

# The effects of digital transformation on health care

PhD thesis

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Budapest  
2022

## 1. INTRODUCTION

In recent years, digital technology has exploded in almost every field, posing new challenges for organizations and society alike, as well as fundamentally changing the way they operate. In the healthcare sector, the primary goal of digital transformation is to improve the quality of patient care and reduce costs, but it can also contribute to increasing patient satisfaction and increasing the performance and efficiency of the workforce. The outbreak of the COVID-19 epidemic has induced further breakthroughs or accelerated the spread of digitalisation solutions, such as the publication of the legislation on telemedicine services and their financing in Hungary in 2020.

However, in addition to technological development, we must not forget the human aspects of change, which are reflected, among other things, in the changes in the doctor-patient relationship. Today, the traditional, paternalistic approach to medicine is increasingly being replaced by patient-centred care, which sees patients as partners and actively involves them in making decisions. Ideally, the therapeutic decision is made with the patient's involvement, i.e., an “agreement” is reached between the doctor and the patient on the most acceptable treatment, considering the patient's priorities and needs and the therapeutic goal. This process is called concordance. However, this can only be achieved if the patient has the knowledge and information required to make an informed decision.

There is traditionally an information asymmetry between patient and physician, as the patient usually does not have in-depth medical knowledge. In the past, there were few sources available beyond the information provided by the doctor, which has been radically changed by the widespread use of the Internet. The amount of information available has multiplied, but its quality and reliability can vary widely, and misleading, false information can often be found in online sources. It is difficult for the average person to distinguish between reliable and misleading information.

Lately, there has been a significant increase in the proportion of user-generated content (such as blogs, forums, and social networking sites), which often contain unreliable information. An additional problem is that many websites contain commercial, marketing

information and therefore cannot be considered completely objective. These pages often predominate in the results of Internet search engines, even in the form of sponsored links and advertisements.

Easily accessible information has both positive and negative effects, even if it is of adequate quality. On the positive side of the balance sheet, the most important thing is “empowerment”, which means involving patients in decisions and taking more responsibility, which can lead to better therapeutic results and higher patient satisfaction. Another important advantage is that the patient can control the pace of information processing and reception, thus reducing the information “overload” often experienced during care. This means that they can not only rely on verbal information received during the visit, but they are also able to process the information at home, at their own pace. On the negative side, in addition to the quality problems mentioned earlier, the patient’s concern about the doctor’s disapproval appears, that is, the fear that the doctor has a negative attitude towards online information, which can lead to anxiety and frustration. This could be reduced by proper communication between the doctor and the patient. It is also common for patients to try to diagnose themselves by looking for their symptoms. This self-diagnosis without the proper medical knowledge and based solely on subjective symptoms can often lead to erroneous results, as some symptoms can be caused by a variety of diseases. For those who are prone to this, it can even lead to so-called cyberchondria, when the information found on the Internet makes the patient convinced that they have an (often severe) illness.

In terms of online information, it is worth mentioning the phenomenon of the “filter bubble” created by Eli Pariser in 2011. Many digital services (such as Google or Facebook) seek to enhance the user experience by offering personalized content that is compiled by a complex algorithm based on information collected about the user, their past activity or the content shared on a social network. The purpose of this is to give everyone access to the relevant information that interests them most. However, as a side effect, users are “bubbled in”, meaning that it is more difficult to access information that doesn’t fit their worldview, in the worst case starting a negative spiral: users usually choose from the first few pages of the search results, and with this, they confirm their relevance for the algorithm. This causes a

problem if it diverts the user towards unreliable information, such as convincing the patient about the effectiveness of non-scientifically based treatments or strengthening their anti-vaccination opinions. The main problem is not the existence of the algorithm itself, as in many cases it can be really useful, but rather its invisibility.

Thus, the previous lack of information has now turned into the opposite extreme, an excessive abundance of information. Nowadays, a huge amount of information is pouring in on us from the media and through social media as well, sometimes stating something completely different about the same thing. From this, David J Rothkopf created the term “infodemic”, defined as “the worldwide spread of factual pieces mixed with fear, speculation and rumour, amplified and relayed swiftly by modern information technologies that result in further distortions”. The term was formed in 2003 by combining the concepts of information and epidemic/pandemic, originally linked to the SARS epidemic but applicable to other areas as well. Since then, for example, the proliferation of smartphones, the Internet and social media have increased these effects even more, and the term infodemic has become relevant again related to the COVID-19 epidemic.

The above changes pose new challenges for the physician-patient relationship. Visits take place in a stressful environment, which can negatively affect patients’ ability to process information and make decisions. Anxiety can be high, especially in newly diagnosed patients, which can be exacerbated by too much new information about the disease. As a result of these factors, the accuracy of recalling information obtained during visits is low. Therefore, it may be helpful for patients to have some form of access to the information at home after the treatment, in a more relaxed setting, and to read it more than once if necessary. Both printed and digital content are suitable for this purpose. Instead of or in addition to verbal communication, several methods affect the effectiveness of communication to varying degrees. So-called “structured patient education” generally proves to be more effective than ad hoc information transfer. This is especially important for chronic patients, as these often require long-term lifestyle changes and require the patient to acquire new competencies and skills.

Finally, it is also important to mention that digitalization can change not only the content of the communication but also its channel. Today, many sub-processes or even the whole process of care can be successfully implemented using telemedicine solutions, that is, without a direct, on-site meeting between the doctor and the patient. Regular home monitoring and data sharing allow previous periodic visits to be replaced by continuous communication, even for real-time intervention. The spread of these technologies requires new, different attitudes and behaviours on the part of both physician and patient. The importance of non-face-to-face forms of care and communication channels has increased exponentially in the context of the COVID-19 epidemic. Even if definitive care cannot always be provided, it is also sufficient in many cases to decide by a telephone or video consultation whether it is an emergency, or the care can be postponed. In addition to the online consultation, further solutions include the use of sensor data or the so-called chatbots, which can answer the patients' most frequently asked questions, and provide some basic information and suggestions without the involvement of medical staff.

The processes presented above have taken place in all developed countries, although the pace of change varies from country to country. The spread of digital technologies in Central Europe, including Hungary, started later than in Western countries, but thanks to the rapid growth over the last few years, they are already part of everyday life also in this region.

In the field of healthcare, it is worth examining the changes from the following three perspectives:

**1. Infrastructure:** The most basic condition for using various online services and accessing Internet information is to have an Internet subscription. According to the data from the Hungarian Central Statistical Office, the number of fixed-line subscriptions increased between 2003 and 2020 from 600,000 to 3.15 million, ie more than five times. Mobile internet access has grown even more: from 200,000 in 2006 to over 7 million in 15 years.

**2. Population needs:** There was no literature data available at the beginning of my research, so I started my work by surveying it. Subsequent research suggests that the majority of respondents are willing to use online services. One-third of patients had already

communicated online with their doctor and were generally satisfied with this channel. The majority believe that the ability to communicate online would have a positive impact on their care.

**3. Attitudes of health professionals:** The earliest available literature is a 2012 qualitative survey that examined physicians' opinions using an interview method. Only a quarter of the respondents found the patients' use of the Internet useful, and the majority were at least ambivalent or outright negative. 58 per cent feared that the doctor-patient relationship would change in a negative direction as a result of patients' use of the Internet.

## 2. OBJECTIVES

Digitalization has a significant impact on our everyday lives as well as on healthcare: the doctor-patient relationship is changing, new channels of communication are opening, and the Internet is providing information in an unprecedented quantity but also highly variable quality. In my dissertation I map the situation in Hungary, examining the relationships and attitudes of both the population and practising and future health professionals towards digitalization.

The most important questions asked in my research are the following:

1. Questions related to the habits and attitudes of the population:
  - a. What proportion of the Hungarian population is using the Internet as a source of health information?
  - b. What are the most popular topics?
  - c. Is there a difference between age groups' activity and area of interest?
2. Questions related to the experience of health professionals:
  - a. What do professionals think about the phenomenon, do they support the use of online resources?
  - b. How does digitalization affect the doctor-patient relationship, does online information acquisition cause problems?
  - c. What digital tools and services do healthcare professionals use?
  - d. What are their views on the impact of digitalisation on health, and what do they expect from the future?

### 3. METHODS

In my dissertation, I examined the effects of the digitalisation of health on different actors from the following three aspects:

#### 3.1. Case study

I compared care models using traditional and digital solutions on the example of diabetes. The care of chronic diseases accompanies the patient for the rest of his life, and continuous medical control and self-management are also required to prevent complications. Appropriate tools for self-monitoring of diabetic patients have long been available, primarily in the form of home blood glucose monitors, more and more of which provide telemedicine solutions (by saving measurement results automatically to a remote server), offering a good foundation for digital care models. I presented the results of these based on literature examples and compared them to traditional solutions.

#### 3.2. Examining the information needs of the population

Until the beginning of my research, no survey was available on the online activity of the Hungarian population related to health issues, so I conducted exploratory research to fill this gap. I used the self-report questionnaire method to analyse the online activity of the users. The first data collection took place in the summer of 2013, partly online and partly in person (**Research 1**). Due to the rapid development of digitalization, I repeated the study in 2021, this time exclusively with online distribution, and then compared the responses received (**Research 3**).

The questions assessed the frequency of Internet use, the health-related topics sought, and the various Internet services and applications used by patients. Questions also included whether participants used smartphones and health-related applications. Respondents were also asked to subjectively assess the quality of the information available. In the second data collection, I expanded the answers in some cases, for example, I supplemented the tools used by the respondent with activity meters and other digital medical devices that have



become popular in the last few years, and I also asked about coronavirus epidemic activity in search topics.

In addition to the results of the questionnaire, I surveyed the other side in semi-structured interviews with physicians, i.e., what do health professionals perceive about these processes; whether patients' information on the Internet is a problem or an advantage in their practice; and whether they encourage their patients to use online sources (**Research 2**). The six interviewees included two GPs, two internal medicine physicians, one gynaecologist and a surgeon.

### **3.3. Examining the attitudes of healthcare professionals towards digital technologies**

I also surveyed the attitudes and opinions of Hungarian health professionals towards digital technologies using a questionnaire method (**Research 4**). Like in the previous study, it was important to incorporate subjective elements, which were measured by evaluating the statements using the Likert scale method. In addition to active health workers, the target group also included prospective professionals, i.e., students in health education. The data collection took place on the one hand through online interfaces and on the other hand in person, at professional events and training.

The questions included the opinions about artificial intelligence and the impact of digital technologies on the respondent's field, as well as several statements about digital technologies. Respondents involved in patient care also received some additional questions about the way they communicate with patients and about their experiences and attitudes related to patients' online activities.

Due to paper-based data collection at events, an important goal was to keep the questionnaire relatively short (fit on two printed pages). In the case of some questions, it was not possible to explain the details, for example, artificial intelligence includes many methods and fields of application, the usability and practical applicability of which may differ significantly from each other. Thus, the research provides a comprehensive, general picture of attitudes towards digitization.

## 4. RESULTS

### 4.1. Case study: The digital diabetes care model

The long-term care of people with diabetes is primarily the responsibility of primary care, with the involvement of a general practitioner, a diabetes nurse, and a dietitian, which includes patient education in addition to monitoring the value of physiological parameters. In the traditional model, the frequency of doctor-patient encounters is 2 to 6 months, depending on the type of disease, the type of treatment, and the severity of the disease. This means that between two check-ups, the patient is self-reliant for months, monitoring his or her own condition and following appropriate lifestyle changes. If the patient feels that a problem has occurred, he or she can visit the GP on his or her own initiative. They can record their blood sugar levels in a manually kept diary, which the doctor can evaluate using the “look at” method at the next check-up.

A good example of taking advantage of modern digital technologies is the Onduo Virtual Diabetes Clinic (VDC). The method is based on the VDC mobile application, which brings together care-related activities. One of the pillars is regular blood glucose monitoring, in the form of real-time continuous blood glucose monitoring for high-risk patients. The application collects the data of the measuring device and transmits the results to the central server. It is also possible to log other data, and the app provides access to educational materials and helps the user with reminders and alerts. The other pillar of the model is the team of specialists who constantly monitor and assist the patient. The patient can connect with trained diabetes educators and “health coaches” through the app, who provide personalized advice and educational materials and videos. If necessary, a telemedicine consultation can also be initiated. All data will be shared with the patient’s GP.

Although such a complex program does not yet work in Hungary, there are attempts for digital solutions (mainly mobile applications) to support the care process, which can contribute to increasing the patient's motivation and thus improving their health.

The digital care model has several advantages over traditional care. In the latter, patients do not meet the health care system for months, so if their therapy is not set up properly or the therapy and especially the lifestyle goals set are not adhered to, it becomes clear only late. The feeling of being left alone can reduce the patient's motivation and increase the feeling

of anxiety and insecurity. Prolonged untreated conditions contribute to the development of complications.

In contrast, in the case of forms of care that use continuous online monitoring, the problem becomes apparent almost immediately to the care team and they can intervene before the situation becomes serious. If the patient does not perform regular self-monitoring, it is also revealed by the lack of data, so there is an opportunity for further education and increasing motivation. Based on the published results, Onduo VDC had a positive effect on the condition of the patients, with more than 90 per cent of the patients with the worst initial condition having improved HbA1c levels during the program. It is noteworthy that not only did there be a change in physiological parameters but also in their psychological state, the level of anxiety associated with the disease decreased significantly during the six-month follow-up.

## **4.2. Information needs and Internet usage habits of the Hungarian population**

### **4.2.1. Results of Research 1 (2013)**

In the 2013 survey, 408 respondents completed the questionnaire, 245 of them online and 163 in person. In the case of online respondents, the younger age groups were more represented, while many of the older respondents did not or only occasionally use the Internet.

The vast majority of respondents use the Internet to search for health-related information: in 2013, 75% of all respondents and more than 84% of Internet users marked at least one topic. The most common goals of searches include obtaining information about a disease or health problem (58%), treatment or intervention (53%), or a professional (43%).

The respondent population was divided into three age groups: 18–29 years, 30–49 years, and over 50 years of age. The sample size of the three groups was similar (140, 132, and 134 individuals). The proportions of those searching for information on the Internet were 85%, 91.7% and 47% in the three groups, respectively. Examining the differences with the  $\chi^2$  test, we can observe a significant difference ( $p < .001$ ). When the groups were examined

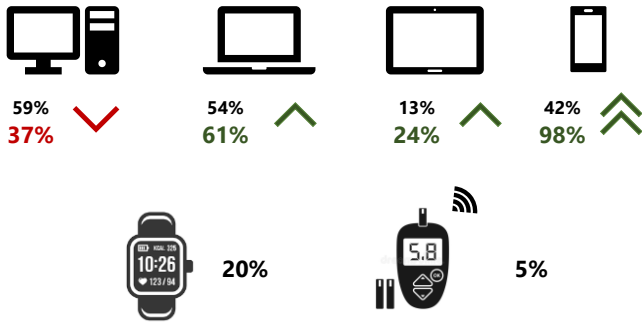
in pairs, there was no significant difference between the first two groups. If we consider only those who actively use the Internet, we can find a rate of 73% for the third age group, which is still significantly lower ( $p < .001$ ) than for the younger age groups.

In addition to searching, respondents often use online services to log data related to a healthy lifestyle (34% - mainly younger people) and to search for people with similar problems (29%). More older users log their disease-related data (such as blood sugar levels) through online services, but the overall rate was only around 6%.

#### **4.2.2. Results of Research 3 (2021)**

The questionnaire of the repeated survey was completed by 181 people. The results below will be compared with the opinions of 245 people who responded online in 2013. Regarding the demographics of the respondents, the biggest difference is in the proportion of the 50-64 age group, their proportion has increased from 13% to 27%. The vast majority use the Internet every day, with only five individuals reporting it as less common. The difference is mainly present in the older age groups, the proportion of daily Internet users increased from 55 to 93 per cent between the ages of 50 and 64, and from 22 to 100 per cent over the age of 65.

In the eight years between the two surveys, there has been a significant rearrangement in the tools used. The rate of using a desktop computer has decreased, while the number of people using laptops and tablets has increased. The biggest difference is in the prevalence of smartphones, which has more than doubled over the period under review and is now available to everyone, with a few exceptions. 17 per cent use only mobile devices (smartphones and/or tablets) and no desktop or laptop computers at all. One-fifth of the respondents have a smartwatch or an activity meter. Medical devices that can be connected to a computer or smartphone are even less common, only 5% of the respondents are using such devices.



In 2021, only 4 per cent said they were not used to looking for health-related topics at all. 7 respondents were only curious about the current information about the coronavirus epidemic, if they are not taken into account, the proportion of non-users is still only 8 per cent. In terms of topics, there is a significant increase in the case of “illness or health problem” and “examination, test result”, in the other cases there is no significant difference in the proportions. 52 per cent of respondents sought information about the coronavirus epidemic.

The differences between the age groups have essentially disappeared, with the activity of the older age groups approaching that of the younger ones. The only significant difference is in the case of childbearing information, in which the younger ones are often not yet involved, and the older ones are no longer affected, so this answer was marked by the highest number among those aged 30-49.

The popularity of video content has risen from 20 per cent to 33 per cent, and the option of “searching for people with similar health problems” was replaced by 19 per cent instead of 29. The popularity of other online services has not changed significantly.

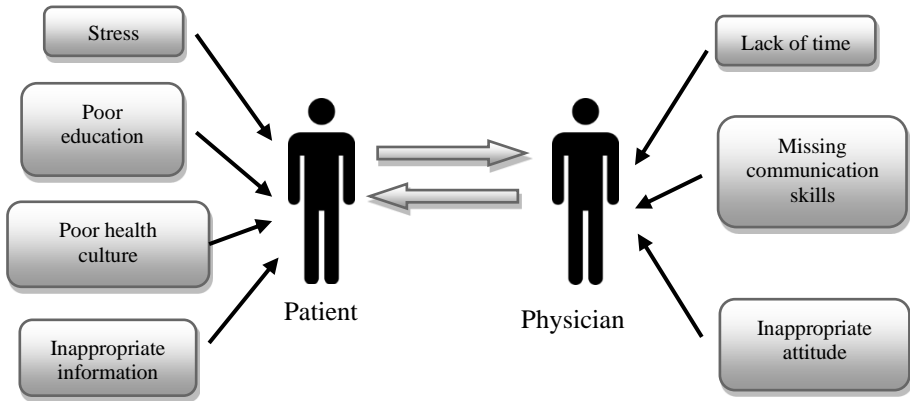
#### 4.3. Results of Research 2: Physicians' experiences of online information seeking

According to the experience of doctors interviewed during the research, patients often make their own diagnosis based on what they read on the Internet, or they even suggest a specific treatment. Some say this may be true for up to 60 to 70 per cent of patients, and they typically discover rare, special, often exotic diseases in themselves. Others say patients are

more informed and pay more attention to themselves and their illness. In their experience, the effect also depends largely on the personality of the patient.

Half of the responding physicians used to recommend their patients be informed on the Internet, but usually, only in general, specific pages were mentioned by only one of them. Those who do not recommend the internet usually claim that the information available is unreliable, there is a lot of misleading information and unproven “cure” recommendation on social networking sites and other channels. The majority believe that more reliable, “official” professional sites would be needed, and it would be important to indicate the source of the information.

Summarizing the scientific literature sources and the results of the research conducted, we can conclude that despite the readily available online information, physicians are still important sources of information for the patient, but communication is often inadequate. The reasons for this are summarized in the figure below. Key limiting factors include patients' stress/anxiety, poor education and/or health culture, and incorrect information from other sources (including not only online information but also lack of information or misunderstandings due to insufficient information from previous care). From the providers' point of view, the lack of time and the incomplete communication skills of some doctors are the most important. In addition, there may be the possibility of an inappropriate attitude when the doctor has the opportunity to pass on the relevant information but does not feel it is important or his job to communicate it.

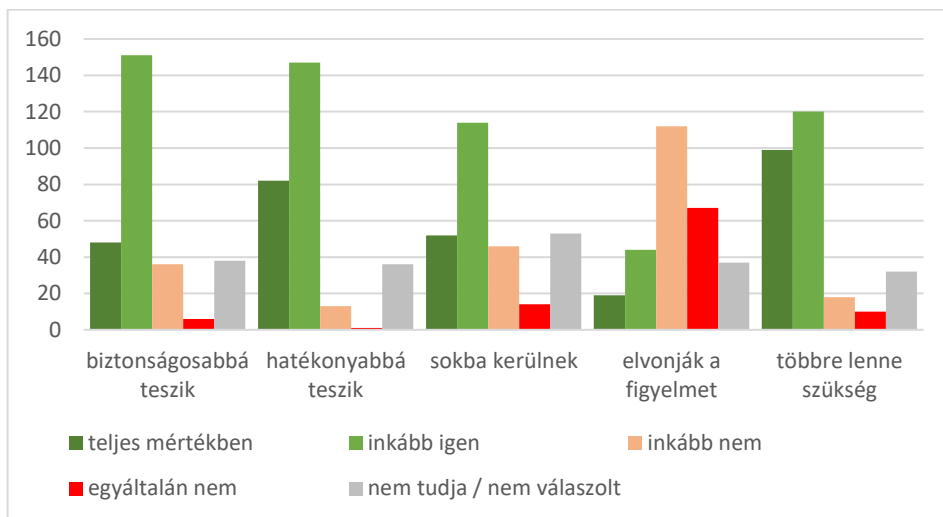


#### 4.4. Results of Research 4: Attitudes of health professionals

A total of 279 health care workers or students completed the questionnaire. 77% of respondents were women, 23% were men; 57% were active workers, 30% were students and 13% were working and studying at the same time. In terms of demographics, the higher proportion of women can be explained by the fact that many nurses and other professionals responded, the majority of whom are women. In addition, women are generally more likely to complete online questionnaires. Among the age groups, the proportion of those under 29 (37%) and those aged 40-49 (34%) is the highest, the former standing out due to the target group of students. 15% of the respondents were aged 30-39 years, 10% were 50-59 years, and 4% older.

The responses of 145 respondents who are actively involved in patient care confirm that patients often try to get information from online sources before seeking care: 70% agree that patients refer to what they read on the Internet, two-thirds experience self-diagnosis and half of the caregivers say that patients are requesting specific treatment. 73% of respondents say the issue of online orientation arises during doctor-patient encounters. In this situation, they almost equally try to discourage the patients from this or direct them to specific, trusted sites.

Respondents were asked to rate five statements about the impact of digital technologies according to how much they agreed with them. According to the majority, more digital technology would be needed in Hungarian healthcare, and these solutions will make patient care more efficient and secure, but at the same time, they are not afraid that it will distract their attention from the patients. Opinions are most divided on costs, and here are the most uncertain who did not answer or cannot judge the question.



At the same time, telecommunication solutions have only limited scope for caregiver-patient communication: 69% of respondents working in patient care communicate with patients by phone, 39% by email, while less than ten per cent indicated communication on social networking sites or via chat and video calling. Nearly a quarter of the respondents meet patients exclusively in the clinic. However, it is important to note that data collection took place before the outbreak of COVID-19, and the use of these channels is likely to have increased significantly since then.

Regarding the rise of artificial intelligence, the majority is modestly optimistic: 45% believe that it will take a longer time for practical solutions to emerge, while 25% think they will revolutionize healing within a few years. There are more sceptics among workers who say a machine can never replace a doctor's experience and intuition (12%, compared to 6% of students).



## 5. KÖVETKEZTETÉSEK

In summary, digitalisation is already present in many areas of healthcare and affects its functioning and the relationship between doctor and patient. There are existing solutions, such as the diabetes care model presented, that are good examples of the benefits and savings that can be achieved with the proper use of digitalization. The COVID-19 epidemic has also highlighted the need to develop and use services such as ePrescription or telemedicine. At the same time, it must also be seen that by the 21st century, the traditional, long-standing physician-patient relationship will change, and health professionals are no more the sole custodians of knowledge. The growing number of online resources offers a good opportunity to raise patients' health awareness, but inaccurate, false, misleading information can even endanger patients' lives directly or indirectly by directing patients to questionable alternative therapies instead of proven procedures.

The main new results (theses) that can be drawn from the research can be summarized as follows:

- **Thesis 1:** The Internet is an important source of health information for the Hungarian population, 87% of the respondents in 2013 and 96% in 2021 stated that they seek health-related information on the Internet.
- **Thesis 2:** The proportion of people with a smartphone increased from 42% to 98% in the study period, so a higher proportion of users use mobile devices to access online services.
- **Thesis 3:** In addition to diseases and diagnostic or therapeutic interventions, a significant number of respondents also seek information about health care providers (2013: 50%, 2021: 58%, proportion of Internet users).
- **Thesis 4:** Older age groups have become more active in the online space since 2013, and Internet use has become a daily routine for almost all respondents.
- **Thesis 5:** Most healthcare professionals agree that digital technologies make healthcare more efficient and safer, and more such solutions would be needed in Hungary.

- **Thesis 6:** A significant proportion of health professionals encounter the phenomenon that patients refer to information read on the Internet (70%), arrive at the clinic after self-diagnosis (67%), or even request a specific treatment (48%).
- **Thesis 7:** Healthcare professionals use several digital tools and services in their work, the most important of which are the office software tools and patient documentation systems (64-87% use them). Students also expect to need to know this after they get a job, but medical students feel that this knowledge is not given enough emphasis in their studies.

There are several possible interventions for both patients and carers to maximize the benefits of digitalisation and avoid risks:

- Increasing patients' health education and awareness, especially the critical evaluation of online information
- Facilitating access to authentic information by developing websites or certifying existing ones, raising the popularity of trusted sites
- Improving the communication skills of professionals
- Increasing the weight of digital solutions in medical education and developing targeted training programs
- Developing new, digital forms and models of care and creating the conditions for their use and financing, as well as the training of professionals for their use
- Facilitate the digital development of practices (e.g., acquisition of medical devices)

## 6. LIST OF OWN PUBLICATIONS

### 6.1. Publications serving as the basis of the dissertation

1. Dózsa Katalin, Mezei Fruzsina, Tóth Tamás, Perjés Ábel, Pollner Péter: *Countrywide survey on utilization of medical devices by GPs in Hungary: Advantages of the cluster-practice model*. **PRIMARY HEALTH CARE RESEARCH & DEVELOPMENT**, 22 p. e34 (2021)
2. Tóth Tamás, Palicz Tamás, Szócska, Miklós: *A magyar egészségügyi szakemberek digitális technológiákkal kapcsolatos attitűdjének vizsgálata*. **IME: INTERDISZCIPLINÁRIS MAGYAR EGÉSZSÉGÜGY / INFORMATIKA ÉS MENEDZSMENT AZ EGÉSZSÉGÜGYBEN** 19: 2 pp. 44-48., 5 p. (2020)
3. Tóth Tamás, Remete S Gergő, Filep Nóra, Mészáros Anna, Siti Johanna, Várfi András: *E-páciens: barát vagy ellenség? Egészséggel kapcsolatos internetezési szokások Magyarországon*. **IME: INTERDISZCIPLINÁRIS MAGYAR EGÉSZSÉGÜGY / INFORMATIKA ÉS MENEDZSMENT AZ EGÉSZSÉGÜGYBEN** 13:(9) pp. 49-54. (2014)
4. Sára Zoltán, Csedő Zoltán, Tóth Tamás, Fejes József, Pörzse Gábor: *Doctor-Patient Knowledge Transfer: Innovative Technologies and Policy Implications*. **JOURNAL OF INFORMATION ENGINEERING AND APPLICATIONS** 3:(3) pp. 32-38. (2013)
5. Sára Zoltán, Csedő Zoltán, Tóth Tamás, Fejes József, Pörzse Gábor: *A korszerű információ-technológiai megoldások szerepe az orvos-beteg kommunikáció javításában*. **IME: INTERDISZCIPLINÁRIS MAGYAR EGÉSZSÉGÜGY / INFORMATIKA ÉS MENEDZSMENT AZ EGÉSZSÉGÜGYBEN** 12:(4) pp. 20-24. (2013)
6. Tóth Tamás, Dinya Elek: *A személyre szabott betegoktatás lehetőségei*. **ORVOSI HETILAP** 154:(11) pp. 403-408. (2013)...

### 6.2. Further publications

1. Palicz Tamás, Sas Tibor, Szabó Zoltán, Tóth Tamás, Tisóczki József, Bencsik, Balázs, Joó Tamás: *Magyar kórházakban előfordult zsarolóvírus támadások esetei*. **IME: INTERDISZCIPLINÁRIS MAGYAR EGÉSZSÉGÜGY / INFORMATIKA ÉS MENEDZSMENT AZ EGÉSZSÉGÜGYBEN** 20: 1 pp. 32-38., 7 p. (2021)

2. Tóth Tamás, Lőrincz Orsolya: *A vállalkozói szemlélet erősítése az egészségügy területén: Az EnterMode gyakornoki program pilot tapasztalatai*. **IME: INTERDISZCIPLINÁRIS MAGYAR EGÉSZSÉGÜGY / INFORMATIKA ÉS MENEDZSMENT AZ EGÉSZSÉGÜGYBEN** 20: 1 pp. 45-49., 5 p. (2021)
3. Tóth Tamás, Pollner Péter, Palla Gergely, Dinya Elek: *Magyar klinikai vizsgálatok sajátosságai egy nemzetközi adatbázis elemzése alapján*. **ORVOSI HETILAP** 158:(9) pp. 345-351. (2017)
4. Tóth Tamás, Dinya Elek, Pollner Péter, Palla Gergely: *Magyar klinikai vizsgálatok sajátosságai egy nemzetközi adatbázis elemzése alapján*. In: Bari Ferenc, Almási László (szerk.) **Orvosi Informatika 2016**. A XXIX. Neumann Kollokvium konferencia-kiadványa. 146 p. Konferencia helye, ideje: Szeged, Magyarország, 2016.12.01 - 2016.12.02. Neumann János Számítógép-tudományi Társaság (NJSZT), 2016. pp. 21-24. (ISBN:978-963-306-514-3)
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