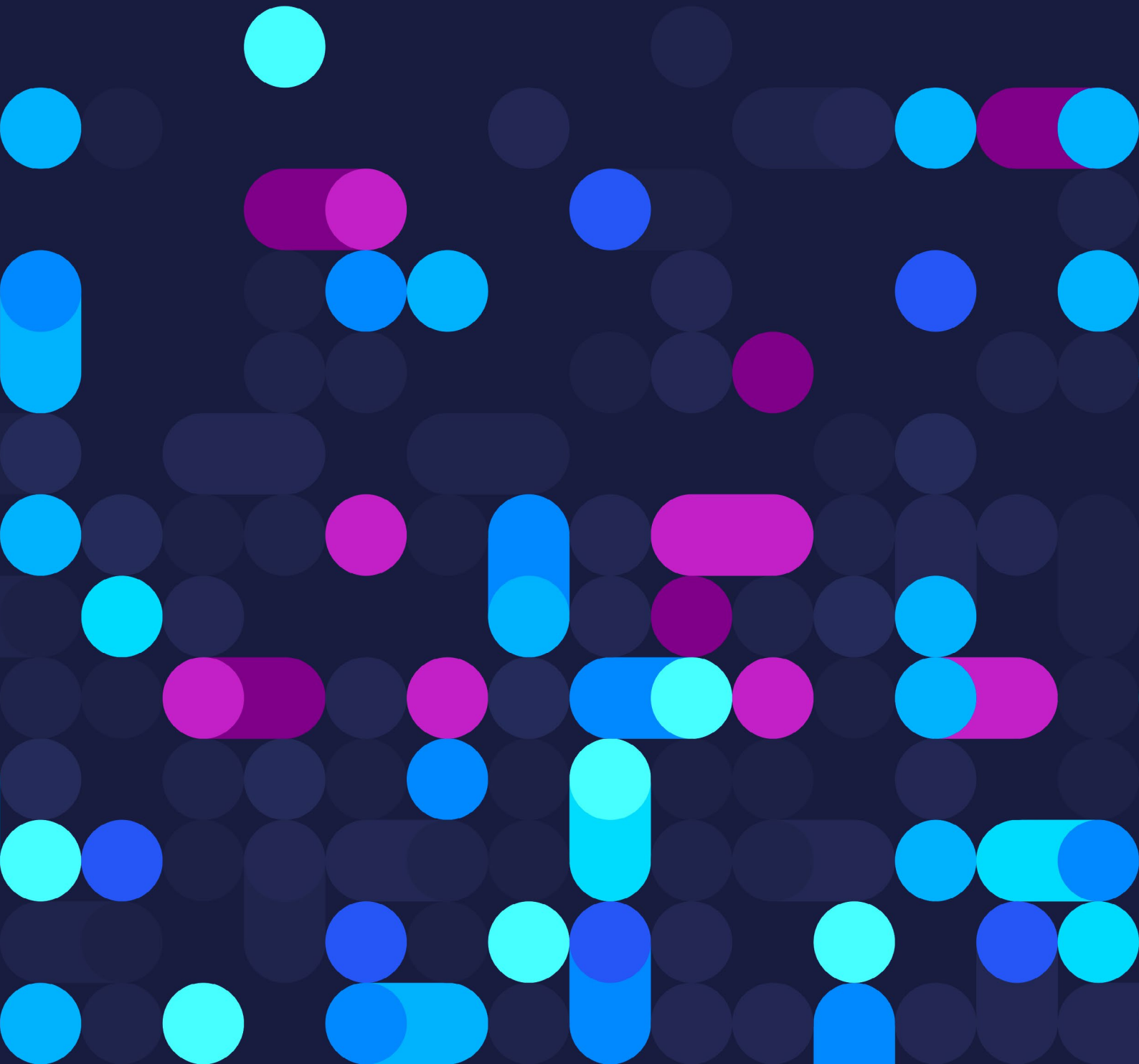


In collaboration with
Boston Consulting Group



Transforming Healthcare: Navigating Digital Health with a Value-Driven Approach

INSIGHT REPORT
JANUARY 2024



Contents

Foreword	3
Executive summary	4
Introduction	5
1 Digital, data and AI can address three persistent and growing healthcare system challenges	6
1.1 Resource constraints: unsustainable cost growth and healthcare workforce crisis	7
1.2 The increasing burden of chronic diseases	8
1.3 Inequitable outcomes and access	9
2 Lack of innovation is not the problem	10
2.1 Digitizing the front-end: reimagining patient journeys for better health	13
2.2 Augmenting the back-end: creating more efficient and sustainable health systems	17
3 Yet there is the opportunity for digital, data and AI to do more	20
4 To unlock the full potential of digital, data and AI, enabling it to scale is essential	23
4.1 Define a digital strategy to transform health	24
4.2 Five enablers to unlock the potential of digital, data and AI	25
5 Making it real: case studies of successfully scaled digital, data and AI applications	38
6 To accelerate the digital transformation of healthcare, the World Economic Forum is launching a new flagship initiative	43
6.1 Many collaborations are ongoing, but there is a need for more public-private partnerships	44
6.2 A call to action: All stakeholders must contribute to unlocking transformative impact from digital, data and AI	45
6.3 In this initiative, the Forum aims to accelerate digital transformation in two ways	46
Conclusion	47
Appendix	48
Contributors	54
Endnotes	57

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Foreword



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 and Healthcare, World
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While almost every part of healthcare has been touched by digital, AI and innovative technologies, a transformative impact on global healthcare systems has yet to be seen. Perennial challenges persist, including insufficient financial and human resources, an increasing burden of chronic diseases, and inequitable outcomes and access to care. Digital is an essential tool that can alleviate these challenges, but healthcare system stakeholders need to work together for digital health solutions to scale. The key to this transformative journey lies in unlocking the potential of data-driven digital tools, heralding a new era of value-driven healthcare.

Delivering on the promise of digital, data and AI in healthcare for improved outcomes will require an ecosystem mentality. No single actor can bring about the digital health renaissance. Stakeholders from all sectors – healthcare providers, payers, suppliers (pharmaceutical, medtech, pharmacies and others), funders, governments, regulators and technology firms – must come together to solve the world's biggest healthcare challenges. A robust ecosystem can tackle the most entrenched problems and scale solutions quickly in ways that individual digital solutions cannot.

Several global coordination initiatives have been formed to amplify gains in digital health and overcome the barriers to progress. Recent examples include the G20 health track and WHO Global Initiative on Digital Health (GIDH), Transform Health, HealthAI, the Global Initiative on AI for Health (GI-AI4H), Digital Square and the 50-in-5 Digital Public Infrastructure initiative, to name just a few. These numerous initiatives have made significant strides, but there is still a critical need to accelerate impact through multistakeholder cooperation.

In its unwavering commitment to fostering a global learning ecosystem, the World Economic Forum has been at the forefront of propelling public-private partnerships. Since 2016, it has been dedicated to accelerating the transformation of healthcare systems worldwide. A cornerstone of this effort has been the development of the first-ever global healthcare systems transformation framework, uniting private and public sectors in a shared mission to enhance patient outcomes through the Global Coalition for Value in Healthcare. For this reason, the World Economic Forum's Centre for Health and Healthcare, together with Boston Consulting Group, is launching the **Digital Healthcare Transformation Initiative**, a natural progression from its foundational work on value-based healthcare, into a new flagship initiative designed to accelerate public-private engagement to improve health outcomes through digital transformation and value-based health.

The initiative builds on its longstanding commitment to systems transformation designed to accelerate the adoption of value-based healthcare practices. Using those same principles, focus is now on creating even more value by 1) providing a vehicle for resolving complex coordination challenges and addressing key enablers for scaling digital solutions, 2) acting as a conduit for partnerships and knowledge sharing across sectors, and 3) helping to set priorities and direct efforts to identify and scale up digital, data and AI applications. The initiative will also further draw upon other ongoing coalitions, alliances and centres in the Forum, including the Digital Health Action Alliance, the EDISON Alliance, the AI Governance Alliance and the Centre for the Fourth Industrial Revolution Network.

Executive summary

Lack of digital innovation is not the problem. Scaling data, digital and AI for impact in healthcare systems requires collaboration.

The digital transformation of healthcare has gained momentum in recent years and is required to address healthcare's most pressing global challenges. These include rising costs, an estimated \$1.8 trillion of wasteful healthcare spending, a workforce shortage of over 10 million healthcare workers by 2030, an increasing burden of chronic diseases, and inequitable outcomes and access to care with massive variation between and within countries.

There is significant innovation coming to the market, and leading healthcare systems have already started their journey digitizing the front-end to optimize the patient-centric journey and improve outcomes and access and augmenting the back-end to support healthcare workers to be more efficient and effective.

However, the world has not yet seen a transformative impact of digital, data and AI on healthcare systems. Digital solutions are a key tool to achieve better health. Yet, not all digital applications will generate better health; focus must lie on use cases with the potential to make a difference in patient outcomes. The key to this transformative journey lies in unlocking the potential of data-driven digital tools, heralding a new era of value-driven healthcare.

Value-based healthcare heavily relies on data and analytics for the purpose of measuring patient outcomes and cost drivers. Digital, data and AI transformation in healthcare is accelerating and playing an increasingly central role in the transition to value-based healthcare. To release the potential of digital, data and AI, healthcare system stakeholders (e.g. patients, providers, payers, medtech, pharma, investors, regulators, digital start-ups and big tech companies) must come together and work as an integrated team on five overarching enablers of digital.

- **Data:** Leveraging health data for transformative impact
- **Tech and analytics:** Engineering a robust foundation for digital healthcare
- **Funding and incentives:** Investing in and rewarding accelerated impact
- **Hybrid healthcare delivery:** Strengthening digital capabilities and user design to facilitate implementation
- **Regulations and policies:** Crafting fit-for-purpose policies to enable digital transformation

Digital health presents an opportunity for the private sector to invest in and build businesses that dramatically improve health outcomes. Yet achieving better health at scale is still a challenge. To expand the reach and impact of digital, data and AI, the public and private sectors must work hand-in-hand.

Thus, the World Economic Forum, building on its longstanding commitment to systems transformation, is leveraging its unique position to build powerful and sustainable alliances between the public and private sector that can accelerate the impact of digital, data and AI in healthcare to improve health outcomes and healthcare resource efficiencies. Initiative efforts will be managed constructively with other ongoing global efforts, focusing on synergy, harmony and amplification.

As part of this work, the Forum will initially focus on two ways to drive accelerated digital transformation of healthcare: 1) Global Insights Exchanges: convening learning communities focused on key enablers for scaling digital solutions, and 2) Regional Activators: creating multistakeholder action groups to drive deployment of digital solutions addressing high-priority healthcare system challenges.

Introduction

Harnessing data and digital to “digitize the front-end” and “augment the back-end” is vital to sustain healthcare systems.

Digital technologies have delivered benefits in healthcare for decades—and new innovations are coming to market all the time. During the COVID-19 pandemic, healthcare leaders pushed past years of inertia and rapidly introduced measures like virtual care, telehealth services, applied AI, healthcare analytics, and data governance. There is now an unprecedented opportunity to further accelerate the digital transformation of healthcare systems by continuing to scale up digital, data and AI solutions, bringing a new era of value-driven healthcare.

Transformation of digital, data and AI in healthcare are inclusive of:

- **Patient technologies:** Patient-facing digital applications and tools to enhance the delivery of care
- **Provider technologies:** Digital applications, tools and systems to support healthcare workers and optimize healthcare system processes
- **Life science and pharma technologies:** Digital applications to capture more diverse trial data and enhance and accelerate drug development

and delivery, and deliver portable, faster, more precise therapeutics and diagnostics

- **Data, AI and security:** All of the above must be supported by accessible, high-quality data that provides AI with the potential to create even more value. All applications and systems must be secure.

To illustrate how emerging digital, data and AI applications are creating value for healthcare systems, this report looks at successful examples and divides the applications into two overarching categories: applications that digitize the front-end of the patient journey and applications that augment the back-end of healthcare systems:

- **Digitizing the front-end:** Digitizing patient-facing applications, using digital, data and AI to deliver better and more efficient care
- **Augmenting the back-end:** Augmenting non-patient facing elements, using digital, data and AI, to improve the efficiency of all facets of healthcare delivery and life sciences.

BOX 1 Limitations to digital solutions

While digital is a key enabler that can accelerate progress towards better health, it is not a panacea. To fully achieve goals of improving healthcare across the globe, it is also essential to improve

social determinants of health, focus on health equity, increase investment and support for healthcare and health workers, accelerate biomedical innovations, improve access to medicines and devices and more.

Despite its enormous potential, digital, data and AI have yet to diminish the most pressing global challenges in healthcare. Most healthcare systems still have fragmented IT infrastructure, incompatible data standards and poor ways of sharing this data, and a patchwork of digital solutions, all of which hinder impact. Overall, healthcare continues to lag many other sectors in terms of digital maturity.

This report presents the major healthcare challenges that digital can address even more effectively, identifies the key enablers that need to be in place to accelerate the adoption and impact of digital solutions, shares best practices and success stories, and charts a path forward to accelerate the journey towards a successful digital transformation in healthcare.

1 Digital, data and AI can address three persistent and growing healthcare system challenges

Healthcare systems are experiencing increasing demand and constrained supply, threatening the health of the population.



The healthcare industry is facing many perennial challenges, and they are pushing the system close to its breaking point. The global demand for healthcare services is increasing due to the increasing burden of chronic diseases, and amidst this increase in demand is the additional

complication of variable outcomes and inequitable access to high-quality care. Simultaneously, healthcare is facing strict human and financial constraints. Digital solutions have the potential to address these supply and demand issues.

1.1 Resource constraints: unsustainable cost growth and healthcare workforce crisis

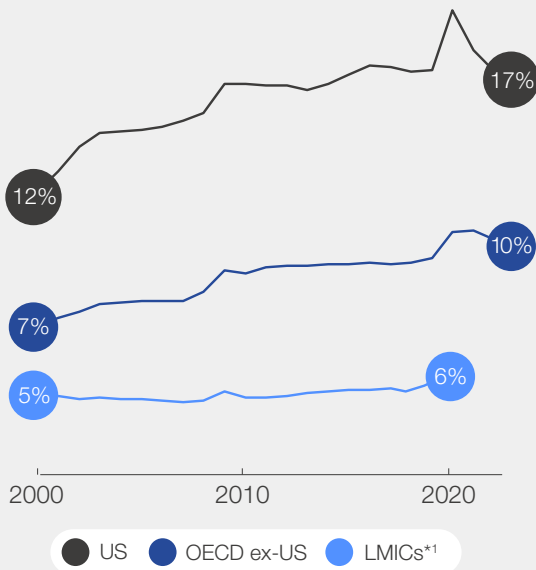
Rising costs continue to burden healthcare systems, governments and individuals, and this cost growth is unsustainable. In wealthy countries, rising healthcare expenditures continue to outpace GDP growth, but higher spending doesn't necessarily correlate with improved health. The US, for example, spends

more on healthcare than any other country in the world, yet among other country counterparts, it has the lowest life expectancy at birth (76 years in the US versus 81 in Germany and the UK), the highest maternal and infant mortality rates, and the highest rate of people with multiple chronic conditions.^{1,2}

FIGURE 1 Escalating cost and workforce crisis pressure health systems globally

Healthcare spend is rising faster than GDP across OECD

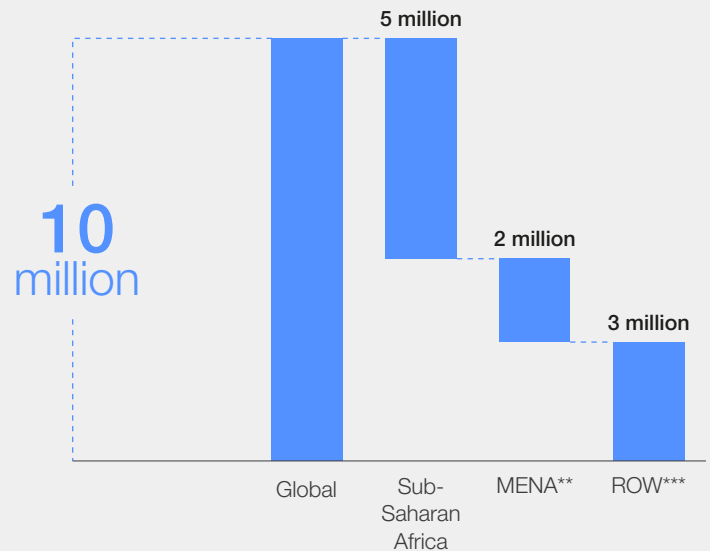
Healthcare spend as a percentage of GDP, aggregate values across country groups



Severe shortage of healthcare workers worldwide

By 2030, estimated shortage of 10 million healthcare workers globally

More than 70% of shortage concentrated in regions with high share of LMICs



*Low- and middle-income countries **Middle-East and North Africa ***Rest of the world

Note: 1 Data on Healthcare spending is only available until 2020 for LMICs.

Source: World Bank; OECD; WHO; "Global health workforce stock and distribution in 2020 and 2030" (BMJ Global Health, 2022)

There is enormous potential to reduce healthcare expenditure by tackling waste in the system. At least 20% of global healthcare expenditure is estimated to be wasteful today, and addressing this problem could allow healthcare systems to redistribute \$1.8 trillion of spending to generate

better outcomes and provide more equitable access to care.³

To make matters worse, healthcare is facing a serious workforce crisis. The WHO estimates a projected deficit of 10 million health workers

by 2030, particularly in low- and middle-income countries (LMICs), where the burden of disease is greatest.⁴

Healthcare systems are also struggling to attract, retain and effectively deploy clinical professionals owing to worker burnout and staffing shortages. Among healthcare workers globally, 25% reported anxiety and depression, and 44% reported sleep disorders in 2020.⁵ Survey data indicates that 32% of healthcare workers are at risk of leaving in the immediate future.⁶ What's more, inadequate investment in healthcare

education and training programmes has stifled the pipeline of new professionals entering the workplace in many countries.⁷

By further leveraging digital solutions, data and AI, it is possible to address the workforce crisis. Digital solutions can make jobs more efficient, enable clinical staff use their skills and expertise to the fullest extent – working on the top of their licence, and support patient self-management, allowing healthcare practitioners to allocate more time to direct patient care and other value-adding tasks, which can increase motivation at the workplace.

1.2 The increasing burden of chronic diseases

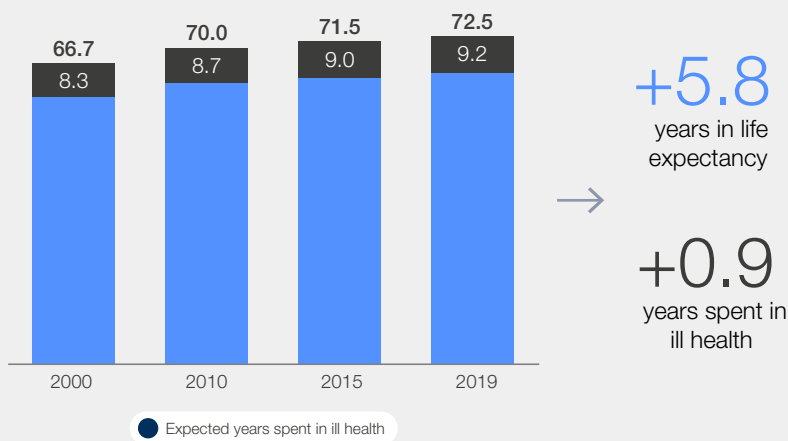
While the resource constraints and the healthcare worker crisis are causing a shortage in healthcare supply, the demand for healthcare services is increasing. People are living longer today than ever before, but this does not necessarily translate into healthier lives. Between 2000 and 2019, global life expectancy increased by about six years, but healthy life expectancy only increased by five years,

which means one extra year of ill health can be expected on average. After age 60, approximately one-quarter of a person's life will be marked by illness, primarily owing to chronic disease. Healthcare systems have gotten better at keeping people who are ill alive, but there is still a long way to go in terms of prevention.

FIGURE 2 Life expectancy increase comes with more years spent in ill health

People now spend over one more year in ill health vs in 2000

Life expectancy at birth in years, global average



Note: Unweighted average for 183 countries

Source: Global Health Observatory (WHO); BCG analysis

Average years in ill health grew by 1.5 years in US

Expected years spent in ill health, change 2000-2019



Chronic conditions, such as cardiovascular disease, cancer and diabetes, are becoming more prevalent. The global prevalence of obesity is projected to rise from 14% in 2020 to 24% in 2035. These chronic conditions account for 70% to 90% of total health spend in the EU⁸ and the US,⁹ and they create an

enormous burden on the healthcare system over the long term. With the help of digital innovations such as remote monitoring, telemedicine, AI-based symptom checkers and other healthcare-related applications, it is possible to prevent and delay the onset of some diseases, leading to longer, healthier lives.

1.3 Inequitable outcomes and access

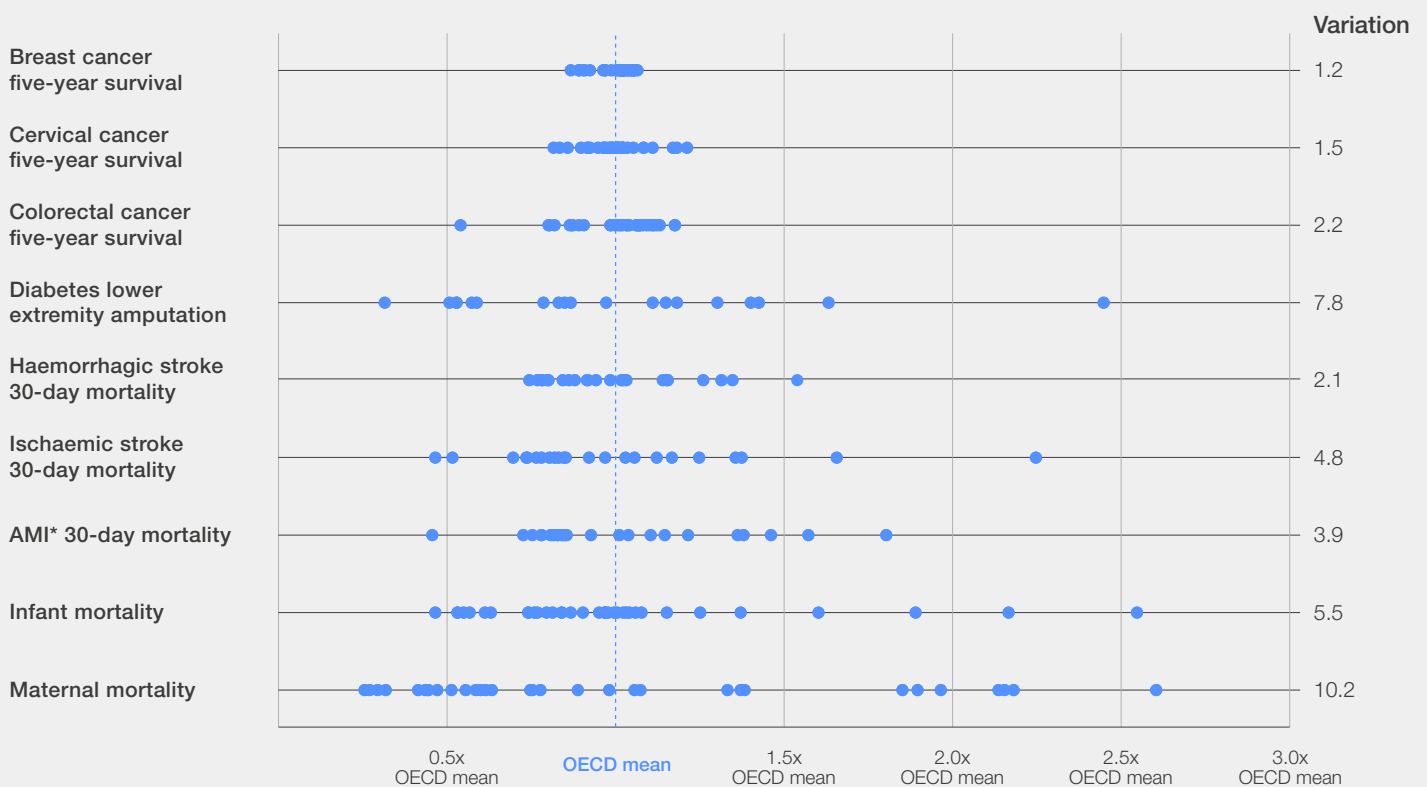
The WHO reports that approximately half the world's population still lacks access to essential health services.¹⁰ Although the WHO has set a clear agenda to deliver universal health coverage by 2030, that goal is still a distant prospect.

Even within and between high-income countries (HICs), disparities exist in healthcare access and outcomes. In the US, for example, people living in rural areas die at 20% higher rates than those in urban areas, and the gap has been widening over the past 20 years.¹¹ Similarly, African Americans are 30% more likely to die from heart disease than non-

Hispanic whites.¹² Meanwhile, women in the most disadvantaged parts of England can expect to live 19 fewer years in good health than women living in the most affluent areas.¹³

Inequitable access to healthcare has dire consequences. People who lack timely access to preventive care, screenings and early interventions are at higher risk of developing severe and costly health conditions. This can be observed by comparing health outcomes across Organisation for Economic Co-operation and Development (OECD) countries, especially the massive variation in maternal mortality.

FIGURE 3 The massive variation in health outcomes across OECD



*Acute myocardial infarction (heart attack)

Note: Most recent data from 2016-2019 (infant and maternal mortality), 2015-2017 (AMI, stroke, diabetes) and 2010-2014 (cancer survival) analysed; Mexico, Colombia and OECD candidate countries not included

Source: OECD Health Data; BCG analysis

Disparities in health access and outcomes are often influenced by socioeconomic factors, discrimination, bias and uneven distribution of healthcare resources. These social determinants of health account for between 30% and 55% of health outcomes and can be more important than clinical care or lifestyle choices.¹⁴ In addition, gender inequalities have a negative impact on health. Several studies show that women experience poorer outcomes in many areas of healthcare.¹⁵

Digital health innovations hold much promise to reduce health inequalities. For instance, remote consultations and monitoring can increase healthcare reach, and digital solutions can increase access to health information (with the help of language and cultural information services, for example), making healthcare more inclusive and available for all.

2

Lack of innovation is not the problem

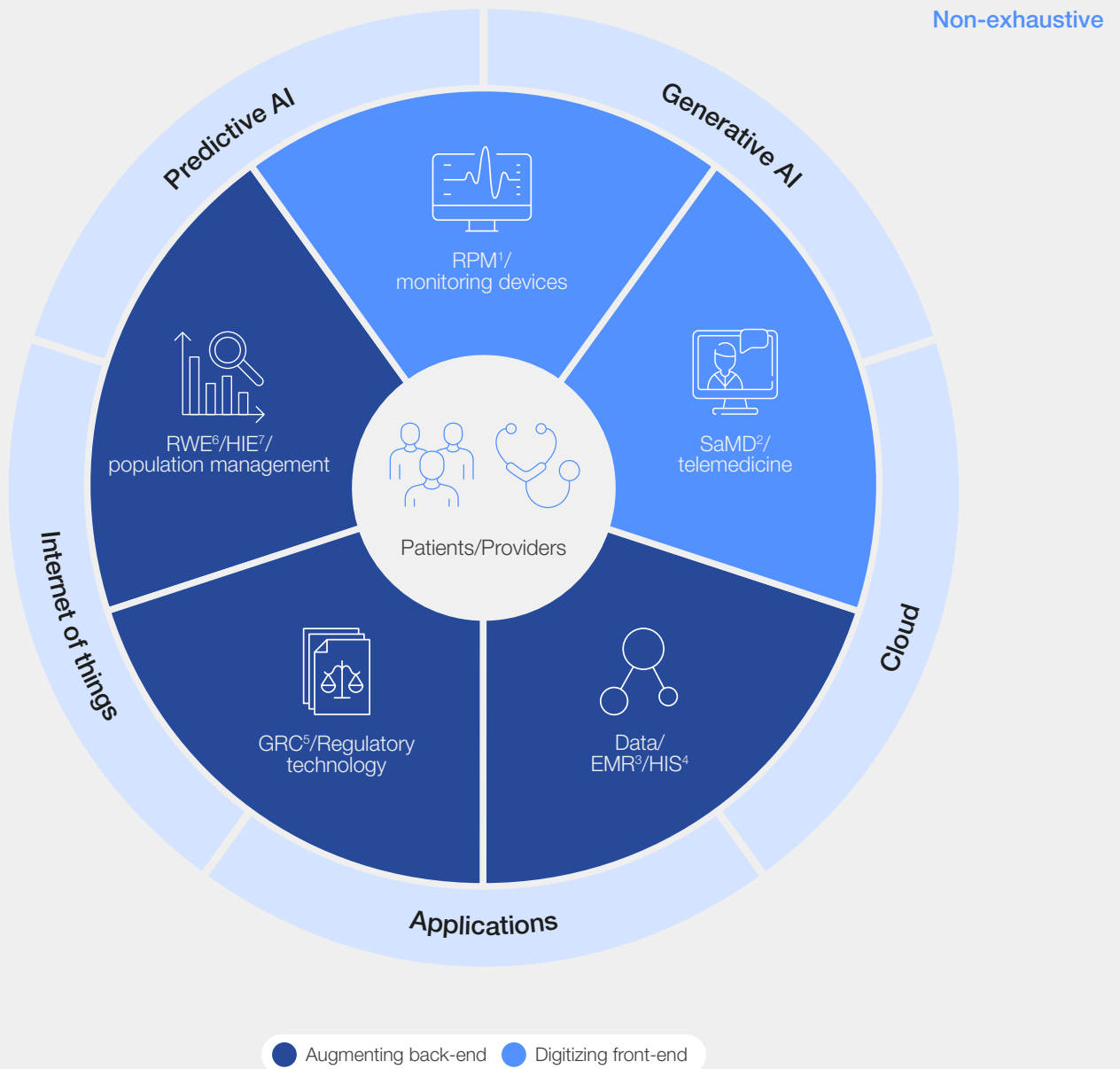
Digital, data and AI are already having an impact by digitizing the front-end and augmenting the back-end of care.



There is no shortage of digital innovations within the healthcare system. Solutions such as predictive AI, cloud computing and the Internet of Things are being used across systems, while remote patient monitoring and software as a medical device are being used in more targeted areas and practices. These digital applications are catalysing a shift away from traditional care into hybrid patient journeys. Healthcare is becoming accessible 24/7 across geographical boundaries.

Treatment and medicines are evolving from being generalized areas to becoming hyper-personalized and preventative instead of reactive. Generative AI is also being tested in many settings and has the potential to further disrupt the way care is consumed and delivered. Notably, major technology firms are breaking ground within the field, such as Microsoft, who became the first large tech player to announce their commitment to use ChatGPT in healthcare applications.¹⁶

FIGURE 4 A myriad of digital applications are being implemented in health systems globally



1 Remote patient monitoring; 2 Software as medical device; 3 Electronic medical records; 4 Hospital information system; 5 Governance, risk and compliance; 6 Real-world evidence; 7 Health information exchange.

“ Digital, data and AI can and must play a pivotal role in addressing systemic challenges, and some impact is already evident.

Digital, data and AI can and **must** play a pivotal role in addressing systemic challenges, and some impact is already evident. However, not all digital, data and AI applications have the potential to make a meaningful difference. There is a need to focus implementation efforts on how digital health can truly transform healthcare systems to deliver high value care. To provide an overview of the myriad of digital, data and AI applications that are emerging and how they can create value for healthcare systems, applications are divided into two overarching categories: applications digitizing the front-end of the patient journey and applications augmenting the back-end of healthcare systems. This is not to say any one organization, or for that matter, any one digital application must exclusively be tied to one category, as the product offering can span over both front- and back-end:

– **Digitizing the front-end:** Digitizing patient-facing elements enables patients to self-manage both prevention and treatment. For example, ensuring interventions occur at the right time and with the right competency.

– **Augmenting the back-end:** Augmenting non-patient-facing elements improves the efficiency of all facets of healthcare delivery and life sciences by optimizing system-wide operations, for example.

By leveraging digital, data and AI, healthcare systems have the potential to improve outcomes for patients, reallocate wasteful spending to areas where it can make a meaningful impact, enable universal health coverage and prevent health inequities.



There is no such thing as health for all, without digital health for all.

Sunil Wadhvani, Co-Founder and President, Wadhvani Impact

FIGURE 5

Digital applications are already having an impact on healthcare systems

Health system challenges



Lack of resources financial and human



Increasing burden of chronic diseases



Inequitable outcomes and access

Digitizing front-end		Augmenting back-end	
Reinvented hybrid patient journey	<p>3 times</p> <p>faster treatment than the average in-person visit</p>	<p>90%</p> <p>automated tasks</p>	<p>Automates administrative burden by connecting vendors, tools and programmes</p>
<p>Around 50%</p> <p>faster treatment than the average in-person visit</p>	<p>Early treatment triggered by sensor monitoring</p>	<p>Early treatment triggered by sensor monitoring</p>	<p>73%</p> <p>reduced time to neuro intervention</p>
Extensive reach with portable health diagnostic tools	<p>Around 2,500</p> <p>hard-to-reach communities</p>	<p>1.45 million</p> <p>underserved patients screened</p>	<p>Connecting community-based activities to large health systems</p>

Non-exhaustive



2.1 | Digitizing the front-end: reimagining patient journeys for better health

Digitizing the patient healthcare journey offers a wide range of benefits and solutions to healthcare system challenges by enhancing efficiency, improving patient outcomes and increasing access

to healthcare. Digital solutions play an important role in providing practitioners and patients with tools to drive better care delivery and engage populations to focus on preventive care and early intervention.

TABLE 1 | Several ways digital front-end solutions address healthcare challenges

Challenges addressed	How to address the challenge	Example solutions
Resource constraints	Enhance efficiency by treating the right patient at the right time, reducing the overall burden on the healthcare system. Digital healthcare solutions are often more cost-effective and more timely when compared to traditional approaches.	<ul style="list-style-type: none"> – Digital triaging – telehealth – Remote monitoring – Digital front-door solutions
Increasing burden of chronic diseases	Empower patients to monitor their health and better self-manage their conditions. By allowing more outpatient care in the community and at home, inpatient hospital care is dedicated to more complex cases and emergencies.	<ul style="list-style-type: none"> – Digital reminders – Tracking apps – Remote patient monitoring
Inequitable outcomes and access	Extend healthcare services to remote and underserved populations, improving access and health equity. By giving health professionals access to remote training, they can upskill their practice and receive real-time guidance, bringing the latest medical advances to LMICs and reducing the skilled workforce gaps. In addition, by enhancing access and participation in pharma trials, it will be possible to increase trial inclusivity and geographic diversity, leading to more representative trial results.	<ul style="list-style-type: none"> – Telehealth – Portable health diagnostic tools – Digital health platforms

The selection in Table 2 provides additional examples of front-end digital solutions. These examples were chosen to represent a range of solutions that deliver benefits across both HICs and LMICs while covering a significant portion of the healthtech landscape. They are based on

information gathered from executive interviews with healthcare leaders and BCG's experience. It is worth noting that the list is non-exhaustive as the landscape is constantly evolving with the introduction of new innovations. Additional examples can be found in the appendix.

TABLE 2 **Examples of impactful digital front-end solutions**

Front-end solutions for healthcare challenges: resource constraints			
	Presence	Solution	Impact
Huma	Global	Digital-first patient care with a platform that enables remote patient monitoring and virtual wards. The technology collects real-world patient data remotely and connects patients and clinical teams. ¹⁷	<ul style="list-style-type: none"> Over 30% reduction in readmission rates, alleviating the workload of healthcare providers, resulting in 2 times the clinical capacity potential.¹⁸ 40% reduction in time spent reviewing patients, 60% reduction in time calling patients, 19% reduction in face-to-face outpatient appointments.¹⁹
K Health Read more about the full story in the section: "Making it real: Case studies of successfully scaled digital, data and AI applications"	US	AI-powered primary care, with a patient symptom checker and AI chat that recommends diagnoses and treatment, reviewed by clinicians. ²⁰	<ul style="list-style-type: none"> 70% of people who start a conversation with K Health AI complete a chat-based medical visit. Healthcare providers selected the AI-generated diagnosis in 84.2% (n=85,976) of cases when virtual primary care recommendations were evaluated.²¹
Osana	Argentina, Brazil, Mexico	End-to-end digital healthcare infrastructure for payers, providers and pharmacies. The solution has around 7 million users and comprises multiple services, including patient ID; consultation booking; medical record management; telehealth consultations; billing and payments; patient follow-up; electronic prescription; digital pharmacy; and patient monitoring. ²²	<ul style="list-style-type: none"> 45% reduction in appointment assignment costs. 38% reduction in appointment absenteeism, reducing wait times to get an appointment. Increased patient population/FTE productivity in chronic patients: 4.8 times patients managed per physician. Reduction of hospitalization and emergency costs due to increased adherence to primary care treatments: 30% reduction in costs. Decision support solution for doctors. Efficiency gains: from 4 to 4.8 patients per doctor/hour. Chronic patient monitoring solutions: 70% patient adherence for diabetic and cardiac patients.
Front-end solutions for healthcare challenges: increasing burden of chronic diseases			
	Presence	Solution	Impact
BioTelemetry (Philips)	US	Cardiology sensors implanted in the patient through non-invasive surgery that monitor pulmonary artery pressure. The medical team in charge of each patient reviews the results on a weekly basis and can trigger early treatment and diagnosis in the case of atypical results. ²³	<ul style="list-style-type: none"> 44-62% reduction in heart failure hospitalizations. Average seven-point improvement in patient's quality of life according to the Kansas City Cardiomyopathy Questionnaire (KCCQ). Increased number of patients feeling more empowered to manage their care.
mDoc	Africa	A platform using an evidence-based, person-centred approach to assist individuals in managing chronic diseases. mDoc securely stores patient information in a centralized repository and facilitates connections between patients and healthcare practitioners, including nutritionists and coaches, to support the journey towards achieving health goals. ²⁴	<ul style="list-style-type: none"> 100,000+ members are enrolled on the Complete Health platform, 87% being women. Five-fold increase in exercise occasions by members, two times more health literate, pointing to 10,000 lives saved.

TABLE 2 | Examples of impactful digital front-end solutions (continued)

	Presence	Solution	Impact
m-mama (public-private partnership with Government of Kenya, USAID, M-PESA Vodafone, Safaricom)	Sub-Saharan Africa	m-mama is an emergency referral system that swiftly transports pregnant women and newborns facing complications to appropriate healthcare facilities. A patient makes a free call to a 24/7 dispatch centre, and volunteer taxi-ambulances take them to the nearest facility able to treat them. ²⁵	<ul style="list-style-type: none"> – 38% decrease in maternal deaths in pilot locations. – Over 28,000 women and newborns transported since 2013 and conservatively estimated to have saved over 900 lives.
Front-end solutions for healthcare challenges: inequitable outcomes and access			
	Presence	Solution	Impact
WISH Foundation*	India	With the mission to build an equitable, innovation-led healthcare ecosystem in India, the Digital Health and Wellness Center's programme leverages innovation and technology to address systemic primary healthcare gaps in remote areas. These solutions include telemedicine (consultations with generalists and remote medical practitioners), automated medicine dispensaries, electronic health records (EHR), etc. ²⁶	<ul style="list-style-type: none"> – 140 million population covered by the WISH Foundation primary healthcare facilities, and 21 million patients served. – Around 38 million consultations and around 70 million beneficiaries. – Successful public-private partnership model by partnering with state governments to upgrade non-functional and low-performing primary healthcare centres.
Medable	Global	Medable is providing a flexible, decentralized clinical trial platform that can be used across all therapeutic categories to mitigate issues in clinical research, such as long study timelines, limited patient access and participation, inadequate data volume and poor quality. The platform is deployable in close to 60 countries and in more than 100 local languages. ²⁷	<ul style="list-style-type: none"> – \$20 million reduction in total cost of trial through patient screening and consent in age-related macular degeneration trial. – 50% reduction in the study-build timeline for a diabetes study through the deployment of the Medable platform. – Has supported more than 300 decentralized and hybrid clinical studies. – In 2022, touched approximately 40,000 patients across more than 3,500 clinical research sites, with over 50 studies in more than 10 therapeutic areas.
Reach52	India, Philippines, Indonesia, Kenya, South Africa	Offers an end-to-end platform supporting solutions addressing health access in underserved communities. Local peer workers get equipped with digital tools to enable the structured collection of individual health data, patient monitoring, targeted health screening, education, training and access to health products and services. This is then used to create a health profile for the community and more targeted access to services.	<ul style="list-style-type: none"> – Active in 2,500 rural communities across six countries. – 80% of community needs identified in collected data are filled. – Social return on investment: every dollar spent by reach52 saves low-income residents \$2.10 in health access costs (based on Impact Investment Exchange analysis).

* The Wadhvani Initiative for Sustainable Healthcare Foundation – the flagship programme of Lords Education and Health Society (LEHS)



By 2030, we hopefully won't be talking about 'digital health'. We'll be talking about health in the digital age.

Mathilde Forslund, Executive Director, Transform Health

“ While many of these digital tools exist today, data integration, personalization and seamless connectivity between virtual and in-person interventions are not yet reality

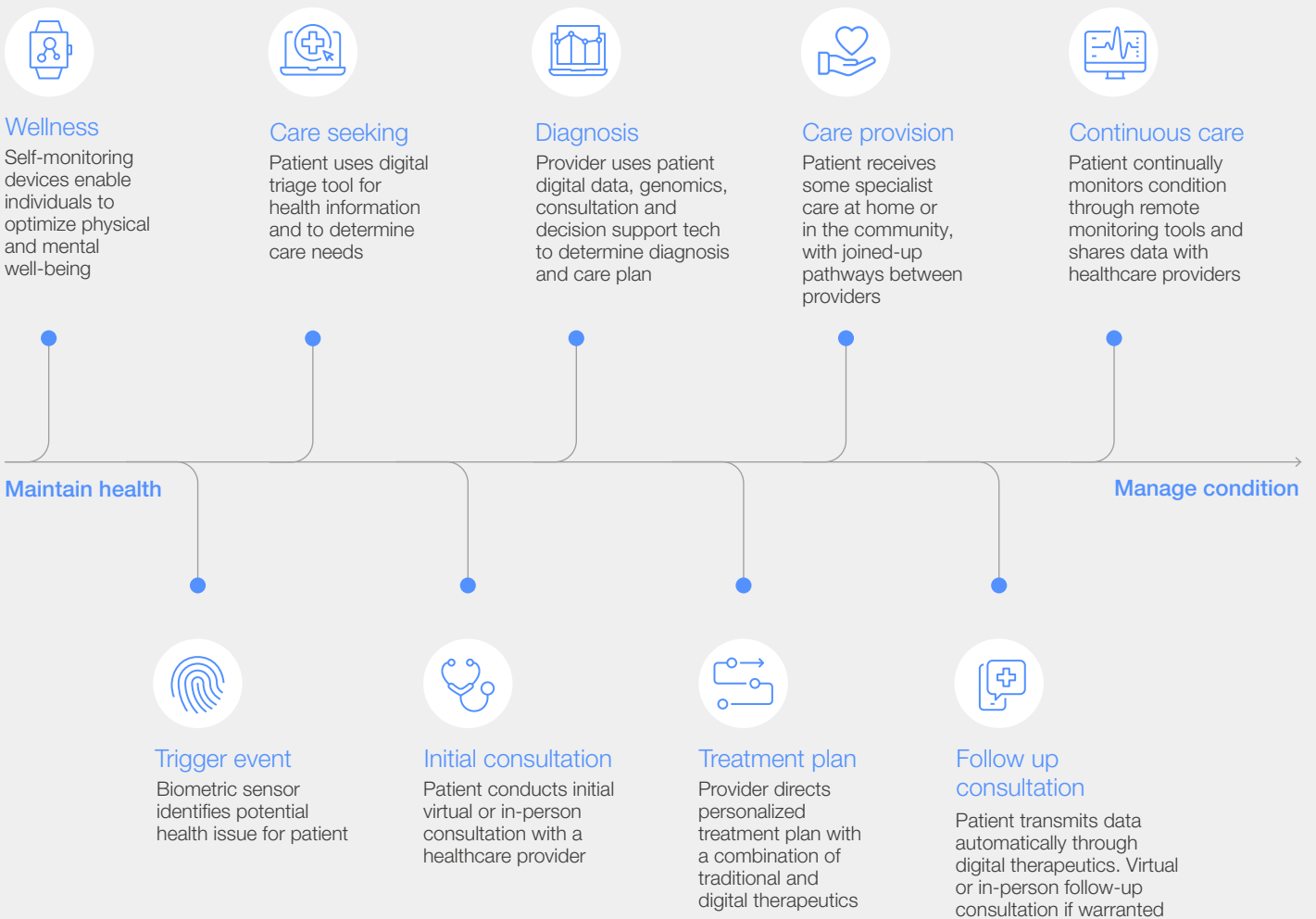
If digital health were delivered in a holistic manner, people’s experiences of healthcare could look very different in the 2030s. Patients in HICs could potentially tap into care from anywhere, using technology to prevent and detect illness early. Patient interactions with healthcare systems could be digital-first, with care proximal to home. Individuals could access and manage their health data, allowing for more informed decision-making, and treatments could be personalized according to clinical needs and preferences. In LMICs, patients could access more healthcare services via their mobile phones. An uptake of wearable devices can put information, diagnoses and clinician advice at their fingertips, empowering people (even those living in remote areas) to take control of their health.

These technologies could dramatically transform the patient experience (see Figure 6). People who are generally healthy can use self-monitoring devices to optimize their mental and physical health, while those with health issues will have access to a wide range of digital solutions. For example, pre-diabetic

patients could be given tailored insights and nudges through their mobile devices, including personalized dietary recommendations informed by data on food purchases, daily habits and exercise. People who are at risk of becoming diabetic could be identified early through a glucose monitoring device that wirelessly transmits data to a central system for AI to interpret. Virtual or in-person consultations could be enriched by monitoring data and genomics, enabling more efficient and personalized treatment plans. The patient would benefit from a combination of traditional and digital therapeutics, and AI could be used to predict blood sugar fluctuations, trigger timely interventions and reduce the risk of severe episodes. The patient would continuously share data remotely with healthcare professionals, who would then track clinical indicators and provide support as needed.

While many of these digital tools exist today as solutions designed to tackle single, specific problems, a high level of data integration, personalization and seamless connectivity between virtual and in-person interventions is not yet a reality.

FIGURE 6 Reimagined digital-first patient journey



2.2 Augmenting the back-end: creating more efficient and sustainable healthcare systems

Augmenting non-patient-facing processes can help reinvent care delivery, both for health providers and patients. Automated solutions increase efficiency, reduce errors, improve patient experiences and

reduce costs, playing a vital part in modernizing the healthcare system, improving patient care and, in turn, addressing healthcare system challenges.

TABLE 3 Several ways digital back-end solutions address healthcare challenges

Challenges addressed	How to address the challenge	Example solutions
Resource constraints	Improve workflows and reduce administrative burden by leveraging data and analytics, enabling health professionals to invest more time in patient care and other value-adding tasks.	<ul style="list-style-type: none"> – Revenue cycle technology – Speech-to-text tools – Workforce optimization – Regulation technology
Increasing burden of chronic diseases	Enable decision-making and reduce the risk of errors and complications by using evidence-based data and digital solutions. For example, AI trained to detect diseases can be a life-saving tool as early interventions are proven to generate better patient outcomes. Surgeries can also become smarter, safer and more efficient by leveraging AI, automation and operating room analytics.	<ul style="list-style-type: none"> – AI-driven surgery platform – Medical imaging and audio software – Pay-for-performance platforms – Analytics for data-driven decision-making – Early detection platform
Inequitable outcomes and access	Ensure the availability of essential resources in remote areas by optimizing resource allocation through supply chain transparency and the use of real-time information. This enables proper healthcare delivery, prevents diseases, and improves overall health in underserved populations.	<ul style="list-style-type: none"> – Real-world evidence – Supply chain optimization – Population health analytics

Further examples illustrating back-end innovations can be found in Table 4. The examples represent a range of solutions delivering benefits across both HICs and LMICs. Additionally, they cover a large portion of the healthtech landscape and are based

on information gathered in executive interviews and from BCG's experience. It is worth noting that the list is non-exhaustive as the landscape is constantly evolving with the introduction of new innovations. Additional examples can be found in the appendix.

TABLE 4 Examples of impactful digital back-end solutions

Back-end solutions for healthcare challenges: resource constraints			
	Presence	Solution	Impact
mPharma Read more about the full story in the appendix	Africa	mPharma acts like a pharmacy benefits manager, buying medicines on behalf of pharmacies, taking ownership of the supply chain and creating greater certainty for suppliers and drug stores. The tech solution analyses driver route optimization, procurement, fulfilment rates and industry networks to help pharmacies source drugs at lower costs and improve inventory management. ²⁸	<ul style="list-style-type: none"> – 30-60% in drug cost savings. – 25% reduction in medicine-related complications.
Rology Read more about the full story in the appendix	Africa, Middle East	AI-assisted technology to match diagnostic images with remote radiologists based on availability and sub-specialty. Identifies areas of interest with a high level of accuracy, guiding radiologists to anomalies and delivering reports in shorter times. ²⁹	<ul style="list-style-type: none"> – 99.53% error-free diagnostic reports. – Less than 60 minute-turnaround time for emergency scans. – 25% in operational expense savings.
Xealth	US	Automates administrative burden by connecting digital health vendors, programmes and tools into clinical and patient workflows. By centralizing all data and analytics, Xealth enables clinicians to track, analyse and evaluate all data coming through the platform. ³⁰	<ul style="list-style-type: none"> – 90% of all activities automated, only 10% done manually. – 50% reduction in IT costs for clients due to quicker deployment time. – 2-3 minute savings per patient order by leveraging automation and integrated clinician workflows.

TABLE 4 | Examples of impactful digital back-end solutions (continued)

Back-end solutions for healthcare challenges: increasing burden of chronic diseases			
	Presence	Solution	Impact
Caresyntax	Global	Caresyntax combines AI-powered software, devices and clinical services to improve surgical outcomes. Caresyntax delivers timely, predictive insights that enable surgeons and their teams to benchmark and improve their care, hospital administrators to use time and surgical resources more efficiently, and practices to grow under both value-based and traditional care models. ³¹	<ul style="list-style-type: none"> – 1.5 times more completed surgeries per day. – Used in more than 3,000 operating theatres and for over 3 million surgical procedures per year.
Innovaccer	US, Middle East	Data platform for value-based healthcare that integrates clinical, claims and other data across systems, such as EHRs, creating unified patient records of high quality. The solutions help healthcare providers make data-driven decisions, improve patient outcomes and enhance healthcare service efficiency. ³²	<ul style="list-style-type: none"> – \$1.5 billion+ healthcare cost savings. – 39 million+ patients on the Health Cloud. – \$4 million in shared savings and a 7% reduction in 30-day readmissions noted by partnering Accountable Care Organization network.
Viz.ai Read more about the full story in the section: “Making it real: Case studies of successfully scaled digital, data and AI applications”	US	Digital care coordination platform powered by AI that accelerates the detection of cardiac and neurovascular conditions and directs patients to the right specialist. With real-time connection to healthcare systems’ data streams, Viz.ai can detect disease earlier and increase access to life-saving treatments. ³³	<ul style="list-style-type: none"> – 87 minutes saved in time to treatment. – 3.5-day reduction in hospital stay. – 16% increase in number of procedures. – 23% reduced disability from a stroke. – 5.6 times more aneurysm patients directed to neurology.
Back-end solutions for healthcare challenges: inequitable outcomes and access			
	Presence	Solution	Impact
Damu-Sasa	East Africa	An end-to-end digital platform built to enable effective management of blood services, leveraging real-time information. Its information management system supports blood sourcing, inventory and transfusion management and haemovigilance. The platform not only ensures accessibility of blood products but also enhances visibility and efficiency across the value chain. ³⁴	<ul style="list-style-type: none"> – 44,000+ registered donors. – 34,000+ lives touched. – 177 hospitals supported.
Medtronic LABS	US, Ghana, India, Sierra Leone, Rwanda, Tanzania, Kenya, Bhutan	<p>Medtronic LABS brings together data, technology, and partnerships to build the health system of the future. LABS provides sustainable and scalable healthcare solutions on a national scale that deliver measurable patient outcomes.</p> <p>Its open-source digital health platform is embedded directly within health systems and government digital ecosystems to transform the way healthcare is delivered. Clinical areas include hypertension, diabetes, mental health, malaria, TB, HIV, maternal health and disabilities.³⁵</p>	<ul style="list-style-type: none"> – 1.45 million patients screened and 215,000 enrolled. – In 2022, a 70% follow-up rate for diabetes and hypertension in Ghana. – In 2022, 75% of active diabetes patients achieved clinical targets outcomes in Tanzania.
TSS	Global	Ensures safe drug delivery to patients through cloud-based and technology-agnostic temperature-control tracking solutions. ³⁶	<ul style="list-style-type: none"> – 50% time saving on supply through automation of report distribution. – £4 million saved annually for pharma companies on product stability.



This is not about a shift from analogue to digital. We must reimagine the operating model.

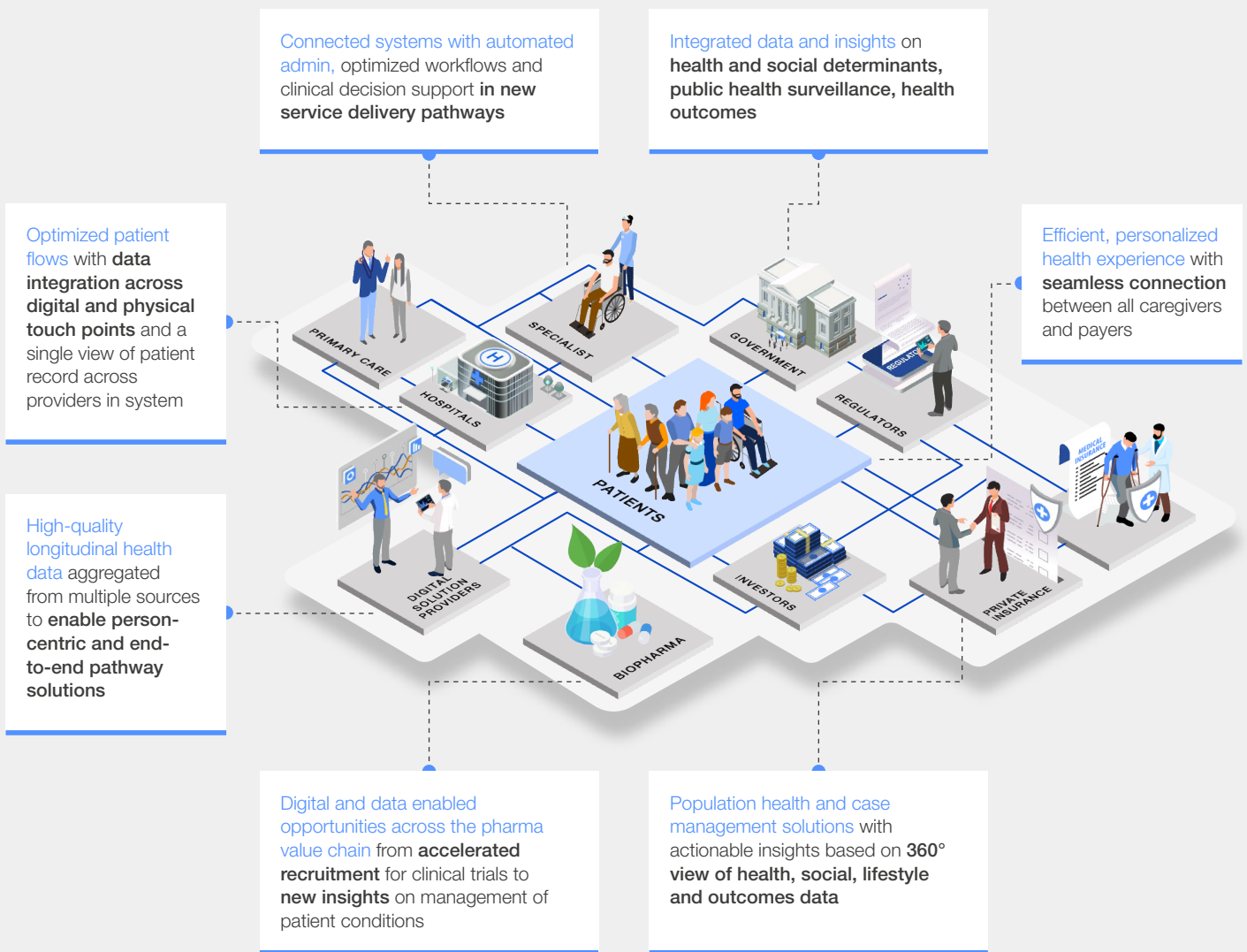
Richard Samuel, National Director of Outpatient Recovery and Transformation, NHS

By augmenting the back-end, there is the opportunity to make the core healthcare operating models more productive and effective, reducing the burden on health professionals. The work of a primary care physician, for example, could be much more streamlined. AI-driven virtual assistants schedule appointments, refill prescriptions and manage documentation, allowing doctors to focus more on patient interactions. Systems analyse patient monitoring data and flag irregularities or trends that need attention. Before a consultation, AI applications gather medical history into a unified health record, analyse symptoms and suggest

potential diagnoses. Physicians would then be able to see a single, comprehensive health record, enabling them to provide holistic and joined-up care.

At a system level, decision-making on policy, funding and service models would be informed by insights from population health data analytics, aligning providers, payers, pharma and tech innovators around coordinated, end-to-end pathways across care sites. For example, AI-driven management of supply chains could ensure that essential drugs reach the right locations efficiently, reducing shortages and waste in LMICs.

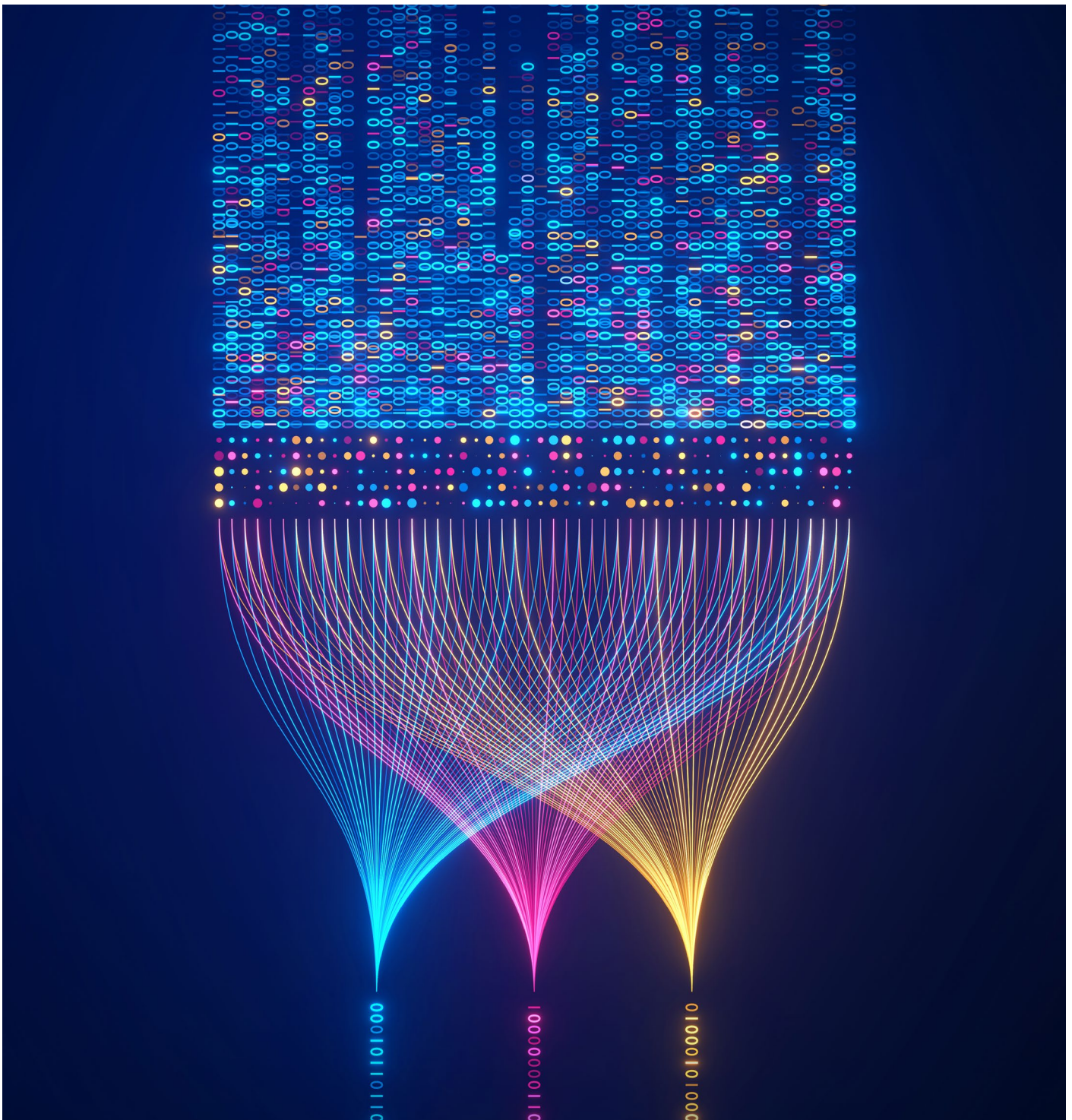
FIGURE 7 Connected and coordinated care enabled by data and automation



3

Yet there is the opportunity for digital, data and AI to do more

Several barriers stand in the way of digital health taking off – but they can be overcome.



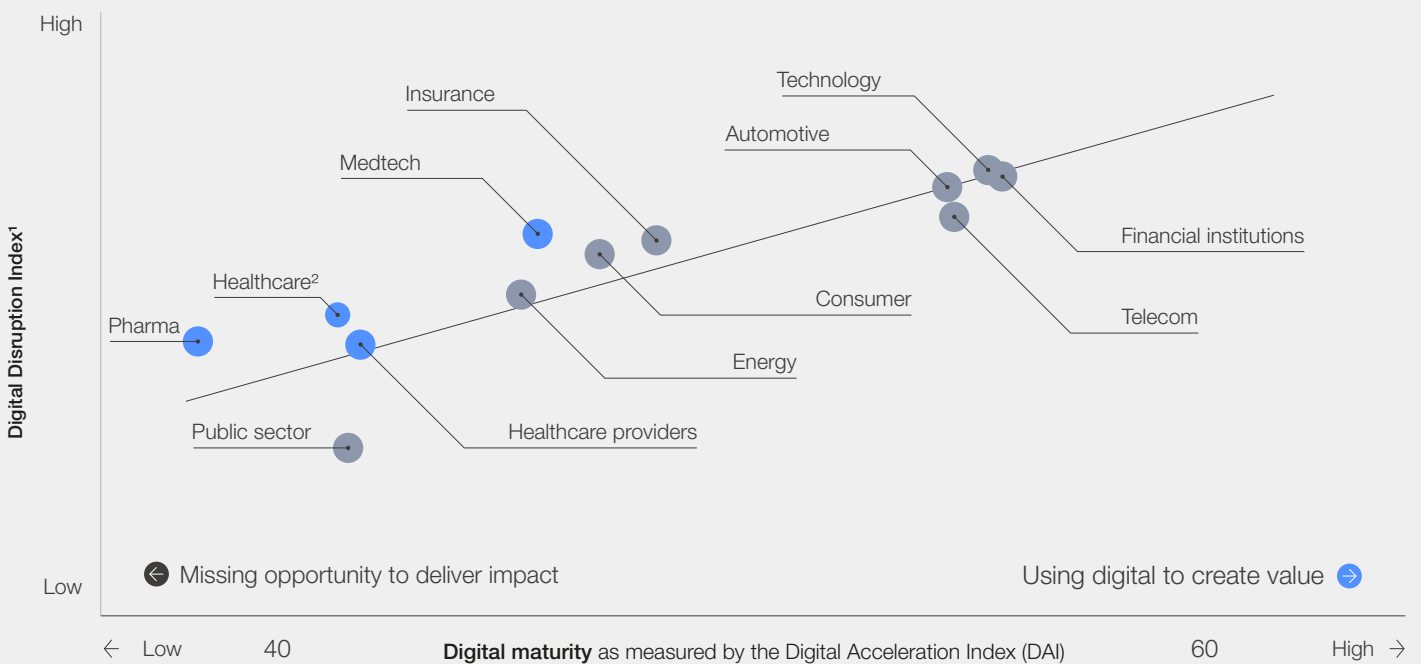
While digital, data and AI are taking off in many sectors, the healthcare sector is lagging in digital maturity, with adoption hindered by several barriers:

- **Legacy or missing infrastructure:** Lack of a strong digital foundation prevents data flow between stakeholders within the healthcare system due to challenges in governance and interoperability. Furthermore, some organizations are still using outdated technologies and systems, inhibiting the adoption of new technologies.
- **Siloed and unstructured data:** Stakeholders reluctant to share data with one another prohibits transparency and data access. The lack of standardization for data storage also makes interoperability difficult.
- **Misaligned incentives among stakeholders:** Digital solutions are typically an additional expense on top of existing costs for

healthcare providers. The fee-for-service model incentivizes care volume rather than qualitative value-driven results, hindering the implementation of preventative solutions.

- **Regulatory issues:** Health regulations are commonly tailored to physical medical devices and not well-positioned to evaluate continuously evolving software, delaying time to market for innovative solutions.
- **Digital illiteracy:** If the healthcare workforce tends to have limited experience working with digital solutions, they will require training to effectively adopt new technologies.
- **Lack of overall vision for digital health:** Many healthcare systems lack a clear strategy for the execution and coordination of digital efforts, adding unnecessary complexity to an already complex system.

FIGURE 8 Healthcare is lagging in digital maturity vs other industries



1 Digital Disruption Index assessed along 4 dimensions: 1) How customer journeys can be disrupted through digital 2) How digital can be scaled across the value chain 3) How attractive the funding is for investors and venture capitalists 4) How players from adjacent industries can make competitive moves; 2 Average of healthcare sectors.

Source: DAI Healthcare Study 2019



To unlock the potential of digital health, public and private stakeholders in the health ecosystem must actively collaborate on the world’s most pressing problems. No group has the tools or capabilities to singlehandedly transform entire healthcare systems.

For digital, data and AI applications to have a transformative impact, healthcare system stakeholders must collaborate and put the right prerequisites in place to enable digital to scale, focusing on hybrid healthcare delivery, tech and analytics, data quality, funding and incentives, and

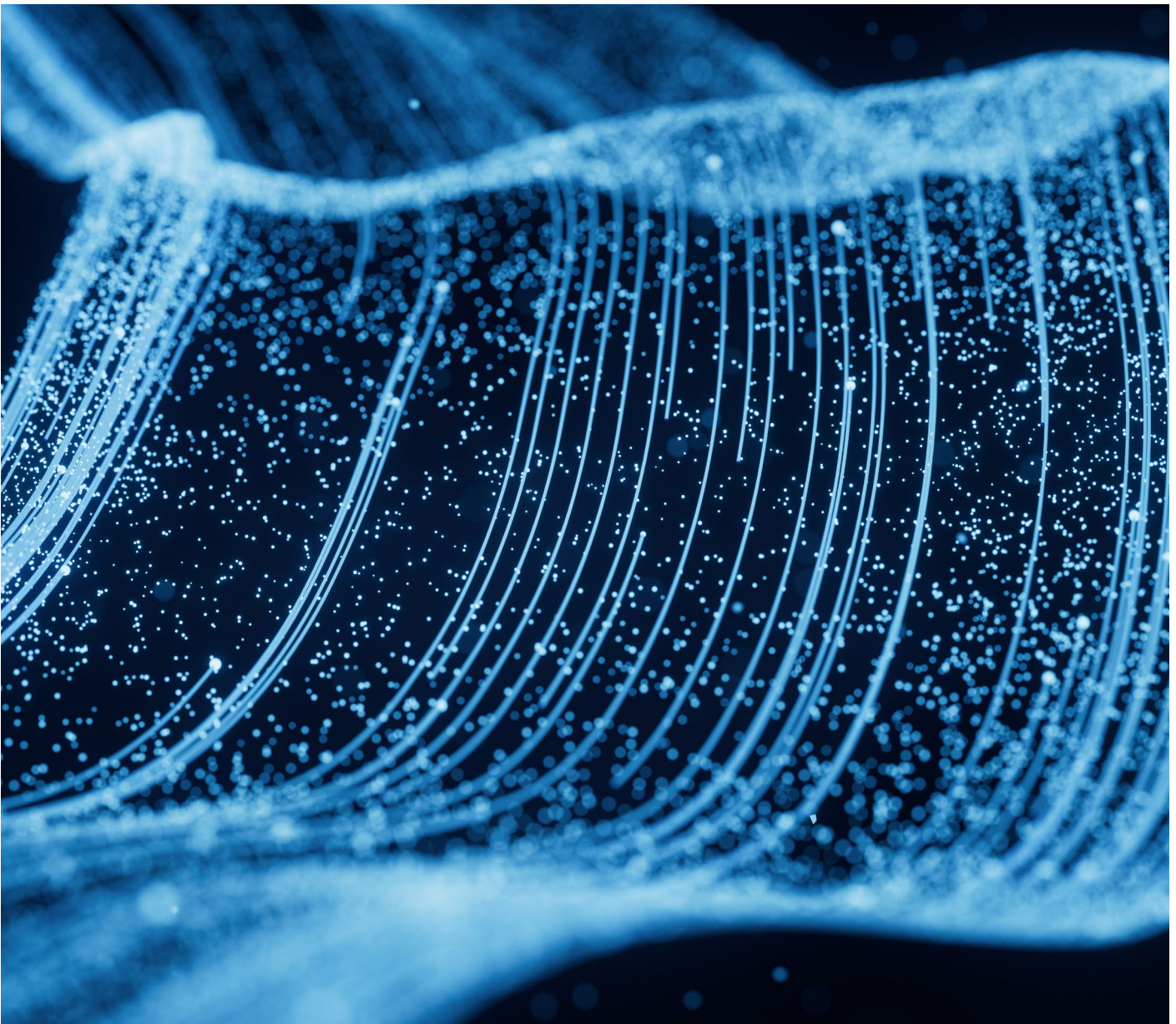
regulations and policies. These components are the foundational building blocks underlying digital transformation, distilling the complexity of healthcare

down to a base level where a diverse range of stakeholders can collaborate on common action.

With this in mind, the World Economic Forum and BCG have developed a **strategic framework for the Digital Healthcare Transformation initiative**, which captures the key ecosystem enablers required to unlock the potential of digital in health. This conceptual framing puts better patient outcomes and more efficient use of healthcare resources at the centre as the ultimate objective, taking a value-based approach and drawing on the core strategic themes from the Global Coalition for Value in Healthcare. The next chapter describes the five enablers in more detail.

④ To unlock the full potential of digital, data and AI, enabling it to scale is essential

Healthcare systems need a strategy for prioritizing digital transformation efforts and addressing five key enablers to realize transformative impact with digital.



As healthcare systems build a digital-first approach, they must focus on two high-level priorities: defining a digital strategy and putting enablers in place to unlock the potential of digital, data and AI. The digital strategy is important because leaders need to move away from ad hoc or piecemeal approaches and instead think about how digital can improve care system-wide, nationwide and on a global scale. In addition, certain foundational enablers must be in place to pursue a successful digital health agenda.

Although healthcare systems will vary in their levels of digital maturity, and priorities will differ, now is the time to accelerate the digital health transformation. The goal is to assess digital readiness (see Figure 10) to understand the system's strengths and weaknesses, recognize which enablers need to be put in place and prioritize efforts.



4.1 Define a digital strategy to transform health

Government leaders, such as the Ministry of Health or equivalent organizations, must prioritize where they will make strategic change and seek investments in digital to address the challenges as part of their national healthcare strategy. The strategy should also be developed in collaboration with other stakeholders across the healthcare system. While many countries and healthcare systems are starting to develop a digital strategy, it is of utmost importance to ensure it is not viewed as a stand-alone plan but as part of the bigger healthcare transformation. A successful strategy will spell out when and where digital tools should be deployed and what barriers need to be addressed.

government leaders created a digital strategy and roadmap to ensure the programme met its health objectives.

Government leaders can also provide national resources to support digital health. In India, the Ayushman Bharat Digital Mission was developed to support an integrated digital health infrastructure. In the US, the Office of the National Coordinator for Health Information Technology supports the adoption of health information technology and nationwide standards-based health information exchange. These entities support and coordinate national digital health efforts and bridge the gap between the healthcare ecosystem stakeholders.

“ A successful strategy will spell out when and where digital tools should be deployed and what barriers need to be addressed.

To make digital an integral part of a system delivering the right care at the right time, strong incentives should be built into its design – not just monetary incentives, but access to services or information. When Morocco launched one of the most ambitious social protection reforms in recent years, including an expansion of universal health coverage from 11 million to 33 million people,³⁷

The WHO established a global strategy to strengthen healthcare systems, empower patients and achieve health for everyone by accelerating the development and adoption of digital health solutions. The *Global Strategy on Digital Health 2020-2025*, offers a strong foundation for all member states to build a national strategy around digital, data and AI.

4.2 Five enablers to unlock the potential of digital, data and AI






Based on executive consultations with more than 80 multi-sectoral leaders in healthcare and technology, five key enablers have been identified that must be in place for healthcare systems to successfully implement digital health at scale:

- **Data:** Healthcare systems need to incentivize health data flow by harnessing fully standardized, interoperable data that can be shared across the care continuum while offering the highest levels of data security.
- **Tech and analytics:** Healthcare systems need to create a unique patient ID tied to high-quality clinical, operational and patient outcome data, ensure easy integration with technology infrastructure and build platforms that support AI analytics.
- **Funding and incentives:** Healthcare systems need to invest in infrastructure and solutions in a sustained way while delivering value-based incentives to enable digital adoption and collaboration.

- **Hybrid healthcare delivery:** Healthcare systems need to establish implementation capabilities and develop human-centric solutions to deliver better patient outcomes. Organizations must hire digital talent, train workers to improve their digital skills and deploy change management programmes when new solutions are introduced.
- **Regulations and policies:** Government leaders and regulators need to create fit-for-purpose digital regulations and policies that support the ethical use of data and new technologies (especially AI and generative AI) and keep pace with evolving technologies with an eye towards improved patient outcomes as the key driving force.

It has been found that no healthcare system has achieved full maturity across all enablers, but there are still lessons to be learned from ecosystems that have reached maturity in one or more dimensions. Four case studies that showcase the implementation of key enablers will be detailed later in this report in the section “Making it real”.

FIGURE 10 Framework for assessing digital healthcare transformation maturity

Transformation components	Stage 1: Early stage	Stage 2: Maturing	Stage 3: Advanced
Define digital strategy to transform health	No clearly defined strategy: - No top-down directive on mission and strategy for overall healthcare and digital	Partly articulated digital strategy: - Articulated digital strategy yet no link to overarching healthcare vision	Holistic healthcare strategy with a role for digital: Clearly defined healthcare vision and strategy to reach it, including what role digital should play and where and when to be deployed
 Data	Low-value and siloed data: - No data standards used consistently - Provider ownership of data - No legislation on data security	Higher value yet siloed data: - Some systems use data standards - Patient ownership of data yet mostly siloed among providers - Data security laws, not fully implemented	High-quality and interoperable data: - Fully standardized data - Data sharing across the care continuum - High data security and cybersecurity
 Tech and analytics	Lacking basic tech requirements - No unique patient ID - Limited digital records; most paper based - No infrastructure for data sharing (cloud)	Majority of tech exists: - Existing unique patient ID - Core healthcare tech solutions in place, yet limited interoperability - Digital infrastructure established	Highly tech-enabled healthcare system: - Existing application and data layer interface enabling integration among stakeholders - Cloud-based storage - Data platforms and AI/ML analytics
 Funding and incentives	Lack of reimbursement models and financing: - No reimbursement for digital solutions - No access to start up capital for development and piloting new solutions - Lack of incentives to build infrastructure	Evolving funding and reimbursement landscape: - On-top payments for use of digital solutions - Donor or sandbox innovation funding, yet time-limited and fragmented	Aligned incentives supporting adoption: - Value-based incentives enabling digital adoption and cooperation - Sustained and coordinated investments in infrastructure and solutions
 Hybrid healthcare delivery	Limited talent and ability to drive change: - Healthcare workforce and patients with limited digital literacy - Solutions deployed without effective change programmes	Developing digital capabilities: - Investment in digital talent and user capability building - Some understanding of required change management in solution deployment	Digital-first workforce: - Well-executed change programmes for adoption of new solutions - Human-centric solution design - Available digital talent
 Regulations and policies	Lack of specific regulations - Limited policies and processes for data and digital solutions	Regulations partly address digital: - Established regulation of data and assurance frameworks for software - Some regulation on the responsible use of AI	Fit-for-purpose digital regulations: - Regulation and assurance on responsible use of AI and generative AI - Regulations keep pace with evolving technology

Non-exhaustive



Data: leveraging health data for transformative impact

Unlocking the value of data is the key to unlocking the potential of digital and AI solutions. Without high-quality data, digital and AI applications will not be able to address healthcare system challenges. The volume of data generated in healthcare is rapidly growing, but the vast majority goes unused today as most health data is unstructured and siloed. Governments and payors need to better incentivize the capturing, sharing and use of data.

By 2025, global data from the healthcare sector is estimated to exceed 10 zettabytes,⁴¹ and the volume is projected to grow at a 36% compound annual growth rate (2018-2025), which surpasses any other field's growth rates.⁴² At the moment, 97% of this data goes unused.⁴³ To tackle the increasing volume of health data, it is crucial to build a digital infrastructure that can effectively use AI and analytics to unlock its value. Sharing this data and enhancing its shareability to improve patient outcomes requires addressing interoperability and governance challenges alongside appropriate access and data privacy.

Another barrier to harnessing the full value from data is that high-quality patient **data often exists in silos** and is not readily shared between stakeholders, hindering its potential to optimize the patient journey and improve health outcomes.

To unleash the potential of digital health, policies and regulations are needed that improve access to individual-level health data. The European Commission, for example, is proposing a strategic initiative and framework called European Health Data Space to provide a trustworthy and efficient set-up for the capture, sharing and use of health data for research, innovation, policy-making and regulatory activities.

It is also essential to establish common **data standards** that dictate what and how data should be gathered. While international organizations have created interoperability protocols, such as HL7, FHIR and DICOM, as well as standardized clinical terminology, such as SNOMED and ICD, the variance between different standards



For AI to be effective, we need to ensure access to good quality data, which is not always the reality today, especially with fragmentation of systems and other challenges.

Laurie Werner, Director of Center of Digital and Data Excellence, PATH

(such as varying representations of the same concept) as well as inconsistent implementation and use of standards lessens their effectiveness. In 2020, the US Office of the National Coordinator for Health Information Technology enforced the Cures Act Final Rule to support seamless and secure access, exchange and use of electronic health information while also preventing industry-wide information-blocking practices that intentionally interfere with data sharing.⁴⁴

The lack of data standards not only curtails the effectiveness of data information but it also limits the potential to build transformative AI-based innovations. AI relies on standardized data to “train” algorithms, validate their performance and continuously improve. Approximately 80% of the time needed to develop machine learning is spent on data collection, cleaning and preparation.⁴⁵ The lack of standardization delays the process of “training” algorithms and increases the cost of developing new AI tools.

TABLE 5 Data standardization needs to be implemented in three key areas⁴⁶

Key area for data standardization	Description
Data capturing	<p>Standards should guide what type of individual data needs to be captured, which technical metadata should be aligned in that collection process and how data should be collected and interpreted to ensure reliability, completeness and diversity:</p> <ul style="list-style-type: none"> – Individual data captured can include a patient’s clinical and personal information, as well as information on interventions, therapies and outcomes. – Metadata can include a patient ID, patient consent for research and other patient permission to be requested. – Collection and interpretation of data should seek to mitigate bias and inequity in the data, including the extreme underrepresentation of data from people with structural disadvantages. Otherwise, the biases will limit the relevance and generalizability of results and continue to increase health inequities.
Data sharing	<ul style="list-style-type: none"> – Standards should be established so that the data can be understood by different information systems. Two types of standards are important here: <ul style="list-style-type: none"> – A Common Data Model, organizes data from different sources into a common template and defines how the individual data and the metadata interact. – A semantic interoperability model aligns data with different coding systems into a single common language that can be understood by the various systems. Semantic interoperability represents one out of the four interoperability levels, with the other three being: <ul style="list-style-type: none"> – Foundational interoperability transmits data from one system to another. – Structural interoperability structures data for exchange. – Organizational interoperability ensures data governance and data privacy across the organization.
Data use	<p>New standards also need good governance that includes norms, guides and regulations to build a common understanding of the use of data, how it is translated to clinical practice and how it can be used for clinical innovation, such as standards on garnering patient consent for the use of personal health data and verifying permission to access and use data. Although the least technical of the three areas, data use standards may be the more complex to define as they focus on the flow of data between patients and the institutional context.</p>



I worry about the lack of guardrails for tech companies building applications and the burden that leaves LMICs with, being locked in with solutions that are non-interoperable.

Edward Booty, Chief Executive Officer and Founder, reach52

In addition to standardizing data, healthcare systems need to boost their cloud computing capabilities. Some healthcare systems are hesitant to adopt cloud computing more broadly due to **security concerns**, including patient confidentiality and the potential exploitation of proprietary data. It is important to use encryption and authentication when storing and retrieving data from the cloud. Arguably more important than applying the technical fixes (which exist) is building trust with solution providers, which can be managed through further education on the technology and by engaging a neutral broker who can facilitate the terms for agreements. These issues can also be addressed by deploying new technologies, such as federated learning and blockchain, which limit the need to move data between entities and thus reduce security risks. For example, TripleBlind delivers collaborative analytics

and model training technologies without moving, sharing, or storing raw data, minimizing healthcare providers' liabilities to transfer protected health information.⁴⁸ Similarly, the Mayo Clinic Platform prioritizes the protection of privacy and confidentiality across the data network for all connected partners using a secure, federated architecture, with each individual partner in control of their own data.

Once a standardized system is in place for secure data collection and data management, healthcare systems should also address the issue of **data ownership**. In many countries, patients are legally entitled to access their health information and control how it is shared. In most instances, however, health data is kept in silos which are hosted by individual providers, limiting transparency and the effectiveness of data to generate insights.



Hospitals have to make investments in EMRs (electronic medical records) and other technologies to keep patients' data safe. It is important to create an ecosystem that would incentivize them to continue investing in these technologies whilst also agreeing to partner with other stakeholders to create scientific insights into the data. When it comes to health data, the real value only emerges when one links data from different sources.

Meni Styliadou, Vice-President, Health Data Partnerships and Data Science Institute at Takeda

Some healthcare systems are attempting to address data ownership differently. Notably, the European Health Data Space will allow patients to own their health data and will ban data-holding

for ethical research and information purposes. It is recommended that patients own their data to ensure ethical use with the patient's consent and to reduce silos between organizations.

BOX 3

Digital public goods and digital public infrastructure

To create value from data and achieve the Sustainable Development Goals adopted by the United Nations in 2015, global efforts are under way to encourage and invest in the creation of digital public goods (DPG) and digital public infrastructure (DPI). DPI and DPG are enablers of digital transformation, helping to improve public service delivery at scale, including many of the foundational elements needed for digital health applications to thrive. United Nations Development Programme is working with leaders and catalysing progress in DPI in 100 countries:

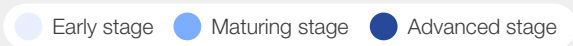
- DPG includes open-source software, open data, open AI models, open standards and

open content that adhere to privacy and other applicable laws and best practices. They adhere to the “do no harm” principle for digital development. The Digital Public Goods Alliance is a multistakeholder, UN-endorsed initiative that facilitates the discovery and deployment of these technologies.

- DPI refers to digital solutions that enable basic functions essential for public and private service delivery. These include digital identification, payment infrastructure and data exchange solutions that help countries deliver essential services to people, empowering citizens and improving lives by enabling digital inclusion.

FIGURE 11 | Singapore: Well-progressed digital transformation journey

Transformation components	Maturity of system	Comments
<p>Define digital strategy to transform health</p>	<ul style="list-style-type: none"> – National health vision in place that specifically defines the role of digital health in the health system’s transformation 	<ul style="list-style-type: none"> – Healthier sustainable development goal transformation strategy being rolled out since July 2023 with focus on promotion of digital solutions
 <p>Data</p>	<ul style="list-style-type: none"> – Standards for data collection helping interoperability with plans to enable direct patient input – Ongoing improvement in data security 	<ul style="list-style-type: none"> – Personal Data Protection Commission in charge of personal data protection – 2021 Healthcare Cybersecurity Essentials guideline for providers
 <p>Tech and analytics</p>	<ul style="list-style-type: none"> – Unique patient ID in place – National EHR in place with increasing interoperability with other information systems 	<ul style="list-style-type: none"> – GPs Clinical Management Systems undergoing an integration with the EHR – Ongoing reform to integrate providers’ management systems and digital apps with the EHR
 <p>Funding and incentives</p>	<ul style="list-style-type: none"> – Reimbursement processes in place only for telehealth 	<ul style="list-style-type: none"> – Telemedicine consultations and remote monitoring are publicly reimbursed – Digital therapeutics and other digital services decided on an ad hoc basis
 <p>Hybrid healthcare delivery</p>	<ul style="list-style-type: none"> – Programmes for digital education in place – Focus on developing human-centric tools 	<ul style="list-style-type: none"> – Ongoing training in digital education in medical schools, but some gaps between clinical practice needs and current education
 <p>Regulations and policies</p>	<ul style="list-style-type: none"> – Ongoing transformation of digital health regulation under the Healthcare Service Act – Guidelines in place where regulation is missing 	<ul style="list-style-type: none"> – Existing regulation for telemedicine – Specialized guidelines for regulation of new technologies (e.g. Artificial Intelligence in Healthcare Guidelines)



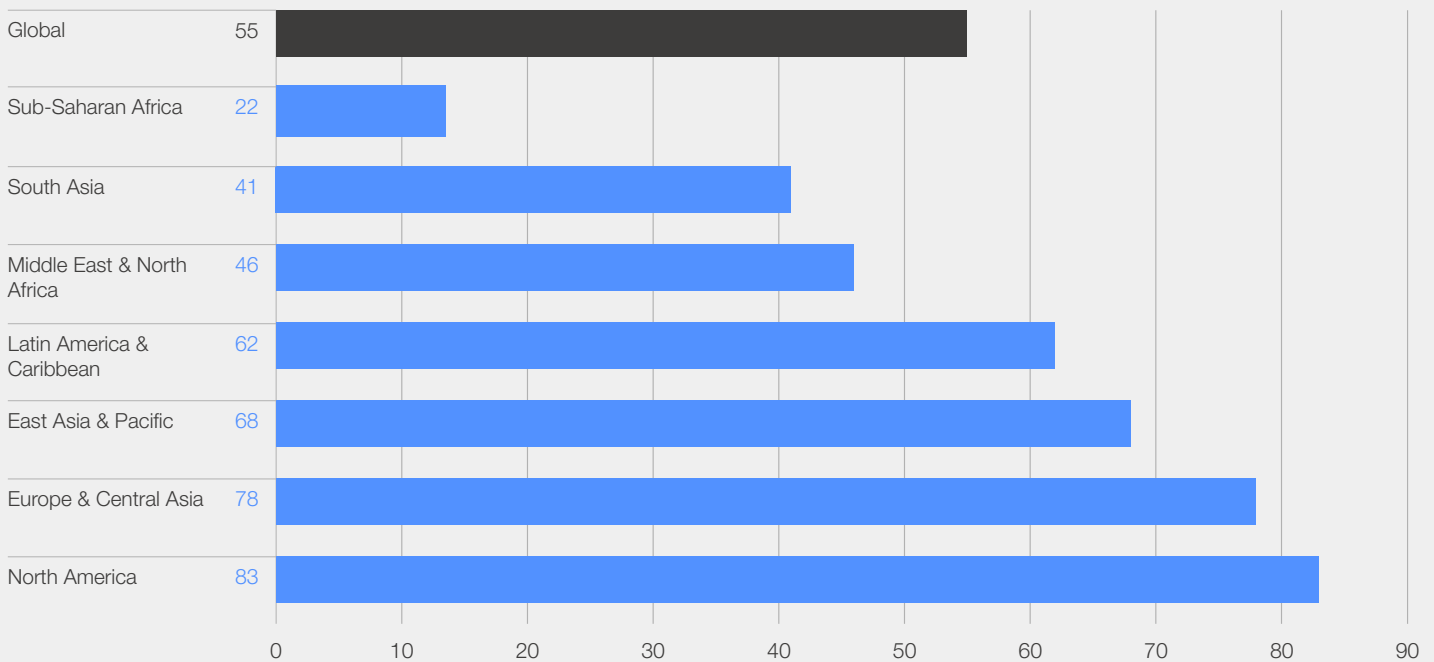
Tech and analytics: engineering a robust foundation for digital healthcare

For digital, data and AI to be deployed successfully, the foundational infrastructure must be in place to ensure that the population – both citizens and healthcare workers – have digital connectivity. Connectivity depends upon robust telecommunications networks and people’s ability to leverage those networks (using mobile and computing devices).

In 2022, 95% of the global population were covered by a mobile network, up from 76% in 2014. That said, 40% of people covered by a mobile broadband network are not using the internet. The percentage of people who are covered and able to access the internet varies dramatically by region, ranging from 83% in North America to 22% in sub-Saharan Africa. Rural areas lag in internet adoption, and women in LMICs are 19% less likely than men to use mobile internet.

To address the disparities and inequities in connectivity, UNDP and its specialized agency, the International Telecommunication Union (ITU), are working to improve access for underserved communities around the world.⁴⁹ ITU, together with UNESCO, is also driving the Broadband Commission for Sustainable Development, an initiative aiming to put universal broadband connectivity at the top of global policy discussion.⁵⁰ With support from its public and private sector members, the commission formulates practical and sustainable policy recommendations to accelerate progress towards achieving a set of broadband development targets. The EDISON Alliance further drives the agenda by offering a platform for public and private organizations to magnify connectivity initiatives globally.

FIGURE 12 Mobile internet connectivity percentage by region, 2022⁵¹



Note: Share of population using mobile internet

In addition to boosting connectivity and access, digital health solutions cannot flourish without a solid technology foundation. This includes four layers:

- **Application layer:** User-facing applications and systems, both for the patient and clinician (e.g. remote monitoring applications, appointment scheduling, diagnostics support software and workflow management software), enable seamless interactions through multiple channels.
- **Integration layer:** The interface between the application layer and the core data layer allows applications to access data in the core data layer (requiring protocols, integration capabilities and patterns and cross-system synchronization, for example). This layer also manages integration and data flow between different stakeholders and entities in the healthcare systems (requiring API services, such as API management, monitoring, developer interfaces, etc.).
- **Core data layer:** This layer accesses databases that host patient registries, billing data, user preferences, etc., and drives analytics that empower patients and healthcare providers to gain new insights from the health data. This

layer requires fundamental cross-sector building blocks, such as personal digital ID and digital payment accounts.

- **Infrastructure layer:** This layer physically stores data either on-premises, in the cloud, or in a hybrid scenario and delivers the software to manage the data storage (such as deployment and configuration of cloud).

Significant funding has gone into all layers of the technology foundation, but more coordinated investment is needed, especially for building up the lower layers of the health tech stack. Without the core data layer and infrastructure layer, investment in applications and tools is more likely to be ill-spent.

Although the technology foundation of high-income countries may be more advanced, their systems often combine complex, legacy architecture with more modern technologies, which creates inefficiencies. Lower-income countries have the opportunity to implement more modern systems and services that work seamlessly together without being held back by legacy systems (see the case study, “CoWIN platform delivers a seamless vaccination programme in India”).

CASE STUDY 1

CoWIN platform delivers a seamless vaccination programme in India

The COVID-19 Vaccine Intelligence Network (CoWIN) showcases the ways a strong digital infrastructure can accelerate digital health.⁵² During the pandemic, the Indian government launched CoWIN, a state-of-the-art platform that enables registration, appointment scheduling, identity verification, vaccination and certification of each vaccinated person. It allows administrators to oversee and maintain vaccine status along with inventory databases while simultaneously enabling citizens to schedule vaccine appointments.

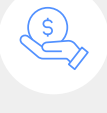
The platform scaled quickly into the world’s largest COVID-19 vaccination programme, facilitating the administration of 1 billion doses within a span of nine months and 1.6 billion doses administered and recorded on CoWIN in total.⁵³ Its success can be attributed to several factors:

- **Interoperability:** The use of open APIs enabled tens of thousands of health facilities across the country to integrate existing applications with the CoWIN platform in a few days. Open APIs also allowed data sharing with other organizations, making services available for community members on various platforms.

- **Scalability:** The use of federated architecture⁵⁴ enabled applications to scale “infinitely” to meet the enormous demand. The scalable architecture played a pivotal role in vaccinating over 25 million people in just one day.
- **Use of digital public infrastructure (DPI):**⁵⁵ The use of well-established DPIs, such as Aadhaar, the Unique Identification Authority of India, enabled a more efficient and effective process of identifying beneficiaries.
- **Leadership and governance:** Top-level leadership and effective governance of the platform enabled unprecedented performance. Programme coordination by a public-private collaboration facilitated joint ownership of decisions and fast implementation.
- **Human-centric:** A user-friendly design that minimized data requirements and offered a multi-lingual interface enhanced accessibility and usability. In addition, the 24/7 toll-free helpline for citizens raised awareness and helped shrink the digital divide, while a technical helpline for health workers provided immediate assistance where needed.

More recently, the CoWIN platform has been repurposed to manage other communicable diseases.

FIGURE 13 | Rwanda: A pioneer in developing a national health information exchange platform

Transformation components	Maturity of system	Comments
<p>Define digital strategy to transform health</p>	<ul style="list-style-type: none"> – Established national digital health strategic plan in 2018. Plan is connected to country’s overall 2050 health and social vision. 	<ul style="list-style-type: none"> – Rwanda passed PPP law to advance progress of partnerships with the private sector
 <p>Data</p>	<ul style="list-style-type: none"> – HIE platform being implemented at over 100 sites – HIE data-sharing guidelines pending approval 	<ul style="list-style-type: none"> – Pioneer among African countries in implementing the first proof of concept for an HIE through the Rwanda Health Enterprise Architecture Project (2010-2014), which will be updated with the new eHealth strategy
 <p>Tech and analytics</p>	<ul style="list-style-type: none"> – Unique patient ID in implementation – EMR adoption stands to reach around 100% in hospitals – Cloud infrastructure in place 	<ul style="list-style-type: none"> – Unique patient ID is being piloted across around 100 healthcare providers – EMR installed at facility level while other health information is hosted in the cloud
 <p>Funding and incentives</p>	<ul style="list-style-type: none"> – Constrained financial resources 	<ul style="list-style-type: none"> – Systematic budget for digital health exists but is insufficient to meet the country’s digital health needs. – Significant donor funding, mostly ad-hoc; government aims to improve telehealth coverage with systematic tariff
 <p>Hybrid healthcare delivery</p>	<ul style="list-style-type: none"> – Lack of digital literacy a major barricade to scaling solutions in addition to the lack of a digitally skilled workforce. 	<ul style="list-style-type: none"> – Digital literacy remains low, challenging the ability to source a digitally skilled, local workforce. – Digital literacy is a goal within the National Strategy for Transformation.
 <p>Regulations and policies</p>	<ul style="list-style-type: none"> – Establishing a tailored regulatory framework for digital health solutions – HIE guidelines under the approval process 	<ul style="list-style-type: none"> – Work under way to improve regulations in partnership with the World Economic Forum, managed by the Centre for the Fourth Industrial Revolution, forming a healthtech regulatory sandbox to harness innovation within healthcare

Early stage
 Maturing stage
 Advanced stage



Funding and incentives: investing in and rewarding accelerated impact

To unlock the potential of innovations in digital, data and AI, it is important to ensure there is adequate financing and, specifically:

– **Funding to scale innovation:** This will require investments from both the public and private sectors, prioritizing underfunded regions and areas of digital health.

– **Financial mechanisms to drive transformation on a system level:** Digital solutions need to be considered and incentivized as a complement to traditional care and not as a cost that comes on top. Given that digital, data and AI can enable healthcare systems to achieve better patient outcomes in a more efficient manner, incentives should be aligned with changing behaviours for better patient outcomes.

Since 2010, over \$100 billion in venture funding has been invested in digital health companies, and digital health received unprecedented levels of funding in the wake of the COVID-19 pandemic, with major investments flowing from both venture capital (e.g. General Catalyst, Sequoia, Accel, Andreessen Horowitz) and private equity (e.g. KKR, EQT, Permira, Bain Capital).⁵⁶ In the US alone, approximately \$30 billion of venture investments were made in 2021, and approximately \$6 billion of investments were made in the first half of 2023.⁵⁷ Despite this, digital health funding is experiencing an overall decline, with funding levels in 2023 reaching the lowest point in years.⁵⁸ Certain areas are also lacking capital because previous funding efforts were primarily focused on point solutions, with limited guidance from government and healthcare system leaders regarding priorities.

A digital divide is also emerging, with minimal funding for innovators in the global south. In contrast to the billions going into US healthtech, digital health start-ups in Sub-Saharan Africa received only \$125 million in 2022 (and 90% of this was directed to just three countries).⁵⁹ The investments going into LMICs are typically fragmented and focused on vertical therapeutic areas, not sustained growth. On the ground, community health workers in LMICs use multiple digital tools, sometimes with different devices, for overlapping purposes (e.g. using different supervision systems among managers and for different disease types) when a common and general digital tool would ease the process and enable continuity in the supervision. Some organizations are now addressing this. HealthTech Hub Africa, for example, is a pan-African healthtech accelerator that helps local governments and start-ups collaborate on data and technology-enabled innovations that strengthen African healthcare systems.

Beyond private sector funding from venture capital, private equity or philanthropic investments, there is also a need for governments to fuel innovation by funding healthtech companies. Some countries are leading the way on this. Australia's National Digital Health Agency, for example, has committed to investing over \$640 million in digital health over the next four years.⁶⁰

Re-evaluating current ways of incentivizing care needs to start with getting the fundamentals right, including eliminating misaligned incentives between payers, providers and tech players, and establishing specific reimbursement pathways for



Putting patients at the centre of everything we do and considering their holistic health needs — while driving access, affordability, and quality — adds value and helps us to align incentives across an integrated health system.

Nari Gopala, Senior Vice-President and Chief Digital Officer,
Kaiser Permanente

digital services. Most healthcare financing today follows a fee-for-service reimbursement system that incentivizes volume as opposed to a value-based reimbursement system that incentivizes optimal patient results. The fee-for-service system hinders the integration of digital health and digital therapeutics into clinical practice because the focus is primarily on the cost of adopting new technologies rather than the cost savings that will come in the future when patients receive better treatment. The Forum's insight report, [The Moment of Truth for Healthcare Spending: How Payment Models Can Transform Healthcare Systems](#), found that fee-for-service payments contribute to the unsustainable development of healthcare systems. By implementing value-based payment models, there is a key opportunity to further emphasize quality of care over volume.⁶¹

Aligning incentives for digital care goes beyond covering the established digital solutions. Novel digital approaches (such as virtual outpatient clinics) must also be considered in a way that drives patient-centred care. The US healthcare system, for example, has developed reimbursement schemes that facilitate the adoption of new solutions.

- In the US, the Center for Medicare and Medicaid Services (CMS) implemented New Technology Add-On Payments in 2012, which fund the use of high-cost technologies for specific health indications. For hospitals to access this funding, the technology should be new (usually not more than three years beyond FDA approval), there must be a gap in diagnosis-related funding, and it should improve patient outcomes compared to current treatment options.



For prescription digital therapeutics, more important than any other factor is the current lack of clear reimbursement pathway.

Edward Cox, Head and General Manager, Digital Health and Medicines,
Pfizer



FIGURE 14 | Germany: Introducing a digitally tailored approval process

Transformation components	Maturity of system	Comments
<p>Define digital strategy to transform health</p>	<ul style="list-style-type: none"> – Established digital health strategy and vision with clear connection to overall health strategy 	<ul style="list-style-type: none"> – Federal Ministry of Health, together with numerous stakeholders, has developed a common vision and strategy for digitalization of the healthcare system.
 <p>Data</p>	<ul style="list-style-type: none"> – Patient ownership of data yet highly siloed among providers – Some use of international data standards 	<ul style="list-style-type: none"> – Health data siloed because of the highly fragmented health system – Access is subject to very strict data protection standards and concerns, especially for secondary use
 <p>Tech and analytics</p>	<ul style="list-style-type: none"> – Unique patient ID – Digital HIE platform established – Limited interoperability 	<ul style="list-style-type: none"> – Health insurance number used for data exchange – National EHRs offered by the health insurers but only used by 1% of the population (opt-in model); limited types of data but expanding gradually
 <p>Funding and incentives</p>	<ul style="list-style-type: none"> – On-top payments for the use of digital solutions – Substantial innovation funding to promote the development of digital innovations 	<ul style="list-style-type: none"> – Digital health applications (DiGAs) were introduced in 2020, enabling health apps to be prescribed by doctors and financed by payers. Areas poorly covered are pricing and physician uptake, which has limited adoption.
 <p>Hybrid healthcare delivery</p>	<ul style="list-style-type: none"> – Limited understanding of required change management for effective solution deployment 	<ul style="list-style-type: none"> – GPs poorly informed about conditions and advantages of using DiGAs: use of DiGAs remains low – Roll-out of EHR required action by citizens to confer consent through a cumbersome application process
 <p>Regulations and policies</p>	<ul style="list-style-type: none"> – Established regulations for data use 	<ul style="list-style-type: none"> – Germany plans new health data act to improve health data access for research and comply with expected European Health Data Space requirements.

● Early stage
 ● Maturing stage
 ● Advanced stage

Hybrid healthcare delivery: strengthening digital capabilities and user design to facilitate implementation

“ Capacity building helps healthcare workers evolve from being data collectors who report information to becoming data users who can leverage data to improve decision-making and delivery of care.

It is important to establish digital implementation and adoption capabilities so workers can take advantage of new digital health technologies. Adopting new technologies can be challenging at best (or counter-productive at worst) for frontline health professionals if these technologies do not fit into their usual workflows, and the benefits can take time to materialize. Furthermore, clinicians may be expected to engage in multiple system interfaces, which exacerbates the burden on healthcare professionals. Recent studies indicate that US doctors spend more time working in their EHR system than with patients.^{62,63}

There is a need for a wide variety of digital skills, ranging from basic data entry to sophisticated data processing and analytics. Skill sets vary widely around the world, and levels of digital literacy are generally low in the global south. Healthcare systems need to work closely with technology developers to facilitate the optimal integration of new digital tools. As Stan Huff says in *The Patient Priority*, “The human side of interoperability is the most challenging, and where we have the most work left to do”.⁶⁴

The effectiveness and speed of digital transformation depend on the digital literacy and capacity of healthcare workers as well as their motivation and incentives to switch from paper to digital processes. Capacity building helps healthcare workers evolve from being data collectors who report information to becoming data users who can leverage data to improve decision-making and delivery of care.

To ensure the smooth integration of digital solutions and the lasting success of an organization’s digital transformation, a change management process is imperative. Empirical studies of failed transformations highlight that limited knowledge of new technologies and their value causes unnecessary frustration and negative feelings within the organization.⁶⁵

Patients, too, vary in their ability to use and benefit from digital tools and services. In the UK, more than 11 million people lack the basic digital skills to use the internet effectively.⁶⁶ Worryingly, there is a close correlation between digital exclusion and social disadvantages.⁶⁷ Patient acceptance and uptake of digital tools is also paramount, but several studies have shown that up to 70% of patients invited to use technologies such as health apps either decline or stop using them very early.^{68,69}

To address these issues, it is vital to have tools that are structured around the needs and preferences of users. Users should be closely involved throughout the design process, from initial design to live service and beyond. Unfortunately, there is often a disconnect between the design of digital health tools and the patients and/or healthcare workers they are created for. When users are actively involved in the design and development of digital health products and services, the technologies have higher uptake and continued use.^{70,71}

“ These are fundamental behavioural changes, not digital programmes – for success, it is critical to build on existing users’ behaviours, habits and attitudes, making it seamless to drive the desired health change and outcomes.

David Evendon-Challis, Executive Board Member and Chief Scientific Officer, Bayer Consumer Health



Regulations and policies: crafting fit-for-purpose policies to enable digital transformation

There is a need to speed up the process for innovators to gain market access to reduce the risk of start-ups failing before even testing their products in the market. However, this cannot come at the

cost of risking patient health. To address this issue, regulatory sandboxes present a potential solution and regulators globally should seek to implement them more frequently.

BOX 2

What is a regulatory sandbox?

A regulatory sandbox is a framework created by health authorities or regulatory agencies to permit healthcare innovators to test new digital health solutions with relaxed regulatory constraints. This controlled environment allows these innovators to trial their solutions, ensuring they meet safety and efficacy standards while avoiding the full scope of stringent healthcare regulations until they have

demonstrated their viability and safety in practice. This approach encourages innovation in the healthcare sector while maintaining patient safety and regulatory oversight. The concept is widely supported by the OECD, the UK Information Commissioner's Office, the European Commission and the United Nations, to name a few.

Healthcare systems also face several challenges when implementing digital, data and AI applications, including biased outputs, discrimination, threats to patient privacy, copyright infringement and false or misleading information. Therefore, there is a need for more tailored regulations and policies around the following: data standards, use policies and security standards to ensure high-quality data and safe use of data, liability coverage in case a digitally aided decision turns out to be incorrect and ethical guidelines for the use of AI. The regulatory landscape is evolving, with many new AI-specific

regulatory frameworks coming to market, such as the EU AI Act and the US Digital Health Center of Excellence. Regulators should help organizations navigate ethical, legal and technological challenges, provide frameworks to support decision-making and offer tools to monitor and manage risks.

With AI solutions, as opposed to traditional medicines and devices, post-market surveillance is particularly important since the algorithms evolve over time. Proper regulation allows stakeholders to be confident in approved technologies and fosters adoption.



Regulation provides guardrails for operations. We need to have early and thoughtful regulation. The last thing that people want is an untoward outcome which will freeze development.

Shez Partovi, Chief Innovation and Strategy Officer, Philips



Regulation is not keeping pace with the exponential evolution of technology. We need a stronger regulatory environment to allow us to test and approve the solutions faster.

Esther Kunda, Director General of Innovation and Emerging Technologies at Ministry of ICT and Innovation, MINICT/MOH Rwanda

There is still work to do in advancing the approval process for AI applications, data sets and algorithms. Japan's approval review system for AI-based medical devices, established in 2019, treats every software update as if it were a new product.

This is likely one of the reasons for the low numbers of approved AI-based medical devices in Japan (compared to the US, for example). The Japanese government is now discussing ways to ease regulation to resolve roadblocks.^{38,39,40}

5 Making it real: case studies of successfully scaled digital, data and AI applications

Several case studies highlight the power of digital, data and AI when successfully scaled.





Advanced AI to provide data-driven, personalized care



Context

Expanding access to primary care will improve population health, enable longer lives and increase health equity.

K Health has built a clinical grade medical chat based on large datasets, and offers 24/7 virtual primary care medical services to people in the US through its partnerships with leading health systems and insurers, including Cedars-Sinai, Mayo Clinic Health Systems, Elevance Health and UnitedHealthcare. Providers are also available through K Health’s web app. K Health’s clinical and AI offerings create a high-quality, cost-effective system of care for provider systems and patients.

Enablers to scale



Data, tech and analytics

Data-driven technology, easily accessible by consumers and physicians. Uses data standards to ensure interoperability with EMR, integrating the application in the clinical workflow and aiding adoption.

Licensed existing datasets to build and train machine learning model on high-quality data, initially medical records from an Israeli health provider covering 2.1 million people. Recently licensed another large, anonymized dataset from the Mayo Clinic, used to refine its model and develop new algorithms.



Funding and incentives

K Health is addressing a significant pain point (access to primary care), and its value proposition has a clear short-term financial return on investment. Provider systems that integrate the technology increase the efficiency of physicians and accelerate access to the specialties that are more profitable.



Healthcare delivery

K Health works with academic researchers to evaluate the accuracy of its AI and build predictive models to help doctors optimize treatment. A retrospective study of 100,000 K Health patient visits found that clinicians agreed with the AI-recommended diagnoses 84.2% of the time. Another peer-reviewed study shows how an AI model built by K Health using de-identified data from Mayo Clinic is proven effective in predicting optimal medication regimen in hypertension patients.

Ecosystem partners



Database partner

Israeli HMO Maccabi Healthcare Services, Mayo Clinic Platform



Partners

Cedars-Sinai Medical Center, Mayo Clinic Health System, Mayo Clinic Platform, Elevance health, UnitedHealthcare



Joint venture

CS-Connect (Cedars-Sinai), Anthem (Blackstone)

Solution and impact

Patients are given the option to connect with a medical provider who takes over the chat armed with the pre-populated symptoms, medical history and diagnosis suggestions. Clinicians also have access to AI models to help them predict and optimize treatment.

This technology enables an innovative model of care:

- Giving patients 24/7 access to primary, urgent and preventative care
- Increasing physician bandwidth
- Speeding up the routine intake process for common, low-risk conditions

<p>10M+</p> <p>Over 10 million users</p>	<p>Billions</p> <p>of clinical data insights</p>	<p>48</p> <p>48 states served</p>
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Uses AI to accelerate diagnosis and treatment



Context

Viz.ai uses AI to accelerate disease detection and care coordination, reducing systemic delays that stand between patients and lifesaving treatments. Cardiovascular disease and strokes are the first and second leading causes of mortality and major causes of morbidity worldwide. Detecting disease earlier in conditions such as cardiomyopathy and stroke gets patients treated earlier and improves outcomes.

Enablers to scale



Data, tech and analytics

Viz.ai is connected in real-time to a healthcare system's data streams, including imaging, electrocardiograms (ECGs) and electronic health records (EHRs). As a mobile-first, cloud-based platform, Viz.ai speeds decision-making at the point of care with instant notifications, a high-fidelity viewer and communication tools.



Funding and incentives

In 2020, the CMS awarded Viz LVO (large vessel occlusion) the New Technology Add-on Payment (\$1,040 per patient), which supported hospitals adopting the technology for the demonstrated impact on stroke outcomes for Medicare beneficiaries. The programme evaluated the use of the technology, and the payment is now embedded in stroke-related diagnostic-related groups (DRGs) for wide use.



Healthcare delivery

Viz.ai brings an experienced clinical team that collaborates with care teams to optimize workflows and implement the new technology into their daily practice to improve patient outcomes. With 12 regulatory-cleared AI algorithms and more than 30 care pathways available commercially and for research, Viz.ai offers a comprehensive AI-powered solution. Viz.ai is also partnering with seven of the leading global pharmaceutical and medical device companies to develop and deploy new algorithms and care pathways.

Ecosystem partners



Providers

1,500 hospitals, including HCA Healthcare, CommonSpirit Health and Mt. Sinai Health System



Life science partners:

Seven leading global pharmaceutical and medical device companies, including Bristol Myers Squibb and Medtronic



Tech/AI and device partners:

Illuminate, Us2.ai, Hyperfine, Cercare, Redox



Financing:

Kleiner Perkins, Google Ventures, Scale Venture Partners, Insight Partners, CRV, Tiger Global



Solution and impact

The Viz.ai platform detects disease earlier and expedites care coordination for conditions such as hypertrophic cardiomyopathy and stroke.

It coordinates specialist teams across the country and reaches diverse patient populations in the community to increase access to live-saving treatments.

39.5 mins saved in access to neuro care	23% reduced disability in stroke	16%+ Over 16% increased number of procedures	3.5 days reduced length of stay in ICU
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USAID m-mama

A cost-effective and scalable way to tackle maternal mortality



Context

High rates of maternal and newborn mortality persist in Tanzania, in part due to delays in accessing and paying for transport to ensure that pregnant women and newborns experiencing complications can receive timely, quality lifesaving healthcare.

Enablers to scale



Data, tech and analytics

m-mama ICT app uses existing digital tech already at scale (M-PESA) and a standardized way to refer maternal and newborn emergencies, running on a tablet without internet connectivity. It supports dispatchers in rapid management of emergency referral and transport. A nurse dispatcher triages the emergency based on a nationally-approved algorithm. Using the m-mama app, they determine the level of care required and contact the nearest appropriate facility to confirm they can manage the complication. Data generated through the system provides end-to-end visibility on all trips, which the government use to improve health system performance.



Funding and incentives

The programme pilot is funded by donors, national scale-up is co-funded by the Tanzanian government. Women experiencing an emergency and/or health workers can call the dispatch center on a dedicated toll-free number available to users in all networks. Community drivers paid based on pre-negotiated rates via the mobile app M-Pesa (quick payment and low admin costs). Operational costs are kept low, e.g. using community vehicles vs investing in ambulances.



Healthcare delivery

Clear roles and responsibilities of all stakeholders and a robust governance model, with local government ownership and cross-stakeholder leadership team. Implementation follows a well-tested process that first gets local buy-in from the regional and local govt authorities.

Ecosystem partners



Implementation partners:

Touch Foundation, Pathfinder, Vodafone Foundation



Providers:

Facilities that offer emergency obstetric and newborn care and healthcare workers



Financing:

USAID, Vodafone Foundation, Government of Tanzania



Policy-makers:

Regional and local government agencies

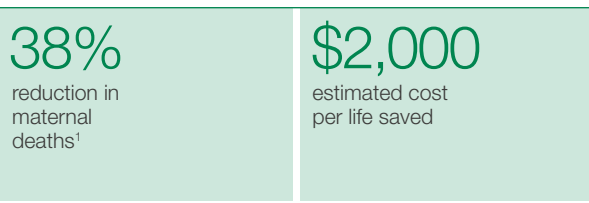


Community:

Community health workers and community drivers

Solution and impact

m-mama is an emergency referral and transport system that uses mobile technology to connect pregnant women and newborns to appropriate care and emergency transport, contributing to reductions in maternal and newborn deaths.



¹ Between 2016-2020 in Shinyanga Region, Tanzania



Comprehensive ecosystem to integrate digital care at scale

Context

Ping An has developed a one-stop healthcare ecosystem to enable individuals, payers and providers with technology to meet the challenge of relative scarcity and uneven distribution of healthcare services in China. It provides 24/7 online consultations through in-house doctors and partners with other players to form an ecosystem of services.

Enablers to scale



Healthcare delivery

Ping An allows medical resources, both payers and providers, to address market demand more effectively by connecting various stakeholders, built on a holistic online and offline approach.



Data, tech and analytics

Ping An integrates online diagnostic services with a physical network. Insights provided by their dataset increase with every new interaction with the platform and are being used to constantly improve offerings. Further, Ping An provides AI-assisted literature analysis to help doctors make diagnoses and treatment decisions.



Funding and incentives

Having everything within the network, from insurance to healthcare facilities, provides synergies that help manage healthcare costs. Ping An provides membership-based healthcare services via dedicated family doctors, guiding members through an "end-to-end" service network that covers consultation, diagnosis and treatment.

Ecosystem partners



Providers:

Partners with 10,000 hospitals, 220,000 pharmacies and 45,000 contracted external doctors in China



Payers:

Connected to multiple social health insurance programmes and private health insurance companies



Policy-makers:

Guangxi Government, National Clinical Research Centre

Solution and impact

Has established a new AI-powered business model that combines insurance and healthcare, connecting payers, hospitals and doctors in the process and built on digital platforms:

- "Good Doctor" telemedicine platform connects individuals with health services
- "Smart Healthcare" digital integration platform for providers with AI diagnostic toolsSpeeding up the routine intake process for common, low-risk conditions
- HealthKconnect: AI-powered risk management solution for health insurers

<p>99% Accuracy of AI-based triage</p>	<p>30% Improvement of diabetes care adherence</p>	<p>80% AI prediction accuracy for chronic obstructive pulmonary disease</p>
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6

The World Economic Forum is launching a new Digital Healthcare Transformation Initiative

The Forum's Centre for Health and Healthcare is prioritizing public-private partnerships to accelerate the impact of digital, data and AI in healthcare ecosystems.



The World Economic Forum will use its unique position to convene private industry with public stakeholders in an effort to build powerful and sustainable ecosystems that can accelerate the digital transformation in healthcare. All stakeholders must challenge the status quo and commit to the shift required to unlock the potential of digital, data and AI. Based on the Forum's longstanding support of systems transformation, the new **Digital Healthcare Transformation initiative**

springboards from the foundational initiatives of the Global Coalition for Value in Healthcare, highlighting value-driven systems thinking. The new Digital Healthcare Transformation initiative elevates data-driven, digital-tool-enabled healthcare systems with the aim of improving outcomes through more efficient and effective mechanisms alongside leaders from the public sector and industries such as medtech, pharma, tech, investors and others.

6.1 Many collaborations are ongoing, but there is a need for more public-private partnerships

Digital health presents an opportunity for the private sector to build businesses that promote better health around the world. It is also an opportunity for the public and private sectors to join forces to address the perennial healthcare challenges the world is facing. While many collaborations are underway to accelerate digital health, most involve partnerships between the public sector, multilateral organizations, civil society and academia. Notably, there is an absence of collaboration between the public and

private sectors, which is essential for solving current challenges. The required collaboration efforts will vary depending on each country's digital maturity and unique challenges. For example, in LMICs there will be more focus on establishing the technology foundation, addressing incentives and ensuring mechanisms for payment. In a country like the US, however, interoperability will be key and will require much more private-sector engagement given the fragmented healthcare system.

FIGURE 19 Many ongoing initiatives, but in general have limited private sector engagement

Approximately 25 ongoing initiatives mapped ...



... to geographical presence, focus areas and sector engagement

Transformation components	Global efforts	LMIC efforts	US/EU efforts
Define digital strategy to transform health	●	●	●
Data	●	●	●
Tech and analytics	●	●	●
Funding and incentives	●	●	●
Hybrid healthcare delivery	●	●	●
Regulations and policies	●	●	●

● Bubble size represents # of initiatives addressing enabler

Only 15-20% of initiatives have private sector representation in steering leadership

6.2 A call to action: All stakeholders must contribute to unlocking transformative impact from digital, data and AI

To achieve the digital health transformation, organizations will need to do things differently. The following recommendations show how

organizations can adopt new approaches to accelerate the digital transformation in health.

TABLE 6 Call for action: what is asked of each stakeholder

Stakeholder	Urged to move from...	... to instead further
Healthcare system leaders (e.g. ministries of health or equivalent)	Enacting incremental policy changes on standalone topics (to address funding, for example)	Formulate a comprehensive vision for digital health and communicate the strategy, explaining the role of digital within the healthcare system and optimizing investments at system level
	Focusing on application layer and bringing more point solutions to market	Shape the environment through targeted efforts to mature the enablers (by mandating compatibility with international standards on data interoperability, for example)
	Making limited investments in digital health solutions	Make game-changing investments in areas that will deliver the most impact, such as advancing the technological foundation
Healthcare providers	Procuring and implementing systems and solutions without ensuring data compatibility	Implement common data standards to increase the quality of data (using responsible procurement solutions aligned to standards, for example)
	Taking a siloed approach to patient data and patient journeys	Take a holistic approach that allows data to be shared across the patient journey with all relevant stakeholders
	Treating digital as an IT challenge	Establish change management programs across the organization to support the behavioural changes that will help healthcare providers advance the digital transformation
Healthcare digital, data and AI providers (e.g. healthtech, pharma, medtech, life science)	Fitting solutions on top of existing patient journeys	Rethink hybrid, digital patient journeys to ensure that solutions are patient-focused and easy to use
	Settling for regulatory approval	Prove the value of your solution with data-driven clinical studies on outcomes and impact to gain clinicians' trust and thereby drive adoption
	Not taking the time upfront to evaluate how the innovation will work within the health ecosystem	Have a clear strategy on how to scale the solution, including how to make use of partnerships across the broader healthcare system
	Developing solutions without considering data standards and interoperability	Develop solutions according to data standards, allowing for interoperability and easy integration into existing systems
Payers	Expanding an offering too early to attract further investments	Solve a large enough problem to make meaningful impact but expand the offering slowly to reduce risk of becoming stretched too thin
	Paying for digital solutions on top of existing costs in health system, with a fee-for-service approach	Instead pay for outcomes and value, including for preventative solutions
Investors and funders	Investing in digital point solutions	Align funding with overarching healthcare strategy, investing in solutions that adhere to data standards, with a clear impact and path to scale
Regulators	Evaluating digital solutions within existing frameworks	Develop and use fit-for-purpose and agile regulatory frameworks that evaluate on an ongoing basis the safety, efficacy and outcomes of digital solutions



6.3 In this initiative, the Forum aims to accelerate digital transformation in two ways

To accelerate digital transformation of healthcare both at the global level as well as on regional level the Forum will drive two workstreams:

The Global Insights Exchanges will establish working groups around key enablers to scale digital, data and AI. The programme will convene public and private stakeholders to share perspectives and experiences, provide guidance on best practices and strategize on ecosystem transformation. Key workstreams and focus areas will likely include data and digital infrastructure development, digital health funding and incentives conceptualization, and exploration of critical issues within AI and emerging technology.

The Regional Activators will create multistakeholder action groups to identify and accelerate high-priority healthcare system challenges that can be addressed with digital solutions. The aim of the Activators will be to holistically implement digital, data and AI to solve challenges in local healthcare systems, led by the Forum's partners. These efforts have the potential to be scaled up, accelerated and combined with existing efforts. By forming regional health transformation groups in this manner, partners can share their unique resources to drive an even greater impact.

Conclusion

There is an urgent need to scale digital solutions that both digitize the front-end of care and augment the back-end to address healthcare's biggest challenges and improve outcomes. Healthcare systems must first define a robust and forward-thinking digital strategy, where government and healthcare system leaders prioritize the digital health investments that can solve the most pressing healthcare challenges globally. Next, stakeholders in the ecosystem need to build the digital healthcare infrastructure, better incentivize the capturing, sharing and use of data, develop digital health capabilities, align incentives, provide access to funding and create fit-for-purpose regulations and policies in the transition to value-based healthcare.


There is an opportunity for governments and healthcare system leaders to invest in the health of their population, with improvements in healthcare clearly delivering value to all aspects of society. Digital health also presents an opportunity for the private sector to invest in and build businesses, which leads to better health. But to succeed, public and private stakeholders must collaborate and focus on catalysing change over the long term and at the system-wide level. It is time to build a healthcare system that is truly affordable, equitable and consistently capable of delivering the highest quality of care that leads to improved health outcomes.

Appendix

FIGURE 20 Estonia: One nationwide interoperable eHealth platform

Transformation components	Maturity of system	Comments
<p>Define digital strategy to transform health</p>	<ul style="list-style-type: none"> – Defined eHealth vision and strategy and connection to overall healthcare 	<ul style="list-style-type: none"> – National eHealth vision and strategy established, execution aligned and coordinated across healthcare, social welfare and labour sectors by a national ICT competence centre: "Health and Welfare Information Systems Centre"
 <p>Data</p>	<ul style="list-style-type: none"> – Fully standardized data across stakeholders – Data sharing across care continuum (patients, providers and payers) – High data security and cybersecurity 	<ul style="list-style-type: none"> – Applications developed by public and private sectors follow the same standards, making them interoperable – 100% of the population (1.3 million) is included in National Health Information System (NHIS); 2.7 million patient queries monthly
 <p>Tech and analytics</p>	<ul style="list-style-type: none"> – Unique patient ID – Variety of high-quality data captured (clinical, admin, outcomes) – Cloud-native platform 	<ul style="list-style-type: none"> – NHIS expands with data requirements for healthcare providers, linking all medical records to unique digital ID – Electronic health records and health insurance registries fully in place
 <p>Funding and incentives</p>	<ul style="list-style-type: none"> – Policies incentivizing private provider participation in digital health ecosystem 	<ul style="list-style-type: none"> – Policies enforced so that providers cannot get paid unless they access payment systems of payers via a dedicated data exchange platform (X-Road)
 <p>Hybrid healthcare delivery</p>	<ul style="list-style-type: none"> – Upskilled healthcare workforce – Available digital talent 	<ul style="list-style-type: none"> – Coordinated investments in the development of digital skills of current health workers, e.g. publicly-funded training courses for physicians and nurses – Highest percentage (8%) of ICT graduates in the EU
 <p>Regulations and policies</p>	<ul style="list-style-type: none"> – Established regulations for data use 	<ul style="list-style-type: none"> – Implemented regulations to protect citizen health data and ensure that healthcare providers are autonomous entities operating under private law

FIGURE 21 | Morocco: Holistic digital healthcare transformation in progress

Transformation components	Maturity of system	Comments
<p>Define digital strategy to transform health</p>	<ul style="list-style-type: none"> – Articulated digital strategy defined as part of healthcare vision 	<ul style="list-style-type: none"> – Vision for a national transformation for universal health coverage enhanced by a new digital vision and infrastructure – Transformation led by recent internal changes from the public healthcare payer
 <p>Data</p>	<ul style="list-style-type: none"> – In the transition to maturing stage; currently, providers have a fragmented patient data ecosystem – Legislation and institutions in place to ensure data security and confidentiality, including healthcare data 	<ul style="list-style-type: none"> – HIE approved but not yet implemented – The National Commission for the Protection of Personal Data Protection is in charge of developing policies for health data security and privacy
 <p>Tech and analytics</p>	<ul style="list-style-type: none"> – No unique patient ID but unique beneficiary ID – Fragmented digital records among different providers, efforts to digitalize public insurance records in place 	<ul style="list-style-type: none"> – Public health insurance is undergoing a digital transformation, including creating a unique beneficiary ID, leveraging digital for claims management
 <p>Funding and incentives</p>	<div style="border: 1px dashed gray; padding: 20px;"> <p><i>n/a</i></p> </div>	
 <p>Hybrid healthcare delivery</p>	<ul style="list-style-type: none"> – Limited digital literacy among patients – Limited digital training possibilities among clinical staff 	<p>– <i>n/a</i></p>
 <p>Regulations and policies</p>	<ul style="list-style-type: none"> – Limited digital health policies in place 	<ul style="list-style-type: none"> – Holistic digital roadmap to build new digital pathways in the Moroccan healthcare system within the next seven years

Early stage
 Maturing stage
 Advanced stage

Rology

AI-assisted teleradiology platform allowing remote diagnostics reports



Context

Rology uses AI-assisted technology to match diagnostic images with radiologists remotely based on availability and sub-specialty. In African health systems, there is a severe shortage of radiologists in hospitals. The demand for radiologists increases 55% year-on-year while the supply of radiologists increases by 3%, leading to a delay in reporting and interventions.

Enablers to scale



Data, tech and analytics

Rology creates and harnesses data flywheel effects. It used data from thousands of scans to train its algorithm to better spot issues, which improved radiologist reporting speed on its platform by 30%. This has allowed Rology to get more output from the radiologists, which feeds the continuous improvement cycle.



Funding and incentives

Simple business model, delivering operational savings. Hospitals are charged a competitive fee per scan, which is a variable rate, and a lower fee than the cost of delivering the specialist services in-house. There are zero set-up costs, and the scans are fast and accurate.



Healthcare delivery

Strong demand and supply factors. The platform solves a real need for many hospitals that do not have coverage for all sub-specialties. In addition, radiologists are better used and more productive with AI-assisted technology, and they have an opportunity to make extra income.

Ecosystem partners



Providers:
150 hospitals in nine countries (Africa and Middle East)



Financing:
Investment companies and individual investors

Solution and impact

Hospitals upload scans and medical history. Rology matches cases with the optimum radiologist based on availability and sub-specialty, who reports on the scan.

AI-powered platform identifies areas of interest with a high level of accuracy, guiding radiologists to any anomalies and delivering reports in a shorter time.

Stringent hiring criteria (certification, sub-specialty training, most have over 5 years experience) and robust quality assurance programme

99.53% error-free diagnostic reports	60mins turnaround time for emergency scans	30% faster radiologist reporting speed	25% operational expense saving
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FIGURE 23 | mPharma: Improving access to medicines through financing and inventory management solutions

mPharma

Improves access to medicines through financing and inventory management solutions



Context

mPharma improves access to and the affordability of medicines by taking ownership of the supply chain, eliminating inefficiencies and introducing price controls. Pharmacies across Africa have frequent “stock-outs” of life-saving medicines, and patients are charged high prices (due to intermediaries in the supply chain), making treatments unaffordable. Non-communicable diseases like cancer, hypertension and diabetes are rising, and drugs are not reaching people who need them most.

Enablers to scale



Data, tech and analytics

Digital records and real-time management solutions. Cloud-based software connects patients, pharmacies and hospitals in real time to give patients reliable access to medicine. Digitized inventory management gives pharmacies stock visibility and data to manage the supply chain pipeline.



Funding and incentives

Consignment stock model and network effects make it easy to scale once critical mass is established. Pharmacies are stocked with no upfront payments, making them affordable and attractive to new participants. As the network grows, there is collective benefit from increased purchase power to negotiate lower prices with the best manufacturers.



Healthcare delivery

Strategic pivot to address a more fundamental issue after initial growth. mPharma first launched as an ePrescription system, directing patients to pharmacies with the prescribed drug in stock. Although successful, this didn't address the core supply chain issues. mPharma changed its direction and business model to supply management, securing new investment to grow.

Ecosystem partners



Providers: 155 hospital partners and 850 pharmacies and drug stores across nine African countries



Biopharma: Partnership with major drug manufacturers, including Novartis, Bayer and Pfizer

Solution and impact

mPharma acts like a pharmacy benefits manager, buying medicines on behalf of pharmacies, creating greater certainty for suppliers and drug stores.

mPharma analyses driver route optimization, procurement, fulfilment rates and the industry network to help pharmacies source drugs at lower costs and improve inventory management.

<p>30-60% 30-60% in drug cost savings</p>	<p>2 million 2 million patients served</p>	<p>25% 25% reduction in medicine-related complications</p>
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TABLE 7 | Additional examples of solutions digitizing the front-end of the patient journey and augmenting the back-end of healthcare systems

Front-end solutions for healthcare challenges: resource constraints			
	Presence	Solution	Impact
Kry/Livi	Europe	Healthcare provider offering seamless integration between primary and specialty care, as well as between digital and physical care settings. Focus on addressing clinician shortage and burnout by incorporating existing healthcare infrastructure into one single workflow on their platform Livi Pro.	<ul style="list-style-type: none"> – 6 times more efficient visits with digital vs. physical, given higher utilization and less time spent on administrative tasks – Improved accessibility, 1.5 times appointments per patient, while reducing the overall cost of treating the patient base by 5-20%
Front-end solutions for healthcare challenges: inequities in outcomes and access			
	Presence	Solution	Impact
eSanjeevani	India	Cloud-based telemedicine platform launched by India's Ministry of Health aiming to improve access to doctors through its expansive network of health centres, providers and healthcare professionals (around 180,000 providers and 225,000 doctors). ⁷²	<ul style="list-style-type: none"> – 135 million patients served, with increased access to rural population (85% beneficiaries), women (57% beneficiaries) and senior citizens (12% beneficiaries) – Increased compliance in follow-up cases
Ping An Read more about the full story in the section: Making it real: Case studies of successfully scaled digital, data and AI applications	China	Ping An offers an online-to-offline healthcare service platform with a comprehensive ecosystem of physical and digital services to tackle the scarcity and uneven distribution of healthcare services in China. Ping An supports the end-to-end patient pathway, from online consultation to in-person visits at partner clinics, pharmacies and hospitals. ⁷³	<ul style="list-style-type: none"> – 99% accuracy of AI-based medical case triage – 30% improvement in adherence among type 2 diabetics compared to a human-only system – 80% prediction accuracy of AI- model screening of chronic obstructive pulmonary disease⁷⁴
Back-end solutions for healthcare challenges: resource constraints			
	Presence	Solution	Impact
athenahealth	US	Revenue cycle management (RCM) technology and services to reduce administrative tasks and optimize financial performance. Automating routine accounts receivable tasks, such as speech-to-text note-taking, enables revenue cycle efficiency by relieving staff of burdensome work. By tracking RCM tasks, potential financial improvement opportunities can be identified. ⁷⁵	<ul style="list-style-type: none"> – 156 hours saved per provider annually on inbound documentation – 99% average documentation accuracy with the athenaOne Voice Assistant
Platform24	Northern Europe	AI-driven platform to equip healthcare systems with data-driven support to streamline workflows, decrease the administrative burden and improve communication. ⁷⁶	<ul style="list-style-type: none"> – 30% efficiency gains across customer segments – 3 times nurse efficiency in digital consultations versus physical – >25% of patients receive help without healthcare worker involvement
SCP Health	US	AI-driven dynamic staffing tool to optimize the clinical workforce. SCP Health provides a scheduling design that optimizes clinical staffing coverage with planned scalable surge support. Their clinical workflow technologies also ensure investment in the growth and maintenance of new clinicians. ⁷⁷	<ul style="list-style-type: none"> – 97% clinician retention rate – Less than 1% locum use – 2 million+ virtual patient visits annually supported by predictable scheduling of nearly 10,000 clinician shifts monthly
symplr	US	symplr is a solution provider in governance, risk management and compliance enterprise operations software and services. They offer a wide range of cloud-based solutions across healthcare operations such as data management, workforce management, quality and safety, enabling care providers to handle administrative tasks faster, enhancing engagement and productivity. ⁷⁸	<ul style="list-style-type: none"> – 60% reduction in time spent managing contracts – 90% reduction in potential penalties – 75% reduction in time to reimbursement

TABLE 7 | Additional examples of solutions digitizing the front-end of the patient journey and augmenting the back-end of healthcare systems (continued)

Back-end solutions for healthcare challenges: increasing burden of chronic diseases			
	Presence	Solution	Impact
Bayesian Health	US	A real-time early warning system using an adaptive AI platform to detect clinical markers for deterioration and send sepsis-risk alerts to clinicians, enabling them to diagnose and intervene early. ⁷⁹	<ul style="list-style-type: none"> – 5.7 hours earlier lead time on detection of the most severe sepsis cases – 82% sensitivity of sepsis case identification – 89% frontline user adoption over 2 years – 18.2% relative reduction in sepsis mortality
LOGEX Healthcare Analytics	Europe	Analytics solutions enable data-driven decision-making by transforming healthcare data into actionable insights. LOGEX offers solutions facilitating benchmarking, collaboration and treatment insight sharing across healthcare systems to drive clinical improvement and innovation. ⁸⁰	<ul style="list-style-type: none"> – Decisions based on 18 million+ unique patient data – \$75 billion+ in healthcare funding decisions supported with LOGEX solution annually
Back-end solutions for healthcare challenges: inequities in outcomes and access			
	Presence	Solution	Impact
Univfy	US, Canada, Europe	The Univfy AI platform creates scientifically validated, personalized reports to offer counselling to patients from diverse demographics regarding their likelihood of IVF success, establishing appropriate expectations of the potential success rate. The platform also develops special pricing programmes, such as IVF refund programmes, to enable affordable treatment plans. ⁸¹	<ul style="list-style-type: none"> – Qualify 50-80% of patients for refund programme, a significant increase compared to traditional programmes, which qualify only a small percentage. – 2-5 times IVF conversion, increasing providers' revenues by 30% – More than 95% accuracy in prediction of IVF success rate

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