Research on Current Execution of Knowledge Management in Taiwan's Medical Organizations

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Abstract

Since the execution of National Health Insurance system in Taiwan, the competition of medical industry is becoming more and more severe. The ways the hospital operate knowledge management (KM) concept, combine current human resources and professional knowledge by information techniques and upgrade the competitiveness through reinvention of organizational culture have become the important issues. This research is based on the relationship between KM and organizational operation, integrates the characteristic of medical institutions and framework of medical knowledge cycle and starts the research subject by questionnaires from three dimensions: current situation of KM construction in medical organizations, executive effect of KM activities and the challenges faced by KM; subsequently, from qualitative interview, this research attempts to understand how a medical organization executes and adjusts in the consideration of theory and reality as well as quality and costs when actually operates the organization. This research accesses to KM system application of medical institutions and the empirical executive benefits and difficulties through questionnaires. The research results are as follows: (1) having initial understanding toward current KM establishment of medical institutions; (2) confirming the most important items of KM establishment of medical organizations; (3) understanding the most difficulty which the medical organizations encounter when executing KM; (4) establishing medical knowledge cycle figure of the hospitals receiving interviews. Through case interview, this research profoundly accessed to the actual operation of KM application of medical organizations. The target hospitals intended to try many medical KM measures; however, during to complicated hospital organizations and cultural characteristics, the promotion was not successful and the results were not apparent. The most difficulty was to change the employees' behavior. The targets believed that only the continuous promotion of KM can allow it to be an important aspect of organizational culture and the competitiveness could constant be upgraded.

Key Words: Medical Organization, Knowledge Management, Competitiveness

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1. Introduction

"Knowledge is Power" is a persistent saying which conveys the influence and importance of "knowledge." In the business circle, the pattern of competition changes every ten years. The 60s was the competition on cost; the 70s focused on quality; the 80s emphasized globalization, rapid enter to market and seizing every minute and second; the 90s was based on innovation. The competition marching in the year of 2000 focused on knowledge. With the advancement of information technology and convenience of internet, Knowledge Management (KM) becomes the main stream of future management. The OECD (1997) divided knowledge industry into two parts: one was knowledge-based manufacturing industry; that was, high-tech industry and medium-tech industry; the other was knowledge-based service industry including finance, communication, business, society, education, medical treatment, etc. Medical organization is knowledge intensive service industry. Its business property is unique and highly specialty-oriented. The managerial quality is directly associated with the fulfillment and operation of the professional skills of the said organization which further influences market competitiveness and the patients' health issues. Therefore, if we can understand current KM application and the difficulties encountered in medical organizations and help provide suggestions and improvement measures by the characteristic analysis of medical organizations, the medical quality in Taiwan will be considerably improved. Although Taiwan is lack of natural resources, with knowledge operation, Taiwan creates the economic miracle of top three information countries in the world. Information industry becomes the critical force supporting domestic economic development. The well-known knowledge intensive enterprises in Taiwan such as Acer and Taiwan Semiconductor Manufacturing Company Limited trigger the wave of KM by their prominent performance and profits. Therefore, valuing "knowledge" and the related application will certainly be the trend in the future. KM will also become the critical issue in business circle and academia. This research expects to explore KM implementation in medical circle by questionnaire survey with respect to present KM execution of medical organizations in Hsinchu region of Taiwan and empirical experience of case interview and further access to the following: (1) understanding ordinary KM system application in medical organizations and the situation of KM implementation; (2) profoundly understanding the execution of KM system in medical organizations through case interview and generalizing their KM structure as the reference for future operation in business circle; (3) understanding the frustration encountered when medical organizations execute KM as the reference for the medical organizations which plan to execute KM in the future; (4) providing suggestion as the criterion for the problems encountered by medical organizations when executing KM.

2. Literature Review

2.1 Knowledge management

Wiig (1993) indicated that KM should include four activities: establishment, proof, utilization and transfer and respectively use knowledge acquisition and collection, the measurement and dealing of knowledge value and knowledge use, distribution and control to represent different KM functions. Nonaka and Takeuchi (1995) defined KM as the process of knowledge creation, saving and acquisition, spread and application. Liebowitz (1999) believed that KM was the process of knowledge identification, acquisition, saving, share, application and selling. Bhatt (2001) pointed out that KM was the process of knowledge creation, examination, formation, circulation and application. KM increases knowledge utilization rate by the execution of various types of activities. The purpose of the activities is to upgrade work quality through knowledge creation, share and use. People can make the decisions according to the knowledge they possess. Efficient shared and use of knowledge can reduce the errors and allow the partners to have better interaction. Executing the best experience can accelerate the process of decision making. According to the previous discussions with respect to the definitions of knowledge, knowledge transformation and KM process, we realize that IT is the critical interface tool to fulfill the organization's KM. Although IT is not the key element of KM, it can allow KM to be more efficient because of the functions of share, delivery speed, saving and acquiring knowledge. The difference between information management and KM is that information management uses technology to collect, save and manage information whereas KM uses technology to share and use information to reach the innovation capacity. In brief, internal Know-How management and share in the organization create new knowledge of innovation and reform through knowledge communication and share which is the ultimate value of KM. The important elements of KM can be represented by the following formula: $KM = (P + K)^S$. P = People, + = Technology, K = Knowledge and S = Share. The above formula intends to express that "the accumulation and management of organizational knowledge must rely on technology to fulfill convenient share of knowledge saving, categorization, reorganization and delivery. If the employees' behavior and thoughts and organizational culture of model share can be transformed, KM can reach the index-like effect." Therefore, the essence of KM is the degree of "share". When the degree of knowledge share is higher, the employees are more likely to acquire the knowledge they need and the knowledge is more likely to be used. In brief, one of the goals f KM is to use technology tool, analysis and synthetic information, stimulate the employees' originality through organizational policies and encourage the employees' knowledge share to strengthen the organizational competitiveness.

2.2 Medical application of knowledge management

In highly knowledge-intensive medical organizations, KM is certainly an important issue. In ordinary firms, KM has been treated as the important tool to upgrade service quality and efficiency and enhance business combat effectiveness and competitiveness. However, the medical organizations still have to make more efforts to keep up with the trend of knowledge economy and KM. Medical knowledge is mostly hidden knowledge which is originally more difficult to be formed and written. Besides, because of the restriction of selfishness or being afraid of losing the advantages, people are not willing to share or guide the freshmen. Thus, knowledge is difficult to be remained, saved or even passed. Only the establishment of excellent and complete KM system can allow diverse knowledge to be efficiently accumulated and the medical service quality to be constantly upgraded. Unlike most of the industrial and office process, medical process tends to be highly unpredictable and it treats safety as the main concern. Therefore, it must provide sufficient flexibility to allow the medical personnel and patients to repudiate routine rules and methods to meet their needs. Present medical decision-making system can provide many flexible functions and ensure that the medical professional personnel have the rights of final decision. However, because of this point, defining responsibilities, safety and use by following the doctors' instruction become the ultimate challenge for KM techniques. Figure 2 is the medical knowledge cycle proposed by Rector (2001) which includes four major points—data management, research information management, medical KM and medical reform; these four major aspects are supported by five systems: patient management, case report data, evidence-based knowledge database, medical knowledge database and quality upgrading/customer message. When the patients register at the hospital, they start the patient management stage. After interrogation enquiry, diagnosis and medical treatment, case report data are produced. The process of transferring case report data to case report database is called data management. Case report database are output from two aspects: reminding and noticing individual customers the time for return and health education promotion according to the data in order to upgrade service quality; on the other hand, the process to turn plenty of data research and discussion into evidence-based knowledge database is called research information management. After transformation, evidence-based knowledge database becomes medical knowledge database which is the aspect of KM. On the one hand, medical knowledge database is used to upgrade quality and strengthen the interaction with the customers according to the latest medical knowledge; on the other hand, the process of informing patient management renewal or increasing the methods of medical treatment and diagnosis turns into medical reform stage. Patient management can also improve the medical treatment and diagnosis through customers' response, message returnee or each complete quality promotion.

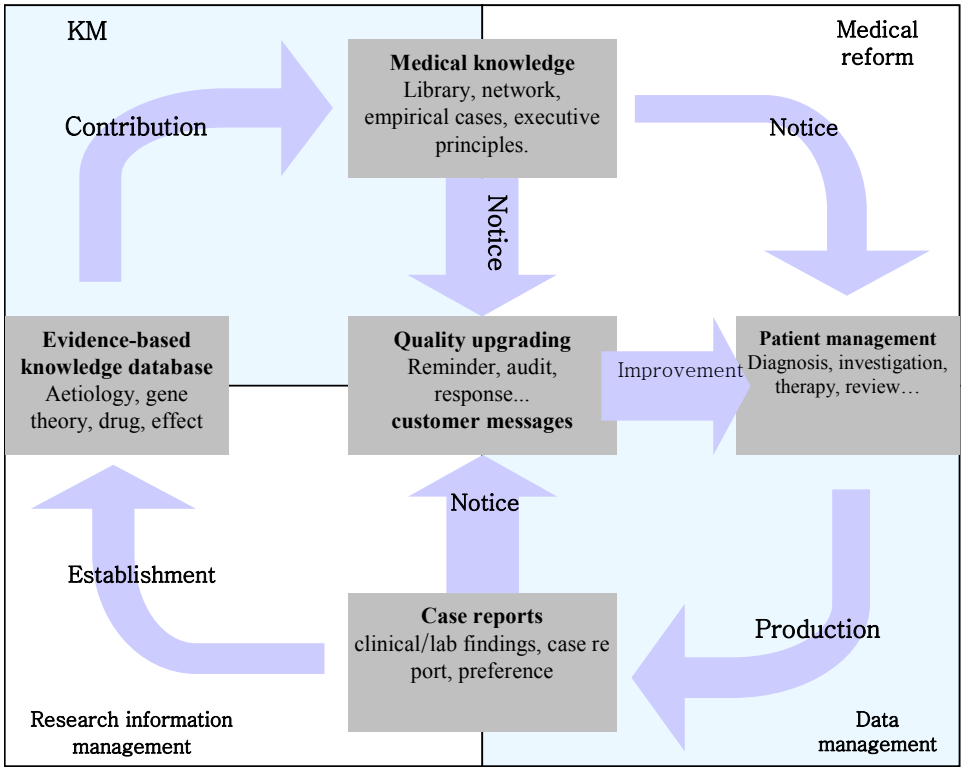

Figure 2. The Medical knowledge cycle

2.2.1 Data management

The following are the descriptions of literatures with respect to the value of medical information, information technique and management, information display and framework, model and system design of information technique, patient management and case report information. Bayless (1996) pointed out that the performance of more and more medical results were far worse than the best situations should be. The medical costs spent were also higher than they were supposed to be. Since there are considerable changes during the process of each diagnosis and medical treatment, it is extremely important to record the process of actual medical care and development in writing. Weir (1998) investigated ordinary clinics' cognition and understanding toward information works and clearly defined six major information management issues: communication, patient evaluation, work monitoring, scientific information searching, policy and process following and data integration. Neame *et al*. (1998) pointed out that everyone generally acknowledges that medical information share is necessary to increase integration, continuity, safety and provide patients the caring efficiency. The aspect is still considerably insufficient in terms of the concept of current medical information management system. From the standpoint of information management, structural message standard

has been considerably promoted and developed. Besides, many electronic case report systems have been proposed and successfully developed. However, the above cannot solve the problem that medical information exchange tends to cross department in order to reach the best quality, cost benefit and low-risk patient caring requirements. With respect to the characteristic of medical information mechanism and the direction of information construction, Schneider (1999) proposed complete opinions and suggestions. Medical information mechanism must include seven necessary characteristics: (1) it must define the data element needed; (2) it must be able to connect data element and record; (3) it must standardize the definition of elements; (4) it must automatically expand the ultimate possible application scale; (5) it must define the process to constantly evaluate data quality; (6) it must have strict control to protect the safety and confidentiality of data; (7) it must define an agreement to allow data to be shared in different organizations under proper environment. Medical plan must expect that computerized patient records will be used and prepare the data management through the following directions for the use of future information mechanism: (1) expanding and enhancing acquisition and use current useable data; (2) establishing an environment encouraging automation data; (3) improving the quality of current automation data; (4) implementing national standard; (5) enhancing the execution of medical KM; (6) establishing a definite commitment for the protection of data confidentiality; (7) careful capital planning. Eysenbach (2000) explored the topics related to customer medical information which was used by the patients through internet and provided response to the questions and medical information education. Customer medical information is one of the aspects of medical information. It can analyze the customers' needs for the information of certain aspect and combine the customers' preference and medical information system. Simpson *et al*. (1998) mentioned the concept of medical knowledge cycle chain. He stated that the caring for each patient could be treated as a control circuit. The judgment could be based on the data obtained from observation and investigation and a set of measure to take care of patients could be designed. Besides, the results were safe, effective and reasonable. The circuit happens in each individual and it can be the resource for all activities in the medical organizations. Case report data refers to the clinical record documents of the of the patients in sickness and it is turns into the case research data which includes the diagnosis and treatment of patients' all conditions and the detail recorders of various efforts and results for the diagnosis and medical treatment. Case reports mean that the records of all kinds of medical affairs such as diagnosis and treatment of the medical personnel in medical organizations when they execute medical business and practice medical treatment for the patients. The said reports are called medical business documents. In other words, case reports are the written records of all treatments during the period in which the patients receive the treatments. Case report is the detail record according to patients' description, doctors' observation and the third party's supplementary description. The detail records are transformed by the doctors' professional competence and designed by

their professional quality such as checking, prescription, treatment and nursing. There is plenty of medical knowledge in the case reports. Thus, establishing a set of complete managerial system to integrate the patients' medical treatment process into more valuable case report data is the first step of medical organizations to introduce KM and it is also an urgent issue.

2.2.2 Research information management

The following will discuss the characteristic of evidence-based medicine: the development of medical practice principles~methodology and design of medical test; presentation of data~display and format; understanding and executing evidence-based medical treatment and medical practice principles. Sackett (1996) elaborated what evidence-based medicine is: it is related to integration of individual clinical medical professional knowledge and the best objective evidence. It is not the "recipe" of medicine and is not restricted to random test and after-analysis. It can constantly pursue the best objective evidence for further solution of medical problems. Altman (1994) severely criticized the quality of medical research. The inferior-quality medical research was due to the weakness of methodology used by the doctors (such as improper design, samples without representative characteristic, few samples, incorrect analysis and wrong explanation). However, these researches were still published in medical periodicals since no papers would be rejected merely because of statistical reasons and there were many periodicals receiving the research findings with few or without statistical evidence. Since this system encouraged the researches with bad quality, it is the system which should be changed. We need less and better researches and the studies explored for the right reasons. The most common definition of evidence-based medicine derives from Sackett (1996): "evidence-based medicine means when taking care of each patient, present optimized evidence is carefully, clearly and profoundly used for decision-making. In other words, it is to integrate the clinical specialty and optimized external medical evidence of systematic research." Evidence-based medicine is the decision-making process integrating clinical specialty, patients' values and optimized evidence for caring the patients. Clinical specialty refers to the doctors' accumulated experience, education and clinical techniques. The patients describe their personal specific worry, expectation and values during diagnosis and medical treatment. The optimized evidence can usually be acquired through the clinical related research results upon the execution of correct methods. People started to gaze at evidence-based medicine in the 90s and the medicine became the major force of many medical institutions. Evidence- based medicine claimed to use the latest and optimized evidence from the medical research as the base of decision-making. There are three major advantages in evidence-based medicine: (1) it provides the most objective method to determine and maintain high standard of medical operation; (2) it can accelerate the process to transform medical research findings into actual operation; (3) it can significantly reduce the cost of medical institutions. Six steps of the process of evidence-based medical treatment are shown in Table 1.

Table 1. Six steps of the process of evidence-based medical treatment

Patients	1. starting from the patients: a clinical trouble or problem starts from the caring for patients
Questions	2. establishing a complete clinical issue from this case
Resources	3. choosing proper resources and executing searching
Evaluation	4. evaluating the correctness and propriety of evidence
Patients	5. back to the patients: combining the evidence, clinical specialty and patients' preference and applying it to the reality
Self-evaluation	6. evaluating self-performance from this patient

2.2.3 Medical knowledge management

As to how to develop practice principles, Jackson *et al*. (1998) proposed a simple and practical strategy which included three elements as the basic framework of practice principles: (1) ensuring major decision-making and the possible result; (2) checking related and efficient evidence and evaluating the advantage, risk and cost of the possibly selected decision making; (3) proposing the evidence needed and use simple format which is easy to understand to inform the major decision makers. With respect to the initial stage of evidence-based practice principles development, Shekelle (1999) also proposed five steps which should be considered: (1) confirming and selecting the scale included in practice principles- arranging the priority of the issues and selecting the scale of subjects; (2) practice principles developing team starts to operate; (3) ensuring and evaluating the evidence-systematic checking; (4) translating the evidence into actual medical practice principles; (5) reexamining and renewing practice principles. Finally, the researchers also listed three principles. They believed that these were the base for developing efficient and useful practice principles: (1) the development of practice principles requires sufficient resources. From the perspective of people possessing diverse skills, specialized medical personnel, research personnel of health service and the financial support should be involved; (2) systematically checking the evidence and the checking must focus on the essence of each practice principles; (3) when translating the evidence into practice principles, the people in different academic fields should be involved. A medical decision-making support system is to provide, remind, suggest or analyze certain patient at certain time by an information system. As to the influence of work culture on KM, Friedman (1999) proposed the concept of culture and described four special cultures co-existing in medical organizations and indicated that it was absolutely important to understand the influence of these cultures on efficient management and use of information resources, particularly for the KM executives. In order to be successful, the managers must be become a part-time anthropologist who participate in various working places of in the organization in order to access to their works and the cultures formed in the works.

2.2.4 Medical reform

The CQI (Continuous Quality Improvement) is a kind of broad and integrated managerial philosophy. For the service quality defined by the customers, it examines, plans and executes the improvement plan through the construction of the whole organization participation in order to upgrade overall quality. Precise quality definition is the key to reach CQI. The central idea of this philosophy is "leading." It encourages "learning organization. Learning organization encourages the formation of central strategy through acquisition and new knowledge use. The strategy can be repetitively used in this changeable environment. Learning organization also recognizes the necessity to authorize the employees to learn and participate. The advantage of CQI is to combine management and cooperation by systematic method (Shortell, 1995). The core basic elements of CQI include: (1) a leading role in managerial level; (2) acting according to the facts; (3) a systemization method; (4) cooperating with the all of the people participating in this process with regard to quality refinement. Integrated Care Pathway (ICP) is also called care map and clinical pathway. It is the mission-oriented care plan which carefully lists the necessary steps to take care of a patient with certain clinical problem and the patient's expected clinical treatment. It provides an organizational method to develop and execute the care agreement established. This agreement is according to evidence-based practice principles. Using ICP can allow a team to examine their business process and actual execution and upgrade the clinical effect. ICP follows quality cycle and feedback circuit through describing the mission of health care team and eliminates changes and possible risks as Figure 3. Through the accomplishment of cycle, the quality guarantee is thus improved. Besides, resource management can be upgraded by the most efficient way. Quality feedback circuit can be transformed to apply to the cycle of care management pathway. This cycle can reduce the change of clinical results and provide reappearing results. Thus, the clinical pathway can be strengthened and the risk can be reduced (Johnson, 1998).

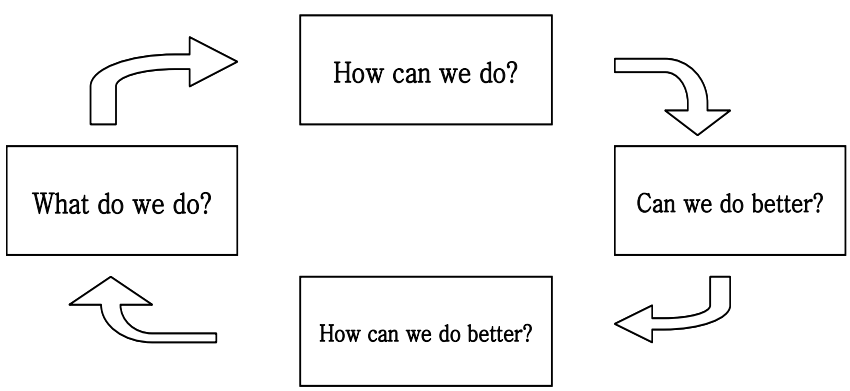

Figure 3. Process cycle of Integrated Care Pathway

3. Research Methodology

This research combined the characteristics of qualitative and quantitative researches to proceed with the exploration and investigation of the related subjects. The research first adopted questionnaire survey method to have general understanding toward the research targets; subsequently, according to the above questionnaire research results, the researcher designed and developed in-depth case interview to access to and experience the respondents' cognition toward KM and the executive process, current situations and difficulties encountered or KM in the organization. The following is the general description of the base, characteristics and key points of the research method selected by this research. This research was divided into "the first stage research: questionnaire survey" and "the second stage research: case interview." The following are the respective detail descriptions of the research process, questionnaire design, research target and sampling and data analysis methods.

3.1 The first stage: questionnaire survey

According to the above research motives and purposes, the research proceeded with related literature collection and generalization and followed the articles of Ruggles (1998) to design the questionnaire framework and content which can led to this research purposes. In order to allow the questionnaire content to meet the research purpose and increase reliability and validity, the researcher first proceeded with few test questionnaire survey and managed the pretest with respect to the medical personnel with the related background and identifications in Bureau of Health, Hsinchu city, Taiwan. There were 30 questionnaires distributed for pretest. According to the results of pretest, the questionnaire content was modified. The questionnaire content mainly included four major parts: organizational performance when promoting various activities of KM, general situation of the application of KM, the difficulties to solve different problems and basic information of the organizations. Based on current executions of several major KM establishments, we intended to access to current general situation of KM application of the medical organization. The content included "establishing internal website", "constructing database/knowledge database", "using decision-making support system", "employees' internal knowledge exchange network", "the catalogue to look for internal expert knowledge", "setting up specialized knowledge manager' and "providing knowledge-based product or service." We accessed to the performance of the medical institutions from several critical activities to promote KM. The content included producing new knowledge", "acquiring valuable knowledge from external aspects", "applying the acquired knowledge to decision making", "combining knowledge in the service process and quality", "encouraging knowledge share through the establishment of organizational culture", "encouraging knowledge share through stimulation", "transferring the original knowledge to other departments" and "understanding

the value of knowledge asset." The research also discussed the ultimate difficulty when the medical organizations promoted KM. The content included "changing people's behavior", "evaluating the value and efficacy of knowledge asset", "deciding what kind of knowledge should be managed", "with limited resources, KM is worthy of promotion", "systemizing the original knowledge in the organization", "determining the proper scale of KM", "establishing the standard process of knowledge work", "allowing knowledge to become useful", "overcoming the restriction of techniques", "assigning proper team or leader to promote KM", "attracting and keeping people with unique talents." The research accessed to the basic information of the medical institutions of the questionnaire respondents including the types of hospitals, total numbers of employees, the respondents' positions, capital and annual business revenue. The research treated the Taiwan's medical organizations as the research targets including different types of medical organizations/departments (over 300 hospitals and clinics of Chinese and western medicine. The questionnaire survey of this research treated the medium and high level executives as the major targets as well as the personnel with medical background in the bureau and office of health, such as doctors, nurses, pharmacists, etc.

3.2 The second stage: case interview

According to the result of the questionnaire survey in the first stage, the researcher profoundly explored certain specific medical institutions by case interview and managed in-depth exploration and analysis with respect to the background, development, behavior and concept of KM application in the hospitals. The case interview was based on medical knowledge cycle and semi-structural qualitative interview. The researcher first designed interview outline and generalized, reorganized and analyzed the interview content. Case interview would be based on four major points of medical knowledge cycle-data management, research information management, medical KM and medical reform; based on five major systems-patient management, case report data, evidence-based knowledge database, medical knowledge database, quality upgrading/customer message and the description of the difficulties in actual execution to design the interview outline.

(1) **Data management:** (a) How to integrate and reorganize the patients' data such as integrate diagnosis, investigation research prescription therapy and subsequent visit into case report data?; (b) How to acquire information and repetitively use it from case report data and allow case report data to fulfill the ultimate effects?; (c) Management of case report data; (d) What is the interface used to collect and understand the customers' opinions and complaints and how to deal with them?

(2) **Research information management:** (a) How to acquire the best methods from case report data and experimental research results and save them in evidence-based knowledge database; (b) The sources and strategies of research information; (c) Management

of evidence-based knowledge database.

(3) Medical knowledge management: (a) Current establishment, practice situation and evaluation of medical KM; (b) The process and development of KM establishment; (c) Future direction and plans; (d) What is the method used to set up practice principles?; (f) Implementation, effects and difficulties with respect to the establishment of KM such as Intranet, database/knowledge database and decision-making support system.

(4) Medical reform: (a) What is the method used to adjust and review medical affair management in order to upgrade medical quality?; (b) The difficulty encountered when promoting medical reform.

(5) Difficulties to execute KM: (a) What is the cognition and value degree toward KM of the executives in the hospital?; (b) What is the most difficulty faced when promoting KM activities?; (c) The employees' educational training; (d) Critical factors of market competitiveness.

4. Analysis and Results

The research will use questionnaire survey to understand the role of KM in medical organizations and current KM establishment in medical institutions and the potential of future development. The focus will be based on the respondents' positions, the types of their medical institutions, numbers of employees, annual business revenue, capital volume and current situation of KM application. The research used SPSS statistical software as the analytical tool to analyze and compare the basic information which further became the analytical report. The researcher also used the evidence analysis of return samples to elaborate KM application of medical organizations as the reference for the business circles' practice and execution of KM system application in the future.

4.1 Basic information analysis

4.1.1 Analysis according to the medical organization type of return samples

The survey treated the Taiwan's medical organizations as the samples and there were 300 questionnaires sent out in August 2006. Each medical organization filled out one questionnaire and there were 92 return questionnaires. The return rate was 30.7% as in Table 2. As to the sample information, there were one public general hospital (1.1%), 3 public hospitals (3.3%), 1 Chinese medicine hospital (1.1%), 1 specialized hospital (1.1%), 0 dental hospital 0% (there was no dental hospitals in Hsinchu area), 3 private general hospitals (3.3%), 2 private hospitals (2.2%), 18 specialized clinics (19.6%), 21 ordinary clinics (22.8%), 12 Chinese medicine clinic (13.0%), 29 dentist clinic (31.5%), 1 other medical institution (1.1%).

Other medical institution is in the type of united clinic.

Table 2. Structure distribution of investigation samples

Categories	Numbers	Ratio (%)
public general hospital	1	1.1
public hospital	3	3.3
Chinese medicine hospital	1	1.1
Specialized hospital	1	1.1
Dental hospital	0	0.0
Private general hospital	3	3.3
Private hospital	2	2.2
Specialized clinic	18	19.6
Ordinary clinic	21	22.8
Chinese medicine clinic	12	13.0
Dental clinic	29	31.5
Others	1	1.1
Total	92	100.0

4.1.2 Analysis of the numbers of employees in medical organizations of return samples

There were 72 samples in which the numbers of employees were less than or equal to 10 people, 10 samples with 11~30 employees, 31~60 samples with 3 employees, 1 sample with 61~120 employees, 4 samples with 121~500 employees and 1 sample with 501 employees as Table 3. In the return samples, most of them were the private clinics with less than 10 employees. The reason was in that there were less large scale medical organizations in Taiwan and the system was formed mostly by urban small clinics. For the concern of analysis, the researcher divided the samples into three clusters: cluster A-the organizations with less than 10 employees (there were 72 samples); cluster B-the organization with 11-60 employees (13 samples); cluster C-the organization with over 60 employees (7 samples) as Table 4.

Table 3. Analysis of numbers of sample employees

Total numbers of employees	Numbers of samples	Ratio (%)
< = 10 people	72	78.3
11~30	10	10.9
31~60	3	3.3
61~120	1	1.1
121~500	4	4.3
Over 501	2	2.2
Total	92	100.0

Table 4. Sample analysis of group of employee numbers

Group	Numbers of employees	Numbers of samples
Group A	< = 10	72
Group B	11~60	13
Group C	> 60	7
Total	92	

4.1.3 Analysis of the questionnaire respondents' positions

Among the questionnaire respondents, there were 72 respondents having the presidents (or person in charge) filling out the questionnaires (77.2%), 2 respondents by vice presidents (2.2%), 4 respondents by department directors (4.3%), 1 respondent by KM department executives (1.1%), 2 respondents by planning department executives (2.2%). There were no information management department executives filling out the questionnaire (see Table 5).

Table 5. Position ratio of sample respondents

Positions	Numbers of samples	Ratio (%)
President	71	77.2
Vice president	2	2.2
Department director	4	4.3
KM department executive	1	1.1
Information management department executive	0	0.0
Planning department executive	2	2.2
Other	12	13.0
Total	92	100.0

4.1.4 Capital analysis of the medical organizations

Among the questionnaire respondents, there were 79 samples with less than NT$50 million capital volume (90.8%); 3 samples with NT$50~100 million (3.4%); 3 samples with NT $100~

Table 6. Capital volume analysis of medical organizations of samples

Capital (NT$)	Numbers of samples	Ratio (%)
Less than 50 million	79	90.8
50~100 million	3	3.4
100~500 million	3	3.4
500 million~1 billion	1	1.1
1~2 billion	1	1.1
Over 2 billion	0	0.0
Total	87	100.0

500 million (4.3%); one sample with NT$500 million~1 billion (1.1%); 1 sample with NT$1~2 billion (1.1%) (see Table 6).

4.1.5 Annual business revenue analysis of the medical organizations

Among the questionnaire respondents, there were 70 samples with less than NT$10 million business revenue (81.4%); 7 samples with NT$10~20 million (8.1%); 6 samples with NT$20 ~40 million (7.0%); 2 samples with NT$40~80 million (2.3%); 1 sample with NT$80~100 million (1.2%) (see Table 7).

Table 7. Business revenue analysis of sample medical organizations

Annual business revenue (NT$)	Numbers of samples	Ratio (%)
Less than 10 million	70	81.4
10~20million	7	8.1
20~40 million	6	7.0
40~80 million	2	2.3
Over 80~100 million	1	1.2
Total	86	100.0

4.2 Performance of KM activity promotion

With regard to the main categorization of 9 KM activities, the research inquired the respondents about the performance of their organizations when promoting the KM activities: (1) producing new knowledge; (2) acquiring valuable knowledge from external aspect; (3) applying acquired knowledge to decision making; (4) combining knowledge in service process and quality; (5) encouraging knowledge share through the establishment of organizational culture; (6) encouraging knowledge share through stimulation; (7) transferring the original knowledge to other departments; (8) understanding the value of knowledge asset; (9) understanding the impact of KM. The respondents did not have high evaluation toward their own organizations' performance in terms of KM activities (see Figure 4). Among all of the categories, apart from "combining knowledge in service process and quality", less than half of the respondents in other categories indicated that their organizations had fine performance (better than ordinary). If we further explore the point, we can find out that the last three items of the items with worse performance-"producing new knowledge", "encouraging knowledge share through the establishment of organizational culture", "transferring the original knowledge to other departments", "encouraging knowledge share through stimulation" were the activities related to "human" and "share" factors.

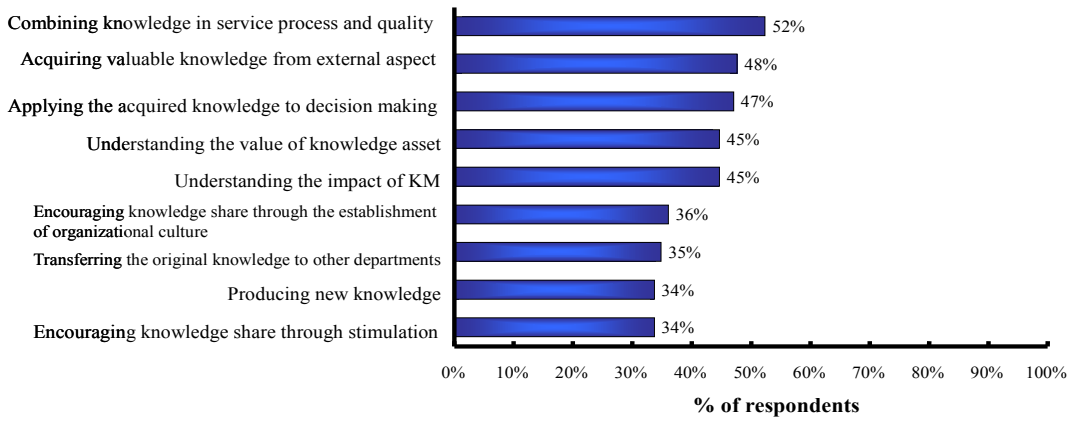

Figure 4. The proportions of "good" and "very good" performance of KM activities

In terms of the numbers of people in the organizations, there were three cluster divided—cluster A: the organizations with less than 10 employees; cluster B: the organizations with 10~60 employees, cluster C: the organizations with over than 60 employees (see Figure 5). We can find out that cluster C is significantly better than cluster A and B in terms of knowledge share, knowledge transfer, the cognition of the value of knowledge asset and the impact of Km. The reason was in that the managerial level of larger organizations were more likely to recognize the importance and necessity of Km and upgrade KM by more abundant resources from the aspects of policy, organization and system. Thus, they had better performance. Generally speaking, the items with worse performance were "encouraging

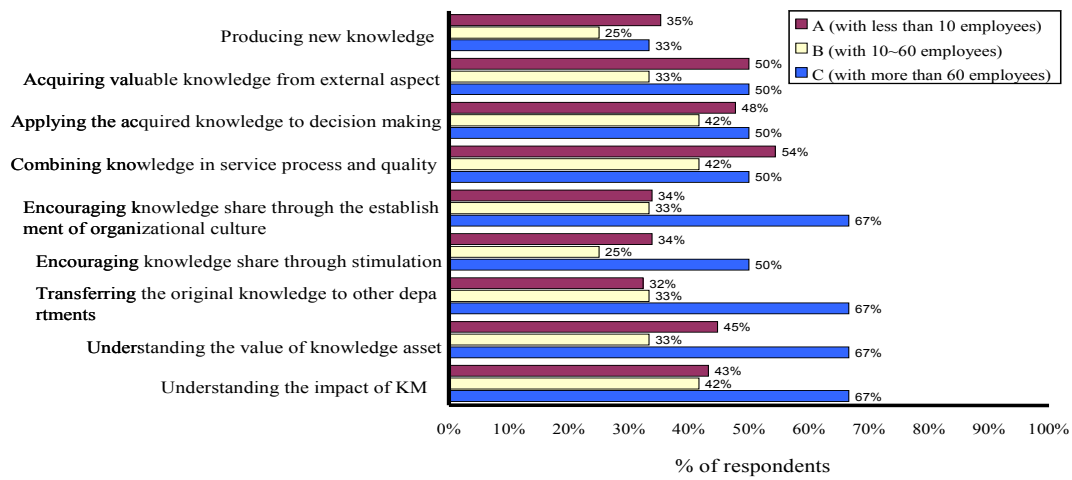

Figure 5. The proportions of "good" and "very good" KM performance in terms of large and small scale organizations

knowledge share through the establishment of organizational culture", "transferring the original knowledge to other departments" and ""encouraging knowledge share through stimulation" which were the activities related of "share" and "human." It showed that the activities of "personnel management" and "encouraging share" were the most discouraging aspects without satisfying results. Larger scale organizations were significantly better than smaller organizations in terms of knowledge share, knowledge transfer, the impact of KM and cognition of value. It revealed that large medical organizations had more sensitive perception of market competition and comparing with small organizations, they recognized more about the importance and value of knowledge. They clearly realized the influence of KM on the organizations in competitive market; thus, they actively promoted KM.

4.3 Establishment of KM

In the categorizations of the above 9 KM, the organizations usually employ specific project plan to strengthen the organizational performance. Thus, we listed several major plans of KM establishment and inquired the respondents about the present establishment situations in each specific project: (1) accomplished; (2) ongoing; (3) planning; (4) it is not planned but might be managed in the future (5) will not do it in the future. The content included "establishing intranet", "establishing database/knowledge database", "using decision-making support system", "employees' internal knowledge exchange network", "catalogue to look for internal expert knowledge", "setting up specialized knowledge manager" and "providing knowledge-based products or service." The overall investigation result was shown in Figure 6. Generally speaking, the proportion of all of the "accomplished" KM establishments did not exceed 30%. It showed that KM in medical organizations was still at initial stage and

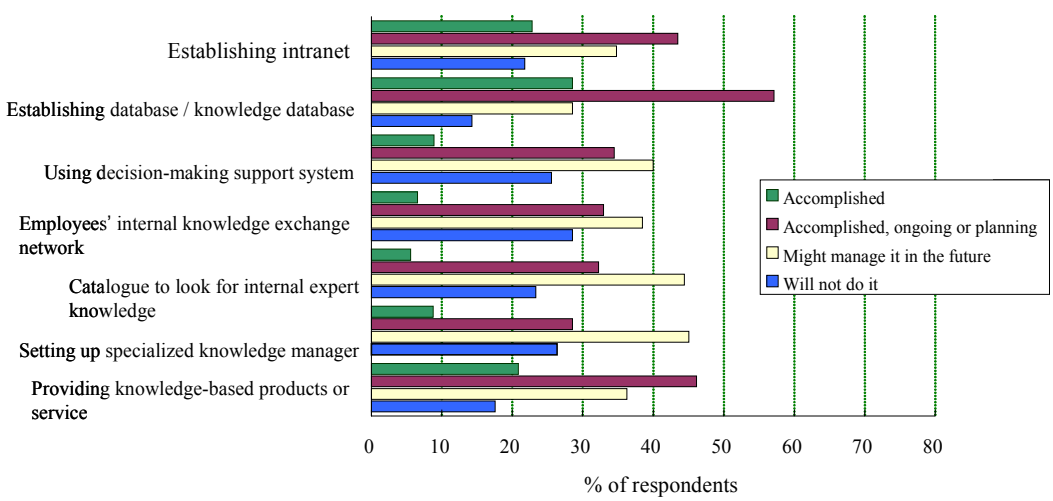

Figure 6. Current establishment and significance of KM

not popular. However, over 70% respondents identified with the positive value of KM establishing and believed that they will construct KM in the future.

4.4 Difficulties to solve various problems

The design intended to understand the degree of dealing difficulties of the possible problems when the organizations solve or execute the related KM activities. The content included "changing people's behavior", "evaluating the value of knowledge asset", "determining the knowledge of the management", "promoting KMwith limited resources", "systemizing the original knowledge in the organization", "deciding the scale of KM", "establishing the standard process of knowledge work', "turning knowledge into useable one", "overcoming the restriction of techniques", "assigning the one to promote KM", "attracting and keeping the employees with unique talents." The difficulties were divided into five options: "no problem-1 point", "slightly difficult-2 points", "ordinary-3 points", "difficult-4 points", "very difficult-5 points." The lower the score is, the better the problem-solving competence is. According to the proportions of "difficult" and "very difficult", when the proportion is higher, it means there is higher degree of difficulty. As in Figures 7 and 8, top three difficulties were "changing people's behavior", "assigning proper team or leader to promote KM" and "attracting and keeping the employees with unique talents." Interestingly, the above three were related to human beings. However, it seemed that KM activities could systematically solve these difficulties.

The KM application in the medical organizations is still at the initial stage. According to KM implementation of over half of the large organizations, KM certainly reveals necessity and impact. However, clever KM should expand from the original resources in the organ-

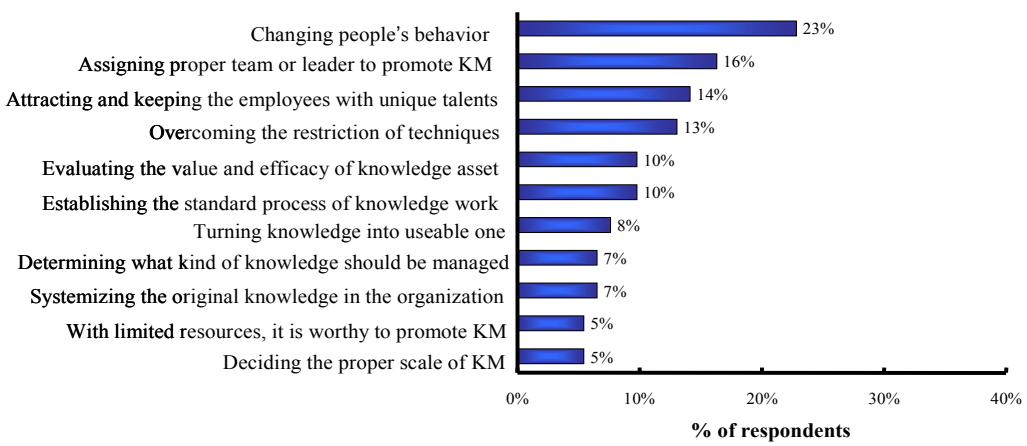

Figure 7. The most difficulties (the proportions of difficulties)

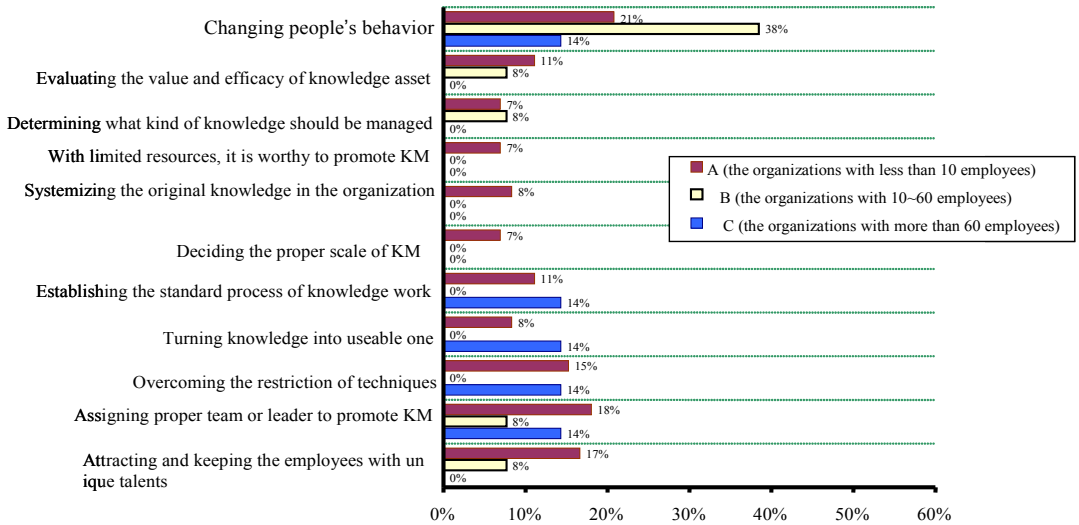

Figure 8. The proportions of difficulties according to organizational scale

ization and use present managerial strategies and skills for promotion to yield twice the result with half the effort. First of all, we should examine what kind of resources we possess (such as information management system, manpower resource management, library, complete training plan or good database system). If we can use present resources well, we are able to manage knowledge in low-cost and high-efficiency methods. Secondly, we evaluate organizational culture of the organizations, employees' willingness to share knowledge and use complete corresponding measure such as tempting stimulation system to decide the most proper KM. We can start from small scale aspect and the most urgent problems for dealing and evaluate the feasibility of each plan and the importance of knowledge field involved for the organizations. We start from knowledge with high value and it is better to proceed with multiple fields at the same time such as techniques, organization and culture. Placing KM specialized role in the organization is an excellent strategy. However, in order to allow KM to root and vigorously develop in the complicated medical system, each employee's participation is in great urgency. KM should be part of the work of all employees. If the organization only constructs the information-oriented system for saving and conveying knowledge and the employees are not willing to use it and contribute their knowledge, the project will be doomed to be a failure. Therefore, the managerial level should treat KM as the major strategy and have efficient management. Apart from standardizing each process, the organization should allow each employee such as doctors', nurses', checkers' and pharmacists' hidden and unique professional knowledge and experience to be internalized into unique knowledge in the organization through discussion, share and improvement. The organization should estab-

lish KM mechanism which meets organizational culture and efficiently save, analyze and operate the cultural results in order to fulfill rapid learning and conveyance and further possess the capacity of innovative knowledge. Thus, we encourage the personnel in the organization to completely use knowledge database, cultivate the air of public communication and encourage community activities to stimulate the employees to convey knowledge and experience; by establishing knowledge share culture and creating the additional value of medical service, the continuous competitive advantage will certainly formed.

5. Case Study

The interview target, A hospital was a regional teaching hospital; there were nearly 1,000 employees, 680 hospital beds and the annual business revenue was NT$1 billion and NT $740 million. The personnel interviewed were the president, secretary and personnel affair director. The time was in 2005. After comparing the interview results and the three major subjects of questionnaire survey in this research: KM establishment situation, KM activities and KM challenge, we reorganize the above as follows. The network system in the hospital was complete and it has constructed intranet, database, knowledge database, decision-making support system, employees' forum, bulletin board, financial management system, storage management system, case report database, disease analysis database, Intranet, Internet, professional knowledge checking system, full-text searching engine for helping checking and internal expert system checking. The hospital has already valued the preservation of knowledge and encouraged the employees to discuss and share their experience. For the data related to important techniques and confidentiality, the hospital set up the authority as control. As to the messages in the hospital, apart from E-mail distribution, the hospital often frequently announced the messages on electronic bulletin board. The function of database was mainly to save case report data which included the patients' basic information, medical diagnosis, checking, prescription, treatment and results. It played considerably important role in data management of the hospital, such as the patients' names, birth date, address, e-mail address, contactors for urgent situations, telephone numbers, the date of visits, case report numbers, date of hospitalization, bed numbers, doctors' names, personal social and file management data which were for identifying the patients and their case reports in order to allow the efficient ongoing and promotion of business in hospitals.

The data also recorded the patients' symptom, dealing diagrams and records. The diagrams referred to the records of body temperature, pulse, breath and blood pressure, other observation items and nursing prescription, the details of other dealings or the findings, researches, conclusions and medical activities recorded by the doctors. The aspects formed the whole medical history of the patient which usually included identification information, pa-

tient's main symptom described, family disease history, personal disease history, current disease history, body checking, internal medicine or surgical dealing, operation records, pathology reports, doctor's advice, patient's condition development record, patient's condition leaving the hospital, final diagnosis, subsequent visit records, anatomy reports, etc. The target hospital allowed the clinical data acquisition, presentation and management to reach the optimized state through various activities such as daily morning meetings, each departmental affair meeting, case review meeting, inspection tour teaching, etc. Through the discussion, communication and share of the personnel in the organization, everyone's clinical experience, case patient clinical reaction and external evidence conclusion were integrated into a common consensus which becomes the evidence of evidence-based knowledge database as the best guideline of future clinical decision-making support. The evidence-based knowledge database could enhance patient care, reduce clinical error and reduce the medical personnel's pressure. The case report data through analysis and integration could become the construction element of evidence-based knowledge database. The doctors acquired the information needed for clinical medical treatment from case report data and accumulated and internalized them as personal experience and knowledge. Through organizational system design, the hidden knowledge was transformed into explicit knowledge which could be distributed and repetitively used for the reference of future organizational research development and medical diagnosis. In order to allow knowledge to be more flexible and meet the employees' requirements, the hospital set up professional knowledge checking system and hyperlinked other medical knowledge websites such as Department of Health, Executive Yuan, National Science Council, reduced pathway and made efforts to eliminate the obstacles for the employees' searching for knowledge. Apart from medical decision-making support system and disease analysis database, there were also the information of personnel information system and offering of personnel's professional background, educational background, experience and checking, reward and punishment; storage management system, financial management system and accounting management system formed a complete and connected system. The internal knowledge exchange network of intranet system in the hospital provided the more relaxed aspects such as employees' forum, bulletin board, personal stories, experience share and chat room which allowed the employees to freely convey, exchange, share and discuss the knowledge and express their emotional feelings. The target hospital indicated that when the manager managed the operation from open and liberal perspectives, the exchange system would be extremely lively and diverse. There would be many innovative ideas for the decision makers. It was also a powerful force for the coherence in the organization.

The system recorded all of the personnel's educational background (majors), experience, specialized department, personal specialties and personal publications for the employees' checking and application. In external network, there were the introduction of each department and development published for the public's understanding; all of the doctors' specialties, educational back-

ground and experience were also reorganized so that the public could look for the experts' problem solving. At present, the hospital did not set up a specialized position of knowledge manager. The information system was directed and undertaken by the information director who manages the related business according to the president's instruction. The hospital indicated that KM activities were everywhere in the hospital and always on the go. Everyone in the hospital was the knowledge manager. The hospital set up a complete external website which introduced the history of hospital, location, introduction and development of each department for the people's understanding; it described the reasons and methods of each checking in detail to solve the people's bewilderment; it reorganized all of the hospital doctors' specialties, educational background and experience so that the people could look for experts for treatment. The hospital also listed the specific medical instruments on the website which not only educated the public new knowledge, but also showed the said hospital's techniques which were better than other hospitals. There were also medical consultation, medical Q&A and various medical health edu-

Table 9. The KM establishment in a hospital

Items of establishment	Executive content
1. Internal website establishment (the most important item)	Internal network, information database, knowledge database, decision-making support system, employees' forum, bulletin board, financial management system, storage management system, case report database, disease analysis database, Intranet, Internet, professional knowledge checking system, full-text searching engine for helping the checking, internal expert system checking.
2. Database establishment	Case report database, personnel information database, storage database
3. Knowledge database establishment (the most important item)	Evidence-based knowledge database, professional knowledge checking system, hyperlink other medical knowledge websites
4. Using decision-making support system	decision-making support system, disease analysis database, personnel information system, storage management system, financial management system, accounting management system.
5. Employees' internal knowledge exchange network	Intranet system, providing employees' forum, bulletin board, personal stories, experience share, chat room.
6. Looking for the contents of internal expert knowledge	Employee information database, specialty introduction.
7. Setting up specialized knowledge manager	At present, the hospital did not set up a specialized position of knowledge manager. The information system was directed and undertaken by the information director who manages the related business according to the president's instruction.
8. Providing knowledge-based products or service (the most important item)	The external website introduces the history of hospital, location, introduction and development of each department and describes the reasons and methods of each checking in detail, all of the doctors' specialties, educational background and experience, specific medical instruments and facilities, medical consultation, medical Q&A and various medical health educations.

cation on the websites which completely interacted with the on-line users. The respondents indicated that “establishing internal website”, “establishing knowledge database” and “providing knowledge-based products and service” were the most important items at present. The above were reorganized in Table 9.

The hospital advocated proposal system and promoted innovation air. As to managerial system, medical new knowledge and each process improvement, it encouraged the employees to assume boldly and look for evidence carefully and stimulated them properly. Case review, clinical pathway, and various conferences were also the major channels to acquire new knowledge in the hospital. The main channels to acquire knowledge from external aspect were to arrange the employees to receive on-the-job professional training, research, study and talent exchange. As to professional education training, doctor association, internal medical education committee and other medical associations were in charge of the professional courses. Besides, there were district cooperation center and alliance hospitals holding educational training courses. The trainings were in obligatory system. The score card controlled the hours of training which each person should receive in every year. The score of score card directly affected the employees’ promotion and merit. Since the implementation of the system, the results have been prominent. The hospital often invited the experts for holding specific project lectures. As to research and advanced studies, the target hospital had collaboration project with the medical centers of National Taiwan University Hospital, Veterans General Hospital, Chang-Gung Memorial Hospital and Mackay Memorial Hospital; besides, the hospital cooperated with National Hsing-Hua University, National Chiao-Tung University, Industrial Technology Research Institute and Taiwan Pig Research Institute for providing the employees advanced studies and various basic academic studies. Through high-quality systematic management, training and invitation of excellent talents, the hospital required the research innovation of medical technology in order to upgrade the research level and results. As to talent exchange and flow, the hospital was based on trimming organizational employees to reduce the personnel affair cost and maintain certain degree of medical level. The target hospital also cooperated with neighboring hospitals upon contract and the personnel exchange and support for each other. The hospital saved the knowledge in knowledge database with different categories and had complete searching system to allow the employees to acquire and operate knowledge at any time. According to knowledge properties, the knowledge was turned into cases and saved in decision-making system to avoid repetitive errors and upgrade the service quality of the hospital. The hospital completely promoted quality management activities and has passed the certifications of ISO 9001, ISO 17025, ISO 1518. Each year, there was the educational training of about 5,000 person-times in the hospital. It also held a series of common trainings such as executive cooperation camp, model learning, quality control circle, service manners, doctor cooperation camp and executive agent training and turned share into one part of organizational culture. The outsourcing of advisers and experts were executed by echelon and group. It also frequently invited the experts for holding specific project

lectures, case report record management training and treated the quality of case report record as the indicator of doctors' performance and merit and each departmental medical quality in order to strengthen the doctors' value toward case report record. It held the evaluation of the specialized network establishment maintenance, awarded the prominent units, set up the reward system of employees' publication of professional knowledge papers as the reference for promotion. Practice principles was the manual of medical business which set up business regulation and was made into various written data which allowed the medical personnel to accomplish the business in the highest-efficiency and lowest-risk standard method when facing different clinical situations. With regard to practice principles planning and establishment, the target hospital established a specific project team and held the meetings every two weeks. In the meetings, people discussed and selected the scale of practice principles and arranged the priority of issues. The hospital then systematically examined the clinical evidence and external searching of related cases; after confirmation and evaluation, the common consensus was reached. The hospital translated the evidence into the practice principles of actual medical operation, re-examined and renewed the practice principles every season. The target hospital indicated that knowledge preservation, distribution and innovation were urgent issues. In the competitive market of Hsin-Chu, in particularly, the gradual participation of Mackay Memorial Hospital and Cathay General Hospital will start the era of "three kingdoms." It believed that knowledge application will be the key for success. The respondents indicated that the items with the best performance were "encouraging knowledge share through the establishment of organizational culture", "applying the original knowledge to other departments" and "combining knowledge in service process and quality"; the items with the worst performance were "producing new knowledge", "acquiring valuable knowledge from external aspect", "understanding the value of knowledge asset." The above were reorganized in Table 10.

As to the management of target hospital, the more complicated and difficult aspects were the following: (1) changing the employees' behavior: it is difficult to deny old thoughts. The employees generally resist changing. For example, they do not like the change of work content, change of process, modification of rotation sequence and extra responsibilities. In order to change a person's behavior, the organization should start from the essence of thinking model which is related to the aspects of society, family, economy and personality. It is difficult to observe it in short term; (2) employees were not willing to share: the employees believed that share will popularize the professional advantage. In the environment without reward, many employees were not willing to easily propose their opinions; (3) the personnel flow changed frequently and it was difficult to attract and keep the employees with unique talents: many doctors treated the target hospital as the gangway of their career lives or freshman training place of internship. After accumulating sufficient experience, they would leave the hospital. The knowledge cycle figure of A hospital was shown in Figure 13.

Table 10. The KM activities in A hospital

Activity items	Practice content and effects
1. Producing new knowledge	Proposal system, case review, clinical pathway and various conferences. However, the results are not significant.
2. Acquiring valuable knowledge from external aspect	Doctor association, internal medical education committee and other medical associations were in charge of the professional courses. Besides, there were district cooperation center and alliance hospitals holding educational training courses and specific project lectures. It had collaboration project with the medical centers of National Taiwan University Hospital, Veterans General Hospital, Chang-Gung Memorial Hospital and Mackay Memorial Hospital. Besides, it cooperated with National Hsing-Hua University, National Chiao-Tung University, Industrial Technology Research Institute and Taiwan Pig Research Institute for providing the employees advanced studies and various basic academic studies. It also cooperated with neighboring hospitals upon contract and the personnel exchange and support for each other.
3. Applying the acquired knowledge to decision making	Knowledge is saved knowledge database. The employees can acquire and operate the knowledge at any time through searching system. According to the knowledge properties, the knowledge is turned into cases and saved in decision-making system to avoid repetitive error which is considerably beneficial for medical service.
4. Involving knowledge in service process and quality	Completely promoting quality management activities. They have passed the certification of ISO 9001, ISO 17025, ISO 1518. Continuously promoting TQIP, model learning, 5S activities, quality control circle and complete quality management such as Balance Score Card and service manners to fulfill customer orientation. In recent years, service quality has been considerably improved.
5. encouraging knowledge share by the establishment of organizational culture	A series of common trainings such as executive cooperation camp, model learning, quality control circle, service manners, doctor cooperation camp, executive agent training can generally be accepted by the employees.
6. Encouraging knowledge share by stimulation	Holing case report record management training as the indicator of performance and merit, holding the evaluation of the specialized network establishment maintenance and awarding the prominent units, setting up the reward system for the employees' publication of professional knowledge papers as the base of promotion. The process was slow and gradual.
7. Transferring the original knowledge to other departments	practice principles, business regulation, clinical pathway, various conferences. Since they are business requirements, there will be the effects to some degree.
8. Understanding the value of knowledge asset	The respondent hospitals believe that knowledge application is the key for success; however, it still takes long time to allow the employees to understand and accept the value of knowledge asset.
9. Understanding the impact of KM	The target hospital believed that with the advancement of information network, the impact of KM will be infinite. However, the employees did not completely accept it. The education should start from the executives and further to the employees.

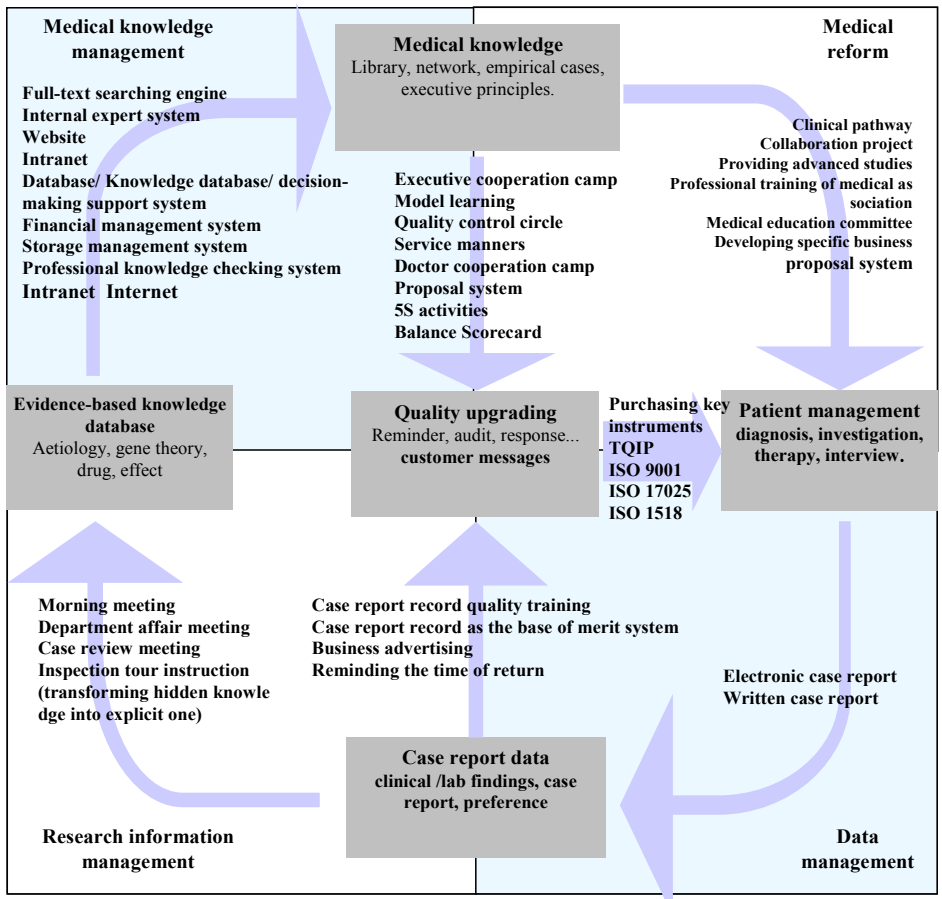

Figure 13. The cycle of medical organization knowledge in A hospital

After the patients register at the hospital, they start the patient management stage. After the medical personnel's investigation, diagnosis and review, the electronic and written case report were produced which was the process of case report database. It was the key of data management. On the one hand, case report database enhanced the medical personnel's professional and practical aspects of the content by case report record quality training and had health education promotion or reminded the patients of the return time according to different situations of the customers in data in order to upgrade service quality and have close interaction with the customers (quality upgrading, customer message). On the other hand, the hospital held morning meetings, departmental meetings, case reviews and inspection tour teaching to strengthen the aspect of information management and integrated, judged and transformed the information in case report database through the medical personnel's specialties and further combined it with external knowledge to become the case in evidence-based knowledge database. The process referred to research information management. The process

in which evidence-based knowledge database derived from the repetitive use, reorganization and introduction of the related system was called medical KM. The sources of medical knowledge were not only restricted to evidence-based knowledge database acquisition; it could also come form external specialized publications, medical review and research development and exist in libraries, network, standard business manuals, etc. On the one hand, medical knowledge database upgraded the service quality (quality upgrading, customer message) by general common trainings such as executive cooperation camp, medical affair cooperation camp, model learning and quality control circle; on the other hand, the process in which the hospital enhanced the patient management functions through various professional trainings, collaboration project, advanced studies and clinical pathway development was called. Patient management functions could be upgraded by purchasing key instruments, TQIP and ISO activities. The target hospital required itself to possess managerial depth and scope different from other hospitals in terms of management, provide the employees the spacious development and offer them the ultimately possible supports.

6. Conclusions

In all of KM establishments, the proportion of "accomplished" did not exceed 30%. It showed that KM in medical organizations was still at initial stage. However, over 70% respondents identified the positive value of KM establishments and believed that they will set it up in the future. The proportion of accomplished establishments in large scale cluster C was much higher than that of cluster A and B. It revealed that large medical organizations identified more with KM establishment and they were more likely to become KM learning organizations. The larger scale organizations were significantly better than small organizations in terms of knowledge share, knowledge transfer, KM impact and cognition of value. It showed that large medical organizations had more sensitive perception of market competition and comparing with small organizations, they understood more about the importance and value of knowledge and the significance of share which was as $KM = (P + K)^S$ proposed by Arthur Anderson which pointed out the important role of share.

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