

What's next in medical science—Precision, Prevention, and Prediction

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TRANSFORMATIVE SHIFTS IN MEDICAL SCIENCE

As we stand at the cusp of an unprecedented era in medical science, the horizon is illuminated by a confluence of groundbreaking advances that collectively herald a profound transformation in healthcare. The trajectory of medicine today is distinguished not only by isolated discoveries but by the synergistic integration of diverse disciplines, such as omics, artificial intelligence, bioengineering, and data science, each amplifying the other's potential. This convergence is catalyzing innovations that promise to redefine our fundamental approach to understanding, preventing, diagnosing, and treating disease, moving beyond incremental improvements toward paradigm-shifting revolutions.

FROM REACTIVE TREATMENT TO PROACTIVE HEALTH MANAGEMENT

Embracing proactive care for lasting wellness

A central theme emerging from this new era is the decisive transition from reactive to proactive medicine. For decades, healthcare systems have focused primarily on treating illness after its onset. However, the persistent global burden of chronic non-communicable diseases (NCDs), including cardiovascular and cerebrovascular diseases, cancer, chronic respiratory conditions, and metabolic diseases, demands a reorientation toward prediction, prevention, and sustained health maintenance (Figure 1).¹ The future of medicine lies in anticipating disease trajectories and intervening earlier, thereby mitigating or even averting the progression of illness. This philosophy is increasingly embraced by international health authorities such as the World Health Organization, which advocates for robust investment in primary prevention, health education, and accessible primary care infrastructure. These strategies yield far greater returns than late-stage disease management, both in terms of health outcomes and economic sustainability.

Precision health: Customized prevention and therapy

Precision health epitomizes this transition. Large-scale initiatives, such as the PREDICT studies, have illuminated the remarkable heterogeneity in individual responses to diet, exercise, and environmental exposures. The era of one-size-fits-all health recommendations is giving way to personalized

interventions informed by an individual's unique genomic, microbiomic, metabolomic, and behavioral profiles. The rapid clinical adoption of GLP-1 receptor agonists,² including Semaglutide and Tirzepatide, exemplifies this shift. These agents not only facilitate effective obesity management but also interrupt the cascade of obesity-related comorbidities, thereby fundamentally altering long-term health trajectories.

TECHNOLOGICAL INNOVATIONS RESHAPING MEDICINE

Gene and cell therapies: Redefining biological boundaries

The preventive focus is inextricably linked to the rapid advancement of disruptive technologies that are reshaping the medical landscape. Among these, genomics and gene editing stand at the forefront. The clinical approval of CRISPR-based therapies, such as Casgevy for β -thalassemia and sickle cell disease, marks a watershed moment in translating gene editing from theoretical promise to practical reality. Gene therapy is no longer confined to rare monogenic disorders; treatments like Zolgensma for spinal muscular atrophy demonstrate the expanding therapeutic horizon. As delivery mechanisms improve and off-target effects diminish, the prospect of addressing complex polygenic diseases through sophisticated multi-gene editing strategies becomes increasingly tangible.

Cellular therapies represent another transformative frontier. The success of CAR-T cell therapies, including Kymriah and Yescarta, have transformed the management of hematological malignancies and are now being adapted to solid tumors, autoimmune diseases, and regenerative medicine. The broader vision is to harness engineered living cells as programmable therapeutic agents capable of dynamic, context-specific responses, thereby revolutionizing treatment paradigms.

Organ regeneration: Turning the tide on organ failure

Organ regeneration and fibrotic diseases are pivotal challenges shaping medical science's future.³ Fibrosis, traditionally seen as the irreversible outcome of chronic injury in organs like the lung, liver, kidney, and heart, causes significant global mortality and signals regenerative failure. Emerging



Figure 1. An illustration depicting the future of medical science Driven by proactive health management, technological innovations, and the integration of AI with digital health, future medicine will be fundamentally characterized by precision, prevention, and predictive capabilities.

evidence reveals fibrosis as a dynamic, reversible state influenced by the balance between scarring and regeneration. Advances in single-cell analysis, stem-cell therapy, and microenvironment engineering highlight key pathways such as Hippo/YAP, Wnt, and Notch that can promote tissue repair. Concurrently, AI-driven imaging and modeling improve early detection and treatment precision, suggesting that combining antifibrotic and regenerative approaches could transform organ failure into a treatable condition.

Organoids: Personalized disease modeling and drug screening

Over the past decade, organoid technology

for solid tumors has emerged from scratch, successfully generating organoids from epithelial-derived human tumors such as those in the colon, liver, lung, pancreas, prostate, and ovaries. Among these, synthetic hydrogel-based organoid models for solid tumors retain key characteristics of the original tumors, including phenotypic and genetic diversity as well as mutational profiles. They provide robust platforms for preclinical research and have also advanced the development of precision medicine, revolutionizing disease modeling and personalized drug screening. Additionally, the construction of organoids for non-solid tumors, such as hematologic malignancies, and other suspension cells like synovial fluid and immune cells, with the design of interactive biomaterials, represents a future trend in organoid development.

Xenotransplantation: Redefining organ replacement

Xenotransplantation offers a potential solution to the chronic shortage of donor organs, a crisis that has long constrained transplantation medicine.⁴ The recent successful transplantation of genetically engineered pig hearts into human recipients, albeit temporarily, underscores the feasibility of this approach. As gene editing further improves graft compatibility and durability, xenotransplantation will become an essential strategy for patients with end-stage organ failure.

The rise of intelligent diagnostics and therapeutics

Advances in diagnostics and therapeutics are equally remarkable. Liquid biopsies enable real-time, minimally invasive cancer monitoring, facilitating personalized treatment adjustments. Theragnostic platforms, exemplified by Lutetium-177 PSMA (Pluvicto) for advanced prostate cancer, integrate precise diagnostic imaging with targeted radiotherapy, embodying a new paradigm of integrated diagnostic-therapeutic approaches. Subcutaneous depth-selective spectral imaging with Multiple μ -spatially offset Raman spectroscopy (μ pSORS) enables non-invasive glucose monitoring. By simply placing the palm gently on the detection device, blood glucose levels can be accurately measured, eliminating the pain and potential risk of infection associated with invasive blood glucose testing. Nuclear medicine is evolving to deliver increasingly precise radiation doses guided by molecular signatures, enhancing efficacy while minimizing collateral damage.

THE FUSION OF REAL-WORLD AND DIGITAL HEALTH

Artificial intelligence: The new operating system of medicine

Artificial intelligence (AI) has emerged as a pervasive and multifaceted catalyst across the biomedical spectrum (Figure 1).⁵ AI algorithms demonstrate superhuman proficiency in interpreting complex medical images, such as optical coherence tomography, mammography, computed tomography, and pathology slides, enhancing diagnostic accuracy and efficiency across specialties from ophthalmology to radiology. Clinical reasoning is being augmented by AI models like Google's Med-PaLM 2, which exhibit expert-level performance on medical licensing examinations, foreshadowing a future where AI serves as an indispensable clinical decision-support partner, complementing human judgment in differential diagnosis and therapeutic planning.

Digital health and real-world data revolution

Digital health technologies and biomarker discovery are generating vast streams of real-world data. Wearable devices, such as the Apple Watch, with its FDA-cleared atrial fibrillation detection algorithm, generate continuous real-world data, while digital therapeutics like reSET-O provide evidence-based interventions for opioid dependence. Emerging fields like digital immunology seek to decode these data, enabling hyper-personalized health insights, predictive analytics, and remote disease monitoring at the population level, thereby transforming health management.

Drug discovery and repurposing in the era of AI

In drug discovery, AI accelerates target identification, compound screening, and drug design, compressing timelines that traditionally spanned years or decades. Drug repurposing is gaining renewed momentum, offering a rapid and cost-effective path to therapeutic innovation. The expansion of

Semaglutide's indications from diabetes to obesity management and cardiometabolic risk reduction, alongside ongoing trials exploring Metformin's potential anti-aging effect, such as the TAME trial, illustrate how existing pharmacological agents can be leveraged to address broader medical needs.

Autonomous surgical systems and rare disease advances

Robotics is advancing from physician-controlled instruments to autonomous surgical systems, exemplified by the STAR robot, which performs complex soft-tissue procedures with exceptional precision and reproducibility, potentially democratizing access to high-quality surgical care. Concurrently, advances in rare disease research—fueled by improved classification systems, patient registries, and genomic tools—offer hope to populations historically underserved by conventional medical research.

Emerging frontiers: Extreme environment and systems medicine

New disciplines continue to broaden the scope of biomedical science. Extreme environment medicine, informed by studies such as NASA's Twins Study, elucidates the physiological impacts of prolonged spaceflight, deep-sea exploration, and polar expeditions. These insights inform our understanding of human resilience and may translate into novel strategies for overall health promotion. Meanwhile, the integration of digital health with large-scale analytics promises to revolutionize population-level health strategies and enable de novo personalized interventions.

TOWARD A FUTURE OF PREDICTION, PREVENTION, AND PERSONALIZATION

Looking ahead, the evolution of medical science will not hinge on isolated breakthroughs but on a continuous, multifaceted progression driven by the fusion of knowledge and intelligence. This future is marked by the seamless integration of profound biological insights with advanced computational capabilities and engineering innovations, all centered on the goals of prediction, prevention, and personalized care (Figure 1). Despite significant obstacles, such as cost barriers, equitable access, regulatory challenges, clinical validation, and ethical considerations, the overall direction remains clear and promising.

Our shared vision goes beyond simply treating illness; it aims to extend and improve human health span fundamentally. The objective is to leverage technology not only to heal but to understand, foresee, and prevent disease before it arises. We strive to build a global health system that is smarter, more resilient, and inherently focused on prevention—ultimately, one that is more attuned to human needs. The powerful forces converging today herald not just incremental improvements but a true renaissance in human health. At the same time, we must remain vigilant against the threats posed by widespread infectious diseases and take proactive steps to mitigate them. The next era of medical science is unfolding now, carrying the extraordinary potential to transform human well-being. It is the responsibility of the scientific and medical communities to guide these advancements wisely, ensuring they translate into fair and broad health benefits for everyone.

REFERENCES

1. Xiao N., Ding Y., Cui B., et al. (2024). Navigating obesity: A comprehensive review of epidemiology, pathophysiology, complications and management strategies. *Innov. Med.* **2**:100090. DOI:10.59717/j.xinn-med.2024.100090
2. Xu Y. and Li J. (2024). GLP-1R agonists: Full of hope, use with caution. *Innov. Med.* **2**:100086. DOI:10.59717/j.xinn-med.2024.100086
3. Mo C., Zhou A., Wang Z., et al. (2025). Organ regeneration and fibrosis sub-forum advances global solutions for fibrotic diseases. *Innov. Med.* **3**:100170. DOI:10.59717/j.xinn-med.2025.100170
4. Zhang Y., G P.J. and Yang Y. (2024). The rapid development of gene-editing technology is making xenotransplantation increasingly common in clinical practice. *Innov. Med.* **2**:100074. DOI:10.59717/j.xinn-med.2024.100074
5. Dai J., Xu H., Chen T., et al. (2025). Artificial intelligence for medicine 2025: Navigating the endless frontier. *Innov. Med.* **3**:100120. DOI:10.59717/j.xinn-med.2025.100120

DECLARATION OF INTERESTS

The author declares no competing interests.