



**ADDIS ABABA UNIVERSITY**  
**SCHOOL OF INFORMATION SCIENCE AND SCHOOL OF PUBLIC**  
**HEALTH**  
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**Proposing A Knowledge Management System (KMS) Architecture for**  
**Traditional Medicine**

**By**  
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**June, 2015**

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**By**  
**DerejeAyalew**

**A Thesis Submitted to the School of Graduate Studies of Addis Ababa**  
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**ADDIS ABABA UNIVERSITY SCHOOL OF GRADUATE STUDIES  
SCHOOL OF INFORMATION SCIENCE AND SCHOOL OF PUBLIC  
HEALTH**

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**Declaration**

I declare that the thesis is my original work and has not been presented for a degree in any other university.

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**Signature**-----

**Date** -----

## **Dedication**

This work is dedicated to my family without whom this all wouldn't have been possible.

## **Acknowledgment**

First of all I would like to thank the almighty GOD, for his blessing in my entire life time. Secondly, I would like to thank my beloved family for their support throughout my study.

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## List of Abbreviations

CAM	Complementary and alternative medicine
EPHI	Ethiopian public health institute
ICT	Information communication technology
KDD	Knowledge discovery in databases
KM	Knowledge management
NGO	Non- Governmental organization
SSM	Soft system methodology
TM	Traditional medicine
TMK	Traditional medicine knowledge
TMKM	Traditional medicine knowledge management
TMKDB	Traditional medicine knowledge databases
TCM	Traditional Chinese medicine
WBS	Work breakdown structure
WIPO	World intellectual property organization

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## **Abstract**

**Background:** Traditional medicine knowledge is a medical knowledge developed by indigenous cultures that incorporates plant, animal and mineral-based medicines, and manual techniques designed to treat illness or maintain well being. The provisions of this service depend on managing its knowledge properly. Knowledge management is a process that deals with knowledge creation, storage, dissemination and application to improve the overall business performance. A knowledge management system (KMS) is the use of ICT platform that combines and integrates functions for the contextualized handling of both, explicit and tacit knowledge as part of knowledge management initiative. In Ethiopia, there exists gaps in managing traditional medicine knowledge and KMS has not been designed and implemented for traditional medicine practice.

**Objectives:** The objective of the project is to propose knowledge management system architecture to promote knowledge management in traditional medicine practice in Ethiopia.

**Methods:** Methodology for proposing knowledge management system architectures is used. A non- probabilistic purposive sampling technique is used to conduct key informant interview with experts working in the Ethiopian public health institute, Ethiopian biodiversity institutes, Addis Ababa University School of pharmacy, school of botany and school of anthropology. The data collected was analyzed to define requirements for designing KMS architecture for traditional medicine.

**Findings:** Through assessment of the existing knowledge management practices for traditional medicine, Gaps in knowledge management practices were identified. KMS architecture was proposed as an artifact for the identified problems. The proposed KMS architecture, which is a base for designing and implementing the knowledge management system, adopted three stages in the knowledge management cycle which are knowledge capturing, knowledge storage and knowledge sharing.

**Conclusion and Recommendation:** This study provides a guide for implementing a KMS in TM practice and leverage knowledge, which in turn helps the community and the whole country in terms of supporting the existing health system. Therefore, the recommendation of this project is that KMS for traditional medicine practice should be designed and implemented by the Ethiopian government (Ethiopian Public Health Institute) based on the proposed architecture.

## CHAPTER ONE

### INTRODUCTION

#### 1.1. Background

Traditional medicine (TM) describes a group of health care practices and products with a long history of use (1). It frequently refers to medical knowledge developed by indigenous cultures that incorporates plant, animal and mineral-based medicines, spiritual therapies and manual techniques designed to treat illness or maintain wellbeing. TM tends to be practiced inside of allopathic medicine (also known as biomedicine, conventional or Western medicine), which is the dominant system of medicine in the developing and developed world. In many cultures, TM functions as a comprehensive system of health care refined over hundreds or even thousands of years. Some of the best-known TM systems include traditional Indian (Ayurveda) medicine, traditional Chinese medicine (TCM), and traditional Arabic (Unani) medicine (1). The World Health Organization (WHO) defines traditional medicine as “the sum total of the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health, as well as in the prevention, diagnosis, improvement or treatment of physical and mental illnesses”(1).

World intellectual property organization’s (WIPO’s) current working definition of traditional knowledge, “refers to the content or substance of knowledge resulting from intellectual activity in a traditional context, and includes the know-how, skills, innovations, practices and learning that form part of traditional knowledge systems, and knowledge embodying traditional lifestyles of indigenous and local communities, or contained in codified knowledge systems passed between generations. It is not limited to any specific technical field, and may include agricultural, environmental and medicinal knowledge, and any traditional knowledge associated with genetic resources” (1).

It is known that many countries in African, Asia and Latin America use traditional medicine (TM) to meet some of their primary health care needs. In Africa, up to 80% of the population uses traditional medicine for primary health care (2). Over one-third of the population in developing countries lack access to essential medicines. The provision of safe and effective TM/CAM therapies could, thus, become a critical tool to increase access to health care. In

Ethiopia up to 80% of the population uses traditional medicine due to the cultural acceptability of healers and local pharmacopeias, the relatively low cost of traditional medicine and difficult access to modern health facilities(2). According to the most recent Ethiopian Demographic and Health Survey (Mini EDHS, 2014), twenty- eight percent of births were assisted by traditional birth attendants and fifty-seven percent of births were assisted by a relative, or some other person (2).

Traditional practitioners include bonesetters, birth attendants, tooth extractors, (called '*Wogesha*', *yelimdawalaj*' and '*tires neqay*' respectively in amharic), herbalists(*yebahlmedhanitkemami*), as well as Witch Doctors('*tenquay*'), and spiritual healers such as '*debtera*', '*weqaby*' and '*kalicha*' (2).

“Knowledge Management” is a process used by organizations and communities to improve how business is conducted by leveraging data and information that are gathered, organized, managed, and shared(3). Knowledge management focuses on the collective rather than the individual; knowledge management studies and tries to improve individual knowledge processing by improving the collective process (3).

Knowledge management is the explicit and systematic management of necessary knowledge and the accompanying processes of creating, gathering, unlocking and developing this knowledge. It can also be seen as the collection of processes that govern the creation, dissemination and leveraging of knowledge to fulfill organizational objectives (3).

The field of Knowledge Management (KM) can bridge **the knowledge/practice gap** – the gap between what is known and what is practiced. Practicing KM can ensure evidence and knowledge about *what works* is used to find solutions to public health issues (4).

Information acquisition and skill building occur within an ecological framework; that is, information acquisition and skill building is influenced by, and influences, factors at the individual, interpersonal, community, organizational and policy levels. An ecological framework suggests that learning can be enhanced through mutually reinforcing message components at different level (e.g., individual, community or organizational) and through different platforms or channels. This framework can be used in acquisition of traditional medicine knowledge as part of the knowledge management strategy (5).

Knowledge management is a natural process that humans use to maintain and improve their survival (5). Since the first tribe, humans have been governing the production, transmission and

acquisition of knowledge. The survival and legacy of a tribe depended on how well knowledge was managed. For a long time, knowledge has been transmitted from generation to generation and from culture to culture through oral and written history, storytelling, teaching and so on. In a time of crisis, the tribe made rapid adjustments to its knowledge base if a portion of an essential knowledge base was destroyed. Throughout history, storytellers have recited a culture's oral history, passing it on from generation to generation (5).

Knowledge management systems (KMS) are a collection of information systems that are integrated to enhance organizational knowledge management activities (6). The KM life cycle provides a basis for the definition of application areas from which KMS are designed and consists of a number of KM tasks (6). KMS are the technological part of a KM initiative that also comprises person-oriented and organizational instruments targeted at improving productivity of knowledge work. Architectures in general play an important role in management information system as blueprints or reference models for corresponding implementations of information systems (6). A concise KM architecture consisting of a KM service infrastructure on different levels helps reducing complexity and improving flexibility of KM initiatives. One of the major advantages of a KM service infrastructure is the ability to build it once and reuse it frequently.

Regardless of the tools and techniques applied a successful knowledge management system must be able to (3)

- a) Identify the existing knowledge and knowledge management practices
- b) Provide a means to collect, store and organize the existing knowledge
- c) Provide a means to share the existing knowledge among users(3).

The main objective of this project is to propose knowledge management system architecture for traditional medicine practice by first assessing and identifying the gaps in current knowledge management practice in traditional medicine as a base for the effective design and implementation of knowledge management system for traditional medicine practice. Although implementing effective KMS is a complex process, this study contributes how to solve KM problems from technological point of view.

## **1.2.Statement of the problem**

Traditional medical knowledge is community based which has been generated over a period of time through the process of learning and sharing by the members of a particular society or community. It takes several generations and iterations to refine or improve the knowledge base with expertise gained through experience and it's passed from generation to generation. Ultimately, it becomes the integral part of the cultural identity of a community. If documented and properly used, traditional medical knowledge would provide health security to millions of people in developing countries like Ethiopia (7).

In Ethiopia up to 80% of the population uses traditional medicine due to the cultural acceptability of healers and local pharmacopeias, the relatively low cost of traditional medicine and difficulty of accessing modern health facilities. Having recognized the significance of traditional medicine more readily, greater attention has been paid by governments of many developing countries in recent years to promote the widespread application of the practice in health care (2, 8).

Ethiopians heavily relied for centuries on a system of traditional or indigenous health care knowledge for various physical and mental disorders. It is widely perceived and embedded in beliefs, and practices primarily through the use of plant- based remedies. In the Ethiopian context there seems to be no village, town or city where traditional medicine is not involved in the provision of health care, since it is an integral part of the local culture and accessible to the majority of the population, even where there is demonstrably efficient and less costly alternative care. With such significant use and width of practice, support of traditional medical knowledge with new technologies and IT tools seems to be very small, especially in developing countries like Ethiopia (9).

Capturing and storing TMK may help preserve knowledge. Today, the cultural survival of many indigenous communities is threatened, and some traditional systems of disseminating knowledge may already be lost. Modern lifestyles and the disruption of traditional ways of life may cause younger generations to lose interest in learning about traditional medicine. Traditional languages

used to pass down information may no longer be widely understood. Documenting and storing TMK may help preserve this knowledge for future generations (1).

Capturing and storing traditional medicinal knowledge may also improve the use of TM. Capturing, storing and disseminating the traditional medicine knowledge can be a vital step in facilitating research on TM safety and efficacy. In addition, capturing and storing TMK may assist with clinical practice and teaching. Given the important role traditional medicine plays in providing health care, capturing, storing and sharing TMK in systematic ways may help in appropriate health planning and implementation. Therefore, the major gap in managing the knowledge of traditional medicine practice in Ethiopia is the lack of a well-designed knowledge management system which facilitates the capturing and storing available knowledge as well as allowing different stakeholders to effectively use the available knowledge. Due to lack of a well-designed system, limited protection and preservation as well as sharing of traditional medical knowledge exist in Ethiopia. Furthermore, projects for capturing, storing and making available traditional medical knowledge for the research community as well as for the general population are very less in number. Therefore to capture, store and share traditional medicine knowledge in systematic and scientific ways and bring organizational and stakeholder collaboration, knowledge management system is required (1, 7).

There is a high need for developing traditional medicine knowledge management system for Ethiopian traditional medical practice with current ICT advancements. The system should take advantage of the current digital technologies and also should protect the knowledge from misuse and misappropriation by preventing illicit access to the knowledge base (1, 7).

The purpose of this project is, therefore, to study the current traditional medicine practice and propose architecture for a traditional medicine knowledge management system. The architecture will enable to design knowledge management systems that can enhance appropriate management of traditional medicine knowledge as well as bringing organizational collaboration.

### **1.3.Objectives of the study**

#### **1.3.1. General objective:**

The general objective of this project is to propose knowledge management system architecture to promote knowledge management of traditional medicine practice.

#### **1.3.2. Specific objectives**

To achieve the general objective of this study the following specific objectives are attempted.

- To Identify existing knowledge management practices on traditional medicine
- To Identify gaps in the current knowledge management practices on traditional medicine
- To construct an architecture that guide effective management of traditional medicine knowledge
- To evaluate the feasibility of the proposed architecture.

#### **1.4. Significance of the project**

The provisions of safe and effective TM/CAM therapies become a critical tool to increase access to health care. Knowledge about traditional medicine should be managed appropriately in order to analyze and triangulate it with modern medicine. As knowledge management is a key for development, it is very important that TM starts making use of ICT technologies to do so. Especially traditional herbal medicine knowledge should be well managed and should be made accessible to different pharmaceutical companies so that it is accessible with the right dose and with affordable price. In order to do this, a knowledge management system should be designed and for a knowledge management system design the knowledge management system architecture should be built.

This project proposes the knowledge management system architecture to design the knowledge management system for traditional medicine practices. This architecture will help stakeholders in traditional medicine practice such as the Ethiopian public health institute, the Ethiopian biodiversity institutes, pharmaceutical companies, researchers, traditional medicine practitioners as well as the general public to identify their roles in managing the traditional medicine knowledge and ensure proper use of it. Additionally, it serves as a base for any organizations which attempts to design and develop a knowledge management system for traditional medicine practices.

### **1.5. Scope and limitation of the project**

The project aims to identify current knowledge management practices for traditional medicine which are undertaken by the EPHI and also analyzing the availability of knowledge under some institutes on traditional medicine and assess the collaborations of stakeholders in management of traditional medicine knowledge. Its scope is limited to proposing knowledge management system architecture. It does not include designing the knowledge management system, content analysis as well as confirmation of the safety and efficacy of the traditional medicine practice.

It is only limited to providing insights on how traditional medicine knowledge is captured, stored and transferred by using knowledge management tools and techniques.

The limitation of this project is that it does not analyze and differentiate the knowledge of traditional medicine practice that is going to be managed. Additionally, this project does not indicate ways for empirically testing knowledge associated with beliefs and religion. Many folklore practices associated with beliefs which have not been scientifically tested are included as traditional medicine knowledge and the architecture does not provide any means to analyze as well as scientifically test the knowledge for proper management.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

Traditional medicine is a cooperative effort of the members of a particular society and is part of social process of learning and sharing from generation to generation mostly through word of mouth and enhancing their knowledge domain with their particular personal experience. It is unique to each culture as influenced by various factors such as economic, socio-cultural and ecological (7).

People use traditional medicine because of its accessibility, affordability and perceived safety. Traditional medicine therapies are commonly used in developing countries; some of the reasons are the following. First, they are more widely available than conventional therapy. Traditional medicines are also often woven into everyday life and belief system. Further, traditional healers are trusted members of the community traditional medicine is often the first source of healthcare at community level (10).

In addition, most poor people cannot afford transportation cost to get to public facility. Herbal medicines in developing country are often cheap and traditional medicine may accept a trade in kind or offer a sliding payment scale, In addition many herbal medications are available for purchase in stores, so patient may buy and take medication without ever incurring the cost of seeking a practitioner (10).

Traditional medicine are also popular because of the lower rate of adverse effects compared to some pharmaceutical therapies (10). Since the traditional medicine practitioners are also part of the community and have developed a psychological sense of respect, they are well trusted by users (10).

## **2.1. The important role of traditional medicine in human health care**

The twentieth century witnessed a revolution in human health care. The dramatic decline in mortality, the increase in life expectancy and the eradication of smallpox are highlights of this success. Scientific innovation, leading to the development of new medicines, has played a major role in this achievement (11).

However, despite these successes, it is estimated that over one-third of the world's population lacks regular access to affordable essential drugs. In the last decade, there has been a global surge in the use of complementary and alternative medicine in both developed and developing countries. According to various government and non-government reports from the developed countries, the percentages of the respective populations having used complementary and alternative medicine at least once are as follows: Germany – 90 per cent, France – 49 per cent, Canada – 70 per cent, Australia – 48 per cent, the United States – 42 per cent, and Belgium – 31 per cent (11).

The most widely used traditional medicine and complementary and alternative therapies are herbal medicines and acupuncture. Today traditional medicine and complementary and alternative medicine play an increasingly important role in the reform of the health sector of many countries. In 2000 the Secretariat of the Convention on Biological Diversity reported that the world market for herbal medicines, including herbal products and raw materials, was US\$60 billion (11).

TM practices share many of the same core values. These practices tend to be characterized by a holistic and highly individualized approach to treatment, an emphasis on maximizing the body's inherent healing ability, involving patients as active participants in their own care, addressing physical, mental, and spiritual attributes of a disease, and placing a strong emphasis on prevention and wellness (11).

At the same time, TM practices display considerable diversity and can vary significantly between regions. TM therapies involve assorted levels of training and have different degrees of evidence-base and efficacy. In addition, TM practices are governed by a heterogeneous group of state and national policies and regulations and have a variety of associated cultural beliefs (1).

The use and application of appropriate indigenous knowledge systems can promote environmental conservation (land, forests, grasslands, wetlands and biodiversity) and management of disasters in disaster prevention, mitigation, recovery, prediction or early

warning, preparedness, response and rehabilitation. Indigenous knowledge systems can promote poverty alleviation through traditional food production and preservation and health care through traditional medicine practices (1).

In study conducted in Kenya, South Africa, Swaziland and Tanzania Indigenous knowledge systems have enabled the various communities to live in harmony with their environments for generations, and the systems are important tools in environmental conservation and natural disaster management. Nearly all the communities had powerful structures that exercised authority to ensure smooth compliance with the observances and rules of indigenous knowledge (1).

The indigenous knowledge systems provided with a variety of options and innovations to deal with the challenges of nature conservation and disaster management in the course of making a living. The knowledge systems were particularly evident in agricultural production, food preservation and storage, health care, and in dealing with natural disasters (12).

## **2.2. Characteristics of traditional medicine in Ethiopia**

Ethiopia has a long history of traditional medicine and has developed ways to combat disease through it. The ways are also as diverse as the different cultures. Healing in Ethiopian traditional medicine is not only concerned with curing of diseases but also with the protection and promotion of human physical, spiritual, social, mental and material wellbeing (2,8).

It is widely believed in Ethiopia that the skill of traditional health practitioners is 'given by God' and knowledge on traditional medicines is passed orally from father to a favorite child, usually a son or is acquired by some spiritual procedures. Traditional Healing knowledge is guarded by certain families or social groups (2, 8).

The interest in and intrinsic value of traditional Ethiopian medicine should not only be attributed to the lack of access to modern medicinal services. Even in cities where modern health services are more accessible and specialized; many people continue to go to traditional healers (2, 8). This may be due to the cultural acceptability of healers, the respect they have and their easy accessibility to clients. The healing process is often carried out in an atmosphere of mutual confidence and shared expectations. Compensation in traditional medicine is different from the payment system of official health services. Healers typically receive an initial payment in money (or in goods in rural areas) and then negotiate subsequent payments with the patient (2, 8).

In cases, where treatment is ineffective, the patient does not have to pay beyond the initial payment. In spite of its potentials for the development and greater contribution, traditional medicine in Ethiopia has not received significant inputs from the administration. This is more revealing when compared with what has been achieved in many other developing countries. The system is deteriorating primarily due to the lack of concern and, at times, due to apparent ignorance on the part of the authorities in responsible positions (2, 8).

### **2.3. Knowledge and its classification**

Knowledge can be thought of as information combined with experience, context, interpretation, reflection and is highly contextual (3). It is a high- value form of information that is ready for application to decisions and actions within organizations (3).

There are two primary types of knowledge: Tacit knowledge and Explicit knowledge (3). Tacit knowledge: can be defined as knowledge that is subconsciously understood and applied, difficult to articulate, developed from direct experience and action, and usually shared through highly interactive conversation, storytelling and shared experience (3). Examples of tacit knowledge include “best practice” performed in technologies and management skills. Tacit knowledge is, by definition, hard to codify and store (3).

Explicit Knowledge: Explicit knowledge, on the other hand, is more precisely and formally articulated, although removed from the original context of creation or use (3). Explicit knowledge includes, for example, the content of spreadsheets, management reports, procedural and trainings manuals. In other words, explicit knowledge is any knowledge that can be codified and document (3).

### **2.3. Knowledge management**

Knowledge management deals with knowledge creation, storage, dissemination and application of knowledge to improve the overall business processes. Knowledge Management (KM) became a discipline during the 80’s, and the growing role of information technologies enabled the development of efficient KM tools using databases and collaborative software (13).

In light of the extant literature, according to Gover & Davenport (14) and Nonaka, (15), the KM process can be generically represented as four cyclic activities: knowledge creation, knowledge codification, knowledge transfer, and knowledge application as shown in Figure 1. Knowledge creation includes all activities involved in the acquisition and development of knowledge (15).

Knowledge codification involves the conversion of knowledge into accessible and applicable content (15). Knowledge transfer includes the sharing of knowledge from its point of creation or codified to the point of use. Knowledge application includes retrieving and applying codified knowledge in support of actions, decisions, or problem-solving. Ideally, these activities do not represent a monolithic set of activities, but an interconnected and intertwined set of activities (16).

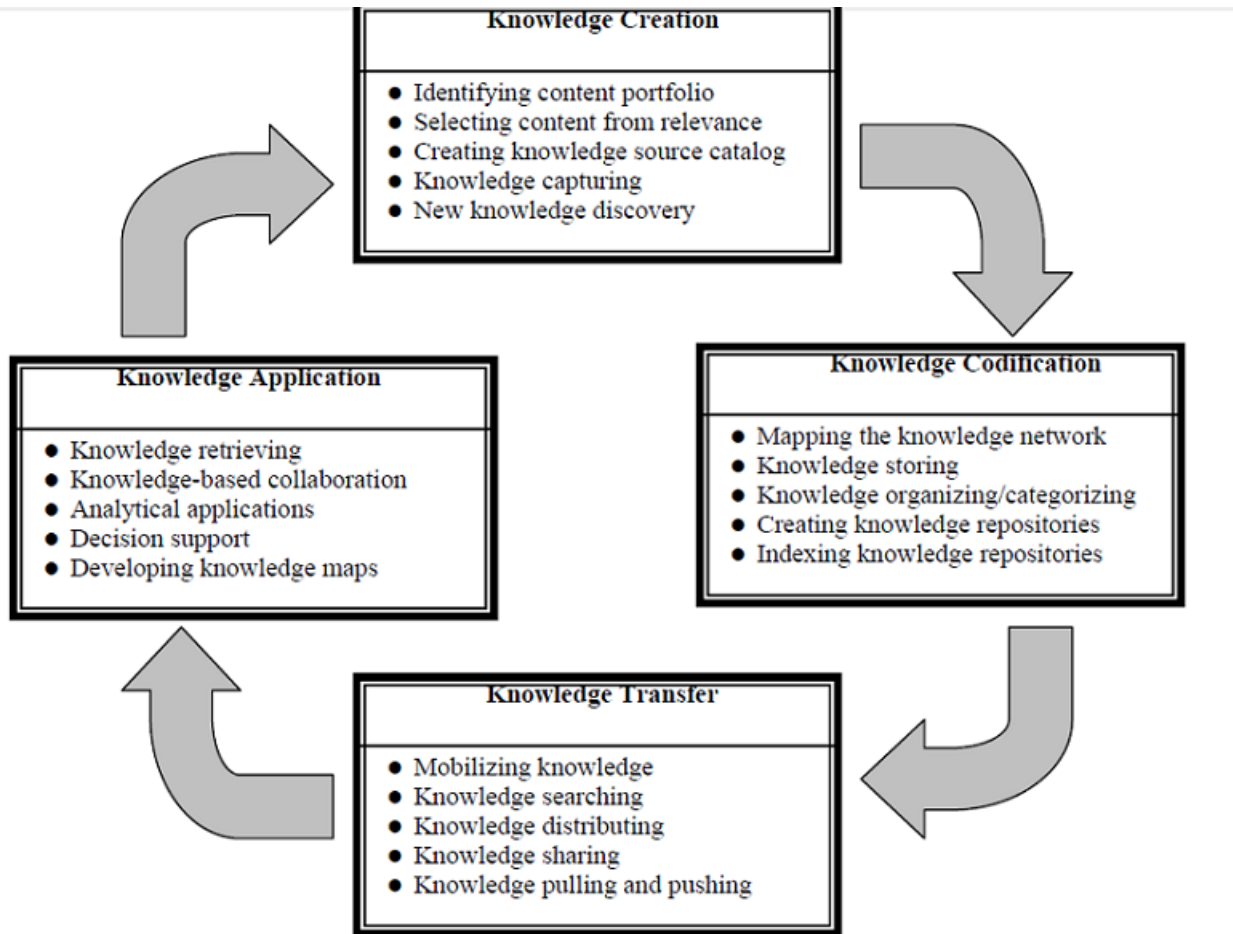


Figure 1: knowledge management cycle (Adopted from Tzyh-Lih Hsia et.al, (16))

### Knowledge Creation Process

The process of knowledge creation is a part of knowledge acquisition and its representation. There are many sources and methods of knowledge creation such as research and development center, learning outcomes of an organization, innovation and analysis of knowledge learned by lessons. The methods and procedures of knowledge acquisition from both sources internal and

external, needs to be developed (13). The major sources of knowledge in Traditional medicine include tacit knowledge from traditional medicine practitioners and healers, various researches conducted on efficiency and efficacy of traditional medicine by different departments of universities, researches performed by institutes and research centers and the world wide web.

**Structuring/codification** process: - The knowledge structuring process consists of defining, storing and knowledge categorization, indexing and linking digital form of knowledge such as documents and pictures. The idea of mapping available knowledge of organization, including employees experience and skills in the sense of its context, importance and area of knowledge helps in classification of organizational knowledge (13).

A proper storage of knowledge with proper indexing and linking with other relevant knowledge for example:-company yellow pages of experience and knowledge, skill development and company training materials. So planning the knowledge classification plays an important role in development of better knowledge structure. A structured knowledge system with planned classification groups same kind of documents together and keep them under one category of knowledge, which can be generated by manual or automated methods or with the combination of both. To take the full advantage of knowledge, organizations must define the multiple ways of its categorization. By this way KMs users can take the benefit of their required knowledge for the specific problem solving (13).

International Classification of Traditional Medicine (ICTM) was proposed as an affiliated part of the WHO-FIC in 2006 (17). One of the main issues of the project was introducing the international standard terminology and Accordance to the international classification of disease (ICD-10). Many experts from different countries collaborate in ICTM project (17). The project was continued by development of three subgroups of acupuncture, herbal medicine and international classification of health interventions (17).

It is expected that the ICTM project would develop the traditional medicine as mainstream medicine through recording traditional medicine terms in ontology software, establishing communication with the ICD and creating WHO Family of International Classifications (WHO-FIC) (17).

**Dissemination/Transfer process:-** Knowledge dissemination process consists of different techniques and methods of knowledge sharing and collaboration. Knowledge presentation includes searching, pulling and providing relevant content for using automatically to the user on the basis of user requirements. Knowledge sharing uses different means of amplification which are manual and automatic, such as training, education, documentation and newsletter and organizational literature (13).

**Application process:-**consists of applying, which includes knowledge retrieving and using. This process support knowledge in decisions, actions, solving different sort of problems and increase mapping ability to place people in better jobs for better productivity, the establishment of different communities, workflows and training the people to meet the requirements of current issues (13).

A knowledge management system is a specific combination of some subset of people, processes, and technologies concerned with identifying and leveraging the collective knowledge in a specific organization to help that organization compete (16).

#### **2.4.Knowledge management system**

A knowledge management system (KMS) is an ICT system in the sense of an application system or an ICT platform that combines and integrates functions for the contextualized handling of both, explicit and tacit knowledge, throughout the organization or that part of the organization that is targeted by a KM initiative (6).

A KMS offers integrated services to deploy KM instruments for networks of participants, i.e. active knowledge workers, in knowledge-intensive business processes along the entire knowledge life cycle. Ultimate aim of KMS is to support the dynamics of organizational learning and organizational effectiveness (6).

Knowledge management systems refer to a class of information systems applied to manage organizational knowledge (6). That is, they are IT-based systems developed to support and enhance the organizational processes of knowledge creation, storage, transfer, and application. Many knowledge management initiatives rely on IT as an important enabler. Recently, progress in IT provides KM capabilities that were not possible before. Examples include finding an expert of recorded source of knowledge using online directories and searching databases; sharing

knowledge and working together via Internet or Intranet; accessing to information on past projects; and learning about customers' needs by mining transaction data (13).

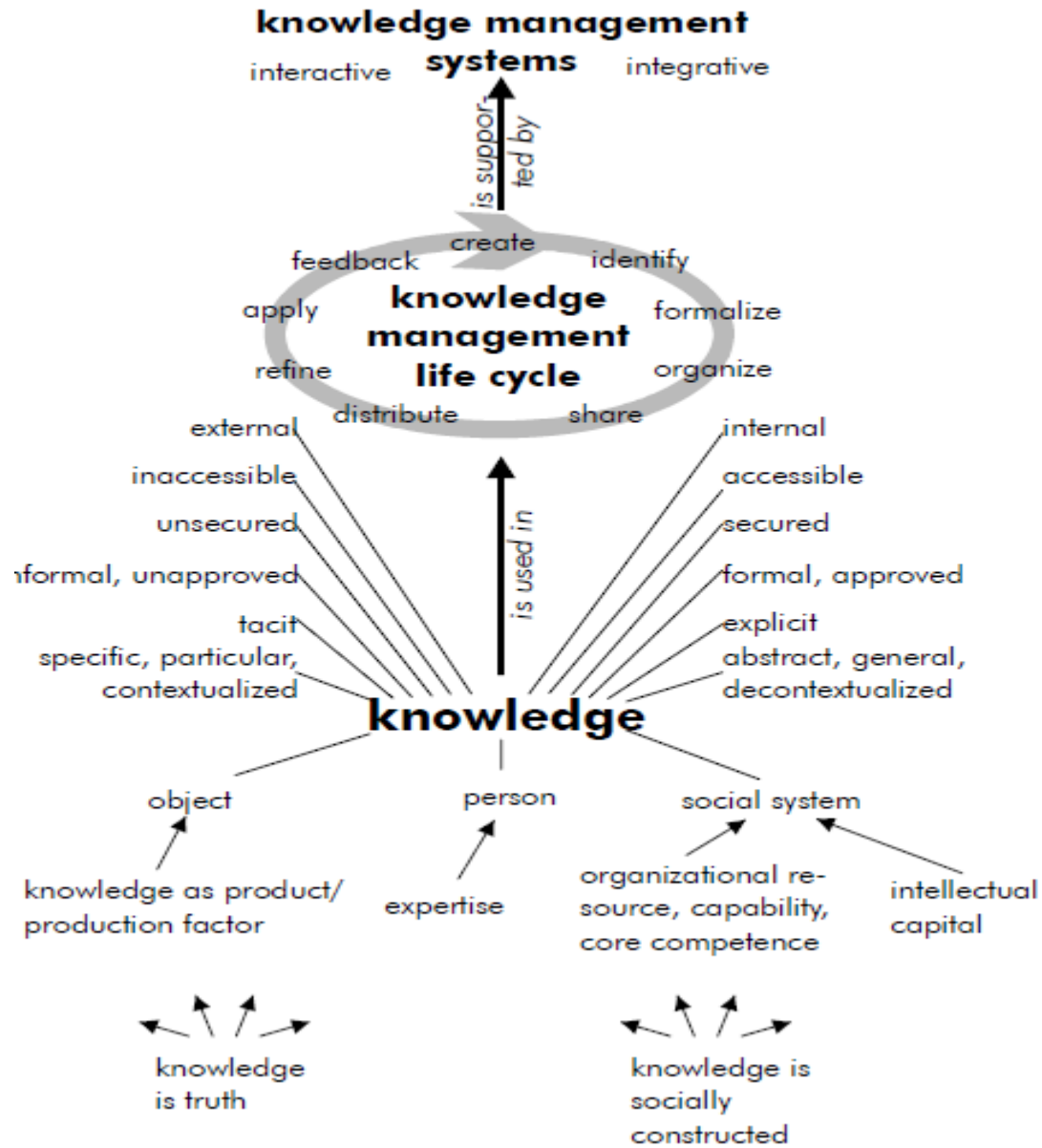


Figure 2: Relation of knowledge, knowledge management and knowledge management systems

## **2.5. Information and Communication Technologies infrastructure for Indigenous knowledge management**

A reliable and accessible infrastructure (radio, TV, telecommunications, Internet) is a prerequisite for modern information exchange. The starting point for economic development in the information age is the existence of a suitable ICT infrastructure. Ethiopia has made significant stride in rolling out infrastructure to various part of the country through Rural Connectivity Project, Woreda Net, School Net and Agri Net, but this has yet to make dent on the flow of indigenous knowledge. Many people still see the Internet as a consumption tool—as a means of recreation, information gathering and shopping, but the Internet has been a key resource for exchange of knowledge. A significant amount work still remains in turning Internet and other technologies around to facilitate the exchange of indigenous knowledge (18).

There is no specific software designed for indigenous knowledge. Some attempts have been made by different projects to set of open source software tools to enable indigenous communities to protect their unique cultures and knowledge through digitization. Different software tools and platforms ranging from database management systems, Geographic Information Systems to text and speech and character recognition tools, graphical touch screens, audio and video editing tools may be considered for the management and dissemination of indigenous knowledge (18).

Knowledge management tools and platforms ranging from content management systems to group collaboration tools, synchronous and asynchronous communication can also help to capture and share indigenous knowledge. However, the application of these tools should be preceded by understanding of the context of local innovators and those who benefit from indigenous knowledge. Low-tech approach to Indigenous Knowledge should be a starting point as the majority of those who use Indigenous Knowledge system may not have advanced technologies (18).

## **2.6. Traditional medicine knowledge databases**

A database is a collection of related information, and traditional medicine knowledge databases (TKMDB) refer to compilations of traditional medicine knowledge. Databases exist in many different forms. They may be compilations of printed material, or information may be stored electronically. Electronic databases, in turn, may be simple and publicly accessible, or complex with varying levels of restrictions on information access. For example, access may be reserved

for the exclusive use of indigenous and local communities and protected under customary law. Three principal types of TMKDBs exist: community TMKDBs managed by indigenous communities, external TMKDBs managed by non-community collaborators, and TMK registers which are usually managed by governments or organizations (1).

TMK holders may create, develop and maintain databases directly, with or without external assistance. If TMK holders are documenting TMK independently, the process of collecting information essentially creates a database. Community TMKDBs have the advantage of permitting TMK holders a high degree of control over documented TMK. Sophisticated electronic databases, however, can be expensive and technically challenging to develop. Databases created by external collaborators are the most common form of TMKDB. These may be maintained by organizations including universities, museums, corporations, and NGOs. External collaborators have a variety of motivations for maintaining databases, such as to provide legal protection for traditional medicine knowledge or to make knowledge easily accessible to facilitate academic research. Some of these databases have been created with the participation of TMK holders, but others simply consist of information claimed to be in the public domain (1).

## **2.7. Knowledge management system architectures**

A concise KMS architecture consisting of a KM service infrastructure on different levels helps reducing complexity and improving flexibility of KM initiatives. One of the major advantages of a KM service infrastructure is the ability to build it once and reuse it frequently. However, the efforts to implement a KM service infrastructure should not be underestimated. Already established KM services have to be identified and made available. New KM services have to be implemented. KM services have to be composed and decomposed finding the appropriate level of detail. The quality of KM services has to be assessed and documented in order to provide a constant level of quality throughout the knowledge life cycle. The KM service infrastructure can be considered as an approach of a strategy based integration of KM services which provides a blueprint, i.e. a framework and platform for dispersed KM services defined in heterogeneous KM initiatives (6).

Zack (19), classifies KM tools and systems into one of the following two segments: KMS with an integrative versus an interactive architecture. This corresponds to the two main directions of

KM research, human orientation and technology orientation, and Hansen (20) distinction of KM strategies into a personalization versus a codification strategy.

- **Integrative knowledge management architecture:**

Integrative KM applications focus a repository and the explicit knowledge it contains as the primary medium for knowledge exchange. Integrative knowledge management applications can be further segmented according to the extent to which knowledge producers and consumers come from the same knowledge community. On the one extreme (called *electronic publishing*), there is neither direct interaction nor a shared context (in terms of e.g., belonging to the same community of practice) between producers and consumers of knowledge. Consumers do not give feedback and do not modify the knowledge in the repository. On the other extreme (called *integrated knowledge base*), producers and consumers share context intensively (e.g., they belong to the same organizational unit or community of practice) (19).

- **Interactive knowledge management architecture:**

Interactive KM applications primarily facilitate the exchange of tacit knowledge among people. If there is a repository, it is seen more as a by-product the content of which changes dynamically. Interactive KM applications can be further segmented according to the expertise level of producers and consumers and the degree of formalization imposed on the interaction. On the one extreme, there is a formal, well defined knowledge transfer between “knowers” and “not knowers”(called *distributed learning*). On the other extreme, there is ad-hoc or emergent interaction more like an electronic discussion space (called *forum*) (19).

Holistic KMS implementations aim at bridging the gap between these two architectures, at their combination and integration into a single KMS architecture. As mentioned by Zack, context plays the key role in bringing these two architectures together. In proposing a KMS architecture contextualization is an important cornerstone in KM (24).

## 2.8. Architecture for implementing a knowledge management system in Brazilian national cancer institute

This study which is conducted by (21) used a qualitative design to analyze and describe the conceptual framework of the knowledge management system implemented in the Brazilian national cancer institutes. Additionally, the authors applied analysis and incorporation of architectures through literature review and proposed an architecture by including important layers such as decision support systems and data mining technologies which is a base for implementing the knowledge management system as seen in the figure below (21).

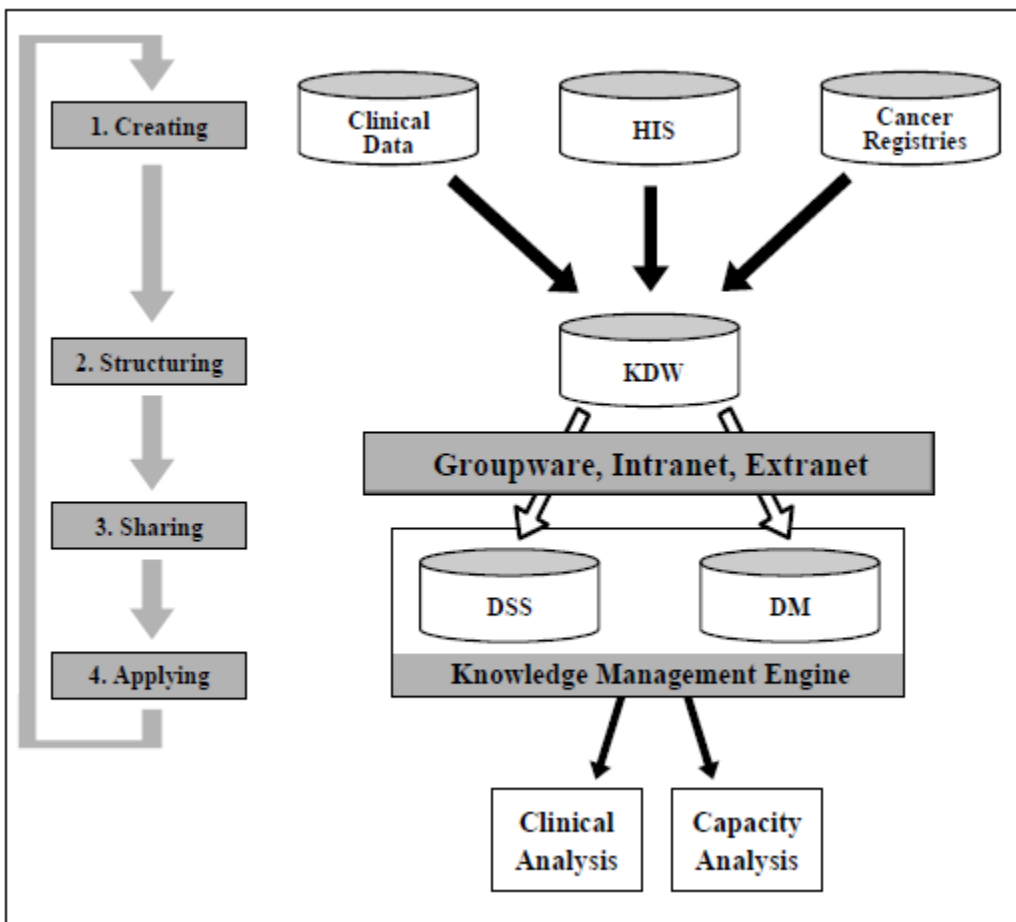


Figure 3: Architecture for knowledge management system of Brazilian cancer institute

## **2.9. Knowledge management system (KMS) architecture to promote knowledge sharing among CBE employees**

A study conducted by (22) for proposing a KMS architecture for commercial bank of Ethiopia synthesized a new methodology for building KMS architecture from previous works which involves (1) understanding of existing business context, (2) identifying business process to be supported through KMS (3) developing KMS goals, (4) identification of knowledge management tools, and (5) classification of KMS tools to different KM activities to build the KMS architecture. Through such analysis architecture of KMS for commercial bank was put forward by the paper (22).

## **2.10. Knowledge Management in Traditional Chinese Medicine**

Countless medical practices and theoretical researches in Traditional Chinese Medicine (TCM) have accumulated a great deal of data and knowledge in the form of ancient books and literatures. With a history of several thousand years of studying human diseases and practicing diagnosis and treatments, TCM provides an organized and systematic approach to view human life (23).

In an effort to group, analyze and understand the huge amounts of data in TCM, previous work has been done in the areas of data mining and computational methods for data processing and knowledge discovery. A survey of approaches and resources for data mining in TCM are presented by Lukman et al. (24) and Zhou et al. (25). The survey presented by Lukman et al. (24) focuses on computational methods for TCM classifications, types of databases and mining tools. The survey by Zhou et al. (25) focuses on publications that are concerned with data mining techniques for the processing of TCM data, searching in full-text databases in Chinese, bibliographic databases such as PubMed and popular textbooks and up-to-date international publications.

For knowledge discovery, Feng et al. (26) presented four main fields: Knowledge discovery in databases (KDD) for Chinese medical formula, KDD for Chinese herbal Medicine, KDD for TCM syndrome research, and KDD for TCM clinical diagnosis. ZhuGe (27) presented an analysis of the knowledge structure between the concepts and practice in Traditional Chinese Medicine diagnosis.

### **2.11. Digital Libraries of Traditional Medicine**

A number of countries are using information technologies to develop digital libraries of traditional knowledge both to use the knowledge in current community projects but also to prevent misappropriation of the knowledge through commercial patents (28).

India in particular has developed a Traditional Knowledge Digital Library that contains information on 36,000 formulations used in Ayurveda—India's 5,000-year-old system of traditional medicine. The information presented in English, French, German, Spanish and Japanese was created in a format accessible by international patent offices to prevent the granting of inappropriate patents (28).

The Indian system uses a classification system similar to that used by the International Patent Classification (IPC). The IPC has agreed to include the Indian system in its own classification, which will be expanded to include about 200 sub-groups of drugs derived from Indian medicinal plants. This will significantly aid patent offices who can search the databases to ensure that proposed patents are truly novel and have not been previously reported (28).

Following the success of the Indian system, other South Asian countries (Bangladesh, Bhutan, Maldives, Nepal, Pakistan and Sri Lanka) that are members of the South Asian Association for Regional Cooperation (SAARC), have decided to create a composite digital library that will network the individual Traditional Knowledge Digital Libraries (TKDL) from each country. The SAARC TKDL will provide a uniform system for organizing, disseminating and retrieving traditional knowledge seamlessly across regions or countries. Accessible via the Internet, the library will initially contain information on traditional medicine including:

- Materials used for treatment e.g., plants, animal products, minerals
- Their generic or specific method of preparations or designs
- Their dosage, mode and time of administration
- Their therapeutic action or application.

The SAARC digital library will be used to fight contentious patent claims by proving the prior existence of knowledge, as well as promoting research on novel drugs, enhancing the region's share of the global herbal medicine market and helping set the international agenda on intellectual property rights (28).

## CHAPTER THREE

### METHODOLOGY

The project primarily adopted method of developing KMS architecture which was synthesized by Temtim et.al (27), which used 5 procedures to build KMS architecture. These procedures are;

- Understanding of existing business context,
- Identifying processes to be supported through KMS
- Developing KMS goals
- Identification of knowledge management tools, and
- Classification of KMS tools to different KM activities

In the first stage of this project, data were collected in order to understand the existing context of traditional medicine knowledge management. In this stage, sources of traditional medicine knowledge were identified and the availability of knowledge management activities were assessed. In the second stage of the project, existing problems in managing traditional medicine knowledge as well as challenges hindering KM activities were identified. In the third stage, goals of the new KMS architecture were developed as a solution to the problems identified in stage two. The goals were crafted to address the current KM problems and user requirements. In the fourth stage, KMS architecture was proposed as an artifact to solve the identified problems in stage two. Relevant KMS tools for traditional medicine knowledge management were also identified based on the KMS goals and reviewing literature on KMS.

#### **3.1.Data sources**

For understanding existing context of traditional medicine practice and identifying the knowledge management process involved in traditional medicine practice, the project leveraged qualitative data through key informant interview. Therefore, the study used a non- probabilistic sampling technique which is purposive sampling by identifying research experts who have been working on traditional medicine practices and processes for over 5 years and experts who have been front in organizing and participating collaborative effort on traditional medicine practice. Experts who have been working in EPHI traditional medicine research directorate, researchers working on medicinal plants in the Ethiopian institute of bio diversity as well as researchers

working in the Addis Ababa university school of pharmacy, natural herbarium and school of anthropology were selected for the key informant interview.

The reason for selecting these organizations and experts is that these organizations such as the EPHI are established and mandated as part of efforts of the Ethiopian government to develop and use the knowledge for health planning and intervention. The Ethiopian government organized and assigned responsibilities to these organizations through various proclamations and regulations. This is expressed by reorganizing a research institute, namely the Ethiopian Health and Nutrition Research Institute (EHNRI) that facilitate a multidisciplinary research in traditional medicine and its practices as well as modern drugs, and study the integration of those found to be useful into the official service systems as expressed in Article 4, Article 5: sub-articles No. 6,8,9,10 and 11 of Proclamation No. 26/1996 of the Ethiopian Health and Nutrition Research Institute establishment. The EHNRI mandate was further amended recently by the inclusion of additional responsibilities following Business Process Reengineering (BPR) due to the additional mandate given to the restructured institute, Ethiopian public health institute (EPHI) as expressed in the legal framework Regulation no 301/2013.13, 14.

The Directorate of Traditional and Modern Medicine within EPHI has the mission, development of validated traditional medicine products package and delivering evidence based information through research thereby contribute to protect and promote the health of people. In order to fulfill its organizational mission, it captures stores and analyzes traditional medicine knowledge. The directorate documented information on medicinal plants species and their folklore use in the traditional health care system in an electronic data file without which no appropriate research agenda can be formulated. Multi- disciplinary research works have been and being undertaken with major emphasis on the evaluation of the safety, efficacy, constituents and quality of traditionally claimed medicinal plants on diseases of public health importance. Encouraging results have been obtained on the efficacy and safety of some of the medicinal plants for priority health problems from these studies. Many research papers and publications have been resulted from these undertakings. The directorate also works with traditional healers willing to collaborate through Memorandum of Understanding to scientifically validate the traditionally claimed remedies. It is currently more focused on product development from traditionally claimed medicinal plants following experimental validation in collaboration with higher

academic and research institutions as well as manufacturers. Therefore, EPHI traditional medicine directorate has been legally mandated for capturing, analyzing, storing and disseminating traditional medicine knowledge. The directorate apart from conducting experimental research works in managing traditional medicine knowledge. The main research institutes and schools which EPHI works together to validate traditional medicine practice include but not limited to school of pharmacy, the natural herbarium of school of botany and institute of biodiversity. Therefore the project has also selected these organizations for assessing the availability of explicit knowledge and researches and to identify how these organizations collaborate with the EPHI for knowledge management of traditional medicine practice.

Conservation and sustainable utilization of medicinal plants is undertaken by the establishment of the Institute of Biodiversity within Ministry of Agriculture mandated by Proclamation No. 381/2004 and furthermore by Proclamation No. 482/2006 that ensures the country and its communities to obtain fair and equitable share from the benefits arising out of the use of genetic resources and community knowledge and community right. Therefore qualitative data is also going to be collected from the institute of biodiversity through key informant interview as they are legally mandated for storage, analysis and conservation of medicinal plant knowledge which makes them directly involved with knowledge management efforts for traditional medicine.

All data sources are selected using non-probabilistic purposive sampling. This technique is preferred when the objective of the sampling is to identify specific target groups who possess special characteristics. In this case, interviews were conducted in the project by selecting individuals who have published researches on traditional medicine and have worked on collaborative undertakings in studying traditional medicine practice. From the EPHI traditional medicine directorate staffs, the prominent researcher who has worked in the directorate as a head as well as a leading researcher selected based on above 5 years of experience and his expertise on the field. From the biodiversity institute two researchers were selected as they were the only ones working on medicinal plant conservation and research analysis. Experts working for listed schools of Addis Ababa University were also selected for the interview.

Additionally, various literatures have been reviewed and documents have been analyzed to understand existing context of traditional medicine practice and its knowledge management.

### **3.2.Data collection techniques**

In-depth interviews were conducted by using semi structured interview questions with principal traditional medicine knowledge managing experts to understand existing context of traditional medicine practice, identify knowledge management activities, identify existing gaps and propose knowledge management system architecture for traditional medicine. The interview questions were prepared by using knowledge management lifecycle as a lens (SOURCE). Additionally, literatures which provide tools and technologies for managing indigenous knowledge have been reviewed and documents such as proclamations and regulations on traditional medicine have been analyzed to understand existing context of traditional medicine practice and its knowledge management.

### **3.3.Data analysis techniques**

To make sense of complex data, successive interpretation has been done during and after data collection. The interviews have been recorded and analysis was done by untangling each knowledge management activities and matching them with methods of architectural design of knowledge management system. The information was organized in a sequential scheme, under descriptive approach to get the full picture of the existing knowledge management practices and infrastructures.

### **3.4.Method of dissemination of the results**

The printed version of this paper, with its end result which proposes knowledge management system architecture in traditional medicine practice will be disseminated to the Addis Ababa University, Federal Ministry of Health and also to the Ethiopian Public Health institute, Menelik II Health science college library and non-governmental institutions working on traditional medicine practices.

## CHAPTER FOUR

### DEVELOPING KMS ARCHITECTURE

#### 4.1. Understanding the existing context of TM knowledge and KM activities

Ethiopia has a long history of traditional medicine and has developed ways to combat disease through it. Some of the traditional medicine practices include but not limited to the application of plant and animal products, inoculation, thermal water, cauterization, counter irritation and traditional surgery. The traditional health practitioners are generally categorized into: Herbalists, Bone setters, Traditional birth attendants, Diviners and magicians and Spiritual healers. Traditional medicine knowledge is both a process and a product; it is dynamic and mostly available in the “heads” of individuals and also embedded in a practice of livelihood. Two different types of knowledge in traditional medicine are distinguished. These are

Tacit knowledge - unconscious and intuitive knowledge gained through experience that allows individuals to make decisions without referring to rules or principles (e.g. knowing how to perform traditional medical operations, knowledge of practitioners to process and prepare herbal medicine).

Explicit knowledge – knowledge that is articulated and accessible to anyone who reads, hears or looks at it (e.g. Research papers on safety and efficacy of different traditional medicine practices).

	Explicit Knowledge	Tacit knowledge
Individual	Verbalized or documented thoughts and strategies	Unconscious, intuitive
Inter-subjective	Books, Libraries, Manuals, Technology	Group behavior

Table 1: Different dimensions of knowledge

Much effort has been undertaken by the Ethiopian government in the development and promotion of traditional medicine through national policies, legal and regulatory framework as well as institutional structure. These include establishing institutions such as the Ethiopian public

health institute to capture, store and disseminate as well as perform experimental studies on traditional medicine for proper management of traditional medicine knowledge.

Through the interviews conducted, the traditional medicine knowledge sources identified were two, which are tacit knowledge of traditional medicine practitioners in the community and explicit knowledge found in research institutions and universities.

From the interview, it became known that many students and researchers in Addis Ababa university school of anthropology, school of pharmacy and school of natural sciences have performed various researches on traditional medicine and are major sources of explicit knowledge. But lack of collaborative effort for managing this knowledge has led to just a simple storage in book shelves and libraries. Knowledge management in traditional medicine can be summarized in two ways

- Knowledge that have already been captured and managed by a simple database by the EPHI but which is not accessible by the public
- Knowledge which have not been managed yet and are still in the hands of Addis Ababa university schools and library, researchers, institutes and the community.

#### **4.1.1. Existing traditional medicine knowledge capturing process**

As EPHI traditional medicine directorate is mandated for capturing, analyzing, storing and disseminating traditional medicine knowledge, it tries to capture available tacit knowledge in two ways, these are:

1. Through deep interview with traditional medicine practitioners and healers and also with focus group discussion with the healers to identify the knowledge and store it with a memorandum of understanding signed by the institute and the healers.
2. By conducting a research, a survey, which is able to identify the knowledge and which later be tested experimentally.

Through the above methods, tacit knowledge of healers and practitioners are captured and are made ready for storage and further research. Though it is also mandated to capture and manage explicit knowledge, researchers in the institute only use the internet portal for any availability of explicit knowledge and to check for new updates on the knowledge they have captured.

The directorate captures every traditional medicine practices including herbal medicine, how it is prepared and used for medicinal purposes. The biodiversity institute also performs various researches on medicinal plants, document and store them on a database.

There are also much explicit knowledge on traditional medicine practices performed by higher education institutions such as Addis Ababa university schools but this knowledge are not captured or a means to capture them lacks in the EPHI. Rather the major source of explicit knowledge is researches found on the World Wide Web and the research conducted by the institute’s own researchers. The use of ICT to capture traditional medical knowledge is very small in the institution.

#### **4.1.2. Existing traditional medicine knowledge storage process**

In cases of storing traditional medicine knowledge, the EPHI traditional medicine directorate stores and manages the captured tacit knowledge along with its research findings on a database with requirements made to match with WHO guideline. In a new effort to centralize the database as well as have the backup copy of the stored knowledge, the institute has recently managed to have a central database management unit. Therefore, currently all of the information on traditional medicine is stored in the central repository.

Regarding medicinal plants storage, there are also databases managed by the Ethiopian biodiversity institute which stores researches conducted on the plants by the institute. Generally regarding storage of traditional medicine knowledge, the databases used can be identified as two, which are depicted in the table below.

Table 2. Identification results of traditional medicine knowledge management

no	Name	Administrators
1	Database of Ethiopian traditional medicine practices	Ethiopian public health institute traditional medicine unit
2	Database of Protection of Medicinal Plants and Traditional Medicine and	Ethiopian Biodiversity Institute and Ethiopian agricultural research institute.

#### **4.1.3. Existing traditional medicine knowledge sharing/dissemination process**

In the aspect of knowledge sharing, the EPHI allows researchers and university students' access to available knowledge by only providing hard copies of the available knowledge, but does not provide access to the database. Access to the database is only given to researchers working inside the EPHI. Although the institute has undertaken some measures to disseminate the available knowledge through publishing books, still the books have not been disseminated towards the community due to financial issues. Traditional medicine Knowledge sharing among research institutes and higher education institutes is very poor as knowledge is scattered through the institutes and there is limited access given for the general public. There is also efforts to share the available knowledge by the Ethiopian biodiversity institutes but still various researchers as well as the community is not still accessing them.

In addition to this, many researches have been conducted by Addis Ababa university different departments and they are huge sources of explicit knowledge but they have not been integrated with the stored knowledge and databases managed by the Ethiopian public health institute and shared to the public. There is limited use of ICT tools as a means of disseminating knowledge. This means that only computers are used to access some stored information and intranet is not used as a primary knowledge sharing tool inside the organization. Figure 4 summarizes the understanding of the existing traditional medicine knowledge and knowledge management practices.

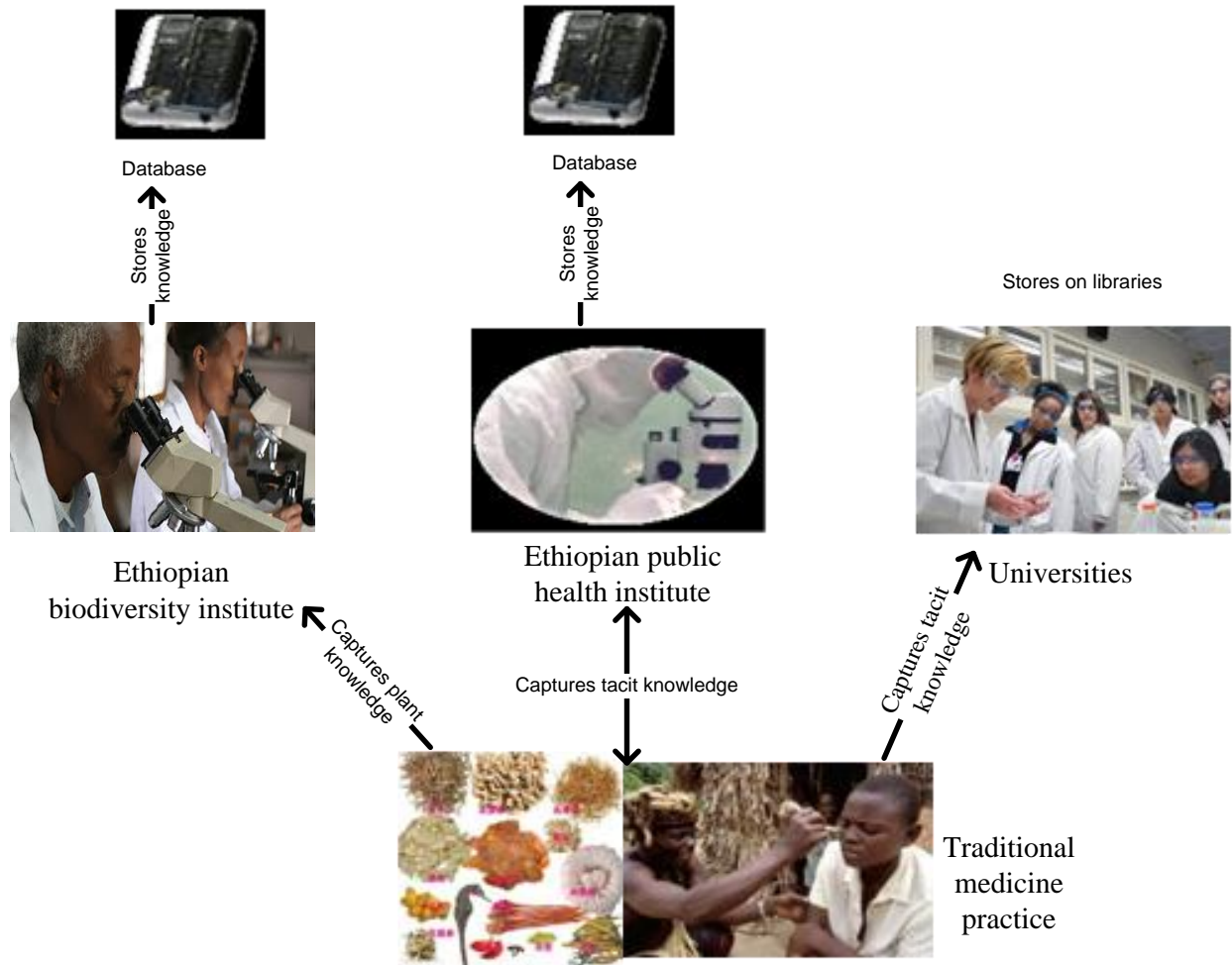


Figure 4. Existing knowledge management practices in traditional medicine

#### 4.2. Knowledge management problems in traditional medicine practices

Even though, efforts have been made by the EPHI and other institutions to manage traditional medicine knowledge through capturing; storing and disseminating knowledge there is still limited coordination among the different institutions and also the current practice is not satisfactory to maximize the utilization and accessibility of the knowledge. Exploration and research have been carried out by researchers from various Research and development institutions such as the Ethiopian public health institute as well as the Ethiopian biodiversity institutes and universities, but the results of these studies are managed in a limited run in the form of databases by research institute, so that they cannot be accessed by the public. Apart from that, there is a lot of traditional medicine knowledge in the community which has not been recorded and documented in the form of database. Therefore, traditional medicine knowledge,

especially of natural medication might disappear. The following problems were identified in the current KM activities

1. Lack of centralized knowledge repository which is able store both explicit and tacit knowledge with all the available technology which is connected in a network with higher education institutes and various research institutes in the country.
2. Limited use of ICT tool support in cases of capturing the tacit knowledge such as digital video cameras
3. Absence of well organized knowledge management team to support the collaborative efforts in knowledge management of traditional medicine practice.
4. Lack of ICT support in cases of knowledge sharing and dissemination which includes providing access to researchers and the community

#### **4.3.Goals of the KMS**

Therefore, the plan for traditional medicine practice knowledge management which is scattered in research institutes and the public must be to integrate it nationwide through a single portal and fulfill the expectations of the scientific community and the general public to be able to access this knowledge from a single portal so that the traditional medicine knowledge can be managed well. As the result, the international community can recognize the traditional medicine knowledge of Ethiopia and avoid misappropriation of this knowledge.

Based on analysis of business context and KM problems, the following KMS goals are identified:

1. To support knowledge capture process with ICT tools and knowledge capturing methods.
2. To centralize knowledge repositories so that knowledge captured by different institutions end up at one knowledge warehouse.
3. To create integration and easy access to existing knowledge resources
4. To support the knowledge sharing activity with ICT tools so that knowledge is accessed from everywhere.

To fill the above listed gaps and support the existing knowledge management activity, this study proposes an architecture which is helpful for designing and implementing a knowledge management system for traditional medicine practice by adopting three major knowledge management activities from the knowledge management cycle. These are the knowledge capturing, knowledge storing and knowledge disseminating.

#### **4.4. Knowledge management tools**

This study identified the necessary KM tools and techniques for supporting a knowledge management system approach on traditional medicine by using the knowledge management process as a lens. Therefore, it has configured which tools and techniques are important in capturing, storing and disseminating traditional medicine knowledge. The following proposed architecture (figure 5) along with its description provides which knowledge management tools and techniques are configured with knowledge management activities in traditional medicine.

#### 4.5. The proposed architecture

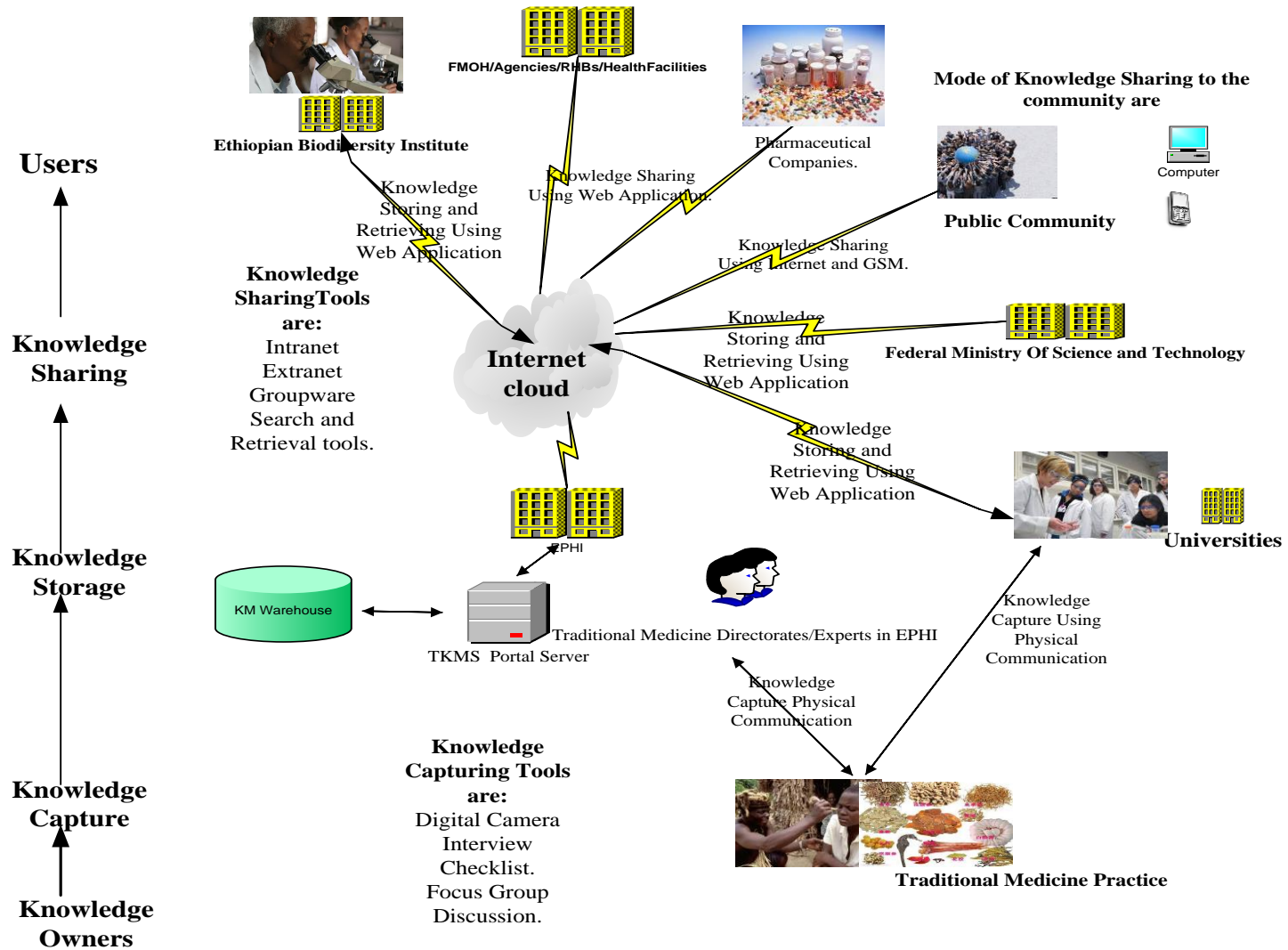


Figure 5: Proposed architecture for traditional medicine knowledge management

The proposed architecture has three major components: knowledge capturing, knowledge storage and knowledge sharing. Description of each component of the proposed architecture is given as follows.

#### **4.5.1. Knowledge capturing**

The major sources of traditional medicine knowledge are traditional medicine practitioners. To enhance activities of capturing the tacit knowledge from the practitioners, especially the EPHI along with the proposed KMS architecture, must use the approach of a small group discussion as this will help in solicitation of information and testing one healer expertise with the group one. The main method of capturing this knowledge should be a thorough interview with healers and this interview must be supported with digital video and photographic cameras as this will ease the process of knowledge storing and codification as well as provide the capturing of unaltered traditional medicine knowledge. Capturing of the knowledge should also ensure benefits for the healers as part of the intellectual property rights of the healers and ensuring this must be main activity of the EPHI traditional medicine directorate together with the Federal Ministry of Science and Technology. Knowledge captured on the use of medicinal plants must be assessed experimentally and in addition explicit knowledge from Ethiopian Biodiversity Institute must be captured by using web application. In terms of capturing the explicit knowledge, any research conducted by the higher education institutes on traditional medicine should be captured by the EPHI directorate through allowing web access to the higher institutes and Ethiopian biodiversity institute to store as well as retrieve knowledge through web application with the EPHI central knowledge warehouse. The explicit knowledge should then be analyzed by the knowledge management team and should be codified, classified and stored for proper use.

#### **4.5.2 Knowledge storage**

For analyzing and appropriately managing the knowledge, a knowledge management team must be formed which is organized by the EPHI. This team will be responsible for classification and appropriate storage of the traditional medicine knowledge. Knowledge storage of traditional medicine should incorporate the following tools and technologies.

### ***Knowledge warehouses/knowledge base***

Knowledge Warehouses act as a repository for current and historical operational data. The traditional medicine knowledge and practice has a poor record in terms of standardization, therefore information is used and misused in an ad hoc manner. The knowledge warehouse [KW] allows the information to be presented in several formats and to be distributed more widely in communities of practice.

The Knowledge Warehouse (KW) provides the means for analysis of traditional medicine knowledge through ad hoc and managed query environment, statistical analysis tools, and knowledge mining technologies. Therefore, all captured knowledge has to be classified based on the standards provided by WHO classifications of traditional medicine and should be linked and stored on the central knowledge warehouse. Through networked access and storage on the warehouse, Efficiency due to inter-institutional research will be mutually sustainable and does not overlap, and minimizes even duplication of research activities. Besides, the industry does not need to only focus on research, but also need to harness and optimize the results of research into products that are economical and have high value. This can be achieved through availability of a central knowledge warehouse managed by the EPHI.

#### **4.5.3. Knowledge sharing**

The traditional medicine knowledge should be made accessible for the community, researchers and pharmaceutical companies through web application, by giving different stages of access for the knowledge warehouse based on the agreement with the EPHI. Knowledge can also be shared by GSM mobile services; especially by using short message services in order to share specific and significant knowledge with the community. This will enhance the knowledge sharing activity towards the community. To enhance these activities traditional medicine knowledge management should use the following technologies and tools.

### ***Search and retrieval tools***

These tools allow anyone with access to the knowledge warehouse to search and retrieve specific knowledge resource in response to user inquiries. Knowledge repositories contain generalized knowledge about traditional medicine practice irrespective of the specific user requirements. It is the task of the search engine tools to search and retrieve the specific knowledge from large pool of knowledge repository. The search engines should have a capability to retrieve knowledge from a variety of knowledge sources. Therefore it is important to include these tools for proper knowledge storage and retrieval of traditional medicine knowledge

### ***KM Portals***

Knowledge portal supports personalization of knowledge resources by accepting personalized query from end users and retrieving knowledge content that meets the users query. The personalized search may also include for potential traditional medicine directorate experts or knowledge sources if the actual content is not found in the knowledge repository.

### ***Intranet, Extranet, Groupware***

These technologies should be implemented by the EPHI so that experts and researchers can access the traditional medicine knowledge. By providing a secure access through extranets, the environment allows for secure, selective sharing of key information and knowledge. Students from various universities should have access to the knowledge. This access is provided to them through web applications. Both asynchronous and synchronous communication tools can also be used which allows discussion with traditional medicine knowledge management experts, practitioners and researchers on how the knowledge can be used for action. Video conferencing and seminar presentation through the web should facilitate the knowledge sharing.

## **4.7. Evaluation of the proposed KMS Architecture**

Evaluation is used to check alignment of the new system with expected user requirements. Descriptive evaluation method was used to evaluate the proposed KMS architecture. This method uses qualitative evaluation by asking potential users of the system. The proposed architecture is evaluated from user acceptance and capability of EPHI to design and implement KMS based on the architecture. Therefore, ten potential users who work in EPHI, EBI, FMOH

and Addis Ababa University were selected based on their technical expertise and experience on traditional medicine. In depth interviews with explanation of the architecture were given to the users and their response was summarized on the basis of acceptance, feasibility and capability of the proposed architecture in order to design and implement KMS for traditional medicine. Additionally, limitation of the proposed architecture was analyzed based on the response of the potential users.

With regard to user acceptance, users confirmed that the proposed architecture has high acceptance as it allows access to traditional medicine knowledge based on the authorization provided to them by the system and getting the access through web allows them to get the knowledge wherever they are located. It also provides additional web based communication channels to further discuss on the traditional medicine knowledge. Additionally, wrong practices identified through experimental testing of the traditional medicine knowledge by the EPHI will be notified to users through their mobile phones (SMS).

EPHI has the internet infrastructure to implement a web based KMS based on the architecture. It has also IT professionals which maintain and provide solutions whenever problems in the network exist. The internet technology is currently in place on all users indicated in the architecture, therefore it is easy to use the architecture to design and implement KMS for traditional medicine. The EPHI, in its strategic plan, wants to build a model research institute in Africa and therefore has a plan to better organize and upgrade the traditional medicine directorate with ICT tools and technologies. Therefore, the proposed architecture is aligned with strategic goals of the organization. The proposed architecture solves the currently observed KM problems in traditional medicine and ensures inter-collaborative efforts towards managing traditional medicine knowledge. Despite this, experts have identified that there is limitation in the architecture, in which the contribution of the knowledge owners (traditional medicine practitioners) in the architecture is very low as the architecture did not provide how they use ICT tools and contribute in the knowledge management activities. But, the capability of the traditional medicine practitioners to use ICT tools and technologies has to be assessed in future studies and incorporated during implementation of the KMS.

## **CHAPTER FIVE**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1. Conclusion**

Knowledge of Ethiopia's traditional medicine practice in today's society has not been managed effectively. Even though, recent efforts are there to capture and manage the knowledge by the government through establishing organizations and forwarding proclamations, rules and regulation, The knowledge is still scattered in research institutes, university libraries, community and individuals' shelf, if no action of integrated management is made, the knowledge will be lost. Through this study, it became known that Traditional medicine knowledge is currently found at different levels, such as institution level, association levels and individual level.

Therefore, a knowledge management system has to be designed and implemented by the EPHI for management of this knowledge. This allows for traditional medicine to be captured from different areas, stored appropriately and then shared accordingly. This study proposes a knowledge management architecture which will be used for designing, developing and implementing knowledge management system for traditional medicine practice. The main contribution of the study is to provide a guide for the government to implement a KMS and to leverage knowledge which in turn helps the community and the whole country in terms of supporting the existing health system. The study also suggests the necessary knowledge management tools and how they are integrated to implement the proposed KMS architecture. Although the architecture needs empirical evaluation, from the preliminary evaluation results it is found that it can be used as a starting point for designing an effective KMS for traditional medicine practice.

## **5.2. Recommendation**

As this study is a base for designing a knowledge management system for traditional medicine the recommendation is to design and implement a knowledge management system suited for traditional medicine practice. Additionally, the following points are the major recommendations of this project

- The EPHI has to mobilize, governmental and nongovernmental organizations in order to work collaboratively to design and implement a knowledge management system for traditional medicine practice
- The EPHI together with the Federal Ministry of Science and Technology should work to prepare appropriate policies and laws to consider the intellectual property rights of traditional medicine practitioners when capturing their tacit knowledge.
- Nationwide forums have to be conducted with initiation by the EPHI so as explore and encourage traditional healers, researchers and university students to work collaboratively towards knowledge management approach of traditional medicine.
- EPHI should strengthen its current KM activities on traditional medicine and also should play a leading role in implementation of knowledge management system for traditional medicine practice.
- Further studies have to be performed to assess how traditional medicine practitioners contribute to managing traditional medicine knowledge by using internet and other technologies.

## Reference

1. Ryan Abbott, Documenting Traditional Medical Knowledge, World Intellectual Property Organization, Geneva, Switzerland, March 2014.
2. Kebede Deribe Kassaye, Alemayehu Amberbir and Binyam Getachew. A historical overview of traditional medicine practices and policy in Ethiopia. *Ethiop.J.Health Dev.* 2006; 20(6): 127-134.
3. Steve Morrissey, The design and implementation of effective knowledge management systems, Ford motor company MBA fellowship, U.S.A., January 2005.
4. Association of State and Territorial Health Officials, Knowledge Management for Public Health Professionals, Washington, ASTHO,2005.
5. Anna Schurmann, Leah Gordon, Lisa Mwaikambo, Knowledge Management for Data Use and Decision Making in International Public Health, USA Carolina Population Center, 2011.
6. Ronald Maier, Knowledge Management Systems: Information and Communication Technologies for Knowledge Management, Leopold-Franzens-University of Innsbruck, School of Management Information Systems, 2007.
7. Ankur pant and A.L. Moorthy . knowledge management and safeguarding Indian traditional knowledge, *annals of library and information studies.* 2013; 60 (6): 88-97.
8. Dejene Teshome Kibret, An overview of the role of traditional medicine in Ethiopia, ABHINAV national monthly refereed journal of research in arts & education, 2011; 2(4): 15-25.
9. World health organization, region for Africa, legal status of traditional medicine and complementary /alternative medicine: a worldwide review, Geneva, Switzerland, 2010.
10. James hook, Traditional and complementary medicine policy. *Management sciences in health,* 2012;8(7): 35-48.
11. Sophia Twarog and Promila Kapoor, protecting and promoting traditional knowledge: systems, national experiences and international dimensions, New York and Geneva, united nations , 2004.
12. Peter Mwaura, indigenous knowledge and disaster management in Africa, United Nations environment programmer, Nairobi Kenya, 2008.

13. Rizwan Saeed Mirza, Knowledge Management and Clinical Framework For Cross Country Health Care Organization, MSc Thesis, Pakistan, 2009.
14. Davenport, T. H. & Prusak, L. Working knowledge. *Harvard Business School Press*. 1998; 2(7): 42-56.
15. Nonaka, I. The knowledge creating company. *Harvard Business Review*. 1991, volume 69, number (6), pp 96-104.
16. Tzyh-Lih Hsia, A Framework for Designing Nursing KnowledgeManagement Systems. *Interdisciplinary Journal of Information, Knowledge, and Management*. 2006; 1(1): 14-26.
17. Aghebati Azita, Safdari Reza, Dargahi Hosein, Gushe Gire Seid Ashrafoldin. Traditional Medicine Information Management. *American Journal of Health Research*. 2014; 2(2): 43-48. doi: 10.11648/j.ajhr.20140202.12.
18. Lishan Adam, PhD, Information and Communication Technologies, Knowledge Management and Indigenous Knowledge: Implications to Livelihood of Communities in Ethiopia, ICT in Development Researcher, 2003.
19. Zack, M. H, Managing Codified Knowledge. *Sloan Management Review*, 1999; 40(4): 45-58.
20. Hansen, M. T., Nohria, N., Tierney, T. What's Your Strategy for Managing Knowledge? *Harvard Business Review*.1999; 77(3-4):106-116,.
21. José Geraldo Pereira Barbosa, Antônio Augusto Gonçalves, Vera Simonetti, Altino Ribeiro Leitão, A Proposed Architecture for Implementing a Knowledge Management System in the Brazilian National Cancer Institute, BAR, Curitiba. July/Sept. 2009; 6(3): 247-262.
22. Assefa Temtim, Garfield Monica, Meshesha Million, Proposing a knowledge management system (KMS) architecture to promote knowledge sharing among employees, Twenty Second European Conference on Information Systems, Tel Aviv 2014.
23. Maria Carolina Herrera-Hernandez, Engineering of a Knowledge Management System for Relational Medical Diagnosis, University of South Florida Scholar Commons, Graduate Theses and Dissertations, 2012.

24. Lukman S, He Y, Hui S. Computational methods for Traditional Chinese Medicine: A survey. *Computer Methods and Programs in Bio Medicine* 88, 283-294. doi: 10.1016/j.cmpb.2007.09.008.
25. Zhou X, Peng Y, Liu B. Methodological Review: Text mining for traditional Chinese medical knowledge discovery: A survey. *Journal of Biomedical Informatics* 43, 650-660. doi: 10.1016/j.jbi.2010.01.002.
26. Feng, Y., WU, Z., Zhou, X., Zhou, Z., Fan, W. “Knowledge discovery in Traditional Chinese Medicine: State of the art and perspectives”. *Artificial Intelligence in Medicine* 38, 219-236. doi: 10.1016/j.artmed.2006.07.005. 2006.
27. ZhuGe, J. “Diagnosis of Traditional Chinese Medicine based on the Structural Model of Knowledge Discovery Technology”. *Third International Symposium on Intelligent Information Technology Application*, IEEE Computer Society. 2009.
28. Jane Hunter, *The Role of Information Technologies in Indigenous Knowledge Management*, The University of Queensland, St Lucia, Queensland, 2008

## **Annex**

### **Interview questions and guideline to identify existing knowledge management practices**

#### **General purpose of the study**

This study is conducted to identify existing knowledge management in traditional medicine so that a well established system is recommended based on the findings by using scientific methods. This study will try to identify the ways applied by your institutions to capture, structure, and store and share traditional medicine knowledge both implicit and explicit. The interviewer would like to assure that the answers you provide will only be used to support the study and also names and positions of the interviewed expert will be made highly confidential and will not be mentioned explicitly by any means.

#### **Operational definitions**

**Tacit knowledge:** can be defined as knowledge that is “subconsciously understood and applied, difficult to articulate, developed from direct experience and action, and usually shared through highly interactive conversation, storytelling and shared experience. Tacit knowledge is very hard to codify and store.

**Explicit knowledge:** is “more precisely and formally articulated although removed from the original context of creation and use”. Explicit knowledge is any knowledge that can be codified and documented.

Questions which address specific objective 1 and 2: **Identifying existing knowledge and knowledge management practices as well as gaps in management of traditional medicine knowledge.**

#### **Key informant interview question guides for EPHI traditional medicine experts**

1. What is the sole purpose of EPHI traditional medicine directorate with regard to traditional medicine knowledge?

2. How many researches have been performed on traditional medicine by your organization?
3. Where do you keep the researches?
4. How do you capture tacit traditional medicine knowledge from the community?
5. Do you use any ICT tools while capturing traditional medicine knowledge?
6. Do you also capture and analyze explicit traditional medicine knowledge?
7. Do you work closely with research institutes such as Addis Ababa university school of pharmacy, department of botany and biodiversity research institute for capturing and analysis of traditional medicine?

If yes, then how is the knowledge from such organization linked and stored in your organization?

8. Do you perform any classification and codification of traditional medicine knowledge that you captured (both implicit and explicit)?
9. How do you store the captured traditional medical knowledge?
10. Do you use any ICT tools for storing the traditional medical knowledge ?
11. How do you secure the storage?
12. Do you have a digital library for traditional medical knowledge?

If yes, who has the right to access it?

13. Are there any knowledge sharing activities on traditional medicine knowledge?

If yes , how is the knowledge shared and who is it shared to?

14. Do you use any ICT tools to ease the process of knowledge sharing?
15. Do you verify each traditional medical knowledge through experiments and research?
16. Is there one central database for storing the traditional medicine knowledge available from different organization?

if no, what other organizations hold/store traditional medicine knowledge on a database?

Interview question guide which address specific objective 3: **constructing an architecture for traditional medicine knowledge management**

1. What are the factors which hinders knowledge capturing process of traditional medicine practice?
2. What elements do you think should be emphasized on for the process of knowledge capturing of traditional medicine?
3. What ICT tools do you think are helpful for capturing traditional medicine knowledge?
4. In what ways should inter organizational linkage exist for capturing explicit knowledge?
5. What are the factors which hinders storage of traditional medicine practices?
6. What elements should be considered for storage of traditional medicine practices?
7. What are the security concerns with regard to storing traditional medicine knowledge?
8. What additional database requirements do you think are needed for establishing storage of traditional medicine?
9. Who do you think should have access to the database and why?
10. Which organizations do you think have to be involved in disseminating and sharing of traditional medicine knowledge and why?
11. What ICT tools do you recommend for sharing and disseminating traditional medicine knowledge?
12. What other ways do you recommend for sharing traditional medicine knowledge?
13. Who do you think are the major users of the shared traditional medicine knowledge?

**Interview questions for Addis Ababa University School of pharmacy, school of botany, school of anthropology and Ethiopian biodiversity research institute**

1. How many researches have been done by your students or researchers on traditional medicine?
2. How do you store the available knowledge from the research findings?
3. Who is able to access those researches and the knowledge from them?
4. Do you use any ICT tools to store and share the available knowledge?
5. Do you work closely with the EPHI traditional medicine directorate to appropriately manage the knowledge on traditional medicine practice?

**Interview question guide for addressing specific objective 4: Evaluating the proposed architecture**

1. Do you think the architecture is feasible to be used for designing a knowledge management system?
2. Do you think the infrastructure in your organizations is enough for the implementation of the proposed architecture?
3. What limitation do you think this architecture has for designing a knowledge management system in traditional medicine?
4. What are the challenges involved in implementing the proposed architecture?
5. Do you think the proposed architecture is complex or simple?