The Implementation of Telemedicine Increases the Quality of Medical Services

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Abstract

The purpose of the article is to shed light on the characterization of the development and limitations of telemedicine in Romania, as well as on related managerial actions for change and implementation of telemedicine at the institution level.

Adopting an exploratory approach, this paper analyzes the documentation found in various publications and scientific articles to illustrate the potential advantages of implementing telemedicine in Romania. The method used is descriptive and quantitative, given the fact that the subject is very widely discussed.

Telemedicine cannot replace a classic medical examination, but it can play the role of a preliminary medical consultation, having multiple benefits for both the patient and the healthcare professionals. Telemedicine improves the quality of life of patients with chronic diseases that require continuous monitoring, reducing the frequency of visits to the doctor and the number of hospitalizations. Along with all the other benefits presented in this article, properly used telemedicine can be an important resource for health systems leading to an increase in the quality of medical services.

In a context where the development of telemedicine still remains deficient in this country, knowing the benefits offered by telemedicine in the medical field leads to the efficiency of its implementation within the institution. Through a more in-depth analysis of the advantages of telemedicine, we want to encourage providers of medical services and to expedite the transition from the design phase to the implementation and development phase at the national level.

The future of telemedicine foresees, along with a wide applicability of artificial intelligence, services for the management and improvement of chronic diseases, as well as health services offered in the comfort of the home, offering the opportunity for the Romanian health system to solve the unequal distribution of medical resources at the national level.

Keywords:

Telemedicine, telehealth services, healthcare services, quality of healthcare services, COVID-19, monitoring , diagnosis.

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Introduction

Telemedicine represents the virtual, continuous, and democratic provision of healthcare services without the need for physical contact between the patient and the healthcare service facilitator (Saigi-Rubio, F.; Borges do Nascimento, I.J.; Robles, N.; Ivanovska, K.; Katz, C.; Azzopardi-Muscat, N.; Novillo Ortiz, D., 2022).The World Health Organization (WHO) has also created a definition that states that telemedicine represents "the delivery of health care services by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of diseases and injuries, research and evaluation and for the continuing education of healthcare providers,

in which distance is a critical factor, all in the interest of promoting the health of individuals and their communities."

There are two types of telemedicine programs, synchronous and asynchronous programs (Allely, 1995). Synchronous programs occur in real-time and involve interaction and communication between the patient/client and healthcare provider, using a device such as a smartphone, tablet, or computer, through a website or application. Asynchronous programs, also known as "store-and-forward" applications, are not live and involve the transfer of data, images, videos, or other clinical information, which the provider analyzes and subsequently provides a response. (Anon., 2015).

1. A brief history of telemedicine

A modern summary of telemedicine: its early history began with the implementation of the telegraph, radio, and telephone in the communications field. Telemedicine was not a sporadic effort dedicated solely to the needs of historic conflicts, but rather continued to adapt and improve to support medical care delivery, especially in situations where healthcare providers and patients could not be in the same place at the same time. The first telemedicine consultations were conducted over the telephone, enabling doctors to communicate with patients and provide advice directly. Through the phone, doctors were also able to communicate with each other to exchange experiences and information. Modern medicine is considered to have started in the 20th century, and during this century, telemedicine experienced sustained growth due to electrical, electronic, and computerized innovations, which were implemented through electronic and then digital communication techniques and data processing with the help of computers. A key moment in telemedicine history was the pioneering experiments of the Dutch inventor of the electrocardiograph, Willem Einthoven (Barold, S., 2003) . He transmitted the electrocardiogram recordings over long distances through fixed telephony, the only means of communication available at that time. Thus, one of the first telemedicine applications was in the field of cardiology, not radiology as initially assumed. Following Einthoven's successful experiments, medical consultations were conducted using radio communication in the 1920s, 1930s, and 1940s between doctors in hospitals in Norway, Italy, and France, and patients on ships at sea and on remote islands. In the following decade, radiographic images were transmitted in the United States, followed shortly by similar experiments in Canada. A centralized telemedicine project was initiated in the United States in the late 1950s, when several programs were opened and operated for two decades (Medicine, 2012). Research was halted due to administrative causes, namely a lack of funding, for a decade. The new wave of programs had a much larger scope and coverage than those operated in the mid-20th century, bringing together a series of state or local initiatives carried out in the United States and Canada. For example, in the mid-20th century, radiological images taken in Pennsylvania were sent from one doctor to another over telephone lines, but the first proper teleradiology system was created by Canadian doctors several years later. Another example, in 1959, the University of Nebraska used interactive telemedicine to send neurological examinations, a pioneering event in the field, the first telemedicine consultation conducted via live video call. Many such programs were developed, most of them taking place in an academic setting. Among the documents transmitted were fluoroscopic images, radiographs, stethoscope sounds, and electrocardiograms (ECGs). In the late 1960s, the 911 emergency number was implemented in the US. The system encompasses all the attributes of telemedicine, providing continuous virtual medical assistance to anyone who seeks help. Telecardiology was a successful field for a group of doctors in Gwalior, India. They were able to detect arrhythmias based on ultrasound-coded electrocardiograms transmitted over the phone as early as 1975 (Montano, et al., 2022).

The last ten years of the second millennium have been marked by uneven progress, but telemedicine has been implemented in most medical and support activities, progress being due to the internet, which in that period became accessible to the general public and civil institutions. In addition to consultations, the field of telemedicine began in the 1990s to incorporate patient education modules, ways of transmitting complex medical images, remote video consultations or performing measurements of vital signs of the body, also remotely.

For the administrative sector, electronic medical records have appeared, which have facilitated the exchange and storage of clinical data. For the general public, web portals have appeared where patients could receive investigation results or messages from their treating physicians.

2. Current challenges for telemedicine

The present of telemedicine is supported by advanced telecommunication and electronic communication methods, as well as increasingly performant high-tech devices. With their help, and the mobile telecommunications infrastructure, telemedicine has become "omnipresent," democratizing access to medical care in most populous areas of the world. As a result, medical services are available anytime, anywhere with essential electricity and internet services, offering patients the necessary tools immediately, without additional administrative costs and time consumed by travel.

Telemedicine also supports patients who do not have access to reliable transportation or who may become ill from long-distance travel. This is also the case for patients with cystic fibrosis, who can choose a phone or video consultation to avoid nosocomial infections.

The benefits of telemedicine are reflected in three groups: the benefits of healthcare providers, the benefits obtained by clients and beneficiaries, and the benefits brought to society and the community. The United States of America provides a good example of this practice, with over 100 specialized telemedicine service centers and other organizations currently operating. Statistics from the American Telemedicine Association and the California eHealth and Telemedicine Center, two of the institutions that were among the founders of specific telemedicine regulation legislation, demonstrate that two decades of activity have brought real and significant improvements, both in terms of the speed, safety and quality of medical care and financially, as a secondary benefit.

Such centers can be found not only in the USA but also in countries such as Nepal, Mexico, Pakistan, India, Chile, Colombia, and Venezuela. Although none of these countries have shown outstanding performance in economic or social support sectors, they have recognized the importance and usefulness of telemedicine, and there are currently investment projects being implemented in telemedicine dispatch centers with innovative and appropriate equipment, as well as telemedicine networks to serve the medical act and the parties involved, the doctor and the patient. An example that can illustrate the above is the call center organized in Ecuador, considered to be the largest in the world, with 1200 employees, including 100 doctors, the rest being medical assistants and data operators.

Another example from the USA is the eHospital program, launched in 2014. It offers patients access to medical assistance during the night (7:00 pm - 7:00 am) through remote monitoring, with specialists being in constant contact with patients and evaluating their data and individual files in real time. The specialists involved in this activity can also intervene in case of emergency through technology, activating surveillance and communication systems installed near the patient in question, while also communicating with the patient's caregivers and family.

Cleveland Clinic launched a program in 2016 to improve hypertension remotely, aiming to minimize mortality and morbidity associated with high blood pressure using telehealth services. The initiative was first put into practice with the help of 80 high-risk hypertensive patients who were monitored and followed through a Bluetooth-compatible remote monitoring device. The device had the ability to export blood pressure values to a server. On the other end, a multidisciplinary team of doctors, nurses, and pharmacists used the information to adjust medication when needed and provide advice to improve the patient's lifestyle. The entire project lasted for 24 weeks, during which time the patients' systolic blood pressure decreased by an average of 7.5 mm Hg and their diastolic blood pressure by 3.1 mm Hg.

Remote monitoring of those with high blood pressure is also used in other institutions, such as the Veterans Association (VA), starting in 2016. Nearly 19,000 war veterans have benefited from access to the remote monitoring system, and the number is expected to grow.

3. US Laws and the statistics of telemedicine services

A benchmark legislation in telemedicine comes from the US, where regulations have been considered a barrier to interstate practice, as licenses limit the capacity of some providers. Federal law requires them to be fully authorized to practice medicine in the state where they offer consultations, where the patient resides, or where the service is provided. Providers with interstate coverage are required to pay multiple licenses because current laws on practice licenses vary from state to state. To mediate the situation, several states have joined the Interstate Medical Licensure Pact, offering the possibility of interstate and multi-state licenses in the future.

The federal law is called "Tele-Med" and was introduced in 2015 but remained unadopted. The law includes a passage referring to inter-state service provision and notes that "allows a Medicare provider to provide telemedicine services to a Medicare beneficiary who is in a state different from the one in which the provider is authorized or licensed to provide health care services." A study estimates that 7 million patients in the United States will use telemedicine services only this year. In 2016, it is estimated that 61% of the US medical sector institutions and 40% to 50% of hospitals have implemented telemedicine. In just one year, from 2012 to 2013, the telemedicine market saw a 60% growth (Mahar, Rosencrance and Rasmussen, 2018). Among the limitations that arose were low rates of reimbursement from health insurance funds to providers, but also dilemmas related to program licensing.

Telemedicine addressed to military medicine has registered notable results, reducing hospitalizations for mental health by over 40% in 2012, hospitalizations for heart conditions, especially heart failure, by 25%, and hospitalizations for diabetes and chronic obstructive pulmonary disease by approximately 20%. In 2015, 677,000 veterans received an average of 2.1 million telemedicine consultations (Dinesen et al., 2016). Another niche sector of telemedicine addresses people in rural areas or areas with limited access to health professionals, with 59 million Americans currently living in such areas. Such patients may face long waiting times for appointments and a lack of treatment continuity due to limited access to the same medical service provider.

Additionally, telemedicine offers access to care for patients without reliable transportation or those who may be too ill to travel long distances. For some patients, such as those with cystic fibrosis who do not want to come to the hospital for fear of contracting more antibiotic-resistant bacteria, a virtual visit to the clinic can be safer.

4. Methodology

The present article includes an analysis of the documentation found in various publications and scientific articles in order to illustrate the potential advantages of our country. Therefore, we conducted a comprehensive research into numerous sources of secondary data, such as articles, reports and books from the following areas: telemedicine, health services, quality of health services.

For the research, we also used electronic databases, such as PubMed, Academia. EDU, BRILL and Wiley Online Library. Other sources were the archives of different journals.

The method used is a descriptive and quantitative one, given the fact that the subject is very widely discussed.

5. Telemedicine in Romania

Telemedicine is rapidly developing in Romania, both in the private and public sectors, especially due to the need to provide medical services in the context of the COVID-19 pandemic. The government has recently issued regulations for telemedicine, which have allowed healthcare providers to offer online medical consultations, including electronic prescriptions (ROMANIEI, din 14 septembrie 2022 privind aprobarea Normelor metodologice de punere în aplicare a prevederilor Ordonanței de urgență a Guvernului nr. 196/2020 pentru modificarea și completarea Legii nr. 95/2006 privind reforma în domeniul sănătății) (ROMANIEI, 2020)

Through telemedicine, patients can receive online medical consultations, get electronic prescriptions, or receive advice on personal care in the comfort of their own home. Additionally, telemedicine can be used to improve access to medical services in rural or isolated areas of Romania where it can be difficult to obtain quality medical services.

In Romania, there are various online telemedicine platforms where patients can communicate with specialist doctors and receive recommendations regarding the diagnosis and treatment of diseases. These platforms are supervised by public health authorities and must adhere to medical standards and regulations to ensure quality medical services.

In the future, telemedicine is expected to become increasingly used in Romania, due to its benefits such as improving access to medical services for patients in rural or isolated areas, increasing efficiency, and reducing costs for the healthcare system.

Romanian telemedicine is regulated and includes various medical specialties such as pathology, allergy, clinical immunology, infectious diseases, cardiology, surgery, diabetes, hematology, oncology, ophthalmology and neurology.

According to a 2018 study by PwC for the European Commission, telemedicine is generally considered cost-effective in 73.3% of the cases analyzed in the literature. This is due to the reduction in costs associated with consultations, time, and travel, as well as the improvement in patients' quality of life.

6. Telemedicine and COVID-19

Recent history has added a chapter to the telemedicine sector. The COVID-19 pandemic in 2020 contributed to the acceleration of telemedicine development, after physical distancing became a social norm to prevent the spread of the contagious SARS-CoV-2 virus, the pathogen that created the pandemic. As patients with pre-existing conditions were among the most protected social categories, telemedicine interventions aimed to continue therapeutic management. Similarly, those diagnosed with COVID-19 also benefited from video or telephone calls with their doctors.

Although there were voices that contested the efficiency of such consultations, the patients who benefited from them proved otherwise, as their doctors were just as well-prepared as those they would have visited in person. Medical staff were able to prescribe medications based on the identified conditions and could be with their patients as long as needed, all with the help of technology.

Also, thanks to telemedicine, the costs of a consultation were reduced, as several cost-generating factors were eliminated. Telemedicine enables the efficient distribution of personnel and medical care resources in a care unit or system, while also reducing the financial impact that patient absence could have. Telemedicine can also reduce the number of unnecessary visits to the emergency room and private clinics, as well as hospitalizations.

7. Artificial intelligence, an possibility for telemedicine to better understand each patient

A novelty in telemedicine is represented by the integration of artificial intelligence. An evocative example is the algorithm for determining a personalized diet. One of the advantages of such an algorithm is that it eliminates the need for randomized studies to follow subjects who have followed the same diet for years, thus being suitable for evaluating the effects of the diet.

The success of artificial intelligence in analyzing large data sets has led to a discovery by researchers indicating that dietary plans should be personalized based on human metabolism, digestive microbiome, and the surrounding environment.

Based on this technology, researchers Eran Segal and Eran Elinav from the Weizmann Institute of Science in Israel published the paper "Personalized Nutrition by Prediction of Glycemic Responses" in the journal Cell (Zeevi et al, 2015). They stated that high postprandial glycemic levels are an indicator of the risk of diabetes. However, avoiding sharp increases in blood sugar is not demonstrated to eliminate the risk, but is only an individual organic response to food. The results obtained are objective proof that each individual reacts differently to food, even if the type, quality, and quantity of food are the same.

The study involved 800 people who did not have a diagnosis of diabetes. The data collected from each participant included meal times, the amount and content of food and drinks consumed, physical activity, height, weight, and sleep patterns. In addition, participants had their blood quality, intestinal microbiome content, and blood sugar analyzed for one week. During the study, participants received over 5,000 daily meals consisting of chocolate and ice cream, as well as another 47,000 meals based on the foods the subjects regularly ate.

The data was processed using artificial intelligence to delimit the factors that determine a different glycemic response in some subjects. Based on this analysis, an algorithm was constructed that generated over 100 factors that could determine a different glycemic response, with the intestinal flora being central, as it can create a unique response.

This applicability of artificial intelligence offers the possibility for medical and nutrition specialists to intervene more quickly and easily. Through smartphone applications, users can scan their food, sending the data to servers with access to databases in which our glycemic response to various foods is recorded, and

with the help of artificial intelligence, they can find out how their metabolism will react to the scanned foods, ultimately creating a diet tailored to their own needs.

8. The management of telemedicine services

Management of telemedicine services refers to the strategies and practices used to ensure the efficient and effective delivery of health services through remote communication technologies. This involves managing human, technological, and financial resources, as well as defining objectives, policies, and procedures for the delivery of telemedicine services.

Management practices for telemedicine services include:

- Identifying patient needs and developing services tailored to those needs.
- Selecting the appropriate technology for delivering telemedicine services and ensuring compatibility with other existing systems.
- Ensuring data security and patient information confidentiality.
- Recruiting and training medical and technical staff specialized in the use of telemedicine technologies.
- Planning and implementing monitoring and evaluation activities for the quality of telemedicine services.

To ensure proper development of telemedicine services, their management must achieve the following key areas of telemedicine management:

- Infrastructure: Telemedicine requires adequate infrastructure such as reliable internet connectivity, video conferencing equipment, and secure electronic medical record (EMR) systems. Telemedicine managers must ensure that the infrastructure is adequate and meets the technical requirements for delivering quality healthcare services.
- Authorization and regulations: Telemedicine managers must be familiar with licensing and regulatory requirements for telemedicine in their jurisdiction. They must ensure that healthcare providers providing telemedicine services are licensed and that the services provided comply with all relevant regulations.
- Staff training: Healthcare providers providing telemedicine services must be trained to use technology and the EMR system efficiently. Telemedicine managers must ensure that providers receive adequate training and support.
- Workflow and processes: Telemedicine managers must develop and implement workflows and processes that are designed to support the delivery of telemedicine services. This may include scheduling, patient evaluation and assessment, documentation, and follow-up care.
- Quality control and monitoring: Telemedicine managers must establish quality control and monitoring processes to ensure that telemedicine services are delivered in accordance with best practices and that patient outcomes are optimized.
- Patient education and engagement: Telemedicine managers must develop strategies to educate patients about telemedicine services and engage them in the process. This may include providing information about how to access telemedicine services, explaining the benefits of telemedicine, and addressing any concerns or questions patients may have.

To ensure effective management of telemedicine services, it is important for providers to be able to collaborate with other entities in the healthcare field, tailor their services to the needs and requirements of patients, pay attention to data confidentiality and security aspects, train their staff in the use of telemedicine technologies, and monitor and evaluate the quality of services provided. (Kuzmar, I.; Mercedes, R.,B., 2014)

Results and conclusions

The future of telemedicine foresees, alongside a wide applicability of artificial intelligence, services for the management and improvement of chronic diseases, as well as healthcare services offered in the comfort of one's home.

Data from the United States indicates that services for the management of chronic diseases have not developed to the capacity they could, considering the developments in the field of telemedicine. Such patients require frequent visits to the doctor, and approaching these vulnerable groups can reduce the number of emergency visits and hospitalizations.

Another segment of telemedicine is "the hospital at home". Patients who meet hospitalization criteria, with stable progression, can be treated at home for diseases such as chronic obstructive pulmonary disease, pneumonia, or heart failure. Previous studies have indicated that such a therapeutic approach, when used with safety parameters in mind, is not more cost-effective, but it involves a better patient outcome, shorter treatment duration, and reduced rates of delirium.

The main benefits of telemedicine are:

- Comfort for everyone. The development of applications has allowed doctors to offer consultations over the phone and internet, which means that patients do not have to leave the comfort of their homes to receive care and advice.
- Waiting time in waiting rooms is eliminated.
- Elimination of patient travel
- Attenuation of the spread of infectious diseases
- Increased clinical efficiency
- Huge savings for patients, in terms of time and fuel
- Financial benefits for clinics, allowing for fractional employment and enabling highly trained professionals to work at maximum capacity, thus promoting a new sense of "quality over quantity" in healthcare.
- Online monitoring helps patients avoid chronic diseases, leading to long-term financial benefits for both patients and society.
- Resolves the unequal distribution of medical resources.

All these benefits lead to an increase in the quality of medical services.

References

Allely, E., 1995. Synchronous and asynchronous telemedicine. *J Med Syst,* 9, pp.07-212.

Barold, S., 2003. Willem Einthoven and the birth of clinical electrocardiography a hundred years ago. *PubMED,* 7(1), pp. 99-104.

Dinesen, B., Nonnecke, B., Lindeman, D., Toft, E., Kidholm, K., Jethwani, K., Young, H.M., Spindler, H., Oestergaard, C.U., Southard, J.A., Gutierrez, M., Anderson, N., Albert, N.M., Han, J.J. and Nesbitt, T., 2018. Personalized Telehealth in the Future: A Global Research Agenda. *Telehealth and Medicine Today*, 2(3), pp.1-17. https://doi.org/10.30953/tmt.v2.18.

Guvernul Romaniei, 2020. *ORDONANTA 196 din 18 noiembrie 2020.* [online] Available at: https://legislatie.just.ro/Public/DetaliiDocumentAfis/233458 [Accesat 16 May 2022].

Guvernul Romaniei, 2020. *ORDONANTA nr.96.* [online] Available at: <https://legislatie.just.ro/Public/DetaliiDocumentAfis/226730> [Accesat 15 May 2022].

Guvernul Romaniei, 2022. Hotarare din 14 septembrie 2022 privind aprobarea Normelor metodologice de punere în aplicare a prevederilor Ordonanței de urgență a Guvernului nr. 196/2020 pentru modificarea și completarea Legii nr. 95/2006 privind reforma în domeniul sănătății. *Hotarare nr.1133.* [Interactiv] Available at: <https://legislatie.just.ro/Public/DetaliiDocument/259367> [Accesat 15 May 2022].

Kuzmar, I.; Mercedes, R.,B., 2014. How to create a telemedicine service: telemedicine heptagon. *Reseaech Gate,* Volumul 99, pp. 44-45.

Mahar, J.H., Rosencrance, G.J. and Rasmussen, P.A., 2018. Telemedicine: Past, present, and future. *Cleveland Clinic Journal of Medicine*, 85(12), pp.938–942. https://doi.org/10.3949/ccjm.85a.17062.

mdportal, 2015. *Categories of Telemedicine*. [online] Available at: <https://mdportal.com/education/telemedicine-categories/ > [Accessed 15 May 2023].

Medicine, 2012. *The Role of Telehealth in an Evolving Health Care Environment.* Washington: National Academies Press.

Montano, I.,H.; Lafuente, E.,P.; Martinez, J.,B.; Mansilla, A.,O.; Torre Diez, I: Lourdes Del Rio-Sola, M, 2022. Systematic Review of Telemedicine and eHealth Systems Applied to Vascular Surgery. *PMID,* 46, p. 104.

Nesbitt, T. S., 2012. *The Role of Telehealth in an Evolving Health Care Environment: Workshop Summary.* Washington (DC): National Academies Press (US).

Saigi-Rubio, F.; Borges do Nascimento, I.J.; Robles, N.; Ivanovska, K.; Katz, C.; Azzopardi-Muscat, N.; Novillo Ortiz, D., 2022. The Current Status of Telemedicine Technology Use Across the World Health Organization European Region: An Overview of Systematic Review. *J Med Internet Res*., 24.

Zeevi, D.; Zmora, N.; Halpern, Z.; Elinav, E, 2015. Personalized Nutrition by Prediction of Glycemic Responses. *PubMed*, 19, pp. 1079-1094.

Zeevi, D.; Zmora, N.; Halpern, Z.; Elinav, E., 2015. Personalized Nutrition by Prediction of Glycemic Responses. *Cell*, pp. 1079-1094.