Research of Hospital Knowledge Management Based on Case-Based Reasoning Technology

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Keywords: Health Care, Knowledge Management (KM), Case-Based Reasoning (CBR).

Abstract. Knowledge Management (KM) aims to form core competence of the organization, bring actual interests for the organization. To remain invincible, hospital must improve its competitiveness and enhance its medical technology and service level. That is to strengthen hospital’s knowledge management. Realization of KM can’t leave the support from related technologies. This article gives detailed descriptions on Case-Based Reasoning (CBR) technology, analyze on its realization of knowledge management in health care and clarify the knowledge management process based on CBR by some examples.

Introduction
With the coming of knowledge economy, knowledge has become key resource to support the development of hospital. Operation process in hospital is to make knowledge and technology contribute its maximum effectiveness. As the first production factor, knowledge can create infinite value for hospital. At present, knowledge management (KM) has entered into a new development stage of theory and practice, whose core has transferred to combination with information technology and business process. Implementation technology of KM has been seen as an integral part of nature, which should be in favor of knowledge conversion and sharing. Case-Based Reasoning (CBR) is this kind of technology. CBR is a rapid and effective inference method in the field of artificial intelligence, which has been successfully applied in many fields, such as general problem solving, judicial judgment, medical diagnosis and so on[1]. This article will combine KM of hospital and CBR technology and then apply these in hospital’s daily decision-making, in order to improve its knowledge management level, accelerate staffs zeal to participate in knowledge management, and increase transformation efficiency from knowledge to specific business ability.

CBR Technology And KM In Hospitals
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**Basic Principle of CBR**

Under the inspiration and support by cognitive science theory, Roger Shank, who ever worked in Yale University, firstly put forward cognitive model and framework of CBR theory in 1982 in the book named Dynamic Memory. After that, Kolodner and her students worked out CBR system named CTRUS. So CBR began its research and application in the field of artificial intelligence.

Case-based reasoning (CBR), broadly construed, is the process of solving new problems based on the solutions of similar past problems. CBR is a rapid and effective inference method in the field of artificial intelligence, a kind of cognitive similarity reasoning simulation, with basic assumption that a similar situation cause similar results and has a similar solution. CBR system can find solution through retrieve similar one from memory cases.

CBR system has been formalized for purposes of computer reasoning as a four-step process [2]:

- **Retrieve:** Given several features of a new problem as query term, retrieve from memory cases relevant to solving it. A case consists of a problem, its solution, and, typically, annotations about how the solution was derived.
- **Reuse:** Map the solution from the previous case to the target problem. This may involve adapting the solution as needed to fit the new situation.
- **Revise:** Having mapped the previous solution to the target situation, test the new solution in the real world (or a simulation) and, if necessary, revise.
- **Retain:** After the solution has been successfully adapted to the target problem, store the resulting experience as a new case in memory. Analysis on the target problem, and then store and update case base.

![Flowchart of CBR System](image)

CBR method can reduce difficulty to obtain knowledge, which directly uses some segments and make exact and abstract knowledge not needed. More importantly, CBR system has its inherent feature to reflect dynamic process of system operation and maintenance. CBR adopts incremental learning method—new solution and new case are stored for future use—learning...
ability has been continuously improved and then knowledge and experience has been increased.

**KM in Health Care**

Hospital is a knowledge incentive institution. Hospital knowledge is a dynamic composition of experience, value, relevant knowledge and insight, whose framework can continuously assess and absorb new experience and information. Hospital knowledge includes not only systematic rule, concepts, and experience obtained through related information reasoning and validation, but also mass of data and information which are existing in daily medical treatment activity and not systematic [3].

According to the report of The Knowledge-Based Economy by Organization for Economic Co-operation and Development (OECD), knowledge is defined in a way of 4W.
- Know what, refers to knowledge about facts
- Know why, refers to scientific knowledge of the principles and laws to nature.
- Know how, refers to skills or the capability to do something.
- Know who involves information about who knows what and who knows how to do what.

The first two are explicit knowledge, which can be easily obtain from hospital books, magazines, text medical records, electronic database and etc. all kinds of documents and hospital records, as well as doctors’ dissertation and some winning subjects. The rest two are tacit knowledge, which is deeper, difficult to express and record, not easy access and transmission. Tacit knowledge is a result of long time creation and accumulation, which is not easy to share, measure its vale, be realized and be understood. Tacit knowledge is invisible and not codified attached to the brain, working procedures or a situation, such as medical workers’ clinical experience, diagnosis and treatment ability and skills, medical ethics, department team spirit and so on.

KM in health care is to set up a complete set of mechanism about knowledge creation, contribution and sharing and then make application level of hospital knowledge get fundamental change through a process of knowledge collection, classification, application. Management of hospital explicit knowledge embodied management on medical knowledge; Management of hospital tacit knowledge embodied management on medical workers. Management on changes between hospital explicit and tacit knowledge embodied the setup of hospital culture environment and management system.

For hospital, the most valued knowledge is tacit knowledge existing in personal or organization. But this kind of knowledge is easy to be lost or forgotten, due to lack of a set of effective management system and conservative and confidential psychology in clinical workers. With the rapid development of medical technology, experience-based medicine can’t meet the need of modern medical treatment, which has been more rely on evidence-based medicine. Good responsiveness and flexibility in hospital knowledge management system to adapt to above change. Knowledge management in health care should make full use of modern information technology, set up suitable organization model and incentive system, stimulate people’s learning potential, develop knowledge resources and make good use of tacit knowledge, finally to enhance hospital’s competitiveness and performance.
**Internal Consistency Between CBR Technology and KM in Health Care**

Medical process is based on the knowledge and information reasoning of intelligent decision-making process, which provides possibility for wide use CBR technology. Besides, CBR technology has its own characters, which are well suitable for the realization of KM in health care. CBR is a kind of reasonable describe and a basic method during the period of solving realistic problems. Its combination of narrative ability and knowledge classification in computer supplies a basic technical guarantee for the realization of KM system and widened application of case-based reasoning.

In CBR, case is a unit of knowledge and a section of relative complete segment. A complete case at least includes two parts: first is the cause of the event, the background can be used if reasons are no clear; second is the result, that solution or effect. The process of the connotative sense is anyone's guess. On the one hand that the mining tacit knowledge has the certain difficulty, on the other hand, for the case, that also has necessary to dig deeper.

The finishing process is undergoing process of knowledge. New knowledge will be found during the process of knowledge conversion, especially from tacit knowledge to explicit knowledge, which is a process of understood and owned by persons. In cases, tacit and explicit knowledge are not entirely separated and they mix together at lots of times. Hospital knowledge includes in the two fields of business and administration, which make it necessary for a special person to decide when to setup new cases and delete old case and which one is right[4].

Internal consistency between CBR technology and KM in health care embodied not only in case description, but also in the function of CBR system. Realization of CBR system objectively realized knowledge sharing and application.

**Hospital Knowledge Management Based On Cbr Technology**

As mentioned earlier, CBR is to directly use previous case for a solution, which effectively solves a bottleneck problem to obtain knowledge. In hospital knowledge management, CBR makes cases as knowledge representation of knowledge base. CBR system can operate independently and be used as one functional module or used together with other functional modules. The following is the flow chart.

![Figure 2. Hospital knowledge management based on CBR technology.](image)

Two jobs need to be done for case base setup: first, to make hospital knowledge be described as case form; second, to select important and typical cases in the case base. Cases in the case base are carefully selected, including segments of tacit and explicit knowledge.
Hospital knowledge is stored in a structured form, generally in document form. For example, in hospital each department has its own system to store related documents, in order to access and use them for medical workers. Realization technology in CBR system includes:

**Case Description**

Case description, can completely describe the cases of causality and take steps, can use attribute extraction method, frame structure, text mode, causality diagram or relational database to express. Along with the information technology and the development of computer technology, the picture, the image and sound and other multimedia technology can express tacit knowledge existing in experts mind. In summary, an effective case description should include 3 parts: cause or background, features, process and solution, and result.

**Retrieve**

Retrieve, a key step in CBR system, which will directly affect the quality of reuse, modification and system. Characters to be used as retrieve should have such features as predictability, clear distinction, interpretability and introspection (can identify inefficient retrieval path, to avoid using again). Current matching algorithm commonly used is adjacent algorithm, inductive reasoning strategy, knowledge guidance strategies and neural network.

**Reuse**

To find solution for new problem, it is necessary to amend solution of old case when old case in case base can’t match with new case. In the specific application of technology, reuse is to adapt to new situation through the way of adapted case based on rules, that is to provide some rules by experts or get through analogy method in case base.

**Dynamic Maintenance**

CBR system can continuously accumulate experience and knowledge through incremental learning, which comes from reservation of new cases and solutions. But this kind of case reservation will result in another problem. That is to say, if case increase can’t be controlled, operation efficiency will decrease and retrieve cost will correspondingly be increased. To solve this problem, whether to keep new example depends on comparative result between similarity and setting threshold. If similarity is seen between setting threshold and 1, which is very similar and case won’t be kept due to low information and knowledge content. Reservation value is not great. Otherwise, cases will be kept. Of course, realization of system is not only a technological problem, but also other problems, such as hospital system.

Following chart reflects solving process for hospital management decision problems. Decision-making process starts from new problem, problem identification module formed the characteristic information of the decision making problems, these information can be recognized and stored by computer system; case base will recall according characteristic information; at last, experience knowledge in similar case will be amended adaptively and find solution. Case base and rule knowledge base are the source of knowledge in decision-making process of hospital knowledge management.
Figure 3. Decision-making process of hospital knowledge management based on CBR.

Conclusion

CBR technology is to use previous experience to solve new problem. It is a natural implementation techniques for knowledge management in hospital, involving in a process of recognition, obtain, classification, store, transmission, sharing and restoration. It has some weak points, such as its static methods, which can’t adapt to changing situations some times. So, it is necessary to use dynamic representing method for cases. KM in health care should pay more attention on self-learning skills of CBR and knowledge recovery ability, in order to improve its operating quality and efficiency through learning from other technologies' strong points to offset its weakness.

References


