DEVELOPMENT AND EVALUATION OF A MONITORING SYSTEM TO ASSESS THE QUALITY OF HOSPITAL INFORMATION SYSTEMS

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Abstract

Hospital information systems (HIS) are an important quality and cost factor in health care. Monitoring of HIS quality is an important task for information management; however, this task is often seen to be insufficiently supported by available methods and tools. The aim of this research project is to develop a comprehensive monitoring system to assess the quality of hospital information systems, taking into account both computer-based and paper-based information processing. The structure of this monitoring system consists of a matrix, crossing HIS quality criteria on one axis (e.g. accessibility of information, or correctness and completeness of information) with a list of process steps within patient care on the other axis (e.g. patient admission, order entry, or clinical documentation).

Each of the fields in this matrix, being defined by one quality criterion and one process step, contains detailed questions, which access the HIS quality with regard to the given criterion in a given process step. The ongoing international evaluation considers completeness, reliability, validity, and feasibility of this HIS quality monitoring system.

Introduction

Hospital Information Systems (HIS) can be understood as the complete information processing and information storing subsystem of a hospital, this definition comprising both computer-based and conventional information processing tools (Haux, Winter, Ammenwerth, & Brigl, 2004). HIS are becoming an important quality and cost factor for health care. Insufficient designed information systems can have negative effects on efficiency and quality of patient care (Rigby, Forsström, Roberts, & Wyatt, 2001). On the other side, good information systems can support clinical workflow in various ways and thus contribute to a better patient care.

Planning, directing and controlling of information systems are the tasks of the information management in a hospital (Winter et al., 2001). The goal of information management is systematic information processing that contributes to the hospital's strategic goals (such as efficient patient care and high satisfaction of patients and staff). Information management therefore directly contributes to the hospital's success and ability to compete. The general tasks of information management are planning, directing, and monitoring. In other words, this means

- planning the hospital information system and its architecture,
- directing its establishment and its operation, and
- monitoring its development and operation with respect to the planned objectives.

Information management encompasses the management of all components of a hospital information system – the management of information, of application components, and of physical data processing components (Haux et al., 2004).

While planning and directing of information systems are well understood and supported (e.g. (Winter et al., 2001), (Gartner Group, 1998)), monitoring of information systems is often insufficiently supported. In most hospitals, regular HIS monitoring activities with quantified assessment of HIS quality are missing both on the strategic and tactical level. One reason could be that standardized methods and tools for monitoring are missing. For example, hospital quality programmes such as JCAHO (JCAHO, 2002) or KTQ (Deutsche Krankenhausgesellschaft, 2002) only comprise very few aspects of HIS quality. Other approaches such as software ergonomic standards (e.g. (ISO, 1993)) concentrate only on computer-based tools and ignore the significance of paper-based tools in a hospital. Projects

such as (Ammenwerth, Buchauer, & Haux, 2002) describe HIS functionality in a rather comprehensive form, but do not support the evaluation of quality, and do also not consider the effects of HIS on working processes.

Aim of research project

The aim of this research project is to develop and validate a comprehensive monitoring system to assess the quality of a hospital information system in a quantitative form, taking into account both computer-based and paper-based information processing.

Material and Methods

First, we discussed the requirements of information management with regard to a monitoring system in workshops with representatives of information management (e.g. CIO of a large hospital). Also, we analysed literature from various fields such as medical informatics, industrial informatics, information theory, quality management and organizational science. Based on those analyses, we created the following concept:

An important aim of a hospital information system is the optimal support of clinical working processes. The monitoring system must thus be able to evaluate in a quantitative form, whether the HIS fulfils those aims (benefit-oriented approach). This also means that structural aspects of HIS (e.g. how many computers are used, what is the bandwidth of the network) are not criteria for the outcome quality of HIS - but they can indeed indicate reasons for bad information processing.

Benefit-oriented quality criteria must be able to assess how good information processing in clinical situation is. This means that, e.g., availability and correctness of information are important quality criteria for a HIS, or the time effort needed for documentation activities in certain situations (such as ward rounds). When all information processing tools collaborate in an optimal way, clinical working processes should best be supported. This means the monitoring system must be able to cover both computer-based and paper-based tools.

The users of HIS are the distinct experts for its evaluation. They can tell how good they are supported by the various information processing tools in the daily working activities. HIS assessment must thus being done based on comprehensive, standardized questioning of the users.

Based on those assumptions, we developed a matrix-oriented structure for our monitoring systems (figure 1), combing two axis: quality criteria and process step.

(Figure 1 about here)

The **x-axis**, comprising the overall quality criteria, is ordered as follows:

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A1 Accessibility and availability of information;

A2 Correctness and completeness of information;

A3 Readability and clarity of information;

A4 Usability of information;

A5 Fulfilment of legal regulations;

A6 Effort for information processing.

The **y-axis**, comprising the process steps, is oriented on the main steps of patient care:

P1 Patient admission;

P2 Decision-making, treatment planning and organization;

P3 Order entry and results reporting;

P4 Execution and documentation of diagnostic and therapeutic tasks;

P5 Patient discharge.

The various fields of the matrix contain one or more questions which assess HIS quality with regard to a general quality criterion (x-axis) and with regard to a certain process step (y-axis) within patient care. For example, in the field A1 x P3, one question to assess the quality of information processing could be: "How easily can you obtain an overview on new findings during a ward round?"

The questions within the matrix will be answered by a number of users in various roles (e.g. nurse, physician, and administrative staff). The standardization of answers (on a scale from 1 – 5) will allow aggregation of answers in the sense of a HIS quality score or HIS benchmarking.

Results

Based on the described matrix structure, a pool of questions on HIS quality has been developed which comprises in its first version about 100 concrete questions. In parallel, a computer-based tool is just being developed which helps to manage the questions, to carry out the questioning, to document the answers, and to present the aggregated HIS quality results. This is the precondition for the validation of the monitoring systems.

The monitoring system is then being validated in the following step-wise procedure:

1. Completeness of the questions: By interviewing representatives from information management (e.g. CIOs) and from various user groups it will be checked whether certain important aspects have been missed (e.g. certain important situations), leading to additional questions.

2. Comprehensibility of the questions: By conducting test interviews with various users, the comprehensibility and clarity of the questions and of the provided answers will be checked.

3. Reliability of questions: By repeating interviews with representatives from the same user groups, it will be checked how reproducible the results are, that means whether the monitoing systems is able to measure HIS quality in a stable way.

4. Validity of results: By comparing the His quality results with external factors (e.g. overall user satisfaction with HIS, IT budget, etc.), it will be checked whether the monitoring system does in fact measure HIS quality (and not something different).

5. Feasibility of the monitoring system: The monitoring system will be used in various settings (e.g. smaller and larger hospitals) to check the time needed for a complete quality assessment and the feasibility of the chosen approach.

6. Usefulness of the monitoring system: By focus group interviews with CIOs and hospital managers, it will be checked whether the HIS quality score which derive from the application of the monitoring system is of use for the information and hospital management, whether it e.g. can indicate strength and weaknesses of the own HIS.

Discussion

The results of the monitoring system should help to assess "wellness" or "illness" of a hospital, thus helping information management to better plan and direct the own HIS. It is meant as a kind of screening instrument. It will not show in detail the reasons for a good or bad information processing, but indicate in a quantifiable and reliable way whether information logistics is good or bad. For example, is may show that the users judge the availability of information as rather bad in many process steps in patient care. This should then motivate information management to check what the reasons could be, e.g. unavailability of the paper-based patient record, or unreliable software products.

The aggregated quality scores should help to find weaknesses in the own HIS, to describe long-term developments of the HIS quality (e.g. as part of an IT strategy), to compare own HIS with other HIS, and to compare quality of information logistics in one department with other department. In any case, the monitoring system will only be of help when it shows to be a reliable, valid and feasible measurement instrument for the quality of a hospital information system.

Whether this is the case will be shown in the comprehensive pre-test which are planned for Summer 2004 and which will be conducted in different hospitals in various countries. Those pre-test will also answer some of the open questions, namely:

- How many questions are necessary to cover the most important aspects of HIS quality?
- What is the best way to find users to be questioned (representative sample versus expert users)?
- How many users from which user groups have to be questioned to get reliable results?
- Is it necessary to conduct individual interviews with the users, or it is sufficient to conduct a written survey?

The monitoring system has been developed to support information management in the important task of HIS monitoring, helping to higher-quality HIS and therefore to a better support of patient care.

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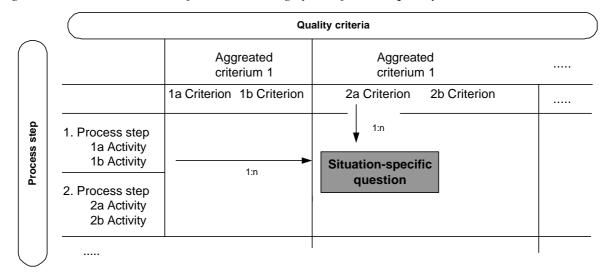
Figures

Figure 1: General structure of the monitoring system for HIS quality.

Process step	Quality criteria			
	Aggreated criterium 1		Aggreated criterium 1	.....
	1a Criterion	1b Criterion	2a Criterion	2b Criterion	.....
1. Process step 1a Activity 1b Activity			→ 1:n Situation-specific question	
2. Process step 2a Activity 2b Activity	1:n			
.....				