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Telemedicine Services: Barriers and the Possible Development in the Czech Republic

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Abstract

Introduction: Recently, the COVID-19 pandemic has increased the need for a more efficient healthcare system (in terms of staffing and better technical infrastructure). One of the systematic ways of improving the efficiency is to employ telemedicine services in, for example, but not limited to, the area of acute emergency, intensive care, or prevention. This study describes recent patterns in providing telemedicine services by selected types of healthcare providers in the Czech Republic and the challenges it poses. We analyse the provision of selected telemedicine services in diabetology and cardiology between 2010 and 2021, as these fields allow the use of high-tech sensors and computer technology that can radically change diagnostic and therapeutic processes. Finally, we compare the usage of telemedicine services across selected European countries. Based on this review, we discuss the feasible scenario for the Czech Republic. The conclusions from this extensive study are then used to offer recommendations for health system leaders or policymakers.

Materials and Methods: The data on IT equipment and its usage are annually collected by the Institute of Health Information and Statistics of the Czech Republic (ÚZIS). For 2020, it consists of 5,155 complete questionnaires of independent practices of general practitioners (GPs both for adults and children/adolescents); the response rate is 84.5%. Additionally, the survey data consists of 174 hospitals and 11,568 independent practices of outpatient specialists, dentists, and gynaecologists. Simple data weighting was used to correct for over- and under-representation of some regions of the Czech Republic. Survey items consist of Yes/No answers on using IT equipment and related services. Furthermore, data on reimbursed telemedicine services in diabetology and cardiology was shared by the General Health Insurance Fund, the biggest fund in the Czech Republic. We follow the trends in quantities by comparing remote and onsite services. Finally, the comparative analysis of selected European countries considered as leaders in telemedicine services was conducted to provide recommendations for health system leaders or policy providers.

Results: The healthcare facilities seem to be sufficiently equipped with the necessary hardware; nevertheless, there is a potential for improved software, enabling them to be more efficient, for example, in the communication with patients. There is still a high number of patients' records kept in paper form; in 13.9% of GP independent offices, 20.2% of Specialist/Dentist/Gynaecologist independent offices, and even 6.9% of hospitals. Apart from the mentioned barriers, there are

obstacles both on the physicians' and patients' sides (e.g., lack of ICT skills, threat to the security of patients' data, lack of knowledge about the existing options). Finally, given the results from comparative analysis, the Czech Republic is behind in unified information technology infrastructure to process electronic health records and securely transfer data. Furthermore, given the late approval of special telemedicine law, it will be difficult to get to the level of EU leaders in this field, such as, Estonia, Denmark, or the Netherlands.

Discussion: Given our results, we propose to follow the best practices from other European countries (e.g., Estonia, Denmark, the Netherlands, and recently Germany) and innovate unified information technology infrastructure to process the electronic health records and securely transfer data. Both providers and patients need to be incentivised to use new technologies (for example, mobile apps and other digital devices) to increase the demand for telemedicine services. In the long term, we suggest setting up regional telemedicine centres that can cooperate with the smaller healthcare providers via telemedicine services.

Introduction

Recently, the COVID-19 pandemic evolving "stay at home" orders and social distancing rules has put increased pressure for a more efficient healthcare system. By using novel approaches, i.e., by employing telemedicine, the healthcare system can work at lower costs and improve the quality of the provided healthcare (Peine et al., 2020). For this article, we use the following broad description of telemedicine adopted by the World Health Organization (WHO) from Kay et al., (2010:9): "*The delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities*". To narrow down the broad definition, we use four following forms of the telemedicine solutions: (1) remote consultation between patient and care provider; (2) telemonitoring of health and diagnostic data; (3) transfer of data/images to the care provider (specialist); (4) consultation between care providers for case management purposes.[1]

The recent stream of the literature supports the advantages of telemedicine solutions (i.e., remote telemedicine centres and providing telemedicine services). For example, Armaignac et al. (2018), Murphy et al. (2009), Rosenfeld et al. (2000), and Treggiari et al. (2007) show clinical and economic advantages in the area of ICU patient management. Consequently, Hollander & Carr (2020), Rademacher et al. (2019), and Young et al. (2011) conclude that telemedicine services in the area of telescreens help to minimize the time of direct patient contact and, thus, help to cut down the infection risk. Hashiguchi (2020) summarises a systematic review of 103 studies related to telemedicine services. He claims that patients demonstrate high acceptability and satisfaction with telemedicine. On the other hand, he states that costs of devices and technological illiteracy may represent a barrier to patient uptake of telemedicine interventions, especially in low-income populations. To conclude, as the main advantage, telemedicine services help to reduce distance barriers between patients and physicians and to improve access to high-level medical care in otherwise underserved areas.

[1] Note that we exclude using wellness/fitness apps (wearables) because the care provider usually does not enter into the process, and the patient manages all his/her actions by himself. Moreover, all equipment follows the producer's rules, and therefore, the regulation is beyond the healthcare centre.

Romanovs et al. (2021) describe possible challenges for resilient telemedicine services in general. They stress that the number of issues preventing telemedicine systems from wide usage shows the importance of one platform for telemedicine systems. First, the standards of data transferring and storage must be designed, so all devices would use the same protocols without the need for a system to adopt for each particular device. Moreover, they claim that a decent number of medical specialists do not have much experience in using information technologies as many medical facilities still don't have information systems and use physical records to store patient cards. This is also the case for some providers in the Czech Republic as we show in the analysis below. Similarly, on the sample of 378 outpatient general internal medicine physicians working at any New York University Langone Health, New York City Health + Hospitals/Bellevue and Gouverneur, and the VA NY Harbor Health System, Wilhite et al. (2022) confirm that experience differences in using telemedicine services were rooted in the type of technology employed. Concretely, safety-net practices conducted mostly telephonic visits, whereas private outpatient sites utilized video, despite both using identical electronic medical records.

Given the advantages and challenges of using telemedicine services, this study compares several ways of incorporating telemedicine services in European countries and provides the possible development of these services in the Czech Republic. To identify the barriers to the further development of telemedicine services we analyse the Czech healthcare system, and we show the example of using telemedicine services in the area of diabetes and cardiology. These two diseases serve as a great example because they allow the use of high-tech sensors and computer technology that can radically change the diagnosis and therapeutic processes (Gruska et al., 2020). Further, to shed more light on the level of preparedness for telemedicine services in the international context, we provide a comparative analysis of using the telemedicine services in the Netherlands, Germany, Estonia, and Denmark, which are considered the leaders in this field (Healthcare Information and Management Systems Society, 2021). Finally, we provide a conclusion based on the comparative analysis of using the telemedicine services in the mentioned countries.

Telemedicine Services Usage

One of the necessary conditions for successful telemedicine provision is a digital transformation of the healthcare system.[2] As Socha-Dietrich (2020:7) from OECD report claims: "*Successful digital transformation in the health sector is not a simple matter of technical change but requires a complex adaptive change in human attitudes and skills as well as in the organisation of work and the related legal and financial frameworks. Digital technologies only provide the tools and cannot transform the health sector on its own but need to be put to productive use by the health workers and patients.*" Consequently, using electronic medical records and electronic health records (EMR and EHR, respectively) is the main driver of digital transformation.

Figure 1 shows the adoption of EHR by general practitioners (GPs) within the European region. The data come from a survey conducted in 2018 on behalf of the European Commission. The depicted score is constructed as follows: 0=not aware; 1 = do not have it; 2 = have it but do not use it; 3 = use it occasionally; 4 = use it routinely. The highest number (3.5), which means that general practitioners use EHR almost routinely, is indicated in Estonia and Denmark.[3] These countries are followed by the

[2] Another key aspect is the development of optical networks making broadband access available to rural households and using Fibre To The Home (FTTH) networks (Lagerstedt & Gutter, 2016).

[3] Each person in Estonia that has visited a doctor has an online e-health record that can be tracked. Identified by the electronic ID card, the health information is kept completely secure (by using KSI Blockchain technology) and at the same time accessible to authorized individuals. In a similar way works the Danish e-Health Portal

UK, Spain, Italy, and Ireland (EHR index of 3.4). The Czech Republic, Germany, Austria, Portugal, Hungary, and Croatia have an index between 3 and 3.1, which means that in these countries, GPs in 2018 reported using the EHR occasionally. One of the possible problems discouraging from routine use of EHR might be the lack of legislation, for example, in the Czech Republic and Austria (OECD, 2020). In the study done by Klocek et al. (2019), which aimed to evaluate the use of information communication technology (ICT) in the Czech Republic, they identified three main obstacle areas: on the side of GPs (such as low perceived usefulness); on the side of patients (such as lack of interest); and contextual barriers (such as lack of time to implement).

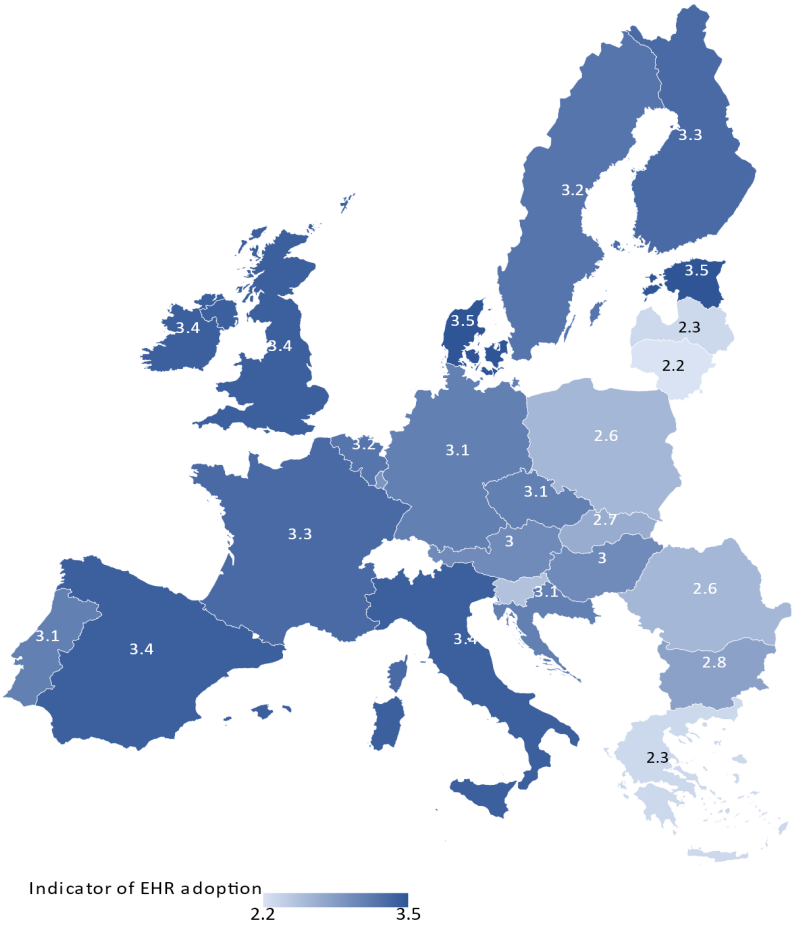
As Hashiguchi (2020) summarises, at the time of writing, eight OECD members did not have national legislation, strategy, or policy on the use of telemedicine (Austria, the Czech Republic, Estonia, Slovenia, Spain, Sweden, Switzerland, and Turkey).[4] However, COVID-19 accelerated the process of preparing the national legislation. In February 2021, the Czech government approved The Act on Electronic Healthcare (the "e-Health Act") to set the framework for the digitalisation of the healthcare system. This act sets common technical standards for digitisation and sharing of health records among healthcare providers and patients.[5] Importantly, the definition of telemedicine acts is necessary given the fee-for-service payment model which is mostly utilised in the outpatient sector.

(Sundhed.dk), which has been a unique national healthcare platform since 2003, containing personal and general healthcare data on all Danes.

[4] Even if these countries do not have any legislation, they do allow telemedicine services.

[5] Act no. 325/2021 of 18 August 2021 on the digitalisation of the health sector.

Figure 1: *Adoption of the Electronic Health Records (EHR) by general practitioners in Europe, 2018*



Source: Authors' creation based on the European Commission (2018)

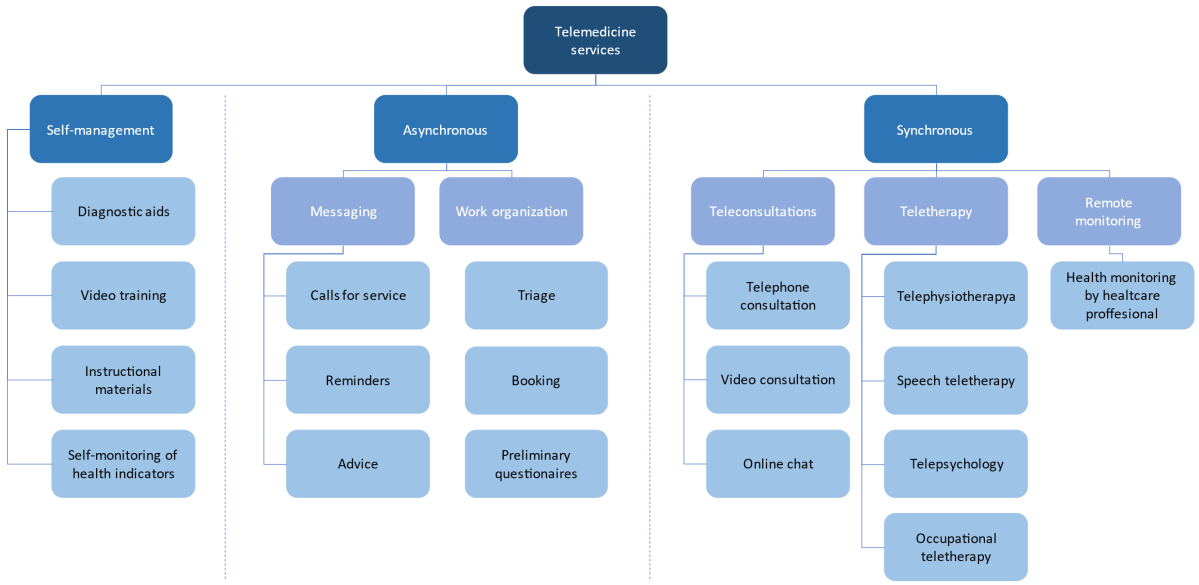
Note: The score reflects the share of general practitioners who indicated the following state of EHR use in their practice: 0=not aware; 1 = do not have it; 2 = have it but do not use it; 3 = use it occasionally; 4 = use it routinely.

For example, the Czech General Health Insurance Fund (in the follow text we use theCzech abbreviation "VZP"), in response to COVID-19, extended its support of remote consultations with patients by adding additional reimbursed services. Moreover, it was incentivised to set up a programme, VZP Plus – Telemedicine, which is expected to identify and exploit the potential of modern technologies in the treatment process, organization, and access to care. However, the more sophisticated telemedicine acts are still not on the list of covered healthcare services in the Czech Republic.[6]

Our further discussion requires more detailed division of healthcare services. We adopt the classification of patient-oriented services by Kay et al. (2010) and Jarviste (2020): self-management; asynchronous and synchronous, shown in Figure 2. The classification of telemedicine services slightly varies across countries, however, the main principle of division into these three categories remains.

[6] For example, the reimbursement process for digital e-health applications ("apps on prescription") as is the case in Germany.

Figure 2: *Patient-oriented Telemedicine Services*



Source: Jarviste (2020)

In the report done by Hashiguchi (2020), nine OECD members do not define jurisdiction, liability or reimbursement of e-health services.[7] On the other hand, for example, in the Netherlands, the following classification of digital care was developed by the Council for Public Health and Society: (1) E-care: e-diagnosis, e-consultations, e-care such as monitoring, e-prevention intervention at high risk in an individual; (2) E-support: e-access to patient records, e-management such as making appointments online; (3) E-public health: e-health education, e-prevention such as detecting certain risk groups. Moreover, since 2020, for a patient who receives telemedicine services in the Netherlands, a maximum of 6.5 hours per month can be declared for nursing and/or personal care. Direct contact time required with telemedicine services can be declared through regular services. This extra compensation is possible in addition to the hours for direct contact time in the case of video calling with a patient. To conclude, the insufficient definition of telemedicine reimbursement might be an obstacle to the further development of e-health.

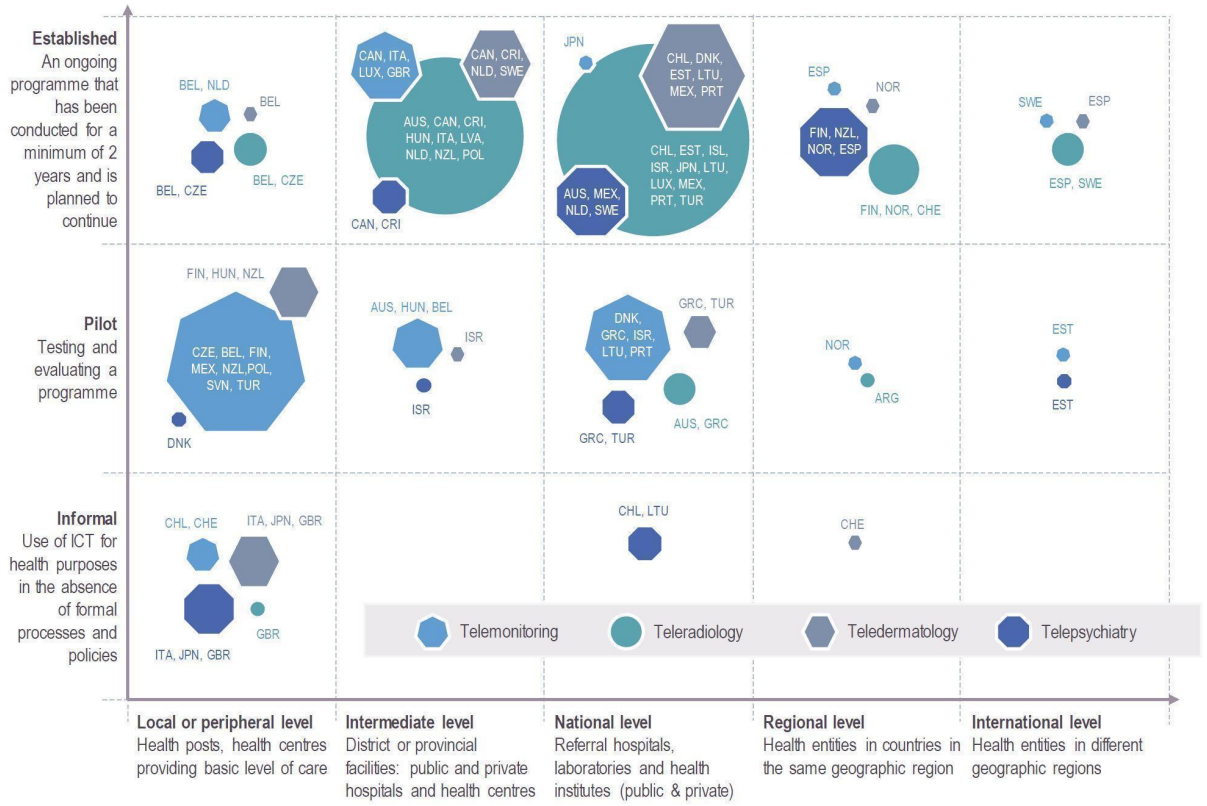
The recent trend is the creation of telemedicine excellence centres, which offer the mentioned telemedicine services. For example, the University Hospitals of Aachen and Munster have set up a "virtual hospital" structure within a few weeks. It serves as a hub of specialist intensivist and infectologist care for over 200 regional hospitals (Peine et al., 2020). In a similar way in China, the National Telemedicine Centre of China in Zhengzhou connects over 120 smaller hospitals (Zhai et al., 2020). In the Czech Republic, the Czech National e-Health Centre (NTMC) was established as a joint workplace of the University Hospital Olomouc (FNOL) and the Faculty of Medicine of Palacký University in Olomouc as a pivotal project of a remote telemedicine centre.[8] As NTMC states, its

[7] See Table 1.1 (Hashiguchi, 2020): Argentina (currently being considered by the OECD Council as a prospective member), Austria, Belgium, the Czech Republic, Estonia, Hungary, Mexico, Spain, and the United Kingdom.

[8] This joint workplace became a national Competence Centre for Telemedicine under the Ministry of Health (MoH) of the Czech Republic. Therefore, it will provide scientific research and expert support to the MoH on the use of information and communication technologies for the remote provision of health services.

major goal is to unify e-health activities under a single organizational structure. Figure 3 shows the level of telemedicine centres in various countries.

Figure 3: *OECD countries reporting use of telemedicine by level and type of programme, 2015, 2018*



Source: (Hashiguchi, 2020), Figure 1.3
Notes: For countries that report more than one level and type of programme per specialty, the most advanced level and type are shown. The size of bubbles is proportional to the number of countries.

As can be seen in Figure 3, most services are provided through small-scale pilot projects involving at most a few thousand patients. One of the most active countries in e-health is Denmark with a range of services and solutions delivered through different programmes, for example, TeleCare North, the Virtual Hospital, and home-based wound treatment. As Hashiguchi (2020:18) further states: "*TeleCare North is a telemonitoring programme involving the North Denmark regional authority, its hospitals, general practitioners (GPs) and 11 municipalities... As for the Virtual Hospital, Aarhus University Hospital uses this concept to monitor women with pregnancy complications in their own homes, a project that is to be scaled nationally in 2020.*"

Although Germany does not appear in Figure 3, its healthcare system has made a lot of progress in the past years, driving forward the legislative framework for the digitization of healthcare—especially in electronic patient records, telemedicine, and e-prescriptions (Richter & Silberzahn, 2020). Moreover, as Richter & Silberzahn (2020) state, Germany has also played a pioneering role in e-health reimbursement: it was the world's first country to establish a combined regulatory and reimbursement process for digital e-health applications ("apps on prescription").

Starting summer 2021, physicians can prescribe certified health apps (according to the Digital Healthcare Act, DiGA) to any of the 73 million statutory-insured German citizens.[9] Among these are solutions developed to support the treatment of mental diseases, diabetes, migraine, insomnia, and obesity. To be listed in the DiGA directory—an official register of prescribable and reimbursable digital therapies—an app must pass an evaluation by the Federal Institute for Drugs and Medical Devices (Bundesinstitut für Arzneimittel und Medizinprodukte, BfArM). Therefore, the app solution makes e-health technically secure and compliant as it pertains to data protection regulations and data security requirements. Furthermore, as Roth (2021) claims: "*Unlike other health apps, the DiGA objective is not to offer a digital product that promotes a healthy lifestyle. A DiGA is intended to provide benefits for the patient and the healthcare system.*" The following section provides general information about Czech healthcare expenditures to shed more light on the possibility of implementing telemedicine services.

The need for telemedicine and its implementation in Czech healthcare

After years of surpluses (since 2014), the health insurance system in the Czech Republic awaits challenging times. The total expenditures of statutory health insurance reached 352.2 billion CZK in 2020. Despite the skyrocketing costs associated with COVID-19 treatment and testing, the revenues of the system were still higher, reaching 358.0 billion CZK. This surplus was mainly due to the unprecedented increase in the per person contributions from the state budget for the so-called "state-insured" such as the elderly, children, students, and other groups. However, for 2021, the health insurance funds expected a deficit of around 13.7 billion CZK (MFČR, 2021). Even though this can be covered from the accumulated reserves, the deficits are expected to prevail in future years. Incoming refugees fleeing from the ongoing war in Ukraine represent a further deterioration of healthcare budgets. However, the exact effect is difficult to predict (April 2022). The everlasting need for effective gains could be at least to a certain extent answered by further digitalisation and a broader use of telemedicine.

To identify the level of digitisation and implementation of telemedicine in Czech healthcare facilities, we use data on IT equipment and its usage that are annually collected by the Institute of Health Information and Statistics of the Czech Republic (ÚZIS). All healthcare providers are bound to fill the online questionnaire, independently on their type and ownership. See Table 1 for a short review of the main results from the E (MZ) 1-01 questionnaire for selected types of providers. For 2020, the data consists of 5,155 complete questionnaires from independent practices of general practitioners (GPs for adults and GPs for children/adolescents) which represents a response rate of 84.5%.[10] Simple data weighting was used to correct for over- and under-representation in some regions of the Czech Republic.

A computer is being used in 98.7% of the GP practices, mostly with an internet connection (97.7% of the 5,155 responding GP practices). Nevertheless, only 67.3% of GP practices have reported ordering and receiving results of laboratory tests through their informational system. Moreover, only 28.8% of GP practices reported using their IT system to share patient information with other healthcare

[9] According to the definition, DiGA is a medical device of risk class I or II used by a patient alone or together with a physician. It must support recognizing, monitoring, treating, or alleviating of diseases, injuries, or disabilities; DiGA is not an app that serves primary prevention.

[10] General practitioners typically run a solo independent practice. Nevertheless, GPs can practice in different types of outpatient care establishments that comprise polyclinics, joint outpatient establishments, health service centres, independent offices, and other outpatient establishments; or in inpatient facilities as well. The E (MZ) 1-01 is filled out by all healthcare providers and their individual establishments.

providers securely. This suggests that GP practices do not fully utilise the possibility of communication with other healthcare providers.

The extent of remote communication with patients depends, among others, on the provider's information system. For example, it enables the patients to inspect the list of their prescribed pharmaceuticals in 6.3% of GP practices. Only in a minimum of GP practices patients can remotely enter measurement records (e.g., temperature, pressure) or insert a text/document into their patient documentation, i.e., in 5.5% and 5.7% of GP practices, respectively.

A step towards e-health would certainly be keeping digital patient records. Nevertheless, medical documentation is being kept solely in paper form in as much as 18.4% of GP practices. Only in 9.8% of GP practices is the documentation strictly digital. The remaining practices reported combining the online and paper form. The highest share of GP offices that keep patient records strictly in paper form is in Zlínský kraj and the Prague region (Hlavní město Praha). Interestingly, Prague also has the lowest share of GP offices with a computer.

In 2020 (during the first waves of the COVID-19 pandemic), only 5.5% of GP offices used real-time video consultations with patients. Information and communications technology (ICT) was used by 11.3% of GP offices to communicate with other providers (to share images or other information). Only 1.6% of GP offices engaged in 2020 a patient into remote monitoring service or remote home care. Nevertheless, since 2017, these have substantially increased from 0.8%, 4.8%, and 0.6%, respectively.

Table 1: Share of healthcare facilities answering "yes" in the ÚZIS survey E (MZ) 1-01, 2020

Question	General Practitioner Office (N=5,155)	Specialist/ Dentist/ Gynaecologist office (N=11,568)	Hospital (N=174)
using a computer	98.7%	95.9%	98.9%
using the internet	97.7%	94.8%	97.7%
patients' records kept in paper form	13.9%	20.2%	6.9%
patients' records kept in paper/digital form	81.8%	63.5%	92.0%
patients' records kept digital form	3.0%	12.6%	0.0%
using IS to securely share information	28.8%	14.1%	62.1%
using IS to receive laboratory results	67.3%	25.4%	86.2%
patients can check their list of pharmaceuticals	6.3%	4.3%	4.0%
patients can enter measurement records	5.5%	4.7%	6.9%
patients can insert a text into their records	5.7%	6.7%	5.7%
offering appointment making online	29.2%	17.2%	35.1%
providing real-time video consultations	5.5%	3.7%	10.3%
using IT to communicate with other providers	11.3%	26.5%	76.4%
engaging a patient in remote monitoring	1.6%	1.1%	12.6%

Source: Data provided by ÚZIS (2022)
Notes: See the Appendix for the complete question formulations in the E (MZ) 1-01 questionnaire defined based on Decree no. 466/2020 Coll.

In 2020, only 3.7% of independent practices of dentists, gynaecologists, and outpatient specialists (*N*=11,568 completed questionnaires, response rate=76.5%) provided real-time video consultations with patients; moreover, only 1.1% of these practices engaged a patient in remote monitoring service or remote home care. However, as much as 26.5% of these practices used ICT to communicate with other providers.

Interestingly, none of the hospitals (*N*=174 completed questionnaires, response rate=96.1%) keeps patients' records fully digital. Nevertheless, the paper form is utilised by only 6.9% of hospitals. Hospitals dominate in communication with other providers, including laboratories, and sharing information securely: 86.2% of hospitals use their electronic system to order laboratory tests and receive the results, and 76.4% of hospitals reported sharing images or other information with other providers. Out of the studied providers, hospitals are also leading in engaging patients in remote monitoring (12.6%). Every tenth hospital (10.3%) provided real-time consultations in 2020.

The process of broadening the use of telemedicine is expected to take time, even though the pandemic quickened it. To provide the actual picture of using telemedicine services in the Czech Republic, the following subsection describes the example of to-date defined and used telemedicine services in the Czech Republic in diabetes and cardiology. As we mentioned earlier, these two diagnoses allow the use of high-tech digital equipment, and therefore, these serve as a great example of telemedicine services.

Provision of selected telemedicine services in the Czech Republic

Data sources on telemedicine use in the Czech Republic are scarce. Data on services that are reimbursed from the statutory health insurance are collected by the health insurance funds. These are administrative data mainly on procedures, hospitalizations, and prescribed pharmaceuticals. There are several typically telemedicine services, such as a phone call between the attending physician and the patient (code 09513 in Decree No. 243/2021 Coll.) or (VZP) Distant Health Consultation by an Outpatient Specialist (code 09614). See other services from the statutory health insurance in Figure 4.

We have managed to get administrative data on the provision of services from the biggest health insurance fund, VZP. In 2020, VZP covered 56.3% (5,936,228) of the insured persons in the Czech Republic, operating in all regions for all age groups (MFČR, 2021; VZP, 2021).[11] In total, given the VZP database, we have information from 2010 until 2021 for chosen services indexed in diabetology and cardiology.[12] We use data on diabetes and cardiology as an example of diagnoses where telemedicine allows the use of high-tech sensors and computer technology that can radically change diagnostic and therapeutic processes. As for diabetes, every tenth person insured at VZP (9.6%; 571,244 persons) was treated with diabetes in 2019 and the treatment cost 7.8 billion CZK, out of this, over 4.6 billion CZK were expended for pharmaceuticals (VZP, 2020). However, when considering not only the direct costs of diabetes treatment but also the costs of complications treatment, including hospitalizations, and others, the costs are significantly higher. According to the president of the Union of Health Insurance Funds (SZP ČR, associating the remaining six public health insurance funds as a counterbalance to VZP), the treatment costs of diabetes reach 53 billion CZK a year in the Czech Republic, i.e., approximately 15% of total expenditures from the statutory health insurance (SZP ČR, 2021). Moreover, SZP ČR (2021) claims that every ninth person in the Czech Republic is treated with diabetes.

[11] In the Czech Republic, there is compulsory membership in the health insurance system based on universal coverage and a universal benefit package.
[12] See Appendix for the data description.

We summarise the provision of five services related to telemedicine and used in diabetology (Figure 4): (1) (VZP) Distant Health Consultation by an Outpatient Specialist, (2) Repeated Continuous Glucose Monitoring Using a Sensor, (3) Professional Continuous Monitoring with Glucose Sensor, (4) Telephone Consultation of the Attending Physician by the Patient, (5) Evaluation of Glucose Profiles from the Glucometer by Computer, and we show the number of standard Follow-up examination by a diabetologist as well.[13]

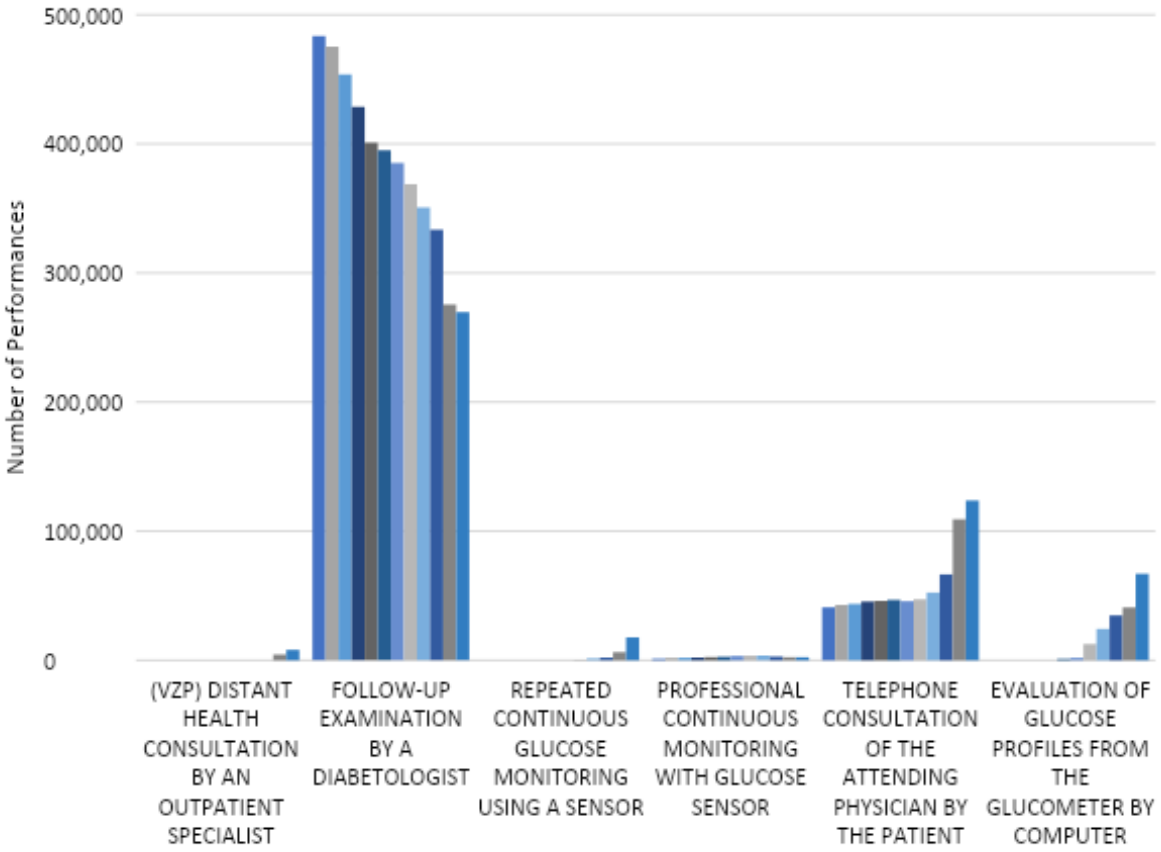
In Figure 4, we see a declining trend in the number of performances of the follow-up examinations, whereas there is an increasing trend in using telephone consultations, (VZP) distant health consultations, and evaluations of glucose profiles from glucometer by a computer.[14, 15] An explanation is offered by the study of Levin et al. (2013), where they find that audio-visual consultations among physicians, patients, and nurse specialists achieved high treatment quality results in essential diabetes treatment parameters. Therefore, they conclude that the telemedicine set-up was mainly associated with improved cost-effectiveness (less time spent in person with the doctor).

[13] The service (VZP) Distant Health Consultation by an Outpatient Specialist was introduced in relation to the COVID-19 pandemic. In April 2022, this service was further developed to reflect more the emerging telehealth program of VZP Plus – Telemedicine.

[14] The evaluation (in person) of glucose profiles uses the information from a personal glucometer, usually for a period of 2-3 months. Therefore, we classify it as a synchronous telemedicine service (see Figure 2).

[15] We would like to stress that there might be other drivers of the declining number of follow-up examinations, such as better general health or lifestyle. However, given the structure of our dataset, we are not able to examine this hypothesis. Moreover, increasing numbers of telephone consultations were positively affected by the pandemic of COVID-19.

Figure 4: Number of Performances of Selected Services reimbursed in Diabetology by the Czech General Health Insurance Fund, 2010-2021



Source: Data provided by VZP (2022)

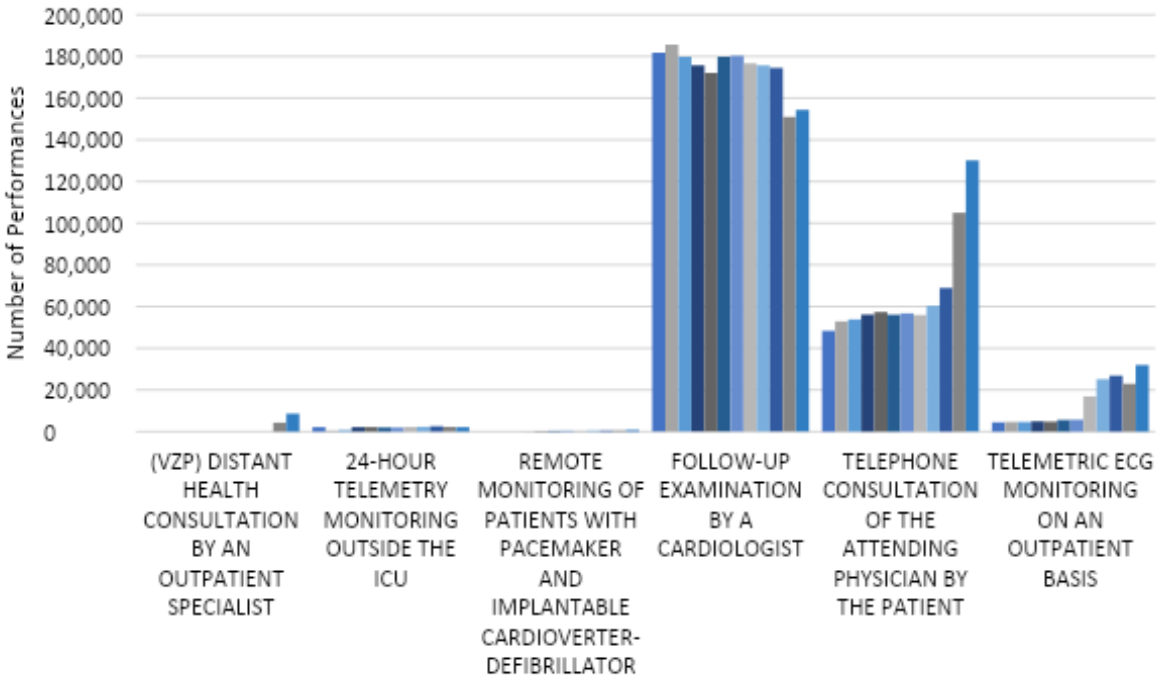
Notes: Only performances provided by diabetologists (speciality 103) are considered. As for the reimbursement, for example, in 2021, a telephone consultation of an attending physician by the patient (code 09513) was evaluated at 87 points (basic value 1.1 CZK/point), and a follow-up examination by a diabetologist (code 13023) was evaluated at 210 points (basic value 1.05 CZK/point).

Figure 5 shows the number of performances of five telemedicine performances used in cardiology: (1) (VZP) Distant Health Consultation by an Outpatient Specialist, (2) 24-hour Telemetry Monitoring Outside the ICU, (3) Remote Monitoring of Patients with Pacemaker and Implementable Cardioverter-Defibrillator, (4) Telemetric ECG Monitoring on an Outpatient Basis, (5) Telephone Consultation of the Attending Physician by the Patient, and the number of Follow-up Examination by a Cardiologist, which is not telemedicine service. We can see a similar pattern as in Figure 4, where there is a decreasing trend in follow-up examinations while there is an increasing trend in telemedicine services (except 24-hour telemetry monitoring outside the ICU showing a stable trend).

As Battineni et al. (2021) claim telemedicine services can help reduce the number of doctor visits. This finding could be one of the explanations for the decreasing trend in follow-up examinations by a cardiologist. However, there might be other drivers, such as better lifestyle, healthier food, etc, that, given our dataset, we are not able to fully examine.[16] To put the level of using the telemedicine services in the Czech Republic into the international context, the next section compares the current stage of these services across five European countries.

[16] Examining of other drivers is also beyond the scope of this study.

Figure 5: Number of Performances of Selected Services reimbursed in Cardiology by the Czech General Health Insurance Fund, 2010-2021



Source: Data provided by VZP (2022)
Notes: Only performances provided by cardiologists (speciality 107) are considered.

Comparative Analysis

According to the survey conducted by the Healthcare Information and Management Systems Society (2021), 23% of healthcare professionals consider Estonia as the role model for digital health innovation in Europe. Estonia is followed by Denmark (14%), the Netherlands (12%), Sweden (11%), Finland (10%), and Germany (7%). Given the survey results, we compare the level of preparedness for telemedicine in the Czech Republic with the first three countries and Germany. We choose Germany mainly because it has recently played a pioneering role in e-health applications' reimbursement.

Tables 2a and 2b show for each analysed country the current stage of legislation, united electronic medical and health records structure, incentives for doctors - covering the costs for apps that are mostly used by healthcare, incentives for patient – awareness and reimbursement, and the system of health insurance funding – coverage of telemedicine services. As for the legislation, Estonia and Denmark do not have any special laws for telemedicine services. In both countries, the provision of telemedicine is subject to the same laws as the provision of regular healthcare services. On the other hand, Germany, the Netherlands, and the Czech Republic introduced special laws related to certain telemedicine services. However, the Czech Republic approved the law as the last one. It is important to note that in the Czech Republic, other than by law, the state cannot enforce on healthcare providers (and their suppliers) the compatibility of their information systems, which is crucial for the smooth transfer of information in real-time.

The delay in approving the law in the Czech Republic has already created troubles for hospitals that decided to digitalise themselves. For example, FNOL is on the way to building a communication and integration platform for its digitalisation and information sharing among other care providers in the

region (the project finished in 2022). The same way proceeded the University Hospital Ostrava, the University Hospital Brno, and the General University Hospital in Prague. Therefore, the law's delay might bring additional costs to making the information systems compatible.

Table 2a: Level of Preparedness for Telemedicine Services

Country	Legislation	United electronic medical and health records structure
Czech Republic	Act no. 325/2021 Coll., approved in August 2021, contains the basic infrastructure for the digitisation of healthcare, roles and responsibilities of entities in the e-health system and definitions of related concepts, communication standards, and rules for sharing or transferring medical documentation.	Act no. 325/2021 Coll. defines the basis of the infrastructure. *
Denmark	There is no special law on telemedicine services. The provision of telemedicine is subject to the same laws and regulations as the provision of regular healthcare services.	Danish e-Health portal, www.sundhed.dk, was launched in 2003 and is an integrated part of national e-health strategies.
Estonia	Estonian law includes a legal basis for healthcare professionals to process personal data for planning and providing healthcare services (§ 41 of the Health Services Organisation Act). However, specialised doctors can only process patients' data with whom they have had a previous doctor-patient relationship, which is limiting.	Each person in Estonia who has visited a doctor has an online e-health record that can be tracked. They are identified by electronic ID cards. The health information is kept completely secure (using KSI Blockchain technology).
Germany	The German E-Health Act (E-Health-Gesetz) from December 2015. The German Digital Supply Act (Digitale-Versorgungs-Gesetz), dated in November 2019, introduced a package of measures.	On 1 January 2021, the largest digitization project in the German healthcare system—the electronic patient health record (elektronische Patientenakte – ePA)—was launched after sixteen years of preparation.
The Netherlands	General healthcare laws such as the Medical Treatments Act (WGBO) and the Individual Healthcare Professions Act ("Wet BIG"). The prescription of medicines at distance is regulated by the Medicines Act ("Geneesmiddelenwet"). In 2020, new Dutch law Healthcare Act (Wet aanvullende bepalingen verwerking persoonsgegevens in de zorg; "Wabvpz") has come into force.	In 2011 the Netherlands introduced Nictiz (the national centre of expertise for standardisation and e-health). This streamlines the development and management of information standards.

Source: (Biolegis, 2021; European Observatory on Health Systems and Policies & Petersen, 2019; Healthcare Information and Management Systems Society, 2021)

* Notes: In 2022, the Czech Ministry of Health jointly worked on "Project X-eHealth: eXchanging electronic Health Records in a common framework" within the programme horizon 2020 with Dutch institution NICTIZ. The aim of the project is to specify the functional requirements for the content of discharge reports, orders, and results of laboratory and imaging examinations. In addition, the Ministry is participating in the technical

specification of transmission formats in all the above-mentioned areas and the global eHealth Digital Service Infrastructure (eHDSI).

The key factor which influences the level of telemedicine services is whether the country has **a united electronic medical and health records structure** (Lagerstedt & Gutter, 2016). Estonia and Denmark are considered to be the leaders in this category. As Metsallik et al. (2018) stress, the main success factors for the e-health system in Estonia are clear governance, legal clarity, a mature ecosystem, agreement about access rights, and standardisation of medical data and data exchange rules. Similarly, this is the case in Denmark and the Netherlands. Considering Germany and the Czech Republic, we can see extensive delays in implementing such a united system. In contrast to Estonia, Germany and the Czech Republic do not have a mature digitalisation ecosystem in general.[17]

Table 2b: Continue

Country	Incentives for doctors - covering the costs for apps that are mostly used by healthcare professionals and patients	Incentives for patient – awareness and reimbursement	System of Health Insurance Funding – coverage of telemedicine services
Czech Republic	Patients are in general required to pay fees for using private telemedicine platforms. (In April 2022, only one health insurance fund reimburses these costs for its customers when they use a specific platform).	There is no uniform approach yet. Healthcare providers and patients use telemedicine services individually according to their agreement. The reimbursement scheme is under development in 2022. Some health insurance funds are testing their pilot projects (e.g., project Horizon II)	There is a system of statutory health insurance (SHI), heavily regulated by the government. Seven public health insurance funds currently act as payers and purchasers of care. Funding of telemedicine services depends largely on the insurance fund.
Denmark	Using the approved telemedicine apps is free/covered.	For example, the app "Min læge" has been issued by the Danish Ministry of Health and the Organisation of General Practitioners (PLO) and allows people quick access to their doctors and the digital solutions they offer. Such services are free of charge within the free Danish healthcare system.	All Danish residents are automatically covered by the national health system. The system is predominantly financed from state-level general tax revenues and a municipal income tax.
Estonia	The current law enables the Estonian Health	There is a nationwide app solution with the support	Estonia has a centralised health system with a

[17] According to the OECD (2021), Estonia, Denmark and the Netherlands have one of the highest mobile broadband subscriptions per 100 inhabitants, ranked 2, 5 and 9 respectively from OECD countries. While the Czech Republic and Germany occupied 25th and 27th place, respectively. The mobile broadband subscription could serve as the proxy indicator of using the mobile application, and therefore the telemedicine services (Allaert et al., 2020).

	Insurance Fund (HIF) to reimburse the cost of medicines, healthcare services, and medical devices, irrespective of the form of provision/prescription of the services. However, if more and more digital services or telemedicine solutions enter the market, it would be wise to establish a separate category for reimbursable telemedicine services/devices.	from the HIF. The use of patient portals to access e-health services has continued to grow (in 2016, 63% of citizens were aware of the patient portal compared with 40% in 2014; in 2016 24% of citizens had accessed it compared with 11% in 2014).	single health insurance fund (HIF), which operates as a semi-autonomous public organisation. The health system is largely funded through payroll tax.
Germany	The costs are covered by statutory health insurance.	If the app is included in the national digital healthcare application (DiGA) directory it can be covered. This encourages start-ups and other companies to develop user-friendly mobile applications.	It has the oldest SHI system in the world. Currently, the multi-payer SHI system consists of 103 sickness funds and 41 private health insurance (PHI) companies. The three biggest sickness funds cover more than one-third of the German population. The Federal Joint Committee takes decisions on SHI benefits, reimbursement systems and quality assurance.
The Netherlands	If the app is used for health purposes it will be reimbursed by the healthcare insurer because the activity is covered by the national basic health insurance ("basisverzekering"), the cost of the app will be covered by the national healthcare system.	As the Dutch government states on their website, they started to heavily promote telemedicine services in 2021.[18] Moreover, the National Healthcare Institute has drawn up an action plan in coordination with the Ministry of Health to encourage the use of e-health services.	There are three schemes that together provide broad universal health coverage: SHI system, single-payer social insurance system for long-term care, and a tax-funded social care scheme implemented by the municipalities. The National Institute for Public Health and the Environment (RIVM) provides guidance for public health services at the national level, while

[18] For example, the Dutch government made the regulations more flexible so that it is easier for GPs to assess a patient's situation. Additionally, speech therapists and medical specialists now have greater scope for providing therapy and care online.

			municipalities cover most services such as screening, vaccination and health promotion.

Source: (CMS legal, 2022; OECD/European Observatory on Health Systems and Policies, 2021a, 2021e, 2021d, 2021c, 2021b; ESPON, 2019; Furlepa et al., 2022; Kuuskmaa L. M. & Laane L-L., 2020)

Another important aspect of further development of telemedicine services is incentivising doctors **and patients,** i.e., covering the costs for apps used mainly by healthcare professionals and patients. As mentioned previously, Germany is the leader here with its concept of digital healthcare application (DiGA). If a telemedicine application is on the DiGA list, it is subject to reimbursement. Therefore, it opens the doors for companies to develop user-friendly applications for telemedicine services, which share the same infrastructure as the core system. The Czech new law is intended to provide the basis for the unified infrastructure as well. However, now, patients in the Czech Republic are generally required to pay fees for using private telemedicine platforms. As for Estonia and Denmark, the reimbursement of mobile applications works similarly as in Germany, although there is high usage of government operating applications in these countries.

Since the system of health insurance funding contains the rules for covering the cost of telemedicine services, we also compare the chosen countries in this category. In Estonia, there is a unique centralised health system with a single health insurance fund (HIF), which operates as a semi-autonomous public organisation. Given this, there is only one entity covering telemedicine services, which makes negotiating between insurance companies and legislators about the scope of the coverage more straightforward. This is not the case in all compared countries. Therefore, as for the system's clarity, Estonia indicates the highest level. This is also one of the strengths mentioned by Metsallik et al. (2018).[19]

Identification of Barriers to Implementing Telemedicine Services

Our analysis identified several barriers that hinder or slow down the implementation of telemedicine services on a larger scale in the Czech Republic. First, the Czech Republic only recently enacted a law that sets the framework for the digitalisation of the healthcare system. As it was impossible before to enforce the compatibility of the emerging information systems, it will require additional time and costs to make the necessary adjustments in the already existing software to transfer the information smoothly among individual healthcare providers.

Second, most of the currently used informational systems do not enable more sophisticated telemedicine services, for example, patients' remote access to medical documentation. The patient cannot enter measurement results into their documentation, insert text or documents, or even check the list of prescribed pharmaceuticals. In 2020, this was possible only in approximately 4-7% of hospitals and similarly in independent outpatient offices.

Third, there are still healthcare providers that do not keep patients' records in a digital form. In 2020, most of the independent outpatient offices kept the records partially in paper and digital form, but some kept them strictly in paper form. However, missing hardware does not seem to be the key issue as these offices are mostly equipped. Nor is the internet connection the issue, as the vast majority of independent outpatient offices reported having it.

[19] Assessing the structure of financing of the healthcare system and its impact on the usage of telemedicine services is beyond the scope of this study.

Klocek et al. (2019) surveyed through an open-ended question (108 responses) the reservations and fears of Czech GPs towards telemedicine and e-health in general. The results show perceived obstacles both on the physicians' and patients' sides: lack of hardware and ICT skills (especially among older patients and physicians), preference for face-to-face communication (fear of a loss of personal contact), perceived threat to the security of patients' data, and the lack of knowledge about the existing options. Some GPs complained about the excessive time needed to implement telemedicine solutions. Similarly, on the side of patients, GPs mentioned the lack of interest. All these factors and fears influence the use of telemedicine.

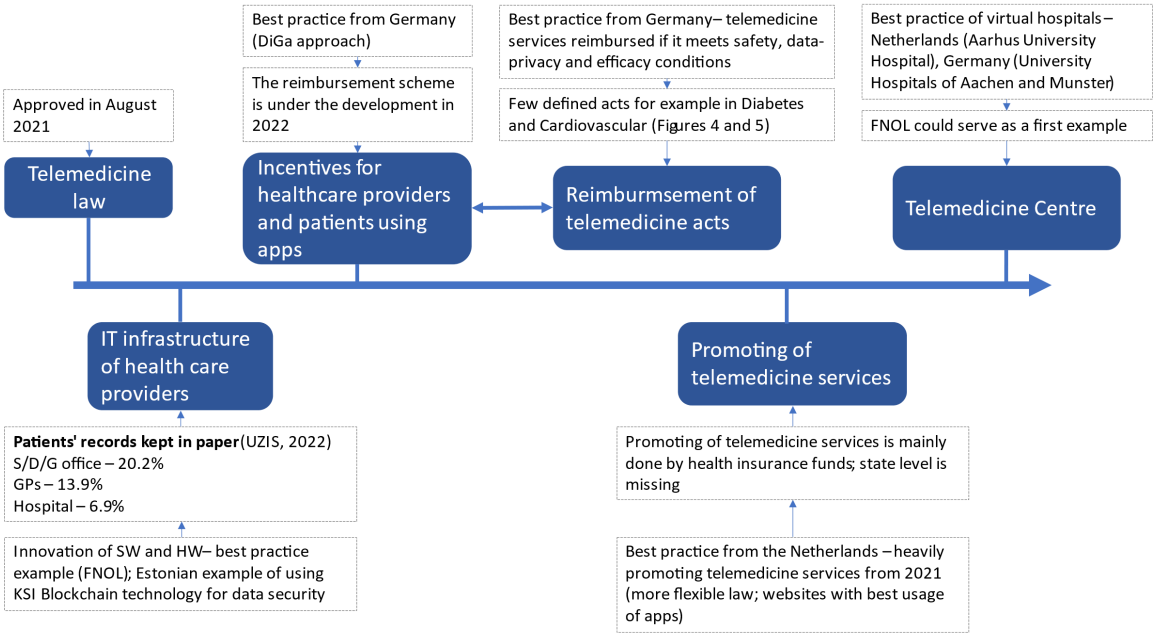
Such barriers are not only specific to the Czech Republic, but we also recognise similar barriers internationally. Hashiguchi (2020) claims (based on a review of 103 studies) that costs of devices and technological illiteracy may represent a barrier to patient uptake of telemedicine interventions, especially in low-income populations. Romanovs et al. (2021), analysing challenges of telemedicine in the world, claim that many medical facilities still do not have information systems and use physical records to store patient cards.

Possible Development Scenario of Telemedicine in the Czech Republic

Given previous findings from the comparative analysis and the identified barriers to further development of telemedicine services, we discuss possible scenarios for extending telemedicine services. Figure 6 summarizes steps toward further developing telemedicine services in the Czech Republic based on our analysis. The first step of approving the telemedicine law was already done in August 2021. Consequently, we see a significant gap in the innovation of information systems and hardware in independent outpatient offices and, to a small extent, in some hospitals (see Table 1 – patients' records kept on paper). The possible way of developing the information system is provided by Romanovs et al. (2021), who reflect general information technologies requirements for general practitioner's offices specific to the Latvia case but could be applied in a broader perspective. They describe the main findings and conclusions regarding cyber security, confidentiality, medical personnel training, patient-provider relationship, medical devices, authentication, and data transfer.

Another critical step is providing incentives to use new information technologies (for example, mobile apps and other digital devices) for healthcare providers and patients. In the Czech Republic, the reimbursement scheme for such devices is under negotiation. This is not the case in Germany, which could serve as a best practice example. The reimbursement scheme in Germany is based on the definition of conditions (safety, data privacy, and efficacy), which the digital device/apps must follow. Therefore, it eliminates the process of defining individual telemedicine acts and fastens the legislative process of approval.

Figure 6: Potential Path of Further Development of Telemedicine Services in the Czech Republic



Source: Author's creation.
Notes: S/D/G office denotes Specialist/Dentist/Gynaecologist office; GPs stands for General Practitioner Offices

Importantly, it is necessary to increase the demand for telemedicine services on both sides – healthcare providers and patients. As Al-Samarraie et al. (2020) claim, perceived usefulness and advantages offered by the innovation are essential facilitators of telemedicine use. At the moment, the health insurance companies promote using telemedicine services individually; however, as a good practice can serve the example of the Netherlands. Their National Healthcare Institute has drawn up an action plan to encourage the use of e-health services. Among their activities, we can see setting up websites with showcases of the e-health options already available to patients, healthcare providers and informal carers; they organize region-by-region events to promote opportunities which telemedicine services offer.

In the long-term, the trend in the compared countries (Germany and the Netherlands) suggests setting up several telemedicine centres across regions in the Czech Republic. These centres can take care of regional healthcare providers via using telemedicine services. As the pilot project, there is the Czech National e-Health Centre established as a joint workplace of FNOL and the Faculty of Medicine of Palacký University in Olomouc, which can serve as a model for other regions in the Czech Republic.

Conclusion

The recent stream of literature supports the advantages of telemedicine solutions in terms of increased efficiency of the healthcare system. There are numerous definitions and categorisations of telemedicine; nevertheless, the digital transformation driven by electronic medical and health records is widely considered necessary for successful telemedicine provision. The already ongoing process of digitalisation and shifting towards remote communication and monitoring has been recently quickened by the COVID-19 pandemic.

We have shown this trend using the example of diabetology and cardiology in the Czech Republic. The number of telephone consultations reimbursed by VZP in both these fields doubled between 2019 and 2021. One can argue this to be only a short-term effect of the pandemic; nevertheless, the increases in performances of, for example, repeated and continuous glucose monitoring using a sensor and the computerised evaluation of glucose profiles from a glucometer are expected to persist.

The level of digitalisation of Czech healthcare is determined, among others, by the use of electronic records. Even though the facilities seem to be sufficiently equipped with the necessary hardware, many patients' records are still kept in paper form in 2020; in 13.9% of independent GP offices, 20.2% of other outpatient independent offices, and 6.9% of hospitals. Klocek et al. (2019) stress perceived obstacles both on the physicians' and patients' sides: lack of hardware and ICT skills, preference for face-to-face communication, perceived threat to the security of patients' data, and the lack of knowledge about the existing options.

Telemedicine in the Czech Republic is further hindered by a relatively late (August 2021) acceptance of the law on electronic healthcare, containing the essential infrastructure for digitisation, definitions, standards, rules, and responsibilities. In the meantime, especially the bigger healthcare facilities and private entities developed some telemedicine solutions (e.g., applications). However, there was no supervision over their compatibility.

We propose following best practices from other European countries (e.g., Estonia, Denmark, the Netherlands, and recently Germany) and innovating unified information technology infrastructure to process the electronic health records and securely transfer data. Both providers and patients need to be incentivised to use new technologies (for example, mobile apps and other digital devices) to increase the demand for telemedicine services. In the long term, we suggest setting up regional telemedicine centres that can cooperate with the smaller healthcare providers via telemedicine services.

Appendix

Selected VZP database description (columns):

Cardiology

- Noninformative provider's ID
- District
- Outpatient (AZZ) or Inpatient (LZZ) facility
- Number of physicians (FTE)
- Number of procedures by relevant codes (assigned to the relevant year by date performed)
    - 09614 (VZP): remote health consultation by outpatient specialist
    - 09127: ECG examination
    - 09511: minimum doctor-patient contact
    - 09513: telephone consultation of the attending physician by the patient
    - 09523: educational interview of the physician with the patient or family
    - 09525: physician-family interview
    - 17021: comprehensive examination by a cardiologist
    - 17022: targeted examination by a cardiologist
    - 17023: follow-up examination by a cardiologist
    - 17129: non-invasive ambulatory blood pressure monitoring
    - 17111: ECG examination by a specialist
    - 17242: telemetric ECG monitoring on an outpatient basis
    - 17244: 24-hour telemetry monitoring outside the ICU
    - 17247: remote monitoring of a patient with a pacemaker...
    - 17260: basic echocardiography
- Number of unique birth numbers for which relevant procedures were reported

Diabetes

- Noninformative provider's ID
- District
- Outpatient (AZZ) or Inpatient (LZZ) facility
- Number of physicians (FTE)
- Number of procedures by relevant codes (assigned to the relevant year by date performed)
    - 09614 (VZP): remote health consultation by outpatient specialist
    - 09511: minimum doctor-patient contact
    - 09513: telephone consultation of the attending physician by the patient
    - 09523: educational interview between physician and patient or family
    - 09525: physician-family interview
    - 13021: comprehensive examination by a diabetologist
    - 13022: targeted diabetes screening by a diabetes specialist
    - 13023: follow-up examination by a diabetologist
    - 13026: evaluation of glucose profiles from the glucometer
    - 13051: targeted diabetes education
    - 13053: team structured group education of diabetic patients
    - 13075: professional continuous glucose sensor monitoring
    - 13077: repeated continuous glucose monitoring using a sensor
    - 13081: optimization of insulin pump settings

    - 13083: bolus calculator settings for flexible insulin dosing
- Number of unique birth numbers for which the respective performances were reported

ÚZIS data collected through E (MZ) 1-01 questionnaire with the following questions:

- 81: The healthcare provider uses a computer.
- 82: The healthcare provider uses the internet with any connection.
- 85: The healthcare provider keeps the medical documentation fully in paper form.
- 86: The healthcare provider keeps the medical documentation in paper and electronic form (combination).
- 87: The healthcare provider keeps medical records fully electronic.
- 95: Do you use your electronic system to share clinical patient information with other healthcare facilities securely?
- 96: Do you use your electronic system to order and receive laboratory test results?
- 100: Does your electronic system allow patients to remotely view the pharmaceuticals lists in their electronic records?
- 103: Does your electronic system allow patients to remotely record measurements (e.g., pressure, temperature)?
- 104: Does your electronic system allow patients to enter text or other documentation remotely?
- 105: Does your healthcare facility offer patients to make an appointment online?
- 108: Did your healthcare facility provide real-time video consultations during the reference period?
- 109: Did your healthcare facility use any technology during the reference period, such as uploading images or other patient records later displayed in another location by another physician?
- 110: In the reference period, did your medical facility include one of the patients in the remote monitoring service or remote home care program?

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