Proposal of an information system to support risk management – the case of the Portuguese hospital center CHTMAD

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Abstract

Health care institutions need to implement rigorous clinical management systems. In this context, risk management has an important role aiming to minimize the likelihood of adverse events, thus contributing to improve the quality of provided health care. As the number and complexity of issues that must be addressed in hospitals is quite high and is increasing, it is essential the use of information systems to gather and monitor the hospital data. This paper proposes a new system to support the management of risk indicators, presenting the case of CHTMAD, a Portuguese hospital center.

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1. Introduction

The concept of clinical risk is recent and it is defined as an event that has a negative effect, direct or indirect, on the quality of health care, and may threaten the safety of patients, cause high operational costs or

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affect the image of the involved institution. Clinical risks may be related to the provision of care (acts, materials and products, ethical and information risks), to the hospital’s structure (fire occurrence, electricity failures, computer failures, lack of water) or to the organization of the institution (loss of human resources, lack of protocols, nonconformities, patient transport, accidents, strikes and frauds) [1].

The risks faced by patients in health care are several and come from many factors as, for instance, the occurrence of medical errors. Recent biomedical and technological advances have contributed to the decrease of these errors, enabling to implement accurate clinical management which gives a better quality in the provision of health care, a more efficient use of resources, the effective promotion of safety of professionals and users, the identification of systemic failures, and development of the ability to learn with the mistakes [2].

In this article it is proposed a new information system to support risk management in the Portuguese hospital center CHTMAD. The article starts with a brief introduction about the concept of risk management, discussing the importance of information systems; then it is described how risk management takes place in CHTMAD; next is presented a system prototype to support the management of risk indicators. The paper ends with some final remarks and future work.

2. Context

Clinical risk management main objectives are the following [3]: the development and implementation of processes to identify and prioritize risks in a way that they can be reduced or eliminated; protection of the hospital, patients and professionals; reduction of adverse effects which can represent significant costs and damage to the image and credibility of the hospital; and the development of indicators to measure and improve the health care services quality provided by the hospital.

The improvement in the quality of care can be done through [3]: a commitment to active participation of all professionals; the creation, development and implementation of mechanisms to allow formal evaluation of strategies, plans, processes and incidents occurred; the development of preventive maintenance plans of facilities, materials and equipment; the development and improvement of the working systems with the objective to reduce the likelihood of human error; and, finally, the development of skills to deal with emergency situations.

The general public is becoming more aware of the role that quality plays in health care. Nevertheless the definition of quality has not changed recently, the public and the industry’s awareness about it certainly has. In this context, quality consists on the degree to which health services increase the likelihood of desired health outcomes, consistently with current professional knowledge, to meet the expectations of health care consumers.

Patient safety failures have had a profound impact on the evolution of the public’s awareness on quality of care. Patient safety plays an important role in quality performance, but it is important to note that quality and safety are not the same things. Patient safety is a subset of the larger, much more complex and multidimensional, concept of quality. Highly publicized patient care failures, were the catalysts that prompted a national evaluation of the patient safety issues that concerned health care [4].

Implementing a clinical risk management system is not easy. Many times, during clinical risk management systems implementation, the number of professionals remains the same or even decreases. The new systems must follow rules, regulations, practical guides and safety recommendations, leading to the need of the improvement of professionals’ knowledge and skills, new software applications, and to the development of new approaches to risk management. Thus, it requires new information systems to allow processing more data from multiple sources and making meaningful reports on time. Avoiding adopt new systems can reduce considerably the value that risk management brings to the organization [5].
The information systems enable to gather and consolidate information, to analyze data and to report results, being the improvement of the quality of products and services an important motivation for its adoption [10].

Whenever data is registered, the corresponding information should be immediately available for the managers and directors of the organization. It is also essential to grant that only authorized personnel can access the information [5].

In the list of elements that can be reported we can find [6]: losses or accidents by department or service and date of occurrence; costs; current status of complaints; frequency of accidents by work type or location; number and types of injury to workers and patients; medical teams involved in the occurrence, names and contact details of witnesses and lawyers, and actions taken. Can also be reported the classification of accidents by severity and the immediate consequence of it.

In practice, the review by automated means has proved to be more accurate, systematic and efficient than manual records, eliminating human error caused by fatigue, distraction, difficulty in reading handwriting of the professionals and missing data. Information systems have the power to enable quick access to archived information and to enable to analyze data in a few seconds otherwise can take weeks or even months to be reviewed by non-automated means, being this way essential for good management. Paper reports can take months or even years to be placed in the system. In contrast, online reports facilitate immediate action, research and daily review, enabling to define who can view, print, insert or update data, offering also better control of the data flow, preventing others from deleting, changing or losing any reports [7].

In the field, to better decide, professionals have to access the right information at the right time, requiring tools to help them to identify problems in a timely manner. Frequently these problems are unidentifiable without information systems that support risk management. Risk management professionals must decide who should be entitled to receive information, how it will be used and how often will be available. May also decide which data sources will be used and how information is better presented (v.g. in graphic form or text). They should also evaluate which factors should be tracked and analyzed.

3. Method

This project started with a literature review on "management of clinical and non-clinical risk for production of quality indicators". After a deeper understanding of the state-of-art and current trends, the next step was the gathering and organization of the informational requirements of a hospital center concerning risk indicators. These indicators were then grouped into three categories: Clinical Indicators, Non-clinical Indicators (which includes the group of management indicators) and Benchmarking Indicators. Each one of the categories of indicators has several subdivisions. In order to specify the new system to be developed were created use-case diagrams. Use-cases diagrams describe the services that the actors of a system need. It aims to show what the system should do and describes the relationship between actors and use-cases.

Figure 1 shows the main packages of the identified services. Each package contains a set of use-cases that should be implemented in the new information system. Tables of risk indicators were also created with detailed information, including the risk identification, name, the way it is calculated, the data source, authentication required, involved users, data format, format presentation, observations, periodicity of data record, etc. Table 1 presents an example of a risk indicator detail.

A case study was conducted in the Hospital Center of Trás-os-Montes and Alto Douro, EPE (CHTMAD) which is the reference health entity of the Portuguese Trás-os-Montes region. This hospital center consists in four hospitals units and one continuing care unit. The hospital units are in Vila Real (head office), Chaves, Lamego and Peso da Régua and the Continuing Care Convalescent and Palliative Care unit in Vila Pouca de Aguiar.
The various purposes/missions of this Hospital Center are:

- Provide health care services with quality and efficiency in liaison with other health and social services of the community, focusing on motivation and satisfaction of its professionals with a level of quality, effectiveness and efficiency;
- It is also part of its mission to post-graduate teaching and development of training functions deemed necessary by the development of CHTMAD professionals;
- Research and scientific development in all areas of science.

![Diagram of new information system to support risk management]

**Fig. 1. Main packages of the new information system to support risk management**

**Table 1. Detail of indicator QPS.3.1.2**

<table>
<thead>
<tr>
<th>Identifier</th>
<th>QPS.3.1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Number of non-conformities in the time delay from screening until the medical evaluation</td>
</tr>
<tr>
<td>Calculation</td>
<td>Difference between the evaluation time and the medical screening time</td>
</tr>
<tr>
<td>System data source</td>
<td>SONHO/Alert</td>
</tr>
<tr>
<td>Responsibility of data</td>
<td>Informatics Center</td>
</tr>
<tr>
<td>Data collection</td>
<td>Data Warehouse</td>
</tr>
<tr>
<td>Format presentation</td>
<td>Number with thousands separator (,)</td>
</tr>
<tr>
<td>Periodicity of registration</td>
<td>Daily</td>
</tr>
<tr>
<td>Periodicity</td>
<td>Monthly</td>
</tr>
</tbody>
</table>

This hospital center offers nowadays a large set of services to the community, but it has started with the services of general medicine, surgery, pediatrics and gynecology, expanding it later, from 1980 until 1991, to: cardiology, anesthesiology, internal medicine, urology, dialysis, gastroenterology, orthopedics, clinical pathology, otolaryngology, dermatology, physiatry, ophthalmology, intensive care, neurology, pathology and
finally pulmonology. Therefore, it is possible to find a fairly diverse medical and surgical services and support.

To collect the requirements were conducted interviews on CHTMAD, with the participation of the heads of several departments of the hospital: Informatics Center; Quality Office; Information Management Office; Equipment Maintenance Service and the Department of Hygiene and Safety at Work. The interviews enabled to gather and validate the data about the indicators and the system risk management. It is important to note that many of the indicators that are analyzed by CHTMAD are aligned with the guidelines of the accreditation process defined in the manual of the International Joint Commission. Finally it was created system prototype.

4. Quality and risk indicators

Quality and risk indicators allow to organizations the self-assessment, by identifying gaps and opportunities for improvement in several areas, being fundamental for accreditation and certification processes. In addition allow the comparison with other institutions in order to obtain references. However, the data collection about risk and quality is not aimed only at developing projects for accreditation and certification. The monitoring of specific indicators are also required by tutelage (v.g. ARS (Administração Regional de Saúde), DGS (Direcção Geral de Saúde), ACSS (Administração Central dos Sistemas de Saúde)).

Involved in the processes of accreditation, licensing and certification of hospitals are two main types of organisms: agents that require health care organizations to operate and obtain the license (for instance, the Department of Health and Human Services and State Department of Health); and entities that evaluate and improve the quality of treatment at the request of organizations to make accreditation (for instance, the Joint Commission and National Committee for Quality Assurance).

The accreditation plan by Joint Commission International (JCI), founded in 1951, provides assessment, consultation and accreditation standards to long-term care units, ambulatory health care organizations, home care agencies, hospices, hospitals and organizations that offer mental health treatment. This process involves several steps: training, initial diagnosis, assessment of progress; simulated auditory and final auditory.

CHTMAD undertook an accreditation project, to improve health care users, satisfaction and to reduce risk [8]. The process began in October 2005, in the hospital units of Vila Real and Peso da Régua, and in March 2007, the administration board decided to extend it to Chaves Hospital and the newly built hospital unit (Lamego). This decision brought some problems since the last two hospitals to join CHTMAD hospitals had different organizational cultures and are about 160 kilometers apart.

The quality indicators are quality regulatory instruments and service that meet established and reviewed regular standards. They are defined as measures of health care quality that make use of readily available hospital inpatient administrative data, and concern to several organization components, including structure and processes.

In the specific case of hospitals, these indicators can be classified in four major groups: clinical indicators, non-clinical indicators, management indicators and benchmarking indicators.

The group of clinical indicators contains the following indicators: evaluation of the sick; safety and quality of the control programs of the laboratory; safety and quality of the control programs of imagiology; surgical procedures; use of antibiotics and other medication; use of sedation and anesthesia; use of blood; accessibility content; and use of clinical processes and clinical research.

The group of non-clinical indicators includes the following indicators: security plan of premises, persons and property; temperature monitoring; medical equipment monitoring; waste management plan; hazardous materials; and supply, inspection, maintenance and monitoring of supply networks.

The group of management indicators has the following indicators: acquisition of normally required supplies and essential medicines to meet patient needs; communication activities as required by law or
regulation; risk management; use management; expectations and satisfaction of the patient and family; expectations and satisfaction of the professionals; demographic data and diagnoses of the patient, financial management; monitoring, control and prevention of adverse events to the safety of patients, family and professionals; and nosocomial infection risk reduction.

In the group of benchmarking indicators we have the following indicators: production indicators; quality and efficiency indicators; performance indicators; financial indicators; and clinical safety indicators.

5. Proposal of a risk management information system

Most of the hospital information, reports and indicators, can be found on the current CHTMAD information systems. The main existing systems are SONHO (Sistema Integrado de Informação Hospitalar)/SAM (Sistema de Apoio Médico)/SAPE (Sistema de Apoio às Práticas de Enfermagem) which use the same data and share the data model and the record structures, LIS (Lab Information System), PACS (Picture Archiving and Communication System), RIS (Radiology Information System). There is also a datawarehouse which was created with the objective of some data consolidation.

The information in these systems is stored in different formats and structures. So to produce risk indicators it is necessary to consolidate data from several sources and formats. Inclusively, some data is on paper support. With this project it is intended to create an information system for clinical and non-clinical risk management.

Through the scheme presented in figure 2 it can be seen the various interactions that occur between the information subsystems.

![Information system generic technological architecture](image)

Based on the identified system requirements, it was created a non-functional prototype. Figure 3 shows some screenshots of the information system prototype, to allow the identification and monitoring of risks management.

The system has a homepage with links to the pages to the main types of indicators: clinical, non-clinical, management, and benchmarking. In the homepage we find an information icon that takes the user to a page which explains the purposes of the system and how to introduce data, consult information or access the reports.
In each page of the indicator groups, the user finds a list of indicators related to that indicator type, which takes him to the detailed information of that indicator.

Fig. 3. Screenshots of the system prototype

6. Conclusions

The creation of an information system to support risk management in a hospital is essential for its proper functioning, as it ensures a good record, organization and easy access to data. Also allows the implementation of benchmarking processes, which can be defined as "the process of identifying, learning, and adaptation of practices and processes of any organization, anywhere in the world to help the organization improve its performance" [7]. It is a useful management tool to improve business performance and gain advantages over the competition, being a systematic structured step by step in order to evaluate the methods of work [9]. Its main advantages are [5]: to introduce new concepts of evaluation, setting viable and realistic goals, with the identification of areas for improvement; create planning priorities, improving the knowledge of the organization; and promote knowledge of the competitors and the level of competition in the market, being a method of learning and comparison with the best.
In this paper was proposed a new information system to support the risk management in CHTMAD. Until now, the new system was specified using UML (Unified Modeling Language) diagrams and a prototype was created. In the next few months this system will be implemented and it is expect to have a strong impact on the hospitals’ capability to plan and control risks.

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