

Introduction

Technology is reshaping the relationship between patients, healthcare providers, and the health system. Mobile will play a crucial role, as it has become the patient's constant companion. By connecting patients and healthcare providers, treatments can be improved due to non-stop real-time gathered data. By providing access to such accurate information, healthcare providers are able to take immediate action if necessary. This will prevent conditions from worsening and therefore improve quality of life. The transformational change in the healthcare industry is thus only taking place because patients are empowered by using digital tools on every step of their journey.

Healthcare systems are facing global challenges

Changing demographics

In nearly all countries over the world, people live longer thanks to rising living standards, improved lifestyle, and better education, as well as greater access to quality health services. The average life at birth exceeds 80 years in OECD countries and continues to lengthen.¹ With increased longevity, the demand on the healthcare delivery organizations is increasing rapidly. However, not only are people living longer, but people are living longer suffering from chronic diseases. Primarily chronic diseases, also known as non-communicable diseases (NCDs) such as cardiovascular diseases, cancer, diabetes and chronic respiratory diseases, are conditions of long duration and generally slow progression that lead to premature death.

The rise of chronic diseases will dramatically affect health systems. As the prevalence of chronic diseases increase, there will be a higher demand for chronic disease-related healthcare, which will increase the pressure on health expenditures and additional health financing challenges. Chronic

diseases are generally more expensive to treat and require patients to have multiple interactions with health systems (as different chronic diseases can be correlated) over a longer period. The demand for more effective treatments is likely to rise. These trends highlight the need for health systems in many countries to undergo significant adaptation (related to service delivery, organization, skills, equipment, and financing models) in order to effectively address chronic diseases in both care and financial aspects.

Chronic diseases represent 77 percent of the total burden of disease in Europe and are responsible for 86 percent of all deaths. They affect more than 80 percent of people aged 65 years and older, who are usually affected with multiple chronic diseases, or co-morbidities. Around €700 billion is spent each year in the European Union on chronic diseases, representing 70-80 percent of a country's total health expenditure.² Luxembourg, Germany, and the Netherlands respectively have the highest spending per capita (Figure 1).

Demographic and economic trends ask for different healthcare delivery. The rise in chronic diseases is putting an increasing stress on healthcare and social systems in the EU. As the demand increases, a global shortage of clinicians is appearing as well. Today, healthcare systems have to face multiple challenges: ensuring the quality and access to healthcare for patients while managing costs and technological progress.

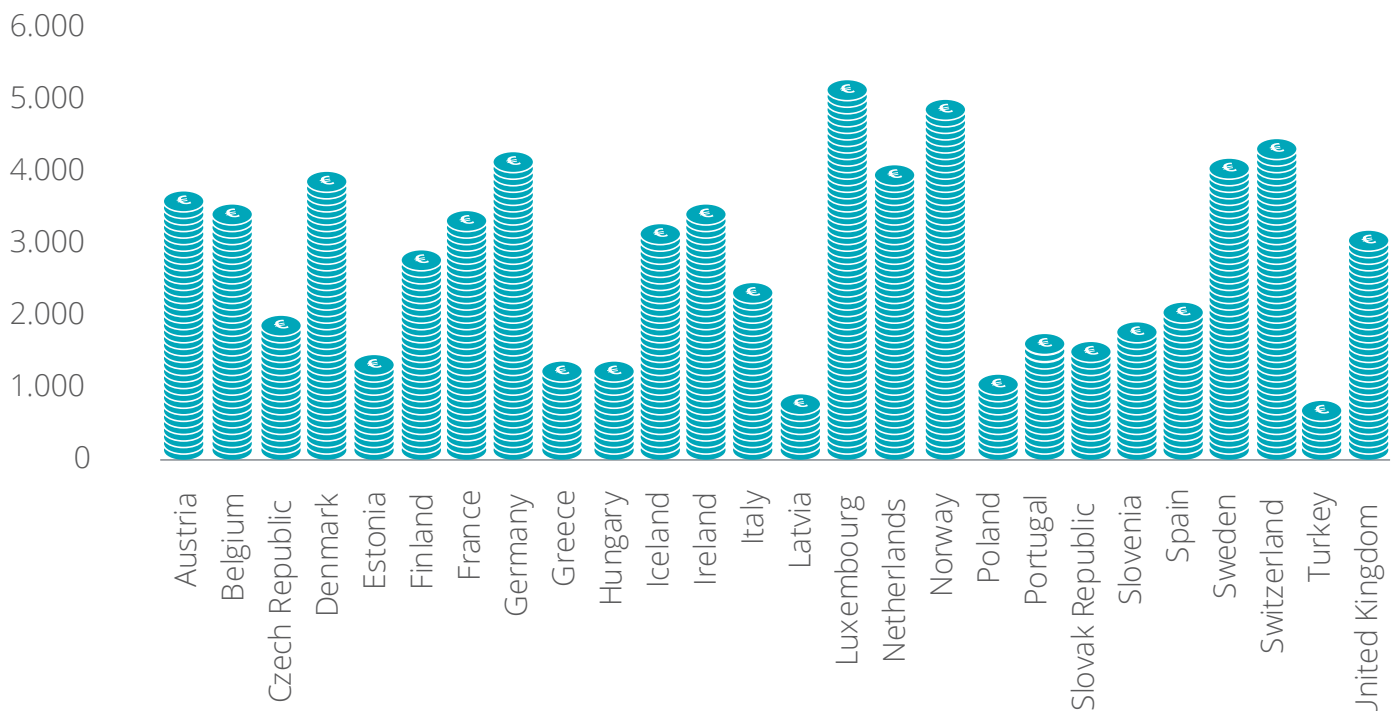
A shift toward a patient-centered healthcare paradigm is necessary to address these demographic changes. Consumers demand personalized services, transforming healthcare from its predominant one-size-fits-all approach to a more consumer-centric tailored approach. Emerging digital technologies help the system move from episodic to collaborative and longitudinal care. Besides, the digital age will enable us to move toward a prevention-focused and outcome-driven healthcare.

1. OECD (2017). Health at a Glance 2017: OECD Indicators. See also: www.goo.gl/ZiZ7Jg

2. European Parliament (2014). Public Health in the EU: State-of-play and key policy challenges. See also: www.goo.gl/W25SGR

“Health systems are not a drain on resources but an investment in health and wealth – that is in the health of the population and in economic growth.”³

Figure 1: Health spending per capita by government schemes and compulsory health insurance in 2015



Source: OECD Health statistics

3. European Observatory on Health Systems and Policies Series (2012). Health Systems, Health, Wealth, and Societal Well-being: Assessing the case for investing in health systems. Edited by Figueras, J., & McKee, M. See also: www.goo.gl/XMNnZK

Equalizing the power

Patient's needs and expectations toward healthcare organizations are changing. Patients want to be informed, engaged, and connected to all the stakeholders within the healthcare system in order to become an expert in their treatment pathway. Therefore, healthcare providers will need to focus on how to become customer-driven, placing the patient at the center of his or her own medical journey. Mobile, and more broadly Internet of Things (IoT), will play a crucial role, as the smartphone has become the patient's constant companion.

Mobile devices have great potential to support the healthcare industry's transformation from a provider-driven marketplace into a patient-centric ecosystem. Besides the traditional impact that technological innovations brought to hospitals and clinics (i.e., better productivity, improved processes), they are also redefining patients' expectations. Greater access to information and knowledge, experience with self-management programs, and new regulations for patient involvement have contributed to creating new dynamics through which patients are redefining their roles in relation to healthcare. The patient is becoming a partner of their healthcare providers instead of a simple care-receiver. This growing patient-based movement therefore also creates a bottom-up demand for change.

Patient empowerment is an important step in enabling patients to manage their care process. The WHO defines patient empowerment as "a process in which patients understand their role, are given the knowledge and skills by their healthcare provider to perform a task in an environment that recognizes community and cultural differences, and encourages patient participation."⁴

New technologies will enable the evolution of the patient's journey and thus challenge the current status quo. The key discussion remains how healthcare systems should transform so that they facilitate dialogue, co-production, and collaborative care in order for patients to feel empowered to become an equal and active partner in managing their own health. At the same time, healthcare leaders should consider how to address these trends by planning for appropriate investments in people, processes, and premises enabled by digital technologies.

“Digital technology has the potential to transform medicine and the healthcare industry in a sustainable way. At the same time, digital technology could equalize the relationship between medical professionals and patients.”

4. World Health Organization (2009). WHO Guidelines on Hand Hygiene in Healthcare: First Global Patient Safety Challenge Clean Care Is Safer Care. See also: www.goo.gl/4kWMnM



Digital technologies offer opportunities to revolutionize the way care is delivered

Despite of the complex regulation and the significant costs to innovate within the healthcare sector, digitalization is starting its expansion within the entire industry. In this paper, digital health is defined as “the convergence of digital and genomic technologies with health, healthcare, living, and society to enhance the efficiency of healthcare delivery and make medicine more personalized and precise”.⁵

The convergence of science and technology in our dynamic digital era has resulted in the development of innovative digital health devices that allow easy and accurate characterization in health and disease. The trend toward a digital future is gathering an increasingly amount of adherents, from patients to healthcare organizations and payers.

The main reasons for this increasing appetite is the growing quality of patient care and treatment as well as the scale of potential cost savings in the long term. Much of the healthcare expenditure in OECD countries is inefficient or even wasteful.⁶ Evidence suggests that up to one-fifth of health spending could be used more effectively. Figures show that many patients are unnecessarily harmed at the point of care or receive unnecessary or low-value treatments. The same benefits could often be provided using fewer resources. For instance, some healthcare systems provide care in expensive places such as hospitals, rather than in more cost-effective settings (e.g., e-consultations, telemonitoring).⁷ In addition, a number

“The convergence of digital and genomic technologies with health, healthcare, living, and society enhances the efficiency of healthcare delivery and makes medicine more personalized and precise.”

of administrative processes add no value, and money might be lost to fraud.⁸ Eliminating a fraction of this sum is a huge opportunity and digital technologies can bring solutions.

Healthcare providers can leverage technologies to transform care delivery, patient experience, staff management, operation management, and hospital design. Patients are now eager to get more insights into their treatment path and how they can speed up that process. Consumer adoption of digital health has reached its peak level; compared to a few years ago, more people use wearable devices, access telemedicine, and go online to search for health-related information. In addition, the study published by the EU Digital Transformation Monitor in January 2017 states that 83 percent of patients are more willing to share their data in order to treat themselves.⁹ Furthermore, insurers and governments, who are pushing for more prevention rather than cures, are also increasingly demanding “value-based” reimbursement, which give them much better insight into which treatments work.

5. Bhavnani, S. P., Narula, J., & Sengupta, P. P. (2016). Mobile technology and the digitization of healthcare. *European Heart Journal*, 37(18), 1428–38.

6. OECD (2017). Tackling Wasteful Spending on Health. See also: www.goo.gl/RDsJ7x

7. *ibid*

8. *ibid*

9. European Commission (2017). Digital Transformation Monitor: Update of digital solutions in the healthcare industry. See also: www.goo.gl/sYiYcG

The latest developments in digital technologies prove that the way healthcare is delivered will change drastically. Digitalization will influence the roles and responsibilities of every stakeholder in the industry. Overall, five main opportunities were identified, which are described below.

Access to real-time shared data reduces duplication and errors

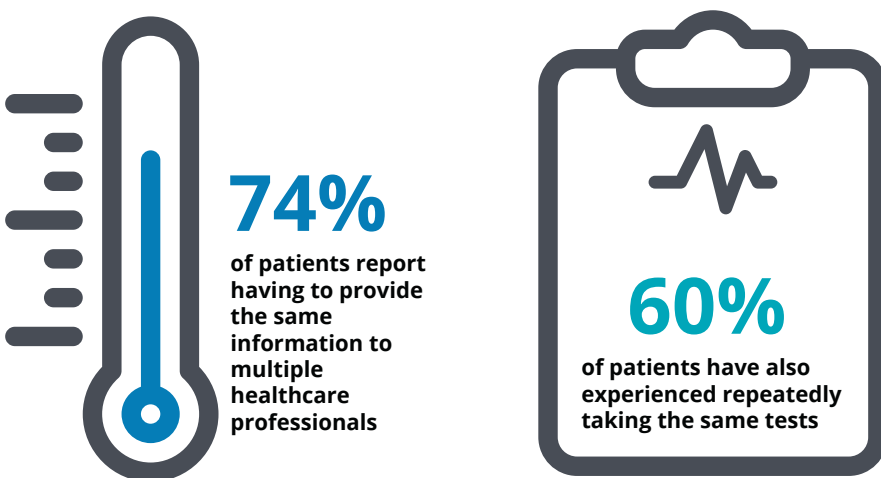
A growing number of patients are visiting multiple professionals during their treatment path. Some explanations for this phenomenon relate to clinician factors (e.g., inconvenient office hours, long waiting times) while others relate to personal factors (e.g., personal characteristics, insufficient communication) or to illness factors (e.g., symptom persistence, lack of understanding, non-acceptance of the diagnosis or treatment).¹⁰ No matter the reason for visiting various professionals, patients are often facing unnecessary bureaucracy. Philips Future Health Index revealed that 74 percent of patients are providing the same information to multiple healthcare professionals. Furthermore, 60 percent of patients also indicated that they repeatedly take the same tests (Figure 2).¹¹ Digital technology can be used to

successfully streamline and coordinate all healthcare related data, thereby reducing the significant risk of duplication or neglect.

Nevertheless, progress has been made in many countries toward compiling a national medical record. In the United Kingdom for example, Patients Know Best (PKB) is a med-tech firm that puts patients in control of their own medical records. The software allows patients to see their full medical record from all primary, secondary, tertiary, and social care providers (e.g., laboratory results, GP notes, etc.). Another important feature of PKB is that it integrates fully into any health records system and is available for use worldwide.¹² Consequently, the system empowers patients and puts them at the center of their health records. Patients are finally deciding who is granted access to their records. Moreover, patients can manually add their own symptoms into the system. Data gathered from wearables and devices can be automatically transferred into the system as well. This allows healthcare professionals to draw on patient-generated data during consultations. As soon as results are outside the norm, both clinicians and patients are alerted.

Besides the fact that technology is able to streamline and better coordinate data and communication between the healthcare stakeholders, it is also an enabler of real time data due to the ability of devices to gather data on their own.¹³ While in the past, caregivers had to spend time next to the patient in order to guarantee that the data they enter is accurate, now machines are continuously collecting real-time data. Consequently, human errors can be prevented. Moreover, quality of care is also improving due to two main channels: firstly, caregivers have more time to focus on the patient; secondly, access to real-time information enables healthcare professionals to make informed decisions and provide a treatment that is efficient and evidence-based.¹⁴ Thus, because of automated medical surveillance tools, immediate reactions can be ensured and resources can be allocated to other, more pertinent areas. This in turn will improve disease management or the outcome of treatment. Moreover, accurate and automated data collection, combined with data-driven decisions, cuts down costs and, most importantly, minimizes errors.¹⁵

Figure 2: Information redundancy



Source: Future health index 2016, Philips

10. Sansone, R.A., & Sansone, L. A. (2012). Doctor Shopping: A Phenomenon of Many Themes. *Innovations in Clinical Neuroscience*, 9(11-12), 42-46.

11. Philipps (2016). Future health index 2016 report. The capacity to care: Measuring perceptions of accessibility and integration of healthcare systems, and adoption of connected healthcare. See also: www.goo.gl/VDPe5S

12. Patients Know Best. See also: www.goo.gl/EZZzfP

13. Niewolny, D. (2013). How the Internet of Things is Revolutionizing Healthcare. See also: www.goo.gl/fhfcYp

14. Deloitte Luxembourg (2017). The Internet-of-Things. A revolutionary digital tool for the healthcare industry. Inside (15), 82-89. See also: www.goo.gl/31C95p

15. Patel, K. (2016). 6 benefits of IoT for hospitals and healthcare. See also: www.goo.gl/sL5TR0

Digitalization supports the delivery of integrated care

Closer care integration offers patients significant benefits. The most recent developments in technological healthcare solutions allow healthcare providers to monitor patients on a real-time basis due to the collection, recording, and analysis of comprehensive information using sensors. The development of connected devices has had a significant impact on the overall healthcare sector and has been significantly valuable in remote clinical monitoring, chronic disease management, preventive care, and assisted living for elderly people. The total value of the wearables market is expected to reach \$40 billion in 2018.¹⁶

Internet-connected devices have been introduced to patients in various forms (Figure 3). The diversity of the sensors can be related to the nature of stimuli that they respond to (e.g., physiological vital signs such as heartbeat, blood pressure, or body movements) and to the location on the body the sensor is placed (i.e., clothing, subcutaneous implant, wearable devices such as smart watch and glasses).

Connected devices have changed the game within the healthcare industry by lowering costs, improving efficiency, and bringing the focus back to quality patient care.¹⁷ These devices bring together the healthcare professionals involved in patient care, allowing consistent and coordinated services.

In particular, patients whose physiological status requires close attention (e.g., chronically ill, elderly, or hospitalized patients) could be constantly monitored using IoT-driven, non-invasive monitoring. On the one hand, IoT has the potential to improve the quality of care through constant attention and on the other hand, to cut down costs of care by eliminating the need for a caregiver to actively engage in data collection by checking the patient's vital signs at regular intervals.

“Wearable technology surrounds us with devices that primarily enable other devices with digital information, which in turn support us in taking real-word actions.”¹⁸

Figure 3: Diversity of healthcare IoT devices



Source: The Future of Digital Health by Ranjan Karthik, Electronic Design, 2017

16. Wearables market outlook 2020: Drivers and new markets (2017). See also: www.goo.gl/JtgQmu
 17. Transparency Market Research (2016). The Future of Internet of Things (IoT) in Healthcare Market: Game-changing Trends and Influencers. See also: www.goo.gl/cBhaxf
 18. Deloitte UK (2014). Tech Trends 2014: Inspiring Disruption. See also: www.goo.gl/dWk5qx

“Nearly 80 percent of surveyed doctors believe telemedicine to be a better way to manage chronic diseases.”¹⁹

Telemedicine opens a window for remote monitoring

Access to healthcare infrastructure and effective treatments can be complicated for populations living in remote regions. Through remote monitoring technologies, patients living in rural areas can now easily gain access to medical care. The power and reach of technology overcomes geographic distance and allows clinicians to cover a larger area, even at international level.

Moreover, shortages of healthcare professionals can be handled. The effective use of remote monitoring technologies can reduce the number of unnecessary face-to-face consultations.²⁰ Indeed, telemedicine makes healthcare services more accessible to patients so that they can minimize their visits to the hospital or physician’s office. It allows them to access care via different devices (e.g., mobile phone, web platform, etc.) and reduce treatment costs by keeping people out of the hospital when it is not necessary.

Recent studies of monitoring technology have found positive impacts on behavior change, including medication adherence, physical activity and overall responsibility,^{21,22} as well as improved treatment outcomes, including reduced mortality for heart failure patients²³ and improved blood pressure control for those with hypertension²⁴.

The cost of non-adherence can be calculated in terms of generating additional costs or wasting resources.²⁵ On the one side, costs increase because of misuse or non-use of drugs. According to calculations conducted by the World Health Organization, adherence to long-term therapies in developed countries

is around 50 percent, and even lower in developing countries.²⁶ This often leads to deterioration in the patient’s condition and therefore to further treatment or even hospitalization. While on the other side, resources are wasted by buying, but not taking the prescribed medicine.

New technologies can help patients follow their treatment more efficiently. Electronic reminders and alerts, via text message or apps, can support patients during their health journey. As patients receive reminders in real time, it can be assumed that it changes their attitude in a positive way towards the prescribed treatment. Even though there is no personal contact, patients feel accompanied on their journey. Due to those simple yet very effective technologies, diseases can be better managed and the outcome of treatment improved.

Most importantly, improved adherence allows healthcare professionals, as well as pharmaceutical companies, to obtain a better understanding of the impact of drugs in terms of efficiency. Due to the fact that medicine is taken as prescribed, complications and drug interactions become noticeable and the collected data can be used for further research.

19. Telehealth Index: 2015 Physician Survey Insights. See also: www.goo.gl/hSckDm

20. Caffery, L. J., & Smith, A. C. (2010) A literature review of email-based telemedicine. *Stud Health Technol Inform*, 161, 20-34.

21. Ammenwerth, E., Woess, S., Baumgartner, C., Fetz, B., Van der Heide, A., Kastner, P., Modre-Osprian, R., Welte, S., & Poelzl, G. (2015). Evaluation of an integrated telemonitoring surveillance system in patients with coronary heart disease. *Methods of Information in Medicine* 54(5), 388-397.

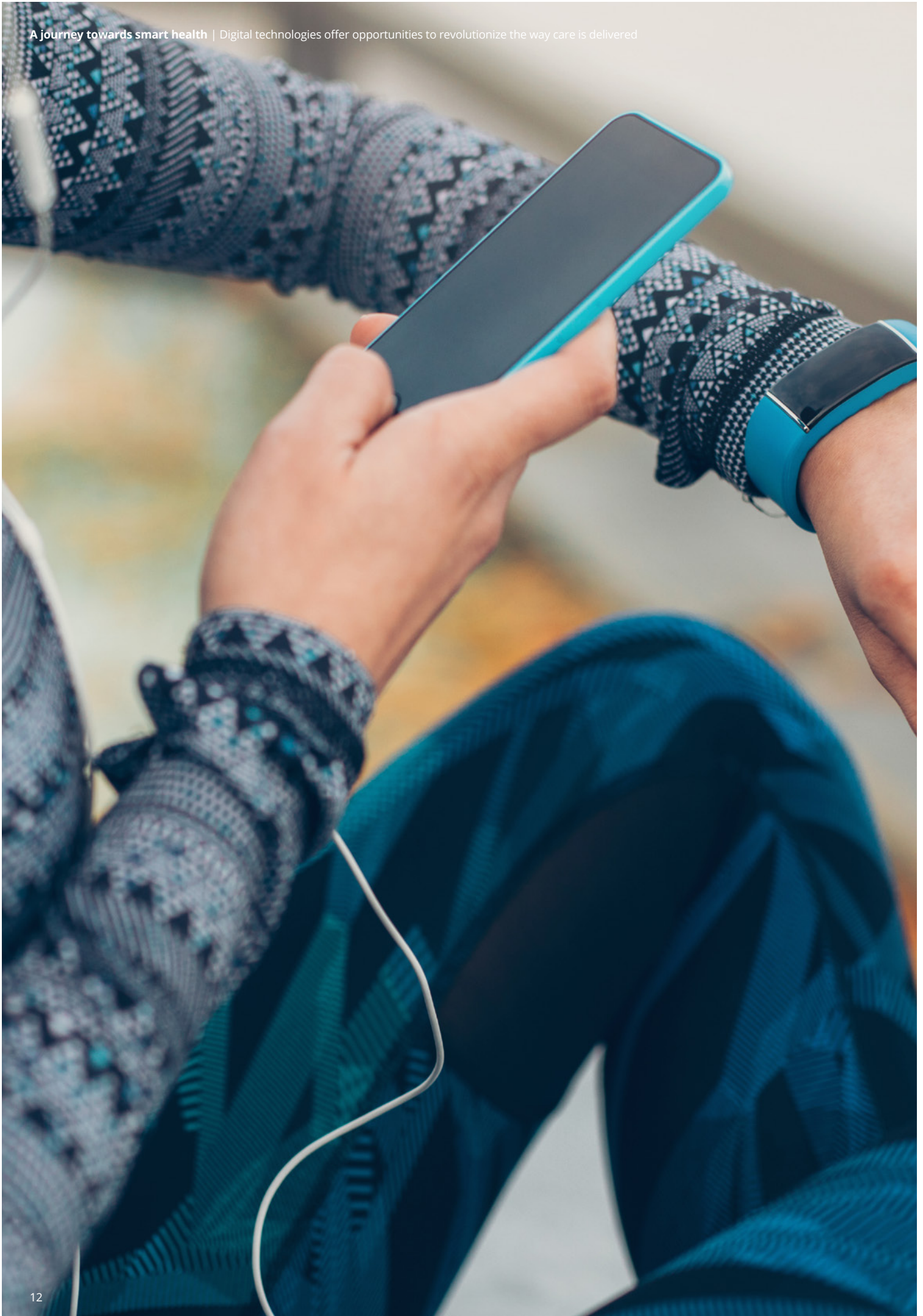
22. Fairbrother, P., Pinnock, H., Hanley, J., McCloughan, L., Sheikh, A., Pagliari, C. & McKinstry, B. (2013). Exploring telemonitoring and self-management by patients with chronic obstructive pulmonary disease: a qualitative study embedded in a randomized controlled trial. *Patient education and counseling* 93(3), 403-410.

23. Inglis, S. C., Clark, R. A., Dierckx, R., Prieto-Merino, D., & Cleland, J. G. (2015) Structured telephone support or non-invasive telemonitoring for patients with heart failure. *The Cochrane Library*.

24. McKinstry, B., Hanley, J., & Lewis, S. (2015). Telemonitoring in the management of high blood pressure. *Current pharmaceutical design*, 21(6), 823-827

25. Pharmaceutical Group of the European Union. Adherence. See also: www.goo.gl/uFtTQw

26. Sabaté, E. (Ed.). (2003). Adherence to long-term therapies: Evidence for action. World Health Organization.



Data analytics increase the quality of diagnostic and treatment

With the exponentially increasing pool of data derived from various sources such as electronic health records, wearable devices, mobiles, as well as health and fitness apps, there is an increasing necessity to treat data as a strategic asset. In fact, big data is the enabler to personalized medicine. The gathered data will ensure that decisions about care are linked to both treatment and financial outcomes.

The most promising feature of big data analytics is predictive analytics, as it will enable a more proactive and targeted care. For instance, the cost of sequencing a human being's full genome has dropped over the past years.²⁷ The ability to decode the human genome reveals potential disease risks even before they occur. This, together with improvements in diagnostic scanning and in vitro testing, opens new doors for precision medicine and evidence-based approaches to prevention and self-management.²⁸ Besides genomic sequencing, big data also helps to predict the flight path of a patient.²⁹ By leveraging historical data from other patients with similar conditions, machine-learning algorithms will be able to faithfully predict the trajectory of a patient over time.³⁰

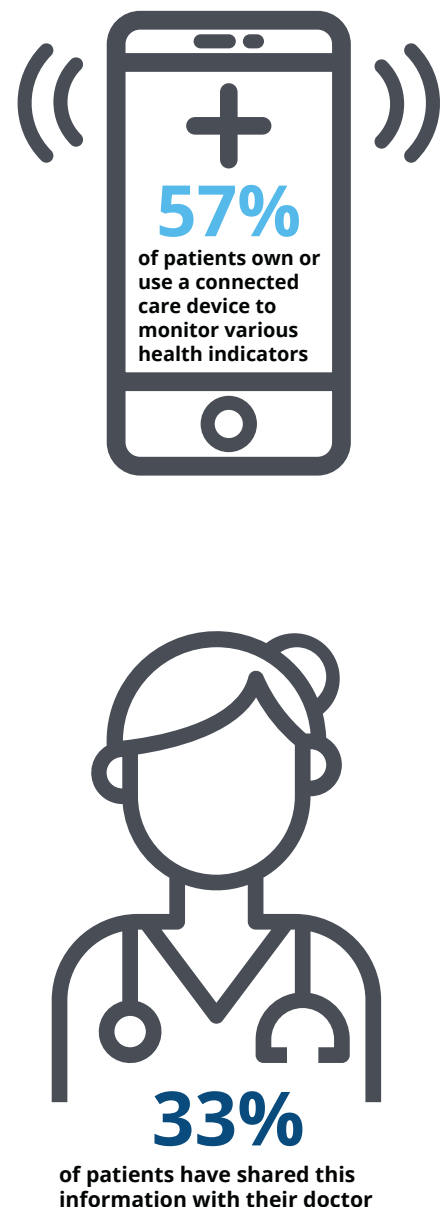
Hence, the usage of big data analytics enables healthcare professionals to make better, more accurate, and faster diagnoses as well as more informed treatment decisions.

Technology-enabled care is revolutionizing the patient experience

The connectivity of the healthcare system through the connected devices places emphasis on the patients and on their needs. The patients are now able to take control over their own health, to self-monitor and to communicate whenever necessary with their healthcare providers. This is leading to a new type of physician-patient relationship in which the patient becomes a partner to set up appropriate (or even proactive) treatments, improve accuracy of the diagnosis, and timely intervention by physicians.

Consumers have an appetite for using technology-enabled care. A recent study commissioned by Philips showed that 57 percent of patients own or use a connected care device to monitor various health indicators (Figure 4).³¹ However, although more than half of patients own or use a connected care device to monitor their health, only one third of these patients share this information with their healthcare professional.

Figure 4: Lack of information sharing



Source: Future health index 2016, Philips

27. National Human Genome Research Institute (2016). The Cost of Sequencing a Human Genome. See also: www.goo.gl/jmtgcu

28. Deloitte UK (2015). Connected health: How digital technology is transforming health and social care. See also: www.goo.gl/XzqWM1

29. Sanders, D., Crockett, D., & Gressel, J. (2015). Patient Flight Path Analytics: From Airline Operations to Healthcare Outcomes. HealthCatalyst. See also: www.goo.gl/x8QV4D

30. Adamson, D. (2014). Big Data in Healthcare Made Simple: Where it Stands Today and Where it's Going. HealthCatalyst. See also: www.goo.gl/fruHdZ

31. Philipps (2016). Future health index 2016 report. The capacity to care: Measuring perceptions of accessibility and integration of healthcare systems, and adoption of connected healthcare. See also: www.goo.gl/VDPe5S

In particular, telemedicine is the most popular technology. In the Deloitte 2016 Survey of US Healthcare Consumers, consumers reported the highest interest in using telemedicine for post-surgical care and for monitoring chronic conditions—49 and 48 percent, respectively (Figure 5).³²

32. Deloitte US (2016). Will patients and caregivers embrace technology-enabled health care? Findings from the Deloitte 2016 Survey of US Health Care Consumers. See also: www.goo.gl/FRrZji

Figure 5: Patients' interest in using telemedicine

Post-surgical care



49%

Chronic disease monitoring



48%

Minor injury



32%

Care while traveling



36%

Source: Deloitte 2016 Survey of US Health Care Consumers, Deloitte US, 2016

Note: Chart shows respondents who are likely to use the technology, where "likely" is defined as answering "4" or "5" on a five-point scale in which "1" is "not at all likely" and "5" is "extremely likely"

Interesting initiatives have been launched in some countries to respond to the patient's needs:

In *Denmark* for example, general practitioners are obliged to offer their patients consultations via email since 2009. Only four years later, in 2013, 11.2 percent of all primary care consultations were already done by email.³³

In *Belgium*, ViViDoctor, meaning Virtual Visits to real Doctors, is revolutionizing doctor visits. By offering patients a virtual doctor tool, they increase accessibility of care in a time where doctor visits are often perceived as a burden. Indeed, during a ViViDoctor-visit patients will be taken care of by a Belgian board-certified doctor without having to leave their home. Patients first have to choose a doctor through the mobile application. In a second step, they are asked to enter their symptoms as well as some background information in order to ensure that the doctor is fully informed prior to the visit. The doctor can prescribe e-prescriptions to the patients, which are filed online in the patient's e-ID. Moreover, the patient is able to consult his records 24/7 through the application.³⁴

In *Missouri, USA*, in October 2015, Mercy Virtual Care Center's doors opened and became the world's first hospital dedicated entirely to telemedicine. Meaning that healthcare professionals take care of patients outside the hospital's walls. There are no waiting rooms, hospital beds or even patients on site. According to president Dr. Randy Moore providers can see patients wherever they are through technology such as highly-sensitive cameras and real-time vital signs devices. The Center is home to a variety of programs that allow value-based care for patients remotely 24/7, which also avoid expenses and hassle on both sides. Telemedicine is an important driver towards a more efficient healthcare ecosystem. From a patient point of view, but also from a cost point of view (e.g., through adapted treatments, lower readmissions, optimizing staff schedule, etc.). Besides, Mercy's Virtual Care Center

is also designed to be a collaborative workspace fostering innovation in patient care and technology testing.³⁵

Although there are still challenges to integrate digital technology in the healthcare system, there is an urge to move towards digitalization. Technology increases productivity and changes the way services are delivered. Patients expect innovative and easy-to-use solutions. There is a clear demand from patients for monitoring devices that do not interfere with their daily life. Looking at the overall patient experience trends at present, consumers will drive and personally direct their healthcare experience in the coming years like never before.

“Although there are still challenges to integrate digital technology in the healthcare system, there is an urge to move towards digitalization.”

33. Hansen, C.S. Patients and general practitioners have different approaches to e-mail consultations. See also: www.goo.gl/mNa8vX

34. ViViDoctor. See also: www.goo.gl/9mFzBY

35. Mercy Virtual Care Center. See also: www.goo.gl/zuERGf

The patient journey has been transformed due to higher connectivity

In 2017, the number of internet users has climbed up to 3.58 billion.³⁶ In fact, internet users launch two billion searches a day and healthcare appears to be the second most searched topic on Google. On top of that, healthcare is the third largest web activity across all generations. Digitalization has transformed relationships in the healthcare sector, as patients are more self-reliant, better-informed, and comfortable finding information independently. This affects the way of working for healthcare providers, insurance companies, pharmaceutical industries, and the healthcare systems in its entirety.³⁷

As discussed previously, Internet of Things (IoT) is another rising common practice in healthcare as it connects devices and people across the healthcare ecosystem. This innovation will be enabled by the embedding of electronics into everyday physical objects and making them 'smart'.³⁹ The purpose is to acquire, aggregate, and analyze data in order to gain actionable insights. There is a stronger focus on consumer engagement and new approaches to integrate IoT-based healthcare. Consequently, connected care will bring professional care outside of the hospital into a patient's pocket.

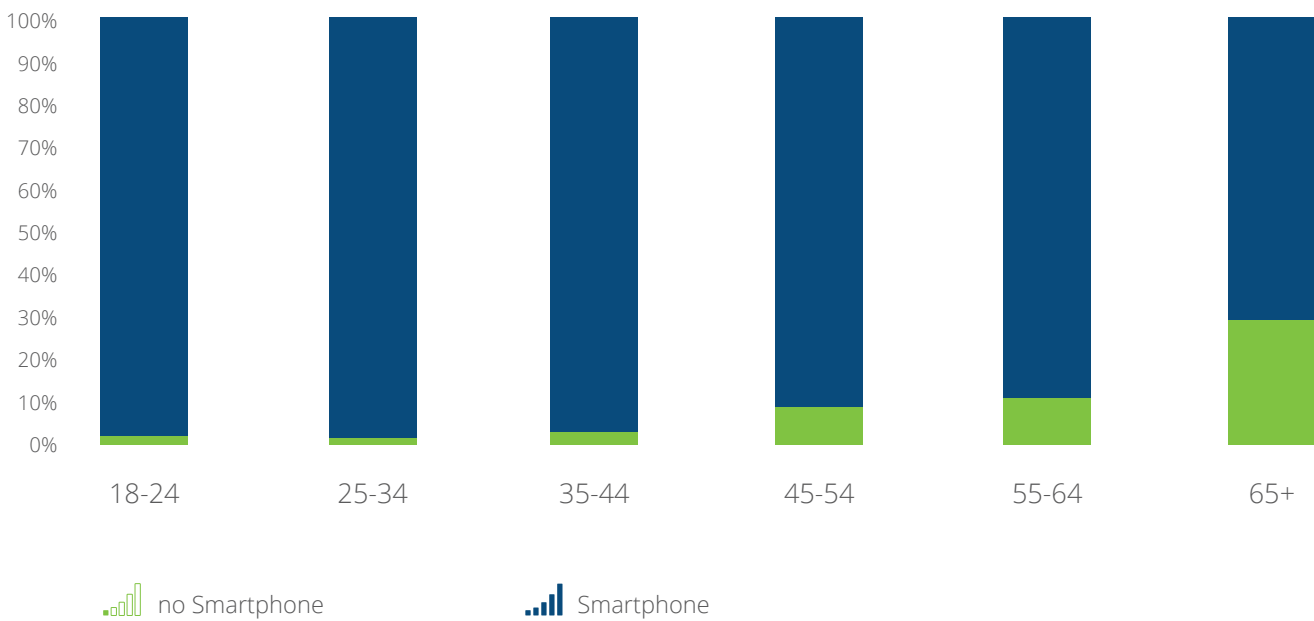
Patient's empowerment can be provided through mobile technology. Such 'portable' technology makes patients less dependent on healthcare professionals as it helps them to easily manage their health around the clock, inform themselves, and share experiences. Taking ownership and education are main drivers of patient engagement.

It is no secret that people become increasingly connected via mobile technology. Deloitte's Global Mobile Consumer Survey revealed that in Luxembourg 91 percent own a smartphone and that Luxembourg's smartphone

"Six out of ten Europeans go online when looking for healthcare information."³⁸

penetration rate has increased by 3 percent from last year.⁴⁰ However, the smartphone adoption rate decreases as the age increases, passing from 97 percent of adoption among 18-24 year olds to 70 percent for those over 65 (Figure 6). This underlines the challenge of technology adoption for the elderly.

Figure 6: Smartphone adoption rate in Luxembourg



Source: Global Mobile Consumer Survey 2017, Deloitte Digital Luxembourg, 2017

36. Statista. Number of internet users worldwide from 2005 to 2017 (in millions). See also: www.goo.gl/XNd0Z3
 37. Weaver, J. (2013). More people search for health online. NBC News. See also: www.goo.gl/X7iU1i
 38. European Commission (2014). Europeans becoming enthusiastic users of online health information. See also: www.goo.gl/sNpV5x
 39. Miorandi, D., Sicari, S., De Pellegrini, F., & Chlamtac, I. (2012). Internet of things: Vision, applications and research challenges. *Ad hoc networks*, 10(7), 1497-1516.
 40. Deloitte Luxembourg (2017). Global Mobile Consumer Survey 2017. See also: www.goo.gl/HSzauz

Alone in 2017, 78,000 new health apps were added to app stores increasing the overall offer to 325,000 health apps.⁴¹ In fact, the number of health apps on the two leading platforms increased notably. iOS has seen a growth rate of 20 percent from 2016 to 2017, and Android even a 50 percent growth rate.⁴² Healthcare apps encourage smartphone owners to improve the monitoring and management of their personal health. Such apps have a wide range of uses from personal monitoring to chronic care management to complex population health analysis (Figure 7).

This increased connectivity as well as the significant offer of health related apps will have a profound impact on how the whole healthcare ecosystem engages with patients and how patients deal with their own health conditions in interaction with healthcare professionals. This connectivity leads to better health

outcomes and a more convenient and personalized service, through: informing/educating; two-way remote monitoring; and supporting treatment adherence.⁴³ All these technological advances are driving a completely different level of engagement.

As will be demonstrated in Emma's journey (Figure 8), the patient experience will become more contextual and adapted to the dynamic needs of the patient at that moment in time. Due to the more proactive role that people are taking, partnerships with healthcare providers and life sciences companies can be created.⁴⁴ The ability to connect healthcare providers and patients will lead to better decisions, which in turn will lead to better health outcomes and lower healthcare costs.

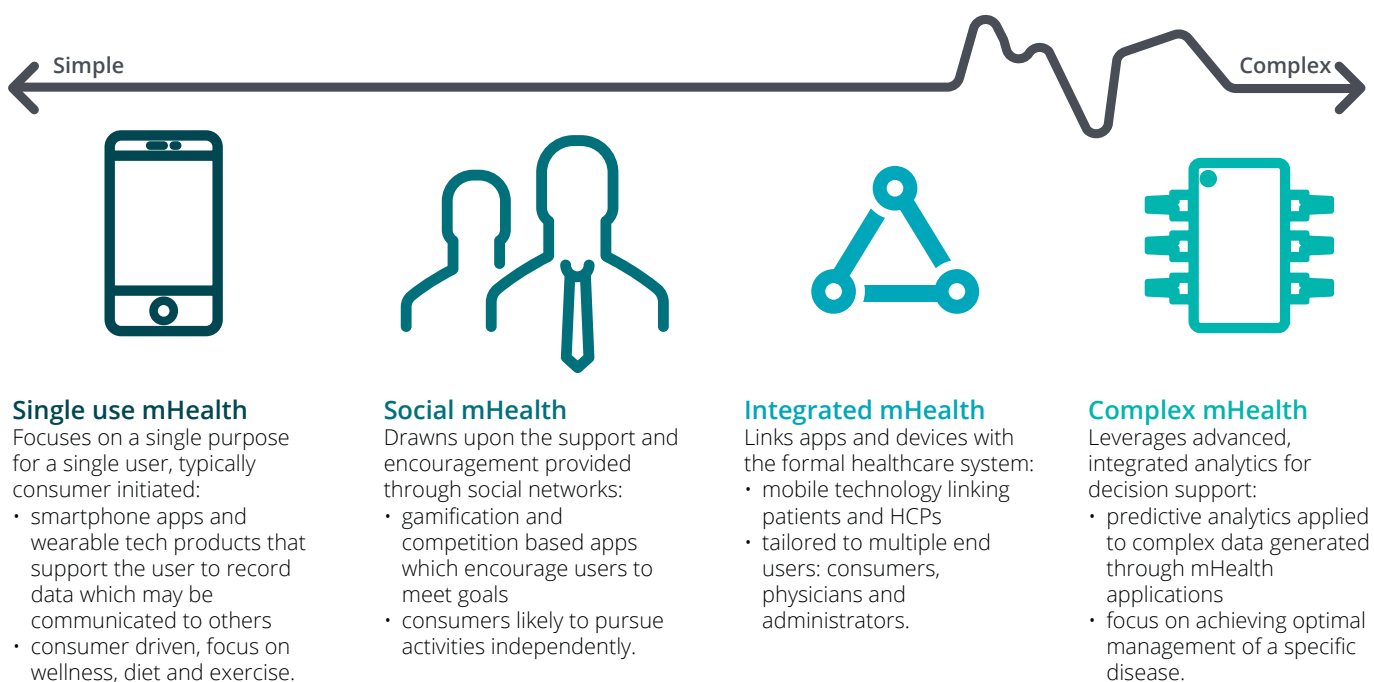
41. Research2Guidance (2017). mHealth App Economics 2017 – Current Status and Future Trends in Mobile Health. See also: www.goo.gl/Pn27Xr

42. *ibid*

43. Deloitte UK (2015). Connected health: How digital technology is transforming health and social care. See also: www.goo.gl/XzqWM1

44. Hibbard, J. H., & Greene, J. (2013). What evidence shows about patient activation: Better health outcomes and care experiences; fewer data on costs. *Health affairs*, 32(2), 207-214.

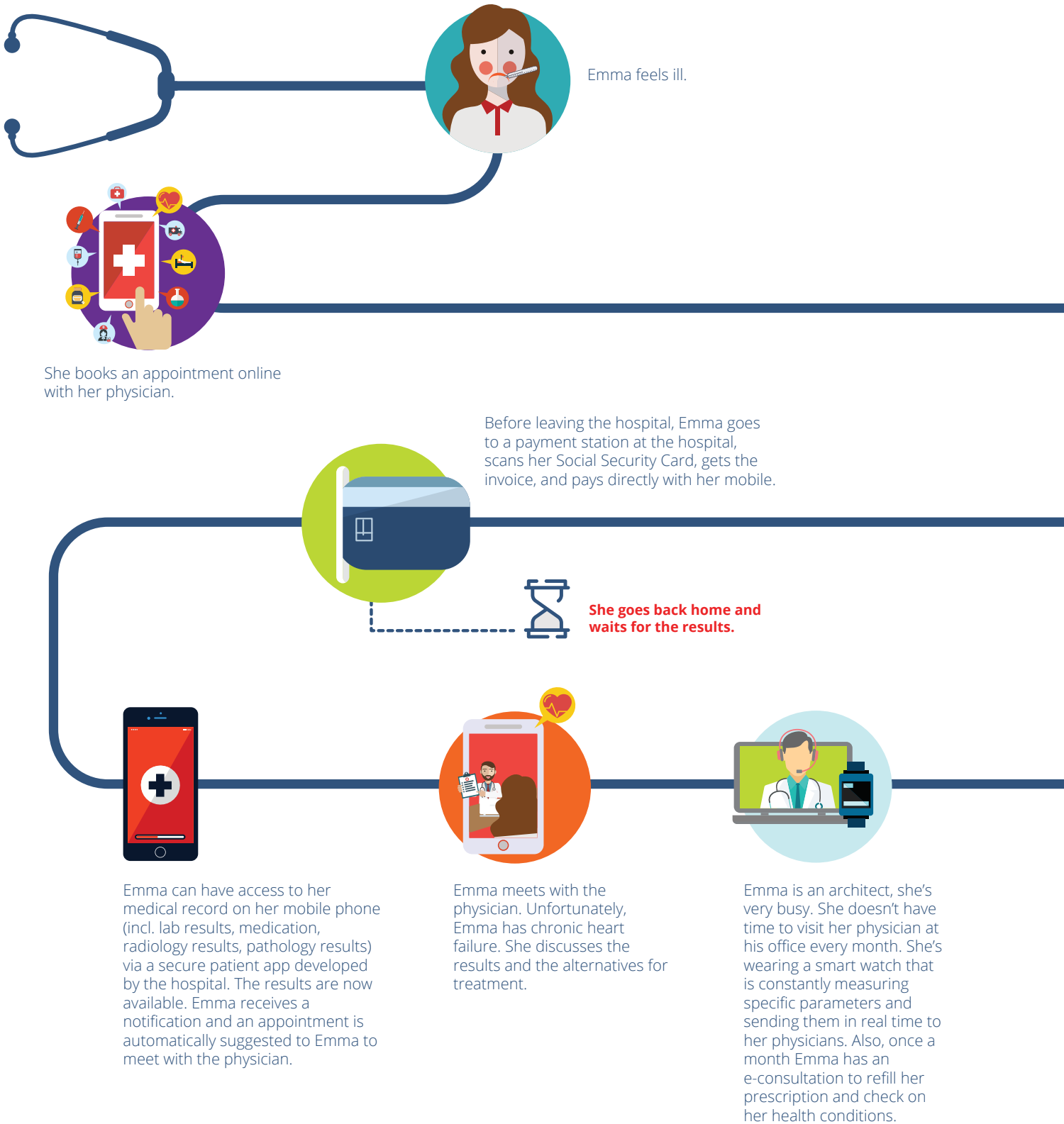
Figure 7: mHealth – From simple to complex



Source: Four Dimensions of Effective mHealth, Deloitte US Center for Health Solutions, 2014



Figure 8: Emma's journey towards smart health



Her physician prescribes her medical tests at the hospital. He books an appointment for her at the hospital with the specialists by directly checking their agendas.

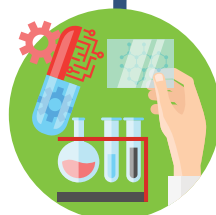


On the appointed day, Emma checks herself in at the hospital before she meets with the doctor.

Emma does the requested health tests. The information is recorded in the hospital electronic record and automatically sent to the National Electronic Record.



Emma connects with other patients suffering from heart failure on a patient network (sharing data on their health conditions, treatments, etc.)



Emma wants to support the development of research in chronic heart failure. She agrees to participate in a clinical trial for a new medical connected device. Her data is collected and analyzed to assess the accuracy and efficiency of the device.

Figure 9: A patient-centric ecosystem



As demonstrated by Emma's journey, digital technologies improve care delivery, create operational efficiencies, and enhance patient and staff experience. By collecting data through devices, viewing patient information and providing a diagnosis in real time, the entire healthcare system can be improved. Effective healthcare depends on speed and accuracy. The ability to easily monitor and manage the patient's health can save precious minutes every day for healthcare providers. By applying digital technologies into daily practices, healthcare providers can provide qualitative care

more quickly and manage the healthcare environment more efficiently. The returns of using new technologies are thus multiple: higher quality care, improved efficiencies, as well as increased patient satisfaction.⁴⁵

Consequently, healthcare is transformed from a provider-driven marketplace to a patient-centric health ecosystem (Figure 9). Patients are becoming more engaged in and responsible for their own health while the utilized technologies help healthcare providers to be efficient and to deliver added value to their patients.

45. Deloitte US Center for Health Solutions (2017). The digital hospital of the future: In 10 years, technology may change the face of global health care delivery. See also: www.goo.gl/sX6UK8

Conclusion

With economic changes, an aging population, and higher prevalence in chronic diseases, the healthcare sector has seen a dramatic increase in costs. As a result, the industry has had to adapt to these pressures, readjusting its focus to efficiency and quality. Digital technologies provide a solution to this. Not only patients, but also healthcare providers have much to benefit from digital healthcare.

Digital technology has transformed the way we live our lives. Consumers already encountered big changes especially in the financial services, transportation and manufacturing industry. In fact, almost every industry has been heavily impacted by technologies. Accessing sources of information has become barrier-free and limitless. Those new technologies will now finally revolutionize the healthcare industry. They will support patients along their entire journey, transforming the way they stay and keep connected to their healthcare professionals. Despite the barriers, technological devices are bearing (security, data privacy, interoperability issues, ethical issues, etc.), it is one of the brightest hopes on the horizon. Particularly, people with chronic diseases can benefit from improved, but most importantly ongoing support services.

Apps and wearables are the enablers that provide patients with 24/7 user-friendly solutions. These technological devices, which are mostly connected to the patient's personal smartphone, increase patient engagement and provide patients with more personalized care options. With the availability of new technologies, the healthcare industry is thus able to encourage the empowerment of patients, allowing individuals to monitor as well as educate themselves and promote preventative measures, in a cost-efficient manner. This greater connectivity also helps to generate a more informed patient base.

Moreover, the exponential rise in technology-enabled care requires healthcare providers to redefine staff roles and responsibilities. All stakeholders of the healthcare industry will have to adapt their way of working. Still nowadays, healthcare is largely defined by 'place' of work and based on providing hands-on care to patients.⁴⁶ Nevertheless, in the very near future it will be common to partake in e-visits, write e-prescriptions as well as track, diagnose, and deliver treatment via remote digital monitoring. This new way of working will allow healthcare providers to save costs and optimize staff time.

To ensure the adoption of new technology and the transformation of the processes in which care is delivered to patients, governments will have to rethink their reimbursement schemes. Despite the digital progress made in the healthcare industry, the current reimbursement system is still in a "fee-for-service" configuration meaning that the only way that physicians get paid is to have face-to-face medical visits with patients. This leads to a paradoxical situation since new technologies reducing face-to-face interactions are promoted, while the current reimbursement system urges the opposite. However, a shift towards a value-based care model can be observed.

A value-based reimbursement system will force healthcare providers to change the way they bill for care. Instead of being paid by the number of visits and tests prescribed (fee-for-service), healthcare providers' payments will be based on the value of care they deliver to the patient (value-based care).⁴⁷ Hence, healthcare providers will be rewarded for both efficiency and effectiveness.

Such a system will thus incentivize all stakeholders to use new technologies. Therefore, it is of utmost importance that the regulatory and reimbursement environment accelerate its work on implementing the necessary changes for connected health programs.

By 2022, medicine is expected to be fully predictive, preventative, personalized and participatory (P4 Medicine). Insights from human genetics, precision and personalized medicine will transform healthcare, bringing value through innovative biotechnology and requiring the healthcare system to move away from looking at the average patient to looking at the individual patient.⁴⁸ Technology will reshape the current healthcare model. The new model is finally moving away from reactively treating illness to proactively promoting wellbeing and prevention. This is not only good for patients, but also reduces cost of care significantly to release the pressure on the healthcare systems themselves.

46. Deloitte UK (2015). Connected health: How digital technology is transforming health and social care. See also: www.goo.gl/XzqWM1

47. Brown, B., & Crapo, J. (2017). The Key to Transitioning from Fee-for-Service to Value-Based Reimbursement. HealthCatalyst. See also: www.goo.gl/SwCz2y

48. Deloitte UK (2017). The future awakens: Life Sciences and Health Care Predictions 2022. See also: www.goo.gl/S8aet3

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