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Original Article

The Feasibility of Deploying Business Process Management in Hospitals in Iran

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Abstract

Background: Business process management (BPM) systems can automate all processes in an organization. These systems provide the possibility of identifying, modeling, deploying, implementing, function managing, integrating with other information systems, monitoring and improving an organization's business processes in a standard form. As far as the authors know, no related research has been performed in this field.
Objective: This study investigated the feasibility of establishing BPM in hospitals in Iran.
Methods: This qualitative research involved 13 participants selected by purposive sampling, including faculty members from medical universities and managers of hospitals. Data was collected through semi-structured interviews and analyzed using qualitative content analysis.
Results: Interviewees were asked about the requirements for establishing BPM. To more easily understand the content, the interviewees responses were classified into two general categories: prerequisites for guidelines and procedures, and prerequisites for electronic healthcare records.
Conclusion: Despite slight differences between the two groups of respondents (healthcare administrative experts and medical informatics management experts), there was a consensus among the experts about the effectiveness and efficiency of using BPM in healthcare organizations. Furthermore, respondents maintained that, even though numerous prerequisites would be needed for the establishment of this kind of processing reform given the current situation in Iran, some benefit could be gained from implementing to any extent possible this approach in Iran's hospitals.
Keywords: Business process management, Process improvement, Healthcare organizations

1. Background

Business process management (BPM) is a process that places a set of services in sequence so as to achieve the optimized objectives of the process. BPM, in fact, is a managerial approach that considers processes as strategic assets and a thorough understanding, management, and improvement of them is necessary to deliver value-added services and products to customers.[1] The concept of continuous improvement is the heart of the BPM approach,[2] and the main infrastructure of the approach is its related software which enables rapid changes and continuance in a time of crisis.[3] In recent years, BPM has become a managerial priority for many organizations,[4] while for many years, other organizations have used BPM principles, re-engineering and automating the main processes to address strategic priorities successfully. A few years ago, these principles were alien to healthcare organizations, perhaps because of the incredibly dynamic nature of the environment of healthcare organizations and the high complexity of processes in them.[5] In fact, it can

be said that, because healthcare organizations tend to use this approach, processes are not limited to the organization itself, but include a wide range of groups and organizations.[6] Moreover, the rising costs of healthcare and the competitive pressure to consider patients' satisfaction mandate the implementation of reforms in these organizations.[7] In fact, because hospitals should be everywhere to meet the needs of communities throughout the world, because common to all these organizations are many and complex business processes, and since these organizations are under constant pressure to reduce costs and increase service quality in order to survive, the principles of business processes should be considered and problems continually followed.[8] BPM is divided into three main stages: work processes design, implementation, and monitoring.[9] Moreover, it strongly emphasizes the modeling of processes to identify, review, validate, explore, and improve them.[10] Examining the results of healthcare organizations that have been able to successfully implement this approach in the organization, it can be seen how the successful implementation of BPM

can lead to better clinical outcomes through following agreed-upon clinical policies and providing similar services. The end result of implementing BPM is the provision of IT-based solutions and a digital infrastructure that manages key functions and automates the processes of the organization.[11] Furthermore, the examination of relevant literature shows that, by implementing BPM, a large number of hospitals, insurance companies, and other health organizations around the world have been able to automate their key business processes and have benefited from its advantages, such as reduced administrative workload and a greater influence on processes to manage and reform. For example, Chester County Hospital used BPM to automate and manage its various processes and achieved reduced manual workloads, increased speed and accuracy, and improved results.[12]

2. Objective
Given that the deployment of this approach depends on the existence of legal and cultural requirements and that little research has been done on this subject, this study was conducted using a qualitative approach. This study investigated the feasibility of establishing BPM in hospitals in Iran.

3. Methods
This 2014 qualitative study was conducted with 13 participants including faculty members of the Isfahan School of Management and Information Sciences and Mashhad School of Health and managers of hospitals in Isfahan. The ages of participants ranged from 35 to 55 years with an average of 43 years; 10 subjects were men. Seven subjects had a PhD and 6 had a master's degree. Inclusion criteria were the minimum of a master's degree and two years of management experience in a healthcare organization. The sampling method was initially based on availability; then purposeful sampling was employed. Semi-structured interviews were conducted with faculty members and managers who had rich experiences and were willing to talk about them until data saturation.[13] After participants were informed about the purpose of the study, their informed consent to participate in recorded interviews was obtained. They were assured that anonymity and confidentiality would be maintained.[14] Because of the participants' scientific and research expertise and their time constraints, individual semi-structured interviews were conducted by the researcher in Persian at each participant's workplace. Each interview lasted almost 80 minutes. Based on the purpose of the study, interviewees were asked general questions about the topic; then, based on their answers, the questions continued. The text of each interview was immediately transcribed word for word and analyzed using qualitative content analysis).[15] After several readings for accuracy by the researcher, the texts of the interviews were analyzed using open coding to identify categories. Primary codes based on differences and similarities[16] were then reduced to sub-categories, abstract categories, and key concepts.[17] At this stage, 477 codes were obtained and summarized and categorized based on conceptual similarities and differences. The categories were compared with the data again to ensure the accuracy.[18] The unit of analysis was identified, and the initial codes were extracted based on the units of meaning from the participants' descriptions. They were then classified based on the differences and similarities of the initial codes.[19] Finally, based on the researcher's careful interpretation and continuous comparison of the data, key categories and concepts were extracted.[20] The credibility and objectivity of the data were obtained when collecting data, diversity of participants, review of frequent data revisions, participants and two researchers' review.[21]

4. Results
After reviewing the interviewees' responses, the prerequisites of BPM were classified into two main categories to facilitate study of the content. Finally, the experts' comments were classified in two general categories, each having seven sub-categories. The data is presented in Table 1.

The first category is requirements related to guidelines and procedures, and the second category is requirements related to electronic patient records.

Each of the studied components in the questionnaire with some comments of interviewees are provided below.

4.1. Reforms Related to Guidelines and Procedures
4.1.1. Integrate Hospital Health Information System, Electronic Patient Records, and Work Flow
Medical treatment processes are representative of the main processes of healthcare centers and rely heavily on medical knowledge and specific case decisions. Decisions are made during the clinical process by interpreting certain patient data and are based on the medical knowledge of the medical team. To provide clinical decision support, patient-specific data and medical guidelines should be integrated in the hospital information system (HIS). Integrated medical knowledge, specific patient data, and complex decision support systems allow high flexibility in the treatment process.[22] One interviewee said, "Through the integration of these systems, the physician could access related information; the patient's history and information was accurate, and medical errors were reduced." Another interviewee said, "This objective is in line with the targets of clinical governance; the integration of information systems could improve service quality and save time."

4.1.2. Removing Non-value Added Activities
In a domain such as healthcare, there are various legal restrictions and treatment guidelines that physicians must follow. Having the freedom to reorganize, remove non-value added activities, and revise mandatory procedures and medical information systems seems essential. Using the flexible principles of BPM is suggested. BPM and workflow software are commercially available; through regular changes they lead to a reduction in repeated human health errors. BPM is the planning, control, and monitoring of internal and external processes of an organization to make operational sequences and structures available, in

Table 1. Categories of Interviewees' Comments in Original Forms With Sub-categories

Categories of Interviewees' Comments		Sub-categories of Interviewees' Comments	
1	Reforms related to guidelines and health procedures	1	Integration of hospital information system, electronic patient records, and work flow diagrams
		2	Removal of non-value added activities
		3	Use of declarative modeling languages rather than imperative languages, entrusting immediately decisions to the medical team in unforeseen conditions
		4	Combination of declarative and imperative languages
		5	Definition of social rules for interactions within the organization, when someone does not have the ability to do something
		6	Explore processes
		7	Knowledge gained from problems and events during the implementation process; prediction of future events and ongoing process reform accordingly
2	Reforms related to electronic patient records	1	Web-based electronic records
		2	Recording the content of process-centric electronic records, not on the basis of data collection
		3	Requirements for controlling and accessing patient records
		4	Careful access control to her
		5	Mandatory access control to her
		6	Role-based access control to EHR
		7	Combination of these methods to establish access control system

Abbreviations: HIS, hospital information system; EHR, electronic health record.

accordance with the process continuous and frequent improvement.[23] One interviewee said, "A fundamental point in the automation of processes is the high initial cost and time spent; so, continuous control and reform is appropriate." Regarding some clinical procedures, there is no agreement on the reduction of human errors. For example, CPOE (computerized physician order entry) that is virtually automated prescriptions is proven to reduce medical errors, but there is doubt in some other aspects, and in others there is the probability of errors of another type. Another interviewee said, "The design of EHR (electronic health record) is a kind of effective re-engineering that can help immensely in removing non-value added activities."

4.1.3. Using Declarative Modeling Languages Rather Than Imperative Languages; Entrusting Immediate Decisions in Unforeseen Conditions to the Medical Team

Current clinical guidelines are not flexible enough to deal with particular diseases or unexpected situations. In imperative modeling languages, users executing orders have no options in implementing the process. Even in the case of inappropriate procedures under certain conditions, BPM recommends the use of modeling language CIGD (declarative language). It identifies essential activities of the treatment process and the dependency between tasks without specifying the sequence of tasks or the emphasis; hence, the user has much freedom in choosing the treatment. Rules in declarative modeling languages are called mandatory limits which should be respected, and violating these boundaries is not allowed. Declarative language allows an immediate decision under certain types of unforeseen conditions. Moreover, it allows the possibility of improvement with the development of technology and knowledge.[24] One interviewee said, "The final decision is up to the physician, and even red lines cannot choose the path for the physician; they can only give alarms." Another interviewee said, "There should be an alert in the treatment

process, but it should not be imperative. Taking freedom from the medical team is to reduce the physician's incentive and accountability. Hierarchy, and imperative hierarchy, can be useful, i.e. at the lowest level (workers), guidelines are imperative, but at higher levels (physicians), guidelines are more declarative."

4.1.4. Combination of Declarative and Imperative Languages

One of the interviewees said, "Organizational positions should be taken into account; for example, guidelines are imperative for lower levels, and for higher levels they are declarative."

4.1.5. Definition of Social Rules for Interactions Within the Organization When Someone Does not Have the Ability to Do Something

The introduced approach follows a normative system and includes defining social rules and roles to facilitate interactions in abnormal situations where borders are ignored and red lines are crossed. Social norms represent the capabilities of human interaction within organizations and can be effective under unusual conditions when following rules and guidelines may not protect the patient's interests.[25] One of the interviewees said, "According to Iranian rules, the physician can do anything if he accepts the consequences." Another interviewee said, "In Iran, follow-up depends on the level of power. In such cases, the physician may take some actions with confidence and take other actions with greater caution."

Another interviewee said, "Saving the patient's health and life in any state should be important, and measures should be taken towards this goal."

4.1.6. Exploring the Processes

Activities designed to explore the processes consist of three stages: reviewing the results of the processes, comparing them with the predicted results, and discovering deviations.

This information is very useful for reforming processes. In some cases, deviations from the specified processes lead to better results which can be assessed using the exploring process.[26] One interviewee said, "It is not bad that people give suggestions for process reform, but reforms should be ratified in formal meetings and with the participation of experts." Another interviewee said, "The exploring process can be considered as a link in the process chain."

4.1.7. Learning From Problems and What Happened During the Implementation Process and Predicting Future Events and Ongoing Process Reforms Accordingly

The continuous improvement of processes is possible with the use of the learning process. The learning process is a closed-loop model that includes set major and minor objectives, determines exceptions and incomplete states at the time of implementation, and automatically matches the process with discovered states. The purpose of the learning process is not only to learn from problems that have arisen during implementation, but also to adapt to changes in technology and to environmental requirements such as new rules, policies, and initiatives.[27] One of the interviewees said, "Regarding the increase of development of technology and its application in the healthcare system, the learning process for users of technology in these systems should be planned and organized." Another interviewee said, "With this, in fact, we inject economy into health. By learning from the problems and self-assessment of the medical team, many errors can be avoided and the system performance enhanced."

4.2. Reforms Related to Electronic Patient Records

4.2.1. Web-Based Electronic Records

A current challenge to health information systems is personalizing patient data and providing an efficient information flow between different healthcare providers by reducing human errors and increasing the quality of services.[28] One interviewee said, "One of the fundamental measures to reforming the process is to use the web through which patient information can be access at any time or place. With this access, there is greater control over the treatment process."

4.2.2. Recording the Content of Process-Centric Electronic Records, not on the Basis of Data Collection

The existing information system is data-centric and therefore sufficient solutions are not provided. It is suggested that a process and patient-based information system be provided. In BPM, the flexible design of electronic patient records is suggested that allows both providers and patients access to information of past and future, as well as awareness of future developments.[29] One interviewee said, "Being process-driven in the field of information and action can be very helpful in improving the patient."

4.2.3. Requirements to Control and Access to the Contents of the Patient Records

Today, the focus is on nationalizing electronic health records to reduce costs and improve performance by increasing efficiency. Some countries have attempted to nationalize EHR by centralizing services carried out individually in databases; however, this focus leads to new problems for the safety and protection of the confidentiality of patient information. For this reason, new access control approaches that consider the privacy and security of patient information is introduced herein.[7]

4.2.4. Careful Access Control for Electronic Health Record Access

With the introduced method, the patient is the owner of his information records and allows access to information contained in it to trusted users. One weakness of this method is the patient's lack of expertise in identifying the data required for any user.[30] One interviewee said, "It seems that patients' rights are considered in this method, but a lack of knowledge may create risks for the patient."

4.2.5. Control mandatory access for Electronic Health Record Access

With this method, access rules are determined through the system, and the patient does not interfere with entrusting the user in cases where confidentiality is not respected.[31] One interviewee said, "There should be a link between different levels of treatment and the family physician. Family physicians should be the ones to collect the patient's information and give access to it to other physicians."

4.2.6. Control Role-Based Electronic Health Record Access

With this method, users are allowed access to patient data based on their role in the patient treatment process.[32] One interviewee said, "The patient should not decide; this seems reasonable in the case of a clear policy."

4.2.7. Combining the Above-Discussed Methods for an Access Control System

The combination of these three methods is used for an access control system, because none of these three methods alone meets the information security and confidentiality requirements.[33] One interviewee said, "Especially for a combination in which the patient's opinion and selection is important to access, there should be enough culture and training already."

5. Discussion

Two significant differences between healthcare organizations, especially hospitals, and other organizations are the consumer of the organizations' services and the sensitivity to the quality of services provided by these organizations. Since consumers of hospital procedures are patients who require special attention because of dramatic conditions, and since there is the possibility of errors occurring at any stage of service delivery including the likelihood of irreparable injury or even death, the need to manage and improve hospital processes can be clearly understood. A review of the literature related to the implementation of BPM in healthcare organizations indicated that BPM is an interesting technology that,

by turning today's organizations into process-driven organizations, provides them with many benefits.[34] Because of the poor management of processes in most hospitals, personnel spend a lot of time doing non-value added activities, and patients frequently complain of long waits for service delivery. The current study investigated the feasibility of deploying BPM in hospitals in Iran using a qualitative study and semi-structured interviews. In the process of qualitative content analysis, information is collected and analyzed at the same time.[35] One reason for this kind of interview is to collect information about not only the attitudes and beliefs of the participants, but also their experiences and viewpoints. Other reasons are its low-cost, flexible, and stimulating features interviews and its capability to obtain valuable information.[36]

In the treatment process, the main method of patient-healthcare system communication is in-person visits in which the patient's information is recorded by the physician or nurse interviewing him. In addition to the possibility of errors, this method is costly and time consuming. Buisman et al presented a method that considers the importance of integrating information systems, the patient HER, and work flow[37]; using their method, significant advances have been made.[38,39] Their results confirm the results of the current study.

A workflow management system (WfMS) consists of software components for storing and interpreting the meanings of the process, creating and managing the flow of work in the implementation, and controlling its relationship with members and functions of work flow. Work therapy is defined as duties associated with the treatment observed in the patient conduct path. Using WfMS for workflow management of the treatment was presented for the first time by Dadam et al.[40] Wakamiya and Yamauchi presented five basic requirements for implementing electronic treatment: notes in EHR, record statistics and variances, CPOE, checklist of editable activities, and models. The information was consistent with the views of the interviewees in this study.[41] In a review by Gooch and Roudsari, it was found that HIS studies can be divided into 10 main clusters. They showed that the development of therapeutic path-based clinical decision systems occurs through semantic networks, combined official, clinical, and organizational ontologies, and the use of WfMS.[42]

In past decades, researchers have looked for ways to reduce unnecessary visits and long waits in hospitals and clinics. The method introduced by Kirk et al and Dessertine provided the possibility of monitoring patients who suffer from chronic diseases such as diabetes or asthma from a distance.[43,44] Kaish provided a method that, in addition to the above, showed advances in the treatment process.[45] Brown introduced a method which had an advantage over the previous methods in that appropriate training was provided to the patient.[46] A patient's health information was transferred to the physician by a network, and after analysis, an appropriate training program was provided to the patient via electronic message. This method verifies the results of this study regarding the importance of training.

In accordance with the interviewees' comments, Mulyar

Research Highlights

What Is Already Known?

The extraordinary dynamic natures of healthcare systems and complicated procedures have led to the necessity of understanding BPM use within these organizations. Therefore, to reduce the costs and improve patients' satisfactions, a general consensus was obtained for BPM utilization in the healthcare and treatment organizations.

What This Study Adds?

The results of this study indicated that two major measures must be taken regarding BPM utilization in hospitals: modifications of guidelines and procedures and reformation of patient's electronic profile. However, according to many limitations, localization on the performance was strongly suggested.

et al showed that computer-interpretable guideline (CIG) modeling languages not only match with languages of traditional work flow in terms of flow control, but are also able to cover more models of work flow, leading to higher flexibility in making difficult decisions.[47]

Providing access to patient information and maintaining the confidentiality and safety of the patient's medical records are new challenges for health management in today's world. Access to medical information for the patient, his relatives, and health authorities (including the physician, nurse, and other medical team members) was provided by the method introduced by Buxey et al,[48] but the safety and confidentiality of records remains a controversial issue.

For a network of recording patient information, providing necessary training for the patient, ensuring treatment process follow-up, and maintaining the safety and confidentiality of patient information, Jacobson presented the inefficiency of the worldwide web, emphasizing the study's results on access control to patient records, careful access control for electronic health records, and the importance of the possibility of training in the network.[49]

6. Conclusion

It seems there is a general agreement on deploying BPM in healthcare organizations as a new method of reforming processes in Iran. However, given that deploying such approach depends on prerequisites based mainly on legal and cultural requirements, budget limitations, and the country's current situation, Iran is still far from localizing the approach that can provide deployment advantages.

Limitations of the Study

Unfortunately, due to their personal concerns and despite repeated follow-ups by the researchers, some managers and professors provided no opportunity for the researchers to visit and interview them.

Authors' Contributions

All authors contributed significantly towards the study.

Conflict of Interest Disclosures
None.

Ethical Approval
In this study, the written consent of all interviewees was obtained, and all participants were thoroughly informed of the study's aims prior to the interviews. To protect the rights of individuals, all information was kept confidential, and no names were provided during the study.

References
1. Rudden J. Making the Case for BPM-A Benefits Checklist. BPTrends. http://www.bptrends.com/publicationfiles/01-07-ART-MakingtheCaseforBPM-BenefitsChecklist-Rudden.pdf. Published 2007.
2. Huser V, Rasmussen LV, Oberg R, Starren JB. Implementation of workflow engine technology to deliver basic clinical decision support functionality. BMC Med Res Method. 2011;11:43. doi:10.1186/1471-2288-11-43.
3. Anyanwu K, Sheth AP, Cardoso J, Miller JA, Kochut KJ. Healthcare enterprise process development and integration.J Res Pract Inf Technol. 2003;35(2):83-98.
4. Kumar A, Shim S, editors. Eliminating emergency department wait by BPR implementation. 2007 IEEE International Conference on Industrial Engineering and Engineering Management. IEEE; 2007.
5. Lenz R, Reichert M. IT support for healthcare processes–premises, challenges, perspectives. Data Knowl Eng. 2007;61(1):39-58.
6. Becker J, Fischer R, Janiesch C. Optimizing US health care processes-A case study in Business process management. AMCIS Proceedings; 2007:504.
7. Chen P. Goal-oriented business process monitoring: an approach based on user requirement notation combined with business intelligence and web services [Thesis]. Canada: Carleton University, Canada; 2007.
8. Müller R, Rogge-Solti A, eds. BPMN for healthcare processes. In: Proceedings of the 3rd Central-European Workshop on Services and their Composition (ZEUS 2011). Karlsruhe, Germany; 2011.
9. Love PE, Holt GD. Construction business performance measurement: the SPM alternative. Bus Process Manag J. 2000;6(5):408-16.
10. Soti P, Pandey S. Business process optimization for RHIOs. J Healthc Inf Manag. 2006;21(1):40-47.
11. Scheer AW. ARIS—From the Vision to Practical Process Control. In: Scheer AW, Abolhassan F, Jost W, et al, eds. Business Process Excellence. Berlin Heidelberg: Springer; 2002:1-13. doi:10.1007/978-3-540-24705-0_1.
12. Hess R. The missing link to success: using a business process management system to automate and manage process improvement. J Healthc Inf Manag. 2008;23(1):27-33.
13. Weber RP. Basic Content Analysis. Sage; 1990.
14. Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. Qual Health Res. 2005;15(9):1277-1288. doi:10.1177/1049732305276687.
15. Wildemuth BM. Applications of social research methods to questions in information and library science. Westport, CT: Libraries Unlimited; 2009.
16. Roberts CW. Other than counting words: a linguistic approach to content analysis. Social Forces. 1989;68(1):147-77.
17. Stone PJ, Dunphy DC, Smith MS. The General Inquirer: A Computer Approach to Content Analysis. Cambridge, MA: MIT Press; 1966.
18. Graneheim UH, Lundman B. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. Nurs Educ Today. 2004;24(2):105-112. doi:10.1016/j.nedt.2003.10.001.
19. Wiener A, Diez T. European Integration Theory. Oxford: Oxford University Press; 2009.
20. Krippendorff K. Content analysis: An Introduction to its Methodology. Thousand Oaks, CA: Sage; 2004.
21. Priest H, Roberts P, Woods L. An overview of three different approaches to the interpretation of qualitative data. Part 1: Theoretical issues. Nurs Res. 2002;10(1):30-42. doi:10.7748/nr2002.10.10.1.30.c5877.
22. Lim ET, Pan SL, Tan CW. Managing user acceptance towards enterprise resource planning (ERP) systems–understanding the dissonance between user expectations and managerial policies. Eur J Inf Syst. 2005;14(2):135-149. doi:10.1057/palgrave.ejis.3000531.
23. Fox J, Dunlop R, editors. Careflow: theory and practice. International Conference on Business Process Management; 2007: Springer.
24. Mulyar N, Pesic M, Van Der Aalst WM, Peleg M, editors. Declarative and procedural approaches for modelling clinical guidelines: addressing flexibility issues. International Conference on Business Process Management; 2007: Springer.
25. El-Hassan O, Fiadeiro JL, Heckel R, editors. Managing socio-technical interactions in healthcare systems. In: International Conference on Business Process Management. Springer; 2007.
26. Peleg M, Soffer P, Ghattas J, editors. Mining process execution and outcomes–Position paper. In: International Conference on Business Process Management. Springer; 2007.
27. Ghattas J, Soffer P, Peleg M. Improving business process decision making based on past experience. Decis Support Syst. 2014;59:93-107. doi:10.1016/j.dss.2013.10.009.
28. Grigori D, Casati F, Castellanos M, Dayal U, Sayal M, Shan MC. Business process intelligence. Computers in Industry. 2004;53(3):321-43.
29. Blobel B. Authorisation and access control for electronic health record systems. Int J Med Inform. 2004;73(3):251-257. doi:10.1016/j.ijmedinf.2003.11.018.
30. Alhaqbani B, Fidge C, eds. Access control requirements for processing electronic health records. In: Business Process Management Workshops. Berlin Heidelberg: Springer; 2007.
31. Mandl KD, Markwell D, MacDonald R, Szolovits P, Kohane IS. Public standards and patients' control: how to keep electronic medical records accessible but private. BMJ. 2001;322:283. doi:10.1136/bmj.322.7281.283.
32. Motta GH, Furuie SS. A contextual role-based access control authorization model for electronic patient record. IEEE Transactions on Information Technology in Biomedicine. 2003;7(3):202-7.
33. Bacon J, Moody K, Yao W. A model of OASIS role-based access control and its support for active security. ACM Transactions on Information and System Security (TISSEC). 2002;5(4):492-540.
34. Hickman GT, Smaltz H, eds. The Healthcare Information Technology Fieldbook: Tactics, Tools, and Templates for Building Your IT Plan. HIMSS Publishing; 2008.
35. Mayring P. Qualitative content analysis–research instrument or mode of interpretation. In: Kiegelmann M, ed. The Role of the Researcher in Qualitative Psychology. Tubingen: Verlag; 2002:139-148.
36. Speziale HS, Carpenter DR. Qualitative Research in Nursing. Philadelphia: Lippincott Williams & Wilkins; 2011.
37. Buisman HJ, Tesanovic A, Udink RT, Inventors. Patient monitoring system. Google Patents; 2012.
38. Brown SJ, Inventor. Multi-user remote health monitoring system. Google Patents; 2015.
39. Say J, Tomasco MF, Heller A, et al, Inventors. Analyte monitoring device and methods of use. Google Patents; 2016.
40. Dadam P, Reichert M, Kuhn K. Clinical workflows—the killer application for process-oriented information systems? In: BIS 2000. London: Springer; 2000:36-59. doi:10.1007/978-1-4471-0761-3_3.
41. Wakamiya S, Yamauchi K. What are the standard functions of electronic clinical pathways? Int J Med Inform. 2009;78(8):543-550. doi:10.1016/j.ijmedinf.2009.03.003.
42. Gooch P, Roudsari A. Computerization of workflows,

guidelines, and care pathways: a review of implementation challenges for process-oriented health information systems. J Am Med Inform Assoc. 2011;18(6):738-748. doi:10.1136/amiajnl-2010-000033.

43. Kirk DM, Gehring NC, Butorac GJ, Inventors. Health support system. Google Patents; 1995.
44. Dessertine AL, Inventor. Patient compliance and status monitoring system. Google Patents; 1991.
45. Kaish N, Inventor. Patient operated system for testing and recording a biological condition of the patient. Google Patents; 1996.

46. Brown SJ, Inventor. Health management process control system. Google Patents; 1999.
47. Mulyar N, Van der Aalst WM, Peleg M. A pattern-based analysis of clinical computer-interpretable guideline modeling languages. J Am Med Inform Assoc. 2007;14(6):781-787. doi:10.1197/jamia.m2389.
48. Buxey FD, Martin NA, Nenov VI, Inventors. Method and system for dispensing communication devices to provide access to patient-related information. Google Patents; 2002.
49. Jacobson DA, Inventor. Method and system for providing medical information. Google Patents; 2002.