Knowledge Management and Clinical Framework for Cross Country Healthcare Organizations

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ABSTRACT

Healthcare organizations are big source of knowledge creation. Acquiring knowledge, storing and transferring it to others in affective way has its own importance for healthcare organizations. In such organizations, clinical staff is one of the key sources of knowledge creation. This knowledge is important for healthcare organizations to diagnose the diseases and their changing conditions in better way. An intelligent knowledge management system with large amount of such information can fulfill the updated knowledge requirement for healthcare organizations. Our thesis is also consists of such techniques of gathering clinical knowledge. We have proposed a clinical knowledge management system for cross country healthcare organizations. In this study we have discussed about some current issues in clinical knowledge management and proposed our idea as a solution of clinical knowledge management. This study highlights the knowledge management process and their impact on clinical knowledge acquisition.

**Keywords:** Knowledge Management, Healthcare organizations, Clinical KMs.
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Introduction

Knowledge Management is a knowledge system to manage the knowledge production resources in business or governmental organizations [1]. The idea of KMs is to develop such systems which help the organizations in creating, storing, transferring and application of knowledge [2]. Many factors and variables are defined which are helpful in creating and sharing knowledge in organizations. Knowledge processes normally comes under the category of acquisition of knowledge, sharing, application and security [3].

Knowledge enablers are the important factors for any organization infrastructure to increase the efficiency of knowledge management processes, where knowledge processes have their own importance [4].

The medicine practice is knowledge intensive. Medical staff, like physician assistants, nurses and other clinical staff faces difficulties due to shortage of time where they have to perform several duties, and their control dissipated by insurances and third party payers. To deal with such situations technology plays important role for time saving and performing duties in easy way [5].

Knowledge management is playing important role in modern medical practices. Where research continues for applying best solutions, tools and techniques of knowledge management for healthcare decision support and healthcare education.

Advancement in technology is aimed towards reducing cost and time durations. This affect of technology has also increase the interest organizations in knowledge management tools. In healthcare organizations, Electronic Medical Record (EMR) is an example of it, which stores all patient information and helps healthcare organizations to remain update with the medical history of their patients [6].

When we talk about knowledge management tools, the web is one of the most sufficient technologies for knowledge management as it is easy in access for every one and low cost. Web can be very helpful for integration of knowledge and skill using latest web technologies like Resource Description Framework (RDF) and Web Ontology Language (OWL).

In our research we have tried to develop knowledge and working strategy for the nursing staff using knowledge management processes and techniques. We also describe how IT involvement can stream line the knowledge management process in healthcare organizations and by this knowledge strategy how healthcare organizations can give better suggestions and attention towards their patients with the ease of knowledge process.

To make our research more fruitful we targeted the key staff of hospitals that frequently interact with patients and examine their problems time to time. For more accuracy we selected two different and advanced countries in the field of medical with different culture and organizational strategies and compared both on the basis of our survey.

The structure of our research study is as follows: Our first chapter which is background describes the related work to our study. In second chapter we discussed the problem definition and goals of our research. In third chapter we discussed the research methodology for our research. In fourth chapter we described about knowledge management, knowledge management process and knowledge enablers and strategies and some main issues in healthcare organization regarding knowledge management. In fifth chapter we compared both countries knowledge management systems and discussed about our survey and findings.
In sixth chapter we have given our results on the basis of our survey and proposed framework. In seventh chapter we made some discussion about our study. Our last chapter consists on future work. In the end of our report references are given.
1 Background

1.1 Knowledge management

Transformation and summarization of data on logical patterns is called information. This information turned into knowledge when it can be used for actions and decision making. In other words knowledge management (KM) is a management model which includes intensive, coordinated and planned efforts to manage the organizational knowledge through processes for finding and making it powerful to increase the organizational abilities. The purpose of KM is to increase the knowledge creation ability and awareness in organizations. According to the study by Davenport & Prusake (1998), there are three main aims are mostly used in development of KM projects: (1) to ensure the knowledge quality and purpose of knowledge while gathering it and make is accessible through maps, books and hypertext tools; (2) to develop a knowledge intensive culture where employees can be encouraged to share their knowledge and make some efforts to acquire knowledge from other employees experience; (3) to develop a culture through which people can be connected like web using organizational facilities, space, time and tools. [9]

We can take knowledge management as a source of transforming data in to information and turning it from information to knowledge. Its larger part depends on cyclic process including different activities (Nonaka 1991). This process can be divided in subcategories, for example, for creating internal knowledge, gathering external knowledge, knowledge storage, and updating knowledge with consistency and amplifying knowledge internally and externally (Alavi & Leidner, 2001). According to existing literature (Gover & Davenport, 2001; Nonaka, 1991), knowledge management process generically can be represented as four cyclic actions: knowledge acquisition, codification of knowledge, knowledge transformation and knowledge Application as shown in Fig 1. In creation of knowledge all the activities of acquisition and knowledge development take part. The codification of knowledge depends on the knowledge conversion into accessible and actionable content. The knowledge transformation includes the knowledge amplification from the point codification of creation to the point of its use. The process of knowledge application includes accessing and applying transferred knowledge to supporting decisions, actions and solving problems. These activities are not the representation of huge set of activities, but a cyclic and interrelated set of activities. [9]

The knowledge importance in societies in general and for organizations in particular is questioned very rare and studied for a long time. So there is no doubt that in the field of KM it has injected ideas, theories, and new approaches from diverse disciplines. [7]

The industry of heath care is knowledge intensive and current developments in industry have proved it (Morrissey, 1995; Desouza, 2001). As an example of it, doctors use about two million pieces of information to deal with their patients. About a third of doctor’s time is spent in managing, recoding and gathering the information and a third of costs of a healthcare professionals are spent on professional communication. Every day new scientific findings replaces the old information. It is estimated that healthcare knowledge increases fourfold during a healthcare professional’s carrier. After this there is no doubt that one cannot perform high quality of services in healthcare without continuously updating his or her medical knowledge. As a result unfortunately the healthcare professionals cannot meet this speed of knowledge creation. Hence it becomes a difficult task for healthcare professional for mange their patients with new symptoms. [8]
1.2 Knowledge management Cycle

For any organization its knowledge is as professional mind, which deals as know-what, know-how, know-why, having the ability to motivate for creativity, good practice, ideas, culture, values and methods of working and knowledge gathering that can be shared and communicated. Knowledge could be explicit or tacit, if knowledge is in explicit form it means that it is well structured and suitable for storage and processing, like data stored in databases, if knowledge in tacit form it means the knowledge is subjective and not is not structured yet. Such knowledge needs to be structured first, so that it could be stored and used for processing like concepts, values and decisions of individuals. Knowledge management cycle shown in Fig 1, consisting four processing steps, knowledge creation, structuring, transferring and knowledge application. All four processes are described briefly an under: [17]

1.2.1 Knowledge Creation Process

The process of knowledge creation is a part of knowledge acquisition and its representation. There are many sources and methods of knowledge creation such as research and development center, learning outcomes of an organization, innovation and analysis of knowledge learned by lessons. The methods and procedures of knowledge acquisition from both sources internal and external, needs to be developed. Normally the knowledge is represented by using the formal methods settled by organizations (Wielinga, Sandberg & Schreiber, 1997).

1.2.2 Structuring/codification process

The knowledge structuring process consists of defining, storing and knowledge categorization, indexing and linking digital form of knowledge such as documents and pictures. The idea of mapping available knowledge of organization, including employees experience and skills in the sense of its context, importance and area of knowledge helps in classification of organizational knowledge. A proper storage of knowledge with proper indexing and linking with other relevant knowledge for example company yellow pages of experience and knowledge, skill development and company training materials. So planning the knowledge classification plays an important role in development of better knowledge structure. A structured knowledge system with planned classification groups same kind of documents together and keep them under one category of knowledge, which can be generated by manual or automated methods or with the combination of both. To take the full advantage of knowledge, organizations must define the multiple ways of its categorization. By this way KMs users can take the benefit of their required knowledge for the specific problem solving.

1.2.3 Dissemination/Transfer process

Knowledge dissemination process consists of different techniques and methods of knowledge sharing and collaboration. Knowledge presentation which includes searching, pulling and providing relevant content automatically to the user on the basis of user requirements. Knowledge sharing uses different means of amplification which are manual and automatic, such as training, education, documentation and newsletter and organizational literature.
1.2.4 Application process

The application process consists of applying, which includes knowledge retrieving and using. This process support knowledge in decisions, actions, solving different sort of problems and increase mapping ability to place people in better jobs for better productivity, the establishment of different communities, workflows and training the people to meet the requirements of current issues.

![Knowledge Management Cycle](image)

**Fig 1:** Knowledge management cycle. [9]

1.3 Explicit and Tacit Knowledge

In the field of knowledge management, a huge part of knowledge is tacit not explicit. That is the people who hold the knowledge usually not describe their knowledge explicitly, and some times it is not easy for them to transfer their knowledge in the form of book or manual.

Nonaka and Takeuchi (1995) developed the theory related to knowledge and its creation on the basis of division and differences of tacit and explicit knowledge, as shown in **Fig 2**, in which four parts of knowledge production are described by them:

1. Knowledge form tacit to tacit lies under the category of socialization. We can transfer our knowledge by showing instead of speaking about our knowledge.
2. Knowledge from tacit to explicit knowledge considered as externalization, in this knowledge intensive task, knowledge can be transferred by documenting it and formulating knowledge in formal procedures.

3. Knowledge from explicit to explicit lies under the combination block, where knowledge can be created through the integration of explicit knowledge.

4. Knowledge from explicit to tacit lies under internalization; it means that by performing the same task again and again leads the person to state where he or she can carry their task without thinking.

For knowledge creation, organizations required the all four types at a continuous basis. [9]

![Fig 2: Nonaka’s model of the dynamics of knowledge creation, built upon the distinction between explicit and tacit knowledge. [9]](image)

1.4 Knowledge Management Systems

KMs belong to the category of information systems used to manage organizational knowledge (Alavi & Leidner, 2001). That is, the knowledge management systems are IT-based systems and they are developed to enhance and bring effectiveness in organizational processes of knowledge creation, storage, transformation and application (Bames, 2002). Several knowledge management components depend on IT as core enabler. Current progress in IT enhances knowledge management capabilities that were not possible before. For example finding the relevant recorded source of knowledge using the facility of online databases; knowledge sharing and working in groups through internet; access of information of previous projects and getting know how about customers requirements using data mining techniques. [9]
1.5  Web Technologies and Knowledge Management

Study proves that web technology is playing important role for the integration of information and knowledge for many years. The recent development in web technologies and rapid use of methodologies and latest technological tools has allowed knowledge representation to integrate information. Different private and governmental organizations are using these technologies for their developments. Current web technologies such as Resource Description Framework (RFD) and Web Ontology Language (OWL) has change the concept of web and made it more intelligent than the old web systems. [31]

The current web developments in knowledge management are contributing significantly for the performance of KM like;

- Knowledge integration.
- Involving human role for the integration of knowledge management.
- Introduced social networks to increase social activities.

1.6  The Nursing Process

Nurses Association of USA describes nursing as “The diagnosis and treatment of human responses to actual or potential health problems” In year 1980, and nursing procedure involve these phases or steps: [9]

1.6.1  Assessment

This is very important and serious step and analyses of answering some questions, e.g. what is the real problem and what is happening, or some time it depend on prediction that what might occur. In this particular step organizing, analyzing and collection some particular data about related patient to place. Data collection done by examine different tests, interviewing the patients, and personal observations, normally we have subjective or objective data. Symptoms about disease that patient explains, e.g. I can’t stand up, and then Signs that are normally observe by experts, e.g. swollen tissues,

1.6.2  Diagnosis

Diagnosis is a suggestion or statement that explains some human reaction to reality, or some kind of possible health troubles that necessitate nursing involvement.

1.6.3  Plan

This phase helps to give reliable and incessant care that match the patients unique desires, this is important if achieve patient targets and nursing order, patients targets are connected with patients issues as mentioned in diagnosis, and explain the required output of nursing care and nursing order explain how nurse help patient to attain specific targets.

1.6.4  Implementation

This phase apply the tactics required to implement nursing order. And one of the important job which involve reassessing patient, and also justify weather the care plane is precise, engaging nurses order and maintaining the chart of patient care and situations.
1.6.5 Evaluation

This is a comparison phase in which patients current status is compared with patient goals, and normally it consists of: assess quality of hardcopy of care plan, assess customer progress, and assess status of care plan. Nursing guidelines and protocols are normally called nursing practice and these protocols help out the care health proper delivery. In general nurses use health care knowledge with the use of their own experiences and now a day’s enabling technology is working in these kind issues.
2 PROBLEM DEFINITION/GOALS

Normally hospitals are known as knowledge intensive units, and in hospitals knowledge is represented in different features, some of them are following. Treatment record in hard and soft format, In detail summary before any operation, meetings and discussions after operation, death issues, etc [10]. Knowledge in hospitals also includes personal, equipments, hospital management.

Many healthcare organizations are facing lack of knowledge. The reason behind it that healthcare organizations in developed countries are lacking of processes for knowledge management. So they face difficulties while acquiring the knowledge due to its rapid growth. Moreover they cannot meet the requirements of knowledge capabilities in their professional activities, which is a big hurdle to improve the efficiency and quality of treatment [11]. Ignoring knowledge management and its capabilities is another reason of it. The existing problems in healthcare knowledge management are as follows: the first reason is illogical distribution of knowledge. Large amount of knowledge which should be acquired by the healthcare organizations is still tacit. Main source of knowledge creation is grass root level staff, where the upper staff knowledge is built on old information. The second problem is lack of knowledge sharing culture; one department has no such contact with other where both can share their knowledge, this problem leads them towards the narrow vision of knowledge, and as a result it becomes difficult for healthcare organization to work as a group. This problem leads organization to the falling of efficiency. The third main reason is the lack of knowledge acquisition system in healthcare organizations due to these reason healthcare experts cannot keep themselves updated, and the knowledge in large amount remains out of their reach. [12]

As the main source of information in hospitals is the middle level or the grass root level staff, it means this is the nursing staff of the hospital that examines and experience the new knowledge during the patient care. So it is really important to get knowledge with this source of experience. As much as hospital with take advantage of this knowledge they will improve with patient care and will be able to share with other hospitals.

2.1 Challenge/problem focus

The areas of investigation from both countries in this research are as under:
1. What are the main components of KM process and infrastructure for healthcare organizations?
2. To support and improve nursing role in healthcare what type of KM characteristics are required?
3. What type of knowledge system required for cross country knowledge collaboration?

2.2 Goal/Result

1. Conducting comparative study of KM at the level of workers connected to knowledge.
3. Understanding, to support and improve nursing role in healthcare what type of KMs is required?

The goal of this study is focus on the role of KM in the nursing and patient care in healthcare organizations. During the patient’s treatment in hospital, the interaction between the nursing staff and the patients is very important knowledge acquisition and transfer event. This is the nurse who observes the changing conditions of patient. This knowledge observed by the nurse causes the discussing between nurse and physician who involved with the patient’s care. On the basis of this discussion and transfer of knowledge physician suggests the better treatment and tests for fast and better patient cure.
3 **METHODOLOGY**

Under the definition of research methodology we consider the following: research activities, research processes and measures or metrics. For conducting research there are several approaches. In these approaches qualitative, quantitative and mixed research methods are mostly used. Qualitative and Quantitative research approaches are normally differs with each other. To describe human knowledge and experience, qualitative research is the key tool. The purpose of qualitative research is to describe the social world view, through detailed descriptions of their symbolic actions, and through rich meanings and observations. [13]

“Mixed method research in which the researcher uses qualitative research paradigm for one phase and the quantitative research paradigm for a different phase of the study”. [14] Mixed method research is the best method to collaborate the qualitative research and quantitative research methods. Mixed research method provides free, realistic and sensible approach to researchers to get best solutions to their answers.

We used the mixed research methodology for our research findings, and conducted both qualitative and quantitative research methodologies. Study is divided into two parts; first part consists on literature review, in this part we have studied the literature about our research area and questions. The second part consists on survey and interview which we conducted in healthcare organizations. We conducted the survey and interviews to investigate current level of Knowledge management in hospitals and nursing system. We studied the literature to highlight the research work done by Knowledge management experts, and to gain knowledge about latest research on Knowledge management and to support our ideas.

The following figure shows the flow of our work.

Figure 3 describe the process of obtaining the results. First of all we identified the problem to understand the research related knowledge and to set our scope we did some study. In second step we planned our whole work with the time. Our next step we selecting the research methodology for our research. So we selected a mixed methodology to achieve our goals. First of all we reviewed the literature to get some knowledge that what literature says about our research area.
3.1 Literature Review

Literature review is an important part to know about what other researchers says about that particular research topic. For getting the answers of our question and to gather information about our topic we did the deep literature study. We searched on different search engines and research portals like ACM and IEE and some other sources of research material like ebrary, Science direct and get some informative and useful articles related to our research, keeping in view consulting with latest research articles. All these sources of research are very well known among researchers to make their research affective and up to date. We also reviewed by some books related to our research subject and research topic.

We focus on to know more and more that what other researchers have done yet on knowledge management strategies in the area of healthcare. We also go throw with some web sites of healthcare organizations to get some information that how they are improving healthcare facilities through their knowledge and management.

While collecting the material (articles and books) on our research topic we keep some factors in our mind which are as under:

- Quality of research
- Source of information
- Relevance of data and information to our topic
• Suggestions and findings

3.2 Organization Survey

Before starting the research, it is important to know the latest trends of the organizations. We conducted our survey in Swedish and U.S healthcare organizations to know their current state of applying knowledge strategies. For our survey we selected the renowned healthcare organizations from both countries. In our survey we focus on some critical and problematic areas regarding knowledge management and patient health care. For this purpose we tried to approach the hospital staff (nurses, charge nurses and nurse supervisor) that has key roll in all this practice to manage knowledge. We interviewed to staff that were present in that shift with some close and open ended questions.

Our questions were focus on their knowledge strategies during their work. Open ended questions were as under:

• How do you follow the knowledge management process or strategy?
• What type of knowledge you normally exchange and through which process?
• How your knowledge strategy helps you to improve your practice and patient dealing?

Our questions were focusing to know the views of staff about their organization’s strategy to manage knowledge. For our survey we selected two large healthcare organizations, Karolinska University Hospital Sweden and Bridgeport Hospital Ct United States on the basis our working experience with them and was sure that these organizations are working to develop patient health care strategies.

Karolinska Hospital Sweden has facility of 1600 beds, 14,500 employees, 600 physicians and 2100 nurses. Karolinska University Hospital is recognized for the quality healthcare. The goal of hospital for future healthcare based on current technology. The organization is striving for the achievement of its goal to recognize as Europe’s top hospital by 2011. Finally behind every activity in this organization there is some courage to enhance their expertise and abilities in healthcare. In this region this hospital is one of the advanced and specialized healthcare organizations. Healthcare services in this organization are looking after by 8 divisions including 69 departments and units. [15]

Where Bridge port Hospital Ct United States has the facility of 800 beds, 3,000 employees, 600 physicians and 900 nurses. The goal of this organization for quality healthcare is to achieve patient satisfaction by getting results through their best clinical outcomes in an efficient working environment. Top quality of healthcare facilities and safety are at their priority list. The organizational staff is committed in enhancing the patient care abilities, applying performance management initiatives. This organization is dealing patients with the services of Rehabilitation Center, Anesthesia and Pain Management for Surgical Patients, Antenatal Testing Unit, Bloodless Medicine and Surgery, Burn Center, cardiology center, Cancer Institute, diabetes care center, and many other medical facilities. [16]
Knowledge management is a systematic and active process of managing the knowledge in an organization. It is the well process of transferring information from individual to individual [27]. With the passage of time more and more research is being done and knowledge is increasing in every field. So with this increase of knowledge, organizations are becoming knowledge dependent. To manage their increasing knowledge has become the need for every organization, as they want to make advancement in their functionality and performance with ease, otherwise the organization could collapse or could create bad reputation because of its bad knowledge management process.

As compare to other organizations, the need of knowledge management is high for healthcare organizations because many human lives are dependent on their service and perfection. This improvement in service and perfection can come only through better knowledge management in healthcare organizations.

Knowledge management is a new concept and related with creating organizational models with all aspects of knowledge, including knowledge creation, codification and knowledge sharing. Knowledge management covers both technological tools and organizational routines. Integral components of knowledge management are as follows: [18]

- New knowledge generation
- Access to valuable knowledge form different sources
- Using knowledge in decision making
- Knowledge enabling in processes
- Knowledge representation
- Knowledge growth with culture
- Knowledge transfer

4.1 Knowledge Categories

Mostly knowledge is categorized according to the object of knowledge development. Categorization put strong impact on knowledge development process. Different categories of knowledge are described as under: [19]

4.1.1 Tacit Knowledge

Every human knows more than he can express to others. This category of knowledge plays an important role in development of knowledge, transfer of knowledge relative to the interaction of explicit and tacit knowledge.

4.1.2 Embodied Knowledge

In this category, knowledge produced through experience and project works. The emphasis lies on the knowledge development process.
4.1.3 **Encoded Knowledge**

Knowledge that remains the part of organization after leaving its employees. Documents, employees, customer records, rules, regulations, organizational literature and training material.

4.1.4 **Embrained Knowledge**

This category of knowledge depends on the learning and judging abilities which allow of the recognition of underlying patterns for example a new industry.

4.1.5 **Embedded Knowledge**

Embedded knowledge lies in knowledge process and development. This type of knowledge embedded in different factors. Different organizational cultures, work groups and languages generate shared knowledge.

4.1.6 **Event Knowledge**

This category of knowledge describes regarding knowledge of events, occurred within or outside the organizations.

4.1.7 **Procedural Knowledge**

This knowledge is different from event knowledge and a large part of it lies under knowledge processes but opposed correlations e.g. if…..then and different scenarios.

4.2 **The process of Organizational Knowledge Creation**

4.2.1 **Individual’s Knowledge Enhancement:**

The key figure of knowledge creation in any organization is the individual. Individuals directly gain tacit knowledge by their experience. There are two important factors that influence the quality of this knowledge. First factor is the “variety” of experience in an individual’s personal experience. In case this experience is limited or short about specific field knowledge, then there are more chances that this amount of repetitive knowledge and experience will be decrease gradually. Routine and repetitive tasks reduce the creative thinking and creation of new knowledge. How ever it is not compulsory that the variety of experience will improve the quality of tacit knowledge. If individual have several unrelated experiences then there will be small chances that they can be integrated to create some new ideas.

The second factor that determines the quality of individual’s knowledge is “knowledge of experience”. The core of “knowledge of experience” is structure of knowledge gained through vast experience and commitment. The concept of “high quality experience” and “knowledge of experience” may raise the tacit knowledge quality, the quality of tacit knowledge helps to balance the quality of further approach and knowledge, such types of approaches called “knowledge of rationality,” which describe the balance in experiences. To raise the over all quality of individual’s knowledge, the enhancement of tacit knowledge is
dependent with the continuous relation of relevant aspects of explicit knowledge. Individual knowledge can be enhanced by the interaction between experience and rationality. [20]

4.2.2 Sharing Concepts and Tacit Knowledge

As we discussed in previous section about individual’s tacit knowledge enhancement. This treasure of knowledge remain personal unless it is amplified through social interaction and more and more discussions. Another way to create “field” or “self organizing team” of individual members where they can interact with other members of same field to transfer their concepts and create new ideas. To amplify the personal knowledge and introduce it with social context and to solve the problems regarding individual’s concepts the creation of “field” is necessary.

4.2.2.1 Experience Sharing

For starting the process of concept creation using “self organization team”, the first step is to create mutual understanding among participants. The easy way to create mutual understanding is to share one’s original experience- the basic source of tacit knowledge

4.2.2.2 Conceptualization

Once the mutual understanding builds among the members of “self organization team” through experience sharing, the team needs to clear the perspective through dialogues. Externalization is useful model here to create good knowledge conversion. Externalization is directly facilitated by this process activity of dialogues.

![Organization Knowledge Creation Process](image-url)
4.2.3 Crystallization

The knowledge and ideas are created by the individuals or members of “self organizing team” has to be form in any product or a system. The conversion of knowledge in concrete form is called crystallization.

Crystallization is related with socialization and this process is controlled at group level. This is also called “synergetics” between different organizations and departments. This is most effective way to gain knowledge when the critical knowledge conversion takes place.

4.2.4 Justification and Knowledge Quality

Normally knowledge is defined as “justified true belief”. The transformation of knowledge required the base of justification and truthfulness of idea. Justification is a valid argument for the quality of knowledge. The advantage of transforming knowledge is to make knowledge qualitative and simple.

4.2.5 Knowledge Networking

In this stage of knowledge creation, the concept and knowledge has been created and justified and merged into organizational base system which consists of the whole organizational knowledge network. After this the organizational knowledge base system reorganized and passes through multi inducing system to merge new knowledge with already existed knowledge.

4.3 Knowledge Management Models

Taking the advantage of knowledge in effective way and to manage the knowledge in well manner there is always need for the knowledge management model. Some largely used knowledge management models are discussed as under:

4.3.1 Knowledge Management Capability Model

To make the knowledge management more effective for organizations Gold et al. (2001) examined the issues with organizational capabilities point of view, and suggested the given model shown in Fig 5, this knowledge model consisting on technology, structure and culture including knowledge process architecture of acquisition, conversion, application and important organizational capabilities for valuable knowledge management. [21]
4.3.2 Nonaka’s Knowledge Management Model

Nonaka’s model is a high level of knowledge management representation model. The models of this category are discrete components of knowledge management. Nonaka’s knowledge management form is shown in Fig 2. This model describes that transformation of tacit knowledge in other processes is possible through the process of socialization. The externalization process can change tacit knowledge, from tacit to explicit knowledge. This model also describe that explicit knowledge can be transformed into tacit knowledge using combination process.

4.3.3 Boisot’s Knowledge Management Model

Boisot’s model is an example of knowledge category model. Within an organization this model describes knowledge as codified or uncodified and as diffused or undiffused. The term codified in this model is used to describe the prepared knowledge for transmission purposes e.g. financial data. The term uncodified describe that knowledge is not easily available for transmission purposes e.g. experience. The term diffused describes that knowledge is available for easy sharing where the term undiffused describes that knowledge that is not available for easy sharing. The diagram of Boisot’s model is given below:
4.3.4 Intellectual Capital Model or Skandia IC Model

This model is based on the assumption that knowledge can differ in three elements of growth: human, customer, and process. These elements are part of other two categories: human capital and organization capital. Like Nonaka’s model, this model assumes that it is possible to decompose knowledge management into objective elements. Another assumption in this model is that knowledge can be treated as an asset of the organization, similar to other organizational assets.

![Diagram of Intellectual Capital Model of Skandia IC Model](image)

4.3.5 Demerest’s Knowledge Management Model

The main focus of this model is knowledge construction within organizations. This construction of knowledge is not limited to specific scientific inputs but also includes social knowledge construction. According to this knowledge model, the implementation of knowledge in an organization is not complete with explicit knowledge but also includes the process of social interchange. **Fig 8** is a modified version of Demerest’s model, which solves the limitations of explicit knowledge as were in Demerest’s old model, and this puts a positive impact both on social and scientific knowledge constructions.
4.4 Ten Principles for Effective Knowledge Management

To improve the knowledge management practices is always the core issue for organizations. There are different factors that urge the organizations to improve their facilities; these factors are processes, demands and organizational desire to grow up in their domain. To make knowledge management effective is not an easy process. There are many systems which are compulsory to build a strong knowledge system for organizations with complex culture. The key goal of these principles is to make knowledge system effective and successful. [22]

1. Find out the complexity
2. Better system adoption
3. Provide concrete benefits
4. Set priorities according to organizational needs
5. Adjustable and planed system
6. Strong cooperation
7. Reduce risks
8. Create environment for discussions
9. Always validate new knowledge experience
10. Carefully follow the organizational rules.
4.5 Knowledge Management and Healthcare

Knowledge management is a growing field. The goal of knowledge management is to support in actions, facilitating with “a knowledge pull” instead of increasing knowledge load in healthcare. There are many reasons for adopting the better knowledge management practices in healthcare, like patient safety, supporting care and reducing treatment cost are the factors for knowledge management adoption. Knowledge management also supports to apply better approaches in prescribing of medication and way of curing or tests, and as a reminder of best practices used for the particular problems. To dealing with tasks we always need knowledge, and for better dealing the relevant knowledge from domain knowledge source is essential. The challenge in healthcare is to increase such knowledge systems in active manner so that healthcare professionals could take the rich benefit for their routine purposes. For many years healthcare professionals are relying on fixed and specific amount of knowledge and records to deal with their patients. This system was full of limitations and hurdles to deal patients in effective way, on the other hand there was no system to share knowledge with others. So by the passage of time healthcare professionals felt the necessary of advance systems to strengthen their organization’s information system. [23]

Like every organization, also in healthcare organizations knowledge creation take place at individual and group level. Several gathered parts at this level might be raw data, and after processing it transforms into information, this information is used for experience, learning and to train organization employees to create knowledge, as shown in Fig 9. [8]

![Fig 9: Staged look of Knowledge management in hospitals.][8]

4.6 Knowledge Management Processes

The core of knowledge management is KM process. There for a lot of research work has been done on knowledge management phases and processes. [24]
Anderson and APQC [1996] proposed the process to convert the knowledge from tacit to explicit, so that all the members of an organization can take benefit by each others experiences. Delphi [1998] proposed four steps of knowledge management process. Knowledge created through research and experience, considered under the “capturing” process. The amplification of knowledge is the part of “sharing”. Knowledge transformation in product or service is the definition of “leveraging” process. Embedding knowledge to increase the value of service is the part of “feeding”. Demarest [1997] divided KM processes in three parts; “construction” describes the designing and discovering knowledge. “Embodiment” discusses the selection of knowledge. “Dissemination” describes about technical infrastructure that uses the embodied knowledge accessible for the other persons of organization. Below mentioned Table 1 is the summary of some major proposed KM process.

<table>
<thead>
<tr>
<th>Author</th>
<th>KM Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthur D. Little [1998]</td>
<td>Acquisition and creation, Saving, Dissemination, Use</td>
</tr>
<tr>
<td>Delphi [1998]</td>
<td>Capturing, Sharing, Leveraging, Feeding</td>
</tr>
<tr>
<td>Demarest [1997]</td>
<td>Construction, Embodiment, Dissemination, Use</td>
</tr>
<tr>
<td>Ernst &amp; Young [1998]</td>
<td>Planning, Acquiring, Applying, Assessing</td>
</tr>
<tr>
<td>Jang &amp; Lee [1998]</td>
<td>Knowledge acquisition, Schema codification, Knowledge codification, Knowledge retrieval, Knowledge embedding, Problem analysis, Problem solving, Knowledge shaping</td>
</tr>
<tr>
<td>KPMG [1998]</td>
<td>Creation, Application, Exploitation, Sharing and dissemination, Encapsulation, Sourcing, Learning</td>
</tr>
<tr>
<td>Lee &amp; Kim [2001a]</td>
<td>Accumulation (acquisition and creation), Integration, Reconfiguration</td>
</tr>
<tr>
<td>Nenzi et al [1995]</td>
<td>Acquisition, Dissemination, Utilization</td>
</tr>
<tr>
<td>Nonaka &amp; Takeuchi [1995]</td>
<td>Sharing tacit knowledge, Creating concepts, Justifying concepts, Building a archetype, Cross leveling knowledge</td>
</tr>
<tr>
<td>Pentland [1995]</td>
<td>Construction, Organization, Distribution</td>
</tr>
<tr>
<td>Ruggie [1997]</td>
<td>Generation, Codification, Transfer</td>
</tr>
<tr>
<td>Schumpel et al [1998]</td>
<td>Use and multiplication, Development and acquisition, Transfer, Institutionalization</td>
</tr>
<tr>
<td>Stein &amp; Zwass [1995]</td>
<td>Acquisition, Retention, Maintenance, Search and retrieval</td>
</tr>
<tr>
<td>Szulanski [1996]</td>
<td>Initiation, Implementation, Ramp-up, Integration</td>
</tr>
<tr>
<td>Spek and Spierver [1997]</td>
<td>Developing, Distributing, Combining, Holding</td>
</tr>
<tr>
<td>Walsh &amp; Ungson [1991]</td>
<td>Acquisition, Retention, Retrieval</td>
</tr>
<tr>
<td>Wilg [1995]</td>
<td>Creation, Manifestation, Use, Transfer</td>
</tr>
<tr>
<td>Winhoven [1998]</td>
<td>Acquisition, Retention, Search, Maintenance, Dissemination</td>
</tr>
</tbody>
</table>

Table 1: KM process summary [24]

4.7 Knowledge Management Enablers

Knowledge management is a complex process which is supported by enablers such as strategy, leadership, culture, measurement and technology. Different researches resulted that IT infrastructure plays an important role in supporting knowledge creation and transfer especially where technology is not in ready state to amplify. [25] [26]

The table containing summary of KM enablers is given below:
<table>
<thead>
<tr>
<th>Author</th>
<th>KM Enablers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthur D. Little [1996]</td>
<td>Organizational culture, IT, Strategy, KM processes, Content</td>
</tr>
<tr>
<td>Delphi [1998]</td>
<td>Organizational culture, IT, Strategy, KM processes</td>
</tr>
<tr>
<td>Demarest [1997]</td>
<td>Culture, Operational, Technical</td>
</tr>
<tr>
<td>Ernst &amp; Young [1998]</td>
<td>Organizational culture, IT, Strategy, KM processes, Knowledge content</td>
</tr>
<tr>
<td>KPMG [1998]</td>
<td>Organizational culture, IT, Strategy, KM processes</td>
</tr>
<tr>
<td>Lee &amp; Kim [2001a]</td>
<td>Knowledge worker, Content, IT, KM processes</td>
</tr>
<tr>
<td>Leonard-Barton [1995]</td>
<td>Strategic intent, Core capability, Signature skill, Creative abrasion, Continuous, experimentation, information-porous boundaries, Cognitive variety</td>
</tr>
<tr>
<td>Nevis et al [1995]</td>
<td>Ten factors (ex. openness, operational, variety, leadership)</td>
</tr>
<tr>
<td>Nonaka &amp; Takeuchi [1995]</td>
<td>Organizational intention, Autonomy, Fluctuation and creative chaos, Information redundancy, Requisite variety</td>
</tr>
<tr>
<td>Pan &amp; Schhovaupp [1996]</td>
<td>Culture and strategy, Technology, Organizational learning, Measurement</td>
</tr>
<tr>
<td>Pentland [1995]</td>
<td>Social interaction</td>
</tr>
<tr>
<td>Probst [1998]</td>
<td>Top management support, Organizational structure</td>
</tr>
<tr>
<td>Szulanski [1996]</td>
<td>Knowledge content, Source and recipient, Context</td>
</tr>
<tr>
<td>Spok and Spjervet [1997]</td>
<td>Organization and personnel, IT, Management, Culture and motivation</td>
</tr>
</tbody>
</table>

Table 2: Summary of KM enablers [24]
5 KNOWLEDGE MANAGEMENT & CLINICAL SYSTEM

The main goals of any information strategy in healthcare organizations are knowledge intensive, high performance, information flow, quality, better care and customer satisfaction. Knowledge management is a powerful tool that can help organizations to meet their goals. A successful knowledge management system leads organizations towards better knowledge sharing culture and build concrete organizational infrastructure.

After reviewing the literature and latest research work on improving organizational clinical system, we conducted the survey and interviews from workers of healthcare organizations to know about their current information and practices using knowledge management strategies.

In this chapter we have discussed about survey and interviews, their answers and statistical analysis of current situation of knowledge management in two countries. We also discussed about our findings as the result of our research.

5.1 Survey Plan

To make our survey successful and reliable we tried to get better and more accurate results, we contacted to many organizations from Sweden and USA, but we get feedback from only two organizations, one from each country. In the questionnaire we included open ended as well as close ended questions, depending upon the nature of question. To conduct this survey, we selected/target the low level management instead of high level management. After conducting our survey we did some statistical analysis to analyze our final results.

5.2 Survey Design

To conduct the survey, we designed a questionnaire based on literature review and all the other information gathered during research; this questionnaire included both open and close ended questions, depending on the nature of question and required feedback. As we believe that healthcare system is knowledge intensive and the knowledge capability model is a standard model used for healthcare organizations [21]. So we kept in mind the capability model while designing our survey questions. But during making contacts to different organizations about our survey distributions we observed that many small organization’s workers have not much knowledge about knowledge management strategies so to increase the participation and to include such workers ideas in our research we also designed some open ended questions. Close ended questions were used as online questionnaire, for interviews we used telephonic way because it was not possible to interview in person. Both questionnaires are given in Appendix section.

5.3 Cross Country Survey Demographics

The cross country demographic is shown in Table 3. In U.S the average education of nurses is about 1.3 or more years where the same situation is in Sweden. Nurses also showed few years in their job experience which indicates the huge turnover in nursing.
The great turnover of face to face communication with patients is shown by the nurses of both countries. Where the telephonic conversation and emails are very small in percentage in both countries. Even the same situation is in internal communication system. Where nurses relay more on personal interactions. The demographic table is given below:

<table>
<thead>
<tr>
<th></th>
<th>U.S Healthcare</th>
<th>Swedish Healthcare</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean, SD</td>
<td>Mean, SD</td>
</tr>
<tr>
<td>Education</td>
<td>14.23, 1.27</td>
<td>13.94, 1.24</td>
</tr>
<tr>
<td>Work Exp</td>
<td>4.06, 1.64</td>
<td>3.71, 1.72</td>
</tr>
<tr>
<td>Prof Exp</td>
<td>8.30, 4.52</td>
<td>7.81, 4.54</td>
</tr>
<tr>
<td>% of comp usage</td>
<td>2.65%, 1.47%</td>
<td>2.98%, 1.33%</td>
</tr>
<tr>
<td>Working Collaboration</td>
<td>58.59%, 16.85%</td>
<td>50.65%, 17.09%</td>
</tr>
<tr>
<td>Communication with pat in %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Email</td>
<td>1.90%, 1.25%</td>
<td>1.05%, 1.11%</td>
</tr>
<tr>
<td>Phone</td>
<td>2.75%, 1.52%</td>
<td>2.31%, 0.90%</td>
</tr>
<tr>
<td>Face to Face</td>
<td>88%, 9.99%</td>
<td>81.47%, 10.82%</td>
</tr>
<tr>
<td>Internal comm in %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Email</td>
<td>3.54%, 1.64%</td>
<td>3.23%, 1.07%</td>
</tr>
<tr>
<td>Phone</td>
<td>6.84%, 1.68%</td>
<td>7.39%, 1.22%</td>
</tr>
<tr>
<td>Face to Face</td>
<td>72.59%, 11.14%</td>
<td>89%, 12.66%</td>
</tr>
</tbody>
</table>

Table 3: Survey Demographic

5.4 Survey Analysis

Due to intensive nature of healthcare system we designed our survey on the basis of knowledge capability model [21]. Each question is representing the each part of the model and the percentage is showing the component relation in model; the questionnaire is given in Appendix A. According to the survey statistics in both countries shown in Chart 1, the ratio about organizational functionality is almost the same. This chart shows that both countries are trying to implement latest trends to treat their patients. As both countries having the almost same situation they are lacking with organizational culture, acquisition, conversion and application system.

5.5 Conducting Interviews

Along with the survey we also conducted telephonic interviews with the healthcare organization staff nurse supervisors, charge nurses and other nursing staff to know their opinion and suggestions about knowledge management, and about their organization working. The questions were open ended; the questionnaire is given in Appendix B. Some questions we asked are given as under:

- How do you follow the knowledge management process or strategy?
What type of knowledge you exchange and through which process?

How your knowledge strategy helps you to improve your practice and patient dealing?

5.6 Organization Selection

For our interviews and survey we contacted to many hospitals in U.S and Sweden, but most of them were not interested in any type of interview or survey. During contacting organizations we observed lack of coordination between departments of different organizations. Eventually we succeeded to get some positive response from each organization of both countries as we discussed the organization information earlier the Karolinska Hospital Sweden and Bridgeport Hospital Ct, United States. We took the interviews of clinical staff present at the time of interview including nurse supervisors, charge nurses and other staff nurses.

5.7 Interview Findings

During the interviews nurses informed us about different IT application they are using during their duty hours including record system for patients where they maintain log notes about
their patients. For checking medication’s side effects, a pharmaceutical system is used to connect with pharmacy system. Mostly the source of interaction among staff is face to face, or on telephone, and very less with emails. Below we have given some personal views of the staff about their organizational system and strategies:

The nurse supervisor says “At the end of our shift we conduct meeting with next shift’s staff to inform about the conditions of the patients. Each floor of the hospital has the separate supervisor and charge nurse and other staff. So, on every floor they conduct such meetings.” This quote describes about the organizational culture and gives us idea about the importance of organizational culture that how meetings could play important role in knowledge creation and conversion. But there is flaw in this, that this knowledge is not being transferred to rest of the floors nurses. That is why in large organizations such staff has not enough contact with the staff of other floors and same situation for other healthcare organization that these sort of knowledge cannot be amplify to others.

On the other hand technology and infrastructure plays an important role in health care organizations [27]. The following point of view of a charge nurse defines the importance of infrastructure to enhance the nursing practice. The charge nurse described about “To make patient chart on daily basis is our knowledge transfer process. This chat is about patient symptoms that a nurse observes.” After this statement another point raised that this form of explicit knowledge also can be used as a training material not only for the nurses of inside the organization but also for the nurses of other organizations.

Healthcare information system can be defined as a very high level of knowledge creation to find out the problems. The interaction between clinical staff and the patients is a big source of knowledge creation [28]. According to the above opinion of the staff we conclude that knowledge conversion cannot be good enough till then working on the enablers of organizations for knowledge management. This also shows that the acquiring knowledge is more important than the conversion, because well acquired knowledge can result the good knowledge conversion.

We also analyzed the views of nurses, one of them is as “The doctors/ providers comes to visit the patient once in a day for few minutes. Its our duty to look after the patient and observe the changing symptoms of the patient during their care and conversation with them. We try to note every changing condition in our charts and if necessary we call the doctor to examine the patient. So before examine the patient doctor go through with the charts first.” After this one thing is very clear that nursing staff plays an important role in helping the doctor for better treatment of the patients and this impact on the overall medical treatment. Without implementation of knowledge management system this nursing process could cause different problems, but this process can be more effective with the implementation of knowledge management system because the knowledge system definitely will increase the nursing efficiency and power to take decisions for better observations.

The healthcare organizations have made the standardized procedures to maintain healthcare, and every organization is following the same functions. This standard needs to acquire knowledge from the nursing processes. [12]

5.8 Knowledge Management in Nursing

The nursing process in healthcare organizations has the similarity with the Fishcher and Ostwald knowledge creation model as shown in Fig 10. As we observed by our interviews that after interaction with patient, nurses store the created knowledge in their KM system. In future this is available for other nurses and doctors to give better service to the patient.
Nurses share this knowledge in different ways with other nurses and doctors. This knowledge transfer could be shift meetings, during the rounds of patient ward and through charts. The interaction between patient and staff is a very degree of knowledge creation and application, this interaction is the real source of knowledge creation in healthcare organizations.

![Diagram of Knowledge Creation process](image)

Fig 10: Knowledge Creation process [29]

### 5.9 Knowledge Management Processes in Healthcare Organizations

There are four basic processes for clinical knowledge management system, which we identified with the help of our research, literature study and interviews. These four processes are as under:

#### 5.9.1 Knowledge Acquisition

To make interaction with patients during rounds is a source of new knowledge generation. This knowledge can be improved by using this knowledge for nursing education. Nurse supervisor must play their role to identify best interaction procedures and facilitate nurses with meeting for knowledge exchange.

#### 5.9.2 Knowledge Application

Knowledge acquired by experience and gathered through meetings with staff is required to merge in standardized nursing systems with the help of tutorials and force the nurses to use their new acquired knowledge to interact with patients for better problem solving and for better new knowledge creation. So this more reliable recorded knowledge can help the physicians to make better diagnosis.

#### 5.9.3 Knowledge Conversion
To improve nursing services using new created knowledge, the literature containing daily meeting discussion should be distributed throughout the organization staff, and make changing accordingly in patient charts. This way of knowledge conversion and distribution will gradually help to eliminate the old knowledge and an updated knowledge will take place.

5.9.4 Knowledge Protection

Patient record and organizational knowledge data is an asset for any organization. So this record must be protected from the access of the people other than the organizational staff using staff logins, authentications and by maintaining log files to keep the record of accessed data by the staff.

5.10 KM Characteristics for Supporting Nursing Process

The main advantage of knowledge management system is that it helps the healthcare organizations to increase their efficiency; it means an effective knowledge management system put its impact in every area of healthcare system in healthcare organization including nursing processes [30]. The effective delivery of health services depends on the ability and approach to provide valuable services systematically and in well manner. Culture and organizational policies are the key factors for building and developing better knowledge management system. Knowledge management system stores the every information feed given by the staff or the management, and in the feedback it provide better and efficient mechanism not only to increase staff efficiency but also generates organizational health service efficiency statistical reports. So that healthcare experts can easily analyze their graph of success and if needed they can make changes in their policies and organizational culture rules to implement better service plan. In the given Fig 11 it is shown how knowledge system generated reports and information entered by management and staff can help organizations to make better policies.

Nursing systems have five basic processing steps: assessment, diagnosis, plan, implementation and evaluation. During the assessment process a knowledge management
system can provide help to nurses while collecting, organizing and analyzing patient information on the basis of previous records of the patients with similar conditions. So the staff can inquire from patient about his/her symptoms with the help of information provided by KMS. Same as in next step diagnosis the clinical staff and physicians can diagnose patient accurately due to effective and brief information gathered from patients. In next step plan, clinical staff can take decision that in specific problem what procedures they can adopt to better look after the patient and how they can achieve their desired goal about patient care. In implementation step the clinical staff can get information that what sort of skills and equipment is required to look after the patient so that they can take valid and accurate steps without any mistake. In last process evaluation staff can double check their progress in achieving goal of patient care and also can evaluate their care plan and quality on the basis of information provided by KMS.

5.11 Knowledge Management System for Cross Country Clinical Support

To support cross country clinical system and to get help and to take benefit from each others clinical knowledge experience, we have proposed a web based KMS. As we observed by the interviews that charge nurse or the supervisor is the only key person who can help the nurses during their duty hours. As on each floor there is one supervisor and more than fifty nurses perform their duties. So it is a difficult task for a supervisor to deal with all staff with great attention and presence of mind. While contacting for interview with different organizations, specially some small organizations to know about their knowledge management systems we come to know by staff views that they don’t use any computerized system for such tasks. So there is big problem for this kind of small organizations and nursing homes to deal their patients with the help of latest and well developed knowledge. In our proposed system we have explained that how with the help of our system, clinical and other staff can take advantage by the experience of other organizational clinical staff weather they are in same country for from cross country organization.

We designed our web based KMS using standard knowledge capability model which is according to literature review most of the organizations are implementing and keeping in view the requirements gathered during our survey and interviews. Some organizations are using their knowledge management systems within the organizations, but this can provide more help with reliable acquired knowledge from other organizations.
6 RESULTS

Nursing process is a complex and knowledge intensive system. It is highly depends on nursing knowledge and experience. It is very important from healthcare point of view that whether nurses can perform these processes effectively or not. Current technology is enough efficient to affect the nursing expertise and knowledge. Although patient care is a difficult task and it highly depends on health information containing by healthcare organization staff [9]. As much as the healthcare organization staff increases their ability to deal with patient it will help them cure patient with correct diagnosis. Healthcare knowledge management system is a key source for healthcare organizations to make their staff more efficient and experienced with the help of such intelligent knowledge management systems. As in previous chapters we have quoted the views of different nursing staff and get information about their working procedures, by this information we concluded that there is lack of knowledge sharing between clinical staff. Especially in big organizations where staff is performing their duties with different departments on different floors have no such contact to acquire and amplify each other information. We also concluded that the group discussion is much important than the individual discussion so that each person can share and acquire more knowledge in less time. We observed that many healthcare organizations have no contact with other healthcare organizations at worker level where the organizational workers could share their knowledge. Many organizations are using different knowledge management systems and technologies for different purposes but their influence is within the healthcare organization or within the chain of such organizations. Where some small healthcare organizations are partially or totally unaware of the importance of knowledge sharing and acquiring. Our idea can promote the culture of knowledge sharing at very low cost and definitely will help to improve the patient care procedures and expertise. It will not only help the healthcare professionals but can equally be useful for the healthcare students and for the healthcare organizations of developing countries where they don’t have such activities of knowledge sharing or knowledge sharing culture. On the other hand these countries will also learn about different healthcare knowledge updates from the healthcare organizations of developed countries like United States and Sweden.

We feel there is more research required on it especially in nursing processes, to make sure that the information acquired from patient is gathered and structured accurately by clinical staff. As we have conducted our survey in one organization from each country. For more reliable results more organizations should be included for survey and interviews.

In this chapter we have given a detailed description of our knowledge management system how it will be useful for cross country healthcare organizations and how the clinical staff can take benefit of it with its easy use.

6.1 Web Based Knowledge Management System

We have proposed our knowledge management system keeping in view the cross country nursing requirements and nursing processes. The purpose of this knowledge management system is to provide healthcare knowledge facility and updated knowledge information for clinical staff. This system will help to increase the abilities and knowledge of clinical staff for better dealing with their patients during their stay in hospital. This system will not only be helpful for working clinical staff but also for nursing students to get information about latest clinical knowledge updates. We have described below about different components and their functions in our proposed system.
6.2 Proposed Knowledge Management System Architecture

6.2.1 Organizational Knowledge

This part of KMs indicates that the organizational knowledge other than clinical knowledge will be provided by the doctors and the organizational management about their organization development, policies and latest medical updates made by the organization at expert level.

6.2.2 Clinical Knowledge Providers

This section will be hold by clinical staff like charge nurse, supervisor and staff nurse. They will have different level of authentication in this system. Only charge nurse and supervisor nurse could be able to feed information in knowledge system according to the different nursing process categories, after analyzing the quality of the knowledge provided by the nurse.

6.2.3 Knowledge Management Process

This section of the knowledge management system will be manage through the four knowledge management process “acquisition”, “storage”, “transfer” and “application” processes. These processes will analyze that the knowledge provided by the clinical staff or the organizational management is comprehensive and can be retrieved easily.

6.2.4 Knowledge Acquisition

This part will collect and structure all information provided by different sources organizational and clinical knowledge e.g. books, already existing knowledge databases, nursing tutorials, expert views, latest research information etc.

6.2.5 Knowledge Storage

SQL database will be used and develop for data categorizing and storage. All images and other files will be link to this database. This database will also have the search function for searching e.g. different medicine names, information about their usage and side effects, different clinical task information, instructions to perform these functions and pre-cautions etc.

6.2.6 Knowledge Transfer

The required processed knowledge will be transfer to the user who will send the query to the knowledge system database via standard internet browser, and only the user of registered healthcare organizations with this system will be able to access the required information. This knowledge transfer process will show required information with user friendly interface.

6.2.7 Knowledge Application
This knowledge process will provide information about most and commonly used procedures in clinical health services in standard format. Information technology will help application process to help user with most frequently search queries and latest updates.

6.2.8 Information Technology

The user interface will be developing using current web development technologies JavaScript and PHP. The data sharing in knowledge management system will be done through ODBC. Our proposed knowledge management system is give below in Fig 12:

Using this system the all health care organization will be connected through one plat form where they could be able to communicate and participate in each other healthcare activities. This system will result to produce the quality knowledge for clinical staff to increase their knowledge and improve their skills. As a result the clinical staff will be able to create more reliable knowledge and this approach will definitely make them able to participate in knowledge sharing activities within and out side the organization. This web based system will be accessible for every registered organization. So developing countries will also be able to share the knowledge of developed countries.
After this study we concluded that to acquire and amplify the organizational knowledge, healthcare organizations must develop such organizational culture where the individuals can interact with each other. Not only inside the organization but also with other healthcare organizations. Small organization and doctor clinics staff don’t do much efforts too keep themselves updated or they didn’t get such facility from their organizations to keep themselves updated with latest knowledge updates. The web based knowledge management systems are very useful for such organizations. And in large organizations where clinical staff cannot make much interaction with other staff working on different floors such systems can help them to fulfill their knowledge requirements. We feel that a good knowledge management system can also help healthcare organizations in improving their policies and can change the organizational cultural environment. By conducting training sessions using KMs healthcare organizations can also increase the practical abilities of their clinical staff and will also be help full for charge nurses and supervisors for guiding their staff with much better approach.

According to our point of view there is some more research work required. One organization from each country cannot represent the healthcare culture of whole country. So there is need to raise healthcare organizations to participate in such research activities of healthcare knowledge acquisition, when more and more organizations will participate in it the research results will definitely improve and will help the researchers to give better solutions. There is also need of deep study to make improvement in nursing processes so that they could acquire more and more knowledge to transfer.

Our proposed knowledge management system is not very mature because our focus was only towards knowledge management processes with the very small participation of clinical staff. And the study was conducted only on the systems of two developed countries, where many other developed and developing countries are making their contributions in healthcare. So there is also need to get their views about this area of study.
REFERENCES


[23] Linda Bird, Sam Heard, Jim Warren, Knowledge Management in Healthcare, CRC for Enterprise Distributed Systems Technology DSTC Pty Ltd, Level 7 General Purpose South The University of Queensland, Australia.


## APPENDIX A

In the following survey which was conducted online, we used five close ended options: Strongly Agree, Agree, Disagree and Neutral.

### Our hospital KM:
1. Improves time management during patient care.
2. Is helpful to improve the working ability of clinical staff.
3. Is helpful to improve diagnosis, and extra patient’s appointments.
4. Enhances the overall organization working ability.
5. Is helpful for better relation between staff and patient.

### Our hospital has:
1. Well defined rules and regulations about medical services knowledge.
2. Well defined rules and regulations about medical process knowledge.
3. Facility for working cooperation with other knowledge persons in organization.
4. Facility to map the different type of medical knowledge.
5. Facility to retrieve knowledge related to clinical services.

### In past few years our hospital enhanced its efficiency to:
1. Point out latest medical services trends.
2. Find out new opportunities for medical services.
3. Adopt quick medical knowledge changes.
4. Check the results of new services.
5. Show its responsibility towards patient needs.

### In our hospital:
1. Departments are structure to share more and more knowledge.
2. Structure encourages employees for group discussions instead of individual.
3. Medical processes are facilitated by knowledge exchange.
4. Facilitate medical staff with material to gain more knowledge.
5. There are no limitations for knowledge creation.

### In our hospital:
1. Employees are encouraged to acquire and share knowledge.
2. Staff is encouraged to help each other when others need their help.
3. Staff is encouraged to discuss their knowledge with other department’s staff.
4. Value of sharing knowledge is more than its cost.
5. Upper level staff gives the importance to new created knowledge.

### Our hospital:
1. Has process facility to gather knowledge for patient symptoms.
2. Facilitate in creation of knowledge from old knowledge.
3. Has facility to check results of projects for improvements.
4. Facilitate employees to devote themselves for best services.
5. Have processes for knowledge sharing between staff.

<table>
<thead>
<tr>
<th>Our hospital have processes for</th>
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</thead>
<tbody>
<tr>
<td>1. Updating knowledge for medical services.</td>
</tr>
<tr>
<td>2. Amplifying knowledge in whole organization.</td>
</tr>
<tr>
<td>3. Acquiring knowledge sources and types.</td>
</tr>
<tr>
<td>4. Structuring knowledge.</td>
</tr>
<tr>
<td>5. Eliminating old knowledge with new knowledge.</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Our hospital:</th>
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<tbody>
<tr>
<td>1. Has the process facility to bring new knowledge quick implementation.</td>
</tr>
<tr>
<td>2. Has facility to take advantage of new implemented knowledge.</td>
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<tr>
<td>3. Has facility to use knowledge for solving new problems.</td>
</tr>
<tr>
<td>4. Has facility to provide knowledge for desired staff.</td>
</tr>
<tr>
<td>5. Have better knowledge sources for solving problems.</td>
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</tbody>
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<table>
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<tr>
<th>Our hospital has process for:</th>
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<tbody>
<tr>
<td>1. Knowledge security to avoid unauthorized access within the organization.</td>
</tr>
<tr>
<td>2. Knowledge security to avoid unauthorized access outside the organization.</td>
</tr>
<tr>
<td>3. Knowledge access under some authentications.</td>
</tr>
<tr>
<td>4. Employees to not to let them share organizational information with any irrelevant person.</td>
</tr>
<tr>
<td>5. Clarifying the knowledge protection rules in organization.</td>
</tr>
</tbody>
</table>

1. Total years in present job …………..
2. Total years in this profession………..
3. Total years of education………..
4. Gender: M F
5. Daily computer using hours……… %
6. Daily communication with co-staff, Email….. %, Phone……… %, Face to face….. %
7. Daily communication with patients, Email….. %, Phone……… %, Face to face….. %
8. Daily group tasks……… %
Following questionnaire we used for interview in healthcare organizations. This interview was conducted through telephonic conversation.

1. How do you follow the knowledge management process or strategy?
2. What type of knowledge you exchange and through which process?
3. How your knowledge strategy helps you to improve your practice and patient dealing?
4. What type of current technologies you are using to manage your knowledge?
5. Do you give suggestions to your organizational management regarding the solution of current problems?
6. Are you satisfy with the functionality of knowledge management system currently being used in your organization?