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IT SOLUTIONS FOR HEALTHCARE SYSTEM IN POLAND: IN SEARCH OF BENCHMARKS IN VARIOUS ECONOMIC PERSPECTIVES

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ABSTRACT. The aim of this research is to describe and compare the Internet connectivity and the use of eHealth solutions in the selected EU countries. Possible reasons for the differences in the use of information and communication technologies (ICT) in different economic conditions are identified. This paper focused on the benchmarks applicable in Polish healthcare system in relation to other non-health related activities where ICT use is much broader and in majority is based on secondary data taken from the reports conducted by Polish, European, and global institutions, as well as the databases of Eurostat and Central Statistical Office of Poland. The use of ICT in healthcare differs among the analyzed countries. Estonia's example indicates that the development of highly effective IT solutions is achievable. There is a need for further studies to monitor and optimize application of IT solutions for the healthcare system in Poland.

JEL Classification: I15, I18, I19, L86, L96

Keywords: healthcare system, IT solutions, Internet connectivity, Poland.

Introduction

Digital technologies have revolutionized the world. In particular, a significant development has occurred in information and communication technologies (hereinafter: ICT) in Europe over the past twenty years. These approaches support consumers in different parts of their lives, including the structural changes in healthcare systems and healthcare delivery to individual consumers (European Commission, 2014). Digital technologies have direct effects on people's lives, with the estimates that there will be 6,58 connected electronic devices per person all over the world by 2020. These projections estimate that staggering 50 billion devices will be connected to the Internet by 2020 (Evans, 2011). According to McKinsey Global Institute, worldwide Internet of Things market will have a potential of over 10% of the world economy by 2025 (Manyika *et al.*, 2015).

Digital progress has made inroads in nearly all economic sectors, including healthcare. As such, information and communication technologies enable patient centricity in the delivery of care, improved access to relevant resources, healthcare providers, and bidirectional flow of information between individuals and healthcare providers. As a result, healthcare system should become more personalized. More involved and informed patients can obtain better

results by implementing measures (healthy lifestyle, diet and exercising) to prevent diseases (thus, in the long-term prospective reducing healthcare expenditures at both individual and social levels). Improved communication healthcare provider (physician, nurse)-to-patient, patients' access to the information on the methods of therapy, and their health state, as well as to the test results increase participation in the treatment process, and can have significant impact on the state of health (Earnest *et al.*, 2004). Thanks to greater access, possibility of controlling patients' health information gives them chance to increase health literacy and engagement (Weitzman *et al.*, 2009). Their satisfaction is greater, while time needed for orientation how to use electronic devices is relatively short (Greysen *et al.*, 2014). More involved and informed patients are less likely to choose the non-adherence to prescribed therapy, which is now the case with up to 50% of patients even in situations after life threatening illness such as heart attack. Another potential benefit for patients and healthcare expenditures is greater detection and avoidance of medical errors due to ICT use. As a result, healthcare quality could improve, with better application of the guideline mandated therapies and shortening of the most expensive element in the patient journey through the healthcare, namely hospitalization. IT solutions enable measures to be embedded and monitored throughout the healthcare system. They also provide a platform for faster and more effective comparative research. They also should be envisioned for faster implementation of therapeutic guidelines.

According to the European Commission: „eHealth is the use of ICT in health products, services and processes combined with organizational change in healthcare systems and new skills, in order to improve health of citizens, efficiency and productivity in healthcare delivery, and the economic and social value of health" (Communication from the Commission, 2012, p. 3). eHealth presents ICT application in the entire set of functions affecting health care sector. It contains tools not only for health care authorities and health care providers, but also for patients (COCIR, 2015). From the standpoint of this research: "eHealth covers the interaction between patients and health-service providers, institution-to-institution transmission of data, or peer-to-peer communication between patients and/or health professionals" (Communication from the Commission, 2012, p. 3).

The definition of Electronic Health Record (hereinafter: EHR) is variable. According to eHealth Strategies Report, EHR is the longer-term electronic record of a patient which comprise or virtually interconnected data in numerous Electronic Medical Records (hereinafter: EMR) and Electronic Patient Records (hereinafter: EPR). This record is to be shared and exchanged across healthcare system, between institutions – healthcare service providers. EHR is also patient-centric (Stroetmann *et al.*, 2011, p. 20). It should be interoperable, as its purpose is to incorporate the contacting history of patients with healthcare providers from all the organizations which delivered care to this particular individual (OECD, 2013). EHR is also a real-time record. It provides secure and straightaway available data on patient (WHO, 2016, p. 21) and includes structured and unstructured information from the all available sources (Denaxas and Morley, 2015). The term EMR is understood as the electronic record of patient located in an outpatient clinic or doctor's office. The definition of EPR indicates electronic record of a patient conducted in a hospital or other medical facility. Usually EMR is provider-centric, held in one setting, whereas EPR is broader in scope. The latter is organization-centric, and is usually in one institution (Stroetmann *et al.*, 2011, p. 19).

Comparing to the other EU Member States, Poland is a country that has not developed sufficiently an electronic flow of information in the healthcare sector yet. Although the agreement exists among policy makers that such flow enables the coordination and transmission of information between all participants of patient's therapeutic process, providing higher efficiency of treatment while maintaining financial efficiency (Ministry of Health, 2015), the implementation of this approach has still fallen behind. According to the

results of the control conducted by the Supreme Audit Office in Poland, health care providers, which kept at least part of the documentation in the electronic form, have eliminated a number of deficiencies regarding its completeness and readability (Supreme Audit Office, 2016).

The aim of this paper is to compare the level of IT solutions implementation in the healthcare systems in different EU countries, particularly in Poland, and in Germany. Internet access, and Internet use, as well as hospital IT expenditures, were chosen as the indicators of economic conditions. The adoption and the use of digital communications tools by healthcare providers were presented subsequently. Afterwards patients' online access to the healthcare information and the availability of online booking of appointments were collated. At the end the Internet use by individuals was compared. The main goal was to look for the benchmarks to monitor further development of IT solutions in the healthcare system. Benchmarks for Polish healthcare system were searched not only in healthcare systems in different EU countries, but also in a broader context – in different parts of economy, in other sectors (specifically, in online banking).

1. Data and methodology

The data used in this analysis were taken from different Polish, European, and worldwide reports, as well as Eurostat and Central Statistical Office of Poland databases. The collection of primary data was not feasible. Nevertheless, secondary data allowed to present analysis in regard to selected European healthcare systems. They are reliable, as they were collected by official institutions. The descriptive analysis conducted in the empirical part is based on the data from six selected countries: Denmark, Estonia, Germany, the Netherlands, Poland, and Sweden. The selection of these countries is not coincidental. Estonia is one of the former Soviet Union republics that is well developed in IT solutions. Sweden and Denmark are two Scandinavian countries that belong to EU and are considered as well advanced in digital technologies. The Netherlands is one of the best countries in the usage of eHealth solutions, and Germany was selected as it is the largest EU country neighbouring Poland. Additionally complex EU data were presented to show position of selected countries in relation to EU situation in general. The data published in European Hospital Survey describes the comparative analysis of 30 European Countries – 28 EU Member States together with Iceland and Norway. Complex data on EU countries alone was not available in this particular case. In this situation, it is a reason of presenting aggregated statistics for 30 countries.

In accordance with the desk research character of the comparative analysis, scientific papers and official EU documents were studied to present definitions of eHealth, EMR, EPR and EHR. Then the ICT utilization necessity in healthcare system was described. As a result secondary data showing ICT use in chosen countries were presented and compared. Data on the online booking of appointments by patients provided by one of the biggest private outpatient clinic in Poland were added as a best practice in this field. ICT use in different sectors of economy in Poland including the healthcare was also collated. Data collected from different sources allows to conduct multi criteria analysis, which shows interdependences between broadband access and the use of Internet by citizens and the use of ICT in health care sector.

2. Internet access across the European Union countries

In the majority of the EU countries, rapid expansion of the households with the broadband Internet access has been observed for the last 6 years (2010-2015). This important economic factor shows the economic growth. In Poland, the proportion of the households with the broadband Internet access rose by 14% in years 2010-2015, which mostly parallels

the overall growth in Internet access. In other countries the fastest growth of households with broadband Internet access (23%) in years 2010-2015 was observed in Estonia (Eurostat A and Eurostat B).

Table 1. Internet access in 2015

Country	% of households with:	
	Internet access	broadband access
EU	83	80
Netherlands	96	94
Denmark	92	84
Sweden	91	83
Germany	90	88
Estonia	88	87
Poland	76	71

Source: based on Eurostat's Database (Eurostat A and Eurostat B).

Poland, with 71% of households with broadband Internet access in 2015 is still behind others (*Table 1*). The gap between Poland and the EU countries in share of the households is 7% in Internet access and 9% in broadband Internet access in 2015, respectively. In countries such as Sweden or the Netherlands, which were close to the saturation already in 2010, a comparatively small growth in the percentage of households with Internet access was observed (Eurostat, 2015). The Netherlands had the highest percentage of households with Internet access and broadband in 2015.

Table 2. Internet use in 2015

Country	% of individuals (aged 16-74) using the Internet:	
	at least once a week	in the last 3 months
EU	76	79
Denmark	93	96
Netherlands	91	93
Sweden	89	91
Estonia	86	88
Germany	84	88
Poland	65	68

Source: based on Eurostat's Database (Eurostat C and Eurostat D).

In the EU countries, 76% of citizens used Internet at least once a week (regular users) in 2015 (*Table 2*). It corresponded to 65% of individuals accessing Internet on a regular basis in Poland. The highest use was observed in Denmark. Hence, Poland lags behind many EU countries, both in the availability of Internet access and the frequency of use. According to the data delivered by Central Statistical Office of Poland based on households' survey, the most common reasons for the lack of Internet access at home were perceived no need to have such access, the lack of appropriate skills, and excessively high costs of both hardware and Internet access (Central Statistical Office of Poland, 2015).

3. Disparities in IT healthcare expenditures as an important economic indicator

IT expenditures review allows for the evaluation of the potential future IT deployment in hospitals. These expenditures should be recognized as an important economic indicator. It is worth to underline, however, that in different countries hospitals' budget are differently structured. As presented in *Table 3*, the Netherlands hospitals were heavily investing in IT. The hospitals in Germany were a little bit above the group of 30 European countries hospitals (EU countries plus Norway and Iceland).

Table 3. Hospital IT expenditures

Country	IT budget as a % of hospital budget			
	<1	[1 - 3]	[3,1 - 5]	> 5
EU/Iceland and Norway	39	47	10	4
Netherlands		45	41	14
Germany	19	60	12	9
Sweden	11	67	17	6
Denmark	38	12	50	
Estonia	60	40		
Poland	63	30	7	

Distribution (expressed in %) of hospitals in different budgetary categories.
Source: based on European Commission (2014).

The hospitals in Poland allocated a lower proportion of their budget on IT. They represented one of the lowest IT investment levels. Such situation is caused due to the very limited financial resources that can be devoted to these investments in Poland (Supreme Audit Office 2013 and 2016). Sixty-three percent of hospitals in Poland devoted less than 1% of the budget on IT. None of the hospitals in Poland allocated more than 5% of the budget to IT. Despite the fact that a similar situation existed in Denmark, none of the hospitals in Denmark devoted over 5% of their budget on IT, the situation in this country looked quite different. For half of the hospitals IT budget represented between 3,1 and 5% of hospital budget (European Commission, 2014).

4. Application of digital communication

The clinical care information exchange is needed to assure healthcare services quality and efficiency. For physicians, it is easier and safer to treat patients when the information is readily available from different healthcare providers. Furthermore, inappropriate and wasteful referrals can be reduced, with less laboratory and other diagnostic tests duplication. In *Table 4*, the percentage of surveyed hospitals, which share information with other healthcare providers, is displayed.

It is noteworthy that all surveyed hospitals in Denmark exchange electronically clinical information. Ninety-four percent of these hospitals exchange information with general practitioners, who are not working in the same hospital, 81% with others hospitals, as well as with external specialists. Only 6% hospitals exchange information with other healthcare providers in other EU countries, or outside the EU. Estonian, Dutch, and Swedish hospitals are not far behind Danish hospitals. The situation in Germany, with 56% of hospitals exchanging clinical care information, looks worse, and it remains a 1% below the EU situation. Poland with only 29% of hospitals exchanging clinical information is the worst performer in this category among the presented countries. Seventeen percent of Polish

hospitals exchange electronically clinical care information with other hospitals, 15% with external specialist, and 6% with external general practitioners. Only 3% hospitals exchange information with other healthcare providers in other EU countries, and only 1% outside the EU. Among the analyzed countries, the highest proportion of hospitals that shared information with healthcare providers in other EU countries was observed in Sweden and Estonia. Still this percentage was only 8% (European Commission, 2014).

Table 4. Electronic clinical care information exchange – hospital-to-other healthcare providers (%)

Country	Exchange	None
EU/Iceland and Norway	57	43
Denmark	100	
Estonia	92	8
Netherlands	88	12
Sweden	85	15
Germany	56	44
Poland	29	71

Source: based on European Commission (2014).

Despite the long debates on necessity of exchanging clinical information within healthcare system, the situation is still far from desired state. The proportion of hospitals exchanging this kind of information would be expected to be much higher. However, lack of connectivity is visible in many EU healthcare systems. From the economic point of view such situation needs improvement.

Medical information can be captured in virtually all points of contact between patient and healthcare system. The percentage of EMR and EPR adoption and use is presented in *Table 5* (OECD, 2013).

Table 5. Use of EMR and EPR in offices of primary care physicians, specialists and in hospitals (%)

Country	Primary care physician	Medical specialist	Hospitals
Netherlands	100	100	100
Sweden	100	100	100
Estonia	98	50	100
Germany	>80	>80	>90
Denmark	51	10	100
Poland	~15	~10	~5

Source: based on OECD HCQI Questionnaire, Secondary Use of Health Data: Electronic Health Records, 2012 [after:] OECD (2013).

In some countries, like the Netherlands and Sweden, all information captured by primary care physicians, medical specialists and in the hospitals, was captured electronically. In Poland these percentages were at appallingly low levels. It is hoped that the action plan is developed among policy makers to develop comprehensive plans for capturing all health-related data electronically. From the economic perspective it would be less expensive and

faster. Without the necessity of covering additional cost the treatment process would become more effective.

5. Internet use in interactions with the patients

Electronic capture of information about patient is only the first step. Other aspects include patients' access to their EPR. In the group of EU countries, Iceland, and Norway the online access to EPR does not exist in 91% of hospitals. The situation looks quite different in Estonia and in Denmark, where 75% and 62% of patients have the right of entry to their medical records via Internet, respectively. However, this access is limited to selected information, like tests results. As shown in Table 6, no surveyed hospital in Germany was providing the online access to EPR to their patients. In Poland such access was available in only 3% of hospitals. These data show that the vast majority of hospitals in the EU do not provide electronic access to healthcare information despite the fact that in accordance with law (Directive 95/46/EC), the individuals in the EU may access their personal data, including health data. Unfortunately, in the majority of cases their rights are not executed via electronic means but by the traditional written forms. Patients do not have remote access to their health history. There is much to be desired concerning this possibility, as it would be faster and economically more efficient. Only 1% of surveyed hospitals provide access to all the information collected about the patient (European Commission, 2014). In accordance with Polish law, in 2017, all healthcare records must be conducted electronically (Patients' Right and the Commissioner for Patients' Rights Act).

Table 6. Online patients access to Electronic Patient Records (%)

Country	Yes	No
EU/Iceland and Norway	9	91
Estonia	75	25
Denmark	62	38
Sweden	8	92
Netherlands	4	94
Poland	3	97
Germany		100

Source: based on European Commission (2014).

The possibility of the online booking of appointments with physicians directly by patients, or in real time by general practitioners does not often exist in European countries, as presented in the Euro Health Consumer Index 2014 (hereinafter: EHCI). The existence of such solution can potentially eliminate the waiting lists problem, as patients may book appointments for the most convenient time (a vacant slot). The availability of this service is increasing in European countries (*Table 7*).

In 2014, in 13 countries (Denmark, Lithuania, Norway, Spain, Latvia, Estonia, FYR Macedonia, Luxemburg, UK England, Sweden, Hungary, Iceland and Portugal) out of 37 countries covered in EHCI, sizeable part of patients obtained the opportunity to book online appointments with their physicians. It is worth to underscore, however, that cut-offs for the country to obtain grades: "good" (score 1) or "so-so" (score 2), have been stable for the last 6 years, since 2009 (Björnberg, 2015). In comparison with the other European countries Polish situation in this field, with score "not so good" (score 3), is rather weak. Denmark, with grade

"good", holds the first position with almost widely offering the possibility for patients of booking online appointments with physicians.

Table 7. Online appointments in 2014

Country	Mean	Score
Denmark	1,39	1
Estonia	1,71	1
Sweden	1,94	1
Netherlands	2,19	2
Germany	2,46	2
Poland	2,57	3

Scoring for the indicator: 1 – widely available facility; 2 – it is only offered by a few pioneering healthcare providers; 3 – it does not exist, or exist very rarely.

Source: based on Björnberg (2015), EHCI 2014 Single Indicator Score Sheets.

In the survey carried out in 2010 in the EU, the overall 71% of hospitals offered eBooking. Estonian hospitals were above this average. However, this ratio was much lower in Poland. Such possibility existed only in fewer than 50% of hospitals. Germany's hospitals were at the same level as all hospitals in the EU. This solution was available in 71% of their hospitals. Patients had a possibility of eBooking only in 11% of all surveyed hospitals which offered such IT solutions. In 73% of hospitals, this solution was available only to internal medical, nursing or administrative staff, and in 54% only to internal medical staff. In 22% of hospitals physicians, which were not working in this hospital (external medical staff), were able to book appointments for their patients directly, online into the system (Deloitte & Ipsos Belgium, 2011).

According to the results of the control of Supreme Audit Office in Poland, 32% of hospitals did not use software to create EMR at the end of June 2012. Moreover, 78% of hospitals did not use Internet in healthcare–to–patient interactions, even in the quite simple registration process. This situation looked even worse when it comes to the patients' medical tests results online availability on an individual patient account. Ninety-two percent of hospitals did not provide such opportunity (Supreme Audit Office, 2013). As it was described above, the accessibility of the appointments online booking by patients is very low, especially in Poland.

Table 8. The percentage of online booking of appointments in one of the private outpatient clinic in Poland

Month	Percentage
1	51
2	54
3	53
4	54
5	54
6	59
7	53
8	53
9	54
10	55

Source: data from one of the private clinic in Poland.

Above is the example of the opportunity in a selected clinic (*Table 8*). It shows that more than 50% of patients in one of the private clinics in Poland prefer to book their visits online. This ratio, observed within ten months of 2014–2015, varied between 51% and 59%. The data suggest that there is a stable group of people which use the online booking system frequently, and there was no growing tendency observed. However, it is worth to underline, that for the most of the patients services in such private clinics are covered by employer as an additional health insurance. These patients may differ from the rest of population being younger and actively employed.

Patients' medical data from the visits and lab tests results are shared electronically by some physicians, primary care doctors and specialists in several private outpatient healthcare networks of clinics and hospitals in Poland (OECD, 2013). In some private outpatient clinics, the possibility of electronic communication between physicians and patients exists. However, this communication works one way. For example, in some outpatient clinics, physicians can interpret the patients' tests results online, however, the patients are not able to ask questions about tests results or identify their problems with the prescribed treatments adherence or tolerability.

6. Online services in healthcare and other sectors

Digital technology has revolutionized consumer attitudes. Individuals are using Internet for private purposes. One can ask a question whether, there is any difference between online booking holidays or a ticket to a theatre, e-banking, and booking online an appointment to the physician. In the EU countries 46% of individuals used online banking services in 2015. Among analysed countries, Denmark, the Netherlands, and Estonia had the highest rate of individuals using such services (81-85%). Poland (31%) was far behind Germany (51%), not even mentioned Sweden with 80% of users (Eurostat E). When it comes to the Internet usage for seeking the health information by individuals there is a visible gap between Poland and other countries. In all 28 EU countries 46% of individuals were looking for health-related information online. The share of individuals varied between 52% for Sweden and 66% for Denmark. Poland was far behind with only 28% of people seeking for health-related information online (Eurostat F).

ICT has changed consumer attitudes in Poland, but not with regard to the health-related issues. The individuals used Internet most frequently for sending and receiving e-mails (54%), reading and downloading online magazines (47%), finding information about goods and services (42%), and social networks (41%). Online banking services were on fifth place. Thirty-one percent of individuals (almost 46% of all Internet users), aged 16-74, used such services over the 3 month period. These numbers indicate that consumers trust the online services. Within this period, only 28% of all individuals searched for information related to health issues (Central Statistical Office of Poland, 2015).

Table 9. Online services in 2015 in Poland (%) by individuals over the 3 month period

Online services	Age			
	Total	16–24	25–54	55–74
General Internet use	68	98	82	36
The use of online services related to travel/accommodation	17	19	23	8
Online banking	31	27	43	15
Searching for information related to health issues	28	27	36	18

Source: based on Central Statistical Office of Poland (2015).

As it is shown in *Table 9*, the existence of generational differences in the use of online services in Poland is clearly visible. The highest share of users looking for information on health-related issues was found in the group of women at the age 25-34 (52% of all women in this age group), versus only 10% of women aged 65-74 (Central Statistical Office of Poland, 2015).

Table 10. Healthcare-related online services (%) in Poland in 2015 over the 12 month period

Online services	Age			
	Total	16–24	25–54	55–74
General Internet use	70	98	84	38
Searching for information related to health issues	39	40	49	23
Health-related inquiries with physicians	1	1	2	0
Access to EMR	3	1	4	2
Booking online an appointment with a physician	6	4	8	2

Source: based on Central Statistical Office of Poland (2015).

In *Table 10*, the use of selected healthcare-related online services was presented in different age categories. Similar to the use of selected online services, generational differences in the online services related to health-related issues use were evident. In Poland, almost 40% of individuals were looking for information related to health issues in one year period. When comparing age groups, the highest share was observed in age group 25-34 of women (almost 69%). The higher education is another factor which contributes to the more frequent use of online services related to health-related issues. Among the individuals with higher education the share of people using online services related to health-related issues has been increased, reaching 69%. There was negligible Internet use for contacting physicians (with the purpose of obtaining prescription or an answer for the health-related queries). This share was higher among women with higher education, but still remained at a very low level of 3%. Although the law permits patient to have access to their health data this possibility was used only rarely via electronic means. Only 3% of individuals had access to their EMR. This share is increased among people with higher education, amounting to 9%. More over in women in age group 25-44, this share was higher, reaching 6%. The numbers describing more frequent access to EMR among women aged 25-44 with higher education can be explained by more common use of private healthcare providers which offer such possibilities. Only 6% of individuals booked online an appointment with a physician in the one year period. Similar, to numbers showing the situation with access to EMR, the higher percentage of patients booking online appointments with physicians was in age group 25-44 (more than 12% of women in this group). Additionally, the self reported health state can be an important driver to book online appointments with physicians, as people who described their status as “bad” or “very bad” used this possibility in 18% and 11% cases, respectively. The access to broadband and Internet using frequency also tend to increase this service utilization. Seven percent of individuals with the broadband versus 4% with lower speed access and 9% of regular users versus 1% of irregular users used this service in one year period (Central Statistical Office of Poland, 2015).

Table 11. Self-reported importance of Internet services in the selected areas (%)

Key areas	important	rather important	rather unimportant	unimportant	I don't know
Online access to health/ diseases history	44	38	5	2	11
Booking online or via email an appointment with a physician	46	35	6	3	11

Source: based on PBI study „e-administracja w oczach internautów 2013", [after:] Ministry of Administration and Digitalization (2014).

As shown in *Table 11*, more than 80% of Internet users in Poland valued an access to their health history via Internet as at least "rather important". Only for 7% of Internet users such option seemed to be "unimportant" or "rather unimportant". In case of the availability of eBooking of an appointment with a physician the situation looked similar (Ministry of Administration and Digitalization, 2014). Eighty one percent of Internet users in Poland valued possibility of booking online an appointment with a physician as "rather important" or "important" factor. However, the problem is that there is still lack of such opportunities for the majority of patients in Poland.

Conclusions

The differences in the IT solutions application in healthcare systems between the EU countries are apparent. The reasons for these differences can be linked to the disparities both in the IT expenditures among countries and in the percentage of households with access to the Internet, especially broadband access (*Table 12*).

Table 12. Multi criteria analysis (%)

Country	Broadband access	Internet used: at least once a week	IT hospital budget >3%	Electronic clinical care information exchange	Use of EMR in hospitals	Online patients access to EPR	Use of online banking
Denmark	84	96	50	100	100	62	85
Estonia	87	88	0	92	100	75	81
Germany	88	88	21	56	>90	0	51
Netherlands	94	93	55	88	100	4	85
Poland	71	68	7	29	~5	3	31
Sweden	83	91	23	85	100	8	80

Source: based on data from Tables 1-6 and Eurostat's Database (Eurostat E).

The access and the Internet use vary across the EU countries. Estonia represents a positive example where a high level of ICT utilization in healthcare system was achievable. Estonia has successfully taken the advantages of introducing ICT in healthcare. It is observed in the highest patients' online access to EPR and the broad use of EMR in the hospitals. In contrast, despite some year-to-year improvements Poland continues to have an inadequate Internet availability. Situation in Poland is far from expected. The Estonia's case however

shows that it is possible to implement broadly ICT in healthcare like in other sectors, including online banking successfully.

Digital progress offers significant opportunities. With the ICT use, information about patients and their health state can be available virtually everywhere. The medical information flow across the entire healthcare system can be made easier. Direct access to health information can both improve patients' satisfaction and also helps physicians prevent medical errors. As a result the quality of care and patients safety should increase. It could be monitored on local or national levels. With ageing society and the subsequent increase in the burden on the healthcare services, the ICT use can produce several improvements. It can reduce financial and administrative burdens and helps to improve economic efficiency in the healthcare systems.

For the majority of Poles it seems important to have the possibility to access their EPR. The lack of knowledge or more likely the lack of access to eHealth is a reason for very small percentage of patients booking online appointments with their physicians. However, IT solutions (electronic access for patients to their medical history and the possibility of booking online an appointment) are available in many private clinics. For example, more than 50% of patients in one of the largest private outpatient clinic in Poland booked online their appointments.

Owing to progress in digital technologies and the ICT use, there is an opportunity to make healthcare systems more patient-centric. For patients, arranging appointments could be faster and easier. Other interactions may include seamless flow of prescriptions between healthcare provider, pharmacies, and the patients; the adherence to treatment monitoring can be also made easier. From the point of view of the entire healthcare system, there is also a real opportunity for re-energizing new medical discoveries via monitoring of health outcomes in real settings. IT solutions implementation can be recognized as a potential remedy for reducing inefficiencies and even fraud, specifically potential duplication of tests, double payments. Owing to the medical errors avoidance and faster professional therapeutic guidelines implementation, there is a long-term potential for fostering savings in healthcare systems on national or regional levels. In conclusion, significant gaps in the ICT use in healthcare system have been identified. To this end, further research should concentrate on practical and reliable benchmarks development to monitor progress in this field. Financial savings analysis both at the national and regional levels should be also conducted. Further investments in IT infrastructure and education of healthcare providers and patients regarding the benefits of digital technologies are needed.

References

Act of 6th November 2008 Patients' Right and the Commissioner for Patients' Rights, *Journal of Laws* of 2009, No. 52, item 417 as amended.

Björnberg, A. (2015), *Euro Health Consumer Index 2014 Report*, Health Consumer Powerhouse, http://www.healthpowerhouse.com/files/EHCI_2014/EHCI_2014_report.pdf (referred on 30/10/2015).

Central Statistical Office of Poland (2015), *Społeczeństwo informacyjne w Polsce. Wyniki badań statystycznych z lat 2011-2015*, Warszawa, http://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/spoleczenstwo-informacyjne/spoleczenstwo-informacyjne-w-polsce-wyniki-badan-statystycznych-z-lat-2011-2015,1,9.html (referred on 1/10/2016).

Central Statistical Office of Poland (2015), *Wykorzystanie technologii informacyjno-(tele)komunikacyjnych w przedsiębiorstwach i gospodarstwach domowych w 2015 r.*, Excel spreadsheets, http://stat.gov.pl/obszary-tematyczne/nauka-i-technika-

spoleczenstwo-informacyjne/spoleczenstwo-informacyjne/wykorzystanie-technologii-informacyjno-telekomunikacyjnych-w-przedsiebiorstwach-i-gospodarstwach-domowych-w-2015-r-,3,13.html (referred on 26/11/2016).

COCIR (2015), *eHealth Toolkit. Integrated Care: Breaking the Silos*, Fifth Edition, May 2015, http://www.cocir.org/fileadmin/4.4__eHealth/15013.COC_2.pdf (refferred on 1/10/2016).

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *eHealth Action Plan 2012-2020 – Innovative healthcare for the 21st century*, Brussels, 6.12.2012, COM (2012) 736 final, http://ec.europa.eu/health/ehealth/docs/com_2012_736_en.pdf (referred on 10/10/2015).

Deloitte & Ipsos Belgium (2011), *eHealth Benchmarking III*, SMART 2009/0022, Final Report, 13.04.2011, European Commission, https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/ehealth_benchmarking_3_final_report.pdf (referred on 10/15/2015).

Denaxas, S. C., Morley, K. I. (2015), Big biomedical data and cardiovascular disease research: opportunities and challenges, *European Heart Journal – Quality of Care and Clinical Outcomes*, 1(1), pp. 9-16, http://ehjqcco.oxfordjournals.org/content/ehjqcco/1/1/9.full.pdf (reffered on 3/10/2016).

Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, O.J. L 281/31 of 23.11.95.

Earnest, M. A., Ross, S. E., Wittevrongel, L., Moore, L. A., Lin, C. T. (2004), Use of a patient-Accessible Electronic Medical Record in a Practice for Congestive Heart Failure: Patient and Physician Experiences, *J Am Med Inform Assoc.*, 11(5), pp. 410-417, http://jamia.oxfordjournals.org/content/11/5/410.long (referred on 10/12/2015).

EHCI 2014 Single Indicator Score Sheets, *Health Consumer Powerhouse*, http://www.healthpowerhouse.com/ehci2014-indicators/ (referred on 30/10/2015).

European Commission (2014), *European Hospital Survey: Benchmarking Deployment of eHealth Services (2012-2013)*, Final report, JRC Scientific and Policy Reports, https://ec.europa.eu/digital-agenda/en/news/european-hospital-survey-benchmarking-deployment-ehealth-services-2012-2013 (referred on 15/10/2015).

Eurostat (A), http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=tin00088&language=en (referred on 14/12/2015).

Eurostat (B), http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tin00073&language=en (referred on 14/12/2015).

Eurostat (C), http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=tin00091&language=en (referred on 14/12/2015).

Eurostat (D), http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=tin00028&language=en (referred on 14/12/2015).

Eurostat (E), http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=tin00099&language=en (referred on 14/12/2015).

Eurostat (F), http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=tin00130&language=en (referred on 14/12/2015).

Eurostat (2015), *Key figures on Europe. 2015 edition*, Eurostat Statistical books, European Union, http://ec.europa.eu/eurostat/documents/3217494/7072644/KS-EI-15-001-EN-N.pdf/318ee884-50d6-48f0-b086-4410da85d6b6 (referred on 30/11/2015).

Evans, D. (2011), *The Internet of Things. How the Next Evolution of the Internet Is Changing Everything*, White Paper, Cisco Internet Business Solutions Group, https://www.cisco.com/web/about/ac79/docs/innov/IoT_IBSG_0411FINAL.pdf (referred on 1/09/2015).

Greysen, S. R., Khanna, R. R., Jacolbia, R., Lee, H. M., Auerbach, A. D. (2014), Tablet Computers for Hospitalized Patients: A pilot study to improve inpatient engagement, *J Hosp Med.*, 9(6): pp. 396-399, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4043916/pdf/nihms571976.pdf (referred on 10/10/2015).

Manyika, J., Chui, M., Bisson, P., Woetzel, J., Dobbs, R., Bughin, J., Aharon, D. (2015), *The Internet of Things: Mapping the value beyond the hype*, McKinsey Global Institute, http://www.mckinsey.com/insights/business_technology/the_internet_of_things_the_value_of_digitizing_the_physical_world (referred on 10/10/2015).

Ministry of Administration and Digitalization (2014), *Społeczeństwo informacyjne w liczbach 2014*, Departament Społeczeństwa Informacyjnego, Warszawa, https://mac.gov.pl/files/spoleczenstwo_informacyjne_w_liczbach_2014_srodek_lekki.pdf (referred on 10/10/2015).

Ministry of Health (2015), *Policy paper dla ochrony zdrowia na lata 20114-2020. Krajowe ramy strategiczne*, Warszawa, http://www.mz.gov.pl/__data/assets/pdf_file/0003/34887/Policy-Paper-dla-ochrony-zdrowia-na-lata-2014-2020-przyjety-przez-KE.pdf (referred on 3/12/2015).

OECD (2013), *Strengthening Health Information Infrastructure for Health Care Quality Governance: Good Practices, New Opportunities and Data Privacy Protection Challenges*, OECD Health Policy Studies, OECD Publishing, http://www.keepeek.com/Digital-Asset-Management/oecd/social-issues-migration-health/strengthening-health-information-infrastructure-for-health-care-quality-governance_9789264193505-en#page3 (referred on 10/10/2015).

Stroetmann, K. A., Artmann, J., Stroetmann, V. N., Protti, D., Dumortier, J., Giest, S., Walossek, U., Whitehouse, D. (2011), *European countries on their journey towards national eHealth infrastructures. Final European progress report*, eHealth Strategies Report, European Commission, https://ec.europa.eu/digital-agenda/en/news/european-countries-their-journey-towards-national-ehealth-infrastructures-0 (referred on 30/10/2015).

Supreme Audit Office (2016), *Informacja o wynikach kontroli Tworzenie i udostępnianie dokumentacji medycznej*, KZD.410004.2015, Nr ewd. 199/2015/P/15/061/KZD, https://www.nik.gov.pl/plik/id,10736,vp,13069.pdf (referred on 1/10/2016).

Supreme Audit Office (2013), *Informacja o wynikach kontroli Najwyższej Izby Kontroli Informatyzacja Szpitali*, KZD-4101-05/2012, Nr ewid.: 20/2013/P/12125/KZD, https://www.nik.gov.pl/plik/id,4849,vp,6462.pdf (referred on 27/11/2015).

Weitzman, E. R., Kaci, L., Mandl, K. D. (2009), Acceptability of a Personally Controlled Health Record in a Community-Based Setting: Implications for Policy and Design, *J Med Internet Res.*, 11(2): e14, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2762802/#!po=2.63158 (referred on 10/12/2015).

WHO (2016), *From innovation to implementation – eHealth in the WHO European Region*, WHO Regional Office for Europe, http://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf?ua=1 (referred on 1/10/2016).