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A New Approach for Goal-oriented Analysis of Healthcare Processes

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Abstract

The development of efficient e-services for patient-centered healthcare requires insight into concrete problems in administrative and clinical work processes as well as an understanding of the strategic goals that should guide these healthcare processes. However, considering both concrete process-related problems and high-level strategic goals during process analysis and solution design can be problematic. To address this, we propose a structured approach for analyzing both high- and low-level goals in a healthcare process and relating these to identified problems. Thereby proposed solutions for each problem in form of, e.g. e-services can be connected to strategic goals. The approach consists of five steps; process modeling; process-based problem identification and classification; process goal identification; mapping to strategic goals; and solution proposal. The approach is illustrated by examples from a case study of Swedish stroke care. In conclusion, the approach enables analysis of high- and low-level goals in a healthcare process by relating these to identified problems. The results thereof form a basis for redefinition of current care processes, as well as for design of supporting e-health solutions.

Keywords:

Medical informatics, Systems analysis, Process assessment (Health Care)

Introduction

Healthcare is facing a number of challenges, due to demographic, economic and societal developments. This has brought a movement away from episodic treatment of acute health issues to provision of coordinated services that will provide continuity of care for those with chronic conditions and enhance the health status of defined populations [1-3]. Yet, current care provision processes remain to a large extent organisation focused, which leads to fragmented care and a lack of continuity. This is particularly problematic in the care of patients with chronic, sometimes multiple, conditions who require care from many care provider organisations.

One example of increased focus on a holistic, high-level view, of healthcare processes is the recent interest in *patient-centered* care. The concept is used to describe a shift from organization- to patient-centric provision of healthcare, in order to strengthen the role of patients and family carers [2]. This change poses new challenges for existing healthcare processes; new solutions that create concrete value for patients while meeting general high-level goals set by the healthcare community need to be provided. In order to be able to redesign healthcare to meet the described challenges, new instruments to represent and visualise the complexities of healthcare are required.

The objective of this paper is to describe an approach for analyzing high- and low-level goals in a healthcare process by relating these to identified problems in the process, and to apply this approach in form of a case study.

Related work

The approach presented in this paper combines the use of processes and goals. Generally a process describes a set of linked activities that produce a certain output [4]. In the health care sector the use of processes is crucial to understand problems and improve performance [5]. While we in this paper use processes as a mean to identify process related problems in a health care organization, more detailed process models can also be used for verification purposes [6]. Together with processes we employ the notion of goals to relate high-level strategic goals with the low-level goals needed to be attained in order to solve the identified problems. The way we use goals in this paper is similar to the well-known approach of goal decomposition [7]. However, rather than performing a top-down decomposition, such as in [8] and [9] we relate identified low-level process problems to a fixed set of high-level goals.

Material and Methods

Data for this study is collected: (1) from documents, (2) through focus groups with different stakeholders, (3) through interviews with single experts, and (4) by using the Business Process Modeling Notation (BPMN) [10] for process model-

ing. These methods are iteratively applied during the approach described below, using document analysis, focus groups and BPMN for initial process modeling and applying focus groups and expert interviews in each successive step of the approach for further modeling and verification. The entire approach is then applied in form of a case study using stroke care.

Overview of the proposed approach

The purpose of the approach presented in this paper is to improve healthcare processes by aligning them with well-accepted, high-level goals, starting from concrete problems that exist in the processes and continuing to propose solutions to those problems. The suggested approach consists of five steps:

Step 1 - Process modeling: the healthcare process at hand is modeled (if such a model is not already available). This is done in collaboration between all the stakeholders relevant for the given healthcare process and process modeling experts.

Step 2 - Process-based problem identification and classification: concrete problems in the process are identified by using a *problem classification* based on process aspects. Here, we address four process aspects (functional, behavioral, organizational and informational [11, 12]), but other aspects can be taken into account. For each process activity, every process aspect is considered and related problems are identified.

Step 3 - Process goal identification: all identified process problems are transformed into low-level goals, by rewriting the problem as a desired state that alleviates the problem.

Step 4 - Mapping to strategic goals: after defining a process goal, this low-level goal is mapped against one (or more) strategic, high-level goals. The high-level goals can either be set-up on a process basis, or more likely, a well-established set of goals such as the organization's strategy can be used. In this paper, we apply the major aims for healthcare improvement set up by the Institute of Medicine (http://www.iom.edu/); safety, effectiveness, efficiency, patient-centeredness, timeliness, and equity [13].

Step 5 - Solution proposal: the final step is to propose possible solutions in order to solve the problems and achieve the goals. In this step the problem classification and each problem's related goal can aide in the design of the solution.

In contrary to previous work, we chose these steps because a bottom-up analysis was considered best to relate existing problems to strategic goals. This way we aim to both find suitable solutions for the problems and to elucidate the entire process between the operational and the strategic level.

Application of the approach to Swedish stroke care

In the following sections details of our approach will be further explored by describing how each of the five steps in the proposed approach was performed in the VIPPA (the Swedish acronym stands for visualization of patient-centered process models in healthcare) research project.

Step 1: Process modeling

In the VIPPA project a combination of process-modeling, interviews, and structured problem analysis was used to gather information about the stroke care process and its inherent problems. Modeling of the stroke care process was based on documentation of previous work done in Sweden [14] as well as interviews with key stakeholders. Swedish national guidelines and national performance measures [15] for stroke care was also a valuable source of information. The modeling was done according to the Business Process Modeling Notation (BPMN) [10]. Both process modeling and analysis were done in collaboration between experts on process modeling, stakeholders from healthcare and health informatics researchers. The results were also presented to different stakeholders who had not been actively involved in the modeling process to receive feedback and validation.

An extract from the process model, showing discharge of a patient from hospital care to homecare, including examples of identified problems, is presented in Figure 1.

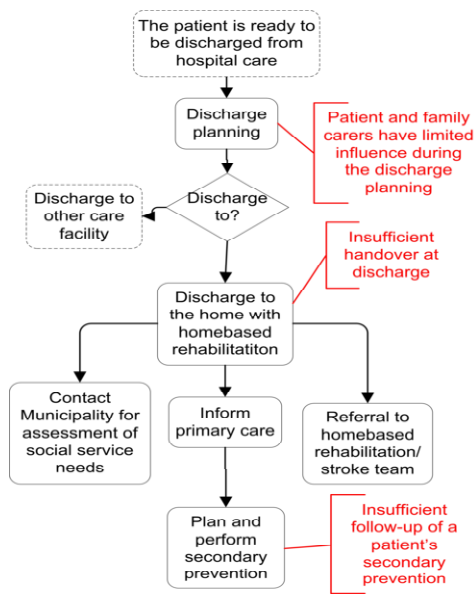

Figure 1 – Extract from the Stroke care process model indicating identified problems

Step 2: Process-based problem identification and classification

The process modeling revealed a number of problems in the stroke process. To structure, document and analyze the problems they were classified into four problem classes. Each problem class conforms to a specific process aspect, as presented by Jablonski [11] and Raush-Scott [12]:

Information: problems related to availability of process information. It is for instance problematic if the hospital doing the

acute treatment does not pass on information to the primary care and the patient's municipality.

Functions/Activity: Problems related to the outcome and execution of process activities; for instance limited follow-up activities regarding secondary prevention is considered a functional problem.

Behavior/Time: These problems refer to the timing, ordering and selection of activities; for instance, in the stroke process it is important that the time between the first symptoms (the first activity) and diagnosis is less than three hours in order for certain effective treatments, such as thrombolysis ("clot busting"), to be possible.

Organization: Problems referring to the actors that participate in the process and their available resources, such as skilled nurses and physicians, and equipment. It is for example considered as an organizational problem that patients and family carers have limited influence on discharge planning.

Each elicited problem in the process was assigned to one of the above described problem classes. When an initial problem was difficult to classify it was further decomposed into more concrete problems by the use of the four problem classes.

Figure 2 illustrates how the problem "Insufficient handover at discharge" is broken down into three more concrete problems in this manner.

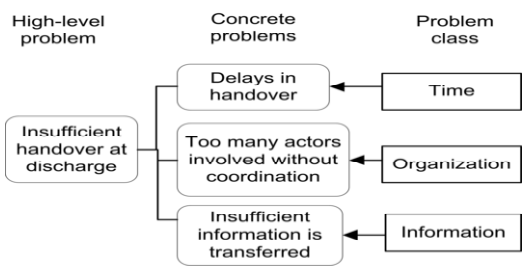

Figure 2 – Problem break-down and classification

Step 3: Process goal identification

Once the problems identified in step two are addressed the health care process under study can be improved. However, in addition to addressing classified process problems it is of interest to examine how a solution of the problems contributes to high-level goals, such as increased patient safety.

In order to relate the problems to high-level goals we transform each problem into a low-level goal by rewriting the problem as a desired state that alleviates the problem. Since each problem is related to a problem class (information, behavior/time, functions/activity, organization) we can express the desired state in terms of the desired condition for that class. For example the information related problem "Delays in handover from hospital care to other care providers" (figure 1), can be expressed as a desired state of the *behavior/timing* of the process, "Reduce delays in handover from hospital care to other care providers".

In Table 1, we provide a number of low-level goals defined based on the problems illustrated in Figures 1 and 2.

Table 1 – Classified problems related to lw-level and high-level goals

Problem class	Problem (concrete)	Low-level goal	High-level goal
Behavior/Time	Delays in handover from hospital care to other care providers	Reduce delays in handover from hospital care to other care providers	Timely care (continuity of care)
Organization	Too many actors involved in the care of a patient without coordination	Appoint a coordinator that is responsible for the overall care process	Patient-centered care
Information	Insufficient information is transferred from hospital care to other care providers	Improve the quality of the information being transferred	Safe care
Functions/Activity	Insufficient follow-up of a patient's secondary prevention	Create routines for continuous follow-up of stroke patients	Effective care
Organization	Patients and family carers have limited influence during the discharge planning	Invite patients and family carers to take a more active part in the discharge planning	Patient-centered care

Step 4: Mapping of low-level goals to strategic, high-level goals

After defining a low-level goal, the goal needs to be mapped to one of the high-level goals. In doing so, the goals of the process become justified from a strategic perspective. The approach presented here can be applied when using any high-level goal framework; it is up to the healthcare management to set up overall high-level goals. In order to illustrate our approach, we apply a framework of six goals proposed by the Institute of Medicine [13]. These goals state that healthcare should be

1. *Safe* - avoiding injuries to patients from the care that is intended to help them,
2. *Effective* - providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and overuse, respectively),

3. *Patient-centered* - providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decision,
4. *Timely* - reducing waits and sometimes harmful delays for both those who receive and those who give care,
5. *Efficient* - avoiding waste, including waste of equipment, supplies, ideas, and energy, and
6. *Equitable* - providing care that does not vary in quality due to personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.

In order to map an elicited low-level goal to a high-level goal it is examined *why* a certain low-level goal should be fulfilled. For example, why is it important to "Improve the quality of information transferred"? Is it (primarily) because safety will be improved (the first high-level goal), or is it because of effectiveness reasons (the second high-level goal)? In this case we indicated that improved information quality is primarily motivated by the desire to improve patient safety (Table 1).

Step 5: Solution proposal

Proposing solutions is a creative process, involving initial brain storming techniques to propose alternative solutions to each problem. Often a few solutions appear obvious, such as directly fulfilling each individual low-level goal. However, it is important to take this process further by considering how different solutions could contribute to several high and low-level goals.

As an example, Figure 3 depicts how a solution in form of an e-service for discharge care planning is suggested as a potential solution to achieve the different low-level goals. The solution analysis can be detailed to different levels, either remaining on high level suggestions, or being further detailed into different models depending on the type of problem analyzed. Further analysis of an informational problem may e.g. result in e-service specifications including information models.

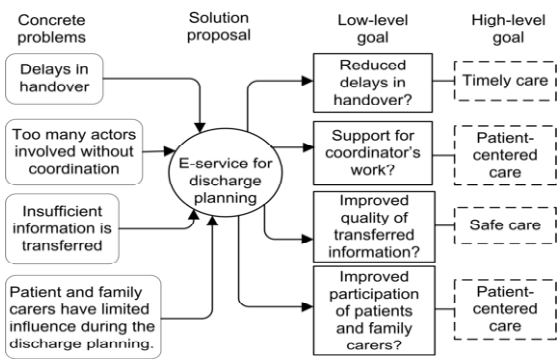

Figure 3 – Solution proposal

Results

We consider the application of this five step approach as useful for analyzing complex processes in multi-actor environments and specifically for elucidating the entire process between the operational, tactical and strategic level.

More specifically, we found the following advantages. Although some problems were previously known, others were first discovered and made explicit during the process modeling and analysis. Use of the process aspects was very useful to classify the problems and also when concretizing the problems further. As the low-level goals are defined based on the classified problems, they are process-related and concrete enough to be defined in a measurable form, In turn, high-level goals are difficult to measure but as they are connected to low-level goals, their impact on specific problems can be shown and it is possible to evaluate the impact on a strategic level. The mapping from low-level goals into high-level goals is not always a straight-forward process. However, the mapping is made simpler if the high-level goals are well defined, or even broken down into sub-goals. Likewise, the mapping is made easier if the low-level goals are not too wide; in the approach presented here this is ensured by using the four process aspect framework to break down the problems. In addition, the defined low-level goals will be further useful when evaluating the impact of the e-service. Considering several different concrete problems, low-level and high-level goals can improve the design of the e-service such that it gets the ability to tackle several problems in the complex care process. Moreover, during the detailed solution design, design decisions can be made and, sometimes more importantly, motivated based on the desire to reach the high-level goals associated with the solution.

Discussion and future work

Implementation of health information systems (HIS) will only be successful if decision-making processes at strategic, tactical and operational levels can be matched [16]. This is especially true for HIS that should support patient-centered care as they usually need to support both multiple actors and multiple organizations. The approach presented in this paper is a first step towards matching different levels by connecting problems in existing processes with high- and low-level goals as well as supporting e-services.

In the VIPPA-project, the entire stroke care process was modeled; from primary prevention, acute and continued hospital care, rehabilitation, discharge to primary care/homecare and finally secondary prevention activities. A holistic view of the process enabled us to identify problems relating to for example continuity of care and patient-centeredness that could otherwise have been overseen. The process involves a large number of different stakeholders, and we also aimed at analyzing the process from their different perspectives in order to capture all potential problems and their respective goals.

The goals described here need to be broken down further and be related to each other in order to evaluate potentially conflicting goals. Similarly, problems and possible solutions need

to be fine-grained and mapped to each other. In addition, their impact on the redesign of existing processes has to be analyzed. In order to be able to better understand all these relationships, we aim for visualizing selected scenarios out of the whole process. As a next step we will visualize a scenario as is in current care processes, then discuss possible sub-solutions for each identified problem, relate these to identified goals and visualize how implementation of these solutions would meet these goals and change current care processes.

Conclusion

In this paper, focus was on analyzing problems in existing healthcare processes, in order to solve them in alignment with strategic goals, as established in a certain healthcare community. Using a process modeling approach, we classified problems into four categories: behavioral/time, functional/activity, informational and organizational. This approach is used to aid domain experts when identifying problems in current processes. Once identified and classified problems are transformed to process-related goals, which aim to improve the functional, organizational aspects of processes. Those process goals are further examined for a relation with a set of well-established, high-level goals to justify requests for their realizations. A way to realize the goals implies the design of adequate solutions, for example in the form of e-services.

In conclusion, the approach presented in this paper enables analysis of high- and low-level goals in a healthcare process by relating these to identified problems in the process. The results thereof can be used as a basis for decision making and redefinition of current care processes, as well as for design of e-health solutions to support the re-designed processes.

Acknowledgments

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