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Bakalářská práce

bakalářský studijní obor **Angličtina v elektrotechnice a informatice**

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Telemedicína

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Darkins, A.W., Cary, M.A. (2000). Telemedicine and Telehealth: Principles, Policies, Performances and Pitfalls. New York: Springer Publishing Company.

Mahen, M.M., Whitten, P., Allen, A. (2001). New York: Jossey Bass, A Wiley Company.

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ABSTRAKT

Tato bakalářská práce pojednává o Telemedicíně a jejím využití v dnešní společnosti s přihlédnutím k sociálním a technologickým aspektům minulosti, současnosti a budoucnosti. Hlavním účelem této práce je informovat širokou veřejnost o možnostech telemedicíny a zvýšit tak jejich povědomí o moderním systému péče o zdraví. Práce se v první řadě zabývá rozdělením virtuální medicíny do oborů ehealth, telehealth a telemedicíny. Následně historickým vývojem tohoto oboru spolu s technologickým postupem a vzájemným propojováním. Soukromé a bezpečné propojení mezi pacienty, doktory a specialisty je velmi důležité. Proto jsou metody přenosu dat v tomto odvětví klíčová nejen v dnešní době ale i v budoucnu. Telemedicína je následně rozdělena do oborů, jež ji využívají s přihlédnutím k sociálním aspektům. V neposlední řadě je zde budoucí vývoj z hlediska ekonomiky, lidských faktorů a technologie.

KLÍČOVÁ SLOVA

Telemedicína, telehealth, zdraví, medicína, lékařská informatika

ABSTRACT

This bachelor thesis deals with Telemedicine and its use in today's society, considering the social and technological aspects of the past, present, and future. The main purpose of this work is to inform the general public about the possibilities of telemedicine and thus raise their awareness of the modern health care system. The work first deals with the division of virtual medicine into the fields of ehealth, telehealth and telemedicine. Subsequently, the historical development of this field along with the technological advancement and interconnectivity. Private and secure links between patients, doctors and specialists are very important. Therefore, data transfer methods are crucial in this field not only today but also in the future. Telemedicine is then divided into fields that use it and considered through the social aspects. Last but not least, there are future developments from the points of economics, human factors, and technology.

KEYWORDS

Telemedicine, telehealth, health, medicine, medical informatics

Table of Contents

1 INTRODUCTION

Telemedicine has been around us since the people started communicating with each other over distance. Medical care is important for every person as it is our human right. The goal of this thesis is to help raise awareness of this new and quickly developing medical field and inform people of possibilities that technology has brought into healthcare.

This bachelor thesis is divided into seven chapters. The first chapter deals with differences between Telemedicine, eHealth, and Telehealth. It also helps us understand where the telemedicine as a medical field belongs to in the Healthcare system altogether. The second chapter focuses on history and the roots of telemedicine and gives an example of how their application progressed along with technology. The third chapter describes the methods of communication and interface that can be used to deliver the information from a patient to a doctor or between doctors. It also explains advantages and disadvantages that different forms of interface have. The fourth chapter examines the delivery method of telemedicine, from store and forward method to a real-time communication namely asynchronous and synchronous communication. Asynchronous and synchronous communication are forms in which the parties communicate between themselves. Explained here is also Telemonitoring which is a big part of telemedicine as both real-time and store and forward methods of communication can be used jointly. This knowledge is essential to understand how the different fields apply the modern technology to give medical care. The fifth chapter outlines the many fields in which telemedicine is applied in and gives a brief example of application. The sixth chapter focuses on social aspects such as age, location, ethnicity, race, and the way they influence the use of telemedicine services. The last chapter focuses on the future development from the points of economics, human factors, and technology.

2 TERMS

Before we start talking about telemedicine, we must first understand what it really is and what are the differences between eHealth, Telehealth and Telemedicine. These terms can all have different definitions depending on the organizations and parts of the world.

2.1 eHealth

eHealth means electronical health. The term is similar to eGovernment for computerized state administration or e-learning for education and eBanking for banking. According to Eysenbach (2001) eHealth can be defined as a new medical field which includes elements of health informatics, organization of healthcare, focused on health service and information sharing over the internet and similar technologies. The aim is to improve healthcare across the board.

2.2 Telehealth

Telehealth includes a wide range of services to improve healthcare system and patient care. The difference between telemedicine and telehealth is in its scope. Telemedicine referrers specifically to remote clinical services while telehealth can refer to non-clinical, such as administrative, education, training, and health promotion in addition to clinical services. Telehealth is subset of eHealth.

2.3 Telemedicine

The World Health Organization (WHO) defines telemedicine as: “The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities” (2010:9) They use very broad definition and interchange the terms Telehealth and telemedicine. In this work we

separate the two of them by the scope of their application. We can then say that Telemedicine is subset of Telehealth.

3 HISTORY

If we are looking at telemedicine in broader spectrum such as long-distance medical communication, then the predecessors of this field could even be smoke signals. The long-distance medical communication existed before the era of computers and communication technologies. Some of this technology is used to this day for example, maritime signal flags.

3.1 Earliest instances

Středa and Hána (2016) speculate that smoke signals could be considered the earliest instances of telemedicine. Used in Africa by tribal shamans to warn random passer-by or neighbours about a plague in the village. This was considered a sort of quarantine or prevention. Smoke signals were not only used by Africans but also by American Indians and Australian aborigines.

Another kind of remote care can be for instance when there was need to bridge the gap between the patient and the doctor. Situation when a representative of a patient went to the doctor and described the illness and came back with a cure or treatment procedure. This method did not have any requirements for technology only manpower. The system of messengers was used for example in military as they were often outside of area where medical help was easily accessible.

In navy there is used a system of flags that have international meanings. These flags are used to this day. The Flag a) in figure.1 means “I require medical assistance”, The flag b) says “I have a doctor on board”. These flags can be considered a primitive form of telemedicine. They inform other ships of their medical situation.

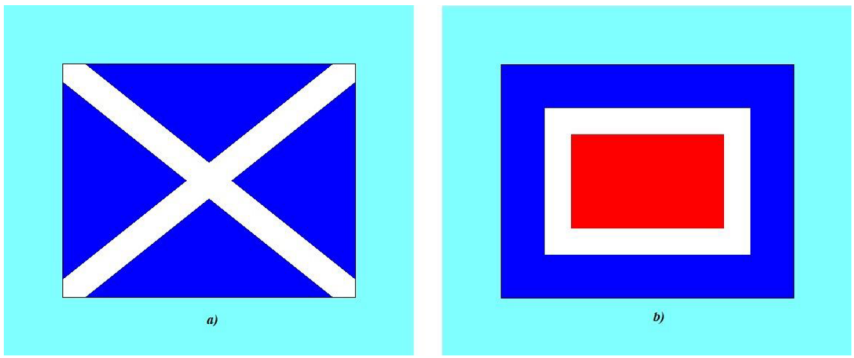

Figure 1 Maritime signal flags. Reprinted from

(http://www.anbg.gov.au/flags/signal-meaning.html)

3.2 Modern history of telemedicine

In definitions of many organizations the history of telemedicine starts with electronical communication and transfer of information through communication technologies. According to that the beginning of telemedicine starts in 19th century with the invention of telegraph. Vsee (n.a.) says that telegraph saw its use in war period of American Civil war. In aspect of telemedicine, it was used to deliver list of injured, dead or order medical supplies. The technology progressed and telegraph was soon replaced by radios and telephones. Analog technology was succeeded by digitalization and internet spread the Telemedicine to all corners of medicine.

3.2.1 Radio

There are many instances when telemedicine was used to give medical help through radio communication. Středa and Hána (2016) give us an example of the use of pedal powered radios to communicate with The Royal Flying Doctor Service of Australia in 1929. They also mention organization CIRM (Centro Internazionale Radio Medico) that was established in 1935 in Italy. To this day it offers free medical assistance to any

ships regardless of their nationality. The web eVisit (2018) mentions Hugo Gernsbacher, Luxembourgish emigrant to the USA, who in 1925 wrote an article for the magazine Electrical Experimenter. In his article he talked about a device called "teledactyl" that will be in the future used to treat patients remotely. His description of the device works on similar principle as today´s robotic surgery.

3.2.2 Telephone

Středa and Hána (2016) talk about Dutch physiologist prof. Willem Einthoven started experimenting with transmissions of EKG through telephone lines on distance of 1.5 km from hospital to his laboratory in 1905. There is also an establishment of EKG centre in Ukraine in 1935. This centre was connected to infection ward with special cables spanning 500m, enabling the examination of patients without the risk of moving them to another ward.

Telephone telemedicine progressed along with modern mobile phones. Today we have many applications focused on Health. Mobile phones allow us to directly speak with the doctor be it in form of call, video call, SMS, or e-mails. The new category that is associated with mobile phones and is connected to Telemedicine is mHealth also called mobile health.

The web Innovatemedtec (n.a.) says that this category has wide range of applications. For example, remote monitoring, remote data collection, diagnostic and treatment, support and education, and awareness spread. This category also includes wearable devices that allow users to continuously track and manage health data.

3.3 Mid 1900s to 1990s

According to Maheu, Whitten and Allen (2001) the development of telemedicine was connected to the plan of sending astronauts into space in 1960s. The American and Soviet were developing technologies to monitor physiological parameters of astronauts in space (p. 5).

Středa and Hána (2016) comment that development was also prompted in other places. In 1964 the Norfolk State Hospital and Nebraska Psychiatric Institute, separated by 200km, began using two-way video communication for consultation and education

purposes.

Maheu, Whitten and Allen (2001) also mention that in 1967 a first telemedicine clinic was founded at Massachusetts General Hospital to give a 24/7 medical help to patients at international airport in Boston through two-way audio-visual microwave circuit (p. 5).

Středa and Hána (2016) give examples that the 1970s brought projects such as AFHCAN (Alaska Federal Health Care Access Network) where 26 sites in Alaska were picked and used to verify the reliability of telemedicine trough satellites. Another project they mention was STARPAHC (Space technology Applied to Rural Papago Advanced Health Care) which focused on delivering medical help in rural areas. The mobile medical unit was used for communication between these rural areas and Hospital in Tucson. These mobile units were equipped with devices for videoconferences, teleradiology, telepathology, voice communication and data exchange.

They continue in 1985 where they mention first projects for distant home telemedicine care through cable television in Hyogo Japan and 1989 after a massive earthquake in Armenia when Nasa created US-Soviet telebridge for consultation network between Yerevan and four medical centres in the USA. Apart from governmental and multinational projects Středa and Hána (2016) talk about a progress in private companies. The first commercial product using telephone lines was mobile controlled defibrillator (MDPhone Transtelephonic Defibrillator) which was introduced by American company MedPhone. Designed to remotely diagnose and treat patients that require cardiac resuscitation.

Středa and Hána (2016) further mention that from 1990s the Europe, Asia and Australia are more engaging in research of telemedicine even though the primary research is still focused on the USA.

3.4 21st century

With the adoption of Internet and information and communication technologies in the last decades into methods of care, the Telemedicine has moved forward and broadened its possibilities. It is now much easier and quicker to share and process data. Internet

became part of our society, enabling transfer of any kind of data and connecting the whole world. Matthews (2018) explains that in the last decade the integration of IoT (Internet of Things) has accelerated the industry. In 2015 the world's first medical facility dedicated only to telemedicine opened in Chesterfield, Missouri called Mercy Virtual. In the 21st century the telemedicine is becoming a part of eHealth.

4 METHODS OF COMMUNICATION

In telemedicine the communication can be divided into verbal, visual or data communication. This requires a strong and reliable connection to deliver all the data from one place to another. This delivery can be either synchronous communication or asynchronous communication. Both types of communication are used in telemedicine.

4.1 Synchronous Communication

Also called live streaming. It is a communication that records and broadcasts in real time. The tools of this communication are for example chat, videoconference, or basic phone call. It enables both parties to ask questions and get answers immediately. It is used mainly in medical consultations or videoconferences. Very challenging synchronous communication is used in telesurgery.

4.2 Asynchronous Communication

Středa and Hána (2016) explain this as Store and forward method. This is a technique in which data is sent to an intermediate station where it is kept and later sent to the destination or another station. It does not require both parties to be present at the same time as there can be time delay. The communication can be done through email, online forums or SMS and does not require and immediate response. The content is more thought out and has more information. It is used in more telemedicine because it is cheaper and technologically easier to implement.

4.3 Communication interface

It is important that a correct method of communication is chosen in terms of application. We have analog, and digital, one-way, or two-way communication, verbal, written or video. The analog, communication is slowly disappearing and is being replaced by digital. Communications means that are used are:

4.3.1 Landline

Rouse and Wigmore (2016) explain landline as metal wire used for transmission of spoken language, fax, or data. The advantages are big availability, low price, and simple technology. The disadvantages are a fixed connection between two points, cost-effective expansion to remote locations, difficult communication between more than two users, frequency band and significant interference.

4.3.2 Wireless communication

This is a radio communication that uses frequencies from 10kHz to several GHz. It is not restricted by any connection points. Transmitters, television broadcast, GSM, Wi-Fi, and mobile satellite communication all belong into this category.

4.3.3 Mobile Communication GSM

Rouse and Mixon (2019) define The Global System for mobile Communication as a standard developed for mobile phones. Formed by cellular network it has great availability and low cost. The disadvantage would be the dependence on GSM network and on provider

4.3.4 Satellite communication

Labrador (n.a.) says that a communication satellite is placed in geostationary orbit which is approximately 35,800 km above the equator. They relay and amplifies radio telecommunications signal via a transponder. Satellites can reach places that are not covered by GSM and since they are so far away from earth, they are safe from natural disasters. Their disadvantage is high cost.

4.3.5 ISDN

Web Whatismyipadress (n.a.) explains Integrated Services Digital network as a set of communication standards for digital transmission enabling simultaneous transfer of voice, video, and data through landlines. The advantage is faster connection and use of multiple digital channels. The disadvantage is slower transmission speed and the need for a fixed connection to the telephone network.

4.3.6 Broadband connection

Fcc (2014) describes broadband as a connection with higher speeds than ISDN. For example, ADSL or Wi-Fi. The advantages are same as the ISDN with higher transmission speed.

4.3.7 Internet (TCP/IP)

Internet is global system of interconnected computer networks and KK (n.a.) explains TCP/IP (Transmission Control Protocol/Internet Protocol) as the main protocol suite that determines how the data is transmitted, addressed, packetized, routed and received. Today it is the most widespread method of information transmission. The most used internet communication applications are e-mail, internet calls (Skype and VoIP), communication trough social media and other.

5 DELIVERY

The use of telemedicine in medical field has some common elements. Healing from distance allows doctors to cross barriers and improves access to medical care. Regardless of the field the telemedicine is used, we can divide its form of application into three categories:

5.1 Store and forward

We already talked about this as “Asynchronous communication” but in telemedicine this method is applied for example, in transmission of medical images. Středa and Hána (2016) give examples where these images appear in telemedicine and what standard and system they mostly use. In teleradiology for radiographic images or in Telepathology for image-rich pathology data. Data must be structured according to some standard. The most commonly used standard is DICOM (Digital Imaging and Communication in Medicine). This data standard determines how the information should be stored and transmitted in different devices such as scanners, servers, workstations, and other digital diagnostic devices. Then we should mention PACS (Picture archiving and communication system). This is a medical imagining technology which provides economical storage and easy access to images from different medical workstations such as X-ray, computer tomography (CT), ultrasound, magnetic resonance imaging (MRI) and other. PACS can process the large amount of data, these specialised devices generate and enables their archiving and at the same time the access to this information.

5.2 Remote Monitoring

eVisit (2018) explains this method of Telemedicine as one that allows doctors or other healthcare providers to track patients’ vitals and other forms of data from a distance. It can be in a form of videoconference when a patient has monitoring device at home that is connected to the internet and the doctor can then evaluate and recommend the follow up procedure. The monitoring can even be “store and forward” when the data from the

patient are gathered and sent later to the doctor for evaluation. eVvisit (2018) further comments that this kind of method is used for example in monitoring: blood pressure, weight, daily activity or caring for chronically ill and if all is well, those results are recorded and kept aside. If some problem arises the doctor can call in the patient for a consult. The key to remote patient monitoring is having the right equipment. In today's age it is becoming easier with growing popularity of wearables and mobile devices. Patients have better, cheaper, and more accessible tools for tracking their health and reporting it to their physicians.

5.3 Real-time interactive

Also called "synchronous communication". The distance between the patient and doctor is bridged by a technology. Be it in a form of video or audio communication. This is meant to offer an alternative to the in-person doctors visit but also to give care to patients in remote locations cutting the costs of time and travel. Telesurgery also belongs into this category.

6 SERVICES

Telemedicine has many applications. Ranging from simple monitoring of weight or videocall to remote surgeries performed by robots. The application of this field is evolving every day and provides more people with medical care. Středa and Hána (2016) (p. 70-143), VSee (n.a.) and WHO (2010) (p. 37) describe services of telemedicine as:

6.1 Telenursing

Telenursing refers to remote care in nursing when a physical distance exists between a patient and nurse. It has contact with other non-medical fields, such as, teleconsultation, telediagnosis and telemonitoring. This field is growing because of increase in number of aging and chronically ill population and expanding coverage to rural areas together with effort to drive down cost of health care in many countries. Home care is one of the focuses of telenursing. For example, patients who live in remote areas, who are immobilized or chronically ill can stay home and be “visited” by a nurse via videoconference, internet, or videophone. This cuts down on travel time and keeps patients out of hospital.

6.2 Teleaudiology

Teleaudiology is utilization of telemedicine to provide audiological services. There are two types of teleaudiology tests. The first one tests the patient and then transmits the data via e-mail or internet to a specialist who will give a diagnosis. This is called store and forward or also asynchronous. The second test is done in real-time (Synchronous). The audiologist will test the patient as if he was sitting in front of him. As they usually test patients in sound booths while they sit outside, this method only changes glass window for a monitor screen.

6.3 Teledentistry

One of the first uses was the Total Dental Access in 1994 introduced by US Department

of Defense for the Army. The goal was to increase the soldier's access to dental care and reduce the cost. Nowadays Teledentistry mainly focuses on transmitting high quality images between medical facilities and improves services to remote, rural, or less developed areas. It can also be used to assist general dentist with difficult work as they can ask specialists for diagnosis. Patients can thanks to this service, seek access to healthcare earlier, get specialist care, minimise their traveling time over long distances and reduce long waiting times. Teledentistry has the potential to reduce the inequalities in oral care.

6.4 Telepharmacy

Telepharmacy is a medical field which delivers pharmaceutical care via telecommunications to patients. Patients have no direct contact with a pharmacist. Telepharmacy is subject to legal standards so its development differs depending on the country. Services of telepharmacy include remote drug delivery, drug therapy monitoring, patient counselling and other. Patients that live in faraway locations from their pharmacist have access to professional pharmaceutical care from their home. They can for instance order their prescription online and get it through mail or other delivery services. This method is however not applicable anywhere for example, in Czech Republic the legislative does not allow to sell prescription drugs online.

6.5 Teleneurology

Teleneurology provides remote neurological care including care for epilepsy, dementia, movements disorders (Parkinson's disease), care for stroke and others. Consultations are primarily done through videoconferences. As the number of neurologists is low, teleneurology is a big help in this medical field. Patient can be examined by a paramedic or general practitioner who is led by a neurologist. Big advantage of remote consultations is reduced costs of transportation. For patients with movement disorders the long journeys can be difficult so remote consultations with specialists that can be located anywhere in the world, allow them to get the best care while cutting the costs for traveling and waiting times.

6.6 Telerehabilitation

Sometimes called e-rehabilitation delivers rehabilitation services over telecommunication networks and internet to patients who cannot travel to a clinic because of their disability or because they live too far. Fields that use telerehabilitation are neuropsychology, speech-language pathology, audiology, occupational therapy, and physical therapy. Most telerehabilitation uses webcams, videoconferencing, phone lines, videophones, and internet applications. Virtual reality and internet applications are newest tools in telerehabilitation. Sensors and devices for body monitoring are also used for rehabilitation purposes. Rehabilitation bracelet is one such example. Developed in Czech Republic, it monitors condition of the patient and periodically informs the doctor. The device which looks like a watch, registers the length and accuracy of the exercise. It can be worn on arm or ankle. The bracelet can recognize the moves of arms and legs and can be programmed with a certain move that the doctor determined. In the case that the move is made correctly the device plays a melody. This kind of rehabilitation shows patient if he is improving. It is also equipped with GPS tracker that helps watch over disoriented and senior people. Telerehabilitation helps spread the rehabilitation into the homes of patients and encourages them to exercise so they can make full recovery.

6.7 Teletrauma care

Also called trauma surgery. The survival of these types of injuries is time-dependent, which means that the earlier the treatment begins, the better the chance of good outcome. Trauma surgeons utilize both operative and non-operative procedure to treat traumatic injuries, often in acute settings. Telemedicine can be utilized here so trauma specialist can interact with personal on scene of disaster or mass casualty. They can assess the severity of injuries using for example video cameras on mobile phones that have internet connection. Further provide assessment as to which patients require immediate care. They can obtain images and reports that prepare them for the needed surgery if the patient is being transported to their trauma centre.

6.8 Telecardiology

Telecardiology focuses on patients with heart disease. It works with technology like

monitoring implanted heart devices, transmission of home or ambulatory EKG and blood pressure. The transfer of data from patient to doctor is through landlines or mobile network. Remote monitoring leads to a cheaper cost and saves time of both patient and doctor.

The biggest medical cost comes not from the treatment but from the repeated hospitalization of patients after acute heart failure. It is necessary to monitor these patients and with it comes a personal and time cost. For treatment and prevention, we can implant into the patient a pacemaker or specialized devices such as, ICD (implantable cardioverter-defibrillator) or device for cardiac resynchronization therapy (BIV ICD – biventricular ICD). Patients with these devices must periodically visit a doctor to check a flawless function of the device. In most of the cases the check-up is without a problem so we could say that they are useless and take time of both the doctor and patient. But with less frequent visits, the problem with the device or worsening patient condition could be found out too late.

That is where home monitoring could save time expenses and lives. The example of such a system is German HomeMonitoring from the Company Biotronik. The transmission of data between pacemaker and mobile unit called CardioMessenger is wireless. The data is encrypted and transmitted to central system database through mobile network. In the database the data can be viewed by specialized technicians and authorized doctors. If some of the measured data from the patient exceed limits (electrode impedance, electrode dispensing thresholds and so on) the attending doctor is notified through e-mail, fax, or SMS. If the patient is required to visit the doctor, he will be notified by blinking diode on the CardioMessenger.

We should also mention a Czech company MDT (Medical Data Transfer). They specialize in automatic transmission of EKG values. The data is automatically sent through the mobile phone which gathers the information from the device with electrodes that the patient has on his body. This data is then available in cardio centre and the telemedicine company. When the monitoring is done, the information is e-mailed to doctor.

6.9 Telepsychiatry

Telepsychiatry is another field of telemedicine that mainly uses videoconferencing to deliver psychiatric services for patients. It is used so that patients do not have to visit the psychiatrist personally. Originally it was used for those who did not have the access to psychiatric help, mostly in remote areas. The telepsychiatry can be individual or in group therapy. The group therapy enables people from different places to meet without the need to travel. We can further divide the Telepsychiatry into these categories:

6.9.1 Home-based telepsychiatry

Treatment of patients who are at home or another private place. It requires only a webcam and high-speed internet connection.

6.9.2 Forensic telepsychiatry

Use of remote consultation from psychiatrist or nurse practitioner for psychiatry in prison or other correction facility.

6.9.3 On-demand telepsychiatry

Emergency consultation for psychiatric patients with suicidal or homicidal tendencies and the ones suffering from depression and maniacal inclinations.

6.9.4 Scheduled Telepsychiatry

Facilities that provide behavioural health care use telepsychiatry to increase care capacity. Those remote providers can be consulted for variety of purposes which allows those in rural areas to have greater access to variety of special care.

6.9.5 Other

Telepsychiatry finds it application in other fields such as, child therapy, in army, places of disaster or in preventive care.

6.10 Teleradiology

Teleradiology sends radiological images such as x-rays, computed tomography scan (CTs), magnetic resonance images (MRIs), direct (DR) and computed (CR) radiography

from one place to another. Teleradiology betters the medical care for patients in a way that a radiologist does not have to be in the same place as the patient. This is very helpful in cases when there is a need for specialist. For this process to work, three basic components are needed, an image sending station, transmission network (high speed internet) and receiving station. The radiologist can then evaluate the images and send it back for example in e-mail.

6.11 Telepathology

Another field of telemedicine is telepathology which is a practice of transmitting image-rich pathology data between distant locations for purposes of diagnose, education, and research. Telepathology can be divided into these groups:

6.11.1 Dynamic telepathology

Dynamic here means that the diagnose is done in real-time. Pathologist can operate an electronic microscope from remote area. This device is very expensive, and the transmitted image is not sharp enough. These are the shortcomings of this field.

6.11.2 Semi-dynamic telepathology

When a pathologist is dealing with a difficult diagnosis and ask for an opinion from his colleagues, that is called semi-dynamic telepathology. The cost of devices is lesser as this method is not as challenging as dynamic telepathology.

6.11.3 Virtual pathology

This form of pathology is used when the autopsy is not possible. The body is scanned in detail usually by computed tomography. The 3D image is then reconstructed with which the pathologist can then work as a three-dimensional data and virtual reality. This method is not applicable is tissue sample is required.

6.11.4 Static pathology

This method uses database and discussion forums. Users can place images with commentary and other data for consultation into the database. The pathologist can then access the database and review the case he was assigned. The diagnosis can be delivered

through the database or by e-mail.

6.12 Teleophthalmology

Teleophthalmology is medical field that allows clinicians and eye specialists to provide care remotely and through digital medical equipment. This service has seen significant increase in research and application over the past decade thanks to the communication technologies. Eye specialists can provide ophthalmic disease screening, diagnose and monitoring to remote areas. Patients can be examined locally and only make the trip to hospital for necessary surgery. This is a big help to people in developing countries as it massively cuts down travelling expenses to remote hospitals. Mobile applications have also found their way into these services, with applications such as visual acuity, colour test and viewing eye images as tools for eye tests.

6.13 Telesurgery

Telesurgery combines elements from many fields to perform surgery on a patient where the physical distance is irrelevant. Most of the surgical procedures are performed from the same room but there are instances of trans-Atlantic surgeries. The reason for using robotic assisted surgeries where the surgeon performs the procedure and the robot applies his moves, is that the robot can eliminate deviations such as shaking hands and is generally more precise than a human. Every robot has computer system that amplifies precision for safer surgery. The disadvantage is that the surgeon is not physically present and has to rely on his vision and experience. Another big drawback is the price of such robots that can start at tens of millions of crowns. We can divide the robots into three categories. The first on is Assistant robot which is controlled by voice and is supposed to replace the assisting doctor. The second is robot guided by imaging techniques. The last one is surgical robot controlled by the doctor personally.

7 SOCIAL ASPECTS

Since telemedicine is closely connected with technology, differences in availability depending on social aspects such as age, demographics, employment and race or ethnicity appear. The use of telemedicine has been gradually increasing but major influence that has been behind the exponential popularity growth in telemedicine in recent year is COVID 19 pandemic.

Here is data from Kantar Group and Affiliates 2021, American Medical Association, American Well and Healthcare IT News. Kantar for example has registered an increase of people using telemedicine by over 3000%. They suspect that this number will most likely decrease with the gradual opening of medical offices that have been closed due to the pandemic outbreak but will still be higher than the percentage before the lockdown period.

7.1 Generational use

If we divide the population using the telemedicine by age, we can see the direct correlation between telemedicine usage and age of consumers. The surveys have been taken from multiple websites in the USA and compared.

7.1.1 Ages 18-34

The youngest age group is the most likely to want to use telemedicine and the most likely to have used it. According to Amwell, they are three times more likely to have tried using telemedicine compared to other age groups. The biggest factor for this group according to the survey from Amwell is cost. Expensive cost is also a reason why they delay seeking medical care in hospitals in USA. Statistics vary from source to source. Kantar uses their system of data analysis. In one week, 53,4% of people between age 18-24 used telemedicine for healthcare visits. Amwell survey asked two thousand people from all age groups and found out that 8% used telemedicine and from those, 54% were from this age group.

7.1.2 Ages 35-44

This age group is often times making decisions about primary healthcare in family. Be it for their children or for their elderly parents. According to Amwell, 25% people from survey use telemedicine, but 72% say, that they would be willing to use a video visit. Their concerns about using telemedicine were privacy and their preference for in-person care. Survey from Kantar was for age 25 to 44 and came out higher at 35.6% which can be attributed to younger age group then in the Amwell survey.

7.1.3 Ages 45-54

This generation is highly focused on pharmaceuticals. It is no surprise then, that 80% of people who were thinking about using telemedicine said that they would use it for prescriptions. 69% of them also said, that they want to stay with their primary care physicians then try the ones who offer video visits. According to Kantar survey, which is for ages 45 to 64, 33% of people use some form of telemedicine service.

7.1.4 Ages 55-64

Second oldest age group according to Amwell survey has the lowest percentage of people who have concerns about using technology as a barrier for telemedicine at only 4%. The people from this age group who have used telemedicine are only at 3% but 60% were willing to use it for its time saving possibility and convenience reason. The people from this group willing to use telemedicine can be divided into two groups. One of them is specifically interested in using technology for chronic disease management and the other group would try telemedicine in order to connect with their doctor.

7.1.5 Ages 65+

The senior population is the most likely one to need a chronic disease management, but only 55-60% of them own a smartphone or have access to internet according to America Medical Association and Pew Research Centre. From those who have the necessary equipment to access internet, the knowledge and ability to use it is the second biggest hurdle. Only around 60% of those were able to find a website, fill out a form and send an email which substantially increases the difficulty of setting up a virtual visit. The Amwell survey states that this age group has the lowest interest rate in using the

telemedicine at only 52%. Prescription renewals and chronic care were their main interest in using technology.

7.2 Location

Telemedicine can be different depending on the part of the world you are living in. It can be a developed country where high percentage of people have access to internet or one where internet penetration is below 10% such as African countries. Culture habits are also a big part of telemedicine implantations in different countries. Yet, regardless of development level of a country or culture, they can benefit through various implementations of telemedicine. Governments of many countries are still exploring how the implementation of various projects can be beneficial for the healthcare systems.

India with a population of 1.4 billion people has more than 72% of them located in rural areas while more than 75% of doctors are based in cities according to Data.The World Bank. In 2015 India launched the National Telemedicine Network to provide services in rural areas from the nearest district hospitals. According to The Better India, a major goal for relevant agencies is to institutionalize telemedicine services for those living in remote areas.

In Review of telemedicine in China, we can see that with the quick development of telecommunication networks, three major telemedicine networks have appeared: Golden Health Network, International MedioNet of China, and the People´s Liberation Army. The disproportionate economic development across China benefits smaller hospitals and clinics located in rural and poor areas from connecting with large hospitals to provide telemedicine services such as teleconsultation, telemonitoring and telediagnosis.

According to Worldometer, the Mongolia is one the most sparsely populated countries in the world and the 18th largest country. The capital city is home to 45% of the population and only place where specialists are available. Since telemedicine is the tool to address remoteness and the discrepancy between rural and urban regions, the United Nations Population Fund, Ministry of Health of Mongolia, and the government of Luxembourg have worked together to implement service that focuses on one of the main problems in Mongolia and that is a maternal care. The website unfpa.org informs us that The Swiss Surgical Team provides software, and local doctors are able to consult

with the experts in real time and connect with provincial hospitals and the National Centre for Maternal and Child Health. Currently, 21 provincial hospitals participate in this network.

According to Quartz India, Pakistan is a country where woman account for 70% of the students in medical schools but more than half of female graduated never practice. That is because in Pakistan culture, a highly qualified female doctor is in a family mainly a status symbol. Most families insist that a woman devote their time and attention to their husbands and children. Sehat Kahani (translates to Story of Health) enables female doctors who are unable to leave their homes to practice medicine via a telemedicine. This service is addressing several cultural and technological challenges, including making patients comfortable with female doctors, videoconferencing and applying digital health techniques in a country with only 18% internet penetration.

Although telemedicine can help expand health services too remote areas, current laws in some countries and states dictate that patients should not be treated by doctors from another country or state: This issue of legal barriers to practice telemedicine across states has been a problem for veterans in United States. According to VA, it has been surmounted when U.S. Department of Veteran Affairs has announced in 2018 that telemedicine can be used regardless of where in the United States the provider or veteran is located. But restrictions on intercountry telemedicine still remain for veterans. Example of innovative multicounty initiative can be SickKids. SicKids Caribbean Initiative was started in 2013 by a hospital in Canada with a goal to help improve the survival rate of patients in Bahamas, Barbados, Jamaica, St. Lucia, St. Vincent, Grenadines, Trinidad, and Tobago. This initiative facilitates access to healthcare services for children with cancer and blood disorders. Telemedicine connects Caribbean doctors with Canadian specialists. The consultations can be from early diagnosis stages to surgery´s procedure.

Telemedicine continues to evolve but does pose a challenge because of each country´s unique laws and regulations in implementing innovative services. There is not only a lack of resources to provide for the increasing demand but also an uneven distribution of geographical availability of these services, worldwide. The challenges are not limited to overcoming the technological barriers but also the mindset of people, ethical issues,

conflicting values, norms, and interests. The projects mentioned are helping change all of this and may help revolutionize healthcare delivery across countries.

7.3 Income, Employment status and education

While age and location are a major role in customers willingness and exposure to telemedicine, there are also other factors. According to survey be Amwell, households with higher income are more likely to use telemedicine services. Education also increases the willingness. 69 % of college graduates are willing to use telemedicine while only 61% of people with high school diplomas. Employment status can also influence the consumers decision to use telemedicine as employers offer more healthcare benefits, sometimes even telemedicine services. 72% of employed people said that they would use telemedicine services if they were available. Only 57% of un-employed people expressed willingness. The Kantar survey with its database showed that full-time and part-time workers have higher usage of telemedicine at 33.9% and 35.3% respectively. While not employed people use it only 25.3%. Customers with lower income relied on telemedicine 28.9% middle income 30% and the high-income patients used it 31% of the time.

7.4 Race/Ethnicity/Gender

Race and ethnicity as a factor are in telemedicine usage closely connected to a geographical location. Every country has its own cultural heritage, language, history or social treatment and it can be an obstacle for implementing new and technological practices. There can be a big difference between African – American person living in America with high internet penetration, higher wage and education and the same person of the same race and ethnicity living in Africa with low internet penetration, lower income, and lesser opportunity for education. Religion has impact on healthcare, as some do not allow the modern hospital practice. Amish for example do not restrict its members from seeking modern medical care but telemedicine would not be an option for them as they do not possess any electronic devices. According to Amwell survey, gender has little to no impact on the usage of telemedicine, as 51% of the people who used telemedicine were women and the other 49% were men. Since race and ethnicity in

telemedicine depend on location and conditions, they do not influence the usage of services as much as the previous criteria. If we look at all variables, then the most likely person to use telemedicine would be a young female college graduate from a country with high percentage of internet penetration and who has a high-income job. On the other end, the person to most likely not ever use telemedicine would be an unemployed senior man with little to no education who lives in a poor country where there is little internet penetration.

8 FUTURE DEVELOPMENT

The telemedicine market and usage has been steadily growing over the past years. Lots of people are discovering the usefulness of telemedicine thanks to Covid-19. They will very likely expect to be able to have the same options after the pandemic is over. Since the healthcare industry is slow in adopting new technologies, the covid-19 has accelerated the adoption of many telemedicine services ahead of time. This has also resulted in increase in investments into telemedicine from healthcare providers and countries. The healthcare delivery will move from hospital or clinic into the home

The patients who live a hectic lifestyle and routine visits do not fit in their schedule will have an option of virtual visits and if they feel that their care is as good or better then routine visits in person, they will no longer have to endure the long wait when it is avoidable. When patients grow more comfortable and accustomed to virtual care, those that do not offer that option will probably see a decrease in volume of patients from those who choose providers that offer telemedicine.

According to CDC, chronic diseases that account for most of the healthcare spending can be avoided through preventive care services. By offering more convenient and available services in follow-up care, specialists for faster diagnosis and telemedicine treatment, hospitals will have fewer readmissions of patients that come back because of complications and inadequate follow-up treatment. This will reduce costs for treatments and services in hospitals.

There will be centres where hospitals can call 24/7 and have access to specialists from all areas. This immediate access to wide range of physicians who are experts in their field will allow hospitals to offer their patients wider range of focused care. The cost for hospitals would be reduced as they would not have to hire full-time staff of experts. For example, a doctor in a hospital would not have to recommend a patient to a specialist in another hospital because his does not have one but could set up a videoconference with a patient and the required specialist who works in one of the centres and get immediate results and advices on the treatment. Without this, the patient would have to set up a meeting with the specialist in other hospital, bring his files, and probably go through another examination before he could bring the results from that specialist to his hospital

and doctor. As technology becomes more involved in healthcare, doctors will have to put enough effort behind their virtual care capabilities.

Technology will keep moving forward in all aspects of our lives, it will be no different in healthcare. The doctors right now are unable to listen to our heart during virtual visit. This problem can be solved by having our own stethoscope which is widely available. It just needs to be adapted to a virtual platform. These kind of connected medical devices are already available to us. One of them is for example from company One Drop which sells a kit and an app for measuring blood sugar levels and reporting them directly to our doctor. Health care kits will transmit our data we take at home to diagnostic centre and our caretakers. In future we will probably see more then wrist wearables but also hearing aids that listen to heart rhythms, finger rings that monitor skin temperature and other vitals or clothing with all these functions built in. These devices will get much more advanced in the next years. Apps are also a growing wave of digital health applications. The more these devices and apps grow, the more will they be able to replace in-office doctor's visit.

Integration of systems would allow doctors to see if their patients had a refill of their prescribed medicine and adhered to the medical plan. This will give doctors and caregivers more insight into people's lives between visits.

Extended reality is another technology that has the potential to be used in telemedicine. It Includes Virtual reality (VR), mixed reality (MR), and augmented reality (AR). While augmented reality and mixed reality overlay information on top of the real world through the use of heads-up display, virtual reality is completely immersive with headphones and body motion tracking sensors. The two former technologies have the potential to aid doctors, surgeons, and specialists in their work. The virtual reality is the most mature one and is already used in multiple areas, such as pain control, anxiety, education, exposure therapy and even fear of death. Although this technology requires expensive setups, the past years have shown that their development is steadily moving forward and decreasing their prices.

Artificial intelligence will probably be one of the most important tools in future of not only telemedicine but healthcare as a whole. AI can analyse tremendous amount data in the shortest amount of time. This together with remote monitoring can lessen the burden

on the doctors and reduce the hospital wait times and other processing inconveniences. With a sufficient data the AI can direct the patients to specialist based on the results of their symptoms rathe then sending them to the first available doctor.

If we look into the not-so-distant future as Miles Romney paints it, we can see how future virtual care would look. We could wake up not with the alarm clock but by an app installed in our micro-implant. Our morning shower would be installed with full-body MRI scan and dozens of instruments that would collect our samples and record our vitals. These results are then analysed by an AI in real time and sent to our care team. From the collected data a dose of vitamins, relaxants, pain killers and even stimulants could be specifically tailored for us. When you have a meeting with doctor it will be through video or VR. This new form of healthcare would not change the number of doctors employed in hospital. It would allow them to focus on more patients and specialize in one field. You may never even personally see your doctor because if something happens, we will be directly sent to a specialist. Thanks to all the monitoring devices, the doctors will have a far greater knowledge of your health. The future of healthcare lies in technology and it is getting much closer thanks to all the innovators.

9 CONCLUSION

The thesis focused on the still developing medical field of Telemedicine. This medical field is still not firmly established, and definitions vary depending on country or organization. The thesis first described the differences between the terms used by organizations all over the world (eHealth, Telehealth and Telemedicine) and explained where the telemedicine belongs. Telemedicine has been part of the healthcare since people started communicating with each other. Only the communication was much simpler before. As the technology developed and spread across the whole world the telemedicine has developed along with it.

The main goal of the thesis was to provide general public with enough information about the topic so they would not simply think about telemedicine as a medical care for remote and rural areas but as new field of medicine that is already functioning around us and a field that will make medical care more available and cheaper. The way in which technology and telemedicine are used has changed along with the progress of society.

In future, studies should focus on the application, advancement, and social aspects of individual services. Every field of medicine has different tools that are indispensable for modern medical care and must be studied and researched further to be adapted to usage in telemedicine.

LIST OF FIGURES

LIST OF REFERENCES

AMA (n.a.), Why achieving health equity is so hard in the telehealth age (2020), Retrieved from: https://www.ama-assn.org/practice-management/digital/why-achieving-health-equity-so-hard-telehealth-age

Amwell (n.a.), Telehealth Index: 2019 Consumer Survey, (2019), Retrieved from: https://static.americanwell.com/app/uploads/2019/07/American-Well-Telehealth-Index-2019-Consumer-Survey-eBook2.pdf

Amwell Blog (n.a.) 2019 Consumer Survey: Majority of Consumers are Willing to Use Telehealth but Use Varies by Age (2019), Retrieved from: https://business.amwell.com/2019-consumer-survey-majority-of-consumers-are-willing-to-use-telehealth-but-use-varies-by-age/

Appinventiv (n.a.), 7 Trends Shaping the Future of Telemedicine (2020), Retrieved from: https://appinventiv.com/blog/top-telehealth-trends/

Bhattacharya A. Pressured to give up their careers, Pakistan's "doctor-wives" are using tech to find work again. (2017), Retrieved from: https://qz.com/india/1064758/sehat-kahani-pressured-to-give-up-their-careers-pakistans-doctor-wives-are-using-tech-to-find-work-again/

eVisit (2018) What is Telemedicine, Retrieved from: https://evisit.com/resources/what-is-telemedicine/

Eysenbach, G. (2001) What is e-health?, Retrieved from: https://www.jmir.org/2001/2/e20/

FCC (2014) Types of Broadband Connection, Retrieved from: https://www.fcc.gov/general/types-broadband-connections

Innovatemedtec (n.a.) mHealth, Retrieved from: https://innovatemedtec.com/digital-health/mhealth

Kantar (n.a.), What are the social determinants of telehealth use?, Retrieved from: https://www.kantar.com/inspiration/coronavirus/how-have-social-determinants-affected-telehealth-use-during-the-covid-19-pandemic-he/

Khuraam SS, Aga IZ. Sehat Kahani | The story of health. (n.a.)., Retrieved from: https://sehatkahani.com/

KK (n.a.) TCP/IP Protocols, Retrieved from: http://www.crypto-it.net/eng/theory/tcp-ip-protocols.html

Labrador, V. (n.a.) Satellite communication, Retrieved from: https://www.britannica.com/technology/satellite-communication/Development-of-satellite-communication

Maheu, M. & Whitten, P. & Allen, A. (2001) E-Health, Telehealth, Telemedicine: A guide to Startup and Success, Retrieved from: https://books.google.cz/books?id=T8gwu1okBW4C&pg=PA51&hl=cs&source=gbs_selected_pages&cad=3#v=onepage&q&f=false

Matthews, K. (2018) How is IoT enabling Telemedicine of Tomorrow, Retrieved from: https://www.iotforall.com/how-iot-enables-tomorrows-telemedicine/

Mercy Virtual (2015) About, Retrieved from: https://www.mercyvirtual.net/about/

Modern Healthcare (n.a.), Predicting the Future Role of Telemedicine (2020), Retrieved from: https://www.modernhealthcare.com/technology/predicting-future-role-telemedicine

National Library of Medicine (n.a.), Telemedicine in the Future (2005), Retrieved from: https://pubmed.ncbi.nlm.nih.gov/16356311/

Rouse, M & Mixon, E. (2019) GSM (Global System for Mobile communication), Retrieved from: https://searchmobilecomputing.techtarget.com/definition/GSM

Rouse, M. & Wigmore, I (2016) Landline, Retrieved from: https://whatis.techtarget.com/definition/landline

SickKids-Caribbean Initiative, (n.a.), Retrieved from: https://www.sickkidsfoundation.com/whyweneedyou/partnerforbettercare/caribbeaninitiative

Středa, L. & Hána, K. (2016) eHealth a telemedicína. Grada Publishing, a.s., 2016

U.S. Department of Veteran Affairs (n.a.) VA Expands Telehealth by Allowing Health Care Providers to Treat Patients Across State Lines, (2018), Retrieved from: https://www.va.gov/opa/pressrel/pressrelease.cfm?id=405

UNFPA (n.a.) In remote Mongolia, telemedicine connects pregnant women to faraway care. (2015) Retrieved from: https://www.unfpa.org/es/node/11804#

VSee (n.a.) What is Telemedicine, Retrieved from: https://vsee.com/what-is-telemedicine/#3

Wang Z, Gu H. A review of telemedicine in China. J Telemed Telecare. (2009), Retrieved from: https://doi.org/10.1258/jtt.2008.080508

Wangchuk R. Uttarakhand DM's award-winning initiative connects citizens to 20+ health schemes. (2019), Retrieved from: https://www.thebetterindia.com/178305/uttarakhand-ias-officer-hello-doctor-health-governance-india/

WhatIsMyIpAdress (n.a.) What is ISDN?, Retrieved from: https://whatismyipaddress.com/isdn

WHO (2010) Telemedicine: opportunities and developments in member states: report on the second Global survey on eHealth., Retrieved from: https://www.who.int/goe/publications/goe_telemedicine_2010.pdf

Worldometer (n.a.), Mongolia population, Retrieved from: https://www.worldometers.info/world-population/mongolia-population/

ROZŠÍŘENÝ ABSTRAKT

Tato bakalářská práce se zabývá Telemedicínou a jejím využití v dnešní společnosti s přihlédnutím k sociálním aspektům a technologickému vývoji. Hlavním účelem této práce je informovat širokou veřejnost o možnostech telemedicíny a zvýšit tak jejich povědomí o moderním systému péče o zdraví. Práce se v první řadě zabývá rozdělením virtuální medicíny do oborů ehealth, telehealth a telemedicíny. Tyto pojmy jsou kolikrát zaměňovány různými celosvětovými organizacemi, které používají vlastní definice a kategorizují služby virtuální medicíny do těchto skupin podle sebe nebo tyto termíny zcela míchají. Je proto důležité si prvně utvořit přehled o každém pojmu a jak do sebe zapadají. Po ověření mnoha definicí, a to i těch ze Světové Zdravotnické Organizace, která zaměňuje termín telemedicína a telehealth je vidět, že se termíny ještě neustálily na celosvětovém měřítku. Bylo tedy nutné si tyto kategorie na prvním místě definovat. eHealth můžeme tedy definovat jako hlavni obor, do kterého spadá telehealth a telemedicína. Rozdíl mezi telehealth a telemedicínou bude v jejich službách, kdy telehealth se zabývá administrativou, vzděláváním, propagací zdravotnictví a zdravotnickým systémem. Do oboru telemedicíny tedy spadají všechny vzdálené klinické služby.

Z historie se můžeme dozvědět, že telemedicína tu byla už dávno předtím, než byly vynalezeny první telefony nebo dokonce i telegrafy. Jelikož se v telemedicíně jedná o komunikaci na dálku a tím poskytovanou pomoc, tak za první případy takové vzdálené pomoci můžeme považovat kouřové signály, které kdysi byli varováním na epidemie. Dalším takovým případem mohou být poslové, kteří byli posláni k doktorovi na místo pacienta a mohli mu popsat příznaky a vrátit se k pacientovi s léky a léčbou. V takovém případě byl posel předchůdcem telekomunikační technologie. S vývojem technologie bylo možné komunikovat na větší vzdálenosti a mnohem rychleji. Tento vývoj začal s telegrafem používaným ve válkách, a který byl poté nahrazen rádii a telefony. Vývoj technologie šel kupředu a s ním i telemedicína. To dokazují různé projekty jako například přenos EKG dat v roce 1905 mezi laboratoří Nizozemského psychologa Willema Einthovena a 1.5 km vzdálenou nemocnicí. S dalším vývojem přišly další experimenty a pokusy, které tyto nové technologie využívaly. Od prvních telegrafů až

po dnešní chytré telefony. Toto vše bylo jen urychleno vynálezem internetu věcí. Ten nám dovolil komunikovat a sdílet data po celém světě, čímž propojil celý svět. Pokrok technologie umožnil v roce 2015 otevřít vůbec první nemocnici plně dedikovanou telemedicíně v Chesterfieldu USA pojmenovanou Mercy Virtual. Všechna naše dnešní technologie nám umožnuje komunikovat v reálném čase s někým, kdo je na druhé straně světa. Komunikaci můžeme rozdělat na dva druhy. První je už zmíněna komunikace v reálnem čase, tzv. synchronní, patří sem videohovory, hovory a chat. Umožnuje nám dostávat okamžitou odezvu. Druhá kategorie je tzv. asynchronní. Odešleme data druhému člověku nebo na nějaký vzdálený server a tato data mohou být zobrazena později. Nemusí tedy být přítomny obě strany, aby mohli komunikovat. Formou této komunikace je SMS, email a další.

Soukromé a bezpečné propojení mezi pacienty, doktory a specialisty je velmi důležité. Proto jsou metody přenosu dat v tomto odvětví klíčová nejen v dnešní době, ale i v budoucnu. Máme zde na výběr pevnou linku, bezdrátovou komunikaci, mobilní sítě, satelitní komunikaci, internet přes pevnou linku a samotný internet.

Tyto technologie nám umožnují komunikaci na velké vzdálenosti a v telemedicíně ji můžeme rozdělit do tří skupin. První skupina je asynchronní, jež se v telemedicíně využívá například k přenosu vysoce kvalitních snímků. Pro přenosy těchto dat se využívají standardy, které určují, jak by měly být uloženy a přeposílány v různých zařízeních jako jsou skenery, servery a pracovní stanice a další digitální zařízení. Druhá metoda je synchronní neboli v reálném čase. V telemedicíně se využívá především k video nebo audio hovorům mezi pacientem a doktorem. Nabízí to alternativu k osobním návštěvám u doktora. Pacienti už nemusejí čekat v čekárnách, ale mohou se se svým doktorem spojit pomocí videohovoru, čímž ušetří za cestování, a navíc je možné poskytnout péči v odlehlých místech. Telechirurgie také patří do této metody komunikace. Vzdálené monitorování je dalším způsobem, jak spolu mohou pacienti a doktoři komunikovat. Může být ve formě asynchronní, kdy má na sobě paciente nějaké zařízení, které monitoruje jeho životní funkce a tato data posílá na server, kde si je může doktor později prohlédnout. Nebo komunikace s doktorem v reálném čase, kdy doktor vyšetřuje pacienta pomocí zařízení, jenž má pacient doma. Monitorování je velmi závislé na zařízeních. V dnešní době už máme mnoho nositelných zařízení, která monitorují různé funkce našeho organismu.

Telemedicína má mnoho možností, jak být aplikována ve službách a s dalším vývojem technologie se tyto možnosti jen rozšíří. Služby v telemedicíně jsou rozděleny podle oborů samotné medicíny. Máme zde: Teleošetřovatelství, jež spojuje sestry a pacienty, Teleaudiologie, která využívá asynchronní komunikaci k přeposílání dat mezi specialisty a doktory nebo synchronní komunikace ve formě videohovorů přes, které může doktor vyšetřit pacienta, Telezubařství poskytuje zubařům možnost přeposílat snímky a spojovat se se specialisty na odlehlých místech, Telelékárna pro doručování léků a spravování lékařských receptů přes komunikační technologie, Teleneurologie umožňuje specialistům jichž je v tomto oboru nedostatek poskytovat pomoc pacientům vzdáleně, Telerehabilitace poskytuje rehabilitační služby pro obory jako fyzická rehabilitace, okupační terapie, řečová patologie a další, Teletrauma péče spojuje specialisty s personálem v místech nehod, a ti se pak mohou připravit na příjezd pacienta lépe, když ho na dálku mohli prohlédnout, Telekardiologie může monitorovat implantovaná srdeční zařízení, přeposílat data z EKG naměřená u pacienta doma nebo na ambulanci, Telepsychiatrie využívá videohovory k poskytování psychiatrických služeb, Teleradiologie je využita k přeposíláni radiologických snímků jako CT sken, magnetické rezonance a další, Telepatologie je obor, jež se také využívá k přenosu obrazově bohatých patologických dat mezi vzdálenými místy, Telechirurgie kombinuje prvky z mnoha oborů k provedení chirurgického zákroku u pacienta, u jehož je vzdálenost mezi pacientem a doktorem irrelevantní.

Na sociologické aspekty v telemedicíně je nutno se zaměřit abychom pochopili, kdo a jak její různé služby využívá. Z hlediska věkových skupin je vidět že nejmladší skupina mezi 18 a 34 roky má s telemedicínou největší zkušenosti, ať už z hlediska ochotnosti ji využívat nebo ji už využívá. S rostoucím věkem tyto čísla klesají, což můžeme předpokládat, jelikož moderní telemedicína je zde velice krátce a starší lidé jí nebyly tolik vystaveni. V aspektu lokality záleží na mnoha faktorech jako je dostupnost internetu v dané zemi nebo i kulturní zvyky. U rasy, etnického původu nebo pohlaví zatím nebyly zatím prokázané žádné velké rozdíly. Toto se však v budoucnosti může změnit, jak bude telemedicíně vystaven větší počet lidí. V neposlední řadě je zde budoucí vývoj z hlediska ekonomiky, lidských faktorů a technologie. V budoucnosti už nebude muset být možné rozdělit telemedicínu a medicínu na dvě části, jelikož budou obě součástí základní zdravotní péče poskytované každému člověku.