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Knowledge Richness for Electronic Health Development: The Trap of Excessive Knowledge for Usability of Electronic Prescription

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Abstract
Objectives: The present research has a significant value for the theory of and research in health informatics and clinical practice. The aim of the article was to investigate how important is knowledge richness and linkage as knowledge quality for the information technology system success decomposing existing electronic Prescription systems in the context of comparison regarding the building process. *Methods:* The four most actively used Lithuanian electronic Prescription modules have been selected for the research. To achieve the purpose, decomposition of electronic Prescription processes have been carried out to assess relations between knowledge richness and richness adopted in the electronic Prescription module and knowledge usability. The method of heuristic assessment and cognitive walkthroughs was used. The heuristic method is used for the evaluation of an information system by a specialist in the field or by qualified members of the information system development team. *Results:* A completely developed electronic Prescription system functioning in the entire state has been implemented only in several European countries and Finland is one of the best examples. Despite the fact that several information systems have been developed in Lithuania that prescribes electronic Prescription with 40 million Euros spent on information technology systems, still, 15% of all prescriptions are written on paper in Lithuania. *Conclusions:* A dynamic selection rule could be apply to address the issue of electronic Prescription use. Such analysis can help the healthcare administrators and professionals to evaluate the potential of enabling information technology and the opportunity it created to rethink or reengineer the e.Prescription process and the associated activities based on the enabling information technology capability.

Keywords: e.Prescription; e.Health; Stakeholder; Information Systems

Introduction

Information and communication technologies (ICT) based innovations have proposed a wide range of new services for Heath care users and providers. However, the digitalization process often is neither smooth nor successful. The difficulties that national health care systems across Europe have been faced creating electronic health (e.Health) becomes an interesting research topic pointing out the complexity of the issues when ICT specialists, physicians, pharmacy specialists, health managers, lawyers and politicians are interconnected [1].

The electronic prescription (e.Prescription) is an essential tool for e.Health development and proposes several benefits for the health care system and the patient in particular. However, only a few European countries developed the e.Prescription to its full operational mean until 2011 [2]. Encouragingly, most countries continue to work to improve their e.Health systems by introducing e.Prescription modules. Although the e.Prescription is not the main element of e.Health, it essentially contributes to the improve the efficiency of services rendered to the patient [3]. The structure of the e.Prescription is not a complex constituent part of e.Health, but the e.Prescription module itself aims to improve user-friendliness to a range of stakeholders, including doctors, patients and pharmacists. Therefore successful functioning of the e.Prescription as an additional module of e.Health is possible only when its information system is acceptable by stakeholders.

e.Prescription within the whole e.Health is the object of knowledge management (KM) literature that gives insights about the routes of e.Health development and recommendations for progress measuring. KM models help to evaluate the success of information systems (IS) according to various aspects, including a stakeholder approach and user roles both in the development of the system and evaluation [4]. Analysing information systems (IS) for KM models, it has been proved no direct relation between the information quality proposed by KM system and the usability of this system [5]. However, there is a direct link between information richness and the intention to use the system and therefore, the extent of KM system usability particularly depends on stakeholder input in all stages of IS development [6]. Those findings could be applied to e.Prescription, saying that information richness in the e.Prescription system is an important element that could be respected during developing system phases. Equally, the success of knowledge richness that could be measured by the user's intention to use a new system. If users are reluctant to use and are discontent with the system, the ICT development omitted some serious elements connected with the stakeholder input.

That pointed out the mater of prime importance creating e.Prescription what is to ensure the higher possible level of knowledge richness and then measure it through the users' perspective, e.g. developers should be interested in how quickly new users become familiar with the system in the first exploitation period. However, the knowledge quality equally depends on the knowledge richness and knowledge linkages. So one measures the user's intention to use a new information technology (IT) system, simultaneously we can measure richness and linkage together. If knowledge richness is more determined, linkage has not so well determined expression for measuring and less captured. So there is a gap in the literature to measure the knowledge quality partially connected with linkage and there is no clear understanding of whether knowledge richness and linkage could be replaced by each other.

The main purpose of the article was to investigate how important is knowledge richness and linkage as knowledge quality for the IT system success decomposing existing e.Prescription systems with the aim to compare them regarding process building. This paper investigates the issues of cultural differences (in the Lithuanian context) and it's effects of acceptance of knowledge management systems. To achieve the purpose, a statistical analysis of implementation and use of the most modern e.Health module (introduced in Lithuania in 2016) and decomposition of e.Prescription process into stages has been carried out with the aim to assess relations between knowledge abundance and usability. We have presented a detailed process-view of organizational knowledge management with a focus on the data richness and stages linearity.

ICT for Knowledge Management in e.Health Systems

ICT makes an enormous impact on knowledge management within the Heath care system, mainly by creating an e.Health infrastructure. The key advantages were initially foreseen for patients, physicians and managers [7]. The e.Health has several benefits to offer: IT facilitates the promotion of mobility in terms of information, time and distance and ensures continuity and openness of healthcare by giving stakeholders access to knowledge, which would be inaccessible without the e.Health system [2]. ICT within the e.Health also provides a possibility to aggregate a huge amount of data with the purpose of helping physicians make data-based health decisions [2]. e.Health contributes to a new level of knowledge management embracing different functions ranging from data storing, accumulation and conceptualization to knowledge production, knowledge sharing, knowledge transferring and better knowledge utilization [8]. e.Health consumption also positively affects patients' better engagement into the health management process, from searching specific health information to approaching the healthcare system [4]. Such engagement has a positive impact on a better perception of healthcare quality as a whole.

Not surprisingly, knowledge management challenges have been translated to e.Health development challenges. The part of healthcare and management that relies on documents and is known as explicit knowledge in the knowledge management perspective [9] has been successfully transferred to the e.Health by creating repositories for e.Health users [10]. Another part of knowledge (for instance, the organizational routine, processes, practice norms or values) that corresponds to tacit knowledge is accessed with more difficulties in spite of the fact that ICT can provide some reliable solutions. How well both knowledge types are absorbed by KM systems is a question of research scientists are working on.

Thus, the success of e-health depends critically on the collection, analysis and seamless exchange of clinical and medical information or knowledge within and across the above organizational boundaries [7]. A well designed IT-based knowledge management system has become an ever more central force in improving the quality of care in competitive e-health environments. However, very little is actually known about how to effectively integrate the technologies, knowledge management activities and the enabling IT in facilitating e.prescription knowledge management practices. To address this problem, a comprehensive framework that guides the design of an e.Prescription KMS is necessary.

In light of the extant literature [11, 12], the KM process can be generically represented as four cyclic activities: knowledge creation, knowledge codification, knowledge transfer, and knowledge application. Knowledge creation includes all activities involved in the acquisition and development of knowledge. Knowledge codification involves the conversion of knowledge into accessible and applicable content. Knowledge transfer includes the sharing of knowledge from its point of creation or codified to the point of use. Knowledge application includes retrieving and applying codified knowledge as support of actions, decisions, or problem-solving. Ideally, these activities do not represent a monolithic set of activities, but an interconnected and intertwined set of activities [13].

e.Prescription

E.prescription is inseparable from the goal of improving or preserving a patient's health, and in many countries, electronic prescribing can be understood as one of the main goals of e.health components [14]. Then, most developed countries using modern information and communication technologies are systematically implementing prescription computerization, enabling conditions prescriptions to reach pharmacies directly [15]. The European Union describes e.Prescribtion as the process of electronic transfer of a prescription by a healthcare provider to a pharmacy for dispensing drugs to patients [2]. It is an opportunity to eliminate geographical disparities between physicians, patients electronically, and pharmacies to improve healthcare delivery [16]. This is the system that allows the sending of accurate and comprehensible prescriptions electronically from a medical institution to a pharmacy. The e.Prescription as an important part of the e.Health system is considered a multi-benefit innovation [17]. Electronic prescription makes it easier for doctors to monitor prescribing and purchasing [15], and facilitates pharmaceutical work for prescription readability, archiving [18], as pharmaceutical practitioners face additional difficulties in reading a handwritten prescription encountered additional work and time costs [19]. From the medical perspective, it contributes to minimization of medical errors in pharmacies and facilitates patient management at the pharmacy. From the patient perspective, it helps to avoid misinterpretation and falsification [17]. The e.Prescription allowed patient to see what medications the doctor has prescribed by other healthcare professionals and to assess how well the patient's medications are compatible [17]. Patients typically express a strong interest in awareness about prescribed drugs and subsequent treatment procedures [20]. In addition, an electronic prescription can encourage patients to choose generic drugs that reduce public spending on the healthcare system [21]. From the organizational perspective, e.Prescription minimizes paper work and keep records for future decisions [22] Also, e.Prescription reduces healthcare costs [28] and reduces pharmacy costs by up to 20 percent [23]. In general, by electronic prescription benefits doctors and pharmacists by improving the efficiency of the prescribing process [3, 24, 25], by reducing prescribing and treatment errors [26, 27] and costs [25]thus improving medication safety [28], and meeting consumer needs (especially through prescription) [23, 29].

Implementation and ICT use of e.Prescription associates with a wide range of issues, ranging from safety issues (network safety) to user-friendliness and cost-effectiveness. In the framework of the e.Prescription, ICT materializes needs of different stakeholders, e.g. healthcare institutions, pharmacies, refunding agencies, physicians and patients, to facilitate the exchange of prescription data in a safe electronic environment. So the successful creation of a single module of e.prescription is crucial for the whole e.Health system development. There is a need to be able to assess the new IT system and determine the main threads, flaws, or errors for its improvement.

e.Prescription in Lithuania

Implementation of e.Prescription in many EU e.health policy priority areas [29, 30] Lithuania is no exception. Development of Lithuania's national e.Health information system was initiated in 2001 and did not start actually until 10 years ago. At that time, it was noticed that healthcare services were first offered on-line by big healthcare institutions and private clinics. Meanwhile, e.Health development procedures started by the Ministry of Health of Lithuania in 2000 were not assuccessful as expected. In 2006, the maturity of internal control of the Ministry of Health was assessed as a non-existing process. The Ministry of Health had no IS control procedures, no IS policy, no IS risk assessment procedures and no incident monitoring or evaluation. In 2008, the State Control Authority stated that the Ministry of Health had failed to fully control the process of the national e.Health system implementation and therefore had not achieved some of the results foreseen in the project agreement and failed to follow requirements of legal acts in e.Health system development in spite of the fact that the terms of implementation had been extended twice.

New financial perspective and previous historical failures, helped to concentrate efforts and to create a modern and user-oriented e.Health system. Since 2011, different strategies have been introduced in e.Health management where the responsibility for e.Health framework was delegated to health care institutions and the Ministry was left only a coordinating role. Thus, in 2011, the Ministry of Health started to coordinate provisions of the information system of the new national e.Health service and cooperation infrastructure (EHSCI IS in Lithuanian) with the authorized institutions. A significant part of EHSCI IS technical specifications was devoted to the e.Prescription. The e.Prescription as the next step of e.Health enhancement stage was introduced in Lithuania in 2014 and it took two years to develop to the contemporary level. The project implementation was centralized and the Ministry took the leading role to manage the process and delegate operational powers to the Centre of Registers, a state-based company which took the responsibility to operate the system of data storing and data exchange. The Centre of Registers is a public entity of limited civil liability with the function of administration of Real Property Register and Cadastre, Register of Legal Entities and Address Register.

The process of creation of the e.Prescription module has demonstrated a rather innovative approach to public decision making by public institutions, Ministry in particular. For the task implementation, Ministry formed a working group endowed with the responsibility for the process operation that incorporated a wide range of specialists with highly valuable competencies. Representatives from IT companies, Centre of Registers, highly motivated leaders of health care institutions and public managers were invited. The group works in close cooperation with IT specialists and physicians, who rendered advice on a wide range of specialist issues. The operational system to build the e.Prescription module seemed really progressive from the perspective of stakeholder attitudes management. Tight deadlines forced the implementers to seek more contacts and support from stakeholders.

Taken into account the European practice, the United Kingdom, for example, the e.Prescription may be twofold: 1) a mechanism where prescribers can download a prescription automatically from a central repository and then can produce an e.Prescription; the system, however, greatly resembles a paper-based prescription; 2) a mechanism where prescribers can use their electronically coded signature and transmit the prescription to the pharmacy electronically instead of transporting it physically [31]. Lithuania opted for the latter mechanism combining other opportunities as well. Lithuania's legal regulations provide a possibility to produce an e.Prescription by both EHSCI IS and commercial IS installed locally in healthcare institutions. There is only one requirement to be followed by the institutions: the produced e.Prescription has to be transferred to EHSCI IS and only then submitted to a pharmacy. Technically this means that the corresponding data control processes are interconnected. In other words, to produce an e.Prescription, a doctor has to register a patient's visit, fill in a corresponding visit form (E025) and only then issue an e.Prescription.

Not surprisingly, once e.Prescription was loaded for using, it faced resistance and negative reaction from the user, particularly doctors at the first sight. One of the possible reasons of such resistance may be the novelty of the product. All new products are usually followed by a certain degree of user dissatisfaction as they induce a sense of insecurity caused by the external pressure to change the existing habits. Luckily, it is rather temporary. The subsequent use of the system typically neutralizes the initial negative reaction, in particular when the user perceives advantages and user net benefit of the system. However, some criticism left even after one year of system operation. The issues were not so obvious. System appears to be well developed with a complete set of the necessary information, it responded to safety threats, plenty of advantages for patients. Screening the most common complains, it was found that procedural time to fill the prescription seems not satisfied. The e.Prescription procedure takes at least 10 minutes, even for a skilled specialist after 6 months of practice. Since Health care system admits that an e.Prescription module is a necessary mean in the context of data control in e.Health, it is essential to acknowledge the observed inadequacies and errors to allow further improvement of the system. The main causes of that situation will be further looking through knowledge management success evaluation literature.

Knowledge Management and IT Success Evaluation

According to Alavi and Leidner (2001), KM system is "IT-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application" [13]. Thus, recognize how well KM system can achieve its goals is a task for creation success evaluation models. A huge body of knowledge comes up from 1992 when DeLone and McLean created the IS Success Model (1992, 2003) [32], then such as model was adopted to the knowledge management success [6] and the clinical information system success [33]. The IS success model pinpoints quality issues in three different categories of system quality, data quality and service quality. IS quality issues are evaluated under user perception of the quality in two categories (the intention to use, user satisfaction and net benefits), considering that the quality of the system, information and services predetermine the use of the system and user satisfaction. The IT success model has been effectively applied to specific needs of health care. KM success model added more details to the quality categories, specifying system quality as a technical resource, knowledge quality as KM strategy and service quality as management support. The model was further improved by adding components of social influence and facilitating conditions of the work environment and was eventually named a Clinical Information Systems Success Model [33]. The next attempt to adapt the model to the "user-centered view" was taken by Jesus and co-authors who added the process dimension to describe the service quality. The model also included an additional quality element for communication [34]. The model takes into account the cyclical nature of the processes however, the user centrality is not so substantial.

The IT Success models and the later KM success model [6, 27] are based on linear dependency between quality dimensions and user acceptability (satisfaction and intention to use). Model testing in different environment provide plenty of data about the content of every single quality issue. For instance, it has been proved that understanding of the system quality is less important for the user than the quality of knowledge, because the importance of the system quality tends to reduce over time of using the system as a part of life [35] and the importance of knowledge quality emphasized. According to Jennex and Olfman (2009), knowledge quality could be further analyzed as two-dimensional categories as knowledge richness and linkages [6] revealed the dynamic nature of knowledge and dependence from permanent renewal. Later more dimensions of knowledge quality were emphasized, exactly accuracy, adequacy completeness, format, reliability, scope, usability, and usefulness [34].

There is also evidence that cultural differences reflect upon acceptance of knowledge management systems and knowledge richness, especially when it is related to the social context [36].

Role of Stakeholders

Scholars argue, "KM success is crucial to understanding how these initiatives and systems should be designed and implemented" [6]. However, evaluation of prospective success when the product is accomplished and ready to be used is a bit tricky. Investment in labor and financial resources is likely to be less if user perception is taken into consideration before the product is developed. To acquire tacit knowledge, one could use stakeholder input. However, it is important to cast the knowledge implicity in stakeholder values as close to IS systems as possible and success evaluation models may be of great help to overcome the existing barriers.

In spite of ICT issues in knowledge management being a hot and complex topic with a diverse range of issues for researchers and practitioners, management is more likely to cause ICT project failures [37]. One issue for management is stakeholder management with the focus on their role and engagement level. Some tacit knowledge is hidden inside stakeholder cognitive understanding about e.Health. The importance of stakeholder input is conceptualized as necessary and this issue is on the agenda of e.Health developers. There could be two approaches towards stakeholder input, namely, the customer based models (ICT, IS, or clinical system success model) and participation-based models.

In the context of the existing practice around Europe, the stakeholders role is rather limited to granting them an advisory function mainly. Thus, there is a common approach to stakeholder management, creating advisory bodies and embracing professional associations, patient representatives, third parties and care providers [2]. It seems that a deeper penetration of stakeholders into the process of ICT application is needed. For instance, it has been long argued that ICT grants the patient the possibility to acquire more information that enables them to be active in their health management. However, long term social science research comes up with the discussion that the positive outcome of ICT-patient relationship is not absolutely obvious [39]. E.Health policy documents discuss patient's role very broadly. According to Andreassen (2012) [8], the patients role is predetermined by 1) the need for involvement into health care, 2) the need for information, 3) the necessity to act as a health consumer entitled to make their choice in the market and 4) the need for individual/local adoptions of health care. However, the same documents confine the role of the patient to the ability "to equal the challenge to choose on a health market". Thus, the premises of patient roles in e.Health policies are rather conflicting [8].

Summing up, the success of e.Health with all its modules depends on the three components of quality, system quality, knowledge quality, and service quality, whereas knowledge quality as information richness and linkages have a mutual dependency. If richness is present, but linkages are absent, then the a e.Health system is not accepted as being. In this sense, the stakeholders involvement and theirs role during development are very important to build a successful e.Health system.

Material and Method

The research has been carried out by juxtaposing several ISs having an e.Prescription function with the latest EHSCI IS with the aim to identify reasons causing user dissatisfaction. Also, the fact that several health care institutions have chosen alternative IS instead of the latest EHSCI IS, prompted us to compare the systems in terms of completeness and process consistency. To achieve the purpose was decomposition of e.Prescription processes have been carried out to assess relations between knowledge richness and its use in e.Prescription module and the used knowledge. If the data sorted are tied with the process phase it corresponds to knowledge richness, the specific sequences of stages and rules for data use could be recognized as linkages.

The four most actively used Lithuanian e.Prescription modules have been selected for the research. Their characteristics are presented in Table 1.

Table 1. Analyzed four modules for e.Prescription, currently used in Lithuania.

Code	Country of origin	Platform	Market	Number of modules	According to projects implemented in Lithuania (percentage)	Number of employees in 2018
IS1	Lithuania	web	Health care institutions	10	41	10
IS2	Romania	web	Health care institutions	<10	-	3
IS3	Lithuania	web	Health care institutions	>10	7	5
IS4	Estonia	web	Health care institutions	10	33	60

Process decomposition of the e.Prescription has been done on the basis of principles of the user interface usability estimation. Although the full evaluation includes an automated evaluation carried out by means of specific evaluation tools, an empiric evaluation and a heuristic evaluation based on the analysis of user opinions, the research entailed only the process decomposition and evaluation based on specific tasks. The research aims to identify the main drawbacks of the process encoded in the system that prevents the system from smooth functioning. To carry out the evaluation, a problem has been formulated to set tasks and find the corresponding information in all four e.Health information systems (Table 2). Also, it was requested to write an e.Prescription in all four e.Health information systems. Respondents were doctors and nurses who performed tasks and wrote e.Prescriptions. The required number of steps and the complexity of the whole process were calculated.

Table 2. Tasks are formed to monitor the respondents

No.	Tasks
1	Write an e.Prescription for measles in a 43 year old woman
2	Find a list of e.Prescriptions issued to the patient in the last 6 months

Data were collected, processed, filter, select by attributes, normalize and present in an appropriate uniform form for visualization into networks. This allows the data to be analyzed in various sections, step by step, selecting the data set of interest at each stage. Visualization of the process decomposition has been based on multidimensional scaling. We used mathematical networking methods allowing data visualization by pinpointing a set similarity and creating matrices of objective distances for elements of similarities. This is a non-linear dimensionality reduction method, which uses concepts of space and distance, reflecting the internal structure of a network. Such process network representation may help reveal which objects are close to each other (similar) or reveal a potential dividing line between sets of objects [38]. When objects are "socially" close to each other (are linked or have something in common), they are marked in the graph close to each other and objects that are "socially" distant one from another (are not linked and have nothing in common), they are marked far from each other. The network analysis and network visualization were processed by UCINET software analyzing both two-mode networks (e.Prescription processes matching specific realization with a special IS) and one mode network derived from the two mode network.

In the evaluation of the visualization of an e.Prescription model, the most important point of reference is the continuity of node positions where loops or reversions are absent or minor, etc. In terms of social network analysis terminology, the network with a low degree and centralization values are more rational, within such a network one can take less time to reach every node and are easier perceived by the user. Therefore, the process network has to be linear and contain no forks or additional structures.

The Scope of e.Prescription Module Usability

The data in Table 3 reveals that the earliest introduction of electronic prescription was in Denmark (1994), followed by Sweden (2000), Greece (2000) while accounts for more than 98% of all prescriptions. Among the analyzed countries, Estonia, which started implementing e.Prescriptions in 2010, reached over 99% of all prescriptions in 2018. Sweden is considered the forerunner of electronic prescribing, whereas the world's first electronic prescription was in Sweden in 1983. In Sweden, about 9 million e.Prescriptions are issued every month, more than 98% of recipes e.Prescriptions. In Finland, a fully operational national e.Prescription system was introduced in 2012-2015, which aimed to increase the safety of the use of medicines by the population through healthcare institutions in Finland. Starting with 2017, all prescriptions must be electronic, while paper prescriptions must be written only under certain exceptional circumstances.

Table 3. e.Prescription trends in Lithuania and ES

Country	Start of e.Prescription implementation	e.Prescription (of all prescriptions) percent (2018)	According to Lithuanian e.Health system 2015-2020 development program was to be ready e.Prescription (of all prescriptions) 2020 percent
Denmark	1994	> 99	
Sweden	2000	> 98	
Norway	2004	> 75	
Finland	2012	> 90	
Greece	2000	> 98	
United Kingdom	2005	> 98	
Italy	2008	> 90	
Estonia	2010	> 99	
Belgium	2007	> 90	
The Netherlands	2008	> 90	
Lithuania	2015	> 65	> 99%

Note: The author compiles the table based on the research and sources analyzed: Parv et al., 2014 [40]; Deetjen, 2016 [23]; Hibberd et al., 2017 [41].

In 2016, Wales claimed to manage 78 million electronic prescriptions. In Greece, the development of e.Health started in 2010, and in 2011 the electronic prescription system was launched in the country. In 2013, 98% of prescriptions issued in the country were electronic [37]. In Italy, an electronic prescription methodology was developed in 2008, which led to the replacement of handwritten prescriptions in 2010 with electronic prescriptions. In 2017, in all Italy regions, electronic prescriptions accounted for 90% of all prescriptions issued. Starting in 2018, all doctors in the Netherlands will use an electronic medical record management system. However, although the country has well developed regional electronic registration systems, there is still no national system for the electronic prescription.

Officially, the e.Prescription has been used in Lithuania since November 2015. 2.77 million e.Prescriptions were issued in Lithuania in 2017. The number of e.Prescriptions is increasing systematically, as in 2017 e.Prescriptions accounted for 39 percent and in 2018 - 65 percent. 2017 can be considered a breakthrough year for e.Prescription, as the number of e.Prescriptions have increased 18 times compared to 2016. Thus, it can be stated that the e.Prescription system operating for over a 4 year generates 75 percent of all prescriptions issued in Lithuania, which means that it may take more time to completely digitize Lithuania's prescription system. It has to be noted, however, that the number of e.Prescriptions produced by pharmacies is unknown. As the legal regulation of the e.Prescription stipulates no mandatory IS to be used for e.Prescriptions, health care institutions are free to choose IS at their own discretion. Health care institutions strongly oriented towards IT innovations have immediately developed their local e.Health module thus raising e.Prescription numbers to a higher level. Figure 1 illustrates the number of produced e.Prescriptions have doubled since 2016. Such an increase may associate with significant health care institutions that boosted the number of e.Prescriptions, but on the national scale, the numbers are still insufficient. The poor e.Prescription rates imply that the reasons have to be looked for in the e.Health IS.

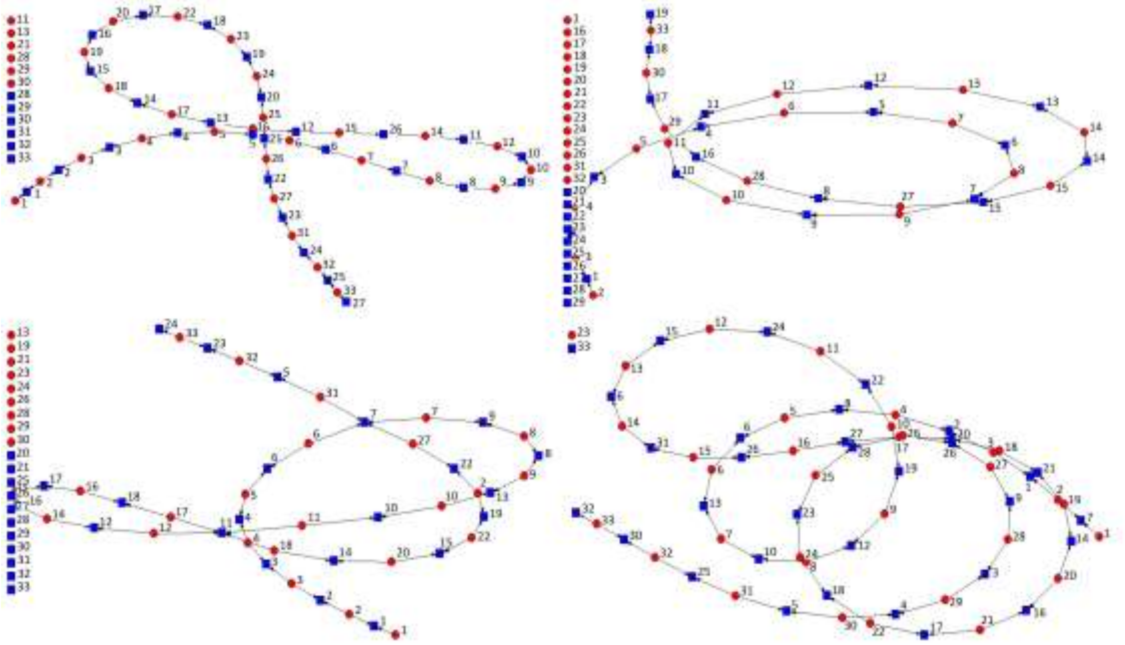

Figure 1. Information systems e.Prescription step-by-step process (two-mode network visualization)

Results

Process of e.Prescription Decomposition

Lithuania's e.Health marked is dominated by 3 commercial e.Health ISs. Lithuania's health care institutions use ISs that were developed in different periods and by different suppliers. As the introduced systems had different objectives and were to meet different needs, the state is now encouraging the development of an eHealth system that would integrate the existing platforms into a uniform information system officially referred to as EHSCI IS. Institutions that have no information system introduced may immediately use EHSCI IS. Legal requirements for e.Prescriptions are standard for all ISs; however, e.Prescription designs and styles may differ. Therefore e.Prescription ISs offered by different suppliers may have different menus, command options and direct manipulation and form filling dialogues. The number of procedural steps, available options and manual/automated window selections also differ. Obviously, the differences should have an impact on the system's acceptability by the user and the user-perceived benefit.

Decomposing e.Prescription presiders into steps, the content of every step, and the number of the steps corresponds to the knowledge richness in IT success model. The way every step is selected and step connectivity correspond to the knowledge linkage in the system. Figure 2 illustrates the sequences of procedural steps in EHSCI IS provided by different suppliers. Each step is encoded by numbers from 1 to 33. e.Prescription can be a maximum of 33 steps, but others companies shorten the steps to 24. The sequence of steps in e.Prescriptions are encoded on the basis of a logical sequence and valid legal acts of Lithuanian and the EU. The more loops the procedural sequence contains, the more complex the consistency of the e.Prescription is. On the other hand, one should account for the type of the field: automated or manually filled in. The more fields are automated, i.e., bound to each other according to certain rules of selection, the more productive the method of e.Prescription is and the less the entire process takes. Also, a bigger number of options automated according to the set selection rules reduces the number and frequency of errors. Figure 2 shows that the consistency, continuity, and convenience of operational steps are best realized in I1 and I2 information systems. It is the I2 information system that was used for the major part of e.Prescriptions (25% of all electronic prescriptions produced in Lithuania) by 2017. The national EHSCI IS has the smallest number of automated procedural steps and some of the leaps are so wide that allow an opportunity of direct manipulation. It contains the least automated e.Prescription procedure among the used systems. The other three information systems IS1, IS2 and IS3 and in particular IS2 and IS3 entail a considerably lesser number of optional steps. This does not mean that other systems include many mandatory steps to produce an e.Prescription: they simply offer a wider range of information to be included. To produce an e.Prescription, all systems require to fill mandatory windows independently on the range of options.

In the analysis of the process of e.Prescriptions, the sequence and continuity of steps to be taken are of key importance. In the course of the research, the procedure of e.Prescription in the information system IS1 has been taken for the point of reference as the most logical system. E.Prescription procedures of all other information systems were subject to comparison with IS1 (Figure 3). The research-based on the visualization network of the necessary steps has revealed that the information systems IS3 and IS4 are less consistent and contain more leaps than the former ones. Such information systems are earmarked by chaotic electronic processes that discomfort the end-user and significantly extend the process duration. Some of the leaps are wide and significant enough to raise a question of the consistency factor and doubts about the consistency of procedural steps. The sequence of steps also contains reversion elements, e.g., steps 6 and 7, from steps 27 and 31 in the information system IS3. According to the present simulation-based research, e.Prescription process in IS1 is the most consistent and orderly in terms of the sequence of procedural steps. Although the electronic process IS2 is weaker in its sequence than that of the IS1, it is the most economical of all analyzed systems in terms of the number of procedural steps.

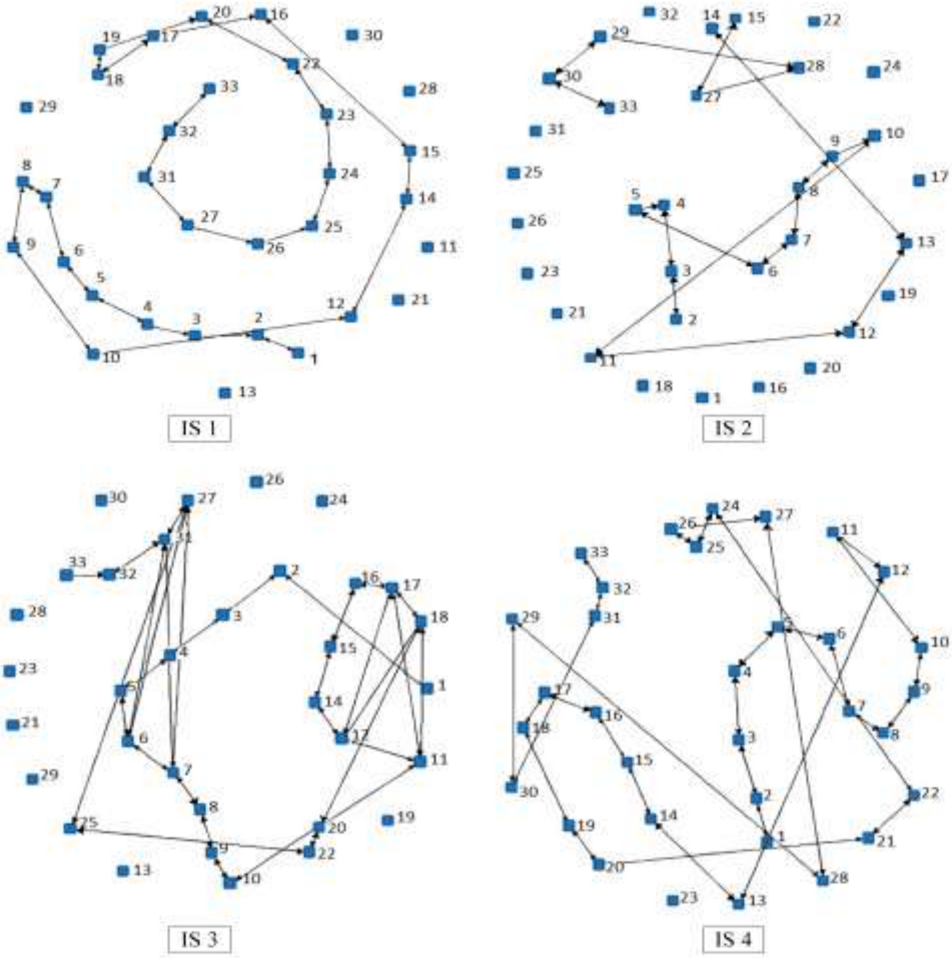

Figure 2. A step by step process of decomposition of an e.Prescription in the form of a network according to the process of scaling with respect to the system IS1 (one mode network)

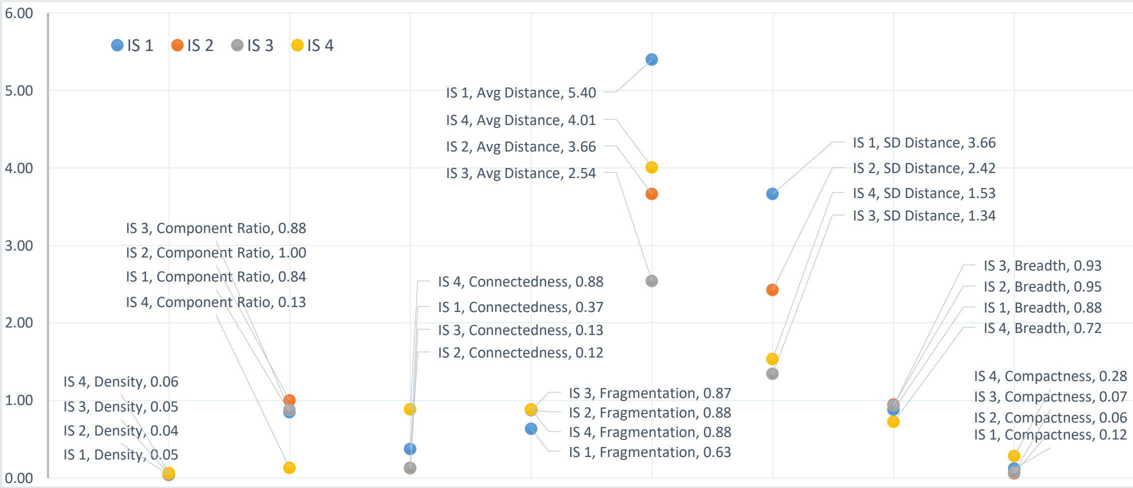

Figure 3. Information Systems e.Prescription process indicators visualisation

In the analysis of various process networks of e.Prescription information systems, some of the network characteristics may be expressed in parameters (see Figure 3). One of the simplest network parameters is the size of the network, which is equal to the number of nodes. The biggest value of the parameter has been observed in IS4 and the smallest is identified in IS2. The density of a network shows how well the procedural steps are linked to each other. Network density is quite easy to identify and it renders valuable information about usability and development prospects of the links. In other words, network density reveals existing limitations on node interconnections. The densities of all analyzed information systems are similar and have no essential differences, except for procedural steps of the two initial systems that are stronger interconnected. Network connectedness indicates the proportion between existing and possible bonds between process elements or procedural steps in this case. Here, IS4 diverse mostly (0.884) as it contains the biggest number of steps and renders the biggest proportion. Having accounted all procedural steps, the smallest fragmentation has been observed in IS4. Such a result is quite logical as it is the national EHSCI IS, which may not contain fragmented information and typically includes random data subject to no selection rules. One of the most interesting indexes is the IS condensation or data compression and conciseness. IS2 and IS3 are more condensed than theirs remaining counterparts. This testifies that the data here is compact, which may frequently predetermine user satisfaction. However, it does not mean that a better condensation degree also entails more dynamic selection rules.

Analysis of network components allows the distinction of concentrated node groups, identification of the network structure, grouping nodes according to their similarities and differences and identification of the key index that is the average distance between nodes. It also gives a possibility to pinpoint the most effective distances to transfer information e.g. the shortest possible distance to the network node or subject. The average distances between procedural steps are bigger in IS1 and IS4 which may be interpreted as the lack of consistency in the structure. However, the main parameter is the duration measured in steps, e.g. the number of steps and the time the entire e.Prescription procedure takes. The average number of steps is 25 and the IS1 contains the smallest number of steps. By introducing dynamic selection rules, the number of steps may be reduced by 40% and the duration taken by an e.Prescription may be reduced by 50%.

Discussions

The majority of authors acknowledge that modern information systems' usability greatly depends upon knowledge abundance and is likely to even more dependent upon the development of new knowledge and its practical usability in process control in the future. The increasing flow and quantity of information are making a considerable impact on information systems, and therefore, it is very important to know how to optimize electronic processes. The emergence of competition between e.Prescription ISs in Lithuania's healthcare institutions shows that the user is likely to choose systems with the possibly smallest number of necessary procedural steps even at the cost of knowledge richness in the system. The number of procedural steps typically depends upon the number of steps in the critical path, and therefore it is essential to ensure the shortest possible critical path of an e.Prescription in the production process. A larger number of procedural steps often grants more information for the end user; however, it is important to maintain both the optimal quantity of information and the optimal number of procedural steps as they directly predetermine how fast the information system is able to produce an e.Prescription. Another important criterion in the heuristic evaluation of information systems is the sequence of procedural steps. A sequence of procedural steps based on a consistency principle helps to logically bind various operations of an information system, that shortens the distance between objects of the system. When principles of knowledge control fail to be followed, patients tend to find themselves trapped by innovations (e.Prescription). The same applies to doctors, who make another group of users. Their contribution is minimal. They may adopt a consumerist approach [4] instead of full participation, as all EU policy documents stipulate.

Although EHSCI IS as a system has been developed in accordance with knowledge richness criteria with the aim to compile an extensive database, the system failed to eliminate all encumbrances for the user to enjoy its added value. The present case reveals a dilemma between the need for a higher knowledge abundance and security of an acceptable level of usability.

Completeness or abundance makes a direct impact on the intention to use the system. However, richness alone is not enough to create adequate level of the user satisfaction. On the contrary, it can even have an opposite impact: owing to data- which are not important for a particular user or overload with data is difficult to surf by confuse users and the user may avoid to use the system. The system could be functional and well organized to fit any possible need, but it fails to satisfy a particular user who needs less but more concentrated information urgently. The discrete failure may reduce user's intention to use the whole system. Thus, some balance between presented richness and usability as linkage needs to be accounted for in order to increase user satisfaction and system usability. The same was proved by the research in nursery personnel. The research has proved a tight connection between satisfaction and intention, however links between completeness and intentions have not been observed [13]. However, it should not become a motive to refuse the criterion of knowledge abundance. Knowledge quality with the same level of knowledge richness may possibly be realized creating linkages as additional selection rules set to classify and renew available knowledge and erase obsolete data. Eventually, storage of such knowledge incorporates knowledge adaptation and application to new contexts and new problems. Development and application of selection rules is often based on knowledge structures used ~~to~~ by splitting it into pieces with common characteristics. So far, the e.Prescription has been lacking application of dynamic selection rules, which may partly help to deal with the problem of user acceptability. Another important aspect is that in the absence of dynamic selection rules, doctors and patients react to unusual situations, e.g. e.Prescription, intuitively and instinctively, what is not justifiable in the present circumstances. Intuitive and instinctive behavior in the case of e.Prescription most often associates with a paper prescription entailing both a different quantity of data and a different procedure. KM systems have to aim to meet abundance requirements as such requirements constitute a quality element; however, abundance systems have to be subject to dynamic selection rules, allowing adaptability to the user needs and palpable benefit for the user by granting an opportunity to independently develop dynamic rules of the system according to the evolving needs. Minimization of primary rules is particularly important at the onset of IS development and during the adjustment stage since the user initially uses personified information and only then refers to codified data [18].

Conclusions

The research has revealed a controversial impact of knowledge richness upon the intention of the user to use the IT System. Although research generally states that a higher knowledge richness implies a greater value and benefit for the user and consequently the IS success, at the same time efficiency of the use of knowledge stay limited if another element of linkage is neglected. The user having a single specific need becomes unable to utilize knowledge available in the system independently. Linkages could be solved by applying different knowledge classification rules. The more information is available to the user the more operational rules apply. Modern ISs can deal with such problems. One of the ways to preserve knowledge richness may be the application of dynamic selection rules set to classify and renew available knowledge and erase obsolete data. The selection rules may be standardized or dynamically developed and modified by the user himself. The latter, of course, applies when the System is open and flexible. Such decisions can help the healthcare administrators and professionals to evaluate the potential of enabling IT and the opportunity it created to rethink or reengineer the e.Pprescription process and the associated activities based on the enabling IT capability. The work is the beginning of a line of research focused on e.Prescription informatics. It aims to develop a conceptual framework to identify the critical factors that are involved in the development of e.Prescription knowledge management systems.

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