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Impact of the COVID-19 Pandemic on Digital Solutions of Healthcare in Hungary

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The aim of this paper is to provide an overview of the short-, medium- and long-term impacts of the COVID-19 pandemic on digitalization processes, primarily through the example of the Hungarian healthcare. The main task was to explore how the pandemic affected the Hungarian healthcare services both of public (state) and private providers and what role healthcare digitalization played in this. The investigation contained a questionnaire survey which was conducted among private healthcare providers in 2024. The findings were supplemented by statistical analysis, literature review, document analysis and interviewing. Among the results, it can be mentioned that the pandemic accelerated the rapid and widespread spread of telemedicine in Hungary, and also resulted in the effective interaction of public and private healthcare, and thirdly, through private investments, serious developments were made in the application of telemedicine even before the pandemic which were also strengthened by the effects of the coronavirus epidemic. In addition to private investments, the Hungarian public – state – healthcare has also made significant developments in the application of telemedicine. All of these interventions in the digitalization processes of healthcare are still noticeable today due to the impact of the pandemic and will stay with us in the long-term.

Keywords: *COVID-19 pandemic, delivery of healthcare, digitalization, telemedicine, Hungary*

Introduction

The novel coronavirus pandemic has had a variety of impacts on countries' healthcare systems in recent years. These impacts have varied over time and space, but one of the most striking consequences of all has been the digitalization process. Since the spring of 2020, national healthcare systems, including Hungary's, have faced numerous challenges, which required rapid and effective responses to protect the population. The new situation has required new solutions from healthcare actors in the short-, medium- and long-term. The problems and challenges associated with the pandemic have arisen in both public and private healthcare, as well as in the healthcare background sector, the healthcare industry. Healthcare digitalization has played an important role in developing an effective adaptation strategy and achieving appropriate resilience.

However, it should also be mentioned that the development of the e-health sector (telemedicine) had already begun before the pandemic and was an advanced process in Hungary. State interventions, partly European Union (EU) subsidies, and partly private investments brought serious results in the use of domestic telemedicine

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before 2020. Namely, digitalization in healthcare was already a prominent feature of the EU's development policy before the pandemic, which led to the widespread availability of e-health to healthcare providers and the general public. The COVID-19 epidemic transformed the consumer needs (patients), the forms of healthcare use, and because of these, existing digital solutions, e-health applications under development, and newly introduced telemedicine services resulted in previously unexperienced phenomena in healthcare digitalization.

The overall aim of the paper is to analyze the direct and the indirect long-term effects of the coronavirus pandemic on Hungarian healthcare, but the specific research task is to interpret the consequences of digitalization in this context. The other important task is to explore how the pandemic affected the Hungarian healthcare services both of public and private providers and what role health care digitalization played in this.

The paper consists of the following sections. The section of the literature review summarizes the most relevant international and domestic antecedents on that topic how digitalization could be widespread in healthcare regarding the effects of the COVID-19 pandemic. The section based on the methodology describes the quantitative and qualitative methods that were applied to answer the research questions. The section of the results is based on three subchapters to present them in the light of applied methods. The section of discussion examines the primary findings in the context of the antecedents. The final section of the paper integrates clear conclusions.

Literature Review

Since the coronavirus pandemic became global – from March 2020 – countless scientific publications have addressed the conditions of its emergence and spread, or its effects and consequences on healthcare and health status, and the possible forms of health response measures (Antonietti et al. 2021, Boutsioli et al. 2022, Buzhenitsa et al. 2024, Cheng 2024, Galea et al. 2022, Madewell et al. 2020, Perera et al. 2020, Wang et al. 2020, Wang et al. 2021). Among the scientific publications, various global organizations were prominently featured, drawing attention to the possible complex health and other socio-economic effects of the pandemic (The Global Risks Report 2021, UNDP 2020a, 2020b, WHO 2020). The processing, compilation and synthesis of international and domestic literature review covers the period between spring 2020 and the end of 2024. The aim was to explore the aspects from which the antecedents assessed the relationship between healthcare digitalization and the pandemic and what main results they reached. Based on the content of the reviewed international and domestic publications, four main groups of antecedents can be distinguished that examine the relationship between the epidemic, health and healthcare using different aspects and different methods during the period under review. It is important to note that this distinction should be handled flexibly in the thematic focus, because these research topics are not sharply separated from each other, and there is a lot of overlap between them within a single literature source or research. However, it is a fact that the interpretation of healthcare

digitalization and the development of telemedicine in connection with the epidemic featured prominently in the literature.

These are the main thematic groups of major international papers on the health consequences of the COVID-19 pandemic:

1. Examination of the epidemiological emergency situation itself: research topics are e.g. novel challenges in healthcare, spread of infectious diseases, prevention of mortality, effects of lockdowns (Amdaoud et al. 2021, Filip et al. 2022). In this thematic group, the study of digitalization was implemented in two ways. On the one hand, the focus was on examination the novel role of telemedicine during the lockdowns and its long-term effects on using healthcare services (Ferwana & Varshney 2024, Moynihan et al. 2020). On the other hand, a special examination focus appeared among the antecedents on how new tech gadgets and smart devices became widespread across telemedicine regarding the pandemic management (Albanese & Senesi 2023, Channa et al. 2021).
2. Examination on the healthcare of the non-communicable diseases during the pandemic: research topics are e.g. effects of the pandemic on the healthcare of non-communicable disease, barriers in access to healthcare during the lockdowns, post-acute COVID-19 syndrome etc. In this thematic group, the study of digitalization appeared through the following research topics: e.g. novel application of telemedicine in the treatment of chronic diseases, possibilities of telemedicine services without physical contact, adapting to the changing needs of patients in the development of telemedicine (Aihaz et al. 2024, Ricci et al. 2020).
3. Examination the health inequalities and their spatial distribution regarding the pandemic: research topics are e.g. effects of the pandemic on health inequalities and their socio-spatial inequalities, changing quality of life regarding the pandemic, socio-economic aspects of health inequalities due to the pandemic etc. In this thematic group, the study of digitalization especially appeared in that way how digital inequalities and 'digital gap' influenced access to healthcare during the pandemic (Giansanti & Veltro 2021, Frey et al. 2024a, 2024b).
4. Examination the effects of the pandemic on healthcare industry: research topics are e.g. transformation of supply and demand in healthcare industry, supply and logistic disruptions during the lockdowns, stock shortage during the pandemic etc. In this thematic group, the study of digitalization the role of Industry 4.0 technologies in the healthcare industry due to the pandemic, novel digital solutions in healthcare industry regarding the pandemic etc. (Kiss & Uzzoli 2024, Paranitharan et al. 2022, Quadri et al. 2020).

The literature review of the domestic antecedents was accompanied by the following experiences. Hungarian researches on pandemic-related healthcare digitalization separately address the results achieved in public healthcare and private healthcare (Girasek et al. 2022). While the former primarily emphasizes the role of public developments in healthcare digitalization, the latter mainly highlights the

importance of private capital in digitalization-based investments. The National eHealth Infrastructure and its professional modules were implemented with the support of the European Union co-funded by the Hungarian state in 2017 (eeszt.gov.hu). The marked further improvement of this National eHealth Infrastructure (in Hungarian: EESZT) was introduced in 2020 which was a direct consequence of the epidemiological measures and resulted in 100% spread of e-presciptions in Hungary (Szabó 2020). The Hungarian e-Health Infrastructure helped organize Covid vaccinations in the spring of 2021 and it also became the electronic platform for the EU digital Covid card (Paragi 2022). On the other hand, this e-Health Care Cloud Hosting was also applied by private healthcare providers, so one of public digital developments became the part of private healthcare too. Essentially, the digitalization of state-owned healthcare services emerged in connection with the pandemic through the possibilities of telemedicine (Paulikné 2021). At the same time, it was also observed from spring 2020 that 'consumer' demands increased the value of digital tools, but the public healthcare sector reacted only belatedly (PWC 2021). Furthermore, based on the experiences of the literature analysis, contradictory factors determined the digitalization processes in private healthcare in the first two years of the pandemic. On the one hand, there was an accelerated growth in sales during the epidemic compared to the years before the pandemic, but with decreasing profits (Portfolio 2021a, 2021b). On the other hand, due to the pandemic, more and more investments were made – including modernization developments – but these further reduced profits by employing increasingly expensive labor. In addition, it was observed that new demands in private healthcare emerged from patients regarding COVID-19 testing, treatment of complications caused by the disease, and the availability of telemedicine services (Csiki 2020). In essence, the responses of private healthcaree providers to the effects of the pandemic have been realized in new investments, broadening the range of services, launching new specialist orders, switching to COVID-19 testing, introducing COVID-19 screening packages and developing digital solutions (Csiki 2021).

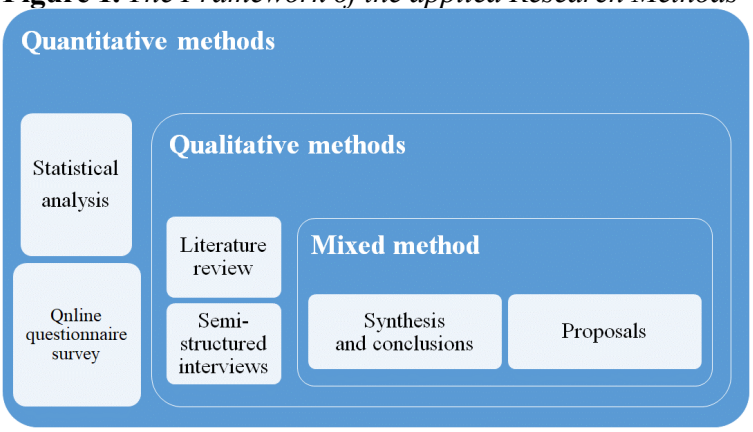
Data and Methods

The effects of the pandemic in healthcare have had a significant impact on digitalization processes. This was explored using various research methods, which also helped to answer the following key questions.

- What responses have healthcare providers given to the challenges caused by the COVID-19 pandemic? What role did digital solutions play in these?
- What novel digital solutions have emerged in healthcare as a result of the pandemic compared to those that already existed?
- Is there a difference in how public and private healthcare providers responded to the effects of the pandemic through the application of digitalization solutions?
- How can the digitalization solutions that emerged in connection with the pandemic be defined in the short-, medium- and long-term?

The implementation of the research aims and the answering of the key questions were based on a mixed methodology, i.e. the combined use of quantitative and qualitative research techniques (Tariq & Woodman 2013, Wisdom & Creswell 2013), primarily through the application of the so-called parallel or concurrent structure (Beharie et al. 2020) (Figure 1). The essence of this is that the results of quantitative and qualitative data collection and analysis were only combined in the final comparison and interpretation of the relationships. Thus, the experiences gained separately and independently complemented each other and provided a more complex picture of the topic under study.

Figure 1. *The Framework of the applied Research Methods*



Statistical analysis was extremely limited due to the lack of telemedicine data in Hungary. There are no public databases, there are only secondary sources from which one can indirectly draw conclusions about digitalization processes in healthcare. Primarily summary statistics are available, from which conclusions could be drawn about digital healthcare data. The used statistical data in all cases came from official data sources. The applied statistical data are therefore only very limitedly suitable for presenting healthcare digitalization, and data gaps must be taken into account in their interpretation. Due to the limitations of statistical analysis, this research obtained additional information from the questionnaire survey and interviews.

An online questionnaire survey was conducted among the Hungarian private healthcare providers in July of 2024. The sample of the questionnaire was generated by Google Online Form Creator. The survey questions were related to the following main topics:

- General data on the private healthcare provider,
- Challenges caused by the pandemic and the responses to them,
- Role of the pandemic in the digatalization developments.

The questionnaires were sent to 55 private healthcare providers, and to increase the response rate, the direct inquiries (by email) were repeated several times. In spite of this, only 11 providers (20%) answered the questions (N=11). Although the sample size is too small and it does not form a representative one, but it can be considered

appropriate because there is many useful information on the examined topic which is mostly not available from other sources.

The experiences with the questionnaire greatly contributed to the compilation of the questions for semi-structured interviews with various stakeholders in private healthcare.

Interview questions can be classified into the following groups:

- General information on the private healthcare provider,
- Pandemic-related crisis factors and their temporality,
- Digital solutions before and after the pandemic,
- The impact of public healthcare on digitalization in private healthcare.

A total of 12 requests for interviews were made, of which 7 interviews were conducted with private healthcare stakeholders during November and December 2024 (N=7). Six of the interviews were conducted online and one was conducted over the phone, and they generally lasted 40 minutes (the shortest lasted 25 minutes, the longest 54 minutes). All interviews were audio recorded according to the GDPR regulations. The interviewees were private healthcare stakeholders who were affiliated with the given private healthcare provider in a leadership, ownership, research or management status. The main aspects of the content analysis of the transcripts from the audio recordings were the following:

- Exploring the local catchment area of the private healthcaree provider,
- Identifying the challenges caused by the pandemic in relation to the epidemic waves,
- Interpreting the reasons of digital solutions before the pandemic,
- Defining pandemic-induced digital solutions,
- Learning about the possibilities of artificial intelligence in digital solutions,
- Defining the challenges of public healthcare through the perception of private healthcare providers,
- Knowing about the developments and spatial expansions that have taken place at private healthcare providers.

Among the applied methods, the literature review focused on the summary of international and domestic antecedents. This was complemented by document analysis, which was based on the evaluation of Hungarian policy strategic and development documents after 2010.

The results and experiences obtained during the studies are summarized through a discussion of the literature background, and the conclusions drawn in this way are suitable for developing proposals to support policy decision-making.

It is worth mentioning that the research was not addressed to analyse the role of Internet or social media in healthcare digitalization at all (De la Cruz 2024).

Results

The main results of the research are presented in the light of applied methods. The development of healthcare digitalization related to the pandemic is described based on a literature review as it could be seen in the previous chapter. The examination of the emergence of healthcare digitalization in the Hungarian development strategies is carried out through document analysis. The main characteristics of the spread of telemedicine during the pandemic are presented in light of the available statistical data. The presentation of the pandemic impacts and the responses to them, as well as the digital solutions emerging in all of this, is presented in the light of the questionnaire survey and interviews based on the experiences of private healthcare providers.

The Emergence of Healthcare Digitalization in the Development Strategies in Hungary after 2010

Domestic development policy documents (sector strategies, development programs, guidelines and plans) published in the last 15 years were divided into three groups and the content analysis was carried out in this way:

1. Sectoral strategic development documents in healthcare: e.g. Semmelweis Plan (2010), Healthy Hungary 2014-2021 Sectoral Strategy (2015), Healthcare Industry Support Program (2020), Healthy Hungary 2014-2021 Sectoral Strategy (2021).
2. Economic and competitiveness development documents: e.g. New Szechenyi Plan (2011), Szechenyi 2014-2020 Program (2014), Szechenyi Plan Plus 2021-2027 (2021), National Development and Territorial Development Concept (2013), Competitivness Strategy for Hungary 2024-2030 (2024).
3. Development documents on digitalization: e.g. Natioanl Infocommunication Strategy 2014-2020 (2014), National Smart Specialization Strategy (2014), Development Strategy for Digital Healthcare Industry (2017), National Strategy for Digitalization (2014, 2022).

The aim of the content analysis was to explore the opportunities that healthcare digitalization has presented in the development policy in Hungary after 2010. Although the development documents examined are aimed at decision-making and interventions that can be implemented at the state level, their review and evaluation can also provide useful information regarding the Hungarian private healthcare sector. This is because domestic private healthcare providers need to implement their investments and ventures in a macroeconomic framework in which the current government strategies and measures are essentially implemented.

In general, it can be stated that healthcare digitalization has been a defining development direction in Hungary over the past decade and a half. E-health as the synonymous of healthcare digitalization or telemedicine has come into focus in domestic sectoral and digitalization strategies primarily through the development of data-driven healthcare and the technological development of the healthcare industry. This has come to the fore in policy decision-making in the form of development

goals and plans aimed partly at infrastructure investments and partly at research, development and innovation (R & D & I). Over the 15-year period under review (between 2010 and 2025), a fine-tuned transformation of strategic directions can be observed, primarily in response to the digital challenges caused by the COVID-19 pandemic. Before the pandemic, the development of e-health in Hungary served more as an infrastructure investment to reduce the overload of healthcare (e.g. the creation of eeszt.gov.hu). However, after the pandemic, it has become increasingly important to develop a practical model of artificial intelligence and to apply digital solutions in everyday life in response to changing consumer needs (e.g. smart swatch for elderly people).

It should be emphasized that domestic efforts towards healthcare digitalization are in line with the 'Smarter Europe' investment priority, one of the central objectives of the European Union's regional and cohesion policy for the period 2021-2027, which actually puts the importance of digitalization on an equal footing with the thematic areas of innovation and the development of small and medium-sized enterprises. The primary EU document in the field of digitalization is the Digital Compass (Roadmap to a Digital Decade) policy program until 2030, which sets out the digital transformation of enterprises, the digitization of public services, secure and sustainable digital infrastructures and the development of digital skills (European Council 2022). These guidelines also serve as a guide for private healthcare providers in Hungary, who can essentially directly exploit the beneficial effects of public developments and digital investments.

Overall, Hungary enacted several legislative measures to support digital health solutions during the pandemic (Döbrössy et al. 2024). These included regulations on telemedicine practices, reimbursement policies, and data protection. The National Health Informatics Strategy, introduced in July 2021, outlined a long-term vision for integrated, people-centered digital healthcare, ensuring the sustainability of digital solutions beyond the pandemic.

The Healthcare Digitalization in the Light of some Statistical Data

The Ministry of the Interior is responsible for managing and implementing digital health projects. Telemedicine is regulated by Directive 2020/559/HU, which covers the reimbursement of online prescriptions, treatments and therapies (mandatory prerequisites: identification, data protection and suitable equipment). The Hungarian government has already initiated the digitization of the healthcare system through its digital patient record in 2017. This record is now accessible via the National e-Health Infrastructure (EESZT). This is a central IT system that ensures communication between all healthcare providers. The EESZT is in number (https://www.eszfk.hu/, 2024):

- more than 3.5 billion health records
- over 700 million care events
- about 800 thousand e-prescriptions per a day
- 40-60 thousand logins to the Citizen Portal Site of EESZT per a day
- 27 thousand connected healthcare providers

- 6 thousand connected GP practices
- 12 thousand connected healthcare providers
- over 3200 connected pharmacies
- 300 connected out-patient providers
- 250 connected rescue stations
- more than 100 connected in-patient providers

In 2021, 43% of the adult population in Hungary were in fact active EESZT users and only 24% were unaware of its existence and the rate of e-prescriptions was over 90% in 2021 (Rosta et al. 2023).

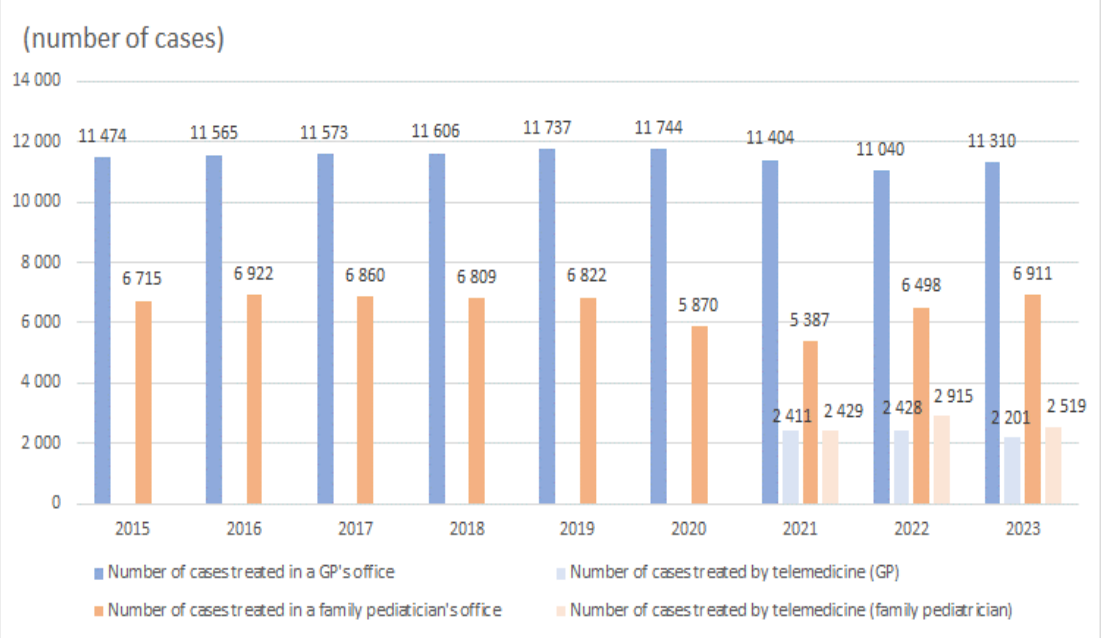
During the pandemic, On April 30, 2020, the Hungarian government issued Government Decree no. 157/2020 (IV. 29.), known as the Telemedicine Decree. This decree mandated healthcare facilities to provide teleconsultations, outlining criteria and objectives for telemedicine services. This was the regulatory framework of the Hungarian healthcare digitalization regarding the COVID-19 epidemic.

As a result of the legislation, the number of telemedicine services in general practice care has been statistically demonstrable since 2021 (Figure 2). In general, the number of care provided by family doctors has decreased during the pandemic compared to the years before the pandemic. Except for the first year of the pandemic, 2020, when the increase was caused by the fact that during the lockdowns, essentially only primary health care – mainly GP's care – was available in Hungary. Since 2021, the rate of cases treated by telemedicine was about 21-22% compared to the total number of cases treated in GP's office. The rate of telemedicine services in family pediatrician care was twice as high as in family doctor care in 2021 and 2022. In 2023, the number of cases treated by telemedicine has already visibly decreased, meaning that the system based on personal doctor-patient contacts is slowly starting to recover. However, it is expected that telemedicine services will remain with us in the future in primary health care.

Hungarian family doctor's care (GP) is also an important achievement in the healthcare digitalization e from other perspectives. In 2013, a family doctor patient management system was established with private healthcare investment. This management system (erodium.hu) helps GP services and provides an integrated patient management and online appointment booking service. During the pandemic, many family doctors joined the system on their own capital (out-of-pocket) and, for example, the Covid-19 vaccination was already organized with this. Here are some relevant data on this Hungarian patient management system in primary healthcare from March 2025:

- 299 connected GP providers
- 87,542 patients called for primary healthcare
- 35,098 submit online applications
- 16,359 serviced phone calls

Figure 2. *Number of Cases treated by Telemedicine in Primary Healthcare in Hungary, 2021-2023*



Source: https://www.ksh.hu/stadat_files/ege/hu/ege0007.html

The Effects of the Pandemic and the Responses to them in the Light of Digitalization Developments – A Case Study among Hungarian Private Healthcare Providers

A questionnaire survey was conducted with private healthcare providers in July 2024, with a response rate of 20% (N=11). Therefore, the survey results are not representative, but they provide a lot of relevant information about the effects of the pandemic and digitalization developments. The results of the survey are complemented by the experiences of semi-structured interviews (N=7) conducted with private healthcare stakeholders, therefore the results of the questionnaire survey and the interviews are presented simultaneously. More healthcare private providers from the capital city Budapest participated in the questionnaire survey (82% from the capital), therefore there were more rural stakeholders among the interviewees (57% rural). 5 out of 7 interviewees work not only in the private sector, but also partly in the public sector, so they had insight into state healthcare. Of the private healthcare providers participated in the questionnaire survey, 5 had a workforce of 21–49 people, 4 had a workforce of 50–249 people, and 2 had a workforce of less than 20 people, so the majority of the companies included in the study were medium-sized. Anyway, the majority of the Hungarian private healthcare providers are located in the capital city Budapest or its agglomeration: based on their geographical location within the capital city, they are concentrated in the city center, the prestigious Buda hills, the larger junctions and larger office buildings (Pál & Uzzoli 2024).

According to the survey, the COVID-19 pandemic has had a variety of impacts on the private healthcare providers. These were the following: partial or complete shutdown of healthcare services, supply disruptions in medical devices, transformed demand needs, decreasing in use of healthcare services and proceeds, human

resource shortage. However, most and the biggest challenges have been more short-term, occurring mainly during the first and second epidemic waves in 2020. '*Unplanned operation*' (interviewee 1), '*high degree of uncertainty*' (Interviewee 8), '*the period of uncertainty was about a month*' (interviewee 2). However, it is a fact that from the beginning of the epidemic, it became clear that patients' needs also quickly changed, firstly towards reducing physical contact in healthcare, secondly towards performing COVID-19 tests, and thirdly towards making up for missed diagnoses during the lockdowns.

Both the questionnaire survey and the interviews confirmed that the coronavirus pandemic had not only negative, but also positive effects. Among the direct and indirect positive consequences of the epidemic, the following were mentioned: e.g. increasing of the use of private healthcare services and sales revenue in the medium-term, expansion of the existing healthcare services, introduction of new healthcare services, capacity and employment expansion, digitalization development. These positive effects primarily occurred in the medium-term, from the second half of 2020. Due to the transformed the consumer needs, i.e. the novel needs of patients, newly introduced healthcare services appeared at private healthcare providers in 2020 or later, most of which were related to outpatient clinics, pediatrics, diagnostics and laboratory tests.

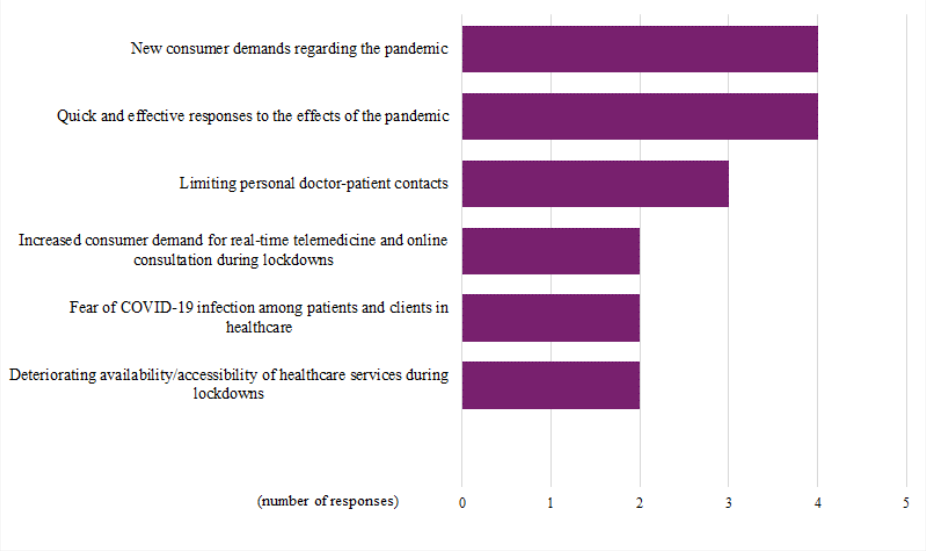
However, the interviews also drew attention to the fact that the introduction of new outpatient clinics after 2020 was not only due to the pandemic, but also due to the growing waiting lists in the state healthcare system (Interviewee 2, 4, 7). One of the main reasons for this was that the pandemic had an exponential impact on state or public healthcare: '*… public healthcare was practically inaccessible at the outpatient level for a year or a year and a half*' (Interviewee 7). Due to delayed diagnoses and missed treatments, a large number of patients began to use public healthcare services, which undoubtedly led to further overloading of the system. These factors then in many cases led patients to seek private healthcare.

There were different responses to the negative effects of the pandemic by private healthcare providers, which were as follows: e.g. introduction of new health services that were directly related to the pandemic, searching for new supplier relationships, preparing a risk management plan, part-time employment. Among these responses, development of telemedicine services had a prioritized task. It means the development of existing digital solutions and the introduction new ones. It is worth mentioning that the use of various digital solutions was already widespread in the operations of the Hungarian private healthcare providers even before the COVID-19 pandemic. The main reasons for their introduction before 2020 were the following: organizing more efficient patient way, further development of existing technologies in healthcare, the expansion of digital technologies in healthcare, or the needs of patients.

The digitalization developments related to the COVID-19 pandemic were mainly due to new consumer demands, quick and effective responses to the effects of the pandemic, and epidemiological restrictions (decreased doctor-patient contacts) (Figure 3). The digital solutions newly introduced or developed as a result of the epidemic were, according to the majority of questionnaire responses, the following (Figure 4): online consultation, e-prescription, online organizing patient way, online diagnostics, online monitoring, online appointment scheduling. Based on the results

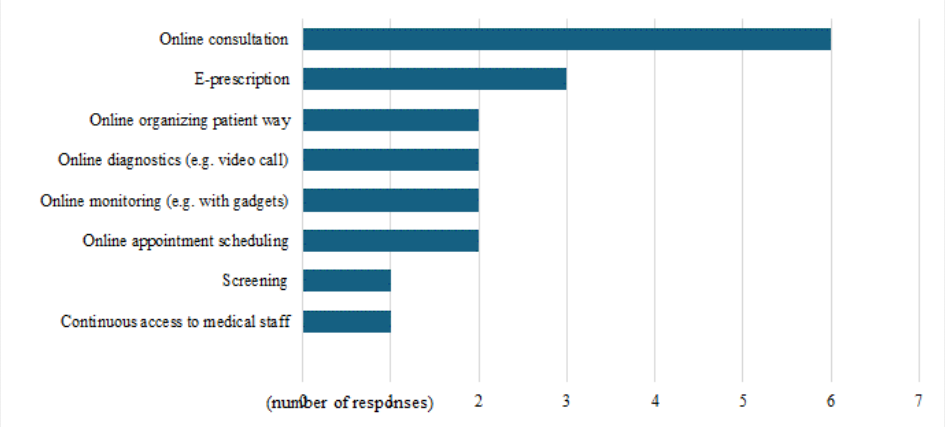
of the questionnaire survey, the following activities were the most digitalized in the Hungarian private healthcare providers due to investments made before and after the pandemic: appointment scheduling, patient way organization, administration of healthcare documents, online doctor-patient contacts, and contact with clients. All of these results were also supported by the semi-structured interviews (e.g. Interviewee 5 and 7).

Figure 3. *The Main Reasons for Introducing Digital Solutions on the Short- and Medium-term Impacts of the COVID-19 Pandemic in Hungarian Private Healthcare Providers*



Source: own questionnaire survey, 2024.

Figure 4. *Digital Solutions introduced by Hungarian Private Healthcare Providers to address the Short- and Medium-term Impacts of the COVID-19 Pandemic*



Source: own questionnaire survey, 2024.

It is important to mention that the private healthcare stakeholders participating in the questionnaire survey and in the interviews were unanimous in their opinion that the most visible digital result of the novel coronavirus epidemic was the widespread use of e-prescriptions in HuUngary, which have remained with us for a long time after

the pandemic. However, this is fundamentally based on a state healthcare service (EESZT), which has been further developed since the very beginning of the pandemic and the appropriate regulatory environment for its widespread use has been continuously shaped by decision-making.

According to the questionnaire and interview experiences, the development of telemedicine on the short- and medium-term effects of the coronavirus epidemic was observed mainly in diagnostic professions (e.g. teleradiology, telepathology), which are most closely related to medical imaging and diagnosis (telediagnosis) (e.g. Interviewee 1). '*Data-driven healthcare is the healthcare of the future*' (Interviewee 3). A novel opportunity in data-driven healthcare that has emerged in the past several years is the use of artificial intelligence (AI), currently mainly in the evaluation of findings, but the future holds many new applications (Interviewee 1 and 5). Further effective spread of telemedicine was also experienced in the areas of internal medicine and cardiology during the pandemic, which can be linked to the remote monitoring of certain health parameters (e.g. blood pressure, blood sugar) (remote surveillance). However, remote consultation has not been able to successfully replace the doctor-patient meeting based on physical contact in all medical professions, and its frequent use in the long term has remained primarily in psychology/psychiatry (e.g. Interviewee 2 and 7). It can also be deduced from the responses and opinions that in those areas and cases where the presence of a doctor and quick decision-making are absolutely necessary (e.g. emergency care), i.e. when the care involves a specific medical examination or intervention and is not limited to sending and evaluating images and other health data, the possibilities offered by telemedicine cannot be used or can only be used to a limited extent (e.g. Interviewee 5 and 6).

Discussion

My own examinations have diverse findings regarding how the COVID-19 pandemic has affected digitalization processes in the Hungarian healthcare system. Based on all of this, some contradictory results have been obtained. These results will present by answering the research questions too.

Healthcare digitalization is not a new phenomenon, neither in public nor private care, but the impact of the pandemic is clear in its development and widespread spread (Girasek et al. 2022). The acceleration of digitalization processes was mainly experienced in 2020 and 2021 as a direct consequence of the COVID-19 pandemic, but from 2022, other crises (energy crisis, inflation) also had an impact. That is, the short-, medium- and long-term effects of the pandemic in digitalization are influenced by different determinative factors. The development of National eHealth Infrastructure (EESZT) among Hungarian healthcare providers was a direct consequence of the epidemiological measures (see e-prescription), which contributed to the spread of telemedicine nationwide (Paulikné 2021, Szabó 2020). Ultimately, the organization of the COVID-19 vaccination as a relevant task in the fight against the epidemic was already taking place on a digital basis, which was the result of a state digital development. This state digital development also made it possible to use the EU

Digital Covid Certificate in Hungary, which was applied in all member states of the European Union (Paragi 2022).

Similar to public healthcare, the acceleration of digitalization in private healthcare was also due to the effects of the pandemic in Hungary, but in contrast to public healthcare, it was based on a self-developed project and a quick response to transformed consumer needs (Uzzoli 2025). Furthermore, private healthcare providers partially took advantage of the benefits of state digital developments in its own digital developments, so using EESZT also helped them offset the effects of the pandemic.

My own research results, in line with the most important antecedents, confirmed that the most telemedicine developments in Hungary in the following segments, in connection with the short-, medium- and long-term effects of the coronavirus epidemic:

- online appointment scheduling,
- online organizing patient way,
- real-time telemedicine services,
- using e-prescption.

Conclusions

Healthcare digitalization was already a prominent feature of Hungary's development policy before the COVID-19 pandemic, with telemedicine becoming increasingly accessible to healthcare providers and the public. However, this process was accelerated by the pandemic and was accompanied by the emergence of novel phenomena that have been observed in both public and private healthcare services in recent years.

During the COVID-19 pandemic, both public and private healthcare providers in Hungary adopted digital solutions, but there were key differences in focus, flexibility, and innovation between the two sectors (Table 1).

Standardized and nationwide systems in public (state) healthcare were designed for universal access, sometimes at the cost of user experience or speed of innovation. Digital tools and services had to conform to national standards and protocols. Their rollout was slower due to infrastructure limitations and regulatory hurdles, but coverage was widespread. Decrees allowed teleconsultations in public healthcare, especially for general practitioners and chronic care. The National eHealth Infrastructure (EESZT) was the backbone of digital public healthcare. It offered e-prescriptions, referral tracking, COVID-19 test and vaccine records, and hospital data exchange. It was expanded to support vaccination scheduling, test result access, and digital vaccine passports during the first two years of the pandemic.

Table 1. *Some Features of Digital Solutions in Hungary's Healthcare Hungary regarding the Impacts of COVID-19 Pandemic*

Feature	Public (state) healthcare	Private healthcare
System integration	national, standardized	costum-built, flexible
Telemedicine	legalized during pandemic	fast adoption, smoother experience
EHR and patient access	mainly through National eHealth Infrastructure (EESZT)	dedicated portals and mobile apps, but through EESZT too
AI and innovation	minimal use	advanced tools (e.g. symptom checkers)
Payment model	publicly funded and free	out-of-pocket or private insurance
Speed of implementation	slower, bureaucratic	market-driven, costumer needs

Hungarian private healthcare providers often offered the following during the pandemic: patient portals, mobile apps with integrated appointments and lab results, online payment systems, real-time chatbots and remote diagnostics. These services were usually fee-based, attracting those who wanted faster and more personalized care. Private healthcare clinics quickly adopted AI tools, smart triage systems, and integrated telehealth platforms. Less burdened by bureaucracy, these private clinics could innovate and scale digital solutions faster.

Overall, the direct and indirect effects of the COVID-19 pandemic influenced public and private healthcare in different ways (Győrffy et al. 2020). The main reason for these different ways can also be found in consumer behavior, as the use of the two forms of healthcare (public and private) is different (Szigeti 2023). On the one hand, the impacts of the epidemic led to the further development of digital solutions that already existed before 2020 and the introduction of new ones in private healthcare providers. On the other hand, in public healthcare developments, digital solutions that can be implemented on a national scale and that can also be used by private healthcare providers had to be prioritized. Among the public digital solutions, the National eHealth Infrastructure (EESZT) became a central platform for healthcare data exchange. It enabled electronic prescriptions (e-prescriptions), electronic referrals, and access to medical records. During the COVID-19 pandemic, EESZT was enhanced to support vaccination appointment bookings, digital vaccination certificates, and COVID-19 test result tracking.

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