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Title of the Project: Developing an Enterprise Framework for Mental Health Information System in Addis Ababa

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Table of contents

Dedication

This work is dedicated to my Mom.You are my strength.

Acknowledgment

First I would like to express my heartfelt gratefulness to my advisors Ato Ermias Abebe and Dr. Negussie Deyessa for their consistent and relentless engagement in my work.

I can't thank enough my family, especially Mam for all the sacrifices you made to put me here today. It is all because of you and Ababi for your unlimited support in every angle.

Yohannes, thanks you are a great and loving friend, thanks for all your support through those tough times and for all your efforts to relax me and for making life a lot easier.Thanks for being there for me. I am glad to have you. I thank you sincerely.

Finally I would like to acknowledge Wondwosen Shiferaw for his suggestion and support.

List of Figures

List of Tables

List of acronyms

ADM	Architecture Development Method
ART	Anti-Retroviral Therapy
BPR	Business Process Reengineering
EA	Enterprise Architecture
EAF	Enterprise Architecture Framework
ECG	Electro Cardio Graph
ECT	Electro Convulsive Therapy
EEG	Electro Echo Graph
EFY	Ethiopian Fiscal year
HER	Electronic Health Record
EHRS	Electronic Health Record System
EPR	Electronic Patient Record
ERA	Electronic Reference Architecture
FEAF	Federal Enterprise Architecture Framework
FMOH	Federal Ministry of Health
HEAF	Health Enterprise Architecture Framework
HEART	Health Enterprise Architecture Repository Tools
HEAL	Health Enterprise Architecture Laboratory
HIE	Health Information Exchange
HMIS	Health Management Information System
ICD	International Disease Classification
ICT	Information Communication Technology
IEAF	Integrated Enterprise Architecture Framework
IPD	Inpatient Department
IS	Information System
IT	Information Technology
MCH	Maternal and Child Health
MHIS	Mental Health Information System
NHIS	National Health Information System
OPD	Outpatient Department
TOGAF	The Open Group Architecture Framework
UML	Unified Modeling Language
VCT	Voluntary Counseling and Testing
WHO	World Health Organization

Abstract

Background: “Mental health information system is a system for collecting, processing, analyzing, disseminating and using information about a mental health service and mental health desires of the population”.

All types of mental health organizations should have a clearly defined set of quality information that is gathered and consolidated in to meaning full indicators for clinicians, managers and the executive.

Objective: The general objective of this project was todevelop an enterprise framework for mental health information system in hospitals that provides mental health care in Addis Ababa.

Methodology: For data collection interview, observation, document and literatures review was done. For the framework development the Zachman and the open group architectural frameworks were used. Iterative system development methodology was used for over all framework development.

Discussion of Results: By using the perspectives of the Zachman framework and the open group architecture template different business, data and information architecture works were done. Taking the mental health organization mission, strategy and objectives in to consideration the investigator identified the architecture mission, business and information principles, information flow between different departments and different stakeholders that have impact on mental health information systems.

Conclusion: Information is a critical component of mental health institutions for many purposes like patient care, decision making, and monitoring of outcomes. As a result of this proper and standardized way of information flow can improve communications among the business organizations and different stakeholders.

This mental health information system architecture framework will serve as a base for developing more complete architecture framework of mental health institutions in the future.

Chapter one

1. Introduction

Every organization has an information system for assisting its business. An Information System has different benefits like supporting decision making, coordination, and control and may also help managers and workers analyze problems, visualize complex subjects, and create new products. According to a study conducted in the 1990's, information architecture was referred to as one of the most important developments in the management of information systems research and practice. As stated by Zachman, "with increasing size and complexity of the implementation of information systems, it is necessary to use some logical construct (or architecture) for defining and controlling the interfaces and the integration of all of the components of the system" [1].

Enterprise architecture is the process of interpreting business vision and strategy into effective enterprise change by creating, communicating and improving the key principles and models that describe the enterprise's future state and enable its evolution [2].

Enterprise architectures are blueprints for scientifically and completely defining an organization's current (baseline) or desired (target) environment. Enterprise architectures are essential for evolving information systems, developing new systems, and inserting emerging technologies that optimize their mission value [3].

An enterprise architectural framework (EAF) comprises a set of models, principles, and methods that are used to implement enterprise architecture. The framework provides a means to communicate information about architectural artifacts, their relationships to each other, and to their stakeholders using a common vocabulary. An EAF may also help in the architectural planning process and provide guidelines and measures to help conduct a maturity assessment of EA methodology within the organization [4].

For meeting the challenge for efficient, high quality and sustainable care increasingly specialized and distributed health systems in developed and more in developing countries require extended communication and cooperation between all principals involved in patient's care. Principals are all actors within the information management chain such as persons, organizations, systems, devices, applications, components or even single objects [5].

A critical part of improving safety and quality of care provided to patients is the gathering, analyzing and use of information concerning clinical performance. All types of healthcare

organizations should have a clearly defined set of safety and quality information that is gathered and consolidated into meaningful indicators for clinicians, managers and the executive [6].

With the advancing ability for technology to work in seamless, integrated ways, health and delivery entities are re-thinking the ways they use technology. Increasingly, they are looking for ways to make lasting investments in solutions that help manage the vast complexity of large-scale health care systems, assist health and social care workers to perform their jobs more effectively, and manage the sensitive and private data for each individual in the system in a way that improves service [7].

1.1 Background

"Mental health is a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community" [8].

"A mental health information system (MHIS) is a system for collecting, processing, analyzing, disseminating and using information about a mental health service and the mental health desires of the population it serves. The MHIS aims to improve the effectiveness and efficiency of the mental health service and ensure more equitable delivery by enabling managers and service providers to make more informed decisions for improving the quality of care" [9].

There are several benefits produced by a MHIS. They are a way of providing accurate, consistent information about a mental health service; they assist with coherent planning; and they are essential for policy implementation and evaluation. Information systems improve effectiveness by enabling the measurement of indicators explicitly determined by the policy framework of the mental health service [9].

Amanuel mental specialized hospital is the one devoted psychiatric hospital with 300 beds and general psychiatric services and clinics. Other three hospitals in Addis Ababa (Tikur Anbessa, St Paul and Zewditu) give only outpatient treatment to the community. The other two hospitals Amanuel and St. Paul hospitals also give substance abuse treatment with 16 & 5 beds respectively [10].

Amanuel Mental Specialized Hospital is the oldest hospitals established in 1930 E.C. by Italian colonizers to serve the indigenous population [11]. It is located in the western part of Addis Ababa in Addis Ketema sub city kebele 08.The hospital has 611 staffs (254 health professionals and 357 administrative staff) and gives outpatient services for about 456 clients per day [11].

The services provided by Amanuel hospital are:

- Psychiatric services including emergency, outpatient, inpatient, ECT, forensic, addiction and rehabilitation services.
- VCT service
- ART service
- MCH service
- Internal medicine outpatient service

It also gives different services like diagnostic, pharmacy, education of psychiatric professionals and research and training. Currently the hospital is integrating mental health service to other health services and giving more services than before. The hospitals top three disease of the year 2005 EFY are Schizophrenia, Epilepsy and depression in is descending order respectively.

1.2 Statement of the problem

The growth of IT and its consequent spreading is an enterprise reality; however, most organizations do not have adequate tools and/or methodologies that enable the management and coordination of their information systems [1].

"In today's complex business environments, many large organizations in the healthcare field have great difficulty responding to change. Part of this difficulty is a lack of internal understanding of the complex structure and components in different areas of the organization, where legacy information about the business is locked away in the minds of specific employees or business units, without being made explicit" [12].

Currently all health care organizations in Addis Ababa that give mental health care use manual system for their client care. As a result of this there are different problems regarding to the manual system and their information gathering, analysis, process, dissemination and use of mental health information.

Some of the problems encountered in the existing system are the following as observed by the investigator.

- There is no standardized way of information flow and access.
- Lack of organized referral system
- Duplication of client data
- Different reporting systems
- Different disease categorization and the formats are not sufficient for mental health categorization
- Poor data quality
- Inadequate knowledge/ understanding of health professionals for collecting MHIS

Therefore development of an enterprise framework for mental health information system will provide guidelines for decision making, coordinate different components of organizations andenable to better understanding of IT capabilities by aligning business functionality with relevant IT resources.

1.3 Objectives

1.3.1 General objective

- To develop an enterprise framework for mental health information system in hospitals that provides mental health care in Addis Ababa.

1.3.2 Specific objectives

The specific objectives of the project were:

- To investigate problems in existing hospitals regarding to MHIS.
- To identify and create business definitions.
- To identify how information flows within and between different case teams.
- To identify stakeholders and their concerns that are involved in MHIS
- To develop a framework for mental health information system.

1.4. Significance

Consolidating currently fragmented mental health information systems into a coherent mental health information system will increase operational efficiencies, improve decision-making and will lead to better mental health outcomes.

Developing an enterprise framework for mental health information system will have the following benefits. It:

- Improves patient care and quality by providing available, accessible, consistent and on time patient information.
- Allows access to, and better use of, improved mental health information system for health professionals and decision makers.
- Provides an opportunity to share/ exchange standardized patient information between different hospitals.
- Support decision making functions of the organization by using the available information.
- Improves data collection.
- Helps to provide a structured way of data collection.
- Facilitates integration and reuse of new systems that will be developed to support MHIS.
- Improves on time reporting of MHIS to FMOH and different funders.
- Improves data quality and reliability.

1.5. Scope and Limitations

1.5.1. Scope

The scope of the project was to develop an enterprise framework for mental health information system in Addis Ababa. From Addis Ababa hospitals Amanuel, St. Paul, Yekatit and Zewditu were selected to collect requirements and to develop the enterprise framework. The project was conducted from March to June 2014 in Addis Ababa.

This project used the Zachman architectural enterprise framework and The Open Group Architectural Enterprise Framework (TOGAF) to develop the framework. The Zachman's framework allows for the identification and description of both the organization's existing and planned component parts, as well as their common relationships.

TOGAF provides a common sense, practical and effective method for developing enterprise architecture. Due to time constrain, from the six Zachman's framework perspectives this project included only three of the perspectives, i.e scope (contextual) perspective aimed at the planner (row 1), the business model (conceptual) perspective aimed at the owner (row 2), and the system (logical) perspective aimed at designer (row 3). From TOGAF architectural framework the project performed the business architecture, application architecture and data architecture. The project involved hospital managers and healthcare providers to identify the requirements that are needed for developing the enterprise framework.

1.5.2. Limitation

The major limitation of this project was time. Because of this it was difficult to develop the whole MHIS architecture framework. It was also difficult to implement and evaluate the framework.

Chapter Two

2. Literature review

2.1. General Literature review

2.1.1 Enterprise Architecture

Organizations nowadays are increasingly implementing enterprise architecture to handle difficulties and continuous transformations. Systematic, enterprise-wide methods are likely to advance business agility, strengthen responsibility, and enhance organizational performance and competitiveness [13].

Enterprise architecture (EA) is a complete description of all of the fundamental elements and relations that make up an organization. It is used to describe the arrangement of an organization's mission, goals and objectives with information systems [14]. Enterprise architecture is the basic organization of a system, embodied in its components, their associations to each other and to the environment, and the principles leading its design and development [15].

Enterprise architecture (EA) plays a major role in public, private as well as other organizational systems, such as health care organizations and educational institutions. EA can be implemented in every organization where IT and organization functionality (business functions) alignments are needed [16].

Enterprise architecture can benefit organizations and their revolution developments by effectively implementing their strategy. It acts as an active planning and steering instrument, which can be used in converting strategy to programs and projects, and rotates around four main components: principles, models, views, and frameworks [17].

An enterprise architecture models explain different "perspectives or views from which the company is considered, focusing on some parts and ignoring others in order to decrease complexity". Thus, a model of a company can have numerous activity, process, organization, information and behavior diagrams of the company [18].

2.1.2 Enterprise Architecture Frameworks

An architectural framework is an initial structure or set of structures, which can be used for developing a wide range of different architectures. EAF define a way for designing a target state

of the enterprise in terms of a set of building blocks, and display how this building blocks fit together [15]. EAF comprise a set of tools and offer a shared vocabulary. Architectural frameworks address IT/IS and business requirement of an organization [16]. Enterprise architectural frameworks organize the types of knowledge needed to define and evaluate the business and IT architectures for the enterprise [13]. Enterprise architectural frameworks are not necessarily complete, but they can provide at least established set of issues and concerns that must be addressed in enterprise architecture development [19].

2.1.2.1 The Zachman Enterprise Architecture Framework

In 1987, John A. Zachman suggested a framework for information system architecture, which is now called the Zachman Framework [20]. The Zachman framework recommends a reasonable structure to categorize and compose the detailed description of organization. It brings an infrastructure which supports the enterprise in developing, integration, design, management and access organization's information system [16].

The Zachman framework uses from business design principles in architecture and manufacturing and delivers a way of viewing an enterprise and its information systems from different perspectives, and presents how the components of the enterprise are connected to each other. The Zachman framework provides a means of classifying an organization's architecture. It is a practical business tool, which can be used to model an organization's current functions, elements and processes, and give support to manage business change[12].

The main idea about the Zachman Framework is that the same complex thing or item can be defined or designed for different purposes in different ways using different types of explanations (e.g., textual, graphical). The Zachman Framework has thirty-six categories for completely describing anything;like industrial goods (e.g., appliances), constructed structures (e.g., buildings), and enterprises (e.g., the organization and all of its goals, people, and technologies). The framework provides six increasingly in depth views of abstraction from six different perspectives [21].

Figure 1 below shows that the Zachman framework which offers a set of descriptive representations or models relevant for describing an enterprise. Each cell in the table must be aligned with the cells immediately above and below it. Each cell is unique. Combining the cells in one row forms a complete description of the enterprise from that view.

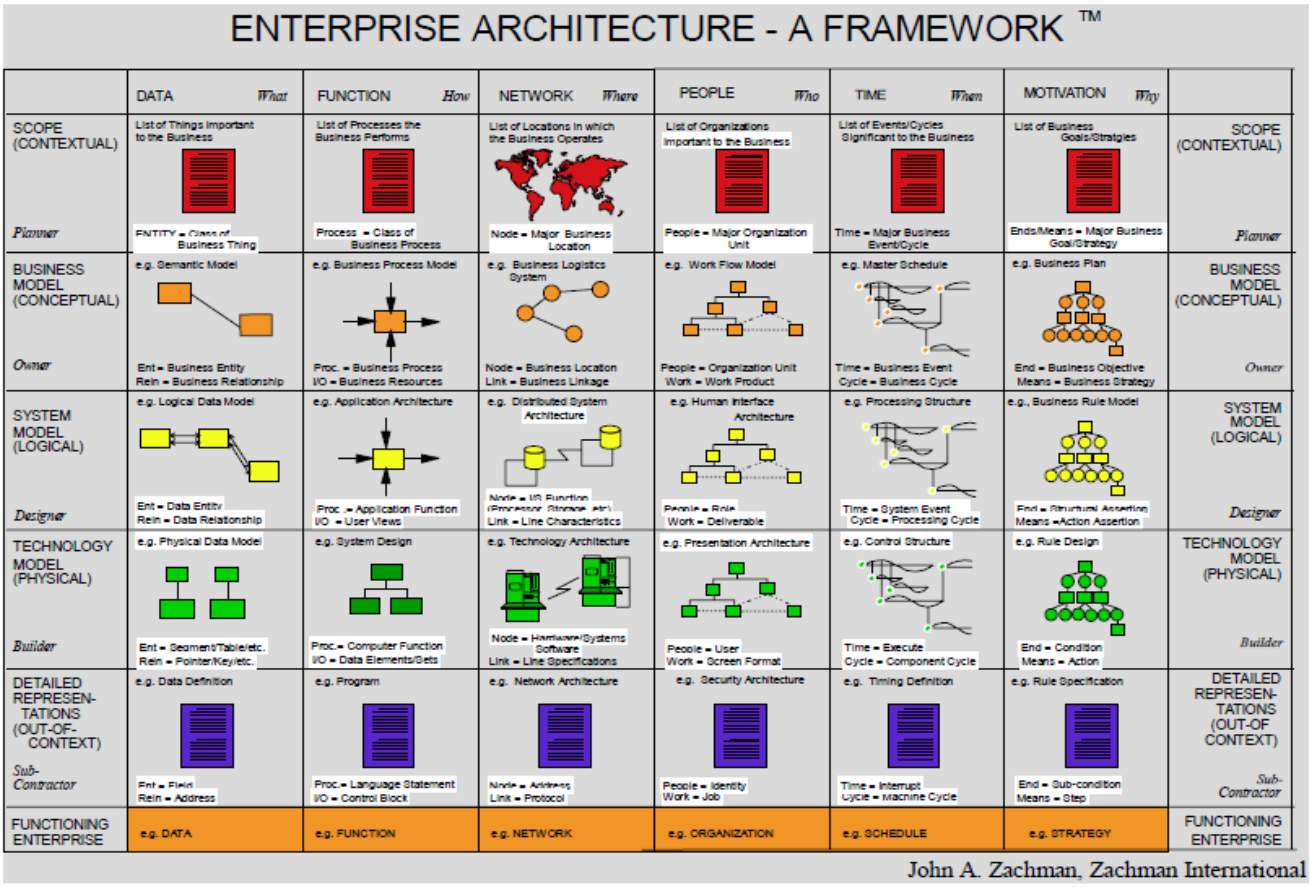

Figure 1: The Zachman Enterprise Framework

The Zachman enterprise framework has a single factor which makes the framework unique, is that each element on either axis of the matrix is clearly distinguishable from all the other elements on that axis. The figure in each cell of the matrix are not merely sequential levels of increasing detail, but actually are different representations, different in context, meaning, motivation, and use. Because each of the elements on either axis is clearly different from the others, it is possible to define specifically what belongs in each cell [21].

The main advantage of the Zachman framework is that; it serves a basis for some other frameworks such as FEAF and TOGAF. Additionally, most of EA tools such as organization designer try to show their compatibility with this framework. It is hard to find a written material on EA without a reference to the Zachman framework [22].

The Zachman framework is only a taxonomy that describes the enterprise using representation of classical architecture; i.e. the design and construction of buildings. The Zachman framework can serve as a classification scheme for information entities. The framework also express an awareness of the system development life- cycle, although it takes a somewhat original approach

towards life-cycle, presenting life cycle phase perspective of the various stakeholders involved in enterprise business effort [23].

The Zachman framework does not provide guidance on sequence, process, or implementation and has no explicit compliance rules since it is not a standard written by or for a professional organization [24].

The Zachman Framework does not include a strategic planning methodology for the architecture; it also lacks methodology covering all the aspects of the framework, repository storing the framework in accordance with the integrity rules and popular modeling notation for all of its columns are the major disadvantage of the Zachman framework. Although it does not provide any place for the technology view, and the business and application views are mixed into a function view [22, 25].

As Pascot , Bouslama and Mellouli explained that the Zachman framework does not describe full guidance on how to make reasoning to collect work plan that are significant to the contribution of technology for redesigning of the organization. Besides, the width of how one lives with a multitude of projects cannot be seen within this framework [26].

2.1.2.2 The Open Group Architectural Framework (TOGAF)

The Open Group Architecture Framework is known by its acronym, TOGAF. TOGAF is developed by The Open Group [27]. TOGAF is developed based on an iterative process model supported by best practices and reusable set of existing architecture resources. TOGAF provides a useful, easily accessible, industry standard method, a set of supporting tools to design an EA and leveraging all pertinent assets in the process. TOGAF is an appropriate framework to understand an organization current state ("as-is") and used an enterprise architecture development method with other deliverables focused frameworks. TOGAF emphases on mission critical business applications that will use open systems building blocks [15, 19]. There are four architecture domains as subset of enterprise architecture, all of which TOGAF is designed to support [15, 27]:

1. Business architecture- Defines the business strategy, organization and key business practices.

2. Application architecture – delivers a blueprint for the individual application systems to be used, their interaction and relationship to the core business practice of the organization.

3. Data architecture- Describes how the enterprise logical and physical data stores are organized and accessed.

4. Technical architecture- Describes the hardware and software infrastructure that supports applications and their interactions.

The TOGAF has an architecture development method (ADM) which offers a confirmed and repeatable process for developing architecture framework. The ADM has different phases which are supported by an iterative cycles of continuous architecture definition and understanding that lets organizations to transform their enterprise in a controlled manner in response to business goals and strategies [15]. Phases of ADM are the shown in figure 2.

One of the most important features of TOGAF's from other enterprise architecture framework is that in architecture development method (ADM), requirements management is a central process that applies to all phases of the ADM cycle. This is useful since architecture by its very nature deals with uncertainty and change, joining the divide between the objectives of the stakeholders and what can be delivered as a practical solution [28].

TOGAF takes a component centric view toward EA. It allows the use of different architectural taxonomies and graphics. TOGAF refers to a continuum of architectures, architectural building blocks, and architectural models, which are relevant to the task of constructing an enterprise – specific architecture which the level of detail maximizes as one move through this continuum [23].

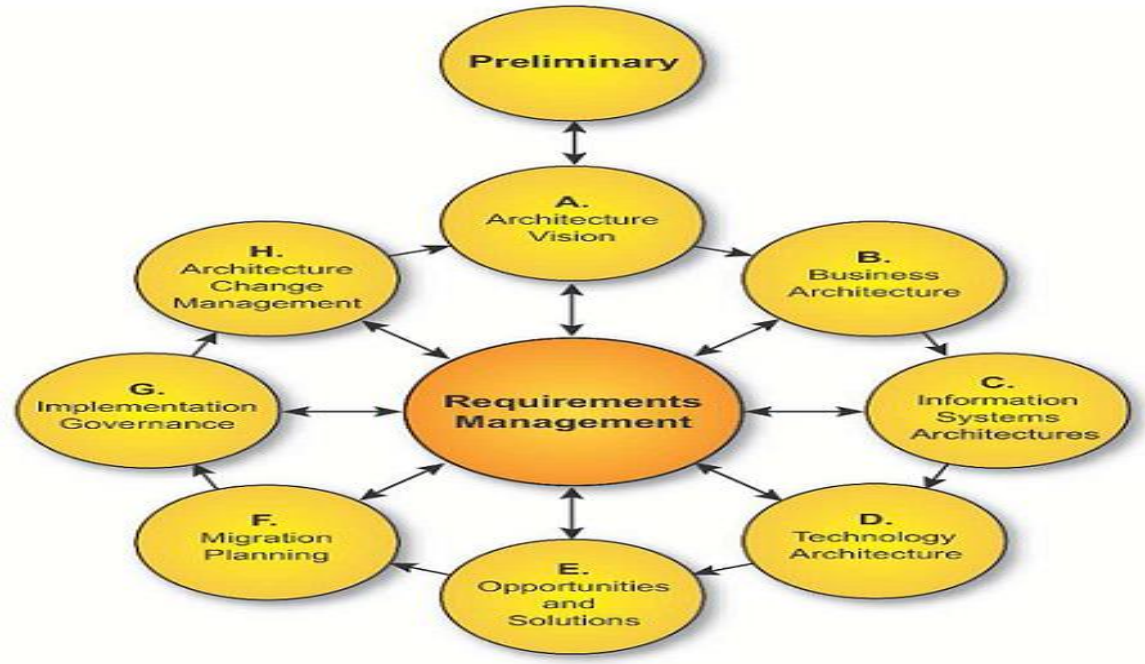

Figure 2 TOGAF Architecture Development Cycle

Figure 2 in the above shows the steps that are implemented in developing an architecture framework with the open group architecture framework.

TOGAF has different techniques, guidelines and templates for adopting ADM. The techniques and guidelines are used to maintain specific tasks within the ADM. The guidelines are the following [15]:

- Applying Iteration to the ADM
- Applying the ADM at Different Enterprise Levels
- Security Architecture and the ADM
- Using TOGAF to Define & Govern service oriented architecture (SOAs)

Techniques of TOGAF:

- Architecture principle - which describes the principles for the use and implementation of IT resources across the organization.
- Stakeholder management – describes stakeholder management by defining stakeholder needs and concerns in the enterprise.
- Architecture patterns - provide guidance on using architectural pattern
- Business scenarios - describe business requirements for architecture development
- Gap Analysis - used to validate an architecture that is being developed.
- Migration Planning Techniques
- Interoperability Requirements
- Business Transformation Readiness Assessment
- Risk Management
- Capability-Based Planning

Business Scenarios implementation helps in order to draw high-level desires in the Architecture Vision and Business Architecture phases. Developing business scenarios targets to capture the business process and applications enabled by the architecture, the business and technology environment, the human and computing entities and the desired outcome of proper implementation [29].

TOGAF explains rules fordeveloping good principles, rather than providing aset of architecture principles. The principles support decision making across the entire enterprise; provide guidance of IT resources; and support architecture principles for development and implementation [24].

TOGAF complements the Zachman categorized as an architectural taxonomy. The Zachman framework provides how to categorize the artifacts but TOGAF provides a process for creating the artifacts [30].

As Cameron and McMillan conclude from their study of different literatures and study group the TOGAF Standard is frequently used for its process completeness, it's Architectural Development Methodology (ADM), interoperability or flexibility in using the elements, availability of architectural knowledge, vendor-neutrality, and alignment with industry standards [4].

The main disadvantage of TOGAF is being big and complex which makes it difficult, time consuming and costly to adopt [31].

2.1.2.3 The Federal Enterprise Architecture Framework (FEAF)

The USA Chief Information Office council established a framework which is called federal enterprise architecture framework. The FEAF is built through a group of interrelated "reference models" designed to assist organization analysis and identification of duplicative investments, gaps and opportunities for collaboration within and across federal agencies [19].

The FEAF provides a permanent standard for developing and supporting architecture descriptions of high-priority areas. It provides direction in relating architectures for multi-organizational functional sectors of the Federal Government [32].

The FEAF enables U.S federal agencies to share information and design common process between other agencies. It also emphases on functional role and enterprise architecture team member's responsibilities [16].

The FEAF has eight components to develop and sustain the federal enterprise architectural framework including architecture drivers, strategic directions, current architecture, target architecture, transitional processes, architectural segments, architectural models and standards [33].

2.1.2.4 Integrated Enterprise Architecture Framework (IEAF)

Integrated enterprise architecture framework is Capgemini's architecture framework. It has a toolbox which comprises processes, products, tools and techniques to generate all types of architectures which are proposed to shape businesses and technology that supports it. The development started in 1993. IEAF has a fundamental line of thought that has proven to be valuable and robust in different types of projects. The basic mechanisms that form IEAF's basis are untouchable. Measurability of decisions, establishing decisions based on principles and minimizing complexity by separating concerns is three of mechanisms that can be applied in any condition [34].

The IEAF has four components namely physical, contextual, conceptual and logical. In each component it explains different domains like business, information, information service and technology infrastructure. The IEAF recognized different organization elements such as units, departments, employee roles, etc. The business process domain consists of business practices and the communication and information domain consists of human or computerized communication channels and the information distributed through them. The services domain consists of IT services, and the behavior domain consists of software behavior. The infrastructure domain consists of all software and hardware needed to aid the higher layers. One of the importance of IEAF is that each layer is not fix but flexible. The IEAF helps as a reference point between diverse organizations, and supports them to understand each other's frameworks. It has also

disadvantages like it focuses on things that are the architect's main responsibility and doesn't much consider other stakeholders involved in the development process [35].

2.1.3 Enterprise Architecture for Mental Health Information System

The accessibility of complete, precise health data can increase healthcare practices for individuals, develop shared knowledge about diseases and proper treatments, enhance insights into the effectiveness and efficiency of healthcare systems, support public health and security goals, and help health care organizations to address their customers' needs. Aggregation of health information into very large data sets and repositories offers extremely valuable chances and benefits in spite of limited understanding of these by the general public [36].

Information handling in health organization is difficult and tremendous due to the high complexity of their structures and processes. Practically everyone working in health care organizations has a huge demand for information, which must be fulfilled to provide well-organized patient care. In order to achieve high-quality patient care, different professional groups, such as physicians, nurses, and administrative staff, must communicate and collaborate closely. The stakeholders' issue is quite complex because different stakeholders are involved in health care organization each have their own concerns regarding to what they need and support. Different types of health professionals discussed and revised treatment plans to achieve effective patient care. Procedures are extremely inconstant and standard 'reference' patient care processes are difficult to define. Decisions must be made quickly to save life and complications and are frequently based on inadequate information. For the above reasons, systematic information management is of tremendous importance in order to plan, monitor and direct information processing in such a way that the information needs of the various user groups are fulfilled in any situation and location [37].

To improve health care services, it is very important that there is consistency in clinical data. Traditionally, large amounts of data have been captured in unstructured formats, but the industry is applying structured data with standardized coding and terminology. EA can make sure that the data structures and taxonomies implemented throughout the organization are in coherence internally and well-suited externally with business partners, regulators, and payers [38].

EA can be used to define the ways for designing health information systems in terms of a clear set of building blocks, and showing how the building blocks fit together and how the communication between the building blocks can be attained [14].

EA can provide a healthcare delivery system, health information exchange (HIE), and/or community with a framework for data and service process planning. This planning may contain detecting key data collection points and the 'true source' of data, avoiding duplication of collection efforts and data interfaces, as well as identifying standardized data for business

processes, which are all key to reporting quality measures and capturing true care costs necessary for value-based purchasing decisions [38].

As the World Health Organization stated 'the enterprise architecture is the succeeding level of explanation of where general lessons, standards, and processes can be combined and documented for knowledge sharing. Well-planned and collaboratively supported enterprise architecture allows systems to be developed and applied using reliable standards for data collection, management, reporting and use. The components of the enterprise architecture will be adjusted from or collaboratively created with the global disease programs whose support and confirmation is vital to its success. Investments in health information systems can be united and leveraged around such architectures to build stronger core health information systems supporting better local health services management, health policy and ultimately stronger health systems' [39].

An EA approach to mental health information systems development lets for significant interrelationships to be identified, including which components need to be associated to which parts and in so doing minimizes the possibilities and reasons of disintegration, duplication, and absence of interoperability. In addition, awareness from governments and commercial bodies have shown that well-developed enterprise architectures decrease the risk of expensive mistakes from applying various information and communication technologies in an unintended and unstructured way, while they facilitate the assessment and acceptance of emergent technologies in a way that benefit the whole system. An EA is not a fixed documentation of a system rather it allows for a long term desire image while assisting gradual development that is informed by continuous involvement and response [14].

2.2 Related works

Thinasagree et al, have highlighted the fact that information is identified by the World Health Organization (WHO), as one of the six building blocks of a health system [40]. Current information systems in most health care organizations lack the capacity to incorporate clinical data, process and outcome data. They do not collect and store the right information; are not appropriately computerized; are not integrated in the sense of being able to connect each other; and lack the hardware, software, and data record support for retrieval and analysis of information [41].

Muhammad & Kamran have suggested that, health care organizations are having problems like medical error and providing health service where doctors are inexperience or not available. The health care organizations address the absence of interoperability and integration among systems. As they described; it will never get advantage of automated systems and these systems are unable to communicate with other system because of different business, application and technology architecture. Finally they concluded that enterprise architecture especially TOGAF provides a way out of these problems, since it develops integrated healthcare information

systems as compare to Zachman; because Zachman is more of taxonomy. TOGAF provides confirmed approaches, shared terminology for understanding information in organization [16].

A project that was conducted in Canada by Canada Health Infoway has an objective for developing an Electronic Health Record System (EHRS) Reference Architecture (ERA). TheReference Architecture described a set of documentation forms, which directs in a structured way both the requirements for the interoperable EHR and the components and tools to meet those requirements. It has also an authorization to develop an information interoperability framework or architecture that will benefit the development of answers for sharing critical health and healthcare information across the country. The Information collected was represented by Unified Modeling Language (UML) and captured in an automated tool that has given rise to a repository of specifications that can be reused by other projects with UML capable software engineering tools. The architecture strategy uses service oriented architecture principles and national standards to implement an (EHR) infrastructure and health information exchange (HIE) across Canada [42].

A study was done in Denmark to know why public organizations implement enterprise architecture programs and the interoperability challenges they are faced with when governing these programs at different levels and diverse functions ofgovernment. They used an exploratory research question, interviewing and interpretive case study approach. The study showed that since 2002, Copenhagen Hospital Corporation (CHC) had worked on an EA and in 2004 they provided a descriptive EA blueprint for Electronic Patient Record (EPR) systems called "The reference architecture for EPR".
This reference architecture defines the semantic and practical requirements for the six hospitals in the Copenhagen region. As they described the CHC architecture was difficult to relate the EA to their strategic goals which includes forming and retaining a consistent IT-environment that works including EPR. Finally there is no overall coordination of the different e-government initiatives in the health sector so they suggested that to reconsider the way that IS is structured and governed in an e government situation [43].

Kabaso and Korpela have suggested that "Africa has seen a balanced rise in the Information and Communication Technology (ICT) systems installed in health care institutions. However, this uncoordinated mass migration to electronic health information systems in Africa has made a diverse and difficult computing environment where most of the installed systems have technologies that are limited, copyrighted and narrow. Still, the infrastructure in Africa to assist the electronic exchange of information has a number of limitations. The structure of connectivity on which applications run is still segmented. Most parts of Africa lack the availability of a reliable connectivity infrastructure. In some cases, there is no connectivity at all. The realities of interoperability and re-usability problems have started to become more prominent in Africa as more systems are developed and deployed [44]".

Moodley, Pillay and Seebregts have shown that there is a Health Enterprise Architecture Laboratory (HEAL) developed in South Africa which is used to undertake research and building capacity in open architectures and technologies for National Health Information System (NHIS).The HEAL clears the gap between current implementation landscape by creating a neutral space in Africa to continuously reflect on and innovate architectures and technologies for African HIS. The lab aims to develop and curate a repository of knowledge, expertise and people to develop new solutions to deal with the changing and unique circumstances and environments in African countries.HEAL developed a Health Enterprise Architecture Framework (HEAF) and Health Enterprise Architecture Repository Tools (HEART) in South Africa, Mozambique and Rwanda especially for low resource settings. Today Health enterprise architecture framework (HEAF) is adding domain specific knowledge, artifacts and patterns in these three countries. Although there are documented practices in a growing number of other developing countries with architecture projects, including Ghana, Kenya and the Philippines. A key distinguishing feature of HEAF is simplicity. HEAF is attempting to distil out the best practices and artifacts that have worked or become entrenched in several developing countries and generalize these into a framework that can be applied in other countries. While the HEART will bring a central point where architectural artifacts can be retrieved, associated and reused. At the end the whole intended result is a user-oriented, practical framework that balances simplicity of adoption and use with completeness and theoretical consistency [45].

Ghana has a national e-health strategy which includes national e health architecture. The e-health architecture is a representation of how health care business actions are carried by e-health solutions. The purpose is to identify all the components that are required to deliver a solution and to clarify their relationships and interdependencies. The National e-health architecture also addresses the information and communications technology requirements for the deployment of systems to support the delivery of healthcare. The e-health architecture encompasses a service oriented architecture that promotes the adaptability of e-health solutions to respond to changing clinical service requirements and emerging technologies [46].

Chapter Three

3. Methodology

The study of EA from a general point of view is in emerging phase which needs practical study of examining enterprises so as to obtain initial findings and researchable hypotheses towards achieving more actual systems work practices [47]. In this study iterative system development life cycle methodology was used.The basic idea behind this method is to develop a system through repeated cycles (iterative) and in smaller portions at a time (incremental).TOGAF and the Zachman frameworks were used to develop the mental health information system architecture framework.

3.1 The study setting

The project was done in four Addis Ababa and Federal hospitals which provide mental health services.From Addis Ababa Yekatit and Zewditu hospitals were selected. From Federal Amanuel and St. Paul hospitals were selected. These hospitals were selected based on the number of patients they see in a day for inclusion in this project. Most of the interview, document review and observation were done in Amanuel hospital because more functions of mental health services are done in this hospital and it includes both outpatient and inpatient services. Amanuel hospital is also a representative hospital for mental health care in Ethiopia. The other three hospitals were used to compare any service differences like diseases categorization and reporting formats by using observation of reporting formats and interviewing of psychiatric nurses that were available for consultation during the study period.

3.2 Source and study population

Different sources were used for this project. Health professionals involved in care giving of mentally ill clients were the study population to understand the patient information flow. Further the plan and program officer was consulted to know the how reporting systems and diseases categorization handle. Documentary sources were used to assess mental health business functions and their strategies. It also used to know different stakeholders involved in mental health care setting and their concerns related to mental health. Literatures were used to take experiences from different researchers on how EA used in different settings.

3.3 Data collection

In this project different data collection methods were used to collect requirements from the four hospitals. The data collection focused on the topics of context, mission, vision, stakeholders, and structure of mental health information system. In order to collect such data structured interviews,

direct observation, referring written documents that were available in the hospitals and from other literatures were used.

3.3.1 Interview

Interview is the major and popular tool used by the requirement engineers to draw system requests and understand objectives of the system through verbal discussion with the stakeholders [48]. Interview is a more flexible form than the questionnaire and if wisely used, can generally collect information of better depth and can be more sensitive to contextual changes in meaning. Interviewing also permits things to be explained more face to face than questioner [49]. The interview process was important as it gives direct references from respondents about their patient treatment, managing mental health information systems and managing stakeholder's process flow and to learn about their ideas, view and facts of how current mental health information systems work. Interview was selected in this project because different stakeholders have dissimilarities in same thing like reporting tools and mental diseases classifications which helped to get more ideas from themselves. The interview was also used to know the personal interaction with the hospital process. The structured interviews were done with twelve peoples (nine from Amanuel hospital and three from Zewditu, Yekatit and St. Paul one in each hospital) including the medical director, psychiatrists, forensic psychiatrist, nursesand plan and program officer of Amanuel hospital who helped me to understand their different concerns about mental health institutions. Most of the interviews were conducted face to face in office at Amanuel hospital with the above peoples. Only three interviews with psychiatric nurses that were found in Zewditu, Yekatit and St. Paul hospital were interviewed while they were treating a patient in their outpatient department room.

3.3.2 Observation

Many projects are done using observation; these projects often emphasize on assessing the relational characteristics or the informational quality of the responses [50]. Observation was used in this project to confirm that the information obtained from interview matches with the reality; to understand the flow of activities in different case teams, to compare the differences of services given by these four hospitals and to evaluate the importance of information that was obtained from interviews perspective. Moreover observation was used to assess the knowledge used and shared among health professionals during mental health information collection, processing, analyzing, disseminating and using of information. The investigator conducted the observations in all the four hospitals. The observation was conducted in registration, outpatient, inpatient, liaison, plan and program office, teaching and research department, laboratory and pharmacy case teams of Amanuel hospital. In addition observation was done in psychiatric OPD of Zewditu, Yekatit and St. Paul hospital. During observation the investigator recognized different types of practice that was done on these four hospitals regarding to mental health reporting systems and disease classification categories.

3.3.3 Review of documents

Review of documents such as business processes reengineering (BPR) documents, annual plan, patient registration books, outpatient and inpatient disease report sheetsand policy & strategy of mental health documents of Amanuel hospital and Federal Ministry of Health (FMOH) were done to know the mission, vision, strategy of mental health care organizations so that the development of the framework could depend on this different documents. More over outpatient disease report sheets were reviewed in Zewditu, Yekatit and St. Paul hospital. Different literatures were reviewed to understand the experience and practice of enterprise architecture in health care organizations in different countries.

3.4 Tools and Techniques

Identification and utilization of an appropriate tool and technique is critical to the success of mental health information system architecture framework development.
The following tools were used in this project:

- Archimate: is an open modeling language for architects to model and communicate Enterprise Architecture in a consistent and coherent way on business and IT levels. Archimate is the open group enterprise framework tool that is used for the modeling of the business principles, mission and vision of mental health organizations. Archimate is selected in this project because of it is easily available and ease to use.
- Microsoft Visio 2010 was used to draw sequence diagrams. Sequence diagram is selected because of it is easily available and ease of use.

3.5 Data analysis & framework development

3.5.1 Data analysis

The data collected were analyzed within each hospital to identify similarities and compare differences on mental health information system. For data analysis business scenarios, use case description and sequence diagram were used. Scenarios were used to organize the narrative and details explanations of current processes required for developing the project. Scenarios also used to define the activities and relations between the stakeholder and the system. A use case defines a set of relations with the system that supports a particular business goal. Use case was used in this project to show complete flow of activities to the stakeholders. Sequence diagram shows the interaction of the tasks with the stakeholders.

3.5.2 Framework development

Information systems are complex and because people heavily depend on them, they have to be established using the right enterprise architecture frameworks (EAFs). Even if many EAFs have

been developed for more than a decade, information systems still fail to satisfy demands that organizations face and this decreases their competitive capacities. The failure may be due to the either the right frameworks are not employed in architecture design or the EAFs are not complete to support detailed architecture design. Organizations still have difficulties in finding a proper EAF so selecting the right EAF for architectural design plays a critical role in system development [51]. The identification of EAF reduces the need to develop new EAF from scratch. Instead, an appropriate framework can be adopted and modified for use.

Chapter two presented the various frameworks for enterprise architecture development. For this project the Zachman and TOGAF frameworks are selected after making a comparison of different criteria that was formed by the investigator based on the literatures reviewed in chapter two.

The following are criteria and their elaboration used for selection of the frameworks.

- Ease of use– the ability of the framework to readily and successfully perform by the user without the need of an advance explanation.
- Serves as a base for other framework development – the framework helps as an initiator to develop other frameworks.
- Complete definition and understanding of the architecture – the framework make use of standard terms, principles and guidelines for consistent application of the architecture.
- Availability of techniques– the framework will provide different techniques for the development of the architecture.
- Availability of tools– the framework provides different tools to support the development of the architecture.
- Level of detail – the ability of the framework to have detailed instructions to help the user to use the framework.
- Availability of documents – easily availability of documents to work with the framework.
- Standardization –ensure development and architecturalstandards are maintained.
- Identification of stakeholders – the ability of the framework to identify different stakeholders that will have impact on the development of the architecture.
- Addressing all requirements – the ability of the framework to address requirement in all phase of architecture development.
- Availability of templates – the ability of the framework to have a standard template for architecture development.

Table 1: Selection criteria for frameworks

Selectioncriteria	Zachman	TOGAF	FEAF	IEAF
Ease of use	✓			
Serves as a base for other framework development	✓			
Complete definition and understanding of the architecture		✓	✓	✓
Availability of techniques		✓		✓
Availability of tools		✓		✓
Expanded level of detail	✓	✓	✓	
Availability of documents	✓	✓		
Standardization		✓	✓	
Identification of stakeholders		✓		✓
Addressing all requirements		✓		
Availability of templates		✓		

In table 1 above, shows the criteria's used to select the framework that are used to develop the mental health information system framework. From the criteria's mentioned above availability of documents and ease of use make more weight to select the framework.

Based on reviewing of different literatures and documents the Zachman and the open group architectural frameworks were used for showing any system assessment and standards for mental health information systems architecture development. Further they used to develop a consistent MHIS architecture framework for their components.

Based on the literatures and criteria's provided the Zachman framework was used as a foundation for the project because of the following benefits like it includes the different levels of modeling abstraction (contextual, Conceptual, Logical and Physical), gives a high level view from other enterprise architectural frameworks and provides brief descriptions of architectural

outcomes.Because of different limitations it is practical to use anotherenterprise framework to support the Zachman framework and to complete what was missing in the Zachman framework.

TOGAF was used to develop the enterprise framework because of the above criteria's. It also offers a complete and step by step guide for the development of an EA and comes up with an architectural development method.

3.6 Method of dissemination of results

The project will be disseminated to mental health institutions, stakeholders involved in mental health service and anyone who needs the document to use as a base for further development and use. The dissemination can be done in any method the way the stakeholders want either by hard copies or soft copies.

3.7 Operational Definition

Enterprise Architecture: are blueprints for systematically and completely defining an organization's current (baseline) or desired (target) environment.

Enterprise Architecture Framework: comprises a set of models, principles, and methods that are used to implement enterprise architecture.

Mental Health Information System: is a system for collecting, processing, analyzing, disseminating and using information about a mental health service and the mental health needs of the population it serves.

The Open Group Architecture Framework: is an open group architecture framework sufficient for an organization to use "as-is" or to adapt as an EA development method for use with other deliverables focused frameworks.

3.8 Ethical Clearance

This project was reviewed and approved by the University of Addis Ababa, department of public health Research Ethics Review Committee.

Chapter Four

4. Analysis, Design and Discussion of Results

4.1 Introduction

This chapter describes the findings from the data collected by observation, interview and document review. Data collected from the various hospitals as well as the experiences of the other researchers taken from the literature where the basic of analysis in this project. This chapter also describes the current system that Amanuel hospital performs and the proposed architecture.

4.2 Findings from data collection

From reviewing of the national mental strategy document and observation, current mental health institution structures are different in different institutions. Full mental health care is given only in Amanuel hospital including outpatient, inpatient, substance abuse treatment, forensic mental health and rehabilitation care. Outpatient care is given in Zewditu and Yekatit Hospitals. St. Paul hospital gives outpatient and substance abuse treatment for mentally ill clients.

From observation of the reporting formats (outpatient and inpatient diagnosis sheet) covers only three mental diagnoses categories, this is used to report at regional and federal level. However these are not found to be enough to all the diseases due to which the data compiler has to use his/her personal perception to fill the form. This kind of disease reporting system decreases data quality, reliability and it is difficult to know the real extent of the disease burden in the country.

The disease reporting categories the hospitals use are based on the FMOH inpatient and outpatient diagnosis sheet. There is, however a gap in the four hospitals with respect to mental health information collection, storage and reporting. As an example, Zewditu Hospital uses one of the disease classification categories for all kinds of the mental diseases to report to the higher level; whereas Yekatit hospital uses two of them from the classification categories. Since Amanuel hospital has high burden of patients with mental illness and different types of disease, it has its own disease classification categories which are classified in ten parts based on the international classification of diseases (ICD-9). As a result of this the details available at the hospitals vary.

People who are involved in the maintenance of MHIS usually lack an adequate understanding of mental health. For example, cases are not classified correctly, mental health activities within hospitals are not adequately monitored, and the quality of data varies between service levels.

The project confirmed that, in the mental health system, there is a strong need for information in the clinical setting where access to certain details such as potential drug interactions or response to previous treatment could have life-saving implications. Access to data and information are also critically important for the day to day management of patients, for strategic planning and evaluation purposes, for undertaking mental health research and for the development and maintenance of system accountability.

Clients who have mental problems most of the time take long term treatments because of which they may have multiple records. Because of this, keeping accurate and current track of patient care can be difficult. Finding aggregate patient information for management purposes can be very time consuming and expensive. This is because of the use of paper based systems for recording and storing information which is the major weaknesses of using a paper-based system.

Interviewees indicated that there is no structured ways for communicating and sharing patient-specific information in a timely manner for use in direct patient care between staffs. This also confirmed by observation done by researchers. The participants further indicated that developing the technological capacity to communicate important patient specific information in a timely fashion is critical to good patient care, management and policy –making.

4.3 Current system Architecture

The health organizations in Ethiopia are now integrating mental health service in their institutions. This integration will profoundly improve access to mental health care and quality of care given to the mentally ill patients [10].

Amanuel hospital provides a full service to mentally ill patients. That includes outpatient and inpatient treatment, substance abuse treatment, forensic psychiatric evaluations, electro convulsive therapy (ECT), psychological treatment and rehabilitation care [11].

The hospital is organized in three clinical directorates which include the outpatient, inpatient and emergency services and three case teams which include central diagnostic, disease prevention and health promotion and central pharmacy case teams. In each directory there are case teams which facilitate patient care. It also has administrative director which include human resource, finance and teaching and research directorates [11].

The hospital uses paper based charts for most of patient care but at triage case team it uses electronic medical record (EMR) system to register only new patients. The following are important observations regarding information flow that are currently performed in Amanuel hospital.

There is full dependence on the medical chart for information. Information is stored and retrieved in the card from the time of assessment, through to the planning and provision of

service activities. While the client is receiving services the chart serves as the central store for information of interest to the health professionals involved in that client's care.

Most of the information in the hospital is closed information, which means information flows to support the care delivered only within the hospital. But there are strict guidelines for the information required for referral,recorded on the paper referral form. So there is measurable preferred entry information to be available and form for client referral.Even if there are guidelines for client referral the systems they use are poorly organized.

4.4 The Proposed MHIS Architecture Framework

A coherent description of enterprise architecture provides understanding, enables communication amongstakeholders and guides complex modification processes.

To develop the architecture framework of the mental health information system the mental health organization mission and strategies was revised to make a coherent document.

The proposed architecture framework was done accordingly to the open group enterprise architecture framework template and the Zachman framework of the perspectives and organized as architecture vision, business architecture and information architecture which contain the data and information architecture together.

4.4.1 Architecture Mission,Vision and Strategies

4.4.1.1. Architecture Mission

The architecture vision and mission describes how the new capability will meet the business goals and strategic objectives and address the stakeholder concerns when implemented. The Architecture Vision provides a first-cut, high-level description of the target architectures, covering the business, data, application, and technology domains. The architecture vision, mission and strategies are derived from the mental health institutions and the national mental health strategies to align the development of the architecture framework of mental health information system.

Table 2: Organization and MHIS architecture framework mission statement

Title	Business Mission Statement
FDRE Ministry of Health: Mental Health System Mission Statement	"To ensure the development and implementation of a mental health system that addressesthe mental wellbeing of all Ethiopians through services that are affordable, accessible, available and of good quality". [Ethiopian Mental Health Strategy, emphasis added]
Amanuel Hospital Mission Statement	"To Provide a comprehensive, qualified, standardized, and efficient mental health treatment service"[Amanuel Hospital BPR - Operation, emphasis added]
The MHIS architecture framework Mission statement	To establish a national framework enabling information technology and processes that supports the development and implementation of a mental health information system.

Table 2 shows the mission of the national mental health strategy and Amanuel hospital so that it will help to drive the MHIS architecture mission.

4.4.1.2. Architecture Vision

To design the mental health information system using the Zachman and the open group architectural frameworks.

4.4.1.3. Architecture strategies

The MHIS architecture strategies

- Promotion of data quality
- Appropriate application of information and communication technology (ICT)
- Enhancement of mechanisms for effective communication, cooperation and coordination
- Development and allocation of MHIS resources (human, physical, financial)
- Strengthening of data sharing, analysis and utilization, at all levels
- Strengthening data collection and utilization in decentralized systems
- Strengthening linkages between Mental Health Information System and Mental Health Research System.

Business architecture strategies

Table 3: Strategic Plans of the Business

Title	Business Strategy Statement
General Strategic Objective	"To provide quality mental health services to the people of Ethiopia that are accessible, freeor affordable,equitable, efficient and effective, through the integration of mental health into primary health care, while focusing on priority disorders and vulnerable groups."
Specific Strategic Objectives	
Being Accessible	To ensure that people with mental illness have access to treatment in theircommunities and as close to their home as possible.
Being Proactive	To enable all health workers to identify, monitor and manage priority mental illnesses and substance abuse disorders.
Special services to special groups	To provide special services to vulnerable groups with specific needs.
Delivering Comprehensive Service	To allow those with both physical and mental health-related needs to be treatedin a seamless and comprehensive manner.
	To increase the proportion of persons with severe mental illness who remain incare by using case-management principles.
Provision of Rehabilitation	To provide rehabilitative services to prevent and/or minimize secondary ortertiary handicaps.
Collaborative and coordinated Effort	To promote collaboration with CBOs, FBOs and NGOs to maximize socialfunctioning and reintegration into society.
Engagement and Education	To help to reduce the stigma and discrimination associated with mentaldisorders and substance misuse problems.

Table 3 in the above shows, the business strategies that are currently followed by Amanuel hospital to achieve its mission and vision statement. These strategies help the architecture framework to formulate its own strategy based on the hospitals strategy.

4.4.2 The MHIS architecture objectives

- To propose ICT for mental health system to improve morbidity, mortality and quality of mental health service.
- To define mental health indicators to be collected and analyzed.
- To provide knowledge based systems to improve decision making
- To increase access and utilization of mental health service through ICT.
- To implement/ develop online patient consultation system

4.4.3 Business Drivers and Constraints

Table 4: Business Drivers

Title	Business Driver
High burden of mental illness	In Ethiopia, mental illness is the leading non-communicable disorder in terms of burden. They are associated with a high burden due to the disability and mortality of patients with mental illness.
The poor state of mental health facilities in the country	There is alack of mental health services and poor coverage of mental health care.
High Turnover of Professionals	Staff retention is difficult in mental health services because of the nature of work.
Governmental and institutional commitment	Nowadays there is a commitment of the government for improving mental health services and their coverage.
Availability of technological tools to support the mental health strategy	Different technologies are now using for patient care in the country. Adopting or developing these technologies will support the mental health strategy.

Constraints

- Adequate resources
- Application integration
- Standardization
- Impact of change
- Time of development

4.4.4 Rationale and justification for architectural approach

- **Improve mental health information system**

Mental health information systems are unavailable due to poor systems for data collection, analysis, dissemination and use. Reliable and timely mental health information system will improve decision making and quality of services.

- **To align mental health information system**

Different mental health institutions implement different types of data collection methods and formats for measuring & reporting mental health which create poor alignment and difficult to coordinate same service.

- **Unavailability of mental health information system**

Currently available mental health information systems are fragmented due to it is hard to generate standardized information at all levels. As I observed in the four hospitals each of them use different types of mental health information system data recording. For example Yekatit hospital uses/records 3 outpatient diagnosis namely mental and behavioral disorder, Epilepsy and other or unspecified disease of the nervous system which are available on OPD diagnosis and attendance tally sheet. Zewditu hospital also uses these OPD diagnosis sheet but they records all of the mental diagnosis as mental and other behavioral disorder whereas Amanuel hospital has its own recording sheet which contains 10 diagnoses based on the ICD- 9 disease classification method.

- **Standardization and Harmonization of mental health information**

Mental health information systems are not organized based on their components. So harmonization and standardization of mental health information system will deliver same output at different level of mental health organizations.

4.4.5 Architecture principles

The Mental health information system architecture principles are formed from the business, data and information principles. The overall principles of the architecture are the following.

- Follow to the architecture of the organization
- The architecture supports the organization structure
- Use of component and service based architecture
- Incorporating existing national standards and applications

4.4.5.1 Business principles

Defining business principles normally lies outside the scope of the architecture function. However, depending on howsuch principles are defined within theorganization itmay bepossible for the set of architecture principles to also restate,orcross-refer to a set of business principles. Within this architecture project, the business principles will ensure that the definitions of these business principles are current, and to clarify anyareas of ambiguity.

Table 5: Business principle 1

Name	**Patient Centered Care**
Statement	The information system[s] will deliver the services of the mental health system to patients and their care givers in accordance with their "needs and choices".
Rationale	This principle is consistent with the one established by the MOH. The very first principle set by the Ministry in creating its Mental Health strategy was that "Services will work to be responsive to the needs and choices of individualswithmental illness and their caregivers." The information system architecture shall provide for systems that will allow all players to facilitate the delivery of mental health services in the time, place, modality, etc selected by the patient and his/her caregivers.
Implications	The implication of adopting this principle is that the mental health system has to carry and addition financial burden. However, this also creates a very good opportunity to for the mental health system to provide better services efficiently. For example, there are cases for which patients and their caregivers spend dear money and time by physically appearing in the institutions. Through the implementation of information systems that adhere to this principle, the patients can get some services (example, advisory services) without leaving their abodes.

Table 6: Business principle 2

Name	**Deinstitutionalization, decentralization and integration**
Statement	The information system will bring the support needed by the patient to his/her abode. Consultation support will be provided through mobile devices enabling the patient and caregivers to get all the benefits without the need to physically go to the mental institutions.
Rationale	This principle is consistent with the Ethiopia Mental health strategy when it says "care will be provided as close to home" and "community level treatment is integral" to the system.
Implications	The implication of this principle is that the mental health institutions can reach out to many patients throughout the country. It also means the per capita spending on each case will be reduced significantly.

Table 7: Business principle 3

Name	**Community, Family and Patient Participation**
Statement	The information system will serve as a platform to bring together the mental care givers, the patients, the family of the patients, and the community at large.
Rationale	This principle is in congruence with the principle identified with the same name in the Ethiopian mental health strategy. All stakeholders need to participate in the prevention of mental health problems as well as in the care of patients. Education is a significant component of the information system.
Implications	The significance of adopting this principle is accessibility of the mental health institution will increase. Harnessing the knowledge of all stakeholders will be possible for the collective resolution of mental health problems.

Table 8: Business principle 4

Name	**Quality Services Built on Evidence-Based Care**
Statement	The information system will facilitate for the provision of quality service for the patients as well as for other stakeholders. The medical practitioners as well as other care givers would get complete information on the patient, his/her disorder, and the diagnosis. Knowledge management component of the system will further increase the capabilities of the medical practitioners by providing scientific information.
Rationale	This principle is consistent with the principle of the Ethiopian Mental health strategy identified by the same title. Quality service based on gathered information and scientific knowledge built in-house/ in-country/internationally will be the hallmark of the mental health institutions.
Implications	The implication of this principle is better clinical, educational, and administrative services to the stakeholders.

Table 9: Business principle 5

Name	**Efficiency, Continuity and Sustainability**
Statement	The information system will facilitate the delivery of culturally sensitive care to the patients. The system will be available at least in the major languages of the country. The system will further provide for case base treatment of patients thereby ensuring the continuity of care provided to patients.
Rationale	The Ethiopian mental health strategy document states that efficient, culturally acceptable, and sustainable service shall be one of its guiding principles. In this regard, the information system will partly answer for this business requirement.
Implications	The adoption of this principle will mean many people will be reached throughout the width and breadth of the country as the system will have localized content. Users will not be intimidated by the system as it will be in the language and context that they are familiar with.

Table 10: Business principle 6

Name	**Inter-sectoral Collaboration**
Statement	The information system will provide for the collaboration of inter-sectoral stakeholders like educators, researchers, funding agencies, and governmental and non-governmental agencies.
Rationale	Inter-sectoral collaboration is at the core of the mental health strategy of the country. This will ensure the not only the delivery of effective mental health care but also raise the knowledge of readiness of all stakeholders so as to combat the problem in a multi-dimensional fashion.
Implications	The implication of this principle is that the engagement of the various stakeholders will be increased thereby building up the resources available for resisting the malady.

4.4.5.2 Data and information principles

Table 11: Data principle 1

Name	**Common vocabulary and data definitions**
Statement	Data is defined consistently throughout mental health institution and the definitions are understandable and available to all users and systems.
Rationale	Systems contain information that has value to deliver care and manage resources in the wider service. This includes information required for management and clinical purposes other than direct patient care, for example
Implications	The mental health architecture and solutions comply with national data standards to ensure that the end to end integrity of clinical meaning is maintained.

Table 12: Information principle 1

Name	**Make information available**
Statement	Deliver information where and when needed, via multiple channels, to maximize its value while ensuring that confidentialityis enforced.
Rationale	Mental health business should not be limited or constrained by lack of available information wherever and whenever needed.
Implications	The mental health architecture will available the information needed at any time.

Table 13: Information principle 2

Name	**Information is secure**
Statement	All information is secured against unauthorized access, modification or loss in accordance.
Rationale	Information systems are responsible for managing, storing and transmitting patient health information and therefore meet the requirements of national information security policy.
Implications	The architecture and solutions, including people, systems, processes and physical components, comply with mental health information security policy, balanced with the need to make information accessible.

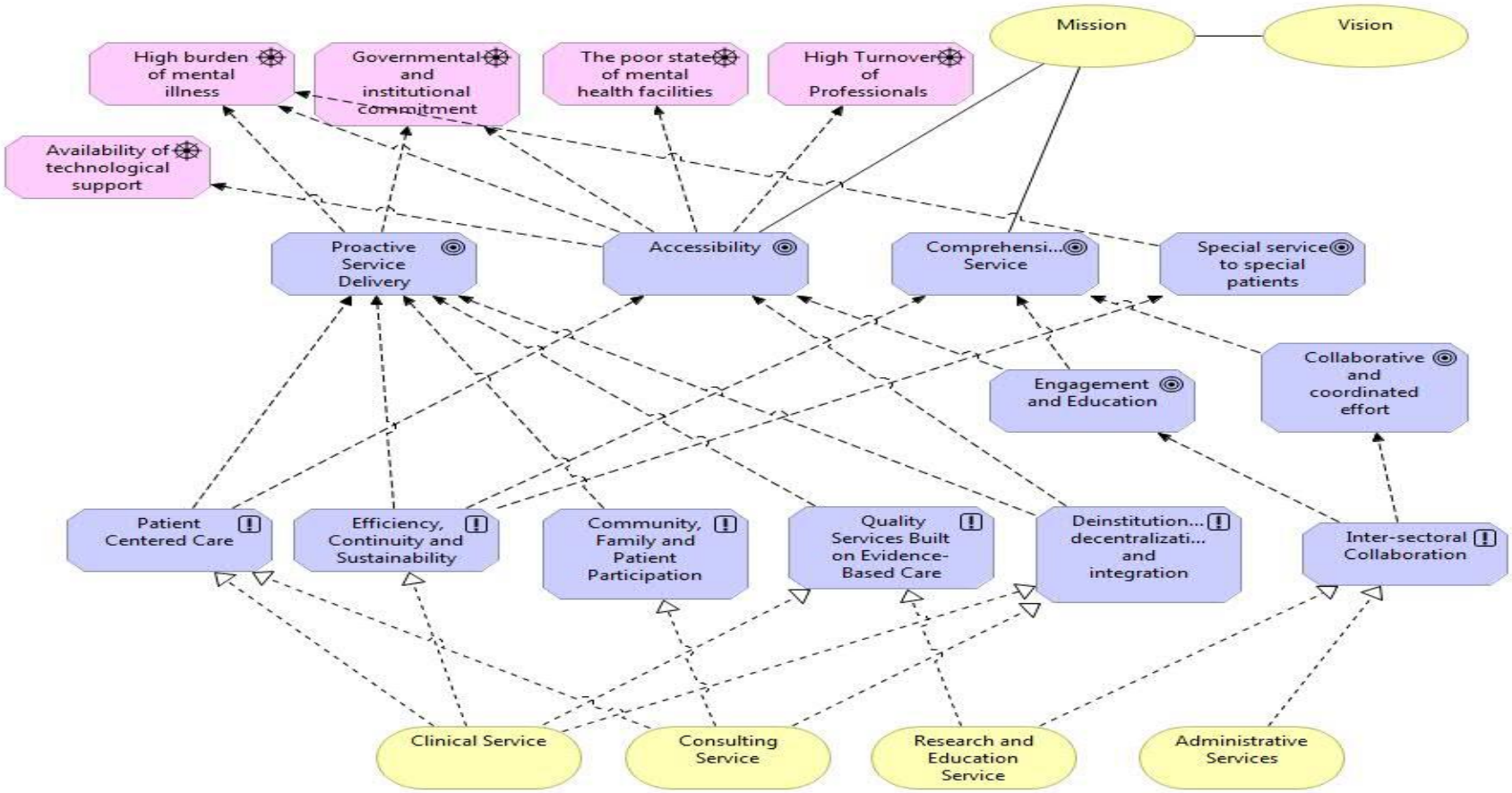

Figure 3: Business principles and services

Figure 3 in above shows how the business mission and vision are related to the business principles. It shows the services that are provided to accomplish its mission and vision of the mental health organization. Also it shows the triggers for the existence of mental health organizations.

4.4.6 Identify Stakeholders and their Concerns

Stakeholders are individuals, organizations or agencies that could influence or be influenced positively or negatively during the development of the mental health information system architecture framework.

The stakeholders involved in mental health information system and their concerns are the following.

Table 14: Stakeholders and Their Concerns

Stakeholders	Concerns
Patient	➢ Clinical status ➢ Privacy ➢ Confidentiality ➢ Treatment procedure ➢ Clean & safety environment ➢ Availability of rehabilitation center ➢ Medication information ➢ Safety of laboratory procedure ➢ Waiting time (the time they spent in healthcare organization to be short) ➢ Reliability
Family	➢ Information on appropriate care for family member ➢ Information on course and likely outcome of family member's condition ➢ Information on available support ➢ Outcomes of the treatment ➢ Cost related to any treatment/ procedures
Health professionals	➢ Knowledge management systems for better management of patients and career development ➢ Availability of clinical decision support systems ➢ Case records ➢ Availability of treatment guidelines ➢ Referral routes ➢ Available resources in different services ➢ Outcomes of patient
Ministry of Health	➢ Mental health policy and plans ➢ Monthly, quarterly and yearly reports on time ➢ Professional and technical support

Chief executive officer & medical director	➢ Resource available to deliver the service ➢ Process of mental health care delivery ➢ Outcome of patient treatment
Universities/ Research institutes	➢ Support teaching and learning of Psychiatric professionals ➢ Statistical data ➢ Patient data ➢ Research inputs
NGO's and partners	➢ Report on different perspectives ➢ Financial Support ➢ Professional and technical support ➢ Coordination of training programs for the staffs
Students & Researchers	➢ Patient ➢ Patient data ➢ Statistical data ➢ Rooms for learning ➢ Teachers
Courts	➢ On time forensic cases report.

Table 14 in the above shows different stakeholders and their concerns that are involved in mental health care organizations. The stakeholder's concern helps the architecture frameworkto be based on the need and tries to satisfy the various stakeholder involved in mental health care service.

4.4.7 Actors and their roles & responsibilities

Table 15: Actors and their role & responsibilities

Actors	Role	Responsibility
Provider		
Specialist	Consultations, Diagnosis, treatment	Prescribing medicine, providing information about the diagnosis, monitoring response to the diagnosis
General practitioner	Diagnosis , treatment	Prescribing medicine, providing appropriate information about the diagnosis, monitoring response to the diagnosis
Public Health office	Diagnosis, treatment	Prescribing medicine, providing appropriate information about the diagnosis, monitoring response to the diagnosis
Nurse	Patient care	Provide safe room for patient, check & write vital sign of a patient
Pharmacist	Drug dispensing	Ensuring safe procurement, discussing medicine related problem with the patient, reporting adverse drug reaction
Laboratory technician/ technologist	Test and investigating clinical lab order	Prepare specimen, report writing based on the result.
Psychologist	Provide consultative care	Assessing client's behavior and needs via observation, interviews and psychometric tests, helping clients to make positive changes to their lives.
Controller		
Federal Ministry of health	Monitoring and evaluation	Provide policy, strategy that governs the hospital,

Chief executive officer	Managing & controlling whole activity	Report compilation, report sending to higher level ,attending a meeting
Medical director	Managing clinical activities	attending a meeting, report compilation
Acceptor		
Patients	Receiving quality health care delivery	Good communication, cooperate with treatment plan
Next of kin/family	Receiving quality health care delivery	Good communication, provide complete medical history,
Supporter		
Human resource	Assigning & controlling clinician/ administrative staff,	Provide training to staff ,
Finance	Control & allocate payment process	On time payment
General service provider	Control, manage , allocate & maintain medical equipment's	Provide quality medical equipment

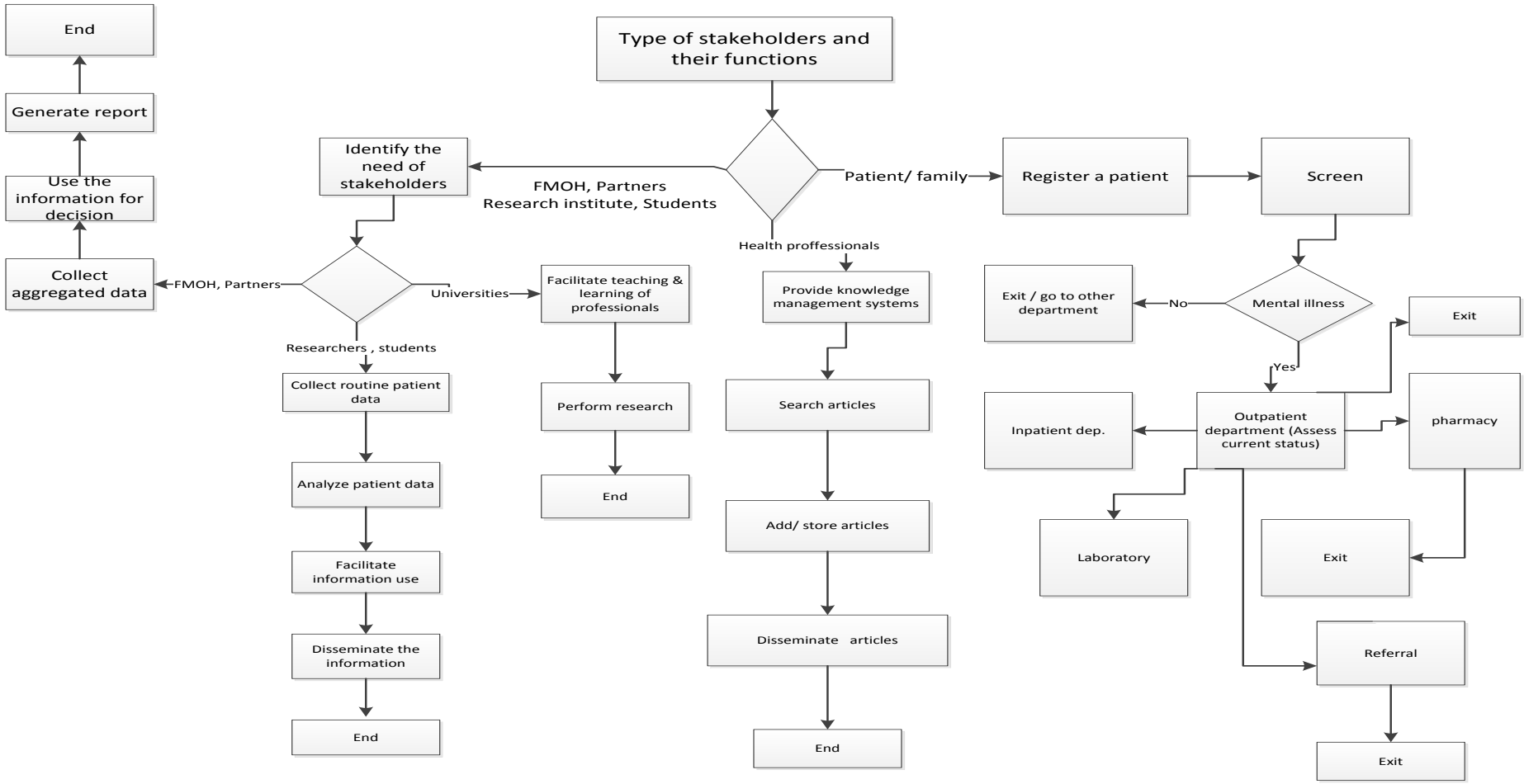

Figure 4: Stakeholders and their functions that are involved in mental health organizations

Figure 4 in the above shows different types of stakeholders and their functions regarding to mental health. It is done based on the Zachman framework. It shows the business model/owners perspective and answers the how part of the column which describes the mental health organization function.

4.4.8 Business scenario to be addressed

- Patient registration
- Diagnosis
- Treatment
- Medication order
- Laboratory investigation
- Admission
- Rehabilitation care
- Patient discharge
- Referral
- Forensic cases
- Teaching of health professional
- Funding from different NGO's
- Knowledge management system
- Planning, monitoring and evaluation
- Information Exchange

4.4.9 Business scenario description

Patient registration

A patient comes to hospital and register to the system. After registering the patient will be screened by public health officer, psychiatric professional or general practitioner. They will assign him/her to outpatient department according to his/her diagnosis type. Before he/ she leave the registration room he /she makes payment or if it is free payment they will give kebele paper to the registration department.

This business scenario performs the following activities

- Patient registration
- Screening
- Making payment

Diagnosis

Patient will come to outpatient department and detailed history & vital sign will be taken. After history taking if needed physical examination will be done. Based on the history the physician will decided differential diagnosis and to confirm it he may order different investigation.

- Identifying the type of clinical symptoms and signs

- Investigating the target symptom and sign

Treatment

Physician will decide the type of treatment that is appropriate for the client/ patient. He also decides the duration of the treatment.

- Investigate the type of treatment
- Set the type of treatment (Medication, psychological, ECT, Observation)
- Set treatment duration
- Follow progress of the treatment
- Give appointment

Laboratory investigation

Based on the type of test the laboratory technologist/ technician will take the sample and perform the procedure. After getting the result he/she relates to the patient.

- Give unique laboratory id number to the patient
- Collect sample
- Perform procedure
- Relate the result to the patient

Medication order

Based on the prescription type the pharmacist dispenses the medication to the patient. If the patient needs any type of information regarding to the medication he will provide it.

- Dispensing the medication
- Registering medication
- Counseling patient
- Performing different analysis to know consumption

Admission

The patient will be admitted to respective ward based on the diagnosis type. He/ she will be assigning to bed.

- Assign bed
- Assign nurse
- Handel different patient sheets
- Assign medication
- Follow progress
- Based on the progress decide on different types of treatment

Patient discharge

After finishing treatment during admission the patient will be discharged from the hospital.

- Write discharge summary
- Scheduling for appointment
- Give medication
- Payment handling

Rehabilitation care

Patients will spend their admission period at rehabilitation centre by performing different types of things like playing music, performing theatres, sowing different cultural closes and playing different types of game.

Referral

If the patient needs more care and treatment which is not available here will be transferred to other hospitals based on the type of disease. Different things will be written on referral sheet like;

- History of the disease
- Treatment given (if any)
- Reason for referral

Forensic care

Patients will be put under observation for two months without medication. The progress of the patient will be reported mentally ill or not to the court.

- Assign bed
- Follow progress of the patient
- Report to court

Teaching of Psychiatric professionals

- Selection of students
- Providing different e books for facilitating the education
- Providing different ICT infrastructure

Funding

- Based on the performance of the hospitals different NGO's support by providing funding.

Planning, monitoring and Evaluation

- Different stakeholders (FMOH, Partners and WHO) need on time report.

Knowledge management systems- This system includes the activities necessary for managing the information exchange between knowledge provider and knowledge customer. Knowledge management is, for example,

- Making available of searches,
- Indexing and updating of content such as: protocols, manuals, instructions, and documents on quality, process descriptions, research publications and educational materials.

Information exchange: contains the activities for the exchange of information between healthcare providers.

4.4.10 List of Data Sources

List of data sources explains the (What) part of the Zachman framework from planners perspective.it is a narrative description of data sources where mental health data are obtained.

- Periodic facility and population based surveys
- Routine HMIS

- Routine patient data
- Outpatient registration book
- Inpatient registration book
- Outpatient diagnosis sheet
- Inpatient diagnosis sheet
- Researches
- Individual record
- Mortality data
- Morbidity data
- Case reporting
- Number of referrals

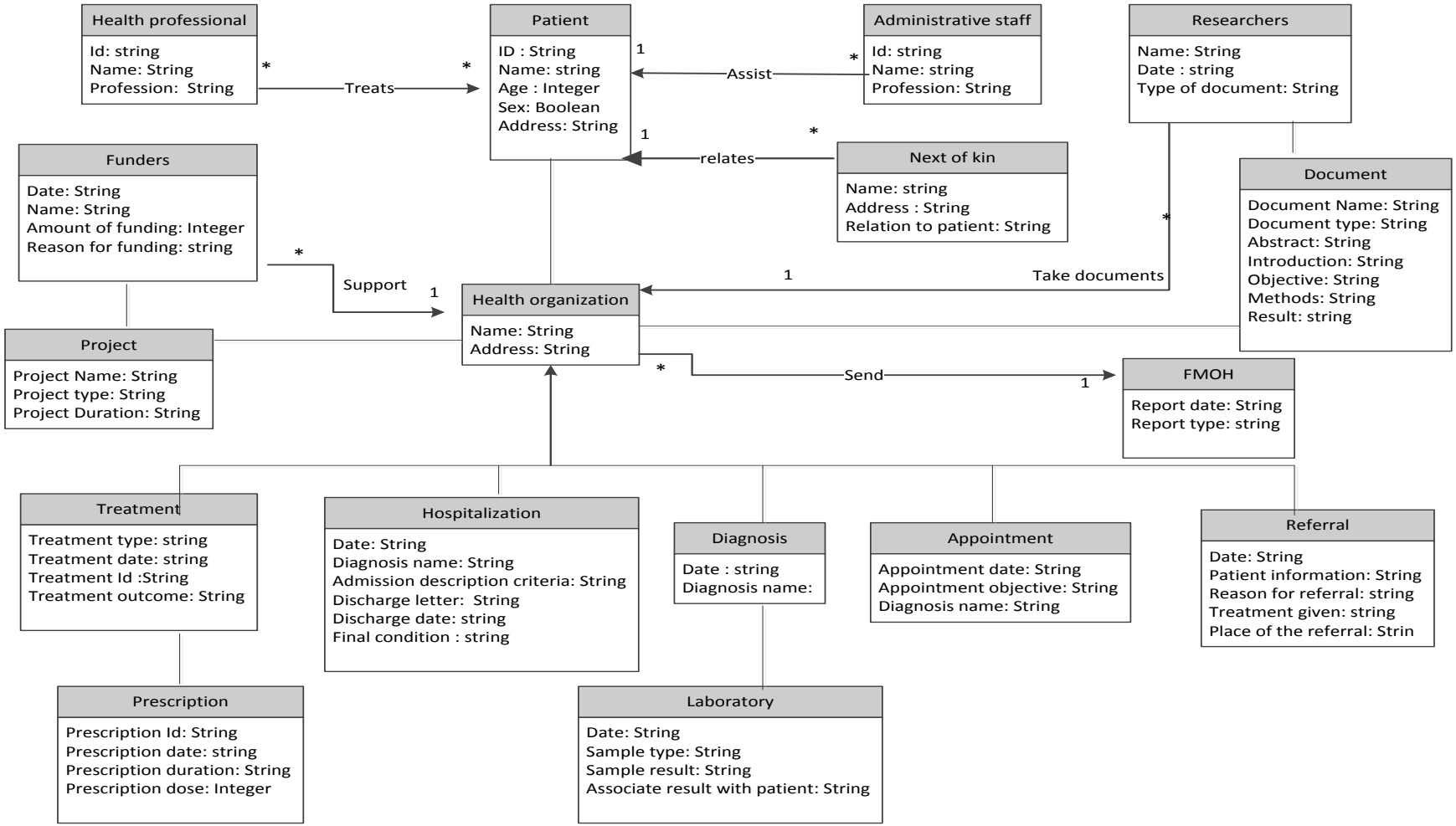

Figure 5: Entity Relation of the Business model of MHIS.

Figure 5 in the above shows the data's involved in mental health care organizations. It is done based on the Zachman framework. It explains the logical perspective on what column.

4.4.11 List of events important to the business

List of events expresses the time to complete business processes that are important to mental health care services. It is done based on the Zachman framework and explains the time or when column.

- Patient triage – 1 minute
- New Registration- 15 minutes
- Appointment Registration- 17 minutes
- Emergency Admission - 8-15 days
- Nonemergency Admission – 30 days
- Forensic & Substance addiction Admission - 60 days
- OPD new patient (Nonemergency) – 23 minutes
- Appointment schedule – 4 weeks
- Supportive psychotherapy – 30 minutes
- Cognitive behavioral therapy – 45 minutes- 1 hour
- Counseling – 1 hour
- Group psychotherapy – 1 hour and 30 minutes
- Couple therapy – 1 hour and 30 minutes

4.4.12 List of locations

List of locations explains the where part of the column in the Zachman framework. As discussed previously mental health care is going to be given in many health organizations as stated by the FMOH strategic plan of national mental health strategy. By taking this into consideration the mental health information system architecture framework include the following list locations.

- Local health posts
- Health centers
- General hospitals
- Tertiary hospital facilities

But currently the project included the following hospitals and their locations are here

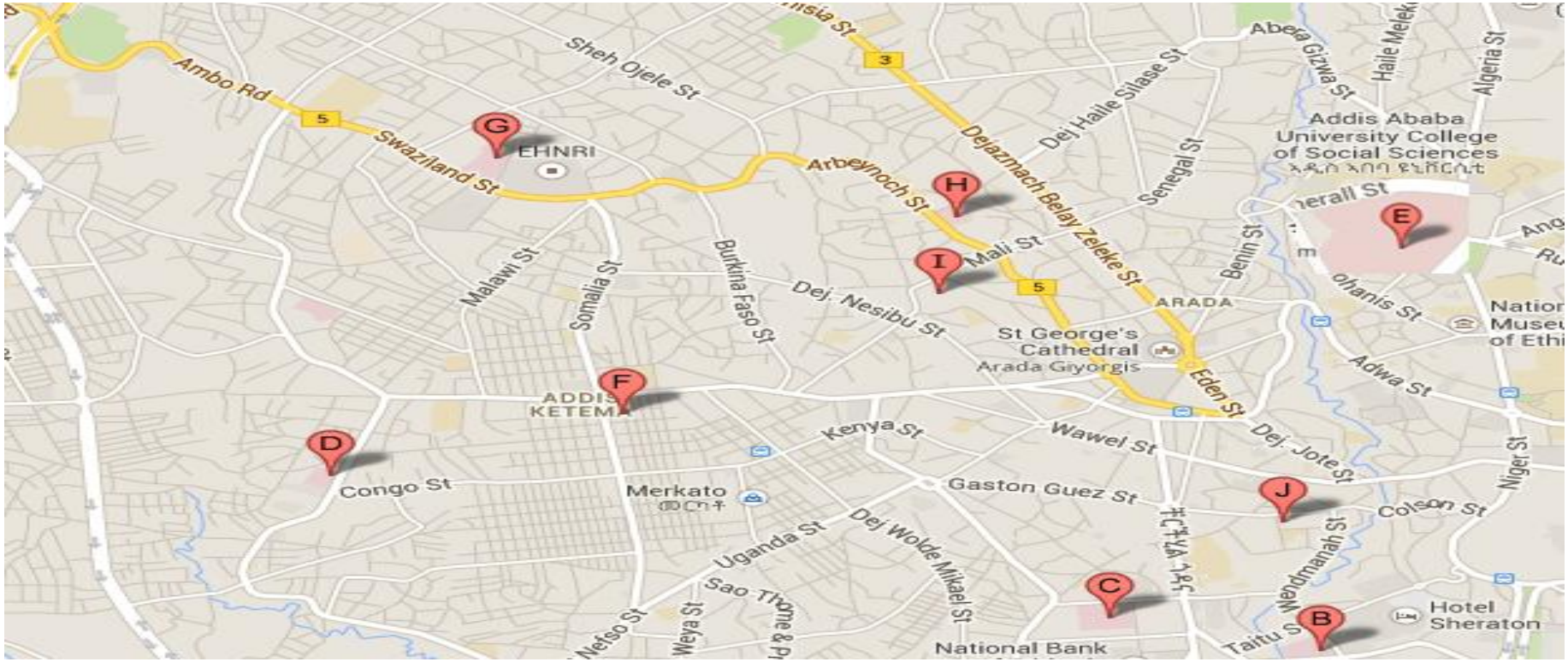

Figure 6: Locations of the hospitals

Where:B is Zewditu Hospital

D is Amanuel Hospital

E is Yekatit Hospital

G is St. Paulos Hospital

Figure 6 in the above shows the list of locations that are involved in MHIS architecture framework. It is done based on the Zachman framework from the where column.

Chapter Five

5 Conclusions and Recommendations

5.1 Conclusions

Information is a critical component of mental health institutions for many purposes like patient care, decision making, and monitoring of outcomes. As a result of this proper and standardized way of information flow can improve communications among the business organizations and different stakeholders.

For the development of mental health information system architecture framework the investigator assessed different systems and their impact on mental health system. The project identified wide-ranging issues like business process identification, information flow, stakeholder identification, mental health data sources and so on.

The major problems of the current system that provides mental health service were the following:

- There is no structured ways of communicating and sharing patient-specific information in a timely manner
- There are different types of disease categorization
- Access to data and information is poor andtime consuming because of the manual system they use
- There is no sufficient disease classification on reporting formats

The main stakeholders are:

- Patients
- Health professionals
- Partners
- Universities and Researchers

This MHIS architecture framework will serve as a base for developing more complete architecture framework of mental health institutions in the future.

5.2 Recommendations

- Researchers/ students should continue the project to complete all the domain of the TOGAF and Perspectives of the Zachman framework.
- Mental health organizations should make revision of international disease classification for mental diseases based on the national revision of international diseases classification.
- In the short run, increasing the diagnosis categories on outpatient and inpatient diagnosis sheet for mental diseases should be considered in.
- The FMOH should do complete integration of the MHIS with the overall health information system.
- Implementation of Electronic Medical Record system should be done in mental health institutions.

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Annex1: Architecture requirement analysis document

Table of contents

List of Figures

List of tables

1. Purpose of this document

The Architecture Requirements Specification and analysis document provides a set of requirements about a mental health information system architecture framework that must do in order to comply with the architecture.

The Architecture Requirements Specification provides a quantitative view of the solution, stating measurable criteria that must be met during the implementation of the architecture.

2. Architecture Requirements

The mental health information system architecture hopes to significantly improve daily service practices and bring new possibilities to all players of the mental health care service: including patients, health professionals, administrative staff, for decision makers and mental health information providers.

The mental health information system architecture will therefore developed in order to have profound effects on the entire work flow, from data capture and collection, analysis, processes management, dissemination and use.

There are different sources for gathering Architecture requirements in developing of mental health information system. The sources are

- Stakeholder needs
- Mental health institutions
- Policy and strategy of national mental health services
- Existing mental health system information

The requirements are further categorized in to three categories; functional requirements, non-functional requirement and data requirements.

2.1 Functional requirements

Functional requirements describe the interactions between the system and its environment independent of its implementation. The environment includes users and any other system that interacts with the system.

The functional requirements are:

- The user log-in in to the system.
- The system registers client in to the system by registering client detail including full name, address, age, medical record number and so on.
- The system records diagnosis and treatment of a client.
- The system records prescription of a treatment.
- The system records admission of a client.
- The system appoints appointment date for a client.
- The system records discharge of a client.
- The system registers referral of a client.
- The system searches any data that is stored on the database.
- The system generates and prints a report.

Stakeholder information need requirement also assessed in this project. The stakeholders are people or organizations that can be affected or affect by the development of the framework. The stakeholder information need described as follow.

Table 16: Stakeholders and their information need

Stakeholder Name	Information type Needed	Type of information/report
FMOH	- Monthly reports, which include VCT, HIV, MCH and key performance indicators reports. - Quarterly reports which include outpatient and inpatient disease and general performance of the whole hospital in narrative form. - Yearly reports which include all the monthly and quarterly reports. - If any break out of diseases occurs, report	- Regular
Funders	- Yearly report	- Ad-hoc
Researchers /Universities	- Outpatient and inpatient disease report - Patient Demographic reports - Treatment reports - Quality measurement report	- Ad-hoc
Students	- Outpatient and inpatient disease report - Patient demographic reports	- Regular
MOFED	- Monthly financial reports	- Regular
Partners	- Monthly report on HIV, VCT, total number of patients seen in a month - Information on the type of their support	- Regular / Ad- hoc
Family / next of kin	- Payment related to treatment	- Regular

2.2 Data Requirements

- For client registration, the system will record client ID, client full name (including client last name, middle name and first name), age, sex, address (city, phone number, kifle Ketema, house number), date of registration and the assigned case team. The system will store next of kin information including first name, last name, address (phone number, kifle Ketema), relationship to client and the date the contact was added.
- The system records diagnoses, treatment, and referrals. Diagnoses made during visits will be recorded with the diagnosis code, description and the date of diagnosis. During treatment of client the system will register treatment plan, duration and date. Client referrals by physician will include a generated referral id, referred physician name, referred facility, referral description and date referred. Patient prescriptions will be stored including a generated prescription id, prescription name, instructions and prescription date.
- For appointments, the system will track appointment date, time and reason for appointment. Each appointment will be scheduled by physician. Each visit may or may not have an appointment. For each visit the system will track visit date and time.
- The system records client admission and discharge. The admission made during visits will record admission date, bed number, physician name admitting the client, admission criteria and the case team name admitting the client. The discharge will record discharge date, discharge reason, physician name discharging the client, ward name and bed number.

2.3 Non- functional requirements

The non-functional requirements define user visible features of the architecture framework that are not designated to the functional behaviour of the system. The basic non-functional

requirements for enterprise framework of mental health information system can be seen as follows:

2.3.1 Architecture Framework Modification

The architecture framework will be modifiable at any time to improve the structures based on the needs of the mental health care institutions. As needs change from time to time the original architecture framework will be made available to fill the gap between the structure and the newly emerging needs. The architecture could be enhanced by adding new objectives without necessarily changing the basics.

2.3.2 Quality Issue

Quality can be achieved through consistency, and accessibility of the framework. The framework should be designed and implemented to have the best quality.

2.3.3 User interface

The architecture framework of mental health information system is going to be used by different user categories (health post, health center, general hospital and referral hospital), it should have a very simple and user friendly interfaces for everyone to understand the functionalities easily.

2.3.4 Security Issues

Security and privacy issues in mental healthcare data are very sensitive; which the system is going to handle personal information which is confidential, it should be protected from an illegal users. No one can log-in into the system without a registered user name and corresponding password.

2.3.5 Documentation

The mental health information system architecture framework will prepare documentation of the architecture for users and the mental health care institutions. On the occurrence of

problems, the documentation will help the user to understand the system's structure and to facilitate maintenance of the so easily.

3. Analysis of the requirements

3.1 Use case descriptions

Currently Amanuel hospital uses a manual system to support its clinical activities and other programs (catering for different stakeholders). This part of the project details the functional specification by identifying use cases and elaborating them. The use case description is required for each use case so that how it is accomplished, what is required to complete it is easily understood. Individuals or other entities that interact with these functions were identified and defined as Actors.

Frequency of occurrence was given on average of their daily performance in each case teams (like registration, admission, discharge, diagnosis, appointment and referral).

Primary actor description

1. **Physician** - a user in the health care organization who gives care for a client including treatment, providing information about the diagnosis and monitoring response to the diagnosis. Physician includes (Specialists, General practitioners, public health officers and Psychiatric nurse).
2. **Registration clerk-** users in the health care organization who registers a client detail information at the registration office.
3. **Client-** a person who comes to the health care organization to get a clinical service.

Table 17: Log- In use case description

UC1:	**Log-in**
Description	This use case describes to confirm users of the system so as to ensure confidentiality of the data.
Primary Actor:	A user (registration clerk, physician, nurse , administrative staff, psychologist, health officer)
Stakeholders & interests:	To log into the system and use the system features as per the defined roles.
Pre-conditions:	
Basic scenario:	1. The user opens the application window by invoking the web address of the application on a browser. 2. The system displays the log-in screen. 3. The user keys in his/her user-name and password. 4. The system verify the user from its user database and displays main application screen.
Alternative scenarios:	
Post-conditions:	The identifications were correct: User is logged in and the system displays main application screen
Exception	else: - User is informed about incorrect identifications -The log-in interface displays the error message
Frequency of occurrence	44 times per day.

Table 18: Use case description for client register

UC2:	**Register client**
Description	This use case describes how to register a new client for service enrollment in the system.
Primary Actor:	Registration clerk
Stakeholders & interests:	-Client is interested in getting a patient card - Registration clerk is interested in registering patient in to the system
Pre-conditions:	- Registration clerk is authenticated -Client may have referral paper
Basic scenario:	1. Client arrives with referral paper 2. Registration clerk clicks on register client menu. 3. The system displays the registration client form. 4. Registration clerk inputs client detail using patient registration screen on the registration form. 5. Registration clerk input receipt number to the system and clicks save 6. The system saves client detail. 7. "Success message box" appears on the screen when the data added is correct. 8. The system automatically prints service ID card.
Alternative scenarios:	1a.if a client is a follow up patient 1a1. Registration clerk searches the client detail by using patient index card number 1a2. Registration clerk updates the date. 1a3. Registration clerk enters and save visit date.
Post-conditions:	Client is registered to the system.
Frequency of occurrence:	40-50 times per day.

Table 19: Use case description for client admission

UC3:	**Admit client**
Description	This use case describes assigning a client in specific ward and bed for inpatient treatment.
Primary Actor:	Liaison officer
Stakeholders & interests:	- Bed is assigned for client to get better service -Liaison officer assigns bed for a client.
Pre-conditions:	-Liaison officer is authenticated -Client is enrolled in the service
Basic scenario:	1. Physician sends admission request form to liaison officer 2. Liaison officer retrieves client detail information from the system by patient ID number 3. Liaison officer checks the availability of bed using the "admission user interface" 4. Liaison officer enters bed room and payment receipt number on admission interface 5. The System checks the validity of the data 6. The System automatically assigns a bed to the client
Alternative scenarios:	3a. if a client is in waiting list for admission 3a1. start with basic scenario 4
Post-conditions:	Client is assigned to specific ward.
Frequency of occurrence:	40-50 times per day.

Table 5: Use case description for client discharge

UC4:	**Discharge client from the service**
Description	This use case describes the process of generating discharge information for admitted patients.
Primary Actor:	Physician (psychiatrist, GP, psychiatric nurse, health officer)
Stakeholders & interests:	-Client is interested to check out from the hospital. -physician is interested to provide timely discharge information.
Pre-conditions:	-Physician is Identified and authorized -Client is enrolled in a program
Basic scenario:	1. Search for client from the system to discharge by patient id card number. 2. Select existing enrollment record from discharge user interface to discharge client. 3. Enter discharge date and reason. 4. The system automatically updates enrolment status to "discharged".
Alternative scenarios:	4a. If a client is dead 4a1. The system automatically updates enrolment status to "dead" 4b. If a client refuses treatment 4b1. The system automatically updates enrolment status to " refused treatment" 4c. If a client escape from the department 4c1. The system automatically updates enrolment status to "escaped" 4d. If a client is referred to other health facility 4d1. The system automatically update enrolment status to "referred"
Post-conditions:	-Client is discharge from the Programme. -Client gets discharge paper
Frequency of occurrence:	30-40 times per day.

Table 20: Use case description for client appointment

UC5:	**Assign appointment for clients**
Description	This use case describes the steps how to create, confirm and print daily client appointments
Primary Actor:	Physician (psychiatrist, GP, Nurse, health officer)
Stakeholders & interests:	-Client is interested to get appointment for the next visit. -Physician is interested to give appointment for clients.
Pre-conditions:	-Physician is Identified and authorized -Client is enrolled in a program
Basic scenario:	1. Physician opens appointment user interface to complete client information. 2. Physician assigns an appointment date on appointment interface. 3. The system adds an appointment date in client's profile. 4. The system automatically saves the data, prints and issues an appointment card
Alternative scenarios:	
Post-conditions:	Client gets appointment card.
Frequency of occurrence:	400 times per day.

Table 21: Use case description for client diagnosis & treatment

UC6:	**Diagnose and treat a client**
Description	This use case describes the process of adding a diagnosis, a diagnosis code and treatment for a client.
Primary Actor:	Physician (psychiatrist, GP, Nurse, health officer)
Stakeholders & interests:	-Physician is interested to record treatment and diagnosis detail of a client.
Pre-conditions:	-Physician is Identified and authorized -Client is registered and assigned to specific OPD
Basic scenario:	1. The physician records current history of the client in diagnosis interface 2. The system displays diagnosis and diagnosis code categories 3. The physician selects/enters diagnosis and diagnosis code 4. The system displays treatment plan 5. The physician selects treatment plan 6. The system confirms diagnosis, treatment plan and displays information. 7. Go to use case 8.
Alternative scenarios:	
Post-conditions:	Client diagnosis information is recorded.
Frequency of occurrence:	400-450 times per day.

Notes:

- Treatment plan include psychological treatment, medication treatment, Electro convulsive therapy (ECT) and rehabilitation treatment.

Table 22: Use case description for Client referral

UC7:	**Client referral**
Description	This use case describes the process of adding client referral into the system.
Primary Actor:	Physician (psychiatrist, GP, Nurse, health officer)
Stakeholders & interests:	-The client is interested to get referral number. -The physician is interested to write referral information to other health care facility.
Pre-conditions:	-Client is enrolled in a program -A referral request has been requested.
Basic scenario:	1. Physician checks patient history from diagnosis user interface 2. Physician fills referral form in referral user interface. 3. The system validates the enters referral form's data 4. Referral paper is issued to the client
Alternative scenarios:	
Post-conditions:	-Referral information is written to other healthcare facility. -Client gets referral paper.
Frequency of occurrence:	2-5 times per day.

Table 23: Use case description for prescribe treatment

UC8:	**Prescribe treatment**
Description	This use case describes the process of generating prescription treatment form by filling the information needed.
Primary Actor:	Physician
Stakeholders & interests:	-Client wants to get prescription paper. - Physician is interested to give treatment prescription paper.
Pre-conditions:	- Physician is authenticated - Client is enrolled in a program -Client is diagnosed.
Basic scenario:	1. Physician opens and check patient diagnosis history from diagnosis user interface. 2. Physician requests prescription treatment form to fill treatment plan from prescription user interface. 3. The system displays the treatment prescription form. 4. Physician fills prescription form on prescription user interface. 5. Physician saves and print prescription paper.
Alternative scenarios:	
Post-conditions:	Client gets prescription paper.
Frequency of occurrence:	350-400 times per day in hospitals.

Table 24: Use case description for search

UC9:	**Search**
Description	This use case describes how the user is able to search and filter the client's information, resource information, and other information detail using different criteria.
Primary Actor:	User (Registration clerk, physician , administrative staff)
Stakeholders & interests:	The user is interested to search for information he/she want.
Pre-conditions:	-The user is authenticated. - The information must exist in the system.
Basic scenario:	1. The user clicks on search button. 2. The system displays contextual search form. 3. The user enters his/her search type (this could be client search, resource search) 4. The user clicks search 5. The system validates the entered data. 6. The system displays list of result by search type
Alternative scenarios:	2a. If the user enters incorrect search information 2a1.The system displays query is not correct. 2b. If the information is not available in the system, the system shows a message to users like: 2b1.information not available message.
Post-conditions:	A user successfully finds the information he/she needs.
Frequency of occurrence:	50 times per day.

Table 25: Use case description for generate report

UC10	**Generate a report**
Description	This use case describes the process of generating different types of reports depending on user need.
Primary Actor:	User (Registration clerk, physician , administrative staff)
Stakeholders & interests:	The user is interested to get the type of report he/she want on time.
Pre-conditions:	-System users are Identified and authorized - All kind of data must be registered/ exist in the system to generate a report.
Basic scenario:	1. User selects report(s) on report user interface. 2. User sets report parameters (e.g. date range, funding, location) 3. User selects output format (PDF, document or spread sheet file,) 4. Resulting report is displayed. 5. User prints the report.
Alternative scenarios:	1a. If the data is not available for report, the system shows a message to users like: 1a1.The required data is not available or incomplete 1a2. The user uses the report out of his/her privilege
Post-conditions:	Generate report
Frequency of occurrence:	1-5 times per month

3.2 Sequence diagram

Sequence diagram is used in this project to describe patterns of communication among set of objects which are participated in the use case description. Communication between objects is represented by message passing between the objects. Objects are represented as columns with the vertical line to represent the life time of the object. In the following section, sequence diagram of the use cases are shown.

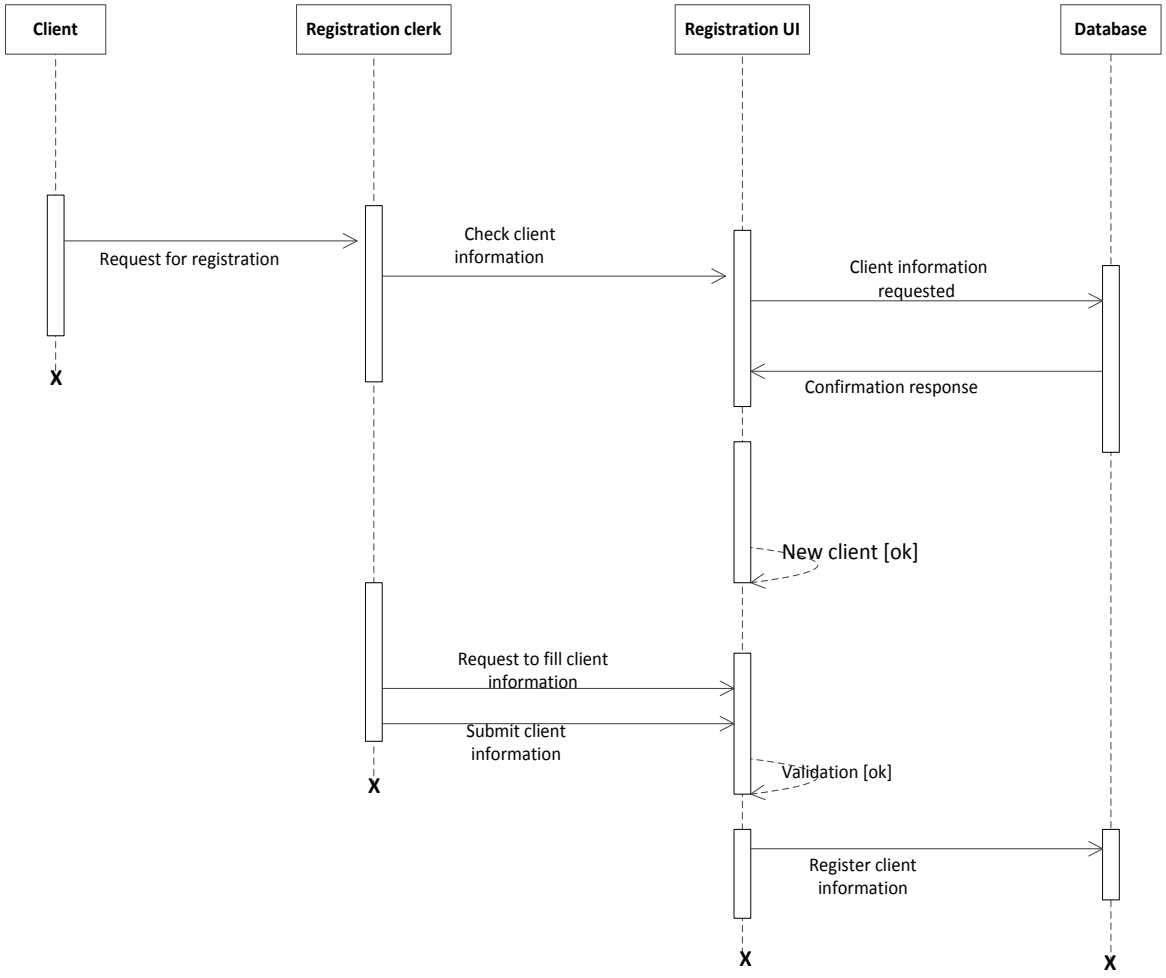


Figure 7: Sequence diagram for client registration

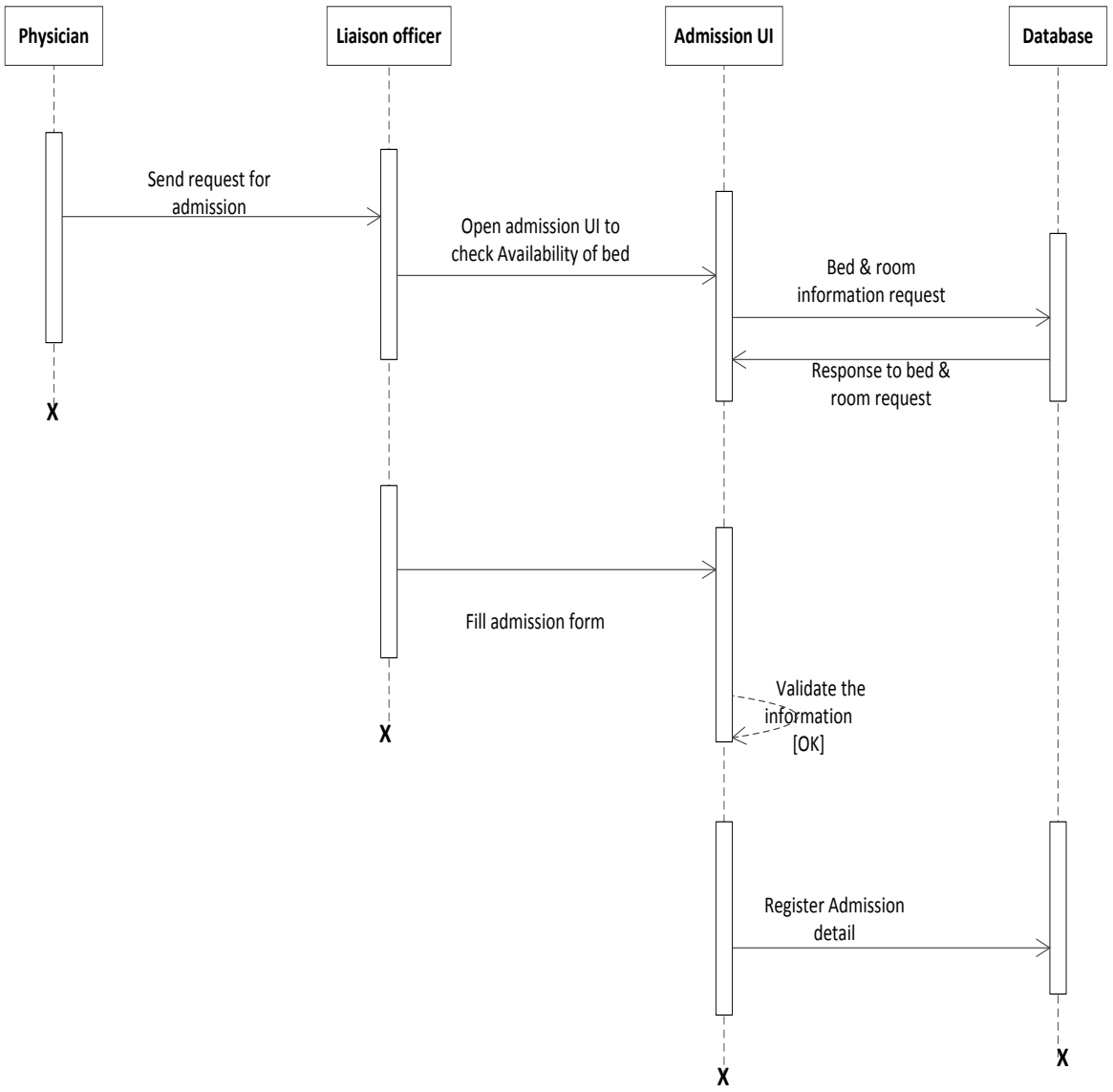


Figure 8: Sequence diagram for client admission

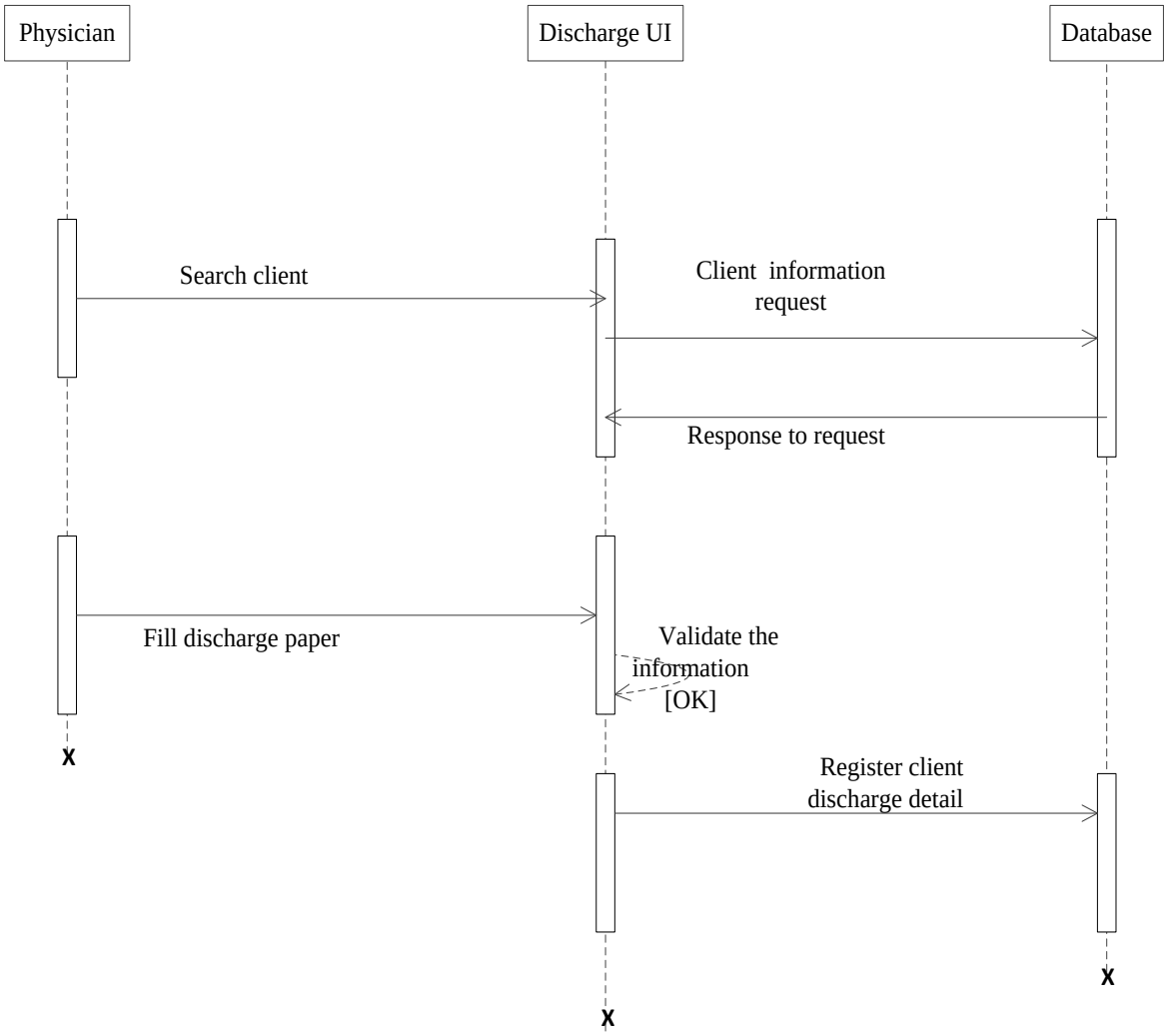


Figure 9: Sequence diagram for client discharge

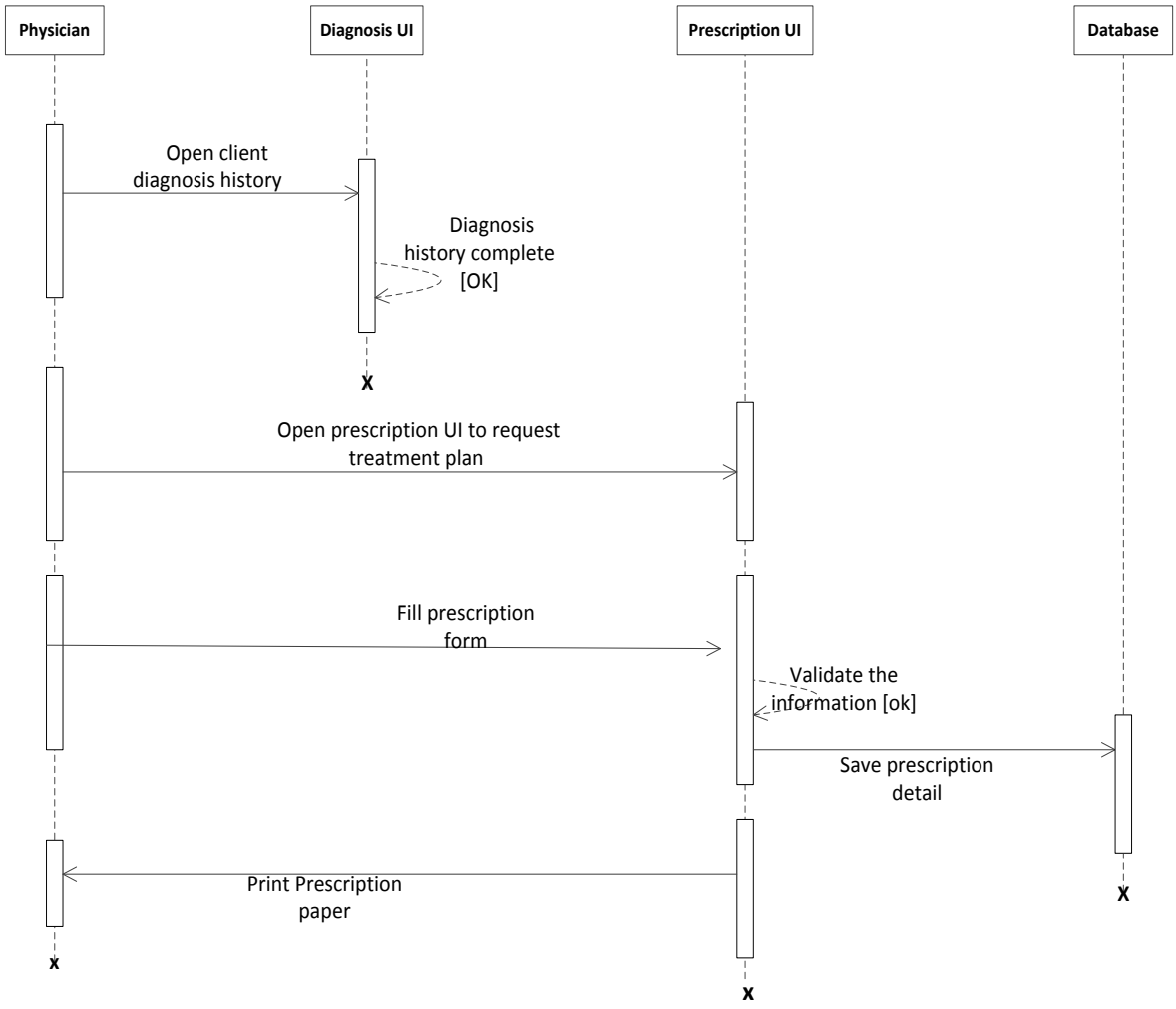


Figure 10: Sequence diagram for prescribe treatment

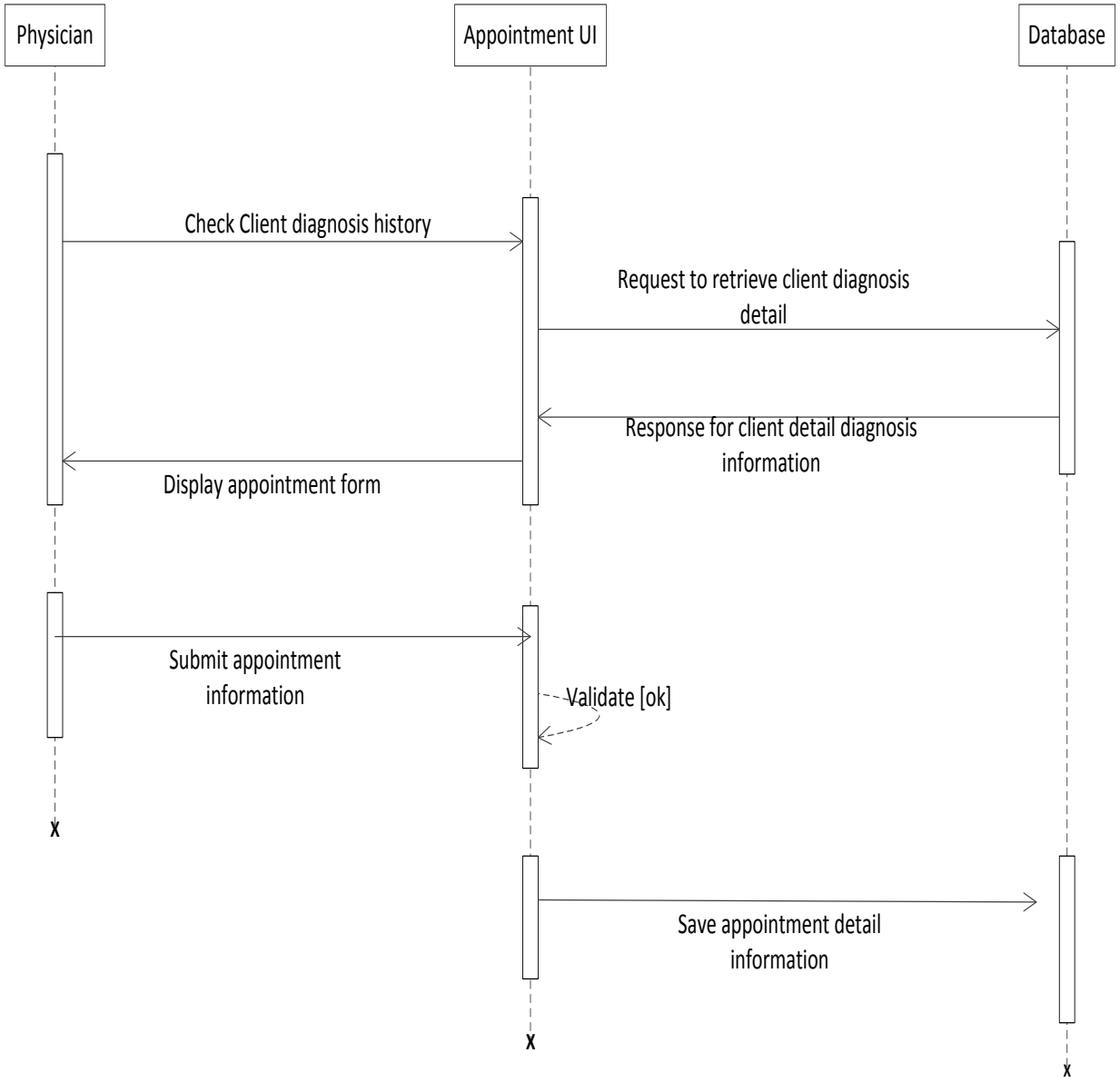


Figure 11: Sequence diagram for client appointment

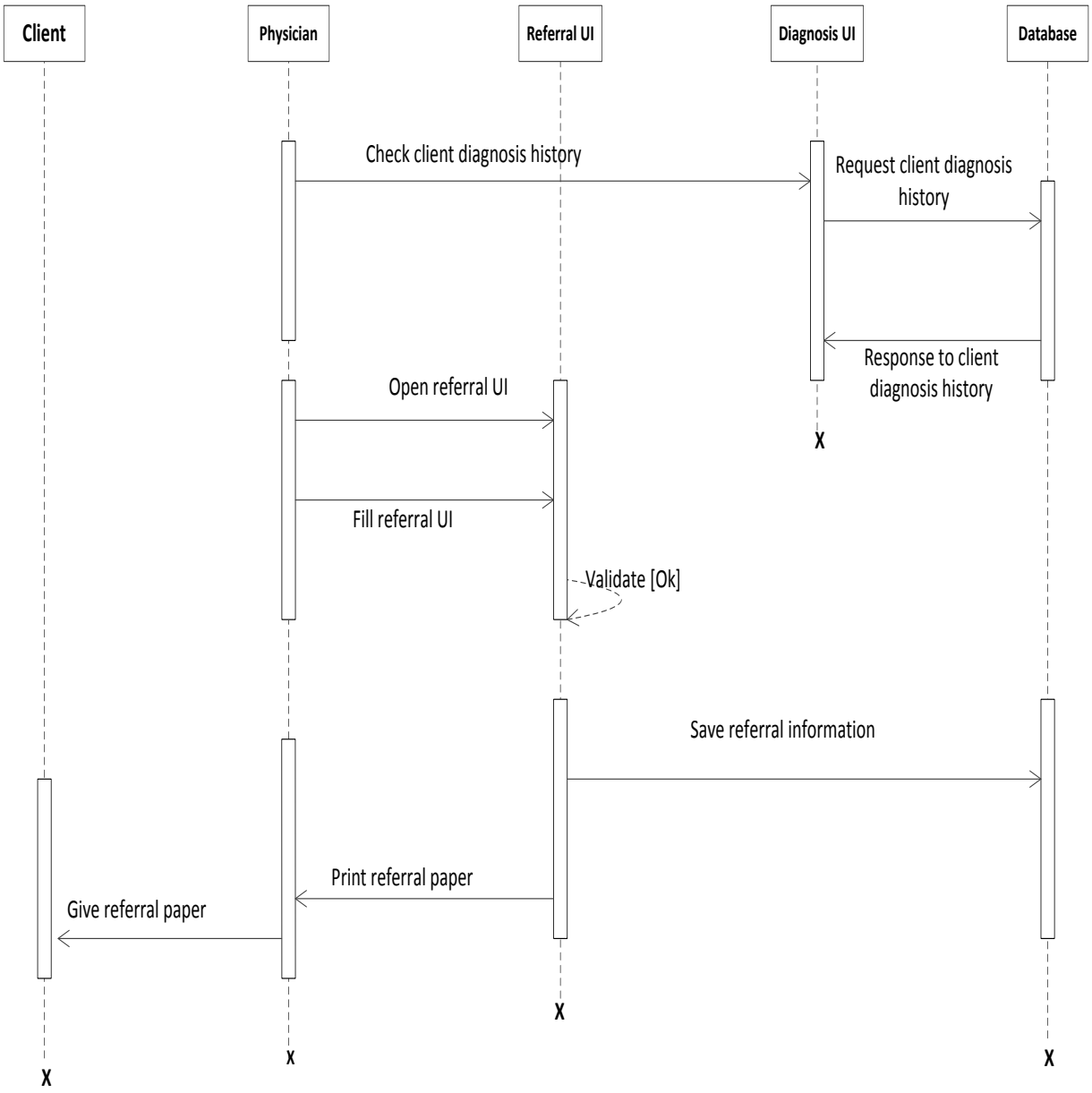


Figure 12: Sequence diagram for client referral

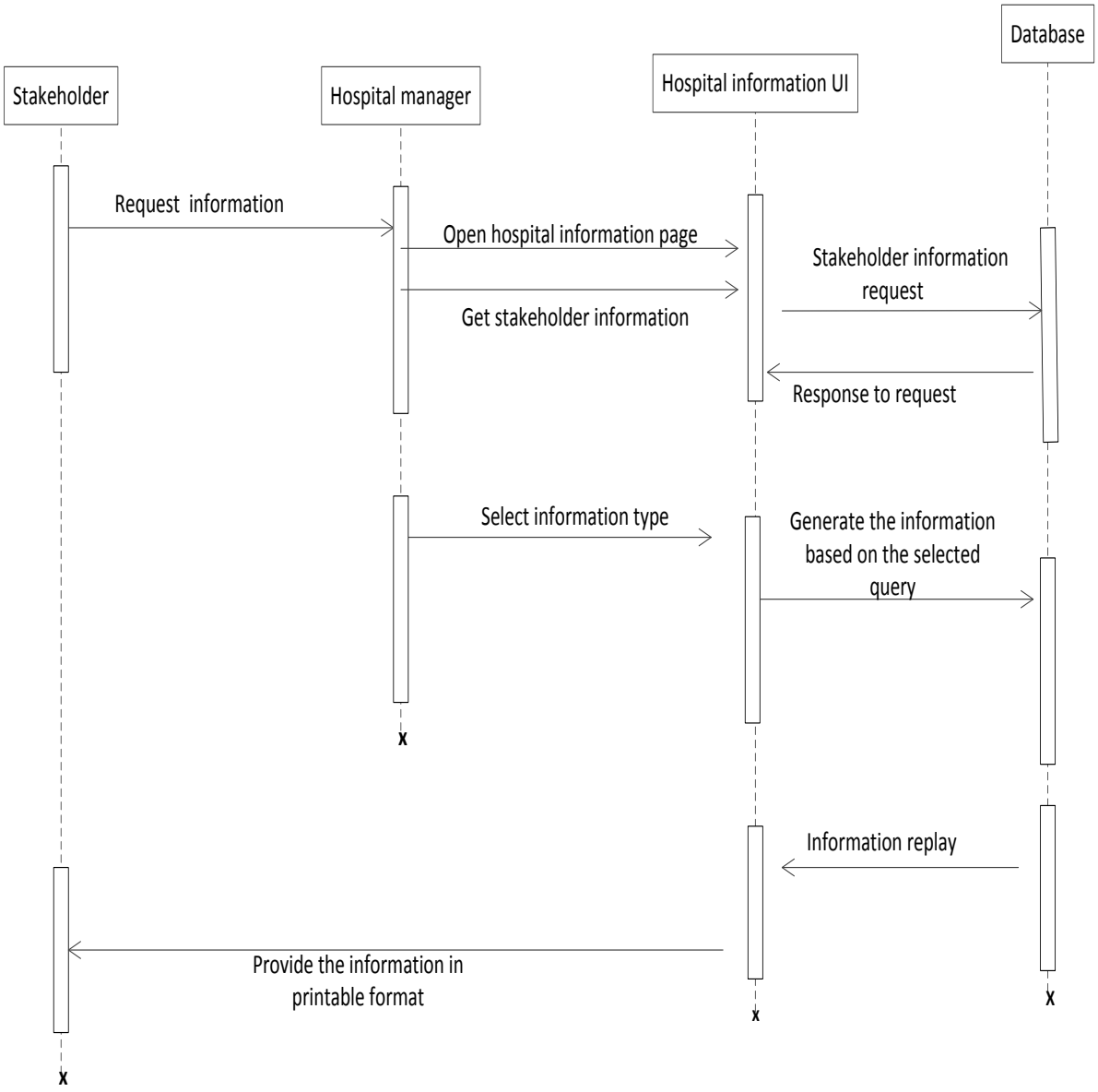


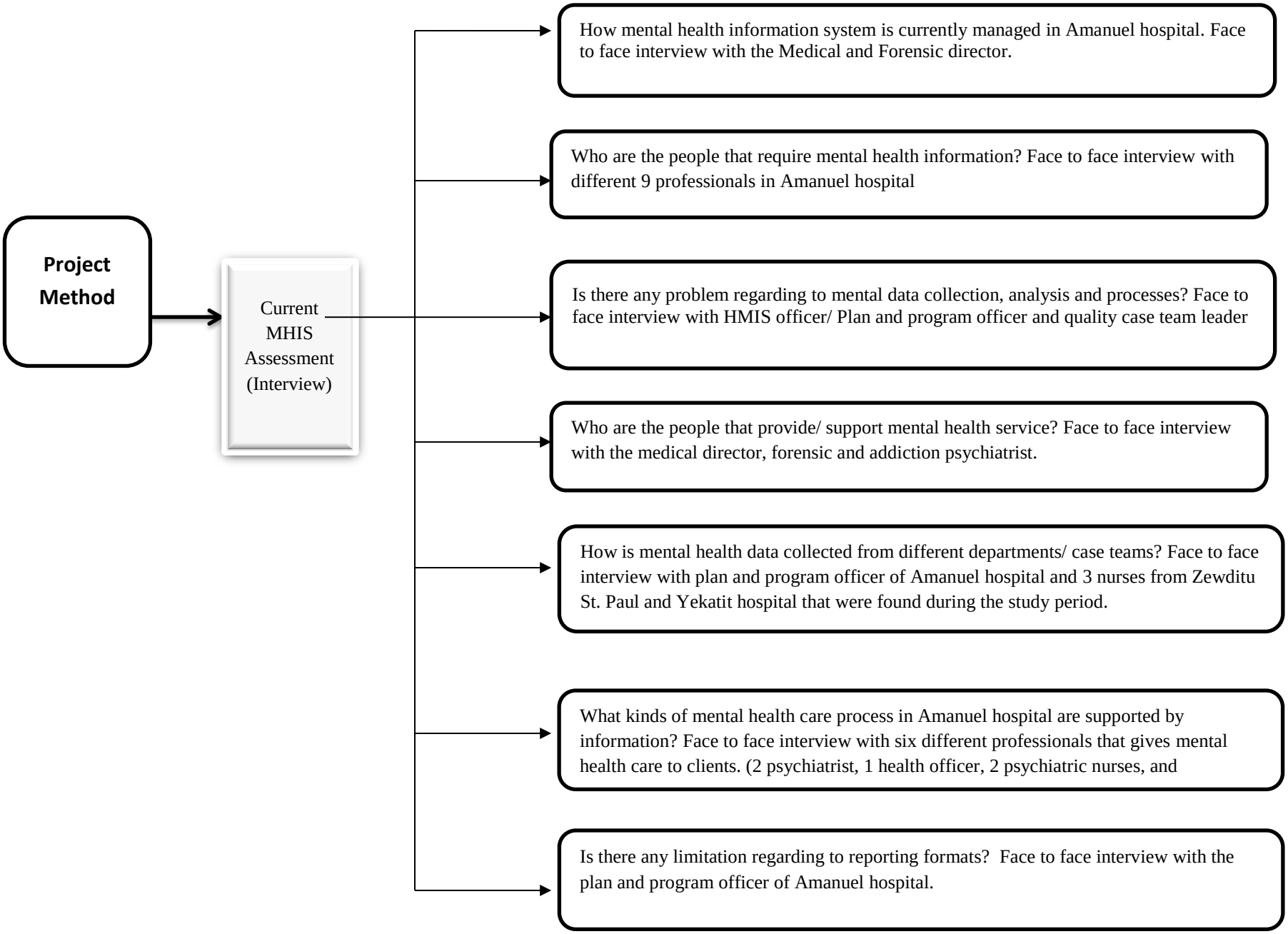
Figure 13: Sequence diagram for stakeholder need handler

Annex 2: Interview and Observation Check list

1. How is mental health information system currently managed in Amanuel hospital?
2. Who are the people that provide/ support mental health service?
3. Who are the people that require mental health information?
4. What kinds of mental health care process in Amanuel hospital are supported by information?
5. How is mental health data collected from different departments?
6. Is there any problem regarding to mental health data collection, analysis and processes?
7. Is there any limitations regarding to reporting formats?

Observation checklist

1. Entries in the registration books are the same and complete for the four hospitals.
2. Entries in the OPD registration books are the same and complete for the four hospitals.
3. Entries in the IPD registration books are the same and complete for the four hospitals.
4. Entries in the Referral form are the same and complete for the four hospitals.
5. The causes of disease in the outpatient and inpatient diagnosis sheet are correctly classified according to the national outpatient and inpatient diagnosis sheet.
6. Entries in the VCT and ART reporting sheets are the same and complete in the four hospitals.


Project Method
Current MHIS Assessment (Interview)
How mental health information system is currently managed in Amanuel hospital. Face to face interview with the Medical and Forensic director.
Who are the people that require mental health information? Face to face interview with different 9 professionals in Amanuel hospital
Is there any problem regarding to mental data collection, analysis and processes? Face to face interview with HMIS officer/ Plan and program officer and quality case team leader
Who are the people that provide/ support mental health service? Face to face interview with the medical director, forensic and addiction psychiatrist.
How is mental health data collected from different departments/ case teams? Face to face interview with plan and program officer of Amanuel hospital and 3 nurses from Zewditu St. Paul and Yekatit hospital that were found during the study period.
What kinds of mental health care process in Amanuel hospital are supported by information? Face to face interview with six different professionals that gives mental health care to clients. (2 psychiatrist, 1 health officer, 2 psychiatric nurses, and
Is there any limitation regarding to reporting formats? Face to face interview with the plan and program officer of Amanuel hospital.