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Article

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Use of eHealth Tools by Primary Care Physicians According to the Provided Healthcare in the Czech Republic

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Abstract

One of the main goals at the European level is that healthcare systems must be accessible but at the same time cost-effective and sustainable in the long term. The implementation of eHealth is one way to contribute to this goal. The presented paper is focused on the evaluation of the usage of eHealth tools in medical clinics in the Czech Republic. eHealth development is an important tool of health policy in the Czech Republic and an important goal of Czech health care reforms, as it has the potential to improve the availability of healthcare and to increase its quality and effectiveness. The aim of the paper is to evaluate the use of eHealth tools adopted in primary care medical clinics according to the type of provided healthcare and according to the NUTS 3 regions in the Czech Republic. The evaluation is performed by application of the multicriteria decision-making methods. The research results indicate that the usage of eHealth tools in medical clinics vary significantly depending on the type of healthcare provided and also in individual NUTS 3 regions. It was found that the eHealth tools are used to the greatest extent in gynecological clinics and to a lesser extent in dentist clinics. Based on the comparison of the eHealth Index, the ranking of the regions in the Czech Republic was determined from the most successful to the least successful in terms of the use of eHealth tools in medical clinics.

Keywords

Czech Republic, eHealth, ICT, MCDM methods, outpatient healthcare, TOPSIS

JEL Classification

H75, I11, I18

Introduction

Healthcare is an important sector of the national economy of the Czech Republic. Its scope affects more or less all members of society and is important not only in the Czech Republic, but also in all developed democratic countries (Stiglitz and Rosengard, 2015). In the Czech Republic, healthcare is one of the sectors of the public sector, where the needs of society are met in the public interest in the form of public goods and public services, which are financed mainly from public budgets (Osborne, 2010). The amount of funds used and redistributed in this sector is very important in the Czech economy. However, total health expenditure as a share of GDP in the Czech Republic is low (7,83 % in 2019) compared to other western European countries (Eurostat, 2021). The health care system is financed mainly by public expenditure. The Czech Republic has one of the lowest shares of private health expenditure among OECD (The Organization for Economic Co-operation and Development) countries (OECD/EU, 2020). The fundamental document of health policy in the Czech Republic is the Strategic Framework for the Development of Health Care in the Czech Republic until 2030, see MZČR (2021). Digitization of health care and implementation of eHealth is one of the important goals of this strategy.

Electronic healthcare is a part of the so-called digital healthcare. eHealth refers to a set of tools and services that use ICTs (Information and Communication Technologies) in healthcare (van Gemert-Pijnen et al., 2018). The basis of eHealth is the connection and sharing of information among patients, individual healthcare providers, and other participants with the usage of modern information technologies. Digital healthcare, as defined by the WHO (World Health Organization), means an area of knowledge and practice that is linked to any aspect of the adoption of digital technologies to improve health, from inception to operation, see WHO (2017). The term digital healthcare is often used today as a broad term that covers both eHealth and emerging areas, such as the use of advanced computer science. Digitization of health care and the development of eHealth is one of the priority areas that currently have the highest potential to improve health care in the Czech Republic and the key aspect of health care modernization and reforms (WHO, 2019; Chaudhry et al., 2006). The potential of this tool is seen primarily in improving the overall efficiency of the health system, but also in improving the health of the Czech population and as a means of coping

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with current trends in socioeconomic development such as demographic change and rapid technical and technological progress that are relevant at EU (European Union) level; see European Commission (2019) and OECD / EU (2020).

eHealth is significantly addressed at the EU level (OH et al., 2005; European Commission, 2012, European Commission 2019). The European Commission promotes cooperation between member states in the field of eHealth and assists them in developing and implementing cost-effective and interoperable eHealth solutions to improve healthcare systems. According to the requirements of Directive 2011/24 on the application of patients' rights in cross-border healthcare (European Parliament, 2011), the EU supports an eHealth network to ensure the sustainable contribution of European eHealth systems, services, and interoperable applications. The benefits of eHealth services for citizens, patients, and healthcare providers are also highlighted in the eHealth Action Plan 2012-2020 (European Commission, 2012), which proposes concrete measures to remove obstacles to the deployment of these services. According to studies of the European Commission (European Commission, 2018 and European Commission 2013), it is particularly important to pay attention to the implementation of eHealth tools in primary health care. Analyses have shown that the implementation of eHealth in primary care had an increasing trend in EU member states, but there is great diversity among the countries studied (Eurostat, 2021).

This paper focuses on the evaluation of eHealth in the Czech Republic. eHealth evaluation is one of the key activities in the process of implementing eHealth. It helps to determine whether the implementation achieves the results that were planned in the strategic documents, whether the right tools for implementation were chosen, or whether resources are allocated efficiently (MZČR, 2019). Currently, this is in the Czech Republic a very hot topic, but so far not sufficiently addressed by scientific research. Most eHealth evaluations focus on the national or international level. More detailed studies affecting the NUTS 3 level and different health care providers are not addressed. This study significantly contributes to the evaluation of the implementation of the current situation of eHealth implementation in outpatient health care in the Czech Republic, as it focuses on the evaluation of the use of eHealth tools in medical clinics according to the provided health care and according to individual regions of the Czech Republic (NUTS 3).

Literature Review

ICTs are an important part of many economic sectors; they are enabling the development of various areas of life and services (Oh et al., 2005; Walczak and Pólkowski, 2013). In addition, the demand for electronic forms of services offered in the public sector is constantly increasing (Abu-Shanab and Bataineh, 2014). eGovernment is currently an important part of the public administration of every developed state and includes, among other things, also the computerisation of healthcare (Twizeyimana and Andersson, 2019 or Ardielli and Halásková, 2015). By connecting of computer technology with medicine and the expansion of the Internet a modern field of healthcare was created, that is called eHealth (electronic healthcare); see Bruthans (2020) or Jung and Loira (2010). Both areas are also significantly interconnected (WHO, 2016).

The main goal is to improve the availability of appropriate information for healthcare workers, to share medical procedures and improve communication with patients; see Ahad et al. (2019) or Chaudhry et al. (2006). This concept is supporting prevention, diagnosis, treatment and promoting public health and a healthy lifestyle (WHO, 2019). New technologies and applications in healthcare open up a number of new possibilities (van Gemert-Pijnen, 2016). The implementation of eHealth tools and services in the Czech environment is focused primarily on higher availability, quality, safety and efficiency of the Czech healthcare system, together with an increase in the citizen's interest in caring for one's own health (MZČR, 2019). eHealth is also one of the important tools to improve the availability of healthcare and increase its quality and efficiency (WHO, 2019; MZČR, 2016).

eHealth consists of individual components, including Health Information Systems (HIS) such as Electronic Health Record (EHR) or Electronic Medical Record (EMR), telemedicine, decision support systems, or eConsulting. The specific field of eHealth is also mHealth (Trent, 2012).

HIS refers to a system designed to manage healthcare data. This includes systems that collect, store, manage and transmit a patient's electronic medical record (EMR), a hospital's operational management, or a system supporting healthcare policy decisions (Honavar, 2020). The purpose of an electronic health information system is to support health care workers in providing health care services to an individual client and to allow data exchange among service providers (Khubone et al., 2020). Records of the patient's health condition and procedures are an integral part of the treatment process. EHRs are systems that are used by health care professionals (doctors and nurses) to manage patient health information and data. They are built to share information among healthcare providers, such as laboratories and specialists, so they contain information from all clinicians involved in patient care (Alsyouf and Ishak, 2018 or Bhartiya and Mehrotra, 2019.) EHRs belong to the most advanced eHealth functionalities in the EU. Implementation in other fields of eHealth - HIS or Telehealth - remains much lower than the adoption of EHRs (European Commission, 2018).

Records of the patient's state of health and procedures performed are an integral part of the treatment process. From the point of view of keeping medical records of patients, the electronic form is currently increasingly applied,

but both forms (paper and electronic) can be used (Ardielli, 2021b). EMR is the patient record created by medical providers for specific physical examinations in hospitals and ambulatory environments and can serve as a data source for an HER (Jung and Loira, 2010). Between EMR and EHR, there is a difference. EMRs are only a digital version of the paper charts in the clinician's office, while EHRs are designed to reach beyond the health organization that originally collects and compiles the information (Honavar, 2020).

Other eHealth systems include, for example, applications for ordering patients, applications for the organization of work in medical facilities, information resources for lay people and professionals, or healthcare reporting systems (Bruthans, 2020; Khubone, 2020).

The practice of medicine that uses technology and ICT to provide health care through remote access is telemedicine (van Gemert-Pijnen, 2016). It allows healthcare professionals to evaluate, diagnose, and treat patients at distance using medical informatics and telecommunications (Středa and Hána, 2016). Telehealth is different from telemedicine in that it refers to a wider scope of remote health care services than telemedicine (European Commission, 2018). Telemedicine refers specifically to remote clinical services, while telehealth can refer to remote nonclinical services (European Commission, 2013 or Bruthans, 2020).

As the subsegment of eHealth has emerged recently the field of mHealth, which is characterized by use of mobile technology and special applications (Trent, 2012; WHO, 2017 or Ahad et al. 2019). Smartphones with advanced functions and tablet apps are especially used in this area. They allow consumers to capture their own health data, without the help or interpretation of a physician. Mobile health has great potential in medicine as an important tool to improve access to care and quality of health care services (Abidi, 2015; Cipresso et al., 2012; Trent, 2012).

In the European Union, a large number of national initiatives have been initialized to implement eHealth (Waterson, 2014). Experience has shown that, despite all the positives associated with eHealth projects, a number of implementation problems arise, which are of a different nature (financial, legal, social, ethical, and security) (Granja et al., 2018; Currie and Seddon, 2014). For this reason, it is not possible to offer precise instructions on how to proceed, the conditions for each country are individual and determined by local conditions.

Theoretical Background

The development of eHealth is one of the priorities of the Czech healthcare system (MZČR, 2021). The first mention of the concept of eHealth in the Czech Republic appeared in the state strategy of the State Information and Communication Policy (MČR, 2004). The aim was to use the most modern ICTs to streamline the provided healthcare and thus to achieve a higher quality of life for citizens. In the field of healthcare, an Interdepartmental Coordinating Committee for the Introduction of Electronic Healthcare was established in 2007. In 2008, they issued the document Objectives of the eHealth project in the Czech Republic, which are based on the document Material Objectives of eHealth Projects (MZČR, 2010). The content of the document was a plan for the introduction of electronic health documentation, electronic prescription of medications (eRecept), electronic identification of insured persons and others (Kolín, 2015). Furthermore, a strategy called Effective Public Administration and Friendly Public Services - Strategy for the Implementation of Smart Administration in the Period 2007-2015 was created, whose objective was to ensure a coordinated and effective way of improving public administration and public services (MVČR, 2007). The content included a number of strategic goals such as Czech POINT, eJustice, eHealth, eCulture, the system of data boxes, and more. The Strategic Framework for the Development of Public Administration in the Czech Republic for the period 2014-2020 was prepared in 2014. The global goal of this framework was to increase the quality, efficiency and transparency of public administration with a focus on weaknesses (MVČR, 2014).

In 2016, the Czech Republic's National Strategy for Electronic Health Care was approved for the period 2016-2020 (MZČR, 2016), which is based on the National Strategy for the Protection and Promotion of Health and Disease Prevention (Health 2020). The aim of this strategy is to support the provision of health care through ICT, which will result in better availability, efficiency, quality, and safety of health care in the Czech Republic. The main purpose is to make the best possible use of existing information systems that meet the requirements for quality and security, as well as the requirements for eHealth systems, which will be able to transfer data due to their predefined structure (MZČR, 2016). In 2017, the strategy was supplemented by the National eHealth Strategy Action Plan for the period 2016–2020, which presents a plan for the implementation of individual objectives of this strategy, shows the links of planned projects to this strategy and sets performance indicators. In 2018, the Digital Czech Republic program was approved. It is a set of concepts that ensure the conditions for the long-term prosperity of the Czech Republic in the context of the ongoing digital revolution since 2018. It focuses on shared services, cross-sectional interdepartmental solutions, and methodological and legislative initiatives that support overall digitization (MVČR, 2020; Digital Czechia, 2021). Implementation will take place through implementation plans, which summarize the individual goals and objectives, which will meet the goals of the program Digital Czechia.

The most recent act in the field of electronic health care in the Czech Republic is the approval of the Electronic Health Care Act in 2021. The Act presents the basic rules and architecture of the electronic health care system (MZČR, 2021; MZČR, 2019). Thanks to the law, data on healthcare professionals and patients should be accessible

more quickly and better.

Currently, most medical clinics in the Czech Republic are increasingly using ICT equipment. According to the Czech Statistical Office, see CZSO (2021), in 2017 97 % of physicians in the Czech Republic used computers in their own surgeries. Currently, computers and Internet connection are common equipment of medical facilities in the Czech Republic. Various eHealth tools can be applied in outpatient facilities (Klocek et al., 2019; Brooks and Manachemi, 2006; Rianne et al., 2019). The most common eHealth tools include online services, such as online consultations and online ordering for physical examinations, keeping electronic medical records or electronic prescriptions (Waterson, 2014).

Integration of ICTs in all types of hospitals is also an important matter (European Commission, 2019). The technological equipment of hospitals in the Czech Republic includes both modern medical tools and modern ICTs, through which patients can find out about office hours, other important information about the facility, online ordering, referring hospitals to their profiles on social networks, sending news or changes to email, the possibility of a mobile version of the website, or the possibility of WiFi connection for patients (Bruthans, 2020). Currently, all hospitals in the Czech Republic use an Internet connection and, at the same time, operate websites (CZSO, 2021). As access to the Internet increases, there is also more pressure for eConsultations to become a part of clinical practice (Trent, 2012). However, the necessary condition for the effective functioning of eHealth are, in addition to the appropriate hardware and software solutions, the computer skills of the users of eHealth tools, which are healthcare providers, individual physicians, and patients (van Gemert-Pijnen et al., 2018).

In 2004, a system of electronic patient health records was created in the Czech Republic, called IZIP, that contained all patient health information. However, the operation of this functionality was interrupted in the following years due to a malfunction (Janasová and Ardielli, 2010). Another important element of Czech eHealth is the issue of reporting incapacity to work. In 2020, the Czech Social Security Administration (CSSA) launched a sharp operation of the mandatory eNeschopenka system. The goal of this functionality is to simplify the flow of information between insured persons, doctors, employers, and the CSSA (CSSA, 2021). This system began to be used extensively during the Covid 19 pandemic, when remote solutions without personal contact were desirable (Ardielli, 2021b).

From 2018, there is in the Czech Republic the obligation to prescribe medical prescriptions only electronically, which applies to all prescribing physicians. The electronic prescription (eReceipt) is stored in the Central Repository of Electronic Prescriptions (CREP) and contains its unique identifier that is obtained by email, SMS, or mobile application (eReceipt, 2021).

Research background

Outpatient care facilities make up a significant part of medical facilities in the Czech Republic. These are mainly independent outpatient facilities, where more than 50 % of all physicians in the Czech Republic are active (ÚZIS, 2019). For this reason, they were selected for evaluation. Outpatient care is a healthcare that does not require hospitalization or admission to a medical facility that provides day care (Hamplová, 2019). It is provided by primary care physicians or specialists. In the case of illness, the patient usually first turns to primary care physicians, that is, general practitioners for adults, general practitioners for children and adolescents, dentists and gynecologists, where he is registered (OECD, 2020; Newton et al., 2005; Ardielli, 2021a). Outpatient care is provided in hospitals and by general practitioners and specialists in private medical facilities (ÚZIS, 2019; Ardielli, 2021b).

In the Czech healthcare system, a primary care physician is a physician providing primary care to registered patients. Specifically, these are the following specializations (Hamplová, 2019):

- General Practitioner for Adults (GP),
- General Practitioner for Children and Adolescents (GPCA),
- General Dentist (D),
- General Practitioner Gynecologist (G),
- Outpatient Specialist (SD).

High demands are placed on knowledge, skills, and competences for primary care services (Newton et al., 2005). Primary care providers are under growing pressure to provide high-quality and accessible care that is, above all, cost-effective (WHO, 2016). Primary care professionals are involved in innovative changes in healthcare, including the implementation of ICTs and eHealth (see Brandt et al., 2018). The use of eHealth tools is not very widespread in the Czech Republic in the international comparisons (Ardielli, 2021a). The main eHealth tool is the clinic website, where basic information is presented or online ordering can be made. Video consultations are not very expanded in the Czech Republic (Eurostat, 2021). Medical documentation is kept in different ways (electronic form or in a combination of paper and electronic form) (CZSO, 2021). Electronic systems (e-systems) are commonly used in Czech medical clinics, and prescriptions are issued in electronic form. This research focuses on a comparison of the use of eHealth tools by different primary care providers in the Czech Republic. The use of eHealth tools in

medical facilities is a prerequisite for affordable and quality services for patients in the Czech Republic (Granja et al., 2018 and MZČR, 2016).

Material and Methodology

The aim of the paper is to evaluate the use of eHealth tools adopted in primary care medical clinics according to the type of provided healthcare and according to the NUTS 3 regions in the Czech Republic. The evaluation is performed by usage of the multicriteria decision-making methods. The selected method for calculation is the TOPSIS method (The Technique for Order of Preference by Similarity to Ideal Solution). This method was used because it represents a suitable tool for the selection and creation of the ranking of the larger number of variants (Yoon and Hwang, 1995). In the research, the results are compared for the individual types of primary care outpatient clinics, which are the outpatient clinics of general practitioners (GP), general practitioners for children and adolescents (GPCA), dentists (D), gynaecologists (G), and specialist doctors (SD). The results of independent outpatient clinics according to NUTS 3 regions in the Czech Republic in the year 2019 are also compared using the eHealth Indicator. The eHealth Indicator was created by summing the results of individual types of outpatient clinics achieved by TOPSIS. The higher the value, the better the implementation of eHealth tools is supposed.

Two hypotheses are verified in the research:

- H1: The use of eHealth tools in outpatient medical clinics is according to the evaluation by usage of relative distance indicator c_i at an insufficient level in the Czech Republic.
- H2: The use of eHealth tools in outpatient medical clinics varies by the type of clinic providing healthcare.

In the research presented, the usage of eHealth tools adopted at outpatient clinics in the Czech Republic is evaluated based on 15 indicators. The data include 14 regions in the Czech Republic. The regions in the Czech Republic represent the NUTS 3 level. There are a total of 13 regions and the capital city of Prague is a separate unit, but in fact with the status of a region. Data were obtained from the database of the Czech Statistical Office (CZSO, 2021). Research shows the state of health electronization in 2019. The results were processed in the SANNA program (Jablonský, 2014).

In this investigation, outpatient clinics were selected for evaluation because a significant part of medical facilities in the Czech Republic consist of facilities that provide outpatient care.

There are also some limitations of the research, which lie in the availability of data, which are available for NUTS 3 regions only in 2019. In addition, there are some limitations concerning MCDM methods. Using TOPSIS, weights for individual criteria are applied that are essential for further calculation and significantly affect the result of the calculation. Therefore, it is necessary to pay attention to their appropriate determination.

Model and Methods

In this paper 70 aggregated values of independent outpatient medical clinics of the Czech NUTS 3 regions (variants) were analysed according to 15 eHealth indicators (criteria). Multi-criteria analysis of variants was used in the solved research. The multicriteria analysis of variants belongs to the group of methods for multicriteria decision-making. In models of multicriteria evaluation of variants, the set of variants is entered in the form of a final list of variants, which are evaluated according to individual criteria (Yoon and Hwang, 1995; Jablonský, 2014). In this research, a discrete model is used, where a final set of variants $A = \{a_1, a_2, \dots, a_p\}$ is given, which is evaluated according to the set of criteria $F = \{f_1, f_2, \dots, f_k\}$. Variants and criteria are arranged in a criterion matrix y_{ij} , where $i = 1, 2, \dots, p$ and $j = 1, 2, \dots, k$. The criteria according to which the most advantageous variant is selected are divided according to various aspects. Depending on the nature of the criterion, we distinguish between: maximization criteria (we assume that a higher value of the criterion is desirable) and minimization criteria (a lower value of the criterion is desirable) (Roszkowska, 2011).

The aim is to find a compromise option that best meets the requirements of the individual criteria. The purpose of model calculations even in these situations is either to find the "best" variant according to all considered aspects, to exclude inefficient variants, or to determine the preferential order of variants in terms of the whole set of criteria (Zmeškal et al.; 2013). The purpose of the presented model is to arrange a set of variants (the ranking of variants) by applying the TOPSIS method.

The TOPSIS method is based on the concept that the chosen variant should have the shortest geometric distance from the positive ideal solution (PIS) and the longest geometric distance from the negative ideal solution (NIS). It arranges the alternatives according to the indicator of relative distance from the baseline (hypothetically worst) alternative (Yoon and Hwang, 1995). Due to its high flexibility, TOPSIS is often and widely used in various situations to solve many theoretical and real-world problems (Roszkowska, 2011; Bhartiya and Mehrotra, 2019).

The process of TOPSIS procedure is as follows (Yoon and Hwang, 1995):

- Data are organized into the criteria data matrix;

- the normalized data matrix is created;
- weight-normalized data matrix is created;
- determination of the ideal and basal variants relative to the matrix values;
- distance calculation of variants from the ideal variant, respectively, basal variant is made;
- calculation of the relative distance indicator of variants from the basal variant;
- creation of the ranking by nongrowing values of relative distance indicator c_i .

The calculation of the relative distance indicator of the variants from basal variant is processed by formula (1):

$$c_i = \frac{d_i^-}{d_i^+ + d_i^-} \quad (1)$$

where

$i = 1, 2, \dots, m$;

The values of the calculated index range from 1 to 0. Value 0 corresponds to the basal variant NIS; value 1 corresponds to the ideal alternative PIS (Jablonský, 2014).

The usage of eHealth tools in outpatient clinics in the Czech Republic is analyzed on the basis of the following selected indicators, see Table 1.

Table 1. Weights of individual eHealth indicators.

Indicator $I_1 - I_{15}$	Weight of indicator $I_1 - I_{15}$
Equipment of medical facilities with selected ICT	25%
PC (I1)	0.0833
Internet (I2)	0.0833
Website (I3)	0.0833
Use of functions of medical e-systems	25%
Ordering for preventive examinations, tests (I4)	0.0417
Diagnosis (I5)	0.0417
Results of laboratory tests (I6)	0.0417
Prescribing drugs (I7)	0.0417
Warnings about drug interactions (I8)	0.0417
Ordering and receiving the results of laboratory tests (I9)	0.0417
Method of keeping medical records	25%
Full paper form (I10)	0.0834
Combination of paper and electronic forms (I11)	0.0833
Fully electronic form (I12)	0.0833
Offered services on website	25%
Online ordering (I13)	0.0833
Online consultation (I14)	0.0833
Online recipe (I15)	0.0833

Source: CZSO (2021), own processing

Indicators I1 – I15 describe the level of eHealth tools used in outpatient medical clinics. They cover the area of:

- Equipment of medical facilities with selected ICT;
- use of functions of medical e-systems;
- method of keeping medical records;
- offered services on the website.

In calculations using TOPSIS, the weights of individual criteria are also considered. All criteria have a maximizing

nature, with the exception of the indicator I10, which is a minimizing nature. Weights were determined using the scoring method.

Results

Outpatient clinics in the Czech Republic reached various values in selected 15 eHealth tools indicators. By use of box diagram, see Figure 1, the symmetry and variability of the data set and the existence of outlying or extreme values are evaluated. It is obvious that the most successful are medical clinics in indicators I1 and I2, which describes the active use of PCs (average value 97.9%) and the Internet (average value 97.4%). In contrast, the application of the surgery's own website with average value 45,9 % is less common (I3), which is a barrier to enabling follow-up online services.

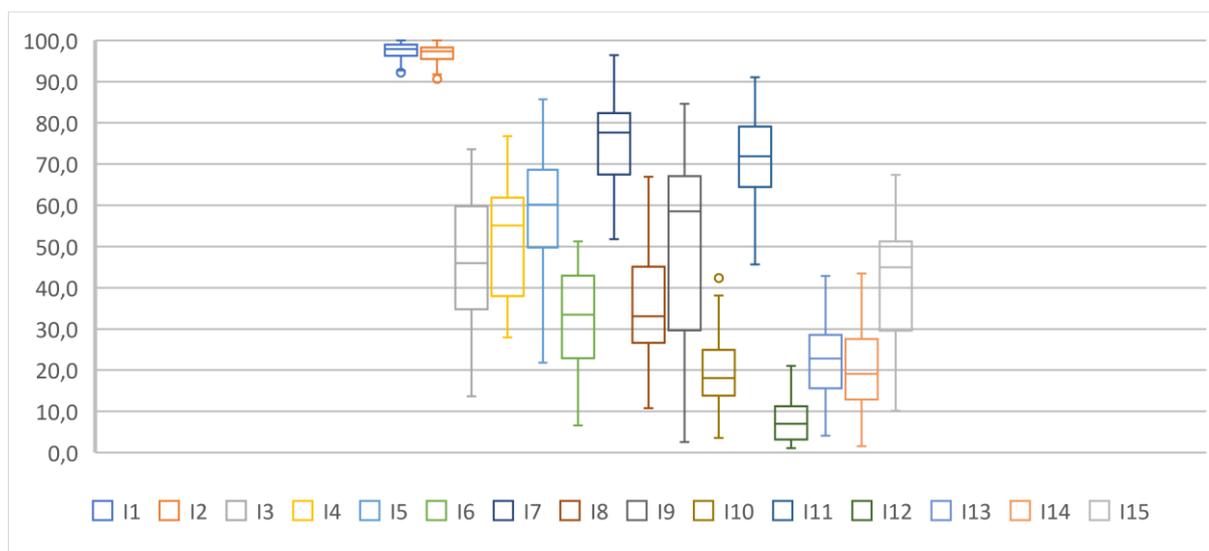


Fig. 1. Evaluation of outpatient clinics in the Czech Republic according to the values achieved in individual indicators by using a box diagram (2019).

Within indicators I4 – I9, the surgeries of physicians in the Czech Republic are evaluated, which have selected patient reports available in electronic systems. The most used is the function of electronic prescription of drugs (I7), where the doctor displays the prescription on a computer and the central repository assigns an identification code to the prescription. The doctor communicates this code to the patient. Based on it, the pharmacist will pick up the prescription from the central repository. In contrast, the least used function of the e-system is on average the function of notification of drug interactions (I8). This is a function in which the e-system alerts the doctor whether the patient is prescribed drugs that affect each other. The largest variance of values is in the case of the indicator I9 (ordering and receiving the results of laboratory tests).

Indicators I10-I12 indicate the method of keeping medical records. It is evident that doctors most often keep medical records in a combined form (electronic and paper), see I11 with average value 71.9 %, while the use of only electronic form is at a very low level (I12), reaching average value 7,0 %. In the case of electronic medical records, all documentation is acquired, processed, and stored only in digital form.

The use of eHealth services on-line is described by indicators I13 - I15. The electronic service of requesting an electronic recipe is most often used (I15). This means that the patient receives an electronic prescription by email or SMS code. The average value of this indicator is 45.0 %. In contrast, little used are online ordering (I13) and online consultation (I14), with average values of 22.9 % (I13) and 19.1 % (I14).

In Table 2, there are summarized descriptive statistics of the relative distance indicator values c_i achieved by calculation using the TOPSIS method. A total of 70 aggregated values of independent outpatient clinics were included in the calculation, which were evaluated according to 15 selected eHealth indicators. The highest value of the indicator c_i was 0.75865 (max value is 1) and the lowest value reached 0.19675 (min value is 0). The mean value is 0.46538.

Table 2. Descriptive statistics of relative distance indicator values achieved by TOPSIS.

Mean value	Mean error	Median	Standard deviation	Variance	Difference max-min	Min	Max	Number of items
0.46538	0.01298	0.47369	0.10859	0.01179	0.56189	0.19675	0.75865	70

Source: CZSO (2021), own processing

The results were most often distributed in the interval [0.4-0.5] (28 items), [0.5-0.6] (19 items) and [0.3-0.4] (11 items). In other intervals, the incidence of values was very low; see Figure 2. There was even no value in the interval of [0.8-1.0], which indicates a relatively large geometric distance of the best variant from the PIS.

The large geometric distance of the best variant from the PIS is supporting the hypotheses H1. It can be stated that the use of eHealth tools in outpatient medical clinics is according to the evaluation by usage of relative distance indicator c_i at an insufficient level in the Czech Republic. There is still significant room for improvement, especially in areas such as electronic patient record keeping or the provision of electronic services on outpatient clinics' websites.

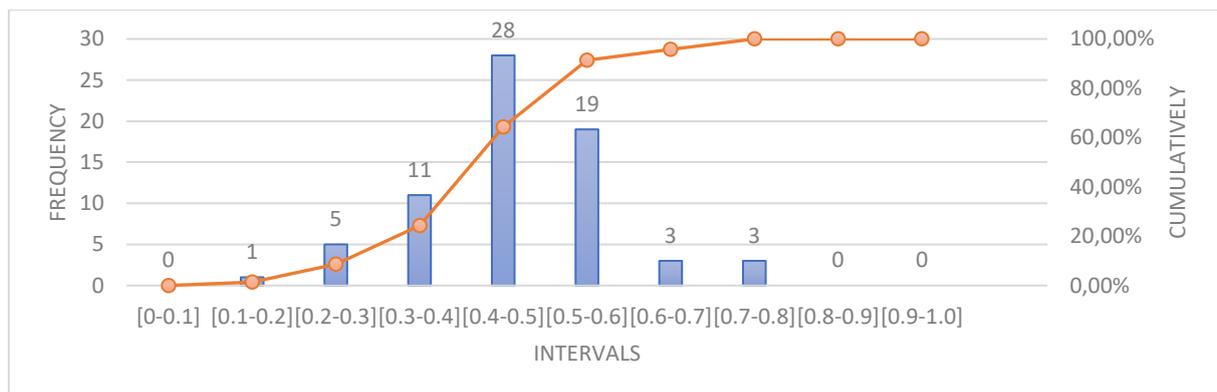


Fig. 2. Evaluation of outpatient clinics in the Czech Republic according to the values of relative distance indicator (2019).

In Figure 3, there are summarized the results according to the provided healthcare of the outpatient clinics. Each group of healthcare providers includes a total of 14 values, which are based on aggregated indicators values for individual NUTS 3 regions of the Czech Republic. The results achieved highlight the disparity between the individual types of outpatient clinics in terms of the use of eHealth tools.

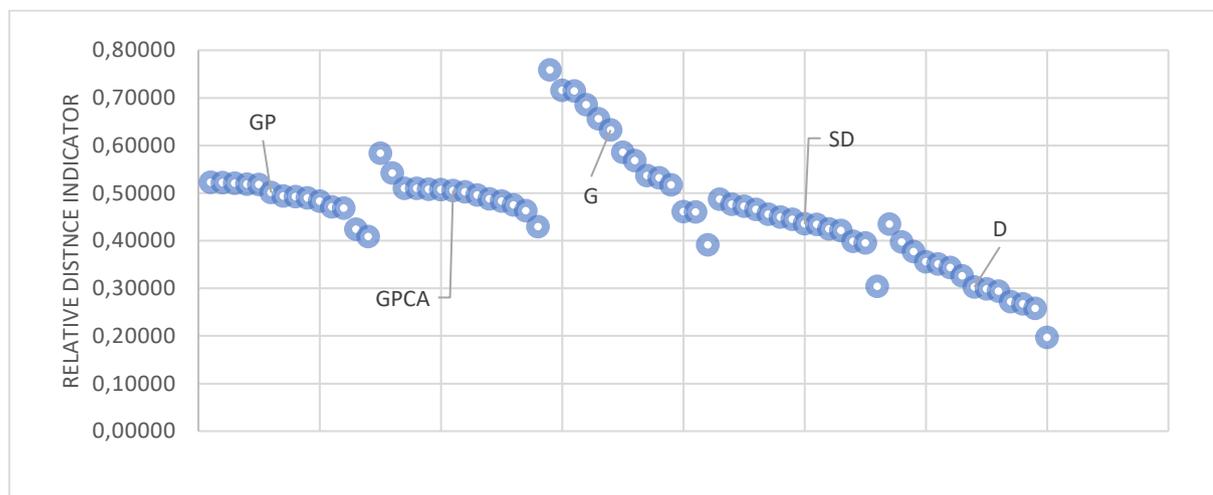


Fig. 3. Evaluation of outpatient clinics according to the provided healthcare by usage of TOPSIS (2019).

In terms of success in using eHealth tools, outpatient clinics of gynecologists appear to be the most successful, while outpatient dentist clinics reach the least successful results, according to relative distance indicator c_i .

In Table 3 there is summarized the descriptive statistics of relative distance indicator values by type of clinic providing healthcare. The highest mean value is reached by gynecological surgeries (G), but they also show the largest variance of values. Outpatient clinics for children and adolescents (GPCA) are slightly more successful than outpatient clinics for general practitioners (GP). Outpatient specialists (SD) show higher values than dentist ambulances (D) that ranked worst.

The average values of the individual types of ambulances indicate differences in the data sets. The similarity in mean values and variance is evident only in the case of GPCA and GP. This supports hypotheses H2. It can be stated that the use of eHealth tools in outpatient medical clinics varies by the type of clinic providing healthcare.

Table 3. Descriptive statistics of relative distance indicator values by type of clinic providing healthcare.

Type of clinic	Mean value	Mean error	Median	Standard deviation	Variance	Difference max-min	Min	Max
GP	0.48795	0.00955	0.49292	0.03573	0.00128	0.11428	0.40819	0.52247
GPCA	0.49991	0.00953	0.50364	0.03566	0.00127	0.15454	0.42891	0.58346
G	0.58656	0.02965	0.57666	0.11095	0.01231	0.36787	0.39078	0.75865
SD	0.43299	0.01237	0.43977	0.04629	0.00214	0.18347	0.30362	0.48709
D	0.31951	0.01669	0.31450	0.06246	0.00390	0.23763	0.19675	0.43439

Source: CZSO (2021), own processing

Figure 4 shows the values of the eHealth indicator in outpatient clinics achieved for individual regions of the NUTS 3 level in the Czech Republic. The eHealth Indicator in outpatient clinics was created by summing the values c_i for individual types of outpatient clinics. The higher the value, the better the implementation of eHealth tools in the region is expected.

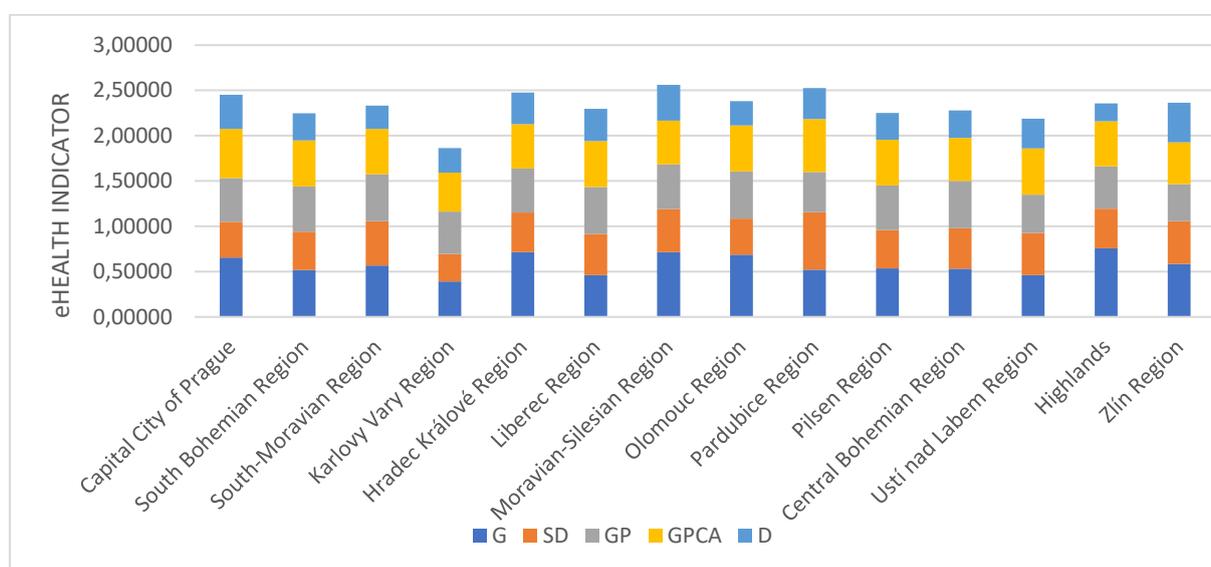


Fig. 4. Evaluation of outpatient clinics in Czech regions by use of the eHealth Indicator (2019).

Based on the comparison of the eHealth indicator in the NUTS 3 regions of the Czech Republic, it can be summarized that the most important usage of eHealth tools was identified in the Moravian-Silesian Region (2.56202), Pardubice Region (2.52645) and Hradec Králové Region (2.47844). Controversially, the lowest use of eHealth tools was found in the Karlovy Vary Region (1.86337), the Ústí nad Labem Region (2.18613), and the South Bohemian Region (2.24761).

Discussion

eHealth refers to a set of tools and services that use ICT in healthcare (Rianne et al., 2019; WHO, 2019). At the international level, this topic is widely addressed by international organizations and professional studies by various authors (European Commission, 2018; Oh et al., 2005; Brandt et al. 2018, Torrent-Sellens, 2018). The goal of eHealth is to improve the prevention, diagnosis, treatment, and provision of healthcare to citizens. The result is improved communication, the ability to share medical procedures and information between physicians, and coordination between healthcare providers and patients (Currie and Seddon, 2014). eHealth is therefore an important goal of the Czech Republic's public policy because it leads to an increase in the quality and availability of healthcare (MVČR, 2019).

The adoption of eHealth in primary healthcare is a very important task in the member states of the European Union (European Commission, 2012). According to the study, see European Commission (2018), the Composite Index of eHealth in EU member states was compared. The results showed that the adoption of eHealth increased from 2013 to 2018 in the EU member states, but there are large differences between the countries surveyed.

The Czech Republic has an average position among EU countries, according to research on eHealth deployment in EU countries; see Ardielli (2020). It is ranked 14th among all EU countries. The best ranking in this area was obtained by Denmark, Finland, or Estonia. In contrast, the worst state of eHealth was reported in Bulgaria, Slovakia, Luxembourg, and Lithuania. According to the Digital Economy and Society Index (DESI), the Czech Republic

ranked 17th in 2018 (Eurostat, 2021). Differences in the level of eHealth in EU countries were also confirmed by Georgiev and Shtereva-Tzouni (2020). In addition, the implementation of individual eHealth tools such as EHR or ePrescriptions varies significantly among EU member states (Bruthans, 2021; CZSO, 2021). However, EHRs are the most developed eHealth tools in the EU (European Commission, 2018). The different development of the implementation of eHealth in EU countries is the major barrier to adopting high-quality, cost-effective, and cross-border healthcare in the EU and represents the main task of European health policy (Currie and Seddon, 2014). It is obvious that more policy efforts on national and international level are needed to enable more improvements in EU countries and the fully functioning of the European eHealth system.

eHealth is the basic part of the digital transformation of the Czech society (MZČR, 2021). Although a larger number of activities were done in the Czech Republic in the direction of eHealth implementation lately (application of ePrescription, electronic sick notes, approval of the Electronic Health Care Act, the introduction of an electronic record of medicines), the biggest problem remains the fact that in the praxis of eHealth of the Czech Republic, there is still insufficient data sharing between individual systems and most health information systems work only in isolation, in a given health facility. This situation should be facilitated by an approved law that will contribute to the interconnection of systems and the functioning of EHRs. In addition, it is necessary to remove implementation barriers, especially legal and financial, increase the motivation and computer skills of physicians, especially the elderly ones (Klocek et al., 2019; Brooks and Menachemi, 2006; Torrent-Selles et al., 2018), and contribute to increasing the citizen's involvement in their own health care and prevention.

The novelty of the presented article is a specification of the situation in the field of implementation of eHealth tools in medical clinics in the Czech Republic. The evaluation of electronization and use of ICT in doctors' surgeries is an important element of evaluation of primary care in the Czech Republic, see (CZSO, 2021). However, this evaluation does not offer a comprehensive evaluation for individual NUTS 3 regions according to the use of eHealth in medical clinics, and the implementation and usage of real eHealth tools by individual primary care clinics and different providers remains unclear. In the presented research, attention was focused on both the results for individual types of clinics and regional results. First, the evaluation of ICT equipment and the use of eHealth tools according to the type of healthcare provided by independent medical clinics was performed; then the evaluation in regions of the NUTS 3 level was performed by using the eHealth Indicator. The NUTS 3 regions were ordered according to the achieved values. In the investigation, two hypotheses H1 and H2 were verified. The evaluation found that there are differences in the level of use of eHealth tools between individual types of medical clinics and also between individual regions of the Czech Republic. Based on the evaluation, the types of clinics and regions of the Czech Republic were identified, in which efforts in the field of electronic outpatient care should be increased. Evaluation of medical clinics according to the type of health care provided confirmed that eHealth tools are used primarily in gynecology clinics. Implementation should be supported, especially in outpatient clinics of dentists and specialists. The results achieved show that in the Czech Republic regions there is great potential for improvement in the monitored area. The average value of ci for all types of ambulances in NUTS 3 units was 2.3269. These findings also confirm the hypothesis H1 that the use of eHealth tools in primary care physicians' medical clinics is not sufficient in the Czech Republic. In particular, in the six regions (Karlovy Vary Region, Ústí nad Labem Region, South Bohemian Region, Pilsen Region, Liberec Region and South Bohemian Region), where the value of the eHealth indicator is below the average value, greater emphasis should be placed on the implementation and increase of the availability of eHealth tools for patients and physicians.

Conclusion

The electronization of health care has the potential to increase the efficiency, quality, and availability of health care services and ensure the availability of health information. Its development is therefore an essential task for the Czech Republic. Through electronization, it is also possible to solve the specific area of cross-border movement of citizens and patients, it is the tool for enabling the interoperability of health information systems, and it is a tool to strengthening of the position of patients and citizens in the healthcare system.

The paper focuses on the evaluation of the use of eHealth tools in outpatient clinics in the Czech Republic. The research results were presented according to the usage of individual types of medical clinics and by NUTS 3 administrative units in the Czech Republic. This type of study is important not only for the national level of administration, but also for the local level of administration, as it addresses all regions of the Czech Republic and compares the achieved level of eHealth according to the eHealth Indicator created within the research.

It was found that the eHealth tools are used to the greatest extent in gynecological clinics. However, even so, the highest value of the indicator ci was only 0.75865, which indicates a large geometric distance of the best variant from the PIS. Hypothesis H1 was confirmed, the use of eHealth tools in outpatient medical clinics is at an insufficient level in the Czech Republic.

In case of evaluation of individual NUTS 3 regions, the highest values of the eHealth indicator were detected in the Moravian-Silesian Region (2.56202), Pardubice Region (2.52645) and Hradec Králové Region (2.47844). The lowest values of the eHealth indicator were detected in the Karlovy Vary Region (1.86337), the Ústí nad Labem

Region (2.18613), and the South Bohemian Region (2.24761).

Differences in the use of eHealth tools were also found in individual types of outpatient clinics. While the mean value of gynecologic surgeries was 0.58656, in the case of dentist surgeries it was only 0.31951. The greatest similarity was shown by the doctor surgeries for adults (GP) and the doctor surgeries for children and adolescents (GPCA), see mean value and variability in Table 3, which means that in these surgeries, eHealth tools are used to a similar extent. Second hypotheses H2 were also verified, the use of eHealth tools in outpatient medical clinics vary by type of clinic providing healthcare.

The most important step for the future in the area of eHealth in the Czech Republic is the implementation of the Electronic Health Care Act. The scope of the law is the creation of essential legal framework, that should secure the data exchange in healthcare. All interactions between patients, doctors, insurance companies, and other entities are going to be more efficient and faster, with an emphasis on cyber security and data protection. However, the digitization of health care is only one of the totals of seven strategic goals that the Ministry of Health wants to achieve in the development of health care in the coming years. The others are the reform of primary care, primary and secondary disease prevention, implementation of integrated care models, integration of health and social care and mental health care reform, staff stabilization, optimization of the health care reimbursement system, and participation of science and research in health care priorities.

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