19 pandemic. Startups such as BeatO, Wellthy Therapeutics, HealthifyMe, and SugarFit have designed Indian-context diabetes management platforms combining digital glucometers, AI-driven coaching, and dietary suggestions customized for Indian meals [6].

- BeatO claims that its ecosystem has supported over 1.5 million users, primarily in India's urban and semi-urban regions. Their app

provides Bluetooth-enabled glucometers, connects patients to certified diabetes educators, and gives real-time alerts to family members in case of abnormal readings [7].

- Wellthy Therapeutics, backed by real-world evidence, has demonstrated HbA1c reductions of 1.2% after 16 weeks of app-based coaching and interventions in Indian populations [8].
- HealthifyMe's Smart Diabetes Plan uses AI-based chatbot 'Ria' and human coaches to monitor physical activity, nutrition, and glucose patterns. It has been used by over 35 million people globally, with nearly 60% from India [9].

Telemedicine has seen massive government-backed scaling in India via eSanjeevani, the national telemedicine platform launched by the Ministry of Health and Family Welfare. As of July 2025, eSanjeevani has facilitated over 200 million consultations, with nearly 15% focused on NCDs including diabetes [10]. Its OPD module allows for free audio-visual consultations between patients and doctors, making it particularly impactful in rural India where endocrinology expertise is sparse.

In 2023, the government integrated diabetes risk assessment and follow-up tools into the platform under the Ayushman Bharat Digital Mission (ABDM), enabling ASHAs and PHC staff to flag high-risk individuals for physician review. This hybrid model of digital screening and teleconsultation is helping to bridge the urban-rural diabetes care divide.

2. Pharmacologic Innovations Relevant to India

2.1 GLP-1 Analogues and SGLT2 Inhibitors

In the global diabetes management landscape, glucagon-like peptide-1 receptor agonists (GLP-1 RAs) and sodium-glucose cotransporter-2 (SGLT2) inhibitors have emerged as game-changers for their dual role in glycaemic control and cardio metabolic protection. In India, however, accessibility, affordability, and physician familiarity vary significantly.

GLP-1 analogues, such as semaglutide and liraglutide, have shown substantial efficacy in reducing HbA1c levels, promoting weight loss, and lowering cardiovascular events. Semaglutide, in particular, has demonstrated HbA1c reductions of up to 1.5–2% and average weight loss of 4–6 kg in trials like SUSTAIN-6 [6]. However, in India, branded versions like Ozempic (semaglutide) remain cost-prohibitive, priced around INR 10,000–12,000 per month, limiting usage mainly to urban tertiary centres and private endocrinology practices.

Meanwhile, SGLT2 inhibitors such as dapagliflozin, canagliflozin, and empagliflozin are gaining traction across income groups due to availability of Indian generics. A study by Unnikrishnan et al. noted improved access and tolerability of generic SGLT2 inhibitors, with wide adoption across both private and public sector clinics [7].

These agents are particularly important in the Indian context, where cardiovascular disease (CVD) and chronic kidney disease (CKD) are prevalent among people with type 2 diabetes. The DECLARE-TIMI

and EMPA-REG trials highlighted the benefits of SGLT2 inhibitors in reducing hospitalization for heart failure and preserving renal function—attributes crucial for the Indian diabetic population with high burden of complications [8].

Despite the progress, GLP-1 RA penetration in India remains <1%, primarily due to cost and need for injections. However, oral semaglutide (Rybelsus) is now available in India and is expected to boost uptake due to easier administration [9].

2.2 Fixed-Dose Combinations (FDCs)

India has a long-standing reliance on fixed-dose combinations (FDCs) in diabetes therapy, due to their cost-effectiveness, convenience, and improved patient adherence in settings with low health literacy. A 2022 study by Awasthi et al. found that nearly 60% of all oral diabetes prescriptions in India involved FDCs, with metformin + glimepiride being the most common combination [10].

Leading Indian pharmaceutical companies like Glenmark, Sun Pharma, Dr. Reddy's, and Mankind Pharma have innovated with over 100 approved FDCs, combining agents such as metformin with DPP-4 inhibitors (like vildagliptin or teneligliptin), sulfonylureas, and SGLT2 inhibitors.

These FDCs have demonstrated clinical equivalence to monotherapy while improving compliance by up to 30–40%, as shown in multicentric trials by Indian Diabetes Research Society (IDRS) [11]. Additionally, these combinations are often priced 30–50% lower than their international counterparts, with monthly costs as low as INR 100–300, making them accessible for economically disadvantaged patients.

Importantly, the DCGI (Drugs Controller General of India) has tightened regulations on irrational FDCs, encouraging evidence-backed combinations that align with ICMR and ADA (American Diabetes Association) guidelines.

In rural India and government settings, essential drug lists now include key FDCs, making them available through Jan Aushadhi Kendras and public sector dispensaries. This has expanded access to rational combinations even in tier-3 towns and rural PHCs.

3. Personalized and Precision Diabetes Care

3.1 Genetic Studies in Indian Populations

India's higher predisposition to insulin resistance and early-onset type 2 diabetes is linked to unique genetic factors. Extensive studies—including the Chennai Urban Rural Epidemiology Study (CURES)—have identified polymorphisms in genes like TCF7L2, PPARG, KCNJ11, SLC30A8, HHEX, and CDKN2A associated with increased risk in the Indian population. For example, the TCF7L2 rs7903146 variant has an odds ratio of ~1.9 for T2DM in Indians, higher than in Europeans [17]. These findings support the development of pharmacogenomic tools and gene-based stratification to tailor therapies—though limited awareness and cost remain hurdles.

3.2 Culturally-Tailored Management

India's diverse cultures necessitate localized approaches. Programs like mDiabetes of Ministry of Health & Family Welfare, and hospital-led AROGYAM offer region-specific coaching in local languages, incorporating yoga, traditional diets, and walking habits. Early evaluations show improved adherence and modest A1c reductions (~0.7–1.0%), demonstrating potential scalability.

4. Behavioral and Psychosocial Interventions

4.1 Addressing Diabetes Distress in Indian Patients

Psychological burden—stress, stigma, and burnout—is common in Indian diabetics. Interventions using digital mental health platforms like Wysa, and NGOs including The Blue Circle Diabetes Foundation, now integrate emotional wellbeing support with diabetes care [18]. These blended models lead to improved self-care behaviours and stable glucose control.

4.2 Community Health Workers and Peer Support

Leveraging India's ASHA network, frontline workers now deliver screening, counselling, and follow-up. Initiatives like Dr. Mohan's Diabetes Peer Educator Program in Chennai have shown reduced HbA1c (by ~0.5%) and better medication adherence in semi-rural populations [19].

5. Emerging Regenerative Therapies

5.1 Islet Cell Transplant and Beta Cell Regeneration

While not yet mainstream, India's Sankara Nethralaya Stem Cell Lab and AIIMS Delhi are conducting pilot islet transplantation and beta-cell activation research. These early-stage trials hold promise for long-term insulin independence [20, 21].

5.2 Stem Cell Therapy and Autologous Cells

Biotech firms like Stempeutics are investigating autologous mesenchymal stem cell therapy for diabetic foot complications and neuropathy (Stempeutics Report). Though experimental, clinical feasibility is being explored through small-scale studies [22].

6. Artificial Intelligence and Predictive Analytics

6.1 Retinopathy and Nephropathy Screening

AI-enhanced retinal screening tools like DRISTi (by Artelus and DrishtiAI) employ deep neural networks to classify multiple levels of diabetic retinopathy and related pathologies with sensitivities/specificities above 90%. Trials in Tamil Nadu (via Aravind Eye Centre) and Rajasthan's MadhuNetr project are scaling AI screening in rural centers (>70 hubs), linking to specialists. Recent multicentric validation using the AIDRSS system showed sensitivity of 92% and specificity of 88% in over 5,000 Indian patients [23].

6.2 Clinical Decision Support Systems

Startups such as Qure.ai and Tricog Health have developed AI models that integrate glucose, vitals, and lab data to support physicians in medication titration and risk prediction. Early evaluations in high-volume diabetes centers show improved treatment accuracy and workflow efficiency.

7. Public Health and Policy-Level Innovations

7.1 National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS)

Initiated in 2010, NPCDCS currently screens over 85 million individuals through PHCs/CHCs [24]. The programme is integrating real-time glucose monitoring, teleconsultation, and capacity building, although challenges remain in data systems and health personnel training.

7.2 Jan Aashaadha and Affordable Insulin Access

The PMBJP (Pradhan Mantri Bhartiya Janaushadhi Pariyojana) provides low-cost generic insulin analogues and oral drugs (metformin, glimepiride). However, newer medications like DPP-4 inhibitors and SGLT2s are yet to be widely covered, limiting chronic complication management.

8. Integrative Approaches and Ayurveda

India's long-standing Ayurveda and Yoga traditions are increasingly being evaluated using modern clinical research frameworks. The Ministry of AYUSH promotes evidence-based integrative approaches combining allopathy and traditional medicine for managing prediabetes and early-stage diabetes [25].

Several RCTs from institutions like CCRAS (Central Council for Research in Ayurvedic Sciences) and NIMHANS (National Institute of Mental Health and Neuro Sciences) have shown benefits of yoga and herbal formulations (e.g., Gudmar, Triphala) in glycemic control.

9. Future Directions and Challenges in India

9.1 Urban–Rural Divide

While urban centres have access to endocrinologists, CGMs, and advanced therapies, rural areas rely heavily on primary care providers and health sub-centres that are often under-equipped (60% unable to manage basic diabetes care). Bridging this gap requires task-shifting, telemedicine, and capacity building. The Chunampet Rural Diabetes Prevention Project showed that tele-diabetology models, with provider training and remote specialist support, can deliver effective diabetes care in rural settings [26].

9.2 Health Literacy and Digital Divide

Digital therapeutics show great promise, but India faces a steep digital literacy gap, especially among the elderly and marginalized communities. Surveys reveal that approximately 70% of the population lacks reliable digital access, and many elders struggle to use smartphones effectively [27]. Innovations must therefore be multilingual, visual, and voice-driven, and delivered through community kiosks and CSC (Common Services Centres) centres to improve accessibility [28].

8.3 Cost and Reimbursement

Out-of-pocket healthcare expenditure remains a significant barrier for chronic disease management. While schemes like Ayushman Bharat PM-JAY (Pradhan Mantri Jan Arogya Yojana) provide up to ₹5 lakhs annually for hospitalization (~55 crore beneficiaries), they largely exclude outpatient diabetes management, digital tools, and remote monitoring services. To be fully effective, PM-JAY must encompass comprehensive outpatient care—including digital health, glucose monitoring, and insulin delivery—to minimize long-term complications and economic hardship.

CONCLUSION

India stands at a critical juncture in the battle against diabetes. While the disease burden is immense, so is the potential for innovation. By embracing emerging therapies, integrating traditional practices, strengthening digital and AI-based tools, and building equitable public health systems, India can lead the way in redefining diabetes management not only for its own population but for other LMICs (Low- and Middle-Income Countries).

The road ahead lies in synergizing science, systems, and society—making diabetes care not just advanced, but accessible and affordable for every Indian.

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