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# MEDICAL KNOWLEDGE MANAGEMENT BASED ON EXPERT SYSTEM
## (CASE STUDY: INFECTION SUB. DIVISION, DEPARTMENT OF CHILD HEALTH DR. HASAN SADIKIN CENTRAL GENERAL HOSPITAL, BANDUNG)

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***ABSTRACT***

*This paper concerns research of the knowledge acquisition process known as one of the most important parts in knowledge management especially in an expert system based. The purpose of the research is to find out the proper expert system for medical field especially on department of child health. This field has its own nature of tacit knowledge, for example, we could see habits of a senior consultant in taking care of a patient. Those activities are still the key factors for the doctors to gain success. Meanwhile, due to the complexity in the world of medical today, those activities surely are just not enough. That is why an expert system approach is needed. A knowledge model known as "process ladder" is used to support the development of this expert system. The model shows inputs, outputs, sources, roles, and also correlation between decisions and each process or task from its section. The result of the analysis would be a beneficial expert system for medical field such as knowledge transfer among doctors. Moreover, the result would therefore contribute in knowledge development in particular, and add to the area of knowledge management in general.*

*Key words: Knowledge acquisition, knowledge management, expert system, knowledge model, medical field, child health*

## 1. INTORDUCTION

The healthcare industry is facing a looming shortage in healthcare professionals due to high employee turnover, transfers, retirements and lack of available trained employees. One approach to address this growing problem is through knowledge continuity management. Continuity management is the efficient and effective transfer of critical operational knowledge from transferring, resigning, terminating, or retiring employees to their successors. Continuity management can provide cost savings and improved productivity which is critical in the current competitive healthcare market (Morgan, 2005).

One of the major challenges facing organizations today is the loss of knowledge when employees leave the organization. The particular criticality of this issue in health care is highlighted by the following scenarios: the 52 year old CFO with eight years tenure at an integrated health system dies unexpectedly of a heart attack while skiing, the Vice President of Medical Services retires at age 65 after working in the same hospital in various positions for 33 years, the Director of Psychiatry for the past five years resigns with two weeks notice to assume a job in a state with lower malpractice insurance rates. Each of these scenarios represents the loss of one of the most important assets for any organization - knowledge. In

today's economy, knowledge is the key resource (Drucker, 1997). Essential for improved productivity (Drucker, 1991), it must be considered and managed as an asset for all industries. Since the health services industry is the largest industry in the U. S. economy, providing 12.9 million jobs in 2002 (Bureau of Labor Statistics, 2004), the stakes are even higher for successful management of knowledge (Morgan, 2005).

Since the 1990s, organizations throughout the world have begun investigating and applying principles of knowledge management in order to protect their intellectual assets and investments (Choo & Bontis, 2002). This is also true of healthcare organizations that have the additional goals of improving patient care and decreasing medical errors (Davenport & Glaser, 2002). Knowledge management is the intentional application of processes and procedures that enhance the production, codification, and dissemination of knowledge throughout an organization for the purpose of achieving competitive advantage. As the pressures on hospitals mount to increase productivity and decrease cost, the management of their knowledge resources is essential (Drucker, 1997; Wickramasinghe et al, 2004).

The main problem in this research especially on Infection sub division department of child health Dr. Hasan Sadikin General Hospital Bandung is lack of communication between senior resident and junior resident or between resident and counselor. The impact of this condition is quality of service to the patient as a customer, customer satisfaction index and customer's trust to the doctor.

Feudalism in Medical Field especially at Pediatric department still exists and many people believe that this behavior is very hard to change with revolution movement. But, since 2001 Infection Sub Division had good move for change this condition. Some senior counselor in this sub division said that if the condition had decreased 10% per year, continues improvement process must have been reached at least for 4 years a head.

The main purpose of this paper wanted to decrease percentage of lack of communication between senior resident and junior resident and between counselor and resident.

## 2. LITERATURE REVIEW

### Knowledge

Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organization, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms (Davenport & Prusak, 1998).

Knowledge encompasses the implicit and explicit restrictions placed upon objects (entities), operations, and relationships along with general and specific heuristics and inference procedures involved in the situation being modeled (Sowa inside Liebowitz, 1999).

Knowledge is the whole set of insights, experiences, and procedures that are considered correct and true and that therefore guide the thoughts, behaviors, and communications of people (van der Spek & Spijkervet inside Liebowitz, 1999).

### Knowledge Management (KM)

KM is the systematic, explicit, and deliberate building, renewal, and application of knowledge to maximize an enterprise's knowledge-related effectiveness and returns from its knowledge assets (Wiig inside Liebowitz, 1999).KM is the process of capturing a company's collective expertise wherever it resides—in databases, on paper, or in people's head—and distributing it to wherever it can help produce the biggest payoff (Hibbard inside Liebowitz, 1999).

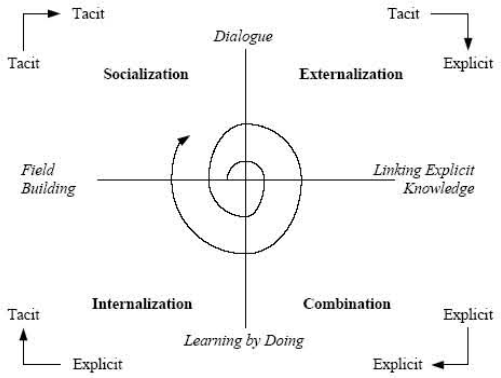


*Figure 1: Knowledge Sphere (Nonaka & Takeuchi)*

The definition above indicates that knowledge is more than just an information, infact it covers a broader component (experience, value, concept, etc). That is why a knowledge is not only tacit or explicit, but also it should be applicable for problem solving and decision making. Thus, we can say that a knowledge management is a systematic and explicit process in raising, coding, and transferring knowledge to the right person in the right time in order to have a positive value for organization and customer.

### Expert System

Expert systems (ES) are a branch of applied artificial intelligence (AI), and were developed by the AI community in the mid-1960s. The basic idea behind ES is simply that expertise, which is the vast body of task-specific knowledge, is transferred from a human to a computer. This knowledge is then stored in the computer and users call upon the computer for specific advice as needed. The computer can make inferences and arrive at a specific conclusion. Then like a human consultant, it gives advices and explains, if necessary, the logic behind the advice (Turban & Aronson, 2001). ES provide powerful and flexible means for obtaining solutions to a variety of problems that often cannot be dealt with by other, more traditional and orthodox methods. Thus, their use is proliferating to many sectors of our social and technological life, where their applications are proving to be critical in the process of decision support and problem solving.

As a part of ES research, this paper surveys the development of ES through a literature review and classification of articles from 1995 to 2004 as a basis, exploring the ES methodologies and applications during that period. The reason for choosing this period is that the Internet was opened to general users in 1994 and this new era of information and communication technology has played important roles, not only in the field of ES, but also in the ability to collect data from online database (Liao, 2005).

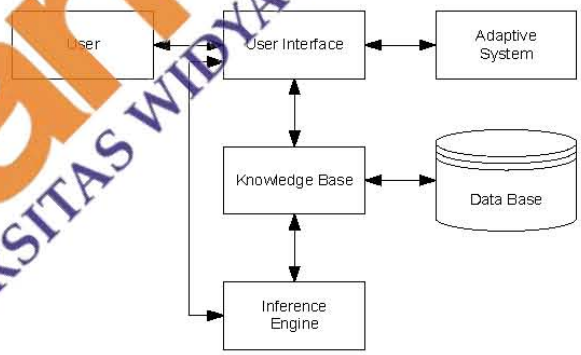


*Figure 2: Expert System Model (Nurzal, 1998)*

## 3. RESEARCH METHODOLOGY

The development of this expert system would become the future reference for the procedure in medical treatment at pediatric based on Firdaus (2006).

### 1) Phase 1: Problems Selection

The process of developing the expert system is started by identifying the problems domain. In this research, the core of the problem is the medical treatment process in a hospital particularly in Infection Sub Division. This unit had an unique characteristic, because a medica treatment is different between this sub division and the others sub division such as Cardiology etc. and needs its own competency.

**2) Phase 2: A Model of Business Process in Department of Child Health, Dr. Hasan Sadikin General Hospital**

First thing to do in the research is to identify the business process for it could help us to get a limitation of the problem that suits well with the purpose of the research. Therefore, we assumed that the business process model in Department of Child Health, Dr. Hasan Sadikin General Hospital is very important.

**3) Phase 3: Design of The Expert System Model**

The planning it is one of the most important element. We could say that this kind of planning is the starting grid of the nurse expert system. The designed model is a result of the model minor modification developed by Nurzal (1998)

**4) Phase 4: Design of the Transfer Knowledge Model**

This phase is taken in order to see the process transfer it self and to ease the controlling process whenever a mistake happens in the system development. The design of this expert system is adapted from a model developed by Nonaka and Takeuchi (1995) and Turban's expert system architecture (1995).

**5) Phase 5: Design of The Knowledge Model**

The knowledge model is designed based on several principles and approaches by using "know-how" procedure, then choose the process ladder as its knowledge model while rule-based system is used as the expert system. Thus, the designed research model would be appropriate and could support achievement of this research.

**6) Phase 6: Expert Selection and Knowledge Acquisition**

Textbooks, research papers, international journals and live discussion about problems solving in Infection Sub Division will serve the user as knowledge or expert sources. In the development of this expert system, knowledge is taken from medical textbooks and the users would gain first hand information from the experts in the Infection sub division.

**7) Phase 7: Conceptual Design**

The conceptual design is a description of the designed system. Through this planning, we could know the system image, ability and the way the system deal with problems. On this stage there are, some planning that covers:

a. Knowledge based
   It is the core of the expert system where this knowledge base is a knowledge representation of an expert. The knowledge base is arranged by rules and facts that formed an expert knowledge.
b. Inference Engine
   As mentioned before, the engine is one other part that contains thinking mechanism and logical reasoning used by an expert. This mechanism would analyze a certain problem and then find the solution of the problem.
c. User Interface
   User interface is a channel between the expert system and its user in form of computer image where there would be an interaction from both of the user and the computer program.
d. Database
   This term is a part that contains facts, both from the beginning of the system operation and when the inference being made by the system.
e. Update system
   This system is used for adding some new rules in knowledge base.

**8) Phase 8: Software and Hardware Selection**

The next phase is the selection of software and hardware for representing knowledge to the user. In developing this expert system, we use Delphi 6 Client/Server as the software because of its function that suitable for creating the ideal expert system.

The ability to manage and the hardware memory would determine the selected software performance. In that case, this research used an Intel Core 2 Duo PC with 1 GB RAM memory and an Intel Atom notebook with 1 GB RAM memory as the hardware. Afterwards, a computer with minimum requirements of Intel Pentium or Intel Celeron Processor with 512 MB memory could operate this expert system.

**9) Phase 9: System Development**

A transcription of everything that we did into the computer system is conducted with a suitable set of equipments. In relation to create a good Expert System program that could answer the nurse necessity, there are several things to put into our attention, and they are:

a. Listing Program that has been arranged should be suitable with the principles of Delphi 6 language programming.
b. The selected database must suit with the needs and the complexity of the problems. For instance, not all of the expert system program needs software likes ORACLE or Microsoft Access for their database storage, but those programs are useful as the supporting media.
c. The writing validity check of a listing program is not only based on error recognition but also relies on a comprehensive checking and evaluating program. Moreover, the process must be evaluated technically and essentially according to the developed expert system.

**10) Phase 10: Testing and Correction**

In this phase, the inference created by the system is tested whether it is fit with the reality or not. The arranged dialogs are also checked so everybody could understand it. The correction process is conducted when some kind of mistakes occur in the expert system and or the dialog in ineligible for the user.

## 4. RESULT AND DISCUSSION

The expert system model is adapted from Nurzal (1998). Since Nurzal's model is assumed to be well designed and proper for the user, the researcher then choose Nurzal's model as the reference in this research. The advantages of this model are laying in the adaptive system facility. It would help users to up date their new findings that can support the expert system. The latter description of the model is described in figure 2.

The main difference of Nurzal's model and the expert model lies in the user interface. In this research, the user interface is divided according to their access right. This is has a strong relationship with the authority and the responsibility of each user. Hence, there is a minor modification applied to Nurzal's (1998) expert model described in figure 3.

The knowledge transfer model is a result of an adaptation toward the similar model introduced by Nonaka & Takeuchi (1995). Moreover, this model is specifically underlines only two process; externalization (tacit → explicit) and combination (explicit→ explicit), they are described in figure 4 is adapted from Firdaus (2006).

This is a representation of an expert, which becomes the core of the expert system program (Nurzal, 1998). The knowledge base is arranged by facts in form of information about the rule and the problem.Given that most of the experts use IF-THEN framework during their problem solving, then the knowledge representation here is written in production principles known as IF-THEN form. To create an IF-THEN principle, a certain model need to be made so that the knowledge representation could easily explains about diagnosis, nursing activities, and the expected result in the computer.

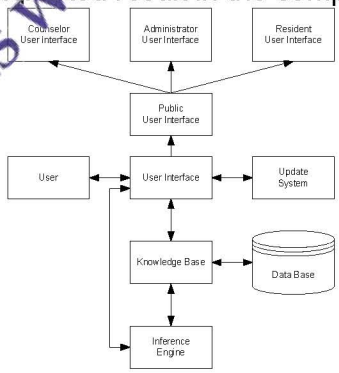


*Figure 3: Model of the Transfer Knowledge Process (this research)*

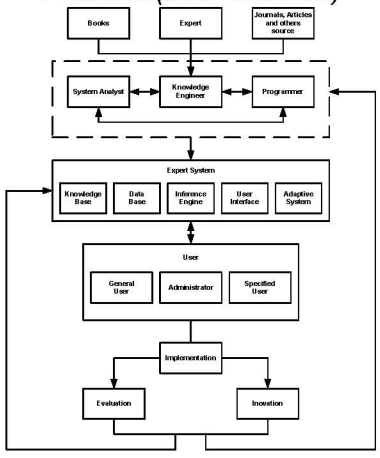


*Figure 4: Expert System Model (Firdaus, 2006)*

## 5. CONCLUSION

From the discussion above, the researcher draws some conclusion as described below:

(a) Knowledge from a senior counselor, junior counselor and resident expertise and other references such as text books and journals has been collected and categorized based on kinds of desease, medical treatment procedure and also the expected result from its knowledge base.

(b) This research has succeeded to create an expert system model that provides some useful facilities for counselor and resident activities. In addition, this expert system designs a level of user access to avoid any overlapping in medical treatment procedure.

(c) The expert system is built to ease the process of knowledge transfer to both of counselor and resident who needs a fresh new knowledge for improving their medical productivity.

(d) The expert system model has provided the management in order to maintain the smooth of medical activities and to be a supportive media in forming cadres.

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