


Knowledge Management for Effective Clinical Diagnosis in Developing Countries 52 Journal of Information Technolo...

Chandana Perera

Related papers

[Download a PDF Pack](#) of the best related papers 



[Knowledge management framework for achieving quality of healthcare in the developing cou...](#)

Jayantha Amarakuchi

[Trace Elemental And Immunological Findings](#)

Chandana Perera

[CONCEPTUAL HEALTH CARE KNOWLEDGE MANAGEMENT MODEL FOR ADAPTABILITY AND INTEROPER...](#)

Anjum Razzaque

Knowledge Management for Effective Clinical Diagnosis in Developing Countries



Amararachchi, J. L.¹, Pulasinghe, K.¹, Perera H. S. C.²

¹Department of Information Technology
Sri Lanka Institute of Information Technology
Malabe, Sri Lanka

²Department of Management of Technology
University of Moratuwa
Moratuwa, Sri Lanka

{jayantha, koliya}@sliit.lk, hscp@mot.mrt.ac.lk

ABSTRACT: *In the last two decades, the Information and Communication Technologies (ICTs) revolution has redefined the structure of the 21st century healthcare organization. The fundamental challenge faced by the 21st century clinical practitioner in a developing country is to acquire proficiency in understanding and interpreting clinical information so as to update knowledge that leverage the quality of decisions made at the clinics. An additional challenge must be considered by the clinical practitioners to make potentially life-saving decisions whilst attempting to deal with large amounts of clinical data. Since the Clinical Knowledge Management Systems (CKMS) consist of most related Data, Information and Knowledge, it could be utilized to achieve the above challenges.*

Shortage of medical experts in Health Institutions located in rural and remote areas in developing countries being a huge problem which effects badly to the quality of healthcare. By providing facilities for medical practitioners to access KMS, this problem can be alleviated substantially.

A Knowledge Management (KM) solution would allow healthcare institutions to give clinical data context, so as to allow knowledge derivation for more effective clinical diagnosis. It would also provide a mechanism for effective transfer of the acquired knowledge in order to aid healthcare workers as and when required.

This study has identified the factors that affect to the knowledge management initiatives. There is a strong association between accessing and using Information/knowledge in clinical activities and quality of healthcare. Moreover, attitudes of Medical Practitioners (MP), Infrastructure facilities, patient Information systems, patient treatment, staff benefits etc., have shown positive effect to the success of Knowledge Management in Health Institutions. The research has used a case study methodology for accomplishing the research objectives. Rural and remote areas in Sri Lanka have been considered for the case study since it is one of the developing countries situated in the Asian region. Based on the outcome of the study, we introduce a KM framework for Healthcare Institutions which would assist HIs to discover and create new knowledge. The framework has been validated using a sample of 15 hospitals situated in the Kandy district in Sri Lanka.

Keywords: KM-Knowledge Management, HI-Healthcare Institute, MP-Medical Practitioners, KMS-Knowledge Management System

Received: 11 January 2013, Revised 23 February 2013, Accepted 1 March 2013

© 2013 DLINE. All rights reserved

1. Introduction

Healthcare professionals face information overload and they come across paradoxical information. They are overwhelmed by information but cannot find a particular piece of information when and where they need it [1]. Technologies have increased the dissemination of information, but worsened the problem of unwanted information.

In an average, a physician today spends about 25 percent of their time managing medical Information and has to learn 2 million clinical specifics [2]. This is further compounded by the fact that biomedical literature is doubling every 19 years. In UK each physician receives about 15 kg of clinical guidance per annum [3]. The above indicators illustrates how difficult it is for Healthcare Institutions (HIs) and Healthcare Stakeholders (HSs) to successfully meet the healthcare Information needs that are growing at an exponential rate.

Up to 98,000 patients die every year as a result of preventable medical errors [4]. A study has pointed out on average drug reactions were serious, 43% of above inpatient reactions were serious, life threatening [5]. The statistics indicated that the mass of Information and Knowledge available for reference by physicians and large number of repercussions that had happened due to the fact that not updating physicians with such Information and Knowledge.

Majority of the population in Sri Lanka still live in rural and remote areas while the majority of medical experts stationed in the urban areas. But, low level medical facilities have given to rural and remote medical centers to serve for majority of the population. Sri Lanka has 80% of its main healthcare centers located in cities and host only 30% of the total population [6]. A 70% of the Sri Lankan population is rural and remote which is served by only 20% of doctors [3]. Therefore rural communities are at far greater disadvantages such as late discovery of ailment, transport time to reach urban healthcare facilities and inexperienced primary healthcare providers in rural areas. In some cases, rural patients are sent or they willingly visit hospitals in developed (urban) areas at considerable expense.

First half of the figure 1 depicts the number of physicians per 100,000 people in the period of 2008-2012, in six developed countries and the other half depicts the same information for five developing countries including Sri Lanka [7]. Sri Lanka has 55 physicians per 100,000 people while in a developed country like Italy has 350 physicians per 100,000 people. According to the annual health bulletin published by Ministry of Health, in Sri Lanka had only 55 physicians /100,000 populations in 2006, which is well below that of many countries with equivalent levels of income [6]. According to the survey conducted in Kandy district, more than 60% practitioners have to treat more than 75 patients per day. This indicates physicians in developing countries have to serve large number of patients per day, thereby the quality of Healthcare may not preserve.

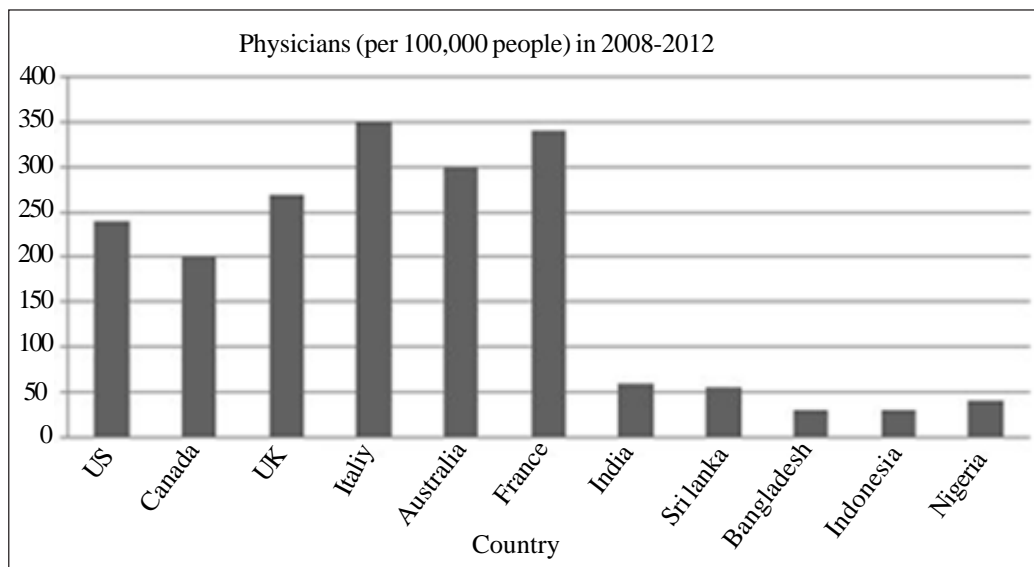


Figure 1. Physicians per 100,000 people
(Source: World Bank. World development indicators-2013)

The lack of medical experts in rural health Institutions has a direct impact to the quality of healthcare. According to the health statistics, 72.7% of specialist's doctors serve in urban centers and 25.1% in semi urban areas and only 2.2% serve in rural areas. But comparatively majority of the patients are coming from rural areas [6]. This implies there is a huge shortage of medical specialists in rural and remote areas. Therefore the specialist health coverage to majority of the population live in rural and remote areas is still a distant dream [6].

The advancement in Information Technology (IT) and in particular the Telecommunications Technology has brought about fundamental changes throughout the healthcare process [9]. Further interaction between the twin revolutions of Information and Communication Technologies (ICTs) and Telecommunications have enabled healthcare technologies based on concepts such as Electronic Patient Records (EPR) and Electronic Health Records (EHR)[10-14]. By incorporating modern technologies to healthcare management, it helps to reduce the workload of physicians which leads to increase the quality of healthcare. A study was been done by the authors to investigate, the Information and knowledge needs of doctors. The study has revealed the knowledge needs of medical practitioners have not been fulfilled specially those who are located in rural and remote areas in Sri Lanka. If the knowledge requirement is readily accessible, then the knowledge gap between medical practitioners and the medical experts could be reduced.

2. The Role of Technology in Healthcare

2.1 E-Health

Delivering healthcare services to the patients is complex process that highly depends on the health related Information and the doctors' experience. One of the major impediments in hospital progress toward, efficiency and cost-effectiveness is the difficulty in sharing Information among healthcare organizations [15]. Over the past decade, the healthcare Industry has increasingly tried to embrace new IT, such as telephony, computer and Internet associated technologies, as it search for opportunities for higher quality care [16]. E-health is currently evolving, which refers to the delivery of healthcare services involving the electronic transfer of health-related Information using electronic-based technologies [17]. The Healthcare Information and Management System Society (HIMSS) broadly defined e-health as IT-enabled healthcare system that improves the access, efficiency, effectiveness and equality of clinical and business processes utilized by healthcare organizations, practitioners, and patients.

Growing use of electronic medical record (EMR) systems in Europe and the United States (US) has been driven by the belief that these systems can help to improve the quality of health care. Decision support systems, particularly for drug order entry, are becoming important tools in reducing medical errors.

2.2 Understanding Knowledge Management in a Healthcare Context

In a healthcare context, it can be argued that Knowledge Management (KM) is the formal management of knowledge for facilitating the creation, identification, acquisition, development, dissemination, utilization, and preservation of a healthcare enterprise's knowledge using advanced technology [18-19]. More so, KM also involves:

- (a) Converting knowledge from the healthcare enterprise's sources (individuals, groups, data and text), and
- (b) Connecting healthcare participants-healthcare professionals, management and patients-with that knowledge [20].

A typical KM structure can be split in to two arms *Knowledge Management process* and *Knowledge Management enablers*. *Knowledge Management enabler* are considered to be the factors that influence the development of the *knowledge management process*.

2.3 Knowledge Management Processes

KM processes consist of number events that form into a cyclic arrangement, i.e. the preceding process providing input to or influencing the subsequent KM process. For our discussion, we regard *creation* as the initial process of the KM framework.

2.3.1 Create:

Responsible for the creation of healthcare knowledge, possibly through trial-and-error or blind variation and selective retention methods.

2.3.2 Identify

Determines the existence of useful healthcare knowledge from the knowledge created in the earlier process. sThis can be achieved through mining efforts similar to that of data mining and knowledge discovery.

2.3.3 Collect/Acquire

Once useful knowledge has been identified, next follows the process of acquiring the knowledge.

2.3.4 Organise/Develop/Preserve

This can be viewed as a form of ‘*knowledge processing*’ whereby the knowledge is transformed, represented, and organized in a defined format. This process also concentrates on the explication of tacit knowledge which is supported by expert systems, issue-based information systems, best-practice databases, and lessons learnt archives. Similarly, knowledge capitalization aims to allow the reuse of knowledge of a given domain previously stored and modeled in order to perform new tasks [21].

2.3.5 Share/Disseminate

Provides the mechanisms to disseminate the stored knowledge to all participants of the healthcare enterprise and possibly to other healthcare enterprises.

2.3.6 Adapt

This process is typically the responsibility of healthcare professionals in their practice. Upon introspection of the ‘*created*’ knowledge healthcare professionals may then need to tailor it to ensure appropriateness, currency and accuracy.

2.3.7 Apply/Utilize

Knowledge when not used is equally, if not more, useless and again, this process is typically the responsibility of healthcare professionals. The success of a healthcare KM framework depends on its success in providing knowledge that is being used effectively to meet the demands of the healthcare enterprise

2.4 KMS for clinical process

Medical Practitioners’ responsibilities in the clinic have been defined as: “*The diagnosis and treatment of human responses to actual or potential health problems*”. The practices (steps) in the clinical process identified as an assessment, diagnosis, treatment and evaluation. They are cyclic overlapping and interrelated.

- ❖ **Step 1: Assessment**, is the most critical step. Try to identify the actual problem or the potential problem with the patient. This step involves collecting, organizing, and analyzing Information/data about the patient. The methods of data collection can be observation, interview, and examination.
- ❖ **Step 2: Diagnosis**, is a statement that describes a specific human response to an actual or potential health problem.
- ❖ **Step 3: Treatment**, is prescribing medications, therapies, undertake surgeries and other treatments.
- ❖ **Step 4: Evaluation**, compare the patient’s with the stated patient goals and has three different operations or purposes. Evaluation of the quality of the written care. Plan and evaluation of the client’s progress.

Doctors especially use the healthcare knowledge combined with their know-how and experience to deliver healthcare services. Today, this work can be enhanced by enabling technologies such as a KMS that provides up to date tacit and explicit knowledge of medical experts.

3. Methodology

We discuss the research design, process, and methods used for data collection of the research in this section. The methodology used to develop and validate a conceptual KM healthcare framework is described. We also discuss the basis for selection of the case study. The research design guided by a qualitative philosophy and used the case study methodology to achieve the research objective, “*To investigate the effectiveness of Knowledge Management Systems for clinical activities of doctors who are located in rural and remote areas in Sri Lanka*”.

The survey has conducted by covering the Health Institutions located in Rural and Remote areas in Kandy district in Sri Lanka. One practitioner from each Health Institution was selected for the survey. Practitioners in these areas play a significant role to the patients in the healthcare.

Conceptual research model was tested using the data collected by the questionnaire. The survey helped to capture believes,

experiences and perceptions of medical professionals on Information and knowledge management which they currently use for their clinical activities. The questionnaires were given to the doctors over 105 health Institutions in Rural and Remote areas in Kandy district. The effective response rate was 55.2%. The questionnaire was organized in a manner that covers four main sections: (1) to investigate the needs of latest medical Information for clinical activities, (2) to study how medical practitioners in rural and remote areas currently meet Information and knowledge requirements for their clinical activities, (3) to examine how medical practitioners in rural and remote areas be motivated to use Knowledge Management Systems for clinical activities on Information and knowledge needs and (4) to make an assessment on existing infrastructure facilities in the rural and remote area medical centers.

Survey items identified in the questionnaire were used to constructs the research model as given in Figure 2. In addition to the survey, several meetings and interviews were held with some selected medical professionals to gain more understanding and clarify certain issues about the healthcare in rural and remote areas.

4. Data Analysis

Analysis of data collected from the main case-survey has done in two phases. The data obtained from descriptive statistics was analyzed first to identify the factors that effect on accessing knowledge/Information in the clinical activities. Secondly the factors that effect on accessing knowledge/Information and Information/KM needs for clinical activities were tested using regression analysis [23].

Correlation analysis has shown that the attitude of a medical practitioner is mostly correlated with computer literacy than other variables. Difficulties in accessing Information/knowledge is correlated with infrastructure facilities most. It seems that most of them are eager to use Information/Knowledge systems for clinical decision making process but they are overloaded with patients.

It can be concluded from the regression analysis that the Patients’ assessment & diagnosis (Y1) linearly depends on attitude of medical practitioners (X1). Quick access to new disease Information (Y2) linearly depends on attitude of medical practitioners (X1) and infrastructure facilities (X2). It can also be concluded that the effective communication between medical expert and physician medical issues (Y4) depends on the attitude of medical practitioner (X1). Quick access to disease Information (Y5) depends on Information systems/software (X3). Patients’ treatments (Y6) highly depend on Information systems/software(X3) [23]. The regression models are as follows.

$$Y1 = 0.381 X1$$

$$Y2 = 0.141 X1 + 0.0076 X2$$

$$Y4 = 0.112 X1$$

$$Y5 = 0.108 X3$$

$$Y6 = 0.095 X3$$

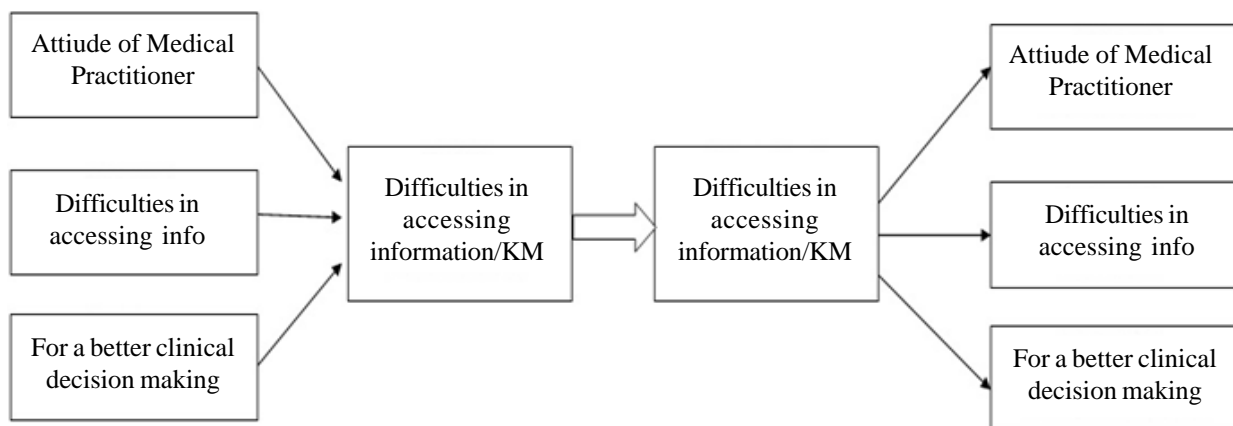


Figure 2. Relationship between difficulties in accessing information and Information/ Knowledge needs for clinical activities

5. Conceptual KM Framework

This section is a discussion of the methodology used to develop and validate a conceptual clinical KM framework for the healthcare Institutions. The framework transforms the conceptual ideas of KM into a customizable working program with defined objectives, using existing industry techniques. The framework also supports the designing, building, and maintenance of a knowledge - sharing platform, both from an IT and organizational.

Main objective of the research is to contribute to the existing body of knowledge on the linkage between three multidisciplinary research themes;

- Healthcare Management Concepts (HMC)
- Information and Communication Technology (ICT)
- Knowledge Management (KM)

The final outcome would be a conceptual KM framework for clinical activities of healthcare Institutions. This would be the basis of designing a clinical KMS for medical practitioners to make better clinical decisions.

The research approach comprised with two steps to follow.

- 1) Develop the first level conceptual clinical KM framework with core features
- 2) Develop the second level detailed conceptual clinical KM framework, on the basis of the revision of first level conceptual clinical KM framework

5.1 The first level conceptual clinical KM

Sprague (1980) pointed out that the development of Information systems should be informed by a well-designed framework. A KMS design framework should integrate business processes and the needed IT with the associated function to facilitate the KMS design [22]. It emphasizes the need to understand the organizational KM activities being supported and signals a shift from technology-led to knowledge-led systems. To develop a successful clinical KMS, a conceptual framework is also required. A clinical KMS will be an IT based system develops to enhance the knowledge creation, codification, transfer, and application to support the clinical process.

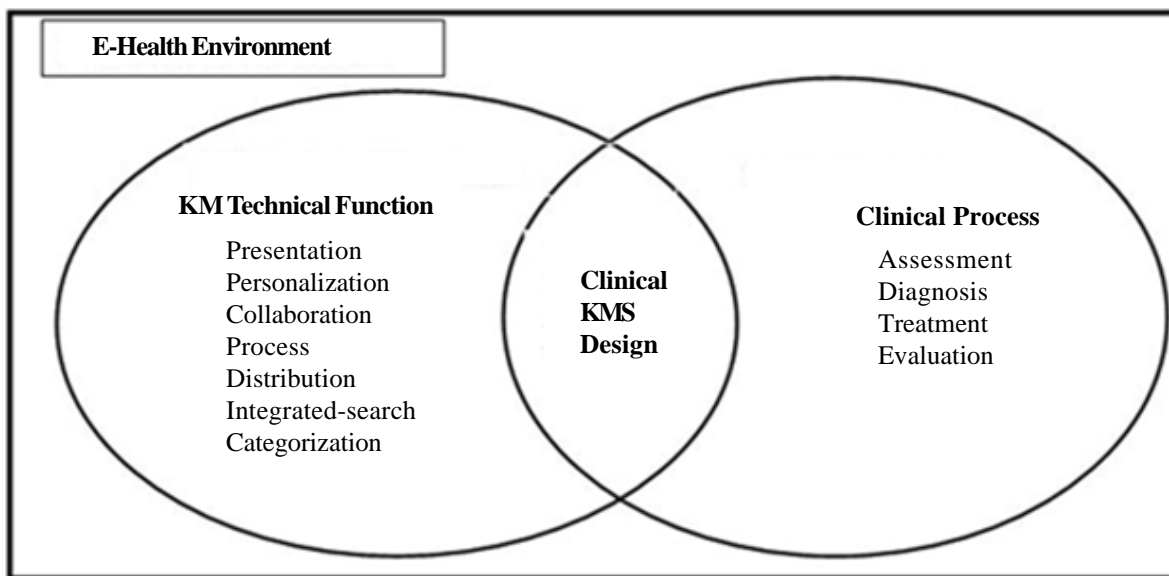


Figure 3. The first level conceptual Clinical KM

Empirical data was gathered via the questionnaire which is the main case. The findings from this case, in conjunction with inputs from the literature review, formed an iterative process. The analysis of the collated data resulted in a first level conceptual clinical KM framework for Healthcare organizations. It can therefore be argued that the dimensions of the clinical KMS design include both clinical processes and KM technologies are driven by the e-health environment, as depicted in Figure 3.

5.2 The second level conceptual clinical KM

Data was gathered from sub-cases (10 National Health Institutions) that supported the main case study. The analysis of this additional data validated the findings obtained. The data obtained from the sub cases lead to a revision of the first conceptual clinical KM framework, leading to a second conceptual clinical KM framework. This ultimately resulted in a revised and final conceptual clinical KM framework as depicted in Figure 4.

Based upon empirical data from the case studies, the final version of a three layered clinical KM framework could serve as basic utensils for healthcare institutions who are interested in developing an understanding on how to develop a KM strategy.

5.2.1 Identification of Health Institutions’ core Competencies

The first step (cage (1) in Figure 4) in formulating a KM strategy involves the identification of the core competencies in healthcare Institutions. This process will enable healthcare Institutions to be clear about its mission, objectives, and strategy. It would also allow for notice how mission, objectives and strategy in context to its economic, industry and status of healthcare outlook is aligned with health institutions’ core competencies.

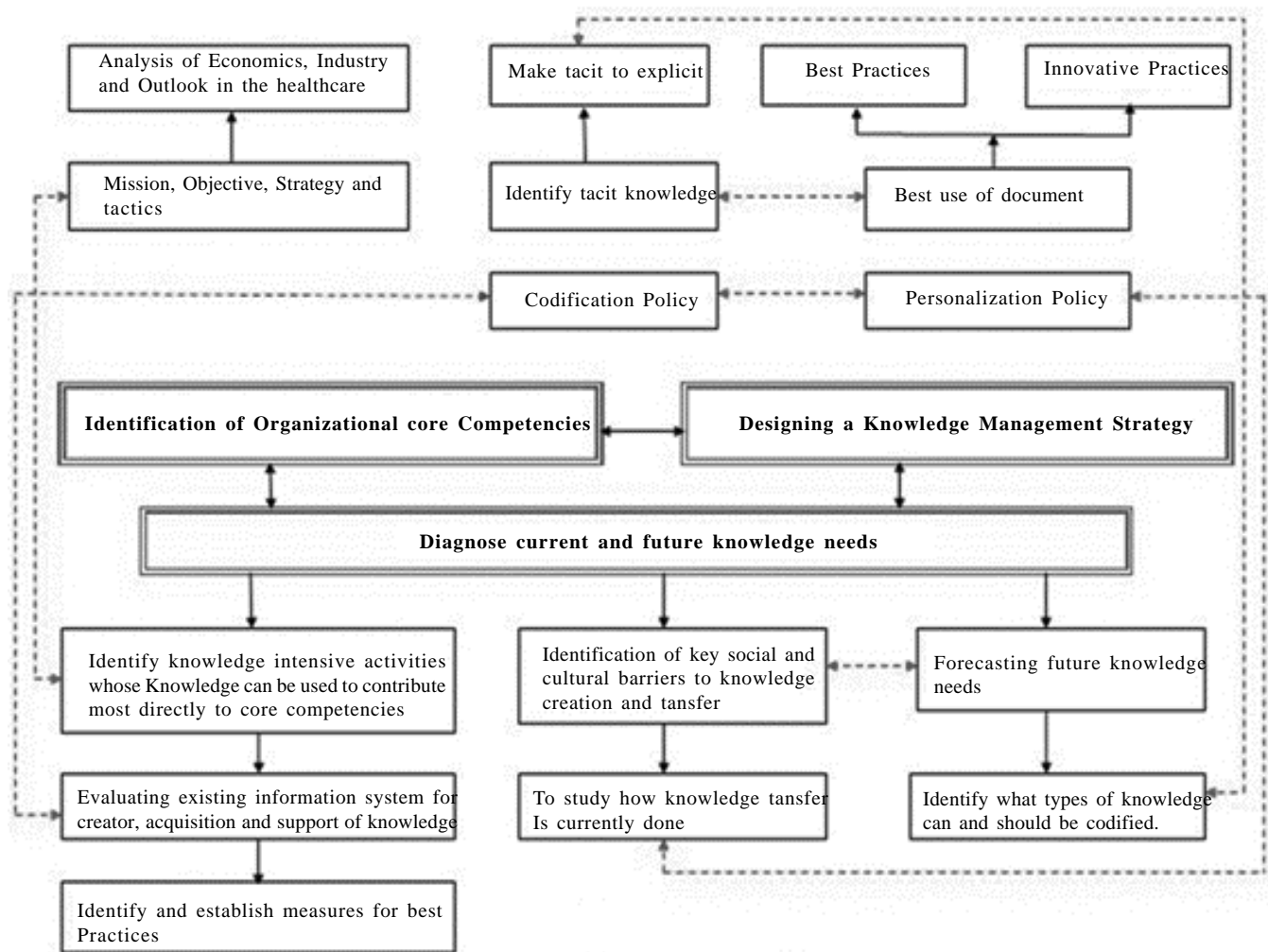


Figure 4. Final Conceptual Clinical KM framework

5.2.2 Diagnose current and future knowledge needs

The second step would be a diagnosis in Healthcare Institution's current and future knowledge needs (cage (2) in Figure 4). This would call for an analysis of the current technological infrastructure (ICT related facilities and e-health applications) in place for supporting knowledge transfer. After this process, an HI will need to identify knowledge intensive activities and assess how much knowledge should and could be codified (cage (2) in Figure 4). This stage will result in the decision to adopt a KM strategy with emphasis on either personalization or codification. Irrespective of the strategy adopted, HIs would have to identify what represents best clinical practices. This is to some extent will help in capturing the tacit knowledge of clinical specialists.

5.2.3 Designing a Knowledge Management Strategy

In the last step (cage (3) in Figure 4), a KM strategy would be identified for HIs. Each HI can either adopt a KM strategy which emphasizes either on the tacit knowledge that resides in its resources or on a KM strategy that emphasizes the organizational processes. If decided to adopt a codification-led KM strategy, then the classification have to be taken on Artificial Intelligent components. This leads to the identification of relationships that exist between different types of knowledge (tacit or explicit) being transferred and to dissemination practices. This then result in a spiral transfer between the processes marked with the broken arrow signs in Figure 4. Finally the knowledge identified, created and generated is then modeled in to knowledge repositories. This articulated knowledge would be disseminated by an appropriate KM delivery medium such as Lotus-Notes.

This work is the beginning of a line of research that focused on Healthcare KMS for doctors' in the developing countries. It was aimed to develop a conceptual framework to identify the critical factors that involved in the development of Knowledge Management Systems (KMS) for clinical process. This framework will provide a systematic guideline for KMS designers to adopt the enabling IT and the needed KM technical functions to support the activities in clinical process when designing a KMS for clinical process of practitioners. With this framework, KMS designers can work with medical professionals to identify suitable IT associations with the clinical process of a practitioner when developing a KMS for clinical activities in a developing country.

6. Discussion and Conclusion

Healthcare statistics shows that no specialist doctors or only few specialist doctors serve in the HIs located in rural and remote areas in developing countries. Further the majority of practitioners serve in HIs in rural and remote areas are overloaded with patients and more than 60% practitioners have to handle over 75 patients per day.

These factors have negative impact on the quality of healthcare. To provide quality healthcare, medical practitioners must access the latest medical Information & Knowledge to update their medical knowledge which makes better clinical decisions.

The findings of the study will lead to insights that will guide clinical KM which helps to improve the quality of healthcare. Further it has discovered some facts that affect Information and knowledge sharing in the clinical activities. By providing IT Infrastructure, reliable communication network and information network, e-Health technology can be initiated in HIs. This facilitates for utilizing Information and knowledge in much effective ways which helps to break barriers in the knowledge culture in HIs. Knowledge Management training and education can fill any gaps and convert the Health Institution to a learning organization.

This paper has reported that there is a strong association between problems in accessing Information and use of Information in the clinical activities for high quality Healthcare. Attitude of medical practitioners, Infrastructure facilities, Information systems software, patient association and diagnosis, patient treatment and staff benefits play a significant role in enabling Knowledge Management in the Health organizations in developing countries.

We conclude with our assessment that the clinical KM framework will provide a benchmark for all future KM implementations in healthcare and orient all future efforts on sharing tacit-to-tacit knowledge in order to avoid knowledge gaps and leverage all available resources.

7. Acknowledgement

The authors would like to sincerely thank Dr. Seneviratne Director, Dr. Nilani Fernando, Deputy Director, RDHS Kandy for providing facilities to collect data in the central province, HIs. They would also like to express their appreciation to Prof. Sheriff,

Director, PGIM, for Information provided. They thank Dr. Rikaz Sheriff and Mr. Hansa Perera for comprehensive feedback given on the statistical data analysis. Finally they thank Prof. Sanath Jayasena and Dr. Vathsala Wickramasinghe for the useful guidelines and feedback given from the beginning of the research.

References

- [1] Gray, M. J. A. (1998). Where's the chief Knowledge officer? To manage the most precious resource of all. *BMJ*, 317, 832-40.
- [2] The Knowledge Management Centre. (2000). About the Knowledge Management Centre. [Online Document], October. Available from: <http://WWW.ucl.ac.uk/kmc/kmc2/AboutKMC/index.html>, [Accessed 12 November 2002].
- [3] Wyatt, J. C. (2004). 7. Intranets, *Journal – Royal Society of Medicine*, 9 (10) 530-534.
- [4] Duff, S. (2002). It's easier to tell the truth, *Modern Healthcare*, 32 (23) 12-13.
- [5] Taylor, R., Manzo, J., Sinnett, M. (2002). Quantifying value for physician order-entry systems: A balance of cost and quality, *Healthcare Financial Management*, 56 (7) 44-48.
- [6] Ministry of Health web site, Sri Lanka, Health manpower, updated on 31.12.2009, [Online Document] Available from: <http://203.94.76.60/nihs/BEDS/Manpowersum-09-12-31.pdf>. [Accessed 27, October 2011].
- [7] Rajam S. Ramamurthy, MD, WWW.San Antonio medicine.com, Future Trends of International Medical Graduates' Availability within the Physician Workforce of the United State.
- [8] De Silva, N. R. (2008). Impact of Migration on the medical workforce in Sri Lanka, Paper for the Third AAAH Conference-Globalizations and its Implications for Healthcare Services and Human Resources for Health', 12-15 October, Sri Lanka.
- [9] Applebaum, S. H., Wohl, L. (2000). Transformation or change: some prescriptions for healthcare organizations, *Managing Service Quality*, 10 (5) 279-298.
- [10] Anonymous, U. K. (2003). Implement Electronic Patient Records, *Information Management Journal*, 37 (4) 7.
- [11] Van der Slikke, J. W., Arvanitis, T. N. (2002). Keynotes, *Technology and Healthcare*, 10 (6) 435-442.
- [12] Safran, C. (2001). Electronic Medical Records: A Decade of Experience, *JAMA: Journal of American Medical Association*, 385 (13) 1766.
- [13] Kondro, W. (1999). Canada must update patient records, *Lancet*, 353 (9152) 568.
- [14] Lohr, S. (2004). Government Wants to Bring Health Records into Computer Age, *New York Times*, 153 (52917) C1.
- [15] Grimson, J., Grimson, W., Hasselbring, W. (2000). The system integration challenges in healthcare, *Communications of ACM*, 43 (6) 49-55.
- [16] Lin, B., Umoh, D. (2002). E-healthcare: A vehicle of change, *American Business Review*, 20 (2) 27-32.
- [17] Engelhard, S. P., Nelson, R. (2002). Healthcare Informatics: An Interdisciplinary approach, Mosby Press.
- [18] O'Leary, Daniel E. O'Leary. (1998). Using AI in Knowledge Management: Knowledge Bases and Ontologies. *IEEE Intelligent Systems*, 13 (3) 34-39, May/June.
- [19] Abecker et al., Andreas Abecker, Ansgar Bernardi, Knut Hinkelmann, Otto Kühn, Michael Sintek. (1998). Toward a Technology for Organizational Memories. *IEEE Intelligent Systems*, 13 (3) 40-48, May/June.
- [20] O'Leary, Daniel E. O'Leary. (1998). Knowledge Management Systems: Converting and Connecting. *IEEE Intelligent Systems*, 13 (3) 30-33, May/June.
- [21] Simon, Gaële Simon. (1996). Knowledge Acquisition and Modelling for Corporate Memory: Lessons Learned from Experience. Proceedings of Tenth Knowledge Acquisition for Knowledge-Based Systems Workshop.
- [22] Alavi, M., Leidner, D. E. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, 25 (1) 107-136.
- [23] Amararachchi, J L, Perera, H. S. C., Pulasinghe, K. (2012). Achieving Quality Healthcare through Knowledge Management Initiatives in Health Institutions in Rural and Remote areas in Sri Lanka, National Conference on Technology Management, January, Sri Lanka.