



ADDIS ABABA UNIVERSITY
SCHOOL OF INFORMATION SCIENCE
AND
SCHOOL OF PUBLIC HEALTH

M.Sc in Health Informatics Program

Designing Physician's Knowledge sharing web-portal at
Tikur Anbesa specialized Hospital

By
Fekadu Debele

June, 2016
Addis Ababa, Ethiopia



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Designing and Developing Physician's Knowledge Sharing

Web-Portal at Tikur Anbesa Specialized Hospital

**A Project Submitted To The School Of Information Science And School Of
Public Health Addis Ababa University In Partial Fulfilment Of The
Requirement For The Degree Of Master Of Science In Health Informatics**

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**June, 2016
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LIST OF ACRONYMS

TASH	Tikur Anbesa Specialized Hospital
CMS	Content Management System
HTML	Hyper Text Mark Up Language
SQL	Structured Query Language
KM	Knowledge Management
IT	Information Technology
ICT	Information Communication Technology
CoP	Community of Practice
KS	Knowledge Sharing
OOD	Object Oriented Development
UML	Unified Modelling Language
PHP	Hypertext Preprocessor
URL	Uniform Resource Locator
CSS	Cascading Style Sheet
USD	Use Case Diagram
ADE	Adverse Drug Events
WPKS	Web Portal Knowledge Sharing

ABSTRACT

Background:

Healthcare organizations are big sources of knowledge. From a functional standpoint, the Web 2.0 paradigm allows achieving the objectives of sharing knowledge.

Objective The objective of this study is to design a web-based platform that facilitates Knowledge Sharing among Health Professionals of Tikur Anbesa Hospital.

Methodology: To achieve the objective of this study the investigator performed requirements identification by applying interview and observation. Once the requirements are defined, object oriented system analysis and design methodology was employed. Analysis, design and implementation of the proposed system are performed using the UML tools for analysis and design, CMS (Content Management System) as a web based application was designed to create and manage HTML.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

According to Nonaka and Takeuchi (1995), knowledge is either tacit or explicit. Tacit knowledge refers to the personal knowledge residing within an individual's head in the forms of personal experience, know-how, insight, mental modes, and personal beliefs, whereas explicit knowledge refers to well-articulated knowledge that is written down and documented (Nonaka & Takeuchi, 1995).

Knowledge Management (KM) facilitates the sharing of tacit and explicit knowledge between individuals and across organizations to meet organizational knowledge needs. KM embraces any practices, cultures, processes, mechanisms, techniques and technologies espoused by related disciplines that might assist with any tasks that have a knowledge element and can deliver potential commercial advantages (Huck et al. 2011).

Knowledge sharing among health professionals is considered to be critical for improving the quality of patient care. In particular, tacit knowledge sharing amongst health professionals, such as the sharing of clinical experiences, skills, know-how, or know who, is known to have a significant impact on the quality of medical diagnosis and decisions (Abidi, 2005). From a healthcare Knowledge Management (KM) perspective, it is vital to harness and facilitate tacit knowledge sharing among clinical teams, particularly when they are not always physically co-located but must nevertheless exchange their critical experiential knowledge (Abidi, 2005).

A fundamental question for Information System researchers and practitioners could be how collaborative technologies and tools can be used to share knowledge. Collaborative technologies are nothing but integrated sets of IT functionalities that facilitate communication and information sharing among interconnected entities (Pavlou, 2008). Therefore, this project deals with assessing the existing knowledge sharing method at Tikur Anbesa Specialized hospital (TASH) and designing web-portal

to facilitate knowledge sharing and diffusion amongst health professionals through collaborative tools.

Healthcare knowledge is generated at a rapid pace (Abidi, 2009) in terms of explicit and tacit resources. Explicit resources include research-based publications, best evidence, systematic reviews, clinical guidelines, clinical protocols and problem-based discussions. Tacit resources include the practice related experiential knowledge of practitioners. The traditional knowledge dissemination mechanisms facilitate the sharing of explicit healthcare knowledge. But, the practice-related healthcare knowledge of health practitioners termed as experiential knowledge is not systematically disseminated despite the fact that it entails vital and pragmatic insights into what worked, what did not work and what are the best practices in specific clinical situations, especially beyond the realm of accepted norms and established beliefs.

From a functional standpoint, the Web 2.0 paradigm allows achieving the objectives of sharing knowledge through collaborative technologies, such as social networking and online discussion forums, to realize a *community* of specialized health practitioners that shares, critiques and validates its collective experiential knowledge to advance the knowledge quotient of the entire community (Krishna (2001).

1.2 Statement of the Problem

The patient is the centre of all activity in health care and any medical error could have a detrimental effect on the patient's health or result in her/his death. Indeed, in the U.S. alone, it is estimated that medical errors cause million injuries and nearly hundred thousand deaths each year (Davenport, 2002); besides, over 770,000 people are injured or die each year in hospitals from Adverse Drug Events (ADEs) (Bates, 1997). ADEs alone may incur an estimated cost of \$3 million each year in a 650 bed hospital (Peirce, et al. 1998), and this cost does not include malpractice and litigation costs, and other economic cost to patients. In the U.S. alone, hospital expenses to treat patients who suffer from adverse drug events during hospitalization are estimated at between \$1.56 and \$5.6 billion annually (Kass, B. L. 2001).

In most countries, such as Sweden and England, the healthcare system is mainly government funded. Hence health care organizations, both in public and private sector, need to respond to patient's needs, the community's need, stakeholders, government policy and changes in medical and patient care practices (Jon Van Beveren. 2003). Some have suggested that responsive organizations such as healthcare industries have the ability to create an environment where specialized knowledge, skills and abilities of all employees are leveraged to achieve advancements in service delivery (Katzenbach, 1993).

One American research association survey reported that lack of knowledge sharing among nurses and physicians caused 75% of patient's death (Joint Commission 2004). Effective knowledge exchange between nurses and physicians is essential in providing safe and effective care, as poor communication represents a major etiology of preventable adverse events in hospitals. A Joint Commission study of 3548 sentinel events reported from 1995 to 2005 indicated that lack of knowledge sharing was the root cause for two-thirds of preventable adverse events in health care settings in America. Even if high-quality patient care is the goal of medicine and nursing, patients are dying and experiencing preventable complications because of poor nurse physician communication in knowledge sharing (Sigrún G, 2009). Poor knowledge sharing between healthcare professionals has a negative impact on the provision of healthcare and on patient outcomes. The consequences reach far beyond stress and frustration levels experienced by professionals; they can result in adverse events such as medication errors and failure to rescue patients. (Jacqueline S, 2010).

At a global level, healthcare is entering its third era, *the era of knowledge*. This era demands healthcare organization to be more effective at managing and sharing knowledge to enhance the useful knowledge of clinicians, patients and staffs along with using knowledge to reduce costs and deliver quality patient care (Pavia, 2001). Furthermore, healthcare is becoming too complex for a traditional "medical expert" based approach to work. Thus, physicians and clinicians must have the means and access and/or share information (knowledge) to already known 10,000 disease, 3,000 drugs, 1,100 lab tests, 300 radiology procedures, 7,000 current procedural terminology (CPT) codes for physician's services, 1,000 new drugs, and biotechnology medicines

in development and 2,000 individual risk factors (Moen,2012). Due to the diversity of physicians' and the centre of referral, assessing the existing systems and developing new system for knowledge sharing in the sector is exclusively important.

According to a report from Addis Ababa Health Bureau (2002 E.C), 100 health professionals are leaving the hospitals per year due to various reasons i.e., retirement, external transfer, death and personal reasons (Panahi,2012). This indicates that there is high rate of health professional turnover. Unless the hospitals facilitate the sharing of their knowledge with others this mobility of experienced and knowledgeable health care professionals will obviously lead to loss of knowledge.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this study is to design and developing a web-based platform that facilitates Knowledge Sharing among physicians' at Tikur Anbesa Hospital.

1.3.2 Specific Objectives

The specific objectives of the study include:

1. To review related literature so as to exploit best practices in knowledge sharing.
2. To identify and analyze system requirement of knowledge sharing web portal system for TASH.
3. To design and develop a Web-based knowledge sharing platform that facilitates knowledge sharing among physicians' atTASH.

1.4 Significance of the project

The new knowledge sharing web-portal platform will hopefully provide different functionalities for different individuals.

Physicians and clinicians

The system is expected to make physicians' work easy by facilitating knowledge sharing, effective and efficient and also it helps them to communicate in a real-time such as using online discussion forum. It will also allow some collaborative processes to take place, such as routinely communicating about a specific case with colleagues, managing workflow, producing clinical case documents, sharing them with colleague within the hospital, scheduling and receiving internal news and updating patients' status.

In addition to this it helps the health professionals in providing quality health care service. It helps to develop organization culture of safety and quality that value patient-centred communications as an integral component of delivering patient-centered care.

Patient

Since the primary goal of the hospital is to provide quality health service to patients, if the design part of this project is developed and implemented, patients could benefit from it by getting accurate and quality health care service and also reduce the risk of injuries from medical error.

Hospital

The hospital also stays competitive or stays on continuous development, since its health professionals easily know how activities are performed without wasting time. Besides, it is expected that such a resource helps in resource allocation and controlling activities.

Other student/Researcher

It can be used as a starting point for other related projects.

1.5 Scope and limitation of the project

1.6.1 Scope of the study

This study focused on the development of patient record system at Tikur Anbesa Specialized Hospital in Addis Ababa

The project does not present a complete outstanding system; rather it provides a blue print of the initial system development iteration process output.

The project uses Object Oriented methodology as modelling method and the iterative process modelling as a process of analyzing and designing the system. The technique used in this system analysis and design are UML modelling techniques.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter will address the key issues surrounding knowledge, knowledge management, and knowledge sharing in the healthcare sector. The importance of knowledge sharing particularly within the healthcare will be discussed with focus on the key challenges and barriers to knowledge sharing within this sector.

2.2 The knowledge ontology

Knowledge is currently regarded as one of the most strategic and critical asset which enables organizations to sustain a competitive advantage in the information age (Choi, Poon, & Davis, 2008). A definition provided by Davenport and Prusak (2000, p. 5) is currently more commonly adopted in the literature: “knowledge as a fluid mix of experiences, values, contextual information and insight that provides a framework for evaluating and incorporating new experiences and information”.

According to Nonaka and Takeuchi (1995), knowledge is either tacit or explicit. Tacit knowledge refers to the personal knowledge residing within an individual’s head in the forms of personal experience, know-how, insight, mental modes, and personal beliefs, whereas explicit knowledge refers to well-articulated knowledge that is written down and documented (Nonaka & Takeuchi, 1995).

Knowledge is an abstract concept. Knowledge may exist in different carriers according to the context. In health industry, the knowledge sources exist in the format of documents, knowledge warehouses/Marts, applications, best practices and discussions (Bose, 2003).

Organizational knowledge reflects organizational culture and defines organization (Smith, 2001). Organization knowledge consists of its current and past employee’s tacit and explicit knowledge and is considered to be a strategic, non-tangible asset (Cabrera, 2002). Given that knowledge is viewed as a key resource, companies invest considerable time and money ensuring they make the most of the potential competitive advantage. There are several other reasons behind implementing knowledge management strategies in organizations, the main being to gain core competencies.

These competencies are dependent upon the expertise and skills of the employees working for the organization.

Knowledge and knowledge management are popular topics in today's scientific literature concerning strategic management, organizational theory, and information systems (Alavi & Leidner, 2001). The ability of organizations and institutions to learn and acquire knowledge has emerged as a key factor influencing organizational performance and has been identified to be crucial for survival in today's complex and rapidly changing environment (Argote, et al., 2003). Therefore, many organizations and institutions allocate dedicated resources to organizational learning and knowledge management (Kane & Alavi, 2007; Schultze & Leidner, 2002)

2.3 Knowledge Management and Knowledge Management Systems

Knowledge Management (KM) facilitates the sharing of tacit and explicit knowledge between individuals and across organizations to meet organizational knowledge needs. KM embraces any practices, cultures, processes, mechanisms, techniques and technologies espoused by related disciplines that might assist with any tasks that have a knowledge element and can deliver potential commercial advantages (Huck et al. 2011).

Knowledge Management has its origins in the economic slump that affected American manufacturing in the late 1980's and early 1990's (Thompson, J, 2010). At this time there was widespread concern that American companies were increasingly unable to compete with foreign competitors, not just on price but on quality of the goods they produce also. This was particularly notable with respect to the success at the time of Japanese electrical and mechanical goods in penetrating American and European markets. Business managers and strategists began investigating the reasons why traditional working methods were hampering success and they began to explore the role that knowledge and knowledge processes could play.

The first introduction of KM to business management was by Peter Senge in 1990 when he produced his book called 'The Fifth Discipline'. His book defined learning organisation' as an organisation that emphasises learning by promoting the exchange,

use and creation of knowledge, and where “people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together”. (Senge, P,1990). This is essentially an organisation in which KM is a primary activity.

There is no universal approach to knowledge management (Cummings & Worley, 2005). It is, however, possible to identify four primary process of knowledge management in literature (e.g. Davenport, Long, & Beers, 1998; Pearlson & Saunders, 2006). The four primary goals are to promote the process of (1) new knowledge creation, (2) knowledge storage; (3) knowledge sharing among organization members and (4) knowledge reuse (knowledge application). These four dimensions are described below.

The first process, knowledge creation, occurs when new knowledge is generated in organizations and institutions (Argote, et al., 2003). It involves developing new content or replacing existing content within the organization’s knowledge (Alavi & Leidner, 2001). Through social and collaborative processes as well as an individual’s cognitive processes, knowledge is created and justified in organizational settings (Nonaka, 1994). If an organization does not create new knowledge, it quickly becomes outdated and loses market power (Nonaka & Takeuchi, 1995).

The second process of knowledge management is knowledge storage. Knowledge storage involves “obtaining the knowledge from organizational members and/or external sources, coding and indexing the knowledge (for later retrieval), and capturing it” (Alavi & Leidner, 2001, p. 127). Empirical studies report that while organizations create knowledge, they also forget (Argote, et al., 1990). Advanced storage technology, such as intranet, multimedia databases, and database management systems, can be effective tools in enhancing the capabilities of knowledge storage (Chou, 2005).

The third main component of knowledge management is knowledge sharing or knowledge transfer (Argote, et al., 2000; Davenport & Prusak, 1998). Knowledge sharing concerns knowledge flows between individuals. It is about the transfer of

knowledge to locations where it is needed and can be used. A major challenge of knowledge management is to facilitate these knowledge flows so that the maximum amount of knowledge transfer occurs between individuals in a group or community of practice. Knowledge sharing occurs at various levels: transfer of knowledge between individuals, from individuals to explicit sources, from individuals to groups, between groups, across groups, and from the group to the organization (Alavi & Leidner, 2001).

The application of knowledge is the fourth and final process of knowledge management. Alavi and Tiwana (2002, p. 1030) state that “knowledge application is the phase in which existing knowledge is brought to bear on the problem at hand”.

Knowledge creation, however, can only occur when knowledge is shared among organizational members (DeTienne & Jensen, 2001). Successful knowledge sharing is an important driving force in knowledge creation (Kang, Rhee, & Kang, 2010). Furthermore, knowledge creation only creates value for an organization when it is distributed throughout the organization and transferred from its previous site and applied where it is needed (Alavi, et al., 2002). These conclusions support the statement that knowledge sharing is a crucial process in many organizations.

Knowledge Management Systems belong to the category of information systems used to manage organizational knowledge. 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 (Alavi & Leidner, 2001). 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.

2.3.1. Knowledge Management in Africa

KM has been going on informally and intuitively in the African region. Empirical study based on a Kenyan perspective that shows KM initiatives are firm based (Mosoti & Masheka, 2010). Organizations in Africa region use in-house approaches or strategic

partnerships as ways of realizing Knowledge management; however, to measure the effectiveness of these practices is difficult due to existing organizational culture. Formal KM is an emergent area with great value proposition in Africa (Karanja, 2010).

Knowledge Management Africa (KMA) is one of the new initiatives that aim at driving KM initiatives in Africa. Besides, The African Medical and Research Foundation (AMREF) is an organization headquartered in Nairobi – Kenya with operations in seven African countries i.e. Kenya, Uganda, Ethiopia, Somalia, Tanzania, South Sudan, and South Africa. AMREF is facilitating a community participatory approach to knowledge Management in the health sector. AM-REF has partnered with local communities, health system formulators and governments with an aim of realizing right to health for all (Ireru & Wairagu, 2007).

Access to current, evidence-based information is crucial for health professionals to design programs and provide high-quality services that improve overall health and well-being. In spite of recent advances in ICTs however, many health professionals and policy makers in Africa still lack the crucial information needed to make evidence-based decisions (UNDP 2013; Pakenham-Walsh & Bukachi 2009).

Ethiopia has made significant stride in rolling out infrastructure to various part of the country through Rural Connectivity Project, Woreda Net, Schoolnet and AgriNet (Lishan, 2006). Many people still see the Internet as a consumption tool—as a means of recreation, information gathering, social networking and shopping, but the Internet has been a key resource for exchange of knowledge. Although the country has expanded its Internet coverage in recent years, Ethiopia yet has one of the lowest rates of Internet users in Africa – only 1.1% – compared with 15.6% in Africa (average) and 34.3% worldwide (Internet World Stats 2012). A significant amount of work still remains in turning Internet and other technologies around it to facilitate the exchange of knowledge.

Generally, Kora, (2006) while evaluating the viability of Information and Communication Technologies (ICTs) as a KM strategy in rural development in

Tanzania, claims that none of the KM research initiatives in Africa has formally focused on Software development for knowledge sharing.

2.3.2. Knowledge Management and IT

In the early days of knowledge management, there was a strong focus on information technology (IT). As knowledge management became the latest buzzword, technology vendors were quick to spot an opportunity to sell “knowledge management solutions” and many of the companies that led the way in knowledge management were quick to buy to their cost. Having made significant investments in the latest systems, they then found that people simply did not use them and so the systems ended up being confined to what became known.

That being said, technology is an important enabler of many, if not most, knowledge management initiatives. Technology can support and enable knowledge management in two main ways: (1) it can provide the means for people to organize, store and access explicit knowledge and information, such as in electronic libraries or best practices databases; (2) it can help to connect people with people so that they can share tacit knowledge, such as through white pages, groupware or video conferencing.

Technology adds value when it reduces the cost, time and effort needed for people to share knowledge and information. However if it is not closely aligned with organizational needs and with people’s ways of working, or if it results in information overload and so people can no longer make sense of it all, then even with the best technology in the world, you will end up right back at square one.

Knowledge as a process is leading to the idea that IT must first of all support the idea of encouraging the knowledge exchange at people level. Looking at IT and the purpose of it, it can be stated that the overarching purpose of information technology (IT) is to increase productivity in the workplace. The right systems provide context and control to all interactions of knowledge creation. Knowledge sharing could already be happening in a typical business environment (Menken 2009, p. 18); the question is on how the people responsible for applying/using it? Information technology in an organization communicates the needs of those seeking knowledge sharing to improve

knowledge exchange and transfer through computer technologies (Figallo & Rhine 2002, p. 86).

Until the IT is able to implement the technology so that it can co-evolve with the organization's changing business models and cultures, with the behavior of people and their habits of knowledge sharing, companies will go through periods where the design of the information interface is not compatible with operational needs. Such incompatibility poses doubt on the acceptance of the IT systems since the logical end-result of using the same is missing. The same can be adapted to the introduction of systems that are not supporting the people in an intuitive and efficient way (Gerhards & Trauner, 2007, p. 86).

Companies that seek to become knowledge centric have been integrating knowledge management concepts with IT and business practices. Since the development and commercialization of the Internet during the 1990s, IT has played a greater role to facilitate knowledge management within organizations (Beath et al. 2012). IT is a tool that leverages technology and information to increase the productivity of processes. Since their introduction the 1960s, IT systems have gone from being used as a tool to managing data and fulfilling management reporting needs, to providing mechanisms for strategic management decisions, and promote collaboration amongst internal and external entities (Petter, et al, 2012).

When it comes to the health sector in particular, the integration of healthcare and IT is commonly referred to as health informatics. Health informatics is becoming a popular topic among the healthcare industry (Berry, 2010). Healthcare informatics aims to provide growths in the value of care and services that institutions deliver to patients (Yasnoff, 2000).

2.3.3 KNOWLEDGE MANAGEMENT IN HEALTH

Throughout the world, people are literally dying for lack of information (Pakenham-Walsh 2012). Health care practitioners without the latest information cannot provide the best care, and the result can be poor health outcomes, including unnecessary loss of life. In fact, a number of health information studies have demonstrated the need for and importance of evidence-based information (Jafar et al. 2005;.

Health information needs assessments to show to what extent health professionals want information that is accurate, up-to-date, relevant to the local setting, and actionable (Sullivan et al. 2012). Ready access to accurate and relevant knowledge helps health practitioners make decisions and implement programs according to the latest evidence and best practices.

Organizations working in global health often have two types of useful knowledge to share. The first type is knowledge related to the various topical areas of health for example, family planning and reproductive health. The second type is knowledge of a particular functional area that supports health goals for example, policy and advocacy, behaviour change communication, or service delivery.

No one has all the knowledge they will need to solve problems that arise in their work. Some answers are known by someone somewhere but the solutions have not been articulated or hared. Other knowledge has not yet been generated. Thus, KM is also about uncovering knowledge wherever it may be, while helping to develop the agenda for research to address as-yet unanswered questions.

KM links health professionals at the global, regional, and country levels, and facilitates knowledge exchange and application throughout a health system or program. Used effectively, KM activities make programs more efficient and effective, spark innovation and creativity, and empower health professionals (Kols 2004).

2.4. Knowledge Sharing

An important process of knowledge management is the transfer of knowledge to locations where it is needed and can be used: knowledge sharing (Alavi & Leidner, 2001). Although knowledge sharing is important for all kind of organizations, successful knowledge sharing is difficult to achieve (Argote, et al., 2000). Knowledge sharing is the process through which one unit (e.g. individual, team, and department) is affected by the experience of another (Argote, et al., 2000). It is a process by which knowledge held by individuals is converted into a form that can be understood, absorbed, and used by other individuals (Ipe, 2003). Gupta and Govindarajan (2000) state that knowledge sharing can be conceptualized in terms of five elements: (1)

perceived value of the source's knowledge, (2) willingness of the source to share knowledge, (3) existence and richness of transmission channels, (4) willingness of receiver to acquire knowledge from the source, and (5) the absorptive capacity of the receiver.

There are many approaches to knowledge sharing. Knowledge sharing within the business sector can take the form of meetings, brainstorming sessions, and the use of knowledge yellow pages (listing employees and their knowledge specialist area) and technology based platforms such as intranets, forums, wiki's and blogs, and internal communities of practice(CoP). CoPs have been described as "groups of people informally bound together by shared expertise and passion for a joint enterprise"(Wenger & Snyder 2000). They differ from teams or functional units as they are self-organising and their lifespan is determined by their members. Such communities are not constrained by time and space and therefore can span organisational boundaries (Wenger 1998). CoPs are very relevant to the not for profit, highly dependent on volunteer organisations, as by their very nature volunteers are coming together to contribute "their shared expertise and passion" for a common goal.

A knowledge-friendly organizational culture is one of the most important conditions leading to the success of KM initiatives in organizations (Davenport & Prusak, 1998). A seismic cultural change is sometimes necessary for the introduction of KM processes, as traditionally organizations usually reward employees for individual performances. Specifically, cultural barriers to KM (e.g., cultural norms that promote and encourage knowledge hoarding) must be replaced by an organizational culture that promotes and encourages knowledge sharing. It is important that the new culture promotes attitudes and behaviors that encourage, allow, and reward sharing of knowledge and insights. An employee must not perceive that his or her value to the organization is worth more if important knowledge is withheld i.e., knowledge hoarding. (Hurley et al., 2005).

Organizational structure can either enhance or prevent knowledge sharing. Organizations with a centralized bureaucratic management style can stifle the creation of new knowledge, whereas a flexible decentralized organizational structure

encourages knowledge sharing, particularly knowledge that is more tacit in nature. (Sharratt and Usoro, 2003). It is argued that the flatter that organizations with a less hierarchical structure may benefit from increased levels of knowledge sharing.

Moreover, technology can be both an enhancer and an inhibitor to knowledge sharing. McDermott (1999) argues that technology can inspire knowledge management and sharing but cannot deliver it. While traditional technologies can facilitate knowledge collaboration and transfer of knowledge, they are limited in their ability to transfer knowledge that is more tacit in nature (Hildreth and Kimble, 2002). For technology to be an enhancer to knowledge sharing the technology itself must be easy to use, and there must be a perception that outcome of using the technology is useful in itself. In order for technology to be successful within a knowledge sharing system, it must be seen to be used by many. Knowledge sharing systems must be easy to use, and participation must be encouraged by the perceived value and benefit of the content, which in turn will encourage further participation.

Since knowledge resides within individuals, knowledge workers must be encouraged and motivated to share their tacit knowledge. It is argued that some incentives may be necessary to encourage the sharing of knowledge. These may be extrinsic as in financial rewards or intrinsic where employees feel that they are well supported by the organization and that they are willing to participate in organizational knowledge sharing initiatives. Hertzberg (2003) in his Hygiene and Motivation theory found that although extrinsic factors such as financial rewards and other external factors are important to avoid unpleasantness at work, they are not necessarily motivating. He argues that motivational factors are based on an individual's need for personal growth, and that motivating factors can create job satisfaction and can encourage an individual to achieve above average performance. Herzberg (2003) includes the following as intrinsic motivating factors – status, opportunity for advancement, gaining recognition, responsibility, challenging/ stimulating work and sense of personal achievement and personal growth in a job.

In addition, a sense of belonging to a community, as in communities of practice, motivates individuals to participate and share knowledge since it breeds the feeling

that knowledge sharing is beneficial to the group as a whole, and to themselves individually.

2.4.1 Knowledge sharing in healthcare

According to the Lin and Hsieh (2006), delivering safe and high quality services to patients is highly dependent on sharing the following types of knowledge, i.e. medical knowledge, scientific knowledge, incident knowledge, and experience knowledge. Although all these types of knowledge have close similarity, they have distinct conceptual features that differentiates one from the other. Medical knowledge is defined as the required information for diagnosis and treatment (Aron et al., 2011). Scientific knowledge is about applying research findings in practice (Ho et al., 2004); while incident knowledge refers to learning from medical errors (Sim et al., 2001); and finally, experience knowledge refers to experienced healthcare providers educating less experienced practitioners about the best practice procedures (Stead and Lin, 2009).

Failure to share the above mentioned knowledge can impact patient safety (Lin and Hsieh, 2006). Thus, all these types of knowledge require special attention, in order to create an environment to improve the quality of healthcare services. EKS (Experience Knowledge Sharing); however, experience knowledge is a more fragile process amongst other of types of knowledge due to the tacit nature of experience knowledge and people's diverse intentions. Knowledge, especially experience knowledge, is a valuable asset which is often considered as a source of power so people might be reluctant to share their knowledge to others or look suspiciously upon knowledge from others (Kankanhalli et al., 2005).

Decision-making in medicine, as in all fields of professional practice, includes internal information and external information, which is what Norman (1998) conceptualised as “knowledge in the head” and “knowledge in the world”. Many decisions will be made based on the healthcare providers' own personal knowledge, but other decisions will be informed by communicating with professional colleagues (Sim et al., 2001). Decisions according to incomplete or out-dated personal knowledge can lead to medical errors. Therefore, senior clinicians in this regard have a crucial role of educating junior clinicians (Mansingh et al., 2009).

The human resources profile of any hospital shows a mix of professional, administrative and non-professional manpower from different occupations. Such a mix is likely to breed conflict among the different groups. Furthermore, values like service-orientation, autonomy, sincerity, justice and confidentiality that the medical profession requires can also make knowledge sharing difficult. Doctors are in contact with the patients, the customers, for 24 hours a day to provide direct and indirect medical services and obtain the most information concerning their reactions and requirements and act as the first point of contact with the customers. Therefore, it is very important to systemize doctors' clinical knowledge and know-how as well as share and utilize their knowledge with others who work with them.

2.4.2 Barriers to KS

2.4.2.1 Individual barriers to KS

Lack of time was recognised by several studies as a major individual barrier to KS (Riege, 2005). Fear and uncertainty are included in the list of personal factors that can adversely affect KS by many researchers (Cheng et al., 2009). It is obvious that the existence of knowledge does not guarantee its sharing and most individual barriers are as a result of lack of socialization (Fong et al, 2011). Thus, there is the possibility that physical distance between team members can hinder adequate KS (McLaughlin et al., 2008). In contrast, the fact that tacit knowledge is socially embedded increases the possibility that simulation of closer physical proximity will lead to improved KS (Cardinal and Hatfield, 2000). As noted by Hansen et al., (1999), not having access to knowledge is a barrier while no knowledge about the existence of valuable knowledge was also reported by Santos et al., (2012).

In another context, the belief that one has no knowledge or relevant information to offer has been noted as a major personal barrier to KS (Lilleoere and Hansen, 2011). Jain et al., (2007) noted that one of the major individual barriers to KS is the assumption that knowledge equals power which was seen as an asset by employees. The significance of information in aiding the development of ideas and decisions has made the open sharing of information important between co-workers. However, the absence of trust affects social relationships within teams working together (Burke, 2007; Von Krogh et al., 2000; Lilleoere and Hansen, 2011).

The lack of a clear understanding about KS processes within the organisation is due to a lack of proper communication of KM activities to employees (Riege 2005). In another perspective, lack of communication would hinder the externalization of knowledge by those who possess it so that it can be shared with those who need it (Hendriks, 1999; Fernie et al, 2003). In the study of healthcare professionals, Esmailzadeh et al., (2013) stated that the emphasis on professional autonomy by physicians was responsible for the physicians' indifference to other subordinate groups in the hospital; thereby preventing them from accessing their knowledge.

2.4.2.2 Organizational barriers to KS

The focus of a majority of literature on organisational culture has been a major factor whose absence or presence will reduce or encourage KS respectively (Alavi et al., 2005). The failure of KS in a firm can be due to an alteration of the organisational culture to meet KS initiatives (Riege, 2005) or the adaptation of KS to fit into the organizational culture (McDermott and O'Dell, 2001). Organisation's culture affects the ability of its members to retrieve and store information, and their ability to absorb and share knowledge (absorptive capacity) (Griffith et al., 2003; Chou, 2005).

The different groups involved in KS in an organization have different programming of their minds that affects all daily routines (Hofstede, 1991). This heavy involvement of culture has led to the understanding that people and their cultural background are important in the concept of knowledge management. Thus, there is empirical evidence on the positive effects of cultural elements like trust, collaborative working environment, shared vision, (Al-adaileh, 2011), communication, management practices and motivation (Islam et al., 2011).

In the views of Zarraga and Bonache (2003) and Robbins and DeCenzo (2008), absence of organisational practices like motivation and reward will adversely affect KS by reducing performance. In another study, the absence of a good working environment will prevent the team members from engaging in KS (Goh, 2002). In their study of KS during the new product development (NPD), Huang et al., (2008) noted that organisational business strategy can pose impediments to KS within a firm. The role of organizational structure was emphasized by Willem and Buelens (2009). Particularly in the medical practice, the hierarchical distance between the consultants,

the juniors and nurses was claimed to be an impediment to KS (Payne et al. 2007). However, Chen and Huang (2009) noted that hierarchy and centralization had no negative effect on knowledge sharing in multicultural organizations especially with regard to the influences of the two major characteristics of multiculturalism: cultural and linguistic differences caused due to reduced communication (Lauring and Selmer, 2011).

2.4.2.3 Technological Barriers

Technology is said to be one of the knowledge management infrastructure along with people and processes (Cepeda-Carrión, 2006). Yang (2011) believes that it is necessary to find technical ways in order to find, disseminate and utilizing the knowledge.

Information technology is usually said to be a good way for inter-organizational knowledge sharing, especially for companies that are dispersed but want an environment which motivates people to share information, knowledge and best practice. IT can create a connection between the knowledge seeker and individuals who may have it without the needs of a formal communication line (Alavi and Leidner, 2001). It is also important to note that KM software needs to be integrated into the organizational culture, human resource as well as IT infrastructure (De Carvalho and Ferreira, 2006).

Another important point is that companies should consider a technology which fits more with their employees and the organization (Riege, 2005). Yang's study (2011) demonstrated that IT infrastructure is one of the important factors which should be considered in implementing knowledge management system. Therefore, it is necessary to understand barriers of knowledge creation and sharing in order to propose the necessary solutions to facilitate the smooth flow of knowledge.

2.4.3 Knowledge sharing success

The barriers to KS can be counter balanced through measures of best practices which present dynamic interactions between linkages and help in the improvement of KS and KM. The study by Alam et al., (2009) observed that four key factors that would positively influence KS among the employees of small and medium enterprises (SMEs) were reward system, culture, trust and technology.

The implementation of specific human resource (HR) practices such as training, teamwork, incentives and performance appraisal systems, help in fostering knowledge sharing, and influence the willingness of individuals to share and create knowledge in organizations (Tan and Nasurdin, 2011; Leidner et al., 2006). The study by Ling et al., (2009) supported linking rewards and performance appraisal while most studies emphasised on right incentives, rewards and recognition (Cheng et al., 2009; Jain et al., 2007). However, Islam et al. (2011) found that reward system does not play a significant role in KS.

The use of appropriate technologies is also an important mediating factor in KS (Kim et al., 2003) and provides the perfect environment to encourage KS (Coakes, 2006). For instance, literature survey reveals several applications of ICT that have helped in ameliorating the challenges of KM in hospitals, through storage systems like the Electronic Medical Record System (EMRS) and the Automated Medical Knowledge Elicitation System (Ting et al, 2011; Evangelista et al. 2010).

From a functional standpoint, the Web 2.0 paradigm allows achieving the objectives of sharing knowledge through collaborative technologies, such as social networking and online discussion forums, to realize a *community* of specialized health practitioners who shares, critiques and validates its collective experiential knowledge to advance the knowledge quotient of the entire community (Krishna (2001).

2.5. Web 2.0 technology for knowledge sharing

Web 2.0 is a set of Internet-based applications that harness network effects by facilitating collaborative and participative computing (O'Reilly, 2006). The precursor to Web 2.0, Web 1.0, was perceived as the static web, for example - web designers or author's compiled web pages and published them on the internet. These sites were static and provided information for the readers. The term Web 2.0 implies the concept of participation in which users are actively involved in the creation of content; the web has evolved from static to interactive. These technologies take the form of blogs, on-line forums/discussions, wikis and other web portal. According to Paroutis et al. (2009) such technologies have distinct technical features that unleash passion for engaging in knowledge sharing and address the drawbacks of current technologies in organisations.

Web 2.0 generally refers to a set of social, architectural, and design patterns resulting in the mass migration of business to the Internet as a platform. These patterns focus on the interaction models between communities, people, computers, and software. Human interactions are an important aspect of software architecture and, even more specifically, of the set of websites and web-based applications built around a core set of design patterns that blend the human experience with technology (O'Reilly, 2005).

O'Reilly (2005) states that Web 2.0 does not have a hard boundary but a gravitational core. The core which O'Reilly refers to is a set of principles that several aspects of the internet industry from software development, through marketing and content development day to day operations. These principles are described in are as follows:

- ❖ Web as a platform – the web should be treated as a platform and not the main application, for example just as the telephone is considered a channel, and the conversation over the telephone line is the essence. Other examples are eBay and Amazon; they provide the channel through which the content is purchased.
- ❖ Active participation of users – in the Web 1.0 era, content managers and experts collected, created, organised and categorised the content for the web. Users mainly accessed this content. In the Web 2.0 era, users are active participants, by means of blogging/WIKI's and on-line forums which gives added value to the content.
- ❖ Content is core : there is control over unique, hard-to-recreate data sources that get richer as more people use them; for example, Amazon's database is relentlessly enhanced, adding publisher-supplied data such as cover images, table of contents, index, and sample material. Even more importantly, they harnessed their users to annotate the data, such that after ten years, Amazon is the primary source for bibliographic data on books. Every significant web application to date has been supported by specialised databases. Google's web crawl and eBay's database of products and sellers are good examples.
- ❖ The perpetual beta: software is developed iteratively and often, with users being co-developers as in open source systems. For example, WordPress' functionality is extended by 'plugins' that are developed and maintained by an open source community for the community (O'Reilly, p.19 2005).

A WIKI is a structured website, i.e. collection of pages sharing the same structure using templates. They allow people to work together and collaborate. Wikis allow multiple users, in multiple locations, to work together on a common project. The templates guide the way people write, and it is the ease of use of these templates that differentiate them from traditional content management systems. The elements of collaboration include communication and the ability of disparate individuals to have access to a shared work project, to make changes and see other participants' changes. Collaborative tools are often self-organizing, allowing those who want to participate to do so, at a level that they choose. Applications like Google Docs and other document-sharing tools provide similar spaces where groups of users can effectively and seamlessly work collaboratively. The most famous wiki is Wikipedia – where this on-line encyclopaedia is written by anyone who wishes to share their knowledge. The reliability and accuracy of this platform can usually be measured by the quality of the references.

2.5.1 Web 2.0 and KM

While knowledge management (KM) is not about technology, technology plays an important role in KM, as it facilitates the process of capturing, representing, and exchanging knowledge (Al-Hawamdeh, 2002). KM tools are technologies that enhance and enable knowledge acquisition, codification, transfer and realization (Ruggles, 1997). Currently, organizations utilize Internet-based technologies as KM tools to manage organizational knowledge. A new generation of Internet-based collaborative tools, commonly known as *Web 2.0*, has increased in popularity, availability, and power in the last few years (Kane and Fichman, 2009). Web 2.0 has the potential to deliver rich peer-to-peer interactions among users, enable collaborative value creation across business partners, and create dynamic new services and business models (Ganesh and Padmanabhuni, 2007). Web 2.0 technologies through rich peer-to-peer user interactions to support collaborative value creation combine the best elements of traditional KM, such as suitability for business environments, and overcome many of the limitations, like limited opportunities for simultaneous collaboration (Wagner and Majchrzak, 2006).

Traditional KM tools, such as expert systems, essentially capture the explicit knowledge of a single expert or source of expertise in order to automatically provide conclusions or classifications within a narrow problem domain. This is in stark contrast to the Web 2.0 KM paradigm (Lee and Lan, 2011), which enables knowledge communities to share knowledge of a more practical or experiential nature, to enable individuals and groups to arrive at their own conclusions (Richards, 2009). An effective way to capture tacit knowledge is to enable knowledge creation through conversation (Von Krogh, 2000). Web 2.0 technology, like Wikis, facilitates such required conversational KM through social interactions (Wagner, 2006). For example, through Wikis, multiple people with different areas of expertise and roles can interact “socially” and work toward a common goal (Mindel and Verma, 2006). Hence, Web 2.0 has great potential to solve one of the great challenges of KM: capturing tacit knowledge and converting it into explicit knowledge (Wagner, 2006). Conceptually, Web 2.0 with its ability to combine traditional KM tools’ features with social computing, where knowledge is evolved through social interactions (Parameswaran, 2007) has been identified as an effective KM paradigm (Fitch, 2007; Mindel and Verma, 2006). With such a capability, Web 2.0 technology has the potential to address many of the KM challenges that organizations face (Minocha and Thomas, 2007; Wagner, 2006).

2.5.2 Healthcare and the Web Tools

According to ‘Health 2.0 Radboud (2011), people in Europe are getting increasingly older. Consequently, the need for healthcare is increasing as well. These developments create big challenges for the healthcare industry. The costs of healthcare will rise, while the government is cutting back in this industry. This situation needs improvement, because plausible outcomes are; decreased quality of healthcare making the service unaffordable for some people. In this regard, web portal might play an important role in improving the situation the healthcare industry is in. In addition, web portal is becoming an important part of marketing in the healthcare industry (Gerstner and Sonntag, 2013).

It is assumed that 8 out of 10 people, who actively use the Internet, are users of web portal as well. In addition, the number of people who search for medical information online is constantly increasing (Mesko, 2011). Moreover, the behavior of the patient is

changing. They do not any longer have to go to the nearest health institution. The patient is well informed about all the offers of organizations in the healthcare industry, partly because of reviews on web portal (Gerstner and Sonntag, 2013). Besides, it is argued that people ‘also rely on the Internet for help with their healthcare decisions’ (Sarasohn-Kahn, 2008, p.3). To be more precise, relying on a big group of people on web portal platforms instead of just one expert increases the chance of understanding and finding medical information that was unknown before (Sarasohn-Kahn, 2008). Moreover, web portal are platforms where patients can connect with other patients and healthcare providers. Consequently, web portal has transformed into support and information supplying system and ultimately might improve patient health (McCarroll, et al., 2013).

According to ‘Health 2.0 Radboud (2011), the relationships between patients and healthcare professionals, as well as the relationship among the professionals themselves, is improving (Korhonen, et al. 2012). Web portal are important tools in this process, because they allow for interaction. The study reveals that healthcare professionals are becoming enthusiastic about web portal and increasingly more healthcare professionals are actively engaging in it.

Nowadays, it is argued that countries increasingly try to develop healthcare systems that are patient-centered. ‘Patient-centered healthcare is part of a shift in focus which has drawn increasing interest in recent years, highlighting the importance of incorporating patients’ needs and perspectives into care delivery’ (Rozenblum and Bates, 2013, p. 183).

Furthermore, web portal are suitable communication platforms for promoting public health as well. For example, using web portal platforms for campaigns to demonstrate the dangers of smoking or dietary interventions will increase the reach of these campaigns, because of the popularity of web portal amongst people (Chou et al., 2009). As a result, by using web portal for public health campaigns, more people will be informed about important health related information. In addition, the public health messages spread faster via web portal and the functional health literacy will improve (Gupta, et al., 2013).

Besides the involvement of patients, web portal offer many opportunities for the healthcare industry. For example, information about health or medicine would normally be obtained by a visit to the doctor or a pharmacy. However, nowadays, a lot of this information can be found via social networking sites. For instance, physicians can upload videos about certain medical topics on YouTube, or professionals within the healthcare industry could use blogs for sharing medical information and education (Subramoniam & Sadi, 2010). In addition, quality in healthcare might increase when organizations in this industry actively use web portal to accelerate communication and provide information to patients and their families (Van de Belt, et al., 2012).

In short, the healthcare industry might benefit from web portal, because they allow for interaction between healthcare professional and patients. Consequently, web portal are becoming the backbone for information supplying systems and ultimately might improve patient health.

2.5.3 Physicians' Use of Web Tools

According to the Matschke et al. (2012), there are a number of characteristics that make Web 2.0 technologies particularly suitable for the healthcare sector. The healthcare sector typically has a large number of healthcare professionals.

The use of the Internet as one of the main communication tools and also as one of the principal ways of seeking medical information has become increasingly popular among healthcare professionals (Bennett, et al., 2006). The latest findings from Manhattan Research (2012a) a global market research firm which surveys physicians' use of the Internet across 17 countries and publishes the results annually, reported that more than 80% of physicians in all countries studied use the Internet for professional purposes and believe that the Internet is essential to their practice. The same report reveals that U.S. physicians (N=3,015) spend an average of eleven hours per week online for professional purposes only, which is 2.5 times more than 2006. Parekh et al. (2009) similarly reported that the Internet is the most used resource by U.S. physicians for finding medical information.

Among the Internet initiatives, the use of web portal platforms by healthcare professionals has grown considerably in recent years (Antheunis, et al., 2013), with most physicians and other medical practitioners having already embraced, formally or informally, most of the social web tools such as blogs, wikis, and social networking websites. A survey by Cooper et al. (2012) shows that 59% of U.S. physicians (N=1750) used social networking sites, more than 41% listened to podcasts, and 12.9% commented on blogs. Similarly, a study by McGowan et al. (2012) also showed that 24% of U.S. physicians (N=485) use web portal regularly (on a daily base) and over 60% use it on a weekly basis or even more frequently to look for medical information. According to this study, nearly 60% of U.S. physicians perceived web portal as a useful, engaging, and good means to receive the latest and high-quality medical information, and about 60% believed that web portal enabled them to practise more effectively. Recent findings from Manhattan Research (2012b) also show that more than two-thirds of U.S. physicians used online videos to learn and keep abreast of the latest clinical information.

In addition, Manhattan Research (2012a) showed that about 22% of European (UK, France, Germany, Spain, Italy) physicians (N=1,218) adopted physician-only social networks (UK was the highest with 48%). A survey conducted by EPG (Electronic Program Guide) also showed that among 315 healthcare professionals (including all specializations) in the same European countries, almost 38% of them are engaged in health-related discussions via online social networks; and 83% would like to participate in the social space, provided there are proper guidelines and regulations (Health Media, 2010). According to this study, the majority of European physicians (60%) used web portal to communicate with peers rather than with patients or pharmaceutical companies. Antheunis et al. (2013) also found that Dutch physicians use primarily LinkedIn, Twitter, and YouTube for professional purposes.

The number of medical bloggers has also increased during the last decade. In addition to the individual medical bloggers, most hospitals have also launched their own blogs. They use blogs for sharing views, perspectives, news, recent knowledge, and any information related to health and healthcare (Petrock, 2010). Furthermore, research shows that nearly half of U.S. physician's active online visit Wikipedia to seek medical

information and 10% contribute to Wikipedia's content (Edwards, 2010). The use of Twitter is also increasing among physicians; however, it is still only a small proportion of physicians who are active users of Twitter (Lulic & Kovic, 2012).

According to Petrock(2010) sharing medical experience, ideas, and points of view anonymously is the primary purpose of physicians joining physician-only social networks, while other reasons include: finding information about new offerings or treatments, developing relationship with colleagues, and in rare cases communicating with patients, and marketing their services.

A study by DocCheck surveyed 441 members of one of the popular physicians social network in Europe, and reported that physicians use social networks for the following purposes: Getting help from their peers about medical issues they encounter in their daily practice (60%); re-sharing information they received via other sources (56%); sharing techniques or insights they learned or developed (40%); and for other reasons, such as talking about their opinions, correcting facts, and so on (11%). The majority of the study participants also stated that medical contents and comments posted by their colleagues on social networks were helpful for them.

Web portal has changed the traditional forms of communication for healthcare. It connects people with similar interests and passions, it allows people to interact, and changes the information flow, for example information used to flow in one direction as in a press release to a large audience, now information can flow in many directions with the audience responding to blog posts or partaking in on-line forum discussions.

There are a myriad of web portal tools using web.2 at the disposal of healthcare. Many use blogging platforms such as WordPress, Youtube, Facebook and Twitter to promote their cause, there are many others. It is important that the healthcare has a goal for engaging web portal; it also needs to know why it is using web portal in order to harness it most effectively. An organisation needs to know that web portal tool such as WordPress can best address their goals.

2.6. The major functionalities of knowledge portal

- **Search and navigation:** This functionality forms the basis for most of the successful public web portals meaning that a successful portal should support its users in an efficient search for contents.
- **Personalization:** Personalization is vital to the delivery of appropriate information to portal user gets only the information which is specifically tailored to his/her needs. Personalization should be used on user roles, as well as user performances.
- **Knowledge mapping:** provides guide to, or inventory of, an organization's internal or external repositories or sources of information or knowledge. These sources may include documents, file and databases, recordings of best practices or activities.
- **Content management system (CMS) :** A Content Management System (hence after CMS) is a platform, system or software application which is powering websites, use to manage, edit, and upload the content of the website without changing any Html code or without having technical skills how the website is working. According to Kathuria (2006) a CMS is used to collect, manage, and publish content, storing the content either as components or whole documents while maintaining dynamic links between components.
- **Infrastructure functionalities:** The infrastructure functionalities constitute the fundamental for the work environment. The other above mentioned functionalities build up on this one. The runtime infrastructure associated with the portal will have a primary effect on manageability, scalability, security and availability.

2.7. System Development Methods, Tools and Techniques

2.7.1. Information System Development

Information system development is steps taken to change object system in a specific environment using a different group of tools and an organized collection of techniques. In addition to the techniques and tools, a developer can use the different process model and modelling methods in the development process of an information system.

2.7.2. Modelling Method

Modelling is a way of depicting the existing business domain in understandable system concept. It also shows the benefits of abstracting complex system to model form. Different system developers can use different modelling methods like, Traditional, structured and Object Oriented modelling methodology.

Structured analysis and design are process centred approaches that transform data into useful information. It uses a series of phases, systems development life cycle (SDLC), to plan, analyze, design and implement (Shelly, 2003)

2.7.3. Techniques

Technique means a set of steps and a set of rules which define how a representation of an information system is derived and handled using some conceptual structure and related notation. Object Oriented analysis and design use static and dynamic UML (Unified Modelling Language) techniques to visualize and document an information system. UML models are used to show the analysis and design of an information system in a different modelling diagram like, Use Case, Activity, Class and Sequence diagrams (Shelly, 2003).

2.7.3.1 Use Case Diagram

An accepted way of accomplishing functional requirement of system is the use case analysis. Use case analysis is a case based way of describing the uses of the system with the goal of defining and documenting the system requirement. It is a powerful technique that describes the kind of functionality that a user expects from the system. It does this by defining a number of actors, which model the roles that users can play when interacting with the system, and describing the use case that those actors can participate in.

2.7.3.2. Activity Diagram

An activity diagram is a flow chart that shows the actions and events as they occur. They show the order in which the actions take place and identify the outcomes. Activity diagrams are dynamic modelling tools that can help a system analyst understand how objects behave and interact with the system.

2.7.3.3. Class Diagram

A class diagram represents a detailed view of a single use case, shows the class that participate in the use case, and documents the relationship among the classes. It is logical model, which evolves into a physical model and finally become a functioning information system (Shelly, 2003). A class diagram is a static model of system, describe the structural relationships that hold between the pieces of data manipulated by the system. They describe how data is parcelled out into objects, how those objects are categorized, and what relationship can hold between them. They do not describe the behaviour of the system, nor how the data in a system evolve over time.

2.7.3.4. Sequence Diagram

Sequence Diagram is used primarily to show the interactions between objects in the sequential order as those interactions occur. A business level sequence diagram can be used as a requirement document to communicate requirement for a future system implementation. The other primary uses of the diagram are in the transition from requirements expressed as use cases to the next and more formal level of refinement.

CHAPTER THREE: PROJECT METHODOLOGY

3.1. Study Design

In this study the object-oriented analysis and design method was used to design the system prototype.

Object oriented system development is the process of finding logical solutions to a problem and applying the solution in the form of objects. OOD is the system design that results from the analysis of user requirements, and is used to develop use case and activity diagram.

Objects can be defined in several ways, but objects generally act upon each other, having roles and responsibilities. The functional and non-functional requirements of the proposed system are described and modeled using Unified Modeling Language (UML).

This system was conducted to increase the quality of website according to the design provided. This is based on as interviewing the physician, communicating them in every issue and changes in site without affecting the main design. The methods used for the successful completion of the project were the incremental model. This project was fully depends on physicians requirement basis that is why the incremental model or incremental development process implementation was decided as one of the main methods. This model is useful for the dynamic website development and allows us to deliver the projects in the different phase and adding features according to the requirements rather than a big bang (Dawson 2009, 120).

3.2 Study area /Case

The study was conducted at Tikur Anbessa Hospital (TASH) which is found in Lideta Sub city, Addis Ababa Ethiopia. In 1998, TASH was handed to Addis Ababa University by the Ministry of Health to be used as a teaching hospital for the then medical faculty. The TASH is the largest and the oldest among health training institutions in the country, staffed with the most senior specialists and subspecialists. TASH is the largest specialized hospital in Ethiopia, with over 600 beds,

and it serves at a training center for undergraduate and graduate medical training as well as the training of dentists, nurses, midwives, pharmacists, medical laboratory technologists and radiology technologists.

The hospital has an outpatient department (OPD) with 28 case teams and inpatient with 20 case teams, 562 beds nine wards (Medical, Pediatrics, GYNOBS, Labor, Surgical, ICU, Orthopaedic, Oncology and Recovery).

The reason why Tikur Anbessa Hospital is selected for this study is that, this hospital is the largest referral hospital in the country. It is also an institution which provides specialized clinical services that are not available in other public or private institutions. In addition to these different cases from different health institutions are referred to TASH. Different expertises are also found at TASH from different places with different experiences. Therefore, it is appropriate to apply this study in this hospital to facilitate the sharing of diverse medical experience available at this site and ultimately to improve the quality of service to be rendered to citizens visiting this public hospital.

3.3. Study Population

The primary population of the study was physicians because physicians are the key players for tacit knowledge engineering.

3.4. Sampling Method

This study used purposive sampling. In other words, interviewees were purposively selected from In accordance with the aim of the study; two criteria were considered for selection of the participants.

The first criterion related to participants' clinical experience; only physicians who had a minimum of five years' clinical experiences were approached for the study. The more experienced the person, the more tacit knowledge she/he may have to share (L. A. Joia & B. Lemos, 2010). In clinical fields, Benner's expertise model (Benner, et.al, 2009) requires an expert practitioner to have more than five years' experience. The Benner's expertise model sets the minimum of five years' clinical experience for the study participants to ensure that they had sufficient experience.

The second criterion is based on the proven experience of the difficulty of accessing physicians, given the work load they have. Getting access to physicians is not always a simple task, particularly for researchers and students who are not involved in any medical practice or research. Therefore, physicians who were willing to sacrifice their time for this study were interviewed.

3.5. Methods of data collection

To identify user and system requirement for the project, the situational analysis was done using in depth interview for the department head.

3.6. Methods of data analysis

UML techniques were used to model the analysis and design of the new proposed system. For the analysis part use case diagram and narrate use cases were used to identify the system boundary and the processes in the system. Activity diagram was also used in the analysis part of the project. Class diagram and sequence diagram were used in the design. The UML techniques are more related with OO analysis and design methodology and the investigator has better knowledge to use it.

3.7. Data quality management

Various effort will be made to assure the analyzed information quality, to achieve optimum system requirement and user satisfaction, users will be involved in each verification process of the design.

3.8. Implementation

In the prototype implementation of the project, the investigator used CMS (Content Management System) as a web based application, designed to create and manage HTML. **WAMP** have been creating a complete development environment with the ingredients like Apache, MySQL, PHP, Perl, and various extensions. This would enable having friendly user interfaces for non-technical users to be able to create, edit, manage and control a dynamic web material. PHP was used to write the code that connects the web page and the relational database which is created using MySQL.

CHAPTER FOUR: DISCUSSION OF RESULT

4.1. Introduction

To design and develop an information system it is important to have a detailed understanding of the existing system. There are different techniques available for identifying the system requirements. As mentioned in the methodology the system requirement was identified and analyzed using UML modeling technique. The information about the existing system was collected using in depth interview. In this chapter the requirement analysis and design of the system will be presented.

4.2. System Analysis

4.2.1 Current system

4.2.1.1. Hardware

In each department of the hospital there is at least latest idle desktop computer which is functional. The main problem is that there is no specific requirement of hardware stated previously in the hospital. Moreover, there is no structural design for the knowledge management system.

4.2.1.2 Software

Currently the hospital is not using any specific software application related to the knowledge sharing system, but the department plans to implement e-learning software to help them in knowledge sharing.

4.2.1.3. Network

The hospital has a broadband internet connection and also used for tele-education and tele-consultation. This internet availability can be valid opportunity in the implementation of web-portal knowledge sharing system.

4.2.2 Proposed System

Recent developments have witnessed the emergence of a new economy where knowledge has become a valuable resource and asset. The dynamism of the new economy requires us to not only quickly create knowledge, but also to acquire and apply knowledge quickly. One possible way to do so is to share our knowledge

effectively, where technology playing an important mediating role in knowledge sharing.

The intervention of information technology (IT) is inevitably important as a tool for a successful knowledge management implementation (Bhatt, 2001).

Therefore a capable knowledge portal with all the essential functionalities is important for health care sector. In relation to the findings of this study the integration of technological solution is important to support KM/KS activities by providing a single-point, easy and timely access to information/knowledge as well as facilitating the necessary tools and techniques to ease interaction of communities of knowledge workers. In addition such a solution could help to efficiently capture, codify and share the vast volume of information or knowledge generated in different activities. Accordingly the project study develops a prototype, knowledge portal, which can support the overall knowledge management as well as knowledge sharing initiatives. The proposed prototype is anticipated to provide a single-point-access to all TASH knowledge resources and information systems. Furthermore it is intended to deliver a common virtual platform to strengthen social ties and trust through providing tools of the modern technology to support collaboration and knowledge sharing between physicians in TASH.

4.2.3. System Roles and Role Players

An actor represents anything or anyone that interfaces with a system. This may include people, external systems, and other organizations and they are always external to the system being modeled. This system has two main types of audiences. These are the customer (the end user) and the administrator of the website. The end user may be author, member or user.

System role players	Definition
Author(content contributor)	Refers to any writers of an article who contributes (Uploads) to the WPKS.
System administrator	A professional who receives publications and makes Publications evaluation.
Physicians	A registered user in the WPKS which can login, upload/download publications
WPKS system	Refers to the system itself

Table 1: System Roles and Role players

4.2.4. System Analysis Models

4.2.4.1 Use Case Diagram

Use Case Diagram (UCD) is developed as a part of the analysis phase of the system development process. The UCD can be changed during the development process. System Use Case modeling is intended to capture the functional and non functional requirements of the system from the perspective of users and the system (Actors). Use case diagrams are behavior diagrams used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actors). Each use case should provide some observable and valuable result to the actors or other stakeholders of the system. These Use Case models reflect the behavioral requirements of the system to be developed.

Figure 1 shows that any authorized user can login to the administration interface and modify their own profile.

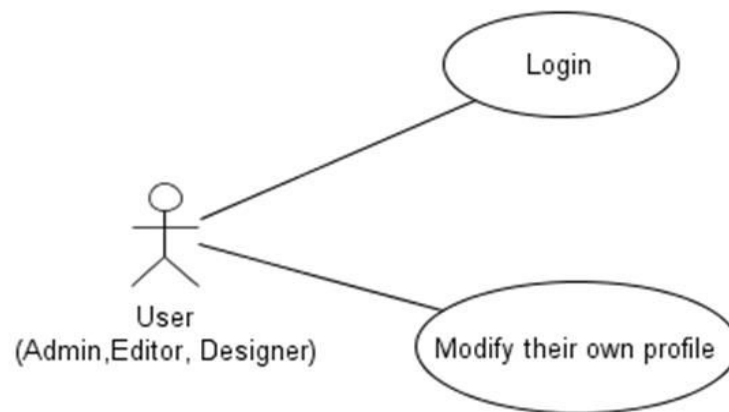


Figure 1. Login use case.

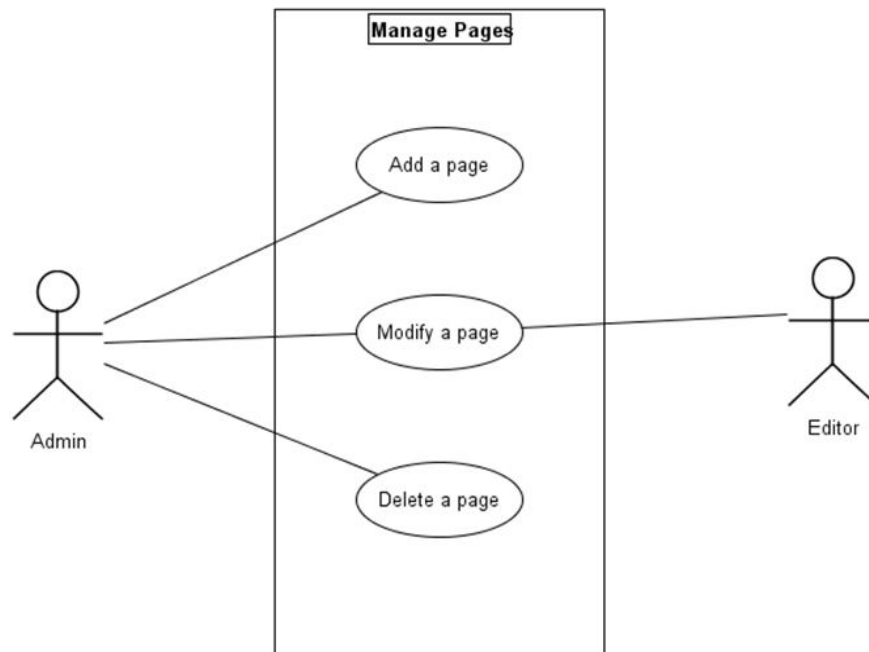


Figure 2. Describes that a user with admin role can manage all pages, but the editor can only modify the existing pages.

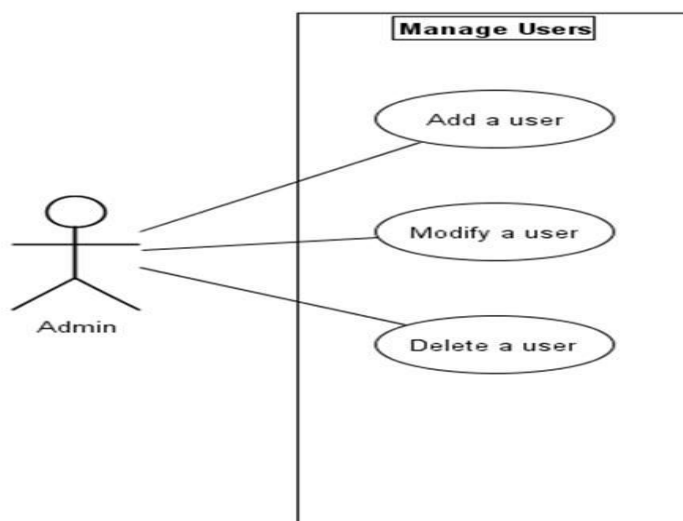


Figure 3. Manage users use case.

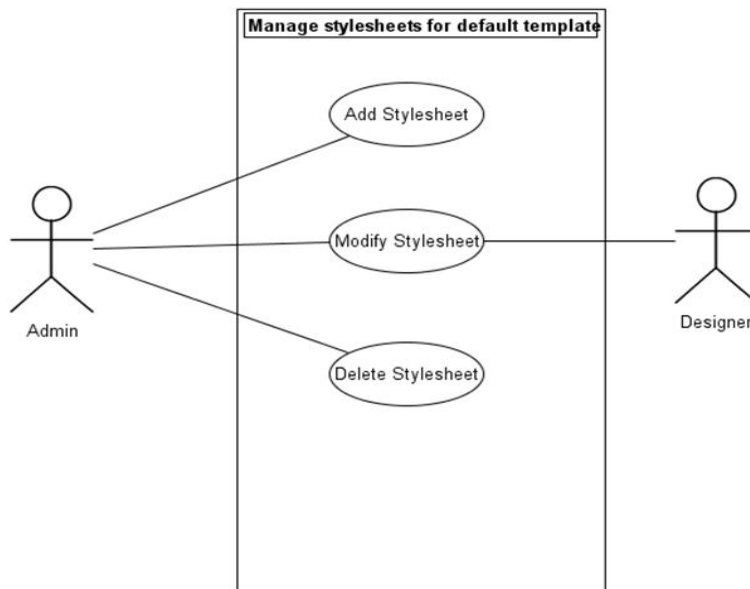


Figure 4. Show that a user admin can manage all stylesheets associated with different templates, while the user with designer role can only modify existing stylesheets.

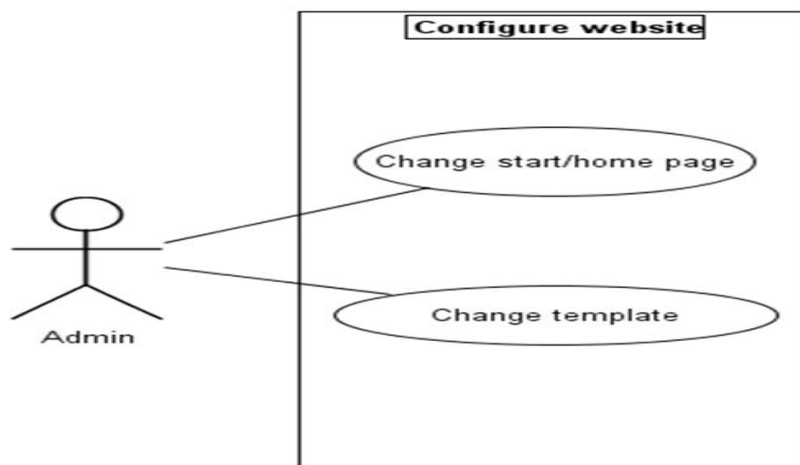


Figure 5. show that a user admin can configure the website which includes setting up a home page and a template for the website.

4.2.4.2. Activity Diagram

Activity diagrams show the procedural flow of control between two or more different entities (people, things, and data) while processing an activity.

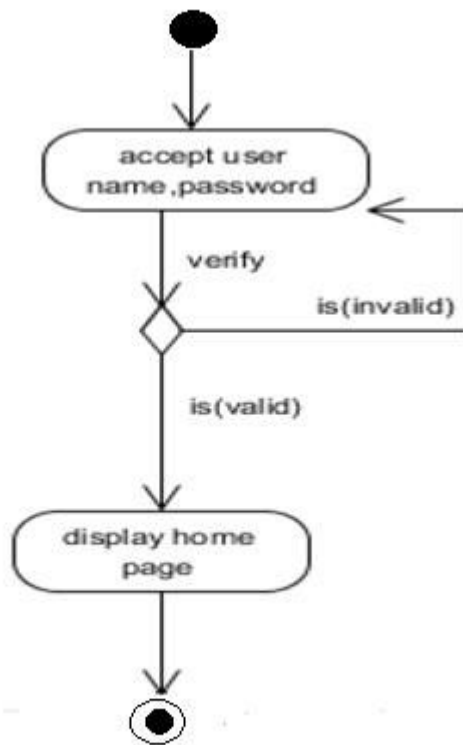


Figure 6: Activity diagram for login use case

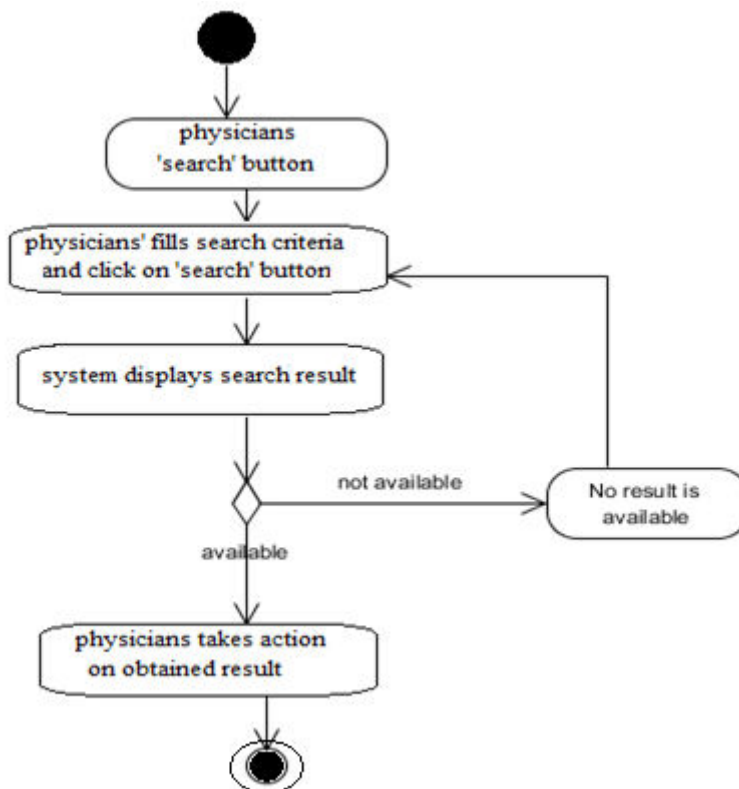


Figure 7. Activity diagram for search use case

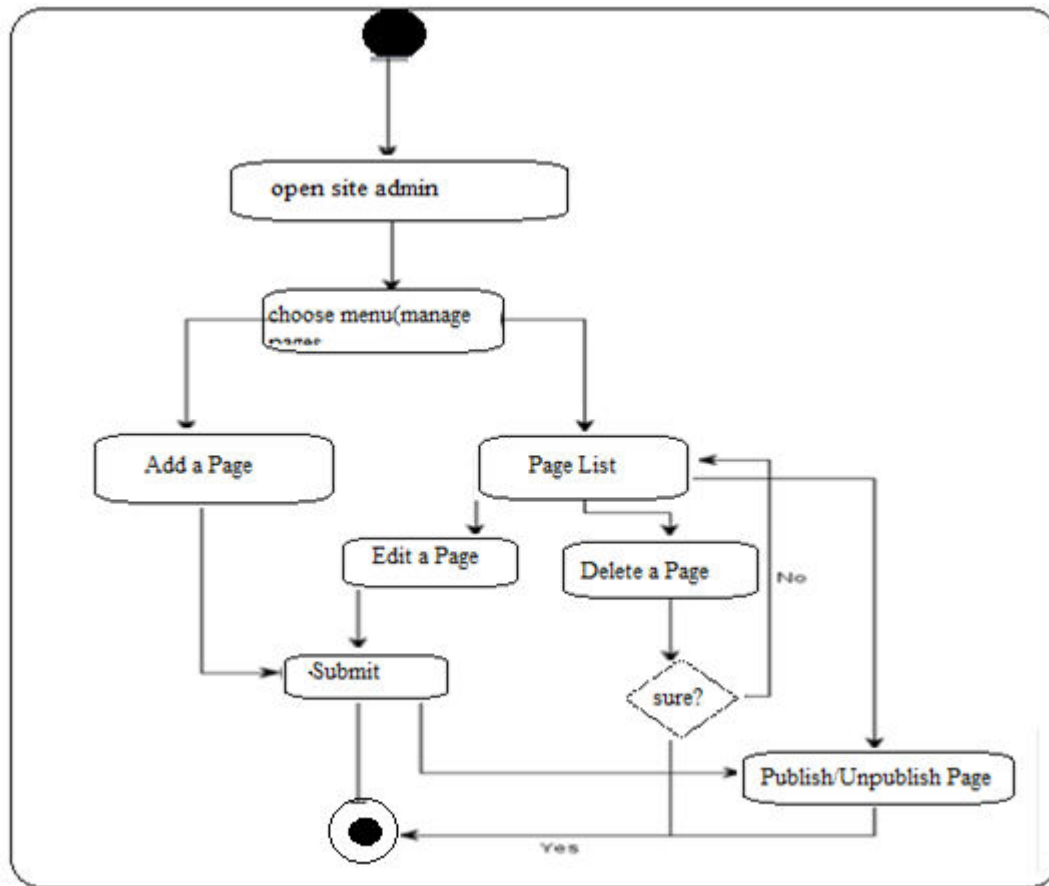


Figure 8. activity diagram for Add/modify page.

4.2.5. Requirements of the proposed system

Common requirements are identified for the new system based on the results of the assessment made and data collected from secondary sources. These requirements are representative of different health institutes for web-based national data center for publications management and processing.

4.2.5.1. Functional Requirements

A functional requirement is a description of activities and services a system must provide.

Requirement definition determines the functional requirement which refers to what fundamental functionalities the system should perform for the users in the future.

It produces a broad outline of the system that identifies the function to be performed. It explains the requirement of the proposed system in terms of defining functional requirement and supplementary specification [2]. System functionality is the interactions between the user and the system, the errors that the system can detect

or/and handles and the environmental conditions in which the system functions are part of the requirement analysis.

Even though there were many Functional Requirements identified, only functions mentioned below are found to be essential for the proposed system.

- Login: System Administrator and Physicians' login to the system. It is responsible for the authentication of users and the maintenance of user profiles. Every item in the data center is secured and control is made for accessing the content. This part controls access and provides security based on users' role in the system. This module is responsible for user registration, user login, user profile management, and security for document accessibility.
- Register: users register and become members when they want to download/upload some access limited publications.
- Manage user account: this module enables web administrators to control members' user accounts.
- Search: it is about searching publications from the system. This system is capable of supporting of publications using title of publication or keywords from the content of the publication.
- Delete: this helps supports deleting submitted articles with limited privilege.
- Upload: this function helps to upload/add pdf format contents to the system.

4.2.5.2. Non-Functional Requirements

Non functional requirement describes how well the system supports the functional requirement. It describes not what the software will do, but how the software will do it (John M, 2004).

- The prototype application should be windows based.
- The application should be user friendly.
- It should be portable. Portable in sense of installation that means this application should be able to install on any computer with Windows operating system.

4.3. System Design Models

4.3.1. System Class Diagram

The Class diagram represents a collection of objects with common structure, common behavior, common relationships, and common semantics. It is the most important

entity in object-oriented analysis and design. It describes the types of objects that exist in the system and shows the static relationships among internal classes of the system. Classes form the main building blocks of an object-oriented application. The Class Diagram can be used to show the attributes and the operations of a class and also the constraints that apply to the way the objects are connected.

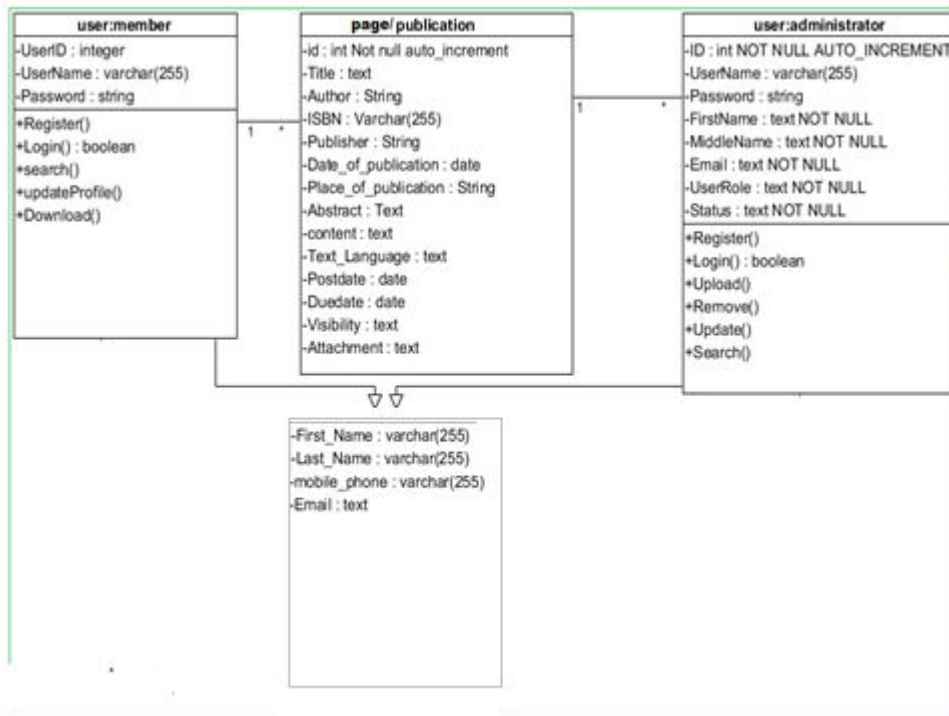


Figure 9: Class diagram of Web-portal knowledge sharing

4.3.2. Sequence Diagrams

UML sequence diagrams are used to represent or model the flow of messages, events and actions between the objects or components of a system. In sequence diagrams time is represented in the vertical direction showing the sequence of interactions of the header elements, which are displayed horizontally at the top of the diagram. Sequence Diagrams are used primarily to design, document and validate the architecture, interfaces and logic of the system by describing the sequence of actions that need to be performed to complete a task or scenario. Sequence diagrams illustrate the objects that participate in a use-case, show the messages that pass between objects for a particular use-case over time. Typically, it captures the behavior of a single use-case.

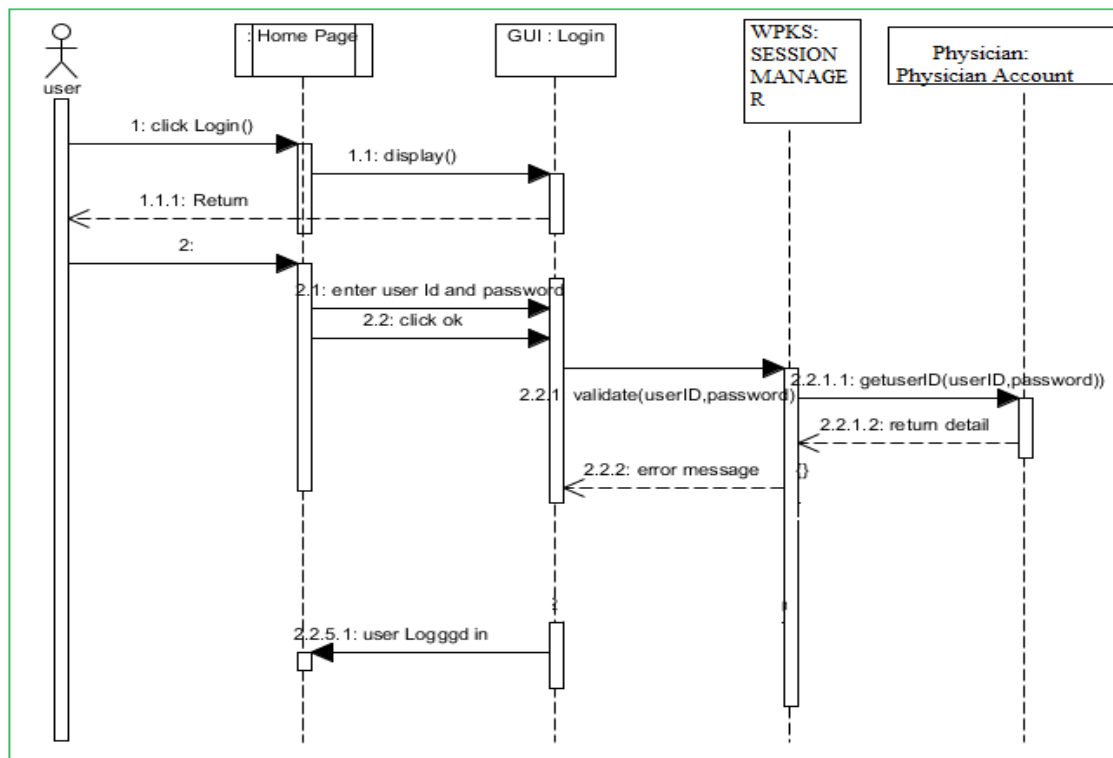


Figure 10: Sequence diagram for Login use case

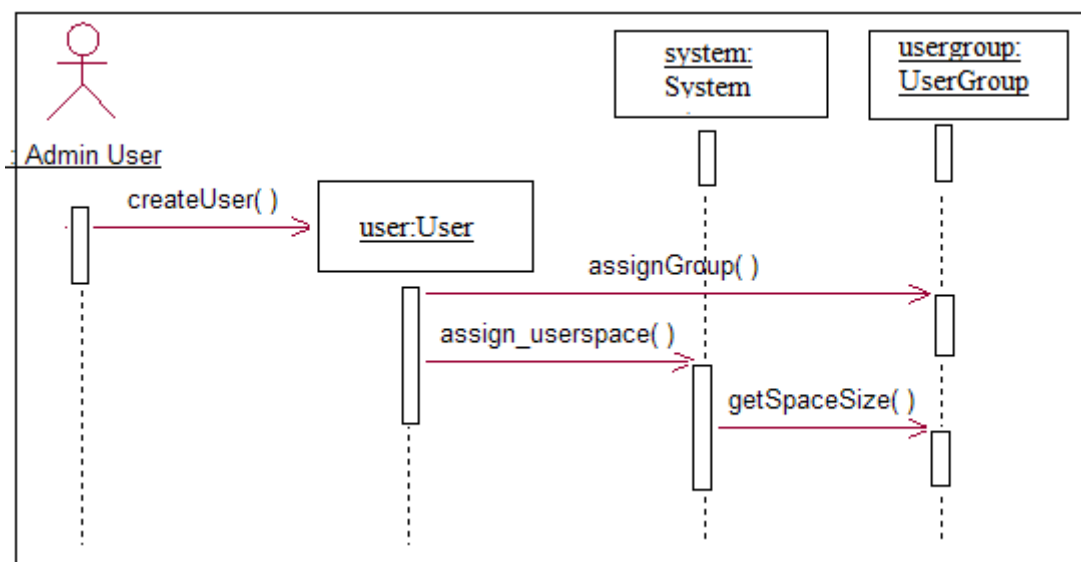


Figure 11: Sequence diagram for user create

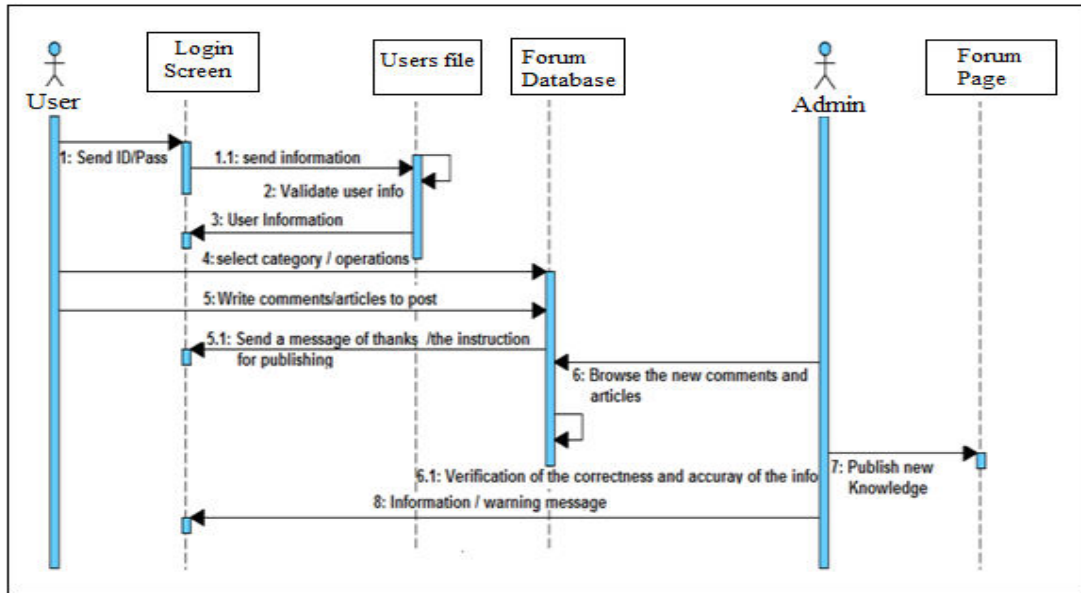


Figure 12: sequences diagram for Publishing

4.3.3 SYSTEM ARCHITECTURE

Knowledge portal is implemented based on the Wordpress architecture. Wordpress architecture also known as 3-tier architecture. It does consist of 3 layers: Extension layer, application layer and framework layers.

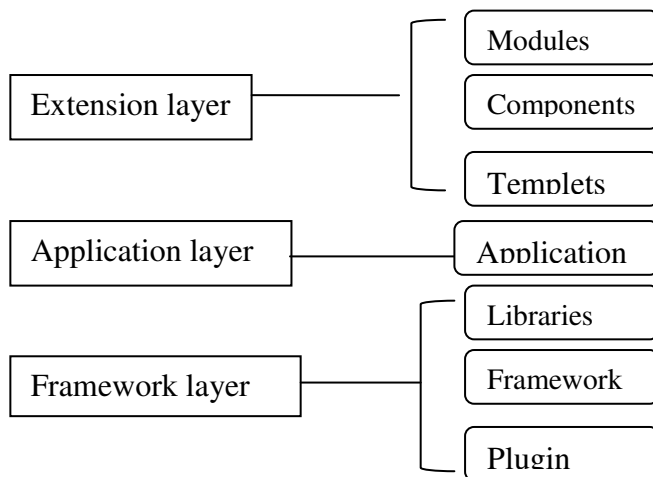


Fig 13: WPKS System Architecture

4.4 Prototype Implementation

Common requirements are identified for the new system based on the results of the assessment made and data collected from secondary sources.

4.4.1 Hardware/Software requirements for deployment of wordpress

4.4.1.1. Hardware requirements

Component	Minimum requirement
Processor	64-bit, 4 cores or above
RAM	8 GB or above
Hard disk	80 GB or above

Table 2: Hardware components and minimum requirement

4.4.1.2 Software Requirements

Faculty academic staff requirements are vital in developing knowledge sharing portal. Our first and the most important concern before gathering the requirement from user, is to identify which development tools is more reliable to be used in developing knowledge portal. WordPress Web content management system was designed to enable non technical user with no knowledge on computer programming, graphic imaging tools, or markup language like HTML to add new material to a website or modify the existing contents as and when required in an intuitive and real-time fashion [4].

For the successful installation of the WordPress, host should need to have PHP version 5.2.4 version or higher and MySQL version 5.0 or higher. Apache as server is recommend. It is the most robust and feature full server to run WordPress, but we can use any other server which will support PHP and MySQL. (WordPress Requirements, retrieved 11.02.2014). I have downloaded the latest version of WordPress and unzipped its data then MySQL database was created using PhpMyAdmin for the web server .On the WAMP server, unzipped WordPress data was uploaded to run the WordPress installation script by using the URL in a web browser.

4.2.5 Prototype of the knowledge portal

Prototyping was used to provide with an incomplete model of the proposed full-featured knowledge portal and to propose a technical solution that addresses project findings.

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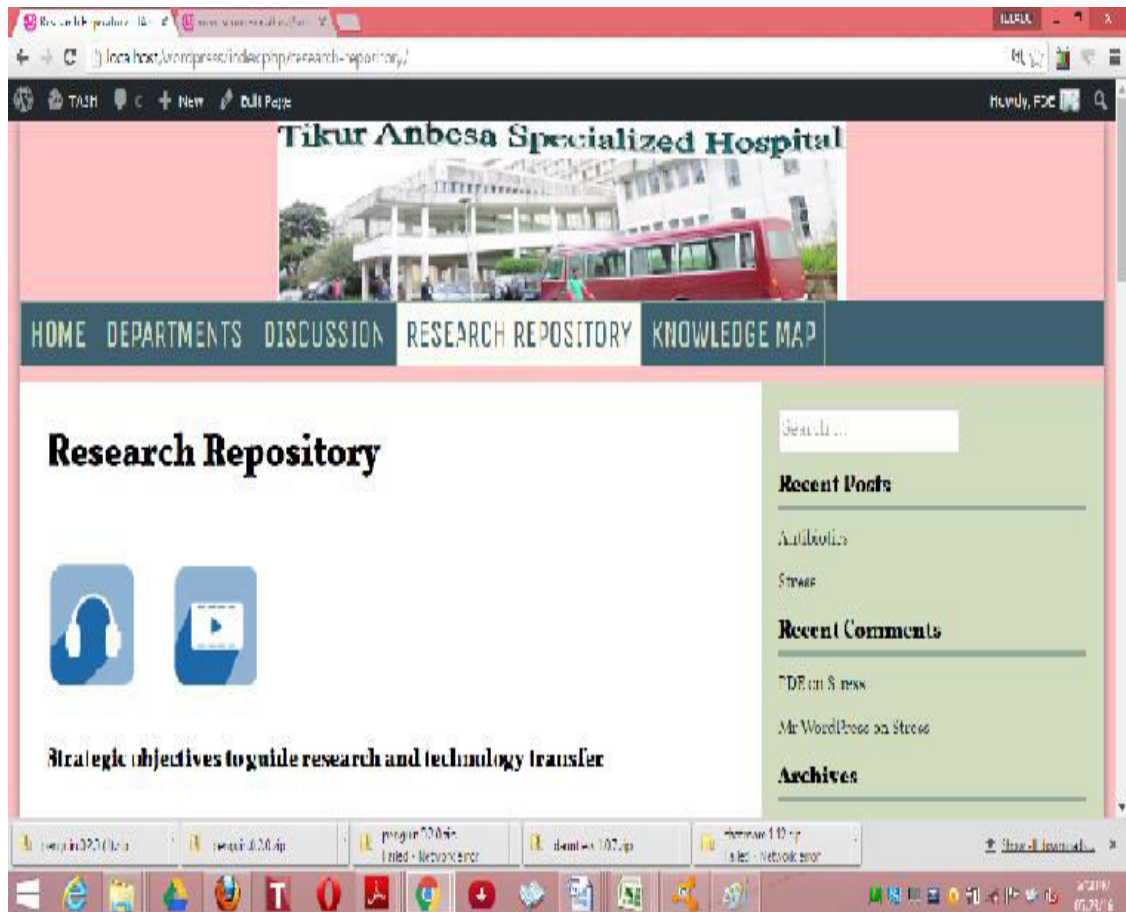


Figure 16: Screen shot of the prototype Repository

CHAPTER SIX: SUMMARY AND CONCLUSION

6.1 Conclusion

The overall objectives of this project are to create a new dynamic website which would allow the physician in TASH to share their experience and to update themselves with rapidly changing environment.

Depending on the requirements CMS required for a system can either be built from scratch or one can use an existing open source or commercial product. The key feature to keep in mind while building a Web based CMS is intuitive and user-friendly administration.

The primary features of web portal knowledge sharing are: (1) easily editable content, (2) templates (default/auto), (3) user authentication, and (4) workflow management.

The administration interface is relatively simple. It features one navigation bar that has different tabs for respective functions, such as Manage Pages, Manage Users, Manage Stylesheets and Configure homepage. It has a workflow which will only allow the publishing of the new content when it is approved by the administrator. It has defined users and roles for users to add, delete or update content within the website. Each user can modify data according to his access rights. Only admin can assign roles to users and has full control over each user and his activity.

The user can easily integrate a new template, which is basically the HTML and CSS files, into this application. Once it is integrated, the user can easily format and edit the page content using the rich text editor without having to deal with the HTML or the CSS code.

Thus this project will be useful to the users with less technical expertise, allowing them to easily manage the content of their page.

6.2 Recommendation

Based on this project the following specific recommendations are made:

- The hospital should plan to implement departmental websites the developed knowledge sharing web portal.
- As most respondent mentioned they have little knowledge on how to use web portal, therefore training and manual should be provided
- It is also necessary to undertake further research as to how to create a networked environment (i.e. online discussion) that enables other hospitals and health centers share knowledge and experience.

ANNEX A

CONSENT FORM

ADDIS ABABA UNIVERSITY

School of information science And School of public health

MSc in health informatics program

This Interview guide is for a Design and development of a web-portal knowledge sharing System: The case of Tikur Anbesa Specialized Hospital.

The purpose of this survey is to determine user requirements for a knowledge portal at the Tikur Anbesa Specialized Hospital. The goal of the knowledge portal is to provide a virtual space that is easily accessible and searchable that will facilitate the creation of new knowledge. The other goal is to create an awareness of knowledge, expertise and events within the Hospital. This may create new collaborative efforts and increase a sense of community within the Hospital.

The data is needed purely for project purpose only and your response to the questions will be kept confidential. It is hoped that the outcome of this study will contribute to the improvement of knowledge sharing in the Hospital. Finally, I would like to express my heartfelt thanks for taking your time in completing the questionnaire.

Thank you in advance for your Cooperation

ANNEX B. INTERVIEW GUIDE

Interview guide for to assess knowledge sharing among

Physicians:

1. Is there any computer software in use for the existing system? What are they?
2. Can you describe your experience in usage, access and availability of existing ICT tools within TASH? Do you believe the necessary tools are there for collaboration and knowledge sharing? Any suggestion for improvement?
3. Is there any computer hardware being used in the knowledge sharing? What are they?
4. Does the organization ready to fulfill suitable hardware infrastructure in the development of knowledge sharing web portal system? To what extent?
5. Do you know everyone in the Hospital who may have knowledge on a specific area / with whom to share knowledge?
6. What is your perspective in designing knowledge sharing platform in the hospital?

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