37. MEDNARODNA KONFERENCA O RAZVOJU ORGANIZACIJSKIH ZNANOSTI: ORGANIZACIJA IN NEGOTOVOSTI V DIGITALNI DOBI
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Environmental Sustainability of Telemedicine

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Abstract In developed countries, the healthcare sector is committed to improving the provision of care, while at the same reduction costs. In the paper, the authors point to the connection of telemedicine and environmental sustainability. Many current practices of the health care system have a negative impact on the environment. Thus, the healthcare industry is the second largest consumer of energy among all industrial sectors. On the other hand, telemedicine, using information and communication technologies, reduces these impacts, ensuring that the healthcare industry better and more efficiently manages natural resources while reducing energy consumption and minimizing waste. Telemedicine and health information technology help save time, energy, raw materials (such as paper and plastic), and fuel material, thereby lowering the carbon footprint of the health industry. From these reasons, the application of telemedicine is an important ecological potential for a global ecosystem of planet Earth.

Keywords: • health system • telemedicine • environmental sustainability • information and communication technologies • greener transports •

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1 Introduction

The health care system is a complex organization system constituted by a plurality of interdependent elements, which in conditions of natural and socio-economic environment, strive in maintaining health, or state of health of the population, taking measures and implementing health care.

The main goals of health care are the preservation and improvement of public health through preventive actions on the prevention of diseases; early detection of disease; and effective treatment and rehabilitation. Achieving the above development of health care related to the existence of homogeneous health care as to its availability to the population, the quality of provision, improvement of the equipment and the capacity of health care institutions, encouraging further development, implementation of good practice, and the like (Jovanović Milenković, Milenković, Vukmirović, & Radojičić, 2016). This trend of growth and development of health care causes, unfortunately, high energy consumption, such as is the case with many industrial sectors. To this should be added the negative environmental impact of the practice of the healthcare system, which is reflected in the pollution caused by extensive travels and administrative activities of patients and health workers.

The application of information and communication technologies (ICT) in health care shows a trend of shifting the focus from resource management to knowledge management and processes. Through using ICT the entire healthcare system is changing. Telemedicine and information technology in health care contribute to savings in time, energy, raw materials (paper, plastic, etc.), fuel and reduced carbon footprint. For these reasons, telemedicine has an important role in reducing the environmental and economic costs in the future, with the simultaneous development of medicine quality.

2 Telemedicine

It is evident that the last decade is characterized by the use of information and communication technologies that are used in the provision of health services worldwide (Andreassen, Kjekshus, & Tjora, 2015; Alsulame, Khalifa, & Househ, 2016). The reason for this can be found in the rapid development of sensor and communications technologies that enabled proliferation of new innovative services in the health sector such as telemedicine (Klaassen, van Beijnum, & Hermens, 2016).

Telemedicine is a combination of information and communication technologies, multimedia and networking that aims to facilitate the transfer of medical data (Jovanovic Milenkovic, Milenkovic, & Ristic, 2016). The prefix "tele" comes from the Greek word meaning "away" or "at a distance", so that the word telemedicine can be translated as "distant healing" (Strehle & Shabde, 2006). When it comes to telemedicine it should be noted that the term comes from the seventies of the last century, and that there is no unambiguous definition of its meaning. Thus, studies in 2007 showed that there are over

104 definitions of telemedicine (Sood, Negash, Mbarika, Kifle, & Prakash, 2007; WHO, 2010). The World Health Organization (WHO) has adopted the following definition of telemedicine:

> *"Providing health care services, where distance is a critical factor, by health care 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 continuing education of health care providers, and all in the interest of improving the health of individuals and their communities "(WHO, 1998).*

Also, telemedicine can be defined as (Jovanović Milenković, Milenković, & Ristić, 2016):

- The use of electronic services for the transfer of medical data from one place to another over the Internet, phone, computer, satellite or video conferences, with the aim of providing health care services (Brown, 1996).
- The use of complex technology for the exchange of information on health and health service provision, in cases where there are geographical, temporal, social or cultural constraints (Reid, 1996).

What is in common to all existing definitions of telemedicine is that telemedicine is considered open science that constantly evolves covering new developments in technology for the adequate adaptation to changes in the system of health care delivery.

Telemedicine technologies offer opportunities for monitoring various parameters based on different circumstances; for example, with applications in patients with spinal trauma or pain in the back. In these patients monitoring the state of health is continuously done, with the help of accelerometers and video. These technologies can be used in situations such as rehabilitation after surgery, preventing the spine curves in children, monitoring the development of the babies, and so on. Examples indicate that through use of telemedicine there is an improvement in the provision of health care services in rural areas, emergency situations, or in the absence of an appropriate medical personnel. Users, primarily doctors, have come up with new knowledge and observed clinical effect and satisfaction, because they get the option of remote consulting, educating and training for work in the modern telemedicine conditions.

Successfulness of telemedicine projects (STP) shows the relationship of application of health services and their accessibility/acceptability of patients and doctors, and is inversely proportional to the costs and objections from health care professionals using this service.

STP=QHS / CTS

STP – Successfulness of telemedicine projects
QHS – Quality of health services
CTS – Costs of telemedicine services

In short, the advantages of telemedicine could be summarized as follows (Jovanović Milenković, Milenković, Vukmirović., Radojičić, 2016):

- Easier access and consumption of health care. Expanded access to the provision of health care services in rural areas and vulnerable population was the main driver of telemedicine applications. Socio-economic incentive provided by strategic aspect of telemedicine.
- Increasing the efficiency of health care. Access to better health care indicates that though application of telemedicine it is easier to follow the patient's health status, monitor the impact of treatment on his health. This applies mainly to patients who have not been able to have an exam of local character.
- Improving communication between members at all levels of health care. The transition to digital communication offers many benefits for medical staff and their patients. Digitized data such as data relating to previous illnesses of the patient, laboratory results and notes for the current episode is easily transmitted electronically, using standard protocols and technology. Digital communication provides an accurate, complete and timely information that lead to better access and quality of service.
- More efficient access to information and improving education. Education via the Internet is possible through access to various sites that provide medical content through teleconsultation and telemonitoring. Better access to information associated with the individual's desire for further improvement. From themselves depends the extent in which they access the electronic library, various databases and information in the right way.
- More rational use of resources. Better use of resources relies on the fact that all processes are recorded electronically, in order to avoid repetition. In this way it contributes to the preservation of existing resources and reduces costs. The possibility of reducing the cost by using telemedicine is various. Reflected in the reduction of consumables, as well as the use of the same equipment by many experts.

Furthermore, the establishment of health care information and communication system between all participants (direct and indirect) provides access to a large number of data and information necessary for decision-making and implementation of business processes (Chatman, 2010; Jeremić et al., 2011; Milenković Jovanović, Milenković, & Dobrota, 2012).

3 Environmental sustainability of telemedicine

The necessity of reversing the process of degradation of the environment and turning toward environmental sustainability, sustainable development and sustainable business practices has become a key postulate of modern activities (Figure 1) (GLRI, 2017). In addition, most businesses are turning to the use of information and communication technologies in order to remain competitive in the changed market conditions, which are characterized by the use of electronic infrastructure (Jenkin, Webster, & McShane, 2011). A similar situation applies to the health care system, which resulted in the use of these technologies in medicine and telemedicine practices.

Figure 1. Sustainable development goals

Healthcare industry in most cases lacks environmentally sustainable practices. Many current practices of the health care system have a negative impact on the environment caused by a large number of travel and paperwork by both patients and health workers. Thus, the health industry is the second largest consumer of energy among all industrial sectors (Lundberg, 2006). On the other hand, telemedicine using information and communication technologies reduce these impacts, ensuring that the health care industry better and more efficiently manages natural resources while reducing energy consumption and minimizing waste.

Several organizations began to focus on how health workers and health systems can be applied to a more environmentally friendly or environmentally similar or greener way. Prominent examples of such activities include Smart Growth Online (www.smartgrowth.org), Practice Greenhealth (www.Practicegreenhealth.org) and Health Care Without Harm (www.noharm.org). Securing Proven Healthcare Energy

Reduction Initiative involves cooperation between the Premier (www.premierinc.com) and Practice Greenhealth's Health Care Clean Energy Exchange. This is carried out so as to reduce the prices of energy and other products, allowing stakeholders from the health care system to increase the proportion of purchases of renewable energy sources and reduce the costs of energy supply.

The American Telemedicine Association task force is focusing on four objectives (Wicklund, 2017):

1. Encouraging ATA members to include "green" outcomes in measuring ROI, and describing those measures and outcomes;
2. Developing tools and guidelines to help ATA members reduce fossil fuel use and carbon dioxide production through less travel;
3. Demonstrating how telemedicine can create more environmentally sustainable practices and health systems; and
4. Showing how telemedicine can mitigate and respond to health crises arising from both sudden and long-term climate change related events, such as global warming, disasters and the spread of infectious diseases.

4 Case study

In the last 5 years, UC Davis Medical Center, California, the United States, had more than 13,000 telemedicine consultations in 30 different specialties, mainly in Northern California. Analyzed in terms of saving carbon, each telemedical consultation on average is about 330 kilometers preserved travel for a single patient. It also achieved the following ecological benefits (Yellowlees, Chorba, Burke Parish, Wynn-Jones, & Nafiz, 2010):

- Total reduction of about 1.5 bilion kilometers of travel and 6 hours of time spent per patient needed to visit this university clinic.
- Savings of about 700,000 liters of gas - equivalent to 1,700 metric tons of reduced carbon emitted into the atmosphere.
- Saved an average of $43.00 for the cost of fuel ($3.00 per 4 liters of gas) per teleconsultation, and a total of $200 per vehicle maintenance costs.

When it comes to waste paper, data for UC Davis Medical Center show that on an annual basis 5,000 sheets of paper are used for admission of new patients, around 147,000 photocopied sheets of paper - the equivalent of 16 trees per year. The process of admission documents is now electronic so that they obtained great time savings in resources. Also in the UC Davis Medical Center all servers that are used for the application of electronic medical records are virtualized - 187 servers is "transformed" into seven virtualized servers, leading to cost savings and energy savings (UC Davis Health, 2017).

The magnitude of the carbon reduction per appointment is extensive and clearly indicates that up-scaling the use of telemedicine could have a large impact on the over-all carbon footprint of the health sector. The hand and plastic surgery clinic reduced the carbon emissions per appointment by more than 70 times without having to make major financial

investments. The yearly monetary cost of a videoconferencing equipment of this standard is approximately 1,100 EUR or 1,500 USD. Further on, when taking into account trends towards greener transports, telerehabilitation is the most climate-smart work model based on our sensitivity analyses (Holmner, Ebi, Lazuardi, & Nilsson, 2014).

In addition to telemedicine, electronic records, placement data centers and virtualization, there are other environmental features that include increased use of electronic modalities of health, such as systems of electronic communication and meeting management, systems for education courses, programs to manage chronic diseases and electronically guided health care and disease prevention. It also examines the potential for establishing a greener ICT.

5 Conclusion

Telemedicine enables health care system to improve their environmental impacts through energy savings, reducing costs and waste. This allows the preservation of the environment and its protection becomes part of the short-term and long-term planning projects, which should be based on the principles of sustainable business, which includes the following: cost-effective energy management, renewable energy, waste reduction at the source of its creation, recycling materials (4R), the further development of electronic medical practices and the expansion of telemedicine applications.

The application of telemedicine is an important ecological potential for a global ecosystem of planet Earth while preserving the environment through eco-friendly and green practices of the health care system that does not only affect the health improvement by assisting in the treatment of patients but also in reducing the full impact of health care on the environment and the wider community.

Research is needed on a larger scale to evaluate the current and future impact of different telemedicine solutions on carbon emissions, from the viewpoint of telemedicine as a well-accepted and fully integrated part of any health care activity.

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