EXPLORATORY STUDY OF E-SERVICES INTRODUCTION IN HEALTH INDUSTRY

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ABSTRACT
Health industry nowadays is experiencing fast growing of various electronic services introduction and wide usage of Information and Communication Technology (ICT) for health care quality improvement. A number of studies show increasing interest and necessity for various e-solutions introduction in health industry, such as mobile-health (m-health), e-health, telemedicine etc. (Al Basheer Al Morshid S, Healy J. C, et al.). In Latvia similar process is occurring showing that e-health processes and services implementation is one of the most important issues at the vast majority of hospitals and health care institutions in the Republic of Latvia. The authors of the given research paper have analysed the situation in relevant hospital in Y2014, conducted the survey amongst medical personnel and gathered data set for assessment the satisfaction of ICT level by physicians and patients, which could essentially implicate the success of e-service project introduction. Interpretation of data allowed carry out several recommendations that could be valuable for similar health care institution management while introducing e-health services or another kind of manual operation automation at medical institution.
Objective: according to research goal the authors formulated the hypothesis that introducing of various e-health services at medical institution may substantially increase the satisfaction of the offered services by hospital' patients and increase the quality of medical care.
Design/methodology/approaches: critical analysis of literature sources, quantitative analysis and interpretation of the data gathered by the survey from the Children's Clinical University Hospital' doctors, semi-structured interviews and discussions with the top medical personnel of two biggest hospitals in Latvia.
Practical implications: The research could impact the behaviour of medical institutions' top management and stakeholders for better governing and managing e-health services introduction for medical care quality improvement.
Keywords: e-health services, information technology, medical care quality

1.INTRODUCTION

Effective usage of Information and Communication Technology for national health care could achieve the main goal of creating and delivering well-designed, efficient and easy-accessible health systems. E-health system should provide the national population of the country improved health services' quality by ensuring fast access to the medical specialists in various areas and reducing the time needed for visiting the doctor and getting the appropriate service. At the same time while developing and implementing e-health system, we need to respect the human rights of the patients, taking care of their personal data, data about persons' health status by following strong procedures and rules in information security area.
Many researchers have investigated different factors that could impact successful introduction of e-health, such as Capacity – human resources knowledge and skills in ICT area; Infrastructure – access to information and communication technologies; Enabling environment – policies and strategies to support the information society, etc. (Dunbar A, et al, 2008). Many authors analyse the business and ICT representatives' cooperation while introducing new ICT solutions (Silvius, A.J., De Haes, Van Grembergen; Silvius, A. J Gilbert; Shpilberg, D., et al.; Spremić, M.; Vasiljeva T, Treiguts E.). They have indicated that business persons' knowledge and skills in ICT area as well as their equipment with modern ICT devices could considerable facilitate and ease the introduction of new ICT solution at an enterprise.
We suppose it is the proper time to drill very deep in investigating abovementioned factors and clarify the situation in our country learning to what extent the medical personnel in the typical hospital in the Republic of Latvia is ready for wide using of ICT tools and introducing of e-services. To motivate our research the authors asked two research questions:

Research Question 1: *How does ICT environment affect the level of IT literacy of the medical personnel at particular typical hospital and encourage adults to use their ICT devices and apply ICT skills for successful introduction of new IT system?*

Research Question 2: *Could we apply the methods of classical business process reengineering to health industry's enterprises?*

We examined these research questions in Latvia, at the Children's Clinical University Hospital, that is typical hospital in the Republic of Latvia, supplying the standard set of health care services and having typical structure of medical personnel. The main research, observations, data gathering by the survey among Children's Clinical University Hospital doctors and data quantitative analysis were done in spring 2014. One of the authors has conducted the series of observations and personally surveyed Children's Clinical University Hospital' doctors verifying whether survey' questions were correctly interpreted by the respondents. For quantitative data analysis and discovering the dependencies various statistical methods and IT tools were used, such as IBM SPSS and MS Excel.

Several deep semi-structured interviews with medical personnel at Riga Eastern University Hospital and Riga Stradins University were conducted in autumn 2014 for discussion the results of the research and trying to assess to what extent the research results could be applicable to other similar medical institutions.

2.THE FRAMEWORK OF THE RESEARCH

The World Health Organization (WHO) defines e-health as "the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research" (Denardis L, 2011). In 2005 the World Health Assembly recognized e-health as the way to achieve cost-effective and secure use of ICTs for health and related fields, and urged its Member States to consider drawing up long-term strategic plans for developing and implementing e-health services and infrastructure in their health sectors (Healy J, 2008). The authors fully agree with Denardis L. who defines the following obstacles for introduction of e-health system in any country (Figure 1).

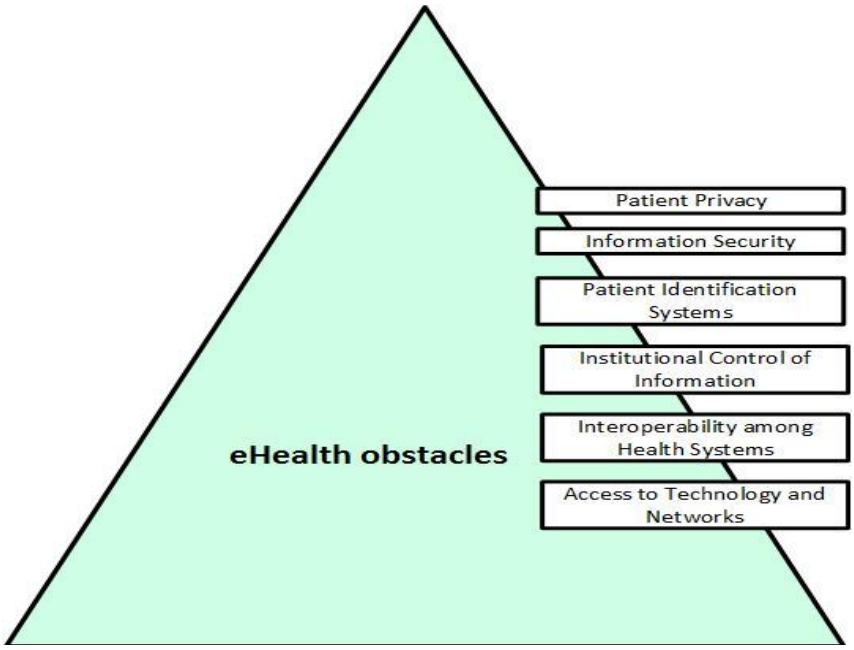

Figure 1. E-health introduction obstacles (Denardis L, 2011).

In addition to common e-health obstacles, in Latvia the authors see some political, technological and social obstacles while trying to introduce so called *electronics health card* (Latvijas veselibas ministrija, 2014) so we need identify what advantages can the society get from this modern tool. For introducing electronic health card at national level the country needs having common ICT infrastructure as for healthy services Providers as well for healthy service customers, namely, hospitals and clinics patients. E-health system at national level needs common understanding of procedures, rules and standards for appropriate data exchange between all participants and components of the system. The authors agree with the researchers who recognise the recent trend in e-health service area as growing mobile technology usage (Al Basheer Al Morshid S, 2010).

Trying to define the most important business processes, activities and tasks that are connected with e-health system and providing different kinds of e-services, the authors recognised three main types:

Managerial processes, Operational processes and Supporting processes.

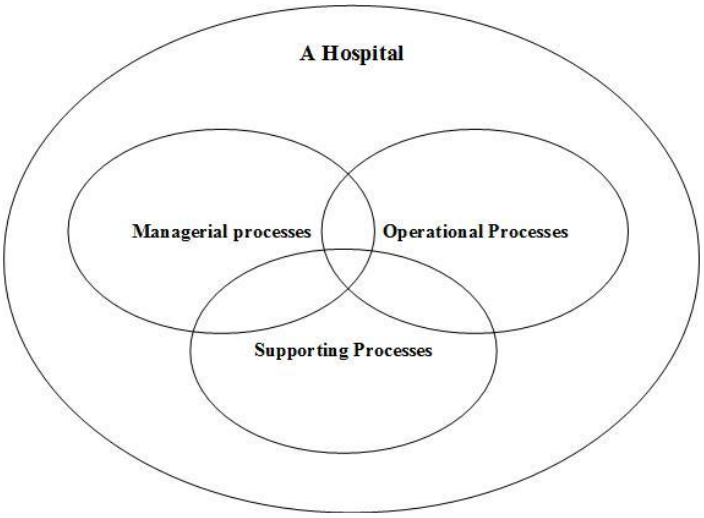

Figure 2. The types of Business processes

Managerial processes are governing the whole system; Operational processes are delivering or keeping core business and deliver added value; Support processes are supporting operational processes. The authors have investigated Support processes in detailed way to analyse and enhance these processes and modifying them for data processing in automated electronic way. Taking into account the definition and concept of e-health that includes wide range of various medical processes and activities, the authors have explored the section of the standardized electronic medical record data and public health data aggregation. In order to determine the data flows of medical documentation and design its possible enhancement we carried out the survey of doctors at the hospital. The survey was carried out taking into consideration the fact that the doctor-related information is a very important section of the hospital in providing medical processes and medical documentation development.

In the given research we have studied four main statements. As a basic for the survey the authors have used some surveys used in medical area and described by known researchers (Dunbar A, et al, 2014 Survey-of-Americas-physicians) adjusting the set of questions according to our research goal and Latvia's peculiarities. So, the questions were split into main groups, additionally considering the doctors' specialization and age:

- access to information technology systems at work and home;
- interest and desire for using the Information System of the Hospital;
- satisfaction with data flows at the Hospital regarding medical information data flows;
- index of information technology usage.

Apart of these purposeful questions, the authors aimed to identity the doctors' age, gender and speciality. 25 questions were included in the survey, all questions were divided into four groups and after mixed randomly. The survey was made anonymous for non-identification of the respondents personally. The respondents had to answer with their personal assessment for each questions by using the following scale: *a)during all the time / it is possible during all the time; b)often / it is possible often; c)rarely / it is possible rarely d) I do not use it / I do not need it.* The first option of answer was awarded 3 points, the second option - 2 points, the third option - 1 point and 0 points for the fourth option.

The table 1 illustrates the key of the survey in details. The appropriate questions group (item) was evaluated according to the number of points. If the item in the survey has obtained points from 0 - 1 the appropriate group of questions was evaluated as catastrophic; if the assessment ranged from 1.01 to 1.70, an item was considered as undervalued; range from 1.71 - 2.20 means that item was considered as a medium-valued; range between 2.21 - 2.60 means that item was evaluated as good; range 2.61 or more means that item was rated as very good.

Table 1

The key of the survey

Access to Information Technology at work and at home	Interest and desire for using the IS of the Hospital	Satisfaction with medical information data flows	Index of IT usage
0-1.0 Catastrophic	0-1.0 Catastrophic	0-1.0 Catastrophic	0-1.0 Catastrophic
1.01-1.70 Undervalued	1.01-1.70 Undervalued	1.01-1.70 Undervalued	1.01-1.70 Undervalued
1.71 –2.20 Medium-valued	1.71–2.20 Medium-valued	1.71 – 2.20 Medium-valued	1.71–2.20 Medium-valued
2.21 – 2.60 Good	2.21 – 2.60 Good	2.21 – 2.60 Good	2.21 – 2.60 Good
2.61 -3.0 Very good	2.61 -3.0 Very good	2.61 -3.0 Very good	2.61 -3.0 Very good

The survey was conducted at the Children's Clinical University Hospital in 2014 February and March, the respondents participated were chosen from various Hospital' departments, with different specialities. The participants were 34 doctors (5,6 % from all doctors at the Hospital) that means that the research covers sufficient number of respondents and can be considered as valid. Four questionnaires were filled in with some errors so they have not been accepted as complete and we analysed 30 surveys. For data processing IBM SPSS was used.

The results of the survey were deeply discussed with nine leading doctors of Riga Eastern University Hospital and Riga Stradins University in 2014 autumn.

In the given research the authors tried to recognize to what extent e-environment can impact and change health care process and study how e-health could continue affecting the health care system and the routine work of a medical institution in the future.

Analysing the gathered data, the authors have found out that 53% of respondents were man while 47% women, comparing with the common staff structure it should be said that more men have answered the survey as gender structure at the Hospital was 77% women and 23% men.

The validity of the questionnaire was checked using Cronbach Alpha Coefficient, calculating coefficient for the entire study as a whole. Cronbach Alpha Coefficient was calculated 0.643 that corresponds with valid and reliable survey data. Normal distribution can be determined with the Kolmogorov - Smirnov test that compares the data from the questionnaires with data set distributed by the normal sample, which is equal to the average value and dispersion. The normal distribution is useful to calculate, because it shows the average random distribution. In our case the test results showed that the data obtained are representable.

Table 2

Descriptive statistics for the whole data set

Statistics parameter	Access to Information Technology at work and at home	Interest and desire for using the IS of the Hospital	Satisfaction with medical information data flows	Index of IT usage
Missing	0	0	0	0
Mean	11,1000	10,9667	20,7667	8,4000
Std. Error of Mean	,33682	,37900	,65158	,44875
Median	11,0000	11,0000	20,0000	9,0000
Mode	11,00[a]	12,00	19,00	9,00
Std. Deviation	1,84484	2,07586	3,56886	2,45792
Asymmetry coefficient Skewness	,020	,147	,317	-,334
Std. Error of Skewness	,427	,427	,427	,427
Kurtosis	-,497	,027	,002	,788
Std. Error of Kurtosis	,833	,833	,833	,833

Exploring the Table 2 with descriptive statistics for the whole data set we see that the asymmetry coefficient for all the items is approaching zero, in this case, it means that the study corresponds with normal distribution. Other coefficients testify the same evidence.

3.THE RESULTS OF THE RESEARCH

Research Question 1: *How does ICT environment affect the level of IT literacy of the medical personnel at particular typical hospital and encourage adults to use their ICT devices and apply ICT skills for successful introduction of new IT system?*

For clarifying the situation at the Hospital with ICT environment, the authors have analysed the responses to the survey.

The results gathered for the first item *Access to Information Technology at work and at home* show the following: more often answers (23,3%) were between 11 and 12 points, that testifies mostly dominated the mean responses with a small deviation to the lower value. At the Figure 3 we can see the average statistical response for this item as 11.10 points, standard deviation 1.845. This distribution curve that is almost in the middle of the set and the asymmetry coefficient is very close to zero, testifies that the results tend to cluster around the average value.

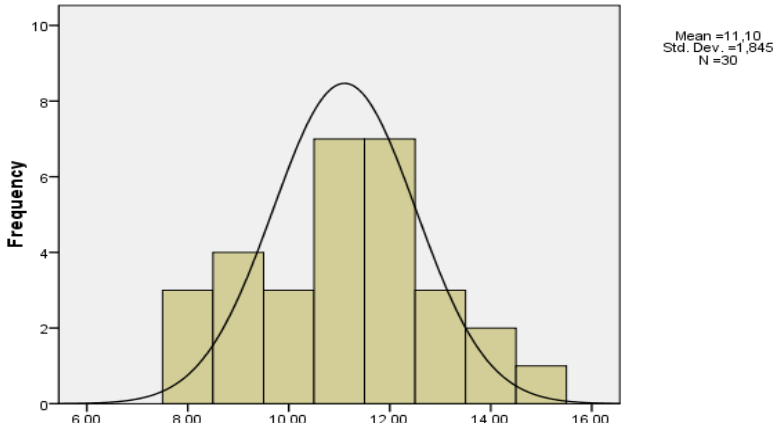

Figure 3. Access to Information Technology at work and at home

The results gathered for the second item *Interest and desire for using the IS of the Hospital* show the following: average statistical response was 10.97 with standard deviation 2.076. Asymmetry coefficient is positive; it shows the results tend to slightly lower values. Kurtosis coefficient is very close to zero, which indicates a tendency to cluster around the arithmetic average – see the Figure 4.

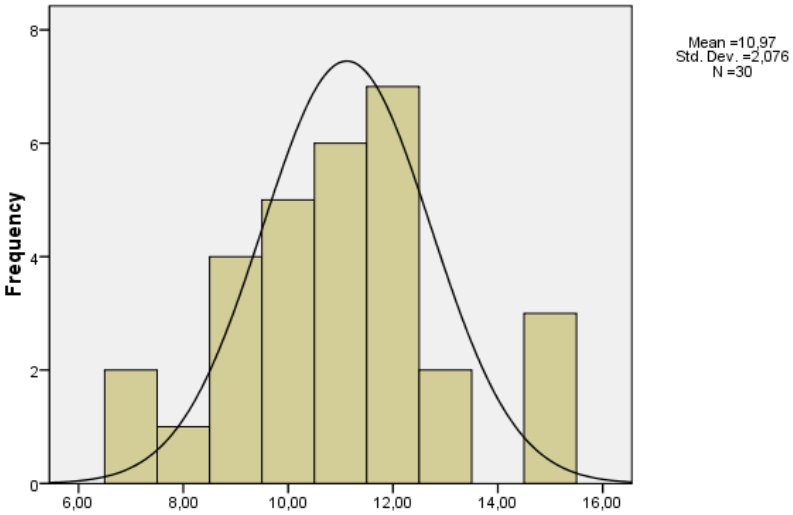

Figure 4. Interest and desire for using the IS of the Hospital

The results of the third item *Satisfaction with medical information data flows* show the following: average statistical response was 20.77, standard deviation 3.569. Normal distribution curve is shifted a bit to the right in the centre, which means it is a bit of a negative asymmetry. Kurtosis coefficient is approaching zero that defines the normal distribution and the schedule is neither stretched nor compressed – see Figure 5.

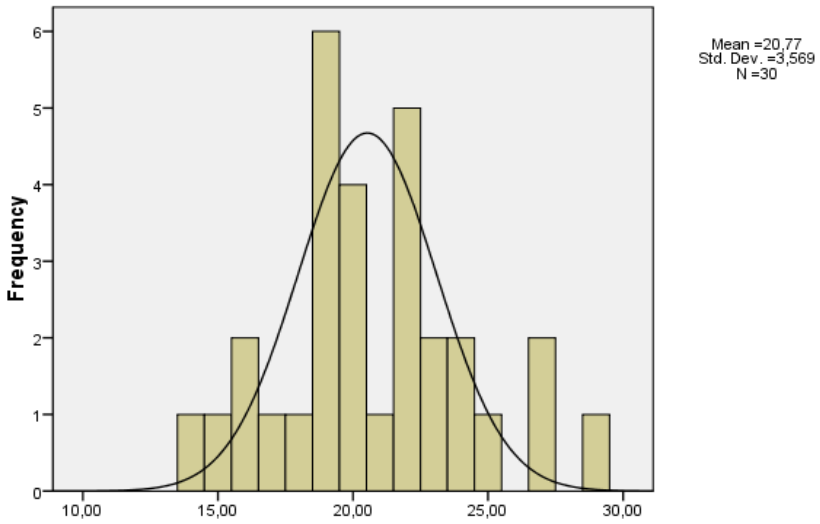

Figure 5. Satisfaction with medical information data flows

The results of the fourth item *Index of IT usage* testify average statistical response 8.4, standard deviation 2.458, with asymmetry coefficient that shows the results tend to slightly higher values, kurtosis coefficient giving evidence for the trend to cluster around the arithmetic average – see the Figure 6.

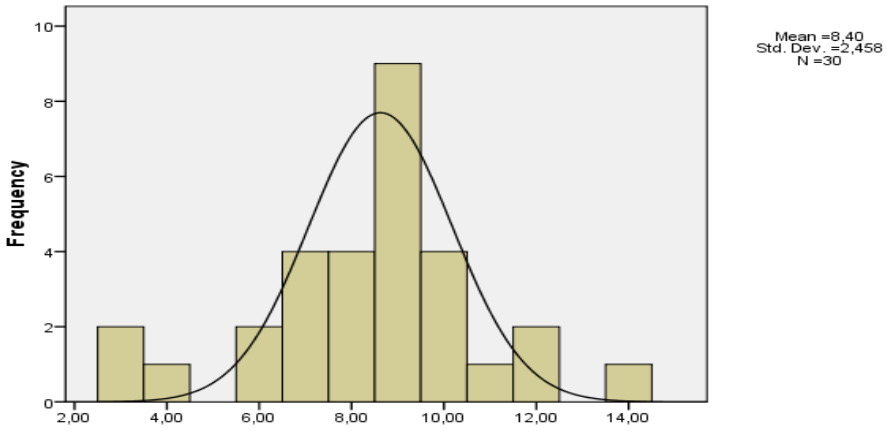

Figure 6. Index of IT usage

According to the research questions the authors aimed to explore the medical staff skills and habit of working with IT and Information Systems, as well as explore doctors' opportunities and their desire for usage of new technologies. The main emphasis was put on the satisfaction with medical information data flows and the cognition of the potential needs for improving the business processes at the Hospital and introduction of health care e-services.

Initially the authors have estimated the respondents' access to information technology resources at work and at home. We do believe this factor is critical as in case the doctor has no free access to a computer at work it could seriously complicate usage of IT in general. Access to the computer at home would be extremely important for effective management of on-call services. Using modern technology makes possible to observe a lot of diagnostic data in remote way for patients saving their time and money when compare such behaviour with numerous physical visits to the hospital.

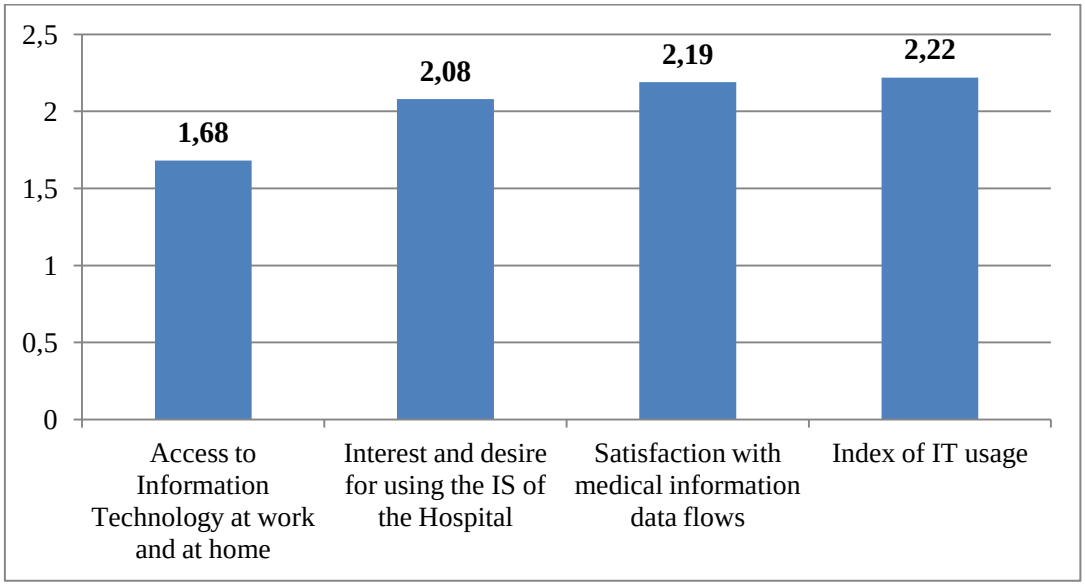

Figure 7. Common statistics for the survey

Common statistics for the survey can be seen at the Figure 7 where the results are given in points.
The lowest score among physicians - 1.68 was got for the Item *Index of IT usage*. According to the questionnaire key, this means very low index of technology using. In this item we asked the questions about specific software and devices (like tablets) usage. Questions were formulated for measuring the frequency of using standard software at the workplaces and for assessment of applying IT tools and applications for work tasks executing.

The second low score was gained for the Item *Satisfaction with medical information data flows* - 2.08 points that means average satisfaction level with medical data and documentation flows. In this item we included ten particular questions thus getting the item as the widest section in the survey.
The third item was *Interest and desire for using the IS of the Hospital* getting 2.19 points meaning the tendency for sufficient level of interest for using IT systems and tools. The authors studied to what extent physicians are using Hospital' Information System; how widely they are using IS functionality; electronic transmission of the data; exploring the answers of patients' analysis and other business intelligence functions.

The best and highest results were obtained for the fourth Item *Access to Information Technology at work and at home* – 2.22 points what testifies satisfactory level of this parameter.

Research Question 2: *Could we apply the methods of classical business process reengineering to health industry's enterprises?*

For identifying the current status of the existing business processes, defining possible improvement and, finally, finding out the answer for the second research question: *Could we apply the methods of classical business process reengineering to health industry's enterprises?,* the authors have deeply investigated the results of the survey as well as analysed in details main processes at the Hospital.

The special section of our research was devoted to extremely important and significant aspect of implementing e-services at the Hospital – the adjustment of existing paper-based business processes and introduction of modern electronic business processes. Our surveys and deep detailed discussions showed the vital necessity of usage e-services for patients and doctors, so, 65.66% of the responses give the evidence of such functionality shortage. 80% of the respondents answered about the exigency for using Hospital' Information System while helping the patients. Comparing various medical processes that are supplied electronically with other processes that are realised in manual (paper) way, better assessments were obtained for electronic processes. Electronic processes have got the average assessment 81.85% while processes in paper way have got only 64.81% from maximal possible assessment.
The following business processes and sub-processes were analysed:

- Patients' on-site registration process;
- Outpatient visit;
- Patients' electronic queues process;
- Patients' stationary visit.

Using standard business requirements defining and modelling approach we have discovered and classified business sub-processes for each business process supplementing it with detailed description of the sub-process, the description of data used in particular sub-process and finally, clarified the type of each singular sub-process documents and processing – either it is electronic or paper form and is it done in manual or electronic way. The Table 3 illustrates the fragment of one business process investigation, namely, Outpatient visit as the example.

Table 3

Outpatient visit process description

Business sub-process	Description of the sub-process	Description of Data used	Processing type
Visit to the doctor	Patient' History (life, family, illness and specific diseases) clearance (anamneze)	Text data	Electronic / paper form, both manual and electronic
	Referrals to particular medical specialists for examinations and tests	Document Template	Paper form, manual
	Extract (the applied therapy, conclusion, recommendations)	Document Template	Electronic / paper form, both manual and electronic
Consultant visit	Answers from particular medical specialists	Conclusion	Paper form, manual
Laboratory	Laboratory tests	Medical examinations and tests, conclusion	Electronic / paper form, both manual and electronic
Radiology	Radiographs	Images, description	Electronic form
	Magnetic resonance, Computed Tomography, Scintigraphy	Visual information of medical examinations, description	Electronic form
Functional Diagnosis	Ultrasonography	Images, description	Paper form, manual
	Electrocardiogram EKG, EEG, EMG, Uraflaometrija, Echocardiography, Endoscopy	Visual moving information, description	Paper form, manual

The medical data flows were found out for all investigated business processes that afforded the authors make the conclusion about the necessity and possibility for implementing new Information System supporting the majority of needed e-services for patients and medical staff. At the same time the authors came to the conclusion that standard approach to business process analysing can be applied in health industry showing good results for modelling business processes that gives the positive answer to the RQ 2.

4.SUMMARY AND DISCUSSION

The given research could be used for generalising some key findings to approve positive answers to the Research Questions 1 and 2. These findings could be valuable for governmental institutions, policy makers and administrative bodies to improve state regulations related to health industry.

Research Question 1: *How does ICT environment affect the level of IT literacy of the medical personnel at particular typical hospital and encourage adults to use their ICT devices and apply ICT skills for successful introduction of new IT system?*

- However E-health is defined as a way for secure and cost-effective usage of information technology in medicine, currently a unified methodology to measure the progress of e-health in a given country and institution not developed yet;
- Although the e-health program is driven by Ministry of Health of the Republic of Latvia since 2005, the quality of laws and regulations base has not been established, thus disturbing the comprehensive development of e-health projects for local medical institutions;

- The level of using ICT technologies and tools amongst the doctors is not very high however it shows clear trend for improvement in the nearest future;
- During the research the authors could draw the conclusion that the doctors' society is conservative enough and changes in business processes are accepted relatively slow. At the same time our respondents rated the advantages offered by the electronic process 17% more convenient than manual paper-based processes;
- Based on the study conducted at the Children's Hospital, the authors conclude that e-health is the way to achieve successful, doctors more comfortable and more accessible to the population healthcare using information and telecommunication technologies.

Research Question 2: *Could we apply the methods of classical business process reengineering to health industry's enterprises?*

- While researching business processes at the Children's Hospital the authors can deduce that a significant attention should be paid to the deep investigation of sub-processes, data flows, business requirements identification for ensuring their amelioration using ICT tools;
- Standard approach for analyzing and modeling business processes and requirements could be successfully applied to the manual processes in health industry institutions to draw new adjusted business processes for e-service offering.
- For the successful realization of e-service project the IT team should include the experts who are competent in both medicine and information technology and could apply the standard approach to business environment investigation. Taking into account the conservative medical environment, a detailed training plan with possible leeway should be developed and approved to introduce ICT reforms.

5.FURTHER RESEARCH

The authors consider the next step for the research should be investigating and testing *the hypothesis, that introducing of various e-health services at medical institution may substantially increase the satisfaction of the offered services by hospital' patients and increase the quality of medical care.*

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