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Human Rights and Artificial Intelligence in Electronic Healthcare Systems

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Abstract. In this paper, we analyze e-Health system from the human-rights based approach, taking into consideration is technical and legal implications; this is important, multidisciplinary approach gives deeper understanding of the problem. Thus an overview of the E-Health legal environment is provided so as to provide a reader with the overall context of electronic healthcare. Technical details of functioning of e-Health systems is also given, with a view to give clear picture of existing risks. As we see the trend of the changing relations between medical professionals (doctors, nurses and other personnel of medical facilities) and patients, we paid specific attention to the issues of data protection, existing advantages and limitations for implementation in E-Health systems. It is shown that COVID-19 led to more extensive application of e-Health system and brought new perspectives to the process. We come to the conclusion that artificial intelligence methods are beneficial for medicine, and from the technical point of view can already provide valuable results. However appropriate legal framework is necessary to ensure the possibilities of control, verification and second opinion by human (doctor).

Keywords: healthcare, e-health, human rights, data protection, medical error, artificial intelligence.

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Права человека и искусственный интеллект в электронных системах здравоохранения

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Аннотация. В этой статье мы анализируем систему электронного здравоохранения с точки зрения прав человека, принимая во внимание технические и юридические последствия; это важно, так как мультидисциплинарный подход дает более глубокое понимание проблемы. Таким образом, нами проведен обзор правовой среды электронного здравоохранения, чтобы предоставить читателю общий контекст электронного здравоохранения. Приводятся технические подробности функционирования систем электронного здравоохранения с целью дать четкое представление о существующих рисках. Наблюдая тенденцию изменения отношений между медицинскими работниками (врачами, медсестрами и другим персоналом медицинских учреждений) и пациентами, мы уделили особое внимание вопросам защиты данных, существующим преимуществам и ограничениям для внедрения в системы электронного здравоохранения. Показано, что COVID-19 привел к более широкому применению системы электронного здравоохранения и привнес новые перспективы в этот процесс. Мы приходим к выводу, что методы искусственного интеллекта полезны для медицины, а с технической точки зрения уже могут дать ценные результаты. Однако необходима соответствующая правовая база для обеспечения возможности контроля, проверки и получения второго мнения со стороны человека (врача).

Ключевые слова: здравоохранение, электронное здравоохранение, права человека, защита данных, врачебная ошибка, искусственный интеллект.

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Introduction

The progress in the development of information and communication technologies (ICTs) in recent decades has led to qualitative changes in the healthcare sector, creating new opportunities in the field of medicine.

The possibilities of ICTs in healthcare are determined by the state of three components: information, telecommunications and medical technologies; thus, their development is an essential basis in the creation of electronic healthcare systems. Such systems are currently put into operation in a variety countries of the world, as the advancement of technologies makes it possible to digitalize many of the existing procedures.

This all lead to the development of the concept of *E-Health or Electronic Healthcare* (EH), which includes a complex of diverse information, communication and medical services provided at a distance. As defined in the Resolution WHA58.28 on E-Health (adopted in May 2005 at the 58th session of the World Health Assembly), the concept of E-Health implies "the use of information and communication technologies both in a given place and at a distance", combining everything related to the use of ICT in medicine.

Telemedicine, including its sub-divisions such as teleeducation, telemonitoring, teleconsultations, plays a major role in this concept. EH covers some other important aspect of healthcare, such as electronic medical records, exchange of medical and managerial data, analysis of laboratory research results and image transmission. Information support for scientific research, etc.

EH is one of intensively developing areas (Sajedi, 2020: 100104): the total funding made by investors in the E-Health industry from 2010 to 2020 increased from 1,1 billion U.S. dollars to 21.6 billion U.S. dollars. These systems have become even more important in the face of the pandemic COVID-19 (Bitar, 2021).

According to Healthcare Information and Management Systems Society (HIMSS) today, a significant number of countries in the world have EH systems, with the United States, Canada and Australia being the leaders in this field. As the HIMSS Annual European Digital Health Survey (HIMSS Survery 2021) shows European Union countries have also established EH systems that are advanced and noteworthy (Sweden, Estonia, Denmark).

However, human rights and their protection are often not viewed as an essential component of such systems; even though countries aim at promotions of respect to human rights. In practice sometimes relevant aspects fall out the focus of attention of those in charge of developing healthcare system in digital environment.

The research in (HIMSS Survery, 2021) analysed the biggest priorities in EH domain (Fig. 1). The dominant e-health priorities are related to security and data privacy issues, the development of which is not only a technical problem (Sajedi, 2020: 100–104). To develop a reliable security model, privacy rights and security for eHealth must be integrated into a comprehensive legal and security framework that addresses the rights and obligations of the healthcare provider: including physicians, hospitals and healthcare enterprises, the patient, medical and cybersecurity researchers, and Internet service providers. The collaboration of government, industry and academia is crucial to the development of security models that will not only protect individual rights, but will meet the future challenges essential to the delivery of healthcare treatment (Bonifazi, 2020: 242–258).

Introduction and development of healthcare system has important influence both on medical professionals (that is, medical professionals involved in the provision of medical services – doctors, nurses, etc.) and on patients (consumers of medical services). It is important to note that from the human rights perspective patients are a very broad category, which covers foreign citizens, stateless persons, and other categories of people that have quite diverse interests, needs, religious and cultural tradition; and thus it is important to take all this into consideration in the process of development of EH systems.

The EH is an interdisciplinary domain, which is influencing the research of the topic, as many different aspects are to be considered. In this respect, in our research the combination of technical and legal knowledge was under-

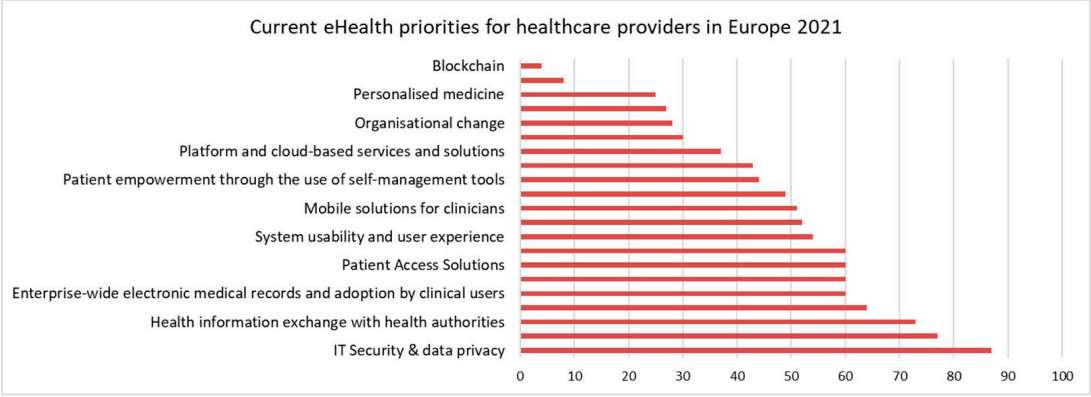

Fig. 1. E-Health priorities

lying the process of tracing the main trends, prospects and challenges in the formation of EH systems taking into consideration the human rights based approach, especially in such areas as decision-making and right to access health information. Specific attention was given to the application of artificial intelligence in medicine, as it influences significantly patient safety and security, and brings new risks with regard to medical errors.

In recent years, there's growing use of the notion "Smart medicine", that is, intelligent healthcare, which uses the latest mobile and digital achievements in the field of E-Health and mHealth, which encourages the development of smart and connected medical devices that ensure constant monitoring of patient indicators outside of medical institutions and, accordingly, the prevention of diseases. In some cases, this type of monitoring can recognize or predict critical health conditions of patients and it can warn health institutions if immediate first aid is needed.

Smart medicine
and electronic health records

The development of the E-Health (EH) is done in a variety of ways that can influence patient's rights. Currently, the creation of E-Health system envisages the formation personal account of the patient, through which it will be possible to make an appointment, call a doctor at home, get an extract from medical documents, a reminder of vaccinations and an electronic prescription, view the results of tests, etc. Implementation of many health information systems is accompanied by creation or linking to it a call service or support services, where all medical information and details, i.e. on the work of medical institutions, cost of their services and other relevant data, can be accessed in one call.

An important part of this process is of course the creation of Electronic Health Records (EHR).

EHR is in its essence a database about patient's medical status (with texts, graphical and other information about his health).

There are a number of human rights that need to be addressed during the process of creation and developing of EHR, which can include, inter alia:

- right to access and read all material in EHR;
- right to refuse to process his data in EHR,
- right to make decisions about his health (including within the framework of digital technologies such as electronic prescriptions),
- the right to remove information about himself and his health from EH systems.

Obtaining health information is an important part of realizing the right to health. Today, the availability of complete, reliable and understandable information is the basis for making further decisions about how and to what extent to receive treatment, how to plan your life taking into account the state of health, etc.

The importance of health data for any patient determines the fact that the information should appear in the EHR promptly and in a sufficient volume (in particular, this applies to the results of tests, data on past appointments, records of information provided to the patient during a personal visit to the doctor, data on manipulations, procedures, medical measures taken in relation to the patient).

In this regard, the **right to obtain information about one's heath** is an important part of States' efforts to improve public health literacy, as it enhances overall effectiveness of healthcare efforts. People are more likely to follow doctor's prescriptions when they understand why they are needed

EHR provides important opportunities for patients, compared to the "regular" way of accessing information about one's health which is stored in a paper format. This process could include making appointment with a medical official, visiting a medical facility, which often leads to problems such as the need to wait in line for a medical worker, requesting your medical card and trying to remember or obtain the copy of the information, limited time to receive information from him, the possibility of illness due to contact with persons who may be infected, etc. There are some other aspects which can hinder the familiarization with one's medical history, such as illegible handwriting of the doctor and the use of special medical terms, without deciphering.

Introduction of a remote access to EHR provides quicker and easier option, which requires only present of a computer (or any other device that can be connected to the Internet, including regular mobile phone), logging and choosing the information that is of interest. As a whole, it seems to be an important way of the realization of the right to access health information, which is an important component of the right to health.

From the technical viewpoint, there are number of steps that one should take in order to access his EHR (Ablameyko, 2007). The first step is authentication. For this, the user account is usually necessary, which is defined by an open user name and an encrypted password. When performing the identification procedure, the user enters her name and password, which are then checked by the system for correctness. If the first step is completed, the user opens a session with the server. All subsequent actions are performed on behalf of the account for which the password was successfully entered.

When accessing the database, the server checks whether the current user has the rights to the information that it requests. In case of a positive decision, the information is provided to the user. In case of a negative decision, the user is denied access.

So, for each HIS object a list must be set, according to which the HIS itself will check whether this user has the right to access this object or not. Such list is usually called Access Control List (ACL). The main objects for which an ACL must be set, are:

- information stored in the database;
- applications included in the system software package;
- commands and functions in applications that can be used with different access levels.

Thus, a patient gets access to EHR only by fully identifying themselves on the network, obtaining a username and password to access the system through their personal account. This is important, as it gives the patient the necessary level of security, as it excludes the possibility of familiarization of third parties.

As a result, within the framework of the current legislation, a centralized approach is considered as most appropriate, as it is focused on the creation of a single database of Integrated IEHR owned by the state and intended for the circulation of information within the health authorities with the right to make changes only by a medical professional. From the point of view of the patient, the IEHR provides for the creation of a personal patient account, where you can: make an appointment with a doctor, call a doctor at home, get an extract from medical documents, get a reminder of vaccinations, get an electronic prescription without visiting a polyclinic, see the results of tests passed.

The EHR can provide quick access to medical information, however the patients may face another problem: they might be unable to **understand medical terms**, slang and ab-

breviations, and thus still not be able to come to the right conclusions about their diagnosis and conditions. There are cases when people thought of committing suicide after seeing in their EHR diagnose or test result that they consider as fatal to them. Thus, automatic placement of all health information in EHR is not a right solution. Special attention should be paid to the so-called "sensitive information", i.e. information that can affect the mental state of a person (a message about cancer, HIV, etc.). In this case, before providing access to this information in the EHR, the doctor must personally familiarize the patient, prepare him morally and give explanations, i.e. the information is entered in the EHR immediately, and access to the patient is provided after a conversation with the doctor. It is obvious that in today's COVID situations, when certain restrictions on movement are in place, face-to-face contact might not always be appropriate; however there are now many technical ways that allow doctor to contact his patient and remotely discuss the details of his condition.

Thus, it is necessary to ensure that health information is fixed in the EHR in an accessible and understandable form to human perception (i.e. decoding of diagnosis). It is important in order to ensure clarity of information about one's health and methods of medical care. Further steps can include the creation of information support services (patient support services): descriptions of diseases, basic treatment methods, descriptions of medicines, etc.

When encoding diagnoses, a reference field should be provided for obtaining general information about a particular disease. This aspect is extremely important, since it is increasingly common for people to receive information from the Internet, which is often of poor quality. In this regard, the provision of general reference information for decoding the diagnosis recorded in the EHR is desirable for the patient himself. In order to avoid misunderstandings. Incorrect interpretation and subsequently self-medication, which can lead to serious consequences.

Another important patient's right, which is close to the personal data protection rights, is a right to **data portability**. At the moment, many medical institutions use their own software and ways of data collection and storage. Thus, patients have problems when they want to transfer their medical history to another institution, as they cannot be viewed or otherwise used there. It is important to aim at the creation of the single information space, which will make it possible to interchange data.

As we've discussed above, Smart Healthcare leverages the latest mobile and digital advances in E-Health and mHealth, driving the development of smart and connected medical devices. The approach to medicine is also changing: with smart trackers, doctors have much more opportunities to constantly monitor patient indicators outside of medical institutions and, accordingly, prevent diseases.

Many jurisdictions give patient a possibility to submit **additional information** about their health into the EHR (assessment of the dynamics (improvement or deterioration) of their condition, assessment of the impact of medicines, data on pressure, the amount of exercise performed, certain pain sensations, etc.). Other countries allow patients only to access their medical data, without making any changes to their own medical record.

In our opinion, the ability to be able to provide additional information is valuable. From the technical view point, it is advisable to provide a section in the EHR that the patient can manage independently. For example, he might be able to supplement the EHR with information obtained in private medical institutions (if the latter do not have access), consultations received abroad, as well as other data (pressure, temperature, etc.). Patients can also add data from their own devices, as there are able to measure the pulse, pressure and other parameters of the human body. Doctors often voice doubts as to reliability of this information; however, it can be useful sometimes, and in any case its application should remain at the discretion of the medical professional.

Let us now turn to the patient's right control of access to his personal data. Who can access patient's EHR? The answers to this questions vary significantly across the world. In some jurisdictions, patients can **decide who**

can access their EHR, and limit even doctors in access to their total medical history. The right of the patient to determine the limits of access to information about his health gives him the opportunity to independently decide whether he wants a particular medical professional to be able to see certain information about him. This can be achieved, for example, by using one-time access codes, generated by the patient who is willing to show his medical details to a specific person.

This approach is quite controversial. The positive thing is that the person himself has the ability to control access to his EHR, i.e. independently decides whether to allow him to get acquainted with his medical history or not. On the negative side, it should be noted that the patient is not always able to understand what information the doctor needs to access to provide qualified care and make the correct diagnosis, because the human body can be considered as a well-coordinated mechanism, and the more information the doctor has, the higher the chances of choosing an effective treatment.

The right to control access to information about one's health may be restricted. In particular to ensure the vital interests of the person, if their consent cannot be obtained. In Finland, the law provides that consent is not required if the patient is unconscious. In France, if a person is unable to express their will and if circumstances require it, the emergency doctor may, in the best interests of the patient, decide to access the EHR without obtaining prior consent.

In recent years, the prevailing position is in favour of providing patients with extended rights, that is, not only to limit access to their EHR, but in some cases to **delete their account** and all information about their health from EHR system.

Due to various circumstances in life, patients sometimes have special interest in selecting persons that can be **informed about their health status**. In Belarus, for example, relevant categories of people (close relatives) are listed in law. However this approach is not always proper, as it often turns out that people have quite tense relations with her relatives, and thus their decisions might not be appropriate. Thus, patients might wish to nominate other people to act in this role. EHR can be used to store this information.

EHR should also include and maybe even specifically mark some other important decision of a patient, e.g. desire not have certain medical care, including medical interventions (namely, consent to donation, blood transfusion, etc.).

EHR should also be considered as a tool for prevention of medical errors.

A medical error can be defined as a preventable adverse effect of medical care, whether or not it is evident or harmful to the patient (Hofer, 2000). Medical errors can result from new procedures, age extremes, complex or urgent care, improper documentation, illegible handwriting or patient actions. But human factor is a dominant source of the medical error (Hofer, 2000).

The analysis and evaluation of medical error can be based on methods of Human Reliability Analysis (HRA).

Though it is often said that E-Health can significantly reduce the level of medical errors, unfortunately they cannot be completely neutralized (List, 2021; Mohapatra, 2021). Therefore, the analysis and evaluation of medical error is important part of E-Health.

There are two ways of solving this issue that are generally discussed (Sanchez, 2017; Zaitseva, 2020:93). The first one is named as "cognitive" and considered in healthcare and medicine and focused on organizational, managerial, ergonomic, physiological factors and their influence on medical errors. Many investigations of this type are presented in journal BMJ Quality & Safety (https://qualitysafety.bmj.com). Alternative way is often named "technical" and bases the studies of patient safety and medical error on the methods of Human Reliability Analysis (HRA). Reviews of HRA methods in healthcare (Lyons, 2004; Sujana, 2016] show that typical HRA methods have restrictions and should be adopted for new area of application. There are differences in organizational and institutional contexts, and the values and needs of stakeholders in healthcare (such as clinical and professional autonomy), as

well as methods from other industries, have to be adapted appropriately.

There are a number of methods of HRA that are most often used in healthcare, for example, FMEA (*Failure Mode and Effects Analysis*), SHERPA (*Systematic Human Error Reduction and Predication Approach*), SPAR-H (*Standardized Plant Analysis Risk – Human Reliability Analysis*), HEART (*Human Error Assessment and Reduction Technique*) and CREAM (*Cognitive Reliability and Error Analysis Method*). Some adaptations and developments of these methods exist for the analysis of specific problems in the healthcare domain. For example, FMEA has been used in cancer diagnosis and treatment (Kapur, 2012) and SHERPA in radiation medicine (Faiella, 2018). The healthcare's SHERPA-based method is OCHRA (Observational Clinical Human Reliability Analysis technique) that allows evaluating of technical error in surgery (Foster, 2016). One more special methods of HRA in healthcare is HFMEA (Healthcare Failure Mode Effect Analysis) (Faiella, 2018). It is FMEA-based method which allows providing the qualitative analysis of healthcare system and for the probabilistic evaluation of medical error.

The process of the medical error estimation starts from the data collection (Dhillon, 2003). This may include ethnographic observation, questionnaires, and structured interviews, examination of time spent on specified activities, verbal protocol analysis. etc. This data is characterized by ambiguity, vagueness and incompleteness. Task description techniques allow this data to be presented in a form that is useful for error analysis and quantification. The most common approaches are hierarchical task analysis and cognitive task analysis (Dhillon, 2003). Task simulation methods build on task description and analysis aspects in different contexts (for instance under stress or time pressure) or in combination with other tasks. This step can be interpreted as qualitative step of the error estimation. The qualitative analysis is continued in the next step on human error identification. Most of these techniques are based on initial task analysis and perhaps also a task simulation to identify a list of the potential errors that could occur associated with this task. For example, such techniques as FMEA or SHERPA can be used in this step. It should be noted that some of techniques (for example SHERPA) incorporate a phase to quantify the human error probabilities. However, mostly the quantitative analysis is provided based on other techniques (Lyons, 2004).

There are some studies of special methods of medical error (Sujana, 2020; Zaitseva, 2020). The Data Mining based method for the medical error evaluation for incompletely specified and uncertain data is presented in (Zaitseva, 2020). The essential goal of this method is construction of the typical mathematical model for the reliability analysis. The well-known methods of the reliability evaluation can be used if the mathematical model is constructed. In paper (Sujana, 2020) authors represented the Safer Clinical System program which aim is to adopt and trial in healthcare proactive safety management techniques from safety-critical industries. Authors of studies in (Dhillon, 2003; Sujana, 2016; Sanchez, 2017) have shown that in medical error evaluation the failure of devices and software should be took into account too. This conception and specific of data collected for medical error evaluation cause the development or adaptation of new methods that allow processing of uncertain and incompletely specified data and quantifying medical error. In particular, the Data Mining based method in (Zaitseva, 2020) allows the evaluating of the complex socio-technical system and can be recommended for analysis and evaluation of E-Health system and/or its components considered in (Ablameyko, 2007).

In any case, EHR system should be construed in a way that takes into consideration the human rights based approach and patient's rights.

Data protection and patient rights

In many jurisdictions information about health is considered as special personal data that require special attention and appropriate measure of protection. As this information is especially sensitive for the people, creation of e-Health system need to take into consideration existing risks. A number of new high-risk ethical issues arose in the process of implemen-

tation of ICT into medical services, which are mainly caused using remote medical equipment, social networks and unclear laws. We were able to identify the following risks which merit specific measures to be addressed properly:

- Risk from device information leakage
- Risk from social network
- Ambiguities in the laws.

Although there are already some laws to protect information security, many laws and regulations on ethical issues are ambiguous. There is no clear indication on the subject of responsibility and the boundaries of information. For example, wrong treatment and diagnosis can cause additional pain and burden to the patient. Therefore, once information leakage occurs, it is still difficult for patients to defend their rights through legal channels. For example, when a device analyzes the users' data and draws a conclusion "do exercise", but the user's physical condition is not good, then how to define responsibility if an accident occurs? (Chang, 2019).

Medical information is a private area, even intimate, so patient confidentiality is the most important issue. But the data can be depersonalized. This way we will get both confidentiality and data integrity. This data will be useful for introducing innovations and strengthening cooperation between suppliers and partners, which will also benefit smart city medicine, including through the exchange of knowledge between doctors from around the world.

The question arises in Smart medicine: who is the true owner of medical data? Who can dispose of them and to what extent (can it be patient, doctor, clinic, insurance company, employer of computing service)?

IoT solutions will play a major role in Smart medicine. IoT interconnects all computational, mechanical, and digital technologies for data transmission over the Internet without the necessity of human interaction. Such interconnected technologies can be considered as remote monitoring systems. Remote monitoring systems based on a sensor system will show, for example, the level of glucose in the patient's blood, and immediately send this data to doctors for analysis and prognosis. Based on the data, specialists will prescribe treatment and prescribe personal medications. And the patient will print the pills at home on a 3D printer. All this without being distracted by visiting a doctor and searching for a pharmacy.

Smart medicine will allow a doctor to quickly communicate with a patient, conduct a remote course of treatment. Through special sensors and chips installed in the human body, the doctor, regardless of the location, will be able to get acquainted with important information about the patient's health status. For example, the doctor will be able to track body temperature, pulse, respiration rate, blood sugar, and blood pressure.

The device-to-device connectivity that underpins smart city services is also opening up a new approach to healthcare. In the concept of a smart city a huge amount of data is accumulated, including on the state of health and well-being of citizens. This data can be used for planning urban space and new services. These data can also invoke some actions focused on improving public urban health – a range of issues that affect urban populations.

This all, however, poses significant data protection issues. What can be done to protect personal data in Smart medicine? From technical point of view, related devices causing information leakage should be identified and protected. These include unauthorized connection to sensors, medical devices, gateways, fog nodes, and mobile devices that capture, aggregate, process, and transmit medical data to the cloud (Tian, 2019).

To respond to threats, IoT devices must always check and censor that the authentication is truly part of the electronic healthcare cloud, and that strong authentication algorithms and key management systems are used to ignore and block unauthenticated requests.

Then network security is very important issue. IoT technologies such as RFID and wireless sensor networks can provide identity verification and tracking capabilities. It should be able to repel cyber-attacks.

Training for patients is also very important, for example, end users should learn how to avoid network's attacks, choose strong pass-

words, and not buy used equipment or equipment of unknown source.

The most important thing is that all service providers should strictly abide by the principle of autonomy priority and provide multiple choices to users. Users have the right not to use these functions or freeze sensor usage and database at any time.

Traditional medical services should not be eliminated, people should have the right to choose between smart medical services and traditional medical services.

Ethical principles include trust, privacy and related data protection, property rights, dignity, fairness and proportionality. Trust must be present in E-Health in such a way that citizens need to be reassured that data are being processed properly, that they are up-to-date and of quality, and that security risks are being taken into account. People will face these problems in new future.

E-Health in COVID-19 pandemic

Electronic health systems that we've discussed above came into the focus of many in the outbreak of COVID-19 pandemic, when practical issues of e-Health application became prominent.

In general, it can be concluded that from the technical viewpoint using E-Health apps helps to mitigate the propagation of COVID-19 and preserve the lives of medical personnel (Mann, 2020; Mollalo, 2020). The use of virtual platforms for medical care reduces the saturation of emergency patients during the pandemic. These virtual platforms allow clinicians to effectively detect patients with early signs of COVID-19 before they arrive at the hospital. Also E-Health applications improve the availability of various medical services and health care in pandemic situation such as home health control for elderly patients and helps patients with minor diseases to get the supportive care they need while minimizing their exposure to other patients.

Authors in (Mann, 220) propose analysis of E-Health transformation under the pandemic of COVID-19 in a large academic healthcare system in New York City – NYU Langone Health (NYULH). A mass migration to telemedicine has been taking place during March and April 2020, co-occurring with a decline of over 80 % in in-person visits. Telemedicine urgent care volume grew from 82 visits on March 4 to 1336 after 15 days. Of these visits, 55.3 % were COVID-19–related, outpacing the 381 COVID-19 visits in all the NYULH emergency rooms that day. Telemedicine visits for urgent care were spread across age strata with the largest use in the group 20 to 44 years of age (Fig. 2). According to the research in (Mann, 2020) the E-Health system in urgent medicine was more effective in COVID-19 pandemic. The intensive application of E-Health in pandemic of COVID-19 has already proved to be an invaluable tool to not only divert an overwhelming volume of patients from the emergency rooms, but also transform the work medical practices, across multiple specialties. E-health system and tools can reliably manage thousands of patients over a short period of time, and provide care at

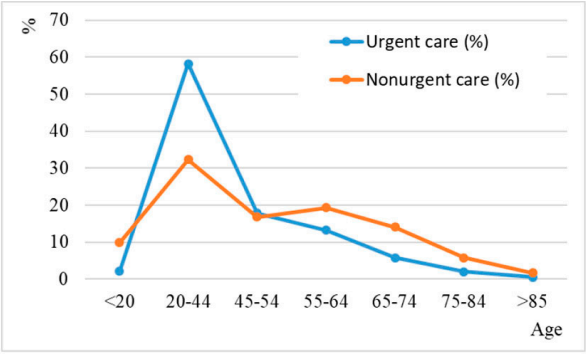

Fig. 2. Distribution of telemedicine visits by age

times of acute shortage in healthcare. The impact of COVID-19 pandemic to E-Health and telemedicine in last year leads the extension of their widespread availability.

Respectively, according to (Bokolo, 2021; Mann, 2020) adoption of E-Health system and virtual software platforms aids in the following:

- Decreases the time required to get a diagnosis and initiate treatment, stabilize, or quarantine a patient
- Facilitates close follow-up with patients who can be monitored from their home to avoid oversaturation of health facilities
- Reduces movement of people, minimizing the risk of intra-hospital infection
- Supports co-ordination of medical resources utilized in distant locations
- Prevents the risk of contagion, particularly for medical practitioners, who are key assets
- Aids in informing the general public
- Saves costs on disposable robes, antiseptic material, gloves, disinfecting of hospital spaces, etc.
- Trains medical practitioners who are new to the treatment of pandemic
- Monitors real-world data.

The efficiency of the E-Health systems in the pandemic is clear, but their wide application depends on some factors. Author of (Bokolo, 2021) considers three groups of factors that have great influence on the E-Health system use: organizational, technological, social. Organizational factors include:

- availability of funding (The deployment of E-Health system requires time and purchase resources and the lack of funding is a barrier for adoption of telemedicine)
- inadequate training (Medical practitioners who interact with patients through E-Health system should be trained and patients need training in adopting digital technologies.)
- workflow integration (Workflows for adoption of virtual software platforms should be drafted to minimize burden for medical practitioners and should them flexibility in providing medical care).

Technological factors are formed by:

- data privacy and access (The protection and privacy of patient's data must be important, but E-Health should guarantee data privacy and access protection, even if in urgent cases (like COVID-19) personal medical data of patients could be accessed without the need to obtain their consent)
- data security and risk (E-Health involves the digital collection and use of sensitive medical information among patients and medical practitioners, which could lead to a security risk, for the collection, use, and disclosure of sensitive personal data).
- broadband access and Wi-Fi quality (The quality of network communication is a key factor that influences adoption of telemedicine)
- availability of IT infrastructure (Uncoordinated and poor technology adoption mostly in developing countries is a major barrier to adopting E-Health)

The most important social factors are:

- licensure requirements (The licensing policy changes should be established during and after the pandemic without geographical borders).
- health insurance and reimbursement policies (Currently, most medical insurances do not cover telemedicine treatment and as such do not provide reimbursement for patients).
- lack of regulation and advocacy (E-Health system can be adopted as an effective tool in helping to manage the current pandemic. However, existing policies are also a barrier that limits how, where, and when they can be used).
- patients' and medical practitioners' willingness (The limited adoption of E-Health systems is mostly attributable to physicians' unwillingness to adopt telemedicine and many hospitals are not adopting telemedicine because many patients are not well-versed in virtual software platforms).

This experience of E-Health system application in the COVID-19 pandemic will likely create future expectations of care convenience and accessibility that will be hard to reverse once the COVID crisis abates. Similarly, the regulatory changes invoked to support easily accessible widespread telemedicine may be equally difficult to reverse.

Artificial intelligence in healthcare

The use of artificial intelligence (AI) in general has a positive impact on many areas of activity, since it is designed to simplify production processes, make life easier for both an individual citizen and society as a whole, but along with this, new challenges and problems arise.

Creation of AI systems in recent years can be characterized by the following

1) Huge increase in data sets sizes;

2) Huge increase in performance of computing;

3) Huge improvement in AI algorithms (Distante, 2020).

However, AI brings together with benefits also various problems. Three main factors can be given that influence significantly absence of trust in Artificial intelligence systems:

- decisions of AI are not transparent: in most cases, the decision taken by AI are not understandable and intelligible to humans;
- AI is biased: the decision taken by AI is not neutral because AI algorithms are learned on training data which affects the decision process;
- privacy and surveillance: there can be concerns about using and collecting some type of data

According to statistics (China, Statista), AI is widely used in medicine. Automation of various sectors of the economy through the introduction of robots creates a threat of failures, unauthorized access with the possibility of modifying embedded programs and actions, the consequences of which are extremely difficult to calculate. At the same time, the regulatory support in this area lags behind the needs of today. On the one hand, this is explained by the fact that adoption of legal acts usually takes place only after new technology (product) appears on the market. On the other hand, technology is developing so rapidly that it is almost impossible to do it in time, given the length of the procedure for adopting legislation, so in most countries it is not available.

If we consider application of AI in health systems, it is possible to see that AI can accelerate the diagnosis process and medical research. The usage of AI in medicine has potential benefits to both doctors and patients. Doctors, for example can be assisted by AI in following cases:

- Assessing the likelihood of complications of diseases;
- Remote first aid and patient data collection;
- Assistance in making diagnoses and prescribing treatment;
- Real-time data analysis of critically ill patients

However, using AI in medicine have some disadvantages:

- Violation of the right of patients to privacy and confidentiality of personal data, disclosure of medical secrets.
- The data from the electronic card is available to the insurance company, which will increase the price of the medical policy and life insurance if the patient does not lead a “healthy” lifestyle and does not follow all the doctor’s recommendations for treatment.
- Overdiagnosis.
- Access to the applicant’s medical data. Refusal of employment due to the presence of chronic diseases and / or genetic predispositions to certain types of diseases. The threat of discrimination against people based on physical and genetic characteristics.
- Many algorithms rely on very complex mathematics, sometimes called the “black box”. In some situations, we should know the reasons for decisions because in the medical area these decisions can affect a patient’s health.

The use of artificial intelligence also brings some ethical challenges, such as:

- Dominance of the technical type model
- Replacing the doctor with robotic systems
- No contact between doctor and patient
- Reducing the responsibility of the doctor
- Loss of specialized skills by doctors.

With the help of AI and machine learning technologies, medical researchers identify the relationship between the patient’s diseases, the conditions in which he lives, and his habits. Even the state of the environment can tell you which patients in a given region are at the high-

est risk. You can also find the most vulnerable regions or segments of the population to give them recommendations in advance, before you need serious medical care (Lehrach).

An important question arises here: can a doctor rely entirely on AI? Because cognitive systems have problems with the quality and volume of medical information. The data accumulated in patients ' medical records may be incomplete, contain errors. Inaccuracies, and non-standard terms. There are not enough records of the patient's life, habits, and behavior. Effective mechanisms for collecting this information do not yet exist. In addition, many of the AI algorithms are considered as black box in which the decision-making process is hidden in network layers. This can be problematic especially in situations that are not present in data set used to train AI algorithms, which will likely result in inaccurate AI decisions.

Another topical issue that needs to be faced are the legal implications of AI systems in healthcare. As soon as AI systems start making autonomous decisions about diagnoses and prognosis, and stop being only a support tool, a problem arises as to whether, when something 'goes wrong' following a clinical decision made by an AI application, the reader (namely, the radiologist) or the device itself or its designer/builder is to be considered at fault (Pesapane, 2018). Legal responsibility for decision making in healthcare will remain a matter of the natural intelligence of physicians. From this viewpoint, it is probable that the multidisciplinary AI team will take responsibility in difficult cases, considering relevant, but not always conclusive, what AI provided.

In the future, the development of intelligent health technologies can also be aimed at simplifying the patient's access to medical services. Today. In the emergency medical centers of hospitals, the order of admission of patients depends on how urgently the patient needs help. Thanks to the use of new technologies, this process can be simplified. Using the digital interface of a dedicated app, patients will be able to report their symptoms, which will be analyzed digitally using standardized symptom tracking protocols to determine the degree of urgency. Some medical services can be provided to the patient at home using digital tools and modern telemedicine. For example, trips to the doctor to ask a few questions and get a prescription for medicines can be replaced by medical kiosks, where patients can communicate with the doctor remotely and get the same answers and prescriptions. These decentralized offices will continue to rely on a reliable central health facility, which will act as the main center for building trust in digital technologies, as well as a digital service provider.

In the future, common digital formats and structures may enable the exchange of comprehensive patient information between all of that patient's healthcare providers. Multimedia and messaging standards can further improve remote treatment, remote patient monitoring, and remote diagnosis. Aggregated health data that is stored in uniform digital formats can improve medical research. Digitally stored genetic data can provide more individualized treatment for patients. Universal standardization, which can be determined by both cooperation between private enterprises and public standards policies, is a necessary prerequisite for any of these advances in E-Health.

Conclusion / Results

The new E-Health system gives fundamentally new opportunities in the development of the industry, qualitatively changes the approaches to the model of mutual support for all participants in the provision of medical care.

Medical professionals receive the necessary information at the time of providing medical care to the patient about critical inconsistencies or deviations from the current standards, or about changes in the patient's vital signs.

For technologies to be useful and transformative, they must be adopted and used by health professionals and end-users. If the tool is designed for patients, but they do not feel its value, or if they do not have enough skills to use this technology, then the digital tool does not benefit. There must also be compatibility between people, so that people's skills and way of thinking about digital health technologies coincide and that they can work with a variety of tools in different circumstances. This means that it is necessary to ensure that both patients

and medical professionals have access to training in E-Health skills related to available technologies.

The ultimate goal of the development of E-Health technologies is to shift the focus in the provision of medical services from the doctor and the hospital to the patient and their well-being through the use of digital technologies. This involves using digital systems to transfer patient data into a single Electronic Health Record that can be accessed by different health professionals, or using electronic medical prescriptions to make it easier for patients to get prescribed medications.

Many countries today considerable attention to the development of E-Health. Many E-Health systems such as Hospital Information Systems, Electronic Health Records and others have been created and work now in hospitals. Using these systems contribute greatly to improve quality of healthcare in a community.

As our research should this process show be structured in a way that promotes human rights. Attention is to be paid to international standards and state's obligation with respect to the right to health and other rights in the process of the development of modern healthcare systems. Foreign experience is valuable too. For example, European countries have extensive expertise in the sphere, that is why they are becoming a reference point around the world (in particular, issues of personal data protection, including the right to be forgotten and the right to delete information). In general, it can be confidently argued that the development of health care within the framework of the development of ICT is inextricably linked with the provision of fundamental human rights and freedoms in particular and society as a whole.

It is fundamentally important that when creating such a system, first of all, the person, his rights, as well as the need to ensure them as fully as possible in the new conditions, are taken into account. This is especially true today, as due to the COVID-19 the level of use of ICT in medical sphere has grown rapidly. People are now more than ever active in using electronic systems. This brings to the light the issues of security and data protection. Moreover, modern e-Health systems seem to be a valuable tool for detection and prevention of medical errors. The amount of data collected in electronic health systems is huge, that, it is possible to use it for different analytical purposes. In some cases, this can lead to the extensive use of the AI, as it has a very valuable potential for the development of healthcare (though some risks exist at the moment too, and it is necessary to take steps for their mitigation or exclusion).

As the analysis has shown, the practical implementation of the measures planned for further implementation, taking into account international obligations, foreign experience and national characteristics, should take into account the need to ensure human rights at the same time. It seems that only in this case, the interaction of medical worker and patient in a new electronic environment will be carried out as effectively as possible, which in general will become an important aspect of the realization of the right to health and other human rights.

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