SOCIETY FOR SCIENCE AND EDUCATION UNITED KINGDOM

JBEMi JOURNAL OF BIOMEDICAL ENGINEERING AND MEDICAL IMAGING

ISSN: 2055-1266
VOLUME 1, ISSUE 2

Towards Knowledge Management for Healthcare: Effects of Latest Medical Information for the Quality of Healthcare in the Developing Countries: A Case Study

Amaraarachchi J.L[1], Perera H.S.C[2], Pulasinghe K[3]
[1]*Faculty of Computing, Sri Lanka Institute of Information Technology, Sri Lanka;*
[2]*Faculty of Engineering, University of Moratuwa, Sri Lanka;*
[3]*Faculty of Graduate Studies, Sri Lanka Institute of Information Technology, Sri Lanka*
jayantha@sliit.lk, hscp@mot.mrt.ac.lk, Koliya@sliit.lk

ABSTRACT

In the last 2 decades, the Information and Communication Technologies (ICTs) revolution has redefined the structure of the 21st century healthcare organizations. It is clear that the 21st century healthcare organizations in developing countries will bring new healthcare services and the traditional management & technological concepts would not be the appropriate conduit for disseminating these new healthcare services.

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 leverages 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 & Information. Since the Clinical Knowledge Management Systems (CKMS) consist of most related Data, Information and Knowledge, it could be utilized to achieve the above challenges.

According to the current economies, developing countries cannot afford to buy CKMS which needs a proper IT backbone and knowledge culture to run it. Medical practitioners (MPs) currently have no proper facilities to access the latest medical Information resources to make effective clinical diagnosis. Shortage of medical experts and MPs in Healthcare Institutions located in rural and remote areas in developing countries are also a massive problem which affects the quality of healthcare badly. By implementing and providing proper facilities for MPs to access KMS, this problem can be alleviated substantially.

The objective of this paper is to investigate the importance of the latest medical Information for making quality clinical decisions which improves the quality of healthcare. Findings of the research have shown that there is a strong linkage between accessing and using latest

DOI: 10.14738/jbemi.12.98
Publication Date: 6th April 2014
URL: http://dx.doi.org/10.14738/jbemi.12.98

Information/knowledge in clinical activities and the quality of healthcare. This research used a case study methodology for achieving the research objectives. Rural and remote areas in Sri Lanka were used for the case study, since Sri Lanka is one of the developing countries situated in the Asian region. As the first step of a solution to the Information problem, a KM framework for Healthcare Institutions to create Knowledge Management Systems was introduced.

Keywords: KM-Knowledge Management, HI-Healthcare Institute, MP-Medical Practitioner, KMS-Knowledge Management System, HC-Health Care, KW-Knowledge

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.

On 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]. These indicators illustrate 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.

As stated earlier, Healthcare professionals in the developed countries meet their medical information requirements with the support of ICT. But Healthcare professionals currently working in the rural and remote areas of healthcare Institutions hardly meet their medical Information requirement or do not meet at all. Clinical decisions made on inaccurate or incomplete information, inevitably mean either loss of lives or effect patients badly.

Majority of the population in Sri Lanka still live in rural and remote areas while the majority of medical experts are stationed in the urban areas. But, low level medical facilities have been given to rural and remote medical centers to serve the majority of the population. Sri Lanka has 80% of its main healthcare centers located in cities and host only 30% of the total population [4]. A 70% of the Sri Lankan population is rural and remote which is served by only 20% of medical practitioners [3]. Therefore rural communities are at a far greater disadvantage 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.

The first half of 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 [5]. Sri Lanka has 55 physicians per 100,000 people while, a developed country like Italy has 350 physicians per 100,000 people. According to the annual health bulletin published by the Ministry of Health, 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, over 60% practitioners have to treat more than 75 patients per day. This indicates the physicians in developing countries have to serve a larger number of patients per day, thereby the quality of Healthcare may not be preserved.

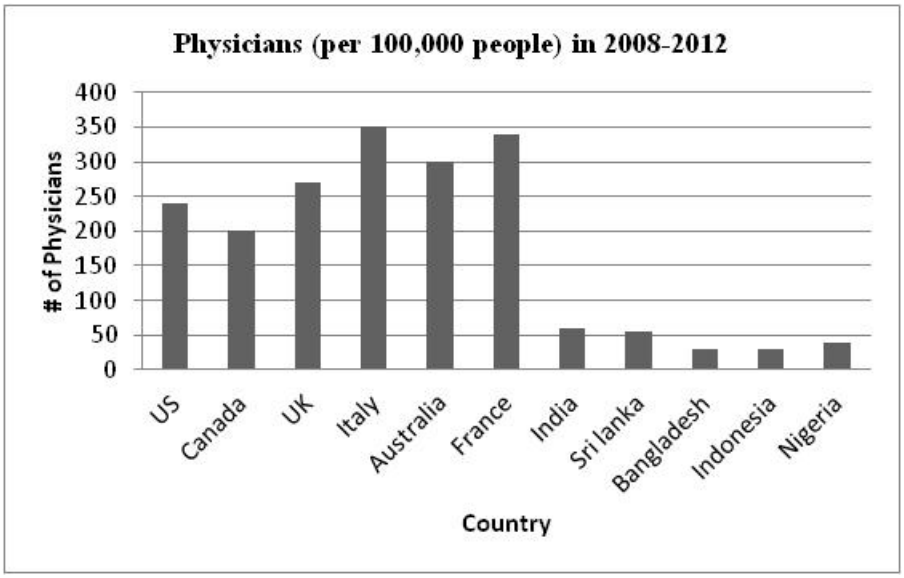

Figure 1: Physicians per 100,000 people in 2008-2012 (Source: The World Bank-World Development Indicators-2013)

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 medical specialists 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 come from rural areas [4]. 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 who live in rural and remote areas is still a distant dream [6].

The advancement in Information Technology (IT) and in particular Telecommunication Technology has brought about fundamental changes throughout the healthcare process [7]. 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)[8-16]. 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 done by the authors to investigate, the Information and knowledge needed by medical practitioners.

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. ROLE OF ICT IN HEALTHCARE

2.1 Healthcare Information

Delivering healthcare services to the patients is a complex process that highly depends on healthcare related Information and Healthcare professionals' experience. Health resources, Healthcare provision, Healthcare utilization, Healthcare coverage etc, are the types of healthcare information required by the healthcare professionals, managers and policy makers at each level of the healthcare system. To identify the utilization of healthcare services provided at primary, secondary and tertiary level, healthcare managers require the information in relation to healthcare utilization, healthcare coverage etc. One of the major impediments in hospital progress toward, efficiency and cost-effectiveness is the difficulty in sharing Information among healthcare organizations [13].

A key element to implement Health Information Technology (HIT) is to understand what to collect, where to collect, whom to report to and how this information will be used and by whom because these are used to provide curative, preventive, rehabilitative and palliative care to the population. Considering this, it is required to determine the information needs, tools for data collection and levels of data generation. Once these are defined and determined, it is easy for the managers and providers to proceed with the implementation process in a better way.

Over the past decade, the healthcare Industry has increasingly tried to embrace new IT, such as telephony, computer and Internet associated technologies, as it searches for opportunities for higher quality care [14]. 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 [15]. The Healthcare Information and Management System Society (HIMSS) broadly defined e-health as an 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 healthcare. Decision support systems, particularly for drug order entry are becoming important tools in reducing medical errors.

2.2 Knowledge Management in Healthcare

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 [16-17]. More so, KM also involves:

converting knowledge from the healthcare enterprise's sources (individuals, groups, data and text), and connecting healthcare participants—healthcare professionals, management and patients—with that knowledge [18].

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

2.3 Knowledge Management Processes

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

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

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

Collect/Acquire: Once useful knowledge has been identified, next follows the process of acquiring the knowledge.

Organize/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 [19].

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

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.

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 Activities

Clinical responsibilities of a Medical Practitioner have been defined as: "The diagnosis and treatment of human responses to actual or potential health problems". The practices (steps) in the clinical process are 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, undertaking surgeries and other treatment.
- Step 4, **Evaluation**, compare the patient 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.

Medical professionals 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

The research design, process, and methods used for data collection of the research are discussed in this section. The methodology used to develop the conceptual clinical KM framework is described in section 5. The basis of selection of the case study is also discussed. The research design was guided by a qualitative philosophy and used the case study methodology to achieve the study objective, "To Investigate the Effects of Latest Medical Information for the Quality of Healthcare in the Developing Countries."

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

The conceptual research model was tested using the data collected by the questionnaire. The survey helped to capture beliefs, experiences and perceptions of medical professionals on Information and knowledge management which they currently use for their clinical activities. A total of 136 questionnaires were given to medical practitioners in 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 has covered four main sections: (1) to investigate

the needs of the latest medical Information for clinical activities, (2) to study how medical practitioners in rural and remote areas currently meet their Information and knowledge requirements for clinical activities, (3) to examine how medical practitioners in rural and remote areas can be motivated to use KMSs for clinical activities and (4) to make an assessment on existing infrastructure facilities in healthcare centers located in rural and remote areas.

Survey items been identified in the questionnaire have been used in the data analysis to identify their relationships. In addition to the survey, several meetings and interviews were conducted with some selected medical professionals to get more understanding and clarify certain issues about the healthcare in rural and remote areas.

4. DATA ANALYSIS

Data collected from the main case-survey was analyzed in two phases. First analyzed the data obtained from descriptive statistics to identify the factors effect on accessing knowledge/Information in the clinical activities. Secondly the effect of latest medical Information/Knowledge with the quality of healthcare was tested [20]. The table 1 is a representation of how medical practitioners' access the information. Among the mode of access it seems that more than 21% of people use e–Learning and Training Courses. More than 57% of medical practitioners' say the resources are not available. It can also be seen that more than 65% of practitioners do not use any mode of access to information. This shows that there is an insufficiency in information to them.

Table 1: Mode of Access*Preference of Information Retrieval cross tabulation

Type of Information Possible to Access * Mode of preference Crosstabulation								
			Mode of preference					
			Strongly-agree	Agree	Disagree	Strongly-disagree	Dn/Cs	Total
Type of Information Possible to Access	Patient records, test results, prescriptions	% within Type of Information Possible to Access	37.3%	34.7%	4.0%	1.3%	#REF!	100.0%
		% within Mode of preference	30.8%	21.0%	25.0%	100.0%	#REF!	25.0%
		% of Total	9.3%	8.7%	1.0%	.3%	5.7%	25.0%
	Electronic medical research information	% within Type of Information Possible to Access	28.0%	44.0%	2.7%		25.3%	100.0%
		% within Mode of preference	23.1%	26.6%	16.7%		21.4%	25.0%
		% of Total	7.0%	11.0%	.7%		6.3%	25.0%
	Electronic drug information	% within Type of Information Possible to Access	30.7%	48.0%	2.7%		18.7%	100.0%
		% within Mode of preference	25.3%	29.0%	16.7%		35.0%	25.0%
		% of Total	7.7%	12.0%	.7%		4.7%	25.0%
	Disease information electronically	% within Type of Information Possible to Access	25.3%	38.7%	6.7%		29.3%	100.0%
		% within Mode of preference	20.9%	23.4%	41.7%		54.2%	25.0%
		% of Total	6.3%	9.7%	1.7%		7.3%	25.0%
Total		% within Type of Information Possible to Access	30.3%	41.3%	4.0%	.3%	24.0%	100.0%
		% within Mode of preference	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	30.3%	41.3%	4.0%	.3%	24.0%	100.0%

Table 2: Type of Information Possible to Access*Mode of Preference Crosstabulation

Mode Of Access * Preference of Information Retrieval Crosstabulation								
			Preference of Information Retrieval					
			Strongly-agree	Agree	Disagree	Strongly-disagree	Dn/Cs	Total
Mode Of Access	Text Books	% within Mode Of Access	36.0%	60.0%	4.0%			100.0%
		% of Total	7.2%	12.0%	.8%			20.0%
	Internet	% within Mode Of Access	49.3%	37.3%	8.0%	4.0%	1.3%	100.0%
		% of Total	9.9%	7.5%	1.6%	.8%	.3%	20.0%
	E - Learning	% within Mode Of Access	57.3%	10.7%	21.3%	8.0%	2.7%	100.0%
		% of Total	11.5%	2.1%	4.3%	1.6%	.5%	20.0%
	Training Courses	% within Mode Of Access	33.3%	52.0%	12.0%	2.7%		100.0%
		% of Total	6.7%	10.4%	2.4%	.5%		20.0%
	No resources available	% within Mode Of Access	57.3%	6.7%	20.0%	12.0%	4.0%	100.0%
		% of Total	11.5%	1.3%	4.0%	2.4%	.8%	20.0%
Total		% within Mode Of Access	46.7%	33.3%	13.1%	5.3%	1.6%	100.0%
		% of Total	46.7%	33.3%	13.1%	5.3%	1.6%	100.0%

The table 2 represents the Type of Information Possible to Access*Mode of Preference crosstabulation. It can be seen that there are more than 71% of practitioners who hope that there is a possibility that they can access new medical information by having information through an electronic information system.

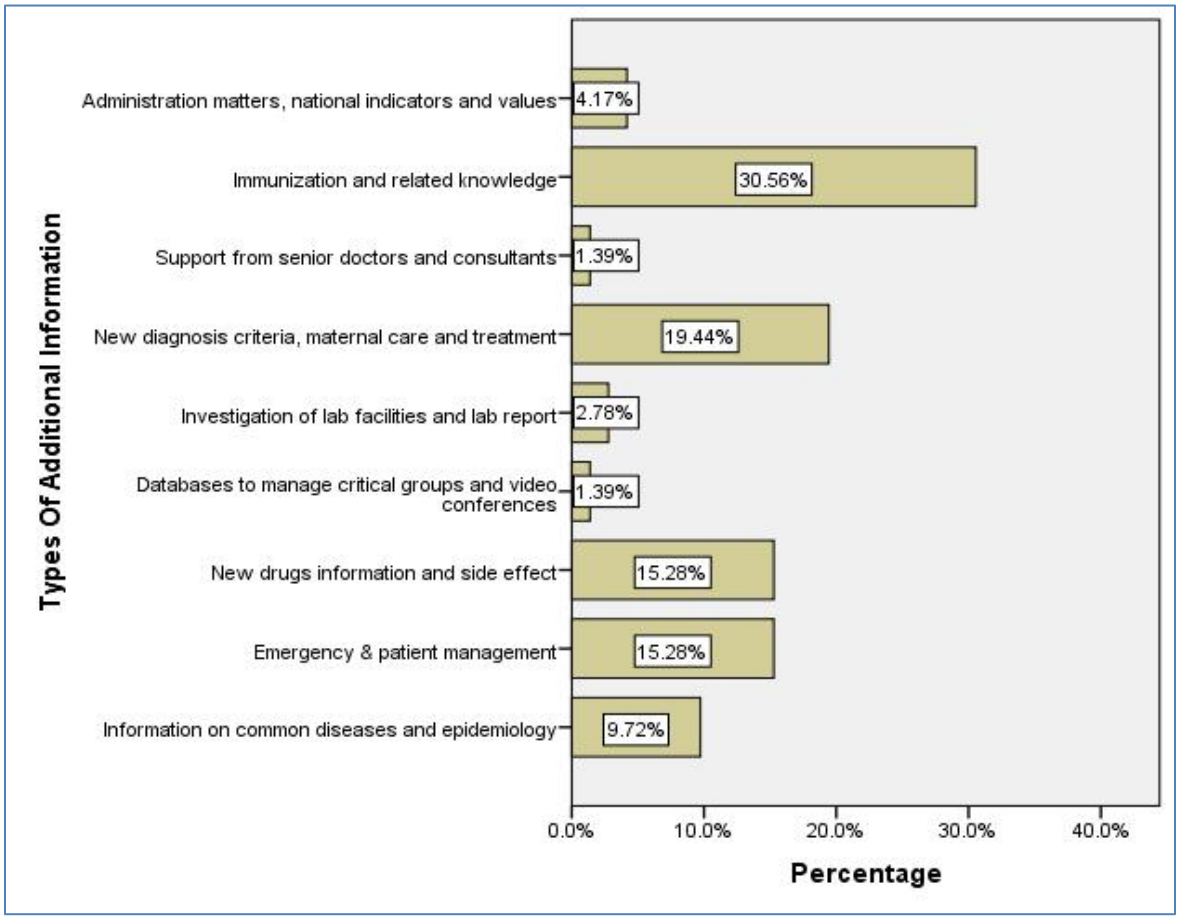

Figure 2: Graph 1-Types of Additional Information

The bar graph 1 is a representation of what types of additional information is referred by medical practitioners. It can be seen that more than 30% of MPs' need to refer information on an immunization and related knowledge while 19% of MP's refer information on new diagnosis criteria, maternal care and treatment. Also bar chart shows that more than 15% MPs refer to information on an emergency & patient management and/or new drugs information & side effects.

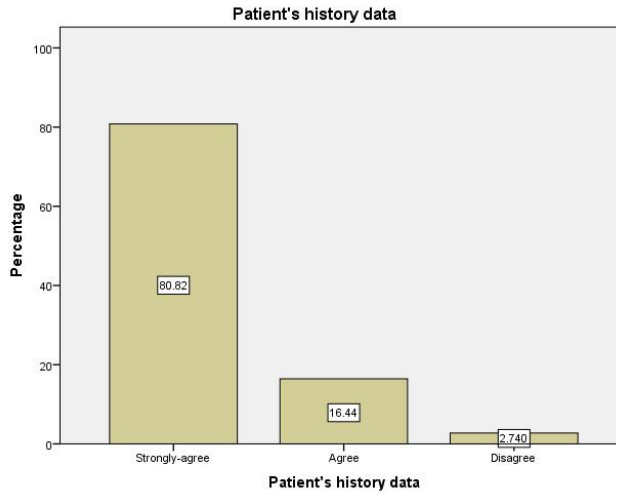

Figure 3: Graph 2-Patient's History data

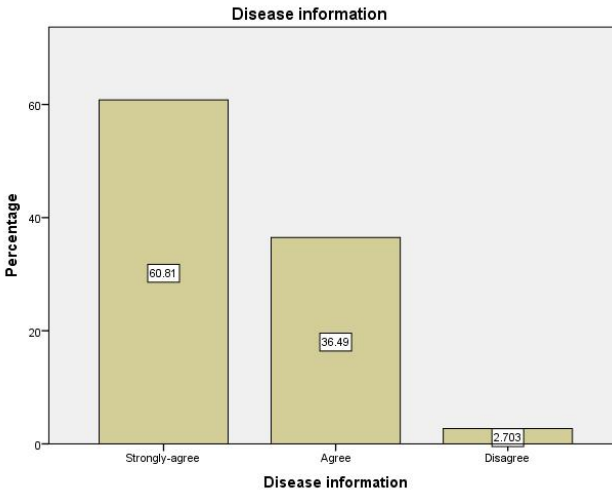

Figure 4: Graph 3-Disease Information

Graph 2 represents patient's history data. It shows more than 97% of MPs like to refer this information electronically for their clinical activities. Graph 3 represents disease information. It can be seen that more than 97% of MPs need to refer disease information system for their clinical activities.

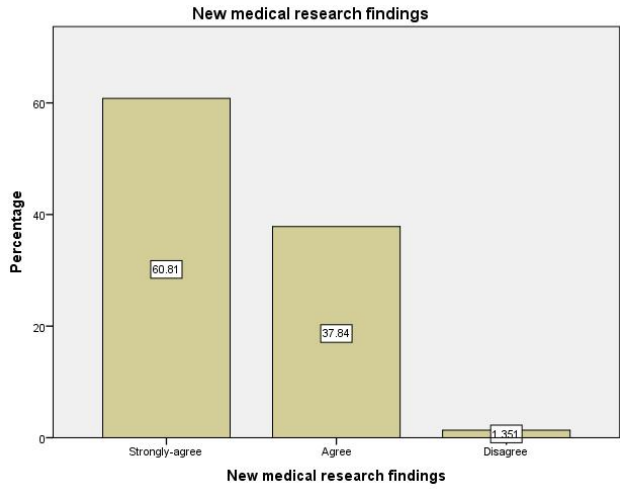

Figure 5: Graph 4-New Medical Research Finding

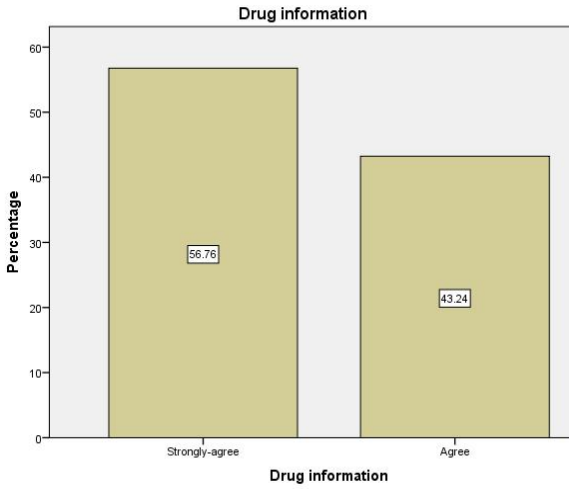

Figure 6: Graph 5-Drugs Information

Graph 4 represents the information on new medical research findings. According to the graph, more than 98% of MPs like to refer this information electronically for clinical activities. Graph 5 represents drugs information. It shows all MPs like to refer drugs information system electronically for clinical activities.

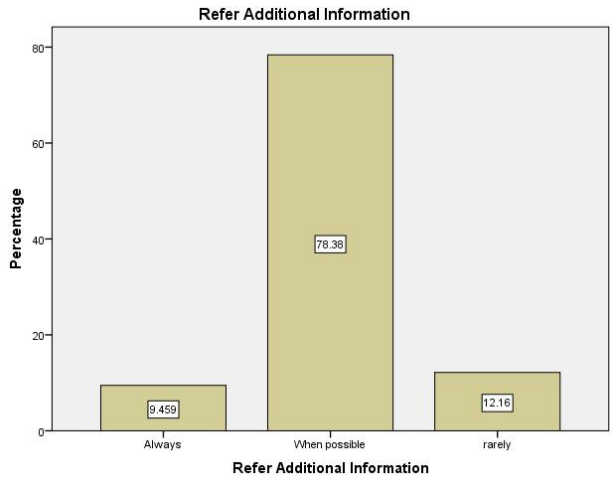

Figure 7: Graph 6-Refer Additional Information

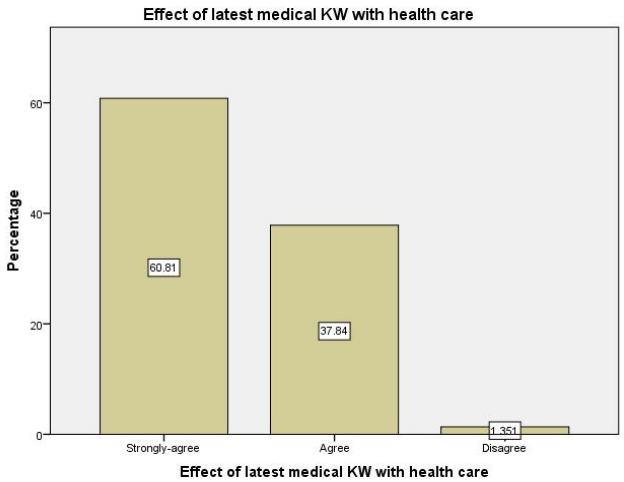

Figure 8: Graph 7-Effect of Latest Medical KW with HC

Graph 6 represents the statistics about 'Referring additional Information' by MPs. It shows more than 9% of MPs like to refer additional information always. But the majorities (78%) of MPs are referring additional information 'when possible'. Reasons for this would be that MPs are fully overloaded with patients or they have not given proper facilities to access necessary information.

Graph 7 represents the statistics about the 'effect of latest medical information/knowledge with the quality of healthcare'. According to the graph, more than 98% MPs have agreed that there is a big impact on the quality of healthcare, if they can access the latest medical information and/or knowledge systems electronically.

Table 3: Factors Effect on Latest Medical KW with Healthcare

		Effect Of Latest Medical KW with health care
New Medical Research Findings	Contingency Coefficient	0.816
	Significance	0.000
Disease Information	Contingency Coefficient	0.759
	Significance	0.000
Drug Information	Contingency Coefficient	0.665
	Significance	0.020
Decision Support Facility	Contingency Coefficient	0.616
	Significance	0.038

The table 3 is a representation of how the above analyzed data would be related to the latest medical KW with healthcare

It seems that new medical research findings are one of the important factors that should be included in the knowledge as it has the highest contingency coefficient among the other factors. From the table 3 of contingency, it can be concluded with 95% level of confidence that new medical research findings, disease information, drugs information and decision support

facility are highly related with the effect of latest medical Information/Knowledge with the quality of healthcare.

5. CONCEPTUAL CLINICAL KM FRAMEWORK

The methodology used to develop the conceptual clinical KM framework for the healthcare Institutions is described here. The graph 7 has shown that the 'latest medical information' shows a relationship with the quality of healthcare. Thus Medical Practitioners must provide access to medical information systems which cover the latest medical information and knowledge. A conceptual clinical KM framework has been proposed. 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 point.

This study contributes 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 in the healthcare Institutions. This is the basis of designing a clinical KMS for medical practitioners to access latest medical Information to make better clinical decisions that leads to raise the quality of healthcare.

The development of conceptual clinical KM framework comprised with two steps to follow.

- Develop the first level conceptual clinical KM framework with core features
- 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 Framework

A KMS design framework should integrate business processes and IT with associated functions to facilitate the KMS design [21]. It emphasizes the needs of understanding 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 required. A clinical KMS will be an IT based system developed to enhance the knowledge creation, codification, transfer, and application to support the clinical activities such as Assessment, Diagnosis, Treatment and Evaluation. .

Empirical data was gathered via the questionnaire which is the main case. The findings of this case, in conjunction with inputs from the literature review have formed in to an iterative

process. The analysis of the collated data resulted in a first level conceptual clinical KM framework for Healthcare organizations in the developing countries. It can therefore be argued that the dimensions of the clinical KMS design include both clinical processes and KM technologies which are driven by the e-health environment.

5.2 The Second Level Conceptual Clinical KM Framework

The data gathered from ten National Health Institutions (sub cases) has supported the main case study. The analysis of the additional data has been used to validate the findings obtained. The data obtained from the sub cases has been used to revise the first conceptual clinical KM framework, leading to the second conceptual clinical KM framework. The ultimate result was a revised and final conceptual clinical KM framework as depicted in Figure 9.

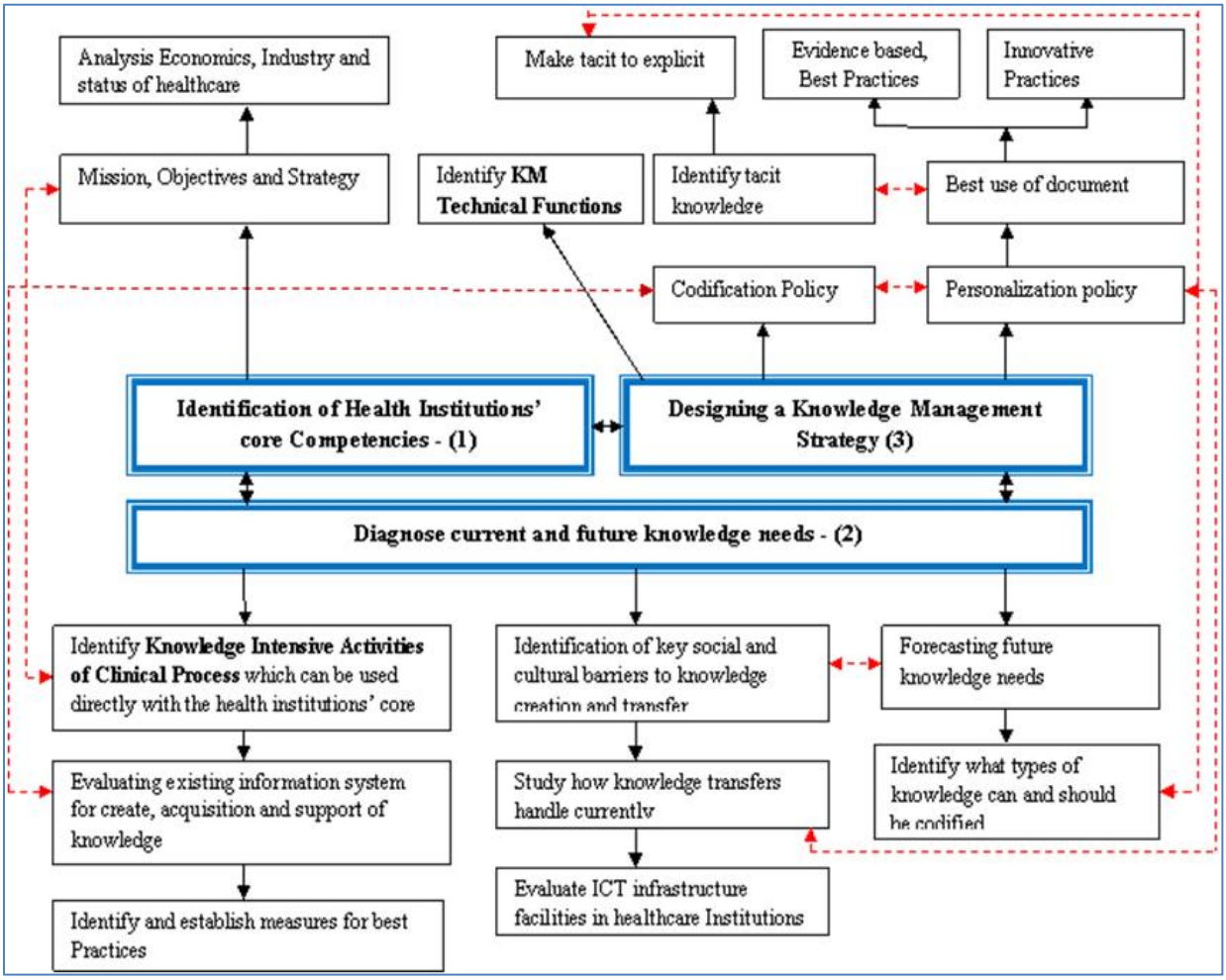

Figure 9: Final Conceptual KM Framework for Clinical Activities.

The final version of clinical KM framework is a three layered system. It is based on empirical data serving as a basic utensil for healthcare institutions for understanding how to develop KMSs.

5.2.1 Identification of Health Institutions' Core Competencies

The first step (cage (1) in Fig. 9) in formulating 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 will create awareness of the mission, objectives and strategy in the context to its economic, industry and status of healthcare outlook.

5.2.2 Diagnose Current and Future Knowledge Needs

The second step is the diagnosis in Healthcare Institution's current and future knowledge needs (cage (2) in Fig. 9). This section of the framework analyzed the current technological infrastructure (ICT related facilities and e-health applications) in place for supporting knowledge transfer. After completion of this process, HIs need to identify knowledge intensive activities and assess what knowledge is to be codified (cage (2) in Fig. 9). It results in the decision to adopt a KM strategy with emphasis on either personalization or codification. Irrespective of the strategy adopted, HIs must identify what represents in the best clinical practices. This will help in capturing tacit knowledge of clinical specialists up to some extent.

5.2.3 Designing a Knowledge Management Strategy

In the last section (cage (3) in Fig.9), a KM strategy would be identified for HIs. Each HI can adopt a KM strategy which emphasizes on tacit knowledge. This 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 is leading to identification of relationships that exists between different types of knowledge (tacit or explicit) being transferred and dissemination practices. Then the result in a spiral transfer between the processes marked with the broken arrow signs in Fig. 9. Finally the knowledge identified, created and generated is then modeled in to knowledge repositories.

This was aimed to develop a conceptual clinical KM framework to identify the key factors involved in the development of Knowledge Management Systems (KMSs) for clinical activities. 'Access latest medical Information for clinical activities' is one of the key factors that led for the development of conceptual clinical KM framework. This framework will provide a systematic guideline for KMS designers to adopt IT and the needed KM technical functions to support the activities in clinical processes when designing a KMS for clinical activities. By developing KMSs for clinical activities, medical practitioners will get opportunities to access latest medical information which leads to improve the quality of healthcare in the developing countries.

6. DISCUSSION AND CONCLUSION

The research outcome has shown that there are no specialist doctors or very few medical specialist who serve in the HIs located in rural and remote areas in developing countries. Further the majority of practitioners who serve in HIs in rural and remote areas are overloaded

with patients and over 60% practitioners have to handle more than 75 patients per day. These factors have a negative impact on the quality of healthcare. According to data analysis, it can be seen that more than 97% of medical practitioners have agreed that latest medical information would affect the quality of healthcare. But due to many constraints they cannot access the latest medical information. It also revealed by the study that some medical practitioners serve in the healthcare Institutions located in rural and remote areas, gather medical information/knowledge from pharmaceutical representatives. Therefore the medical practitioners should have access to the latest medical Information & Knowledge system for clinical activities that help to update their medical knowledge.

Findings of the study also revealed the importance of medical information & knowledge for quality healthcare. This emphasized the needs of complete & reliable clinical KMS to use for clinical activities that improve the quality of healthcare. Further it has discovered some facts that will affect Information and knowledge sharing in the clinical activities. By providing IT Infrastructure, reliable communication network, information network and an e-Health technology can initiate this process in HIs. These factors may facilitate utilizing Information and knowledge in a much effective way which helps to break barriers in the knowledge culture in HIs. Knowledge Management training and education can fill any gaps and convert the Health Organization to a learning organization.

This paper reports statistically that there is a strong association between accessing latest medical Information for clinical activities and quality of 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 Healthcare Institutions in the developing countries.

The authors conclude with the statement that the clinical KM framework will provide a benchmark for all future KM implementations in healthcare which provides access to the Latest Medical Information systems. Clinical KMSs orient all future efforts on sharing tacit-to-tacit knowledge in order to avoid knowledge gaps and leverage all available resources.

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. We would also like to express our appreciation to Prof. Sheriff, Director, PGIM, for Information provided. We thank Dr. Rikaz Sheriff and Mr. Hansa Perera for comprehensive feedback given on statistical data analysis. Finally we thank Prof. Sanath Jayasena and Dr. Wathsala

Wickramasinghe for the useful guidelines and feedback given from the beginning of the research.

REFERENCES

[1] Gray M.J.A, Where's the chief Knowledge officer? To manage the most precious resource of all. BMJ 1998;317:832-40.

[2] The Knowledge Management Centre. "About the Knowledge Management Centre" [Online Document], October 2000. Available from: http//WWW.ucl.ac.uk/kmc/kmc2/AboutKMC/index.html,[Accessed 12 November 2002].

[3] J.C. Wyatt, "7. Intranets," Journal – Royal Society of Medicine, Vol 9, Iss. 10, pp 530-534, 2000.

[4] 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].

[5] Rajam S. Ramamurthy, MD, WWW.San Antonio medicine.com, "Future Trends of International Medical Graduates' Availability within the Physician Workforce of the United State"

[6] N R De Silva, "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 2008, Sri Lanka.

[7] S.H. Applebaum, L. Wohl, "Transformation or change: some prescriptions for healthcare organizations," Managing Service Quality, vol. 10, no. 5. Pp. 279-298, 2000.

[8] Anonymous, "U.K. to Implement Electronic Patient Records," Information Management Journal, Vol. 37, Iss. 4, pp. 7, 2003.

[9] J.W. van der Slikke and T.N. Arvanitis, "Keynotes," Technology and Healthcare, Vol. 10, Iss. 6, pp. 435-442, 2002.

[10] C. Safran, "Electronic Medical Records: A Decade of Experience," JAMA: Journal of American Medical Association, Vol. 385, Iss. 13, pp. 1766, 2001.

[11] W. Kondro, "Canada must update patient records," Lancet, Vol. 353, Iss. 9152, pp. 568, 1999.

[12] S. Lohr, "Government Wants to Bring Health Records into Computer Age," New York Times, Vol. 153, Iss. 52917, pp. C1, 2004.

[13] J. Grimson, W. Grimson, W. Hasselbring, "The system integration challenges in healthcare," Communications of ACM, Vol. 43, Iss. 6, pp. 49-55, 2000.

[14] B. Lin, D. Umoh, "E-healthcare: A vehicle of change," American Business Review, Vol. 20, Iss. 2, pp. 27-32, 2002.

[15] S.P. Engelhard, R. Nelson, "Healthcare Informatics: An Interdisciplinary approach," Mosby Press, 2002.

[16] O'Leary, Daniel E. O'Leary. Using AI in Knowledge Management: Knowledge Bases and Ontologies. IEEE Intelligent Systems, 13(3): 34-39, May/June 1998.

[17] Abecker et al., Andreas Abecker, Ansgar Bernardi, Knut Hinkelmann, Otto Kühn, and Michael Sintek. Toward a Technology for Organizational Memories. IEEE Intelligent Systems, 13(3): 40-48, May/June 1998.

[18] O'Leary, Daniel E. O'Leary. Knowledge Management Systems: Converting and Connecting. IEEE Intelligent Systems, 13(3): 30-33, May/June 1998.

[19] Simon, Gaële Simon. Knowledge Acquisition and Modelling for Corporate Memory: Lessons Learned from Experience. Proceedings of Tenth Knowledge Acquisition for Knowledge-Based Systems Workshop, 1996.

[20] Amararachchi J L, Perera H.S.C, and Pulasinghe K, "Achieving Quality Healthcare through Knowledge Management Initiatives in Health Institutions in Rural and Remote areas in Sri Lanka", National Conference on Technology Management, January 2012, Sri Lanka.

[21] M. Alavi, D.E. Leidner, "Knowledge management and knowledge management systems: Conceptual foundations and research issues,". MIS Quarterly, Vol. 25, Iss. 1, pp. 107-136, 2001.