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Usability of m-Health Services: A Health Professional's Perspective

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In the modern world the use of information and communication technologies, computer networks and systems based on such technologies are the determinants of efficiency and operating performance in healthcare. This paper deals with the concepts of electronic and mobile health and opportunities of their implementation in the healthcare systems. This paper will analyze the factors that influence the acceptance of mobile healthcare services among employees in health institutions. The main goal of this paper was to analyze the possibilities of using mobile healthcare services in health institutions, as well as to analyze the predictors for successful implementation of mobile health services. The research results indicate a high level of knowledge regarding the usefulness and availability of services among healthcare workers in health institutions, which is the prerequisite for a successful implementation of mobile health in the healthcare system.

Keywords: eHealth, mobile health, mHealth, health services, healthcare, mobile health applications

1. Introduction

Doing business or providing quality health information and services as well as exchanging information between entities in the health care sector without modern information and communication technologies and connections is almost unimaginable today.The implementation of information systems in organizations that provide health care services has made a big step forward. It has created a flexible and scalable system whereby healthcare workers and associates provide efficient and economic healthcare. Isolated IT environments in health institutions were standard once. Today, mobile platforms are used in order to develop communication with traditional medical equipment (stethoscopes, devices for measuring blood pressure, ECG, EEG, etc.) as well as for the exchange of data, information and knowledge in the health care system. The availability of healthcare services, accessibility, quality and the price of health services represent a problem in many countries of the world (European Commission, 2012) (European Commission, 2012) (PricewaterhouseCoopers, 2012). Many factors, such as: insufficient financial resources, disability or restricted mobility, lack of knowledge, and even poor weather conditions or long waiting lines, may prevent peoples' approach to health care services or education to improve health. Mobile applications, sensors, medical devices and remote diagnostics are amongst numerous ways of rendering health care services. These technologies help cutting costs of providing health care services and connect the patients with health service providers (West, 2013).

The subject of this paper is to analyse possibilities for application of mobile health care services within health institutions in Serbia. The analysis of some prerequisite factors for succesful implementation of mobile health has also been presented. In addition, the percieved usefulness and availability of mobile health care services among health experts in Belgrade has also been analyzed.

2. eHealth and Mobile Health

Electronic health or eHealth (e-health) has emerged as a field where medical informatics meets public health, and processes regarding providing health services and information generated and shared through the Internet and related technologies (Eysenbach, 2001). In addition to technical development, the broader meaning of this notion represents change in the way of thinking and acquiring positive habits and connecting for the purpose of improving health care on the local, regional and global levels, by the implementation of information and communication technologies (Eysenbach, 2001).

According to the definition of the World health care organization, electronic health (eHealth) represents using information and communication technology in the health care sector (World Health Organization, 2015). According to the Republic of Serbia Information Society Development Strategy for the year 2005, eHealth represents using modern information-communication technologies to satisfy the needs of citizens, consumers of health services, health experts, institutions providing health services and designers of the health care policy (Ministarstvo nauke i životne sredine Republike Srbije, 2005).

Mobile health or m-health (mHealth) notion originates from the notion: electronic health. The notion mobile health is being used for both providing health services and public health, with the support of mobile appliances (World Health Organization, 2011). This includes healthy life styles applications, which either directly or indirectly improve health or the quality of life. Such applications are often connected to medical devices or sensors (watches, bracelets, etc.). Mobile health includes: personal health guidelines, health information providing applications, and reminders, using SMS and telemedicine, via wireless communication (European Commission, 2014). The mobile and smart phones market has advanced so much that even the least expensive phones have some kind of Internet approach features. Thanks to the low price and accelerated development of the mobile network worldwide, tens of millions of people who did not use to have access to telephone or computer, now use mobile devices as the everyday communication and information sharing tool. Mobile communication gives new chances for spreading health information among developing countries people (World Health Organization, 2011). Their ubiquity is the main reason for which the mobile technologies should be incorporated in the new technology solutions for providing health services.

3. Technologies and Conditions for Application of Mobile Health Services

Mobile phones in Serbia are represented in 90.6% of homes, while the Internet is present in 62.8% of homes (Statistical Office of the Republic of Serbia, 2014). Outspread and ubiquity of the mobile technologies and the Internet is the main technological condition for the implementation of mobile health services. There are several key characteristics of mobile technologies which make them superior to other information-communication technologies, particularly when applied in the health care sector (Free et al., 2010). Many appliances used in health care have wireless communication which allows continual monitoring and interaction regardless of the location of the user. In addition, there is the Internet approach through a WAP protocol and a broad band mobile Internet. Mobile devices are personal, the users always keep them with themselves, and are available at any time. The size is appropriate, they are not too large to be portable. Modern smart devices are lightweight with a longer battery life. It is the combination of all those characteristics that makes them irreplaceable for the health care system implementation.

Depending on the field of implementation, mobile health care applications may be used for collecting clinical and general health information as well as for providing communication between people and the health care system. In addition, applications can provide health information, perform monitoring of the patient's health condition in the real time, and provide medical services directly (field of mobile telemedicine). Smart phone applications are widely spread among the users and patients. Among them, there is a great number, above 160.000 (research2guidance, 2015), of various commercial health care applications, which could be downloaded over the online shop application. Such downloaded health care applications usually are not subject to standardization or quality control, so their use in medicine and health care have often been debatable. mHealth applications can be classified in nine categories (Heidi et al., 2014), (UN Foundation-Vodafone Foundation Partnership, 2009), (Ventola Lee, 2014 May):

1. Education. Education systems and systems for increasing awareness about health, providing information on health promotion and prevention of the disease, education programmes, and forming virtual community.
2. Remote monitoring and data access. Remote data access aimed to help health workers in decision making.
3. Patients monitoring. Applications which provide treatment support in regard to control of treatment compliance, rehabilitation, physical exercise, collecting clinical data, etc. as well as the applications for reminding/scheduling appointments.
4. Monitoring of the disease and epidemiology surveillance. Provide real time surveillance of the contagious diseases.

5. „Point-of-care“ support. Used to provide permanent information regarding diagnostics, screening, treatment, access to health information system, as well as the decision making support systems via mobile phones or tablets, instead of previous static computers.
6. eLearning. Providing mobile platform for health education systems support, communication or continuous education or health workers training.
7. Quality of life improving applications. Applications for promoting healthy life styles, fitness and wellbeing.
8. Systems for emergency medical interventions. Provide alarms for accidents, emergency situations, and natural disasters.
9. Applications for financial management. Facilitate the use of smart cards or vouchers for mobile payments

Mobile health care services for promoting patient's health involve direct contact with a patient (PricewaterhouseCoopers, 2012). These are the most common solutions for the prevention of disease, or are intended for persons suffering from certain diseases or are at risk for illness. Numerous such solutions have been implemented with the intention to preserve and promote health, for example, for quitting smoking (Riley, Asif, & Jersino, 2004), vaccination (Vilella et al., 2004), wellness and promotion of mental health (Ahtinen et al., 2013) (Price et al., 2014). One aspect of the provision of health care services through the mobile health consultations by a physician or health care professional are motivational messages or reminders for vulnerable groups (Ramanathana, Swendemanb, Comuladab, Estrina, & Rotheram-Borus, 2013).

Several pilot projects in the underdeveloped countries, where living conditions are extremely poor and where there are obstacles for providing health care, mobile health care services have been shown to be an efficient solution for health care provision (UN Foundation-Vodafone Foundation Partnership, 2009). The patient's vital signs monitoring may be significant in the patient's recovery monitoring, which can influence treatment cost reduction (Chen et al., 2013). Numerous commercial solutions for mobile health care applications with implemented sensors for measuring vital parameters for health promotion or measuring various stages of treatment, improving physical fitness and health life styles promotion (Suunto, 2015), (BASIS Science, 2015), (Maiaa et al., 2014), (Wu et al., 2009), (Millings et al., 2015).

Solutions for health care system strengthening - emergency service, support to health care providers, research and evaluation in health care, administration and jobs which do not include direct interaction with patients, but are primarily intended for improvement of health care workers efficacy within the health care system (PricewaterhouseCoopers, 2012).

Remote monitoring and data access applications provide support for health care providers. Such applications are mostly used for remote diagnostics in the primary health care; they have access to remote databases and help health care workers in decision making (Wolters Kluwer, 2015) (Wolters Kluwer, 2015). Error! Hyperlink reference not valid.

For the purpose of research, mobile health services include services and tools which help health care experts to collect and analyze health information with the aim of monitoring health condition and epidemiology situation. Such systems are support to decision making for health care founder, for example, as in the pilot project in Senegal (World Health Organization, 2011).

Mobile health care services in the field of education in health care can be directed towards patients (customers) or to the health care workers where they are a part of the system to support access to databases of drugs and treatment protocols (World Health Organization, 2011).

Interoperability is a significant condition for mobile health care services implementation. Interoperability in health care represents the possibility for the data and information generated by a health care or some other system to be available to another (health care) system, regardless of the technology that communication is based on. The ideal situation is that the systems involved in the interoperability comply with the standards, while in practice, such a situation is hardly feasible due to the lack of universal standards, rapid technological development, the existence of an inherited system or simply due to the autonomy of each system (Bogdanović, Stanimirović, & Stoimenov, 2008). For communicating and exchanging information between the existing health care system and the mobile medical applications to be adequately supported, all participants in the exchange should support certain standards for data exchange, and security support. From the standards implementation point of view, electronic health care is the most complicated and the most challenging field for standardization.

There are several reasons that make efforts to standardize electronic health so difficult. Technologies used in health care are costly. Then, the electronic health care systems include "big data", i.e., huge amounts of data that make up a multimedia diagnostic images, patient data, test results, research samples, information on insurance and financial reports and other data. eHealth standards do not apply to one isolated field of expertise but to hundreds of them.

And the last, but not the least, reason for the difficulty in standardizing is the fact that the various launched initiatives for applying standardization charge for their applications, which increases the costs of introducing or improving the system of electronic health care. Increasing costs often lead to cancellation of innovation based on eHealth (DeNardis, 2012).

In addition to the technological requirements for the implementation of mobile health care services, it is of great importance for these services to be accepted by employees in health care institutions. Research in the field of information and communication technologies in health care is largely based on the design of information technology solutions and their implementation, as well as on the quality of mobile health applications (Stoyanov et al., 2015) while there is a lack of focus on the acceptance of implemented solutions among health care professionals and end-users (Holden & Karsh, 2010). However, there are numerous studies that have been conducted dealing with the prediction of behaviour and interpretation of the reaction of end users to a specific IT solution in health care (Holden & Karsh, 2010).

Due to the expansion of information and communication technologies in all spheres of life, especially in the field of health care, the importance of theories that predict and explain the factors that influence the adoption and use of information and communication technologies in health care is growing. Mobile Health Services are an emerging technology, commonly used voluntarily among the medical staff, so that the perception of the usefulness (Wu, Li, & Fu, 2011) is of crucial importance in the acceptance of these solutions.

The use of mobile health care services is directly related to the patient's health and quality of life. This fact is probably the reason for hesitation of health care workers to accept new services, including mobile health care services, especially when they are still in the testing phase and in the initial stage of implementation. The perception of usefulness may affect the type of technology that is applied in the solution, the size of the device where the software solution is implemented, the aesthetic design and an interface that is (not) easy to use (Demiris et al., 2013). The degree of education and the health care workers' age influence the perception of usefulness (Illiger, Hupka, von Jan, Wichelhaus, & Albrecht, 2014), and these factors are associated with the understanding of the use of information technology.

Mobile devices with wireless functionality are intended for personal use among individuals and can provide immediate medical support to various activities anytime anywhere. However, the quality of service, such as service availability in real time, is the main "concern" for medical professionals. The reason is that the use of mobile health care is closely linked to the wellbeing and life of the patient. Therefore, medical experts should ensure completeness and timeliness of mobile services access, before the use of the device. The knowledge about the availability of service refers to the extent to which knowledge is true that a certain innovation is accessible and timely, and many studies point to the perceived problem of availability when trying to understand the acceptance of mobile devices (Deng, Zhang, & Zhang, 2012), (Wu, Li, & Fu, 2011).

4. Research Methods

The main goal of this paper is to review the possibilities of application of mobile services in health care, as well as to analyze the factors that are predictors of successful implementation of services which are the perceived usefulness and the perceived availability of mobile health care services among employees in health care institutions.

According to the main goal, the hypotheses in this research are:
H_1: There is a high level of agreement with statements about usefulness of mobile health care services among employees in health care institutions.

H_2: There is a high level of agreement with statements about availability of mobile health care services among employees in health care institutions.

The research was conducted among employees in health care institutions in Belgrade from 19th May to 13th June 2015. Fifty three health care workers and associates from the Belgrade area participated in this study. The

employees work in various types of health care institutions: health care centers, specialized clinics, hospitals, community health care centers and regional institutes. The sample was randomized, selected by the "snowball" model. The initial sample consisted of 12 health care workers and associates for which authors had contact addresses. With their help we came to the other health care workers and associates or their e-mail contacts.

In order to implement the research an instrument – a questionnaire – was designed. The first part of the questionnaire consisted of nominal type questions that examined the demographic information and questions regarding the use of the Internet. The second part of the questionnaire consisted of 5 questions that examined the usefulness and availability of mobile health care services. The possible responses were in the form of a 5-point Likert scale: 5 - I completely disagree, 4 - I mostly agree 3 - I have no opinion about it, 2 – I mostly disagree, 1 – I strongly disagree.

The usefulness of a mobile health care service has been tested through agreement with statements that the list of doctors on duty with the possibility of video calls reduces the waiting time for consultations. Then we examined the attitudes of the respondents to the online consultation with a physician over traditional visits. Health care ID in the phone can be a practical and reliable solution instead of a standard paper ID and we examined whether respondents agreed with this statement. This group of questions also included attitudes as to whether the list of medical institutions with all relevant information (email, address, contact numbers, maps) is useful in the mobile phone and the extent to which mobile health care applications are useful for patients and health care workers.

The availability of a mobile health care service was tested by the views of respondents on whether the mobile health applications allowed health care services to be portable and to what extent the mobile health care allowed access to health services for people in remote areas. Health information for improving the health status are available at the same time for a large number of people through the health care mobile application, especially for the people in the territories affected by natural disasters, and thus make health care services available at the moment when they are indispensable.

The participants were asked via e-mail to participate in the study, and the objectives and methodology of research were explained to them in detail. The model of mobile health care applications ("My mobile doctor"), which was set to Google Play was forwarded to the participants by e-mail.

The respondents were given detailed explanations on the installation and purpose of the applications with mobile health care services. Following ten days of familiarization and the use of applications, respondents were given a survey. The survey was given to the participants at their workplaces. They returned the completed survey the next or the same day (depending on the current business obligations).

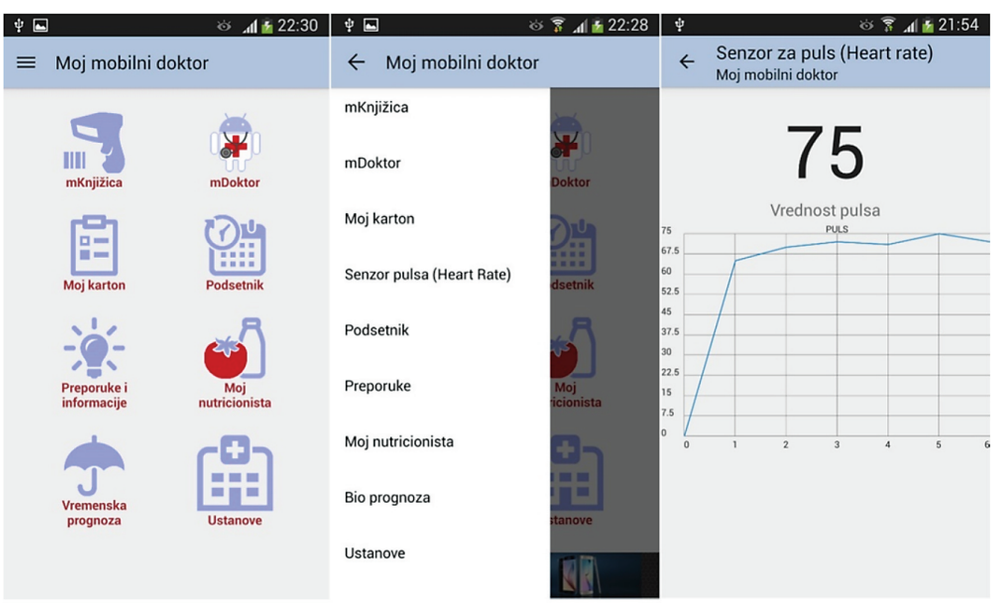

Figure 1: Mobile application "My mobile doctor" screens

For statistical analysis we used the SPSS software version 20. When comparing the average values of the indicators, the analysis of variance (ANOVA), both parametric and nonparametric types, were used. Table 1 shows the descriptive statistics of the sample.

Table 1: Descriptive statistics

Characteristic	Gradation	Frequency	Percentage (%)
Sex	Male	9	17.0
	Female	44	83.0
Age group	18-25	0	0
	26-35	8	15.1
	36-45	27	50.9
	46-55	12	22.6
	56-65	6	11.3
	66 and older	0	0
Healthcare worker type	physician	23	43.4
	technician	22	41.5
	health associate	8	15.1
Education degree	high school	11	20.8
	college	11	20.8
	university degree	7	13.2
	post degree (master, specialization, PhD)	24	45.3
Health care institution	hospital	10	18.9
	specialized clinics	4	7.5
	polyclinic	15	28.3
	community health care centers	17	32.1
	regional institutes	7	13.2
Work experience	less than and 5 years	3	5.7
	6-15 years	17	32.1
	16-25 years	25	47.2
	more than 25 years	8	15.1
Internet usage experience	less than 1 year	0	0
	1-2 years	3	5.7
	3-5 years	11	20.8
	more than 5 years	39	73.6

5. Results and Discussion

Tables 1 and 2 show the indicators of usefulness and availability of mobile health care services and the mean of respondents' answers according to the Likert scale of agreement with the attitude offered.

Table 2: Mean and standard deviation of agreement with questions about usefulness of mobile health care services

Question	Mean	SD
mDoctor, list of doctors on duty with video call option and e-mail contact (with appropriate charging of services) would reduce waiting time for consultation, counselling, doctors' orders, etc.	4.21	0.717
Consultation and counselling with online doctor through video call (consultation for chronic diseases, doctors' orders and other appropriate services) would be as useful as traditional doctors' consultation.	4.17	0.778
Health ID card in mobile phone (in mobile health care application) is a practical, reliable and easy-to-use solution.	4.42	0.750
Health institutions – list with a health care institution name, map, call option and e-mail option is a useful option in the smart phone.	4.74	0.593
Mobile health care applications (mHealth applications) would be useful both for patients and for health care workers (in the role of provider or health care user).	4.56	0.574

Table 3: Mean of agreement with questions about usefulness of mobile health care services

Question	Mean	SD
Mobile health care applications would allow health services to be portable (available anywhere) and anytime (e.g., institutions directories, consultations and counselling with doctors, health records availability, etc.).	4.34	0.678
Mobile health would allow availability of health care services to people in remote areas who have no or limited access to health care services (e.g. transportation, distance, lack of personnel, etc.).	4.34	0.758
Through mobile health care applications, health care information in order to improve health condition or diseases prevention would be accessible to many people.	4.50	0.672
Through mobile health applications, important messages and health information would be easily available to people from territories affected by natural disasters (e.g. floods, snowstorm, earthquake, etc.).	4.40	0.689
Smartphone with mobile health care applications could facilitate access to health care services when needed.	4.34	0.618

Most of the participants display a high level of agreement with statements about usefulness and availability of mobile health care services (consultation and counselling with doctor, institution directories, health ID card, etc.). Thus the proposed hypotheses are confirmed.

Also, we examined the relation between the type of the health care institution where health care workers are employed and the perception of the usefulness of mobile health care services and found that there was no statistically significant difference between these categories. At the same time, the level of education of health workers did not significantly affect the perception of the usefulness of mobile health care services.

The respondents of the age group of 36-45 year olds mostly emphasize the usefulness of mobile health care services with statistical significance ($F=3.403$; $p<0.05$), whereas there are no differences among the respondents' age categories when it comes to the perception of service availability.

A significant impact on the perception of the usefulness of mobile health care services has an Internet usage experience. Users whose experience exceeds five years evaluated positively the usefulness of mobile health care services to a significantly higher degree ($F=4.986$; $p<0.05$).

Conslusion

Mobile technology help health care services to be readily available, accessible and rendered in a satisfactory manner, all in an interesting way. There are many ways for improving the way of providing health care services, starting from mobile applications, sensors, devices for remote diagnosis and proper equipment. The results of this survey demonstrate that respondents who work in health care institutions in Belgrade on average highly agree as regards issues of mobile health care services usefulness and availability.

The maximum extent of mobile health care services usefulness has been perceived by the employees aged 36-45 and those who with 5 years' experience in the use of the Internet. A longer experience in using the Internet and familiarity with modern information technologies have an impact on understanding their usefulness. The level of education had no impact on the perception of usefulness and availability of mobile health care service among employees in health care institutions.

A basic drawback of this research is the subjectivity in the selection of the sample, which probably included participants who were already familiar with information and communication technologies. The future research should include a larger number of employees in health cate institutions chosen randomly. At the same time, future research should include a larger number of factors that describe the acceptance of mobile health care services among health care workers and associates, with the necessary testing of the existing infrastructure in the health care sector, which is a necessary condition for the development of such services. Positive attitudes of the respondents in the sample regarding the questions about usefulness and availability of mobile health services show that mobile technologies have a potential to provide an efficient and economical alternative to some traditional health services and make a good starting point for further scientific research.

A possibility for implementing mobile health care services in health care institutions in Serbia are numerous. As a pilot project, pending the adoption of specific regulations and the provision of infrastructure, solutions that are used for scheduling and various reminders for patients can be deployed. Services for informing the population about health care institutions and the available health care services, as well as implementation of the prevention programs aimed to improve health are certainly solutions that can be implemented and that would be a benefit to the entire society.

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