Volume - 4
Jan - March, 2026

FRONTIERS DIABETES AWARENESS AND RESEARCH SOCIETY
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The HD Times

Comprehensive Health & Diabetes Newsletter

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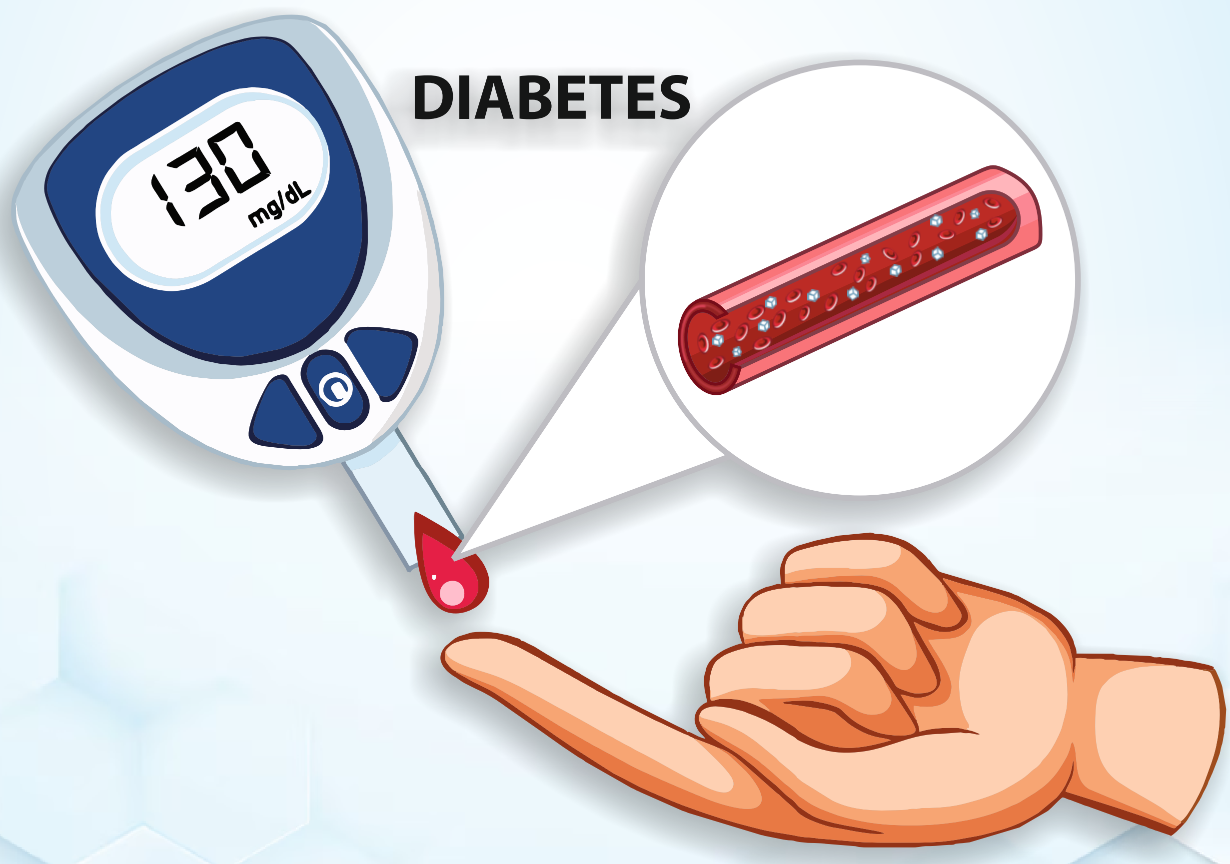

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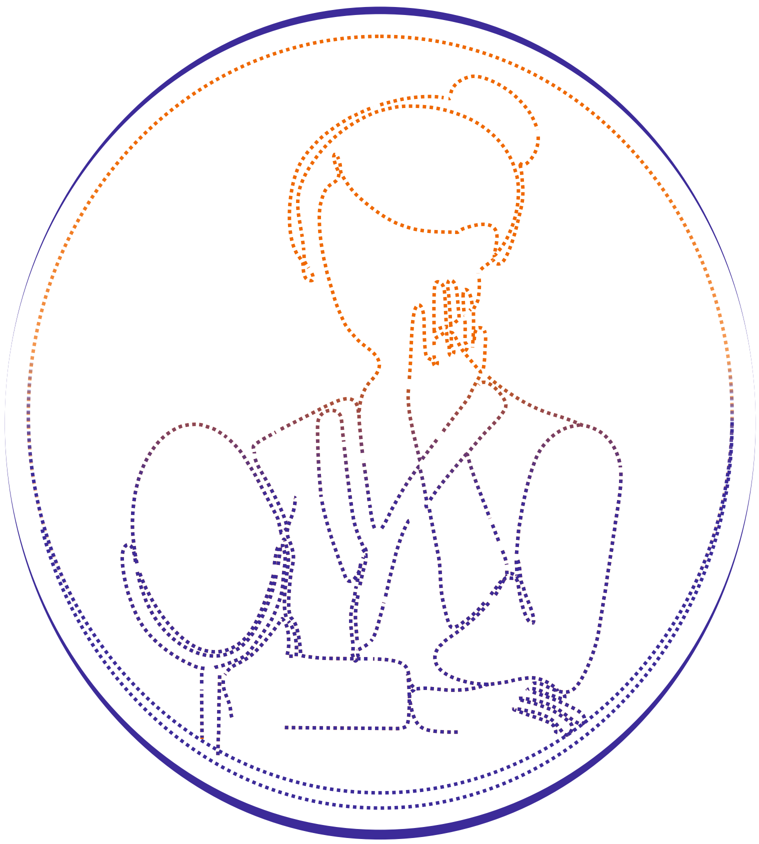

BEST
COMING SOON

CONTENTS

From the President's Desk

Approaching a Decade of Scientific Excellence

Dr. Shaista Farishta
Sr Consultant Pediatrician
President FDARS

As FDARS approaches a defining decade in its journey, we stand at a critical inflection point in the way diabetes, metabolism, and critical care intersect with modern medicine. This scientific update reflects a broader transformation in healthcare: from reactive treatment to anticipatory, data-driven, and patient-centred care, where artificial intelligence increasingly augments clinical decision-making.

Hyperglycemia in critical illness is no longer an isolated biochemical abnormality. It represents the complex interplay of stress physiology, inflammation, organ dysfunction, and therapeutic interventions. Safe and effective management demands not only standardized protocols, but precision—rooted in physiology, guided by evidence, and enhanced by digital technologies and intelligent systems.

FDARS was founded with a vision to bridge frontline clinical practice and translational research. Over the years, our scientific platforms have expanded to include diabetes, obesity, cardiometabolism, nutrition, critical care, and artificial intelligence—reflecting the convergence of human biology and computational innovation.

As we look toward the next decade, FDARS remains committed to advancing precision medicine, promoting technology- enabled learning, empowering young clinicians and researchers, and fostering global collaborations that translate science into meaningful bedside impact.

The coming decade presents both opportunity and responsibility. FDARS remains steadfast in its mission to nurture scientific excellence and shape a future where artificial intelligence and human metabolism converge to improve patient outcomes with precision, compassion, and integrity.

Acknowledgement

The President and Editorial Team sincerely acknowledge and thank all contributing authors and experts for their scholarly write-ups and academic contributions to this scientific update. Their evidence-based insights, intellectual rigor, and commitment to advancing diabetes, metabolic science, and non-communicable disease care have significantly enriched the scientific discourse. Such collective academic efforts are vital to strengthening knowledge translation and fostering excellence in clinical practice and research.

— President, FDARS

Frontiers Diabetes Awareness & Research Society

Editor's Desk

Dear Readers,

As we step into a new era of diabetes care and research, I am delighted to present this special issue of our magazine, curated in anticipation of **HD Times 2026**—a landmark academic event poised to illuminate the evolving landscape of diabetology and non-communicable diseases (NCDs).

Dr. Mohsin Aslam
Sr. Consultant Physician
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Within these pages, we bring together insights from some of the most respected voices in the field, offering a compelling prelude to the thought-provoking sessions planned for HD Times 2026. From the empathetic yet evidence-based approach to patient empowerment in *"Hello Diabetes: The Science and Soul of Diabetes Education"* by Dr. Sunil Gupta, President-Elect, National RSSDI, to the fascinating exploration of *"The Invisible Allies: How the Gut Microbiome Shapes the Battle Against Non-Communicable Diseases"* by Dr. NK Singh, Vice President, National RSSDI, this issue reflects the depth and diversity of discussions that await us.

We delve into emerging paradigms such as the critical Role of Circadian Health in Cardiometabolic Health and Disease Risk with Dr. Arvind Gupta; the nutritional potential of Millets in NCD Management led by Dr. J. Stanley; and the ever-important focus on Diabetes and Foot Complications by the renowned Dr. Vijay Viswanathan.

This issue is further strengthened by a focused contribution from **Dr. V. Mohan** on *"Early Gestational Diabetes: What You Should Know"*, offering key clinical insights into early identification and timely management. Additionally, **Dr. Vijay Viswanathan** provides expert perspectives on the role of *Digital Subtraction Angiography (DSA)* in peripheral arterial disease (PAD), highlighting its importance in accurate diagnosis and limb-preservation strategies in people with diabetes.

Looking ahead, we feature forward-thinking contributions on technological innovation with AI for Healthcare Professionals by Prof. Vinod PK; cutting-edge strategies in Personalized Approaches to Type 2 Diabetes Remission by Dr. Bhavani Prasad Gudavalli; the latest Technological Advances in Diabetes Management by Dr. Ajith Kumar S; and a comprehensive overview of *Emerging Trends in Clinical Research for Diabetes and NCDs.*

This issue is more than a collection of articles—it is a call to action. It reminds us that managing diabetes and NCDs demands not only scientific rigor, but also compassion, innovation, and collaboration. As we prepare for HD Times 2026, may these pages inspire you to engage deeper,

question boldly, and contribute meaningfully to the fight against diabetes.

Together, we can turn knowledge into impact and hope into reality.

Warm regards,

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‘Early Gestational Diabetes: What You Should Know?’.

Padma Shri Dr V Mohan
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Gestational diabetes (GDM) refers to glucose intolerance first detected during pregnancy. Traditionally, GDM was diagnosed between 24 – 28 weeks of pregnancy. More recently, GDM is being diagnosed in the first trimester of pregnancy and this is referred to as 'Early GDM (EGDM)'. The concept of EGDM is rapidly picking up and the International Diabetes Federation (IDF) is also working on a Position statement on EGDM. Since diabetes diagnosed early in pregnancy is now referred to as 'Early GDM (EGDM)', the classical GDM diagnosed between 24 – 28 weeks of pregnancy is now labelled as 'Late GDM (LGDM)'. Hence based on the time of the occurrence of the GDM, it can be classified as 'Early GDM' if it occurs before 20 weeks of gestation and late GDM if it occurs after 20 weeks of gestation.

The prevalence of EGDM varies widely due to different criteria used. However, it seems to be highest in S. Asians, especially in Indians. In the recent ICMR – INDIAB study, we showed that the prevalence of EGDM is 19.2% and that of LGDM is 23.4%. In the Stratification of risk of Diabetes in Early pregnancy (STRiDE) study, we showed that EGDM has a slightly worse metabolic profile compared to late GDM. Moreover, the conversion to type 2 diabetes is also higher in those with early GDM compared to late GDM. The pathophysiology of early GDM appears to be due to more severe insulin resistance coupled with worse beta-cell dysfunction, compared to late GDM. Increased occurrence of adverse pregnancy outcomes and a greater need for insulin use have also been reported in women with EGDM. Till recently there was no randomized clinical trial (RCT) to show the benefit of treating EGDM. The **T**reatment **O**f **BO**oking **G**estational diabetes **M**ellitus (ToBOGM) study published in New England Journal of Medicine (NEJM), is a large randomised clinical trial which included women with EGDM in Australia, India, Sweden and Austria. We at the Madras Diabetes Research Foundation (MDRF) were privileged to be part of the TOBOGM study. This study showed the benefits of treatment of women with EGDM and demonstrated better neonatal outcomes. Based on the TOBOGM study, the concept of EGDM is gaining wide recognition and several countries have already adopted screening I the first trimester of pregnancy for EGDM. However, several questions still remain to be answered including the best diagnostic criteria and treatment for EGDM. In India, universal screening of all pregnant women during the first trimester is preferred whereas in western countries, risk factor based screening is preferred due to the lower prevalence of GDM in their societies. The take home message is **'Early GDM must be diagnosed and treated in India'.**

Role of DSA in Peripheral Arterial Disease

Courtesy: RSSDI Handbook Series; Diabetes and Peripheral Artery Disease- Evangel Publishing

02

Introduction

The gold standard for percutaneous revascularization treatment of symptomatic patients who are not responding to medicinal treatment is digital subtraction angiography (DSA), a minimally invasive procedure. However, in order to properly assess post treatment outcomes and consequences and to re-plan treatment for patients with lower limb terminal ischemia, the accurate interpretation of diagnostic DSA findings is essential.[1]

Dr. Vijay Viswanathan

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Once thought to be the gold standard for diagnosing and evaluating peripheral arterial disease (PAD) lower limb pathology, diagnostic catheter angiography (DCA) was gradually replaced by noninvasive, panoramic techniques like computed tomography angiography (CTA) and magnetic resonance angiography (MRA), which have a lower risk of complications and comparable diagnostic efficiency.

Given its overall sensitivity of 92-99%, specificity of 93-98%, accuracy of 94-98%, positive predictive value of 97%, and negative predictive value of 99%, CTA is currently regarded as the most practical, dependable, and accurate diagnostic imaging technique in the evaluation of lower limb artery disease. Although CTA is noninvasive and has a low effective radiation dose, it may not be as helpful in assessing the extent of stenosis in cases when the lesions are heavily and extensively calcified. Contrast-enhanced MRA seems to be more sensitive than duplex ultrasonography (US) in ruling in arterial stenosis smaller than 50% and more specific than CTA in ruling out arterial stenosis greater than 50%.[2,3]

Even though noninvasive diagnostic imaging is required for disease identification, diagnosis, and stratification, DSA can be used for both diagnostic and therapeutic purposes at the same time. For example, every DSA for lower limb ischemia treatment must include a diagnostic evaluation to accurately identify the pathologic site that will be treated. This is done to ensure that every patient receives the most appropriate and effective treatment possible, as well as for treatment planning.[4]

The foundation of conventional angiography is the acquisition of an image following the injection of a contrast material. The resulting image is composed of bones, blood vessels, and other structures; the superimposition of nonvascular elements makes it challenging to precisely assess the blood vessels. Therefore, a precontrast image (also known as a 'mask image') is first obtained and digitally subtracted from the precontrast images in order to remove distracting structures and improve visualization of vascular structures. Particularly when utilized for single-limb lower extremity angiography, DSA produces high quality and diagnostic angiograms that assess vascular stenosis and opacification. Diabetes-related vascular disease benefits greatly from DSA's ability to visualize tiny vessels with minimal contrast medium consumption.

An antegrade technique is typically used for DSA, which involves inserting a 5 French vascular sheath and puncturing the common femoral artery. Iodinated contrast material can be injected through the vascular sheath, or a straight diagnostic catheter can be used to obtain diagnostic angiography. An automatic injector that can deliver a regulated flow rate and dose of contrast media can be used for injection, or it can be manually. The place of examination and the position of the diagnostic catheter affect the injection amount and flow rate. The common femoral artery is used in a retrograde manner to treat iliac artery disease.

A contralateral retrograde common femoral artery access and the 'crossover' technique, which involves accessing the aortic lumen and then catheterizing the contralateral iliac artery with a pigtail diagnostic catheter, can be used to reach the target limb when an ipsilateral common femoral artery approach is impractical because of vessel occlusion or highly calcified plaques. It is crucial to understand that, in addition to procedural processes, current angiography equipment includes automated sequences that adjust exposure settings and frame speed based on the various parts being analyzed, including the brain, lower limbs, and belly. The widespread usage of methods like view tracing, pixel shifting, subtraction, and re-masking has been made easy and possible by advances in computer processing power.[5,6]

Road mapping (superimposition of the fluoroscopic picture on a DSA image) and unsubtracted image referencing (fluoro save mode) are simple tasks for the operator at the angiographic table. The operator can adjust the gantry angle, edge filters, collimation, magnification, and table location to best visualize the arteries. The advent of high-resolution flat-panel image intensifiers, which minimize parallax distortion and offer excellent image quality, has been a significant technological advancement. Large body segments can be covered by the wide field of vision (FOV) of new flat panels, which reduces the need for contrast material and radiation exposure for both the patient and the operator.[7,8]

When patients need endovascular therapy in the operating room, DSA imaging evaluation can be done on suitable portable C-arm equipment. In the angiographic suite, it can be done on ceiling-fixed angiography machines.[9-11]

Vasodilator medications, the most common of which are papaverine and nitroglycerine, can be administered endovascularly to maximize and enhance arterial artery visibility in the lower leg. In order to guide the endovascular guidewire and catheters and to assess the diseased segment, optimal vision of the arterial vessel is required. Consequently, it is crucial to use oblique projections of the C-arm or the angiography machine: a slight anterior oblique projection, typically no more than 100, is used to evaluate the arteries below the knee, where the proximal tibia-peroneal joint is clearly visible, while a frontal projection can be used to examine the superficial femoral and popliteal arteries.

In the case of common and external iliac arteries, oblique projections help to identify the origin of the internal iliac (or hypogastric) artery, which is mandatory in the case of iliac stenting; identification of the hypogastric artery is carried out in the same way as in the case of uterine fibroid embolization and consists of a 200 ipsilateral anterior oblique projection. The distal tibial arteries, the medial artery, and the plantar arch can be assessed using a pure frontal and, particularly, a lateral projection.[12-14]

Angiographic results

Both pathological signs and procedure iatrogenic consequences might be used to illustrate DSA findings.

Occlusion and Stenosis

A narrowing of the artery lumen, which lowers blood flow to the lower extremities. Is the hallmark of arterial stenosis, which can be localized, brief, or protracted. Conversely, occlusion is defined as an arterial blockage that prevents blood flow to the limb extremity.

Acute or chronic blockage can be focal, brief, or lengthy, and in the latter situation, the distal artery typically receives influx from collateral circulation. Atherosclerotic or calcified plaque, as well as thrombus, are some of the causes of stenosis and occlusion.[15,16]

Dissection

When blood flow enters the media layer through an intimal tear, a second blood-filled channel forms inside the wall, causing arterial dissection, the intima-lined lumen is referred to as the 'true lumen', whereas the blood-filled media channel is known as the 'false lumen'. Due to inadequate blood outflow, the pressure in the false lumen is higher than in the genuine lumen. This results in the actual lumen being compressed, which impairs the arterial flow in the limb extremity (flow-limiting dissection).

Iatrogenic arterial dissection may arise after angioplasty balloon inflation or guidewire passage (because the guidewire tip can go through the subintimal region with no resistance).[17,18]

Arteriovenous Fistula

An abnormal link between an artery and a vein, known as an arteriovenous fistula, causes blood to flow from the structure with the higher pressure (the artery) to the structure with lower pressure (the vein). Following angioplasty of calcified plaques or guidewire passage through a compromised artery wall, it may be iatrogenic. Following a contrast medium injection, an arteriovenous fistula is defined as an early opacification of a channel that cannot be referred to as an artery, with blood flow in the opposite direction of the arterial flow. In order to rule out blood theft from the distal artery, which could induce or exacerbate acute limb ischemia, it is imperative that an arteriovenous fistula be promptly identified.[19,20]

Pseudoaneurysm and Aneurysm

An aneurysm is defined as a vascular diameter expansion of greater than 50% with vessel wall integrity when compared to a proximal healthy section. Conversely, when the vessel wall is injured, and the blood fills the gap between the intima-media and the other layers, a pseudoaneurysm forms, causing the vessel to grow focally. Until proven differently, a vessel dilation that occurs during or after interventional endovascular procedures of a lower limb is typically regarded as pseudoaneurismatic and associated with wall damage.[21-23]

DSA Risks

Complications Associated with percutaneous Arterial Access

Although DSA is an intrusive imaging technique used to diagnose and treat PAD, it has a non-negligible 10% chance of complications. Although patients tolerate angiographic operations well, there is always a chance of morbidity and death. Many of the problems are modest and self-limiting, requiring little to no therapy. Hemostasis formation at the puncture site is the most frequent consequence associated with percutaneous arterial puncture, aside from the previously listed dissection, acute thrombosis, pseudoaneurysm, and arterivenous fistula.

This type of complication is actively reduced by using small bore catheters (3 to 5 French) for the diagnostic workup; nevertheless, the risks of hematoma formation are increased by the rise in endovascular treatments, which call for a bigger working sheath (from 5 to 11 French). When the sheath is removed and pressure is applied at the puncture site or soon after the patient exits the angio-suite, a hematoma typically forms. Nearly all hematomas may be identified and managed before intervention is required since they happen early. Small hematomas usually go away on their own in few days.

Because there is no bony structure beneath the femoral artery to provide compression at the puncture site, it is challenging to conduct adequate hemostasis when a puncture is made cranially to the inguinal ligament. Furthermore, it might be difficult and complicated to diagnose retroperitoneal hemorrhage early on. Prior to femoral puncture, it is recommended to use fluoroscopy to detect the femoral head in order to prevent or at least lessen the danger of hematoma and bleeding.[24,25]

Risks associated with Contrast Medium

Iodinated contrast media use is linked to infrequent but concerning side effects. The two most significant ones are lethal systemic responses and contrast-induced nephropathy. Nephrotoxicity should be taken into account in patients with lower limb peripheral artery disease who are elderly, diabetic, or have reduced renal function. When the estimated glomerular filtration rate is less than 45mL/min/1.73m2, carbon dioxide angiography or other imaging modalities (like MRA) should be taken into consideration.

Radiation Dose

The Society of Interventional Radiology (SIR) published a document in 2012 with guidelines for patient radiation doses in interventional radiology. Current European guidelines emphasize that the patient's total dose during procedures should be recorded as part of the programs related to the quality and safety. DSA is associated with high radiation dose and consequent risk of radiation-induced malignancy. Post processing imaging is required to improve DSA image quality while also reducing the radiation dose.[26,27]

The best clinical practices for interventional physicians can be found in the literature on the subject. Using the available dose-reduction tools and the lowest permissible fluoroscopy rates, avoiding magnification whenever feasible, using last image hold and recorded loops, routinely and intelligently using collimators, and receiving the proper radiation protection training are some of the precautions.[28-30]

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03

Hello Diabetes
The Science and Soul of Diabetes Education

Diabetes education programs play a pivotal role in the prevention, management, and long-term control of diabetes mellitus, a growing global public health challenge. With the rising prevalence of type 1 diabetes, type 2 diabetes, and gestational diabetes—particularly in a country like India—structured, culturally relevant diabetes education has become indispensable for improving clinical outcomes, preventing complications, and enhancing quality of life.

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At the core of effective diabetes education lies patient empowerment. Well-designed education programs enable individuals with diabetes and their caregivers to understand the disease and actively participate in daily self-management. Knowledge related to blood glucose monitoring, nutrition, physical activity, medication adherence, insulin therapy, and use of newer technologies equips people with diabetes to make informed decisions and achieve better glycemic control.

The Hello Diabetes Awareness Mission stands out as a comprehensive, inclusive, and sustainable national initiative dedicated to diabetes education across the life-course. It not only educates people living with diabetes and their families but also creates a strong network of diabetes educators drawn from nutritionists, pharmacists, nurses, allied health professionals, and even parents of children with type 1 diabetes. By strengthening community capacity, Hello Diabetes bridges the gap between clinical care and day-to-day self-management.

A unique strength of the Hello Diabetes mission is its focus on special and vulnerable populations, including children with type 1 diabetes, women with diabetes, gestational diabetes, couples with diabetes, the elderly, adolescents, school children and teachers, college students, corporate employees, and rural communities. Educational content spans the entire continuum—from basic science and prevention to lifestyle modification, pharmacotherapy, insulin use, and the practical application of emerging diabetes technologies.

Prevention and risk reduction form a key pillar of the program. For individuals with prediabetes or those at high risk, structured education on lifestyle modification—healthy nutrition, weight management, and regular physical activity—plays a critical role in delaying or preventing the onset of type 2 diabetes. In pregnancy, focused education for women with gestational diabetes helps safeguard both maternal and fetal health, reducing short- and long-term complications.

The program also emphasizes early detection and prevention of complications. Education on foot care, eye care, kidney health, and cardiovascular risk enables individuals to recognize warning signs early and seek timely medical intervention, thereby reducing the burden of diabetes-related morbidity such as retinopathy, nephropathy, neuropathy, and amputations.

Recognizing the psychosocial impact of diabetes, Hello Diabetes integrates emotional support, confidence building, and behavior-change strategies into its educational framework. By addressing stress, fear, and misconceptions associated with diabetes, the program improves treatment adherence, mental well-being, and overall quality of life.

Academic excellence and professional education are strengthened through Hello Diabetes Academia – International Conclave, which focuses on continuous medical education for family physicians and clinicians, enabling them to deliver evidence-based, patient-centered diabetes care, particularly in resource-limited settings.

The mission's outreach is further amplified through focused initiatives such as JDCON for children with type 1 diabetes, NuCon for nursing students and practicing nurses, and DE-Con for training diabetes educators. Its long-standing mass-awareness efforts include diabetes education programs broadcast on Vividh Bharti, All India Radio for over 25 years, regular print media columns, educational YouTube videos, podcasts, and digital platforms—collectively touching and transforming millions of lives.

Removing myths and misconceptions surrounding diabetes remains one of the most challenging aspects of public health education. Through sustained, community-based, and multilingual outreach, the Hello Diabetes Awareness Mission continues to break barriers of ignorance and stigma, empowering individuals and communities across India.

By integrating patient education, professional training, community engagement, and mass awareness, Hello Diabetes has evolved into a powerful national movement—significantly improving diabetes care, preventing complications, and enhancing the quality of life for people living with diabetes in India.

The Invisible Allies: How the Gut Microbiome Shapes the Battle Against Non-Communicable Diseases

04

Introduction

- The human gut hosts more than 100 trillion microorganisms collectively called the gut microbiome.
- These include bacteria, viruses, fungi, and archaea.
- Beyond digestion, the gut microbiome regulates metabolism, immunity, inflammation, and neuro-endocrine signaling.
- Non-communicable diseases (NCDs) contribute to over 70% of global mortality.
- Recent evidence (2024–2025) highlights gut dysbiosis as a major driver of NCDs.
- Urbanization, dietary transitions, and sedentary lifestyles worsen microbiome imbalance.

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Vice President National RSSDI
FACP, Senior Consultant Physician, Apollo Hospital Hyderabad.
Past President RSSDI and Founder Diabetes and You (DAY)
Society Supporting Children with Type 1 Diabetes

WHAT IS THE GUT MICROBIOME?

- Total microbial mass: approximately 1–2 kg.
- Dominant bacterial phyla:
  - – Bacillota (Firmicutes)
  - – Bacteroidota (Bacteroidetes)
  - – Actinomycetota
  - – Pseudomonadota
- Key functions:
  - – Fiber fermentation to short-chain fatty acids (SCFAs)
  - – Vitamin synthesis (B-complex, K)
  - – Immune regulation and gut barrier maintenance
- Early life colonization:
  - – Vaginal delivery promotes beneficial bacteria.
  - – Cesarean section alters microbial seeding.
- First 1,000 days of life are critical for microbiome programming.

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- Dysbiosis is defined by reduced diversity and loss of beneficial microbes.

MECHANISMS LINKING MICROBIOME TO NCDs

- Reduced SCFAs cause:
  - Impaired gut barrier
  - Increased inflammation
- Lipopolysaccharide translocation leads to metabolic endotoxemia.
- TMAO derived from red meat promotes atherosclerosis.
- High salt diets reduce Lactobacillus and raise blood pressure.
- Immune imbalance (Th17/Treg) contributes to chronic inflammation.
- Environmental factors such as pollution worsen microbial diversity.

ROLE IN SPECIFIC NCDs

OBESITY AND METABOLIC SYNDROME

- Reduced Faecalibacterium prausnitzii and SCFA producers.
- Increased energy extraction and inflammation.
- Higher Firmicutes/Bacteroidetes ratio.
- Maternal diet influences offspring obesity risk.

TYPE 2 DIABETES MELLITUS

- Reduced butyrate impairs insulin sensitivity.
- Decreased Akkermansia muciniphila correlates with hyperglycemia.
- Increased endotoxin-producing bacteria worsen insulin resistance.

CARDIOVASCULAR DISEASE AND HYPERTENSION

- TMAO accelerates plaque formation.
- High salt intake alters microbial tryptophan metabolism.
- Hypertensive microbiome shows increased Prevotella.

CANCER

- Low fiber diets reduce SCFAs.
- Pathobionts like Fusobacterium nucleatum promote colorectal cancer.
- Alcohol disrupts protective microbes.

NEUROLOGICAL AND AUTOIMMUNE DISORDERS

- Gut-brain axis links microbiome to mood and cognition.
- Dysbiosis contributes to neuroinflammation and autoimmunity.

URBANIZATION AND LIFESTYLE INFLUENCES

- Shift from traditional diets to ultra-processed foods.
- Reduced microbial diversity in urban populations.
- Physical inactivity lowers beneficial bacteria.
- Exercise improves microbiome richness.

- Socioeconomic barriers limit healthy dietary access.

THERAPEUTIC STRATEGIES

- Mediterranean and high-fiber diets restore microbial balance.
- Fermented foods enhance Lactobacillus populations.
- Probiotics, prebiotics, and postbiotics show promise.
- Fecal microbiota transplantation has emerging metabolic roles.
- Traditional therapies like berberine improve insulin sensitivity.
- Early-life interventions are critical for prevention.

CHALLENGES AND FUTURE DIRECTIONS

- Most evidence remains associative.
- Long-term human trials are limited.
- Population and sex-specific responses vary.
- Future research must integrate multi-omics and personalized approaches.
- Policy support is essential for equitable implementation.

CONCLUSION

- The gut microbiome is a key mediator between lifestyle and NCDs.
- Microbiome-targeted interventions offer preventive and therapeutic potential.
- Integrating diet, lifestyle, and policy can reduce NCD burden.
- Nurturing our invisible allies may transform global health outcomes.

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Role of Circadian Health in Cardiometabolic Health and Disease Risk

05

Introduction

Human physiology is governed by intrinsic circadian rhythms that regulate sleep–wake cycles, hormonal secretion, metabolism, immune responses, and cardiovascular function. These rhythms are synchronized to environmental light–dark cycles and are essential for optimal metabolic and cardiovascular health. Modern lifestyles characterized by artificial lighting, shift work, irregular sleep, and erratic eating patterns have led to widespread circadian disruption, emerging as a critical risk factor for cardiometabolic diseases.

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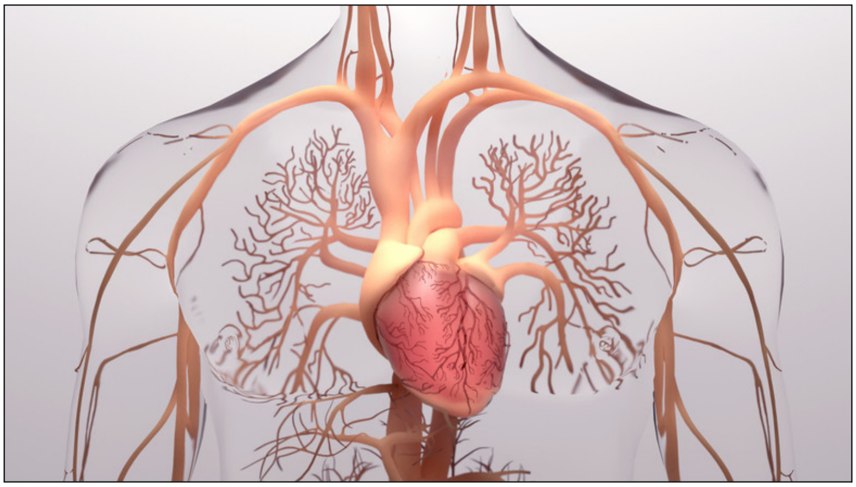
Biological Basis of Circadian Regulation:

The central circadian clock resides in the suprachiasmatic nucleus of the hypothalamus and coordinates peripheral clocks in metabolically active tissues such as the liver, pancreas, adipose tissue, skeletal muscle, heart, and vasculature. Molecular clock genes regulate daily oscillations in gene expression influencing glucose metabolism, lipid handling, mitochondrial function, oxidative stress, and inflammation.

Circadian Disruption and Glucose Metabolism:

Insulin sensitivity and beta-cell responsiveness follow a circadian pattern, peaking in the morning and declining later in the day. Circadian misalignment from late-night eating, shift work, or sleep deprivation impairs glucose tolerance and increases insulin resistance. Epidemiological studies consistently report higher prevalence of type 2 diabetes among shift workers, independent of traditional risk factors.

Obesity and Adipose Tissue Dysfunction:



Circadian disruption alters appetite-regulating hormones, including leptin and ghrelin, promoting increased caloric intake and preference for energy-dense foods. Adipose tissue clocks regulate lipid storage, lipolysis, and adipokine secretion. Misalignment contributes to visceral adiposity, chronic low-grade inflammation, and ectopic fat deposition, increasing cardiometabolic risk.

Blood Pressure and Cardiovascular Regulation:

Blood pressure normally exhibits a circadian dipping pattern during sleep. Loss of nocturnal dipping is associated with hypertension, stroke, and cardiovascular mortality. Circadian misalignment increases sympathetic activity, cortisol exposure, endothelial dysfunction, and arterial stiffness, accelerating vascular aging and atherosclerosis.

Inflammation and Atherosclerosis:

Circadian clocks regulate immune cell trafficking and inflammatory signaling. Disruption leads to heightened inflammatory responses, oxidative stress, and plaque instability. The circadian pattern of acute cardiovascular events reflects rhythmic variations in platelet activity and vascular tone.

Chrononutrition and Lifestyle Interventions:

Chrononutrition emphasizes alignment of food intake with circadian rhythms. Time-restricted eating and early meal timing improve insulin sensitivity, blood pressure, lipid profiles, and inflammatory markers, even without weight loss. Consistent sleep schedules, morning light exposure, reduced nighttime light, and regular physical activity reinforce circadian alignment.

Clinical and Public Health Implications:

Circadian health is a modifiable, low-cost target for cardiometabolic disease prevention. Clinical assessment should include sleep duration, sleep timing, meal timing, and shift-work exposure. Integrating circadian principles into diabetes, obesity, and hypertension management may significantly enhance outcomes.

Conclusion:

Circadian health is a foundational pillar of cardiometabolic well-being. Disruption of biological rhythms adversely affects metabolic regulation, vascular function, and inflammatory pathways, increasing disease risk. Aligning modern lifestyles with intrinsic biological clocks offers a powerful strategy for improving long-term cardiometabolic health.

Millets in Everyday Diets: Moving Beyond Nutrition Fads

06

Introduction

Food debates today are crowded with labels superfoods, clean eating, low-carb, gluten-free etc., each promising better health outcomes. Millets often appear in this crowded space, sometimes celebrated, sometimes oversold. Their real value, however, lies not in dietary fashion but in evidence: as whole grains that address specific nutritional and metabolic gaps created by modern cereal-heavy diets.

Dr J Stanley
Director & CEO Nutri hub & Principal Scientist, ICAR-IIMR, Hyderabad

India's public health challenge is no longer only undernutrition. It is the coexistence of calorie sufficiency with poor diet quality. Rising diabetes prevalence, micronutrient deficiencies, and diet-related non-communicable diseases point to structural dietary imbalances. In this context, millets deserve attention as part of dietary correction, not dietary replacement.

Improving carbohydrate quality, not eliminating carbohydrates

The dominant staples in Indian diets polished rice and refined wheat — provide energy but little fibre or micronutrients. Processing strips away components that regulate digestion and metabolism. Millets, consumed as whole grains, retain dietary fibre, resistant starch, and polyphenols that slow carbohydrate digestion.

A large systematic review and meta-analysis covering 65 human studies found that the mean glycaemic index (GI) of millets was 52.7, compared to 71.7 for milled rice and 74.2 for refined wheat. This represents a 36 per cent lower glycaemic response, a meaningful reduction for populations at metabolic risk (Anitha et al., 2021). Crucially, minimally processed millets were around 30 per cent more effective in lowering meal-level GI than refined cereals. This underscores an important point: health benefits depend on how millets are processed and prepared.

Evidence on diabetes and metabolic health

India accounts for one of the largest global burdens of diabetes. Dietary strategies increasingly focus on reducing post-meal glucose spikes rather than carbohydrate avoidance. Multiple intervention studies show that millet-based diets support this goal.

The same meta-analysis reports that long-term millet consumption reduced fasting blood glucose by 12 per cent and post-prandial glucose by 15 per cent among individuals with diabetes, along with a significant reduction in HbA1c levels among pre-diabetic individuals (Anitha et al., 2021). Complementary evidence from clinical and dietary profiling studies shows that different millet species exhibit low to intermediate GI values, reinforcing their suitability for dietary planning in diabetes and pre-diabetes provided refined formats and excess sugars are avoided.

Dietary fibre and gut health

Modern cereal diets are fibre deficient. This has implications not only for digestion but also for inflammation, immunity, and metabolic regulation through the gut microbiome. Millets contain significantly higher fibre than rice and are comparable or superior to wheat in several aspects. Barnyard millet, for instance, contains about 14.7 g of dietary fibre per 100 g, far exceeding the rice (Anal et al., 2024). Higher fibre intake improves satiety, moderates glucose absorption, and supports beneficial gut bacteria. While gut health is often discussed abstractly, its link to chronic disease prevention is now well established in nutrition science.

Micronutrients and 'hidden hunger'

Despite adequate calorie intake, India continues to face widespread micronutrient deficiencies. Millets contribute meaningfully to iron, zinc, magnesium, and calcium intake, depending on species.

Finger millet is particularly notable for calcium content, while pearl millet and sorghum contribute to iron and zinc intake. Importantly, these nutrients are intrinsic rather than externally added, reducing dependence on fortification.

Concerns about anti-nutritional factors such as phytic acid are valid, but evidence shows that traditional household processing soaking, cooking, fermentation substantially reduces phytic acid levels while improving mineral bioavailability (Sheethal et al., 2022). In sorghum, traditional cooking followed by fermentation reduced phytic acid by over 60 per cent, significantly improving iron and zinc availability.

Beyond diabetes: broader health relevance

Millets are naturally gluten-free, making them suitable for individuals with gluten intolerance. Their polyphenols exhibit antioxidant activity, and several studies associate millet consumption with improvements in lipid profiles and markers of cardiovascular risk. Millets combine nutritional adequacy with climate resilience, reinforcing their relevance for long-term dietary planning rather than short-term dietary intervention (Anitha et al., 2021; Rao et al., 2024).

Who stands to benefit most

Evidence suggests particular relevance for:

- individuals with diabetes or metabolic risk
- women and adolescent girls, given mineral density
- elderly populations, due to fibre-mediated digestive benefits
- children, when millets are introduced early in culturally acceptable formats

However, benefits diminish when millets are ultra-processed or marketed primarily as indulgent snacks.

From awareness to dietary integration

The renewed attention during the International Year of Millets improved visibility, but sustained health outcomes require routine dietary inclusion. Substitution — replacing part of refined cereal intake with millets across the week offers a realistic pathway.

Health gains from millets are incremental, not dramatic. That is precisely their strength. In a food environment dominated by quick fixes and supplements, millets offer something quieter but more reliable: better carbohydrate quality, improved nutrient density, and diets that work with human metabolism rather than against it.

Dietary diversity, not dietary novelty, remains the real objective. In that pursuit, millets are not a solution in search of a problem they are a response to problems already well documented. Translating this evidence into everyday diets requires more than individual choice. Food environments, product formats, and institutional support determine what people eat. This is where institutions play a critical role.

ICAR–Indian Institute of Millets Research (ICAR-IIMR) has increasingly positioned millets within a food-systems framework that links crop science – development of high yielding varieties and scientific crop production with that of the nutrition research, processing technologies, and consumption patterns. This integration is essential to ensure that health claims remain scientifically credible as products move from laboratories to markets.

Within this ecosystem, Nutrihub plays a distinct role in translating nutrition evidence into market-ready foods (Rao & Nune, 2021). Through its incubation and Common Facility Centre platforms, Nutrihub has demonstrated clean-label millet-based products, including honey-sweetened millet cookies, sugar-free formulations, high-fibre snack bars, and baked products developed without refined flour or artificial additives. These demonstrations focus on preserving whole-grain functionality while improving taste, shelf stability, and consumer acceptance.

By validating such products through pilot-scale processing, sensory testing, shelf-life studies, and regulatory compliance support, Nutrihub lowers entry barriers for start-ups and small enterprises. This helps ensure that millet innovation remains anchored in nutritional integrity rather than drifting toward excessive refinement or misleading positioning.

The broader lesson is clear. Improving diet quality requires coordination across research, enterprise, and public systems. Millets offer a scientifically grounded opportunity to improve carbohydrate quality, fibre intake, and micronutrient diversity. Realising this opportunity depends on sustained institutional support, responsible food innovation, and alignment between health objectives and market practices.

The choice before us is not between old grains and new foods, but between narrow diets and resilient ones. In that choice, millets, supported by credible science and careful innovation, make a compelling case.

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Integrated Metabolic Health: A Holistic Paradigm for Diabetes and NCD Prevention in the 21st Century

07

Introduction

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Non-communicable diseases (NCDs) such as diabetes mellitus, cardiovascular disease, obesity, hypertension, and metabolic-associated fatty liver disease (MAFLD) have emerged as the greatest global health challenge of the 21st century. These conditions are chronic, progressive, and interlinked, sharing common metabolic, behavioral, and environmental roots. Traditional disease-centric care models have shown limited success in reversing this growing epidemic. Integrated Metabolic Health (IMH) represents a paradigm shift—from fragmented disease management to a comprehensive, person-centered, and systems-based approach addressing shared metabolic dysfunction.

The Rationale for Integration

Diabetes, obesity, hypertension, dyslipidemia, cardiovascular disease, and fatty liver disease share common pathophysiological mechanisms including insulin resistance, chronic inflammation, adipose tissue dysfunction, mitochondrial stress, and neurohormonal dysregulation. Treating these disorders independently leads to polypharmacy and therapeutic inertia. Integrated metabolic health targets upstream mechanisms rather than isolated outcomes.

Core Pillars of Integrated Metabolic Health

Prevention-Centric Care: Early risk stratification, screening for prediabetes and metabolic syndrome, and community-based interventions form the foundation.

Lifestyle as Therapy: Nutrition, physical activity, sleep optimization, and stress management are central, not adjunctive.

Precision Pharmacotherapy: Modern therapies emphasize cardio-renal-metabolic protection, weight-centric care, and early combination strategies.

Multidisciplinary and Digital Enablement

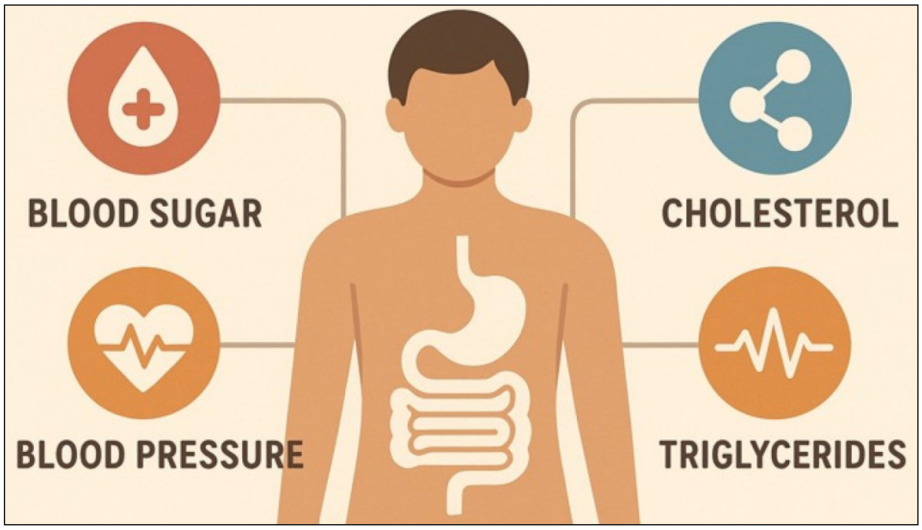
Integrated metabolic health thrives on collaboration between physicians, nutritionists, exercise experts, psychologists, and educators. Digital health tools such as CGMs, wearables, telemedicine, and AI-driven decision support transform episodic care into continuous, personalized management ecosystems.

Life-Course and Public Health Perspective

From maternal health and childhood prevention to workplace wellness and healthy aging, integrated metabolic health spans the entire life course. At a policy level, it aligns with national NCD frameworks through food system reform, urban design for activity, and strengthened primary care.

Challenges and the Way Forward

Fragmented systems, limited training, socioeconomic barriers, and data integration challenges hinder implementation. The future of metabolic care lies in integration rather than isolation, prevention rather than reaction, and person-centered outcomes rather than disease-centric targets.



Conclusion

Integrated Metabolic Health offers a sustainable and scalable solution to the global diabetes and NCD crisis. By addressing shared metabolic roots, leveraging lifestyle medicine, embracing digital innovation, and fostering multidisciplinary collaboration, it redefines healthcare for the 21st century.

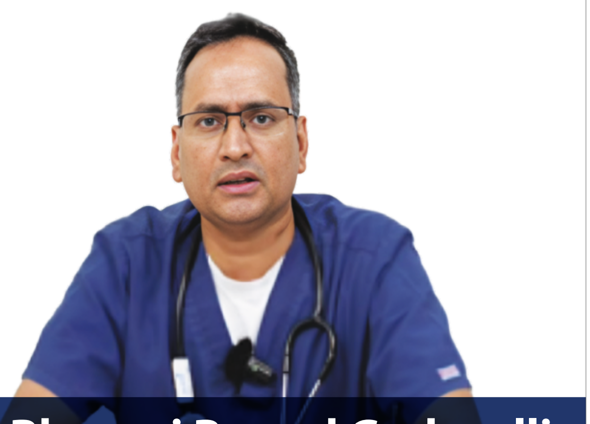
"The future of medicine lies not in treating diseases in isolation, but in restoring balance across the metabolic continuum of human health."

Hyperglycemia in Critical Care: Pitfalls, Protocols, and Precision

08

Introduction

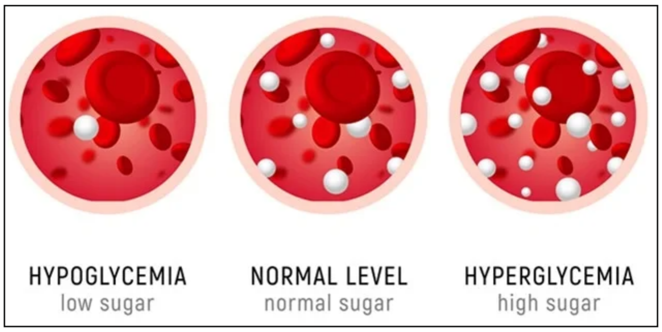
Hyperglycemia is one of the most frequently encountered metabolic abnormalities in critically ill patients, affecting both individuals with pre-existing diabetes and those without prior dysglycemia. Stress-induced hyperglycemia is now recognized as a powerful marker of illness severity and an independent predictor of adverse outcomes in critical care settings. Effective management requires balancing glucose toxicity prevention while avoiding hypoglycemia.



Dr. Bhavani Prasad Gudavalli

Associate Clinical Director
and Head of Department, Care Hospital

Pathophysiology of Hyperglycemia in Critical Illness



Critical illness triggers a neuro-endocrine stress response characterized by elevated catecholamines, cortisol, glucagon, and inflammatory cytokines. These mechanisms promote hepatic glucose production, insulin resistance, and impaired peripheral glucose uptake. Iatrogenic factors such as steroids, nutrition therapy, and organ dysfunction further exacerbate dysglycemia.

Clinical Consequences of Poor Glycemic Control

Uncontrolled hyperglycemia is associated with increased infections, endothelial dysfunction, prolonged ICU stay, organ failure, and mortality. Conversely, aggressive glucose lowering increases hypoglycemia risk, which is itself linked to adverse neurological and cardiovascular outcomes.

Pitfalls in ICU Glycemic Management

Common pitfalls include overly tight glycemic targets, inconsistent glucose monitoring, insulin-nutrition mismatch, protocol deviations, and failure to anticipate steroid-induced hyperglycemia.

AI-Driven Imaging and Omics for Cancer Screening, Diagnosis, and Prognosis

09

Artificial Intelligence in Healthcare: From Medical Images to Precision Medicine

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Artificial Intelligence (AI) is rapidly entering clinical conversations, often accompanied by excitement, skepticism, and confusion. As someone working at the intersection of AI research and clinical applications, we have observed a recurring pattern: clinicians are not asking whether AI will enter healthcare, but how it will meaningfully support clinical practice. This article reflects our experience developing AI models for healthcare, particularly in medical imaging and molecular data and teaching AI concepts to healthcare professionals across specialities. While much of our research experience comes from cancer imaging and precision oncology, the lessons learned are directly transferable to diseases such as diabetes, where early detection, risk stratification, and long-term disease management are equally critical.

At the core, AI in healthcare is about learning patterns in data. AI models learn from medical images, laboratory results, physiological signals, and longitudinal patient records. Whether the task is detecting cancer in a histopathology slide or identifying diabetic retinopathy in a retinal image, the underlying principle is the same: pattern recognition at scale. This perspective often helps clinicians see AI as a computational extension of familiar diagnostic reasoning.

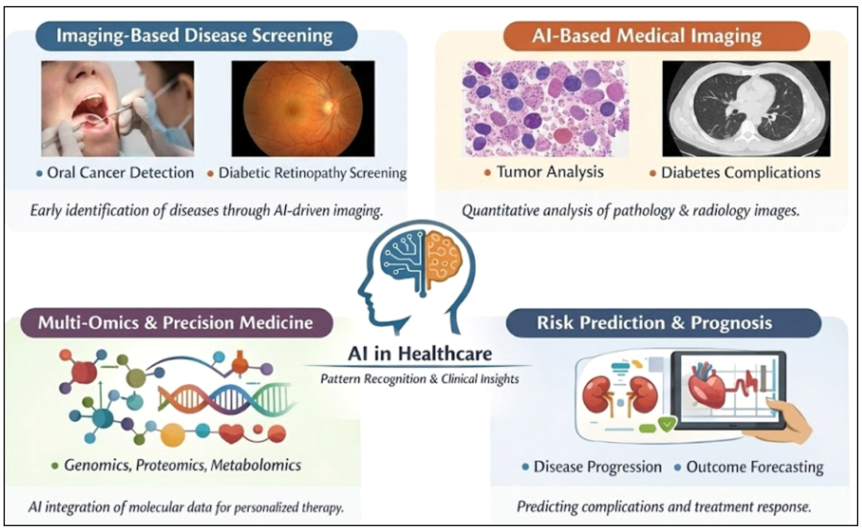
Imaging-based disease screening

Disease screening plays a critical role in reducing morbidity and improving outcomes by enabling early intervention. In our work on oral cancer screening, we developed AI models using smartphone-based photographic images to detect oral potentially malignant disorders (OPMDs) and oral cancers during routine visual examination. These systems were designed to support early triage and referral, especially in resource-limited settings. The same principles translate naturally to diabetes screening, especially for early detection of complications. For example, oral cancer screening using oral cavity images parallels retinal screening for diabetic retinopathy, where AI systems can flag early pathological changes before vision is affected. In both cases, AI improves consistency, scalability, and early detection, making large-scale screening programs feasible and more effective.

AI-based medical imaging

Medical imaging has long been central to clinical medicine, which provide direct insight into tissue structure, disease severity, and organ-level involvement. For clinicians, the key conceptual shift is recognizing that images are no longer just visual records, they are quantitative data sources. AI converts images into numerical representation that capture tissue structure, cellular organization and spatial heterogeneity. Pathology and radiological imaging inform diagnosis, staging, and treatment decisions across a wide range of diseases.

Histopathology remains the gold standard for cancer diagnosis, yet manual slide examination is time-consuming and subject to inter-observer variability. Our research in computational pathology focuses on applying AI to whole-slide histopathology images to support objective and reproducible diagnosis. By training deep learning models on digitized histopathology slides, pathomics features that capture cellular architecture, nuclear morphology, and spatial organization can be extracted. These features enable consistent classification and lay the foundation for downstream prognostic and molecular association studies.



Radiological imaging plays a central role in tumor detection, staging, and treatment planning. We develop AI methods for radiology that go beyond visual interpretation to enable quantitative disease characterization. The work includes AI-based image segmentation and lesion detection, radiomics feature extraction from CT, MRI, and other modalities and predictive modeling using imaging-derived biomarkers. These approaches transform radiological images into structured representations that capture tumor shape, texture, and heterogeneity. Such features are particularly valuable for assessing disease progression, therapy response, and recurrence risk. When integrated with histopathology, radiology-driven AI contributes to a holistic understanding of tumor behavior.

The same approaches are increasingly relevant in diabetes care, particularly in the assessment of organ-level complications. Histological analysis of renal tissue provides insight into the progression of diabetic nephropathy, while radiological imaging plays an important role in evaluating diabetes-associated cardiovascular disease and other structural complications. AI allows these histological and radiological images to be analyzed quantitatively, enabling more precise characterization of disease severity and risk.

Omics and the move toward precision medicine

While imaging captures phenotypic manifestations of disease, omics data such as genomics, epigenomics, transcriptomics, proteomics, metabolomics provide insight into underlying molecular mechanisms. AI plays a transformative role in analyzing these high-dimensional datasets, helping to identify pathogenic genetic variants and integrate multi-omics information for biomarker discovery and drug target identification. These approaches support patient stratification and enable a transition from population-based averages to individual risk trajectories, which is central to precision medicine. Although precision oncology has been an early adopter of multi-omics integration, similar strategies are increasingly relevant for chronic diseases such as diabetes, where molecular heterogeneity contributes to variable disease progression and treatment response.

A central theme of our work is the integration of imaging with omics using AI to bridge phenotype and genotype. This includes linking morphological patterns with molecular alterations, identifying imaging surrogates of genomic and transcriptomic states and building multimodal predictive models for prognosis and treatment response. AI models learn joint representations across imaging and omics modalities, enabling discovery of non-obvious associations between morphology and molecular pathways. This integration is particularly relevant for prognosis, where combined signals often outperform single-modality predictors. These AI systems are positioned as clinical decision support tools, assisting clinicians by providing quantitative risk estimates and interpretable insights, while keeping final decision-making firmly in human hands.

Looking ahead

The future of AI in healthcare is not about replacing clinicians. It is about enhancing clinical judgment in an increasingly data-rich world. As AI becomes more integrated into clinical workflows, its success will depend on thoughtful implementation, clinician engagement, and a clear understanding of its capabilities and limitations.

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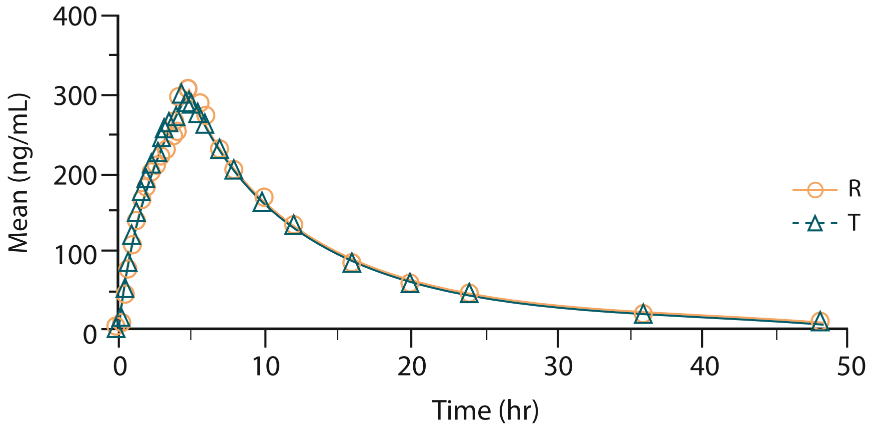
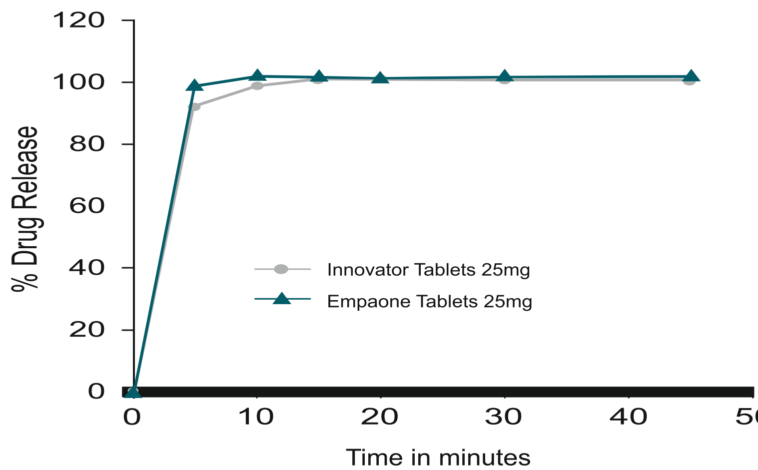


Dissolution profile matches with innovator



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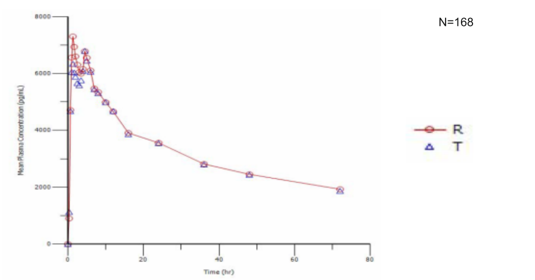

C_{max} and AUC $_{0\text{-}72}$ matches with innovator

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	Test Product (T)	Reference Product (R)				
C_{max} (pg/mL)	7871.7497	8515.5063	39.52	92.44	98.32	83.88 to 101.88
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NOTES

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