Riding the techwave in an era of change

The healthcare guide to the future

SMO Provomendi
Health 41 Team

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The healthcare guide to the future

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Jong SMO publishes the younger generations' vision on the future of the Netherlands. SMO promovendi, SMO Studenten and SMO Young Professionals together make up Jong SMO and voice the opinions of younger generations about current social issues on the interface between society and entrepreneurship.
The SMO promovendi Health 41 Team is a bottom-up initiative of young scientists who share the concern for the sustainability of the healthcare. By combining our expertise from various disciplines (ranging from medicine to human resources and psychology), we investigate a relevant social question in the health sector.

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SUMMARY

Learn how innovation is finding its way within the healthcare sector and get a grip on the latest technological developments.

Based on insights from 77 stakeholders within the Dutch healthcare system, including healthcare professionals, entrepreneurs, researchers, consultants, policy makers, and input from 80 healthcare consumers this book helps you to understand:

- the technologies with the highest implementation potential in the healthcare sector,
- the advantages and disadvantages of such technologies,
- the dos and don'ts when implementing these technologies in your organization, and
- the future of healthcare with technology and patient in the lead.

Riding the techwave in an era of change helps you discover what healthcare experts have to say about technological innovations such as quantified-self, artificial intelligence, standardization of individual profiling, online health platforms, and big data. These are game changers that will revolutionize the healthcare sector.

This book includes a pragmatic set of dos and don'ts, aimed at improving the often-troublesome process of technology implementation in the healthcare sector. The recommendations offered will ease your implementation process and help you surf this techwave towards a sustainable future.

INTRODUCTION

INTRODUCTION

In 2019 about half of Dutch adults will be over 50 years old. The population in the Netherlands will keep aging, leading to a decrease in the number of workers per retired person to less than two by 2030, instead of over three as of 2002. With a reduced inflow of workers into the labor force in the future, our perspective to healthcare will shift from a welfare state approach towards a personal responsibility approach. As the population ages and technology development continues, medical procedures costs and efficiency could be improved. This results in the emerging of new markets.

While most of the traditional industries, such as education, communication, and finance, benefit from technology the healthcare sector seems to be a laggard; the opposite of an early adopter. It seems that neither healthcare practitioners, nor (future) patients are ready to trust human health and lives to an algorithm, which is indeed a sensitive task. While technology and innovations cannot cure cancer yet, they can already help us to, for example, closely monitor our physiological parameters, remotely exchange data with our physicians in real-time, and accurately analyze vast amounts of data to optimize treatments. These would eventually lead to reduced costs and improved quality; however today, the healthcare sector strongly relies on face-to-face human interaction, conveying a sense of privacy and ethical behavior, a critical pillar of the industry.

In that context, SMO Promovendi set itself the aim to render an accurate description of the current status of technology and innovation within the Dutch healthcare sector and its potential applications in the future, listening to every voice composing the ecosystem. The goals of our in-depth research were:

- To understand the actual position of the stakeholders with respect to the implementation of technological innovations based on their past experience;
- To describe the level of readiness to adopt technologies such as Artificial Intelligence, Big Data and Quantified Self from multiple points of view: from that of technologists, healthcare professionals, users, policy makers, researchers and consultants;
- To inform healthcare enthusiasts and the general public on the best practices

in the form of pragmatic dos and don'ts based on the lessons shared by the stakeholders.

Our team interviewed 77 stakeholders of the healthcare sector to get - from every perspective - answers to questions such as:

- What has been the most important technological innovation within your field of experience?
- How have you coped with obstacles (if faced) resulting from implementation of technology in the healthcare sector?
- What are your pros and cons regarding the implementation or use of technological innovation in the healthcare sector?
- How do you picture the healthcare sector in the Netherlands in the year 2041?

This book can be used by people looking for a source to understand not only the present but to gain early understanding of the future role of technology in the healthcare industry. It can also be used by either entrepreneurs or seasoned professionals looking for the latest trends of technology within healthcare.

Every single one of the interviews was carefully analyzed and the insights gathered were categorized composing the following chapters. Chapter 1 describes the general view of technology within the healthcare sector. Chapter 2 is about the importance of game-changing innovations and the use of big data, Chapter 3 is about what stakeholders regard as advantages and disadvantages of use of technology and innovation, Chapter 4 brings forward a practical set of dos and don'ts when it comes to the implementation of technology. Chapter 5 is about the lessons that the Dutch healthcare system can learn from foreign systems. The information channels that stakeholders use to keep up to date are explained in Chapter 6. And Chapter 7 depicts the vision stakeholders have for the future of the Dutch healthcare sector.

The chapters do not necessarily build on the previous one, so you can directly access the chapter that is most relevant to your field. We hope you enjoy reading this book as much as we enjoyed writing it.

This publication is the result of the work of SMO Promovendi, a multidisciplinary and international group of young scientists from universities all over the Netherlands. They work on a voluntary basis to apply their knowledge and skills to help create a sustainable healthcare system. With our unique combination of common denominators such as analytical skills, ambition, societal interest and our diversity in specializations – from psychology to mechanical engineering and medicine – we provide an independent and fresh perspective on the future of healthcare in the Netherlands.

We would like to thank all the stakeholders who have given their time to cooperate with this research. We really enjoyed talking to all the different professionals active in the Dutch healthcare system. The interviews greatly motivated us to continue this work and share our knowledge.

SMO promovendi
Health 41 Team

1.

THE IMPORTANCE OF TECHNOLOGICAL INNOVATION IN HEALTHCARE

CHAPTER 1: THE IMPORTANCE OF TECHNOLOGICAL INNOVATION IN HEALTHCARE

Healthcare costs are rising in the Netherlands. According to the 'Centraal Planbureau', 23 percent of income is spent on healthcare and, if nothing happens, this will rise to 40 percent by 2040.[1] With an aging population, ever growing treatment possibilities and a higher life expectancy, the demand for sustainable healthcare only keeps growing. The healthcare sector faces big challenges to meet its high expectations. It has to improve treatment outcome, eliminate waste, increase quality of care, improve organizational efficiency, increase access, become more patient-tailored, and more, while also lowering costs.

The aging 'baby boomers' want to stay independent and active for as long as possible. This has implications for treatment choices and causes a shift from survival and cure to quality of life. Patients become more demanding and search for alternative sources of information, which are more readily available. This changes the role of the doctor and diminishes the traditional hierarchical model of healthcare. Chronic diseases are on the rise. Therefore, monitoring of diseases beyond the walls of the hospital is needed to improve patient outcomes. Patients stay in the hospital for a shorter amount of time and can rehabilitate at home. This shift in the place of delivery of healthcare means that there is a greater demand for communication and collaboration between the various healthcare professionals. The growing desire for retaining control of one's own life and health also gives rise to a growing need for self-management solutions.

All these trends show that not only the level of demand of healthcare is changing, but also that the nature of the demand is developing. In order to keep a good fit with its customers, the healthcare sector has to adapt to these movements. If it continues to do what it has always done, it will get the same results it has always gotten. The challenges of the future call for new approaches and history has shown that organizations that fail to adapt will suffer.

Innovation is the key to shaping these new approaches. It is considered to be an important component of organizational productivity and competitive survival.[2] Technological innovation gives rise to both product innovation and process

innovation.[3] While product innovation is necessary for business, as it creates additional revenue, process innovation improves organizational potential and quality of service.[4] Both aspects are important in healthcare. Even though most healthcare organizations are not-for-profit, sufficient revenue is still necessary to guarantee their continued existence. Continuous innovation of processes streamlines operations and adapts the organization to the future.

Innovation in healthcare specifically is related to product, process, or structure.[5] The product is the actual service a patient gets. An example of a product innovation is a new diagnostic tool. Process innovation refers to innovation in the production or the delivery method. The process is required to deliver the product and could be a new way of delivering medicine. Structural innovation relates to the infrastructure of the organization. This creates new business models.[6]

Technological innovation is both the cause of and the answer to the trends we see in healthcare today. It can improve patient autonomy. For example, at-home monitoring devices enable patients to be treated in their own home, while online patient portals decrease the knowledge gap between the healthcare professional and the patient.

Technology has the ability to boost the quality of care. By increasing patient autonomy, patient experience is improved. But technology can also improve more quantitative outcome measures. Continuous monitoring of post-surgery patients decreases the risk of adverse event and can alert staff at an earlier time.

Technology can save costs by supporting the staff, but also by eliminating waste and streamlining organizational processes. Ideally, diseases can be diagnosed at an earlier stage, even before they become clinically relevant.[7]

Before diving into the many aspects of the adoption of technological innovation in healthcare, we quantified the importance of technological innovation according to our stakeholders. We asked them the following question: *On a scale from 1 – 10, how important do you think technological innovation is for achieving a sustainable healthcare sector? (10 very important).*

Almost all stakeholders unequivocally agreed that technological innovation is important. Only less than 4% of the interviewees gave a score lower than 6. The overall majority (89%) believed the importance to be equal to an 8 or higher.

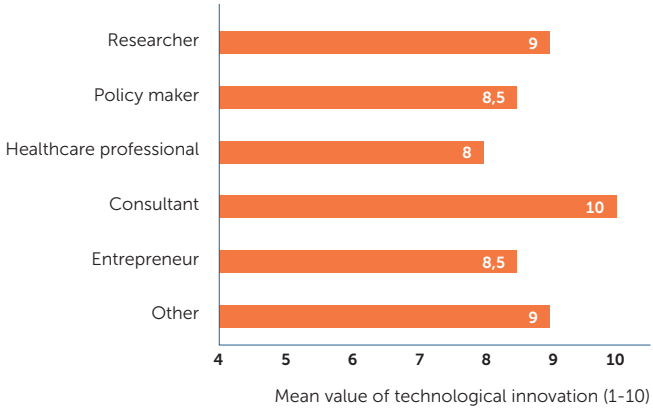


Figure 1. The extent to which different stakeholder groups think technological innovation is important for achieving a sustainable healthcare sector, on a scale from 1-10.

Importantly, the average figures per stakeholder group hardly differed. It is interesting though, that healthcare professionals scored lower than the rest of the stakeholder groups. We hope to shine some light on this observation in the next few chapters.

The pace at which healthcare can adapt to the changing demands of its customers is determined by the pace at which it can innovate. This in turn is not only determined by the speed of new technological development and product innovation but also by the pace at which these innovations are implemented in daily practice. This pace can be strongly affected by healthcare users' willingness to use these innovations. Thus, for technological innovations to be successful, it is crucial that the perspectives of healthcare consumers on implementing technologies in healthcare are taken into account. Therefore, in addition to the above-mentioned stakeholders, we asked 80 healthcare users to indicate on a scale from 1-5 (*5 strongly agree*) if they believe that technological innovations can improve their experience of healthcare services.

Are technological innovations important for healthcare consumers?

The answers are illustrated in Figure 2 and show that the greatest majority of the healthcare users (81%) believes that technological innovation can enhance their experience with healthcare, whereby similar results were obtained for men and women. Thus, the surveyed healthcare users have a positive stance towards the use of new technologies in the healthcare sector independent of their gender.

Healthcare receivers with a (bachelor's or master's) degree from a research university (Dutch: Wetenschappelijk Onderwijs, WO), were the least skeptical about implementing technologies in healthcare, followed by bachelor's graduates of applied universities (Dutch: Hoger beroepsonderwijs, HBO) and healthcare users without any degree from an applied or research university (Dutch: Middelbaar beroepsonderwijs, MBO). The latter group was the most skeptical about implementing technologies in healthcare. In more detail, although 91% research university graduates agreed that technological innovation can improve their experience with healthcare, only 54% of the healthcare users without a bachelor's or master's degree agreed with this statement.

As expected, older healthcare users are slightly more hesitant in embracing new technological innovation compared to younger healthcare users (see in Figure 2). However, the vast majority of healthcare users in both age groups agreed somewhat strongly with the claim that technological innovation can potentially improve their healthcare experiences (73% above 34 years compared to 84% of healthcare users below 35 years). Having said this, it should be taken into account, that, with 39 years on average, our sample of healthcare users was relatively young, which may explain the small differences between the two age groups.

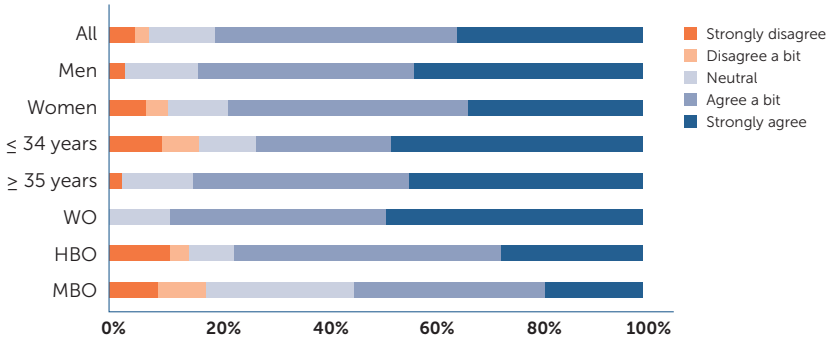


Figure 2. Healthcare users' perspectives on the potential of technological innovation to improve their experience of healthcare: higher embracement of technological innovation among younger and more highly educated healthcare users

Conclusion

Healthcare consumers are generally positive about implementing new technologies in healthcare: most healthcare receivers believe that technological innovations can improve their experience of healthcare. Interviewees that were older and had lower education were somewhat more skeptical about the added value of new technologies in healthcare. Higher education was related to a stronger belief that technological innovation has the potential to enhance users' experience of healthcare. Given these results, we suggest that, in order to increase speed and success of the implementation of new technologies in healthcare, relevant information should be provided for the most skeptical groups: i.e. the older and less highly educated healthcare users, since they are more skeptical about the added value of technological innovation in healthcare than younger and more highly educated users.

2.

WHICH TECHNOLOGIES HAVE THE MOST POTENTIAL?

CHAPTER 2: WHICH TECHNOLOGIES HAVE THE MOST POTENTIAL?

Four technological game changers are promised to cause major changes in healthcare: quantified self, artificial intelligence, standardization of individual profiling, and online health platforms. In the current chapter we assess the potential of these technological innovations to make healthcare sustainable. We asked stakeholders to rate the potential of each of these game changers to make healthcare more sustainable. Although stakeholders generally see potential in each of these game changers, answers vary greatly between stakeholders. This variation stems from the degree to which stakeholders think the obstacles to unlocking the potential of these game changers can be overcome, and the time that stakeholders think it will take to overcome these obstacles. In this chapter, we first elaborate on each of the game changers in detail. We elaborate on the potential that stakeholders see in these technologies and on the obstacles to unlocking this potential they have run into. Secondly, we compare the rating of the potential of each of the four game changers across the different groups of stakeholders. In addition, stakeholders often mentioned the use of big data as an important technological innovation in healthcare. We shortly elaborate on the merits and risks of big data in healthcare.

Our research provides insight into the view of professionals that work in, or do work affiliated with healthcare. We are, however, also interested in the view of the general population, the healthcare consumer. We therefore conducted an additional survey to ask people about their knowledge of technological possibilities in healthcare, and their willingness to make use of new technologies.

Stakeholders' views on game changers in healthcare

QUANTIFIED SELF

The first promising game changer is *quantified* self. Technological innovations make it possible to measure and collect data about our own body 24 hours a day. For example, a smart watch can monitor our heart rate, the number of steps we take and the amount of time we sleep each day. In addition, other data can be added such as our food-intake, weight, blood pressure and other medical information. The data that is produced by an individual using wearables, is called 'quantified self'. Combining this data with our personal health files generates a massive amount of data that is relevant to healthcare. Possibly, this data will play

an important role in the healthcare process in the future. Quantified self enables people to take increased ownership of their health, because it provides them with relevant information and knowledge. Quantified self also includes alarm systems which emit warning signals whenever the collected data suggest something is wrong. This allows people to visit their general practitioner at an earlier stage of disease than they would if they had to rely on their own judgements. Thus, quantified self could make early diagnosis or even prevention of disease a bigger focus of healthcare. Ideally, such prevention is individualized by taking into account what preventive actions fit the individual best, based on their individual health data. Knowledge of their own health data might motivate people to lead a healthier lifestyle. Quantified self can also be a major advantage for patients with chronic diseases. It can monitor the status of chronic illness continuously and request a doctor's appointment at the right moment (not too late, nor too early) on the basis of the data collected.

The stakeholders rated quantified self with an average of 7 out of 10 (*10 = high potential*), and the scores ranged from 3 to 10. The stakeholders' view on quantified self is illustrated in Figure 1. Although this is a high score, the stakeholders were critical about the future of quantified self when asked to explain their score.

The technology does not work

The most important concern of the stakeholders was that quantified self doesn't live up to its own promise:
A large amount of the population cannot or will not use this type of technology. A part of the population cannot use it, others do not want to use it. It seems like this game changer is decreasing in popularity again already, because it is mainly focused on health addicts and highly educated populations.

Thirty-three percent of all stakeholders indicated that creating a lot of data about oneself does not lead to improved health or improved healthcare. They expect that this game changer does not reach enough people, as it will be almost exclusively used by chronically ill or very healthy people. This makes sense, as only chronically ill and very healthy people are likely to invest time in checking their health status daily. In order to function as a useful and preventive tool, a larger part of the population should be motivated and able to use it. Unfortunately, stakeholders expect that people do not want to invest time in checking their health status daily

if they feel fine. Furthermore, other sub-populations, such as elderly people, may find the wearables that are necessary to collect the data too complicated to use. Finally, some cases exist in which people became less healthy due to quantified self, which indicates that there is a dark side to this game changer as well:
In some studies, people became less healthy due to certain health applications. They felt so good because of the positive feedback the application gave that they did not pay attention to healthcare anymore.

Ambiguity regarding privacy

The second concern of the stakeholders was the privacy of the user of quantified self. Of all stakeholders, 8% are worried that the data that is collected will be used for goals other than improving healthcare. For example, the companies providing the applications might use the data for goals that are only beneficial for these companies and not for the healthcare users.

Patients will demand more care instead of less

Another critical comment came from 7% of the stakeholders that expected that people will demand more of the healthcare system, instead of less when they use quantified self. On the one hand, this could happen when normal patterns are (falsely) interpreted as abnormal, for example when people do not understand the data and overinterpret a single abnormal value: *What does a single blood pressure measure of 140 mean?*. It is very likely that you measure an abnormally high blood pressure every now and then if you measure it several times a day, every day. However, this does not mean that something is wrong. On the other hand, abnormal patterns could be detected that would not be detected otherwise, because they do not cause complaints. As a consequence, these abnormalities would be treated, while they may be harmless and would never have caused a problem to the individual if they had not been detected. Therefore, the risk of complications due to treatment becomes more harmful than the initial abnormality was and the pressure on healthcare increases.

Practical issues with the technology

As a final critical note, 7% of the stakeholders indicated that there are practical problems with the technology:
There is a major battery problem. A smartwatch has to be recharged regularly while you should wear it 24/7 for the best results.

In addition to the battery problem, other practical issues that were raised are the fact that the current health system and hospitals are not equipped yet to process data generated by quantified self, and that it is hard or organize and interpret such data. Only if the data would be standardized, healthcare professionals will be able to collect and monitor the data. Otherwise, the professional has to create a different strategy for each patient, which would be too complicated and time-consuming.

Technology is useful for a specific population

On the bright side, 20% of the stakeholders made the positive comment that quantified self is useful when applied to a specific target population:
This game changer might have worldwide influence and is particularly beneficial for proactive patients that have to pay attention to their diseases on a daily basis. For these patients quantified self will provide freedom.

Some specific populations might benefit more from quantified self than others due to their specific healthcare needs. Two populations that were used as an example repeatedly are people with diabetes or people with heart and vascular diseases because both diseases are chronic and have to be monitored on a daily basis. Furthermore, immediate intervention is necessary when something is wrong. Therefore, regular monitoring by means of wearables, for instance, might be highly beneficial for these patients in order to gain insight in their health status. The measurements in a natural setting combined with frequent measurement time points can provide more reliable data than a single measurement in the hospital. Ultimately this will lead to more efficient healthcare for these patients.

Technology is useful for prevention

In addition to targeting specific populations, 10% of the stakeholders indicated that quantified self can be used to target a specific goal:
Healthcare should be moving towards prevention and in order to be able to prevent people from becoming ill, it is important to have individualized feedback on how someone is doing. Wearables can provide such feedback.

When quantified self has the capability to warn people in time and motivate people to take preventive actions before becoming sick, this could lead to improved public health and less expensive healthcare.

Conclusion

In conclusion, the stakeholders recognize the benefits of quantified self for chronically ill people and prevention. However, they are not convinced the population as a whole will be motivated enough to monitor their own data, let alone to take action and adopt a healthier lifestyle based on this data. In addition, the Dutch healthcare system does not seem to be ready yet to incorporate quantified-self data in healthcare processes. Overall, the possibilities are realistic and can be used already, but the implementation in healthcare and motivating people to use this game changer is a major challenge.

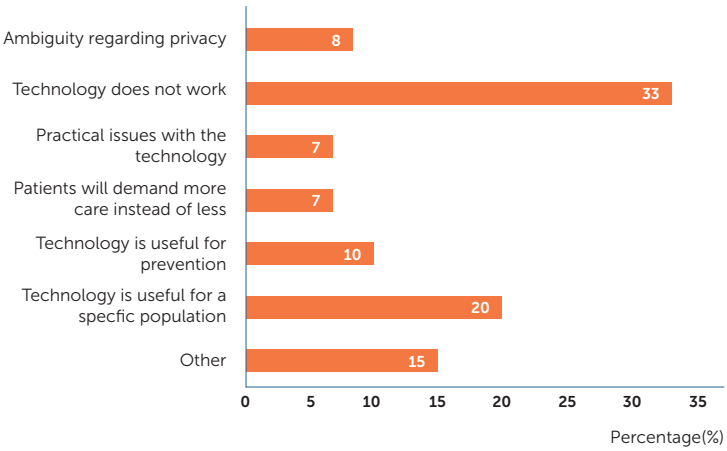


Figure 1. Stakeholders' view on quantified self.

ARTIFICIAL INTELLIGENCE

The second promising game changer we asked the stakeholders about is artificial intelligence. Artificial intelligence refers to intelligent systems that work based on numerous amounts of combinations of symptoms and diagnoses. The difference between traditional computers and artificial intelligence is that this type of technology can learn from previously entered information and create new computation rules, while traditional computers can only follow rules that were explicitly written in the software and entered into the system. The major advantage of this technique is that artificial intelligence can process data much faster at a single point in time that human intelligence can.[8] Therefore, they can consult more sources of information compared to humans. They can predict diagnoses while taking into account not only physical, but also personal aspects of the patient and in many instances, these diagnoses are more accurate than diagnoses by doctors. In the near future, it is expected that healthcare consumers will demand the use of artificial intelligence from their doctors, because people only want the best care and the best diagnosis. Not just doctors, but also patients will have access to such systems, who can use them as second opinion, mentor, or gatekeeper of healthcare. Ultimately, artificial intelligence will make it possible for healthcare users to make their own diagnosis before visiting a doctor.

The stakeholders rated quantified self with an average of 8 out of 10 (*10 = high potential*), and the scores ranged from 2 to 10. The stakeholders' view on artificial intelligence is illustrated in Figure 2. This score is high, but the focus of the main advantages of this technology according to the stakeholders differs from our expectations as described above.

Artificial intelligence as second opinion

Most stakeholders (44%) indicated that artificial intelligence would be a very useful tool, but it's main purpose would be as a second opinion for doctors:
People will always ask a person for advice, not artificial intelligence. Artificial intelligence can be used as an additional source of info for a doctor, but not directly with patients.

Stakeholders indicate that artificial intelligence can process much more knowledge and facts than humans can. Doctors can be provided with access to this knowledge via a system that represents it in a structured manner. In this

way, artificial intelligence could help doctors arrive at the right diagnosis. Artificial intelligence could be particularly valuable in cases involving rare diseases which are hard to diagnose. However, according to the stakeholders, artificial intelligence will never be more than a tool for doctors, because the human factor is essential to healthcare:
The 'annoying' thing about patients is that they never come to you with a diagnosis, but with vague complaints like feelings and anxieties. Only seldom a clear diagnosis can be made based on the complaints of the patient. Whenever a clear diagnosis can be made, this tends to be easy and a doctor makes it as fast as artificial intelligence. However, in most cases you have to read between the lines to know if something is wrong and what is wrong with this patient.

Artificial intelligence will never be able to make an ethical consideration, while ethics play a major role in healthcare.

Opposed to the position described above, 5% of the stakeholders indicated that artificial intelligence will take over decisions that are currently made by doctors:
This is important because it is more efficient, but also because it is hard for humans to detect small abnormalities, which can be done easily with artificial intelligence.

Artificial intelligence can be used in standardized processes

In addition to the use of artificial intelligence for diagnostics, 11% of the stakeholders indicated that artificial intelligence can be built into standardized processes:
In healthcare many things are standardized and artificial intelligence can be used to take over parts of this standardized work if the system is trained properly.

One common example was the use of artificial intelligence to determine what treatment should be given. Artificial intelligence can take into account the effectiveness of a certain treatment in all previous patients that received this treatment in order to determine the best treatment or dosage of medication. Furthermore, individual factors can be taken into account in order to provide optimal treatment and least risk of side effects for a specific individual.

Practical issues with the technology

A concern of 22% of the stakeholders was that this technology still has practical difficulties:

Artificial intelligence systems that we implemented with general practitioners were not used, because they gave too many notifications of possible diagnoses that doctors closed immediately. It is very important to find the right balance between sensitivity and specificity if you want artificial intelligence to become accepted and used.

> Challenge: Finding the right balance between sensitivity and specificity when using artificial intelligence.

Multiple stakeholders indicated that artificial intelligence gave too many or overly severe diagnoses, when doctors could easily estimate that nothing serious was going on with these patients. This indicates that the specificity of the information given by artificial intelligence is too low. On the other hand, artificial intelligence tools will only be used if they are more accurate than doctors and hardly ever provide wrong diagnoses, which indicates that the sensitivity has to be very high. Finding the right balance between sensitivity and specificity is a challenge for artificial intelligence experienced by our stakeholders.

Conclusion

Although almost all stakeholders recognize the possibilities and benefits of using artificial intelligence in healthcare, they do not expect this technology to be available for patients in the near future. In addition, they don't think patients would be able to use artificial intelligence in the right manner, because many stakeholders indicated that artificial intelligence will only be of importance when it is used as second opinion or tool for doctors. The professionals are considered to be necessary to integrate both medical facts and more abstract clinical and ethical information to get to the right diagnosis or advice. Although they are critical of the utility of artificial intelligence as an independent agent, stakeholders are optimistic about its use for matching a patient with the right treatment.

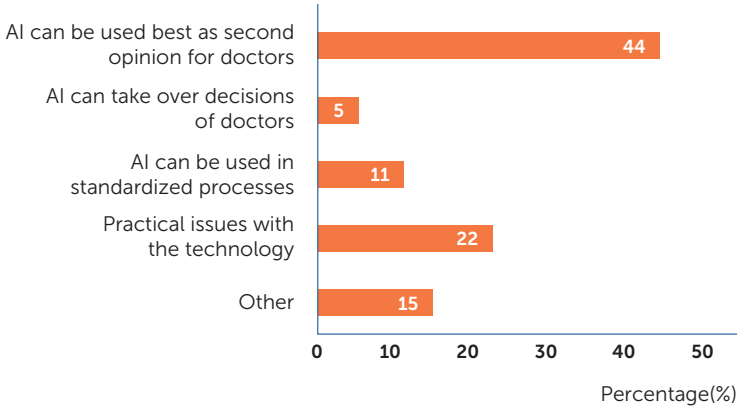


Figure 2. Stakeholders' view on artificial intelligence.

STANDARDIZATION OF INDIVIDUAL PROFILING

The third game changer for healthcare that came up in our interviews was the standardization of individual profiling. People are born with certain characteristics that are recorded in their DNA (nature). In addition, environmental factors influence the development of individuals (nurture). Nature and nurture factors determine the probability that a person will become ill and the chances that treatment will be effective. In the past decades, it has become much easier to investigate and determine these factors.[9] Although techniques for intervening in nature and nurture processes are being conceived – and sound fabulous – more research is necessary to fully develop such techniques because implementing them is very complex. For example, DNA can be sequenced (at high costs[10]) these days in order to use it in healthcare, but it is mostly unknown what the information derived from DNA means and how it can be used. Furthermore, ethical issues arise with the development of such individual profiling and it may take a while before these techniques are fully accepted in society.

Stakeholders rated this technology with an average of 8 out of 10 (*10 = high potential*), with scores ranging from 2 to 10. The stakeholders' view on standardization of individual profiling is illustrated in Figure 3.

Individual profiling contributes to personalized medicine

Most stakeholders were enthusiastic about this game changer because of its contribution to personalized medicine. About 48% of the stakeholders indicated that standardization of individual profiling contributes to adjusting healthcare to the individual:
Diseases differ largely between people: the symptoms present differ a lot and the medications that work for a certain disease also differ between people. Therefore, it is important to be able to give personalized advice and treatment.

However, 9% of the stakeholders pointed out that privacy concerns accompany the use of such individualized information. In addition, stakeholders recognized that science is not completely ready yet to perform personalized medicine. Furthermore, it is more expensive rather than less expensive to personalize medicine, although it may be more cost-efficient in the long run. As a final note, personalized medicine is not useful in every situation:
If you get hit by a car, it won't help much.

Standardization of individual profiling already exists as risk stratification

13% of the stakeholders indicated that the current risk stratification and odd calculation techniques are part of standardization of individual differences and therefore, this game changer has already been implemented, albeit in a less advanced version:
This is a fancy word for a principle that already exists. Currently, risk stratification is used to determine whether medication will work or not. However, further development of this technique is important, but there are many obstacles because the possibilities are endless.

Other

About 30% of the stakeholders gave answers that could not be classified into one category. These stakeholders raised issues with standardization of individual profiling regarding its costs: *if it would save costs, we should standardize individual profiling,* regarding is complexity: *DNA is more complicated than people think and often not successful in guiding therapy,* and regarding whether it is necessary to individualize everything*: Some types of healthcare, in particular prevention, are not about the individual, but about setting one norm for everyone, for example a campaign to make clear that non-smoking is the norm*.

Conclusion

In accordance with the literature, our stakeholders indicate that standardizing individual profiling might change healthcare in the future, represented by high grades for this suggested game changer. Although some element of risk stratification is already used today, the stakeholders recognized that much work needs to be done before it is possible to personalize medicine in a way that is more effective and cost-efficient than current healthcare.

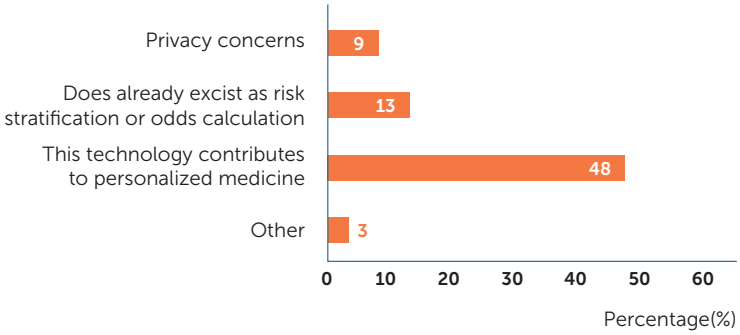


Figure 3. Stakeholders' view on standardization of individual profiling.

ONLINE HEALTH PLATFORMS

The fourth game changer for the future of healthcare we wanted to know about are online patient portals. Following the example of Airbnb and Uber, which changed the hotel and taxi business, the current healthcare system can be expected to change due to large digital platforms that redesign how patients and healthcare professionals communicate with each other. This trend is argued to have a large impact because people will increasingly wish to have control over processes that involve them.[11] People are expected to start demanding control over their health, like they are able control their financials, hotel reservations, and taxi transport. Even though people will want to know in which place they can get the best help or the shortest waiting time, the current healthcare system does not provide large scale possibilities to compare services by different doctors or institutions yet. Therefore, digital platforms providing such information, as well as online information about medical records, such as medication prescriptions and lab results, are expected to develop at high pace. As with previous market

disruptions induced by Uber and Airbnb, new online health platforms can be expected to only have a small influence on the healthcare system at first, but to become very important within a short amount of time. For example, Google and Apple are already very active in healthcare applications.

The stakeholders rated this game changer with an average of 7 out of 10 (*10 = high potential*), with scores ranging from 3 to 10. The stakeholders' views on online health platforms are illustrated in Figure 4. Stakeholders see the importance of this game changer, but they also realize that currently, there are a lot of difficulties implementing online health platforms. All categories were named by 10-20% of the stakeholders, which indicates that not a single topic stood out regarding health platforms.

Pros

A few important advantages of online health platforms were raised:
It would be a great solution if patients have control over their health, because it provides people with the ability to approach a specialist of their choice and with access to personal health information that are relevant for the questions they have. Furthermore, if the patient is in control, it has the psychological benefit that the patient becomes more proactive, because the patient has a problem that has to be solved.

This quote illustrates the advantages of the *increase of control* that patients obtain by using online health platforms. Patients can deal with this increase of control because all the information they need is available through the digital platform. The increase in information that is available to the patient also makes it possible for patients to take a *more critical* position and to discuss their treatment with their doctors at a high level. In addition, the *efficiency of communication* can increase by using online health platforms. Doctors profit from this increased information when preparing consults and while monitoring patients. Patients also profit because they are more in control of their own health and because their treatment becomes better and more efficient:
If someone can make additions to his or her patient file from home, fewer consults are necessary and it is easier to act preventively.

Cons

Stakeholders also named important disadvantages or did not see the potential of online health platforms:

One has to think about which problems one wants to solve and for whom. This could be a development like an ATM. At first it is an extra service of banks to get money, but later on, banks in smaller villages close and only the ATM is left. We should think about whether it is an additional service or substitute for regular care and we should prevent it from becoming a complete substitute.

Some stakeholders argued that there is *no potential* for online health platforms, because past efforts to implement them have failed. Furthermore, some thought it is an *old-fashioned* way of collecting data about patients that has already been replaced by more innovative techniques. These stakeholders considered the other three game changers to be more innovative. Two related concerns that were raised were *privacy and security* on the one hand and *the tension between central and decentral* storage of data on the other hand. Central storage of all healthcare data of one person has been a goal for many years but has not been realized up until today. Decentral storage may be more secure as not all information is in one place and it provides the patient with control over who has access to what information.

Conclusion

Both advantages and disadvantages of online health platforms were recognized by stakeholders. While digital platforms have been shown to be important for other sectors, not all stakeholders believe it is very innovative and that online health platforms will have the power to change healthcare in the future. However, stakeholders do recognize that online health platforms can make communication between patients and doctors more efficient and that it fits with the trend of taking more control over one's own healthcare processes.

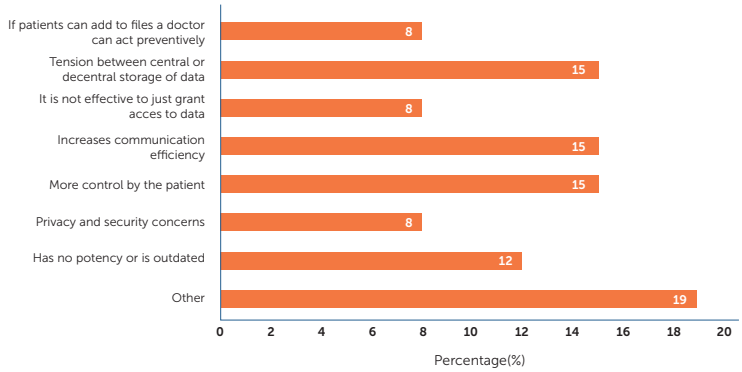


Figure 4. Stakeholders' view on online health platforms.

THE POTENTIAL OF THE FOUR GAME CHANGERS ACCORDING TO DIFFERENT STAKEHOLDER GROUPS

We were also curious to see whether different stakeholder groups view the potential of the game changers differently. Figure 5 shows the rating of each of the game changers for entrepreneurs, consultants, healthcare professionals, policy makers, researchers and 'others'. Although there are slight differences in the ratings between stakeholder groups, the overall ratings are remarkably similar. Interestingly, there is more variation in scores within stakeholder groups than between stakeholder groups.

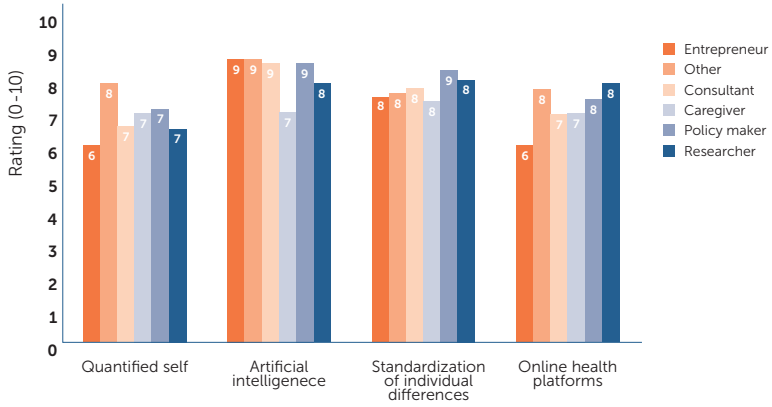


Figure 5. The rating of each of the game changers for entrepreneurs, consultants, healthcare professionals, policy makers, researchers and 'others'.

Other game changers

In Figure 6, an indication is given about other game changers that were named by different stakeholders to be important for the future of healthcare. Although elaborating on all of these game changers is beyond the scope of this chapter, big data stands out as the most important one. Therefore, we will zoom in to this game changer a little more in the next section.

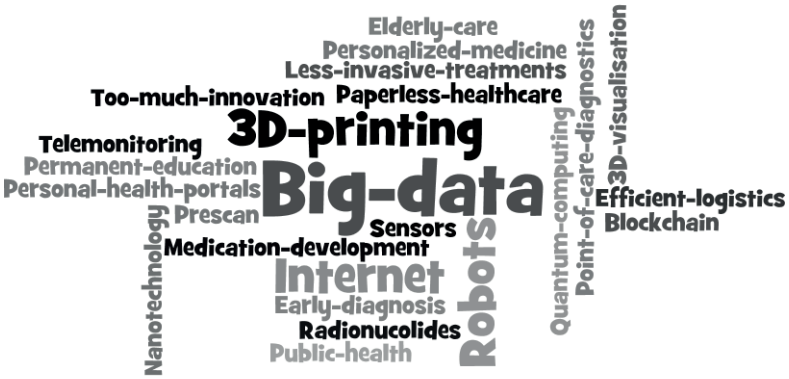


Figure 6. Examples of game changers that were identified by the stakeholders.

BIG DATA

The stakeholders were asked what they thought the role and potential of big data would be in healthcare. As a response, most stakeholders exclaimed terms like: this is the future, this is very important, great potential and none of the four game changers discussed above is possible without big data. It is not a surprise that the answers were not very concrete: as big data does not have one definition, it is hard grasp what big data exactly is and how it can be applied.[12] Big data is not a game changer or technology in itself, but it refers to datasets that contain large amounts of unstructured data. Such datasets are too large and too complex to analyze with traditional methods and new approaches are being developed in order to gain useful information from big data. In general, it can be said that big data is large in volume, is collected at high speed and is usually of low quality. Moreover, big data is unstructured and comes from different sources, and it is hard to say how valuable such data is. In healthcare, big data can be obtained from the internet,

including websites, social media and health apps, from machines that perform measurements, claims to health insurers and other transactions, biometrical data such as scans or blood tests, and from patients' files. The stakeholders' view on big data is illustrated in Figure 7.

Possibilities

The most important potential of big data that was named by 30% of the stakeholders is *finding new associations*. Some stakeholders used rather abstract wording to describe this potential: *To find out what is relevant in a sea of endless data*; others described the potential in more specific words: *It is possible to examine results of treatments, both qualitatively and economically*. When big data is used to its full potential, which is not possible yet in many cases, new associations within diseases can be found. Side effects from certain treatments can be predicted based on previous results, effectivity of treatment can be examined and improved, and different patients can be compared to see on what factors they respond similarly or differently in order to find new symptoms of diseases. This is only possible if a broad focus is used without having a hypothesis in advance. In this way, big data f*acilitates personalized medicine*, because personal factors can be taken into account when analyzing big data. In other words, big data does not only allow us to examine what side effects can be expected, but also for whom they can be expected: *Although most specialists or general practitioners do not realize it yet, big data has the most impact of all innovations. Most importantly, it will bring major improvements in tailor-made treatmen*t.

In addition to finding new associations, big data can also be used as a *preventive tool* in order to predict who will become ill at what point in time and who to target for intervention purposes: *Big data provides the possibility to map inequalities and disadvantaged areas with regard to healthcare at which you can adjust your policy*. Predicting and preventing disease isn't only useful in order to reduce healthcare costs, it can also be very beneficial for companies that can use preventive interventions if their employees are at risk of becoming sick. However, if employers have access to data that can predict which employees will become sick, there is a risk of abuse of these records. Moreover, many (other) ethical problems could appear, of which we are not yet aware.

Another possibility that big data provides, is that it may *take over tasks from doctors*, for example in diagnosing disease or finding the right treatment. Also, the quality of healthcare institutions can be investigated with big data: *Big data can be used, for example in hospitals, in order to optimize hospital admissions. One can for example investigate to what extent surgeries are carried out following protocol and why deviations from the protocol were made, in order to improve the protocol*.

Concerns

In addition to the great possibilities that come with the development of analyzing big data, concerns were raised by the stakeholders. Most importantly, they worried about *the interpretation of the data*: *Just data alone doesn't help, you still need someone to make sense of it* and critical evaluation of the results is necessary: *Conclusions from big data are based on associations that may lead to changes in healthcare. However, the mechanisms behind the associations remain unknown and all conclusions should be interpreted with caution. We need people who critically examine which conclusions can and cannot be drawn*.
Thus, although the potential of big data is big, the data is unstructured, and hard to interpret and turned in to actions. Even though associations between factors may be found, no causal conclusions can be drawn from such data.

Another concern is that *big data is not used to its full potential* yet: *Hospitals already have lots of data available and they need to start using these sources*. The problem is that most institutions do not have the capacity or knowledge to analyze and interpret big data. Therefore, a lot of the time data is collected and stored, but not used yet. Furthermore, the possibility to combine datasets from different institutions is also not being used enough yet and regulations for doing this are strict.

Furthermore, *big data is hard to apply to an individual*: *Healthcare is about the individual and how are you going to use big data on this individual? We should use it mainly for research and then make the step to find out how this knowledge can be applied at an individual level*. Although big data can help to personalize medicine, applying big data to a specific individual is a major challenge. Certain rules may apply to an individual that do not apply to the population as a whole and

people might prefer certain treatments based on personal values. It is up to the doctor to translate the results from big data into useful information for a specific patient and to decide whether the information gained is useful for that specific patient.

As with all game changers, *privacy* is a major concern: *A lot is possible with big data, but using it is very hard because ethical and privacy-issues are hard to solve. Abuse of data is easy because a lot of predictions can be done. This can be used, for example, by insurers and employers in order to make more profit and good international legislation is necessary to regulate the use of big data*. Although most of the data is anonymous, abuse by companies is a major risk of big data. Since big data is still new, no legislation is present yet on how to use it. Therefore, with the improvement of the interpretation of big data it is important to solve ethical and privacy issues as well.

Finally, it is important to *connect data by standardizing it* in big data sets: *I think much can be gained by bundling and standardizing data in order to be able to combine all of the data and analyze it all together*. One of the problems that big data is facing is that it is unstructured and much of the data containing comparable information is stored in different ways that make it impossible to combine these data into one database. If data is standardized and bundled this would provide better opportunities to analyze the data.

Conclusion

Although stakeholders are aware of the many opportunities big data provides, a lot has to be done before it can be safely used. The field is still new and serious thought and policy on how to analyze and interpret big data, how to apply big data to individuals and how to tackle ethical and privacy issues is necessary.

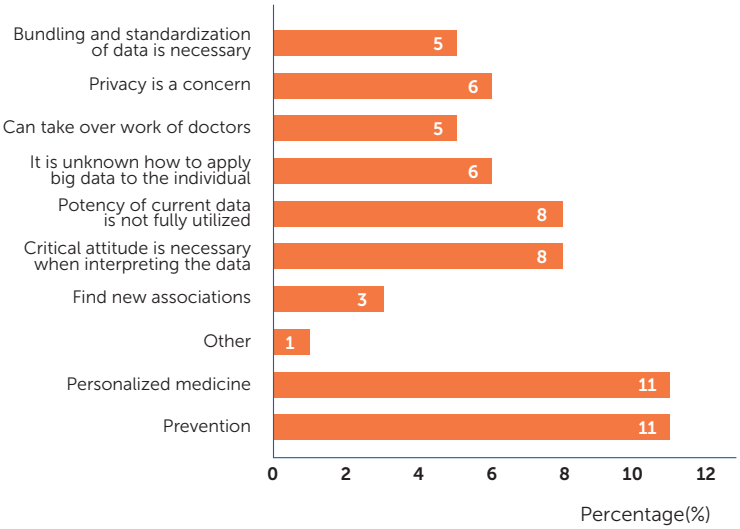


Figure 7. Stakeholders' views on big data.

Healthcare consumers' perspectives on new developments in healthcare

Healthcare users are mostly unaware of, but eager to use the newest technologies in healthcare

The broad implementation of new technologies in healthcare will only be possible if healthcare consumers are willing to use these innovations. Therefore, we asked 80 healthcare receivers about their knowledge and willingness to use nine technological innovations in healthcare. An overview of the results is shown in Figure 8 and 9.

It was striking that only two innovations were known by more than half of our respondents: *planning a consult with a doctor online* (known by 70%) and *sending a digital picture of skin rash to the doctor for a remote diagnosis* (known by 54%). The least known new technological innovations were *using artificial intelligence to interpret a CT-scan* (known by 14%) and *conducting a urinary test with a machine that is connected to your mobile phone* (known by 11%).

We also asked healthcare receivers to indicate how likely it is that they would make use of the included technological innovations if they would be ill (*scale*

from 0, very unlikely, to 5, very likely). Healthcare users were most likely to *plan a doctor's consult online* (94% of healthcare users reported that it is 'a bit' to 'very likely' that they would make use of this innovation) and *send a digital picture of their skin rash to the doctor for a remote diagnosis* (85% indicated that it is likely that they would make use of this technology). Thus, both innovations have a high practical value, since the vast majority of surveyed healthcare consumers is willing to make use of these innovations in case of a future illness. Of all included technological innovations, healthcare users were most skeptical about the use of artificial intelligence for diagnostic purposes and the use of sensors at home to enable remote health monitoring. However, still more than 60% of the healthcare users considered it 'a bit' to 'very likely' to make use of these innovations in case of a future illness.

In general, knowledge about new innovations turned out to be somewhat related to eagerness to use it. However, 80% of the surveyed healthcare consumers would *conduct a urinary test with a machine connected to your mobile phone* in the case of future illness, although this innovation was the least known technological innovation. In conclusion, the results show that healthcare users are willing to use new technologies but are generally unaware about the newest technological possibilities in healthcare.

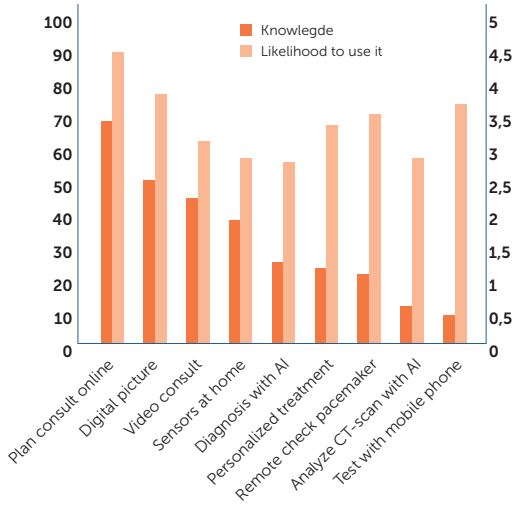


Figure 8. Percentage of healthcare receivers that was familiar with nine technological innovations, compared to their willingness to use these technologies in case of a future illness.

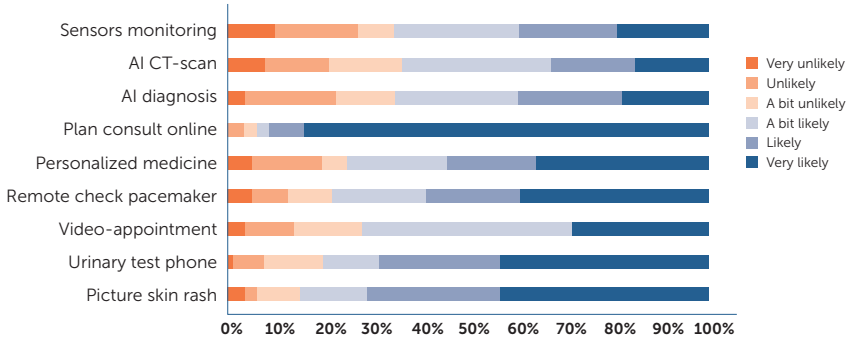


Figure 9. Likeliness of healthcare receivers to make use of the nine technological innovations split up for the different answer possibilities.

As illustrated in Figure 10, male healthcare receivers were somewhat more familiar with most of the included technologies. Differences were most striking for *consulting your doctor with a video-connection*, which was known by 63% of male, but only 33% of female users. However, despite their lower awareness of the latest technological possibilities, women were as eager to make use of new innovations in healthcare as men.

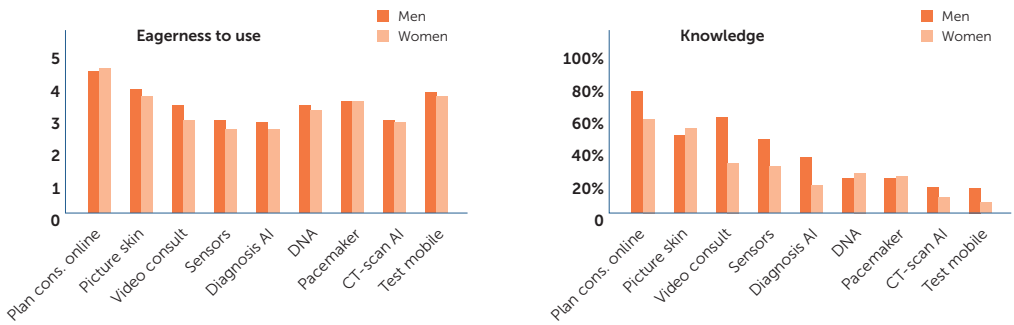


Figure 10. Gender differences in awareness of and eagerness to use the latest technological possibilities in healthcare.

Figure 11 illustrates that younger healthcare users were more familiar with some of the technologies (*e.g. to plan a consult online*), while older healthcare users were more familiar with others (*e.g. a pacemaker that can be checked remotely*). Older healthcare users may generally be more familiar with technologies that are related to diseases that occur more frequently with increasing age, such as heart diseases. Younger and older healthcare users were as likely to make use of most technological innovations. However, younger healthcare consumers were more likely to *plan a consult with their doctor online* or make use of *personalized treatment based on DNA-analysis*. Younger people were more familiar with both technologies, which may explain why age played a role in the willingness to *plan a consult with your doctor online* and make use of *personalized treatment based on DNA-analysis*.

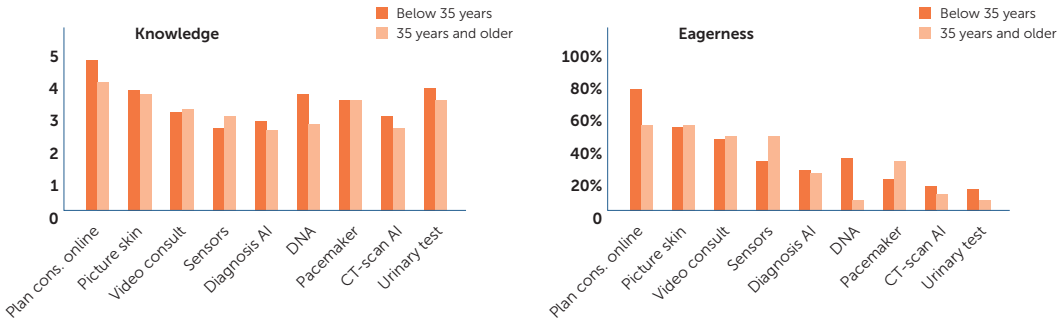


Figure 11. Knowledge of and eagerness to use technological innovations among younger and older healthcare consumers.

Awareness of the latest technological possibilities in healthcare was generally higher among healthcare users that had completed a degree at an applied or a research university (HBO or WO) than among healthcare users that did not have a bachelor's or master's degree (MBO or lower), as illustrated in Figure 12. In addition, more highly educated healthcare users were more willing to make use of technological innovations in case of a future illness.

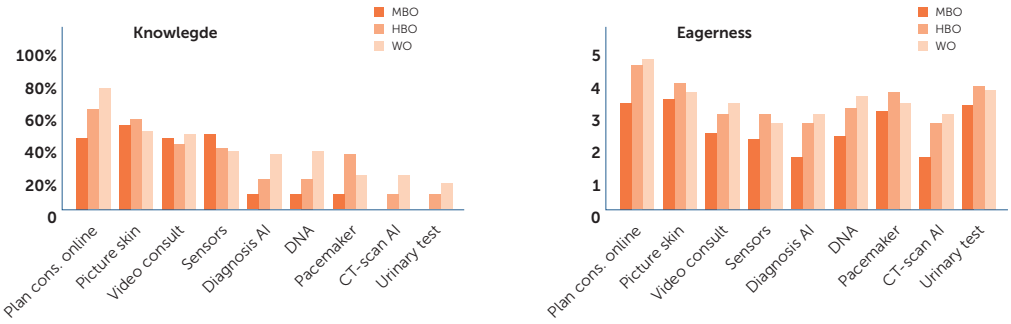


Figure 12. Knowledge of and eagerness to use technological innovations among healthcare consumers with different educational levels.

Healthcare users' level of comfort with different ways of communicating with their doctors

We also asked healthcare users to indicate how comfortable they would be about having an interaction with their doctor using non-traditional ways of communication, such as email or video-connection (*scale from 0, very uncomfortable, to 5, very comfortable*). The results are displayed in Figure 13.

Healthcare users felt by far most at ease about communicating with their doctor at the hospital, the general practitioner's practice or at home. The more non-traditional ways of communicating were all rated much lower, with e-mail being the least liked medium of interaction: 58% of the healthcare users felt uncomfortable about communicating with their doctor via email. Thus, the more impersonal the way of communication, the more uncomfortable healthcare receivers may feel about it, which emphasizes how crucial personal contact with a doctor is for patients. In addition, healthcare users feel more at ease with traditional face-to-face communication with a doctor than with non-traditional communication, such as video-connection.

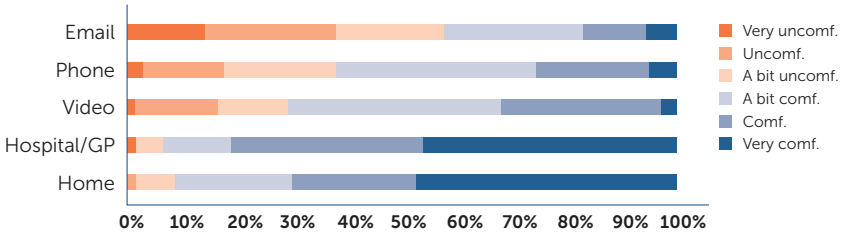


Figure 13. Comparing non-traditional and traditional ways of communication: Healthcare users feel more comfortable about using traditional ways to communicate with their doctor.

As illustrated in Figure 14, the preferred way of communication did not differ much between men and women or younger and older healthcare users. However, more highly educated healthcare users were more comfortable with interacting with their doctor via video-connection than less highly educated healthcare users. The latter felt more at ease about interacting with their doctor at home. Possibly, highly educated healthcare receivers are more open to non-traditional communication ways.

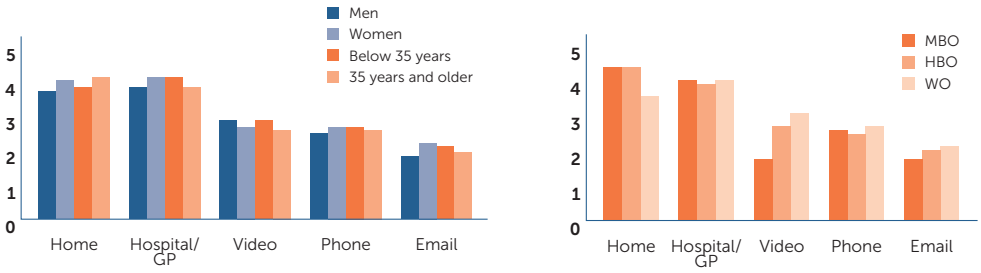


Figure 14. Preferred way of communicating with doctors split up for gender, age and level of education.

Healthcare users prefer healthcare provided by traditional healthcare organizations

Research has predicted that healthcare will not only be offered at hospitals and doctors' practices in the future, but also by organizations not traditionally associated with healthcare services, such as supermarkets or drugstores.[13] In our

survey, we therefore asked healthcare users to state how likely it is that they would use healthcare services offered by a particular organization (*scale from 1, very unlikely, to 5, very likely*).

As illustrated in Figure 15, our healthcare consumers were reluctant about using healthcare services offered by non-traditional healthcare service providers: more than 80% of healthcare users stated that they would not use healthcare services provided by supermarkets or financial service providers. Healthcare insurers, drugstores and pharma-companies did not score much better.

Technology companies were seen somewhat more positively: 22% of healthcare users stated they would make use of their healthcare services. However, healthcare users' scores for technology companies were still much lower compared to hospitals and pharmacies: 92% of healthcare users would make use of healthcare services provided by hospitals and 67% would use healthcare services offered by pharmacies if these services were also provided by other organizations.

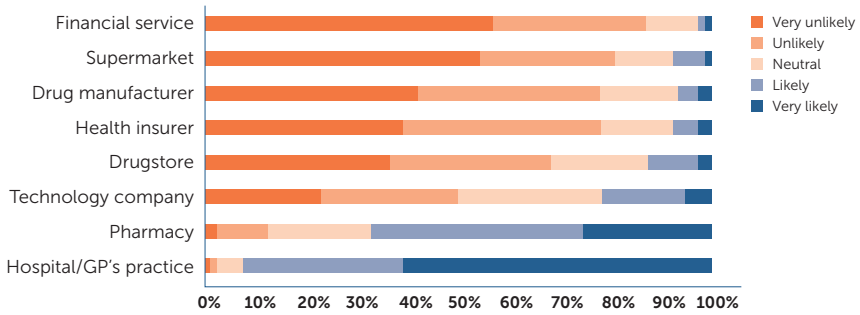


Figure 15. Likelihood of healthcare users to use healthcare provided by various organizations.

Figure 16 displays differences between men and women, different levels of education, and age. Men and women did not differ in their likelihood to make use of healthcare provided by traditional and non-traditional healthcare providers. Younger healthcare users' estimation of the likelihood that they would make use of both traditional and non-traditional healthcare organizations in case of a future illness was higher than that of older healthcare users. In addition, more highly

educated healthcare users were more likely to make use of healthcare provided by pharmacies, drugstores and technology companies compared to less highly educated healthcare users. People with a higher education level may generally be more open to using healthcare provided from organizations other than the hospital or general practitioner.

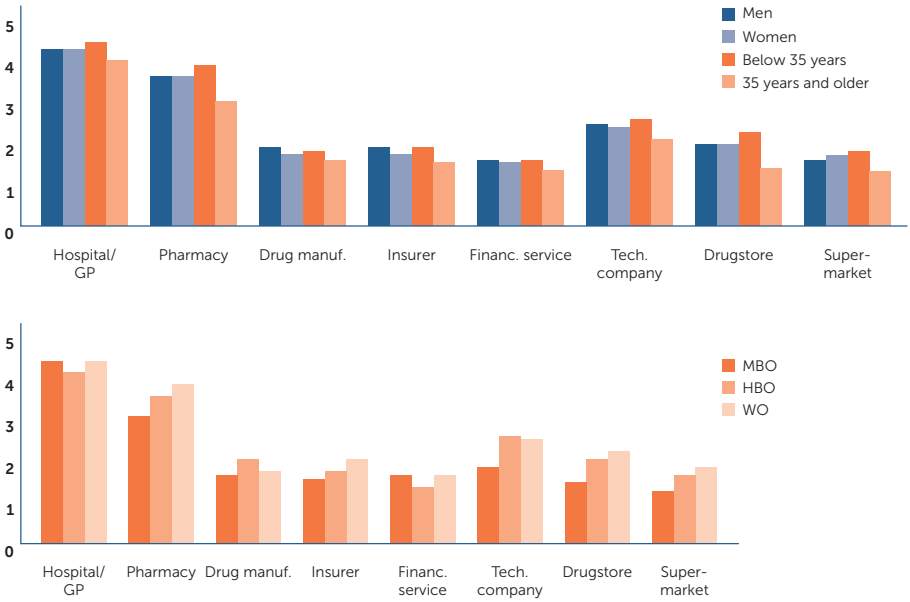


Figure 16. Likelihood of healthcare users to use healthcare provided by various organizations: effects of gender, age and education.

Healthcare users prefer a diagnosis from a doctor with support of artificial intelligence

Finally, we asked healthcare receivers if they prefer a diagnosis given by a doctor, artificial intelligence or a doctor that is supported by artificial intelligence. Figure 17 shows that three-quarters of surveyed healthcare receivers were skeptical about relying solely on artificial intelligence for diagnosing an illness, whereas more than two-thirds of the healthcare receivers were satisfied with a diagnosis given solely by a doctor. However, healthcare receivers were most satisfied with a diagnosis made by a doctor supported by artificial intelligence. Thus, healthcare receivers

may support the use of artificial intelligence as a second opinion to verify the doctor's diagnosis, but they do not trust on artificial intelligence alone.

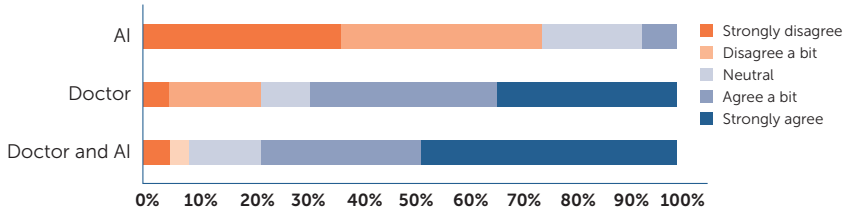


Figure 17. Preference of healthcare users for being diagnosed by a doctor, artificial intelligence or a combination.

Men and women and healthcare users of different age groups did not differ in their opinions about their preferred way of being diagnosed, as illustrated in Figure 18. More highly educated healthcare receivers had a preference for being diagnosed by a combination of artificial intelligence and doctor compared to a diagnosis based solely on the doctor's opinion, whereas less highly educated healthcare receivers preferred a diagnosis based solely on the opinion of a doctor. People with a higher level of education may be better informed about the advantages of including artificial intelligence in the diagnostic process, which can explain this difference.

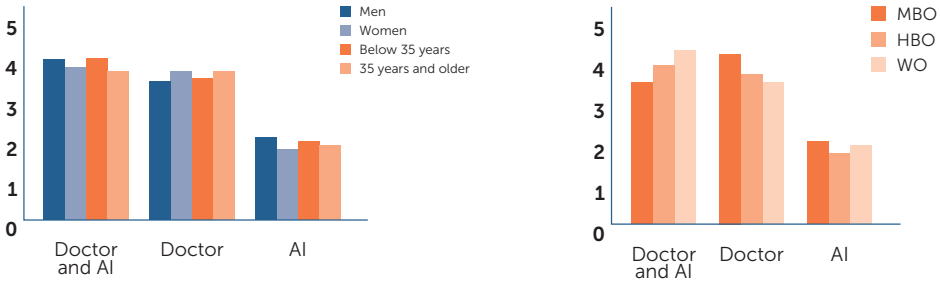


Figure 18. Preference of healthcare users for being diagnosed by a doctor, artificial intelligence or a combination.

Conclusion

Many different technologies have been expected to cause a major change in healthcare, in particular by the people who developed these technologies. We asked the stakeholders about four game changers that stood out in previous literature about the future of healthcare. How important are these game changers for the future of healthcare?

The first game changer was quantified self. Although stakeholders recognized the benefits of quantified self for chronically ill people and prevention, they were not convinced the population as a whole will be motivated enough to monitor their own data or to adopt a healthier lifestyle based on this data. In addition, the Dutch healthcare system does not seem to be ready yet to incorporate quantified-self data in healthcare processes. Overall, the possibilities are realistic and can be used already, but the implementation in healthcare and motivating people to use this game changer is a major challenge.

The second game changer was artificial intelligence. Although almost all stakeholders recognized the possibilities and benefits of using artificial intelligence in healthcare, they did not expect this technology to be available for patients in the near future. In addition, they did not think patients would be able to use artificial intelligence in the right manner, because many stakeholders indicated that artificial intelligence will only be of importance when it is used as second opinion or additional tool for doctors. Professionals are considered to be necessary to integrate both medical facts and more abstract clinical and ethical information to get to the right diagnosis or advice. Despite their critical view of the utility of artificial intelligence as an independent agent, stakeholders are optimistic about its use for matching a patient with the right treatment. The view of the stakeholders matches healthcare consumers' perspectives. Consumers do not trust the sole use of artificial intelligence for diagnostic purposes, but welcome artificial intelligence as a second opinion or additional tool for doctors.

The third game changer was standardizing individual profiling. Although some element of risk stratification is already used today, the stakeholders recognized that much work needs to be done before it is possible to personalize medicine in a way that is more effective and cost-efficient than current healthcare.

The fourth game changer was online health platforms. While digital platforms have been shown to be important for other sectors, not all stakeholders believed it is very innovative and that online health platforms would have the power to change healthcare in the future. However, stakeholders did recognize that online health platforms can make communication between patients and doctors more efficient and that it fits with the trend of taking more control over one's own healthcare processes.

Finally, we discussed the importance of big data for future healthcare. Although stakeholders are aware of the many opportunities big data provides, a lot remains to be done before it can be safely used. The field is still new and serious thought and policy on how to analyze and interpret big data, how to apply big data to individuals and how to tackle ethical and privacy issues is necessary.

Healthcare users' views on the newest technological possibilities

Healthcare users are largely unaware of the newest technological possibilities in healthcare but are generally eager to use them. Healthcare users with a low education level are both less aware of and less eager to use the latest technological innovations. To enhance their willingness to use new innovations in healthcare, healthcare professionals may profit from providing information about the latest technological possibilities specifically to people that do not hold a university degree.

Healthcare users prefer traditional face-to-face communication with their doctor. In addition, trust in healthcare services provided by traditional healthcare service providers, such as pharmacies and hospitals is much higher than trust in healthcare services provided by non-traditional healthcare providers. Healthcare professionals should take these preferences of healthcare consumers seriously. The acceptance of healthcare provided by non-traditional healthcare service providers may take time. Moreover, non-traditional healthcare organizations may need to prove that they are trustworthy first. Otherwise, healthcare consumers may not be willing to make use of their healthcare services.

The results concerning the use of artificial intelligence and non-personal ways of communication, such as email, further emphasize the importance of the

human factor in healthcare. For healthcare consumers, human contact is an essential part of healthcare and healthcare professionals should ensure that, with growing technological possibilities, healthcare does not become more and more impersonal.

3.

ADVANTAGES AND DISADVANTAGES OF TECHNOLOGY IMPLEMENTATION

CHAPTER 3: ADVANTAGES AND DISADVANTAGES OF TECHNOLOGY IMPLEMENTATION

How can technology improve the sustainability of the Dutch healthcare system? Besides diving into the different technologies (see Chapter 2) and implementation experiences (see Chapter 4), we wanted to know the view of the interviewed stakeholders on the use of technology in healthcare in general. What benefits do they see in technological innovation in the healthcare sector and what disadvantages do they predict? We asked the stakeholders to list three advantages and three disadvantages of implementing technological innovation into healthcare.

Most of the advantages mentioned could be categorized into two general themes: efficiency and quality improvement. The main disadvantages were inaccessibility of healthcare for users, decrease of human contact, privacy & safety issues and increase of costs. We noticed that the mentioned disadvantages for technological innovation were more detailed and divided within the sample groups compared to the advantages. This can point to an increased weight that stakeholders give to their negative experiences. To overcome this bias and balance the view that stakeholders have on technological innovation, it seems important all stakeholders are informed on the concrete advantages of technology implementations in their organization.

We also interviewed healthcare consumers on their view of implementing technological innovations. They mentioned similar advantages as the interviewed stakeholders, and, just like the interviewed stakeholders, identified quality and efficiency improvements as the main advantages of technological innovation in healthcare. With regard to disadvantages of technology implementation, a decrease in human contact and interaction was by far the biggest concern of healthcare receivers and mentioned much more frequently than by the interviewed stakeholders. Thus, healthcare consumers seem to be very worried about a possible decrease in human contact due to technological innovation, which is crucial to take into account when implementing new technologies in the healthcare sector.

Summary

Advantages listed by the interviewed stakeholders

The advantages listed by the stakeholders were mostly general themes, such as efficiency and quality, and resonated among various stakeholder groups. The first general theme, efficiency improvement, was often mentioned in connection with automation of tasks and makes it especially important due to the upcoming medical personnel shortages. Furthermore, improvement of administrative efficiency and cost reduction by eliminating redundant activities and early diagnosis were mentioned within this theme. Contrary to what we expected, healthcare professionals mostly focused on the cost reduction aspects and not on the automation of tasks and administrative efficiency. This could be explained by the fact that past technology implementations often increased rather than decreased administrative tasks and workload. The second general advantage that was discussed is quality improvement. Preventive healthcare, value-based healthcare, personalized healthcare, evidence-based healthcare and other recent healthcare trends were all referred to as more specific forms of quality improvement. Stakeholders also mentioned better treatment and diagnosis as examples of quality improvement. Together, these forms of quality improvement are thought to have the potential to transform the entire healthcare system. In addition, many respondents mentioned that new insights can be obtained on the effectivity of treatments among different patient groups so that, instead of treating all patients in the same way, a better distinction can be made between sub-populations. Various stakeholders expect increased accessibility to healthcare and patient empowerment as a result. Because patients will become less dependent on geography and fixed time schedules to visit healthcare providers, it will be easier for them to fit healthcare into their daily life. Additionally, through improved sharing of information between doctors and patients, patients will be better informed on their health.

Advantages listed by healthcare receivers

Like the interviewed stakeholders, healthcare receivers listed efficiency

and quality improvement as the main advantages of technological innovations. On the other hand, an increase in accessibility and patient empowerment was barely mentioned as an advantage of technology implementation in healthcare by this group. Possibly, healthcare users find patient empowerment and enhanced accessibility of healthcare less important than the interviewed stakeholders. However, healthcare receivers may also be less aware of the fact that the implementation of new technologies may increase the empowerment of patients and the accessibility of healthcare. Fifty percent of the healthcare users in our sample were below 30 years old and none of them was older than 61 years. Thus, factors that reduce the accessibility of healthcare, such as physical immobility, may apply less to our group of healthcare receivers than to older individuals. As a consequence, our sample of healthcare receivers may not be very aware of the problem of inaccessibility of healthcare that some groups of healthcare receivers experience. Healthcare users also mentioned some advantages of implementing technology in healthcare that were not or less identified by the interviewed stakeholders, such as an increase in communication and cooperation between different healthcare professionals, healthcare institutions and between patients and healthcare professionals and an increase in objectivity due to the use of technology in healthcare.

Disadvantages listed by the interviewed stakeholders

The stakeholders' views on the disadvantages of technological innovation were more specific compared to their views on the advantages. They were also more divided on this issue. This suggests that stakeholders attribute greater weight to their negative experiences. To overcome this bias and balance the view that stakeholders have on technological innovation, it is important that healthcare providers are informed on the direct advantages of technology implementations in their organization.

One of the negative aspects mentioned was inaccessibility of healthcare for users, caused by technological illiteracy. This isn't only a risk for patients, but this can also affect low-tech health institutions. Most of the

stakeholder groups worry that innovations will lead to a decrease, rather than an improvement in accessibility. Another disadvantage mentioned is the decrease of the human factor in healthcare. For the interviewees, a loss in human contact means a loss in value. Besides this, they also think a decrease of human involvement is linked to a decrease in healthcare quality. When asked to explain this, several interviewees pointed at the relative inflexibility of technology compared to humans, as well as its lack of human intuition. However, policy makers, consultants and entrepreneurs were keen to stress the potential of automation when asked about the negative effects of decreasing human contact. Privacy and safety issues were often mentioned as problematic side effects of innovation. It isn't just difficult to guarantee patient privacy: rather, it is very difficult to control the quality of the data in the first place. However, some doubts were raised on the importance people will ascribe to privacy in the future. Although (as described above) some stakeholders mentioned a decrease in costs as an advantage of technological innovations, others said they expected an increase in costs, because they think the high start-up investments needed for technology and the current financial system are incompatible. Particularly the interviewed healthcare professionals seemed preoccupied with the effects of innovations on cost. Another disadvantage cited is the expected increased dependence on technology. Interestingly, on this topic we found a disagreement between healthcare professionals on one hand and entrepreneurs and researchers on the other hand. It could indicate a different view between those stakeholder groups on the value of technology compared to the value of humans. The low quality of technological products was also mentioned as a disadvantage, most often backed up by examples of situations in which the technology was implemented too soon. Finally, the adaptation of employees to new technologies was raised as a difficulty. Stakeholders believe that employees tend to resist change, that there is often a bad fit between their educational programs and new technological innovations and that employees often fear losing their job.

Disadvantages listed by healthcare receivers

The disadvantages of technology implementation listed by healthcare receivers were similar to those raised by the interviewed stakeholders, but there were also some striking differences. First of all, the interviewed stakeholders were much more concerned about the inaccessibility of healthcare for some patient groups, such as digital illiterates. The healthcare users in our sample were relatively young and highly educated. Therefore, it is unlikely that they have experienced inaccessibility to healthcare due to digital illiteracy. As a consequence, they may be less aware of this problem. On the other hand, digital illiteracy may also be less of a problem for patients than assumed by the different stakeholders.

Some other disadvantages, such as a decrease in the human factor and diminishing quality of healthcare, were mentioned much more often by healthcare receivers than by the interviewed stakeholders. It is crucial to take the importance of the human factor into account when implementing new technologies in the Dutch healthcare sector, since a decrease in human contact and interaction is the biggest concern of healthcare users when thinking about disadvantages of implementing new technologies in healthcare. A diminishing quality of healthcare due to technological implementation is also a major concern of healthcare receivers. Concerns about reduced quality may be based on lacking information with regard to the reliability of new technologies. It is therefore crucial to focus on informing patients about the advantages of new technological developments to enable successful implementation and avoid resistance and mistrust. In addition, to avoid erosion of trust in healthcare users, it is essential to use new technologies in combination with humans and not let technology take over the diagnosis and treatment process completely.

Another major concern of healthcare receivers are privacy and security issues caused by technology implementation. Healthcare users are worried about who will have access to their data and if their data might be used to identify risk groups that have to pay higher contributions or may

be denied adequate healthcare. Healthcare users also raised concerns about the ownership of their data, the potential of abuse of their data for commercial purposes, privacy and security regulations that are lagging behind, monopolies of tech-companies and a rise in cybercrimes that might lead to the leaking of sensitive data. These concerns have to be taken seriously and it is essential to put adequate regulations in place to prevent the abuse of sensitive patient data and differential treatment of patient groups.

Several healthcare receivers also mentioned dependency on technology and higher costs as possible disadvantages of technology implementation in healthcare, but these were minor concerns compared to healthcare users worries about privacy, lower quality and diminishing human interaction and involvement in healthcare due to technology implementation.

Advantages of implementing technology

First to discuss are the positive views on technological innovation. Figure 1 shows the main answers given by the stakeholders related to the advantages of implementing technological innovations. It is very clear that the key advantages are linked to improvement of efficiency (34% of answers) and quality of healthcare (33% of answers). The other benefits that the interview stakeholders see are related to patient empowerment (10% of answers) and improved accessibility of healthcare (9% of answers). We dove into the conducted interviews to extract the specific reasons behind these mentioned advantages. We will examine all these reasons more closely in the following sub-paragraphs.

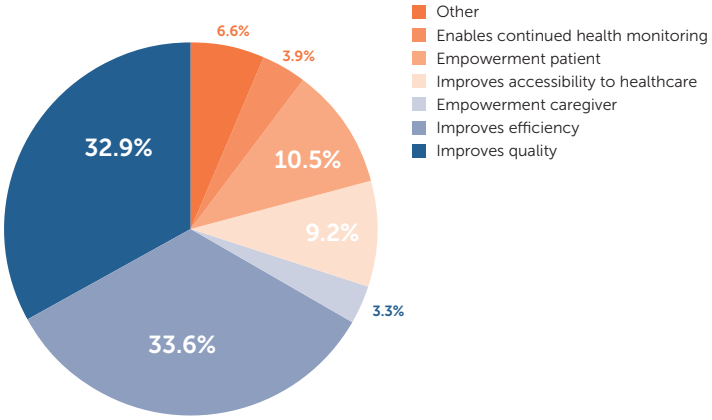


Figure 1. The advantages listed for technology implementation, taken from all interviewed stakeholders.

Technological innovation & efficiency improvement

The ongoing demographic changes in the Dutch society will greatly alter the healthcare sector. Healthcare institutions will face increasing care demands by the aging population, and they will also have to deal with growing labor shortages, due to the diminishing workforce.[14] Both developments highlight the need for a more efficient healthcare system. The efficiency improvement that technological innovation is expected to offer, mainly referred to three domains: improving administrative efficiency, cost reduction, and automation of tasks.

Efficiency improvement: Administrative efficiency

Already for many years, healthcare professionals have been complaining about the ever-increasing administrative burden. With good reason, because on average they spend as much as of 40% of their time on administrative tasks.[15] The interviewed stakeholders mentioned that by using technology, the administrative efficiency will improve. Besides freeing up time for the healthcare professional, the communication between the different professionals should improve as well. With the help of technology, such as better documentation tools, there will be less unnecessary doctor visits or repetitions of tests. This development will enable a new organizational structure for the Dutch healthcare system:

Because of the increasing specialization of healthcare professionals, the commun-

ication within the personal health network of the patient should be improved. It is important to take into account that every patient has a personal health network of healthcare professionals.

In this statement from one of the interviewees, the health institutes do not make up the main structure of healthcare, but the individual patients do, as they connect to healthcare professionals of their personal health network. This marks a transition from a functional organizational structure (based on departments) towards a project-based structure, in which every patient can be regarded as a 'project'. The healthcare professionals of the different functional groups will have to work together to improve or maintain the health of the patient. When healthcare professionals within a personal health network have access to better and more accurate information, the planning efficiency is expected to increase. Improved patient throughput will follow. Waiting times for treatments or consults should decrease, as redundancy is eliminated from the system.

Efficiency improvement: cost reduction

An expected advantage in terms of efficiency improvement is related to cost reduction. Costs are reduced by the aforementioned elimination of redundant activities, but also by early diagnosis and treatment of patients, which is made possible by technological innovation. In the early stages of a disease, a more general and straightforward treatment can be used to prevent the disease from progressing to a stage at which expensive, specialist treatment is needed. Technological innovation will also enable healthcare institutions to benefit from scaling advantages, since the flow of information and experiences within larger organizations will be enhanced. Because the correct information is available for all members of the healthcare organization, the organization can grow, without increasing the number of miscommunications and sharing of faulty information. The enlarged number of healthcare professionals that follows from this growth will enable optimization of diagnosis and treatments, and the sharing of good practices within the organization. However, stakeholders often mentioned that the cost reduction from technology implementation does not happen instantaneously but takes some time after introduction. Most respondents focused on cost reduction after an initial investment with the aim to free up means for other healthcare activities:

People are much more expensive than machines, so you should use technology to free up people for more difficult tasks. This will help people to focus their attention towards the more intricate activities of their profession.

The message of this stakeholder connects well to the numerous remarks we received in relation to the medical personnel shortages that are currently troubling the Dutch healthcare system. Additionally, by 2020, the shortage of healthcare personnel is expected to increase by 20.000 people.[16] Technological innovation can be used to automate tasks that are currently performed by healthcare professionals. This will enable more efficient use of personnel, which is highly needed:
With the ageing population, soon, there will not be enough healthcare professionals to provide sufficient care without the help of technology. Additionally, the demand for care will rise due to the ageing population.

Efficiency improvement: administrative efficiency

When automation takes over tasks from healthcare professionals, more time can be spent on actual care for patients. This can be in the form of longer patient consult times, planning more consults within one day, or by resources meant for extra guidance or counselling for patients. Also, the improvement can be aimed at the healthcare professionals:
I hope that the fun factor in the work will increase: recently, so many administrative tasks have been introduced, so I hope that we can automate these tasks by using data analytics.

Efficiency improvement: stakeholder groups

Figure 2 shows the responses given by the various stakeholder groups when asked how technological innovation might improve efficiency. It is interesting to see that among researchers and healthcare professionals, cost reduction is mentioned 20% more compared to automation of tasks and administrative efficiency. Especially from the healthcare professional, we would expect this group to be more focused on reducing the pressure of their work by automation of tasks and improving administrative efficiency. However, we noticed that during our interviews, various stakeholders mentioned that up to now, technology increased administrative tasks rather than decreasing it:

Right after the implementation [of the National Health Record], it took us a lot of time to enter all the patients into the system. It was a lot of work, and it had to be done for every single patient.

Entrepreneurs stressed both the cost reduction and the task automation potential of technological innovation, while administrative efficiency is mentioned less often. In the case of policy makers, administrative efficiency is not mentioned at all. This can perhaps be explained by their focus on output, number of tasks done (aided by automation) and reduction of costs, but less on the actual implications of the technology on the daily work.

Figure 2. The advantages of technology implementation related to efficiency improvement, compared among the interviewed stakeholder groups.

Technological innovation & quality improvement

The runner-up advantage of technology implementation is quality improvement. To specify the meaning of quality improvement in the healthcare sector, we often heard stakeholders mention a variety of ongoing and future trends:

- Preventive healthcare: the current healthcare system makes a transition towards preventive healthcare. This means that the focus should be put on keeping patients healthy, instead of spending the majority of resources on treating their diseases.

- Value-based healthcare: it is important to consider the value that healthcare adds to the lives of people. It is not enough to cure people, as curing is only a small part of a much larger process: keeping patients mentally and physically healthy.
- Personalized healthcare: technological innovation can incite client-based healthcare. The client is actively involved at the center of care, instead of being a passive object. This means that healthcare is tuned to the needs of an individual patient.
- Evidence-based healthcare: The treatment of patients is guided by reason, less by randomness. By collecting large amounts of data on diseases and treatments, healthcare professionals can use data to support their decisions.

WORKING TOWARDS A NEW FORM OF HIGH QUALITY HEALTHCARE

By combining all the mentioned quality improvement trends, a new form of healthcare can be envisioned: this high-quality healthcare system is based on patient-centered care. Patients are connected 24/7 to the healthcare professional of their *personal health network*. Patients voice their *values* about health, life and disease and actively work on their health, to *prevent* from getting ill. The treatments and guidance they receive are *personalized* and chosen based on previous *evidence* of effectivity.

For a more detailed vision of the interviewed stakeholders on the future of healthcare, please consult Chapter 7.

Other answers linked to quality were mostly related to the potential of improving treatment and diagnosis. This can be done either by improving treatments that are already in use, or by introducing entirely new treatments. Many respondents projected that new insights can be obtained on the effectivity of treatments among different patient groups. This will help determine what treatments should be prescribed for different types of patients and it will also help manage an expanded assortment of treatments.

With technology and data analysis, new correlations can be identified that go beyond the human brain capacity. These new insights can be used to keep people healthy for longer periods of time.

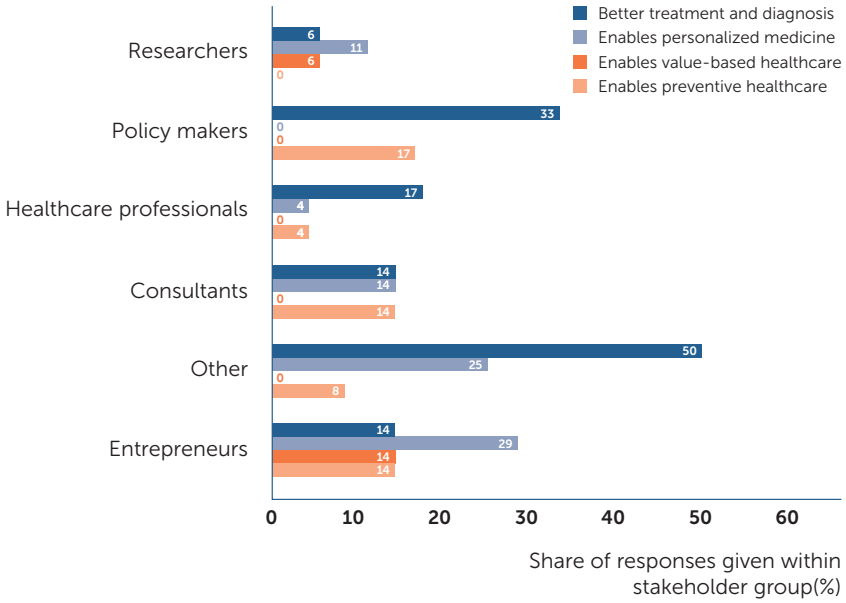


Figure 3. The advantages of technology implementation related to quality improvement, compared among interviewed stakeholder groups.

Figure 3 shows the distribution of the quality-related advantages listed for the different stakeholder groups. Interestingly, only researchers and entrepreneurs mentioned value-based healthcare as a potential quality improvement that technological innovation can bring. Perhaps this can give some insight in new trends that are surfacing in research and commercial markets but are not at the top of the list for healthcare professionals. Personalized medicine is mentioned in all groups, except by policymakers. Better treatment and diagnosis has high scores for most of the stakeholder groups.

Technological innovation & improved accessibility

The technology of the information age has improved connectivity between humans from all over the world. Therefore, it makes sense that the advances in communication technology will be applied to the healthcare sector. The idea is that there will almost be direct contact between healthcare professional and patient, or at least, that at any place or moment in time, healthcare professionals are easily accessible:

Technology delocalizes healthcare. You are no longer dependent on the nearest general practitioner or nearest hospital. You can receive treatment based on international expertise.

Technological innovation & empowerment

A direct result of an increased accessibility to healthcare is patient empowerment. Because patients will become less dependent on geography and fixed time schedules to visit healthcare providers, it will be easier to embed healthcare into their daily life. This will reduce the negative impact of healthcare on daily life and will allow patients to take better charge of their own life and health. For example, chronic patients will greatly benefit from delocalized healthcare. Instead of going to a general practitioner or hospital several times per month, the patient can now communicate via smartphone or teleconference with the relevant healthcare professionals. This will save the patient time and effort, especially if they have a decreased mobility due to age or disease. Thus, patients will be free to plan their own life, without having to take into account rigid schedules with doctor visits. Still, they will be able to feel safe and comfortable, because the amount of contact with healthcare professionals will not decrease.

Another aspect that will empower patients is related to improved sharing of information between doctors and patients. A wide range of media can be used to inform patients on, for example, different treatment procedures or side-effects of drugs. This will not only reassure patients, but also lead to implementation of *shared decision-making*: healthcare providers will be able to take into account the opinion of the patient during the decision process. Additionally, a trustworthy and always-available reference tool can reduce the demand on the healthcare system by replacing small tasks:
Think of 'bad news' conversations that are difficult to remember for patients afterwards. Technology can help to inform these patients. Or think of simple illnesses as bladder infections, where an app is already sufficient to inform patients on side-effects of prescribed drugs or on the expected duration of symptoms.

Although the majority of the answers related to empowerment were focused on the patients (10% of all advantages listed), only 3% of the answers were aimed at empowerment of doctors themselves. Quality improvement of healthcare can be seen as empowerment for doctors, since it will increase the value of their

work. However, technological innovation, such as e-health, can also be used as a support system for a doctor. For example, *big data*-based knowledge that can improve the speed and accuracy of diagnosis and treatment. In addition, when healthcare becomes less linked to specific locations and time schedules, it will also empower doctors. It will give them more flexibility to plan their own work and schedule the more demanding tasks at moments when they can focus best.

Disadvantages related to implementing technology

In addition to the advantages, we also discussed disadvantages related to technological innovations with the interviewed stakeholders. Figure 4 shows the most important disadvantages of implementing technology in the healthcare sector that were mentioned. Contrary to the discussed advantages, in this case stakeholders' answers were much more diverse. The main disadvantages discussed are (specific forms of) inaccessibility for users (16%), decrease of human contact (16%), privacy & safety issues (15%) and increase of costs (12%). Other disadvantages are (specific forms of) dependence on technology (8%), quality decrease (6%) and the difficulty to implement the technology among employees (5%). All these answers are discussed in the following sub-paragraphs.

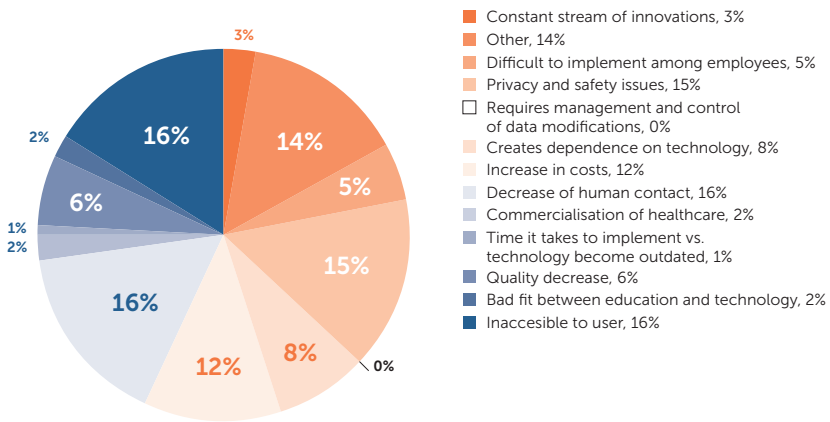


Figure 4. The disadvantages listed for technology implementation, taken from all 77 interviewed stakeholders.

Technological innovation & inaccessibility to users

Many stakeholders are concerned about the negative effect of technology implementation linked to the inaccessibility of healthcare to users. Out of all the answers related to inaccessibility, 68% of the respondents mentioned *technological illiteracy* as the main reason for user inaccessibility. Although daily life is immersed with technology for the majority of the population, still there are sub-populations that keep the interaction with technology to a minimum. For example, the fast pace of innovation is difficult to keep track of for elderly people, because they are not well suited to adapt to new innovations. In addition, this is also the case for low-literate people.

If this trend will continue, then a large gap will arise between people that can adapt to technology and people that are left behind. Those people can be illiterates or people that have low personal health skills. It is important that the technologizing of healthcare will not lead to low quality care for this group.

Apart from erecting barriers to make (practical) use of healthcare services, the upcoming technological changes will also affect patients that are not able to take charge of their own healthcare. Although many stakeholders mentioned patient empowerment as an advantage of technology, they also mentioned that it might not be empowering for everyone. If healthcare does indeed shift to become a more personalized and value-based system, it will favor patients who are outspoken and know their values and needs. Besides potentially excluding people that cannot adapt to or take charge of technology in healthcare, technological developments in healthcare may also pose a problem for healthcare institutions that operate at a lower-level of specialization. Will they be able to adapt to new technologies? Do they have the required resources to adapt to system changes? To address this problem, communication between healthcare institutions will become more important. Through knowledge institutes and training courses, high-level healthcare institutions should share their knowledge with lower-level healthcare institutions.

Of all responses related to a decrease in user accessibility, 24% indicated an *unrealistic expectation of the technology*. Patients can be disappointed by reports on new technologies that they obtain from the internet or the news. They often expect that these new technologies will be implemented soon, while it actually might take years before a reliable implementation is possible.

For example, when it is announced that within the course of 1 year, an AED drone will come to your house, because it predicted that you will have a heart-attack in 5 minutes. At the moment, this is simply impossible, because a reliable statistical analysis isn't available.

Figure 5a compares different stakeholder groups with respect to how often inaccessibility of healthcare due to technological implementation was mentioned. We deduct that the concern is most prominent for the consultant and the 'other' group. Entrepreneurs and policymakers hardly mentioned this disadvantage. It gets even more interesting when we combine, for each stakeholder group, the number of mentions of the potential of technology to *improve* user accessibility with number of mentions of the potential to decrease user accessibility, and then compare between the stakeholder groups – see Figure 6. Researchers, consultants, healthcare professionals and 'other' are mostly concerned about the decrease in accessibility, since they mentioned this the most, while the policymakers only mentioned the increase in accessibility due to technological innovation. These policymakers may have focused on the population as a whole and considered the fact that the group of technological illiterates is relatively small compared to the population that is well-equipped to work with technology. Thus, policymakers may have concluded that implementation of technology will bring the greatest number of benefits for the greatest number of people when it comes to accessibility. On the other hand, other stakeholders, such as consultants and healthcare professionals, might be more aware of the sub-populations that will be left behind. Another explanation could be that accessibility of the current healthcare system is not such a big problem as experienced by the consultants and healthcare professionals or that these stakeholders focus excessively on the negative aspect of this theme. The entrepreneurs consider both the positive and negative aspects of technology on the accessibility of healthcare.

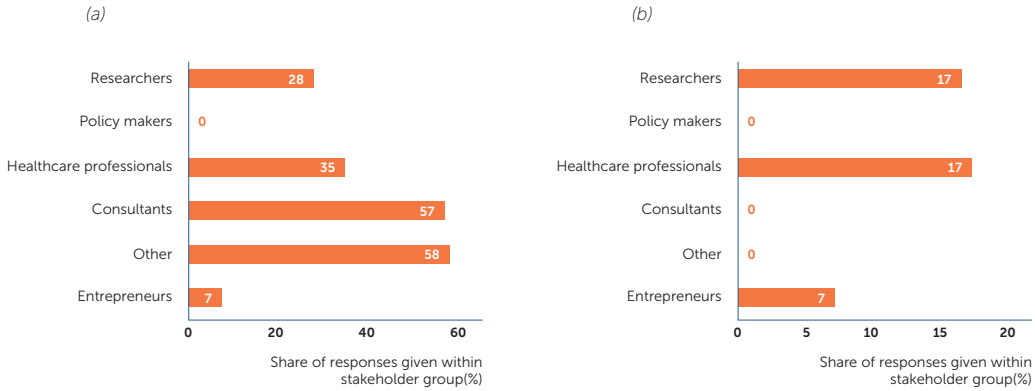


Figure 5. The charts display the percentage within the interviewed stakeholder group that mentioned (a) user inaccessibility, and (b) difficulty to implement among employees, as a disadvantage of technology implementation. For example, 5 (a) shows that 28% of the interviewed researchers mentioned user inaccessibility as a disadvantage of technology implementation in healthcare.

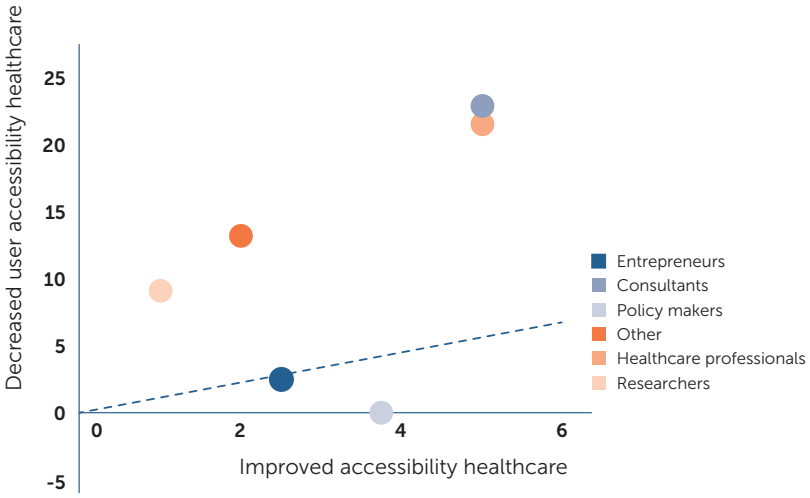


Figure 6. Bubble plot showing the number of answers per stakeholder group on the improvement of accessibility vs. the decrease of user accessibility. All the stakeholder groups above the dotted line are mostly concerned for the decrease in accessibility, while the stakeholders below the line mostly emphasize the improved accessibility of healthcare.

Technological innovation & implementation among employees

The difficulties related to technology adaptation do not only concern patients, but also healthcare professionals. They will have to spend time to get acquainted with a new technology, while they already have a high workload. Therefore, technology can lead to frustration among healthcare providers. This can be caused by an inability to work with the technology or can come from a fear of losing their job. It seems important to explain to such an employee that automation of tasks will not necessarily result in job loss. There are so many other tasks that we cannot and do not want to automate, so this offers an opportunity to free up time for the other tasks. Another problem connected to the adaptation of employees to new technologies is that the education of medical personnel isn't properly aligned with the latest technological developments. Several stakeholders highlighted that more time should be freed up for education on technological innovation, not only for medical students, but also for medical professionals.

HOW TO INCITE TECHNOLOGY IMPLEMENTATION AMONG EMPLOYEES

When discussing how to handle conflict related to technology implementations within a healthcare organization, we got two opposite responses:

Manage with a steady hand

Some stakeholders said that the management should take the lead for the technology implementation:

People don't like change, so conflicts will arise within the organization. A steady hand is needed to introduce the new technology.

Bottom-up instead of top-down

Which is basically the opposite of the previous argument:

A bottom-up approach to technological implementation is needed instead of a top-down approach.

A bottom-up approach refers to building up the technological implementation in association with the end-users, in this case the healthcare professionals, instead of enforcing the technology from above, that the side of the management.

Figure 5b compares the responses of the different stakeholders with regards to the difficulty of implementing a technology among employees. A high percentage (17%) of the interviewed healthcare professionals said that they see the implementation of technology as problematic. This is not surprising, since healthcare professionals are most likely to run into problems concerning implementation because they are the ones who actually work with the new technologies. However, researchers also mentioned this argument (17% of the interviewed researchers). This is surprising, given that the implementation phase of technology is often far away from the developmental phase. It is good to see that researchers are concerned with implementation, which can perhaps be explained by a new focus in the academic world on technology transfer and valorization. Policymakers, consultants, entrepreneurs and other hardly mentioned the concern at all.

Technological innovation & decrease of human interaction

Technology offers the potential to automate various tasks in healthcare; for example in terms of administration, logistics, but also in communication. This can be as simple as sending automated emails to invite a patient to a consult, but it can also entail the complete replacement of human contact during the same consult. A disadvantage of automation often mentioned is the decrease in human contact between patients and their healthcare professionals that it seems to result in:

Technology in a social trade is dangerous. For example: recently, cuddle robots have been introduced for lonely elderly people. We should focus on the opposite and give these people the human attention that they need. We have already lost most of the human factor in the current healthcare system. Just think about home care, where already all the care is scheduled and timed.

Besides the value that interviewees ascribe to human contact, some project that the quality of healthcare will diminish when human involvement decreases. Several interviewees detect a certain inflexibility of technology compared to humans, as well as an absence of human intuition.

One should be careful not to forget the human intuition. This is the pitfall of implementing new technologies. For example, stomach problems can be caused by psychological problems instead of a physical disease. This will not be intercepted by a computerized program. Human contact remains important and

modern technology cannot replace the needed contact between a patient and his doctor. Technology and human contact can co-exist, but technology cannot replace human contact.

Figure 7a compares the responses of the different stakeholder groups with respect to the view that technology leads to a decrease in human contact. Although this disadvantage is mentioned by more than 30% of all stakeholders except researchers, this outcome requires qualification. When we compare the negative responses to the automation of tasks (linked to the decrease in human contact) to the positive ones (linked to automation potential), all stakeholder groups, except for 'other', turn out to have a neutral or positive view on automatizing technology. Especially policy makers, consultants and entrepreneurs emphasize the potential of automation compared to the negative effect of decreasing human contact. Although many captivating opinions were given by the healthcare professionals related to decreasing human involvement, they see an equal potential for implementing technology for task automation.

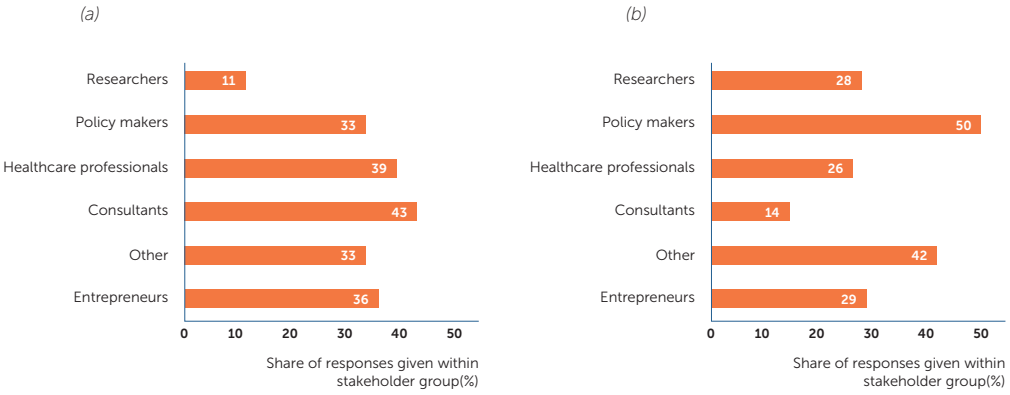


Figure 7. The charts display the percentage within the interviewed stakeholder group that mentioned (a) decrease in human contact, and (b) privacy and safety issues, as a disadvantage of technology implementation.

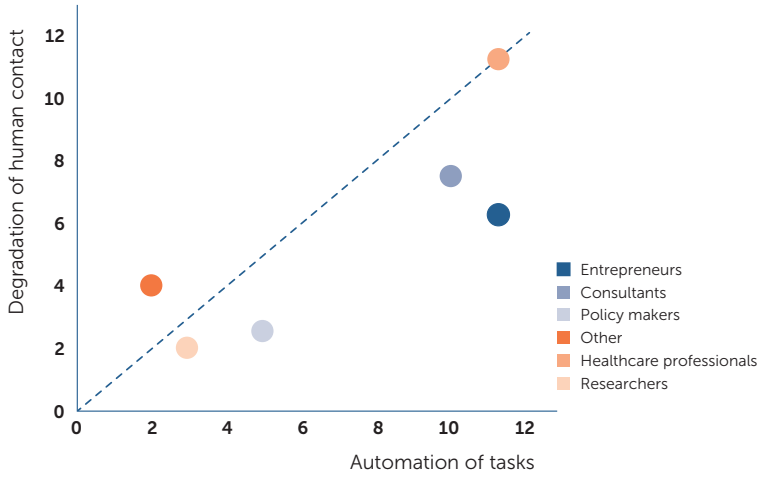


Figure 8. Bubble plot showing the number of answers per stakeholder group on the automation of tasks vs. the decrease of human contact. All the stakeholder groups above the dotted line are mostly concerned for the degradation of human contact, while the stakeholders below the line mostly emphasize the potential of automation of tasks.

Technological innovation & privacy and safety issues

Even though the stakeholders emphasize that the communication between the different healthcare professionals should be improved, the stakeholders are concerned about the privacy of patients when sharing information. The National Electronic Health Record was mentioned very often as a successful technological implementation. Still, problems arise from sharing medical data. It isn't always clear to the user who has access to the data and what they will do with it.

It is unknown who can access the data that you share. Good international laws and policies are needed to solve the privacy issue.

Furthermore, the quality of the available data isn't always guaranteed. The medical information can be incorrect or contradictory. Therefore, errors can propagate in patient files if they are not properly corrected and edited. However, one could also argue that the data quality will improve, as it can be checked by more healthcare providers. Regardless of the demands related to privacy and the quality of the shared data, it was mentioned that the sharing systems should still remain user friendly. These considerations make some stakeholders doubt whether it is even possible to pursue all these demands:

Data sharing was vital for achieving our current progress. Now, the data is shared by new means. Previously, mistakes have been made as well. The current opinions are often guided by fear. Fear of misuse by health insurance companies, or employers. We had to be careful as well when we were still working with paper patient files, we were often dealing with medical ethical committees back then. But this should be of no concern. Especially since everything is being monitored. Privacy will not give any problems in the future.

Figure 7a compares the responses of the different stakeholder groups on technology leading to privacy issues. Among the different stakeholder groups, the disadvantage is mentioned by around 30% of our interviewees. This does not include consultants, who put less emphasis on the privacy issues of technology. Perhaps they already foresee a different public view on privacy in the future. The policy makers and the 'other' group score quite high on privacy issues.

Technological innovation & increase in costs

The stakeholders mentioned that introduction of a new technology often requires a high initial investment, both in money and time. This initial investment causes problems, since it is not always known to what degree the technology will save costs in the long term. We often heard stakeholders complain about the incompatibility of the current financial system with the high initial investments needed. It is difficult to finance the start-up phase of the implementation, when it only costs money. Besides financial investment, a new technology also requires investment of time. This means that employees should be given time to familiarize themselves with the technology or help with the implementation of the technology into their daily practice.

When comparing how often the cost disadvantage is mentioned by the different stakeholder groups (Figure 9a), only the healthcare professionals stand out. For all other groups, 15% of the stakeholders mentions costs, while for the healthcare professionals, more than 40% discuss the disadvantage related to costs. When comparing the cost increase argument with the cost saving argument (Figure 10), one can see that for most stakeholder groups, both are mentioned equally. However, a large share of the healthcare professionals mentions both the advantage and the disadvantage related to costs, while giving more weight to the disadvantages. This can be explained by the knowledge of the healthcare

professionals of the current financial system of the Dutch healthcare sector. They might have concerns about the incompatibility of the high investments associated with technology with the current treatment-based billing system. The consultant and researcher stakeholder groups mention the cost advantage more often compared to the cost disadvantages.

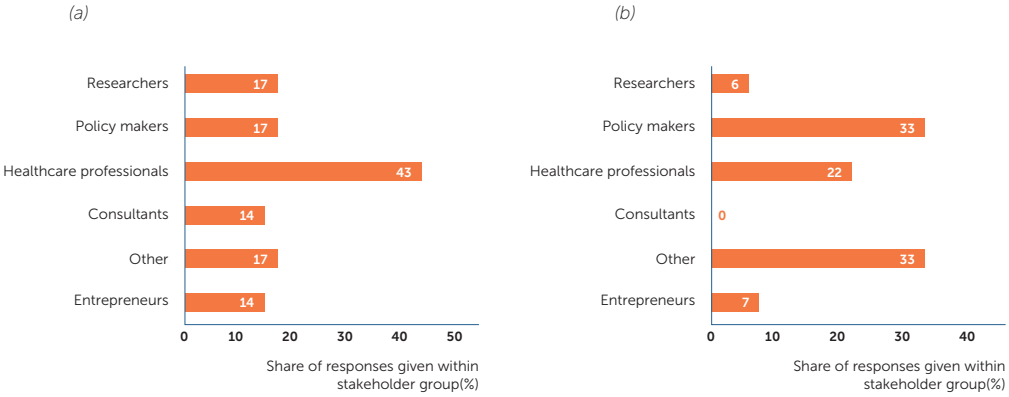


Figure 9. The charts display the percentage within the interviewed stakeholder group that mentioned (a) increase in costs, and (b) dependence on technology, as a disadvantage of technology implementation.

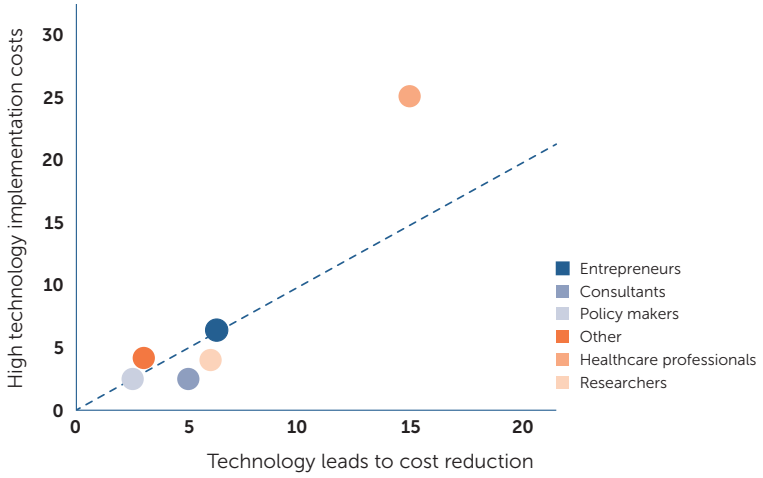


Figure 10. Bubble plot showing the number of answers per stakeholder group on the cost reduction vs. cost increase potential of technology. All the stakeholder groups above the dotted line are mostly concerned for the high implementation costs, while the stakeholders below the line mostly emphasize the potential of cost reduction.

Technological innovation & dependence on technology

With the level of technology implementations increasing in the healthcare sector, a certain dependence of the system on technology is created:
The dependence on technology is increasing dramatically; one might wonder: is this desirable? There is no alternative, I think.

For instance, doctors may become too dependent on technology when they rely on technology to fill gaps in their knowledge or to interpret test-results, thereby failing to maintain their medical knowledge and skills, which may eventually lead to a loss of knowledge and skills. It is difficult to avoid the technological dependence, since the stakeholders have underlined that technology will be crucial to facilitate a more sustainable healthcare system (see Chapter 1). However, efforts can be spent on educating the people that will work with technology about their role in this process.
Furthermore, some stakeholders argue that medical doctors should never be replaced by technology. The technology should act as a support system for the doctor, rather than taking over in the form of an autopilot. Figure 9b shows the share of responses given on the undesired dependence of technology among stakeholder groups. Policy makers, healthcare professionals and 'other' view the dependence on technology as quite substantially, while consultants, researchers and entrepreneurs do not mention it very often. We presume that this is linked to an opinion that technological innovation in the healthcare sector is highly needed, and the dependence is inevitable and thus futile to worry about. Another possible explanation is an increased faith in technology compared to the performance of humans. We often heard the opposite from healthcare professionals, who value the human intuition, or the clinical view of a doctor more highly than the judgment of an artificial intelligence system.

Technological innovation & decrease in quality

Although many technological implementation problems are not related to the quality of the technology itself, the quality of the product should not be overlooked. It is important that the technology is not implemented before it is ready:
When a product is commercialized too soon (for example, a care robot), then it can reduce the desire to use it. It is important to keep the enthusiasm of the users at a high level. However, there should be a balance, you should always go for the minimum viable product.

The underlying reasons for a quality decrease from technological innovation were: the product didn't work yet (57% of all answer related to a quality decrease), it created resistance among users (29%), or that the product didn't meet the needs of the users (29%). Besides low-quality technological products, a problem can arise when the technology doesn't improve the quality of healthcare after implementation.
There is a danger of creating a better mousetrap: implementing technology that does not perform better or worse than already available technology.

This obviously leads to wastage of funds, as the investment in the technology is not justified by the results. It is important that both healthcare institution managers and entrepreneurs stay mindful of what is really important: improving healthcare.
The emphasis can be too much on innovations as the ultimate goal, instead of seeing them as tools (to make healthcare easier or cheaper). Advancing technology should not be the main focus to develop new apps and gadgets.

Technological innovation & keeping up with all the innovations

It is not easy for healthcare institutions to stay up-to-date on technological developments. During our interviews, the stakeholders mentioned the duality between keeping up with the fast pace of technological developments, but also dealing with the slow pace of technology testing and implementation. Due to the constant stream of innovations, it is difficult to stay informed on the latest developments.
The market is overloaded, since so much is developed at the moment. People do not know how to inform themselves and which technologies they should follow and which they shouldn't.

The situation isn't made any easier by the lengthy technology implementation times in the healthcare sector. The clinical studies needed to test a new technology can take many years. Additionally, getting stakeholders aligned within the organization is time consuming as well, and by the time this is achieved, the technology might be already outdated.

Both of the discussed problems underline the importance of keeping up with technological developments during the early stages of development, so that enough time remains to plan the implementation. Additionally, there are many

blogs, websites and institutions in the Netherlands that research and discuss upcoming technologies and can be used for drawing up an implementation plan.

Other disadvantages related to technological innovation

Several less anticipated side-effects can follow from technological innovation in the healthcare sector. For example, it can lead to 'medicalization' of patients: they will spend much more time on their health and will monitor their own data continuously. While this development is partly desirable, it can lead to stress and worry for the patients. They may end up reading too much into their data, which can translate to an increased workload for medical professionals.
Patients can see their own test results before they have consulted a doctor. This can lead to responses, while test results can always be interpreted in many different ways. Healthcare is never unambiguous, even though many people presume that it is.

Another mentioned disadvantage is the anticipated commercialization of the healthcare system. Stakeholders are worried that innovation might only be used to save costs and increase profits, instead of improving healthcare. This opinion is not shared by all, as some welcome the participation of companies in the healthcare sector. They think that patients, as the owners of their own medical data, should be able to share these data with companies, because new and better forms of healthcare will result from it.

Discussion on the positive and negative views of stakeholders

Collecting opinions of stakeholders on advantages of technology implementation is not only valuable in terms of what was said, but also in terms of what was not said. We noticed that most of the listed advantages remained a bit abstract. The advantages were mostly general themes, such as efficiency and quality and resonated among various stakeholder groups. However, the answers related to technology disadvantages were more specific, which explains why the answers were more divided within the stakeholder groups. An important lesson can be learned here. While stakeholders might have as many good as bad experiences or opinions on technology, there is a danger of the negativity bias.[17] This theory claims that people have the tendency to give more weight to negative experiences, even

when they have had an equal amount of positive experiences. To overcome this bias and balance the view that stakeholders have on technological innovation, it is important that employees of healthcare organizations are informed on the concrete advantages of technology implementations in their organization. It is perhaps easier to accept implementation problems when you have a clearer idea of what the benefits will be.

PRACTICAL TIP

When discussing a more abstract technological advantage with a healthcare user or provider, such as cost reduction, try to express the benefit in a more concrete way. Instead of mentioning amounts of money that will be saved, you could quantify the improvement by the number of new employees that can be hired, a new service that can be offered or the reduction in workload that will follow. It is important that the listener can directly relate to the advantage, which means that it should be tuned to their circle of concern.

It will be important to involve all the concerned stakeholders to successfully implement the technology in an organization. They should be given the opportunity to shape the development or use of the technology, so that it is no longer an extra imposed workload, but they can value their own role in making the implementation a success. For more insights on the dos and don'ts of technology implementation, see Chapter 4.

Besides addressing the upcoming problems inside healthcare organizations, it will be important to take measures throughout society. The discussion shouldn't remain within the world of healthcare professionals: everyone should become involved. That is why we also found it very important to question healthcare users on their views and experiences with technology. The consequences of (not) implementing a certain technology in the healthcare sector might have large effects on the lives of people. New technological innovations in healthcare will further push boundaries on what diseases we can treat. Therefore, an ethical discussion is needed to establish new limits of what is desirable. Healthcare

institutions do not have to wait for these ethical discussions to start. With the use of the current digital communication networks, they can already start consulting their patients on these topics.

Healthcare receivers' perspectives: perceived advantages of technology implementation in healthcare

The broad implementation of new technological innovations in healthcare will only be possible when healthcare users are willing to make use of these innovations. Thus, in order to enable the successful adoption of new technologies in healthcare, it is crucial to take the perspectives of healthcare users into account. Therefore, in addition to the perspectives of interviewed stakeholders, we also investigated healthcare receivers' perspectives concerning the advantages and disadvantages of using new technologies in healthcare.

With regard to the advantages of implementing new technologies in the healthcare sector, healthcare receivers mentioned many advantages that the different stakeholders had also pointed out. However, some differences also became visible. Figure 11 shows the advantages of new technological innovations in healthcare reported most frequently by the healthcare users.

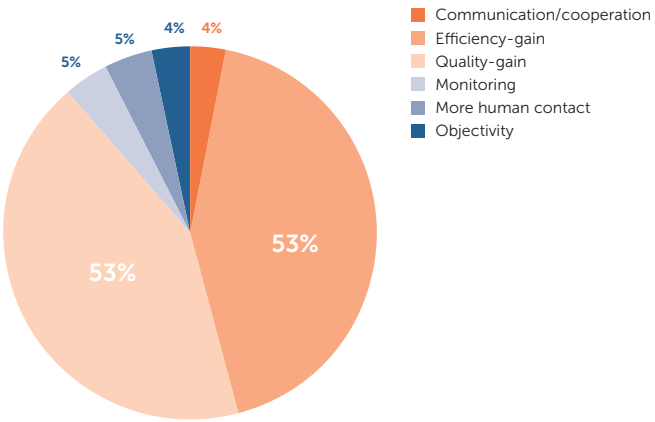


Figure 11. The advantages listed for technology implementation identified for healthcare receivers.

The advantages identified most often can be summarized under quality improvements and efficiency gains, which the interviewed stakeholders also had mentioned most frequently as advantages of technology implementation in healthcare.

Efficiency gains and quality improvements

Quality improvements were mentioned by 53% of the healthcare users as an advantage of implementing new technologies in healthcare. In comparison, of the interviewed stakeholders only 33% had identified quality improvements as an advantage of new technological innovations. Healthcare users named reduction of human errors, more accurate, precise and personalized diagnoses and treatments as well as speeding up the progress of medical knowledge as forms of quality improvements associated with technology implementation in healthcare. One respondent stated for instance:
Technology can support healthcare professionals and, as a consequence, may improve the quality of the delivered care. Technological innovations could for example support nurses with physically demanding tasks and doctors could profit from tools that support them in making the right diagnosis.

In addition, 53% percent of the healthcare users reported efficiency gains as an advantage of implementing new technological innovations in healthcare. In comparison, only 34% of the interviewed stakeholders had identified efficiency gains as an advantage of using new technologies in healthcare. Healthcare receivers named cost-reductions, less work and time pressure of healthcare professionals, shorter waiting times, and quicker diagnoses and treatments as positive outcomes of implementing new technologies in healthcare, which can all be summarized under efficiency gains.

The women in our sample were more focused on quality improvements compared to efficiency gains: 56% of the female healthcare receivers reported quality improvements as an advantage of new technologies in healthcare, but only 44% of the women identified efficiency gains as an advantage. Men on the other hand were somewhat more focused on efficiency gains: 63% listed an increase in efficiency as an advantage of new technologies in healthcare, whereas 49% identified quality improvements as an advantage.

In addition, 4% of the healthcare users mentioned the objectivity of technology as an advantage of implementing technology in healthcare. Gains in objectivity may both lead to efficiency and quality improvements, as emphasized by the answer of one of our respondents:
Technology is the most objective measure and will not lie or try to conceal facts because of (hidden) financial interests of hospitals, pharmacies and doctors, for example to prescribe more medication than necessary or plan more appointments than needed.

Monitoring, human contact and communication

Healthcare receivers also identified continuous monitoring and shorter hospitalization, increase in human contact and personal attention as well as better cooperation and communication as possible advantages of technology implementation in the healthcare sector.

Five percent of the healthcare users reported continuous monitoring and shorter hospitalization as an advantage of technological innovations in healthcare. Similarly, 4% of the stakeholders had reported continuous monitoring as an advantage of technology implementation in the Dutch healthcare sector. In addition, 5% of the healthcare receivers stated that technological innovations might increase personal contact and attention for patients during the healthcare process, due to freed-up resources caused by a gain in efficiency. Better communication and cooperation between different caretakers and healthcare institutions as well as between caretakers and patients was identified as advantage of technology implementation by 4% of the healthcare users.

Patient empowerment and accessibility

In addition, patient empowerment was reported by only 1% of the healthcare users as a possible advantage of implementing new technologies in healthcare, compared to 11% of the interviewed stakeholders. Similarly, improved accessibility was reported by 9% of the interviewed stakeholders as an advantage of new technologies in healthcare, but only mentioned by 1% of the healthcare receivers.

Perceived disadvantages of new technological innovations in healthcare

Figure 12 shows which disadvantages of new technological innovations in healthcare were reported most frequently by our sample of healthcare receivers.

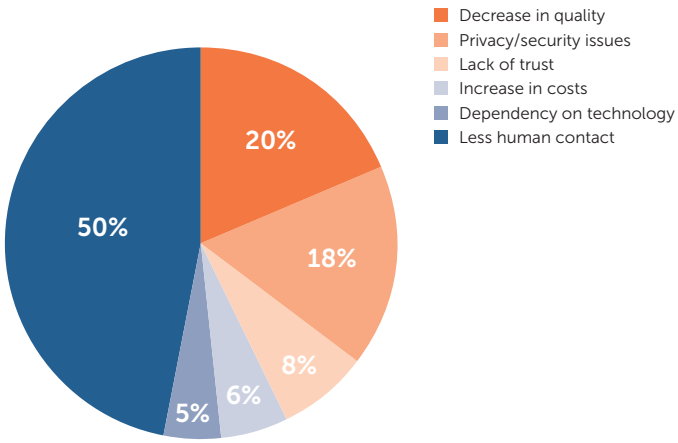


Figure 12. The disadvantages of technology implementation identified by healthcare receivers.

Decrease in human contact and involvement

Fifty percent of the healthcare users in our sample were concerned about a decrease in human contact and involvement in the diagnosis and treatment process of patients due to technology implementation. In comparison, only 16% of the stakeholders listed a decrease in human contact as a possible disadvantage of technological innovations in healthcare. Thus, healthcare receivers are much more concerned that implementing new technologies will make healthcare more impersonal than the interviewed stakeholders. Female healthcare receivers in our sample were generally more concerned about a decrease in human involvement and contact than male healthcare users: 60% of women, as compared to 37% of men, identified a decrease in human contact as a disadvantage of technology implementation in healthcare.

The healthcare users in our sample stated that new technological innovations might lead to a lack of personal interactions, responsive reactions and emotio-

nal support for patients. In addition, healthcare receivers reported that, as a consequence of a decrease in human interaction, not all unique factors of a patient might be taken into account in the diagnosis and treatment process. One respondent of our healthcare user sample stated for instance:
I am afraid that the personal contact will disappear along with the role of 'intuition' or the 'gut feeling' of specialists. Some diagnoses are not visible in the data, but doctors do further investigations because they 'feel' that something is wrong.

Decrease in quality

This quote also emphasizes that healthcare receivers are concerned that the quality of healthcare might decrease due to a decrease in personal contact and interaction during the diagnosis and treatment process. Twenty percent of our respondents reported concerns related to a diminishing quality of healthcare. Men and women were equally concerned about decreases in healthcare quality due to technology implementation. Examples of the mentioned concerns are blind trust in the recommendations of technology and a failure to account for the unique situation and environment of individual patients. As a consequence, exceptions and unobtrusive symptoms might be overlooked. In addition, healthcare users were also worried about the possible statistical errors, false positives and dire consequences of errors made by technology. The interviewed stakeholders on the other hand were mainly worried about a decrease of healthcare quality due to the low quality of a new product introduced in the healthcare sector, and less with technology's failure to account for the unique situation and environment of individual patients.

Privacy and security concerns

Eighteen percent of the respondents in our healthcare receiver sample stated their concerns about privacy and security issues caused by implementing new technologies in healthcare, which means that our healthcare users were somewhat more concerned about privacy and security issues caused by technology implementation than our stakeholders. Concerning privacy and security, healthcare receivers pointed out missing regulations, leaking data and unclear data-ownership status as possible issues. As a consequence, people with chronic illnesses or other risk groups might be treated differently by health insurers and might be forced to pay higher premiums. In addition, patient data might be abused for commercial purposes.

There was a striking difference in privacy and security concerns between men and women, with men uttering much higher concerns than women: 31% of male healthcare receivers, but only 7% of female healthcare receivers, mentioned privacy and security issues as a disadvantage of technology implementation in healthcare.

Lack of trust, higher costs and dependency of technology

A lack of trust in technology and a need to adjust to new technology in healthcare, mainly in the initial stages of implementation, was listed by 8% of the healthcare receivers as possible disadvantage of technology implementation in the Dutch healthcare sector. Eleven percent of men and 4% of women named the lack of trust and need for adjustment to new technology as a disadvantage of new technologies in healthcare. Men where thus somewhat more concerned about a possible (initial) lack of trust and need for adjustment to new technology than women. The interviewed stakeholders on the other hand did not identify this as a disadvantage of introducing new technologies in healthcare.

In addition, 12% of the interviewed stakeholders had mentioned an (initial) increase of costs as a disadvantage, whereas only 6% of the respondents of our healthcare-receiver sample identified higher costs as a possible disadvantage of technology implementation in healthcare. A remark of one of our healthcare users was:
It is questionable if it is financially advantageous: Prior developments show that more possibilities often lead to an increase in use, and rarely to substitution.

In general, healthcare receivers may be less concerned with an increase in costs than our stakeholders because they are less aware of the (possible) costs of technology implementation.

Five percent of the healthcare users identified the risk of dependency on technology as a possible disadvantage of technology implementation in the Dutch healthcare system, as compared to 8% of the interviewed stakeholders. Excessive dependency on technology ensues when doctors rely on technology to fill gaps in their knowledge or to interpret test-results, for example, because they would thereby fail to maintain their medical knowledge and skills.

Other disadvantages

Other listed points of concern were lack of overview, less employment possibilities, monopolies of tech-giants and digital illiteracy of some patient groups. An increase of and more rigid protocols and issues with data-management and storage of the patient-data were also mentioned as possible disadvantages of technology implementation in healthcare.

Six percent of the healthcare receivers stated explicitly that the strength of using technology in healthcare lies in combining it with personal contact and interactions:
I think it is important to combine technology and human contact – using only technology may lead to errors, using only humans will too: the strength lies in combining the two. Patients are also looking for reassurance and human contact, but technology can be a good addition and may improve the convenience in some cases.

Conclusion

The interviewed stakeholders mentioned efficiency and quality improvement as the main advantages related to technological innovation. The disadvantages that were mentioned the most were inaccessibility of healthcare to users, decrease of human contact, privacy & safety issues and the increase of healthcare costs. While the discussed advantages remained a bit abstract, the disadvantages were more detailed. This could be an indication that stakeholders give a large weight to their negative experiences with technology implementation. To overcome this bias and balance the view that stakeholders have on technological innovation, it is important all stakeholders are informed on the concrete advantages of technology implementations in their organization.

Healthcare consumers and stakeholders mentioned similar advantages of technology implementation. Just like the interviewed stakeholders, they identified quality and efficiency improvements as the main advantages of technological innovation in healthcare. With regard to disadvantages of technology implementation, a decrease in human contact and interaction was by far the biggest concern of healthcare receivers and mentioned much more frequently than by the interviewed stakeholders. Thus, healthcare consumers seem to be

very worried about a possible decrease in human contact due to technological innovation, which is crucial to take into account when implementing new technologies in the healthcare sector.

We hope that the views of stakeholders and healthcare consumers on technological innovation will help future technology implementation processes. It is important to learn from the listed disadvantages of technological innovation and address these in future projects. Furthermore, extra emphasis should be put on communicating the concrete benefits of the technology to all the stakeholders and users involved. For every technological innovation, the human contact between patients and their healthcare professionals should be warranted, as this is of great concern to healthcare consumers.

4.

OBSTACLES, DOS AND DON'TS WITHIN THE PROCESS OF TECHNOLOGICAL INNOVATION IN HEALTHCARE

CHAPTER 4: OBSTACLES, DOS AND DON'TS WITHIN THE PROCESS OF TECHNOLOGICAL INNOVATION IN HEALTHCARE

Technology is, according to many, the key to achieving a sustainable and future-proof healthcare system. Nevertheless, technological innovation within healthcare has proven to be challenging. Adoption of new technology is slow, and often turns out to fail on the way. To study the challenges for technological innovations in healthcare as well as possible solutions, we asked our interviewees from various stakeholder groups about the largest obstacles for technological innovation in healthcare. In the following chapter, we summarized their answers in terms of dos and don'ts to overcome potential obstacles and to make technological innovation a success. The topics are subdivided into questions surrounding technology and its development as well as technology implementation within healthcare organizations. We further discuss structural and institutional obstacles and facilitators. Finally, we zoom in on healthcare professionals and care-receivers specifically.

DOS / FACILITATORS

- Co-creation from the start
- Keep it simple and user-friendly
- Have a good long-term financial plan, define business case and (financial) responsibilities
- Have good time management and long-term vision
- Make use of enthusiastic pioneers from within the organization and appreciate the value of critics
- Promote the advantages, not the innovation itself
- Coordination and arbitration by a central organ

DON'TS / OBSTACLES

- Neglecting or underestimating teething problems (integration & compatibility)
- Disruptive technologies are more risky
- Daily routines and bureaucratic practices are hard to break
- Underestimating the burden of proof
- Secure funding only for initial phase
- Fall into gaps of the current reimbursement models
- Not seeing healthcare as a consumer's market

- Map the needs of all different stakeholders involved in the process
- Bottom-up implementation
- Start small and grow from there
- Test your innovations
- Provide after-care, helpdesks and contact
- Learn from existing systems and routines
- Initiate interdisciplinary collaborations
- Good cooperation, communication, and standardization

- The healthcare sector in its entirety is not well suited for fast technological innovation
- Complications through institutionalization and interconnectedness of different segments in healthcare
- Miss the right time point for structural changes and innovations
- Legislation and privacy concerns
- Fear of dehumanization and replacement of care-professionals
- Underestimating workload, time and training of care professionals
- Making technology too complicated

Facilitators and dos of technological innovation in healthcare

Dos: Technology

One of the simple and obvious prerequisites of successful technological innovation is that the technology is well-functioning, reliable, easy-to-use, and adds value. As one of our interviewees puts it:

If it works, it works. Think of implants and modern prostheses, of course, such innovations are here to stay - which is determined by its usefulness and reliability. Within healthcare, innovative tools should be subjected to regulations as strict as those maintained in aviation. The same goes for treatments. We need institutions to check whether the quality is sufficient, and that innovations that are introduced actually add value.

But how can we make sure that technological innovations add value to healthcare?

Our interviewed stakeholders mentioned the following points to consider for the route to success:

Co-creation

A crucial aspect of the development of healthcare technologies is the inclusion of end-users such as healthcare professionals and care-receivers in the creation process of technology, so-called co-creation. Co-creation is important for several reasons. Firstly, as all important stakeholders are included in the development of innovations, the innovations gain support from all parties. This is a vital aspect for the acceptance of new technologies, especially among end-users. Secondly, healthcare professionals and those working in healthcare are most able to critically review the usability and added value of new technologies. The lack of true added value of new innovations is mentioned as one of the root causes of the failure of innovations. Thirdly, co-developing the product is likely to expose the minor, but often missed issues that a product may have in the beginning, also known as teething problems. Many resources are wasted on attempts to implement new technologies within organizations that fail because teething problems of the technology drain the support of healthcare professionals and care-receivers, thereby decreasing the overall willingness to use innovative products.

People do not understand that it is about improving healthcare, and not technology. You have to understand patients and develop good and valuable care. People should realize that technology is only a means to achieve this. The problem is that people often develop tools and only wonder what they could use the tools for afterwards.

Keep it simple and user-friendly

Of key importance is that the tools are easy-to-use. Several interviewees noted that simple solutions are the ones that generally work best. The knowledge of healthcare professionals of digital systems is sometimes limited. Furthermore, care-receivers are an important target group for technological innovations. However, developers often neglect that certain health conditions prevent the use of or the ability to learn to use new and complex technologies, making easy-to-use and simple solutions a must.

A central issue is to make the adoption of the technology as easy as possible. It is framed by developers that everyone should adjust to the system, instead of the system adapting to the people who have to work with it.

Dos: Technological innovation within health organizations

Not only did the stakeholders discuss obstacles in the development of healthcare technology: many of their answers also concerned the implementation of technology within healthcare organizations. This implementation process involves many different parties, who each have their own interests, daily routines, concerns, and desires. To successfully implement technologies means to adhere to these desires as much as possible.

Have a long-term financial plan, a defined business case and clear (financial) responsibilities

An obvious prerequisite for technological innovation within healthcare organizations is the availability of funds for the innovation project. Of major importance for achieving successful innovation is the creation of a long-term financial plan. How are the costs that are incurred to be incorporated in the current model of finance? Define the business case early on and define who is going to pay. Furthermore, it is important to outline how to finance continuation of an innovation trajectory after initial and startup funds run out. Temporary and incidental funds often fail to have lasting impacts. What is of high importance and can be of aid in creating a sustainable innovation trajectory, is to outline how the innovation may be cost-efficient in the long run. An important aspect of being able to innovate with lasting impact is to have enough support from decision makers within the organization. If there is insufficient support at the administrative level, it becomes very hard to realize a long-term project with a supporting financial model. This means that the value and importance of innovation should be very clear and well formulated, as well as the long-term goals of the project, in order to bring all the important stakeholders and decision makers on board.

One way to gain enough financial resources is to pool resources with other organizations by setting up a joint project. A successful example is the creation of general practitioner consortia which has made it possible to gather enough financial resources to invest in devices for fast tests – something that a solo practice could not have achieved on its own.

Another route of support is accessed by putting technological innovation in healthcare on the political agenda, creating more funds for such projects. However, in this case, too, one should intend to innovate with lasting effects and

avoid that when subsidies run out, the project stops, and achievements are only minimal. Furthermore, the way in which a financial model is given shape at the national level strongly determines the possibilities for healthcare organizations. This highlights the importance of a dialogue between the different institutions: together, these make up the rules of the game and determine what structures facilitate valuable and sustainable innovation within healthcare.

Have good time management and long-term vision

Successful introduction of technological innovations is also dependent on the time spectrum. Short-term implementation of many innovations fails. Such fast changes are especially problematic in healthcare. Innovators in healthcare should keep in mind that projects need a long-term vision, and long-term effort and planning in order to have impact. Also, the time of the introduction of new technologies is of importance – all of the involved stakeholders need to be ready for it.

Gain support from pioneers within the organization and appreciate the value of critics

An important aspect of the promotion and implementation of new technologies is the presence of leading figures within the organization that promote the value of innovations. You need enthusiastic care professionals, that are willing to stick their necks out for an innovation. It helps to have opinion leaders that repeatedly emphasize that the innovation is advantageous and value-adding. Preferably such opinion leaders are people from within the organization, who will use the innovation and who have a good relationship with the employees. The more sensitive these are to arguments, the larger the ability of this person to enthuse and gain support for innovation.

While enthusiastic pioneers are important for successful implementation of technology, critics play a very important role too. Those who are very critical towards innovations are likely to influence the opinions of their surroundings. If you can convince even the most critical colleagues of the value of introducing new technologies, then their surroundings are more likely to support the innovations.
Finally, it is of importance that there is sufficient support from higher levels within the organization to achieve innovation with lasting impact. As argued previously, a long term financial model is important for lasting effects; without support from

decision makers this is very hard to achieve. Furthermore, support from decision makers gives pioneers and opinion makers the confidence and support to promote innovation.
I got the feeling that doctors are mainly open to technological innovation if from multiple angles the innovation has proved to be a significant improvement. To address and motivate doctors for an innovative concept with which they are not acquainted will lead to resistance. The work pressure and available time of doctors is important herein, as they have little spare time to activate or involve themselves in the implementation of technological innovations.

Promote the advantages, not the innovation itself
Think about the advantages that the innovation has, perhaps on the long-run, for the organization. The point made by several interviewees was that technology should never be at the center of attention. Rather, it should help organizations in delivering quality healthcare in an efficient way. Thus, one should consider how the innovation will change work practices and the functioning of the organization. Will the innovation decrease bureaucracy? Decrease costs? In other words, how will the innovation affect the organization and its functioning?

Coordination and arbitration by a central organ
Several interviewees highlighted the importance of the presence of a central organ or board for arbitration to guide the organization in times of technological change. It is suggested that in order to timely adapt to changes, brought about, for example, by the introduction of new companies into healthcare such as Apple or Google, we need directors and managers that are open to new information. For the successful implementation of technological innovations in healthcare we need visionaries that have a broader scope than their own sector and are willing to make more radical changes within the organization to make healthcare future-proof.

However, at the same time it was noted that healthcare is a traditional sector and innovation is not its primary focus. This situation is suboptimal for adapting to future changes. As some interviewees noted, innovations, such as digitalized patient files, would greatly benefit from standardization, which would require different healthcare institutions and organizations to work together. The absence of standardization causes many inefficiencies, as systems are often not integrated,

and are not mutually compatible. As some interviewees argue, a central arbiter could improve, or even obligate developers to communicate and cooperate.

Map the needs of all different stakeholders involved in the process

When technologies are implemented within an organization, the changes these technologies bring about are likely to affect the work of a lot of different people. In order to realise a smooth adoption of new technologies, it is important to think about who these people are within your organization, and how their work will be affected by the technology. A central figure is the healthcare professional. Considerations should include the degree to which professionals support the innovation. If professionals are not convinced of the added value of the technology, the likelihood of them adopting the technology decreases. If the support is low, developers should investigate the reasons for a lack of support for the idea. Sometimes unsuspected obstacles may reveal itself. For example, a technological system may decrease the autonomy of a professional, or maybe professionals simply dislike doing their work using a technological tool. Also consider the time it takes for healthcare professionals to learn to work with a new system or tool. Another central figure is the patient. Just as care professionals consist of a diverse group of people, patients vary in the willingness and ability to use new technologies. It is advisable to investigate what kind of patients will be affected by the relevant technological change. For example, the age of a patient group, or the degree of smartphone ownership may be of importance in this regard. Moving further away from usual suspects such as healthcare professionals and patients, we find other stakeholder groups who are affected by technological changes. Treasurers and financial managers are important to help draw up the short and long term financial implications of the technology. Will the project have much chance to receive financial backup after the initial startup phase, or after the initial 'money pot' for the innovation runs dry? To include treasurers, is to increase the likelihood of establishing durable innovation. Another stakeholder is ICT. Initially, the developers of technology, or those implementing it, will be available for support. However, in the long run it is likely to become desirable that internal ICT specialists to some degree understand the technology and able to provide support services. Furthermore, they have important information on how compatible the new technology is with the systems that are already available. Other jobs that may be affected by innovation are the jobs done by support staff that arrange billing, or secretaries. The variety of jobs and stakeholders affected is

of course different, depending on the innovation and the organization. The main point, however, is that the network of different stakeholders affected by innovation should be mapped and included in the implementation project. Including input from the entire chain of stakeholders increases willingness to implement new technologies and decreases the chance of running into unforeseen problems.

Bottom-up implementation

One of the consequences of thinking about the demands and opinions of different stakeholders when creating innovations and planning the implementation, is that the success of technological innovation is often bottom-up. As one of our interviewees puts it:

The most important driver of change is the patient, the people. Innovations should come from people. Consumers hear about new possibilities and want the best care. They are going to experiment themselves and take this information to the doctor. The rest of the stakeholders will have to follow. Patients demand the use of the latest technologies and innovations, such as wearables.

Bottom-up implementation has several advantages. First, because stakeholders can influence the product and process, the support of those having to work with the technology increases. The value of the product increases as it has been tested by those who would have to integrate the innovation in their daily routines. Furthermore, the impact on daily processes has been clarified by those working with the technology. Not sure what technological innovation to implement and how? Ask the customers!

For example, health platforms made for and by patients are successful because patients have initiated them themselves. Such platforms do not have the judicial restraints that for example government-initiated platforms have.

Start small and grow from there

Interviewees suggested that innovation is sometimes made easier by experimenting with the innovation in smaller organizations. In such a context, the number of stakeholders involved is likely to be smaller, which makes cooperation easier to achieve. Also, within smaller organizations, say a general practice versus a hospital, it is easier to have professionals make time to learn to work with the technology, and integrate the technology in daily routine.

The phasing of a service is important for achieving a successful service. Start small.

Projects have teething problems. Keep it small to fix such teething problems. Do things by yourself as much as possible, with say 25 users. In the second phase, it is important to keep track of the results, and if at all possible compare it to a group that is not using the technology or compare the results to the period before the use of the technology. For example, intakes, first aid, evaluation by the patient, self-management. Research components are very important.

Test your innovations

An effective way to test innovations is to create a test area where developers and end-users can put to practice the desired co-creation. However, the following example illustrates that the limitation of time available to professionals can be a problem:

Transition from one type of electronic patient file software system to a new version. The principles are the same, but layout and navigation changed. Everyone needs some adaptation, although one more than another. It worked well because it was announced a lot of time in advance. Contact with implementation team was easy and efficient. One could come over and practice with the new system. They created a 'game' to practice, and a quiz to see who knew best how to work with it. However, this works when people have the time to practice. A lot of people do not have enough time.

The test area has the advantage that it allows developers to make very clear that the technology is still in development, and that the test area is there for end-users to influence the end-product, which enhances willingness and commitment of users. Such a trial or test-area, however, should resemble daily routines as much as possible, to avoid overlooking everyday tasks that may be affected by the technology, but are not present in the test-area. An important component of testing technology is to quantify the results. Monitoring the results of the innovation helps in convincing users and members of the organization of the added value of technology. Furthermore, although a budget for innovation and testing can help give innovation managers the freedom to test real innovative technology, some thoughts should go into what the financing of the project will look like after this initial budget is spent.

Provide after-care, help desks and contact

Finally, it is important to have sufficient support throughout and beyond

implementation. Innovations and needs continue to develop and change, so do not implement and forget, but install a proper after-care, IT helpdesk and keep contact.

Think about the possible collaborations that may lead to the best innovation project

An often-mentioned piece of advice is to initiate collaborations including different disciplines. Although it is not possible to give an exhaustive list of possible collaborations, the examples below may incentivize thinking about what possible, perhaps unexpected, collaborations may lead to the best innovation projects.

EXAMPLES OF POSSIBLE COLLABORATIONS FOR AN INNOVATION PROJECT

- Collaboration between all levels of organization: nurses, specialists, managers.
- Include managers that have knowledge on different stakeholders that can serve as a mediator and bring together the different stakeholders such as doctors and ICT specialists.
- Collaboration between countries, making use of data sources and knowledge from outside the Netherlands.
- Standardization to make systems used by different stakeholders, such as hospitals, general practitioners of physiotherapists, compatible.
- Collaboration between researchers and developers of new systems, for example using Big Data, to guarantee and test the quality of the output of such systems.
- Collaboration between developers and end users, i.e. healthcare professionals and consumers / patients.
- Including insurance companies in the development of new technologies.
- Collaboration between enterprises not affiliated with healthcare and healthcare organizations.

Obstacles and don'ts of technological innovation in healthcare

Don'ts: Technology

Neglecting teething problems

One of the largest obstacles related to technology is an obvious, but recurrent problem, namely dysfunctionalities of the technology itself. As one of our interviewees working in a mental healthcare organization described:
The technology came along with teething problems, which costs a lot of time. The product was not completely developed before it was implemented. Plus, not all systems were compatible. Systems differently accept file and dossier types. Furthermore, not everything is complete. For example, attaching prescriptions was not automated. It is a waste of our time and it does not add to the quality of the health service if the product has dysfunctionalities.

Many interviewees indicated that with the current plethora of technologies, systems and platforms, and a lack of integration, the compatibility between the existing systems is often a problem. Therefore, it is advisable to inform on the existing systems and routines, and test how well new technologies fit within this system. Even better, perhaps, would be to increase coordination in the development of such systems. To this end, national of even transnational standards and coordination may be the best way forward.

The main advice here is to integrate the different stakeholders which are affected by the technology within the development and implementation process. This decreases the chance of dysfunctionalities in the end product and increases the support by end users. Furthermore, it offers continuous reflection on whether the technology is adding value.

Don'ts: Technological innovation within health organizations

Bureaucracy and everyday routines

As the pressure on healthcare increases due to increased demand and increasing cost of healthcare, the strain on healthcare organizations increases, as they have to do more with less. As the pressure increases, the time and resources that these organizations have to spend on innovation decreases. Focusing on making ends meet, implementing technology that disrupts daily routines and bureaucratic practices is a risky enterprise for healthcare organizations. For innovators these concerns should have a central role in designing the innovation trajectory.

Innovation in healthcare and underestimating the burden of proof

Technology in the healthcare sector needs to be validated and risk free. Generally, before an insurer can start reimbursing a certain treatment, this treatment must be evaluated by rigorous scientific testing. Furthermore, to convince highly specialized professionals that there are better and more effective ways of performing their work, requires a lot of proofing and persuasiveness. The combination of the risk aversion of the sector and this high burden of proof seems to pose a dilemma. On the one hand, waiting for validation of technological innovations, for example by science, has been criticized for slowing down the pace at which the sector can innovate. On the other hand, technologies need to be proven to be value-adding and reliable. In reaction to this dilemma, insurance companies have started to experiment with new treatment methods and reimbursement systems themselves. Furthermore, platforms allow for a more direct sharing of positive and negative experiences with innovations. Sharing knowledge among professionals provides a direct and reliable source of knowledge on the value and functionality of new technologies. The emergence of such initiatives evidences the need for faster evaluation of technologies and innovations. Aligning this need with the maintenance of rigorous testing and quality assurance continues to be a challenge. Nevertheless, continuous monitoring of performance in start-up phases and experimental settings generates at least preliminary evidence of the functioning of new technologies. Furthermore, knowledge sharing among professionals, who are likely to find colleagues most credible, is a way to accelerate innovation.

Structural and institutional facilitators and obstacles

Up until now, the healthcare sector has not been affected by technological changes in such groundbreaking ways as other sectors, such as the taxi and hotel sectors have. The health sector appears to be quite resilient to large changes, and companies that are not traditionally directed towards healthcare services, such as Apple or Google, have not yet been able to cause disruptive changes in the healthcare landscape. One of the reasons for the absence of disruptive changes is the institutional embeddedness of healthcare.

The financial system

The most important institutional aspect of the healthcare sector is the way in which financial compensation is organized. As an interviewee put it:

Insurance companies are of primary importance. Health Institute Netherlands decides what care should be covered and what care is valuable. They in turn rely on judgements from medical associations, which base their judgements on what healthcare is scientifically proven to have value. However, medical associations, consisting of practitioners, have little incentives to innovate, since within the current system of compensation there is little to gain from healthcare that decreases patient visits and focuses healthcare on prevention. Moreover, if science has not yet unequivocally established the effects of a certain health innovation, insurers cannot offer that innovation as part of their insurance package. This is the case for E-health, for example. For these reasons, there are now insurance companies that perform their own experiments with innovations that would allow them to provide cheaper and more valuable healthcare. Thus, health insurances are seeking 'the fast route' towards innovation, that circumvents interests of medical associations, and the need for scientific evidence.

Illness and treatment of illness is rewarded while prevention of illness is not rewarded. We have a remuneration system that only reimburses when there is damage or illness. We need to move to a system where health and healthy behavior is rewarded.

From patients to consumers

One of the factors slowing the need for innovation is that healthcare in many countries is not yet a consumer market. In the Netherlands, people are obliged to have health insurance. If people already pay insurance fees, the likelihood of people buying healthcare services from private healthcare providers that are not affiliated with an insurer is low. Within countries in which healthcare and compensation is less centrally organized, competition between healthcare providers is more severe, and consumers have more to gain from choosing among different competing healthcare providers.

Nevertheless, the moment that consumers become more aware of the advantages of new methods, and consumers start demanding to make use of such innovation, healthcare organizations will start feeling the pressure to deliver; *What it needs is that the patient becomes a consumer, which means consumers can judge products... Consumers can judge and compare taxi services from Uber and the Amsterdam taxi company. Or compare Tesla or BMW. But healthcare*

is not a consumer market. The consumers basically do not know what is being withheld from them. In my perspective that is the main obstacle... Upscaling of technology, intelligent internet, connecting care-givers, and the application of intelligent algorithms, all that is only really going to happen if healthcare consumers start to realize the enormous benefits it has to offer.

Interdependency between healthcare organization & innovation within healthcare

A recurring comment from interviewees is that the healthcare sector in its entirety is not well suited for fast technological innovation. The different building blocks of the sector are simultaneously independent and very related. For example, hospitals receive a lot of patients who have first seen a general practitioner. Nevertheless, both organizations are very independent. For example, technology aiding in the analysis of melanomas empowers general practitioners, shifting work from hospitals to general practice. In such an instance, an innovation within a general practice also affects the hospitals, since the treatment of a patient is already one step further before they arrive at the hospital. The interconnectedness of different healthcare organizations makes technological innovation in the healthcare sector more complicated. Furthermore, the different segments of the healthcare sectors are highly institutionalized and bureaucratized. Consequently, getting different segments of the sector to even slightly change the way they work requires a high degree of coordination and a lot of resources. The institutionalization and interconnectedness of different segments in healthcare make cooperation, communication, and standardization important focus points in need of improvement.

Pain points and structural changes

Although large structural changes have been largely absent thus far, several developments may stimulate structural changes in the future. First, the cost of healthcare systems is steadily increasing. Data on 35 OECD countries shows that between 2000 and 2016 healthcare as a proportion of national GDP has increased in all but 2 out of 35 countries, with the US showing the highest increase in healthcare share of GDP with almost 5% increase. As healthcare becomes increasingly costly, the need for more efficient treatment and prevention becomes increasingly important. Especially if we want to sustain a healthcare system in which all socio-economic layers of society can make use of healthcare provisions.

When rising healthcare costs really start affecting the general population, it will become interesting for companies to start competing with traditional healthcare providers, and interesting for consumers to pick among different healthcare providers.

A second structural change is the ageing of populations. As the post-war baby boomers start to age, many modern economies face ageing populations, meaning an increasing usage of healthcare provisions. This increases the costs, especially in more developed welfare states, but also increases the need for workers in healthcare. Prognoses state that it will be challenging to meet this increasing demand for healthcare professionals. This shortage increases the need for more effective methods, and technology.

Finally, as the awareness of personal health among people rises along with the costs of healthcare as well as changing lifestyles, the demand for healthcare that focuses on prevention of healthcare usage increases. Healthcare focused on prevention, including risk analyses based on personal data, general scans, and tracking using fitbits and e-health solutions, currently seems to be the domain of non-traditional stakeholders.

Thus, structural changes in the demographic composition, the rising costs of healthcare systems, and changing lifestyles are likely to create an opening for non-traditional healthcare providers, meaning that disruptive changes in the healthcare system are yet to come, rather than absent.

Technological innovation and legislation

Another structural obstacle that was mentioned is legislation. On the one hand, it can be argued that there is too much legislation. This makes some technological innovations hard to implement because the legislation will not allow it. For example, legislation around privacy makes it hard to share data. On the other hand, there is too little legislation, because currently it allows for too much different systems to co-exist, making integration and standardization hard to achieve. The sector may benefit from designing legislation that already considers the long-term projections on the how the healthcare sector might change. That is, a proactive, rather than reactive legislation. Although national legislation meant to standardize practices may enhance innovation, an alternative route to enhancing cooperation and

standardization that is already being explored is to create platforms and bridging initiatives that consist of key players in healthcare rather than the government.

Technological innovation and privacy

Concerns over privacy have hampered developments to exchange data between healthcare institutions. Many interviewees mention that concerns about privacy, especially among patients, has halted developments. In part such privacy concerns are argued to be unfounded since there are many measures being taken to give patients control over data, and to upgrade the security of data systems. On the implementation of a national patient record one of our interviewees states:

We thought it could be installed within three or four years. Because of political resistance against alleged privacy risks, unfounded by the way. The current situation makes it very difficult to handle such a national project. We have lots of concerns over privacy, but we try to solve it in an administrative and political way, instead of looking very closely into the technology, and what people want. We try to think of a solution without really looking into the effects of not implementing. Subsequently, we are being surpassed. Look at Facebook for example. It is a kind of rearguard action.

In the eyes of many interviewees, privacy concerns are a temporary, unfounded concern that people have, while the topic is dominated by a political debate, rather than a debate lead by technology specialists and healthcare professionals.

Technological innovation and the pitfall of increasing costs of healthcare

As some interviewees note, advancing technology generally goes hand in hand with increasing possibilities for products and services. Thus, as technology advances, possibilities grow, raising the standards of the healthcare we, as consumers, want to receive. This can increase our use of healthcare facilities, rather than decrease it. To illustrate:

For the government, the use of technologies can help people to stay at home longer and avoid or at least delay admission to a care facility. It is frequently thought that this is cheaper than admission to a live-in care facility, but this is not always the case. For instance: the WMO provides bathroom adjustments for people with disabilities. When people can live at home for longer with the help of domotica, the need for adjustments to their homes will rise and thus also the costs for the WMO since a lot of houses are not suited for people with disabilities.

The question policy advisors have been asking – both on a national and local level – is if there should be limits on what can be provided at home and where those limits should lie in order to make sure that care stays affordable for the entire nation. We haven't found the answer yet!

Of course, the same argument applies to more complicated surgery and medication possibilities resulting from technology.

Some interviewees argue that a sustainable healthcare very much depends on the choice that we make on how far we want to go in providing healthcare. For example, treating very rare diseases can be very costly. It is a choice that societies, especially in welfare states, must think about. What do we want healthcare to be about? How far will we go in providing healthcare, even if it benefits only a small group? If healthcare really becomes unaffordable and unsustainable, these questions may have to become guiding in choosing a direction in which we want developments to go.

Technology as de-humanizing human work

An often-heard concern about technology in healthcare is that the introduction of technologies dehumanizes healthcare.

There has been a shift in Dutch healthcare from 'doing things for people' to 'helping people do things for themselves'. Getting used to the new way of can be difficult for professionals: technologies that can help people be more independent can also mean that they, as professionals, have to take a step back and be less hands on. For example: video conferencing with someone to check if they are taking their medicine can be very cost effective because the professional doesn't have to go to several houses. On the other hand: it also means less hands-on contact with clients, which can be seen as a loss by both client and professional.

As this example nicely illustrates, there can be friction between efficiency by the use of technology, and a loss of human contact and human touch to healthcare services. There are, however, others who mentioned that technology, by reducing time spent on daily routines, can actually increase the time and quality of contact with care-receivers. For example, current technological innovations that are being developed that check and remind medicine intake, or robotics helping people in and out of bed, can increase the time and quality of care-givers contact

with care-receivers. Since less time is spent on daily routines, time is freed up for other aspects, such as care for mental aspects. For example, contact with care-receivers via smartphones on the one hand may decrease live visits. On the other hand, however, it can increase the frequency and availability of healthcare professionals to have a small chat or checkup. Thus, although concerns for the dehumanization of work should be taken seriously, technology has the potential to increase the quality, time, or frequency of contact, depending on how specific technologies are developed and used. Once again, co-development between healthcare professionals, care-receivers and developers is likely to be the key to value-adding technological innovation.

Another structural obstacle is that care professionals may fear being replaced by technology, increasing resistance to technological change. It should be made clear that, in many cases, workers are supposed to cooperate with technology, rather than to be replaced by it.

End users and technological innovation

Some interviewees focused specifically on the needs of healthcare professionals. Of primary concern is to convince them of the added value of the technology. The reliability, user friendliness and functionality of a product all contribute to the sense of added value. As described earlier, this can be achieved through co-creation and collaboration. However, time pressure and training have also been mentioned as important factors.

Little time, high workload

Care professionals are generally very busy. As pressure on healthcare increases, time is likely to become even more scarce. As daily routines leave little spare time, the development and implementation of technology run into several problems. First, interviewees mention that technological innovations have sometimes gone hand in hand with increasing amounts of administrative work and increasing bureaucratization. For example, some digital patient file systems have been found to increase the administrative burden for the healthcare professionals. Since time is precious, it is hard to convince users that such a system adds value, since healthcare professionals will perceive that less time can be spent on their primary task, namely, providing care. Although in a system of healthcare chains

good administration is beneficial, it must be evaluated which administration is crucial. Moreover, innovation should continuously be concerned with keeping administrative tasks simple, and quick and easy to perform. Second, co-developing technologies with care professionals is difficult, since healthcare professionals have little spare time to engage in innovation. Third, healthcare professionals have to learn to use new technologies and have to incorporate new technologies in their daily routines. This process takes time, and if there is no time made free or available, this increases resistance among users, and may even lead to a failure to innovate all together. As one interviewee noted with respect to the introduction of tablets in mental care service:
I simply don't use it. I am not that tech-savvy. I want to have a course first. You don't get help to set it up correctly. Colleagues quit using it. It is not in the interest of the patient, because it takes so much time. Precious time.

In conclusion, the time of healthcare professionals is very precious. This makes technological innovation a precarious endeavor. A very important part is to make the advantages of new technology crystal clear. If you are unable to convince users of the added value of the innovation, it is unlikely to be met with much enthusiasm. One way to achieve such support is to co-create innovation with end users. In the case of healthcare professionals, this is not easily achieved, since they have little time for such 'extra' work. Consequently, it is up to developers and managers to inquire about the available time that professionals have, and to set up a plan to free up some of the professionals' time in daily routines, to co-create. Although this may increase costs in the short term, it can be worth the investment in the long run. Especially when there is a risk of innovation failure when such end-user concerns are not taken into account, as in the case of the above example.

Training

Apart from making sure care professionals have time to learn how to work with new technologies, funds should be made available to ensure that professionals get the appropriate training and schooling to work with a new technology or system. According to some interviewees, training is especially important in healthcare because there is generally low affinity with technology and innovation of work practices. Moreover, some interviewees consider professionals in healthcare to be rather conservative and reluctant to change the way they work. This makes

creating the right conditions, such as previously outlined, even more important in order to innovate successfully.

Technological innovations and care-receivers

Interviewees mention that care receivers are a diverse group of people who may react differently to technological changes. Of prime importance is to know how tech-savvy your target group is. For example, if your patients mainly consist of elderly people, it should be considered how feasible it is that this group will successfully and contently use the technology. In short, knowing your target group is crucial.

A colleague of mine who works with young-adults thinks e-health program is a success. For my specific group, people in detox, the e-health program is too complicated.

Conclusion

Many believe that technological innovations are essential in establishing a future-proof and sustainable healthcare system. Nevertheless, technological innovations within healthcare organizations have proven to be slow and subject to numerous obstacles. To help us start thinking about these challenges and their solutions, we asked our interviewees what obstacles to technological innovation in healthcare they foresee and what dos and don'ts there are to overcome these obstacles.

The obstacles that they mentioned are present at different levels within the healthcare system. Some are problems with the technologies themselves; other obstacles are connected to the way in which institutions are organized at the national level. For example, the current system of reimbursement, which compensates health institutions on the basis of numbers of patient visits, is mentioned as a structural constraint hampering more effective or preventive healthcare. Many obstacles, however, concern the way in which technology is implemented within healthcare organizations. Among others, interviewees pointed towards the importance of establishing long term financial plans, time management, identification of the value of technology for the organization at large, coordination by a central organ, and the mapping of all different stakeholders affected by innovation.

The purpose of this chapter is to provide the reader with an overview of the many considerations that should be made when developing and implementing technological innovations in the healthcare sector. We structure obstacles and dos and don'ts across different levels: the level of technology development, the level of healthcare professionals and care receivers (micro), the level of technology implementation within organizations (meso) and the institutional and structural (macro) level. We hope that this structuring makes it easier for different stakeholders to identify their role in the development of technological innovation within healthcare. Furthermore, this chapter aims to clarify what obstacles are influenceable, and what obstacles are out of reach. For managers promoting innovation, awareness about the chain of different departments, organizational layers, and different worker groups that are affected by innovation may help them avoid running into unforeseen problems or maladjustments. For healthcare professionals, the different obstacles and dos described may serve as a reference book for checking which conditions should be met before they can agree with technological changes. For policy makers, this chapter may clarify the structural obstacles that hamper innovation. Finally, the chapter may inform care users about the fast-changing possibilities within healthcare, turning receivers of care, bit by bit, into consumers of care.

5.

20 THINGS THE DUTCH HEALTH-CARE SYSTEM CAN LEARN FROM OTHER COUNTRIES

CHAPTER 5: 20 THINGS THE DUTCH HEALTHCARE SYSTEM CAN LEARN FROM OTHER COUNTRIES

We begin this chapter with a short examination of the Dutch healthcare system, taking the internal perspectives provided by stakeholders active in that system as our starting point. Next, we shift our attention to the healthcare systems of other countries and the lessons that we might learn from those systems.

According to our stakeholders, the three most important aspects of the Dutch healthcare system that can be further improved are: access to secondary care, healthcare costs (funding for basic research and the rigid annual budget plafond), and the speed of adaptation of new technologies.

We tried to provide solutions to these three factors based on lessons from other countries. We also examined whether these solutions are achievable and can contribute to a sustainable healthcare system. After providing a detailed list of lessons from other countries, we found additional "bonus" lessons that we didn't expect. These lessons have implications for the system of Electronic Health Records (EHR) in the Netherlands and the possibility of the existence of a healthcare system that efficiently reaches a balance between patient-centered and cost-efficient approaches. Finally, we conclude with lessons that can be applied to every country, not just the Netherlands.

In an era of rapid technological developments that require fast adaptation of the healthcare sector, there is a great opportunity to learn from experiences of other countries. What can the Dutch healthcare system learn from developments and technological innovation introduced to healthcare in other countries?

One might argue that:
There is no country that could act as a guide for how we could make healthcare more affordable and better in the future in the Netherlands. Every country needs to find out how to do this by itself.

But is that entirely true?

Embracing lessons from other countries and cultures

Looking at the Dutch history and culture, one soon realizes that the Dutch easily adapt to and embrace customs, ideas and products from other cultures. If something is good and works in other cultures, the Dutch tend to be able to not only adopt it, but also embrace it and cultivate it in such a way that it ends up becoming "typically Dutch". An example is the tulip. This lovely flower has been a Dutch symbol for many years. Ask someone which country the tulip originated in and she will probably confidently answer 'the Netherlands'. However, this answer is wrong. Tulips actually originated in the Ottoman Empire, but the Dutch were smart enough to import the flower in the sixteenth century, embrace it and cultivate it in huge quantities. This led to a profitable market and brand that lasts until today.

The tulip is just one example; there are many more items and customs that Dutch people adopted from abroad, e.g. porcelain and spices. If the Dutch are good at adopting products and traditions from other cultures in a large variety of sectors, such as the flower and food markets, wouldn't it be surprising if they couldn't import foreign ideas in such an important field as the healthcare system?

However, in order to adopt lessons from other countries, we first need to examine whether the relevant knowledge is available and whether stakeholders that play a crucial role in the healthcare sector are in contact with other countries and are aware of healthcare systems and technological innovations at an international level.

Is international knowledge about healthcare and technology implementation available?

Only 11% of the stakeholders mentioned that they do not have any international experience or are not familiar with international healthcare systems. This is highly promising, because it means that the knowledge is present: relevant stakeholders either have an international background or are aware of the situation in other countries. If the knowledge is present, then they are already one step closer towards drawing practical lessons and concrete output from the knowledge that is available abroad.

Is the Dutch healthcare system a paradise on earth?

Five percent of the stakeholders (mainly healthcare professionals and consultants) mentioned that the Dutch healthcare system is a role-model and that no change is needed. On the contrary, it is other countries that should take lessons from the Netherlands. We agree that there should always be an exchange of knowledge between different countries, but can we really say that there is no space for improvement in the Dutch healthcare system? If we think so, are we not running the risk of falling into a trap? Possibilities for improvement might be present but we might ignore them by "wearing blinkers" which do not allow us to see beyond our own habits, established procedures and the status quo. To avoid this trap, a moment of introspection is needed.

Dutch healthcare system: a moment of introspection

The first step towards improving a sector is to spot those parts that could benefit from improvements. So, which parts of the Dutch healthcare system can benefit from some improvement at the moment?

The responses from the interviewed stakeholders can be categorized into three main categories: limited access to secondary care, healthcare costs, and the conservative nature of the healthcare sector.

Limited access to secondary care

Limited access to secondary care is a factor that was mentioned frequently by our stakeholders. Under the current system, a patient must first go to the general practitioner who decides whether the patient will be directed to secondary care. The general practitioner thus, functions as a gatekeeper who decides whether the patient will have access to specialist treatment or not. Furthermore, many stakeholders, including medical specialists and general practitioners, admitted that the financing system for secondary care institutions, in which they are financed on the basis of pre-set annual budgets, is too stringent and there is space for improvement. They worry that this might lead to patients not always being able to receive the care they need.

Healthcare costs

Many stakeholders worried about the rising costs of healthcare. Although this is a more global issue and not only a characteristic of the Dutch healthcare system, the aspect that applies to the Dutch system refers to the stringent pre-set annual budgets for healthcare institutions: stakeholders mentioned that this budget should be increased and be more flexible. Stakeholders also mentioned the limited budget for research and innovation. Opportunities for innovations go unnoticed due to reduced funding provided by the government. As one of the interviewees highlighted:

Research costs money. It is relatively little centralized in the Netherlands and increasingly dependent on cooperation with companies. These collaborations are in themselves fruitful but must not be at the expense of fundamental research. Additional funding should be made available by the government. Many talented researchers fall by the wayside because there is too little money available for research, and many potential innovations are lost without being noticed.

Conservative nature

Interviewees acknowledge the importance of having a safe and stable healthcare system, however they highlighted that the current system is very conservative in adopting new technologies. Or, to summarize some of the comments:

There is need for increased openness and flexibility towards new technologies. For example, more e-health technology with which the patients can be better monitored remotely. Other countries experiment more in this aspect.

Ideally our goal would be to provide solutions to the three factors that were mentioned most by our stakeholders. But is this goal achievable? We hope that lessons from other countries will help us shed some light on the issues. So now that we have a better view of our own system, we can take a step towards other countries and the lessons that we might learn from them.

What can we learn from other countries?

Below we mention several lessons that we can take from other countries, according to our stakeholders. The responses were not restricted to technological innovations but also included other important aspects of international healthcare

systems. We asked our stakeholders to mention positive aspects of healthcare systems in other countries. Therefore, when reading this chapter, one should take into consideration that we didn't focus on the negative aspects of the healthcare sectors in these countries. Even though this leads to some bias, it also brings us unexpected and refreshing viewpoints.

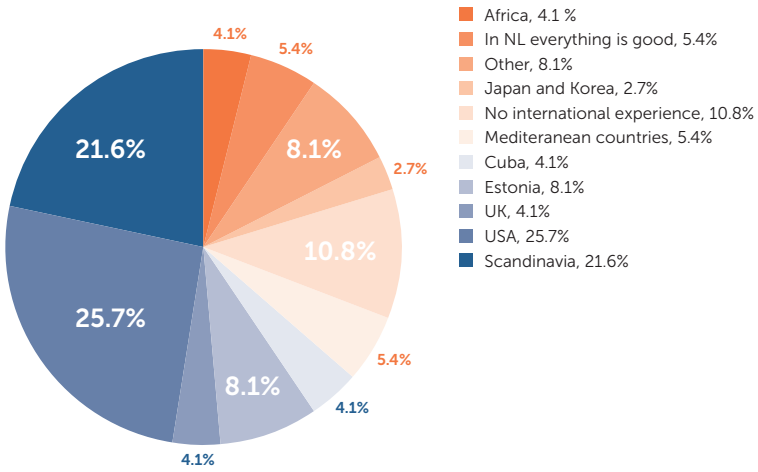


Figure 1. Which countries can provide us with important lessons about the healthcare system? Frequency with which a country was mentioned by the interviewees. The label "Other" refers to countries that were mentioned at a percentage of 1% (India, Singapore, Belgium, New Zealand, Australia, Israel).

Stakeholders mentioned that patients in *Mediterranean countries* have more direct *access to secondary care*. This means that, instead of depending on a general practitioner to refer them to secondary care (e.g. a cardiologist, dermatologist etc.), a patient can go directly to a secondary care institution and consult a specialist doctor. This increases speed of treatment and in some cases might also increase the quality of treatment because the medical specialist has a more in-depth- training in the relevant disease.

In *Estonia*, *blockchain* and other technological innovations are already applied in healthcare. Blockchain refers to a system in which a growing list of records, the blocks, are linked to each other and secured in a cryptographic manner. This makes the exchange of information secure and impossible to read by unauthorized third

parties. Blockchain technology can be relevant for recording sensitive information such as voting records or healthcare information.[18]

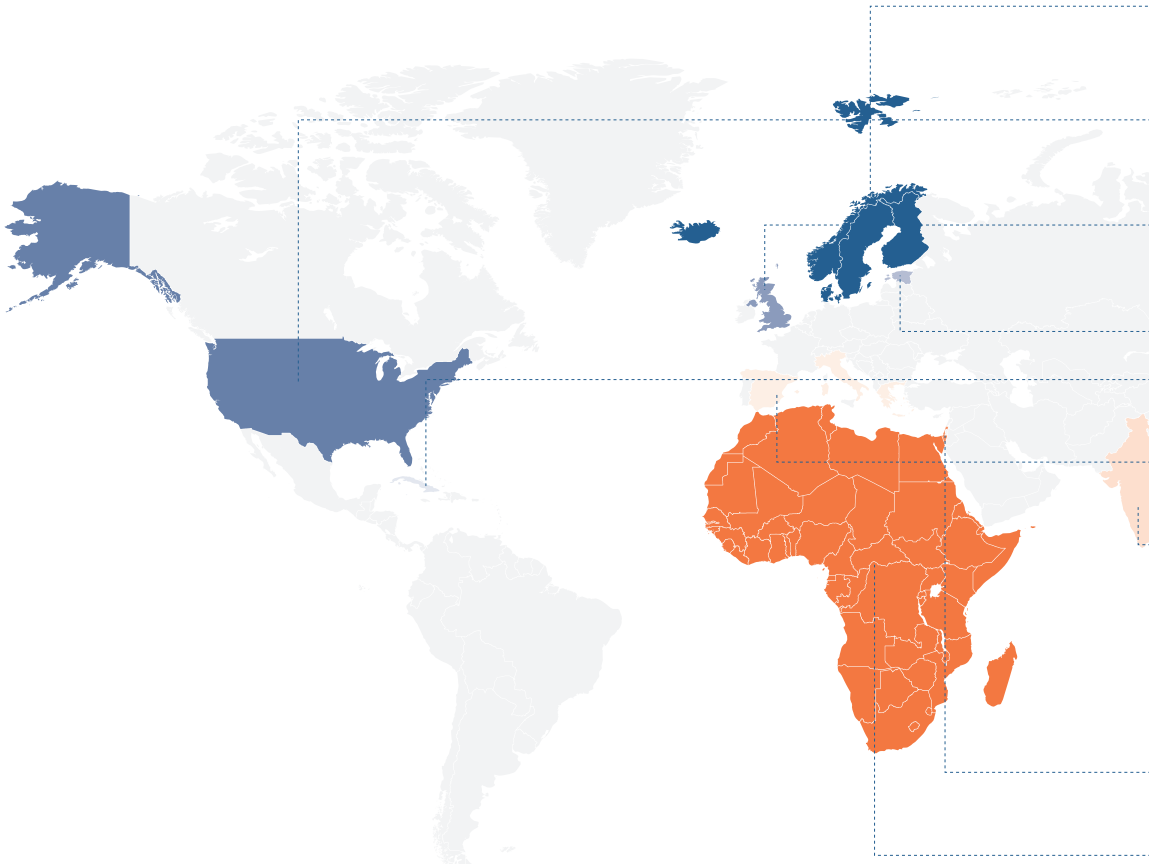
A benefit of the situation in *Cuba* is a well-organized healthcare system that is provided *free of charge* to all the citizens. The guiding question of the system is: *how can we provide healthcare for everyone?* rather than: *how can we save costs?*.

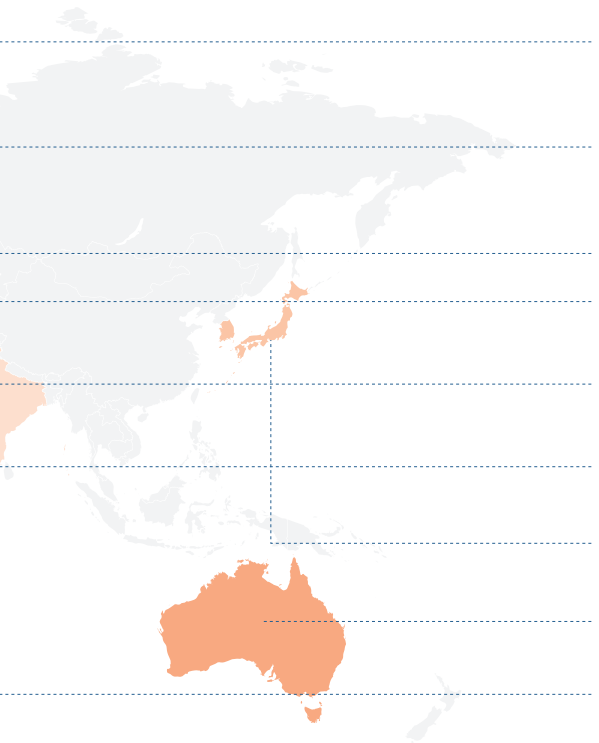
Our stakeholders frequently mentioned the *Scandinavian countries* when asked what the Netherlands can learn from other countries. The first advantage that was mentioned is the *excellent central data collection systems* that these countries have. They collect big datasets that are made available for medical research, which facilitates research and thus leads to healthcare sector improvements on many different levels. In addition, they place a larger emphasis *on mental health* in medical curricula and provide *early education on social values and collaborations*. Scandinavian countries also tend *standardize policy and decision making in their hospitals*. For example, deciding what kind of technological innovations the hospitals will adopt is always a collaborative effort. Finally, *remote care* is well developed in Scandinavian countries, partially because these countries have many remote areas. Lastly, Scandinavian countries have a culture that is *open to innovation*.

One of the advantages of the *United States*, as mentioned by our stakeholders, is the *high speed of implementation of innovations*. This is partially facilitated by the fact that *medical ethics committees are flexible*, thereby accelerating medical research. It is also due to the fact that there is *involvement of entrepreneurs and startups in the healthcare sector*. These new innovations tend to be *patient-centered* (e.g. less side-effects) *instead of cost-centered* (e.g. improving amount of MRI scans that can be made), and the evaluation of hospitals is strongly based on the *outcome of treatment*, instead of on the number of treatments. Also, just like in the Scandinavian countries, there is a *central data collection system* which offers good possibilities for the analysis of big datasets. Finally, general practitioners tend to be well integrated within the entire healthcare system, while there is easy access to private care (provided one has the financial possibilities).

An advantage of the healthcare system in Israel is that it places a large focus *on preventive care*. *Australia* has an excellent system of *National Electronic Health Records*. In *Korea and Japan*, have relatively little *regulation and more freedom for new innovations*. Both of these countries are also *open to new technology*. In *India*, there is an *increased delegation of treatment*: difficult cases are treated by medical specialists, but more general cases are treated by medical assistants. In *African countries*, where there are many remote areas, *remote care* is highly developed. Also, Kenya is particularly ahead with respect to technology of healthcare financing (e.g. it can be ascertained that a specific amount given to a person is spent on healthcare and not on something else).

A benefit of the system in the *United Kingdom* is that there are many possibilities for patients to have *online consultations* with their general practitioner. The government invested in *prevention and education on innovative approaches* in healthcare (e.g. e-health treatments). Also, there is a relatively large amount of *government funding available for medical research* in general. As one stakeholder puts it: *They have a national research institute that has a decent amount of money, and that's how it builds research. Regulation ensures that good research gets pumped out. In this way, the United Kingdom anticipates the execution of solid, well-run research. That is something we could also do.*





- **Scandinavia**: Open innovation culture, collaborating bridging decisions and early education on social values
- **USA**: Quick to implement high-tech innovations, incite involvement of entrepreneurs
- **UK**: Prevention, investment on both traditional and E-health education, funding for research
- **Estonia**: Blockchain applied in healthcare
- **Cuba**: Patient-centered, humanistic approach
- **Mediterranean countries**: Direct access to secondary care and medical specialists
- **India**: High productivity achieved via delegation of treatment
- **Japan and Korea**: Less strict regulations and increased openness to technology
- **Australia**: Good national Electronic Health Records
- **Israel**: Focus on prevention instead of treatment
- **Africa**: Remote care

Figure 2. Lessons and tips learnt from other countries about what makes a good healthcare system. The lessons refer to practical tips about new technologies and innovations but also tips that concern aspects and core-values of the healthcare system (e.g. patient-centred approach, access to medical specialists).

THE DUTCH HEALTHCARE SYSTEM EMBRACES INTERNATIONAL APPROACHES: LESSONS LEARNT

Problem (mentioned for the Dutch healthcare system): limited access to secondary care due to a stringent annual budget plafond.

Requirements mentioned by the stakeholders:

1. Increased access to secondary care;
2. Increased access to doctors also in terms of time: there should be extra services during the evening and weekend;
3. More opportunities for physicians to be proactive: general practitioners should not hesitate to direct patients to the secondary care.

Countries that might function as a role model to fulfil these requirements: Mediterranean countries and Cuba.

Problem (mentioned for the Dutch healthcare system): rising healthcare costs and the stringent annual budget plafond and limited budget for research and innovation.

Requirements mentioned by the stakeholders:

1. Patient centered approach: "how can we provide healthcare for everyone?" rather than "how can we save costs?";
2. Increased funding by the government that guarantees execution of solid, well-run research;
3. Healthcare that is more focused on prevention.

Countries that might function as a role model to fulfil these requirements: Cuba, the United Kingdom and Israel.

Problem (mentioned for the Dutch healthcare system): the healthcare system is conservative in adopting new technologies and data sharing.

Requirements mentioned by the stakeholders:

1. Good central data collection that is available for research;
2. Remote care;
3. Less strict regulations and increased openness to technology;
4. Incite involvement of entrepreneurs and start-up companies in healthcare;
5. Fast adoption of these innovations;
6. Good national Electronic Health Records system;
7. Usage of blockchain in healthcare to safeguard patient health records, privacy and integrity.

Countries that might function as a role model to fulfil these requirements: Scandinavian countries, Estonia, the United States, Australia, Korea and Japan.

The Dutch healthcare system embraces international approaches – a "bonus" lesson: reopen the discussion about the national Electronic Health Records in the Netherlands?

A lesson to be drawn from the combined knowledge acquired by Scandinavian countries, Australia and Estonia is the following:

a. Make use of a good central data collection system that is available for research while paying attention to privacy and ethical issues;
b. Incorporate good national Electronic Health Records;
c. Use blockchain in healthcare to safeguard patient health records, privacy and integrity.

Could this be a good time to reopen the discussion about the national Electronic Health Records in the Netherlands and adopt Scandinavian, Estonian and Australian practices?

The Dutch healthcare system embraces international approaches: are these goals achievable?

Above we mention that, based on our research, there are three aspects of the Dutch healthcare system that can benefit from further improvements: access to secondary care, attention for healthcare costs and the speed of adaptation of new innovations.

Ideally the healthcare policymaker should tackle these three factors. But would that be achievable? The first two points might lead to increases in the already high costs of the healthcare system and might thus prove a bottleneck for the implementation of innovation. However, the third point has high potential to lead to reduction of costs, a sustainable healthcare system and can even facilitate the implementation of the first two points. Indeed, technology can facilitate increased access to secondary care, for example by providing the possibility to do so at a distance. Technology can also enable the creation of datasets that can be subjected to research, thus facilitating the implementation of the second issue. Finally, technology can save costs by eliminating waste, increasing automatization, streamlining organizational processes and in many other ways. In conclusion, new technologies have the potential to initiate progress within the three aspects of the Dutch healthcare system discussed above, without placing an additional burden on taxpayers.

Looking forward to a sustainable healthcare system: is it possible to have a patient-centered, yet cost-efficient healthcare system?

In the previous section we concluded that the key to a sustainable future is the efficient adoption of technological innovations in the healthcare system because this will lead to reduced costs. However, in our view, a sustainable healthcare system is not just a cost-efficient healthcare system but one that manages to be cost-efficient and patient centered at the same time. It is a system that asks: *how can we provide a sustainable healthcare for everyone?* rather than *how can we save costs?*

In this section, we explore if the suggestions for making healthcare more patient centred discussed in previous sections can be cost-efficient. We also investigate whether it is possible to combine technological innovations and cost-efficiency in

a patient-centred system in order to create an optimal and sustainable healthcare system of the future.

One might argue that a patient-centred approach is not possible because it is too expensive. However, it is important to note that better access to healthcare can lead to easier detection of diseases, which in the end will reduce costs. Thus, a patient-centred approach means fast detection of a disease, better and more accurate diagnosis, and increased prevention rates but can at the same time lead to cost reductions.
Besides expressing the need for a healthcare system that focuses on prevention, stakeholders also mentioned that increased funding by the government is necessary. Although, again, this only seems to raise healthcare costs, funding may lead to the execution of solid, well-run research and thus to increased quality and new innovations. Therefore, in the long run, it has the potential to decrease costs.

Finally, it should be noted that the dilemma of choosing between a patient-centered approach and cost-efficiency is overstated. There are countries that are not rich but manage to provide free and high-quality healthcare to all citizens even during economically difficult times. Cuba is an example of such a country. Not only do Cubans have access 24 hours a day to family doctors[19], they also have access to more doctors compared to other countries in general. Already in 1999, the doctor-to-patient-ratio was 58.2 per 10.000.[20] Additionally, the government ensures healthcare for all citizens.[21] Although, as we will elaborate below, to date there is no country that has an ideal healthcare system. For instance, in Cuba, investment on technological innovations is extremely low. Yet it is interesting to think about how Cuba is able to combine a patient-centered approach with low-cost efficiency.

Healthcare lessons generalizable to every country

In this chapter we picked out some good characteristics of the healthcare systems of different countries. This of course doesn't mean that the countries that we mentioned have perfect healthcare systems overall. For instance, the healthcare system in the United States has many shortcomings, the most important of which is the fact that many Americans cannot afford to take out healthcare insurance.[22] This is an aspect that hopefully no European country would want to adopt and,

rightfully, the stakeholders mentioned that it is the American system that should learn from Europe in this case. However, more collaboration with entrepreneurs in order to facilitate technological innovations clearly has benefits.

What action can stakeholders take on the basis of the knowledge retrieved from this chapter? In addition to being encouraged to think outside the box, they can cherry-pick the best elements of each country's healthcare system and try to adopt them to their own country.

A robust healthcare system is one that finds a good balance between opposites. It is a healthcare system that combines the best elements despite the fact that they might seem contradicting at first glance. We can draw an analogy with the ideal landscape: who wouldn't want a landscape that combines sea, mountain and valley at the same time? An ideal healthcare system embraces high-tech developments and big data sharing, yet protects privacy (e.g. using blockchain), for example. It is open to innovation, involvement of high-tech companies and entrepreneurs, while the core values of healthcare are protected. It is careful with costs and expenses in order to reassure sustainability and existence in the future, but this does not come at the expense of a patient-centered approach. It embraces developments and shifts in traditional hierarchical systems, while at the same time the credibility and important aspects of the traditional systems are protected and improved. It is patient-centered, patient-tailored and offers healthcare users the opportunity to be independent for as long as possible, have access to alternative sources of information and self-management solutions. However, this shift does not diminish the credibility of the traditional system and healthcare specialists: for instance, information from automated systems should not take precedence over the advice offered by healthcare specialists. In an era of increased access to alternative sources of information, a need also arises for increased access to credible sources of information (e.g. medical experts and secondary care). This becomes possible if doctors receive an even better education and keep up with new developments. In an era of easy access to multiple alternative sources of information, there is an urgent need for highly knowledgeable and well-informed doctors who are able to correctly guide patients.

It should be noted that when applying these international lessons to the healthcare system of a specific country, cultural differences should be taken into consideration and such lessons should be adjusted to the specific culture. We hope that when this is done, the application of these lessons will lead to a better, more patient-centered, technologically-driven, efficient and sustainable healthcare system.

6.

HOW TO KEEP UP WITH THE LATEST TECHNOLOGICAL INNOVATIONS IN HEALTHCARE

CHAPTER 6: HOW TO KEEP UP WITH THE LATEST TECHNOLOGICAL INNOVATIONS IN HEALTHCARE

Technology and the future of healthcare

Technological innovations are advancing at a remarkable pace. This means that, as a key driver of technology implementation in healthcare, one constantly has to be on the lookout for the latest developments in the area. A common way for innovations to find their way into the public space is by first becoming incorporated into the consumer space, and then moving into other areas such as enterprises. Therefore, it is important to be up-to-date on what is happening now to predict what can be expected in the near future. We asked our interviewees how they inform themselves about new technological innovations.

Interestingly, not many answered this question, making us wonder why that is. Others admitted to feeling overwhelmed by the amount of information available, leading them to not inform themselves at all. Yet others were unsure about where to find reliable and good information. And some just lacked time to inform themselves. This suggests that there is an urgent need for a simpler, clearer way of communicating and advertising about technological innovations which can reach a broad and busy audience.

The answers we received show that magazines and newspapers are the most common source of information on technological innovations, followed the stakeholders' professional network (colleagues, customers and other clients), online news (LinkedIn, Twitter, blogs, websites) and conferences (figure 1). Scientific journals, broadcast TV news, and governmental policy bulletins were the least mentioned.

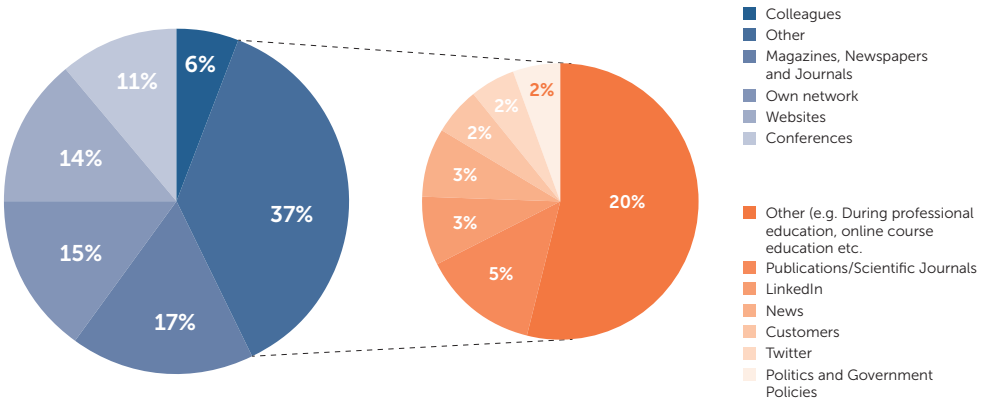


Figure 1. Most common sources of information about new technological innovations in healthcare. Unspecified 'Other' are less than 1% of the provided answers.

The fact that the interviewees find magazines and newspapers appealing sources of information is not surprising: they have an eye-catching appearance and the content is informative yet easily digestible because they are written by commercial organizations and aimed at a broad audience. However, the downside is that the information provided is non-peer reviewed and determined by paid editors and advertisers which could be biased. This is unproblematic as long as stakeholders rely on multiple sources and remain critical of the information they ingest. Traditional media can help create awareness that a certain technology exists; stakeholders can then decide among themselves how relevant that piece of technology is and how good it is. In fact, almost all interviewees said they rely on multiple sources, most notably their network, and that they discuss new technologies face-to-face with peers and during conferences.

Some interviewees also named specific online sources as common go-to sites for developing trends in technology innovation in the area of healthcare, such as LinkedIn, Twitter, blogs but also websites such as:

- http://www.nhg.org
- https://www.skipr.nl
- https://www.zorgvisie.nl
- https://www.smarthealth.nl
- http://www.mobihealthnews.com
- https://singularityhub.com
- https://www.sciencedaily.com
- https://www.ntvg.nl

Different stakeholder perspectives

The results of our interviews suggested that healthcare professionals mainly rely on magazines and newspapers, online news and conferences within their own network for obtaining information on technological innovation and that they rely on these sources in equal measures. Policy makers and consultants, on the other hand, seem to rely mostly on their own network and other sources. Researchers seem to prefer magazines over online news, and favor their own network and conferences, while entrepreneurs and policy makers made the least use of conferences. Also, entrepreneurs seem to mainly inform themselves via magazines and online news as well as other sources. This might be an important insight for those advertising technological innovations to different stakeholder groups.

7.

THE FUTURE OF HEALTHCARE – PATIENT AND TECHNOLOGY IN THE LEAD

CHAPTER 7: THE FUTURE OF HEALTHCARE – PATIENT AND TECHNOLOGY IN THE LEAD

To identify how technological innovation can contribute to the transition towards a socially and financially sustainable healthcare system, it is important to understand what the future of healthcare will bring. As the aging peak is expected to be at its height in 2040,[23] we asked the stakeholders what they think the healthcare sector should look like in 2041. When categorizing the answers, we received divergent, yet specific responses. To help visualize the future of healthcare, we have weighed the answers of the interviewed stakeholders and shaped them into a complete vision of the Dutch healthcare system in 2041. We focused on those values that all stakeholders associated with the future, so that we could keep the vision universal. This means that we do not discuss specific technologies and that we do not compare between stakeholder groups, as the future is the result of a joint effort. The presented vision of the future can function as a basis for constructing new policies, but also act as a guide when choosing technologies to implement in a healthcare organization.

Patients in the lead of digital healthcare

In 2041, the Dutch healthcare system should be patient-centered. This was the single most given answer by the interviewed stakeholders (figure 1, 38%). Most agreed that the sector has already come a long way from the old culture where the doctor was in the lead. The situation in which the patient explains his complains, then humbly agrees with the doctor's diagnosis and solution has been long gone. As society has become more equal, patients have gotten more in the lead.

We believe this to be a very valuable development: patients who are in the lead are likely to have more satisfying contact with their healthcare provider. Moreover, if they formulate a plan of action that they made in co-consultation with their doctor, they are more likely to adhere to it. This brings greater benefit for individual patients. Higher concern for patients' preferences and better treatment adherence can lead to less unnecessary care, which is an advantage for society as a whole.

The second and third most given answers are both related to technology. Stakeholders foresee a more technology- and data-driven healthcare system

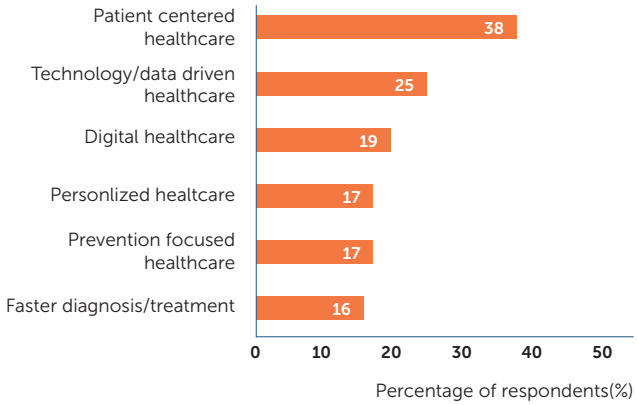


Figure 1. The responses of interviewed stakeholders on their outlook on the Dutch healthcare system in 2041.

(figure 1, 25%) as well as a more digital system (figure 1, 19%). Technology- and data-driven healthcare means that the provider is aided by big data in making decisions; care-robots can also play a role. In a digital healthcare system, the direct, personal contact between patients and their providers is kept to an absolute minimum. Medical examinations and the making of a diagnosis can be done outside the walls of a hospital.

Multiple interviewees said they see a future in which the patient is the owner and warden of their own medical record. If a patient feels sick, they can inform their healthcare provider, who will give them access to the medical records. This is different from the current and rather outdated practice in which the medical records are stored at the office of the provider, often restraining access to other involved stakeholders. Independent of who owns the data, a more effective system in which all involved stakeholders have access to the data and can easily communicate with each other is desired. This ultimately leads to a more comprehensive and quicker diagnosis or decision-making process.

Secured personal health environments give patients an overview of their health. If necessary, they can select the specialist they want to see and schedule an appointment. After medical examinations, they can see their results and make their

own treatment plan, aided by a trusted healthcare coach. This healthcare coach could be a general practitioner, or a trusted third party. If current stakeholders fail to act on the trend of growing patient autonomy soon, new entrants might fill the role of healthcare advisor.

The patient is the pilot and the doctor is in the air traffic control tower, coaching the patient in the right direction with mutual trust.

A healthcare system with patients in the lead requires more responsibility from patients. If they want to make a decision themselves, they will also have to inform themselves. Nowadays, there are more and more sources where patients can get curated health information. Based on our research, there will be a growing demand for these information sources, and also for dedicated training and education on lifestyle, health and food by health practitioners and insurance companies.

Like banking, the patient will arrange his own healthcare, at home.

From reactive to proactive, personalized healthcare

Technology and patient-centered care will give rise to a paradigm shift within the Dutch healthcare system. Ongoing innovations enable a transition from a *reactive* healthcare system towards a proactive healthcare system. Instead of visiting the doctor when you feel sick, everybody can be constantly monitored by small technologically advanced devices. This can give healthcare a more preventive function if the right data is recorded and correctly analyzed and interpreted (figure 1, 17% of all responses).

Focus on prevention of disease instead of trying to fix the damage when it's done.

Technology also makes it possible to give people personalized feedback about their own health (figure 1, 17%). Everybody knows we should exercise enough and should eat as healthily as possible. But this information is hardly ever personalized. Imagine future applications that will suggest a dinner menu or exercise plan, based on information from multiple sources: your recent activity as registered by your watch, your susceptibility for cardiovascular disease based on your DNA, your medical history and the contents of your urine as registered by your own toilet. The benefit of this personalized feedback will be that people can be subtly nudged into the right direction, based on their own life situation, instead of just bombarding them with general health advice and an overload of sometimes contradictory information.

A digital healthcare system that puts patients in the lead might also have an impact on the actual infrastructure of healthcare. Nowadays, a patient has relatively little say in which medical specialist they want to visit. As a result of centralization of care, it is possible that a patient will be sent to one hospital for one illness, and to another hospital for a second illness. Often, communication between the institutes and the sharing of information between different specialist is still too complicated, thereby hindering or creating borders to a personalized, efficient patient-care.

Health institutions: from brick walls to digital environments

It is likely that the healthcare system will consist of a network of healthcare providers instead of hospitals with clear borders in the future. Moreover, the hierarchy of information between patients and specialists is likely to disappear. The hospital of stone and bricks may cease to exist, as the patient is free to shop anywhere for their health. If they want to have their CT scan performed in the shopping mall near their home, this is possible. If they want to have the surgery performed in a highly recommended surgical center 200 kilometers from home, but have the post-surgical check-up performed in their own hometown, this is possible. The communication and transition between the different providers will run smoothly, because of the technological innovations.

Hospitals will only exist for specialist care and only few will offer the entire package of possible health treatments. Technology will blur the borders of a doctor's realm of control. Nowadays, physicians only come to know about their patients' health when these patients visit their clinic. In the future, the patient will no longer be out of sight when they leave the room of their physician, but patients will be monitored at home, for a longer period of time. This will create a continuum of hospital and home. Finally, manufacturers of medical devices will no longer just be suppliers. Instead, they will fulfill an important monitoring role in the healthcare system of their users and as such will be seen as new entrants in the healthcare ecosystem. For example, a pacemaker will no longer be checked once a year by a doctor in the hospital; rather, patients with pacemakers will be constantly monitored by the manufacturer of their pacemaker, who may well be located at the other side of the world.

Future stakeholder relationship status: 'it's complicated'

The role of the doctor will undoubtedly change. Several interviewed stakeholders believe the doctor will become more of a coach, advising and encouraging patients but leaving the final decision or action to them. Information will no longer be based on the expertise of one doctor, but on the experience of doctors around the globe. Medical knowledge will no longer be shaped by strictly coordinated medical trials, but also by algorithms deduced from world-wide patient data. As soon as this information is better available for patients, doctors will lose their monopoly on information. This will put patients in the lead.

However, some say doctors will go back to focusing on their core job, which is the actual healing of patients. The rest, the coaching and offering of a listening ear, will be done by specialized nurse practitioners or non-medical personnel. Depending on how the healthcare sector adapts, there will be a rise of "trusted third parties". Organizations like Best Doctors fulfill the role of sparring partners for patients. They offer expert advice and discuss the various treatment options with their customers, based on their needs.[24]

Not only will the relationship between the doctor and the patient change, the relationship between the various healthcare providers might also change. If patients are more able to compare and select the healthcare plan and providers of choice, this might increase competition between healthcare providers which can affect services and prices. It will become more important to be visible to potential patients. Also, healthcare providers might adapt their proposals to patients' preferences. Although this is favorable in terms of personalized and value-based healthcare, it may also have negative consequences.

To 2041 and beyond!

With healthcare becoming more patient-centered, the definition of healthcare will change. The division between healthy and sick, based on disease, will no longer be used. This means that healthcare will transition from a binary system with two options, 'sick' or 'healthy', to a complex personalized network that will constantly evaluate the life values of a patient. The healthcare system will change from reactive to proactive. Health interventions will take place continuously, in order

to predict diseases and prevent a decrease in the life quality of the patient. This proactive approach will be enabled by technology that will constantly monitor the health of the patient. The main person in charge will be the patient, as a curator of their own digital health network. In conclusion, the future of healthcare can be summarized in terms of four P's: personalized, predictive, preventive and participating.

To make the described vision of the healthcare system in 2041 even more concrete, we have added a fictional case study of a patient, 70-year-old Mary.

FICTIONAL CASE BASED ON VISION OF THE FUTURE: MARY

Mary is a 70-year-old grandmother, who has three children and seven grandchildren. She and her husband John maintain an active social life and love to be outdoors. After having her DNA analyzed a couple of years ago, Mary found out that she has her chances of developing cardiovascular disease are 41.5% higher than average. Since her children gave her an electronic watch, she has been able to keep a close eye on her own health. After their last holiday, a four-week cruise in the Caribbean, she even got a notification on her tablet computer, suggesting she could use some extra exercise.

During one of the long bike rides she and John love to make, her watch and phone began to bleep simultaneously. Some aberrant heart activity had been noticed and her phone suggested she should have some additional testing done. At first, she dismissed the notification. After all, she still felt perfectly fine and had no complaints whatsoever. At home, she received a message from her general practitioner, Dr. Simons, who also got the notification about Mary's abnormal heart activity. At his insistence, Mary had a blood test done. Very convenient – a quick fingerstick at her local grocery store.

The results of the blood tests became available on her secured online patient portal; one of the biomarkers for cardiovascular disease was too

high. Based on her medical history and what is known in the medical field, the algorithm-based system predicted that Mary was developing some form of cardiovascular disease. Quickly, Mary was contacted by Dr. Simons, as he suggested to meet to discuss the results and have some additional testing done.
A couple of days later, Mary is sitting in Dr. Simon's office where he makes an electrocardiogram. It is immediately sent to a board of cardiovascular specialists, while it is simultaneously run through another algorithm-based system. Dr. Simons tells her the final diagnosis: coronary heart disease. There is a plaque building up in one of the coronary arteries, reducing the blood flow to her heart and increasing the risk of a heart attack.

Dr. Simons has uploaded some information onto her personal health environment, which Mary and John study closely. They can easily send Dr. Simons a message if they have some additional questions and he always responds within a day. They meet with Dr. Simons one more time to discuss the various possibilities and Mary explains her preferences. After they've decided she wants to have the small surgical procedure to remove the plaque, John and Mary study the various surgical centers that are available. There is one nearby that has excellent results and positive reviews. After selecting this institute, Mary gives the center access to her medical files.

On the day of her surgery, Mary is brought into the operating room where she is greeted by the nursing assistants. On a large TV screen on the wall, she sees the medical specialist, Dr. Patel. Dr. Patel is a world-renowned robotic surgeon who operates all around the world by internet connection. After bringing her under anesthesia, the surgical robot is docked and Dr. Patel operates on Mary.

When the procedure is finished, Mary awakes in the recovery room. There are lot of sensors attached to her body. She feels safe, knowing that her health is constantly monitored from the medical center's control room, 60 kilometers up north. When the doctor at the control room and the nurses at the medical center decide she is fit enough, Mary is discharged.

Arriving at home, Dr. Simons contacts her to ask how she feels. He has already seen in his system that the operation went smoothly and without complications and that the aberrant heart activity has disappeared. Mary is able to tell him she feels perfect and cannot wait to go for a long bike ride again.

CONCLUSION

CONCLUSION

This report provides an in-depth analysis and evaluation of the current perspectives of healthcare stakeholders towards the long-term impact of technology and breakthrough innovation in the Dutch healthcare system.

Our research showed that almost all stakeholders agreed that technological innovation is important for achieving a sustainable healthcare sector. On a scale from 1 – 10, 89% of the surveyed stakeholders said they believed the importance to be equal to or higher than an 8. The stakeholders recognize the benefits of quantified self for chronically ill people and prevention. However, they are not convinced that the population as a whole will be motivated enough to monitor their own data, let alone to take action and adopt a healthier lifestyle based on this data. In addition, the Dutch healthcare system does not seem to be ready yet to incorporate quantified-self data in healthcare processes.

The main advantage of technology implementation according to the surveyed stakeholders seems to be improvement of efficiency. It involves automation of tasks, which is especially important due to the upcoming medical personnel shortages. Furthermore, it can lead to improvement of administrative efficiency and also cost reduction by eliminating redundant activities and early diagnosis. Another advantage identified was quality improvement in the form of increases in preventative healthcare, value-based healthcare, personalized healthcare and evidence-based healthcare. Another expected form of quality improvement involves better treatment and diagnosis. Together, these types of quality improvement have the potential to modify the entire healthcare system. Many respondents mentioned that new insights should be obtained on the effectivity of differentiating treatment between patient groups relative to the current practice of attuning treatment to the 'average patient'. Various stakeholders expected an increased accessibility to healthcare and patient empowerment as a result.

An expected negative aspect of technology implementation in the healthcare sector concerned the inaccessibility of healthcare to users, caused by technological illiteracy. This isn't only a risk for patients but can also affect low-tech health institutions. Most of the stakeholder groups were primarily concerned about the decrease in accessibility, compared to an improvement in accessibility. Another

disadvantage is the projected loss of the human factor in healthcare. Aside from the loss in value that interviewees associate with a loss in human contact, a decrease in healthcare quality is expected to result from the loss of human involvement. Another major concern of healthcare receivers are privacy and security issues caused by technology implementation. Healthcare users worry about who will have access to their data and that their data might be used to identify risk groups that have to pay higher premiums or may be denied healthcare. These concerns have to be taken seriously and it is essential to ensure adequate regulations are in place to prevent the abuse of sensible patient data and differential treatment of patient groups.

In order for technological innovation to be successful, the technology should meet the following requirements: it is well-functioning, reliable, easy to use, and adds value. A crucial aspect of the development of healthcare technologies is the inclusion of end users, such as healthcare professionals and care-receivers, in the creation process of the technology; this is called co-creation. Of major importance for achieving successful innovation is the creation of a long term financial plan. How are the costs that are incurred to be incorporated in the current financial model? Projects should define the business case early on and define who is going to pay for what. Successful introduction is also dependent on the time-spectrum. Short-term implementation of many innovations fails. Such fast changes are especially problematic in healthcare. Innovators in healthcare should keep in mind that projects need a long-term vision, and long-term effort and planning in order to have impact.

Our surveyed stakeholders keep up-to-date with the latest trends on technology and innovation in healthcare by ingesting information from traditional media, such as magazines and newspapers. These are easy to find and often clear to understand. However, the information provided and the way in which it is presented is determined by paid editors and advertisers, which could introduce bias. Luckily, our interviewees seemed quite well-aware of this danger, as most replied that they rely on multiple sources, most notably their own network. This makes for a good pretty good system of knowledge acquisition after all: traditional media can help to create the awareness that a certain piece of technology exists; stakeholders can then decide for themselves how relevant it is and how good it is, discussing it face-to-face with peers and during conferences.

When we asked what healthcare would look like in 2041, we received divergent, yet specific answers. The answer that was given the most is that the healthcare system will be more patient-centered. The healthcare sector has already come a long way from the old culture where the doctor was in the lead. Patients no longer simply explain their complains, only to humbly agree with the doctor's diagnosis and solution. As society has become more equal, patients have gotten more in the lead. In the very own words of a surveyed healthcare professional: *the patient is the pilot and the doctor is in the air traffic control tower*. The second and third most given answers were both related to technology. Stakeholders foresee a more technology- and data-driven healthcare system as well as a more digital system. This means that providers will be aided by big data in making decisions, that care-robots will play a role and that in-person contact between the patient and their provider will be kept to an absolute minimum. Medical examinations and diagnosis will be able to take place outside the walls of a hospital.

SMO HEALTH 41 TEAM

SMO HEALTH 41 TEAM

Candido da Silva is an immunologist and PhD candidate at the Leiden University Medical Center. His research focuses on the development of novel cancer treatments at Leiden University Medical Center. He joined the SMO Promovendi Healthcare Lab in early 2017 as a volunteer researcher to aid in identifying strategies to facilitate sustainable healthcare in the Netherlands.

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Malou Noten is a PhD candidate at the Department of Clinical Neurodevelopmental sciences at the Faculty of Social and Behavioral science at Leiden University. She joined the SMO Promovendi Healthcare Lab at the beginning of 2017.

Stephanie Holst-Bernal is a PhD candidate at the Leiden University Medical Center. Her research topics are cancer glycomics and mass spectrometry imaging and she has great interest in turning research into clinical solutions. She joined the SMO Promovendi Healthcare Lab at the beginning of 2017.

APPENDICES

APPENDIX 1: RESEARCHING STAKEHOLDERS' PERSPECTIVES ON TECHNOLOGICAL INNOVATIONS IN HEALTHCARE

Aim: To gain insight into the role of technological innovation in the Dutch healthcare system, by studying the opinion of and experiences with technological implementations (past and future) of healthcare stakeholders.

Research method: We chose to combine a qualitative research method with a quantitative one. While quantitative data can be processed using standard statistical programs, qualitative data needs a different approach in order to group and categorize the data. Although quick insights can be gained from questions that ask interviewees to grade a certain topic, answers to such questions do not reveal the underlying opinions related to the grade. Therefore, we chose to ask mostly open questions to gain insights regarding stakeholders' experiences with and recommendations for implementing technology.

Data acquisition: We interviewed a sample group of 77 people that covered 6 stakeholder groups within the Dutch healthcare system: consultants, entrepreneurs, policymakers, researchers, healthcare professionals and the remaining stakeholders, categorized as 'other'. The sample group was obtained by reaching out to people in our own network, and by contacting public figures active in the Dutch healthcare system. The in-depth interview comprised 12 questions, of which 10 were open questions and 2 were multiple-choice questions that required scoring topics on a scale from 1 to 10. The interviews were held during a personal meeting or via telephone call. The interview time ranged between 30 to 90 minutes. The response of the stakeholder was either transcribed verbatim or summarized by the researcher that conducted the interview.

Data-set composition: The number of interviews conducted within each of the 6 stakeholder groups is visualized in figure 1 as a proportion of the total number of interviews conducted. A more detailed description of every stakeholder group is given below:

- Consultants, consisting of (IT) consultancy companies, knowledge centers and organizations for healthcare professionals;
- Entrepreneurs, working in large and small businesses active in the healthcare sector;

- Policy makers, public and private organizations active in healthcare policy development;
- Researchers, active in the medical field or in (medical) technological research and development;
- Healthcare professionals, including medical doctors of various specializations working in university and regional hospitals, pharmacists and general practitioners;
- The remaining stakeholders, categorized as 'other', which include patient organizations, professionals working in healthcare organizations in a non-medical position.

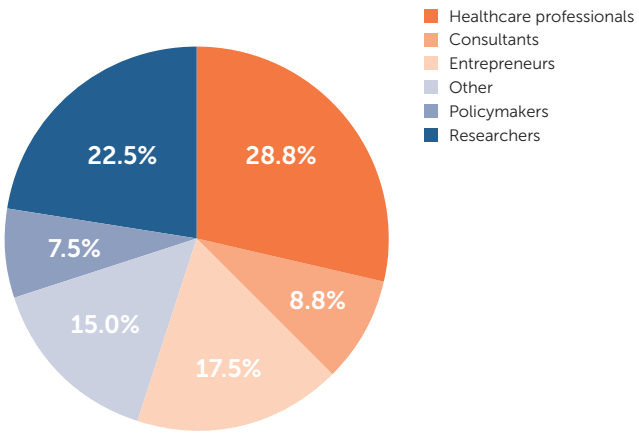

Figure 1. Pie chart displaying the share of every stakeholder group among the conducted 77 interviews.

Data analysis: for the non-numeric data, the analysis was conducted in 3 steps: code development and testing, code application, theme and pattern analysis.

Code development and testing

Coding of data refers to categorization of quantitative data based on a common theme. This is needed in order to analyze recurring patterns and themes in non-numeric data. The codes are organized in a multi-level hierarchy, so that main themes can be identified, but details are listed as well. Based on 10 randomly

chosen interviews, the answers to the interview questions were summarized into separate categories. The interview responses were then loaded into the cloud-based analysis software Dedoose.[25] Since the categorization of interviews is a subjective process that is dependent on the researcher that applies the codes, a coding test was needed. Two researchers independently test coded a random sample set of 10 interviews (that did not include the first 10 interviews). By comparing the applied test codes between the two researchers, a consensus set of categories was generated that accurately represented the answers given in the considered 20 interviews (26% of entire dataset).

Code application

The finalized categories were used to code the answers given in the total data set using the Dedoose platform. By selecting the text in the interview and linking it to the relevant category, all quantitative data could still be traced to the qualitative manuscripts.

Theme and pattern analysis

The applied codes were compared based on code application frequency, which was focused on codes that were applied often, but also codes that had low counts. For the majority of the analysis, we reviewed the answers to the questions across the total sample group. However, for the questions that were discussed in Chapter 2 and 3, we compared the answers between different stakeholder groups. Obtained themes were compared to literature in order to draw and explain conclusions.

APPENDIX 2: RESEARCHING USERS' PERSPECTIVES ON TECHNOLOGICAL INNOVATIONS IN HEALTHCARE

Aim: To gain insight into the perspectives of healthcare users with regard to technological innovations in the Dutch healthcare system.

Research method: A combination of qualitative and quantitative research methods was chosen. Quantitative data analysis is based on descriptive statistics. Qualitative data was grouped and categorized using Excel.

Data acquisition: We conducted an online survey containing seven questions among 80 healthcare receivers to examine their perspectives on new technological innovations in the Dutch healthcare system. We obtained our sample by reaching out to people in our own network. Five of the questions of the survey were multiple-choice and two of the questions were open questions. Participants filled in the questionnaire on a mobile device or a computer using the link that we provided for them.

Participants: The participants of our healthcare-receiver sample were between 23 and 61 years old, with an average age of 39 years. Forty-five of our respondents were female, and 74 were born in the Netherlands. Our sample of healthcare users was relatively highly educated: 69 of the participants had completed a degree from either an applied (26) or a research university (43).

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Appendix 1

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PUBLICATIONS

Kaj Morel: Tijd voor de Betekeniseconomie

In this publication, author Kaj Morel discusses the origins of neoliberalism and the influence that this – initially primarily economic – ideology has (had) on our society as a whole. He expresses surprise at the ease with which many of us have adopted a neoliberal perspective on society without first critically assessing its premises. Infinite economic growth as the solution to everything? Greed as the best motive for action? The individual, unencumbered by social or political ties as the building block for a social theory? Kaj Morel argues that a different perspective is possible – and necessary. By means of ten 'alternative premises' he provides a sketch of the 'purpose economy'. In the purpose economy economic transactions are no longer merely aimed at growth and money. An equally important role is reserved for our striving towards goods of social and ecological value, for example. In this new economy, each organisation is by definition a social organisation.

Price: 17,95

Printed in Dutch

Prof. Rob van Tulder: Getting all the Motives Right - Driving International Corporate Responsibility to the Next Level

Sustainability is one of the grandest challenges of our time. Laws do not suffice to tackle pervasive, international and systemic issues like climate change, poverty, hunger, health, peace or education. Not for individuals. Not for companies. Companies that are serious about their international sustainability (ICR) ambitions have to take up responsibilities beyond compliance with national laws. But international governance gap creates room for companies to adopt higher, but also lower standards of sustainability. These challenges exist instantaneously and often simultaneously. They confront managers and corporate leaders with quite ambiguous environments that even fundamentally questions their own sustainability motivations, but also the sustainability motives of their stakeholders (customers, employees, suppliers, governments). Are they all sufficiently motivated to effectively strive for more sustainability? What drives them and are there 'right' or 'wrong' motives? What motives are easier to realize and what motives might even create (new) barriers to change?

Getting all the motives for ICR right is the main quest of this book. The book applies the latest insight from organizational psychology, organization science and business model literature (amongst others) to help managers better understand their own motivations to become more sustainable as well as show ways to effectively realize these ambitions. This requires selection of topics, sequencing of transition pathways – all depending on a correct assessment of the position companies are in at the moment. The book identifies hundred+ 'bears on the road' that companies need to take into account when they want to drive towards higher levels of sustainability – often in partnership with other parties. The book includes concrete tools for managers, such as a distance map, issue priority schemes, partnership portfolio strategies, identification of tipping points and the like. The book shows the condensed results of ten year of Max Havelaar lectures (organized since 2007) and therefore accumulates also the insights of a large number of opinion leaders such as Georey Sachs, Noreena Hertz and Gerry Gerrefi.

Price: 19,95
Printed in Dutch

Van zelfregie naar zorginnovatie door SMO promovendi, Yvette Ciere, Simone Geldtmeijer, Lieke Kools, Tess van der Zanden (eds.)

Patients need to be more self-reliant is a phrase often heard in health care. On the one hand, greater patient independence seems to be a harsh necessity: in order to keep providing good-quality health care while the demand for health care is rising and health care professionals continue to be scarce, a greater appeal will have to be made on citizens themselves and their direct surroundings when it comes to organising and executing health care tasks. On the other hand, it is also a right: citizens are increasingly getting a say when it comes to making choices about their own health care. Whichever way you look at it, the call for patient self-reliance seems to be a trend that health care professionals cannot ignore.

But what does self-reliance mean in this context? To what extent do patients rely on themselves already? And how can we help people to become more self-reliant?

This publication contains a collection of essays and interviews about self-reliance, each of these written from a different perspective. Through sharing these different perspectives, the writers of this publication have tried to make the rather abstract notion of self-reliance more concrete. In doing so, they hope to help and inspire others to start new collaborations and innovations in health care.

Price: €14,95
Printed in Dutch

Circulaire Economie: Wat? Waarom? Hoe? door SMO promovendi, Bram Bet, Monique de Ritter (eds.)

The continuously growing world population and increasing consumption have become untenable for our planet. The impact of humanity on our planet in the form of climate change is so large that it is uncertain whether future generations will be able to enjoy our current level of welfare. In response to these developments the concept of a 'circular' economy has become a hot topic.

But what actually is a circular economy? Why should we occupy ourselves with the idea of a circular economy right now? And how do we transition towards a circular economy?

In this publication, SMO promovendi attempt to make a unique contribution towards answering these questions, by taking multidisciplinary approach, working closely together in a team of scientists from various academic backgrounds. This stimulates thinking out-of-the-box and can help generate new insights. In this way, they hope to make a start at transitioning to a circular economy!

With essays by: Bram Bet, Joris Broere, Gerjan de Bruin, Sander van Hees, Fons van der Linden, Monique de Ritter, Stefan Roolvink, Mirte Schreuder Hes, Jelle Treep en Jorinde Vernooij.

Price: €14,95
Printed in Dutch