

Transforming Diabetes Care: Entering a New Era of Remission and Recovery

“Diabetes is a chronic disease, but it doesn't have to be a hopeless one.”

— David G. Marrero, President, American Diabetes Association

The Unseen Weight: Living with Diabetes

A phone call from a childhood friend last evening left me deeply unsettled. Her brother, someone I too had known fondly, in those carefree days nearly three decades ago, had developed diabetic neuropathy following a kidney transplant. It crept in silently and struck without mercy, ultimately claiming four of his toes. I sat with the phone in my hand long after the call had ended, thinking of him as I remembered him then, young and bubbly, and feeling the weight of what time and disease had taken. It is one thing to read statistics in journals and quote incidence rates in editorials. It is quite another to hear a childhood friend's voice break as she describes watching her brother lose, piece by piece, what most of us never think to be grateful for. Diabetes does not announce itself with drama. It settles in quietly, and then, when least expected, it takes something that cannot be given back.

Living with Diabetes carries a weight that often remains invisible to those around us, a relentless burden that extends far beyond medical statistics and clinical measurements.

It manifests in the constant calculations, the persistent alarms, the routine finger pricks, and the daily injections. It lives in the mental exhaustion of second-guessing every meal, scrutinising every physical activity, and wondering how a single restless night might tip the delicate metabolic balance. It awakens with you, sometimes from hypoglycaemia's tremors, other times from hyperglycaemia's fog, and occasionally from both within the same night.

Perhaps most wearying is the need to repeatedly explain that Diabetes is not a consequence of poor choices, that there are no “cheat days” in chronic disease management, and that what appears as routine is actually the product of extraordinary daily effort.

Diabetes offers no respite. It demands unwavering vigilance, day after day, year after year. And those who manage it, demonstrate remarkable resilience, even on days when that strength feels depleted.

To everyone navigating this journey: the exhaustion you feel is valid. The effort you invest, though often unseen, is profound. What may feel like mere survival is, in truth, an extraordinary demonstration of human endurance and adaptability. You are not weak. You are profoundly strong, particularly on the days when you cannot feel that strength yourself.

Yet this reality need not remain unchanging.

Indeed, we stand at the threshold of a transformative era, one that offers not merely better management, but genuine possibilities for remission and metabolic recovery.

Rethinking What We Once Considered Permanent

For most of the modern era, *Diabetes mellitus* was described to patients as a permanent condition. It arrived

and it stayed. Doctors guided patients toward careful monitoring, structured routines, lifestyle changes, and a long-term partnership with medication. The role of the clinician was to slow the decline, ease the complications, and maintain quality of life for as long as possible. This mindset shaped generations of physicians and the systems in which they practiced.

Yet this foundation is shifting. New developments in cellular biology, pharmacology, and technology have broadened our sense of what is biologically possible. We now use treatments that reach deeper into metabolic pathways, affecting appetite, liver fat, inflammation, and pancreatic workload in ways that older therapies could not. Devices once reserved for highly motivated or well-resourced individuals have become part of ordinary care. Digital tools have tightened the feedback loop between patients and clinicians.

The medical community is living through something remarkable. In recent years, the treatment landscape has shifted in ways that would have seemed impossible just a decade ago. More than 500 million people worldwide have Diabetes, and clinicians now have tools that can meaningfully change their lives, not merely manage their numbers. This is not about incremental improvements to existing therapies. Physicians are witnessing fundamental changes in how they approach both Type 1 and Type 2 Diabetes. New medications protect hearts and kidneys. Technologies are relieving some of the exhausting mental burden of daily management. Clinicians even have the first therapy capable of delaying Type 1 Diabetes in people at risk. Perhaps most significantly, the concept of Diabetes remission, once discussed only in whispers, has entered mainstream clinical discourse as an achievable goal for appropriately selected patients.

These are not minor adjustments to the status quo. They represent a different way of thinking about what Diabetes treatment should accomplish: moving from lifelong containment toward creating windows of metabolic recovery.

A Shift in Mindset: From Lifelong Containment to a Window of Reversal

For most of contemporary clinical practice, Diabetes management followed a fairly predictable pattern. People with Type 1 Diabetes took insulin. People with Type 2 Diabetes started with pills, added more pills, and eventually moved to insulin when nothing else worked. The focus remained almost entirely on blood sugar levels and HbA1c values. Diabetes was presented as a permanent, progressive condition requiring lifelong medication and vigilant monitoring.

That approach has changed dramatically. Clinicians now understand that Diabetes is not a single disease but a collection of metabolic disorders with different underlying mechanisms. Two people with Type 2 Diabetes and identical A1c readings might have completely different problems driving their hyperglycaemia. One might have severe insulin resistance with adequate beta cell function. Another might have primarily beta cell failure with modest insulin resistance. A third might have both, compounded by incretin deficiency, inappropriate glucagon secretion, and substantial hepatic fat accumulation creating lipotoxicity. Patients also display distinct patterns of visceral fat, inflammatory tendency, and genetic susceptibility. These diverse mechanisms explain why identical A1c readings may yield strikingly different responses to the same therapy.

This recognition matters because it shapes treatment choices and opens therapeutic possibilities. Physicians can now match specific therapies to specific problems. More importantly, the medical community has moved beyond thinking of Diabetes medications as simply glucose-lowering agents. Many newer drugs prevent heart attacks, strokes, kidney failure, and death. That shift in perspective changes everything about how clinicians select treatments.

When physicians intervene early and reduce the metabolic burden on the pancreas, they sometimes see glucose levels normalise without medication. Hepatic fat decreases, insulin sensitivity improves, and endogenous insulin secretion becomes more stable. This is where the possibility of remission enters the discussion. It is not a universal expectation but a realistic outcome for a subset of patients whose biology and treatment timing align favourably.

The New Pharmacology: Medications that Target Multiple Pathways

Incretin-based therapies have advanced this field more than almost any other development of the past decade. Early GLP-1 receptor agonists already offered strong glycaemic control and substantial weight reduction. Dual agonists targeting both GIP and GLP-1 receptors deepened the impact further, improving appetite regulation and more rapidly reducing liver fat. Early data on triple receptor agonists targeting GLP-1, GIP, and glucagon receptors suggest metabolic effects approaching those once seen only after metabolic surgery.

These agents act across multiple organs simultaneously: increasing insulin secretion when needed, suppressing inappropriate glucagon release, slowing gastric emptying, altering hunger signals in the brain, and reducing hepatic steatosis. Their cardiovascular outcome data have been equally impressive, with reductions in major adverse cardiac events that rival traditional cardiac-protective agents. For some patients who achieve substantial weight loss and hepatic fat reduction, normal glucose levels are maintained off Diabetes medications for extended periods, representing genuine metabolic remission.

SGLT2 inhibitors have told a similarly compelling story. Their mechanism seemed almost too simple at first: make the kidneys excrete glucose, lower blood sugar, done. The reality proved far more complex and far more significant. These medications protect kidneys and hearts through mechanisms still being fully elucidated. People with Diabetes and established kidney disease who take SGLT2 inhibitors are less likely to progress to dialysis. People with heart failure stay out of hospital. Mortality benefit is real. That these benefits extend to patients without Diabetes at all confirms that these agents are doing something fundamental to cardiovascular and renal physiology well beyond glucose metabolism.

Insulin therapy, meanwhile, continues to evolve. Ultra-rapid-acting formulations absorb faster and peak earlier, enabling better postprandial control with less late hypoglycaemia. Extended basal formulations with flat, predictable profiles have substantially reduced nocturnal hypoglycaemia. Glucose-responsive insulins that automatically modulate activity based on ambient blood glucose levels remain under investigation but represent a genuinely transformative prospect, one that could resolve the fundamental tension at the heart of insulin therapy.

Across all these drug classes, honest acknowledgment of challenges is warranted. Cost remains a formidable barrier. Side effects, particularly gastrointestinal intolerance with incretin-based agents, limit access for some patients. Long-term safety data continue to accrue. Prescription rates for guideline-recommended agents remain lower than the evidence demands, reflecting cost concerns, clinical unfamiliarity, and entrenched inertia. Addressing these gaps is as much a clinical imperative as developing the next molecule.

Technology: The Digital Revolution in Diabetes

Continuous glucose monitoring has fundamentally changed how patients understand their disease. Rather than isolated snapshots from fingerstick checks, they now see continuous traces showing exactly what

glucose does through the day and night. Patients discover that a bedtime snack spikes glucose until 3 a.m., that stress elevates readings, that exercise has prolonged effects invisible to intermittent testing. This visibility transforms decision-making in ways that no other single innovation has matched.

The technology has matured rapidly. Sensors last longer, accuracy has improved, and most systems now connect directly to smartphones, displaying real-time glucose values and trend arrows showing direction and rate of change. The benefits extend beyond patients using insulin; studies now demonstrate value in Type 2 Diabetes managed without insulin, where real-time feedback reshapes food choices, activity patterns, and medication adherence in clinically meaningful ways.

Automated insulin delivery systems represent arguably the most significant advance in Type 1 Diabetes management since insulin itself. By connecting continuous glucose monitors to insulin pumps through adaptive algorithms, these systems adjust basal delivery automatically. Users typically spend more than 70% of time in target glucose range. Severe hypoglycaemia rates fall dramatically. Night-time control improves substantially. Crucially, users report reduced Diabetes distress and a restoration of quality of life that clinical metrics alone cannot fully capture. Next-generation fully closed-loop systems that automate bolus delivery as well are in late-stage development, with steady and encouraging progress.

Artificial intelligence is increasingly integrated into these systems, anticipating glycaemic shifts before they occur by accounting for meals, physical activity, stress, and circadian rhythms. Remote monitoring platforms allow clinicians to review patient data and adjust therapy without requiring office visits, offering particular value in rural and underserved communities.

A note of appropriate caution is warranted. Algorithms trained on one population may perform differently in another. The human dimensions of Diabetes care, motivational support, emotional presence, nuanced clinical judgement, cannot be automated. Technology must augment the patient-clinician relationship, not displace it. And access remains the most troubling challenge: these systems are expensive, insurance coverage is inconsistent, and the resulting two-tier landscape, where affluent patients access cutting-edge tools while others manage with basics, represents an inequity that the profession must confront directly.

Surgical Approaches: Metabolic Surgery as Diabetes Treatment

Bariatric surgery has evolved from a weight-loss procedure into a legitimate and evidence-based Diabetes treatment. The evidence now clearly demonstrates that metabolic surgery produces superior glucose control compared to medical therapy alone in patients with Type 2 Diabetes and obesity, with substantial numbers achieving complete remission and maintaining normal glucose levels without medication. Long-term follow-up at five and ten years confirms the durability of this benefit, directly challenging the assumption that Type 2 Diabetes is inevitably progressive.

The mechanisms extend well beyond weight loss, involving alterations in gut hormone profiles, bile acid metabolism, and the gut microbiome, all of which improve insulin sensitivity and beta cell function in ways that caloric restriction alone does not replicate. Patient selection remains paramount. Comprehensive preoperative evaluation of medical suitability, psychological readiness, and realistic understanding of postoperative life is essential, as are clear discussions of perioperative risk and the possibility of late relapse. Newer endoscopic techniques offer less invasive alternatives for patients unwilling or unable to undergo traditional surgery, broadening the eligible population.

Breaking New Ground: Disease-Modifying Approaches

The approval of Teplizumab for delaying Type 1 Diabetes onset in high-risk individuals is genuinely historic, representing the first therapy to modify the underlying autoimmune process rather than merely managing its metabolic consequences. By selectively targeting immune cells responsible for beta cell destruction while preserving regulatory immune populations, teplizumab has demonstrated the ability to delay clinical Diabetes onset by several years. The delay is not permanent, but the proof of concept is profound: the autoimmune process is not immutable.

This opens the door to a wider class of immunomodulatory approaches, including antigen-specific therapies designed to induce lasting immune tolerance without broad immunosuppression. If successful, these could prevent Type 1 Diabetes in susceptible individuals or halt progression at diagnosis.

The goal of beta cell replacement has driven research for decades. Islet transplantation has improved meaningfully, with refined isolation techniques and better immunosuppression protocols offering restored endogenous insulin secretion for carefully selected patients with severe, refractory hypoglycaemia. More transformative still, recent protocols have successfully differentiated pluripotent stem cells into glucose-responsive, insulin-secreting cells that behave functionally like native beta cells, providing a theoretically unlimited cell source. The central challenge of protecting transplanted cells from immune rejection without lifelong immunosuppression remains unsolved, but gene therapy approaches and encapsulation strategies are advancing steadily. A biological cure for Type 1 Diabetes is not imminent, but it no longer belongs to the realm of imagination.

Confronting the Access Problem

The most pressing concern in modern Diabetes care is not scientific but structural: access. Remarkable therapeutic advances mean little if they remain beyond reach. The newest medications cost hundreds of dollars per month. Continuous glucose monitors and insulin pumps cost thousands per year. In India, people ration insulin because they cannot afford it. In many low- and middle-income countries, people still die from diabetic ketoacidosis for want of a therapy that has existed for over a century. Technology access follows similar fault lines, with requirements for smartphone ownership, reliable connectivity, and digital literacy creating barriers that disproportionately affect the elderly, rural populations, and those of lower socioeconomic status.

Clinical trial populations continue to underrepresent minorities and non-Western populations, raising legitimate questions about the generalisability of efficacy and safety data. Broadening trial diversity and conducting rigorous post-marketing surveillance in underrepresented groups are not optional enhancements: they are scientific and ethical obligations.

Physicians must advocate persistently for policies that improve medication affordability and technology access. Scientific progress is meaningful only when it reaches all patients, not merely those with good insurance and the resources to navigate complex healthcare systems.

The “Bharat” Perspective: Innovation Under Pressure

Bharat, with over 100 million people living with Diabetes, presents both a sobering challenge and an instructive case study in addressing this disease at scale under resource constraints. The Indian epidemic differs importantly from Western patterns in ways that carry direct therapeutic implications. Diabetes onset occurs typically a decade earlier in South Asia, affecting people in their thirties during peak

productive years. Indians develop Diabetes at lower body mass indices, with disproportionate visceral and hepatic fat accumulation even at weights considered normal by Western standards. Insulin resistance manifests more severely at lower BMI thresholds, and the metabolic syndrome presents with a distinct phenotype that guidelines derived predominantly from Western trial populations may not fully address. These biological differences are compounded by rapid environmental change: traditional diets displaced by processed foods, increasingly sedentary occupations, and the chronic stress of urban transformation, all interacting with genetic susceptibility to accelerate early-onset disease.

The stark reality is that most Indians with Diabetes cannot access the advances that dominate contemporary clinical discourse. Newer GLP-1 agonists and SGLT2 inhibitors remain financially out of reach for the vast majority. Even basic insulin access is inconsistent in rural areas, where cold chain logistics present persistent challenges. Out-of-pocket healthcare expenditure pushes millions into poverty annually, and when families must choose between medications and necessities, medications often lose.

Bharat's robust generic pharmaceutical industry offers potential solutions. Generic versions of older Diabetes medications are widely available and affordable. Prime Minister Modi's vision has been a major driving force in making the generic versions of older Diabetes medications widely available and affordable, primarily through the flagship Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP). The vision is rooted in reducing the out-of-pocket healthcare expenditure for citizens and ensuring "health for all". Also, the biosimilar insulin market has grown substantially, offering lower-cost alternatives to branded analogues. While questions about bioequivalence persist, biosimilars represent pragmatic solutions for resource-limited settings. As newer agents go off-patent, Indian manufacturers can potentially democratise access through affordable generics, bringing advanced therapies within reach of broader populations.

Telemedicine has connected remote communities to specialists. Indian companies are developing lower-cost continuous glucose monitoring systems for price-sensitive markets. Mobile applications providing Diabetes education in regional languages offer genuinely scalable interventions. Simple, affordable tools that patients actually use will always outperform sophisticated ones that remain inaccessible.

Prevention must be the foremost priority. Lifestyle interventions have proven effective in Indian populations, but scale requires sustained government commitment. Task-shifting models, in which trained non-physician health workers deliver protocol-driven care, can extend limited specialist capacity significantly. Cultural tailoring of Diabetes education, acknowledging food traditions and family structures, and a productive rather than dismissive dialogue with traditional medicine systems including Ayurveda, will determine whether evidence-based care takes genuine root.

Indian researchers are making important contributions through epidemiological studies characterising South Asian Diabetes phenotypes and through innovations in frugal healthcare delivery with relevance well beyond Bharat's borders. Global Diabetes trends cannot improve meaningfully without progress in regions where the burden is highest and growing fastest.

Looking Forward: Integrated, Layered Approaches

Type 2 Diabetes is not one disease but several distinct conditions driven by different underlying mechanisms, and the future of care lies in matching therapy precisely to pathophysiology. Some patients have primarily insulin resistance; others have mainly beta cell failure; many have both, with additional contributions from hepatic steatosis, chronic inflammation, and altered incretin response. Identifying which defects predominate and targeting treatment accordingly represents the promise of precision medicine in Diabetes.

Biomarkers that predict treatment response could eliminate much of the trial and error inherent in current prescribing. Genetic profiling may reveal subtypes with distinct natural histories and therapeutic sensitivities. Metabolomic analysis could identify patients most likely to achieve remission with aggressive early intervention. Machine learning approaches are beginning to integrate clinical, genetic, and metabolic data in ways that reveal patterns invisible to individual clinical analysis, though care is needed to ensure these algorithms perform equitably across diverse populations and do not entrench existing disparities.

The gut microbiome represents a genuinely novel and largely unexploited therapeutic frontier. Alterations in bacterial composition and metabolite production influence host glucose metabolism and insulin sensitivity through mechanisms still being characterised. Probiotics, prebiotics, faecal microbiota transplantation, and engineered bacterial strains are under investigation. The evidence base remains preliminary, and the massive inter-individual variability in microbial composition means no universal solution is likely. But personalised microbiome-based interventions may eventually complement existing pharmacological approaches in ways that are clinically meaningful.

The most realistic vision of the future is one of therapeutic integration. A patient might begin with structured lifestyle support, digital monitoring, and behavioural counselling. Incretin-based therapy could reduce weight, hepatic fat, and metabolic strain on the pancreas. An SGLT2 inhibitor could protect the kidneys and heart. Technology could ease daily glycaemic fluctuations and reduce treatment burden. For selected individuals, immune intervention or cell-based therapy could follow. This layered approach mirrors successful strategies in cardiology and oncology, where combination therapy across mechanisms has produced deeper and more durable results than any single agent. In Diabetes, such integration allows clinicians to address insulin resistance, preserve beta cell function, reduce cardiovascular risk, and support weight management simultaneously. For some patients, this comprehensive approach creates the metabolic conditions necessary for remission.

The challenge lies not in the availability of these tools but in their thoughtful orchestration. Timing matters. Patient selection matters. The art of modern Diabetes care involves knowing when to intensify, when to simplify, and when to hold steady while watching for opportunities to reduce medication burden as metabolic health improves.

Making It Work in Practice

Translating advances from clinical trials to routine practice is never straightforward. The complexity of modern Diabetes management increasingly demands genuine team-based care, drawing on Diabetes educators, pharmacists, dietitians, and specialists working in true coordination rather than in parallel. Standard office visits rarely provide adequate time for technology education, medication initiation, and the ongoing support that effective management requires. Group visits, remote monitoring programmes, and expanded roles for allied health professionals are structural necessities, not peripheral enhancements, and healthcare systems must support and adequately reimburse them.

Clinical inertia remains a persistent obstacle. Evidence-based algorithms guide but cannot replace clinical judgement, and they must remain flexible enough to accommodate individual circumstance. Ultimately, the best therapy is the one a patient will actually use. Discussions must extend beyond clinical efficacy to encompass patient preferences, lifestyle, cost, and treatment burden. Shared decision-making and collaborative goal-setting enhance adherence in ways that prescription alone never will.

The Human Side: Beyond the Numbers

Diabetes is exhausting. The constant vigilance, the daily treatment decisions, the undercurrent of anxiety about complications: these create a psychological burden that clinical metrics fail to capture. Technological and pharmacological advances deserve celebration, but they must never obscure what living with Diabetes actually feels like. Interventions that reduce treatment burden matter as much for quality of life as for glucose control, and those benefits deserve to be measured and communicated with the same rigour as A1c reductions. Physicians should routinely screen for depression, anxiety, and Diabetes distress, recognising these as treatable conditions with direct and measurable effects on self-management. Social determinants of health frequently influence outcomes more decisively than specific treatment choices, and prescribing optimal medications proves futile when patients cannot afford them or lack the stable conditions that consistent self-care requires.

Recent years have brought genuine and substantial progress. Physicians have medications that protect organs and save lives, technologies that automate and simplify management, the first disease-modifying therapies, and promising pathways to beta cell replacement. The therapeutic landscape has never offered more tools or more reason for measured hope.

But perhaps the most important change is conceptual rather than technical. Diabetes management is no longer only about stable glucose levels and complication prevention. It is about identifying opportunities for metabolic recovery, supporting patients through interventions that address root causes, and deploying therapies in ways that exploit their full biological potential. Remission will not be achievable for everyone, but the possibility that Diabetes can sometimes be reversed, even partially and for limited periods, reshapes how clinicians counsel patients, design care pathways, and define success.

The profession must work collectively to ensure that advances benefit all people with Diabetes, not only those with excellent insurance and ready access to specialist care. This demands advocacy for rational drug pricing and technology access, inclusion of diverse populations in research, and consistent attention to implementation in real-world settings where resources are constrained and populations are underserved.

The future is genuinely bright. Innovations across pharmacology, technology, cellular therapy, and digital health are converging in ways that seemed impossible a decade ago. The next decade will likely bring more powerful multi-receptor agonists, refined surgical and endoscopic techniques, practical stem cell therapies, and digital ecosystems that seamlessly integrate monitoring, prediction, and intervention.

The responsibility is to integrate these advances thoughtfully, ensuring they serve all patients while maintaining the humanistic foundation of excellent medical care. Diabetes management remains as much art as science. While pursuing glycaemic targets, cardiovascular protection, and opportunities for remission, clinicians must remember the whole person, whose life encompasses far more than their diagnosis. Sleep matters. Relationships matter. The ability to work and care for family matters. Mental health matters. Treatment must fit within the fullness of a human life, not dominate it.

In honouring both the science making these advances possible and the trust patients place in their physicians, the goal must remain clear: not simply longer life but better life, and not simply controlled Diabetes but the possibility, for some, of freedom from it.

A handwritten signature in black ink that reads "R. Bangar". The signature is written in a cursive, slightly slanted style. Below the signature is a thick, horizontal black line that underlines the name.

(Ravindra Bangar)
Editor