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DIGITALISATION OF THE HEALTH SECTOR
MARKET TRENDS
MARKET ANALYSIS

September 2021

MARKET INTELLIGENCE REPORT

Sara Bouchon, Director of Market Intelligence
Rui Zong, Graphic Design

TABLE OF CONTENTS

DIGITALISATION OF HEALTHCARE

The Covid-19 crisis has put the spotlight on our health ecosystems. As for other sectors, COVID-19 is expected to have major long-term consequences on the healthcare industry. The pandemic also largely challenges a sector strongly relying on traditional stakeholders and characterised by specific regulations highly impacting how these stakeholders innovate. Many challenges are brought by digitalisation and the growing role of data. While the health systems, together with the health workers, have heavily suffered from the pandemic, new opportunities have also emerged.

The objective of this report is to identify the **main market trends linked to the digitalisation of health** and to understand **how these trends are shaping the health ecosystems of tomorrow**. The Covid-19 crisis has accelerated some of these trends (e.g. telehealth), while new trends have emerged significantly (e.g. robotics, digital prescription, etc.). These trends are expected to drive recovery strategies, eventually profoundly transforming our current healthcare ecosystems.

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MARKET DRIVERS AND CHALLENGES

Beyond digitalisation, the health sector is bound by some major challenges including the aging population, greater prevalence of chronic diseases, shortage of healthcare workers, an increasing cost along an unequal access to care. To tackle these challenges, the European healthcare sector is now embracing digital innovations and new technologies now more than ever before. Progresses in technologies such as sensors and Internet-of-things, artificial intelligence, data analytics, blockchain, but also robotics and automation are expected to drive most of the market opportunities identified hereafter.

However, there are still significant market barriers preventing market expansion of new data and digital solutions. Examples of these barriers are the need for specific cybersecurity frameworks, guaranteeing the security of patients' data, the standardisation and interoperability of data, but also a cultural change to accept some new technologies in the care journey, the need for new skills among the health workers or the evolution of regulation of medical devices now including new digital dimension.

INTRODUCTION

A growing digital health market focused on the customer and prevention

Digital Health Market

2019 — **$103.1 B**

2025 — **$385.8 B**

Global Preventive Healthcare Technologies And Services Market

2024 — **$432.4 B**

Global Personalized Medicine (Pm) Market

$3.18 T

2025

The growing digital health market is expected to reach USD 385.8 Billion by 2025 from an estimated market size of USD 103.1 Billion in 2019 (Valuates report, 2020). The outbreak has also stressed the need for preventive healthcare, i.e. dealing with the prevention of illness to decrease the burden of disease and associated risk factors (Journal of mhealth, 2020). The global preventive healthcare technologies and services market size is expected to reach USD 432.4 billion by 2024. The growth of this market is attributed to the adoption of advanced technology and development of preventive measures, including vaccines, screening & monitoring devices, and smart devices to reduce medical errors (Grand View Research, 2021).

The increasing amount of data, which use needs to be addressed by additional regulation, allows thinking in terms of an entirely new ecosystem for health care, integrating all personal health data around the individual patient. Standing at the center of the future ecosystem, the individual will become the focus for a hyperpersonalized approach to health and wellness. The global personalized medicine (PM) market size is expected to reach USD 3.18 trillion by 2025 registering a CAGR of 10.6% over the forecast period (Grand View Research, 2020).

Five main market trends

With an horizon of 2-5 years, the main market trends resulting from the digitalisation of the Health sector are expected in the five following areas:

1

THE SHIFT FROM DISEASE TREATMENT TO PREVENTION AND HEALTH MANAGEMENT

2

THE SET UP OF A CUSTOMER-CENTRIC CARE DELIVERY

3

THE IMPLEMENTATION OF A PERSONALIZED CARE JOURNEY

4

A FOCUS ON BUILDING RESILIENT HEALTHCARE ECOSYSTEMS

5

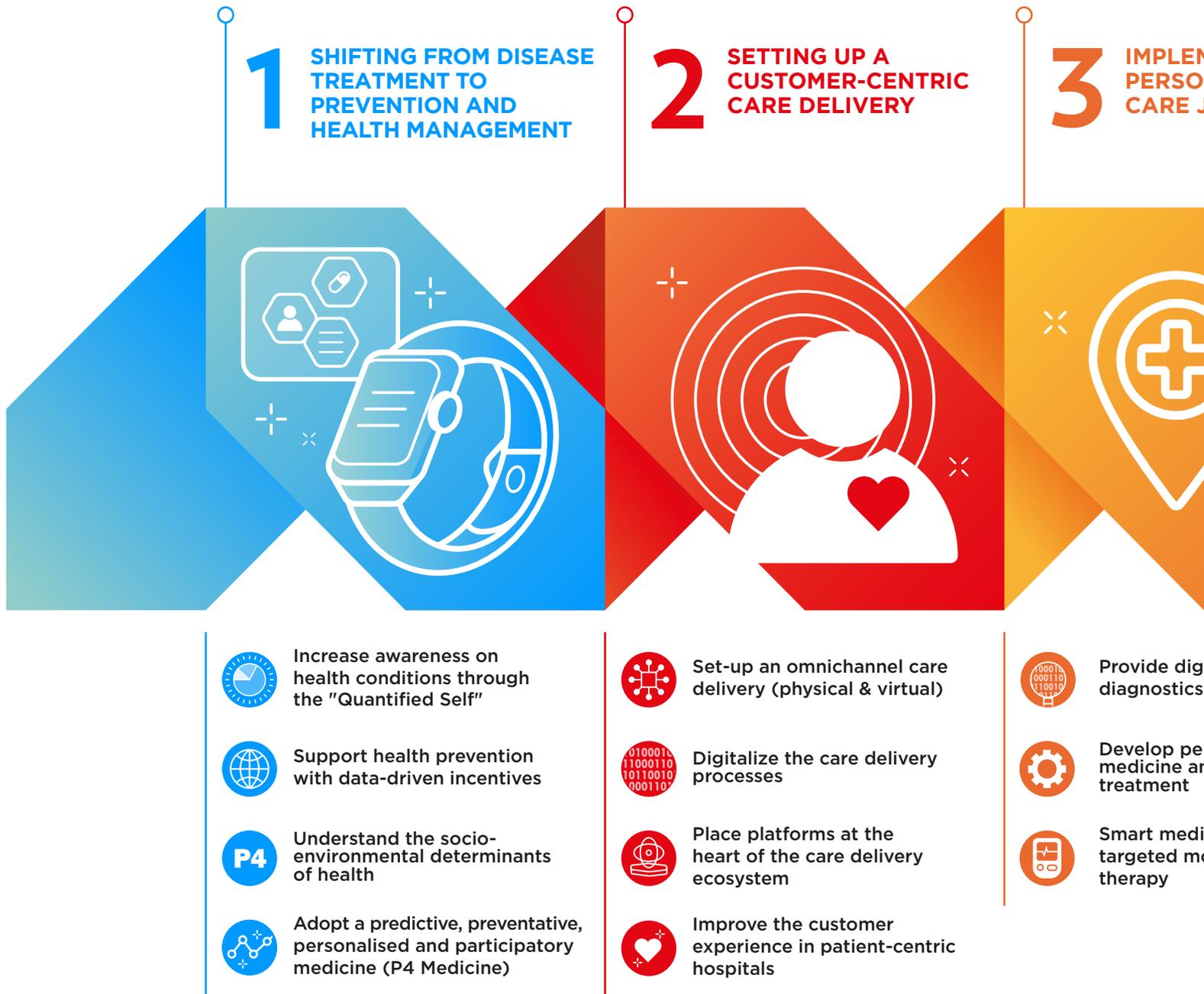THE CREATION OF A COLLABORATIVE, COMPLIANT AND INNOVATIVE ENVIRONMENT

This report is based on a desktop research and provides a state-of-the art of the current information available, while synthetizing the main trends in a comprehensive framework. Additional inputs were provided by the Jean-Philippe Arié, Health Cluster manager at Luxinnovation ad by Francoise Liners and Carole Brückler from the Ministry of Economy.

DIGITALISATION OF THE HEALTH SE

MARKET TRENDS

The following figure provides an overview of the 5 trends and 17 related topics identified as key market trends resulting from the digitalisation of the health sector.

1 SHIFTING FROM DISEASE TREATMENT TO PREVENTION AND HEALTH MANAGEMENT

2 SETTING UP A CUSTOMER-CENTRIC CARE DELIVERY

3 IMPLEN PERSO CARE J

Trend 1:
- Increase awareness on health conditions through the "Quantified Self"
- Support health prevention with data-driven incentives
- **P4** Understand the socio-environmental determinants of health
- Adopt a predictive, preventative, personalised and participatory medicine (P4 Medicine)

Trend 2:
- Set-up an omnichannel care delivery (physical & virtual)
- Digitalize the care delivery processes
- Place platforms at the heart of the care delivery ecosystem
- Improve the customer experience in patient-centric hospitals

Trend 3:
- Provide dig diagnostics
- Develop pe medicine ar treatment
- Smart medi targeted m therapy

CTOR

**...MENTING A
...NALIZED
...JOURNEY**

4 BUILDING RESILIENT HEALTHCARE ECOSYSTEMS

5 CREATING A COLLABORATIVE, COMPLIANT AND INNOVATIVE ENVIRONMENT

...itally-enhanced

...rsonalised
...d targeted

...cal devices for
...onitoring &

Address staff and performance issues with automation and AI in care infrastructures

Digitalising the pharmaceutical industry

Build resilient & regional supply chains

Leverage data for healthcare innovation in sandbox environments

Collaborate with customers, new entrants and the broad ecosystem
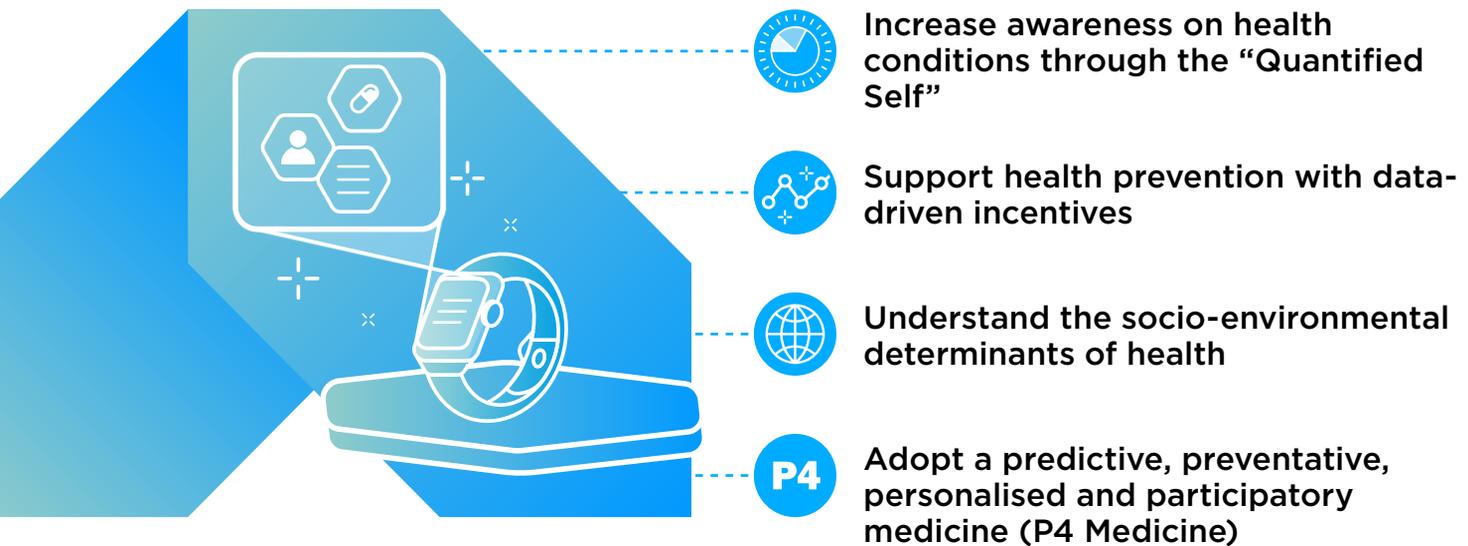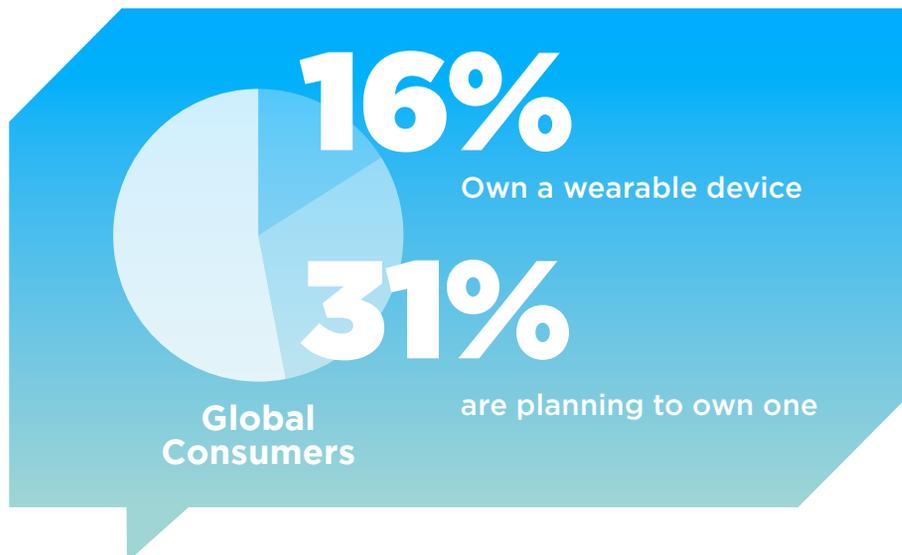
Rethink regulatory compliance and IP

1 SHIFTING FROM DISEASE TREATMENT TO PREVENTION AND HEALTH MANAGEMENT

This trend translates a shift from health care systems, focused on responding to illness, to a care system based on wellness and prevention. While technology allows monitoring the health conditions, taking preventive actions, and understanding better the socio-environmental determinants of health, data-driven incentives will encourage consumers to take charge of their own health and well-being.

Increase awareness on health conditions through the "Quantified Self"

Support health prevention with data-driven incentives

Understand the socio-environmental determinants of health

Adopt a predictive, preventative, personalised and participatory medicine (P4 Medicine)

Increase awareness on health conditions through the "Quantified Self"

A better monitoring of each individual's parameters, sometimes referred to as the "quantified self", will support wellness and prevention. This trend shows how people are encouraged and supported to adopt and maintain healthy lifestyles. Sensors and wearables (Internet of Medical things) allow acquiring data on various aspects of an individual's life, especially parameters such as eating, sleeping or sports habits. The aim is to improve self-sensing, self-awareness and human performance in terms of health and well-being, including tracking mental health. Beyond monitoring, the trend is also to capture data to early detect potential health issues.

16%
Own a wearable device

31%
are planning to own one

Global Consumers

PWC

"16% of global consumers own a wearable device that tracks or monitors their health and 31% are planning to own one"

PWC, 2021

"Data-gathering devices will become exponentially more sophisticated and will continuously track activity, health, and environmental factors. This ongoing monitoring can help ensure that health conditions and risks are identified and addressed early.

Deloitte, 2019

"The home bathroom of the future, for example, might include a smart toilet that uses always-on sensors to test for nitrites, glucose, protein, and pH to detect infections, disease, even pregnancy. A smart mirror equipped with facial recognition might be able to distinguish a mole from melanoma.

Deloitte, 2019

Support health prevention with data-driven incentives

Health incentives aim at encouraging people to move towards healthy living. The final objective is to reduce healthcare costs, trigger lower hospitals admissions, increase productivity and improve the mortality rates. Incentives in health care may include monetary or non-monetary gains and may be adopted by consumers, individual providers or institutions. The role of digitalisation and data is key to a personalised approach (e.g. rewards systems based on health monitoring data, gamification & loyalty programs, etc.). For instance, employers or insurance companies can develop incentives systems where people would obtain financial gains (e.g. lower premiums) when adopting healthy behaviour (Forbes, 2019). However, privacy issues remain a market barrier to be overcome.

The Global Corporate Wellness Market

2020	↗ **7.0 %** CAGR	2028
$52.8 B		**$93.4 B**

Grand View Research

The global corporate wellness market size was valued at USD 52.8 billion in 2020 and is expected to expand at a compound annual growth rate (CAGR) of 7.0% from 2021 to 2028.

GrandView Research, 2021

13

"

Shifts towards sedentary occupations in high-income countries (HIC) over the last decades and the health burden associated with physical inactivity have led to innovative strategies to promote physical activity (PA) among the working population. Financial rewards have been proposed to incentivise participation in programmes promoting PA or the achievement of PA-related goals.
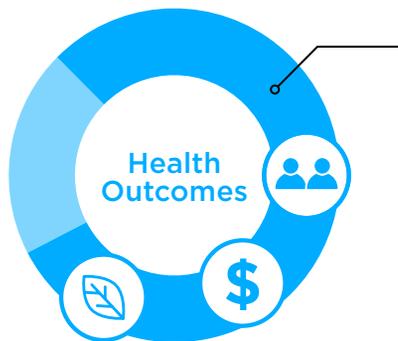
Heise et al., 2021

"

Big data has a potentially critical role to play in preventing disease. It can both allow the discovery of new, personalized disease risk factors related to lifestyle or the environment, and also help people to successfully modify their risk behaviors.

Barrett et al., 2013

"

Understand the socio-environmental determinants of health

Up to

80%

of health outcomes are affected by social, economic, and environmental factors.

PWC, 2019

Some studies say that up to 80% of health outcomes are affected by social, economic, and environmental factors. Drivers of health (also known as *social determinants of health*) include for instance the physical environment, food, infrastructure, economy, wealth, employment, education, social connections, etc. These determinants can impact positively or negatively our health. The collection of relevant data across health systems and these areas is therefore critical to identify the broader social determinants of health. The final objective is to act on these determinants, to increase the health of determined communities in a collective way.

The Global Mobile Health Market

2019
$34.1 B

↗ **34.2%** CAGR

2024
$267.3 B

Pitchbook

The global mobile health market will reach $267.3 billion by 2024, propelled by a 34.2% CAGR from a market size of approximately $34.1 billion in 2019.

Pitchbook, 2020

"
With clinical care representing just 20 percent of an average individual's health, technology can be used to address the remaining 80 percent, which includes health behaviours, physical environment, and social and economic factors.

PWC, 2019

"
Intervening earlier and creating more points deep into communities that enable better access to traditional care, as well as food, educational resources and connections to other social services agencies can help improve the drivers of health.

Deloitte, 2021

"
One Health is a collaborative, multi-sectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment.

Centers for Disease Control and Prevention, 2018

P4 Adopt a predictive, preventative, personalised and participatory medicine (P4 Medicine)

The trend to detect and prevent diseases as early as possible will be a key evolution of the healthcare system in the future. Technological progresses, supported by enhanced data-driven capabilities, will allow each individual gaining personalised and integrated insights from their genetic background, genome, or microbiome, etc. The objective is here to predict risks and take preventive action, getting ahead of sickness and far ahead of catastrophic disease. The term P4 medicine (predictive, preventative, personalized, participatory) is sometimes used to characterize this approach through extensive biomarker testing, close monitoring, deep statistical analysis, and patient health coaching (Fiala et.al., 2019). In response to the P4 approach, the O4 (over-testing, over- diagnosis, overtreatment and overcharging) is advanced as a way to warn about the limits of an excessive technology-driven testing.

"

The 100K Wellness Project is the ISB's flagship venture to affirm P4 medicine's broad goals of "quantifying wellness and demystifying disease." […] The investigators compiled what the article calls "personal, dense, dynamic data clouds" including a participant's full genome sequence and analysis of blood, urine, saliva, and microbiome (stool) samples, which were tested for 643 metabolites and 262 proteins every 3 months. Participants were also equipped with a Fitbit for exercise, sleep monitoring, and completed health history forms and surveys.

Fiala et al., 2019

"

An increased focus on prevention and early intervention—combined with advances in biosensors and digital technology—can create new opportunities for medical technology companies.

Deloitte, 2019

"

Simply put, the objective of genomic medicine is to determine the genetic bases of those differences in response to environmental agents, including medications, and differences that may predispose to the development of common and potentially personally devastating and societally expensive disorders, and to use them in populations to thwart adverse response, increase the frequency of beneficial response, and intervene to prevent or delay onset of disease.
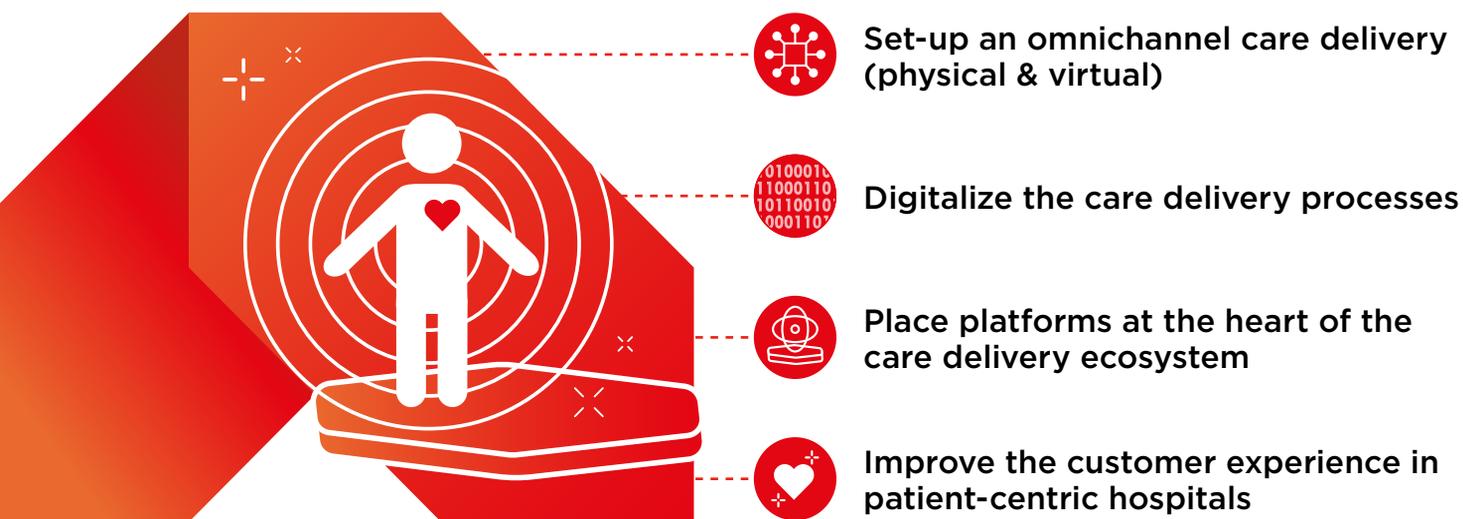
Byers, 2006

"

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2 SETTING UP A CUSTOMER-CENTRIC CARE DELIVERY

The consumer is expected to move at the center of the health care system of the future, while being increasingly involved in his own healthcare decision-making. The opportunities offered by digitalisation and data will be the backbone of the future customer-centric care delivery systems. This will translate into adopting an omni-channel care delivery (both physical and virtual), with an increasing digitalisation of the care process as a whole. Smart hospitals of the future will switch to this customer-centric focus by enhancing the customer's experience. Data platforms are meant to become the heart of the care delivery system, while the challenges raised by the interoperability and security remain barriers to be tackled for further market expansion. The issues at stake are here the access, affordability and quality of the healthcare system of tomorrow.

Set-up an omnichannel care delivery (physical & virtual)

Digitalize the care delivery processes

Place platforms at the heart of the care delivery ecosystem

Improve the customer experience in patient-centric hospitals

Set-up an omnichannel care delivery (physical & virtual)

The Covid-19 pandemic has put the spotlight on digital health tools, accelerating the evolution and deeply transforming how care is delivered. The current market growth of digital technologies such as telemedicine, mobile health apps for chronic disease monitoring, or

wireless biometric sensors means that the care experience is no longer tied to the physician's office. This paves the way for a "health system without walls", combining telehealth and in-person care. This calls the healthcare providers to expand their point of access to get closer, both physically and digitally to their customers. Virtual care at home will range from on-demand virtual urgent care, virtual office visits, to tech-enabled home medication administration (coupled with home delivery of the therapeutics). Virtual care, as a complement to human interaction, is expected to improve access, quality and affordability of care, while reducing the unnecessary visits to the healthcare centers.

The Global Telehealth Market

2019
$65.5 B

↗ **25.0%** CAGR

2026
$312.3 B

Pitchbook

We estimate the global telehealth market to grow at a CAGR of 25% to $312.3 billion in 2026 from $65.5 billion in 2019.

Pitchbook, 2020

The Global Hospitals And Outpatient Care Centers Market

2020
$3384.21 B

↗ **11.8%** CAGR

2021
$3784.65 B

Business Research Company

The global hospitals and outpatient care centers market is expected to grow from $3384.21 billion in 2020 to $3784.65 billion in 2021 at a compound annual growth rate (CAGR) of 11.8%.

Business research Company, 2020

"We've seen health systems doing a decade's worth of work in the span of a few months. (NB: in the context of the Covid-19 crisis)

FIERCE Healthcare, 2020

"Training personnel in building virtual interpersonal relationships can be a major step toward improving consumers' virtual visit experience.

Deloitte, 2021

"Smart hospitals do not attempt to deliver all services under one roof; rather, they deliver a narrower set of high-value services within a broader ecosystem of entities, many of which have not traditionally been associated with healthcare delivery.

Mc Kinsey, 2019

"An omnichannel care model that fully leverages virtual visits includes a mix of telehealth and in-person care with a consistent set of providers, improving patient convenience, access, and continuity of care. This model also enables clinicians to better manage patients with chronic conditions, with the support of remote patient monitoring, digital therapeutics, and digital coaching, in addition to virtual visits.

Mc Kinsey, 2021

Digitalize the care delivery processes

A key element of the virtual care approach is also the digitalisation of the administrative and organisational care delivery process in itself. This includes for instance a growing market penetration of digital appointment solutions, health exams visualisation systems, virtual medicine prescription, digital payment and reimbursement solutions, etc. The overall aim is to improve the user's experience and facilitate the care delivery processes.

The Global Digital Prescription Technology Market

2019
$1.3 B

↗ **24.0%** CAGR

2027
$7.54 B

Globenewswire

The global digital prescription technology market is expected to grow from USD 1.3 billion in 2019 and to reach USD 7.54 billion by 2027, growing at a CAGR of 24.5% during the forecast period 2020-2027.

Globenewswire, 2020

"

Global digital prescriptions technology market is expected to witness significant growth, owing to rising focus on the reduction of fraud and abuse of controlled substances, need to decrease surging healthcare costs, government initiative and incentive programs, and reducing medication errors. Rising adoption of an automated health record system possesses market growth opportunities. However, reluctance to adopt new technology, high cost of deployment, and risks related to privacy and security of patient's data hamper the market growth. Lack of technological awareness among end-users challenges market growth.

Globenewswire, 2020

"

"

Healthcare can learn from the payments models of other industries and improve this process by tapping into the assets at their disposal. With massive data sets, technology and smart algorithms, we'll eventually see a shift to healthcare payments occurring in near real-time—at the point-of-care—creating a more seamless, less confusing experience for patients and faster, more efficient billing processes for providers.

Modern Healthcare, 2020

"

"

The global online pharmacy market by revenue is expected to grow at a CAGR of over 20% during the period 2019-2025. The global online pharmacy market size is likely to cross revenues of over $131 billion by 2025, growing at a CAGR of over 20% during the forecast period. The industry is heading toward unprecedented growth in developing and developed economies.

Market Watch, 2021

"

Place platforms at the heart of the care delivery ecosystem

Data platforms will become the heart of the care delivery ecosystems. Data collected on patients at different stages (e.g. coming from the health monitoring devices or from their virtual or physical consultations) will feed these platforms, to ensure consistency all along the patient's care journey. Boosted by policies requiring centralised patient's data, data platforms will promote closer collaboration among industry stakeholders (patients, clinics, health insurances, laboratories, pharmacies, and professionals), and will favour the emergence of new services based on the gained insights. However, issues such as the interoperability and security of these data among others remain to be tackled to allow higher market expansion.

"Health care organizations are transitioning to health IT systems powered by cloud and data and analytics tools to enable real-time, smart digital health. They are using interoperable data and platforms supported by deep learning capabilities, "always on" biosensors, and behavioral research to shape consumer beliefs and actions.

Deloitte, 2021

"To ensure data connectivity, all entities (including hospitals) must agree on the standard and structure of submitted information, as well as the rules for data collection, storage, transmission, usage, etc. The rules should be designed to ensure that the data is used appropriately and kept secured so that patient privacy is protected.

Mc Kinsey, 2019

"Personal health records will be collected from primary care providers and independent service centers. These records serve as the foundation for the information system. Data from hospital EHR systems is added to the personal health records. The information system enables real-time data sharing and connectivity between the hospital and other players. If legally permissible, health data can be further integrated with claims and payment data (from payers) and even data about health behaviors (from government agencies and technology companies).

Mc Kinsey, 2021

Improve the customer experience in patient-centric hospitals

Complex and very ill patients will continue to need acute inpatient services delivered at the hospital. The well-being of patients and staff members—with an emphasis on the importance of environment and experience in healing—will likely be important in future smart hospital designs. Hospitals will adopt a consumer-centric focus, putting patient experience first. Thanks to data, better information-sharing systems will allow the care staff members to personalize the hospitals care journey of patients. The use of Virtual or Augmented Reality will also transform the way patients receive the care.

> Typically, these cities include future-ready smart hospitals. These hospitals embed new technologies into their design and operations to improve the customer experience, as well as outcomes and costs. The technologies are used not only to improve care delivery within a smart hospital itself, but also to connect the hospital to a wider healthcare delivery ecosystem, one in which hospitals play an important but less central role.
>
> **Mc Kinsey**, 2019

> Connectivity is crucial because the hospitals must understand what happened before hospital admission, manage all inpatient care, and oversee post-discharge interventions.
>
> **Mc Kinsey**, 2019

> Upon arrival at the hospital, the patient can verify his/her identity with an ID card, fingerprint, or facial recognition. The IT system greets the patient and performs automated triage, noting in the record the type of insurance the patient has. The system then explains to the patient where he/she should go next, what examinations will be performed, and what instructions need to be followed. Once the exams are completed, the system automatically delivers the results to the patient.
>
> **Mc Kinsey**, 2019

> Within hospitals, patients and the staff engaged in direct patient care use interactive equipment (e.g., wearables) to enable real-time data collection, tracking, and transmission. In addition, clinical staff members are able to access the data through mobile devices to allow for more efficient clinical operations.
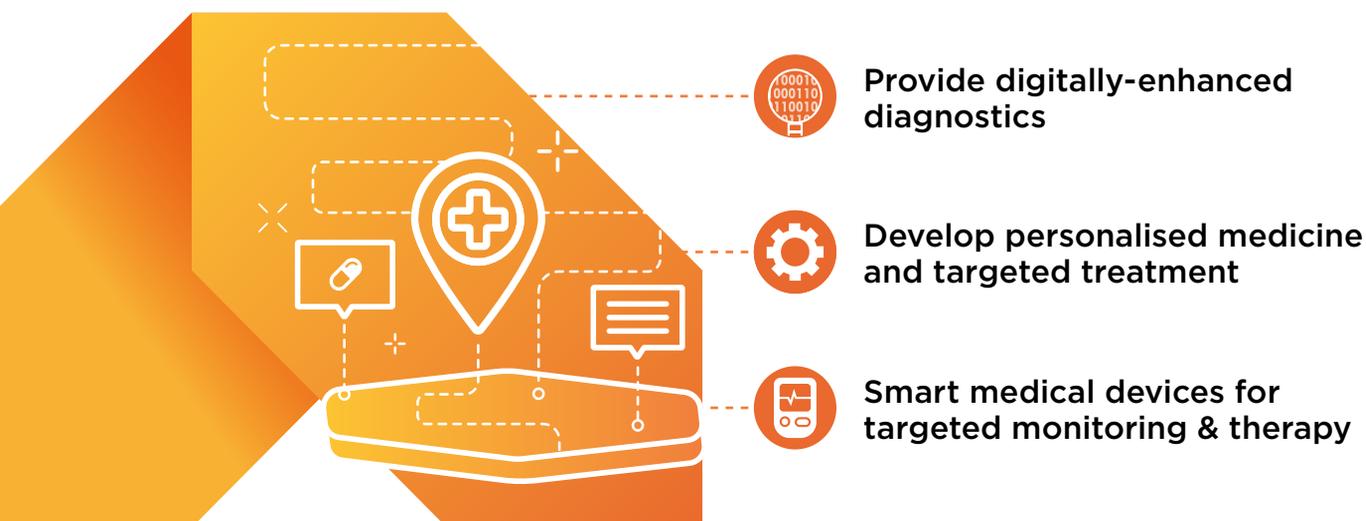>
> **Mc Kinsey**, 2019

3 IMPLEMENTING A PERSONALIZED CARE JOURNEY

Interventions and treatments of tomorrow are evolving towards being more personalised, precise, less complex, less invasive, and cheaper. Future market trends are related to the technologies such as artificial intelligence and analytics, impacting the way diagnostics are performed and leading to personalised medicine and treatment, while the medical devices of tomorrow will become key elements to perform personalised and ad-hoc treatments.

Provide digitally-enhanced diagnostics

Develop personalised medicine and targeted treatment

Smart medical devices for targeted monitoring & therapy

Provide digitally-enhanced diagnostics

The role of artificial intelligence, big data analysis and increased computing power will transform the way diagnostics are performed. Digital diagnostics will not only allow early disease detection, but they will also reduce the time needed, decrease the rate of errors and reduce the costs. Based on collected data such as symptoms library, Electronic Medical Records or Electronic Health Records Analysis and other health advisory content, care providers will be able to perform more informed diagnostics. This evolution will require care providers to learn new skills but also the patients to trust AI and other technologies, as an essential element of the care routine.

The Global Artificial Intelligence In Diagnostics Market

2019
$288.1 M

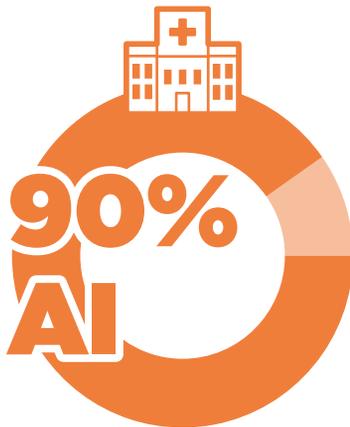↗ **32.3%** CAGR

2027
$ 3,004.2 M
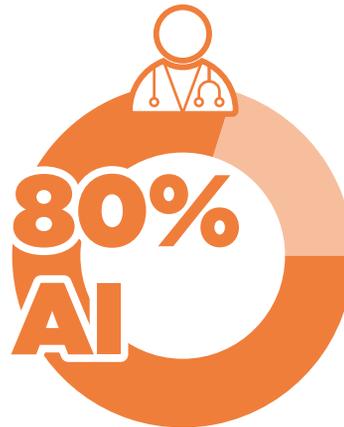
Grandview Research

The global artificial intelligence in diagnostics market size was valued at USD 288.1 million in 2019 and is projected to grow at a compound annual growth rate (CAGR) of 32.3% from 2020 to 2027.

Grandview Research, 2020

Hospitals

Doctors

Trust

90% AI

80% AI

HBR

Some forecast that medical AI will pervade 90% of hospitals and replace as much as 80% of what doctors currently do. But for that to come about, the health care system will have to overcome patients' distrust of AI.

Harvard Business Review, 2019

> Shocking as it may sound, diagnostic and treatment errors are common in healthcare. Research in the United States, for instance, has shown that five percent of outpatient diagnoses are incorrect, diagnostic errors contribute to about ten percent of patient deaths, and approximately 20 percent of orthopaedic surgeons will conduct a wrong-site surgery at some point in their career.[...]These statistics make it clear that the concept of hospitals as the major site of care delivery needs fundamental transformation to improve the quality of care. AI, robotics, and other new technologies can improve treatment precision and dramatically decrease the probability of error.

Mc Kinsey, 2019

> "In terms of revenue, software emerged as the leading segment in market with a share of 43.9% in 2019. This high share is attributable to the development of AI-based software for diagnosis in healthcare. The increasing demand for AI-powered and cloud-based augmented diagnostic solutions that help in increasing the diagnostic precision while interpreting medical images of a patient is one of the key factors driving the segment. Moreover, the introduction of more advanced AI software in diagnostics involving a combination of multiple data sources such as MRI, CT, genomics and proteomics, and patient data that aids in successfully diagnosing disease and assessing its progression is also expected to drive the artificial intelligence in diagnostics market.
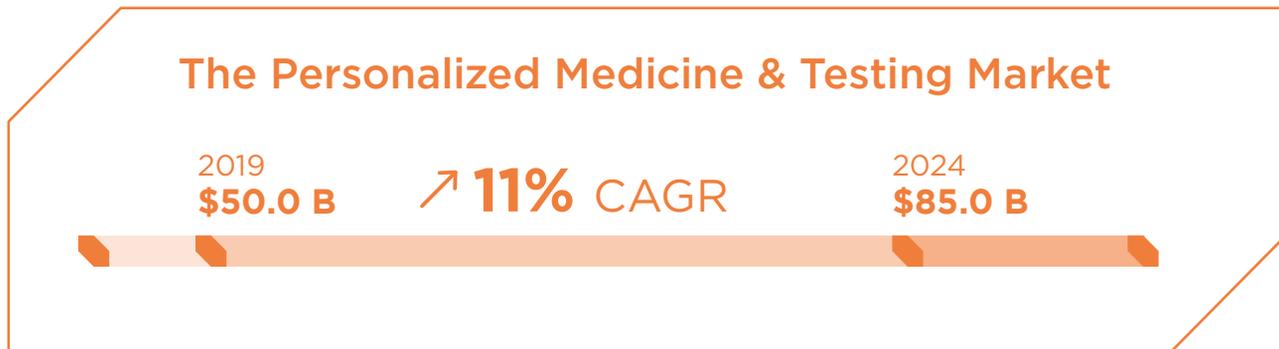
Grandview Research, 2020

Develop personalised medicine and targeted treatment

Personalised medicine, also variously known as individualized medicine, or genomic medicine is a medical model that aims to provide tailor-made prevention and treatment strategies for defined groups of individuals. Personalised medicine aims at treating the patient based on his characteristics, but also at building on insights gained from the patient's environment, or other patient's medical records and related treatments. New genetic technologies such as pharmacogenomics enable scientists to use patients' genetic information to better determine the right active substance, dose and time. Targeted treatment such as nanomedicine or 3D printing for surgeries are also expected to improve the success rate of treatments and interventions, including the post-intervention phase. However, financial, operational and regulatory barriers remain (Pharmaceutical Technology, 2020).

The Personalized Medicine & Testing Market

2019
$50.0 B

↗ **11%** CAGR

2024
$85.0 B

Pitchbook

We expect the personalized medicine & testing market to grow at a CAGR of about 11.0% from $50.0 billion in 2019 to $85.0 billion in 2024.

Pitchbook, 2020

"

AI has the ability to deliver personalized care as well, especially when it comes to prescribing treatments for patients. For example, AI software can review millions of medical studies to find an effective treatment plan based on a patient's condition, age, and other important factors.

StarDust, 2021

"

"

Gene therapies are widely utilized to diagnose both chronic and genetic disorders according to individual's genetic makeup. Growing adoption of gene sequencing and data analytics technologies is anticipated to escalate precision medicine market growth.
Decreasing cost of whole genome sequencing, advancement in cell biology sector, and the development of "Human Genome Project" are several other factors influencing the demand for gene therapy hence, boosting the overall market. Moreover, key leaders are undergoing numerous strategic developments to launch novel personalized products, which will also contribute to the market expansion.

PR Newswire, 20119

"

Nanomedicine is injected into a patient's body to study molecular structure. This is specifically helpful in biomedical research. Nanorobotics, injected in the bloodstream, help in releasing the drug to treat the disease while also monitoring the disease.

CareCloud, 2021

"

"

After the treatment has been administered, all of the patient's data can be aggregated on a cloud platform so that a report on current treatment can be generated. The patient can check the results at any time using a mobile device. The device also sends the patient reminders about medication adherence and notifications about upcoming care, rehabilitation services, and insurance matters. The hospital also uses a telehealth platform to regularly assess the progress of the patient's recovery and provide consultations as needed.

Mc Kinsey, 20119

"

Smart medical devices for targeted monitoring & therapy

Smart medical devices are usually based on wireless technology and use machine-to-machine technology to offer services, enhancing the user experience. In the intervention's room, surgical robotics continue to evolve and AI-enabled robots will eventually use computer vision to navigate to specific areas of the body while avoiding nerves and other obstacles. Some surgical robots may even be able to complete tasks autonomously, allowing surgeons to oversee procedures from a console (Intel, 2021). Increasing prevalence of chronic diseases such as diabetes and asthma is also predicted to stimulate the smart medical devices market demand, e.g. for blood glucose monitors and insulin pumps (Global Market Insights, 2021).
Many medtech companies are already beginning to incorporate always-on biosensors and software into devices that can generate, gather, and share data. The objective is to provide value beyond the medical device and to become solutions-based provider. However, the barriers such as high deployment cost, data security challenges, and an insufficient IoT infrastructure across the healthcare industry may hamper the market growth.

> Over the next two years, more than 80 percent of medtech companies expect to collaborate with organizations from outside of the health sector, according to a survey by the Deloitte Center for Health Solutions and AdvaMed.
>
> **Deloitte**, 2019

> Healthcare organizations are not only buying physical goods, but also opting into an ongoing collaboration with the companies managing those products. This is an important consideration for healthcare organizations increasingly deploying hardware with a service component.
>
> **Accenture**, 2020

> When you then turn up in the operating theater, the chances are that the surgeon may be a robot. Now, that's a little bit of a scary concept. But I think increasingly—and probably by 2030—hands will be seen as illegal instruments. We will think it's weird to put big, clumsy, often not particularly hygienic fingers inside the human body. I think we'll go, "Ew. Weird idea." The robot will do it in a much more precise way, which will mean far less damage to surrounding tissues, far less invasive surgery, and significantly shorter lengths of stay in hospital.
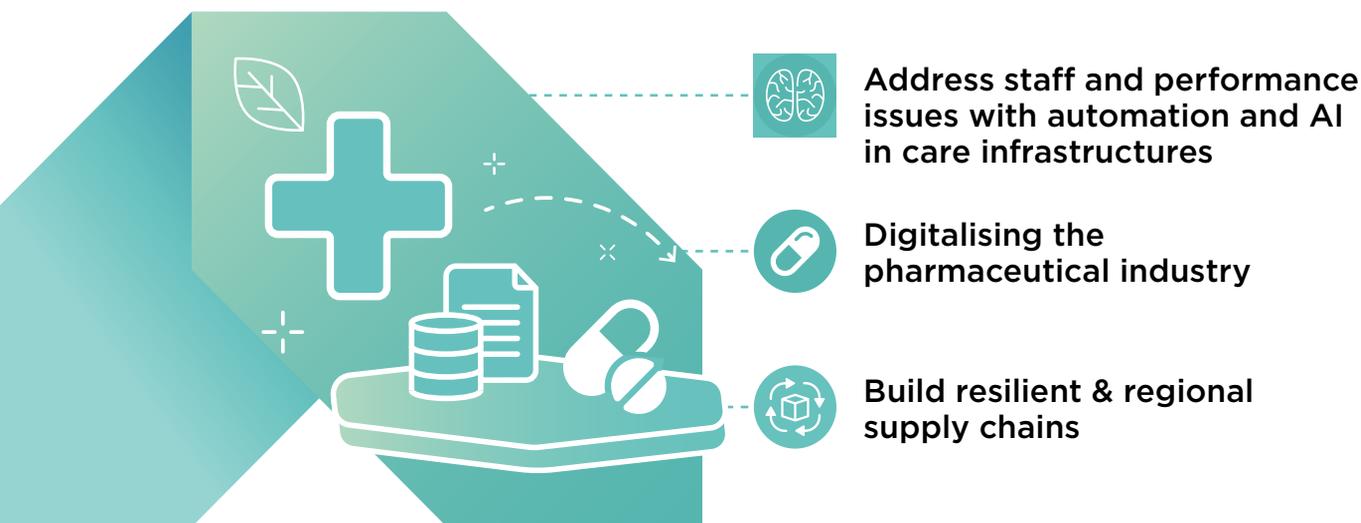>
> **Mc Kinsey**, 2020
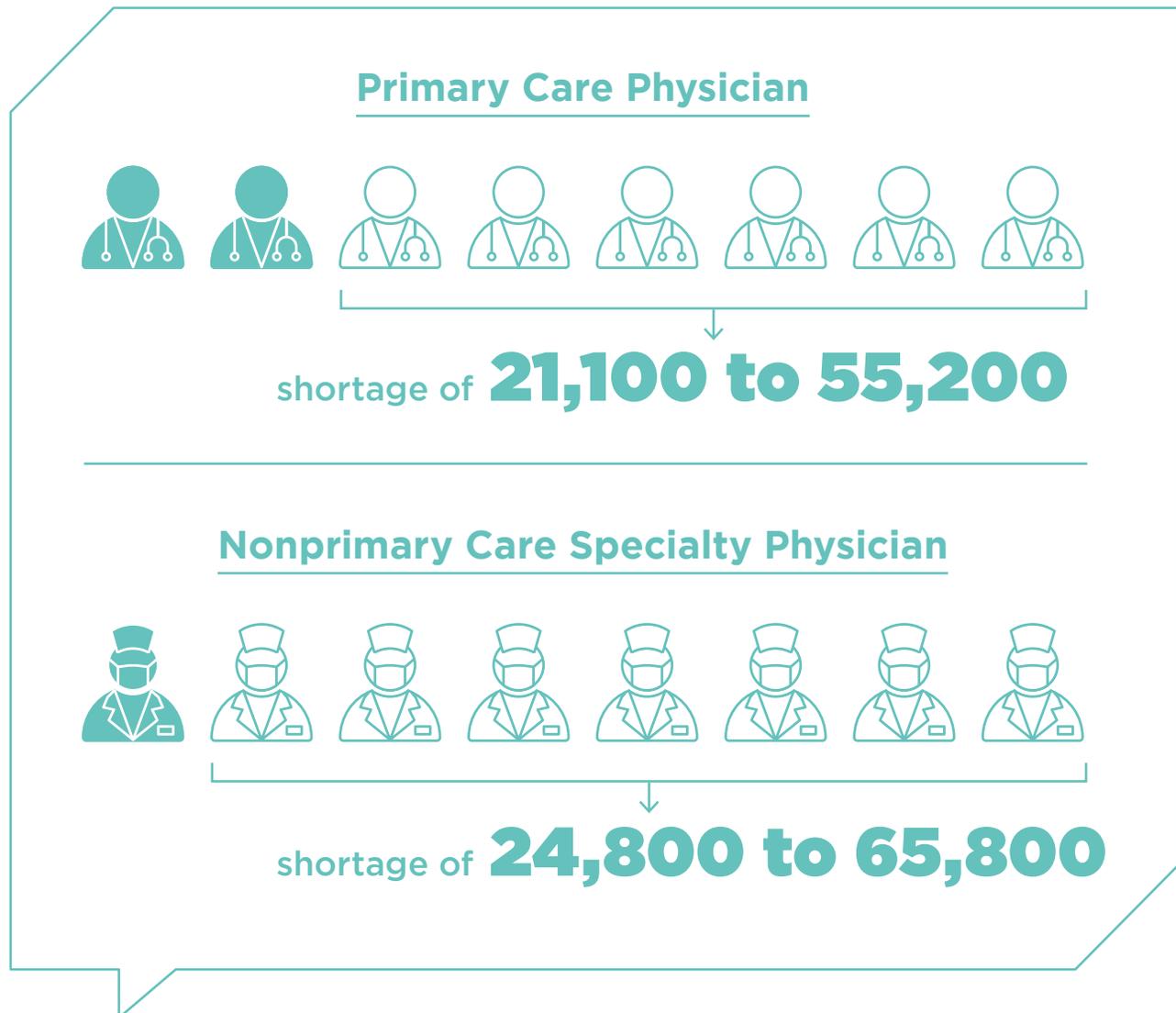
4 BUILDING RESILIENT HEALTHCARE ECOSYSTEMS

The patient care journey as well as a more personalised approach to curing diseases are elements of a complex healthcare ecosystem, where multiple players and stakeholders constantly interrelate, integrate, and inter operate. Care providers and Pharmaceutical companies are two pillars of these ecosystems. While the Covid-19 crisis has highlighted the need to rebuild resilient health ecosystems, the market opportunities brought by the digitalisation and technological evolution of hospitals, the pharmaceutical industry and health supply chains are key factors to help increasing the resilience of the healthcare system as a whole.

Address staff and performance issues with automation and AI in care infrastructures

Digitalising the pharmaceutical industry

Build resilient & regional supply chains

Address staff and performance issues with automation and AI in care infrastructures

Within the healthcare ecosystem, hospitals as infrastructures are currently facing issues related to staff and performance, strongly challenging their capacities to cope with severe crisis such as the Covid 19 crisis. Traditionally, hospital care has been very labor intensive. Future smart

hospitals will leverage technologies to upgrade operations and automate workflows, to optimise care delivery, patient experience, staff deployment and the management of back-office services, reducing costs and improving outcomes. While this may allow hospitals facing the current workforce shortage, this will also implies training and re-skilling hospitals' staff.

Primary Care Physician

shortage of **21,100 to 55,200**

Nonprimary Care Specialty Physician

shortage of **24,800 to 65,800**

Pitchbook

By 2032, the Association of American Medical College predicts a primary care physician shortage of 21,100 to 55,200 and a non primary care specialty physician shortage between 24,800 and 65,800 in the US.

Pitchbook, 2020

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Radiofrequency identification (RFID), bar codes, and other new sensing technologies are used to optimize internal asset management and ensure that all people and materials can be identified, tracked, and traced in real time. Automated procedures and devices replace certain human activities in a range of care settings, freeing up the staff to spend more time on direct patient care. Automation is also used to improve the efficiency of many back-office and front-office processes. Web-based tracking of all patient services, electronic capacity allocation, and digital patient record management further improve the efficiency of hospital operations.

Mc Kinsey, 20119

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Robotic process automation (RPA) and AI can allow caregivers to spend more time providing care and less time documenting it.

Deloitte, 2021

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Digital supply chains, automation, robotics, and next-generation interoperability can drive operations management and back-office efficiencies.

Deloitte, 2017

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When machines take on simple tasks, people can work at a higher cognitive level—but not around the clock. Healthcare organizations must look at the new skills needed to enable fluid interactions between human and machines, and the workforce models needed to support these new forms of collaboration.

Accenture, 2021

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In healthcare as in many industries, robots have typically been tethered to a fixed place. For example, surgical robots used in an operating room or prescription dispensing robots used in a pharmacy. Now, robots are moving freely through hospital spaces and in the community. It's a big leap. The ability for robots to move has become highly important in this era of decided distance. When distance is mandatory to keeping humans safe, robots can help by performing physical tasks, such as delivering supplies and checking temperatures. Robots are even helping to enforce social distancing measures."

Accenture, 2021

Digitalising the pharmaceutical industry

There are at least four key areas where digital and data-driven transformation will drive value for pharmaceutical companies:

- Use data and digital tools in the drug discovery process and clinical trials management;

- Integrate technology and medicines, for instance chip-on-a-pill technologies used to monitor patients' biophysical responses to medications and compliance with their treatment regimes;

- New Marketing channels based on digital-engagement technologies will create new ways for pharmaceutical companies to communicate with patients directly.

- The adoption of smart manufacturing processes will also highly impact the drug and medical devices manufacturing;
The pharmaceutical industry being highly regulated, major barriers to market remain the compliance and regulatory issues.

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Sensors, connected devices, and apps
can also be used as part of clinical
trials which are performed in real-world
settings in order to allow patients to
go about their normal lives. This trend
will reduce the need for interventions at
clinics and trial sites, and alleviate the
burden on the patients involved.

Constantia, 2018

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For example, Japanese pharmaceutical company
Otsuka and California-based Proteus Digital Health
recently won FDA approval for a tiny ingestible sensor
inside tablets of Abilify MyCite®, a schizophrenia drug.
The sensor communicates with a wearable patch which
transmits information to a mobile device, allowing
psychiatrists and caregivers to monitor patient
compliance more easily.

Constantia, 2018

"

Fascinatingly, in resolving workflow problems, these clever startups are unearthing troves of previously hidden data that pharmaceutical companies are eating up in order to solve pain points of their own. It's a beautiful synergy that creates massive data network effects, reinventing some of the processes in drug discovery and development. Flatiron is a very recent example of a company that unlocks a treasure trove of data for pharma. It solves a workflow problem facing oncology centers in need of an electronic medical record system that could gather and structure data in an easily searchable format. Combining big data and machine learning, the Flatiron platform captures structured and unstructured oncology data from scattered sources, such as community clinics, medical centers, hospitals, laboratories and more. In doing so, Flatiron generates a ton of secondary data that happens to offer a rich vein of opportunity for pharma companies like Roche. While this newly available data was able to help Roche improve clinical trial results, it more importantly provided hard real-world outcomes data about the efficacy of Roche's drugs. Roche acquired the company in 2018 for $2.1 billion as a result.

Crunchbase, 2020

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From a manufacturing perspective, pharma engineers require digitalisation in the form of a deeper and narrower focus to achieve fewer variables in order to draw the optimal conclusions and improve batch processing or product quality and cut manufacturing costs. Thus, pharmaceutical manufacturing needs high-quality actionable intelligence from their data.

Pharma Industry Review, 2020

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Build resilient & regional supply chains

The Covid-19 crisis has shown how vulnerable the medical supply chains were and the virus has challenged the industry to reconsider its definition of supply-chain resiliency. Technologies and digitalisation will be key enablers of more resilient supply chains. By re-designing cross-functional processes and enablement through digital technologies, costs and inefficiencies within healthcare supply chains can be reduced drastically. This digital ecosystem enables the connection of the healthcare manufacturers to the distributors, as well as the providers. It allows visualization of the data within the supply chain to keep track of the orders and facilitate communication. Sharing data throughout the supply chain would make it less fragmented, more resilient and better integrated.

> Knowing this, now is the time to implement a complete transaction management strategy to streamline provider and supplier communications in a compliant fashion, and automate order placement, confirmation and payment processes. In addition to time savings, streamlining transaction management processes offers greater visibility into the status of orders and supplies, supports remote working environments, and creates a foundation of data to drive planning and allocation algorithms.
>
> **Supply Chain Brain**, 2020

> Going forward, supplies will need to have a primary or secondary sourcing that is local.
>
> **FIERCE Healthcare**, 2020

> To achieve this, the supply chain management needs to be focused on data-driven efficiency. The shift from manual processes, which need an inventory buffer to account for uncertainty, to a JIT (just-in-time) system is enabled by data (data integration) and easy-to-monitor solutions (service design). These elements allow anticipatory shipping, dynamic pricing and recommendations to customers to drive sales of stocked items.
>
> **Futurice**, 2020

> Analysing the data from distributors and providers will allow manufacturers to adapt the supply chain more holistically. The data would feed into a platform that connects multiple actors and touch points of the supply chain and thus create a digital ecosystem. Internal and external data sources make real-time demand and supply shaping possible. Dynamics between supply and demand can be shown in real time by analyzing inventory, production, and point of sale (POS) data. This allows adaptations like changing the price or promoting specific products.
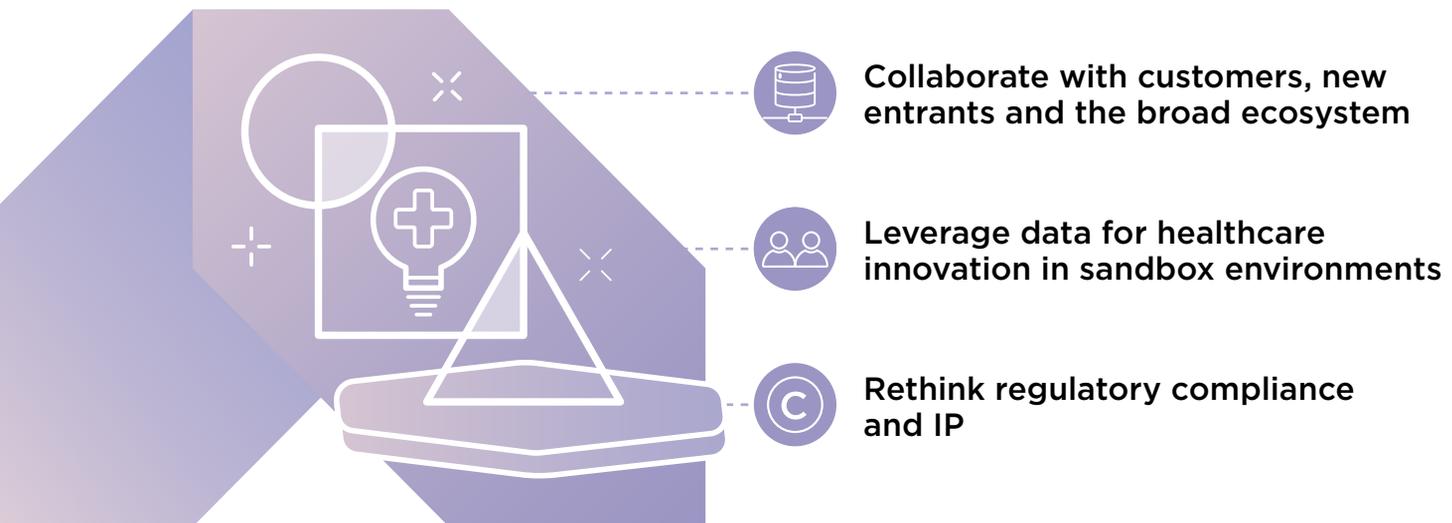>
> **Futurice**, 2020

5 CREATING A COLLABORATIVE, COMPLIANT AND INNOVATIVE ENVIRONMENT

Digitalisation of the healthcare ecosystem ultimately challenges the current foundations of the ecosystem, based on the regulation of innovation, the role of the traditional health stakeholders and a strict Intellectual property regime. The amount of data now available, as well as the role of non-traditional players in the field of healthcare, calls for a new innovation paradigm, enhanced collaboration among stakeholders and questions the current Intellectual Property regime as it is.

Collaborate with customers, new entrants and the broad ecosystem

Leverage data for healthcare innovation in sandbox environments

Rethink regulatory compliance and IP

Collaborate with customers, new entrants and the broad ecosystem

One of the main lessons learned from the Covid-19 crisis is the renewed focus on collaboration across the health ecosystem. Traditional care stakeholders are called to collaborate with new entrants (e.g. technology giants, originating from outside the health care sector). While some of these new entrants are often seen as a threat in an especially traditional ecosystem, they do offer new opportunities, especially around building a new relationship with the customer. According to Accenture, "healthcare organizations must recognize this new "co-ownership"

paradigm with customers and work to design their products and ecosystems to accommodate ongoing change." (Accenture, 2020)

> One legacy of the pandemic is likely to be a renewed focus on collaboration across the health ecosystem. Traditional boundaries have become more porous or even erased, creating opportunities for new health care behaviors, new business and funding models, and more effective stakeholder collaborations, leading to novel combinations of products and services from incumbents and new entrants.
>
> **Deloitte**, 2020

> Throughout these trends, you will see that to unleash innovation in the new future of healthcare, emerging business and care models must be rooted in collaboration. As technology's level of impact grows ever higher throughout society, successful organizations will be those that use new models to invite people—patients, employees, partners or the public— to co-create their new course for the future.
>
> **Accenture**, 20211

> Organizations like CVS and Walmart now offer basic primary care, simple diagnostic services and chronic disease management — services that health systems have struggled to provide and do so profitably. Identifying opportunities to partner with retail organizations to fill this gap can help simplify organizational services, increase access and provide better patient care at a lower cost.
>
> **Trustees**, 2021

Leverage data for healthcare innovation in sandbox environments

The healthcare of tomorrow calls for a fresh and collaborative approach to innovation, which cuts across scientific disciplines and breaks down silos to allow education, research, big firms, retailers, and patients to collaborate in real time. The digitization of health data from thousands of patients will provide the ground for data exchange and insights. It will also call for new forms of innovation in the healthcare industry. Elements such as Open Innovation initiatives or hackathons will foster innovation, as well as the collaboration of the traditional healthcare providers with tech startups. This shift in innovation is also about "making the space to test, learn and recalibrate", which is sometimes complex in a this highly regulated industry (Accenture, 2020). Creating innovation environments, such as regulatory sandboxes would allow businesses to test products with real customers but free from usual regulations. This would offer opportunities to test new services or products where it is unclear at the outset, which specific regulations would apply, and to understand where new regulation needs to be developed.

> Therefore, healthcare entities have to build a test and learn capability into the operating structure. Testing and learning poses challenges for healthcare as it is a higher liability industry that commonly seeks to minimize variation within a process". So how do you reconcile the need for higher reliability with test and learn? Reliability is about outcomes and not process.
>
> **Accenture**, 2020

> Healthcare organizations will find that their ability to iterate and improve products (and outcomes) over time will continue to grow exponentially as the data they use becomes more granular. With the right data, an organization can create a mirror image—a digital twin—that is testing hypotheticals or simulating scenarios related to never-ready products and sending information back to vendors to continue to improve the solutions. Testing products and services in hypothetical ways will allow the organisation to understand how to maximize the value of the technology and to mitigate risk of deployment in critical areas.
>
> **Accenture, 2020**

> Digital Twin technology allows us to create virtual representations of physical objects or structures. It helps to bring lifesaving innovations to market fast, at a lower cost, and with the highest level of patient safety.
>
> **Siemens Healthineers, 2021**

Ⓒ Rethink regulatory compliance and IP

Governments and regulators are looking closely at healthcare regulation, seeking to address weaknesses revealed by the current pandemic, including dependencies on third countries and security of supply (Linklaters, 2020). Whilst in normal circumstances IPR rightholders are granted protection over their intellectual property ('IP') against third-party use, the pandemic has created an unprecedented situation whereby IPR holders may be forced, even temporarily, to allow third-parties to use their IPRs, patents or designs, for the public interest. This raises the question of the role IP plays in the public versus private interests.

Digitalisation also challenges the current regulation of the healthcare market, introducing new tools and products currently not addressed in health regulations in force. The EU is for instance planning to roll out Medical Device Regulation (postponed because of the Covid-19 crisis), which will extend to digital health technologies. In contrast to some other healthcare industries which are often developed over a slower period of time, product life cycles in the digital health industry are typically much shorter. Thus, digital health businesses need to develop and regularly revise their IP strategy.

> "
> One observation is developing cycles in digital health technologies are much shorter than what is known for medical devices." […] "Already, medical devices compared to drugs have a much faster cycle. Here we see even shorter cycles. This is a challenge for regulatory processes because there is no need to do a lot of work if you already have an outdated version when you get the regulatory approval. So that is something that is going forward as a challenge.
>
> **Mobihealthnews**, **2019**
> "

> "
> Mechanical, chemical and/ or electrical components of a digital health product may be patentable if they are new and inventive. Methods and protocols associated with using the digital health product may also be patentable. However, digital health products often comprise software and/or a computer-based element which may be difficult to protect using patents.
>
> **MedTechNews**, **2019**
> "

> "
> The rapid evolution of technology in the digital space may mean that companies choose to move forward without formal IP protection, focusing instead on staying ahead of the technology curve. However, for early-stage companies seeking investment, patent protection might be preferable as a trade secret's value is often more difficult to quantify.
> The digital health landscape presents various challenges for protecting innovations due to the differing technologies they can encompass. Consequently, digital health companies should adopt a flexible approach to IP protection and consider all the options available.
>
> **Managing IP**, **2020**
> "

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5, avenue des Hauts Fourneaux
L-4362 Esch-sur-Alzette
Luxembourg

+352 43 62 63-1
info@luxinnovation.lu

luxinnovation.lu