

# From treatment to prevention: The evolution of digital healthcare



## AUTHOR

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**D**igitization in healthcare is revolutionizing the way we prevent, treat and manage health conditions. Emerging technologies not only expedite the development of new drugs, but also introduce a completely new class of therapies, such as digital therapeutics (DTx), which are software-based solutions that can treat and support a specific disease or disorder. Digital health has a growing impact on the delivery of care and provides the opportunity to tackle the next frontier in healthcare by shifting the focus from treatment to prevention.

Over the past decade there have been rapid advancements in the digital health space, which

is reflected by the increasing number of emerging digital health companies and the influx of capital from private and public investors, the medical industry and governments. As a life sciences company with a track record in delivering life-changing pharmaceuticals into peoples hands, Bayer G4A aims to change how people experience health and care through digital health collaboration and co-creation.

### DIGITAL RESEARCH: A SUBSTITUTE FOR BIOLOGICAL MODELS?

Since the 1970s, computational data approaches have complemented biological research and have evolved into

powerful scientific disciplines such as bioinformatics, systems biology and computational genomics. The evolution was driven by the growth of computing power, cost-efficient data storage systems and the implementation of diverse data analytics solutions. Specifically, advances in artificial intelligence (AI), machine learning and deep learning have provided the necessary tools to understand and interpret 'big data' in medicine. Today, we can simulate how cells – and even complex organs like the heart – may respond to drug treatment<sup>1,2</sup>. Such examples beg the question: Will computational approaches substitute *in vitro* experiments?

The power lies in a two-fold approach. Algorithms rely on input data from *classical* experiments in order to *learn* how the biological system – the cell or organ – behaves. Changes in metabolic systems are simulated with stimuli, such as a drug treatment, in order to understand possible unwanted side effects or to investigate more effective drug combinations. Companies like our Accelerator cohorts Cyclica<sup>3</sup> and Turbine<sup>4</sup> can predict drug candidates much more quickly than traditional methods. Their approaches differ in the types of data they use for their model inputs, disease areas and case applications.



Figure 1. The Current Pharmaceutical Value Chain. Source: Bayer G4A.

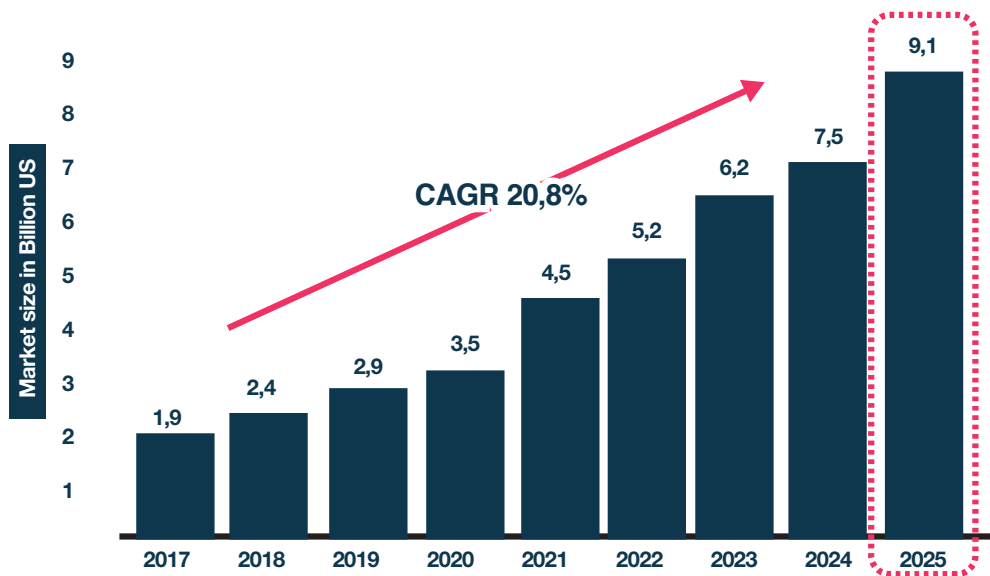


Figure 2. DTx Market Growth By 2025 (USD Millions). Source: Grand View Research 2017<sup>10</sup>.

Certainly, with increasing data availability and insight generation capabilities, digital research has a great future. Digital data and molecular testing are in a tight, interdependent relationship. Computational results can inform *in vitro* research for a faster, more targeted drug discovery approach. Biological data serves as additional parameters to make models more robust. The next steps will be to get closer to successfully modelling full and complex organ systems, as well as using data inputs from primary cells and clinical samples.

### **DIGITIZING CLINICAL TRIALS: FOR VALIDATING BETTER DRUGS FASTER**

Clinical trials help to assess the efficacy and safety of drug candidates. The lengthy, high-risk and expensive process of drug discovery and development can take a total of 10 to 15 years (Fig. 1). The reduction of this timeframe will deliver life-enhancing medications faster to patients in need. There is no doubt that there is an urgent need to improve clinical trial efficiency. There are several points in the research

and development process that technology can intervene to achieve improvements. Due to strict eligibility criteria or the rarity of a disease, identifying patients eligible for clinical study enrollment can often be a limiting factor. Electronic health records (EHR) present a great opportunity to increase patient visibility and decrease recruitment time. However, only a handful of countries, such as Estonia, have successfully executed approaches to convert handwritten physician notes, annotate information and integrate various EHR systems. Various digital health solutions can also support patients and caretakers to comply with medication intake regimen<sup>5,6,7</sup>.

Decentralizing clinical trials to patient homes with new technologies is making clinical trials more successful. So-called 'remote trials' can help in recruitment, communication, data capturing and patient monitoring – all within the comfort of patients' homes. Wearables can record and analyze measurements, such as vitals, and automatically share them with the study group. Smart

algorithms, like that of *xbird*, can indicate changes in behaviour and activity patterns in patients, as shown in an observational study with pulmonology patients<sup>8</sup>. Continuous outcome measurement in remote trials may better assess the efficacy of a drug candidate when compared to less frequent measurements taken during hospital visits. This approach also increases patient engagement and has the potential to decrease dropout rates. Remote trials can complement traditional approaches by considering country-specific regulations for technologies, such as telemedicine, and health regulatory guidance on evidence generation for market access.

An exciting new area is the emergence of digital biomarkers. The goal is to detect or even predict health threats, such as heart conditions, based on data from mobile and/or wearable devices. In collaboration with Stanford University School of Medicine, the Apple Heart Study demonstrates Apple Inc's ability to identify atrial fibrillation, which is a possible precursor of stroke and heart failure<sup>9</sup>.

Digital health bears exciting

opportunities to identify and develop helpful new medicines. A collaboration between technology companies, the pharmaceutical industry, patient and physician groups and regulatory bodies will pave the way for further innovation in the world of medicine.

### **DIGITAL THERAPEUTICS (DTx): CHANGING BEHAVIOURS AND PRESCRIBING DIGITAL MEDICATION**

Digital therapeutics (DTx) deliver evidence-based interventions to prevent, manage or treat medical disorders and diseases, and are driven by high-quality software programs<sup>4</sup>, whether as a standalone monotherapy or an optimization to support current medication and treatments. Evidence is growing that DTx used with or without a combination molecular therapy can improve outcomes, personalize care and decrease costs<sup>5</sup>. Digital platforms have delivered similar or better results than the current standard of care. For example, Propeller Health's asthma platform demonstrated a 79% reduction in rescue inhaler use<sup>8</sup> and a 57% reduction in asthma-related emergency department visits and hospitalizations<sup>9</sup>. The results from Propeller Health and many other DTx companies demonstrate why the market is estimated to grow to US\$9 billion globally by 2025 (Fig. 2).

Successful DTx interventions must understand the larger societal context and various worldviews that influence an individual's values, motivations, behaviours and goals. Qualitative research methods pull lessons from the fields of psychology, sociology and behavioural sciences to understand particular problems and to generate useful insights.

Bayer's G4A team spends significant time in the field to observe and interview patients, healthcare providers, payers and influencers. This is an essential step before designing personalized solutions tailored to specific needs. DTx success heavily relies on its seamless integration into both the existing healthcare infrastructure and an individual's habits and lifestyles.

As with any transformation in the field of healthcare, the players that must keep up with the fast pace of digital health are the key regulatory bodies. For example, the United States Food and Drug Administration (FDA) began to recognize DTx medical outcomes as companies seek payer reimbursement. The FDA pre-certification programme focuses on expedited review of DTx and

other digital health solutions, including real world evidence in the process.

**DIGITAL HEALTHCARE TODAY**

It seems hard to believe that recent advancements in DTx and human-centric solutions have measurably affected the overall healthcare experience of patients, physicians and caregivers. The aspirations of digital medicine companies to reform healthcare vastly differ from the realities of systems-level adoption of innovation. However, if digital health services meet and provide the level of care that patients expect, McKinsey & Company's international survey reports that more than 75% of all patients expect to use digital services in the future. The practice of digital health not only allows for

the better monitoring of disease progression and general health tracking, it allows physicians to be able to provide better, more personalized care and diagnose patients effectively and efficiently through various ways such as access to quality data, interoperability and care delivery.

Depending on the healthcare system's payer model, meaning private or public insurers, patients are more or less willing to pay out of pocket. In countries with primarily government-funded healthcare, patients are less likely to seek out-of-pocket options, making it harder for new DTx solutions to gain a foothold. As the market of new, patient-centric digital solutions matures, companies increasingly aim to design a reimbursable product, which insurance companies

recognize as more cost effective than the current therapeutic options.

As more digital health solutions enter the market, physicians and patients alike are gradually adopting some of these technologies in practice. One early digital health development was the personal EKG (electrocardiogram) monitoring device, AliveCor. This FDA-approved medical device has software that is able to detect three of the most common arrhythmia types<sup>11</sup> and enables patients to be monitored from the comfort of their own home. The company also allows physicians to review patients' data remotely, reducing the need for office visits. AliveCor was the first of its kind and other similar companies have since evolved, such as FibriCheck and Cortrium.

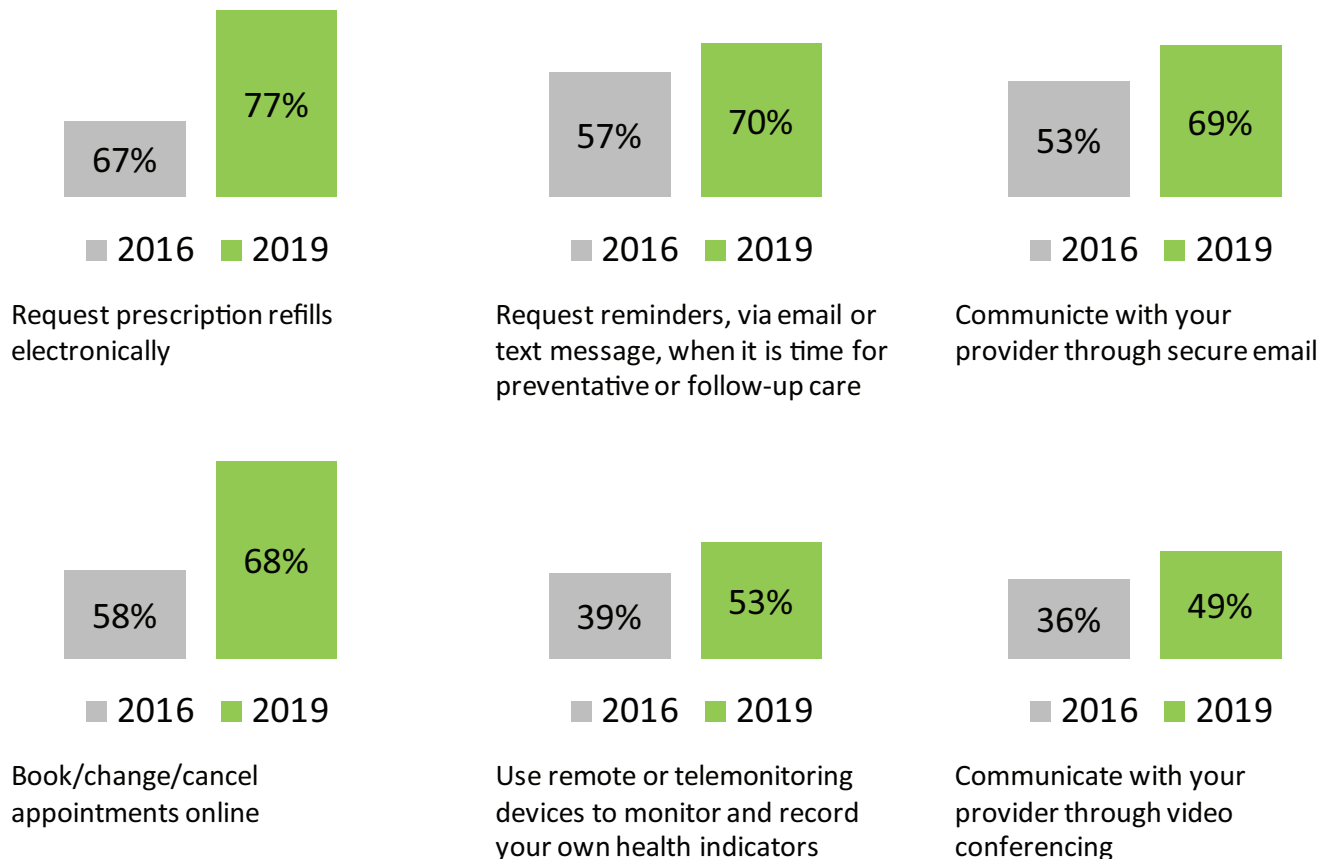
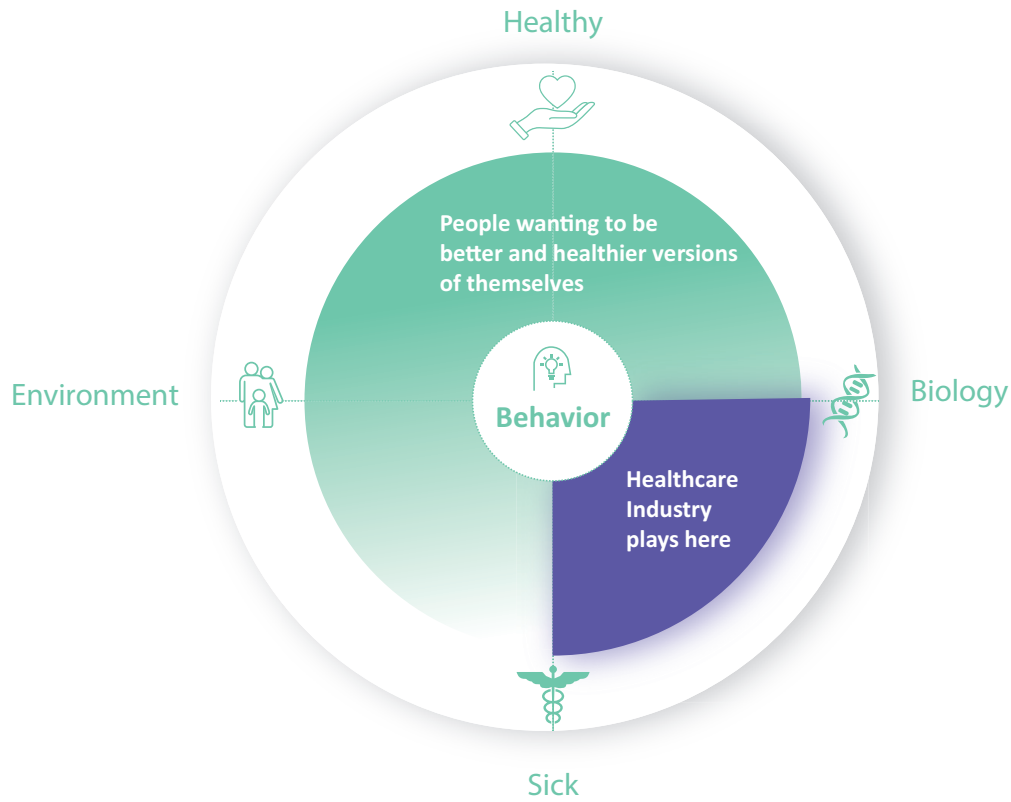


Figure 3. Consumers Increasingly Will Choose Medical Providers Who Offer Digital Capabilities. Source: Accenture 2019.



**Figure 4. The Evolving Landscape of Healthcare to Health.** Historically in the traditional healthcare model, the industry has focused on downstream interventions to provide access to care and treatment services. As the focus shifts from treatment to prevention, the model of integrated healthcare focuses on empowering people to become 'better versions of themselves'. Source: *YourCoach.Health*.

Many other digital health solutions and platforms that benefit both patients and physicians include digital stethoscopes with a combined electrocardiogram (ECG), which can then be integrated with electronic health records<sup>12</sup>. Online doctor visits change the way that care is received and delivered<sup>13</sup>, and digital therapeutic applications for type 2 diabetes management are now reimbursed<sup>14</sup>. However, digital health companies are not just limiting their products to cater simultaneously to patients and physicians. OncoAssist, a smartphone-based decision support tool for oncologists, solely caters to assist oncologists to make better decisions on available treatments for individual patients. On the contrary,

SideKick Health is a wholly patient-centric solution that supports its users to adhere to their treatment regimen and is based on the latest behavioural and economic models.

A maturing and growing digital health market is reflected by an increased uptake of new solutions among physicians and patients in acute and chronic care settings. Many patient-facing digital health products assist patients to improve outcomes through behaviour and lifestyle changes, either on their own or in conjunction with existing treatments. In the future of digital health, the next logical step would be to apply technology to support population-level preventative health and lifestyle change efforts.

### THE RISE OF WELL-BEING AND PREVENTION

Over the past decade, healthcare has seen a paradigm shift with the rise of digital health, which is likely to produce more health-conscious advocates and empowered physicians and patients. Consequently, this shift gives the industry the opportunity to build new models of care and to respond to new demands from patients, physicians and consumers. In this generation, young consumers (Gen Z) are less likely to have primary care physicians (55%) than their baby boomer counterparts (84%)<sup>15</sup> (Fig. 3). These new groups of health conscious advocates are more likely to seek out wellness options beyond traditional medicine, such as yoga, acupuncture

and healthier lifestyle choices. The expectations for effective, efficient and cost-conscious digital healthcare is higher than ever before.

Across the spectrum of care we now see more empowered health-seekers who want access to better care, transparency of costs, and access to personal health records for self-improvement, chronic disease monitoring or solely out of curiosity (Fig. 4). As consumer behaviour and preferences change, the digital health landscape is able to adapt quickly to provide various regulated and non-regulated tools and platforms – the aim is to provide personalized, efficient care to make the user feel safe, satisfied and mindful. In this new era of digital health, tech giants and smaller companies are racing to make sense of the available data, to monitor patient communities and to provide on-demand digital health services. Consumer platforms such as the Apple HealthKit allow Apple users to track their nutrition, fitness activities and overall well-being. Similarly, tools like ResearchKit allow researchers and developers to create digital health tools for medical research.

As the industry observes groundbreaking innovation, the pressure to create ethical digital health solutions becomes more relevant than ever before. Companies are racing to make sense of large amounts of data to improve predictive analytic techniques and ultimately apply innovative solutions to improve the quality of care and outcomes. The growing adoption and acceptance by patients, physicians, regulators and the healthcare industry demonstrates that digital health is here to stay and change the status quo. As the digital health landscape makes its shifts and changes, the G4A team

looks into exciting areas of the new digital health frontier such as neuro-technology, comprehensive wellness solutions, voice biomarkers and digital therapeutic solutions among many others. As we look towards the future of digital health and the patient-centric experience, we are working to adapt effectively to the needs and demands of a new era of health seekers.

### CONTRIBUTORS

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