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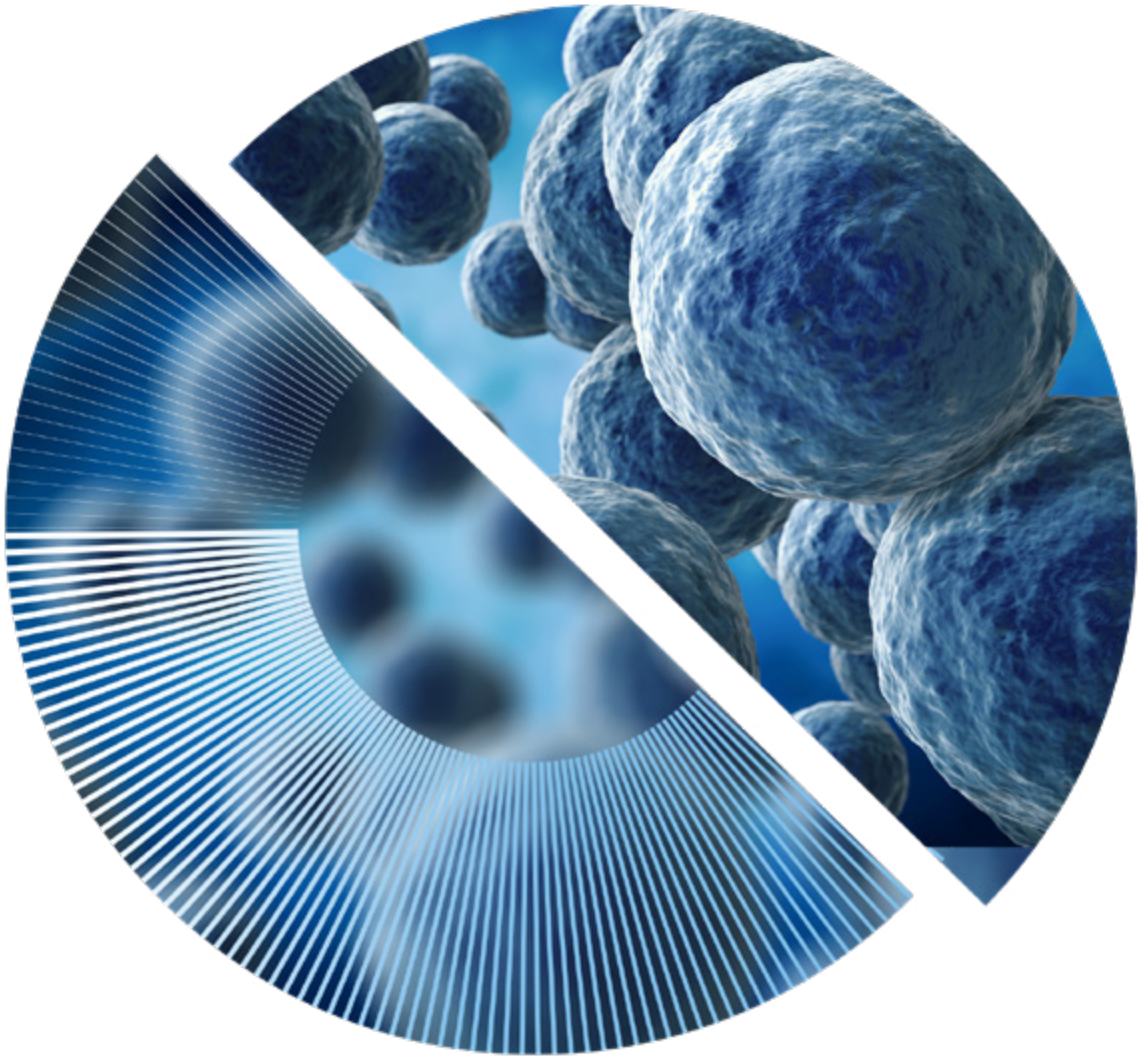


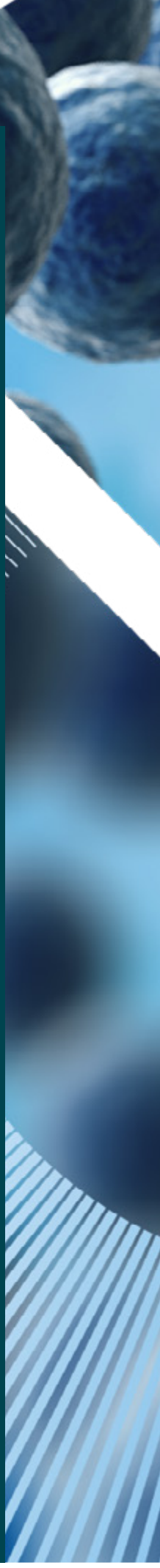
Accelerating the future
Interdependent innovations in science and technology are reshaping treatment paradigms

Life sciences and healthcare predictions 2030

Deloitte Centre *for* Health Solutions

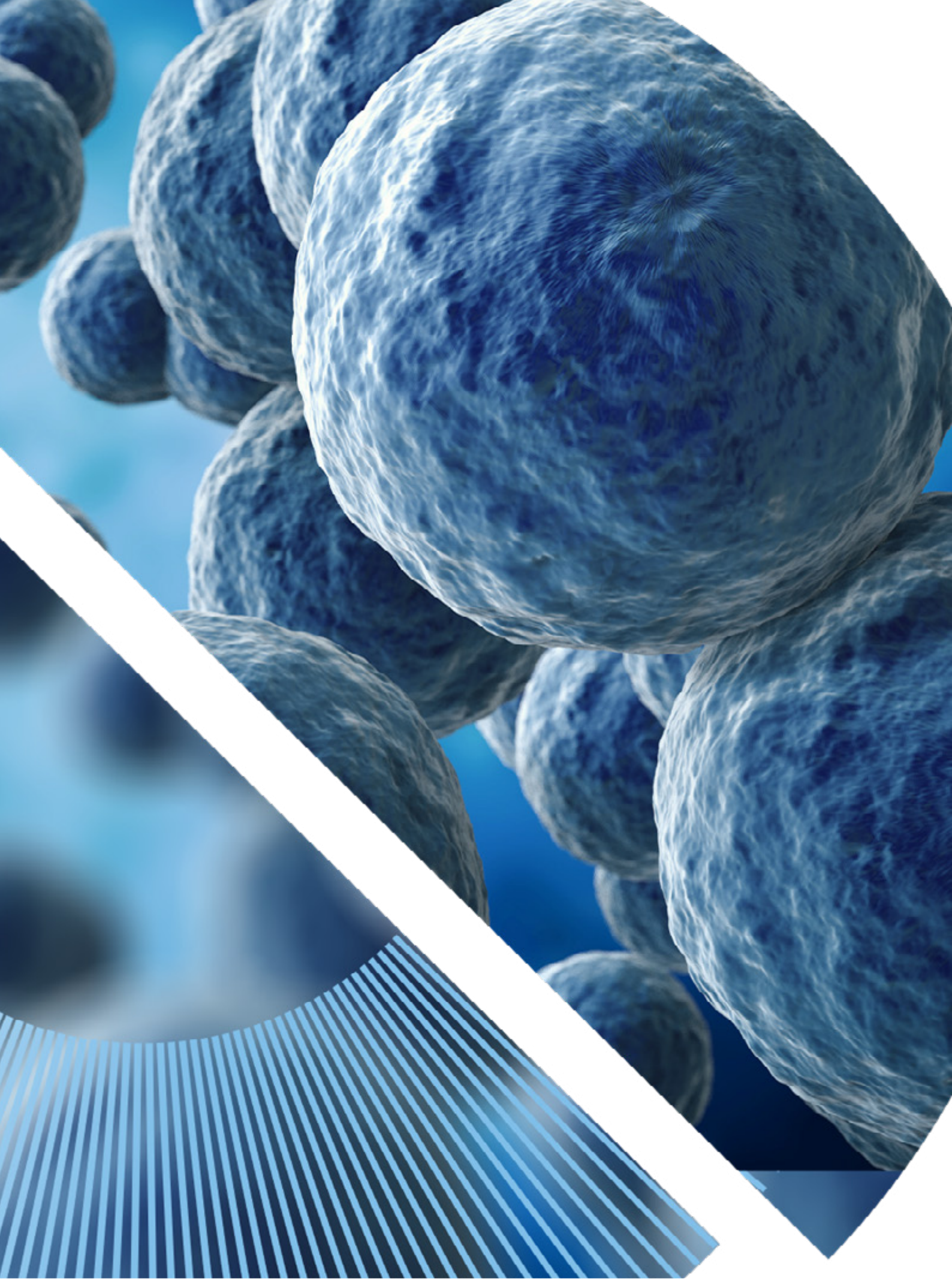
Interdependent innovations in science and technology are reshaping treatment paradigms

Enabling more precise, predictive and personalised diagnostics and treatments that deliver better health outcomes



Prediction 2030

Innovations in technology have driven innovations in science, and vice versa. The adoption of quantum computing, AI-enabled technologies and access to multiple sources of health data have led to more precise and predictive diagnostics and life extending therapies. Data from MedTech devices, wearables, genomics and other real-world evidence (RWE) are collated and integrated ethically into individuals' electronic health records (EHRs) and used to create comprehensive, real-time population health profiles. These profiles are used to identify precise drivers of disease and develop advanced therapies, building on innovations approved in the early 2020s, such as cell and gene therapies, immunotherapy and mRNA technologies. Scientists can identify and target genetic mutations and create precise, personalised and, sometimes, curative treatments for many cancers, dementias and rare diseases. Pharmacogenomics, single-cell analysis, brain mapping, nanotechnology, 3D printing, implantable sensors and advanced prosthetics have increased survival rates for some diseases by more than ten years. Clinicians have improved their understanding of the social determinants of health and have embedded considerations of health equity into the design of services and treatments.



The world in 2030

- Rapid translation of genomic data into clinical insights and actions have increased the accuracy and speed of diagnoses and treatment plans, improved survival rates and reduced inequalities in healthy life expectancy.
- Advances in technologies such as proteomics, metabolomics and microbiomics, via mass spectrometry, nuclear magnetic resonance and advanced sequencing, provide a better understanding of patients' biology and related treatment plans.
- Some innovations are fully curative and by tackling the underlying biology of ageing, are extending healthy lifespan by postponing the onset of age-related conditions.
- Harnessing the potential of the human microbiome has led to innovative non-drug-based therapies that can restore the balance of the body and provide treatments for difficult-to-treat diseases.
- Prevention has been enhanced by the development of vaccines (mRNA platforms and other novel approaches) for an increasing number of infections and non-communicable diseases (such as recombinant vaccines for cancers and heart disease).
- Developments in nanomaterials, hydrogels, microneedles and implantables allow more precise and targeted drug delivery, reducing side effects.
- Precision microtechnology enables microscale robots to deliver small molecule therapies to targeted areas.
- Liquid biopsy assays for early cancer detection, minimal residual disease testing and tumour profiling, provide cost-effective diagnostics.
- Quantum computing and advances in neurotechnology, such as brain-computer interfaces, deep brain stimulation and neuroprosthetics, are revolutionising neurological treatments and restoring functions.
- Customised care plans for mental health conditions, based on an individual's genetics and biomarkers with trusted digital therapies, improve mental health treatments and self-management.

Conquered constraints

Skills and talent

Life sciences companies employ people with a broad range of skills, such as clinical pharmacology, computational biology and chemistry; and healthcare related data analytics, AI engineering and bioinformatics. They also value people trained in cyber security, regulatory and compliance requirements. These skills are either developed in house through recruitment and training or acquired through partnerships and alliances. Clinicians have strong digital skills and a robust understanding of immunology and genomics and how GenAI can augment and accelerate their choice of treatments.

Funding and business models

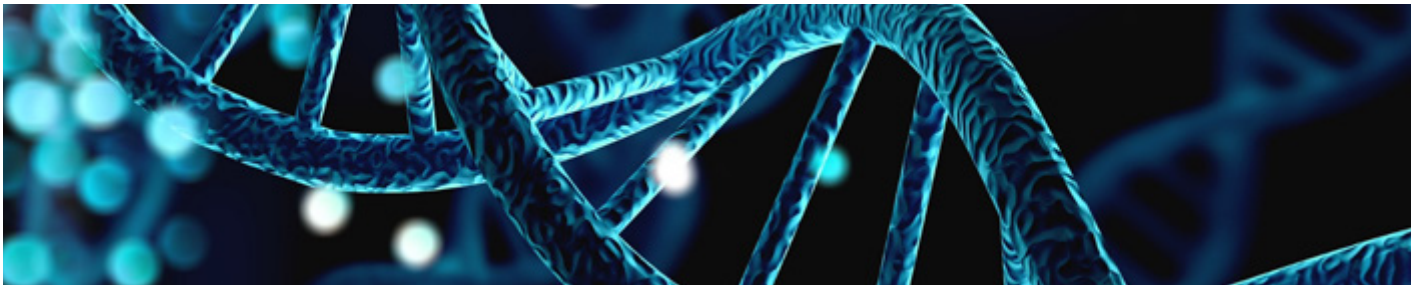
Outcomes-based funding is the dominant model in government and private financing initiatives. Providers use purchasing strategies that secure the availability of critical drugs based on scenario planning and predictive modelling. Quicker approvals bring new products to market faster, improving both affordability and equitable access through value-based pricing models. Platform-based business models facilitate the exchange of data, goods and services among ecosystem players.

Regulation

Regulatory bodies maintain the balance between encouraging innovation, protecting consumers and addressing the impact of disruption. Patient experience as part of RWE is a requisite for decision-making. AI-enabled pharmacovigilance systems quickly identify emerging safety signals and the roll-out of regulations in the US and in Europe has reduced costs and improved access.

Digitalisation and data

Omics data sharing has proved crucial to research enabled by collaborative reporting and analysis software, databases and knowledge sharing. Digitalisation is end-to-end, with data protected across the value chain using encrypted servers, secure cloud storage and robust transmission protocols. Firewalls and intrusion prevention systems protect against unauthorised access. Data backup and disaster recovery measures help reduce and restore system failures and breaches. Companies have adopted a 'security-by-design' approach and established real-time monitoring, cyber-threat modelling and analysis, threat mitigation and remediation.



Imagine the world in 2030*

How a global pharma company is using omics data and the mRNA vaccine platform to tackle infectious diseases

Pharma companies leverage data from clinical genomics and phenomics, and from clinical histories to develop more personalised treatments, such as customised vaccines. They have expanded their partnerships with others across the ecosystem, including academic institutions, to have quick access to new molecules, enabling faster drug development. Ana is the research lead of a global pharma company. Following an outbreak of an infectious disease in South America, she led the sequencing of the viral genomics, and shared this promptly to help stop the spread of the infection by steering research on to the development of a new vaccine using the mRNA platform. Scientists designed the vaccine alongside a delivery vehicle based on a GenAI chemistry algorithm, enabling optimal absorption. To reach the right people and increase the pace of the development process, the company used a first-virtual, adaptive trial design, incorporating real-time data analysis and allowing adjustments in the vaccine, to achieve high efficacy while reducing the risk of severe side effects. Safety and efficacy data were communicated rapidly. Effective liaison between marketing and commercial teams and the country's national health system and its health technology assessment body has helped to agree fair pricing and reimbursements, in order to drive market penetration. GenAI was used to prepare the regulatory dossier, accelerate the regulatory process and reduce costs. Automation of formulations and filling systems helped to streamline and scale vaccine production and distribution processes.

How CRISPR gene editing technologies helped cure a patient with a rare genetically inherited disease

At birth, all babies are offered whole genomic sequencing, accelerating the diagnosis of hundreds of rare diseases and revealing the exact genetic mutation of the underlying cause. Shortly after his birth, Tom was diagnosed with a rare genetic condition and his genetic profile was shared promptly and securely across borders through interoperable platforms, in order to identify the best therapy. Exact personalised genome modifications were designed using CRISPR enabled by large language models (LLMs) to speed up the process and identify the correction of the underlying genetic abnormality with a one-off treatment, offering the potential for a lifelong cure. Tom's clinician actively engaged his parents in designing the treatment plan and provided them with access to a virtual coach to address any concerns and provide information on Tom's condition. They could also access a virtual platform to monitor lab results, schedule appointments and follow the therapy production process. Prior to commencing the treatment, personalised vaccines were used to provide Tom with protection from infections and reduce the risk of complications. Tom's prognosis following the treatment is excellent, nevertheless Tom's parents continue to monitor a set of health parameters using customised wearables which are automatically shared with his clinician. Tom's parents also agreed to share Tom's health data with public and private research institutions to help them improve their understanding of the disease and accelerate the development of life-saving therapies.

How innovative at-home diagnostics are helping to deliver more precise, predictive and personalised healthcare

Diagnostic technologies are critical in healthcare and integrating diagnostics into every care pathway enables earlier diagnosis and more precise and personalised treatment plans and monitoring. Omer is the CEO of a diagnostics company that invests extensively in developing genomic and other point-of-care tests that can be used throughout an individual's life to inform the development of new therapies. Some of these tests also deliver proactive alerts and measure deviations from treatment plans. The company has recently invested in research to improve the cost-effective development of innovative diagnostics such as protein and liquid biomarkers and single cell multiomics. Omer has a team of epidemiologists to track changes in population demographics and consumer behaviours, to ensure that the company's technologies remain relevant to the changing needs of the population, including identifying disease risks such as cancer and neurodegenerative diseases. Omer's company focuses on tests that can be used by individuals at home, but which are supported with access to virtual coaches, so people are confident in using the diagnostic tests and acting on the results. In addition, Omer also works closely with CEOs and research directors of other life sciences companies to collaborate in the development of companion diagnostics for new therapies, leveraging AI technology to support clinicians with accurate diagnoses. Data is collected and analysed to create a strong evidence base, to demonstrate the value of their products, and Omer uses this data to negotiate reimbursement models across geographies.

* Note: All elements on this page are from a perspective of 2030 and are fictional

Evidence in 2024

GLP-1-receptor agonists (GLP-1) are transforming healthcare

For example, semaglutide was approved in 2005 for treating diabetes and in 2021 was approved to treat obesity. Since then, the number and adoption of **GLP-1 drugs** has risen exponentially.[1] It is estimated that the market will reach US$100bn by 2030, and that by 2035 24mn people in the US (7% of the population) will be using GLP-1 drugs. The drugs can cost around $1,000 a month and may require extended use to yield benefits. Other benefits include cardioprotection and they are being tested for sleep apnoea, addiction, Alzheimer's disease (AD) and fatty liver diseases.[2] Evidence is mounting that around two-thirds of patients newly-initiating GLP-1 therapy for obesity without a prior diabetes diagnosis stop using these drugs in the first year. In the second year, around a quarter of individuals who used weekly injectable GLP-1 products persisted with their obesity therapy. These trends invite debate over the cost of these drugs.[3]

Genomics in mental health

Aarhus University conducted a genetic study of 1.3mn people, more than 370,000 of whom suffered from depression. The study found that people with hospital-treated depression often have a higher risk of developing diseases such as substance abuse, bipolar disorder, schizophrenia and anxiety disorders. It is possible to predict the risk of developing these psychiatric disorders using genetic analysis, paving the way for better prevention and treatment.[4]

The global AD market

The global AD market driven by 23 novel therapies for the treatment of agitation and disease-modifying therapies, is projected to grow by 20% annually to reach US$13.7bn by 2030.[5] They include donanemab, lecanemab and remternetug; immunotherapies which are used to target amyloid plaques in the brains of people affected by the disease. The first two have been approved for use in the US, with the phase III results for remternetug due in 2025.[6]

Radioligand therapy (RLT) is revolutionising cancer treatment

RLT uses a ligand that targets cancer cells, expressing a specific biomarker combined with a therapeutic radionuclide to deliver cytotoxic radiation. This offers targeted solutions for various cancers, including gastroenteropancreatic neuroendocrine tumours and prostate cancer.[7]

mRNA technology

mRNA technology was first approved for COVID-19 vaccines in 2021, and by March 2024 there were more than 1,000 mRNA drugs in the pipeline, with 33 in phase III trials.[8] A **Moderna** survey found that 42% of respondents believe that mRNA technology will have a decisive influence on future medicine; and 68% consider cancer treatment as a promising area of application, followed by infectious diseases, autoimmune diseases, and rare diseases.[9] A personalised mRNA immunotherapy vaccine for melanoma has entered a phase III clinical trial in the UK, aimed at preventing the recurrence of cancer after removal of the tumour. A sample of the patient's tumour is removed during surgery, and DNA sequencing and AI are used to custom-build a therapy that is specific to each tumour. The phase II trial showed a 49% reduction in the risk of recurrence or death after three years, compared with the standard treatment.[10] An mRNA-based vaccine for respiratory syncytial virus (RSV) is also being tested: a phase II-III trial showed a vaccine efficacy of 83.7% against RSV-associated lower respiratory tract disease with at least two signs or symptoms, and 68.4% against RSV-associated acute respiratory disease.[11]

Development of personalised therapies

Cell and gene therapies (CGTs) have been developed to treat (and even cure) cancers and rare diseases. As of March 2024, there were 36 gene therapies approved by the US FDA, with 500 more in the pipeline.[12] Although CGTs are very expensive, the market is expected to increase from US$5.3bn in 2022 to $19.9bn in 2027. The high prices of individual treatments mean that companies are updating their business models. For example, **Pfizer** is launching its haemophilia B gene therapy Beqvez with a warranty programme based on the durability of patients' response.[13]

The n-Lorem Foundation provides experimental antisense oligonucleotide (ASO) medicines to treat patients with nano-rare diseases caused by a single gene mutation. By coupling ASO technology with their model, they are bringing genomic discovery to personalised medicine, one patient at a time, for free, for life.[14]

CRISPR gene editing for treating rare diseases.[15] In November 2023 the UK became the first country to approve a cell and gene therapy that uses CRISPR, Casgevy, for the treatment of sickle cell disease and β-thalassemia – genetic conditions that can lead to attacks of very severe pain, serious and life-threatening infections, and anaemia.[16] Casgevy has been shown to prevent severe pain episodes and maintain haemoglobin concentrations above 9 g/dl.[17]

Artificial intelligence and the transformative power of GenAI

The impact on diagnostic and treatment paradigms

AI has emerged as a source of innovation, promising to redefine the art of the possible. Used responsibly, AI can analyse large datasets, and combine genomics, clinical history, lifestyle and social determinants of health to provide deeper insights. Developments in GenAI can support clinicians' decision-making, including improving the speed and accuracy of diagnosis, the breadth and depth of treatment options, adaptation of treatment plans, optimising medication doses and predicting adverse drug reactions. Collaborations between pharma companies and GenAI technology giants are growing in scale and ambition as both sectors seek to capitalise on the massive amounts of health data generated by healthcare and life sciences.[18]

- GenAI can collate and summarise vast amounts of scientific literature, enabling clinicians and researchers everywhere to have fast access to the latest scientific evidence on new therapies and treatment pathways.

- GenAI can match polygenic risk scores with behavioural insights to design personalised treatment plans that include exercise and nutrition, and use virtual coaches for behavioural support and prompts, extending locations where interventions can be delivered (community hubs, primary care clinics and at home).

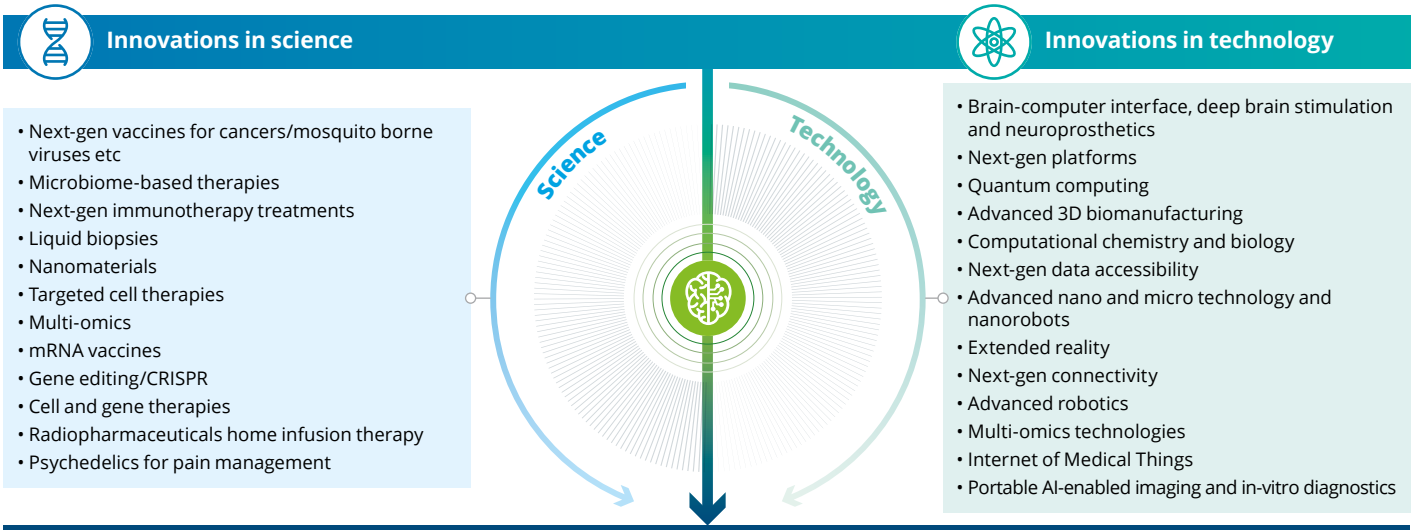
- GenAI has the potential to improve public health significantly by accelerating the discovery of better treatments and cures for diseases. Its ability to analyse vast amounts of data can lead to more targeted and effective treatments, directly benefitting patients and, by extension, society at large.[19]

- GenAI can reach across supply chain datasets and help to increase precision in supply and demand forecasts and reduce the risk of shortages in critical therapies.[20]

- Medical imaging plays a crucial role in diagnosing and treating diseases. GenAI can enhance medical imaging tasks such as data augmentation, image synthesis, image-to-image translation and radiology reporting.[21]

GenAI tools can readily create materials at multiple literacy levels and in a range of languages and can also be customised to suit different geographic and cultural factors. Keeping humans in the loop remains critical to check and validate the accuracy of AI and to address any bias or other problems as they arise. Guardrails are needed to engender trust and ensure transparency and explainability.

The interdependent innovations in science and technology that are poised to transform the future of health in 2030



Source: Deloitte analysis.

Examples in 2024

IBM have used advanced AI algorithms to model clinical trials to find new uses for existing drugs and therapeutics, such as potential treatments for dementia that typically accompanies Parkinson's disease. They used retrospective, de-identified data from EHRs and claims to model and emulate clinical trials, generating simulated cohorts of individuals who either received or did not receive certain drugs. Having corrected for potential confounding and selection bias the analysis revealed therapeutic benefits of two drugs in decreasing the population-level incidence of Parkinson's disease dementia. One of these drugs, rasagiline, was already used to treat motor symptoms in patients with Parkinson's disease. The other, zolpidem, is commonly used to treat insomnia.[22]

Profluent, a Berkley-based AI company, has developed OpenCRISPR-1, a LLM that it believes can extend the reach of CRISPR gene editing tool in the development of new therapies. Profluent's OpenCRISPR initiative aims to provide customisable gene editing proteins that are designed by AI from the ground up and which take their inspiration from nature. It aims to accelerate the development of the technology for many other currently incurable diseases.[23]

DNAnexus allows researchers to collaborate, share and analyse multiomics and clinical data. AI-driven analytics are integrated into the platform, allowing comprehensive interpretation, simplifying disease diagnosis, drug discovery and personalised treatment strategies. They have also collaborated with Oracle to advance precision health by accelerating innovation in genomics and healthcare.[24, 25]

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Contacts

Authors

Karen Taylor
Director
Centre for Health Solutions
kartaylor@deloitte.co.uk
+44 20 7007 3680

Márcia Costa
Research manager
Centre for Health Solutions
mcosta@deloitte.co.uk
+44 20 7303 7529

Emily May
Research manager
Centre for Health Solutions
elmay@deloitte.co.uk
+44 20 7007 5694

Key contacts

Hanno Ronte
Partner
Life Sciences and Healthcare Strategy
hronte@deloitte.co.uk
+44 20 7007 2540

Elizabeth Hampson
Partner
Life Sciences and Health Innovation
ehampson@deloitte.co.uk
+44 20 7007 8169

James Gregson
Partner
Life Sciences and Healthcare lead
jgregson@deloitte.co.uk
+44 20 7007 8866

Robert Hankey
Partner
Life Sciences Margin Optimisation
rhankey@deloitte.co.uk
+44 20 7007 0274

Sara Siegel
Partner
Global and UK Head of Healthcare
sarasiegel@deloitte.co.uk
+44 20 7007 7908

Contact information

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Deloitte UK Centre for Health Solutions
1 New Street Square
London EC4A 3HQ

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