SCIENTIA CUM INDUSTRIA (SCI. CUM IND.), V. 4, N. 3, 167—174 , 2016

IT self-service applications in polyclinics: a model for the improvement of the patient-treatment process

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Abstract

Information technology has become essential in supporting growth and sustainability of many types of organizations, including healthcare organizations. These organizations can improve its processes and patient flow. However, IT in the hospital sector can be considered underdeveloped when compared to other sectors. For this reason, an analysis of the healthcare system is useful, mainly with the goal of minimizing the cost of healthcare and maximizing the quality of the patient's processes. In this paper, our aim was to present a framework showing the applicability of IT self-servicing app in patient's treatment. The framework is structured by five types of self-servicing IT apps and eight patient's processes steps, settled in a Polyclinic Cardiology. Our results affirm that self-servicing IT apps are applicable both for medical staff and for the patient's satisfaction and treatment, from the "information help desk" step to the "patient check-out". Our work could contribute for implementations and suggestions in future research. In fact, in a increasingly digitalized world, the healthcare sector has a great growth and improvement potential to receive thanks to IT.

Keywords: IT self-service applications; polyclinics; Design Science Research; Model

I. INTRODUCTION

Recently, the necessity of a study and analysis of any healthcare system is increasing remarkably, in particular because its performance over time has met a number of, often conflicting, objectives and targets, such as minimizing the cost of healthcare, maximizing the utilization of human resources, optimizing the quality of care and diagnostic systems [1].

In fact, healthcare providers are facing an increased pressure for providing higher quality care in a decentralized and competitive market: the variety of specializations and therapies is rising, while patients demand services of a higher quality and shorter waiting times [2].

Information technology has become essential in supporting the growth and sustainability of all types of organizations [3,4]. The healthcare industry, like other types of organizations (education, financial among others) requires adequate IT infrastructure and information systems to deliver excellent services to the citizens.

A large majority of the recent studies show measurable benefits emerging from the adoption of health information technology: the expansion of health IT in the health care system is worthwhile [5,6].

For this reason, hospitals must integrate their information systems to better coordinate the healthcare processes. However, information systems in the hospital sector are underdeveloped when compared to other sectors [7], particularly in terms of low technological sophistication and integration sophistication [8].

This failure to recognize IT as a key stakeholder in hospital decisions, the implementation of Electronic Health Records(EHRs), and lack of funds are shown to be some of the top IT management issues in hospitals [9]. Besides technical issues, the complexity of processes also introduces a variety of organizational challenges. These issues provide an obstacle for process improvement, and therefore, the quality of healthcare also.

Polyclinics, as all other organizations, perform processes with the purpose of providing added value to their services or products. In this particular case, the fundamental process concerns caring for the patients, but there are also supporting processes for administration, procurement, logistics et cetera. The whole patient-treatment process can be improved by using theory behind Business Process Management (BPM). Business Process Management is a discipline that aims to "support business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information" [10].

A BPM maturity model for hospitals may assist in improving BPM maturity and help to tackle these challenges, thereby improving the overall quality of healthcare. In fact, a recent study [1] about the current BPM state in hospitals affirms that there is room for improvement and that their maturity levels and overall performance are currently self-assessed as being low to average.

In order to provide guidance on when and under what conditions that polyclinics should apply which types of IT applications in the patient-treatment process, the research question is: *How can self-servicing IT applications for patients help improve the polyclinic processes?*

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Data de envio: 05/11/2016
Data de aceite: 20/12/2016

http://dx.doi.org/10.18226/23185279.v4iss3p167

To answer this research question, it is intended to develop a model. The model proposed will contribute to the improvement of the patient-treatment process, in terms of patient satisfaction, cost reduction and process efficiency.

In this study, in-depth patients' treatment flow will be examined, step by step in order to point out its bottlenecks and an innovative process model will therefore be proposed that solves the main obstacles by taking advantage of Information & Communication Technology (ICT), with a focus on self-servicing applications for patients. It is done so by constructing an artefact, in this case a model adopting the method design science research [11]; This article is structured as follows: Section 2 shows the literature review on polyclinic processes and the types of IT-applications for the healthcare system. Section 3 presents a methodology adopted in this study, the method, Design Science Research which identifies possible bottlenecks in a typical polyclinic patient. Section 4 presents the conclusion and further research.

II. LITERATURE REVIEW

In order to explore existing theories and previous researches about the theme of this study and supporting the development of the artefact, which consists of a new process model using self-service IT applications, a search strategy was defined: first, identifying the main key-words of the research aim and using scientific research engines thereafter. The main sources were Research Gate, Science Direct, Google Scholar, AIS Library and Web Of Science. Based on the aim of the research, structured by the two dimensions of the model, the processes and the self-serving IT-applications, the following keywords were selected. Respectively for the first dimension: patient, healthcare, polyclinic, workflow, process, waiting time. For the second one: e-Health, digital self-service, polyclinic IT applications and business process management. Literature on these themes provides a good range of works and perspectives.

Articles were selected from the best journals and used also conferences' reputations as a quality criteria. Moreover, information of the papers' abstract was analyzed as a criteria of inclusion and exclusion based on the keywords defined. After these analyses, the articles were selected to compose the database of references.

In order to have an updated version, recent papers were chosen that were published within the last five years. A report was also used on the existing situation in anticipation of the new way of working at the cardiology polyclinic as a starting point and as an additional reference.

The model was developed by considering two different objectives. The first one is the patient's perspective with the goal of improving patient satisfaction, which is the mental result that the patient experiences during and after the interaction with the whole treatment process. The second point of view is the polyclinic, with the goal of reducing costs and increasing automation of the patient's treatment process.

Polyclinics can be defined as a co-location of a range of specialties to provide different healthcare services to the people such as diagnostics, minor surgery and pharmacies. [12]. Due to the range of services delivered to the citizens, a polyclinic has a complex infrastructure with a range of technologies to support the demand and needs an improvement to resolve the remaining bottlenecks.

Hospital waiting times are considerably long, with no signs of decreasing any time in the future. A number of factors including population growth, the ageing population and a lack of new infrastructure are expected to further exacerbate waiting times in the near future, but healthcare services' workflows can also be modelled as queueing nodes, highlighting how workflows can be optimized during execution in order to reduce patient waiting times [13].

Furthermore, another study about flow modeling and performance analysis of the healthcare delivery processes in hospital [14]. Considering the current scenario of continuously increasing healthcare costs and scarcity of resources, shows how the optimal utilization of resources without hampering the quality of care has gained importance in any country. Modeling, analysis and management of patient flows, in this context, plays a key role in performance analysis and improvement of hospital processes. This is because appropriate modeling of patient flows may help healthcare managers to make decisions related to capacity planning, resource allocation and scheduling, appointment scheduling and for making necessary changes in the process of care. From the literature, most specifically from [15] and [16], the following generic process steps were identified in the patient-flow oriented hospital environment:

- patient referral
- planning an appointment
- preparing consultation
- reporting for consultation
- waiting time
- examining/treating/talking
- follow-up determination
- concluding consultation.

Organizations are introducing self-service technologies, providing customer service, for three main reasons: to reduce costs, to increase customer satisfaction as well as loyalty and to reach new customer segments [17]. Customers value self-service technologies that saves them time or money, or provide them with an easier access better than personal service [17]. This is particularly true for customer service applications where companies see tremendous potential for saving labor costs when technology solutions are substituted for personal care.

The complexity of process management in hospitals lies in its large variety of medical specializations [18]. Patients may require the care of different medical specialists of different

hospital departments throughout their care process. This proves to be a challenge, since data relating to the patient may be recorded inconsistently between specialists or stored in separate information systems [19]. The complexities of healthcare processes introduce a risk of error and unnecessary waiting times. Patients with the same diagnosis may encounter different waiting times in their process and the reasons for this are not always known [20]. Earlier research shows a correlation between BPM maturity and process performance [21]. Thus, it follows that the improvement of BPM maturity and related capabilities may improve the process performance and quality of care in hospitals.

A paper written by [22] analyzed data from 567 U.S. hospitals, showing that IT is associated with swift and even patient flow, which in turn is associated with improved revenues. Interestingly, the results show that the improvement in financial performance is not at the expense of quality because they find similar effects of IT and patient flow in improvements in the quality of patient care.

At the same time, interesting findings were shown by [23] that created a model of access and triage known as 'specific timely appointments for triage' (STAT), in which appointment slots are preserved in advance specifically for new patients based on calculation of average demand.

Therefore, IT support for healthcare processes has the potential to significantly reduce the rate of adverse events by selectively providing accurate and timely information at the point of care. Yet, there is a discrepancy between the potential and the actual usage of IT in healthcare [24].

Table 1 shows the seven application categories and the types of IT app related to each category. A literature review was produced which identifies the main relevant literature.

Table 1: Self-Service IT applications

Categories	**Self-Service IT applications**	**Relevant Literature**
Data access - DA	Self- service kiosks	Meuter et al., 2000 [25]; Gupta et al 2010 .,[26]; Buntil et al, 2011 [27]; Brooks et.al, 2011 [28]
	On-line applications and Portals Personal Health Records Digital customer service (FAQ, order tracking, bill tracking, delivery tracking)	Buntil et al, 2011 [27]; Misser etl al, 2014 [29]; Swan, 2009 ,[30]; Brooks et.al, 2011 [28]
	Digital Customer Services	
	Automated test result notification system to patient. On-line Portals to verify the exams.	Misser etl al, 2014 [29]
Identification - ID	Biometric Identification	Gupta et al., 2010 [26]; Salamati & Zbigniew, 2014 [31]
Self-service diagnosis and diagnosis information - SSDI	Database with patterns of illness and anomalies for helping the patients in the identification of possible reasons.	Dolan, 2002 , [32] in Rozenblum et al., 2013 [32]; Gupta et al., 2010 [26]; Swan, 2009 [30]; Tan et al, (2015) [33]
	Self-Triage smartphone app	Find a Doctor, Symptom Checker, Conditions, Medications, Procedures and Hospitals – iTriageHealth.com
Self-service treatments and treatment information - STTA	Information system providing data to assist the patient-treatment process. Automatized and smart system ready to give information in real-time for patients' treatment. This information can be based in the cases of others patients.	Rozenblum, 2013 [32]; Morgan, 2000 [32] in Rozenblum et al., 2013 [32]; Green, 2004 [32] in Rozenblum et al., 2013 [32]; Swan, 2009 [30]; Brooks et al., 2011 [28]; Tan et al, (2015) [33]
Self-service monitoring and monitoring information SSMMI	Applications to monitor the patient, such as smart gadgets (smart watches, smart phones, brain-computer interface, neuro sensing, emotional mapping, home automation sensors and environment monitoring sensors). These applications are useful for monitoring all patients' life cycle.	Salamati & Zbigniew, 2014 [31]; Lupton D., Jutel A., (2015) [34].; Salamati, F., & Pasek, (2014) [35] ; Tan et al, (2015) [33]; Higgins, J. P. (2016) [36].

Self-service referral and self-service appointment	Self-referral and appointment via smartphone app or online portal, where you can also see free slots for appointment and probable waiting time.	Smart Operations, (2016) [37]; Capterra, (2016) [41]
Helpful information and services	Smartphone app with: 1) interactive map to help people orientate themselves in the hospital with a search option for the different polyclinics and medical staff; 2) an updated real-time waiting list feature for increased patient satisfaction with notifications; 3) online payment.	Careggi University Hospital. (2016) [38].

Table 1 presented the different types of IT app for the healthcare system. The next section presents the method used to develop the model.

III. DESIGN SCIENCE RESEARCH

Many theories argue that it is necessary to use information systems in order to manage the effectiveness and efficiency of interactions between people, technology and organizations. This way, research on information systems need to be aligned with the business strategy, IT strategy, organizational infrastructure and the IT infrastructure. This combination allows for different organizations leading business, making information systems become emerging tools for this embodiment.

Therefore, to solve organizational problems, a method that has gained popularity mainly in the areas of information systems, is DSR - Design Science Research. The aim of the DSR is the development of innovative devices that generate knowledge for solving a specific problem domain [11,40]. IT artefact is a software, a module of software, processes or organizational methodology for information systems [43]. The key elements of the DSR on investigations into information systems, is the possibility of new fields of research, conduct testing and validation of theories, or build new theories. The purpose of this work is the development of a model to contribute to the improvement of the healthcare industry.

The results of a report were used on the existing situation in anticipation of the new way of working at the cardiology polyclinic as an explorative case study for the research. This report offers an example about how digitization leads to new ways of working, that seem to have a considerable impact on the staff's activities and on processes surrounding the administration and, simultaneously, influence the patient's treatment.

All in all, this study highlights the main bottlenecks in a patient-treatment flow that could be optimized by integrating self-servicing IT applications. The report is highly applicable as an explorative case study for the artifact because it doesn't contain specific theory on self-servicing IT apps, so it leaves space to hypotheses about different kinds of applications and about their efficiency in the treatment process.

The specific case of the cardiology polyclinc process is also good starting point for an exploratory case study because polyclinic processes follow common patterns and are straightforward, which make them easily generalizable.

Below (Table 2) is the analysis from the case study document [41] (Report on existing situation in anticipation of the new way of working at the polyclinic cardiology, 2016) in terms of process steps, and possible directions for IT solutions:

Table 2: Analysis Processes Polyclinic

Process step	**Description**	**Main bottlenecks**	**Possible self-servicing IT applications**
1. Patient referral	Referral of a patient to specialist through external/internal referring (phone, written letter, digital system, fax) or via emergency room.	- Receiving and processing referrals through CD (Care Domain, computer application) is long and no particular person is defined for this role.	data access, identification, self-service referral, helpful information and services
2. Planning an appointment	Scheduling of an appointment to start or continue a treatment. This step is done via telephone or front desk.	- If a patient calls, but his triage still isn't completed, he/she is asked to wait. - If there's no quick response the patient will call multiple times. - In many cases, after scheduling an appointment, a patient receives information via telephone only. - Overcrowded polyclinic calendar, which results in long waiting lists. - When taking an appointment at the counter, the agreement is written by hand on the appointment card.	data access, identification, self-service appointment, helpful information and services
3. Prepare consultation	Preparing and checking the patient's (previously stored) information before the real consultation. The information might need last-minute changes.	- Employees continuously re-check medical files and consultation lists.	data access, identification
4. Report for consultation (Check-in)	Registration at the reception in order to avoid waiting for patients that don't show up and to start preparing the consultation.	- Doctor's assistant is not doing work directly related to receiving patients. - Front and back office operations are mixed.	data access, identification, helpful information and services
5. Waiting time	Patients spend time waiting for the appointment with the specialist in the appropriate waiting room, indicated previously by the check-in desk.	- Undesirable long waiting times can build up. - Patient is not or not sufficiently informed about the respective waiting periods.	data access, identification, self-service treatments, self-service diagnosis, helpful information and services
6.Examine/treatment /talk	Initiation of the care treatment process.	- Acts carried out by the doctor that can be delegated. - Doctors' and assistants' activities are not always aligned to each other.	data access, self-service treatment, self-service monitoring
7. Follow-up determination	The care provider determines the next necessary steps: a patient may need additional treatments or tests, either on the same or on a later day. The patient may need to plan another appointment or remain in the polyclinic.	- Team discussion for additional treatments or exams is unclear and safeguarded insufficiently.	data access, identification, self-service treatment
8. Conclude consultation (check-out)	The patient leaves the hospital. In the meantime, supplementary diagnosis or treatments are processed and the patient's files are updated.	- Increasing number of unhandled phone inquiries. - Increasing number of non-approved GP letters.	data access, identification, helpful information and services

The analysis of the case study at the polyclinic cardiology shows that most of the processes from literature are one-to-one processes which is confirmed in the case study. This also holds true for the types of IT-applications that may solve the bottlenecks identified in the case study.

A) ARTEFACT OUTLINING & OPERATIONALIZATION

Table 3 represents the model, made of two dimensions: process steps and self-servicing IT applications. For each process step, it was possible to find different kinds of self-servicing IT apps that can improve the patient-treatment flow. In the model, it was also possible to identify in which step and in which application optimizes patient satisfaction as well as cost reduction, as can be viewed in the legend.

The model proposed is based on eight processes steps and seven self-serving IT apps. This is seen in Table 3. For each IT app, the following symbols were used, X, X, X, according to the legend to analyse the process improvement.

Table 3: Model proposed – Process Step and Self Servicing IT applications

	Self-servicing IT app						
Process Step/ Self-Serving IT App	Data access	Identification	Self-service diagnosis and diagnosis information	Self-servicing treatments and treatment information	Self-servicing monitoring and monitoring information	Self-servicing referral and appointment	Helpful information and services
Patient referral [1]	x x	x x	x x x		x	x x x	x x x
Planning and appointment [2]	x x	x x				x x	x x x
Prepare consultation [3]	x x	x x					
Report for consultation [4]	x	x x					x x
Waiting time [5]	x	x x	x x x	x x x			x x
Examining/ treatment [6]	x x			x x x	x x x		
Follow-up determination [7]	x x			x x x	x		
Conclude consultation [8]	x	x x					x x

Legend

Cost Reduction x — Patient's satisfaction x — Correspondence between process step and possible improvement with IT app x

Table 3 presented the model proposed. The model steps are divided into processes, phases and the categories in the IT app. The categories are also explained in Table 1. The main purpose of this model is to show which IT app has some impact on reducing cost or patient´s satisfaction. 1,2,3 – [42]; 1,2,3,8 – [43]; 4 – [39]; 5- [37].

The next section the conclusion and further research are presented.

IV. CONCLUSIONS AND FURTHER RESEARCH

The aim of this study was to develop a model for the improvement of the patient-treatment process, in terms of patient satisfaction, cost reduction and process efficiency. For the development of the model, the Design Science Research method was used. The following research question was addressed in this article: *How can self-servicing IT applications for patients help improve the polyclinic processes?* To answer this question, the following steps were conducted.

First, the main bottlenecks of a polyclinic process were identified. After that, the literature review presented a set of self-servicing IT-applications for improvement of the polyclinics processes: eight different categories were produced. Finally, a list of self-service applications was developed, for the improvement of each process step according to two perspectives, the patient's satisfaction and cost reduction.

The contributions of this study is a model (Table 3) with two dimensions, process steps and self-servicing IT applications. The model is structured by seven categories of self-servicing IT apps and eight patient's process steps, starting from a report on the situation of a cardiology

polyclinic and it is generalized to all polyclinics. For each process step, different types of self-servicing IT apps were found to have a positive effect on a patient's treatment. The most suitable applications in particular were highlighted, for the improvement of patient satisfaction and cost reduction. As a result of the artifact, it was concluded that there *are positive effects* such as: reduced waiting time, real time-notification, possible self-monitoring and self-treatment, easier referral and appointment system among others, thanks to the self-servicing IT applications for both for medical staff, and for the patient's satisfaction and treatment, from the starting point of the "information help desk" to the "patient check-out".

Regarding the limitation of this research, it is necessary to point out that the literature review was limited in terms of databases that were consulted and the structures that were explored. In addition, the model proposed is yet to be validated by experts.

For future research, it is suggested to investigate more extensively, which self-servicing applications are the most effective in each process. It is also considered to use the model to further validate the impact of self-service IT applications on organizational performance in terms of patient satisfaction and cost reduction. To measure this impact, a possible solution is to conduct a survey with patients and the polyclinic staff in different countries to benchmark polyclinics.

Additional research could be done in the development of an online e-Health portal or mobile application, which can integrate all the seven different functions of self-servicing IT applications.

V. REFERENCES

[1] Mens, J.F. (2016). Master Thesis: A maturity model for BPM capability assessment in Dutch hospitals(supervisors: Batenburg, R.S., Spruit, M.R. and Raveysteyn J.P.P.).

[2] Øvretveit, J. (2000). Total quality management in European healthcare. International journal of health care quality assurance, 13(2), 74-80.

[3] De Haes, S., Gemke, D., Thorp, J., & Van Grembergen, W. (2011). Analyzing IT value management at KLM through the lens of VAL IT. ISACA journal, 5, 27-34-

[4] Wu, S. P.-J., Straub, D. W., & Liang, T.-P. (2015). How information technology governance mechanisms and strategic alignment influence organisational performance: Insights from a matched survey of business and IT managers. MIS Quarterly, 39(2), 497-518.

[5] Buntin, M. B., Burke, M. F., Hoaglin, M. C., & Blumenthal, D. (2011). The benefits of health information technology: a review of the recent literature shows predominantly positive results. Health affairs, no 30(3), pp 464-471.

[6] Lenz, R. and Reichert, M. (2005) IT Support for Healthcare Processes. In: Proceedings 3rd International Conference on Business Process Management (BPM'05), 5 - 8 Sep 2006, Nancy, France. pp. 354-363.

[7] Helfert, M. (2009). Challenges of business processes management in healthcare: Experience in the Irish healthcare sector. Business Process Management Journal, 15(6), 937-952.

[8] Paré G, Sicotte C. (2001). Information technology sophistication in health care: An instrument validation study among Canadian hospitals. International Journal of Medical Informatics. 63:205–223.

[9] Jaana, M., Tamim, H., Paré, G., & Teitelbaum, M. (2011). Key IT management issues in hospitals: Results of a Delphi study in Canada. International Journal of Medical Informatics, 80(12), 828–840. http://doi.org/10.1016/j.ijmedinf.2011.07.004

[10] Weske, M. (2012). Business Process Management Methodology. In Business Process Management (pp. 373-388). Springer Berlin Heidelberg.

[11] Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, *28*(1), 75-105.

[12] Brooks, L. Mehta, R. & Huang, Z. (2011). Information sharing in NHS polyclinics, International Conference on Information Systems (ICIS).

[13] Meli, L., Khalil, I. and Tari, Z. (2014). Load-sensitive dynamic workflow re-orchestration and optimisation for faster patient healthcare. Computer Methods and Programs in Biomedicine, vol 113, no 1, pp 1-14

[14] Bhattacharjee, P., & Ray, P. K. (2014). Patient flow modelling and performance analysis of healthcare delivery processes in hospitals: A review and reflections. Computers & Industrial Engineering, no 78, pp 299-312.

[15] Rohleder, T. R., Lewkonia, P., Bischak, D. P., Duffy, P., & Hendijani, R. (2011). Using simulation modeling to improve patient flow at an outpatient orthopedic clinic. Health care management science, 14(2), 135-145.

[16] Mallmann, G. L., Plaisier, M., Versendaal, J., Ravesteyn, P. (2014). The Influence of Digital Self-Services on Patient's Experience in a Polyclinic Context: A Framework Construction. Journal of International Technology and Information Management, vol 23, no 3-4.

[17] Bitner, M. J., Ostrom, A. L., & Meuter, M. L. (2002). Implementing successful self-service technologies. Academy of Management Executive, 16(4), 96-109.

[18] Mans, R. S., Schonenberg, M. H., Song, M., van der Aalst, W. M., & Bakker, P. J. (2008). "Application of process mining in healthcare–a case study in a dutch hospital." In International Joint Conference on Biomedical Engineering Systems and Technologies. Springer Berlin Heidelberg, pp 425-438

[19] Mans, R. S., Aalst, van der, W. M. P., & Vanwersch, R. J. B. (2013). Process mining in healthcare : opportunities beyond the ordinary. (BPM reports; Vol. 1326). BPMcenter.or

[20] Mans, R. S., Schonenberg, M. H., Song, M., van der Aalst, W. M., & Bakker, P. J. (2008, January). Application of process mining in healthcare–a case study in a dutch hospital. In International Joint Conference on Biomedical Engineering Systems and Technologies (pp. 425-438). Springer Berlin Heidelberg.

[21] Ravesteyn, P., Zoet, M., Spekschoor, J., & Loggen, R. (2012). Is There Dependence Between Process Maturity and Process Performance?. Communications of the IIMA, 12(2).

[22] Devaraj, S., Ow, T. T., & Kohli, R. (2013). Examining the impact of information technology and patient flow on healthcare performance: A Theory of Swift and Even Flow (TSEF) perspective. Journal of Operations Management, no 31(4), pp 181-192.

[23] Harding K.E. , Bottrell J. (2015). Specific timely appointments for triage reduced waiting lists in an outpatient physiotherapy service. Physiotherapy, In Press.

[24] Lenz, R., Miksch, S., Peleg, M., Reichert, M., Riano, D., & ten Teije, A. (2013). Process support and knowledge representation in health care. Lecture Notes in Artificial Intelligence (first ed.), Springer, New York.

[25] Meuter, M. L., Ostrom, A. L., Roundtree, R. I. & Bitner, M. (2000). Self-Service Technologies: Understanding Customer Satisfaction with Technology-Based Service Encounters. Journal of Marketing, 50-64.

[26] Gupta, A., Das, S., McEwan, T., & Jayachandra, M. (2010). Biometric Self Service for Healthcare.

[27] Buntin, M. B., Burke, M. F., Hoaglin, M. C., & Blumenthal, D. (2011). The benefits of health information technology: a review of the recent literature shows predominantly positive results. Health affairs, 30(3), 464-471.

[28] Brooks, L., Mehta, R., & Huang, Z. (2011). Information Sharing in NHS Polyclinics. International Confernece on Information System, ICIS.

[29] Misser, N. S., Versendaal, J., Methorst, M., & Stork, B. (2014). Dutch Healthcare: An Overview and Application.

[30] Swan, M. (2009). Emerging patient-driven health care models: an examination of health social networks, consumer personalized medicine and quantified self-tracking. International journal of environmental research and public health, 6(2), 492-525.

[31] Salamati, F., & Zbigniew, J. P. (2014) Personal Wellness: Complex and Elusive Product and Distributed Self-Services. Procedia CIRP 16. 283-288.

[32] Rozenblum, R., Donzé, J., Hockey, P. M., Guzdar, E., Labuzetta, M. A., Zimlichman, E., & Bates, D. W. (2012). The impact of medical informatics on patient satisfaction: A USA-based literature review. International Journal of Medical Informatics, 82, 141-158.

[33] Tan, C., Sun, L., & Liu, K. (2015). Big data architecture for pervasive healthcare: a literature review. ECIS, Proceedings.

[34] Lupton D. , Jutel A. (2015). It's like having a physician in your pocket!' A critical analysis of self-diagnosis smartphone apps. Social Science & Medicine, vol 133, pp 128 – 135.

[35] Salamati, F. & Pasek, Z.J (2013). Modeling for personal well-being: time for paradigm change. In Proceedings of the Grand Challenges on Modeling and Simulation Conference. Society for Modeling & Simulation International, Vista, CA.

[36] Higgins, J. P. (2016). Smartphone applications for patients' health and fitness. The American journal of medicine, no 129(1), pp 11-19.

[37] Smart Operations (2016). Retrieved from http://mariorapaccini.wixsite.com/smartoperations/blank. Accessed 10 August 2016.

[38] Capterra (2016). Retrieved from http://www.capterra.com/medical-scheduling-software/. Accessed 10 August 2016

[39] Careggi University Hospital. (2016). Retrieved from http://www.aou careggi.toscana.it/internet/index.php?option=com_content&view=article&id=1725&lang=it. Accessed 10 August 2016.

[40] Kuechler, W., & Vaishnavi, V. (2012). A framework for theory development in design science research: multiple perspectives. *Journal of the Association for Information systems*, *13*(6), 395-423.

[41] Report on existing situation in anticipation of the new way of working at the Polyclinic Cardiology (2016).

[42] Aktepe, A., Türker, A. K. and Ersoz, S. (2014). Internet Based Intelligent Hospital Appointment System. Intelligent Automation and Soft Computing, 20(4).

[43] Itriage (2016). Retrieved from http://www.itriagehealth.com. Accessed 10 August 2016

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