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THE CLUSTERS OF TELEMEDICINE (THE SCOPE AND MAIN ECONOMIC ISSUES OF TELEMEDICINE)

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Abstract: *The introduction of telemedicine tools was motivated by the need to reduce the risk of infection. This paper deals with the main areas of telemedicine. It presents a definition of telemedicine and its most typical manifestations. It discusses the role of health in economic growth. It also discusses the legislative background to telemedicine. It analyses the two major clusters of telemedicine, primary health care and VR-based care. Primary care includes online rounds, remote examinations, remote diagnostics, remote intervention, remote monitoring and surveillance. The second cluster, based on virtual reality, already includes elements such as surgical interventions, pain relief, attitude modelling, rehabilitation, anxiety and phobia management, eating disorders management, relaxation, medical care in disaster situations. A separate chapter of the study deals with the economic indicators and revenues of telemedicine.*

Keywords: *Remote diagnostics, remote intervention, VR-based care, Rehabilitation*
(JEL code: I1, I3)

INTRODUCTION

There are marked differences in internet usage patterns, even in search methodology, between different social strata, genders, and age groups. Those who use the Internet more for information are primarily women, those with higher education, young people, and young adults. Many factors influence behavior in the virtual space, be it place of residence, profession practiced, or current studies and interests.

A typical attitude in our country is that some users are not looking for information for themselves. However, for a relative, family member, or friend, and in these cases, health content is the most prevalent. In many cases, the patient or his/her family member will seek information from internet sources before the first medical treatment, as the search for a quicker home solution is a primary idea for minor problems, and this has become a natural habit in the country. Of course, prior information can significantly shorten the visit if it is professional and increases efficiency since, in most cases, the vast majority of medical activity involves providing information and education. (Miller, E. A. 2003)

The dangers of obtaining information online from the wrong source demonstrate the justification for efficient and professional telemedicine systems, as a vast amount of information is still available to the user when browsing. Soon enough, the article seems quite technical; there needs to be regulation on publishing the subject.

In the context of pandemics, the term 'infodemic' has become a frequently used term, in parallel with 'pandemic,' to describe the rapid and widespread spread of misinformation. In a closed living environment, the need for patients to actively learn online has become a major challenge, which continues to place a heavy burden on medicine today. The emergence of misleading, pseudo-scientific articles negatively impacts the development of the doctor-patient relationship of trust. Preformed opinions with medical consultation make communication between doctor and patient easier, thus making it easier to make a diagnosis quickly and, in many cases, to treat patients effectively.

During the epidemic, moreover, the vast majority of general practitioners encountered patients who had already read an Internet resource before the telephone consultation and had adopted a negative attitude towards the definition of therapy. In such cases, using high-quality and professionally appropriate telemedicine strictly regulated by law would be important. Recording the anamnesis is extremely important in most cases, and in emergency care, it is paramount.

Decision-making in non-contact therapy is a matter of increased pressure for professionals; it is impossible in some medical specialties. The current advantage of using online interfaces is their popularity and professionalism. With appropriate professional control, they are a time—and cost-ef-

fective tool in the hands of healthcare professionals, and thus also an economic issue.

Quality online information (provided exclusively by an accredited telemedicine provider) supports the patient and the doctor in decision-making. It can also reduce the anxiety associated with morbus by creating a sense of control. It moves the healing process in the desired direction, and using the right resources also supports maintaining professional standards. It should be stressed that treatment in virtual space requires the same professional competencies as traditional treatment and thus guarantees the same professional standards.

Web content is a double-edged weapon in telemedicine since, in addition to authenticity, it is important to make it accessible to the public, mainly for the reasons mentioned above. Ethics is also a recurring problem, as the chances of the searcher encountering services of an economic nature, often for profit, increase with the severity of the illness in most of the results found on the Internet. In this respect, there is still a complete lack of legal background and a system of sanctions in our country.

Usability is a constant issue, as are the age and educational characteristics of the user groups. Our country has a high degree of ambivalence about health issues, creating a crisis of confidence in virtual health services. The only way to alleviate this is to develop professional and systematic telemedicine systems. (Győrffy Zs. szerk. 2021)

MATERIALS AND METHODS

This study is based on a qualitative analysis of legislative frameworks, technological developments, and economic impacts related to telemedicine in Hungary and broader European contexts. Secondary data were collected from existing literature, legislative documents, and official health economic indicators. The clustering of telemedicine services was performed using bibliometric analysis with VOSviewer software (2024), enabling the identification of major thematic groups in the field: primary health care and VR-based care. A descriptive approach was applied to present the medical, technological, and economic implications of these clusters.

RESULT AND DISCUSSION

DEFINITION OF TELEMEDICINE AND ITS MOST COMMON MANIFESTATIONS

Telemedicine is a health service with an appropriate professional structure but without direct contact between the provider and the recipient. Communication and activity between the two people occurs exclusively through a data transmission system.

In order to define telemedicine, it is worth distinguishing between medical activities according to the purpose of the relationship, its direction, and its professional quality, as follows:

- Teleconsultation: The doctor providing care can be involved in the process of diagnosis, prescription of therapy and treatment online, and maintaining one-way or two-way communication with the patient as required.

- Telemedicine: The examiner and the patient are spatially separated, and the diagnosis is made via a data communication system

- Remote monitoring: During the treatment of the patient, the current status is recorded by the transmitting systems and transmitted to the specialist care provider, who has the possibility of continuous monitoring but does not need to be physically present.

- Remote manipulation: To perform the examination, the healthcare professional uses remote sensors to examine an interactive space, which can be optical, robotic, or other remote-controlled devices (AAS, I.H.M.,2007).

The pandemic has given the development of healthcare in this area a huge boost, and the spread of telemedicine has been a forced process in managing the health situation, forcing the authorities to provide legal backing for its introduction and operation. The first legal amendments were made to two regulations, namely Decree 60/2003 (20.X.) of the ECSCM1 on minimum conditions for practices and Decree 9/2012 (28. II.) of the NEFMI2 on health services accounting (9/2012.(II. 28.) NEFMI Decree on the definition of outpatient specialized care activities eligible for financing from the Health Insurance Fund, the eligibility criteria and rules applicable to the use of such activities, and the settlement of claims).

Based on these legal amendments, the possibility of using telemedicine in a specific situation was created within the framework of public funding in cases where it did not conflict with medical-professional contraindications. Patient care was provided via the Internet or telecommunication devices in real time but separated in space. The following activities were developed and implemented in the context of the roll-out:

Diagnosis and follow-up

- Remote consultation during triage (professional pre-screening) to determine the need for care and, if necessary, remote consultation for further medical intervention and medication.

- Set up diagnosis and therapy using teleconsultation, applying remote diagnostics, and, depending on this, remote monitoring and, if necessary, teleconsultation.

- Specialist advice, consultation, and therapeutic advice by telephone

- Follow-up after diagnosis using telemonitoring and infocommunication tools and data-based assessment and implementation.

The introduction of telemedicine tools was motivated by the need to reduce the risk of infection, and the establishment of a professional and regulatory framework has made it effective to introduce and expand this form of care at the national level. The expansion has been ongoing ever since, as has the revision of the legal and regulatory framework, as bridging distance and physical presence have significantly increased the effectiveness of diagnosis and therapy under the pressure of specific legislation.

The time management provided by telemedicine optimally increases the number of care spectrums, and using fewer human resources and equipment also increases the provider's profits. In any case, it is cost-effective to introduce this method for primary care prescribing, and time management is significantly

facilitated. This will also allow for an increase in the number of services available and introducing new services. Of course, using more complex diagnostic and therapeutic procedures has its risks, and providers need time for experience-based analysis before stable implementation. (Bán A.,2013, 2014)

THE ROLE OF HEALTH STATUS IN ECONOMIC GROWTH

In the general public mind, the importance of an individual's health status needs to be sufficiently linked to the scale of the public health challenge and its impact on the economy, and people are most aware of its everyday role. Quality of life and the long-term preservation of an individual's longevity and working capacity is also an economic issue, whether we look at labor market characteristics or the burden and cost-effectiveness of the public care system.

1. For all economic actors, it is optimal for the worker to live as long as possible, to be able to work as long as possible, and to cost the employer and the public sector as little as possible, so the impact on the national economy is two-way. The role of health in the national economy is nevertheless a subject that is treated with caution, even in the case of professional decisions. It would be necessary for more sections of society to recognize that health is not only an individual interest and priority but also a key pillar of economic competitiveness. (Breen G.M., Matusitz J. 2010)

1. Introducing telemedicine can significantly raise awareness and increase cost-effectiveness. However, the upfront investment appears to be costly, and the return on investment will only be reflected in long-term economic indicators. Nevertheless, efforts continue, and investment in this area has tripled in the last three years (The role of health in economic growth, in IME- The journal of health leaders, Volume XVIII, Issue 7, September 2019).

From the population's point of view, telemedicine solutions are likely to positively influence health improvement, triggering a two-way process, ideally in terms of population and earning power. In addition, humanity's constant vulnerability to epidemics also underlines the justification for interactive care systems, as maintaining the ability to work in these situations is a critical element of economic performance. The development of telemedicine is constantly raising questions and generating problematic issues of both utility and medical and economic efficiency.

The critical prerequisite for a service system is strict adherence to technical standards

and compliance with strict technical standards by providing qualified medical equipment, which requires a significant investment by the provider. The above diagram illustrates the key issues in the operation of European telemedicine service delivery systems. With evolving technology, there is a growing number of similar healthcare services and mobile applications, the actual qualifier of which is the user community.

LEGISLATIVE BACKGROUND

The first official definition of telemedicine is described in the Decree of the Ministry of Health No. 28/2010 (12 May 2010), which states that"...telemedicine is a health service that allows communication between the provider and the recipient of care via a remote data transmission system, without the parties meeting in person." (Decree No 28/2010 (12 May 2010) of the Ministry of Health on the professional criteria and policy priorities to be applied in the procedure for the inclusion of health technologies used in preventive health care procedures in health insurance financing, and on the administrative service fees to be paid for certain procedures related to their inclusion). However, the legislation needs to provide detailed information on the specific services, and the professional conditions will be defined later in the Decree 60/2003 (20.X.2003) of the ECMR by setting the minimum conditions for the services (Decree No 60/2003 (20.X.) on the minimum professional requirements for the provision of health services).

The regulation allows medical specialists, paramedical staff, and clinical psychologists of various specialties to send health data using information communication tools and make diagnoses, therapeutic recommendations, and consultations without the patient being present if the care parameters and the medical judgment allow it. It is important that the conditions laid down in the regulation are met for the performance of the specified activity and that the legal requirements concerning the processing and protection of health and personal data are fully respected. (Fejes Zs., Mihók S., Matusz M. 2019)

In addition to the above, the legislation describes the possibilities for using teleconsultation, telediagnosis, and teleconsultation, as well as the minimum conditions for using teleradiology. Teleradiology is a telemedical activity in which the results of diagnostic imaging examinations are transmitted electronically between sites so that they can be evaluated and form the basis for diagnosis.

The scope of teleradiology includes the following services:

- Telediagnostics: The image evaluation following the examination is performed away from the examination site; this may be the first or second opinion with the opinion of one or both participating physicians.
- Teleconsultation: evaluation of the findings during or even after the imaging examination, if the result influences the course of treatment, or if the anamnesis includes an evaluated examination, the re-evaluation of which will provide new criteria.

Although many of the precise parameters are defined and regulated above, the domestic legal framework needs to catch up to the much more complex system of Western European regulations. It is worth noting here that the social security system in Western countries is tied, limiting and expanding the number, quality, and availability of benefits according to levels and even priority. Secondarily, the reason for this lies in the speed of legislation, not only in technical and infrastructural conditions, which implies the speed of technological development and the emergence of innovations.

In telemedicine, the pandemic emergency and the subsequent introduction of a specific legal framework have brought about a major change in our country, as the focus has shifted to virtual healthcare. The basic legal principles of teleconsultation were first published in April 2020 in Government Decree

157/2020 (29.4.2020) and then in the supplementary EMMI Decree 33/2020 (16.9.2020). 1. (33/2020.(IX.16) EMMI Decree amending Decree No. 60/2003 (X. 20.) of the Ministry of Social Affairs and Health on the minimum professional conditions for the provision of health services and Decree No. 9/2012 (II. 28.) of the Ministry of Social Affairs and Health on the definition of outpatient specialized care activities eligible for financing from the Health Insurance Fund, on the eligibility criteria and rules applicable to the use of such activities and on the accounting of services). The second wave of the pandemic has made it clear that telemedicine is indispensable and that its daily practice is essential for both public and private health services.

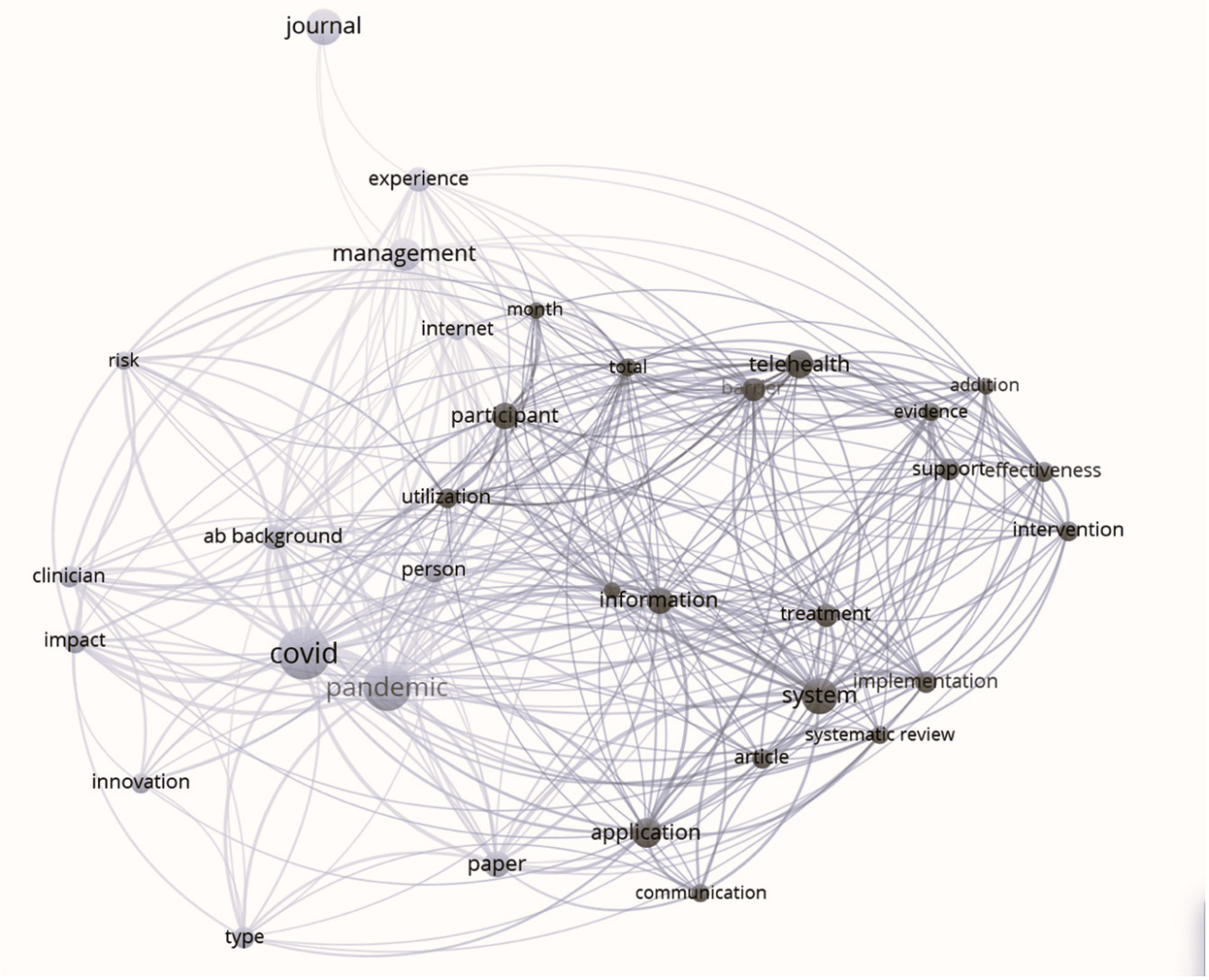
The content of the previously mentioned legislation is summarized in paragraph 37 of Act LVIII of 2020 on the application of telemedicine, with a precise definition of the term: telemedicine is an activity aimed at the provision of telemedicine in the absence of the patient:

- detailed assessment of the condition
- identification of diseases and risk factors
- accurate diagnosis, ordering detailed tests, and initiating treatment to assess the patient's condition better
- Assess the treatment outcome by remote consultation, monitor the patient's condition, and make a diagnosis by remote monitoring (Act LVIII of 2020 on transitional rules and epidemic preparedness in connection with the end of an emergency).

THE HEALTH CLUSTER SYSTEM ABOUT TELEMEDICINE

Clustering is a complex concept in itself; it involves clustering based on professional parameters. Their composition can be extremely diverse and, based on practice, constantly changing regarding the number of participants and their specialties. In our country, the number of clusters in the health sector has increased considerably in recent years, and experience with them has been a constant topic of discussion at medical conferences and in economic forums.

Figure 1. Cluster analyzis



Source: Own elaboration by VOSviewer (2024)

Cluster 1: Primary health care

The online visit is the encounter between doctor and patient, in our case, using telecommunication. The visit is not face-to-face, the submission of necessary and other medical documentation is done through data upload and transfer. The doctor diagnoses, provides information, and sends referrals, if necessary, based on the data uploaded by the patient. After the referral, there is also a data-based follow-up, consultation after the examination, and, if possible, therapy ordering. This is of particular importance in Hungary, as the hierarchy of the medical profession and the care competencies are closely interlinked. In the case of state funding, the regional provision of care should be noticed.

At present, the use of eHealth in Hungary is implemented at the state level using the unified EESZT (Electronic Health Service Space). The possibility of teleconsultation using the EESZT system is made possible by a state legal and regulatory system in such a way that only specific healthcare providers are entitled to use the system, and the basis for identification is the unique identification number used for social security purposes, i.e., the social security number. Patient data's electronic storage and transmission is linked exclusively to the social security number.

Tests, remote diagnostics

The term 'telemedicine' refers to the process whereby the doctor making the diagnosis is in contact with the patient exclusively in virtual space during the diagnosis. It can be very diverse in terms of its specialization, and the following areas can be differentiated according to the professional parameters of diagnosis:

- Imaging diagnostics: most radiological examinations, CT, MR, UH, CBCT, etc., where the findings are analyzed via an info-communication channel, and the results are made available to the specialist requesting the examination in the patient's medical records.
- ECG remote diagnostics: This form of care was first introduced in our country by the OMSZ. It consists of sending the ECG results obtained at the point of care to the specialist using mobile technology, who uses them to determine the most optimal place of care or even the parameters of the on-site care. The technical background is provided by a TTEKG device, which transmits the patient's findings to the cardiac center, where a cardiologist is in charge of the monitoring 24 hours a day. The findings can be immediately assessed, and the care facility to which the ambulance unit will transport the patient will be determined.

In the case of remote diagnostics, communication with the patient is necessary, since the exact formulation of the complaint is necessary to record the anamnesis, the doctor can also question the patient, and the results of the examination and the recordings are available in the virtual space, on the basis of which, in non-emergency cases, the specialist can respond within a few days, possibly suggesting therapy or referring the patient. If the online visit is insufficient to diagnose accurately, the doctor can also invite the patient for a personal visit. Currently, telemedicine services are included in the repertoire of major private providers in our country, reducing the time needed for treatment and increasing the number of treatments.

Remote intervention

Remote intervention, or remote manipulation, is a complex process that relies on remote sensing systems. These systems enable practitioners to conduct examinations or interventions from a distance. A notable example of this is the practice of endoscopic examinations. The use of robotic devices, in conjunction with video guidance, is gaining traction in this field.

The notion of telesurgery may seem bizarre in the current public consciousness. However, its development is becoming increasingly necessary, as the differentiated nature of surgical science means that, in some cases, no specialist surgeon is available. This also means that there is a great need for development worldwide. The chances of a patient's recovery in extreme cases are greatly enhanced by how quickly specialist care arrives, a specialism that would also be needed in trauma and emergency care. The specialty of telesurgery can also extend to other specialist medical activities, such as gynecology, orthopedics, neurology, cardiology, and specialist pediatric care. Currently, the best-known and most widely used robotic surgery system is the DaVinci system, which is used by more than eight hundred institutions worldwide. (Marescaux, J., Leroy, J., Rubino, F., et al. 2002)

Surveillance and Monitoring

Remote monitoring is required when a specialist is needed to care for and monitor the patient. However, sensors and signal transmitters trigger his presence and competence during the monitoring. Examples include using devices for measuring vital parameters, such as sphygmomanometers, pulse oximeters, blood glucose meters, or the ECG mentioned earlier. The system's operation requires the activity of the two sides of the signal-receiving system. This is the area where telecommunication devices and mobile applications have the most significant potential.

There are currently several working examples of remote monitoring in our country. Treating patients based on data recorded by a smartwatch or other device, either online or during a face-to-face visit, is good practice. Continuous monitoring is essential for some conditions and is becoming more convenient and faster with the development of smart devices.

During the data capture process, pre-screening is possible, whereby the device's AI-based software will flag extreme anomalies, alert the specialist care provider immediately if necessary, or even call for help. Some of the analytics can be analyzed using AI, but differentiation of rare pathologies is impossible. For the health professional, continuous control is essential in many cases. However, personal presence can also be a risk factor for the patient, as the COVID epidemic has shown very well. Maintaining continuous control is practical, and personal intervention is only necessary when necessary or immediately required.

An excellent example of necessity is in chronic care and

elderly care, where therapy is prolonged and requires minimal or infrequent but continuous supervision. (Á, Móré M, Zombory J.,2020): Other specialties also involve long-term patient care, and the method may be relevant in the case of antenatal care, psychiatry, or even oncology care, as these specialties require significant human resources.

Monitoring is also becoming increasingly valuable for health promotion. To strengthen the culture of health, individuals must have a rational view of their health status and be able to identify their vital parameters or deviations from them.

Telemonitoring has several advantages over classical methods, some examples of which are:

- negative changes in the patient's condition can be detected quickly, with a faster reaction
- rapid, professional, and cost-effective care, which determines the outcome of therapy
- Improved contact with professional staff (long-term harmful reduction in morbidity and mortality)

The basic system of telemonitoring:

- Biological sensors worn by the patient (ECG, blood pressure monitor, pulse oximeter, blood glucose meter, etc.)
- Smart IT devices (e.g., smartphones with apps, IT software)
- Additional devices that power the sensors (Bluetooth, wifi, ant+)
- Connectivity devices (Internet, GSM, private networks, VPN) with telecom solution
- Host-side systems (central servers, data storage, cloud and specialist systems)
- Healthcare providers and their staff (doctors, specialists, nurses, assistants, IT specialists)
- A Clinical Decision Support System (CDSS) is an interactive application that assists in diagnosis.

With the massive development of telemedicine and its integration into daily care, frontline healthcare professionals and the general public have been exposed to the concept of online rounds. Private and public care have used online rounds effectively during the pandemic, with several providers introducing it as a new feature in primary and specialist care. (Breen G.M., Matusitz J., 2010)

Cluster 2: VR-based care

VR technology can be applied in many specialized areas within the healthcare sector. It is still difficult to define the importance of technology at this stage, but we can see that it is proving to be professional in new areas in the short term. VR technology is not necessarily a therapeutic activity or a therapeutic tool only. In order to use it in the field of medicine in a controlled and regulated way, it is essential that its user is a medical professional and uses the virtual device responsibly. The technology is not inherently harmless, as there is a high risk of addiction.

It must always be made clear that VR technology is merely a virtual reality that provides a deceptively realistic experience but is not a substitute for real human contact. Particular care must be taken when dealing with minors; as for young people, the real and virtual worlds overlap easily, which can disrupt their development and socialization processes.

Surgical interventions

VR technology can be applied in several areas of surgery. Today, it is useful to model and perform surgeries in real life, support the patient's recovery, and provide medical education. Surgical training, surgical planning and modeling, integrated anatomy education, and telesurgery can all benefit from VR technology. 3D visualization of a limb or organ system allows all the details to be planned accurately before the operation. Also, it allows medical students to see the details of the entire operation.

On YouTube and IndaVideo, several educational short films are recorded with a 360-degree camera, which, when viewed through VR glasses, gives the user the illusion of being part of the operation in the flesh, close up, at the surgery site. Artificial simulation during examinations and surgical procedures allows surgeons to acquire outstanding and practical skills in specialized fields (neurology, cardiology) since learning during actual operations is a risk for the patient. VR offers infinite practical opportunities in a much safer environment than the core program of traditional surgical training.

Pain relief

VR applications, most notably fully immersive devices, can remove the user from one environment and transport them to another reality. In this way, making stressful and occasionally painful experiences for the patient more tolerable and pleasant can be supported. This could be relaxing music to help the patient relax in a harmonious virtual space or a soothing but static environment with neutral sound effects.

Attitude shaping

VR offers an opportunity to change attitudes toward problem patients over the long term through the use of real-world experience. Textbooks and theoretical knowledge alone are often insufficient to provide higher-quality care to patients, and in many cases, face-to-face contact with patients does not ensure that the health professional has an empathic attitude toward problem patients.

For example, some research has shown that medical professionals in the fields of addiction and geriatrics have a markedly negative attitude. Institutional education cannot fully prepare them for these experiences; VR technology can help. There is, for example, a virtual program where the user can experience the role of a person with dementia, with all its limitations. This helps to develop the necessary empathy.

Rehabilitation

There is growing potential in rehabilitation, and perhaps the most significant demand for telemedicine tools is being expressed in this field. Non-evasive technologies have already been effective in this field, but with the introduction of fully-evasive technology, real-world experiences can be created for

the rehabilitated.

Currently, the most researched area is related to rehabilitation methods for diseases associated with mental decline, such as Parkinson's, Alzheimer's, and other dementing diseases. The use of VR in this field is based on research showing that these patients can be developed using their traditional pedagogical tools, using their childlike instincts (competitive ability, ability to play), which are essential not only for maintaining mental health but also for maintaining physical fitness, dynamism, and muscle strength through linked exercises. The overall aim is to improve quality of life in the long term, and VR can be used to model a range of playful movement forms linked to daily routines, such as the popular virtual hand program.

Managing anxiety and phobias

The primary and most researched application of VR applications within the field of psychiatry is the treatment of anxiety, phobias, and mixed personality disorders. Software developments are becoming more and more common, which provide patients with the possibility to effectively and long-term get rid of their fears and phobias by using ever-changing methods. The basic principle of these interventions is a gradual and cautious approach, in which the VR experience helps the patient to face the phobia factor in an experiential but step-by-step way. This may occasionally require several years of therapeutic practice.

Another area of particular interest is the rehabilitation of people with post-traumatic stress syndrome. Life-like visualization is a great help in processing traumatic experiences, for example, in the care of disaster or war survivors, which requires a long period of therapy and gradual caution. Equally important and exciting is the pathology of social anxiety, where the fear factor can be a person, place, or even an object, which can be visualized and corrected by VR technology to correct abnormal behavior. Creating a realistic experience is also crucial in dealing with difficulties in social interaction. For example, in the case of vertigo, many VR programs are in use today, where the user can control the virtual situation.

Treatment of eating disorders

VR has also become an accepted technology for eating disorders, where visual motivation is an essential factor for people suffering from this disorder and where previously only video and images were available to professionals. VR is used in the treatment of eating disorders in several areas. In the treatment of anorexia nervosa, two of the most important areas are body image correction and overcoming food aversion. The virtual mirror is the most commonly used VR application to correct body image distortion.

Relaxation

VR applications can excellently enhance the positive effect of satisfying relaxation. Within a short period, the user finds himself in a relaxing environment, be it a forest, a river, a meadow with flowers, or even a room. In all cases, the experience is lived and reacted to in a safe environment where the sense of fear is reduced,

According to the medical indication, appropriate relaxation in recovery distinguishes two to three levels.

Medical care in disaster situations

Some specific medical situations cannot be reproduced artificially to a great extent or only partially, yet a high level of skill is required for the professional to carry out medical work in such situations. Disaster situations and the emergency medical care required in such situations are prime examples. Natural disasters cannot be prepared for under simulated or artificial conditions, but the professional needs to know exactly how and what type of tasks medical practitioners should perform in such circumstances and how to carry out procedures according to protocol.

Economic indicators and revenues of telemedicine

The economic indicators for telemedicine in the field of health services in Hungary have changed significantly and continue to develop dynamically. Some key economic indicators related to telemedicine in Hungary:

- Cost reduction: Telemedicine offers an opportunity for health systems to reduce administrative costs and the cost of patient care. For example, by reducing the number of outpatient visits or repeat tests.
- Improving accessibility: Telemedicine allows doctors and patients to connect remotely, improving access to healthcare, especially in areas where shortages of specialists or distances make healthcare challenging.
- Increasing efficiency: Telemedicine allows healthcare providers to manage time and resources more efficiently, as patient communication is done remotely and health data is available electronically.
- New business models: Telemedicine enables healthcare providers to develop new business models, such as subscription-based healthcare services or specialized healthcare applications.
- Technological development: Telemedicine constantly evolves with information and communication technologies that enable secure and efficient health data management and communication between patients and doctors.

These economic indicators also play a key role in improving the development and efficiency of healthcare services in Hungary. Technology and healthcare practices are constantly changing and adapting to new challenges and opportunities. (Daragó, L., Engi, Cs., Pesti, I., et al. 2010)

Calculating the economic efficiency of telemedicine is complex, and many factors need to be considered. Some important aspects to consider when assessing the economic efficiency of telemedicine are:

- Cost savings: It is essential to consider how telemedicine contributes to cost savings in the health system. For example, it can reduce the number of repeat medical visits, the length of hospital admissions and stays, and travel costs for patients

and health professionals.

- Increasing efficiency: It is also essential to consider how telemedicine contributes to increasing the efficiency of the health system. For example, remote consultations allow doctors to treat more patients in less time or allow health data to be shared more quickly and efficiently.

- Patient satisfaction: The introduction of telemedicine also can potentially improve patient satisfaction with healthcare. Benefits such as faster access to doctors, convenient home consultations, and reduced waiting times can increase patient satisfaction.

- Investment in technology: It is also essential to consider the technological investments needed to implement telemedicine. These include improving IT infrastructure, protecting health data, and educating and training healthcare professionals and patients.

In European countries, the cost of renting telemedicine equipment varies depending on the type of equipment, the duration of the rental, the needs of the renter, and the service providers' prices. In general, prices can vary between countries and regions. Here are some examples of prices for telemedicine equipment rental in European countries:

- Telemedicine equipment: The rental fees for telemedicine equipment can vary depending on the type of equipment, e.g., ECG, blood pressure monitor, digital otoscope, etc. Rental fees can be charged monthly or annually and usually range from several euros to several hundred euros.

- Video communication equipment: The rental of video communication equipment allows doctors and patients to carry out remote consultations. Rental fees are usually charged monthly or annually and vary depending on the service provider.

- Mobile health units: These devices allow healthcare providers to offer mobile health services like health screenings or examinations. The rental fees for mobile health units can usually be higher, including equipment and vehicle rental.

Prices may also include other variables such as the number and quality of equipment, services, maintenance and support, etc. Renters must obtain detailed information on prices and services and discuss the rental conditions with the chosen provider to find the optimal solution. (Dózsa Cs., Ruzsovics Á. 2019)

Discussion

The pandemic accelerated the adoption of telemedicine, revealing its transformative potential across the health care sector. This study confirms that telemedicine can be divided into two main functional clusters: primary health care and VR-based care.

Primary care applications—such as remote diagnostics, teleconsultation, and remote monitoring—demonstrate the feasibility of integrating digital solutions into public health systems. They offer measurable benefits in terms of cost-efficiency, time management, and access to care, particularly in rural or underserved regions. Hungary's implementation of EESZT exemplifies a centralized, regulated model of eHealth deployment, showing both the potential and limitations of top-down digital health policy.

In contrast, VR-based care represents an emerging and experimental domain. While currently limited in widespread adoption, its utility is growing in fields such as rehabilitation, psychiatry, surgical training, and phobia management. However, its ethical implications—especially regarding minors and the blurred boundary between virtual and real environments—necessitate stringent guidelines and professional oversight.

From an economic perspective, the study illustrates that telemedicine is not merely a cost-cutting measure but a long-term investment. Telemedicine reduces administrative burdens, hospital visits, and unnecessary procedures while improving health service accessibility and efficiency. Nevertheless, high initial infrastructure costs and a lack of harmonized regulation across Europe remain barriers to full-scale implementation.

Legislation in Hungary has evolved rapidly since 2020, responding to emergency needs with legal frameworks for teleconsultation and teleradiology. However, gaps persist in comparison to Western European standards, particularly in data protection, service definitions, and financing mechanisms.

CONCLUSION

Telemedicine is often referred to as a phenomenon of constructive or disruptive innovation. However, innovation is divisive, with numerous challenges and features affecting social responsibility and ethical issues. It poses a problem for the global health community, professional actors in the global innovation process, and funding companies and governments. A coordinated and robust approach to innovation management would be needed, together with professionals from health and other disciplines (IT, economics, technology). Over the last decade, telemedicine has begun to bridge the gap between innovations used at the extremes and integrated developments used by the majority. (McCue, M., Fairman, A. D., Pramuka, M. 2010)

In all European countries, telemedicine methods and, in the process of integration, even the patient care process itself, are increasingly being pushed outside the institutional framework and are slowly finding a place for themselves in virtual space. In personalized care and nursing, these methods are becoming more widespread in small and medium-sized countries. With telemedicine, patient care is increasingly shifting from hospitals to home care and monitoring by mobile devices. Convenience and cost-effectiveness are the main drivers. Receiving care at home instead of in a hospital is an improvement even for the patient.

This is also the trend in our country, where, in addition to regional specificities, different areas of the country are developing specificities in line with demographic conditions. However, telemedicine is also justified by the fact that, as the burden on regional care systems increases, there is a growing willingness to seek alternatives and, thus, to be open to telemedicine methods. (Daragó L., Jung Zs. 2019). Telemedicine has emerged as a critical innovation in modern healthcare, driven by the need for safe, efficient, and accessible medi-

cal services. This paper analyzed the dual-cluster structure of telemedicine—primary care and VR-based care—and assessed its legislative, medical, and economic dimensions. The findings indicate that telemedicine can significantly enhance healthcare delivery by improving accessibility, reducing costs, and promoting patient-centered care. However, successful integration depends on sustained investments in infrastructure, robust legal frameworks, and interdisciplinary collaboration.

LIMITATIONS OF THE RESEARCH

Reliance on Secondary Data: The study is predominantly based on literature review and legal documents, lacking empirical validation through surveys, interviews, or patient/provider-level data. Geographical Limitation: The focus is largely on Hungary and similar Central European systems, which may limit the generalizability of findings to countries with different healthcare financing models. Rapidly Changing Technological Landscape Given the fast evolution of telemedicine and VR-based healthcare, some insights may become outdated without continuous data monitoring and updates. Incomplete Economic Metrics: The analysis does not provide a full cost-benefit model or quantitative assessment of telemedicine's return on investment, which would strengthen conclusions about efficiency and sustainability. Regulatory Variability: The fragmented nature of telemedicine regulation across European countries makes it difficult to propose universally applicable policy recommendations.

POSSIBLE RESEARCH DIRECTIONS

Introducing telemedicine can optimize costs by reducing the need to admit patients to hospitals and travel and transport costs. It can also increase productivity and access to the labor market. Telemedicine requires much new investments. I envisage possible further research questions in the following areas:

1. Cost-Effectiveness in Public Healthcare Systems: Assessing how telemedicine optimizes expenditures in publicly funded systems (e.g., V4 countries) by reducing hospital admissions, travel needs, and time to treatment.
2. Comparative International Analysis: Benchmarking Hungary’s telemedicine development against countries with more mature digital health systems to extract best practices in regulation, financing, and implementation.
3. Technology Adoption and User Behavior: Analyzing demographic, social, and educational factors influencing the acceptance and usability of telemedicine tools, especially in marginalized or elderly populations.
4. Long-Term Economic Returns on Investment: Evaluating how initial infrastructure and technological investments contribute to long-term improvements in population health, workforce participation, and economic productivity.

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