

## Transformation

# Disruptive Dozen: Top 12 emerging healthcare technologies

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### Key takeaways

- Three of today's fastest breakthrough areas in medicine - brain health and central nervous system disorders, oncology, and inflammation and immunology - are shaping the future of healthcare and have the potential to greatly improve patient outcomes and quality of life.
- The "Disruptive Dozen" identifies 12 emerging technologies in healthcare innovation and explores the promise of these breakthroughs as well as challenges in their development.
- These transformative technologies range from obesity drugs and diabetes treatments to new therapies for ALS and a blood test for Alzheimer's disease.

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The speed at which emerging technologies in healthcare will become clinical realities impacting patient care is astounding. And moving these innovations into clinical practice depends on everything from robust research practices to prudent piloting to smart partnering.

This week, Bank of America joined Mass General Brigham to present the World Medical Innovation Forum, where clinical experts, industry leaders and venture investors explored advances in brain health / central nervous system (CNS) disorders, oncology, and inflammation and immunology. We highlight the twelve emerging technologies – the "Disruptive Dozen" – with the greatest potential to impact and transform healthcare in the next several years. These breakthroughs range from obesity drugs and diabetes treatments, to new therapies for ALS (amyotrophic lateral sclerosis), and a blood test for Alzheimer's Disease.

### 1. New type 2 diabetes drugs show promise in obesity

Obesity has become a worldwide problem, with 13% of adults considered obese, a figure that has tripled in the last 50 years. New drugs that mimic a hormone that curbs hunger, glucagon-like peptide 1, commonly called GLP-1, are blazing a new trail in weight loss. These drugs, which were first approved for type 2 diabetes, can have remarkable effects on weight loss. They have been shown to help some patients lose more than 15 percent of their starting weight. But they must be injected and can cost over \$13,000 annually. With a worldwide surge in obesity rates, GLP-1 drugs could enable safe, effective weight reduction and possibly help reduce the adverse outcomes linked with obesity, including heart disease, diabetes and cancer. However, there are important concerns, too, including the uncertainties associated with long-term use, equity, access, and the potential harms of a society that overemphasizes weight loss.

### 2. RSV vaccine approaches the clinic

After years of painstaking work, a vaccine that protects against the respiratory syncytial virus (RSV) is at last within reach. RSV typically causes mild or no illness, but in vulnerable populations, including the very young and the elderly, it can be a serious threat. Last fall and winter, the US endured a particularly severe surge of RSV, a situation made worse in part by the lack of an effective vaccine. An early vaccine developed in the 1960s failed tragically: rather than protect against disease, it made the illness worse. Now, armed with decades of knowledge of RSV biology and immunology, scientists have forged a path toward a safe, effective vaccine.

### 3. Building the next generation of mRNA vaccines

Messenger RNA (mRNA) technology took center stage during the COVID-19 pandemic as it was central to the development of life-saving vaccines, which have proven safe and effective in millions of people worldwide. That success has propelled mRNA's wider application to vaccine development as mRNA vaccines offer several advantages over traditional vaccines. The technology can be used to produce vaccines quickly and cheaply. It also enables the rapid modification of existing vaccines as new viral variants emerge, as they did during the COVID-19 pandemic. Now, a new generation of mRNA vaccines is under development, and could advance the treatment of a wide range of diseases, from common respiratory infections to long-standing global scourges to cancer.

#### 4. New therapies for ALS

Amyotrophic lateral sclerosis (ALS) is a devastating disease involving motor neurons in the brain and spinal cord. These neurons send signals from the brain to muscles, coordinating the movements required to walk, talk, eat and breathe. In ALS, these motor neurons degenerate and die, leaving patients paralyzed. Many patients do not survive a few years beyond diagnosis. Two new treatments were recently approved for ALS, bringing the total number of approved drugs to just seven. One involves a pair of drugs that work together in combination to prevent neurons from dying. The other is a gene-based therapy tailored to patients with a rare genetic form of ALS. While the unmet need for ALS therapies remains high, these new therapies signal an important step forward.

#### 5. Harnessing the power of large language models to improve health care

Artificial intelligence (AI) holds promise for automating and streamlining information processing tasks across major industries, including healthcare. Over the last several years, major advances in a form of AI called large language models (LLMs) are stirring excitement. LLMs work by sifting through massive datasets to discern patterns and relationships among words — a process known as training. Once these models are sufficiently trained, they can perform a variety of language-based functions, including recognizing, summarizing, translating, generating, and predicting text. LLMs could have a significant impact in medicine by streamlining and supporting the work of physicians. Two key areas include clinical decision support and administrative workflows — offering information and suggestions at the point of care and reducing the time spent on manual, repetitive tasks.

#### 6. The first “in human” gene editing therapy

One of the first in vivo gene-editing therapies is now in early-stage clinical trials and, if proven safe and effective, could signify a landmark in the history of biopharmaceuticals. The one-time therapy uses a genome editing system, known as CRISPR-Cas9, to make double-stranded cuts in the DNA and repair errors in the genetic code. It targets a disease known as transthyretin amyloidosis (ATTR), which arises when a misfolded protein forms abnormal clumps and damages important tissues and organs, like the nerves and heart.

#### 7. A novel non-hormonal treatment for menopause

80% of women experience a range of symptoms during the transition to menopause, including hot flashes, which can be severe, extremely debilitating, and negatively impact quality of life. Hot flashes can first emerge months to years before menopause and persist for over a decade. Hormone therapy is the most effective current treatment, but some women cannot take it due to health concerns; others choose to avoid it. Now, a novel, non-hormonal drug was recently approved that can reduce the frequency and severity of hot flashes by blocking the signals that trigger hot flashes in the brain's thermostat. This is a promising safe, effective, non-hormonal approach for controlling menopause symptoms.

#### 8. Defining a new era of precision oncology

A new class of bifunctional precision cancer therapies is gaining traction, in which one part of the drug is designed to zero in on tumor cells and the second part delivers a cancer-killing payload while limiting damage to healthy cells and tissues. One approach involves linking tumor-homing molecules to radionuclides, which use radiation to destroy tumor cells. Another uses antibodies coupled to chemotherapy drugs. Part of what makes these antibody-drug conjugate (ADC) therapies so powerful is the rise of companion diagnostics that allow the clinician to first visualize tumors that carry the target protein on their surfaces prior to their treatment. Now, a new generation of ADCs are under development that promise to replace conventional, systemically administered chemotherapies for the vast majority of cancers in the next decade. Together, these therapies are improving outcomes for cancer patients and defining a new era of precision oncology.

#### 9. AI tool predicts lung cancer risk in smokers and non-smokers

Lung cancer causes more cancer deaths among American adults than any other cancer. The reason is twofold: the disease is common, and it is difficult to treat once it has advanced. That's why early detection efforts are focused on those believed to be at highest risk - patients with a history of cigarette smoking. Yet, recently, a rise in lung cancer among non-smokers suggests a need for new approaches. To help, researchers have developed an AI-based tool that can predict whether patients will develop lung cancer within 6 years. The AI tool uses images from low-dose computerized tomography (CT) scans to accurately predict patients' future risk of lung cancer for both smokers and non-smokers.

#### 10. Protecting retinal cells to preserve vision

Many adults fear vision loss only slightly less than cancer, as it can trigger social isolation, loss of independence and depression. The retina is home to specialized neurons that are required for normal vision. When these specialized neurons degenerate and die, vision impairment and eventually blindness ensue. While the causes of retinal degeneration are varied, a common treatment strategy is in the works that could help the tens of millions of people in the US with retinal disease. The idea is to develop neuroprotective therapies that can protect these cells from injury and death, thereby preserving vision. These therapies could help patients across a range of retinal diseases, including macular degeneration, diabetic retinopathy, glaucoma, and optic neuropathies. Given that preserving vision is a top health priority, the potential is remarkable.

## 11. Toward a simple, cost-effective blood test for Alzheimer’s disease

Alzheimer’s disease and other neurodegenerative conditions represent a major public health burden. By 2050, it is projected that 13 million people in the US will suffer from Alzheimer’s, and the cost of care will approach \$1 trillion. Researchers are working to develop a simple, cost-effective way to diagnose these conditions decades before the onset of physical symptoms — when the course of the disease could potentially be halted or perhaps even reversed. Such a diagnostic test could rapidly accelerate the development of effective treatments for these diseases, and also form a key piece of the puzzle for lowering the future public health burden of Alzheimer’s disease.

## 12. Slowing the progression of type 1 diabetes

Type 1 diabetes is among the most common diseases to affect children, second only to asthma, affecting over 1 million people in the US. It is a chronic illness that results when the body’s own immune system attacks the insulin-producing cells in the pancreas, destroying the cells and creating a life-long dependence on exogenous insulin. Although insulin replacement is an effective treatment, it is not a cure. A newly approved drug that targets a critical protein on T-cells, deactivating them and thwarting their destruction of insulin-producing cells, has been shown to delay the onset of type 1 diabetes in children and young adults at high risk for the disease by about 2 years. Children who are diagnosed before the age of 10 can lose more than 14 years of life expectancy, underscoring the power of novel therapies that can delay or even halt the onset of the disease.

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### Sources

#### World Medical Innovation Forum

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#### Mass General Brigham

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